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IEA DHC|CHP

International Energy Agency
IEA Implementing Agreement on District Heating and Cooling,
including the integration of CHP

Policies and Barriers for District Heating and Cooling outside EU countries

ANNEX IX of the IEA Implementing Agreement on District Heating and Cooling, including the integration of CHP

Policies and Barriers for District Heating and Cooling outside the EU Countries

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NOTES:

The IEA Programme District Heating and Cooling, also known as the Annex IX (2008 – 2011) research projects Implementing Agreement "District Heating & Cooling including the Integration of Combined Heat and Power", functions within a framework created by the International Energy Agency (IEA). Views, findings and publications of the IEA Programme District Heating and Cooling do not necessarily represent the views or policies of the IEA Secretariat or of all its individual member countries.

The experts interviewed by the Project do not take any responsibility for the text and the recommendations presented here as they do not necessarily reflect their opinions.

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General Preface Annex IX 2008-2011

Introduction

The International Energy Agency (IEA) was established in 1974 in order to strengthen the co-operation between member countries and reduce the dependency on oil and other fossil fuels. Thirty years later, the IEA again drew attention to serious concerns about energy security, investment, the environment and energy poverty. The global situation is resulting in soaring oil and gas prices, the increasing vulnerability of energy supply routes and ever-increasing emissions of climate-destabilising carbon dioxide.

At the 2005 Gleneagles G8 an important role was given to the IEA in advising on alternative energy scenarios and strategies aimed at a clean, clever and competitive energy future. Two years later, at the Heiligendamm G8, it was agreed that “instruments and measures will be adopted to significantly increase the share of combined heat and power (CHP) in the generation of electricity”. District Heating and Cooling is an integral part of the successful growth of CHP: heat networks distribute what would otherwise be waste heat to serve local communities. The IEA is active in promoting and developing knowledge of District Heating and Cooling: while the DHC programme itself is the major global R&D programme, the IEA Secretariat has also initiated the International DHC/CHP Collaborative which assesses global markets and policies for these important technologies.

The IEA’s latest CHP report, "Cogeneration and District Energy: Sustainable energy technologies for today…and tomorrow", released at COGEN Europe meeting in Brussels on 21 April 2009, identifies proven solutions that governments have used to advance CHP and district energy, setting out a practical ‘’how to’’ guide with options to consider for design and implementation. The report concludes that these technologies do not need significant financial incentives; rather they require the creation of a government ‘champion’ to identify and address market barriers. This makes CHP and district energy ideal investments at a time of tight budgets.

The CHP report follows the IEA’s first report from March 2008, "Combined Heat and Power: Evaluating the Benefits of Greater Global Investment". There are also 11 "Country Scorecards" that evaluate different countries’ success in achieving increased use of CHP and DHC. In November 2009, the IEA joined with the Copenhagen District Energy Summit to issue the first Global District Energy Climate Awards in order to recognize communities that have embraced district heating and cooling as a vital sustainable energy solution.

The major international R&D programme for DHC/CHP

DHC is an integrative technology that can make significant contributions to reducing emissions of carbon dioxide and air pollution and to increasing energy security.

The fundamental idea of DHC is simple but powerful: connect multiple thermal energy users through a piping network to environmentally optimum energy sources, such as combined heat and power (CHP), industrial waste heat and renewable energy sources such as biomass, geothermal and natural sources of heating and cooling.

The ability to assemble and connect thermal loads enables these environmentally optimum sources to be used in a cost-effective way, and also offers ongoing fuel flexibility. By integrating district cooling carbon-intensive electrically-based air-conditioning, rapidly growing in many countries, can be displaced.

As one of the IEA’s ’Implementing Agreements’, the District Heating & Cooling programme is the major international research programme for this technology. Active now for more than 25 years, the full name of this Implementing Agreement is ‘District Heating and Cooling including the integration of Combined Heat and Power’. Participant countries undertake co-operative actions in energy research, development and demonstration.

Annex IX

In May 2008 Annex IX started, with the participation from Canada, Denmark, Finland, the Netherlands, Norway, South Korea, Sweden, United Kingdom, United States of America.

Below you will find the Annex IX research projects undertaken by the Implementing Agreement "District Heating & Cooling including the Integration of Combined Heat and Power".

Annex IX (2008 – 2011) research projects Implementing Agreement "District Heating & Cooling including the Integration of Combined Heat and Power".

Project title	Company	Number
The Potential for Increased Primary Energy Efficiency and Reduced CO2 Emissions by DHC	SP Technical Research Institute of Sweden Project Leader: Monica Axell	8DHC-11-01
District Heating for Energy Efficient Building Areas	VTT Technical Research Centre of Finland Project Leader: Kari Sipilä	8DHC-11-02
Interaction between District Energy and Future Buildings that have Storage and Intermittent Surplus Energy	Gagest Inc. Project leader: Tom Onno	8DHC-11-03
Distributed Solar Systems Interfaced to a District Heating System that has Seasonal Storage	Gagest Inc. Project leader: Tom Onno	8DHC-11-04
Policies and Barriers for District Heating and Cooling outside EU countries	Energy-AN Consulting Project leader: Arto Nuorkivi	8DHC-11-05

Benefits of membership

Membership of this implementing agreement fosters sharing of knowledge and current best practice from many countries including those where:

- DHC is already a mature industry
- DHC is well established but refurbishment is a key issue

- DHC is not well established

Membership proves invaluable in enhancing the quality of support given under national programmes. Participant countries benefit through the active participation in the programme of their own consultants and research organisations. Each of the projects is supported by a team of experts, one from each participant country. As well as the final research reports, other benefits include sharing knowledge and ideas and opportunities for further collaboration.

New member countries are very welcome – please simply contact us (see below) to discuss.

Information

General information about the IEA Programme District Heating and Cooling, including the integration of CHP can be obtained from our website www.iea-dhc.org or from:

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Acknowledgement

The team wishes to express their sincere gratitude to both the members of the Expert Group[3] for their excellent guidance throughout the study project as well as those national experts that all provided their knowledge and experience to the country specific chapters (the national experts are listed in Annex 2).

[3] Dr. Robin Wiltshire (chairman), Mr. Lars Gullev, Mr. Mark Spurr, Mr. Chris Snoek, Dr. Seok-Mann Yoon, Prof. Rolf Ulseth, Ms. Heidi Juhler and Mr. Jari Kostama

1 Executive Summary

The report at hand being under the umbrella of IEA DHC research program has been issued in parallel to EcoHeat 4EU, both studies covering together the institutional framework of DHC and CHP in the northern globe.

DHC with CHP offers an effective tool to reduce flue gas emission, including CO_2 in the world. The status of the tool, however, widely varies among countries. Therefore, lessons learned in one country may be helpful in another country.

The approach was to review lessons learned about the institutional factors from countries such as China, Russia, USA, Canada, South Korea and selected European countries outside EU, based on the comprehensive team experience, contacts and available reports and files. The team also reviewed the key institutional barriers of DHC development by giving clear examples from the various countries. Best practices useful for sustainable development of DHC were identified by giving a brief analysis and individual examples from the countries examined.

The countries are in very different stages of DHC development as presented in Table below.

Table 2.1: Allocation of countries to four groups according to development status of DHC.

Emerging	Canada and U.S.A.
Expanding	China and South Korea
Consolidating	
Refurbishing	Bosnia & Herzegovina, Croatia, Kazakhstan, Kosovo Macedonia FYR, Russia, Serbia, Ukraine, Uzbekistan

In China and Russia alone, some 200 million people in total are served by local DH systems. The selected 13 countries cover more than 70% and 95% of the DHC market in the world and outside the EU, respectively. Therefore, the geographical coverage of the DHC market included in the study report is extensive. The EcoHeat4EU project in parallel has taken care of the similar issues in a 14 EU member countries. The two projects together have about 95% coverage of the DHC market in the world.

The reason for having five small countries, almost half of all in number, from the Balkan region is that the countries started from the same stage, Yugoslavia, but have had very different approaches and outcomes in DHC development. Therefore, their investigation will provide various lessons from the Balkan to be learned in the other countries.

As comparative advantages DH offers:

1. The ability to use a variety of fuels, which provides flexibility in using the fuels of the lowest price and stability in heat price development;,
2. DH system with back-up in terms of various heat sources and looped networks provides reliable heating services to customers;
3. in heat supply and stability in heat price development;
4. The only way to use various waste heat sources to heat up the residential buildings;
5. The centralized flue gas cleaning benefiting from scale while using solid fuels;
6. Safety to customers: there is no possibility of fire or explosion caused by handling of fuels in houses and buildings;
7. Benefits from economy of scale while producing heat at the central plant and using solid fuels;

8. Reliability of heat supply due to professional operation and continuous monitoring of heat production and distribution;
9. Improvement in urban air quality while eliminating small and polluting boilers and using advanced flue gas cleaning systems;
10. The only way to generate electric energy from solid fuels at high efficiency by means of CHP; and finally,
11. The most efficient cogeneration of electricity from natural gas.

The DHC expansion enables effective CHP production, the unique possibility to generate electric power at a high efficiency of 85-95% from any fuel whether fossil, biomass or even nuclear. CHP is an extraordinary way to reduce primary energy consumption and GHG emissions based on commercial technology, as already done in some European countries but still being an unexploited potential elsewhere. Some of the best practices are briefly discussed later in the study report.

The main barriers for DHC development were identified as follows:

1. DHC is local business in which the municipality should be strongly involved at least at the beginning. However, poor financial status and lacking energy experience of the municipalities often prevent DHC development (all subject countries);
2. Legislation does not consider DHC and CHP as an energy efficiency measure to be supported (USA, Canada);
3. Poor financing possibilities for DHC and CHP rehabilitation and development prevent efficient use of the already existing basic DH/CHP infrastructure (Russia, Ukraine, Kazakhstan, Uzbekistan, the Balkan countries);
4. Holistic management of the integral DHC development is compromised by the split responsibility among the various key organizations (China, Russia, Ukraine, Kazakhstan); and,
5. Lump sum heat tariffs motivate neither the heating company nor the customers to energy efficiency. The consumption based billing based on heat metering and two-tier tariffs is not implemented as remedy (China, Russia, Ukraine, Kazakhstan, Serbia, Kosovo).

In the Table below the main institutional features of DH and CHP status in the selected countries have been summarized. The indications are general and descriptive. Item 11 “Consumption based billing” states that there is no such practice in Russia and China, for instance. There is indeed consumption based billing in those two countries but in an early stage.

Table 2.2: Main institutional features of studied countries.

		BiH	CAN	CHI	CRO	KAZ	KOS	KOR	MAC	RUS	SER	UKR	USA	UZB
2	Building regulations with EE	y	y	y	y	y	y	y	y	y	y	y	y	n
3	DH prices regulated	y	n	y	y	y	y	y	y	y	y	y	n	y
4	Main competitor	Gas	Gas	none	Gas	El/gas	El	LNG	EL	none	El	Gas	Gas	none
5	Feed-in tariff scheme for RES and/or CHP	y	n	y	y	n	n	n	n	n	y	y	n	n
6	Emission trading scheme	n	n	n	n	n	n	n	n	n	y	n	n	n
7	Carbon tax in use	n	n	n	n	n	n	n	n	n	n	n	n	n
8	Investment grants for DH/CHP	n	n	n	n	n	n	n	n	n	n	n	n	n
9	DH customer rights (Weak/Strong)	W	S	W	S	W	W	S	W	W	W	W	S	W
10	DH service quality (Good/Poor)	P	G	P	G	P	P	G	G	P	P	P	G	P
11	Billing based on consumption	n	y	n	y	n	y	y	y	n	n	n	y	n
12	Municipal role (Weak/Strong)	W	W	S	W		W		W	W	S	W	W	W
13	Private sector involvement	n	y	y	n	y	n	n	y	n	n	n	y	y
14	Synergy allocations: CHP/Res													
15	Integrated resource planning	n	n	y	y	n	n	y	y	n	n	n	n	n
16	Heat planning and zoning	n	n	y	n	n	n	y	y	y	n	n	n	y
17	Technical standards	New	New	New	New	Old	New	New	New	Old	New	Old	New	Old
18	Refurbishing strategy in use	y	n.a.	y	y	y	y	n.a.	y	n	y	n	n.a.	n
19	DHW supplied with DH	n	y	n	n	y	n	y	n	y	n	y	y	y

Clarifications: n=no, y=yes, EL=Electricity, W=Weak, S=Strong

The report at hand starts with explaining the objective (Chapter 3), background (4) and the study project itself (5). Thereafter, good practise examples are briefly described (6) in order to offer views of the development target regarding sustainability: economy and environment. The status of institutional issues as well as recommended steps to be taken in selected countries is described in the consecutive chapters (7-19). Links to other studies are presented in Chapter 20 and finally, the conclusions in Chapter 21.

2 Main Abbreviations

EIB	European Investment Bank
CEEC	Central and East European Countries
C&I	Control & Instrumentation
CHP	Combined heat and power
DC	District cooling
DE	District energy
DH	District heating
DHC	District heating and cooling
DHE	District heating enterprise
DHW	Domestic hot water
EAR	European Agency for Reconstruction
EE	Energy efficiency
FIT	Feed-in tariff
FYR	Former Yugoslavian Republic
GHG	Green house gases
IBRD	International Bank for Reconstruction and Development (e.g. The World Bank)
IDA	International Development Agency, a member of the World Bank Group
IEA	International Energy Agency
IFC	International Finance Corporation, a member of the World Bank Group
KfW	Kreditanstalt für Wiederaufbau, German Development Bank
NIB	Nordic Investment Bank
O&M	Operation & Maintenance
PEEREA	Energy Charter Protocol on Energy Efficiency and Related Environmental Aspects
PEF	Primary energy factor
RES	Renewable energy sources
SH	Space heating
SIDA	Swedish International Development Co-operation Agency
UNDP	United Nations' Development Program
USAID	United States Agency for International Development
WEC	World Energy Council

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3 Objective

The overall objective was to identify and review barriers and best practices for sustainable development of DHC in order to facilitate an expansion of DHC systems outside the EU countries in order to increase the global energy efficiency, fight Climate Change, and to increase national security of supply.

4 Background

More than half of the largest DH systems are in transition economies and the rest in Western Europe, North America and Asia. All IEA member countries have DHC systems already. DH is growing quickly in Asia, whereas DC is growing in Asia and Europe. Therefore, the institutional opportunities and barriers faced by DHC development play an important role in the world as a means to fight Climate Change.

Institutional factors for DH including CHP have been recently discussed and analysed in the following publications:

- IEA, Coming in from the Cold, Improving District heating Policy in Transition Economies, 2004
- Energy Charter Treaty (PEEREA): Cogeneration and district heating - Best practices and the role of municipal planning, 2004
- Ecoheatcool project, IEE program, 2005-2006
- CHP/DHC Country Scorecards of IEA in 2007-2008
- District Heating and Cooling Country by Country, 2009 Survey, Euroheat&Power
- BASREC, Institutional Handbook for CHP with District Heating, 2002
- WEC, Towards Local Energy Systems, revitalizing district heating and cogeneration in Central and Eastern Europe, 2003.
- DHCAN, Institutional guide, 2004.
- DHCAN, Ownership guide, 2004.
- WEC, Regulatory issues in District Heating/Combined Heat and Power, July 2004.
- IEA, District heating in transition economies, 2004

Most of these publications focus on Central and Eastern Europe in the aftermath of serious attempts to start rehabilitation of DH systems in these countries. In these attempts, institutional factors have often been barriers to rehabilitation projects. As recently published, these publications contain many detailed descriptions of the institutional environment for district heating and CHP in Central and Eastern Europe. It is now possible to summarise these findings in an umbrella analysis and to use the lessons learned to assess all major institutional factors in countries outside EU, such as China, South Korea, USA, Canada, and the other European countries outside the EU.

Ideally, the DHC/ CHP system would have the features as follows. It should:

- Be relatively large in the community to distribute the high investment costs. The coverage of residential customers of about 90% is desirable.
- Have a long operation time in a year in an efficient way in order to share the high capital costs to all hours of a year. Combined service of DHW, SH, industrial heating as well as DC would contribute to continuous operation of the system.
- Integrate all energy needs in the community such as residential, industrial, public and commercial in order to have several parties to share the high capital costs and to achieve aggregate load profiles.

- ❖ Integrate all energy needs of the community in order to reduce any losses due to high level resource integration. The heating network losses should not exceed 5-12% of the production, the lower percentage in large and the high percentage in small DH systems. The heat production efficiency should be rather higher than 90%.

I institutional barriers prevent the materialization of the above listed features. The barriers are related to laws and official regulations, inadequate investment incentives and even subsidies, for instance but are different in countries of various development stages. Using the three categories of countries mentioned above, the typical barriers can be summarized as follows:

Table 4.1: Main barriers faced by DHC per country category..

Emerging: Canada and U.S.A.	National policies do not clearly support DHC development. Financially and politically weak municipalities have restricted possibilities to support DHC development locally. High investment costs with long pay back times do not attract private sector investors to DHC. Residential customers could nopt be attracted to DHC but only public and commercial ones.
Expanding: China and South Korea	China: inadequate incentives to EE are caused by lump sum billing China: outdated technical standards lead to suboptimal technical solutions (CHP heat extraction, group substations and secondary networks, etc.)
Refurbishing: Bosnia & Herzegovina, Croatia, Kazakhstan, Kosovo Macedonia FYR, Russia, Serbia, Ukraine, Uzbekistan	Tariffs may not cover all costs, which leads to subsidy systems and inadequate refurbishment activities. Lump sum tariffs do not give incentives to the company and its customers to save energy, Often poor management of DH companies hampers both refurbishment and optimal operation. Overlapping and unclear rights and responsibilities of the owner and energy management hamper both refurbishment investments and optimal operation. Outdated technical standards lead to suboptimal technical solutions: over-sizing, redundant components, etc.

The study at hand aims at identifying the barriers and opportunities that DHC faces in the selected countries and offers some recommendations to phase them out.

The major target audiences of the study at hand are:

- ❖ The international community of decision makers and financiers (environmental and energy policy) concerning DHC systems;
- ❖ National associations advocating DHC, environmental protection and sustainable development;
- ❖ National governmental departments responsible for energy policies; and,
- ❖ Price regulation commissions and organisations.

The aim is to help the environmentally focused audience understand the importance of DHC in alleviating emissions and improving efficiency while providing energy services for the society by

- ❖ Clarifying the expected benefits of DHC development;

- Identifying and phasing out institutional barriers; and,
- Identifying best practices to promote DHC internationally and nationally.

5 Issues for discussion

The matrix below explains the major institutional factors that will be discussed in the country specific reports.

Table 5.1: Issues having been discussed in the Study Report.

Issue group	Issues
Legal and regulatory framework	1. National Energy Policy 2. Building regulations 3. Price regulation 4. Competition 5. Feed-in-tariffs for CHP and RES 6. Emission trading scheme 7. Carbon tax 8. Investment grants
Customers	9. Customer rights 10. Service quality 11. Billing
Ownership	12. Municipality role 13. Private sector involvement 14. Synergy allocations (CHP, RES,…)
Planning	15. Integrated resource planning 16. Heat and urban planning
Technical	17. National technical standards and design conditions 18. Refurbishing strategies

The eighteen issues listed in the Table above can be briefly emphasized as follows:

1. Legal and regulatory framework either does or does not provide a solid basis for DH/CHP development in a country. The laws, regulations and possible subsidy systems should stem from the policy to create and maintain a healthy environment for the DHC and CHP to grow under economic and environmental terms;
2. Building regulations are important to provide hot water circulation in apartments to enable centralized heating of room space (SH) and eventually tap water (DHW). The regulations also set the requirements for water temperatures and heat load to be met by the energy production system;
3. Price regulation sets the rules of energy pricing whether to be set by the DH enterprise, the municipality or the regulator either on regional or governmental level, how the tariffs are set according to the costs and market needs, does the tariff reflect the cost structure of the DHC services; what kind of incentives are set to energy conservation;
4. Competition on heating market is an incentive to the DH companies to improve their economic and technical performance in order to better meet the needs of the customers;
5. Feed-in-tariffs for CHP and renewable energy production are needed to support emerging technologies and practices to enter the market faster than the normal market behaviour would enable. Such tariffs shall be for a long period of time but be used for the early birds only;

6. Emission trading scheme is a financial way to invest in sustainable energy systems and energy efficiency in objects where the environmental benefit is the highest, thus supporting DHC and CHP development;
7. Carbon tax is a financial way to support sustainable energy systems that have low primary energy factors such as DHC and CHP have;
8. Investment grants are useful to support new technologies such as DH and CHP to enter the market or to improve their efficiency with new refurbishment technologies if already existing.
9. Customer rights being strong provides the DH company with incentives to improve the customer service level and the overall efficiency of the DHC system;
10. Service quality of DH is a problem in Central and Eastern Europe and in Asia, except South Korea. Inconvenient room temperatures create dissatisfaction towards DHC, and when the heating market opens for competition, this may create a boom of customers to escape the DHC to more convenient heating systems;
11. Billing based on metered heat consumption is a strong incentive both to the customer and the DH company to reduce heat losses in heat production, distribution and end-use;
12. Municipality role is important in initiating the DH services, because street areas and public buildings are needed in starting DHC implementation;
13. Private sector involvement is useful after the DHC system is in operation as a means to extend it on commercial conditions. A private operator may be better suited to the commercial business than the municipality;
14. Synergy allocations are important while allocating the benefits of CHP to the steam, hot water and electricity in order to support sustainable development of the integral system. The heat load is a precondition of CHP. Therefore, various heat pumps driven by electric energy that is generated by CHP may not be optimal on the DH supply areas, because they reduce the potential to generate CHP power;
15. Integrated resource planning should be carried out by somebody in order to reach a holistically optimal and integral DHC and CHP system and to benefit from the scale. Such integration comprises combination of industrial, residential and other heat and chilling loads in the urban area; logistics of locally available (renewable) fuels; availability of waste heat sources; etc.;
16. Heat and urban planning carried out by the municipality is important to plan and possibly zone the areas appropriate for centralized energy solutions as DHC and CHP;
17. National technical standards and design conditions are needed to support reliable and economic DHC and CHP systems by preventing excess capacity and redundancy that are uneconomic and unnecessary; and,
18. Refurbishing strategies are needed to optimize the rehabilitation of the existing DHC and CHP systems. According to best practice, the refurbishment should start from the customer part, then replace some 10-15% of network sections of worst technical condition; and finally, rehabilitate the base load heat sources and leave the other as back up and peak load sources.

In each country 1-5 experts have been interviewed in order to identify the main documents and the actual status to complement the files and knowledge the authors already may have had from the particular country. The list of the interviewed experts is presented in Attachment 1.

For each issue and factor, both good practise and barriers have been reviewed, giving a balance between good and bad experiences. This is an important angle, since most projects and reports within this subject tend to focus on barriers and problems, giving an atmosphere of bad reputation for district heating.

This project was carried out in four phases:

1. Identification and planning of issues and countries to review
2. Information gathering

3. Analysis and evaluation
4. Communication and reporting

Basically, the framework is illustrated in the picture below, which connects the district energy enterprise to its owner and customers, the supporting organizations such as financiers, investors and other energy producers that could supply energy to the enterprise's customers. All connections are stipulated under the regulatory framework: tariffs, ownership rules, customer rights, corporate responsibilities, etc.

A couple of best practices from Europe will be given as examples to offer an idea of how system performance could be improved in any of the countries. However, the best practices may not be directly replicable due to different circumstances prevailing in the countries.

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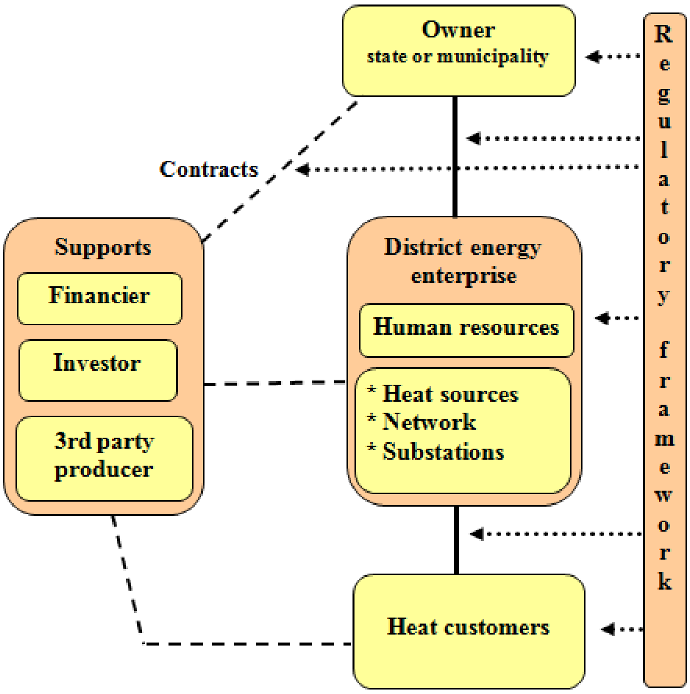

Figure 5.1. The general framework of institutional issues faced by DHC.

6 Good Practices

6.1 **Issue-by-issue**

The good practices are discussed here in three ways:; by means of (1) issue-by-issue, (2) examples from four European countries, and (3) primary energy factors.

The good practise cases are selected from the EU, where different changes in DH have taken place in the past years and decades. The DHC systems of Denmark and Finland, in particular, are the only ones by far that have been awarded by the IEA with the highest five star scores thanks to their successful DHC and CHP development in the past decades and promising future prospects.

In most of the countries of the study, refurbishment of old DH systems is underway. Therefore, in Appendix 1, the experiences of DH rehabilitation from Central and Eastern Europe have been summarized. In such a way, discussion of good practices has been brought to a more thorough and detailed level.

The good practices based on issue-by-issue approach are presented in the following text boxes.

1	**National Energy policy**
	The national energy policy shall determine the main pillars of the management and principles

	of regulation and principles for the development of the energy sector An energy strategy shall describe the development path of the energy sector and the various types of energy carriers. An action plan is needed to allocate responsibilities.

2	**Building Regulations**
	International experience shows that the introduction of obligatory energy saving requirements to buildings under construction and reconstruction is the most economically effective way of energy saving in the housing sector. Energy efficiency improvement in the housing sector requires regular revision of standards applicable to heat insulation of buildings, so that the most effective new technologies are incorporated. Building regulations shall require at least heat metering on building level and thermostatic control valves in rooms. The indoor piping shall be of horizontal type (room radiators connected in parallel) in order to allow good control of room temperatures. This is the good practise in the EU, Canada, USA and South Korea already, and the practise is expanding in many other European countries as well. Heat cost allocators are used in a number of EU member countries in order to allocate the heating bill of the building to the apartment owners (The Baltic countries, Poland, Denmark, Bulgaria). Building codes should be converted towards minimizing the primary energy consumption.

3	**Price Regulation**
	Uniform rules for cost accounting, definition of justified costs, tariff approval procedures, and tariff structure should be applied. Tariffs have to be cost-reflective and shall gradually reach full cost coverage. Cross-subsidies between various consumer groups shall be eliminated. A price-cap regulation should be taken into account, when DH Companies have reached a certain performance level. A heat tariff system of price cap type and cost covering level combined with consumption based billing will convert the DH services from social to commercial (economic) activity, which sets appropriate EE incentives to all actors.

4	**Competition**
	About 15 years ago, the heat market was opened for competition in a number of Central European countries (Poland, Estonia, Latvia, Lithuania, Bulgaria), in which DH system rehabilitation had started already. At the beginning, DH systems lost customers to the competitor, gas heating, because DH services were outdated without any control at the customer side, leaving the customer out of DHW for a couple of weeks in summer, providing overly high room temperatures in spring and autumn but too low temperatures in winter, for instance. Losing customers created a strong incentive to the DH companies to improve their performance. Therefore, the DH companies started actively installing heat meters to customers and introducing consumption based billing, installing temperature control systems to consumer substations in order to enable the customers to control their heat use, established customer relation departments in their organization structures to systematically address the complaints received from the customers, started marketing of the benefits of modern DH compared to competitors, etc. A few years later, the customer flow turned back to DH for two reasons. First, the gas prices tended to rise faster than the DH prices; and second, there occurred a couple of fatal explosions of old indoor gas systems that ignited serious concerns for the safety of gas heating in apartments.

5	**Feed-in Tariffs**
	A feed- in tariff is used in Europe to support a new energy production system to enter the market faster than the unbundled market would enable. Such a feed-in tariff for CHP is used in Germany and Serbia, for instance. The feed-in tariff has to be high enough and for a period

	long enough to attract investors in CHP. A feed-in tariff contract should be offered for the first investors only until the market penetration has taken place, and normal commercial investments have become viable. Particularly for larger CHP plants, a cost allocation methodology that allocates sufficient benefits to heat could be an alternative to feed-in tariffs.

6	**Emission Trading Scheme**
	CHP and DH are efficient ways to reduce primary fuel consumption and GHG emissions. Therefore, CHP should be covered by the emission trading systems. The baseline is relatively easy to be set explicitly and the measurement of the benefits can be reliable. In China, first such cases have materialized in Liaoning province.

7	**Carbon Tax**
	Carbon tax, as commonly set on fuels in the Northern Europe, for instance, is an effective incentive to EE and RES development, including CHP and DH. Nevertheless, before a carbon tax is implemented, energy carrier prices should be fully cost-covering and cross-subsidies been eliminated.

8	**Investment Financing**
	DH is capital intensive with long construction times. Often, the connection fees paid by new customers are considered investment grants to the DH company. Investment grants are indispensable for rehabilitation of DH systems, as the respective DH companies are mostly under-capitalized and do not have access to normal credits. In transition countries, the depreciation should be based on new replacement values instead of remaining low asset values, as is the current practice. Realistic depreciation would provide in-house financing resources for the companies.

9	**Customer Rights**
	DH shall be a normal commercial commodity in order to be a customer oriented and demand driven product, buyable at low costs but at good performance. Therefore, the customers must have rights and facilities to control their own heat consumption in accordance to the needs and affordability. The DH company has to deploy systematic practices to process customers' complaints in a way to improve the quality of the heating product. Rights and liabilities of customers should be laid down in a clear and transparent manner in a supply contract.

10	**Service Quality**
	Converting DH from social service to commercial commodity by means of cost based pricing, consumption based billing and room temperature control systems is the best way to improve the quality of heating services. In the past two decades such commercialization has occurred in Poland, the Baltic countries, Bulgaria, for instance, and is under way in the Balkan countries. More experiences are summarized in Appendix 1.

11	Billing
	The DH company has to take full responsibility for billing and collection, the cash inflow of its services. In the long term, the cash flow has to cover all costs of the company, also the replacement investments. Therefore, the DH company has the natural motivation to systematic billing and effective collection in order to finance all its operations. A computerized customer database including billing and collection functions with ledger is a necessity.

12	Municipality Role
	When starting DH services, the role of the municipality is vital. The municipality as the owner of streets, land and public buildings needs to be closely involved in order to ensure the viability of the capital intensive DH system construction under relatively long pay-back times. The DH customers are tax payers of the municipality and the individual voters of the local politicians. Therefore, there prevails strong local interest in DH services. Most DH systems in the world have been initiated by municipalities while following national policies and laws. Once a DH system has been installed, the role of the municipality should be reduced to that of an owner or co-owners. In several counties, municipalities are also regulators, which have the power to fix the tariffs. However, the various roles of the municipality as owner, regulator, and political body, that is looking for voters, creates a conflict of interest. In practise, this means daily political interventions into the management of the companies as well as low tariffs that do not cover the costs of services.

13	Private Sector Involvement
	The private sector has often brought good management practices to municipal DH systems, especially in Central and Eastern Europe. The involvement has taken place either through long term leasing agreements or through ownership. In the first option, the assets will be returned to the owner after the leasing agreement expires. Private sector operators of DH systems on international level are Dalkia, Fortum, Vattenfall and E.ON, for instance.

14	Synergy Allocations
	The allocation of CHP costs and emissions to power and heat can have a great impact on success of DH and CHP schemes. There have been three main approaches as follows: (i) in CEEC, the power sector has obtained all benefits of CHP even to the extent that that heat has had to cover high costs, even more than would be the alternative to produce heat by means of heat-only-boilers ; (ii) in Finland and Sweden, both products have benefited equally from CHP compared to their alternatives, condensing power and heat-only-boilers; and (iii) in Western Europe, due to strong competition with gas, the heat of CHP has benefited more of CHP than power in order to succeed on the heat market and to create the solid basis for CHP development. As a good practice, heat should substantially benefit from CHP in order to create a solid basis for CHP development, and thus optimizing energy supplies at high efficiency and low emissions.

15	Integrated Resource Planning
	IRP in the energy sector means a holistic approach taking into account both the supply and

	demand side. Regarding DHC, CHP and their primary energy supplies should be embedded into the whole energy system at least costs, whereby least costs refers to financial and economic, environmental, and other costs during a long period of time.

16	**Heat and Urban Planning**
	In case the market behaviour is not mature to optimize energy system development in the long-term, heat plans should be used to separate the dense urban areas being feasible for DH development from the distant and scarcely built areas that are suitable for individual heating solutions. Heat planning is successfully carried out in South Korea, China and Denmark, for instance.

17	**Technical Standards and Design Conditions**
	Modern technical standards are based on long and good experience in reliable and economic operation of the DH systems. Standards set the rules to manufactures to produce equipment that will allow competitive bidding at lowest costs and expected technical performance. Modern pumps and heat exchangers, for instance, are so reliable already that their doubling, as still required by outdated standards, does not provide any added value but excess costs both in investment and maintenance. Due to lack of metering, outdated standards also require excess capacity in boilers, networks and customer installations as another reason to excess costs.

18	**Refurbishing Strategies**
	Basically, it is a great advantage that large DH and CHP systems exist in several transition countries already. Unfortunately, they are often in bad technical shape and just need comprehensive refurbishment. There prevails vast experience in rehabilitating DH systems in Central and Eastern Europe (Appendix 1). Briefly, introduction of consumption based billing together with modern consumer substations will convert the system from production to demand driven operation. The substation includes the temperature controllers and heat metering. Usually, some 10-15% of the pipelines need to be replaced immediately, which already cuts the heat losses by half. About a half of the heat production capacity shall be considered a base load capacity with high efficiency, preferably CHP, and the rest as peak load and back-up capacity.

Moreover, good practices of four countries are presented below as more holistic examples. The countries are:

- Bulgaria, which successfully started DH refurbishment from the customer side by means of heat metering and temperature controlling;
- Denmark, which has extensive DH/CHP systems based on extensive regulatory framework;
- Finland, which has economic DH/CHP systems based on free market conditions; and,
- Germany, which has a strong feed-in tariff system to support expansion of both CHP and RES, and simultaneously DH as well.

6.2 Bulgaria and Central Europe

District Heating (DH) is the most economic form of providing heat in urban areas where DH networks exist. [4]However, starting from the early 1990s, before Bulgaria's accession to the EU, the district heating sector in Bulgaria went through difficult times. Some of the difficulties faced were:

- *Switch to uneconomic forms of heating*: Declining incomes did not allow consumers to afford district heating (DH) and about 30% of the consumers disconnected themselves from this service. These consumers moved to other forms of heating – mainly electricity. Heat delivered through electricity typically consumes more fuel compared to DH. Thus, the switch by consumers to use electricity for heating purposes was not economical for Bulgaria.
- *Lack of demand-side management (DSM)*: Consumers could not control their heat consumption because heat radiators lacked regulators. Bills were not based on actual heat consumption but on apartment size. Further, the heat entering a block of apartments through a sub-station was not measured because there were no meters in substations. These factors did not encourage energy conservation. In addition, because consumers could not control heat consumption room temperatures were adjusted by opening or closing windows, which wasted energy.
- *Inadequate tariffs leading to the need for operating subsidies*. Because tariffs did not cover operating costs the DH companies became dependent on State operating subsidies, for example, in 2002, US$70 million in subsidies was provided to the DH companies. Insufficient tariffs also prevented the DH companies from making investments to rehabilitate the DH networks. Since Bulgaria lacked a clear policy to increase tariffs and costs were rising, the DH companies' financial situation grew worse each year.
- *Depletion of assets*. The financial constraints of the DH companies made network rehabilitation unaffordable, which increased heat and water losses. Routine maintenance was deferred and parts were not replaced, which in turn led to increased heat and water losses affecting the financial position of the DH companies.

To address these issues, the Government prepared a District Heating Strategy (August 2000) that was eventually adopted by Parliament (July 2002). The strategy identified the issues in detail and proposed policy measures, including some that led to the revival of the sector—related to regulating tariffs, promoting DSM, and privatizing DH companies.

In year 2008 the project in Sofia (TS) and Pernik (TS) was completed with the following outcomes.

- Improved quality of heating services, measured through increased connection rates from 85 to 96% in Sofia and from 63 to 85% in Pernik.
- Improved financial viability, measured through

  (i) Positive fiscal impact: improvements supported under the project were projected to decrease State assistance to TS and TP to zero after 2005; and

  (ii) Increased bill collection rate: domestic bill collection rate (with arrears) was 80% in TS and 50% in TP, and these were increased to 86% in Sofia and 85% in Pernik by end-2007.
- Increased environmentally friendly operations through energy conservation and pollution reduction through:

  (i) Reduced network heat losses: in 2002, network heat losses (total heat loss divided by production) were 16.7% for TS and 31.8% for TP. Over the life of the project, heat losses were changed to 17.5% in Sofia and 24.4 0% in Pernik. Even though the percentage values did not change much, and even increased a little in Sofia, the quantitative loses reduced substantially, but could not be seen in the percentages because the heat production (denominator) decreased due to improved energy efficiency of customers as well;

[4] Implementation Completion Report and Results Report (IBRD – 47030, 47040) of the World Bank on a Loan in the Amount of US$34.2 M to Toplofikacia Sofia and Pernik DH Projects, Bulgaria, December 30, 2008.

(ii) Decreased energy consumption: initial heat consumption of the customers of 12.7MWh/year/household in TS and 14.9 in TP dropped by 2007 to 9.1 and 9.9 MWh/household, respectively; and

(iii) Other environmental benefits were achieved in through rehabilitation of the heat sources and converting the CHP plants as base load suppliers and leaving the heat-only-boilers as peak load reserves.

DH network water losses decreased by 26% for TS (from 3.1 M m^3/year) and by 50% for TP (from 0.4 M m^3/year).

About a decade ago, disconnections were a serious problem in Bulgaria, when about 30% of the radiators in the country were disconnected. By year 2006, the problem has been solved and virtually all apartments in buildings that were served by DH have been reconnected.

To overcome the disconnection problem, there should be a fixed charge to the customer to be paid anyway, because the DH connection is physically available, as was done in Bulgaria. The fixed charge will reduce the barrier to the customer to reconnect the DH system. The City may also apply for a court decision to prevent installation of individual boilers in apartments in densely populated areas that are currently served by the DH system. The court decision would be needed in order not to compromise the benefits of collective DH systems.

Comprehensive DH refurbishment similar to the Bulgarian example has been successfully carried out in East Germany, the Baltic countries, Hungary, Czech Republic and Poland. More experiences in DH system rehabilitation from Poland are presented in Appendix 1.

6.3 Denmark

Denmark[5] is here as an example of widely spread DH supported by strong national regulation. The regulation sets priority to DH in areas with dense construction. Consequently, the DH has a large market share and it has become a popular and desired heating mode all over the country. Comprehensive CHP has been built to serve the DH systems and the national power grid at high efficiency.

The first Heat Supply Law of 1979 has been an important factor in CHP / DH market growth by creating a new public planning process that rationalised heat supply. The government's more recent Energy Strategy 2025 builds on this track record to address the challenges of rising fuel prices, declining internal energy production, and growing environmental pressures. It aims to promote new clean technologies and increase its share of renewables and CHP through well-functioning energy markets and international cooperation.

With the development of CHP and DH in the 1980s and 1990s, Denmark became less dependent on coal and oil as an energy source. Initially, coal and natural gas fired CHP, and the increased use of renewable sources, slowly replaced some oil - with coal in turn also being displaced since the mid 1990s.

Alongside the drive to energy sufficiency and efficiency has been the growing trend towards decentralisation of power generation. The figure presented below illustrates the change that has taken place since the mid 1980s when a handful of large power stations generated the country's domestic energy. Today, as a consequence of the pro-CHP and wind policy programmes, energy is supplied from a much larger array of smaller scale units based mainly on CHP (which are co-located with heat loads) and dispersed wind farms located in rural areas.

[5] IEA: DHC Country Scorecard - Denmark

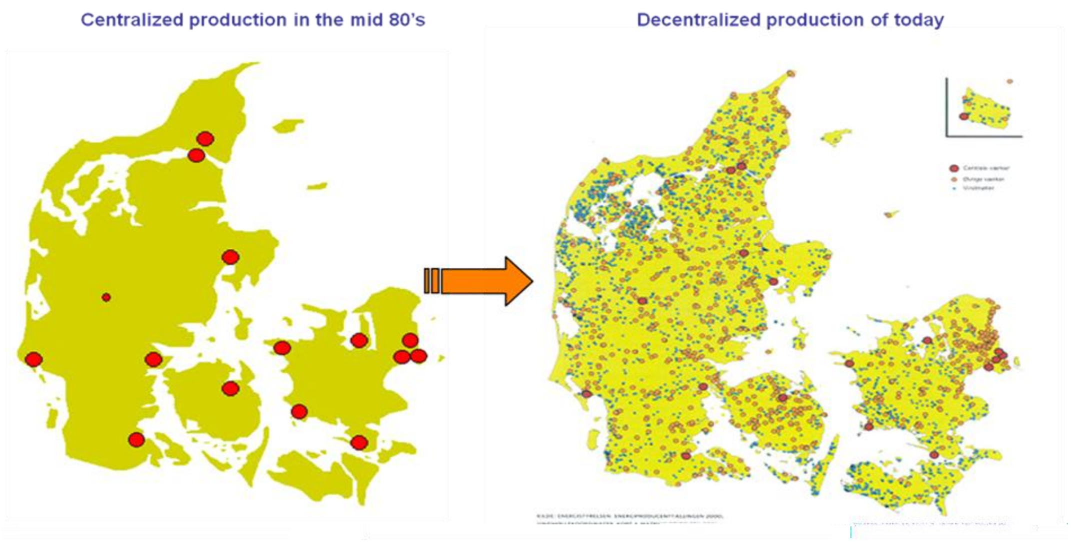

Figure 6.1. Growing decentralisation of electricity generation.

In its Energy Policy Statement 2008, Denmark aims to tackle the climate challenge at minimal economic costs and without risking the security of supply. This will be achieved by making improvements in

- Energy efficiency
- Renewable energy
- Technological development.

Specifically, Denmark aims to

- Reduce the country's total energy consumption by 2% in 2011 and by 4% in 2020 based on 2006 figures; and,
- Increase the use of renewable energy to 20% of gross energy consumption by 2011.

To help meet these ambitious targets, the government will increase funding for research, development and demonstration of energy technology to €135 million / year.

The majority of the CHP plants serving the DH networks is owned by local authorities and co-operatives, and is fuelled by natural gas. The Heat Supply Law stipulates that DH schemes must operate on a non-profit basis, and heat and electricity prices must be cost-reflective.

Having now achieved a comprehensive energy system based on CHP, DH and wind, Denmark now aims to substitute fossil fuels with biomass in its CHP plants to further reduce GHG emissions and enhance long-term energy security.

The Heat Supply Law made local authorities responsible for identifying the potential for public heating in their areas. Efforts were then made to introduce collective heating schemes in the most appropriate areas, these forming the basis for DH systems, while the local authorities were able to start drawing up heating plans in their municipalities.

The planning process detailed by the law was divided into three phases:

- Phase 1: Local authorities had to prepare reports on their own heat requirements, the heating methods used and the amounts of energy consumed. Heating options were also assessed. Local plans were aggregated at county level to prepare regional heat supply strategies.
- Phase 2: Local authorities had to prepare a draft of their future heat supply needs. The county councils then prepared regional supply need plans.
- Phase 3: The county councils prepared definitive regional heat plans based on this information.

These plans were used to highlight in which areas the various forms of heat supply should be prioritised, and where best to place future pipelines and heat supply installations.

Financial Support Policies are as follows:

1) Taxation on fuel for heat

Placing a high tax on fuel used for heat generation, with no tax on the fuel for electricity production, has encouraged a shift from heat only production to CHP operation. As of 1st January 2002 CHP producers using natural gas could calculate the fuel used for electricity generation and subtract this from their total fuel consumption. The level of energy tax varied depending on the fuel used:

- Fuel oil: €223 per tonne
- Coal: €139 per tonne
- Natural gas: €c0.13 per m^3.

Not only did the fuel tax encourage the transition to CHP generation, it also made biofuels competitive with fossil fuels as renewable fuels avoided the tax.

2) CHP electricity production subsidy (feed in tariffs)

This subsidy was originally only available for electricity produced by renewable technologies and fuels, but was extended to include natural gas based CHP in 1992. The original scheme supported all CHP plants, but the feed in tariffs are now only available to CHP plants with an electricity capacity less than 25MW using waste, biofuels and natural gas. The level of tariffs has also been reduced. Table 2 summarises the current tariff scheme.

The main planning policies are as follows:

1) Obligation to connect or remain connected (1982, amended 2000)

Local authorities have the power to require that all consumers connect either to a natural gas supply or to a district heating network. This obligation applies to new and existing buildings, but for existing buildings the connection needs to occur at the latest 9 years after notification of owners. The guaranteed revenue from the captive customers on the network was used to incentivise the installation of CHP units.

2) Electric Heating Ban (1988, amended 1994)

Electric heating is banned in all new buildings and in existing buildings that have a water based central heating system or access to a public supply of natural gas or district heat. This helps create the heat loads necessary to sustain efficient DH CHP schemes.

6.4 Finland

The Finnish energy situation[6] is influenced heavily by three main features:

- The country's cold climate.
- The need to reduce energy imports.
- The effort to reduce carbon emissions.

The high national level of CHP utilisation has been achieved with little direct government support. In a country with such a cold climate and limited resources of energy, CHP has been the natural economic choice for many applications. Three main drivers of CHP have comprised the needs (i) to reduce energy imports, (ii) to maximize the economy of energy supplies, and later on in some cases, (iii) to increase economic attractiveness of CHP over heat only generation by means of governmental energy taxes.

Highly economic and mainly centralized CHP has offered favourable energy prices – low prices even at the European level - to the Finnish customers. Regardless of the low sales prices, CHP have been a successful business to its owners, usually municipalities. Despite of the low prices in heat and power, the Finnish CHP companies often generate financial profit of more than 10% of the turnover.

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[6] 6 IEA: DHC Country Scorecard - Finland

However, in the future, Finland faces challenges in exploiting the few remaining locations suitable for CHP, and increasing the use of DH further in cities such as Helsinki, where over 92% of building volume is already served by DH.

The cold climate requires that space heating is needed almost nine months a year and, in winter, electricity for lighting is needed for a large part of the day. Naturally DH produced with CHP is served all year round to all buildings for domestic warm water, bathroom heating and other purposes. Energy efficiency is therefore an important national goal.

CHP has been successfully incorporated into both DH and industry in Finland, with the country's cold climate (giving a faster return on heat supply infrastructure investment) and the integration of the forestry and paper industries (with their associated high energy intensity) primarily responsible. Finland is probably the best example in the world of a buoyant market for CHP that is not underpinned by a strong government incentive regime. During the whole of its history, DHC with CHP has been also good business to owners.

In Finland, there are around 150 independent DH companies. Each company has its own strategy, tariffs, contracts, prices, customers, etc. The companies are typically owned by municipalities in the range of 95 % of companies and 87 % of heat sales. The municipal ownership is governing, but not because of legal provisions, but for natural reasons. Some 5-10 years ago there was a forecast expecting a major switch towards privatization. That privatization boom, however, did not materialize, because the DH and CHP is a good business for the municipalities. In several cases, the profit level has been 10% or more from the annual turnover, which could be used by the owner, the municipality, to fund several public services to their citizens. Without such profits collected from DHC and CHP, the municipal taxation would have been on a higher level.

Around 40 DH companies generate electricity (CHP) as well.

One third of DH is produced by another company than the one, which distributes it

The branch has a strong tradition of voluntary cooperation between companies in the Finnish Energy Industries (FEI) association. The association has two main functions as follows: (i) creating recommendations on tariffs, maintenance practices, contracts, marketing etc. to member companies and collecting energy statistics; and (ii) lobbying towards the governmental authorities and public mass media by providing facts and opinions in order to have legislation and public opinion that is fair for DH and CHP to ensure sustainable development of optimal energy practices.

The Figure below highlights the estimated fuel savings that the Helsinki Energy utility has seen as a result of generating heat from CHP. Without CHP, the primary fuel consumption would have been around 25,000 GWh (90 PJ) instead of the real 15,000 GWh (54 PJ) a year.

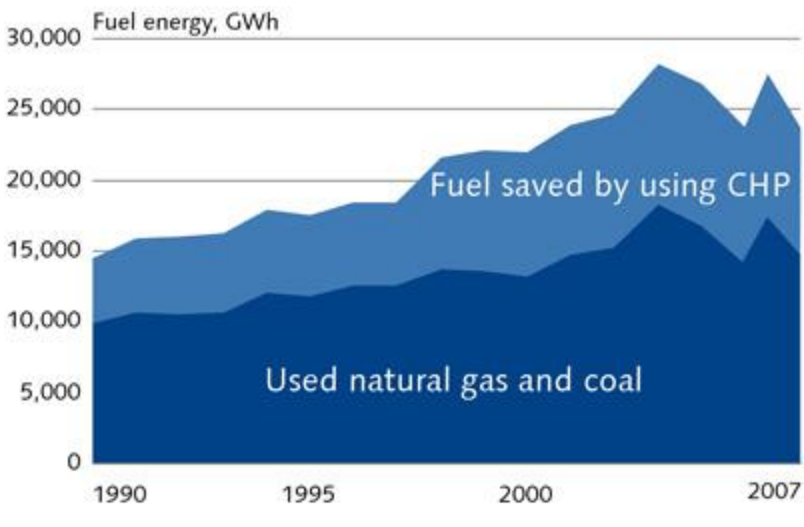

Figure 6.2. Fuel used by conventional and CHP generation.

In Finland, the house-owner associations are the customers of DH, not the individual apartment owners. The associations allocate the heat bills to the customers according to the room area. The one-family houses, however, are directly heat customers of the company. The building level substation is owned by the heat customer.

There has never been a heat law in Finland. The heat customers are protected by normal customer protection laws as DH, DC and electric power are considered as ordinary commercial products.

The DH tariff structure is as follows:

1) Connection charge

The customer pays a connection charge when connected to DH network. The charge depends on the size of the customer and also on the heating market competition situation. In 2009, the charge varied from 75 to 340 €/kW depending on the size of the new customer.

2) Fixed charge

The fixed charge is paid annually and depends on the size of the customer. As country averages, the fixed charge ranged from 20 to 36 €/kW depending on the size of the customer, including VAT of 22%.

3) Energy charge

4) The energy charge is constant for all customers in one DH systems. In 2009, the country average was 44 €/MWh (incl. VAT 22 %). The ratio between the highest and lower energy charge in Finland was 2 to 1, the highest prices being at small companies using oil and the lowest ones at large companies having comprehensive CHP systems or industrial waste heat purchase.

6.5 Germany

In Germany, there are feed-in tariffs for electric energy generated by both renewable sources as well as CHP. The latter one is based on the law on Protection on Power Generation from CHP[7]. In year 2000, the Law has set a minimum fee for CHP power at 9 pf/kWh, equal to 4.5 €cnts/kWh. From Jan. 2001, the fee has constantly fallen by 0.25 €cnts/ year, and will become zero by year 2018.

Based on the Law and its amendments later on, the status report from year 2005 states that 38 GW of CHP is covered by the Law, comprising[8]:

- 402 old CHP plants (coal, lignite),
- 3.827 new CHP plants (coal, lignite, gas, renewable fuels),
- 74 modernized CHP plants (coal, lignite),
- 7.049 small CHP units (gas engines and turbines)
- 70 fuel cell based small CHP units.

One may see that the Law has ignited a strong boom in CHP expansion in Germany. In parallel with the CHP expansion, strong measures have taken to extend DH networks and customer base, as the CHP requires heat load to function. One of such measures is innovative pricing of DH: new customers do not need to pay connection fees, but the connection costs will be collected during the years to come; public subsidy is given to customers who replace the existing heat source with DH connection, for instance.

By year 2005, the CHP plants had generated 215 TWh and by 2010 are expected to generate 560 TWh of electric power to the grid.

Together with CHP and DH expansion substantial environmental benefits have been achieved. The CHP generation has reduced 8.5 - 10 M metric ton of CO_2/a in year 2005 is expected to reduce 14 M metric ton in year 2010.

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[7] Gesetz zum Schutz der Stromerzeugung aus Kraft-Wärme-Kopplung (Kraft-Wärme-Kopplungsgesetz), Vom 12. Mai 2000

[8] Zwischenüberprüfung des Kraft-Wärme-Kopplungsgesetzes, Bundesministerium für Wirtschaft und Technologie & Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, 2006

As another support to DH development, some German DH companies (MVV, for instance) have reduced the customer barrier to join the DH systems by neglecting the connection charge and even paying subsidies for connection. Such subsidies are used to support the replacement of the existing heat source of the customer by DH connection. The costs of connection will be collected from the new customer by the DH Company during the years to come.

6.6 Primary energy factors

The efficiency of DH and CHP systems compared to other ways of delivering heat and power should be based on primary energy factors in order to quantitatively and in a uniform way to express the energy savings and emission reduction benefits of DHC compared to other heating modes.

Primary energy refers to energy that has not been subjected to any conversion or transformation process (e.g. oil in the oil fields). Primary energy may be resource energy or renewable energy or a combination of both. Resource refers to a source depleted by extraction (e.g. fossil fuels) and renewable energy to a source that is not depleted by extraction (e.g. biomass, solar).

The use of the primary energy factor (PEF) enables to measure the savings and losses occurring from energy generation to the delivery to the building. The PEF expresses the ratio of the non-regenerative resource energy Q_P required for the building heat supply to the final energy supplied to the building Q_E.

$$PEF = Q_P/Q_E$$

The PEF represents the energy delivery but excludes the renewable energy component of primary energy.

The advantages of DH and DC become visible in the frame of such a broad analysis based on the use of fuel input. In effect the PEF shed light on the benefits of using fuel and energy (in the form of waste heat) that would be emitted into the atmosphere unused if it were not possible to use the heat in district heating and cooling systems. Such fuels and energy streams include, for example: biomass, biogas, blast furnace gas, landfill gas, residual waste, sewage sludge, solar and geothermal heat, and surplus heat from industrial processes.

Average PEF of district heating systems is lower than other common heating systems in Europe. Lower PEF means savings of fossil fuels.

Table 6.1: Typical primary energy factors (PEF) of various heating modes[9]

District heating	PEF	Building-specific heating	PEF
CHP fuelled on gas	0.5	Gas boiler	1.3
CHP fuelled on coal	0.8	Coal fired boiler	1.5
Biomass	0.1	Oil fired boiler	1.3
Waste incineration	0.05	Electric heating	2.5
Oil	1.3	Heat pump	0.9

CO_2 emissions of DH systems are substantially lower than those of alternative heating systems, as presented in Table above. A building specific compressor also has other greenhouse gas emissions

[9] ECOHEATCOOL,Work package 3,Guidelines for assessing the efficiency of district heating and district cooling systems, Euroheat&Power, supported by Intelligent Energy Europe, 2005-2006

due to leakages of refrigerants. The total greenhouse effect of a building specific compressor is more than the effect of CO_2.

Table 6.2: Primary energy factors of various heating modes[10]

District heating	**CO_2 (g/kWh)**	**Building-specific heating**	**CO_2 (g/kWh)**
CHP fuelled on gas	10	Gas boiler	260
CHP fuelled on coal	270	Coal fired boiler	530
Biomass	30	Oil fired boiler	350
Waste incineration	20	Electric heating	850
Oil	360	Heat pump	300

The values of Table 6.2 are based on technology that is currently available. The values of existing heating systems are typically higher than the values of Table 6.2. As efficient heating systems replace old applications, significant amounts of CO_2 emissions will be saved. A higher market share of DH means lower CO_2 emissions of heating. Therefore, CO_2 saving potential of DH is really significant.

[10] ECOHEATCOOL,Work package 3, 2005-2006

7 Bosnia & Herzegovina

7.1 Features and Extent of DHC/CHP

History

In Bosnia&Herzegovina (BiH) larger centralized DH systems emerged in the 60ies and 70ies of the last century. The Sarajevo DH ("Toplane Sarajevo") system is the largest in Bosnia and Herzegovina. Centralized DH in Sarajevo started in 1968 under the umbrella of the local housing company (Stambeno preduze ć e Sarajevo) by operating boiler facilities previously managed by tenants' councils. The public utility "KJKP Toplane Sarajevo" was eventually established in 1978 as an autonomous enterprise. A few years later, a natural gas-fired boiler conversion program started aiming at eliminating a larger number of small boiler units that used solid and liquid fuels. During the war, the DH system was heavily damaged, but meanwhile has succeeded to supply the number of flats heated in 1992.

The DH Company of the city of Banja Luka is the largest one in the Republic of Srpska. The centralized district heating system started after the earthquake in 1972.

Another larger DH Company, JP Grijanje Zenica, was established in 1967 as a branch of the Electricity Company Elektroprivreda. In the 90ies, it was a part of the Iron Works Zenica and finally in 1997 it was established as an independent company.

District heating operation in Tuzla started already in 1955, but only in 1983, it was connected to the CHP plant. The DH system has been developed in compliance with heat development plan.

Statistics from past three years

There is no official DH or energy statistics.

DHC and CHP market shares

District-heating (DH) systems used to be in most cities with a population of 20,000 and above. Before the war, the number of DH Companies was more than 30, but lacking maintenance and repairs resulted in big damages and eventually heat supply had to be stopped. DH in BiH served 120,000 flats, equivalent to 450,000 inhabitants or 10% of the population.

The table below shows the current situation of DH. In the urban areas, DH has is still a significant heating option. About 39% of the households are supplied by DH[11]. About 10% have electric heating and 27% have gas heating.

[11]Statistical Office, Living Standard Measurement Survey In B&H

Table 7.1: Overview on the DH sector in BiH

		Entity *)	Installed capacity	Con-	CHP	Con-nected load	Net-works	Length	Sub-stations	Residential area	Non-residential area
			MW(th)	MW(th)	MWth	MW(th)	No.	Km	No.	m²	m²
1	Banovic	FBIH									
2	Lukavac	FBIH			35			25	48	123.000	34.000
3	Tuzla	FBIH		282	??		1	50	420		
4	Breza	FBIH									
5	Kakanj	FBIH	58	36			1	10	23	156.070	49.780
6	Tesany	FBIH									2.100
7	Zenica	FBIH	220		174		1	12	548	1.000.000	372.049
8	Sarajevo	FBIH	497	333			130	74	180	2.692.498	298.324
9	Konjic	FBIH	30				4	10	10		
10	Sanski Most	FBIH									
11	Banja Luka	RS	246	220			3	220	230		
12	Bijeljina	RS									
13	Bosanski Brod	RS									
14	Celinac	RS									
15	Derventa	RS									
16	Doboj	RS	58				2	13	80	350.000	98.000
17	Gardiska	RS	12				1	12	98		
18	Islo cno Sarajevo	RS	29		20				4		
19	Pale	RS	6					4		37.700	12.300
20	Prijedor	RS	60				1	10	43	201.999	75.041
21	Sokolac	RS	3				1	3	7	88.000	?
22	Zvornik	RS	21				1	2	28		

Source: ESSBIH, Energy Sector Study, Module 9, 2007

**) BIH: Federation of Bosnia and Herzegovina, RS: Republic of Srpska*

So far, only Sarajevo has undergone a comprehensive rehabilitation and modernization program. The others are still waiting for financial support. The ESSBIH[12] study estimated the total investments costs to amount to € 360-480 million. These numbers include, however, connection costs for new buildings and heat cost allocators.

Heat consumption in Bosnia is relatively modest compared with other countries in the region. The DH Company of Sarajevo measured the heat consumption for several years. New buildings have a heat consumption of 80 kWh/(m², y) and older ones 130 kWh/(m², y). The number of degree-days is 3.300. In Serbia the typical average heat demand is 140 kWh/(m²,yr), although the number of degree-days is only 2.600. The likely explanation for the difference is better building construction and better enforcement of building codes in Sarajevo.

Some of the thermal power plants supply heat for district heating systems and steam for industry, but the amount of produced heat energy is small. Before the war, various plants (14 in total) with a total capacity of 294 MW(el) were operated in the industrial sector, but only four of these units with a total capacity of 34 MW(el) are now available.

For the time being, only the DH systems of Tuzla and Kakanj are supplied by CHP. In both cases, the heat is delivered by the same CHP plant.

There are, however, plans for new CHP plants. In 2000, the DH Company of Sarajevo commissioned a first feasibility for a CHP plant with 50 MW(el). However, the Electricity Company did not show any interest and the project was not followed up further. A few years later, another study was carried out. The basic idea was to supply the electricity to public and cantonal entities. The electric capacity was limited to 5 MW, but the Electricity Company again rejected the

[12] ESSBIH, Energy Sector Study, Module 9, 2007

proposal. Nowadays, the situation has changed. Although there is still no special legislation to support CHP, the new management of the Electricity Company is supporting the project and the feasibility study will be updated soon based on a preliminary agreement about a joint CHP project.

Types of DHC consumption

Table 7.1 shows that about 2/3 of the DH is consumed by residential customers and the remainder by commercial and budgetary customers. None of the DH Companies supplies domestic warm water.

Selected technologies with customer connections

Different concepts for DH have been applied for building the DH systems. While most cities have only one single or very few networks, there are 129 small networks without interconnection in Sarajevo. The largest boiler facility is 56 MW. More than 100 boiler facilities use natural gas, while the others are dual-fuel boilers (natural gas and heavy oil). About 90 are roof boilers that have been installed before 1984. All substations are direct ones.

To illustrate the variety of technical concepts, characteristics of some DH systems can be described as follow:

- Tuzla is supplied by the local CHP plant and operates itself only a few small boilers. Heat is supplied by a transmission line of 15 km. The pipe is in a bad shape and losses have been estimated to amount to some 9%. The piping system has been designed for a temperature differential of 145/75 ^{o}C. Most substations are indirect ones equipped with remote monitoring and control.
- The DH system of Zenica is supplied by the local Iron Works. The temperature differential in the primary system is 130/70 oC and in the secondary system 62/50 ^{o}C. 80% of the substations have been direct ones.
- Kakanj is also supplied by CHP Kakanj via a transmission pipe of 9.5 km. There are 2 large group substations and a number of building substations for one-family and private houses.
- Banja Luka is supplied mainly by a central HoB-plant. The network has high water losses amounting to some 800-1000 m3 per day. A large part of the pipes is made by the LUBIT and PLUBIT technology, while another part is made by pre-insulated pipes. Although several substations are equipped for DHW supply, only space heating is supplied, The substations are indirect and regulation is automated or manual,
- The network in Prijedor has been designed for 130/92 oC. Substations are indirect and with automated regulation.
- Pale uses biomass, that is waste wood, for heat production

Heat metering rate

Heat metering is under development, but achievements are so far quite different. Bulk heat supply is usually metered when delivered by a third party. Larger boiler houses or rooms have also been equipped with heat meters.

Regarding heat metering in substations, some DH Companies perform heat metering for larger customers, but the heat consumption of residential customers is usually not metered with the exemption of Sarajevo.

In Sarajevo, the installation of heat meters started some years ago. In 2010, most buildings in Sarajevo have been equipped with heat meters (1.400 in total); in 2011, 100% will be reached. All new buildings that have been connected to DH have individual (apartment-wise) heat meters.

For the time being, heat meters are not used for billing.

Market expanding/shrinking

Even in Sarajevo, that is a quickly growing city, there are not many applications for new connections. In the last years, the growth rate was between 1% and 2%y.

Local DHC association

There is no DH Association in B+H. There have been some contact between the Federal Republic and RS, but the idea was not followed further.

7.2 Legal and Regulatory Framework

National policy

The country comprises two governing entities, the Federation of Bosnia and Herzegovina and Republika Srpska, with a third region, the Brčko District. Accordingly polices and legislation are not uniform, but sometime harmonized as in case of the legal framework for the electricity sector.

The Government of Republika Srpska approved the "Energy Strategy Development Plan of Republika Srpska until 2030" in 2010. The plan stated in the Strategy also envisages the connection of 20 percent of households to natural gas network, construction of hydropower plants on the Drina River and completion of Gornji Horizonti project, revitalization of thermal power plants and construction of gas heat and power stations in Banja Luka.

The Federation of BiH has drafted a strategic plan on, but it has not been adopted yet.

There is no comprehensive national DH strategy.

On the local level, however, companies have developed their development strategies. For Sarajevo, a number of potential projects for further improvements of Sarajevo DH have been identified:

- Implementation of consumption-based billing
- Continued installation of the remote control and management system
- Completion of reconstruction of the boiler-houses, distribution networks, and substations
- Replacements of convectors in flats with radiators and installation of thermostatic valves
- Construction of facility for combined generation of around 5 MW of heat and 5 MW of electricity
- Construction of a larger CHP plant
- Organizational improvements

The Republika Srpska has an Energy Law adopted in 2009, which also addresses heating. Distribution and supply of heat like various other energy carriers are "are the activities of general interest and are carried out in the system of the public service obligation pursuant to the law and license for that activity." Besides that, of the important Laws of the Republic are the electricity and the Gas Law.

The Federation of BiH did not yet adopt an Energy law or gas law, but an Electricity Law has been adopted already.

There is no corresponding legislation for DH. Moreover, there is neither an Energy law nor an Energy efficiency law.

The countries have two regulatory agencies. RERS, the Regulatory Commission for Energy in the Republika Srpska, was established in 2002 in order to "regulate monopolistic behavior and provide transparent and non-discriminatory position of all participants in the electricity market in Republic of Srpska, pursuant to the Law on electricity (Official Gazette of Republic of Srpska number 66/02, 29/03 and 86/03)". The Agency is only responsible for electricity regulation.

FERK, the Regulatory Commission for Electricity in the Federation Bosnia and Herzegovina, was established in 2002. Like the one in Republika Srpska, it is only in charge of electricity regulation.

Building regulation

Before the war, the housing stock consisted of about 1.2 million houses, while more than 450.000 have been destroyed in war. Housing maintenance companies exist only in the Canton Sarajevo. Till now, the regulation from 1987 is still in force that proscribed a relatively weak level of thermal insulation.

Accordingly, the energy consumption of existing buildings and has been estimated tom amount to 200 kWh/(m²,y) thermal energy. The building sector is the biggest energy consumer with 55% of the final energy consumption and most of this is spent for heating.

The new Energy Strategy of the Republika Srpska envisages an improvement of thermal insulation in 137,000 buildings that is, on 12.25 million square meters of surface, as well as determining more demanding the standards for thermal insulation for newly constructed buildings.

Price regulation

Tariff setting is the responsibility of the regional (cantonal) or municipal authority. There is no uniform methodology for determining DH tariffs. DH Companies submit their tariff proposal to their owners (cantons or municipalities), which have to approve or modify the proposal. In theory, a cost of service tariff regulation is applied and respective municipalities and cantons should cover any gap between approved tariffs and costs, but in practice usually only a part is paid.

Social considerations are not relevant in the Canada case. There are no special subsidies paid for targeted consumers, such as low-income households. There no special targeted subsidy programs for heating.

DH companies still apply lump sum tariffs. The tariff relates to the heated area and has to be paid for six months in BiH and 12 months in RS.

The DH Company of Sarajevo would like to implement consumption-based billing, but the Cantonal government does not provide permission for the existing buildings. The situation is different for new buildings. About 500 flats have consumption-based billing, also a small a part of commercial consumers. All new buildings that are connected to DH have consumption-based billing

Competition

There has been a strong competition by natural gas in the last two years particularly for the supply of new buildings. The DH Companies are in a bad condition. Instead of being accepted as privileged consumers, they have to pay higher gas prices than private households (the DH Company of Sarajevo pays currently 1.3% more for gas).

Feed-in tariffs

The Regulatory Commission for Energy of RS is responsible for issuing the rules for establishing the system of incentives that will stimulate the production of energy from renewable sources and cogeneration. The incentive scheme proposes a guaranteed Feed-in price consisting of a reference price plus a premium. Although Renewable Energy Strategy on the State level does not exist, some important steps related to implementation of Directive 2001/77/EC have been made at Entities levels. Systems of incentives for electricity generation from renewable sources and co-generation for installed capacities below 5MW at the level of both entities have been adopted.

The Decision is an important step for the development of the renewable energy sector. This decision has been implemented in both entities

It describes the methodology for determining prices for energy produced from renewable sources,. It also imposes an obligation on these electricity companies to give some advantage to renewable sources of energy over other conventional sources,

The public electricity utilities companies, Elektroprivreda F BiH dd Sarajevo, Elektroprivreda RS ad Banja Luka and Elektroprivreda HZHB dd Mostar, are obliged to take over l all energy produced from the renewable energy sources.

Only plants with a maximum capacity of 5 MW will receive the incentives. In case of hydropower, the threshold has been set at 10 MW.

The determination of the purchase price level of electric energy from renewable sources with installed power up to 5 MW will be done by application of corrective coefficients on the amount of the current tariff items for active energy, higher seasonal and higher daily, for consumption category on 10 (20) kV voltage from the tariff items The relative correction coefficients are:

- Small hydropower plants 0.80
- Power plants on biogas from the waste area and biomass 0.77
- Power plants on wind and geothermal sources 1.00
- Power plants on solar energy 1.10

In June 2010 the government of the Federation B+H signed a decree about the use of renewable energy and CHP. The decree established also an Operator for renewable energy- The operator will purchase electricity produced from renewable energy and CHP with prices settled by the agreement.

Table 7.2: Feed-in tariffs in Bosnia & Herzegovina.

Energy source	Correction coefficient	Feed-in-tariff (EUR cent/KWh)
Small-scale hydropower plants	0.80	3.96
Landfill-gas and biogas plants	0.77	3.81
Wind and geothermal power plants	1.00	4.95
Photovoltaic installations	1.10	5.45

Source: Stability Pact Watch Group, Arrested development energy

Efficiency and renewable energy in the Balkans, 2005

Emission trading

Bosnia and Herzegovina first signed on to the UNFCC in 2000. The INC report is the latest step in the process of mitigating climate change. UNDP Bosnia and Herzegovina organized the report with the financial support of the Global Environment Fund. As part of that process, 50 local experts from a variety of disciplines helped prepare the report in accordance with international standards.

Bosnia and Herzegovina ratified the Kyoto Protocol in April 2007, and the country is now eligible for the use of CDM, which could mean a significant boost in the economy and creation of jobs.

Carbon and other taxes

A carbon tax is not applied. The same VAT rate is applied for all fuels in BiH.

Investment support

Investment support came in the last decade mainly from the International Financial Institutions, particularly the World Bank, and from bilateral assistance programs.

Loan financing has to be approved by the respective owner, but so far no larger loan project has been approved. In BiH, Canton governments do usually not allow loans for DH Companies.

An IDA credit of US$ 20 million was provided for the "Emergency District Heating Rehabilitation Project" aimed to restore heat to urban customers and to rapidly regularize dangerous gas connections-namely in Sarajevo. Medium term objectives included rehabilitation of other urban district heating systems, securing an assured supply of gas, and improving cost recovery in both subsectors. Sector investment programs were developed by donors and the sector authorities. As of end-1998, eight donors had firmly committed US$99 million and disbursed US$75 million.[13]

7.3 Customers

Status, rights and responsibilities of customers

There are no special supply contracts or regulation governing the powers and liabilities of customers.

In Sarajevo Canton, regulations allow rejecting disconnection. DHC Sarajevo decided in agreement with the Cantonal Government to allow disconnections under certain conditions. A disconnected customer has to pay 40% of the tariff to cover the fixed costs.

Service quality

DH Companies are obliged to operate and maintain the DH systems.

7.4 Ownership

Role of the government and municipality

The governmental of the entities, i.e. Ministries of Energy and Mining, are supervising three electricity utilities, oil refineries, natural gas transmission and distribution utilities and coal mines. Except for the Joint Power Coordination Centre, there are no functional state-level institutions. The legal and regulatory framework is also set at the entity level, although plans to establish State and Entity regulatory agencies are at an advanced stage.

District heating regulation falls under the responsibility of municipal (RS) and regional (cantonal) governments (BiH)[14]. In BiH, DH assets and companies are owned by the cantonal governments.

In Republic of Srpska, the DH assets are owned by the Government of RS and the companies have been established as municipal enterprises. In BiH, DH assets and companies are owned by the cantonal governments.

Private sector involvement

To date, there the private sector is not involved in DH business.

The investment climate is not attractive. The US Department of foreign Affairs describes the situation as follow[15]"

[13] The World Bank, Lessons For Rebuilding Southeast Europe, The Bosnia And Herzegovina Experience

[14] The Federation of Bosnia is divided into cantons, each with its own government. The cantons are again subdivided into municipalities. The Rebublic of Srpska has a central government and municipalities constitute the second level political units.

[15] http://www.buyusa.gov/

> Foreign investors continue to face a number of serious obstacles, including a complex legal and regulatory framework, non-transparent business procedures, and weak judicial structures. Privatization of state-owned enterprises continues to lag behind others in the region including Croatia, Serbia, Montenegro, and Macedonia. Although some government authorities have begun to address these obstacles as part of the transition to a market economy, foreign investment -- particularly Greenfield investment -- has shown only limited gains.

There is no special legislation regulating third party access, also a number of DH companies are supplied by third parties.

Legislation for Public Private Partnership (PPP) has been adopted in Republika Srpska and is under preparation in BiH. The Law of the Republika Srpska is fully in compliance with the relevant EU Directives. The Law allows a special form of long-term cooperation agreements whereby the public and private sectors can join resources, capital and professional knowledge.

Synergy allocation

There is no special regulation in force.

7.5 Planning

Integrated resource planning

The new Energy Law of the Republika Srpska addresses Energy Planning as an import task." The energy policy of the Republic of Srpska provides the priorities and guidelines of the energy sector development in order to achieve the long-term aims". The set of goals comprise a set of goals, such as energy efficiency and use of renewable energy. Article 7 of the law stipulates, that "the institutions of local authorities are obliged to harmonize its development documents with the Energy development strategy." Heating is explicitly mentioned as an activity to be covered by the development plan.

Heat area planning

Heat development plans have been developed before the war and should be updated to reflect the current conditions adequately. Moreover, in BiH, local and cantonal governments do no longer follow these plans.

According to the Energy Law of the Republika Srpska, municipalities will be obliged to prepare local plans in compliance with the national development plans. For the time being, it is not clear whether this will comprise the preparation of local heat plans.

7.6 Recommendations and good practices

Legal and regulatory framework

Issue	National Energy Policy
Problem	An Energy Law and Energy Strategy have only been adopted by the Republika Srpska, but not yet by BiH. There are no special development strategies for DH.
Recommendation	BiH needs to adopt an energy law and a strategy. Both entities need a strategy for the development of DH.
Good practice	Chapter 6) , Poland (Appendix)

Issue	Building regulations

Problem	Outdated building codes
Recommendation	Implement the corresponding EU directive and determine more demanding building codes
Good practice	

Issue	Price regulation
Problem	Energy Regulators on the entity level are not in charge of DH regulation, which is actually the responsibility of local and cantonal entities. Lacking uniform rules for clear and transparent tariff calculation and approval procedures.
Recommendation	Uniform rules at least at the entity level. Regulatory agencies should be in charge of DH regulation
Good practice	See chapter 6(3), Kosovo, Macedonoia FYR

Issue	Competition
Problem	Where natural gas is available, it has already become a serious competitor to DH. Price distortion referring to DH, electricity, and natural gas
Recommendation	Remove price distortions Develop local heat plans
Good practice	See chapter 6 (4)

Policy support issues

Issue	Feed-in-tariffs for CHP or renewables
Problem	Feed-in tariffs do not cover CHP plants using fossil fuels.
Recommendation	Determine feed-in tariffs for fossil CHP facilities or a corresponding cost allocation methodology
Good practice	See chapter 6 (5), Germany

Issue	Emission trading schemes
Problem	DH rehabilitation could be supported by CDM
Recommendation	Prepare CDM projects, particularly for DH systems outside Skopje
Good practice	The European Union, See chapter 6 (6)

Issue	Carbon tax
Problem	A carbon tax does not exist
Recommendation	As DH is mostly produced by natural gas, a carbon tax might not be a first priority.

Good practice	See chapter g (7)

Issue	Investment grants
Problem	Rehabilitation of an existing DH system requires likely some essential grant financing, which does not exists for the time being
Recommendation	Based on the results of the heat plans, municipalities and central government should provide some grant financing for rehabilitation.
Good practice	See chapter 6 (8)

Customer issues

Issue	Customer definition and rights
Problem	Comprehensive supply contracts are usually not applied.
Recommendation	Apply supply contract defining powers and liabilities of both parties. The contracts should be uniform at least on the entity level.
Good practice	See chapter 6 (9), The European Union

Issue	Service quality
Problem	Service quality is hard to achieve by non-rehabilitated DH systems-
Recommendation	Rehabilitation investments are indispensable to improve the service. Rehabilitation should go in parallel to the implementation of service quality requirements.
Good practice	See chapter 6 (10), The European Union, USA, Canada

Issue	Billing
Problem	Consumption-based billing is not applied
Recommendation	Uniform regulations should be applied in accordance to rehabilitation progress.
Good practice	See chapter 6 (11), The European Union, South Korea, USA, and Canada, Kosovo

Ownership issues

Issue	Municipality role
Problem	Potential conflict of interest. Municipalities/cantons are owners and tariff regulators.
Recommendation	Separate regulatory powers from ownership
Good practice	. See chapter 6 (12), The European Union, Kosovo

Issue	Private sector involvement
Problem	Private investors seem not to be interested in the DH systems
Recommendation	A clear and reliable regulatory framework for DH is needed
Good practice	Fortum and Bashkirenergo (Russia), Skopje (Macedonia), see chapter 6 (13)

Issue	Synergy allocations
Problem	Regulations for fossil CHP plants are lacking
Recommendation	Feed-in tariffs for electricity produced in fossil CHPP plants or a corresponding methodology for cost allocation should be adopted.
Good practice	See chapter 6 (14)

Planning

Issues	Integrated resource planning
Definition	
Problem	BiH is not yet adopted an Energy Strategy. The Energy Development Strategy of the Republika Srpska seem to apply the principles of integrated resource planning
Recommendation	BiH should adopt an Energy Strategy
Good practice	The European Union, South Korea, see chapter 6 (15)

Issue	Heat and urban planning
Problem	On the local level, (updated) heat plans are usually missing
Recommendation	Approach and objectives of the Energy Development Strategy has to be reflected by local heat development plans
Good practice	See chapter 6 (16)

Technical

Issue	National technical standards and design conditions
Problem	A number of technical standards and norms are outdated in view of new, modern technologies.
Recommendation	Review the technical standards and compare them with those applied in EU
Good practice	See 6 (17), New European Standard for design outdoor temperatures and using modern practices

Issue	Refurbishing strategies
Problem	Most DH systems are technically still in a bad shape and need urgent rehabilitation and modernization
Recommendation	Rehabilitate and modernize existing DH systems. Implement financial support systems
Good practice	See 6 (18), Poland (Appendix), Sofia/Bulgaria (Chapter 6), Mytishi (Russia), Subotica (Serbia)

7.7 Information sources

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8 Canada

8.1 Features and Extent of DHC/CHP

History

The first DH system in Canada was introduced in the early 1880s in London, Ontario, to meet the heating needs of university, hospital and government complexes. The first known commercial DH system in Canada was established in 1924 in Winnipeg. Regardless of the early start, the DH industry has not much expanded, mainly because of municipalities having had been financially weak as initiators and supporters of DH as well as long pay-back times of DH investments having had been out of the interest of the private sector.

Statistics from past three years

There is no DHC statistics collected at the moment in Canada, but the collection process has been initiated by CDEA.

DHC and CHP market shares

Historically, Canada has had the highest per capita energy use of the developed countries, as a result of the harsh climate and relatively low-cost, abundant energy. So the benefits of DHC energy would be particularly welcome to save energy. In Canada, there are records of some 120-160 DHC systems in the country, and almost a half of them located in Ontario Province alone. About 27 million m^2 of residential, industrial, and institutional floor area are connected to the DHC systems. This represents about 1.3% of all floor space in Canada. Natural gas distribution has spread everywhere, which is a challenge for DHC expansion. Moreover, at relatively low electricity prices, there is a little market for CHP. No economic market for CHP exists in Canada unless FIT is in place or the electricity is used in-house of producer. Power and gas utilities have not been co-operating so far, because there has been no need for them to co-operate. Now the situation is changing, and those utilities have become interested in DHC, RES and CHP development. Because the structure of the provincial utilities and low electricity prices, only a few CHP based DHC systems are in operation.

Table 8.1: Eight largest (by capacity) DHC systems in Canada '

	Company	City	Ownership	Capacity (MW)
1	Enwave Energy Corporation	Toronto	Private	522
2	University of Toronto	Toronto	Private	251
3	Central Heat Distribution Ltd.	Vancouver	Private	232
4	Laval University	Santé Foy	University	122
5	McGill University	Montreal	University	108
6	Corporation de Chauffage Urbain du Montreal	Montreal	Private	100
7	Communaute Urbain de Quebec	Quebec	Municipal	80
8	University of British Columbia	Vancouver	University	75

Source: Enwave brochure/ Natural Resources Canada.

Types of DHC consumption

The old systems before 1985 are predominantly with steam, whereas water systems have been built since 1985. The supply temperature level has been about 90^oC. Both DHW and SH have been included. Based on water/steam carrier, various combinations of heating and cooling are available in Canada.

Selected technologies with customer connections

There are various technologies available, but since 1985 European type DH systems with plate heat exchangers and temperature controllers have started to take over. Older systems are predominantly with steam distribution. A few biomass fuelled small systems have been built, but they cannot normally beat individual gas heating remote locations or where the biomass serves as a strategic benefit to the community.

Heat metering rate

All customers and heat/cold sources are with energy meters.

Market expanding/shrinking: The DHC market is expanding smoothly due to requirements of reducing GHG emissions and to start creating a different infrastructure to substitute depleting resources of natural gas. In Toronto, for instance, the market is expanding smoothly as well. There are numerous buildings inside the network coverage area that are not connected by far. *Enwave*, the local DHC service provider, has started a co-operation with the city planning office in such a way that all new buildings to be built in the DHC coverage area have to contact Enwave in order see whether DHC would be the least cost solution for them. Neither city nor Enwave can mandate the connection but it will remain within the developer/owner to decide. As customers, the buildings that have only one owner such as the municipal, governmental and rental residential buildings are easy to attract for connection, whereas the condos with apartment specific owners are difficult to attract due to voting requirements. The condo owners do not usually have professional understanding of energy. Therefore, it is difficult to have a rational connection decision there. Moreover, the current individual heating/chiller equipment is without any metering, so the condo owners are not aware of the O&M costs of their heating and cooling facilities. But since they have connected to the DHC system, they have become aware of the real costs and have started to save energy in various ways.

Local DHC association

The local DHC association is named Canadian District Energy Association, CDEA. Canadian Urban Institute[16] functions as a secretariat of the CDEA[17].

8.2 Legal and Regulatory Framework

National policy regarding DHC and CHP

In general, the Federal Government is committed to reducing GHG emissions by 17% below 2005 levels by 2020, but no concrete support to DHC development as a way to such reductions is provided. The Government hesitates to intervene the private sector driven DHC market. However, little investment support from the Federation and OPA (Ontario only) is available.

There is no formal DHC strategy or policy supporting DHC and CHP development in Canada. Nevertheless, a parliamentary committee is working on DHC development and has recommended to the Federal Government to take DHC development seriously. The Government, however, does neither have the tradition nor the willingness to take a strong position in DHC development. In practise, however, the DHC market is expected to rapidly increase due to large gas and power companies / utilities being involved. Such involvement is supported by the Green Energy Act that will provide FIT for RES based electricity generation as well as the slowly depleting gas resources. The gas resources are assumed for the next 20-30 years if no changes are made to the consumption

[16] www.canurb.com

[17] www.cdea.ca

patterns, but alternative solutions shall be introduced early in order to start smooth shift from using fossil fuels toward RES.

There is a strong interest in municipalities to consider DHC introduction and further expansion very much based on European practise. At the municipal level, the market driver is the reduction of the GHG emissions. Many municipalities have set voluntarily targets to the reduced GHG emissions. DHC systems are widely recognized as a potential measure to achieve the targets. The DHC is considered a tool for the urban planners but not an energy issue per se. Private sector cannot be much interested, because starting the DHC is risky: long pay-back times ranging beyond 10 years, limited access to municipal property, challenging contracting of municipal and federal buildings, overall billing and collection of different types of customers. Nevertheless, the municipalities are rather weak, because the municipal taxation only covers property and tourism taxes but no corporate or income taxes. Moreover, municipalities have no mandate on energy. The federal government hesitates to take a strong role while fearing of intervening the private sector driven heating market.

No particular laws on DHC energy prevail except technical requirements on pressure vessels and thermal power plants. In Ontario Province, however, the *Green Energy and Green Economy Act (2009)* as an incentive program operated by the OPA includes the feed-in tariff (the FIT Program) for electric power generated by renewable energy. The Ontario Power Authority is responsible for implementing the FIT program. By encouraging the development of renewable energy in Ontario, the FIT Program will:

- help Ontario phase out coal-fired electricity generation by 2014 - the largest climate change initiative in Canada; and,
- boost economic activity and the development of renewable energy technologies.

Building regulations

Price regulation

The regulators are involved with gas and electricity only, but not with DHC. The provincial regulators approve the profit margin of the gas and power sales as well as approve the licences for the gas and power market operators. Only in British Columbia, DH regulation regarding residential customers prevails.

Two tier tariffs in which the energy fee is pass-through of energy costs and the fixed fee covers the profit, the connection costs and all other costs except energy. Municipal companies operate as non-profit but private companies with reasonable profit with up to 20 year long steady customer contracts.

The DHC companies set their tariffs freely, but due to competition with gas heating and electric chillers, the total pricing of DHC has to be competitive on the market. There are two approaches in Canada as follows. On one hand, the DHC tariffs are set by the private companies such as Enwave individually without regulation. Typically, there is a long term contract with the customer, in which the energy costs are passed through as the variable charge. All the remaining costs such as connection, capital, O&M other than energy are spread over the contracted years as a constant monthly fixed charge. The fixed charge follows the CPI. On the other hand, the municipal companies have to set their tariffs to cover the real costs of operations in a transparent way at no profit.

Connection costs comprise the connecting pipeline, the heat meter and the shut off valves. The connection costs will be spread over the contract period. The disconnection costs to be paid by the customers are based on the remaining contract duration.

Competition

The utilities are empowered to provide the people with gas and electricity at the lowest costs possible. Economic drivers support the selection of the proper technologies, and the provincial regulators ensure that the system availability and safety are maintained at all times. Provincial governments provide some directions to the energy industry, but limit themselves to setting overall goals only. The selection of the technologies is left to the utilities. The separation of the gas and electricity providers makes it difficult or rather impossible to create CHP systems. Natural gas is widely available throughout the country, which is a challenge for other heating modes to enter the market. Serious lack of gas reserves is expected in the future, which means the increasing of alternative energy sources to become realistic. To substitute natural gas, district energy based on biomass and possibly with CHP is an interesting option.

Regarding third party access in power (and heat) production, there is no DH system purchasing heat from the third party in Canada at the moment.

Feed-in tariffs

No feed-in tariffs are used. At present, the electricity prices are low, about 10cnt/kWh, whereas they should be some 20-25cnt/kWh to make CHP applications commercially feasible. No subsidies are available for gas and DHC. In some Provinces low costs of electricity and natural gas are due to local production of hydro power and natural gas. Nevertheless, savings in using such locally generated energy products would allow export to U.S. at a substantially higher price, thus providing export revenues caused by local energy saving.

Emission treading scheme

There is no national emission trading scheme in Canada.

Carbon tax

No emission taxes exist at the moment in Canada. There are no such taxes other than GST, the Goods and Services Tax equivalent to VAT elsewhere in Canada. The municipalities can recover their GST costs from the government, whereas the private sector can recover only a portion through their business tax exemptions.

Investment grants

Ontario Power Authority (OPA) subsidizes investments in electricity savings by paying up to $800/kW of the saved electric capacity. The subsidy used to be 400/kW, but was doubled a few months ago. Customers can use that money as partial payment for the connection costs of DE, thus district energy companies indirectly benefitting from the subsidy system as well. In other ways companies would not be eligible as a private operators. *Federation of Canadian Municipalities*, FCM, as an association funded by the federal government and the municipalities, provides green investment subsidies from the Green Municipal Funds to GHG emission reduction measures only. In certain conditions (RES, CHP) DHC can be included. The subsidy is relatively low and short lasting, but works as stimulator for more extensive investments. On federal and provincial government as well as utility levels, there are various DSM related subsidy systems.

8.3 Customer

Customer rights

The customer is responsible for regular payments of the DHC services. The customers of DHC are subject to common laws on customer protection, The DHC customers are allowed to disconnect but will be subjected to punitive payments, based on the prevailing contracts they have signed. The DHC customers are encouraged to adapt their indoor systems to maximize the use of DE. Such adaptation, however, has not always been done, which has caused low temperature differences and high water flows in the primary side, thus high operating costs.

Developers are easy to motivate to DHC connection, since they will have more room space to sell, avoiding investments in boilers and pipes and chimneys. The customer contract can be resolved but at relatively high costs. The ordered heat/chilling load can be easily increased but reduction is cumbersome, because the investments have been done according to the initial and higher ordered load. Some needs to reduce the contracted load have already been raised by individual customers in a few cases, where the design load was much higher than the materialized load, and the customer wanted to adapt the ordered load to reflect the real load. After the negotiations, the original design load has remained, since that has been still more economic to the customer than the disconnection and the alternative boiler/chiller arrangements.

In general, there is no problem with disconnections. In Toronto about 3 customers of some 160 in total have disconnected during the past ten years, but 1-2 of them have reconnected later on. The disconnection conditions are punitive: The customer either has to pay the connection fee portion of the remaining years, or sometimes even more, all the fixed fees of the remaining contract years.

Service quality

There is no problem with service quality.

Billing

Typically, there is both the fixed and the energy fee. The fixed fee covers the connection costs, as well as the fixed costs of the next 20 years. The invoices shall be paid on monthly basis. The fixed fee can be adjusted annually/biannually with CPI (Consumer Price Index). The fixed fee includes the corporate profit and is basically constant. The energy fee is a pass-through tariff with no profit. In case of Enwave, the gas price of natural gas purchase is lower than the industry normally has, due to bulk purchasing agreements and interruptible tariffs. The fixed fee covering the connections and all other costs except fuel costs is discounted for the next 20 years.

8.4 Ownership

Municipality role

Most of the water based DH systems have s strong municipal involvement. Other systems (London, Toronto, Vancouver, Montreal, Charlottetown) are privately owned and operated. A few companies, such as in Sudbury, are with joint ventures between the municipality and the private sector. The small DH systems in the North West Territories and Nunavut are utility owned and operated.

The municipal DHC companies have to operate in a transparent way at zero profit.

The municipalities are well aware and interested to start/extend DHC to reduce GHG emissions. Financing is the bottle neck, since the municipalities have very limited financing resources and limited power on city development. Ordinary people are not aware of DHC, since it is rather invisible (with underground pipes, a few chimneys, focused on public and commercial but not residential buildings). In Toronto, the developers are not currently required by the municipality to negotiate with Enwave before deciding about the heating and cooling arrangements for their developments, but this may be a possibility in the future.

Private sector involvement

In the largest cities such as in Vancouver, Montreal and Toronto, the DHC companies are rather large and privately owned. The municipality has been heavily involved at the beginning, but while the business has expanded, the private investor has increased its business share, and the municipality’s part has faded. Fading has taken place, because the municipality’s restricted financial resources have prevented further contributions to system expansion. In Toronto, for instance, the DHC company is named Enwave in which there are two shareholders - the majority being with the Ontario Municipal Employees Retirement System (OMERS[18]) and the minority with the City of Toronto.

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[18] www.omers.com

The DHC investor needs the right to build energy sources and underground pipelines to public land for which a contract with the municipality is needed. Normal rights for commercial business apply to DHC.

For financing DHC development, the provincial gas and power companies as well as the pension funds, the latter used successfully in Toronto already, are the key sources.

Synergy allocations

CHP plants are rather small, so no common CHP cost and emission allocation approach was identified.

8.5 Planning

Integrated resource planning

The provincial utility committees are just regulators for electricity and gas, but DHC is not included in regulation at the moment. There is one exception: DH is regulated only in British Columbia and there only regarding residential customers, not others. The strongest supporter for DHC development at the moment can be the provincial government, which has the gas and electricity regulatory commissions in place. The municipalities are weak, but the provincial government and the Federal Government can be rather strong: tax collection as robust estimates are 60%, 30% and some 10% by the federal, provincial and municipal governments, respectively. This shows the relative weakness of the municipal administration. The Federal Government hesitates any interventions to the private sector driven DHC market and may give some general guidelines only.

The Integrated Community Energy Solutions (ICES[19]) Roundtables are to accelerate progress toward reducing GHG emissions by bringing together senior-level stakeholders to exchange views on the best way forward from here. The Roundtables build upon *ICES – A Roadmap for Action*, which was released by the Canadian Council of Energy Ministers at its annual meeting in September 2009. The Roadmap describes the role that Canada's federal, provincial and territorial governments can play in advancing ICES and sets out a broad strategy for action. It also includes a variety of options from which governments can choose, according to their priorities, to advance community energy performance and complement existing energy efficiency activities in different sectors.

The ongoing collaboration of key energy actors and enablers across Canada from the private and public sectors through the Quality Urban Energy Systems of Tomorrow (QUEST) collaborative also informed the Roundtable discussion. In particular, preliminary results from a QUEST-led study suggest that ICES could reduce GHG emissions at the community level by as much as 40 to 50%, resulting in a reduction of 65 Mt by 2020, which is about 20% of Canada's official 2020 target reductions. These results are very promising and highlight how ICES could contribute significantly to improving Canada’s energy and greenhouse gas performance.

Heat and urban planning

Urban planning is just beginning to take energy efficiency/use into account. The municipalities have no authority on energy efficiency/use other than in enforcing the building code. The municipalities cannot spend public money on energy efficiency campaigns or use taxes as a lever to change.

8.6 Technical

Technical standards and design conditions

The standards of new construction of DHC and CHP follow North European practise.

Nevertheless, due to Canadian legislation, remote operation of gas boilers is difficult to permit, and often staffing is needed at the boiler plants at all times. Enwave, for instance, employs 60 boiler operators among three steam plants and a chilled water plant, plus a chief operator managing each plant and a distribution line chief. In Europe, most of that staff could be substituted by remote

[19] oee.nrcan.gc.ca/publications/

control. The excess staff requirement in Canada is an economic barrier to hinder DHC development.

Refurbishment strategies

The water based DH systems re relatively new and modern. The steam systems are old, but converting them into more economic water systems would need a lot of time and money, and is not a priority for the time being.

8.7 Local Example – Enwave in Toronto

In Toronto, for instance, the largest DHC system in Canada is run by Enwave[20] Energy Corporation. Enwave distributes steam and chilled water to over 140 buildings via a 40km underground pipe network that covers most of the city's downtown core. The pipelines connect three steam production plants to each other and to customers' buildings. Enwave's system relies on 16 boilers with a maximum design capacity of 522 MW_{th} and a maximum current capacity of 381 MW_{th}. The thermal energy is distributed through the network at a pressure of 1.38 MPa and at a temperature of 191°C. Some 60% of the customers (Queen' park and hospitals) return the condensate, whereas the downtown customers do not. In heating, typically there is the heat exchanger in the customer entrance, which converts the steam into water. In some hospitals, the steam is issued directly inside for sterilization and humidification. District Cooling, on the other hand, is distributed directly to the rooms without heat exchangers. The DC system of Toronto is using the drinking water taken deep from the Ontario lake at 4^{o}C temperature. The water is used for chilling in the heat exchanger of the returning DC water and returned back to the inlet of the main pumps of the city water system at 7-10^{o}C temperature. The recovered cold will be used most of the year directly for cooling at 5.5^{o}C temperature. However, during the office hours in summertime (5 months times 50 hours a week) the centralized electric chiller is used to reduce the temperature from 5.5 further to 3.5^{o}C. Due to relatively short operation time, the cooling production of the chiller is only some 5% of the total energy produced in the Deep Lake Water Cooling system. The connected buildings are either with DH, DC or with both.

8.8 Recommendations and good practises

As the drivers for boosting DHC development have the fear of depletion of the natural gas resources as well as the existing GHG reduction requirements. In practise this needs strong involvement of:

- The Federal Government to provide clear directions and policies for DHC, CHP and RES development as a practical and efficient way to achieve the set challenging GHG emission reduction targets;
- The local municipality as the owner of streets and municipal buildings as well as the supervisor of the building code implementation;
- The provincial government in terms of possible co-financing or investment subsidy as well as through to energy sector regulation;
- The local/regional power utility that could develop DHC as a strategic source of CHP potential. CHP will become a valuable asset in the future as the unique opportunity to use any fuels at highest efficiency to generate electric power and DHC; and,
- Eventually the local water utility that could participate/take over the DHC operation. There are several synergies with DHC and water utility operations: O&M of water piping, billing and collecting customer in the same community. The DHC could be a new business area for the water utility.

[20] www.enwave.com

Legal and Regulatory Framework

Issue	National Energy Policy
Problem	National policy sets ambitious target for energy saving and emission reduction, but does not include DHC and CHP as tools of implementation. Therefore, developers of DHC and municipal CHP face an uncertain market for their service. Without a decent DHC policy, the building developers continue choosing energy systems with lowest investment costs (electricity, gas) and without fuel flexibility, whereas building occupants would have had preferred low life-cycle costs (DHC) with high fuel flexibility.
Recommendation	National policy should explicitly support DHC and CHP development as a means to meet the ambitious GHG emission target and to increase fuel flexibility.
Good practise	See Chapter 6 (1)

Issue	Building regulations
Problem	
Recommendation	
Good practise	See Chapter 6 (2)

Issue	Price regulation
Problem	No problem
Recommendation	
Good practise	See Chapter 6 (3)

Issue	Competition
Problem	CHP plants using renewable fuels have problems with grid connections, both institutional and economic ones.
Recommendation	There should be an obligation for all utilities to grant priority grid access to green energy projects, including DHC and CHP. Utilities shall be entitled and empowered to recover all related costs. Related costs are to be spread equally across the entire rate base.
Good practise	FIT in Germany , See Chapter 6 (5)

Issue	Feed-in-tariffs for CHP or renewable
Problem	DHC and CHP development is slow even though ambitious plans exist in Ontario at least.
Recommendation	FIT would strengthen the competiveness of DHC and CHP and attract communities and utilities to invest.
Good practise	FIT in Germany, see Chapter 6 (5)

Issue	Emission trading scheme
Problem	There is no price for emissions at the moment.
Recommendation	GHG emissions having a commercial price and the allowance training scheme would both stimulate and optimize the investments in emission reductions. This would support DHC and CHP development as low carbon technologies.
Good practise	The European Union, See Chapter 6 (6)

Issue	Carbon tax
Problem	Fossil fuel prices are relatively low, which hinders adoption of renewable energies. The low price of conventional energy does not reflect the external costs of the damage it causes to the environment.
Recommendation	Carbon emission based tax is an effective way to stimulate bio energy, DHC and CHP expansion in the market .
Good practise	Sweden, See Chapter 6 (7)

Issue	Investment grants
Problem	Investment grants may be justified when emerging technologies need to have faster access on the market as demonstration cases.
Recommendation	Tax exemption can be considered for energy efficient technologies such as DHC and CHP for a limited period of time.
Good practise	See Chapter 6 (8)

Customer issues

Issue	Customer definition and rights
Problem	No problems
Recommendation	
Good practise	

Issue	Service quality
Problem	No problems
Recommendation	
Good practise	

Issue	Billing
Problem	No problem
Recommendation	
Good practise	

Ownership issues

Issue	Municipality role
Problem	Municipalities are rather poor and weak, but they have an important role in the DHC introduction stage
Recommendation	Municipalities need policy and sanction support in order to initiate DHC schemes in the densely built city areas.
Good practise	See Chapter 6 (12), St. Paul (USA), Enwave/Toronto, The European Union

Issue	Private sector involvement
Problem	In general, private sector lacks incentives to participate in DHC and CHP development. The prices of fossil fuels are relatively low, pay-back times of DHC system construction are 10 years or longer, etc.
Recommendation	The Toronto case can be replicable: the municipality starts with DHC supplies on a small scale, after having had increased to a commercial level, the private sector may take over, supported by institutional financing.
Good practise	St. Paul (USA), Enwave/Toronto, Southampton (UK), Bashkirenergo and Fortum (Russia), See Chapter 6 (13)

Issue	Synergy allocations
Problem	Without carbon taxes, FIT, emission trading it is difficult to have DHC ad CHP expanding in Canada
Recommendation	As one more measure, the allocation of CHP costs in such a way that power would cover most of the costs, would stimulate DHC development. The DHC or industrial heat load are the preconditions to CHP.
Good practise	Denmark allocated most of CHP costs to electricity, thus making DH a very competitive product on the heating market. In such a way, DH has reached 50% market share in the country.

Planning

Issue	Integrated resource planning
Problems	The stakeholders of DHC and municipal CHP are fragmented. Municipalities, the provincial and federal government, utilities, developers, builders, building owners and building occupants all have different interests in energy efficiency and planning. The developers are interested in low investment costs e.g. electric and even gas heating, whereas the building occupants in low life-cycle costs (DHC, CHP), but having the developer as the decision maker. Therefore, using electricity and natural gas as the heating source of buildings does not have any redundancy but the occupant is bound with increasing heating costs. Also local industry may have heat load or excess heat that could benefit the community but is not used.
Recommendation	Coherence is needed between energy and other policies in order to

	phase out market barriers faced by DHC and CHP. Integrated resource planning to be carried out by the governments would optimize the energy systems as a part of the community development. For instance, combining industrial heat load and heat production with nearby municipal heat loads would provide synergy benefits for the community. Moreover, logistics of renewable fuels would generate work opportunities to farmers. DHC and CHP system could use a variety of fuels, thus providing heating and electricity services at stable prices and at high reliability.
Good practise	The European Union, South Korea, See Chapter 6 (15)

Issue	Heat and urban planning
Problem	Heating of municipalities is not integrated in urban planning. Therefore, electricity, oil and gas heating have largely spread in urban areas, thus eliminating any flexibility on fuel switching and CHP.
Recommendation	Heating shall be better integrated with urban planning in order to obtain benefits of integrated resource planning.
Good practise	See Chapter 6 (16)

Technical

Issue	National technical standards and design conditions
Problem	Small boilers require staffing at all times even though advanced automation would be an economic and reliable replacement.
Recommendation	Technical standards should be amended to allow automatic operation of small boilers free of staff.
Good practise	In northern Europe, for instance, even large gas/oil boilers of some 100 MW unit capacity have been remote operated reliably from the control centre of the energy utility.

Issue	Refurbishing strategies
Problem	n.a.
Recommendation	
Good practise	

8.9 Sources of information

- Technical standards and safety Act, 2000, Ontario State Regulation 219/01
- The New District Energy: Building Blocks for Sustainable Community Development; On-Line Handbook, January 2008
- Edwards, MacRae, Schorr: Overcoming Barriers of District Energy Projects, Volume 1 and 2, Canadian Energy Research Institute, 2000
- CDEA et al: Canadian Census of District Energy Owners and Operators, September 27, 2007
- CDEA et al: District Energy, A National Survey Report, March 2009
- The Government of Canada's Roundtables on Energy

- Integrated Community Energy Solutions Roundtable, Synthesis of Roundtable Discussion, October 23, 2009, Milton, Ontario (www.oee.nrcan.gc.ca/publications/)
- A Green Energy Act for Ontario:Executive Summary,January 2009 (www.greenenergyact.ca) Enwave corporation: www.enwave.com

9 China

9.1 Features and extent of DHC/CHP

History

Buildings in cities across China have long relied on small coal fired block "boiler houses" as their main heating source. These boiler houses, however, have contributed to significant air pollution and health problems in the country, with their low efficiency and lack of effective emissions control systems.

China enacted its first national regulation stipulating demolition of small independent boilers in 1986, in Article 22 of "The Development of DH Systems" published by the Chinese State Council. According to this article, independent boilers under the following capacities shall be demolished:

- about 32 MW (40 ton/h) in big towns
- about 16 MW (20 ton/h) in average towns
- about 8 MW (10 ton/h) in small towns

This regulation was not followed to a large extent as there were no specific financial incentives to do so. In the 1980s and 1990s, some incentives were implemented for CHP development, including state subsidies and tax exemption on heat sales. These were terminated in the late '90s as China's transitioned to a market economy. As the overall capacity exceeded demand at that time, CHP development slowed down.

To revive CHP development, in line with environmental policies, the Chinese government published a new directive in 2000 pertaining to large scale CHP (greater than 200 MW), stating that a company granted with a heating concession shall not be in competition with independent CHP and boilers.

A revision of this directive was published in 2004, called "Recommendation for the Development of Cogeneration." It contained some new laws in favour of the demolition of small independent boilers, including some articles stating that local governments shall develop strategies to promote environmental protection, energy savings and sustainable development and that a share of the budget shall be allocated to DH system development.

Local governments have political incentives to implement these changes; however, as in the past, no financial incentives or deadlines have accompanied these new policies. Their implementation, therefore, has yielded mixed results with some CHP plants producing more electricity than planned.

Statistics from past year: [21]

The heat load of DH with water as medium has risen up to 200 GW and the DH steam to 100 thousand tonnes per hour in year 2005, as presented in Fig. below. About 29% of the DH water capacity is supplied by CHP whereas the balance of 79% by medium size heat-only boiler plants.

In the past ten years, 1997-2007, the heated floor area has boomed 14% a year on average having had reached 3 billion m^2 by the end of 2007 in Fig 9.1. The boom is expected to continue but at a little slower speed.

[21] http://anser.bc.ca/Statistics/

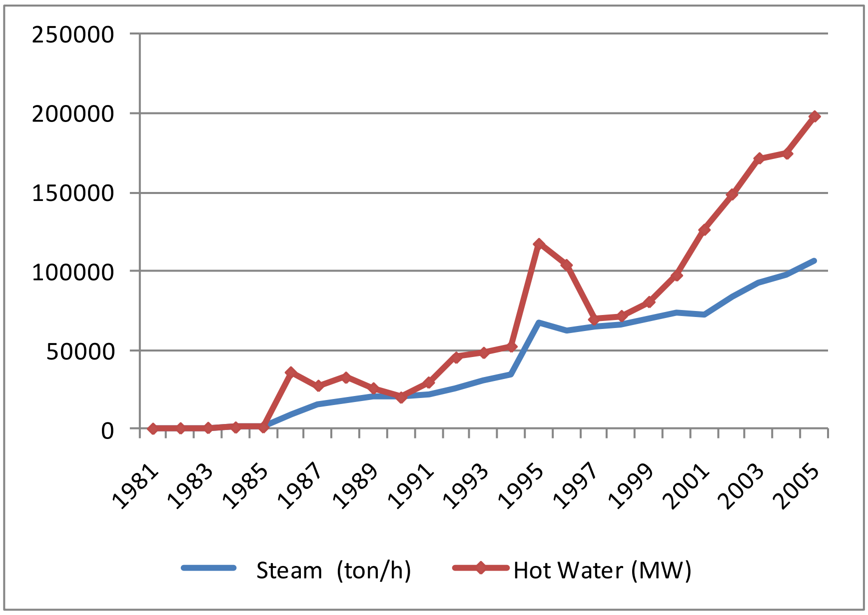

Figure 9.1 Expansion of DH with steam and water as carriers from 1981 till 2007.

In Table below, the Chinese cities with largest DH systems are listed.

Table 9.1: 10 largest DH systems (residential and industrial) in China in 2007 as heat production.

City	PJ
Beijing	148,4
Tianjin	82,1
Daqing (x	70,6
Lanzhou	66,8
Shenyang	51,1
Harbin (x	68,4
Dalian	30,9
Chanchun	38,2
Tangshan	25,0
Yinchuan	23,4

x) Data of Daqing and Harbin from 2005

<u>DHC and CHP market shares</u>

China is the largest carbon emitter in the world. As a result of rapid economic development, China's energy consumption has been growing fast in recent years and energy and environmental issues have become a key challenge to China's future sustainable development. As important energy efficiency technologies, CHP and DHC have received a good deal of attention by the Chinese government. In the past decades, China has issued a series of policies to promote CHP/DHC; as a result, China has become the 2nd largest country in terms of installed CHP capacity. In 2006, CHP capacity in China increased to over 80 GW, providing 18% of nationwide thermal generation capacity. However, in spite of high-level government attention, China has a much bigger potential for developing CHP and DHC than it is currently achieving.

In 2006, for example, there were more than 2,600 CHP units in China, representing over 80 GW of capacity, providing about 18% of the thermal generation capacity. The heating supply from CHP was nearly 2,300 PJ, representing an 18% increase compared to 2005. The National Development and Reform Commission (NDRC) estimates that compared with separate production of heat and power, CHP has resulted in energy conservation of 1,960 PJ (equivalent to 67 Mtce) already.

All new CHP plants, except some small ones with renewable fuel, are based on modern supercritical technology. In supercritical plants, both electric output and overall efficiency have been maximized by means of high steam temperatures and pressures.

DH has been encouraged by the Chinese government for several decades. China's DH area has increased from over 276M m^2 in 1991 to over 1,100 M m^2 in 2000, and exceeded 3,000 M m^2 in 2007, with an annual growth rate of 17%. The growth in DH mainly came from the Northern and the Northeast regions. In China, residential buildings account for about 70% of the total DH area, and commercial buildings account for about 30%. The total heated area estimate in Northern China amounts to about 8,000Mm^2 by the end of 2008, thus indicated the DH rate counts to almost 40% in the northern and northeast regions already.

The heated area of 3 billion m^2 connected to DH corresponds to the population of about 100 million. This is consistent with the DH market share of 7% in Chinese building stock.

In 2005, 329 cities (out of a total of 661 nationwide) had DH infrastructure in place. The total steam heating supply in China was 106,700 tonnes/hour (t/h), and the total hot water heating supply was 198 GW. In 2007, the length of DH pipelines was more than 89,000 km with water and 14,000 km with steam.

Types of DHC consumption

Predominantly, only room space heating is served by the DH water systems in China. Therefore, annually the DH systems are out of operation more than half of the year. The DH steam systems, however, are run all year round while supplying steam to commercial and industrial premises. In the steam cases, also DHW and increasingly district cooling can be provided.

Selected technologies with customer connections

Typically, there are group substations between the (primary) heat transmission and the (secondary) heat distribution networks. The group substation typically supplies heat to 20-30 residential buildings, equal to a range from 100,000 to 300,000 m^2 of heating area. The group substations are usually with water softeners of the secondary network water, heat exchangers, circulation and make-up water pumps.

In existing building areas, the new group substations have replaced old and polluting heat-only-boiler plants. Consequently, old secondary networks connected to the buildings are used and usually are the source of the largest water and heat losses. New building areas are usually connected to brand new networks.

Currently built or rehabilitated DH systems use plate heat exchangers and none use tube exchangers anymore. Preinsulated pipes are used, completely replacing past practices of using old pipes with mineral wool, concrete or with no insulation at all. However, some companies prefer to insulate pipelines themselves rather than buying factory made preinsulated pipelines. Heat metering is gradually used in the modern group substations and at least a basic SCADA is usually installed. However, billing is widely based on a fixed fee based on CNY/m^2 of heating floor area

Water losses in the secondary systems often exceed the softening capacity, thus creating corrosion and premature aging of the pipelines and armatures. However, some internal heating systems in new buildings use PVC piping that does not corrode.

Heat metering rate

Heat metering at the boiler houses in larger DH networks is commonplace and more prevalent in group substations. Although several consumer metering methods are accepted under government regulations, apartment level heat metering has by far the highest penetration in new building stock over recent years. However, the heat meters are not yet widely used for consumption based billing.

By the end of 2009[22],some 400 M m^2 of heating are with heat meters and some 150 M m^2 of it are with consumption billing as well. These values are equivalent to 13% heat metered and 5% consumption based billed of the heating area connected to DH systems in China.

Tianjin continues to remain one of the leading cities in piloting consumption based billing with about 8 M m^2. Even so, billing methods remain conservative. Most households must pay their entire heat bill in one payment prior to each heating season. If metered, households are compensated. In Weihai/Shandong province, for instance, both heat and water metering at apartment level has been organized, and the customers pay for heat and water according to the real consumption.

Market expanding/shrinking

The DH market is expanding fast for two reasons: (i) continued urbanization in China's northern provinces; (ii) continued modernization of heating services through the elimination of small and polluting boilers and connecting the existing the secondary networks to the DH system by means of group substations.

Headway has been made toward reducing the energy used both by household appliances and by buildings themselves. Over the past five years, China has adopted energy efficiency standards for refrigerators, air conditioners, televisions, fluorescent lamps, and clothes washers, which together eliminate the need for 12 large (1,000 MW) coal-fired power plants. The Ministry of Housing, Urban-Rural Development has now completed the groundwork for regulating both residential and commercial building energy consumption:

- The residential building energy code for China's northern "heating zone" was updated in 1996.
- The existing residential building energy renovation code for China's northern "heating zone" was adopted in 2000.
- Residential building codes in China's "hot-summer cold-winter" climate zone (central China) and "hot-summer warm-winter" climate zone (southern China) have been adopted in the last few years.
- A national public building code was adopted in 2005.

Compliance with building codes in particular, however, is poor; it is estimated that only 5% of existing buildings in China meet these energy codes.[23] By the end of 2009, for newly built buildings, however, building envelopes comply with the building energy code 99% in design stage and 90% in construction stage[24].

Local DHC association

China DH Association in China is the main information platform between the Ministry of Construction (Currently: the Ministry of Housing, Urban-Rural Development) and major DH suppliers, institutes and equipment manufacturers. There are also local DH associations in the major cities and regions. The Cogeneration Study Committee of China Electrical Engineering Society in Beijing deals with CHP studies. The Chinese DH Association is based in Beijing and works as an information databank. Their services are for sale.[25]

Regarding cooling, for the time being, there is no clear organization or regulation of cooling activities, but the cooling sector is market-oriented, with prices being negotiated freely (normally

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[22] Feb. 10, 2011, Mr. Xin Tan, Executive Director of National Project Management Office of HRBEE Project in China financed by GEF and managed by the World Bank.

[23] The China Sustainable Energy Program, www.efchina.org

[24] Mr. Xin Tan, Executive director of HRBEE Office on Feb. 15, 2011.

[25] http://anser.bc.ca/

bilaterally).The only active association at the moment is the Chinese Association of Cooling, which carries out research regarding cooling activities.

9.2 Legal and Regulatory Framework

National policy

By the end of 2005, China's total installed power generation capacity reached approximately 508 GW, 75.5% of which came from coal-fired facilities. With electricity demand growing at a torrid pace—15% per annum, faster than anywhere else in the world—China is fast-tracking the construction of new generation facilities, nearly 80% of which are coal-fired. Many of these are constructed without proper environmental approval: over the last two years, China installed over 120,000 MW of new generation capacity, more than one large (1,000-MW) coal-fired power plant per week, and 250,000 more MW are already in the pipeline for construction. A large share of the electric capacity is needed to serve the individual chilling devices in the society. Therefore, extending DH steam networks supplied by CHP plants offers a sustainable opportunity to use steam driven absorption chillers to reduce electricity need as the third driver.

China's leaders understand the urgency of slowing energy demand growth, diversifying China's energy mix, investing in energy efficiency and renewable energy, and cleaning up the environment. China is considering incorporating international best practice policies encouraging energy efficiency and renewable energy development into its power sector reforms and plans to adopt generation performance standards, standards capping power plant emissions based on the amount of electricity the plants produce.

Government plays an important role in CHP/DHC promotion. As a result of the Chinese government's organizational reform, the role of provincial departments in CHP/DHC promotion has been changing. At present, the relevant government actors include:

- National Development Reform Commission (NDRC): the main agency responsible for CHP and industrial policy, energy conservation and resource comprehensive utilization, energy price policy, and other energy policies.
- Ministry of Housing, Urban-Rural Development as the successor of the Ministry of Construction: the ministry responsible for urban construction (including DH) and building energy conservation. Some MOHURD policies on DH issued recently focus on heating reform, including metering.
- Other relevant agencies: these include the National People's Congress (NPC), the State Council and other ministries such as State Environmental Protection Administration (SEPA). These organisations mainly provide high-level view points on the impacts to energy efficiency and environment protection of developing CHP/DHC.
- Local governments: some local governments also provide policies to promote CHP/DHC, such as Beijing, Shandong and Shanghai. Local actions include lowering the fuel price for CHP and providing subsidies to heating supply companies and CHP/DHC retrofit projects.

Several industries play an important role in CHP/DHC technology development. In China, most large-scale CHP plants (≥200 MW) belong to the five key power companies (Datang Group, Huaneng Group, and others). Most of the middle scale (50-100 MW) and small scale (<50 MW) CHP plants belong to municipal companies or industrial end users. In general, DH boilers belong to the local heating companies; however, some local natural gas companies are beginning to promote DHC (CHP) applications.

The Chinese government has begun to pay unprecedented attention to energy efficiency and GHG emissions reduction. Resource saving and environmental protection have become important national policies, and energy efficiency is the priority strategy to address these issues. The Chinese government has proposed the ambitious target to reduce energy intensity by 20% and reduce emissions by 10% during 2006-10. To achieve this ambitious goal, the central government has rolled out a series of supporting policies.

- The Chinese government issued the Energy Saving Law (formulated in 1997, revised in 2007), the Renewable Energy Law, the Air Pollution Prevention Law, the Environment Protection Law, among other laws aimed at promoting energy conservation and environmental protection. In addition, the government has formulated a series of energy conservation standards, such as a series of building energy efficiency standards with different climate zones, energy efficiency standards for appliances (including refrigerators, air conditioners, and lighting), and energy consumption quotas on some energy-intensive industrial products.

- The government has also issued a series of policies controlling new construction, including some that involve the phasing out of energy-inefficient industries. For example, the Energy Conservation Appraisal and Assessment Scheme on Project Investment scheme evaluates the efficiency of various industrial sectors. At the same time, the National Development and Reform Commission (NDRC) has created a plan to phase out the inefficient industries, which accelerates the phase-out of inefficient industries in key sectors such as power, steel and iron, cement. Under this plan, 500 MW of small coal power plants will be phased out during 2005-2010; however, CHP plants are not included.
- The government also provides support to energy conservation projects through a series of dedicated funds, subsidies, and discounted loans for energy efficiency investments.
- The government supports these policies through a public information and awareness campaign which targets energy conservation and GHG emissions reduction. These include public awareness television programmes and outreach via other media. As a result, energy conservation and emission reduction are very well-known issues in China.

Adopted in 2005, China's first Renewable Energy Law (RE Law) has fuelled the development and adoption of these policies: the RE Law led to the establishment, for example, of a feed-in tariff for renewable power, which requires utilities to purchase all renewable power generated at attractive fixed rates, and mechanisms for allocating the incremental costs of renewable energy nationwide, preventing incremental costs from being borne exclusively by consumers adjacent to renewable energy generation facilities. In addition, the RE Law led to the development of legally binding national renewable energy development targets that are among the most aggressive in the world. Now grantees are working to help build China's capacity to implement these policies. The capacity of biomass based renewable energy is expected to rise to about 40 GW by year 2020. This indicates that a large number of biomass driven CHP plants will be erected to meet the increasing need of electric power and DH.

Among the policies mentioned above, some of the most important policies are described below in more detail.

(1) Some Regulations for CHP Development (1998) and Regulations for CHP Development (2000)

In February of 1998, several governmental bodies jointly issued Some Regulations for CHP Development (1998). A key feature of these regulations was for the first time, the ratio between heat and electricity was considered an important indicator to define and approval of CHP.

In August of 2000, the above mentioned Regulations for CHP Development (1998) was revised, which proposed specific regulations on CHP technical indicators, management measures and the relationship of CHP with the power grid. This is the most important regulation governing CHP development in China, and includes the following highlights:

- Requirements for local governments to produce a CHP development plan.
- Detailed CHP project approval conditions.
- CHP technical indicator requirements, including overall efficiency levels and heat and power ratios. For example, for turbine CHP units, it pointed out that the overall annual energy efficiency must exceed 45%; for CHP units greater than 50 MW, the annual heat and power ratio must be greater than 100%; for CHP units of 50-200MW, the annual heat and power ratio must be greater than 50%; and for condensing CHP units greater than 200 MW for DH, the heat and power ratio in heating period should be higher than 100%.
- The Power management departments should provide inspection comments about grid connection admittance for CHP.
- Guidelines that CHP projects should be sized based on available heating load, in order to maximize efficiency.
- Guidance encouraging the maximum use of waste heat, coal tailing, and other waste fuels for CHP.

- Suggestions to use CCHP to improve energy efficiency.
- In the heating range of the planned CHP/DHC project, other newly-added small coal boilers projects will be restricted if the planned CHP/DHC capacity may cover the heating demand.
- A goal to implement heat metering on the basis on heat consumption by 2010.

(2) China Medium- and Long-Term Energy Development Plan (2004) and Implementation Scheme of the National 10 Key Energy conservation Projects (2007)

In November of 2004, the State Council issued the NDRC's China Mid-term and Long-term energy conservation Plan, which considered CHP as an important energy conservation field, listed as one of the national ten key energy conservation programmes which are one of the key policies to realize the energy conservation target.

In 2007, NDRC promulgated the Implementation Scheme of the National 10 Key Energy conservation Projects, which provided important additional details on CHP target applications and supporting policies, including:

- Stated Goal: In 2005-10, new 45 GW CHP units will be constructed in the Northern heating area, and new 8 GW CHP units in the Southern area for industrial heat applications; and
- Key Applications: Requires CHP development in the residential and industrial sectors, and encourages distributed CHP and CHP that uses waste fuels..

(3) Temporary Regulation for Cogeneration and Power Generation of Integrated Utilization of Coal Tailings (2007)

On January 15, 2007, NDRC and MOC issued the Temporary Regulation for Cogeneration and Power Generation of Integrated Utilization of Coal Tailings. Compared with Revised Regulations for CHP Development (2000), more administrative regulations on CHP were proposed.

- The local government was required to stipulate a plan for CHP and coal tailing utilization.
- Regions with severe winters and concentrated heat loads should actively develop CHP to replace small heat-only boilers. In regions with hot summers and cold winters, CHP should be developed where there are concentrated heat loads, and CCHP is also encouraged under proper condition.
- In areas with existing CHP plants, the regulation discourages the development of additional end-use sited CHP plants. Except for large-scale enterprises such as petroleum, chemical, steel, and paper industries, the regulation does not encourage the use of CHP to serve single enterprises.
- Encouraging the use of a variety of approaches to solve heating problems in medium and small cities, such as the use of biomass, solar, geothermal and other renewable energy, as well as the use of natural gas, coal gas, and other resources to implement CHP.
- The grid electricity price should be determined by provincial pricing administrative agencies and authorized city and county governmental agencies, which will make decisions based on relevant national regulations, heat cost and profit ratios.
- CHP should be given an advantage for connecting to the grid.

(4) Guidance Opinion on Pilot Programs of Urban Heating Reform (2003)

In July of 2003, MOC, NDRC and other agencies jointly promulgated the Guidance Opinion on Pilot Programs of Urban Heating Reform. It aimed to stop welfare heating and promote commercial DH. This regulation proposed specific requirements for district heat metering. In addition, the pilot projects for a heating reform were started in the provinces of Northeast China, North China, Northwest China, Shandong and Henan.

An integrated, a "two-handed" approach was considered necessary. On one hand, the creation of a market mechanism was needed through heat reform and heat system modernization by (i) starting the heat customers to pay for actual consumption, (ii) by passing responsibility of payment from employers to households, (iii) by controlling how much heat they consume (by using thermostatic valves to control indoor temperatures), and (iv) by converting the production driven systems to demand driven ones. On the other hand, major improvements in the thermal integrity of urban residential buildings were needed to reduce building heat losses substantially, requiring widespread adoption of more energy efficient designs, new and improved materials and components, as well as adjustments in construction practices.

(5) Urban Heating Price Management Temporary Measures (2007)

In 2007, NDRC and MOC issued the Urban Heating Price Management Temporary Measures, which encouraged CHP/DHC, and dictated the reform of heating prices, whereby regulators will gradually use two tier components: the basic heat price and the metering heat price. This regulation also encouraged the development of CHP and DH and allowed non-public capital (including foreign capital) to invest, construct, and manage heating supply facilities to promote the gradual commercialization of DH industries. The heat tariff, in principle, is determined by the government (tariff administrative agencies at the regional and local levels), but in some regions (where conditions are suitable), the heat tariff may be determined by the market—i.e., by heat suppliers and their customers.

(6) China Energy Saving Law (1997 edition and 2007 revised edition)

In the China Energy Conservation Law (1997), CHP was listed as an energy conservation technology that should be nationally encouraged. In October 2007, NPC approved the China Energy Saving Law (revised edition), its relevant articles with CHP/DHC are as the following:

- Article 31: The country encourages the industrial enterprises to use high efficiency, energy conservation equipment, such as motor, boiler, kiln, blower, pump, encourages the energy efficient technologies including CHP/DHC, residual heat and pressure utilization, clean coal-fired and so on.
- Article 32: The power grid enterprises should arrange cleaning and efficient CHP, utilize residual heat and pressure units as well as other units with resources comprehensive utilization according to the requirements of the Energy Conservation Power Control Management formulated by the State Council relevant department, the online power price executing the country concerned requirements.
- Article 78: The power grid enterprises bear liability if they do not work as the requirement in Article 32.

Building regulations

The torrid pace of China's building construction is the largest and fastest in human history. By 2050, China's urban population is expected to reach 1.17 billion, up from 494 million today. China has added up to 2 billion m^2 of new buildings annually, and practically all those which come to the northern central part of the country will require DH systems to be built/extended. Energy consumption in China's building sector has increased more than 10% each year for the last 20 years and now represents 25% of all energy used in China, a figure that will continue to rise as living standards in China improve. Therefore, the building construction boom is the second strong driver for DH expansion.

The goal of the Buildings Energy Efficiency Program is to encourage construction of energy efficient buildings, as well as the development of efficient appliances and equipment. The Program supports residential and commercial building codes development, and implementation and enforcement pilot programs in Central and South China. The Program also supports appliance efficiency standards and labelling programs nationwide, including advanced efficiency standards for lighting, refrigeration, air conditioning, office equipment, etc. This includes support of standards development, implementation, and enforcement practices.

Energy consumption in China's building sector has increased more than 10% each year for the last 20 years and represents now 25% of all energy used in China, a figure that will continue to rise as living standards in China improve. Increased use of household appliances and new residential and commercial building construction are primarily responsible for this skyrocketing energy use: household appliance ownership rates have been increasing dramatically over the past 25 years, and over the past 15 years, the total floor space of buildings in China has increased by 50 percent.

In China, the heat consumption index of the buildings is officially used as a key indicator of building level integrity. In the Chinese building energy efficiency standards the index is defined as: at outdoor mean air temperature during the heating period, to maintain indoor design air temperature, heat consumed in unit time by unit floor area and to be supplied by indoor heating device. The average conditions are summarized in below Table[26] below.

Table 9.2: A sample of building regulations in China[27].

Official duration of heating season	144 days
Corresponding heating degree days (18°C)	3,240 degree days
Poor EE building heat consumption index(1980)	67.8 W/m^2
30% energy saving building heat consumption index(1986)	47.5W/m^2
50% energy saving building heat consumption index(1996)	33.9 W/m^2
65% energy saving building heat consumption index(2006)	23.73w/m2

Price regulation

The municipality sets the heat tariffs based on the proposal of the heating company. In practise, however, the approved tariffs are usually lower than proposed by the company.

The present Chinese system does not include an energy sector regulator, and regulations are issued by different organizations. Energy prices and cost accounting issues are administered by regions and municipalities following the national guidelines.

The residential heat tariffs are subsidized and based on the heated floor area, not on heat metering. The commercial and industrial customers are charged either according to the floor area or meter readings, depending on the availability of the heat meter.

The connection fees are paid by the housing sector developers as a main source of financing of the DH primary networks and the group substations. The developers are usually responsible for constructing the secondary networks, the ownership of which may be transferred to the local DH company. There are neither disconnections nor disconnection fees in China.[28]

Due to social reasons, the municipality does not allow the DH companies to raise the tariffs according to the cost increases, but the tariff approvals lag behind. The official policy allows the heat price to be adjusted accordingly when coal cost have increased or decreased by 10% or more, but implementation of this policy has not always materialized. Therefore, in such cases the DH operation has to be subsidized by the municipality.

Therefore, the DH operation has to be subsidized by the municipality. The residential heat tariff is equal to all residential customer groups. Therefore, the subsidy is not targeted at the poor, but actually those having larger apartments benefit more from the subsidies than those having smaller flats.

Predominantly the heat tariff is a lump sum tariff in terms of CNY/m^2. The first two part tariff system was introduced in Tianjin, where it was set to a customer group of 4 million m^2 in year 2007. Thereafter, the customers have paid according to the meter readings and the two tier tariff system. The two tier tariff was a joint development of the Ministry of Construction, Tianjin administration and the World Bank. By far, such tariff system has slowly expanded to a few other cities.

[26] The World Bank, Project Appraisal Document on A Proposed GEF Grant of US$ 18 million for Heat Reform and Building Energy Efficiency Project (HRBEE), Jan. 27, 2005.

[27] Mr. Xin Tan, Executive Director of HRBEE Office, Feb. 15, 2011.

The heat metering pilot cities converted the previous lump sum tariff (CNY/m^2) to a two part tariff,i.e., the fix fee and energy fee, each accounting for 50%. In 2011[29], MoHURD asked city to reset the percentage values to30% and 70%, i.e., the fixed fee to account for 30% and the energy fee 70%, in order to offer heat users more energy saving motivation.

In order to speed up the process, an energy price policy reform is a priority. At present, the coal price is based on the market, the price having had grown rapidly in recent years. However, electricity and heating prices are regulated by the government, and typically heat price increases have lagged behind. Promotion of CHP could benefit from more guidance from the government on the cost allocation method between electricity, heat and steam. In addition, more forceful application of the heat pricing reform, with due consideration of social impacts, could be implemented.

Competition

Basically, there is practically no competition on the heating market at the moment. Natural gas being available in many east coast cities is much more expensive than coal based DH and often restricted to industrial use. Geothermal heating is available at some locations (Shenyang/Liaoning Province and Tianjin, for instance) and is used as heat source of DH.

On one hand, the market drivers of DHC are strong: (i) in the absence of affordable decentralized alternatives, DH is the only major heating option replacing the elimination of small and polluting boiler plants in existing building areas; (ii) new apartments supplied by expanding DH are needed to accommodate continued urbanization; and (iii) increasing need of electric power in individual cooling systems offers market for absorption chillers in commercial and industrial premises that are connected to steam networks.

The remaining small and polluting boilers located in urban areas cause serious environmental and health problems. Almost 70% of the urban population, more than 360 million people, lives in areas where air quality is considered hazardous by World Health Organization standards. In two Finnish concessional credit financed projects, evidence from local hospitals was collected. The evidence showed that the frequency of respiratory diseases had dropped after the modern DH had replaced the old small and polluting boiler plants in the city. The two cities with recorded health benefits were Zhangye in Gansu and Yanchuan County in Shaanxi Province[30]. Therefore, elimination of the existing small boilers is the first driver of DH to improve both environment and health.

Feed-in tariffs

China has set ambitious targets to raise the share of RES in the national energy balance. Biomass driven CHP plant would be usually rather small in size due to restricted availability of fuel close to the plant site. Unit costs of power and heat production of such small plants would be relatively high compared to large 300-600 MWe plants. Therefore, small biomass fuelled CHP plants would need special support, feed-in tariffs higher than today for electricity generation, for instance, in order to expand on the energy market.

There are feed-in tariffs for renewable energy sources in China including small scale CHP using biomass in China. The tariff level, however, is too low to boost biomass driven CHP that, for reasons of locally restricted fuel availability, remain small in size. Small CHP plants are not competitive to large coal fired CHP plants without a sufficient FIT system.

Moreover, there is no third party access in the Chinese DH systems. However, promoting innovative micro CHP or tri-generation where gas is available would offer an interesting option to be developed.

Emission trading scheme

No such system exists in China.

[29] Mr. Xin Tan, Executive Director of NPMO of HRBEE project on Feb. 10, 2011.

[30] Project Appraisal Reports of Zhangye and Yanchuan Central Heating Projects, Ministry for Foreign Affairs, Finland

The Environmental Protection Agency of China applies strict emission limits. If the company's emissions exceed the limits, punishment fees will apply. Ultimately, the EPA has the right to stop the company business operation unless emissions are reduced sufficiently.

Carbon tax

No such tax prevails in China *(will be doublechecked)*

Investment grants

The government may issue direct grants for CHP and DH.

The municipalities and developers are responsible for investment financing, not the DH company. In one single case, the difficulty in securing financing for district energy in China was overcome by Dalkia through collaboration with the Asian Development Bank (ADB), in similar fashion to its earlier cooperation in Eastern Europe with the EBRD.

9.3 Customer

Customer rights

Heating in cold climate provinces is required by law and it is considered a vital service. In general, there are no disconnections other than in the newly constructed buildings to which customers have not moved in yet.

The customer rights are restricted to minimum. In case there is evidence that the room temperatures have been frequently lower than the norms, the heat price can be reduced. Since the DH services start and stop on the fixed dates of the year determining the official heating season, the heating needs outside the official heating season are usually not compensated by any means. The DH systems are strongly production driven despite of control systems and heat meters that become more common in group substations. In some cities, however, like Beijing heating may be provided outside the official heating season when the government takes the responsibility for paying for the extra costs of such heating.

Residential customers have not paid for cost covering heat tariff, but both the employer and the municipality have subsidized the tariff. However, since 2007, residential customer started to pay for heating cost, and the operational heating cost are now fully covered by the tariff, so in most of cities municipal subsidies to heating company have ceased to exist. Still the depreciation rate is in inadequate to cover the replacement costs of the fixed assets.

Service quality

Based on several social studies on DH performance, the heat service quality is not adequate.

First, the heating season starts and stops abruptly when the outdoor temperature has reached a certain level for a 2-3 days. Therefore, there are long periods in fall and spring when no DH services are available but the customers suffer from low indoor temperatures.

Also during the heating season, due to poor or missing control systems, the heat distribution is unbalanced. Many suffer from inadequate and some few others from excess indoor temperatures. The general problem is that the customers are always underheated.

Billing

Typically, billing is based on lump sum tariff without heat metering.

9.4 Ownership

Municipality role

The municipality is in the central role while managing the DH services in the city through their financial and heating bureaus, the first one dealing with investment support, tariff levels and the latter one with technical and maintenance related issues.

In Chinese cities and towns many different heating enterprises usually coexist. The following list gives a description of the most common forms of heating enterprises.

- Heating companies registered with the industrial and commercial administration

  The heating companies registered with the industrial and commercial administration may be further divided into the following categories:

  A: Heating companies owned by the local governments. At present, the administrative management of these types of heating enterprises is mainly done by the local public utility or construction administrations.

  B: Heating companies owned by big enterprises and development companies.

- Heating agencies under the ancillary departments of various institutions

  Heating agencies under ancillary departments of various organizations (i.e. hospitals, schools, etc.) are usually very small. Being related to the economic status of the institutions and not to the heat suppliers itself, the quality of heating is usually relatively low. Sometimes seasonal workers operate heat boilers under the supervision of the responsible ancillary department.

- Heating agencies of non-governmental developers

  The typical case in this category of heating company is that a building developer, or a group of building developers, owns the building (or buildings) and the heating systems in connection to those buildings. The heating quality in this heat supplier group is extremely unstable. The DH companies are mainly municipality owned but private ones already exist as well.

The operation and maintenance management of heat substations varies in different cities. Some heat substations are managed by the local heating service companies, and some by the end users.

<u>Private sector involvement</u>

As mentioned above, both large companies and building sector developers may be owners of DH companies.

Moreover, energy service companies (ESCOs) are expanding in the commercial building energy conservation arena, they have also entered the CHP/DHC branch. There is some room for these types of third-party players to come up with innovative means to finance projects.

<u>Synergy allocations</u>

The applied CHP cost allocation method distributes relatively high costs on heat. Also the heat supply contracts of the CHP are usually very robust: price and capacity mainly. Therefore, DH has little incentives to increase the CHP share or optimize the CHP operation.

9.5 Planning

<u>Integrated resource planning</u>

The municipality is responsible for integrated planning regarding DH in the urban areas. Therefore, merging several DH companies and networks should be decided by the municipality in order to improve holistic optimization of heating services.

<u>Heat and urban planning</u>

All urban areas in the cold regions of China will be automatically connected to DH systems. In earlier decades, heat was produced by small boiler plants, but today the small boilers will be eliminated and the networks merged to be supplied by medium size boilers, and increasingly by large CHP plants.

9.6 Technical

Technical standards and design conditions

The technical barriers shall be phased out. While CHP/DHC are proven as existing technologies that do not require major research and development, there are some advanced technologies that could be introduced from IEA Member Countries to improve efficiency and operational benefits. Some of the standard related barriers are summarized as follows:

- One of such advanced technologies is the building level substation concept that would reduce both electricity and fuel costs, convert the problematic secondary network to a part of the primary network with slightly higher investment costs but yielding lower life-cycle costs. Another issue is with the DHW: whether to extend DH services to cover DHW or leave the heating to solar panels. Some China-specific research studies could be conducted to confirm the primary energy conservation performance of these technologies.
- a Chinese city may have several DH systems that are close to each other but are not hydraulically interconnected. By means of modern substations and static pressure adjustments, the networks could be merged to provide energy savings and to improved redundancy.
- DH is often extracted from the steam line of a large CHP plant with 200^{o}C and 10 bar pressure. The exergy losses of such a connection result in reduced electric output of the plants. Extracting the steam at lower pressure and temperature would improve the economy of CHP.
- The existing standards require an excess number of pumps and heat exchangers in parallel, because the old equipment used to be unreliable. Modern pumps, for instance, could be fewer and more economic without compromising the reliability.

Refurbishment strategies

The common practice is to replace the existing small boilers with a group substation of DH in the existing boiler house, but leave the secondary networks as they are. It could be more optimal to remove the entire boiler house and the corroded secondary networks and to install new primary networks and building level substations with heat metering inside the house, but if not possible, adjacent to the building in a separate steel box.

Heat metering of existing buildings often requires a meter at each staircase, which increases costs of metering.

Water losses are high in Chinese DH systems, partly because of leaking secondary networks and partly by illegal tapping of network water in apartments. High water losses are a strong indication of corrosion and premature aging of components. Apartment level water metering, as has been done in Weihai, Shandong Province, for instance, would phase out the problem.

9.7 Local Example 1 – Tianjin and Liaoning Cases with the World Bank

First, in year 2005, the Ministry of Construction with support of the World Bank started the Heat Reform & Building Energy Efficiency Project under grant financing of Global Environment Facility (GEF) amounting to $18 million.

In the project, in Tianjin heat metering on building and apartment level was introduced as well as consumption based billing according to the two tier tariff, as the first case ever in China. The heat metering pilots covered 10 million m^2 in 2007/2008 winter, of which 8 million m^2 at the end of 2009 were billed according to consumption.

The installation of apartment heat meters became mandatory for all new residential buildings in 2007. Also starting in 2007 consumption-based billing was implemented for all new residential buildings in the second year of occupation (occupation rate usually is low in the first year when most households will carry out interior modelling). These requirements were expected to drive up the residential floor areas subjected to consumption-based billing to about 20 million m^2 by 2010.

The similar approach is expected to expand to other cities, starting from Dalian and Tangshan.

In general, however, the expansion of consumption based billing has proceeded slowly in China.

Second, in year 2008, the DH loan of $195 million was approved by the World Bank for medium sized cities in Liaoning province. In addition to normal DH rehabilitation, there will be some innovations as follows: a pilot in which about 100 buildings will be equipped with heat meters; (ii) another pilot in which up to 150 buildings will be equipped with individual substations installed in their basements. In such a way those buildings will be technically prepared for consumption based billing, and simultaneously, the DH system converted from the production to the demand driven mode. Such measures would offer strong incentives and tools for customers to start saving heat energy.

9.8 Local Example 2 – Jiamusi and Dalkia

In May 2007[31], Dalkia signed the concession agreement to manage the former JHC's network. A new joint venture, Dalkia (Jiamusi) Urban Heating Co.Ltd. (Dalkia Jiamusi), was set up with minority participation from a municipal utility company, Jiamusi New Times Urban Infrastructure Construction and Investment (Group). The project took two years to materialize as it was the first concession agreement in the heating sector in China. Now, after two years of operation, Dalkia Jiamusi has increased the network coverage by 56% to 8.6 million m^2 (3.3 sq miles), where 73% of Dalkia Jiamusi's customers are residential and 37% are non-residential, including commercial and public buildings. The company aims to provide DH service to a geographic area covering14.5 million m^2 (5.6 sq miles) by 2020 (75% of the city's total heating service area).

The framework of Dalkia's concession agreement with the municipality gives the company the exclusive right to operate, maintain and carry out investment in a public utility (heating services) for a given number of years (25) and a given geographical perimeter (the city of Jiamusi).

The population of Jiamusi municipality amounts to 2.45 million; 820,000 in the city of Jiamusi. Jiamusi is the third-largest city in Heilongjiang Province, located in the extreme northeast of the country, 100 km (62 miles) from the Russian border and 1,800 km (1,118 miles) from Beijing. The heat load can be characterized by 5,073 heating degree-days annually and by the average temperature December-February being -18^{o}C (- 0.4 F). The heating season lasts from Oct. 15 to April 15.

Dalkia acquired the heating pipelines and some boiler houses, which serve as peak-load plants. Today the peak-load plants comprise 10% of Dalkia Jiamusi's energy mix; the rest is provided by the two local CHP plants.

The two CHP networks are not connected to each other; however, the company's peak-load boilers are connected to the two networks.

The company now communicates with the public via newspapers, local radio, a new Web site and an information stand in the city's main square. To deliver better customer service, Dalkia Jiamusi has introduced a 24-hour customer help desk, begun conducting annual customer satisfaction surveys, opened three strategically located fee collection offices, issued smart cards to facilitate customer payments and offered elderly and handicapped people transportation to and from the collection offices – all of which has helped bring down customer bad debts from 7% to 2%.

The company aims to provide DH service to 75% of the city's total heating service area by 2020.

Dalkia has the majority share in the Chongqing CHP system as well, located in southeast China. The majority share was allowed as the Chongqing CHP is an industrial system and therefore not subject to the same regulations as the heating sector.

9.9 Recommendations and good practises

The recommendations to follow are compiled in the same order as was discussed earlier in the report, but including the major problems, the recommendations to address the problems as well as links to good practices where such problems have been successfully solved.

Legal and regulatory framework

[31] A Pioneering Partnership in China: Foreign investment spurs DH growth. Timothée Prenez, Project Officer, Dalkia Asia Pte. Ltd. District Energy / Second Quarter 2010, Web: www.districtenergy.org

Issue	National Energy Policy
Problem	DHC, CHP, EE and RE are prioritized in the national policy which is excellent. However, supporting reforms proceed slowly. After several years from the decisions, only a few cities are with two-tier tariffs and comprehensive heat metering.
	The national heat reform implementation should be strengthened and fastened in order to obtain savings in fuel costs and reduction in GHG emissions. Heat metering should be installed first in order to learn of the real heat consumption. Analysis of the metering experience shall create the basis for tariff setting.
Good practise	See Chapter 6 (1)

Issue	Building regulations
Problem	(i) The building regulations are challenging and they are mandatory in construction. Follow up experience too often indicated that the real performance of the buildings is worse than was required by the code. (ii) The DH systems are sized according to normative values (W/m^2) but no information is available about the real heat loads. (iii) Installation of heat metering and weather controllers lags behind the regulations
Recommendation	
Good practise	See Chapter 6 (2)

Issue	Price regulation
Problem	For social reasons, the heat prices are usually lagging behind the price increases of coal, the main fuel of DH and CHP, which causes financial problems for DH services providers. Moreover, the current lump sum tariffs do not motivate anybody to save energy.
Recommendation	Heat pricing reform is a priority in order to extend two-tier tariffs and consumption based billing as providing incentives of energy saving, both to heat supplier and consumer.
Good practise	Tianjin in China, South Korea, the European Union, USA, Canada, See Chapter 6 (3)

Issue	Competition
Problem	n.a.
Recommendation	
Good practise	

Issue	Feed-in-tariffs for CHP or renewable
Problem	The existing feed-in-tariffs are often too low in order to extend biomass fuelled CHP on the market. Such CHP plants are often small and not competitive to large coal fired CHP plants

Recommendation	Raising the FIT in order to achieve substantial market boost
Good practise	See Chapter 6 (5)

Issue	Emission trading scheme
Problem	The national emission trading system is not in place, but some international carbon trading cases have recently materialized in the DH sector (Urumqi, Tianjin and Yinkou/Liaoning province).
Recommendation	National emission trading would offer an opportunity to speed up energy efficiency and CHP investments.
Good practise	The European Union, See Chapter 6 (6)

Issue	Carbon tax
Problem	Coal is the dominant fuel and biomass reserves are restricted. In order to maximize utilization of the biomass, introduction of carbon tax is recommendable.
Recommendation	Carbon tax would support renewable energy and CHP.
Good practise	Sweden, See Chapter 6 (7)

Issue	Investment grants
Problem	Lack of investment grants for boosting biomass fuelled CHP to expand.
Recommendation	Investment support to renewable energy to be strengthened
Good practise	See Chapter 6 (8)

Customer issues

Issue	Customer definition and rights
Problem	Usually customers have no contracts and they have a little influence on the technical quality of heating services.
Recommendation	Establish house owner associations for the customers of DH and having them with a written contract with the DH company. In some cities, house owner associations are established, but they are not legal persons eligible to sign any contract with the DH company.
Good practise	See Chapter 6 (9), the European Union, USA, Canada

Issue	Service quality
Problem	Based on the social studies, the technical quality of heating services is often poor: low room temperatures during the heating season, the heating season starting and stopping abruptly and leaving the customers without heating during the transition periods.
Recommendation	Consumption based billing would provide a strong incentive to the service provider to improve the service quality.

Good practise	See Chapter 6 (10), The European Union, South Korea, USA and Canada

Issue	Billing
Problem	Billing is till based on lump sums that motivate neither the DH company nor the customer to save energy.
Recommendation	Introduction of consumption based billing based on two-tier tariffs would motivate the actor to save energy
Good practise	See Chapter 6 (11), The European Union, South Korea, USA and Canada

Ownership issues

Issue	Municipality role
Problem	Often there prevails a double role of municipalities as both owner and regulator: The municipality is heavily involved with management of the DH companies.
Recommendation	
Good practise	See Chapter 6 (12), The European Union

Issue	Private sector involvement
Problem	Municipality is rigid and socially oriented to operate on commercial DH/CHP market
Recommendation	Private sector involvement shall be encouraged in order to bring commercial practices to DH and CHP as a means to improve overall economy and service level. Since 2003, many cities have allowed the private sector to invest in heating industry already.
Good practise	Southampton (UK), Bashkirenergo and Fortum (Russia), See Chapter 6 (13)

Issue	Synergy allocations
Problem	DH pays for CHP heat as much as for boiler heat, thus not benefiting from CHP.
Recommendation	National guidance should be provided for CHP cost and emission allocation as well as for CHP heat contracts in order to motivate both parties to work for optimal expansion and operation of DH and CHP systems.
Good practise	Heat should financially benefit from CHP, and the CHP heat contract should include fees regarding water losses and high water temperature levels. Such practise largely prevails in the EU, for instance.

Planning

Issue	Integrated resource planning
Definition	IRP is needed to optimize the DH CHP and RES.
Problem	Lack of integrated planning: there are several DH companies in a city, which hampers holistic optimization of DH in cities. Moreover, the heat distribution responsibility is divided by the group substations to several companies, which is another reason for hampering holistic optimization.
Recommendation	(i) Merging the networks and introducing co-operation between the companies, (ii) encouraging optimal construction of customer interface with DH by using building level substations in cases where life-cycle costs lower or close to the existing group substation and secondary network practices.
Good practise	The European Union, South Korea, See Chapter 6 (15

Issue	Heat and urban planning
Problem	No major problems.
Recommendation	
Good practise	See Chapter 6 (16)

Technical

Issue	National technical standards and design conditions
Problem	(i) Due to inadequate heat metering and relatively short experience in modern DH, the current technical applications are oversized and technically robust thus causing excess investment and operation costs. (ii) Heat is sometimes extracted from medium pressure level, thus losing electricity output more than would be necessary. (iii) Requirements on allowed water loss are loose, which result in excess heat and water losses and corroding quality of circulation water.
Recommendation	Extending heat metering, analysing the results and use that as a new basis for DH system design
Good practise	New European standard for design outdoor temperatures and using modern practices, See Chapter 6 (17)

Issue	Refurbishing strategies
Problem	Non-optimal practices: heat extraction from CHP at high pressure; group substations with collective control properties; excess number of redundant components, missing heat metering at customer side, etc.
Recommendation	Thermodynamic and economic optimization to be improved based on revised standards.
Good practise	Central and Eastern Europe, the Balkan countries, See Chapter 6 (18)

9.10 **Sources of information**

- CHP/DHC Country Scorecard: China, IEA Collateral 2008: www.iea.org
- The China Sustainable Energy Program, www.efchina.org
- Statistics: http://anser.bc.ca/Statistics/
- Project Appraisal Reports of Zhangye and Yanchuan Central Heating Projects, Ministry for Foreign Affairs, Finland
- A Pioneering Partnership in China: Foreign investment spurs DH growth. Timothée Prenez, Project Officer, Dalkia Asia Pte. Ltd. District Energy / Second Quarter 2010, Web: www.districtenergy.org

10Croatia

10.1 Features and extent of DHC/CHP

History

The birth day of DH in Croatia was in 1964 according to HEP, the state-owned Electricity Company. In that year, a hot water pipeline for heat supply of the Končar factory from EL-TO Zagreb plant was constructed.

End of 2008, there were 20 license holders for thermal energy production, 15 for distribution and 21 for supply. The biggest DH Company is HEP-TOPLINARSTVO d.o.o. (HEP Heating), a child company of HEP. This company also operates DH system in the cities of Osijek and Sisak and also in a part of the Zagreb County. Nevertheless, heat sales constituted only 4% of the total sales of the mother company in 2009

Statistics from past three years

The Ministry of Economy and HERA publish some basic statistics about DH.

DHC and CHP market shares

The table below shows some characteristics of the Croatian DH Companies that have received a license. Heat load densities are relatively high (mostly above 3.5 MWh/km and in average 5.6 MWh/km), which indicates a good suitability for DH.

It is a matter of definition, whether all the companies listed in the table above should be called DH Companies. The Ministry of Economy lists in its annual report[32] only 15 companies. These companies have been marked with an “x” in the column named “DHC”-.

DH constitutes about 11% of the national heat demand. The table below shows the share of households supplied by DH in various cities that are supplied by DH.

[32] Ministry of Economy, Labour, and Entrepreneurship, Energy in Croatia, Annual Report 2008,

Table 10.1: Characteristics of the Croatian DH Systems 2008 (licenses for heat distribution[33])

Company	No of Customers	DHC	Length DH network	Capacity Heat-only	Capacity CHP	Capacity Steam	Delivery DH	Delivery Steam	Load density	Heated area	Fuel
	#		km	MW	MW	t/h	MWh	t	MWh/ km	surface	
1 HEPToplinarstvod.o.o.*											
HEP Zagreb	88.969	X	240,0	464	624	224	1.502	656	6,3	8.063.477	G H, O
HEP Local boiler plants: Zagreb, V.Gorica, Samobor, Zaprešic	16.938	X	20,8	198			209		10,0		
HEP Osjek	11.659	X	47,4	100	24	140	197	145	4,2	1.132.196	G, O
HEP Sisak	4.010	X	13,1	-	50	205	77	312	5,8	263.237	G, O
2 Energod.o.o., Rijeka"	9.845	X	16,0	112.			88	88	5,5	600.000	G, O, H
3 Toplanad.o.o., Karlovac	8.104	X	42,0	178			78	78	1,9	534.475	G, O, H
4 Tehnostan d.o.o., Vukovar	3.211	X	7,2	45			26	26	3,6	176.666	G, O, H
5 Termoplind.d., Varazdin	2.907	X	2,1	41			27	27	12,9	164.164	G
6 Hvidra d.o.o, Split	3.251	X	11,0	22		12	15	15	1,3	222.165	O
7 Brod-plin d.o.o, Slavonski Brod	3.786	X	6,0	49			23	23	3,8	93.000	G
8 Vinkovacki vod. i kanal. d.o.o, Vinkovci	1.680		1,6	17			11	11	7,1	88.958	G, O, H
9 Virkom d.o.o, Virovitica	484		0,9	10			7	7	7,3	30.191	G
10 Inas-Invest d.o.o.	18	X					5	5		32.000	-
11 Energoremontd.d, Karlovac	5	X	-	118			7	7		28.822	-
12 Tekijad.o.o, Pozega	177		0,9	7			4	4	4,0	23.185	G
13 Termalna voda d.o.o, Topusko	205		1,3	n/a			8	8	5,8	37.631	geo
14 Diokid.d.	4		-				8	8		-	-
15 Zracna luka Zagreb	2		2,0				2	2	1,0	-	G, O
TOTAL	155.255		412,3	1.248	698	581	2.290		5,6	11.490.167	

Explanations: G = natural gas, O = fuel oil, l = light heating oil, geo = geothermal energy

** HEP Toplinarstvo d.o.o., Zagreb, carries out only activities related to thermal energy and it supplies more than 80% of customers which use heating from centralized heating systems in Zagreb, Osijek and Sisak, i.e. regional heating plants and heating units in Velika Gorica, Samobor, Zaprešić, energy operator Toplana d.o.o., Karlovac and energy Brod-plin d.o.o. Slavonski Brod.*

Source: HERA, Annual Report 2008, Energy in Croatia 2008, and HEP Annual report 2008

Table 10.2: Share of DH in major cities in Croatia.

	Zagreb	Osijek	Sisak	Karlovac	Vukovar	Vinkovoci	Varazin	Sl. Brod	Rijeka	Croatia
Share of DH	39%	28%	23%	39%	35%	15%	18%	23%	19%	11%

Three cities have CHP plants supplying the local DH systems, i.e., Zagreb, Osijek and Sisak. These plants are operated by the Electricity Company HEP.

- TE-TO Zagreb, 422 MW(el) 500 MW(th)
- EL-TO Zagreb, 90 MW(el) 124 MW(th)
- TE-TO Osijek, 90 MW(el) 24 MW(th)
- CHP Sisak, 230 MW(el), 50 MW(th)

Besides hot water for DH, these plants deliver steam to industrial consumers

In 2008, public CHP plants contributed 23.43 TJ and industrial ones 22.05 PJ to the total fuel consumption of 346.6 PJ. In the same year, public CHP plants 2085.GWh to the total electricity

[33] Midst of 2009, the following licences have been provided: Thermal energy production: 20, thermal energy distribution: 15, and thermal energy supply; 21

supply of 18,051.8 GWh. Public CHP plants and public heat-only plants produced 8,986 PJ and 2,964 PJ in 2008. Accordingly, CHP supplied 75% of the total heat supplied to public networks

Types of DHC consumption

DH is available in larger cities of Croatia. DH is supplied by hot water systems to residential, commercial and public customers, while steam is supplied to industrial companies. In 2006, 2,062 GWh were supplied to DH customers. Almost 2/3 of the heat was delivered to residential customers. Some companies supply also DHW.

Private households accounted for 61 % (49 % in income) and corporate entities for 39 % (50 % in income). In total consumption of district heat, the share of Zagreb (including Samobor, Velika Gorica and Zaprešić) was 85.4 %, Osijek 11.3 %, and Sisak 3.3 %. Consumption of steam delivered for industrial processes was 596,776 MWh (Zagreb 82.11 %, Osijek 15.27% %, and Sisak 2.62 %. Steam sales constituted about 18.5%.

Heat metering rate

The Law on District Heating requested that the final consumption of heat will be metered. Article 36 stipulates:

> (1) Connection to a thermal energy distribution installation for buildings constructed after the entry of this Act into force shall be so designed that each self-contained unit of the building is fitted with a separate thermal energy flow control instrument and a separate thermal energy meter.
>
> (2) Within two years from the date of entry of this Act into force, the energy service company responsible for distribution of thermal energy shall at its own cost install the thermal energy flow control instruments and the heat meters in all thermal stations.

This means that the heat consumption of existing buildings will be metered in substations. New buildings have to be equipped with individual meters. DH Suppliers were obliged to install heat meters within two years after the law came into power (in 2005).

Nowadays, most customers are metered and billed according to consumption. An exemption is the DHC of Karlovac, which still applied a lump sum tariff, although heat meters are already installed. The Company has the highest tariff of all Croatian DH Companies. The heat tariff for metered commercial customers was approx. 108 €/MWh in 2008.

Market expanding/shrinking

Opportunities for expansion are limited. In the last 20 years, the DH market did hardly grow. During 2009 the number of heat energy customers of HEP rose by only 0.4 percent to a total number of 122,054 at the end of 2009, of which 116,136 were households and 5,918 corporate entities.

However, in the previous years the climate was a little bit better. Due to the increase in customer number in 2009, the contracted load in the area of the city of Zagreb increased by 3.09 MW in Zagreb and by 2.3 MW in Osijek.

The “Strategy of Energy Development” (2009) predicts a growth in customer district heating connections of 2 .1% a year and energy development of towns and villages that is systematically planned and consisting of complementary development of natural gas supply and district heating system. The Strategy also envisages encouragement of construction of distributed heat and electricity sources, as complementary systems to large energy systems.

According to HEP, the development of the district heating business will follow urban development plans of Zagreb, Osijek and Sisak. The expected growth in heat consumption is 2 to 3 percent a year. It is planned to expand the heating business in Sisak by building a new unit (230 MW(el), 50 MW(th)) in the location of Sisak thermal power plant in order to increase plant efficiency, to allow better fuel conversion efficiency, and to improve the overall environmental picture of the town and the region.

Although the number of steam customers grew a little compared to the previous year, heat sales were lower by 0.8 percent. This reduction was due to reduced sales of process steam that went down by 10.1 percent. The future will show whether this was caused by the economic situation or whether this is a long term process like in many other countries.

Steam networks exist only in the three cities served by HEP and total network length amounts to 65 km. HEP produced about 760.000 tons of steam in 2009. Reported distribution losses amounted to 21%.

As there was hardly any expansion in the DH sector in the lat two decades, it is difficult to identify effective market drivers. Perhaps the emphasis that is put on DH by the Energy Strategy could be considered as an important driver for the further modernization and expansion of the DH sector, provided. However, the implementation is suffering from insufficient financial means.

Interviews performed under the EcoHeat4EU project[34], identified the following essential challenges and barriers:

- The current system of tariff determination is complicated; it involves long administrative procedures and the tariff amounts are changed approximately once a year i.e. it does not allow a fast response to the changes in prices of input fuel…
- The privileged position of natural gas (see above)
- The still partly outdated and poor condition of DH equipment
- Absence of consequent (heat) energy planning.

Besides these issues, DH managers are criticizing the non-transparent tariff approval procedures. DH companies complain that they are not actively involved in that process. Rather, they submit their proposal and eventually the Government gives a new tariff. Moreover, the Government intends to transfer the responsibility to approve the tariff to the municipalities, which could make the procedure even more non-transparent if DH Companies would become the playing field of local policies (such as often in Serbia).

In addition, tariff approvals have been late. The last time, new tariffs have been set, was end of 2008, although fuel prices have significantly increased since then.

Fees for connection or disco9nnection are determined by the individual DH Company.

Selected technologies with customer connection

The DH systems in Zagreb reflect the state of the art. Energy flows are metered and controlled and substations are automated. The company started a comprehensive rehabilitation and modernization already in the 90s of the last century. However, the situation is worse in the smaller cities, where larger investments for rehabilitation and modernization are needed. There are, however, a few exemptions, like in Vukovar. In case of Vukovar, the municipality has provided funds for the rehabilitation and modernization of the DH system.

Local DHC association

There is no national DH association, but there is a “Group for DH Activities” within Croatian Chamber of Economy.

10.2 Legal and Regulatory Framework

National Policies

The National Energy Program, launched by the Croatian Government in March 1997 consists of the following sub-programs:

[34]EcoHeat4EU, Country Reports (draft), Croatia, without year

- PLINCRO- Croatian natural gas program
- KOGEN - co-generation program
- MIEE - industrial energy efficiency network
- MAHE - small hydro power plants construction program
- SUNEN - solar energy utilization program
- BIOEN - biomass and waste utilization program
- ENWIND - wind-energy utilization program
- GEOEN - geothermal energy utilization program
- KUENzgrada - program for energy efficiency in building construction
- KUENcts - program for energy efficiency in centralized heating system

A “District heating sector development strategy of the Republic of Croatia” was issued in 2006. The main issues covered by the strategy are:

1) General section covers a review of the DH systems
2) The second section deals with planning and refers to the development of DH systems and planning of construction. Two cities were selected as pilot cities to provide good examples for the realization. The selected cities were Karlovac and Slavonski Brod.
3) The implementation and construction section deals with obtaining permits, preparing technical documentations and construction works.
4) The management section describes the modern management requirements and methods for DH systems. It comprises both the supply and demand side.
5) The next section provides some guidelines for the collaboration between governmental administrative bodies in the Counties for Energy Affairs and local self-governments preparing physical palling.

The implementation has been broken down into three phases, which correspond to the first three sections of the sections described above.

However, the implementation of the pilot projects and therefore of the strategy was suspended. The final phase 3/3 of DH Strategy, currently postponed due to financial problems.

Energy sector Strategy (“Energy Sector Development Strategy in Republic of Croatia”) describes the policy to be applied for the development of the energy sector till 2020. It was issued in 2009 and published in official journal 130/09). District heating is a priority of the strategy. It has, amongst others, the following objectives related to DH:

- The development of DH aims to improve energy efficiency, reduce heat distribution losses. Promoting CHP and distributed energy systems and utilization of renewable energy.
- Promoting CHP. The current system of feed-in tariffs will be reviewed to foster the construction of new plants
- Promoting individual heat metering and use of smart metering in combination with regulating devices
- Promoting the modernization of DH systems
- Utilization of renewable energy for heating
- Promoting centralized heating for buildings larger than 1000 m²

Priority of CHP is also addressed by the Heat law (article 9):

1) The construction of a cogeneration unit shall have priority in the selection of proposed energy projects and in deciding on the construction of energy units.
2) An energy service company operating a cogeneration unit and using waste, biodegradable waste ingredients or renewable energy sources for thermal energy production in an

economically justifiable way, in compliance with environmental protection measures, may gain the status of an eligible thermal energy producer.

Besides opting for the modernization and expansion of DH, the policy documents emphasize a priority for CHP and utilization of renewable energy. The share of energy from renewable energy sources and cogeneration in the total electricity consumption has been set as a target that has to be fulfilled. The target does not apply to hydro power plants with an installed capacity higher than 10 MW and electricity produced in cogeneration plants that supply final customers.

The targets that have been set to be completed by December 31, 2010 were:

- Minimum share of electricity produced in plants using renewable energy sources should increase to 5.8% of the total electricity consumption;
- Minimum share of electricity from cogeneration plants whose production is supplied to transmission or distribution networks, shall increase to 2.0% of total electricity consumption.

Legislation

The Energy Law, the Heat Law, and the Act on Regulation of Energy Activities constitute are the essential parts of the legal framework for DH: The Energy Law created the legal basis for establishing the Energy Regulator Agency. According to this Law, the Agency is in charge of setting tariffs for DH. However, as already mentioned, a new amendment to the law intends to transfer this responsibility to the municipalities.

The secondary legislation comprises amongst others:

- Amendment to the Tariff System for Services of Energy Activities of Thermal Energy Production, Distribution and Supply, without the Amounts of Tariff Items issued by HERA (Official Gazette “Narodne novine”, No. 65/07 and 154/08).
- Decision on the Amount of Tariff Items in the Tariff System for Energy Activities of Thermal Energy Production, Distribution and Supply (Official Gazette “Narodne novine”, No. 154/08) hereinafter: Decision on the Amounts of Tariff Items, issued by the Government December 2008.
- In November 2008, the Minister of the Economy, Labor and Entrepreneurship issued an Ordinance on Allocation and Calculation of Costs for Supplied Thermal Energy (Official Gazette “Narodne novine”No. 139/08 and 18/09).

The “Act on Thermal Energy Production, Distribution and Supply” (Heat Law) prescribes the following:

- Conditions and way of carrying out the activities of thermal energy production, distribution and supply,
- Rights and obligations of undertakings carrying out the above mentioned activities,
- Rights and obligations of thermal energy buyers,
- Ensuring financial means for the carrying out of these activities,
- Financing of construction of facilities and installations for thermal energy production and distribution,
- Supervising the implementation of the Act and Fines for those violating the legal provisions.
- In line with the Energy Act, the Act on Thermal Energy Production, Distribution and Supply and the Act on the Regulation of Energy Activities in 2006 two new secondary legislation pieces were passed regulating the carrying out of energy activities from the thermal energy sector,

The Croatian Energy Regulatory Agency (HERA) was established as an independent public institution according to the Act on the Regulation of Energy Activities ("Official Gazette", No.

177/04 and 76/07). The purpose of the agency is to develop, implement and supervise the regulation of energy activities.

HERA is responsible for its work to the Croatian Parliament. HERA is managed by the President of the Managing Council. The Managing Council of HERA consists of five members, one of whom is the President. The President of the Managing Council manages the work of the Managing Council. The President of the Managing Council and its members are appointed by the Croatian Parliament upon the proposal of the Government of the Republic of Croatia for a term of five years. HERA's Expert Services are divided into five sectors, providing expert, administrative and technical services for HERA. HERA's work is of special interest for the Republic of Croatia and HERA performs it based on the public authority.

Fundamental goals of regulation of energy activities are:

- Ensure the objective, transparent and non-discriminative carrying out of energy activities;
- Take care of the implementation of principles of regulated access to the network/system;
- Adoption of methodologies for the determination of tariff items of tariff systems;
- Establishment of efficient energy market and market competition;
- Protection of energy consumers and energy operators.

Regulation of energy activities aims to promote:

- Efficient and rational use of energy;
- Entrepreneurship in the energy sector;
- Investments in the energy sector;
- Protection of environment.

Actually, HERA does not approve tariffs, but gives an opinion about the tariff proposals that have been submitted by the DH Companies to the Government. For the time being, it is the Government that sets finally the DH tariffs.

Recently, the Ministry of Economy prepared an amendment to the Energy Law, which has already been approved by the Parliament. According to this document, the responsibility for determining DH tariffs will be removed from the Government and given to the Municipalities. The role of HERA would be to provide an opinion about the tariff proposals.

Building code

Like in other neighboring countries the energy efficiency of existing buildings is low. Energy efficiency will be fostered by the National Energy Programs, the most important being KUENzgrada (Energy efficiency in building construction), The main goal of the program was the reduction of energy consumption in the design, construction and utilization of buildings and settlements, and in the redevelopment of the existing buildings. In the context of this program, the EPBD Directive was implemented.

The program envisages also changing the existing legislation, building construction codes, introducing energy audits in buildings, using passive solar architecture, renewable energy sources in buildings, promoting energy efficiency and pilot projects.

The “Physical Planning and Building Act” was adopted in 2007. Articles harmonized with the “EU Energy Performance of Buildings Directive” (EPBD) introducing energy efficiency:[35]

- heat savings and thermal protection stated as one of six essential building characteristics
- energy consumption (heating/cooling/ventilation) must be equal or lower than prescribed values
- prescribed energy characteristics must be provided in design, construction, maintenance and use of buildings

[35] EcoHeat4EU, Implementation of EU Directives, without year

- satisfactory indoor climate conditions must be provided
- obligatory energy certification and presentation of certificates for public buildings

New Technical regulation concerning energy economy and thermal protection in buildings has been adopted in 2008. The main objectives are

- technical requirements relating to energy economy and thermal protection which must be met when designing and constructing new buildings and using existing buildings heated at an indoor temperature above 12°C, according to HRN EN 13790:2008,
- technical requirements relating to energy economy and thermal protection which must be met when designing the renovation of existing buildings heated at an indoor temperature above 12°C,

.

Price regulation

The energy law from 2001 stipulates some basic principles in Article 25:

- Energy prices can be free or regulated.
- Regulated prices shall be set by the application of tariff systems if not otherwise provided by the special law.

Energy prices shall also contain the following elements:

- compensation for services provided by energy undertakings under public service obligations,
- compensation for carrying out the regulation of energy activities,
- compensation of stranded costs.

The Heat Law adds the stipulation that a uniform tariff setting method has to apply for the whole country. It also says, that "the amount of tariff items depends on the costs of production, distribution and supply of thermal energy in a distribution area".

Tariff calculation is the responsibility of HERA, although the corresponding methodologies have to be approved by the Government. The current regulation on "Tariff System for Services of Energy Activities of Thermal Energy Production, Distribution and Supply, without the Amounts of Tariff Items" was issued in 2007.

Article 2 defines the cost basis as follows:

> "The methodology of this tariff system is based on legitimate business expenses, maintenance, replacement, construction or reconstruction of facilities and environmental protection, and includes a reasonable recovery of investment in energy facilities, devices and networks, and in district heating systems."

HERA applies a revenue cap method that is described in Article 5

> "Energy entity that performs energy activity in Article 1 this tariff system is obliged to recommend a tariff on the basis of transparent and based the calculation on the condition that the expected income in the regulatory year, calculated using the formula in Annex 1 of the tariff system, does not exceed the regulated maximum allowable income energy subject to regulatory year, which is determined by this tariff system in the production of thermal energy, with the exception of eligible customers, the distribution of thermal energy and heat supply, with the exception of eligible customers."

The Tariff System is based on the justified business operations' costs and the costs of maintenance, replacement, construction or reconstruction of facilities and environment protection, including a reasonable rate of return on investments in energy facilities, installations and the network.

The tariffs have to be determined for each activity. The formula that has to be applied for calculating the maximum revenue for distribution is:

Pmax (t) = Tfix (t-1) · (1 + It-1) · (1-X) + N + RSt
where:
Pmax (t) - the maximum regulated revenue regulatory year t [kn]
Tfix (t-1) - fixed costs in the base year t-1 [kn]
It-1 - consumer price index in the base year,
X - efficiency coefficient, which can not be a [0-1)
N - statutory compensation [kn]
Rst – return on regulated assets in regulatory year t [kn]
Tfix (t-1) represents the amount to cover the fixed costs in the base year t-1 and includes:

a) the cost of materials, services, small inventory and energy for own consumption,
b) costs of ongoing maintenance and investment,
c) the cost of insurance of buildings, equipment and other things
d) the cost of wages,
e) other costs of doing business,
h) Depreciation of funds provided for under applicable regulations.

Depreciation expense of regulated assets in the base year t-1 does not include the amortization of assets received free of charge.

The formula for supply is practically the same, while the formula for production has added a fuel cost component. The formula for price adjustment does not automatically apply automatically. Rather, HERA and finally the government have to approve a price increase. The last tariff approval was end of 2008.

Tariffs for residential and commercial customers are different. Typically, the energy charges for residential customers are lower than for the others, while the capacity charge is the same for both groups. The table below shows the tariffs that have been approved end of 2008 and that are still effective. The biggest cross-subsidies are applied by HEP, which also has the lowest tariffs. The three subsidiaries of HEP (Zagreb, Osijek, and Sisak) are supplied by CHP plants.

Table 10.3: DH tariffs excl. VAT * in Croatia.

Energy operator / Town	Energy		Power	
	Households	Economy	Households	Economy
	[HRK/kWh]		[HRK/kW]	
HEP-Toplinarstvo d.o.o.				
Zagreb	0.12	0.23	11.13	14.42
Osijek	0.12	0.23	11.13	14.42
Sisak	0.12	0.23	11.13	14.42
Local heating plants (separate boiler room)				
Zagreb, Samobor, Zaprešić, Velika Gorica	0.20	0.23	14.42	14.42
Virkom d.o.o., Virovitica	0.22	0.23	18.00	18.00
Termoplin d.d., Varaždin	0.22	0.24	18.70	18.70
Vinkovački vod. i kan. d.o.o., Vinkovci	0.22	0.24	18.70	18.70
Energo d.o.o., Rijeka	0.23	0.28	17.00	18.26
Tehnostan d.o.o., Vukovar	0.23	0.30	18.38	18.38
Brod-Plin d.o.o., Slavonski Brod	0.23	0.30	18.70	18.70
Tekija d.o.o., Požega	0.24	-	18.70	-
Hvidra d.o.o., Split	0.27	0.31	11.22	14.59

**) Capacity (power) charges are per month*

Source: HERA, Annual Report 2008

The tariff for Karlovac is 5.51 HRK/m², month (about 66 €/MWh) and 777 HRK/MWh for commercial consumers (about 108 €/MWh).

In 2009, most companies were applying a two-part tariff consisting of an energy charge (HRK/MWh) and a capacity charge (HRK/MW). Only the DH Company of Karlovac continued to apply lump sum tariffs. Most companies also charge also for abnormal water consumption.

Social considerations are not relevant for Croatian DH Companies. The companies are not obliged to offer special tariffs for certain consumer groups. However, residential customers pay a lower tariff than business customers, i.e., residential customers are cross-subsidized by business customers.

The government aims also to promote individual consumption-based billing. The “Ordinance on Allocation and Calculation of Costs for Supplied heat” came into force in 2008 and defines the rules for the utilization of heat cost allocators and heat metering. It requests the installation of devices for the internal distribution of the supplied heat (heat costs allocators). Heat cost allocators can be installed if more than 50% of the owners agree. It is up to the DH Company to issue the bills to the individual customers. The ordinance also describes models for distributing the costs. So far, the response of final customers is limited mostly because of the high costs (about 50-50 € per radiator). In Vukovar, however, almost all flats have heat cost allocators installed.

Competition

As it can be seen from the next Table most DH Companies supply DH and Gas. Moreover, the biggest DH Company, HEP, supplies also electricity. This provides a sound basis for a harmonized heat planning in the urban areas.

Natural gas, as the main competitor to district heating, is, by the majority of district heating stakeholders, seen in a favored position in comparison to district heating whether from the political, local community or price perspective. The price of gas is closer to the market price, enables profitability and gas network development. Generally the development of gas pipelines is seen as a priority and gas lobby is very influential. The most of the stakeholders agree on this issue.

Feed-in tariffs

Electricity produced from renewable energy and from CHP benefits from a system of feed-in tariffs. In case of CHP, there is a higher (HT) and a lower tariff (LT). The tariffs are valid provided that at least 60% of the fuel comes from domestic resources. If the share is 45% or less, the feed-in tariff will be reduced to 93%. Feed-in tariffs for plants using renewable energy will be adjusted each year in accordance with the retail price index. The feed-in tariff for electricity from CHP is adjusted according to the increase of the average electricity price and the gas price in Croatia. The weights of both factors are 75% for the electricity price and 25% for the gas price.

*Table 10.4: Feed-in tariffs for CHP in HRK/kWh *) in Croatia.*

Item	HT	LT
<= 50 KW	0.61	0.32
A>60 <= 1 MW	0.51	0.26
> 1 MW <= 35 MW	0.44	0.22
> 35 MW	0,39	0.15

On July 1, 2007, the fee for promoting electricity production from renewable energy sources and cogeneration started to be charged from customers, pursuant to the “Regulation on Incentive Fees for Promoting Electricity Production from Renewable Energy Sources and Cogeneration”. Pursuant to the2007 Regulation, the fee for stimulation amounted to 0.0089 HRK/kWh in 2007, 0.0198 HRK/kWh in2008, 0.0271 HRK/kWh in 2009 and 0.0350 HRK/kWh in 2010.

However, so far the results have been disappointing. Despite the big interest for incentives shown by investors, there was a relatively small number of plants in 2007 and 2008, which concluded buy-off agreements with HROTE or started its operation. Therefore the fees were kept at the same level as in 2007, pursuant to the Regulation on Amendments to Regulation on Incentive Fees for Promoting Electricity Production from Renewable Energy Sources and Cogeneration (Official Gazette “Narodne novine”, No. 133/07 and 155/08).

Emission trading[36]

In order to harmonize the Croatian legislation with Directive 2003/87/EC, which introduced the system of GHG emission trading among EU Member States, the Croatian government issued the Regulation on Greenhouse Gas Emission Allowances and Emissions Trading (Official Gazette 142/08) in 2008. This regulation establishes a GHG emissions trading system in accordance with the criteria used to establish the EU trading system. For the first time this sets an upper limit for GHG emissions for electricity producers and industrial facilities in Croatia. By the Air Protection Act (Official Gazette 178/04, 60/08) the government adopted an Allocation Plan for Greenhouse Gas Emission Allowances in the Republic of Croatia (Official Gazette 76/09). The plan sets upper limits for carbon dioxide emissions for the period from 2010 to 2012 for the operators to which the Regulation applies. The Croatian emission trading system is planned to be implemented in two phases. During 2009-2010, the operators will obtain permits for emissions, and during 2010-2012 they will monitor emissions from the plants and submit verified reports thereon. Upon the accession of Croatia to the EU, allowances will be allocated to the accounts of plants in the Register and the Croatian ETS system will be integrated into the EU ETS.

The key document defining the position, goals and methods for fulfilling the commitments under the Convention and the Kyoto Protocol is the National Strategy and Action Plan for the Implementation of UNFCCC and the Kyoto Protocol. Furthermore, in May 2008, the Croatian government adopted the Air Quality Protection and Improvement Plan for the Republic of Croatia 2008-2011 (Official Gazette 61/2008). The National Strategy and Action Plan for the Implementation of UNFCCC and the Kyoto Protocol is an integral part of this plan.

Carbon and other taxes

In Croatia, the following taxes are imposed on energy related products. The revenue from excise taxes and VAT goes into the central budget.

Objective of the tax	Excise tax rate	VAT rate
Unleaded petrol	311.7 EUR/kl	23%
Leaded petrol	376.6 EUR/kl	23%
Diesel	194.8 EUR/kl	23%
LPG	13 EUR/t	23%
Light fuel oil	39 EUR/kl	23%

Other energy products such as coal, natural gas, district heating and electricity are subject to 23% VAT rate.

A sulphur dioxide tax, a nitrogen oxides tax, and emission non-compliance fee are no environmental are applied. The carbon dioxide tax is addressed by the “Regulation on unit charges, corrective coefficients and detailed criteria and benchmarks for determination of the charge for carbon dioxide emissions into the environment”(OG No. 73/07, 48/09) and “Ordinance on the method and deadlines for calculation and payment of the charge on carbon dioxide emissions into the environment”(OG No. 77/07).

Investment support

Neither the Government nor the municipalities provide financial support for DH, but some support is available by the programs described below. The Government has provided political support mainly by issuing the Heat Development Strategy and the Energy Strategy. Moreover, on May 5, 20 Government adopted f the District Heating Strategy (DH Strategy). In parallel to the implementation of this project, the Government, through the Ministry of Economy, Labor, and Entrepreneurship will implement the DH Strategy to strengthen the sector through policy and institutional measures.

[36] www.eea.europa.eu

DH Companies can apply for a commercial Bank loan, but IFIs offer better terms. In 2006 the World Bank approved a loan of Euro 24 million for a District Heating Project for the Republic of Croatia. The District Heating Project seeks to promote the operational efficiency of HEP Toplinarstvo

The District Heating Project has two components:

- The Infrastructure Rehabilitation component included investments in Zagreb and Osijek.
- Development of a “Demand-Side Management” (DSM) Program.

HEP-ESCO

HEP ESCO was established in 90'ies. Although the program focused on the demands side and addressed customers of DH Companies rather the DH Companies themselves, DH and CHP projects were also open for financial support. Several small-scale CHP projects in the industrial sector have been supported so far.

The Energy Efficiency Project Croatia was initiated by the World Bank (IBRD) and Global Environment Facility (GEF) in collaboration with Hrvatska Elektroprivreda d.d. and Croatian Reconstruction and Development Bank (HBOR). For this purpose Hrvatska Elektroprivreda d.d. and/or HEP ESCO was extended a loan by the World Bank in the amount of € 4.4 million and a GEF grant in the amount of USD 5 million. The total value of the Project, with participation of domestic banks, is estimated at 40 million USD over a six-year period. In mid-2010 HEP-ESCO will complete the Energy Efficiency Project supported by the World Bank and GEF. Based on this experience, the operations are planned to be supplemented in accordance with trends in energy efficiency and environmental protection in the EU.

Environmental and Energy Efficiency Fund

The Fund was established in 2003 and started financing projects in 2005. It is mainly financed by pollution charges. The fund supports projects that are in line with the Natural Environmental Strategy and National Environmental Action Plan and the Energy Strategy. DH is one of the programs that are supported. Financial support is limited to HRK 200.000.

The fund offers

- Soft loan: up to 40% of eligible costs max € 230.000.
- Financial Aid (i.e. Grant) :for units of local/regional self-government40% / 60% / 80% of eligible costs depending on the location (island/mountain, assisted regions)
- Donation: up to 27.000 EUR, for promotion, research and development etc.

Loan Program for the Financing of Projects of Environmental Protection, Energy Efficiency and Renewable Energy Resources[37]

The loan program is managed by HBOR. It is open to local self-governments and utilities. There are no limits for the loan amounts and it depends rather on HBOS's financial capabilities, the project type, creditworthiness and quality of securities. The minimum amount is HRK 100.000. The bank finances up to 50%, In case that the Environmental Protection Fund and Energy Efficiency Fund approve the project, the interest rate will be reduced. The interest rate is 4%-6%, the grace period 2 years and repayment period 12 years.

10.3 Customers

Customer rights

Rights and responsibilities of customers are described in general in the Energy Law and the "Cconditions of Thermal Energy Supply".

The "Law on Regulation of Energy Activities" stipulates in Article 12

> "A dissatisfied party may submit a complaint to the Agency concerning the work of the distribution operator and the decision on methodologies (tariff systems, without amounts of tariff elements and compensation for the connection to the distribution networks, and for increase in connected load).

[37] http://www.hbor.hr/Default.aspx?sec=1483

The complaint may be submitted within 30 days from the day on which the irregularity in the work of distribution system operator occurs, and the complaint regarding methodology may be submitted within 60 days from the day on which the methodology is adopted.

The Agency shall take a decision on the complaint within 60 days from the receipt thereof.

The Heat law stipulates in Article 22:

(1) The district heat distribution company shall provide access to the distribution network in accordance with the general terms and conditions of district heat supply.

(2) A party which is denied access to the distribution network, or which is not satisfied with the terms and conditions of access, may lodge a complaint with the Agency. The decision of the Agency shall be final.

(3) The party referred to in paragraph 2 of this Article may finance the construction of a direct line being built by the district heat distribution company with the approval of the Agency for district heat supply.

The Law on Consumer protection (Official Gazette 79/07), stipulates that DH supplier/distributer are obliged to establish a committee for consumer complaints, which should as members also have representatives of consumer protection associations. Such a commission must respond in writing to consumer complaints received within 30 days of receipt of the complaint.

The Heat law describes the conditions for disconnection. A customer may disconnect if all other parties connected to the same heat meter agree and if the DH Company approves the disconnection. Article 22 of the Heat law stipulates:

(1) The tariff consumers of thermal energy shall not opt out of a heating system without prior approval of the energy distribution and supply companies.

(2) The companies referred to in paragraph 1 of this Article shall give approval to a tariff consumer if permissible under current technical requirements and if the tariff consumer obtains approval of all the tariff consumers on a shared heat meter.

Service quality

Important rules regarding the operation of DH systems are described in the "General Conditions of Thermal Energy Supply". The rules regulate the relations between thermal energy buyers and DH suppliers. In addition to that, technical conditions and economic relations between distributors, suppliers and heat consumers are defined. The General Conditions prescribe the following:

- Prerequisites and procedure for connections
- Conditions for the connection, delivery and supply of heat,
- Monitoring security of supply and quality,
- Bilateral contractual relations between energy suppliers and customers,
- Rights and duties of both parties,
- Conditions for the measuring, calculation and billing of delivered heat,
- Conditions for the implementation of interruptions and disconnections from DH
- Procedures for the determination and calculation of unauthorized thermal energy consumption.

The General conditions of DH also comprise the following stipulations regarding consumer complaints:

- if a customer or DH supplier submits a written complaint regarding the quality of heat, the distributor of DH needs to provide measurements within two days upon the receipt of complaint; and to send the written report on the results of the district heat quality measurements to the customer or DH supplier in the next ten days.

- if the complaint is unsubstantiated, the customer bears the measurement costs, and if the complaint is substantiated the DH distributor bears the costs incurred.
- the customer has the right of objections to the work of the DH distributer/supplier within 30 days from the day of the incurred reason; the DH distributer/supplier reaches a decision on the customer complaint within 30 days upon receipt of the complaint.
- a tariff customer may challenge the monthly obligation and additional monthly obligations within 15 days of their issuance
- a tariff customer may challenge in writing, partially or wholly, the invoice for the heat consumed at- the latest within 15 days of the invoice; DH supplier is required to respond to the tariff customer complaint within 8 days from the receipt of the complaint. If the complaint is justified, the customer is issued a new invoice.

The Law on Consumer protection (Official Gazette 79/07), stipulates some basic conditions for metering: sale of energy, when the nature of public service permits, must be calculated according to the consumption

- service of metering device readings are not allowed to be charged, except when the consumer required a non-standard reading prescribed with special regulation
- DH supplier/distributer (in this case) must provide the customer in advance with all terms and conditions of the use of public services and publicly disclose those to the media.

10.4 Ownership

Role of governmental and municipality

Municipalities do not have a direct influence on DH operation and management with the exemption of being an owner of the DH Company. They can, however, exercise some influence through urban planning and local heat planning. Moreover, they have the power to grant concessions for DH.

Energy operators engaged in production, distribution and supply of thermal energy are owned by municipalities, state-owned, or are privately owned. Besides activities related to thermal energy, these companies mainly carry out the activity of gas distribution and other utility services.

Table 10.5: Ownership and business activities of larger DH Companies in Croatia

Energy operator/Headquarters Ownership	City	Ownership	Activities
Energo d.o.o.	**Rijeka**	Private/Municipal	DH, Gas
Termoplind.d. Varazdin	Varazan	Private/Municipal	DH, Gas
Brod-plin d.o.o. Slavonski	Slavonski Brod	Municpal	DH, Gas
Virkom d.o.o.	Virovitica	Municpal	DH, Gas
Tehnostan d.o.o.	Vukovar	Municipal	DH, Gas, building maintenance
Vinkovacki vodovod i kanalizacija d.o.	Vinkovci	Municipal	DH. Water, sewage, others
HVIDRA d.o.o	Split	Private	DH, parking etc
TEKIJA d.o.o.	Pozega	Municipal	DH, water, waste collection, others
HEP Toplinarstvo d.o.o.	Zagreb	State	DH, gas
Toplana d.o.o.	Karlovac	Municipal	DH, gas
Termalna voda d.o.o.	Topusko	Municipal	DH gas

Source: HERA, Annual Report 2008

According to the Heat Law, DH services have to be carried out based on a concession, which will be granted by the respective municipality for a period of 30 years. The concessionaire will be selected through a public tender.

The management is nominated by the company owners. The license prescribes several qualifications, which the license holder has to prove. The Energy Law, Heat law, license and other regulations define tasks and liabilities of the management. The administrative supervision of the implementation of the Heat Law is conducted by the Ministry and the inspectional supervision of the implementation of this Act is conducted by the State Inspector's Office. The Heat Law threatens with fines in case of non-compliance with the heat law.

Private sector involvement

As already mentioned in the above section, the private sector is already engaged in the DH sector. Private investors can apply for a concession, but opportunities are rare as a concession is valid for 30 years. Besides that, they can use the option for third party access to the DH distribution systems. In case that they need to apply for a license, the corresponding liabilities apply.

Another opportunity for private sector involvements provides third party access- The "Law on electricity" stipulates in Article 22 that the Market Operators shall ensure the purchase of electricity from eligible producers at least costs currently effective on the organized market. There is no market operator in the DH sector, but the heat law requests third party access. The law stipulates in Article 20, that the DH Distributor has "to providing regulated access of third parties to the distribution network". CHP producers that use waste or renewable can gain the status of an eligible producer which guarantees the purchase of the produced electricity.

Foreign investors have the same rights, obligations and legal status within an enterprise as domestic investors, provided the condition of reciprocity is met, as follows:

- the rights acquired through capital investments cannot be withdrawn by law or by another legal act
- free repatriation of profits and free repatriation of capital on disinvestments are secured - investors can keep the profits in HRK on domestic currency account; it can be used for loans to domestic entities and for transfers into domestic currency accounts of their foreign persons
- Foreign natural persons and legal entities are free to acquire real estate (including the acquisition of mortgage rights) if the condition of reciprocity on real estate in Croatia is met.

10.5 Planning

Integrated resource panning

The Energy Strategy is based on Integrated Resource Planning. The IRP concept has been applied to the overall energy system and its individual subsystems (electricity, gas and district heating). The Strategy for the Development of the Energy Sector defines also the obligation of the municipalities and the regional self-governments. They are obliged to elaborate plans for the needs and supply of energy, plans for the implementation of these plans and their integral harmonization in relation to the various programs implemented at the state level.

Heat area planning

The heat law addresses heat planning in Article 5 as follow:

1) The Ministry shall take part in preparing the zoning plans adopted by the Parliament of Croatia.
2) The state administration office of a county or the administrative body of the City of Zagreb competent for energy affairs shall participate in drawing up the zoning plans adopted by the representative bodies of local self-government units.

The party responsible for drawing up the zoning plans referred to in paragraphs 1 and 2 of this Article shall obtain a previous opinion from the Ministry or state administration office of a county or the administrative body of the City of Zagreb competent for energy affairs. Article 6.

10.6 Comments and recommendations

The Croatian DH sector has made partially great progress as to rehabilitating and rationalizing the DH systems. DH systems have been modernized, although particularly the smaller DH Companies still need comprehensive investment programs.

Metering and consumption-.based billing is now implemented in most DH systems (except Karlovac) and two-part tariffs are applied as energy charge (HRK/kWh) and capacity charge (HWK/kW). However, residential consumers still benefit from cross subsidies that have to be paid by the commercial customers.

There are, however still some serious barriers and problems that could endanger the sustainable development of the DH sector in the longer run. For example, the price structure of natural gas does obviously not properly reflect the respective costs for the various consumer groups and customer types. Gas prices for DH boilers are sometimes even higher than for retail gas prices for private households.

Transferring the power for setting tariffs to the municipalities could cause a serious setback. Experiences from of other countries (e.g., Serbia) show that DH becomes a playing ground for local policies. Moreover, expertise on DH tariff calculation does usually not exist in municipalities and tariff setting is based often on political deliberations rather than economic and financial ones.

Despite emphasizing the importance of DH and CHP in the Energy strategy, support for DH from the government is weak.

10.7 Recommendations and good practices

Legal and regulatory framework

Issue	National Energy Policy
Problem	DHC, CHP, EE and RE are prioritized in the national policy. However, implementation and actual support for the DH sector is slow and weak.
Recommendation	The Energy Strategy should consequently be implemented particularly in cities outside Zagreb
Good practice	Chapter 6) , Poland (Appendix)

Issue	Building regulations
Problem	The EPBD Directive has been implemented and new building codes came into force
Recommendation	
Good practice	See chapter 6 (2)

Issue	Price regulation
Problem	Price setting is based on a revenue cap, but a price cap seems to be more appropriate for DH The price adjustment formula cannot automatically be applied, but new tariffs have to be approved.
Recommendation	A price cap regulation seems to be more appropriate for DH with its seasonal and structural (impacts of energy saving measures and consumption based billing) fluctuation DH companies should be allowed to apply the price escalator formula without former approval
Good practice	See chapter 6(3), Kosovo, Macedonia FYR

Issue	Competition
Problem	Price distortion between natural gas and DH
Recommendation	Remove price distortions
Good practice	Nordic Countries, Germany

Issue	Feed-in-tariffs for CHP or renewables
Problem	Feed-in tariffs are only valid if the fuel comes mainly from national sources. CHP plants full fired by natural gas do not benefit from the feed in tariff.
Recommendation	Implement feed-in tariffs for fossil CHP Plants or apply a corresponding cost-allocation methodology
Good practice	See chapter 6 (5), Germany

Issue	Emission trading scheme
Problem	Scheme is already in place
Recommendation	
Good practice	The European Union, See chapter 6 (6)

Issue	Carbon tax
Problem	A carbon tax does not exist
Recommendation	As DH is mostly produced by natural gas, a carbon tax might not be a first priority.
Good practice	See chapter g (7)

Issue	Investment grants
Problem	Rehabilitation of existing DH system outside Skopje requires likely some grant financing, which does not exists for the time being
Recommendation	Based on the results of the heat plans, municipalities and central government should provide some grant financing for rehabilitation.
Good practice	See chapter 6 (8)

<u>Customer issues</u>

Issue	Customer definition and rights
Problem	Problems have not been identified
Recommendation	
Good practice	See chapter 6 (9), The European Union

Issue	Service quality
Problem	Service quality problems will likely exist, particularly in some DH systems outside Zagreb
Recommendation	Rehabilitate and modernize DH systems
Good practice	See chapter 6 (10), The European Union, USAm, Canada

Issue	Billing
Problem	Consumption-based billing is already in place
Recommendation	
Good practice	See chapter 6 (11), The European Union, South Korea, USA, and Canada

Ownership issues

Issue	Municipality role
Problem	Municipality is an owner, but room for interventions is small. The planned amendment to the energy law would return regulatory tasks to the municipalities, which would like create conflicts of interests
Recommendation	Maintain the current centralized regulatory system
Good practice	See chapter 6 (12), The European Union

Issue	Private sector involvement
Problem	Private sector is already involved in DH
Recommendation	
Good practice	Fortum and Bashkirenergo (Russia), Skopje (Macedonia), see chapter 6 (13)

Issue	Synergy allocations
Problem	No rules for CHP plants using fossil fuels
Recommendation	Extend the feed-in tariff system or apply corresponding rules for cost allocation for CHP
Good practice	

Planning

Issue	Integrated resource planning
Problem	IRP is already applied in the Energy Strategy and local governments are requested to prepare plans on the local level
Recommendation	

Good practice	The European Union, South Korea, see chapter 6 (15)

Issue	Heat and urban planning
Problem	Heat planning used to be common in Croatia, but has lost its significance. Applying heat planning based on Urban planning and IRP,would allow to improve the development of local heating systems
Recommendation	
Good practice	See chapter 6 (16)

Technical

Issue	Technical standards and design conditions
Problem	EU standards and norms have been adopted.
Recommendation	
Good practice	See 6 (17)

Issue	Refurbishing strategies
Problem	Some DH systems are technically still in a bad shape.
Recommendation	Refurbish DH particularly outside Zagreb
Good practice	See 6(18), Poland (Appendix), Sofia/Bulgaria (Chapter 6), Mytishi (Russia), Subotica (Serbia)

10.8 Information sources

- EcoHeat4EU, Country Reports (draft), Croatia, without year
- EcoHeat4EU, Implementation of EU Directives, without year
- EIHP, Energy Sector Development Strategy of the Republic of Croatia
- Igor Raguzin, Economic Instruments for Renewable Energy Sources in the Republic of Croatia, without year
- Domagoj Jeić, Ministry Of Economy, Labor And Entrepreneurship , Legal framework in District Heating Area In Republic Of Croatia Republic Of Croatia, without year
- Marijan Hohnjec, EPEE Fund in Residential sector, 2008
- HERA, Tariff system for power generation, distribution and supply of thermal energy, without the amounts of tariff items, 2007
- EIHP, Energy Efficiency Policies and Measures in Croatia, 2009
- HERA, Annual report, various years
- Croatian Parliament, Promulgating the act on the production, distribution and supply of thermal energy, 2005

11Kazakhstan

11.1 Features and extent of DHC/CHP

History

The country started restructuring its energy sector in 1996 and over the next 2-3 years privatized a large share of its electricity and district heating assets. The companies supplying fuel to energy producers as well as the residential housing stock were also privatized. This has improved the performance of most of the district heating systems. Heat tariffs were increased and heat suppliers no longer receive subsidies in most cases. However, the privatization did not solve the problems related to tariff regulation and low interests of investors. A cost-based approach to tariff regulation does not encourage operators to cut expenses and invest in energy efficiency measures. Moreover, the low profitability due to the current tariff structure, which includes depreciation based on the remainder value of assets, the asset values not updated to meet the new purchase value, turns away investors and discourages energy efficiency improvements.

Currently, 45% of the country's cogeneration plants connected to district heating systems is private, another 35% are joint-stock companies with combined private and municipal ownership, and the remaining 20% are fully owned by municipalities.

The majority of buildings in large cities receive district heating and hot water from CHP plants (mostly coal-fired), in smaller towns – from smaller boiler houses (heavy oil fired), whereas most of the urban population with no access to DH use coal as a fuel for stoves. It is worth mentioning that the quality of heat supply in most of the DH systems in Kazakhstan is unsatisfactory, as most of the plants are low efficient and rather obsolete due to their age (more than 20 years old).

However, very few residential consumers were disconnected from DH, because of the lack of other heating alternatives. There is no natural gas supply infrastructure in the population centers in Kazakhstan; and consequently the district heating companies have no competitive pressure from natural gas suppliers. Approximately 20 entities operate in the heat sector, and the sale tariff varies by regions (average sale tariff for heat ranged 6.3 – 23 USD/Gcal in 2004). There is, however, no variation in cost to different consumers. About 10% of multi-apartment residential buildings are equipped with heat meters, whereas the billing of energy used in the rest of the buildings is done according to norms51 based on specifications and formulas of Kazakh building standards. The norms are calculated as an assumption for the specific energy demand (per sq. meter of heated area) for maintaining the normal comfort level for consumers. Nevertheless, the existing methods of norm calculations are not accurate.

In this regard, the energy supply company in Karaganda (Karagandy Zhuly) suggested that their norms be verified empirically. The company has identified 16 types of buildings, for each of which heat energy metering is done in order to establish the correct level of energy consumption. It is likely that this method of verification for norms will be widely adopted following the recommendations of the Government of Kazakhstan.

In some regions of Kazakhstan (Kustanay, North-Kazakhstan, Karaganda, etc.) autonomous heating systems (2.000 units) are installed instead of less efficient boiler houses. The reasons are the high costs of heat production with boiler houses and the low level of payments.

According to Almaty Power Consolidated (APK), the Almaty energy supply company, norms are regulated by the Ministry of Energy and Mineral Resources and Regional departments of the Natural Monopolies Regulation Authority (Antimonopoly Agency).

Statistics from past year

There is no statistics on hot water (district heating) separately in Kazakhstan, but there is some data on total heat producing (hot water + steam), as presented below.

Table 11.1: Heat production statistics in Kazakhstan.

	2007	2008	2009	Jan-Nov 2010
Heat energy production (PJ) (DH and steam together)	335,6	338,6	336,4	301,1

DHC and CHP market shares

The scope of DH from CHPs and major (district) boiler plants in 25 developed industrial cities reached 79% by 1990, including 47% from CHPs. If in one developed industrial city the area of connected heat consumers from CHPs and major DH boiler plants is equal in average to 5 million m2, then the total area in Kazakhstan could be 5x25=125 million m^2. And about 70 million m^2 of the area in other cities and oblasts of Kazakhstan is heated from boiler plants, the total is 195 million m2.

Types of DHC consumption

Both DHW and SH are supplied with the water DH system through primary and secondary networks interconnected with group substations, as typical in Russia. Industrial steam is provided as well.

Selected technologies with customer connection

Customers are directly connected, in other words, the hot water from the group substations is distributed through 4-pipe networks as SH of apartments and through the heat exchanger to DHW.

Heat metering rate

The heat metering rate of the residential customers is close to zero.

Under the Law of the Republic of Kazakhstan “On natural monopolies and regulated markets”, article 23, the installation of heat meters to customers (up to the 1st of August 2009) used to the responsibility of natural monopolies and the consumers of regulated public services. The requirement has not been met.

Later on, under Regulation of the Government of the Republic of Kazakhstan № 1725 dated 30 October 2009, the Joint-Stock Company “Kazakhstan Center for Modernization and Development of Housing and Utilities” (“ADS”) was established with the purpose of further development of the housing and utilities sector38. in year 2011 ADS is starts to install building level modern substations (automated individual heat points) in residential buildings and public ones in cities of Kazakhstan, as a pilot project, with heat energy consumption metering. In the future ADS will be responsible for the state policy regarding heat energy consumption metering.

Market expanding/shrinking

The market is rather stable because new construction of buildings is modest.

Local DHC association

Kazakhstan Power Association (KPA) takes care of DH sector co-operation as well.

[38] http://www.ads.gov.kz/ru/index.php?option=com_content&view=article&id=107&Itemid=281

11.2 **Policies**

National policy

Energy efficiency has since 2007 been drawing significant attention in Kazakhstan.

Kazakhstan has room for improving its level of energy efficiency. Its total primary energy supply divided by gross domestic product (TPES/GDP1), an indicator used by, i.a., the International Energy Agency (IEA), is 1.84, in the same class as in Russia (1.65), but many times higher than e.g. in Western Europe[39] (0.17).

Laws

A Government-sanctioned draft Law on Energy Efficiency was initiated in2007, and in June 2009 the draft was filed with the Majilis, the lower chamber of Kazakhstan's Parliament, for eventual adoption.

At the time of writing this Final Report, the law-making process was still ongoing: a Parliamentary Working Group, established in September 2009, had not completed its work, and it was unclear whether some provisions of great potential significance would be included in the law and/or how they would ultimately be worded.

The main laws currently regulating the DH sector are the Law on Natural Monopolies and the Law on Competition, both of them having specific agencies to supervise the implementation of the particular law.

Building regulations

According to the UNDP study, heating in Kazakhstan takes almost two times more energy than in European countries with a similar climate, since more than 90 percent of buildings in Kazakhstan were constructed before 1990. Large heat losses are explained by poor quality of heating mains (80 percent) and furnaces (20 percent), insufficient maintenance and absence of a control system for heat consumption.

Most of the necessary energy efficiency standards and requirements do not exist in Kazakhstan as secondary and tertiary legislation, such as building codes – at least at a level which would be acceptable as "best practices" – but would need to be developed, probably over many years to come[40].

Price regulation

The Anti-monopoly Authority regulates the heat tariffs in the country according to the respective law. Eligible costs components of the cost plus type of tariff are the traditional ones: fuels, water, electricity, staff and depreciation of fixed assets. The basis for depreciation is based on the remaining value of the assets.

In case the company has managed to achieve savings in the costs, then the tariff will be reduced accordingly, thus passing the benefits over to the customers. In contrary, if the costs of the company have increased more than 5% of those other companies being in the similar situation, the company will be fined. The fine will be set by the Agency.

Currently, the heat is sold at as low a price as about 2.5 €/MJ (10.63€/Gcal), with recorded variations of +16% in 2006 and +9% last year. The heat tariffs are negotiated with the authorities. Only one variation per year is allowed. Application has to be submitted three months in advance to the Ministry of Energy and the Anti-monopoly Authority, based on PCHP’s cost estimates. There are up to 5 public meetings with technical experts, representatives of the city and the oblast, the

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[39] Western Europe = 19 European Members of the Organisation for Economic Co-operation and Development (OECD), *i.e.* Austria, Czech Republic, Belgium, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, Netherlands, Poland, Portugal, Slovak Republic, Spain, Sweden, United Kingdom; *plus* Switzerland, Norway, and Iceland.

[40] MVV Decon study 2010

associations of large consumers, the consumers protection authority. The whole process requires up to 2 months. Once the variation has been approved, it has to be published in local newspapers. /MWH report/

The energy prices in Kazakhstan are clearly below the world market level. However, the energy prices should be fully cost-reflective. Of course, world market prices do not always apply to energy – especially for products like heat energy sold through DH networks.

Competition

There is no competition, because natural gas, the potential alternative for heating, is available in some of the western regions only. The main parts of the country are solely dependent on fossil solid and liquid fuels.

Feed-in tariffs

There are no FIT in Kazakhstan.

Emission trading scheme

There is no national emission training.

Carbon tax

VAT on heat and electricity is 12% and there are no other taxes on a finished products except VAT.

Investment financing

The draft Energy Efficiency Law lacks measures to stimulate energy efficiency improvements, such as state subsidies and financial transfers, tax incentives, and preferential credits, are not provided – reportedly because they were removed because of lack of funds, upon the insistence of the Ministry of Finance[41].

No investment grants are available and finding investment on DH and CHP investments is a challenge. In Pavlodar company, however, both EBRD and IFC participate investment financing and shareholding.

11.3 **Customer**

Customer rights

Practically no disconnections from DH occur because of the lack of alternatives.

Service quality

Service quality is poor due to high heat and water losses of the DH systems and due to frequent supply breaks.

Billing

Lump sum tariffs are used in the absence of heat metering even though the tariff in terms of tenge/Gcal has been used.

[41] MVV Decon study 2010

11.4 **Ownership**

Municipality role

Predominantly the DH companies are municipal utilities appointed to operation and maintenance of the DH system, but the decisions on financing and investment planning, for instance are taken elsewhere in the municipal administration.

Private sector involvement

As an exception, the privately owned PavlodarEnergo is a business oriented company with all normal business unit functions.

Contract between AP Pavlodarenergo and AO "Pavlodarskie teplovie seti" (later "PTS" for delivery of thermal energy is concluded in accordance with procedure hiring of the goods (works, services) from one source, subject of the real monopoly AO PTS. PE secures earlier declared amount of hot water needed by AO PTS, on a monthly basis. A correction of the monthly amount is possible 15 days prior the beginning of the month. The amount of delivered thermal energy for the AO "PTS" is defined by calculation. Payment of thermal energy is done through an advance each ten days for the declared monthly amount. Tariff for the delivery of thermal energy is defined by the authorized body and could be changed after being confirmed by the authorized body and accepted by AO "PTS" not earlier than 30 days prior introduction of new tariff in force

Synergy allocations

CHP cost allocation is likely based on energy method, called physical method in Kazakhstan. The current regulatory documents provide for application of the so called physical method of fuel consumption allocation and calculation of relevant technical and economic performance indicators of electric and heat energy supplied to CHPs. According to the above mentioned method, electric energy generation in a CHP cycle is carried out without waste heat losses, with minimal specific fuel consumption for effective work, and significant savings, as compared to a condensation cycle. The whole fuel savings resulted from combined heat and electricity production at CHPs are given to electric energy. The significant part of other current costs (except for the cost of fuel) is allocated between electric and heat energy supplied, in proportion to the fuel consumption. [42]

In such away, DH has to cover costs that are higher than those of the heat-only-boiler operation.

11.5 **Planning**

Integrated resource planning

No IRP was identified.

Heat and urban planning

DH is the sole heating mode in urban areas in the eastern parts of the country, where no heat planning is needed. The situation in the western parts, where gas distribution networks exist, is unknown.

11.6 **Technical**

Technical standards and design conditions

The technical standards in Kazakhstan (GOSTs, SNiP, rules, etc.) are close to the ones of Russia, but DH refurbishment is able to use modern equipment and systems.

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[42] Mr. P. Kouri, DH expert of the World Bank in Moscow during 1995-2005.

Buildings *directly* connected to DH still exist in Kazakhstan – meaning systems where the same hot water circulates both in the boilers of the DH system and the in-house radiators connected to the system. This is one of the worst types of DH systems, since it creates corrosion of pipes and blocking of armatures due to poor quality of water. The water treatment capacity cannot meet the requirements of good quality, because the water consumption is huge, more than a third of circulation water is tapped by customers. Moreover, water to be tapped by customers shall not contain chemicals that normal DH circulation water could contain.

In *indirectly* connected systems, one of the main problems of DH nation-wide is the low efficiency of tube heat exchangers which connect DH networks to in-house central heating systems. Tube heat exchangers are frequently leaking and the tubes frequently blocked by poor quality of water. Therefore, the availability and efficiency remain low. Moreover, the tube heat exchangers require a lot of room space compared to the tiny plate heat exchangers.

While Kazakhstan's winters are usually bitterly cold in the northern parts of the country, DH systems, which prevail in all cities and major towns of the former Soviet Union, mostly rely on piping installed on the ground, crossing streets, rivers and railroads several meters above the ground. This practice, combined with leaking pipes and poor insulation, leads to astonishing heat losses of up to 40 %.

<u>Refurbishment strategies</u>

There was no national strategy for DH refurbishment identified but refurbishment is underway in Pavlodar, the largest privately owned DH/CHP company in Kazakhstan.

To understand the scale of refurbishment need, some figures have to be outlined. The heated area served by DH systems amounts to 195 million m^2 and heat production of year 2009 was 336 PJ. This equals to a very high specific heat production of 1.7 GJ/m^2 (479 kWh/m^2), which, if being on the correct range, emphasizes a large potential for energy savings in the entire DH system.

The working group of EBRD, MVV and CENEf (Russian) representatives have suggested two issues to the Energy Efficiency Law, namely:

- prohibition of overheat pipelines. All new pipelines should be installed underground and in the next ten years the existing overhead lines should be replaced buy underground ones; and,
- conversion of tube heat exchangers to plate heat exchangers.

Those two measures, however, do not address the main problems of EE in the DH systems, such as

- lack of temperature controllers in substations and apartments; and,
- lack of heat metering and consumption based billing.
- direct connections that should be converted to indirect ones by means of plate heat exchangers in priority.

11.7 Local Example – Pavlodarenergo

CHP-2 and CHP-3 located on the north side in the vicinity of Pavlodar are the main generating capacities of PE. The oldest of them, CHP-2, located closer to the town, is in operation since 1961 and the more distant CHP-3 started its operation in 1972. Declared installed electricity generating capacities are 110 MW for CHP-2 and 440 MW for CHP-3.

Both TPPs were developed to provide electrical energy, thermal energy for heating and steam at different parameters for technological purposes of the surrounding industrial plants (oil refinery, petrochemical plant etc.).

CHP-2 is:

- Electrical capacity: 110 MW
- Thermal capacity: 386,1 MJ/s (332 Gcal/h).

CHP-3

- Electrical power at turbine- generators: 440 MW
- Total thermal power: 1.565 MJ/s (1402 Gcal/h)
- of which from turbines 940 MJ/s (808 Gcal/h)

As far as the district heating system of Pavlodar is concerned, this is also property of PE and comprises about 380 km of piping network from which about 102 km are of large diameter (usually 1000 mm)[43].

11.8 Recommendations and good practises

Legal and regulatory framework

Issue	National Energy Policy
Problem	There is no clear policy to modernize DH and CHP systems in the drafted Energy Efficiency Law. Neither any specific Heat Law exists.
Recommendation	Based in international best practices, an action plan should be created for DH and CHP system refurbishment.
Good practise	Bulgaria (Chapter 6), Poland (Appendix 1)

Issue	Building regulations
Problem	There is no building code to set EE targets for new buildings and building retrofits.
Recommendation	Clear and ambitious but realistic targets (W/m^2, MJ/m^2, for instance) should be set to new buildings.
Good practise	See Chapter 6 (2)

Issue	Price regulation
Problem	Price regulation in DH is still cost plus, which does not provide EE incentives. The depreciation level is inadequate to collect funds for refurbishment investments. Fuel price level is very low as to motivate any EE measures in DH or in buildings.
Recommendation	Full cost covering heat tariff based on price cap principle should be adopted in order to provide correct and sufficient incentives to DH companies and customers.
Good practise	See Chapter 6 (3), Kosovo, Macedonia FYR

[43] PavlodarEnergo – Kazakhstan; Technical Due Diligence for EBRD , LDK Consultants Engineers and Planner SA, Oct. 2007.

Issue	Competition
Problem	n.a.
Recommendation	
Good practise	

Issue	Feed-in-tariffs for CHP or renewable
Problem	Low fossil fuel based energy prices do not support CHP or RES development.
Recommendation	FIT should be adopted in order to develop modern CHP and to introduce RES on the energy market.
Good practise	See Chapter 6 (5), Germany

Issue	Emission trading scheme
Problem	
Recommendation	Adoption of emission trading would maximize the benefits of EE investments under restricted financing available
Good practise	The European Union, See Chapter 6 (6)

Issue	Carbon tax
Problem	Low energy prices do not lead to EE and RES investments.
Recommendation	Carbon tax would collect funds for EE and RES investments, including DH and CHP.
Good practise	See Chapter 6 (7)

Issue	Investment financing
Problem	Low depreciation practice and underdeveloped banking sector do not provide financing for DH and CHP refurbishment
Recommendation	Carbon tax, FIT, emission trading and depreciation based on new replacement values instead of remaining asset values would provide substantial funds for refurbishment and improved EE.
Good practise	See Chapter 6 (8)

Customer issues

Issue	Customer definition and rights
Problem	Apartment owner is the DH customer, but sometimes the DH company is responsible to supply either until the group substation or the building basement. There is no contract between the DH company and the customer. Therefore, the rights and responsibilities of the parties remain uncertain.
Recommendation	A system of house-owner association on building level could be

	introduced to clarify the responsibility border of the company and the customer. The contracts should be created between the company and the customer to make the relation commercial and clear.
Good practise	See Chapter 6 (9), the European Union, USA, Canada

Issue	Service quality
Problem	There is no temperature control, which causes excess- and under-heating of apartments. Poor water quality causes corrosion and blocking in old DH system components, which are experienced by customers through frequent supply problems.
Recommendation	Systematic refurbishment of DH systems is the only way to address the service problems to reflect the good DH practices in the world.
Good practise	See Chapter 6 (10), The European Union, South Korea, USA and Canada

Issue	Billing
Problem	Lump sum billing neither offers EE incentives to the DH customer nor to DH company.
Recommendation	Consumption based billing would provide clear incentives to EE, both for the DH company and the customer.
Good practise	See Chapter 6 (11), The European Union, South Korea, USA and Canada

Ownership issues

Issue	Municipality role
Problem	Municipalities as owners are financially weak to support DH/CHP development
Recommendation	Private sector should be attracted to help in financing and overall management.
Good practise	See Chapter 6 (12), The European Union

Issue	Private sector involvement
Problem	There is little private involvement in the DH/CHP sector, except Pavlodarenergo.
Recommendation	More private companies should be welcome to modernize management practices in Kazakhstan. Long-term agreement between the companies, customers and municipalities are needed to attract private involvement in DH and CHP system development.
Good practise	Fortum and Bashkirenergo (Russia), Skopje (Macedonia), See Chapter 6 (13)

Issue	Synergy allocations
Problem	n.a.
Recommendation	
Good practise	

Planning

Issue	Integrated resource planning
Problem	Due to lack of proper legislation and policies, IRP is not used.
Recommendation	Appropriate IRP would reduce the use of physical resources to meet the heating and electricity needs of the society.
Good practise	The European Union, South Korea, See Chapter 6 (15)

Issue	Heat and urban planning
Problem	No major problems, since DH has acquired the urban centres and little if any competition exists on the heating market..
Recommendation	
Good practise	See Chapter 6 (16)

Technical

Issue	Technical standards and design conditions
Problem	A number of technical standards and norms are outdated in view of new, modern technologies.
Recommendation	Review the technical standards and compare them with those applied in EU
Good practise	New European standard for design outdoor temperatures and using modern practices

Issue	Refurbishing strategies
Problem	Rehabilitation and modernization programs have hardly started in Kazakhstan in secondary networks and building sector, where the highest potential for EE prevails.
Recommendation	Rehabilitation and modernization programs are badly needed in Kazakhstan. Tariff reforms and ownership clarifications should be fostered in order to phase out the main barriers. Properly developed heat plans should show whether the rehabilitation of exiting DH systems is viable. Based on this analysis, the government should provide soft loans or grants.
Good practise	Poland (Appendix 1), Sofia/Bulgaria (Chapter 6), Mytishi (Russia), Subotica (Serbia)

11.9 Sources of information

- Quest for Saving in Energy-hungry Environment - Kazakhstan, Removing barriers to energy efficiency in municipal heat and hot water supply (project ongoing till 2011), UNDP-GEF;
- Support The Government Developing Energy Efficiency Law in the republic of Kazakhstan, MVV Decon GmbH for EBRD, March 31, 2010;
- The Clean Technology Fund (CTF) Investment Plan, The Republic of Kazakhstan, February 25, 2010.

12Kosovo

12.1 Features and Extent of DHC/CHP

History:

There exist four DH Companies in Kosovo, i.e., in the Capital (Pristina), Gjakova, Mitrovica, and Zvečan.

The District Heating Company "Termokos" is by far the largest in the country. It was established in 1970 as a district heating company. In 1974 "Termokos" was incorporated into the Housing Enterprise of Pristina. In 1978 it separated from the Housing Enterprise and started operating as an independent heating distribution company, but under the supervision of the Municipality of Pristina.

Before November 2006, "Termokos" was under the supervision of UNMIK's Department of Public Services. Then, the Kosovo Trust Agency (KTA) was established within UNMIK's reserved authorizations. The Department for Supervision of Public Enterprises operated under its authority and "Termokos" was part of it. Beside other responsibilities, KTA supervised all "Termokos" activities, including procurement procedures on fuel supply and donations. Since 2006 it has been incorporated and operates as a public company in “D.H. Termokos j.s.c”. Since June 2008 it has been under the supervision of the Municipality.

The DH Company of Gjakova was established on 1981, which has been operating primarily under the umbrella of the building maintenance enterprise. In 1983 it was established as an independent company. Since then, its legal status was changed several times. Nowadays, the DH Company “District heating Company Gjakova” is under the supervision of the Municipality of Gjakova.

The Third DH Company is located in the City of Mitrovica (formerly Kosovska Mitrovica). The fourth and smallest DH Company is in Zvečan. Both cities are located in North Kosovo, a region with an ethnic Serb majority that functions largely autonomously from the remainder of the ethnic-Albanian-majority of Kosovo

Statistics from past three years

There are no special DH statistics available.

DHC and CHP market shares

District heating systems exist only in four cities. They provide currently for only about 5% of the heat demand in Kosovo. The table below shows the installed capacities and fraction of rehabilitated facilities of the three larger DH systems.

Table 12.1: Heat generation capacities in Kosovo.

Boiler rehabilitation rate		Pristina	Gjakova	Mitrovica
Rehabilitated or new	MW	58	20	28
Total	MW	134	38	37,3
Rehabilitation rate	%	43 %	53 %	75 %
Efficiency of heat production	%	85 %	86 %	94 %

The peak load for Pristina could be estimated to amount to 90-100 MW und for Gjakova it would be 15-16 MW. Mitrovica is a special case that will be discussed below. A comparison of these peak load number with the installed capacities in the table above shows considerable oversizing. The DH companies, however, state that they need some reserve to warm up the water early in the morning when the DH service starts. Prospective for connection new customers is another reason to keep large reserves. Finally, networks are not looped and in case of larger damage in transmission line, large reserve capacities are needed.

The table below shows the length of distribution networks. In Gjakova and Mitrovica, more than half of the network has already been replaced by pre-insulated pipes. In Pristina the rehabilitation rate amounts to almost 49%.

Table 12.2: Distribution networks (double pipe length) in Kosovo.

Network rehabilitation rate		**Pristina**	**Gjakova**	**Mitrovica**
Rehabilitated or new	Km	11,8	6,5	3,4
Total	Km	31,2	11,0	6,2
Rehabilitation rate	%	38 %	59 %	55 %

A large fraction of the substations have been modernized, too (see table below).

Table 12.3: Consumer substations in Kosovo.

Substation rehabilitation rate		**Pristina**	**Gjakova**	**Mitrovica**
with new heat exchangers	#	256	160	54
with heat metering and control		229	30	47
Total	#	291	220	54

None of the DH system is currently supplied by CHP. There is, however, a realistic option to reconstruct one of the two large power plants, i.e., Kosovo B, which is located about 10 km from the city centre of Pristina. In 2005 a detailed technical study was carried out aiming to convert the TPP Kosovo to a CHP plant. The study demonstrated the viability of such investment measure.

According to information published by the Regulatory Office in their Annual Report for 2008, TPP Kosovo B1 operated with a capacity of 290/265 and TPP Kosovo B2 with 280/260 MW. The larger figures relate to generator, the lower to plant exit. The numbers are the consequence of deteriorated performance of the low-pressure cylinder and problems with the last stages of the turbine blades. However, new LP turbine rotors have been ordered from the turbine deliverer, and the previous performances will be restored. In view of its capacity, reliability, and importance of TPP Kosovo B for energy stability of Kosovo, it is quite realistic to predict that TPP Kosovo will continue to operate for a longer period of time and later would experience regular lifetime extension procedure.

The mentioned study proposed that steam should be extracted from the main steam pipeline between medium pressure and low-pressure turbine cylinders. Currently, a new study is carried out to review and update the study and to optimize the steam extraction concept.

The realization of such a project requires besides the modification of the turbine the installation (i) a transmission pipeline, (ii) a heating station in Kosovo B and (iii) a heating station in Pristina. Besides that, a turbine has to be modified to extract steam for producing hot water. The German KfW and EU are ready to finance jointly the investments. The main benefits would be a lower heat price and reduced emissions in the city centre. So far, the DH Company uses heavy fuel oil with relatively high sulphur content.

Types of DHC consumption

The largest consumer group is residential consumers, followed by budgetary and commercial ones. Residential customers constitute about 62%, budgetary customers 34% and commercial customers 4%. The heat consumption dropped due to fuel supply problems which occurred in 2007 and 2008.

Table 12.4: Decomposition of heat consumption in Pristina 2006-2008

	Unit	2006	2007	2008
Heat consumption	MWh/yr	**112,836**	**87,667**	**66,602**
Residential customers	MWh/yr	71,183	54,543	41,002
Budgetary customers	MWh/yr	3,885	3,191	2,823
Commercial customers	MWh/yr	37,768	29933	22777

The decomposition in Gjakova is similar to that in Pristina. The case is completely different in Mitrovica, where all residential and commercial customers are disconnected. The reason was, that electricity consumption was not charged in the last years and these consumer groups switched to electric heating. The Serbian Electricity Company, however, started to charge electricity consumers again in December 2009. This could motivate customers to reconnect.

Selected technologies with customer connections

Heat generation used to be based on heavy fuel oil with high sulphur content. Boilers have been equipped with economizers. The piping system used to be composed of conventional steel pipes in concrete channels. Heat was supplied to the building usually by building substations through shell and tube heat exchangers and without any temperature control. .The indoor heating system was usually a two-pipe system designed for a temperature differential of 90/70^{o}C.

Installation of heat meters in boiler houses, pre-insulated pipes and modernization and automation of substations started only a few years ago was mostly done under projects (co-) financed by international or foreign donors.

Heat metering rate

In the respective cities, a part of customers is with heat meters as is presented for the heating season 2008/09 in the table below.

Table 12.5: Heat metering rate of consumer substations 2008 in Kosovo.

Heat metering	Pristina	Gjakova	Mitrovica	Zvecan
Residential customers	92 %	15 %	82 %	
Public & commercial	62 %	15 %	100 %	

Some 50 substations in Pristina still missed the metering in 2009. In Gjakova, all large substations are with heat meters already. In Mitrovica, heat meters exist in most substations.

The requirement to install meters and using them for billing is stipulated in the licenses. However, given the tough financial situation of the companies, so far ERO has not yet issued a deadline for the installation of the meters. Nevertheless, the need for this installation was communicated to the regulated companies in several meetings and occasions. There is also a provision in the Law on District Heating that obliges the companies to install meters. Article 32 of the Law on District Heating obliges the distributor to install meters on all customers connected to the district heating system within one year from the approval of the law.

Market expanding/shrinking

In Pristina and Gjakova there exists a big need for DH connections due to intensive building constructions. In Pristina, about 400.000 m^2 were already built or were under construction in 2009, which request DH connections. The situation in Gjakova is similar. For the time being, the competitor of DH is the electricity the tariffs of which increased significantly in the last years, and natural gas is not available in Kosovo. There is an old gas pipeline project to connect Kosovo to Macedonia, which could be revitalized, but for the next years, DH is practically the only supplier of heating.

The rules issued by the Regulatory Office (ERO) address in detail connection charges. New connection can be charged with an appropriate proportion of the costs, Cost contributions for reinforcement of the existing network can only be levied if the new load requirements exceed 3% of the existing effective capacity at the relevant points of the network

Disconnections are not a problem in Pristina. So far only a few customers have disconnected. In Gjakova, disconnections amount to 26.3% of the total customer stock connected to the district heating system.

In Mitrovica, all residential customers have disconnected, only 15 of 54 substations are in use. The pipeline to the south part of Mitrovica is not in use at all, not even to the nearby buildings on the street. Of those 15 that operate 9 supply commercial customers and 6 supply public customers.

There was no information available for Zvecan.

Local DHC association:

There is no DH Association in Kosovo.

12.2 Legal and Regulatory Framework

National Policy

The Energy Strategy emphasizes the significance of DH:

> The Strategy continues to support the district heating systems as an important way of diversification of the energy sources for heating purposes.

The strategy lists a number of institutional measures to be implemented in short term

- To prepare / finalize a District Heating Law (already done)
- To establish a heat price regulatory function for the heating sector (already realized)
- To establish legal basis for ownership and operation of heat exchanger substations and pump stations in buildings (i.e. secondary systems);
- To provide the legal basis for old debts collection and enforcement of regular bills payment.

Overall objectives for the period 2003 – 2008 were:

- to increase technical efficiency and reliability of operation of existing district heating plants (Pristina, Gjakova and Mitrovica) and of distribution networks (started);
- rigorously improve the bills payment rate at all DH companies (hard to realize DH Companies are complaining that courts are too slow);
- to gradually introduce meter-based billing systems (not yet realized);
- to increase the number of users connected to the district heating networks wherever possible ((number was slowly increasing).

2009 and beyond

- to promote combined heat and power production both at a centralized as well as decentralized levels all over Kosovo, wherever economically justified (a feasibility study is currently being updated)
- to support research and development of non-conventional means of district heat production (e.g. municipal wastes etc.).

The strategy gave also concrete instructions such as for Pristina

- All new consumers shall install thermostatic radiator valves and heat allocators when connecting;
- 30% of the connected apartment buildings shall install a central hot tap water system heated by district heating. This instruction would help to improve the viability of future CHP supply by Kosovo B.

<u>Legislation</u>

Three important laws affect the DH sector:

- Law on Energy from April 2004, which provides – amongst others - the legal basis for regulating DH tariffs
- Law on Public Enterprises from June 2008
- Law on Central Heating, whereby central heating means district heating, from November 2008.

1) The Energy Law:

This Energy Law defines the basic principles for an energy strategy and energy programs, rules for ensuring the efficient use of energy and the use of renewable energy sources; the rules for establishing an energy market; and other measures necessary to ensure the proper functioning of activities in the energy sector.

2) Law on Public Enterprises

Based on this law the ownership of the DH Companies of Pristina and Gjakova was transferred to the local municipalities in 2009. It also provided a reasonable framework for the commercialization of the DH Companies. The Municipality as the owner is in charge of supervising the company, while ERO approves the tariffs. By separating both functions, the problems that occur in many CEE Countries could be eliminated or at least significantly reduced. If the ownership and tariff setting functions are in one hand, tariffs are typically affected by political deliberations rather than by economic and financial criteria. Moreover, by transferring the control functions to a supervisory board (board of directors), the direct link to the city assembly and council are cut off. The board will consists of 5 members with a term of three years, from which at least two have to be proliferate in accountancy. Each member has to have at least 5 years experience in business management, corporate finance, treasury management, banking, business or industry consultancy, or any other related experience. Members have to be independent and the law defines a number of cases that could constitute a conflict of interest.

Four of the five directors shall be elected at a shareholders meeting and each shall have a term of three years. A "Municipal Shareholder Committee" shall represent the municipality at such meeting and such committee shall exercise the municipality's voting. The other director shall be the POE's CEO, who shall be selected by the POE's board of directors. The Municipal Shareholders Committee shall ensure that at least two elected directors are proficient in, or at least have an adequate knowledge of, accountancy. No person may be nominated or elected to a director position unless he meets the eligibility, independence and professional suitability criteria.

The Board of Directors of a POE shall exercise continuous and rigorous oversight in particular over the conduct of the POE's officers. If the performance of the POE deviates from the targets set in the business plan for the relevant financial year, the Board of Directors shall request a report by the CEO setting out the reasons explaining the underperformance, and shall take any appropriate immediate action. In any event, if the POE fails to meet its performance targets over two consecutive financial years, the Board of Directors shall have an obligation to consider removing and replacing the CEO.

3) Law on Central Heating

The Law aims at setting conditions for the development of a sustainable and competitive heat market, for a safe, reliable, and efficient heat supply, and to ensure a certain quality of heat supply services, and billing and collecting (including disconnections). Moreover, it opens the heat market for independent heat producers and sets some basic rules for the use of waste heat and renewable energies.

The law requires unbundling the various activities:

> "Vertically integrated enterprises shall perform generation, distribution, and supply activities in a functionally separate manner. Transfers of information between such separate activities shall be prohibited to the extent that is required to perform the tasks of the public supply"

This section will help to prevent unfair conditions for independent suppliers. TERMOKOS and DH Company Gjakova have recently started to implement this requirement.

The Law is an umbrella law for the DH sector, which needs to be supplemented by a corresponding secondary legislation. This refers, but is not necessarily limited, to:

- Penalties for illegal connections (Art. 24.3)
- Supply contracts (Art. 22.1 "Heat enterprises may conclude commercial contracts with its customer for installation, service, maintenance, and extension of the secondary network downstream to the delivery point

In accordance with the Law, DH Companies will have an important task to develop the technical codes.

- Elaboration and approval of codes
- Procedures and rules for metering
- Point of delivery
- Technical codes

Energy Regulator

The Energy Regulatory Office was established upon the promulgation by the Kosovo Assembly of the Energy Laws on June 30th, 2004. It requested the establishment of the independent energy regulator to set the regulatory framework for a transparent and non discriminatory energy market based on free market principles and promote competition

ERO regulates the Electricity, District Heating and Natural Gas sectors. To meet its responsibilities, ERO has the power to:

- grant, modify, suspend, transfer and withdraw licenses;
- supervise and control compliance with licenses;
- fix and approve tariffs and tariff methodologies for regulated energy services;
- grant permits for the construction and operation of new generation capacities and gas pipeline systems including direct pipelines and direct electricity lines;
- monitor the unbundling of the legal form, organization, decision making and accounts of energy enterprises;
- prescribe the general conditions for energy supply and the standards of service to be met by the licensees;
- resolve disputes among customers and energy enterprises, system operators and energy enterprises, and between two energy enterprises;

- issue general acts, individual acts, and secondary legislation in accordance with the Law on Energy Regulator;
- revise, approve and control compliance with all codes, including the grid and distribution code, the consumer protection code , the electrical equipment code, electricity standards code, the trade code and the metering code;
- revise, approve and control compliance with all technical rules including the trade rules and rules of access;
- enforce the provision of the Law on Energy Regulator and impose fines for violations;
- perform other duties assigned by the primary energy laws.

Building regulation

Construction activity is intensive. However, buildings are constructed with little or no consideration for their energy efficiency performance. Most buildings have been constructed according to that the building code that is a carry-over from the Yugoslavia (with update in 1989).

With buildings accounting for 33% of the final energy consumption, the building sector is key in addressing the challenges of reducing energy consumption and cut down of the CO2 emissions. Increasing energy efficiency of buildings is in the focus of the local EC Liaison Office. Moreover, the Energy Strategy also emphasized the need for improving the energy efficiency of buildings.

Price regulation

In general, fuel prices are cost covering, which is basically ensured by ERO that regulates electricity and DH tariff. Fuel oil is purchased at market prices from abroad. However, ERO determines DH tariffs based on residual costs, i.e., costs that remain after deducting fuel subsidies paid by the Government. This means in case of heat, that the bulk of fuel costs is not included in the tariff, as this part has been already paid by the Government. This means, ERO determines full cost covering tariffs, but only based on those costs that have been reported in the books of the DH companies. These policies do not apply to the Northern, Serbian part of Kosovo.

From the very beginning, ERO applied a cost plus pricing method, which will be described below. It is, however, foreseen to apply in a couple of years (likely in two or three years) an incentive regulation, which would likely by price cap regulation. Till now, ERO approves tariffs comprising production, distribution and supply, but in future different prices will be determined for each licensed activity.

Tariffs are calculated based on the “Allowed revenues”. Allowed revenues represent the annual cost of the company and consist of i) “justifiable” operational costs, ii) annual depreciation, iii) allowed return on Regulatory Asset Base, (iv) the reconciliation value.

$$R = OC + D + (RoR \times CRAB) +/- VoR$$

Where:

R Total Allowed Revenues

OC Total Operational Cost

D Depreciation for the respective year

RoR Allowed Rate of Return (%) on Closing Regulatory Asset Base

CRAB Closing Regulatory Asset Base

(RoR x CRAB) Allowed Return or Allowed profit (value)

VoR Value of Reconciliation

The DH Company prepares a projection for the coming heating season, which covers basically all operational cost items shown by the income statement. However, bad debts are not allowed to be included.

In addition, allowed operational costs shall not include:

- subsidies,
- costs rejected by tax authorities[44],
- costs of setting aside and releasing reserves,
- lease payments for the value of items which are not kept in the bookkeeping record,
- financial and other extraordinary costs.

The allowed operational costs comprise the fixed part and the variable part according to the formula:

$$OC = OCF + OCV$$

where:

OCF	Fix part of Operational Costs
OCV	Variable part of Operational Costs

The allowed Rate of Return refers to the Regulatory Asset Base (RAB) minus accumulated depreciation. The result in an allowed profit for the district heating enterprise is considered to be a fixed component. The formula is:

$$\text{Allowed Profit} = RoR \times [RAB - \text{Depreciation}]$$

The Value of Reconciliation aims to recover in the allowed revenues of the following tariff review any under-compensation or over-compensation of the allowed revenues of the preceding tariff review. ERO calculates the reconciliation value based on an assessment of actual data and planned data, which is the by ERO accepted differences between the actual and planned Allowed Revenues of DHC TERMOKOS for the heating season. €721,780 was deducted from the Allowed Revenues for the district heating season 2007/08. However, ERO had also to deduct the amount regarding the reconciliation of DH season 2004/05, which was spread over five years and is one fifth of €1,407,867 or €281,573 without interest. ERO also charged the annual interest of 3.9%, which was the equivalent of interest earned on a one year deposit account in Kosovo, by which the amount to be deducted regarding the reconciliation 2004-2005 will be: €281,573 * 1.039= €292,554. This is then the third one fifth of the reconciliation 2004 -2005 including interest, that will be deducted from the allowed revenues for the district heating season 2006 - 2007 for DHC TERMOKOS. According to legislation, tariffs have to be determined for each licensed activity, i.e., production, distribution, and supply. However, ERO still approves tariffs comprising all activities as data are still not sufficiently reliable to allow a reasonable cost separation.

ERO approves only two-part tariffs based on measured consumption. The tariff consists of a capacity charge (per kW) and an energy charge (per kWh). For customers whose consumption is not yet metered, the energy charge is estimated according to some standard consumption numbers and levied by heated area and the capacity charge according to heated area. Obviously, the tariff for non-metered customers is a typical lump-sum tariff at the moment.

The tariff system does not provide any direct incentive for new investment, such as accelerated depreciation. The rate for the return on capital may however provide some incentives for investors, particularly when eventually tariffs for the various activities (production, distribution, supply) will be determined.

There are no special tariffs for privileged customers or low-income households. Social considerations are not relevant for the consideration of DH Companies.

Low collection rates are a serious problem for the sustainable development of the DH sector. In 2006, the Energy Regulatory Office (ERO) issued the "Rule on Disconnection and Reconnection of Customers in Energy Sector in Kosovo", which is valid for electricity and DH. It deals both with disconnections initiated by the company, for example, due to non-payment, as well as

[44] These are costs that are determined case by case

disconnections by request of the customers. The Rule has also determined maximum fees for disconnections. DH Companies are allowed to disconnect non-paying customers. Even multi-apartment buildings can be disconnected, if a larger part of the customers does not pay the bills.

Non-payment is alleged to be caused mostly by affordability problems. However, there is a large fraction amongst the non-payers who are just unwilling to pay. It has been estimated that half of the non-payers could easily pay their bills and that real affordability problems exist only for the other half.

ERO is also in charge of developing a methodology for determining heat and electricity prices from CHP, but for the time being such methodology has not been issued.

Carbon taxes

There are no special environmental or emission taxes applied.

A uniform VAT is applied for all goods and services with some exemption that do not affect the energy sector. According to Regulation No.2005/10 Amending Unmik Regulation No. 2000/2 on Excise Taxes in Kosovo, excise taxes have to be paid for gas oil, mazut, diesel for motor engines, kerosene, heating oil all with 27.5 cents per litre. The excise tax on mazut has been removed last year. A carbon tax is not applied

Fuel subsidies have been provided by the Central Government. The subsidies covered a substantial part of the fuel costs. Fuel subsidies have also been provided for 2009 and, according to TERMOKOS, have been promised for 2010.

Table 12.6: Fuel subsidies (€/yr) in Kosovo.

	Pristina (Termokos)		**Gjakova**	
	2007	**2008**	**2007**	**2008**
Fuel subsidies	2,636,220	1,914,402	189,692	335,589
Total expenditures	7,597,525	5,845,567	1,354,143	1,164,327
Fuel costs	3,331,661	2,735,508	574,222	475,251
Subsidies per fuel costs	70%	70%	33%	70%

Competition

The high consumption of electricity is a big burden for the national power system. The use of electricity for heating accounts for 64.2% of supplied energy and the ratio between the monthly energy consumption in December and in July is 2.4 for the same reasons[45].The Energy Strategy recommended to reduce electric heating, the Government intended to promote the use of heating oil by lower taxation. Another means is the promotion of renewable energy, such as biomass and solar energy (low temperature heating systems)

The main market driver is the construction of new buildings that need DH, as viable alternative options are lacking. Another important market driver is the Government that promotes switching from electric heating to some other option.

The most serious barrier is the low collection rates, which prevent actual full cost coverage. Lacking consumption-based billing, lacking possibilities for disconnecting individual customers, over-burdened courts aggravate the problem.

[45] Energy Strategy and Policy of Kosovo, The White Paper, 2003

Feed-tariffs

For the time being, feed-in tariffs for renewable energy systems and CHP have not been determined.

Emission trading

Kosovo has not yet signed the Kyoto Protocol.

12.3 Customers

Customer protection/motivation

The "Rules on General Conditions of Energy Supply" issued by ERO on June 2006 deal with the supply condition for energy in general and DH in special. According to these rules, the supplier shall "establish department responsible for protecting and providing information, support, and advice to the customers (including customer service, bill enquiries, etc).

The license obliges the DH Company to prepare provisions on dispute resolution and appeal procedures. It also requires assuring that the license holder informs all customers of the procedures for making a claim for damages and establishes adequate appeal procedures to address such claims;

To meet these requirements, TERMOKOS has established a "Supply Department. It is, amongst other tasks, in charge of customer service and coordination with ERO

Service quality

The Energy Regulatory Office has the power to prescribe the general conditions of energy supply and the standards of services to be met by the licensee. Moreover, ERO has the legal mandate to protect energy customers and, therefore, ERO has established the "Rule on Dispute Settlement Procedures" for resolving disputes in energy sector, including complaints by customers against licensees concerning the services provided

In the Rules on Dispute Resolution Procedures is set that the licensee needs to respond to any customer complaints as soon as possible but not exceeding 75 days. Power and liabilities of customers will also be settled in detail in the Supply Contract.

An important issue for disputes is the point of delivery. The General Conditions issued by ERO determine also the contract partner in case of DH services.

> "In district heating, the customer – contracting party is considered the owner or authorized user of facility equipped with the substation and secondary internal heat network.
>
> In case of multi-flat buildings consisting of several (numerous) individually owned apartments, which are the end-users of the heat, the customer – contracting party to the supplier – shall be considered any legal entity performing duties of the housing administration (e.g. administrator, housing association etc.) that will be established in the future.
>
> Until the establishment of housing administration in multi flat buildings, each owner of the apartment shall be considered as the customer – contacting party to the supplier."

TERMOKOS applies a supply contract, which specifies in detail powers and liabilities of the supplier (TERMOKOS) and final consumers. It also addresses service quality, but does not offer compensation in case of service interruptions. The supply contract is, however, only applied for customers that are charged according to meter readings. There are no written contracts for non-metered consumption.

Once consumption-based billing will be comprehensively applied, TERMOKOS will conclude contracts with all individual customers, as long as the corresponding legal representatives have not been established. TERMOKOS intends to implement consumption-based billing in 2011.

12.4 **Ownership**

Municipal role

According to the Law on Public Companies (2008), the DH Companies of Pristina and Gjakova have been established as joint stock companies under municipal ownership. The shareholders rights are exercised through a municipal committee and the Companies are supervised by the board of directors, which is elected by the municipal shareholder. Due to the Law on Public Companies, DH Companies are nowadays acting as normal commercial companies, which are under municipal control, but to a reasonable extent independent from direct and daily interventions of local politicians.

The situation is different for the DH Companies of Mitrovica and Zvečan.. Both are located in North Kosovo, which is dominated by ethic Serbs and is practically autonomous and governed according to Serbia Law. The DH business is part of the local administration and incorporated in a public enterprise that is in charge of various utilities. Under Serbian Law, DH assets are owned by the state and Municipalities are responsible for organizing DH operation.

The Law on Public Companies defines the powers and liabilities of shareholders on the one hand and management on the other hand. The Law is not applied in Mitrovica and Zvečan, which are practically governed by Serbian Law

The DH Companies of Pristina and Gjakova have been established as joint stock companies with 100% municipal ownership. The license stipulates the liabilities for operation and management. The companies in Mitrovica and Zvečan are owner-operated municipal enterprises, where the operation of DH ha been delegated to a public enterprise.

Private sector involvement

For the time being, there is no private engagement in the DH sector.

The Governmental Policy as laid down in the Energy Strategy is promoting the expansion of DH and construction of CHP plants. While DH expansion will need grant and loan financing, CHP plants will likely be financed to a larger extent by private investors.

The investment climate seems to be quite good. In 2009, the Government decided to introduce a tax-flat rate. The corporate tax was reduced from 20% to 10% and the income tax is now in the range from 0% to 10%. At the same time, VAT was increased from 15% to 16%. The Government expects a significant improvement of the investment climate.

Third party access could become an opportunity for private investors. It is one of the objectives of the energy law to: “provide the conditions for developing a modern energy market and to ensure competition in that energy market under the general principles of non-discrimination, transparency, equality and respect for consumer protection.”

Third party access is regulated both for electricity and DH in the same way.

According to the Law on Electricity, TSO and DNO will enable network access to all generators, suppliers and eligible customers. Network prices are proposed by transmission and distribution system operators annually and are approved by ERO. Access can be refused if there is insufficient capacity and risks supply assurance, all this based on applied rules

Regarding DH, the Law on District heating stipulates that the distributor shall allow the producers, suppliers and eligible customers’ access to the heat system on the basis of Energy Regulatory Office relevant rules and regulations. The distributor shall once a year prepare prices and tariffs for the use of the networks based on the average prices for the preceding twelve (12) months period. The price and tariff list shall be approved by the Energy Regulatory Office.

The distributor may refuse access to the heat system where it lacks the necessary distribution capacity.

12.5 Planning

Integrated resource planning

Basic elements of integrated resource planning can be found in urban development plans, which constitute the basis for expansion of the DH networks.

Heat planning and urban planning

Heat planning is incorporated in urban planning. Urban development plans show the locations, where new buildings will be built and allow estimating the future heat demand. In this way, urban development plans guide the investment decisions for expansion of DH system, but experience proved that the plans have often been too optimistic and real heat demand development is lagging behind the plans.

12.6 Technical

National technical standards and design conditions

The standards for DH design are outdated and need to be revised to take into account the effects and possibilities of new technologies. Amongst others, design outside temperatures should be adjusted, which would reduce investment costs and abundant capacities.

Refurbishing and developing strategies

The existing DH companies in Kosovo have already started to rehabilitate the system in compliance with the state of art developed by EU countries. The planned investment programs will continue to realize the strategy.

There are only a few DH systems in Kosovo. The DH system of Pristina is by far the biggest, but even in Pristina only a small percentage of buildings are supplied by DH. The envisaged conversion of the power plant Kosovo B to CHP offers a great opportunity to reduce heating costs, reduce harmful emissions and to expand DH to replace electric heating.

Electric heating is common in Kosovo, both in the capital and in the countryside. Electric heating is a big burden to the national electricity industry, but conversion to other heating systems is costly because buildings are typically not equipped with centralized indoor heating facilities, which would easily allow the connection to DH. A comprehensive reconstruction of the buildings is likely only possible with financial support from the government.

While Pristina and some neighbouring communities can be supplied by the future CHP plant Kosovo B, other communities could be supplied heating system fuels with renewable energy. Biomass is abundant in Kosovo and would allow operating a number of biomass boilers with or without CHP.

12.7 Local Example

There are no special success stories to report that would go beyond the normal and so far successful rehabilitation and modernization programs.

The real success story is actually the legal and institutional framework that has been established for DH and which differs from the other CEECs. The Law on Public Companies established the foundation for the commercialization of the DH sector. The Regulatory Energy treats electricity and DH in the same, non-discriminatory way and tariff calculation based on full cost-coverage and transparent.

12.8 -Recommendations and good practices

Legal and regulatory framework

Issue	National Energy Policy
Problem	The implementation of the Energy Strategy is lagging behind the

	action plan. This refers, e.g., to the envisaged installation of CHP plants, heat cost allocators and domestic warm water
Recommendation	DHC, CHP, EE and RE are prioritized in the national policy. Financial support for rehabilitation and modernization came mostly from abroad. Additional financial means are required to continue the refurbishment of the DH systems and to improve energy efficiency in buildings.
Good practice	Chapter 6(1) , Poland (Appendix).

Issue	Building regulations
Problem	Low, outdated standards results in low energy efficiency of buildings
Recommendation	Review and update building codes and establish a financial support program
Good practise	See chapter 6 (2)

Issue	Price regulation
Problem	Collection rates are still low and the regulatory entity does usually not accept bad debts as justified costs, which caused big financial problems to the DH Companies
Recommendation	1) Tariff should to a certain extent accept bad debts as a cost. 2) In the medium term, a price cap regulation could motivate to improve the efficiency and performance of the DH companies
Good practise	See chapter 6(3)

Issue	Competition
Problem	The biggest competitor to DH is electricity, which is heavily subsidized for private households. Replacing electricity by other heating sources is difficult due to the lacking adequate indoor heating systems. Mazut is currently the main fuel for centralized heating. Natural gas is not available and coal is used in larger power plants.
Recommendation	Conversion from electric heating to DH should be subsidized in compliance with the corresponding savings in power capacity
Good practise	See chapter 6 (4)

Issue	Feed-in-tariffs for CHP or renewables
Problem	Despite legal requirement, special regulations do not yet exist.
Recommendation	Establish a clear and transparent regulation for feed-in tariffs.
Good practise	See chapter 6 (5), Germany

Issue	Emission trading scheme
Problem	Kosovo has not signed the Kyoto Protocol

Recommendation	The new CHP plant should benefit participated already in emission trading
Good practise	The European Union, see chapter 6 (6)

Issue	Carbon tax
Problem	A carbon tax does not exist
Recommendation	A carbon tax would increase electricity prices. Other fuels than coal are currently not viable (Mazut) or not available (natural gas). A carbon tax would only make sense when electricity tariffs will be cost covering.
Good practise	See chapter 6(7)

Issue	Investment grants
Problem	Rehabilitation of existing DH system will be supported by soft loans (KfW). Municipalities as the owners of DH systems do not have the financial capabilities for the time being.
Recommendation	Rehabilitation investment program will likely soon start for existing DH systems. Grant money combined with soft loans could allow constructing new DH systems
Good practise	See chapter 6(8)

Customer issues

Issue	Customer definition and rights
Problem	Currently not
Recommendation	
Good practise	See chapter 6 (9), The European Union

Issue	Service quality
Problem	TERMOKOS applies a supply contract, which specifies in detail powers and liabilities of the supplier, but does not offer any compensation. In the past, DH Company have been forced by the municipalities not to issue bills for customers for periods when heating was not available., which caused additional losses as fixed costs could not be recovered.
Recommendation	Lacking rehabilitation and modernization investments are the main reasons for low service quality and reliability of heating services. Such investments are indispensable for improving the service quality. Guaranteeing service quality and providing compensations is extremely difficult in transition countries. Clear rules for (monetary) compensations should be determined.
Good practise	See chapter 6 (10), The European Union, USAm, Canada

Issue	Billing
Problem	b. While legislation and regulation require consumption-based billing based on metering, implementation is lagging behind. Both, DH Companies and Municipalities seem to be afraid of converting into a new tariff system. c. Low collection rates. DH Companies are complaining about the insufficient support of courts when suing non-paying customers
Recommendation	1) The envisaged investments for rehabilitation of the DH systems will create a reasonable technical basis for implementing the new tariff system. 2) Accelerated legal proceedings for non-paying customers
Good practise	See chapter 6 (11), The European Union, South Korea, USA, and Canada

<u>Ownership issues</u>

Issue	Municipality role
Problem	Recently, ownership was transferred from the Central Government to Municipalities. However, roles, powers, and liabilities of the municipalities are clearly defined by the corresponding legislation.
Recommendation	Ensure the proper application of the corresponding legislation to prevent that DH Companies become the game ball of local policies.
Good practise	See chapter 6 (12), The European Union

Issue	Private sector involvement
Problem	So far, interest of private investors is minimal.
Recommendation	DH Systems outside Skopje should be rehabilitated supported by some grant money. In a parallel or after rehabilitation, DH Companies could be (partially) privatized.
Good practise	Fortum and Bashkirenergo (Russia), Skopje (Macedonia), see chapter 6 (13)

Issue	Synergy allocations
Problem	Not applicable, as neither a corresponding regulation nor a CHP plant exists in Kosovo
Recommendation	Regulations for pricing and/0r cost allocation for CHP should be developed
Good practise	See chapter 6 (14)

<u>Planning</u>

Issue	Integrated resource planning

Definition	
Problem	Integrated planning is in principle applied by the Energy Strategy, but has not been copied to the towns.
Recommendation	Urban plan should use IRP to optimize the mix of the various energy carriers. Based on this, heat plans should be developed.
Good practise	The European Union, South Korea, see chapter 6 (15)

Issue	Heat and urban planning
Problem	Heat planning used to be common in former Yugoslavia, but has lost its role. Heat planning based on Urban planning and IRP, would allow to improve the development of local heating systems
Recommendation	To reduce electricity consumption for heating, municipalities should develop heat plans in compliance with the energy strategy. This will, however require technical assistance and financial support.
Good practise	See chapter 6 (16)

Technical

Issue	Technical standards and design conditions
Problem	A number of technical standards and norms are outdated in view of new, modern technologies.
Recommendation	Review the technical standards and compare them with those applied in EU
Good practise	New European Standard for design outdoor temperatures and using modern practices

Issue	Refurbishing strategies
Problem	
Recommendation	Implement the rehabilitation programs that have been developed under the projects for rehabilitating the existing DH systems
Good practise	Poland (Appendix), Sofia/Bulgaria (Chapter 6), Mytishi (Russia), Subotica (Serbia)

12.9 Information sources

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13Macedonia FYR

13.1 Features and extent of DHC/CHP

History

DH is focused on the Capital, the City of Skopje. The DH Company was established in 1965. The DH systems outside Kopje have been constructed in the last 20 years. The three DH Companies in the city supply about 80 % of the total DH supply. The table below gives an overview on the DH Companies in the country.

Table 13.1: Characteristics of the DH systems in Macedonia

Name	City	Found -ation	Installed capacity	Con- nected load	Heat delivery	Heat losses	Net- work length	Heated area	Specific heat load	Load density	Load duration hours
			MW	MW	MWh/yr	%	km	m²	kWh/m², yr	MW/ km	hrs/yr
Toploficija AD Skopje	Skopje	1965	487	575	617,336	12%	177.5	4,000,000	154	3.2	1,074
Skopje Sever AD	Skopje	2000	46	29	29,239	7%	8.5	220,416	133	3.4	1,008
AD ELEM Energetika	Skopje	1997	32	31	36419	7%	7	155,000	235	4.4	1,175
Toploficija Bitola DOOO	Bitola	1999	28.4	16.68	19,980	6%	9.5	125,000	160	1.8	1,198
PE Doming	Makedonska Kemenica	1990	12	6	6,890		5	23,250	296	1.2	1,148
Total	I		634	689			211.5	4,523,666	0	3.3	

Source: Capacity and production numbers: Annual report of ERC 2008 and 2007 (Bitola), and ASE,

Skopje has three DH Companies, i.e., Toploficija AD Skopje, AD ELEM ENERGETIKA, and the Toplifikacija Sever. The various distribution networks in Skopje are not interconnected. The companies are introduced as follows:

Toplifikacija AD Skopje: The largest DH Company “Toplifikacija AD Skopje” was established as the “Board for Central Heating for the City of Skopje” in 1965 based on a decision taken of the city assembly. In 1973, the board changed its legal status based on a Decision taken by the Assembly of Workers, and was named "Central Heating of the City of Skopje" ("Toplifikacija Skopje"). In accordance with a new legislation on public ownership, the company was later transformed to a shareholding company, whereby it changed from an enterprise with social ownership into an enterprise with mixed ownership, under the name Toplifikacija AD - Skopje c.o.

AD Skopje Sever: AD Skopje Sever (north) is another supplier of heat located in Skopje. It was founded in 2000 and started operation in 2001. The connected load amounts to 60-65 MW. The heating plant Sever uses mostly natural gas. The main shareholder of the Company is “Toplifikacija Skopje”.

AD ELEM Energetika (formerly Energy Department of ESM): In 1997, the Electricity Company of Macedonia (ESM) became owner of the energy department of the “Iron and Steel factory in Skopje” (RZS), which used to operate a number of steam boilers and turbines. JSC ELEM is a shareholding company, which is state-owned. The Company has a license for the generation of electricity. The state-owned joint stock company ELEM is one of the three electricity companies that emerged from the former Electricity Industry of Macedonia (“ESM”). The ESM was divided in 2005, in order to be partially privatized (the distribution sector). ELEM is the largest energy company in Macedonia. Employing 3,800 and producing more than 95% of the total domestic electric energy. ELEM controls two TPPs, “Bitola” and “Oslomej”. It has a total capacity of 800

MW and has five HPP's with a total installed capacity of 530 MW. In the most recent energy outlook for 2010, it is envisaged that ELEM's capacities should produce total energy amounting to more than 6,000 GWh.

Makedonska Kamenica –Doming: Makedonska Kamenica is a city in the north-east of the country, which is located within an important mining area, and has about 8.100 inhabitants. The district heating system started its operation in 1990. The Public Company Doming from Makedonska Kamenica used to be operates this district heating system. The company stopped operation in the late 90s due to financial problems, which have been caused by a high unemployment rate in the city.

Toplifikacija Bitola: Bitola is a city in the south-western part of the country and has a population of about 95.000 people. In order to meet the heat demand of the quickly growing city, Toplifikacija AD Skopje and Primatehna (company from Bitola) created a new shareholder company that was called "Toplifikacija Bitola", in October 1999. In 2008, the company discontinued the operation of DH.

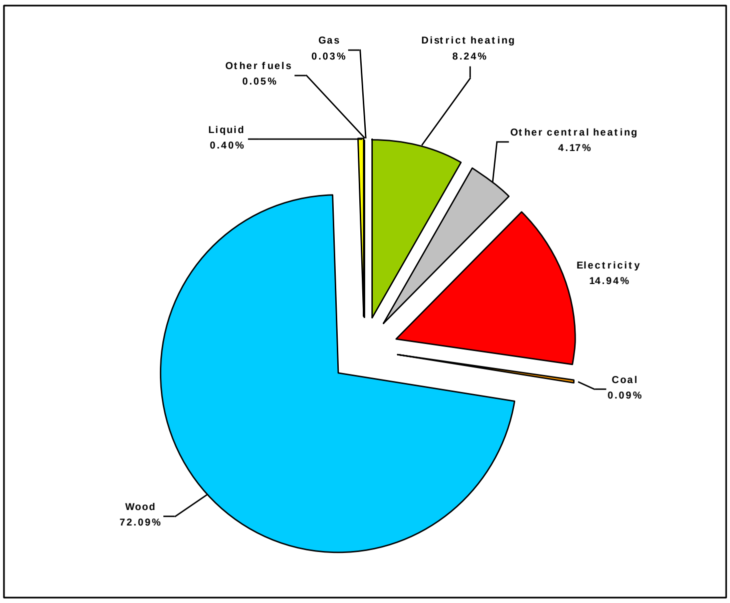
Statistics from past three years

There are no official DH statistics in Macedonia.

DHC and CHP market shares

The country's energy sector is based on coal. Coal consumption constitutes about 45% of the total primary energy consumption in 2007. Most of the coal is domestic lignite, which is mostly used for electricity production. Crude oil constitutes 33% and natural gas only 2.3%. Renewable energy (mostly biomass) constitutes 9%. In the residential sector, electricity is predominantly used for heating.

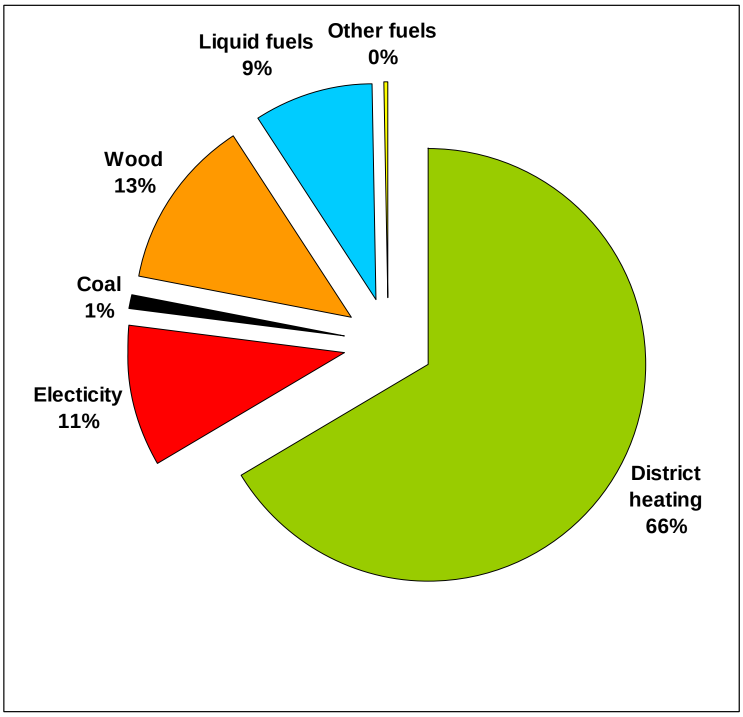
The following Figure shows the breakdown of heating systems according to the 2002 census. District heating supplies only about 8% of the households, while wood serves almost ¾ of the households. More than 14% of the households use electricity in individual heaters. Including central electric heating systems the share is more than 16%.



Source: Census 2002

Figure 13.1: Breakdown of heating systems in Macedonia.

The Figure below shows the breakdown of central heating systems. About 2/3 of the central heating systems are supplied by DH.



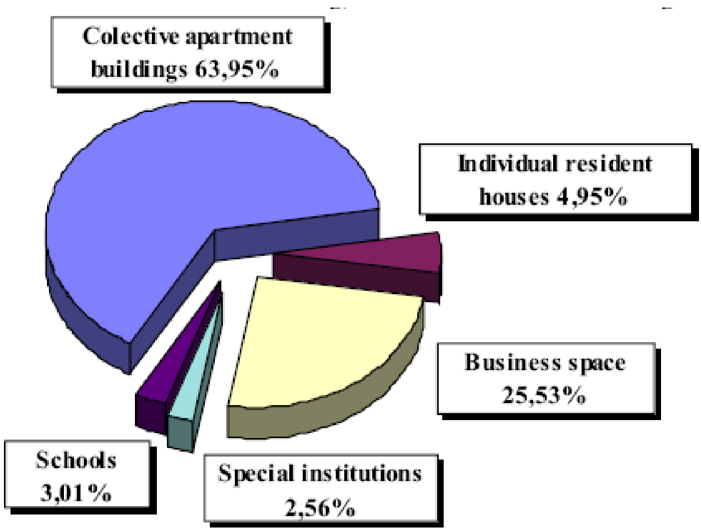
Source: Census 2002

Figure 13.2: Breakdown of central heating systems in Macedonia.

Toplifikacija AD has a share of almost 90% in the total DH supply and provides heat to more than 30% of the households in the city of Skopje. Annual heat production is around 685 GWh, predominantly for residential and commercial consumers.

Types of DHC consumption

District heating companies supply only steam and hot water for space heating, i.e., domestic hot water is not supplied. In Skopje, about 2/3 of the customers are collective buildings (approx. 2.600.000 m² or approx. 41 470 apartments), 5% are individual houses (approx. 140.000 m² or 1.690 apartments), 27% are consumers declared as business and commercial, 2% are users from the public sectors and institutions, and 3% are schools.



Source: Annual Report of Operation and Achieved Results in the Economic Activities of "Toplifikacija" AD – Skopje for the period I-XII 2004

Figure 13.3: Heat consumption by consumer groups in 2004 in Toplifikacija AD.

<u>Selected technologies with customer connections</u>

As the largest DH Company, Toplifikacija AD Skopje" has started a comprehensive rehabilitation in the last two decades and the biggest part of the other DH systems are relatively new, the DH Sector is, from a technical point of view, in a relatively good shape.

"Toplifikacija" AD Skopje: The district heating system of Skopje is a modern system with a high rate of automation of technological processes and a complete computerized monitoring of the heat production and supply. The installed heat generation capacity is 487 MW of hot water boilers and 26 MW of steam boilers, while the connected load amounts to approx. 550 MW. Distribution losses are estimated to be about 12 %. The district heating system of the City of Skopje is a hot water system with a temperature regime of 130/70 °C. About 85 % of the fuel is heavy fuel oil and 15 % is natural gas.

AD Sever: The company operates the first boiler house in the country, which has been built according to international environmental standards. The equipment is relatively new.

AD ELEM ENERGETIKA: The heat generation facilities comprise three steam boilers G-32 (25 MW each) using natural gas, and heavy fuel oil. The equipment is quite old. In particular, the steam generators and the heating distribution system within the premises of the former Energy Division of the Iron and Steel Factory in Skopje (RZS) are more than 30 years old. These boilers were designed to supply steam for two turbines with a capacity of 27 MW(el) that are installed in this energy plant. For the time being, these turbines are not functioning, but they might be activated in the future. The installed hot water capacity of the plant is 15 - 20 MW. Fuels that can be fired in the plant are natural gas, technical gas, gas from gasification factories and heavy fuel oil.

Makedonska Komenica –Doming: The district heating system of Makedonska Kamenica is a relatively new system, which used to be in a good shape. However, with the beginning of the transition period the maintenance of the system quickly deteriorated and finally in 1998 the operation of the whole system was terminated and since then it is out of operation. The plant was to be developed in three phases. In the first two phases the heat component part was supposed to be finished. The capacity was sufficient to supply some 80.000 m² respectively 20—25 MW. In the third phase, the components for electricity production (10-12 MW) were panned to be added. The main fuel of this plant used to be lignite. The plant used coal as main source but stopped working in 1998.

Toplifikacija Bitola: The 7 boiler plants that belong to the Municipality and have been given to Toplifikacija Bitola under a concession contract have a total installed capacity of approx. 26 MW (capable to provide heating services to 220.000 m² of residential and commercial area). Other local heating systems for one, two or more collective buildings have also been installed. The total installed capacity is 2-6 MW. Actually, it is not a district heating system, but these local systems have boiler plants, small distribution grid and indoor installation in the sector to be heated. The company stopped working in 2008.

CHP: For the time being (heating season 2009/2010), no DH system is supplied by a CHP plant, but a new CHP will start operation likely in the heating season 2009/2010. The existing Energetika-Skopje heat and power plant has been operated as an oil-fired heat and power plant with an electric capacity of 30 MW and a heat generation capacity of 100MW as well as process steam of 40 t/h. For the time being, the plant is not functioning.

Heat metering rate

In the service area of Toplifikacija Skopje, the total heat supply is now metered in the building substations. Actually, the measuring of the delivered heat has been implemented since the last 10 years. Toplifikacija Skopje operated 1609 substations and had installed 1789 heat meters in 2008.

Heat meters are now also installed in the other DH systems of Skopje. Since 1999, all commercial customers are metered and residential customers since three years. The Company wanted to implement consumption-based billing already in 2000, but was obliged to postpone it due to political and institutional problems.

Currently, a tender has been published for licenses for three service areas that are currently served by Toplifikacija Skopje. The Energy Regulatory Commission decided that the new heat supply companies should be obliged to install heat cost allocators or meters that measure heat consumption, a cost which will be passed on to the consumers themselves.

Toplifikacija Skopje offered to its customers the installation of thermostatic valves and heat cost allocators. The Price for one radiator is about € 50. So far the response is poor, as the costs are too high for most customers. However, the response was poor due to the relatively high costs of such measure.

Market expanding/shrinking

The Energy strategy forecasts only a very moderate increase of the heat consumption in the residential sector. In Skopje, about 90% of the consumers that are viable are already connected. In the other towns in Macedonia, construction of central heating systems is envisaged only in areas with high specific consumption, i.e. at least 25 MW/km². In the period until 2020 the consumption growth of DH is envisaged to amount to 7% in total or 0.5% annually up to 520 GWh (45 ktoe) in 2020.

According to the base scenario developed in the Energy Strategy, the heat consumption during the period 2006-2020 will be increased by 18% - from 1376 GWh (118 ktoe, 4954 TJ) in 2006 to 1628 GWh (140 ktoe, 5861 TJ) in 2020. According to the scenario with strengthened measures for energy efficiency, the total growth in the above mentioned period is 15% and in the 2020 and the total consumption of heat energy will be 1590 GWh (137 ktoe, 5724 TJ). A significant growth of the distributive consumption is not expected in the analyzed period. For the heating of the homes it is necessary to provide faster and more significant penetration of the natural gas in all cities in Macedonia.

New consumers have to pay a connection fee that is collected by the municipality as legal owner of the network. The municipally has to organize and finance the corresponding investments. The DH company has only to provide the necessary heat supply.

There are now fees for disconnections.

In the last few years the number of new connections was relatively low and the total additional connection load was increased by 10.4 MW serving about 58.500 m² in 2008. Almost half of the additional capacity came from commercial companies.

Non-payment is a frequent cause of disconnection. In case of a first non-payment Toplifikacija Skopje will send a warning to the customer and explain the consequences. After half a year, Toplifikacija will prepare a legal suit to the Court, and very fast (1-2 weeks) they receive permission for temporary disconnection of this non-paying customer from the heating network. The unpaid bills have to be covered in legal process in the court. In case of repeated non-payment, the Company shortens the period to 2-3 months.

In 2008, 315 customers were reconnected, while in total disconnected out of which 986 forcefully.

Of course , disconnections cause a technical problem in case of collective buildings and all radiators in the respective the apartment have to be disconnected, but nevertheless customers still benefit from DH due to the vertical pipes heating pipes passing through the apartment. If more then 50% of consumers must be disconnected, then Toplifikacija is going to disconnect the whole building.

In contrast to the existing older buildings, newer ones have to be equipped with horizontal piping allowing the installation of individual heat meters and shut-off valves.

Local DHC association

There is no DH Association in Macedonia, but within the Chamber of Commerce there exists a DH Group.

13.2 Legal and Regulatory Framework

National policy

According to the energy Strategy from 2010, CHP will play an important role for DH in the future. Two CHPs are under construction or already operating and a third one is planned:

- “Toplifikacija A.D.”, together with the Russian company “Sintez” invested EUR 137 million in a new CHP plant project The new plant will produce 350 GWh of thermal energy. This CHP, together with other smaller CHP plants starting operation in 2010, shall increase gas imports by 268% in comparison with 2009. The plant will have an electricity production capacity of 230 MW and heat production capacity of 160 MW. Its regular operation and trial operation will start in autumn 2010.
- By 2011 it is planned to construct and put into operation the combined heat and power facility of the Skopje Sever heating plant facility with installed electrical power of 40 MW and heating power of 30 MW. This facility will be able to produce 280 GWh of electricity and 60 GWh heat every year. Due to the financial crisis this project will likely be postponed.
- By 2013 it is planned to construct and put into operation another CHP plant in the Western part of the City of Skopje, with installed electrical power of 200 MW and 160 MW of heating power. This combined heat and power facility should cover the basic demand for heat energy of the central heating users connected to the heating plant “Zapad”. The Heating Plant “Zapad” will cover the highest demand of these users in a similar way done by the heating plant east, supplemented by CHP Skopje AD. This facility will be able to produce 1600 GWh of electricity and 200 GWh of heat.

Accordingly, within a few years, a heat capacity of 350 MW will be available, which amounts to almost 60% of the current connected load.

It is also envisaged to promote small combined heat and power plants for the production of electricity and heat using natural gas in towns that will be covered with gasification as well as combined heat and power plants on biomass to cover the demand for heat in certain companies and/or distribution consumption in areas where it is economically feasible. For each of the city areas it is necessary to perform individual technical and economic analysis for the feasibility of construction of central heating system.

There are also some options for new DH systems. A feasibility study carried out by a Greek Consultant identified two cities, i.e., Bitola and Kocani, as preferred candidates for district heating projects. In both cities investment needs amounting to some € 5 million were identified.

Legislation

The current Energy Law, which replaced the Law from 1995, came into force in 2006[46].

The objectives of the Energy Law are to ensure

- reliable, safe and good quality supply of energy and energy fuels to the consumers;
- creation of efficient, competitive and financially sustainable energy sector;
- efficient development of energy sector;
- stimulation of competition on the market, thus respecting the tenets of non-discrimination, publicity and transparency;
- energy efficiency improvement and utilization of renewable resources;
- independent competitive work of the Energy Regulatory Commission and
- protection of the environment from adverse impacts of energy sector activities.

Heat production, distribution, and supply to final consumers are activities of public interest and are therefore regulated in compliance with the energy law.

The "Energy activities of public interest" listed in Article 3 of Paragraph 1 includes now also the generation of electricity from renewable energy sources.

Article 10 defines that the Government of the Republic of Macedonia shall, upon proposal of the Ministry, adopt an Energy Strategy for a period of at least 20 years, which should, among other issues, address long-term objectives for energy activities, and ensure security of supply, set priorities for development, and also define incentives for investment in energy facilities utilizing renewable energy sources, as well as incentives regarding the enhancement of energy efficiency. Following the Strategy, the Government is to adopt a program for the realization of the Energy Strategy for a period of 5 years.

Paragraph II defines the Energy Policy, which shall be laid down in the Energy Development Strategy and the respective Implementation Strategy (Articles 9 to 12). Article 13 envisages a Local Energy Development Program for the City of Skopje and the Municipalities, which is to comply with the Energy Development Strategy. Article 15 sets out that the City of Skopje and the other Municipalities of the country are competent for the distribution of natural gas, the supply of tariff consumers with natural gas, the production and distribution of heat and geothermal energy.

Paragraph III defines the competencies of the Energy Regulatory Commission and the conditions for tariff setting.

Further, the law set out the provisions for licensing, the construction of new energy facilities, for the electricity, gas and oil and thermal energy markets.

Chapter IX deals with Energy Efficiency and Renewable Energy Sources. A strategy for the Improvement of energy efficiency and a strategy for the utilization for RES are to be developed. The Law does not set concrete targets. In the field of energy efficiency, it envisages, among other issues, standards and labeling of household appliances. In the area of RES, transitional support measures for the utilization of RES - including preferential tariffs for electricity producers - are mentioned as required contents of the RES strategy. [ERC, Energy Law]

The Energy Regulatory Commission of the Republic of Macedonia is a regulatory body which is fully independent from the interests of the energy industry and the Governmental bodies. The Energy Regulatory Commission was established in 2002 with the Law on Energy and it is composed of five Commissioners elected by the Parliament of the Republic of Macedonia. The main competences of the Energy Regulatory Commission are to ensure:

- safe, secure, continual and quality energy supply to the final consumers
- protection of environment and nature
- protection of consumers

[46] See Austrian Energy Agency, enerCEE.net

- promotion and protection of a competitive energy market based upon the principles of objectivity, transparency and non-discriminative

Building regulations

The Energy Strategy emphasizes the need to improve building efficiency and to develop new building codes. A Rulebook on the energy efficiency performance of buildings that was adopted in 2008, A separate law about energy efficiency does not exist. The Energy Agency which is responsible for the implementation of the policies in the area of renewable energy and energy efficiency is understaffed.

The Rulebook on created an important step for building energy audit and certification, determining the maximal values for energy losses of buildings envelopes. However, it should be noted that they are voluntary, not obligatory, rules.

Priority is given to implement Directive on Building Energy Performances (2002/91/EC)

Pricing regulation

The Energy Law does not specify principles of price setting. It only stipulates that certain energy prices (amongst them DH prices) have to be determined by ERC according to methodologies approved by the ministry competent of energy and in case of retail prices by the ministry competent of trade.

The law distinguishes bulk energy and retail energy prices. The "production price" of a certain type of energy, in terms of this Law, is the price set at the threshold of the generating facility. The retail price of certain types of energy is the price set according to the methodology on pricing of certain types of energy containing the production cost, the transportation cost, trade margin, levies, taxes and other specific charges.

Tariff setting is the task of the Energy Regulatory Commission. Heating energy pricing is currently done according to the pricing methodology for specific energy types (published in the "Official Journal of RM Official Journal of RM" " 43/98) 43/98)

For determining the heat price, a revenue cap method is applied. Such method can provide incentives to improve the efficiency and performance.

The revenue cap, for example, for license holders for distribution, applies the following formula:

$$MAR_t = [MAR_{t-1} * (1 - C_{t-1}) * (1 + CPI_t) * (1 - X) - K_t - Z_t] / (1 - C_t)$$

where

MAR_t = Maximum allowable revenue to be covered by the holder of a distribution license in the relevant year t;

$MAR(_{t-1})$ = Maximum allowable revenue for the relevant year t-1;

C_{t-1} = Compensation for non-payment in the relevant year t-1;

CPI_t = Consumer Price Index;

X = Efficiency factor;

K_t = Correction factor i.e. Deviation from expected real distributed quantities;

Z_t = Loss factor;

C_t = Compensation for non-payment for the relevant year t.

The formula does not apply automatically, but the new tariffs have to be approved by ERC. The DH Company can apply, if the costs increased by 5%.

The heat price is market dependent, determined in 3 categories: households, schools and hospitals and commercial customers. The payment can be realized on 2 ways: to divide expenses in 12 or 6 equal parts. The most common is payment in 12 equal installments per year.

The heating bill of the final customers is composed as follows:

$$N= W * M + Epot * E + D$$

where

N = Heating costs (in denars)

W = Heat capacity (kW), which is different for each consumer group

Ctm = Price of heating capacity (den/kW)

Epot = Consumed heat energy (kWh), which is different for each consumer type:

- first-group consumers, in accordance with heated surface area in m²
- for all other consumers, in accordance with consumer installed heating capacity

Ce = Heat energy charge defined by the Heating Energy Pricing Methodology (denar/kWh)

D = Price for excess of water flow higher than the allowable one (in denars)

There are no subsidies provided to DH Companies. In principle, tariffs and revenues from DH should cover costs.

In accordance with the pricing methodology, "Toplifikacija" has determined several consumer groups:

- Residential customers
- Commercial customers
- Schools and hospitals
- Experimental heating

The tariff is composed of two components:

- Energy component (levied in accordance with consumed heat energy)
- Capacity component (levied in accordance with installed capacity)

For a transition period there are two ways of billing:

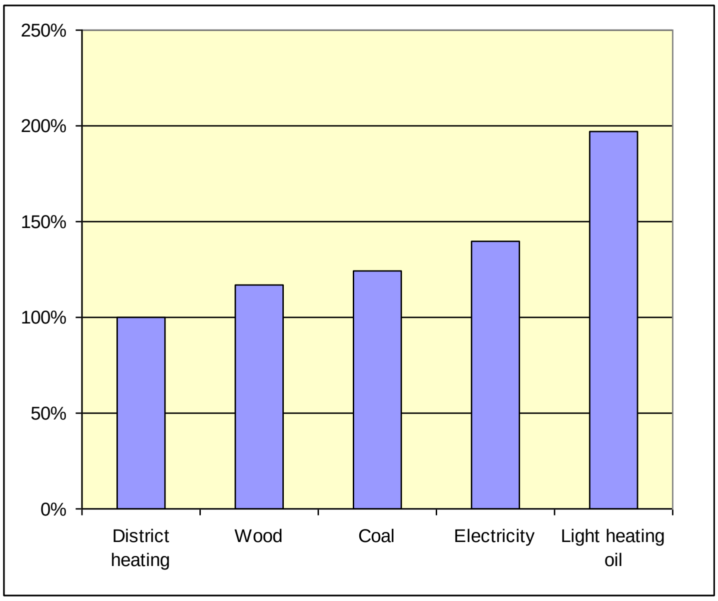
- Lump billing per heated area (m²)
- Meter billing per kWh

The installed capacity is determined according to the design documentation or by real ("active") capacity. Active capacity is the one that is currently utilized and that is corrected every 3 months in accordance with higher or lower consumption. The starting capacity is calculated capacity defined in advance at the start of the heating season. Correction should be made because the charges depend on the real engaged capacity, not that which was announced with the technical design.

Social considerations are not relevant in the Macedonia case. DH companies are not obliged to offer special tariffs for low-income households There is no special program addressing energy needs of low-income households. Social assistance for the low-income households is provided to cover living costs in general. The Social Assistance Law from 2004 identifies two groups of households that should receive social Assistance. The total number of households in Macedonia requiring social assistance was 70,200 at that time. This constitutes approximately 11.42 % of total number of households in the Republic of Macedonia. Total fund for social assistance for 2004 is $59,110,577. .

<u>Competition</u>

The figure below shows the relative prices of energy carriers for heating in the residential sector. In terms of energy carrier prices, DH is the cheapest one provided that the same heat quantity is consumed. However, other energy carriers, such as natural gas and electricity, allow a better control of heat supply. Accordingly, it will be easier to adjust the heat consumption to the personal need and to reduce the bill substantially. For DH the situation would improve, when in the future more thermostatic valves and heat cost allocators will be installed. Such development is supported by the implementation of consumption-based billing.



Source: Heating, Affordability/Social Safety Net – Presentation at Partnership Program meeting at Vermont, Canada 2005, in: ASE

Figure 13.4: Relative prices for heating in Macedonia, 2005.

Natural gas entered the industrial sector only in 1998 and a few industrial facilities were connected to gas until 2002. So far, natural gas is used only in industry and in DH plants, although there are activities underway to introduce natural gas in the residential sector and in the other sectors.

The energy strategy envisages an increase by some 750% until 2020, but mostly for industries. The demand for heat production and final energy consumption is projected to go up by some 200% and 250%. According to this scenario, natural gas would not become a serious threat to DH.

In future, most DH will be produced by natural gas, but natural gas will also penetrate the residential and commercial sector. According to the predictions of the Energy Strategy, direct supply to the residential sector will be limited. However, experience from other countries shows, that gas companies do usually not hesitate to penetrate DH service areas. Under these conditions, DH will not have to compete against other energy carriers, but against alternative gas heating options (decentralized options). DH can be competitive, if gas prices will be cost reflective and a substantial part of heat will be produced in CHP. “Cost reflective” gas prices mean that retail gas prices are higher than bulk gas prices (price at which gas is sold to DH boiler houses).

In January 2008, the Decision ERC announced that Toplifikacija became an eligible consumer of natural gas, which will improve the competitiveness of DH.

Feed-in tariffs

In February 2007, the Rulebook on feed-in tariffs for purchase of electricity produced from small hydropower plants was published by the Energy Regulatory Commission (ERC). The feed-in tariffs apply to the quantity of electricity produced and delivered by newly constructed run-of-river small hydropower plants, which have qualified as privileged producers (Table below).

The privileged producer is obliged to use the feed-in tariffs approved for him for 20 years. The electricity market operator (MEPSO, state owned transmission company) is obliged to purchase the total quantity of electricity delivered by the privileged producer under the approved feed-in tariffs.

Feed-in tariffs for the sale of electricity produced by small hydropower plants are in Table below.

Table 13.2: Feed-in tariffs in Macedonia.

Delivered quantity	Monthly quantity of delivered electricity (kWh)	Annual quantity of delivered electricity (kWh)	Tariff /cents/kWh(
I	1-85.000	1-1.020.000	12.00
II	85.001-170.000	1.020.001-2.040.000	8.00
III	150.001-350.000	2.040.001-4.200.000	6.00
IV	350.001-700.000	4.200.001-8.400.000	5.00
V	>700.000	>8.400.000	4.50

Rulebooks on feed-in tariffs for electricity produced in wind power plants and plants using biogas were adopted in May 2007 and November 2007.

Emission trading scheme[47]

Macedonia joined the UNFCCC in 1998 and to the Kyoto Protocol in 2004. The MOEPP is the focal point for the UNFCCC, and also the Designated National Authority for the CD

Macedonia is a Non-Annex I party member of the Kyoto Protocol,

Macedonia has started to integrate climate change into national strategic planning documents and laws. The Law on the Environment stipulates that Macedonia should adopt a National Plan on Climate Change, but this has not yet been developed. The 2nd National Environmental Action Plan and the National Strategy for Sustainable Development both include climate change, with Energy and Climate being identified as key elements in achieving the goals.

Macedonia has already considered a number of projects for CDM.

Carbon and other taxes

The VAT of 18% is applied for most goods including energy carriers. In addition, special excise taxes are applied (Certain consumers are exempted from the excise tax):

- 42% - 46% for gasoline
- 30% for gas oil
- 10% for light heating oil

A carbon specific tax is not applied.

Investment support

Neither the central government nor the municipalities are obliged to provide investment subsidies. DH Companies are acting like normal commercial companies.

There are no special programs for investment subsidies for DH and CHP in place.

Besides an Energy Efficiency Fund and Environmental Fund, which are restricted in terms of financial volume, there are no special financing sources which could be used for developing DH or CHP projects.

The "**Fund for Environment of Macedonia"** was established in 1997 to mobilize available financial resources. The distribution of funds is accomplished according to the Program complied with the National Environmental Action Plan (NEAP) for environment protection and corresponding LEAP - Action Plans of the local government units.

Contracts constituting the **"GEF- Sustainable Energy Project"** were signed in 2007 and grant money from the GEF (Global Environmental Facility) in the amount of USD 5.500.000 became effective for the implementation of the project. The goal of the project is to promote investments for increased energy efficiency (EE) and increased use of the renewable energy sources (RES) through

[47] Wikiadapt.com

the elimination of the institutional and financial barriers. Besides capacity building, the project comprises the establishment of an ESCO, which shall focus on energy efficiency in public buildings

The new company was planned to be established through a joint venture of "JSC MEPSO" and the district heating company "Toplifikacija JSC– Skopje". The third component will provide favorable credits or credit guarantees for implementation of projects designed to improve the energy efficiency in the industrial sector.

13.3 Customers

Customer rights

Essential rights and powers of customers are laid down in the "Rulebook on supply with thermal energy for heating" (2009).

Toplifikacija has a well developed customer service. With the beginning of the heating season 2008/09, customers of the Company can submit their complaints either via phone or by email or by personal visits. In 2008, more than 43.000 complaints had been registered. The company classified them into 5 groups. Most complaints addressed the quality of heating, two times less were complaints about leakages. The computer aided system that is used to respond to the complaints includes also a reporting centre for the management.

Service quality

Service quality requirements are stipulated in the "Rulebook on supply with thermal energy for heating" (2009).

13.4 Ownership

Role of municipalities and types of ownership

Municipalities are usually not the owners of DH systems and do not have the task to provide heating services. In contrast to DH, the role of local government in providing water and sewerage services is stipulated by the Law on Self-Government. District heating companies are privately owned, with the exempt of ELEM Energetika (which is owned by the state-owned Electricity Company) and Bitola, which is owned by the municipality; Bitola was, however, operated by a private company under a concession contract.

Accordingly, municipal budgets are not affected by financial losses or profits realized by the DH companies. The only link is the heating costs of municipal-owned buildings.

There are various forms of ownership

- Toplifikacija AD Skopje has 100% private ownership. The largest shareholder is the Slovenian company POTEZA with 17.5%. All other shareholders participate with 1% or less The Company Toplifikacija owns only boilers. And the distribution network is owned by the city of Skopje. The customers are owners of the substations. Toplifikacija AD Skopje operates the distribution grid that is in the ownership of the Republic of Macedonia, and the operation with the grid right is regulated in the Contract act between Toplifikacija AD Skopje and the Public enterprise for the management of residential and commercial properties of the Republic of Macedonia where an obligation for reimbursement of 50,000 EUR per year has been regulated. The municipality is owner of the network, which is operated and maintained by Toplifikacija. The Company is obliged to reinvest yearly an amount corresponding to the depreciation charges, which correspond to about € 700,000 – 800,000 per year.
- AD Skopje Sever has 100% private ownership (including network). 99.74% of the shares are owned by Toplifikacija Skopje. The distribution grid of Skopje Sever AD Skopje has been built with Construction Approval issued to Toplifikacija AD Skopje as investor and for the

same grid there is no Approval for operation issued to Skopje Sever AD Skopje, which in fact operates the distribution grid. ;

- AD ELEM (Energetika Dept. of ESM) has 100% state-ownership. AD ELEM is the owner of the distribution grid that the Branch Energetika uses and operate;
- Makedonska Kamenica Doming has 100% municipal ownership
- The municipality of Bitola owns all assets and a private company (Toplifikacija Bitola DOO) used to operate the system under a concession contract).

As the biggest part of the DH sector is privately owned, direct control through the Government or Municipality is limited, i.e., in contrast to most other countries in CEE, direct political interventions in operation and management are not possible.

The permission to operate is subject to a license that has to be issued by ERO. Different licenses are required for each activity, i.e., production, distribution, and supply. Supply refers to heat sales to final consumers.

Although the collection rate is about 94%, Toplifikacija Skopje generates losses in supply, as bad debts are not accepted as a cost. Therefore the company has decided to return the license. According to legislation, the licensee has to continue to operate the system until a new licensee will be determined by a tender. The tender is looking for three suppliers.

There is an open tender for three supply companies that serve the three service areas that are currently operated by Toplofikacija Skopje. According to the conditions stated in the tender documentation, the new suppliers shall deliver thermal energy to approximately 62,000 consumers in Skopje. The company that will be awarded on the tender, besides distributing the thermal energy, will also need to install heat cost allocators (or heat meters) for each apartment. The meters will be installed on each radiator; the price for a single unit was expected to be 150-200 euro. The Regulatory Energy Commission has decided that the costs for installation will be borne by the consumers themselves; the manner of payment (whether during installation or in several installments in the bill for central heating) is being left to be decided by the supplier. There are no legal provisions for the case that no company will be found.

The management is nominated by the (mostly private) owners or, in case of ELEM Energetika, by the state owned Electricity Company. The management has to act in accordance with the stipulations of the Energy Law (see below) and of the license.

The government controls price setting through the approval of the pricing methodologies that have to be applied by the Regulatory Commission. ERC issues license that are required to operate the DH system and approves the tariffs in accordance with the regulations.

The Energy Law describes in Article 108 the liabilities of the DH operator as follow:

- Manage the production facility in accordance with tariffs, terms and criteria prescribed in the license
- Submit annual reports to Energy Regulatory Commission and the mayor or the City addressing the equipment, production, plans for maintenance and planned availability,
- Submit all contracts for the sale of energy and all contracts for the sale of heat and electricity with a duration of 30 or more days to the Energy Regulatory Commission within seven days Signing of such agreements and complying with the conditions in this contract for the production of energy and in the case of combined production to respects the conditions for the delivery of electricity and ancillary services.

In the following section the Law describes responsibilities regarding the operation of the system, including actions to be taken in case of system interruptions

Powers and liabilities of both parties are laid down in:

- The “Grid Code for distribution of thermal energy for heating” was approved by ERC in March 2009 (“OGRM” no.40/2009).
- The “Rulebook for supply with thermal energy for heating” was issued in December 2009 by ERC (“OGRM” no. 151/2009).

Private sector involvement

The investment climate in Macedonia is one of the best in the region, partly because of the well developed regulatory and taxation framework. A flat rate for taxation applied that has fixed all profit and personal taxes at a 10% rate.

Corporate tax and personal income tax have both seen significant reduced under the new system:

- corporate tax: 10 per cent. Reduced from 15 per cent to 12 per cent in 2007, corporate tax has been further reduced in 2008
- personal income tax: 10 per cent. Set at between 15 per cent and 24 per cent before the reforms, personal income tax was reduced to 12 per cent in 2007 and 10 per cent in 2008.

Nevertheless, there has been a lack of investment in new energy production facilities, but the recent investment decisions for new CHP plants (with private investors) prove the success.

Local influence through Municipalities in DH is very restricted and accordingly Municipalities do not provide financial support to DH.

As described in the previous section, the private sector plays already an important role in the DH sector. An additional opportunity for private sector involvement could be created by third party access.

Chapter 10 of the Energy Law defined third party access in articles 114-116:

The Law stipulates in Article 114, that the TSO has the obligation to establish rules for connection and methodology for calculation connection of the costs for connection.

In case of heat, a DH distributor is obliged to buy heat from a non-regulated producer of heat (including geothermal energy), if the price is equal to or lower than the price approved by ERC. Practically, TPA will materialize while connecting the new CHP plant.

A limited TPA and increased competition would also be implemented if different supply companies would be established, as customers could freely select amongst them. Due to the regulated (maximum) prices and the small profit margin, competition will be based mainly on service quality and value-added services.

The energy law, particularly by defining the rules for market access, describes in general terms the specific rights and liabilities of investors in the energy sector. In case of regulated production, distribution, or supply activities, investors need a license. In case of non-regulated heat production, investors can supply existing DH systems, if the heat price is equal to or lower than the regulated price.

Synergy allocation

For the time being, SEC has not yet issued a regulation for setting heat and electricity prices for CHP. However, the commission on the “Rulebook on the method and procedure for establishing and approving the use of feed-in tariffs for purchase of electricity produced from power facilities which use biomass.

Regarding the new, gas fired CHP in Skopje, there is a preliminary agreement between Toplifikacija and the CHP owners. The heat price will be composed of a fuel component that is calculated as if the heat would be produced in a heart only boiler with an efficiency of 95%. The second component covers the fixed costs, that amount to about € 1 per MWh compared with fixed costs of about € 6 for own generation.

13.5 Planning

Integrated resource planning

Elements of integrated resource planning can be found in the Energy Strategy.

Heat area planning

The Energy Law obliges municipalities to develop local energy strategies and actions plans in accordance with the national energy strategy.

13.6 Local Example

The institutional framework for Toplifikacija Skopje is likely unique and could service as a model for other DH system.

The DH system is actually unbundled. Unbundled means that at least accounts are unbundled and business is organized by separate child companies:

- CHP generation is private and not regulated. Electricity has to be sold at market prices and heat prices are based on long term contracts that secure a lower price than the production costs in a separate HoB and the price that fixed for HoB production..
- Heat prices of HoB plants are regulated.
- Heat networks are owned by the municipality. The distribution needs a license and operates the network under a concession contract that requires reinvestments for maintenance in accordance with the depreciation charges. In this way, the municipality has financial interest in DH
- Supply (delivery to final customers) will be done by various independent suppliers on a competitive basis, i.e. customers can freely choose between them. To ensure financial integrity, the tariff component for supply should include a certain percentage of bad debts, as otherwise private companies will likely not be interested in the business.

A relatively high collection rate of about 94% ensured a reasonable cash flow and allowed the company to finance the rehabilitation and modernization of the supply system, although for the last 10-15 years there were hardly any investments in boilers. A larger part of the equity for the new CHP came from sales of assets (in this case, shares in a local bank).

The high collection rate was possible due to an consequent and effective billing and collection policy. Such policy could only be applied, because local policies could not intervene, as the DH business is privately organized.

The example of Skopje shows how the many problems of DH can successfully be tackled and a sustainable development of DH can be initiated based on a right mix of public and private ownership and centralized regulation. The system is not perfect as the case of Toplofikacija Skopje shows, which returned the license because of non-profitability of the supply business. Bad debts should to a certain extent be approved as justified costs depending on the availability and scope of social assistance programs for low-income households.

13.7 Recommendations and good practices

Legal and regulatory framework

Issue	National Energy Policy
Problem	DHC, CHP, EE and RE are prioritized in the national policy. However, supporting reforms proceed slowly outside the capital.
Recommendation	The Energy Strategy should consequently be implemented particularly in cities outside Skopje.
Good practice	Chapter 6 (1), Poland (Appendix).

Issue	Building regulations

Problem	Outdated building codes
Recommendation	Implement the corresponding EU directive and determine more demanding building codes
Good practise	See chapter 6n (2)

Issue	Price regulation
Problem	The regulatory entity does not accept bad debts as justified costs, which is unacceptable for private companies, as this will offset the profit
Recommendation	1) Tariff should to a certain extent approve bad debts as a cost. 2) A price cap regulation seems to be more appropriate for DH with its seasonal and structural (impacts of energy saving measures and consumption based billing) fluctuation
Good practise	See chapter 6(3), Kosovo, Macedonoia FYR

Issue	Competition
Problem	Particularly outside Skopje, DH may be completely ousted from the heat market by decentralized heating systems. This will result in wasting capital invested in the existing DH system and results eventually in less efficient systems.
Recommendation	Carry out or update heat plans for the larger cities, particularly those with existing (but not operated) DH systems
Good practise	See chapter 6 (4)

Issue	Feed-in-tariffs for CHP or renewables
Problem	Despite legal requirement, special regulations do not yet exist. Heat prices from existing larger CHP plants are lower than those from HoB plants, but still relatively high. .
Recommendation	Establish a clear and transparent regulation for feed-in tariffs.
Good practise	See chapter 6 (5), Germany

Issue	Emission trading scheme
Problem	DH rehabilitation could be supported by CDM.
Recommendation	Prepare CDM projects, particularly for DH systems outside Skopje.
Good practise	The European Union, See chapter 6 (6)

Issue	Carbon tax
Problem	A carbon tax does not exist.
Recommendation	As DH is mostly produced by natural gas, a carbon tax might not be a first priority.
Good practise	See chapter 6 (7)

Issue	Investment grants
Problem	Rehabilitation of the existing DH system outside Skopje requires likely some grant financing, which does not exists for the time being.
Recommendation	Based on the results of the heat plans, municipalities and central government should provide some grant financing for rehabilitation.
Good practise	See chapter 6 (8)

Customer issues

Issue	Customer definition and rights
Problem	Problems occur mostly outside Skopje
Recommendation	Revitalized DH system should apply rules and procedures already applied in the Service area of Toplifikacija Skopje
Good practise	See Chapter 6 (9), The EU

Issue	Service quality
Problem	Service quality seems to be decent in the service area of Toplifikacija Skopje, but problems occur in other service areas
Recommendation	Lacking rehabilitation and modernization investments are the main reasons for low service quality. Such investments are indispensable to improve the service quality.
Good practise	See chapter 6 (10), The European Union, USAm, Canada

Issue	Billing
Problem	Consumption-based billing is already in place
Recommendation	
Good practise	See chapter 6 (11), The European Union, South Korea, USA, and Canada, Kosovo

Ownership issues

Issue	Municipality role
Problem	
Recommendation	
Good practise	See chapter 6 (12), The European Union, Kosovo

Issue	Private sector involvement
Problem	Private investors seem not to be interested in the DH systems outside Skopje.

Recommendation	DH Systems outside Skopje should be rehabilitated supported by some grant money. In a parallel or after rehabilitation, DH Companies could be (partially) privatized.
Good practise	Fortum and Bashkirenergo (Russia), Skopje (Macedonia), see chapter 6 (13)

Issue	Synergy allocations
Problem	DH pays for CHP heat somewhat less than for heat produced in own boiler houses. The price is based on an agreement between CHP plant and DH Company. However, despite legal request, there are no clear rules.
Recommendation	The current practise may work for large CHP plants, but in case for smaller CHP plants special feed-in tariffs have to be determined.
Good practise	See chapter 6 (14)

Planning

Issue	Integrated resource planning
Definition	
Problem	Integrated planning is in principle applied by the Energy Strategy, but has not been copied to the towns. In the longer run, this could open the door for an unhealthy competition between DH and Natural gas
Recommendation	Urban plan should use IRP to optimize the mix of the various energy carriers
Good practise	The European Union, South Korea, see chapter 6 (15)

Issue	Heat and urban planning
Problem	Heat planning used to be common in former Yugoslavia, but has lost its role. Heat planning based on Urban planning and IRP, would allow to improve the development of local heating systems
Recommendation	
Good practise	See chapter 6 (16)

Technical

Issue	Technical standards and design conditions
Problem	A number of technical standards and norms are outdated in view of new, modern technologies.
Recommendation	Review the technical standards and compare them with those applied in EU
Good practise	See chapter 6 (17), new European standard for design outdoor temperatures and using modern practices

Issue	Refurbishing strategies
Problem	Some DH systems are technically still in a bad shape and some stopped operation due to technical and financial problems.
Recommendation	Revitalize DH particularly outside Skopje
Good practise	See chapter 6 (18), Poland (Appendix), Sofia/Bulgaria (Chapter 6), Mytishi (Russia), Subotica (Serbia)

13.8 Information sources

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14Russia

14.1 Features and extent of DHC/CHP

History

The history of DH in Russia exceeds 100 years, in other words, having had its origin in the czarean times. In year 1920, the country wide 5- year plan of electrification introduced the idea of DH and CHP development in the Soviet Union. Later on, the 5-year plan 1933-1937 required a substantial extension of DH and CHP that currently is the largest in the world, at least in the terms of length of networks.

The world's largest DH/CHP system locates in Moscow, where 15 large CHP plants and 170 heat-only-boiler plants are connected with almost 8,000 km of networks, some 2,300 km of which primary and the balance of 5,700 km of secondary networks, to the end users by delivering 430 PJ (120 TWh) of heat in year 2007. As much as 77% of the heat was produced by the CHP plants and the balance by heat-only-boilers[48].

The main driver for such fast development until year 1990 was probably the socialistic ideology to provide collective services to the citizens combined with increasing needs of both electricity and heating in the Soviet society. The costs of resources such as materials and fuels were not at economic level, which resulted in the excess use of materials that is emphasized by frequent replacements of corroded and oversized equipment as well as in high losses of energy and water. The Russian DH/CHP system still suffers for the more than 20 year old policies.

The number of the heating enterprises amounts to about 1,500, thus indicating that several heating systems of some 50,000 in total and mainly served by boiler plants are operated by one company. On the other hand, one heating system may involve several companies: the heat production company usually having CHP plants (energo), the heat transmission company (teploset) responsible for the network reaching from the main heat source to the group substations, and the housing services companies (zekh) being responsible for maintenance of the secondary networks between the group substations and the apartments as one of the maintenance tasks. The housing service companies are also responsible for other utilities as well as the building and outdoor areas. Thus, the heat distribution is not the only focus area of such companies. There is a substantial need for qualified and trained personnel in the DH sector in order to improve the level of economy, maintenance, reliability, etc..

Statistics from past years

Currently, statistical data on a number of sectors, such as buildings, heating, and transport is virtually nonexistent. Therefore, estimates had to be used.

In 2007, the DH/CHP systems in Russia comprised 500 CHP plants and 65,000 boiler houses connected to the end users by means of 200,000 km of DH networks. The heat deliveries were approximately 6,100 PJ (1,700 TWh), some 30% of which were produced by CHP, 45% by heat-only-boilers and the balance of 25% by industrial and other sources[49] The housing statistics was not available. Therefore, the heated area had to be estimated by using 229 kWh/m^2, based on the CENEf study and what was typical in Poland in early 90'ies as well as well 20% of produced heat lost in the network. The estimate yields the magnitude of 5.9 billion m^2 heated floor area connected to the DH systems.

Russia's CHP plants operate at a level of energy efficiency well below that of most technologies used internationally. In condensing mode, the gas-fired and liquid/solid fuel fired CHPs abroad typically operate at 51% and 46-48% efficiency levels, respectively. On the other hand, Russia's gas-fired and liquid/solid fuel fired CHPs currently operate at 39%and 36% efficiency levels,

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[48] IEA: the same Collaborative as above.

[49] IEA: CHP/DH Country Profile: Russia, The International DHC/CHP Collaborative.

respectively. Therefore, efficiency advantages of Russian CHPs over international modern condensing plants are minimal[50].

Most of Russia's boilers fall short of the best international energy intensities. One may use as the international benchmark of 95% efficiency for gas-and liquid-fuel boilers and 85% efficiency for coal-fired boilers. These efficiencies are consistent with the efficiency of boilers operating in Western Europe. Official reports on Russian boiler efficiency show the efficiency of DH boilers at 80.3%, and small boilers at 81.6%.[76] Russia's boilers are likely less efficient than official statistics suggest. Energy audits conducted by Russia's Center for Energy Efficiency (CENEf) cast doubt on the accuracy of the official figures[51].

DHC and CHP market shares

DH covers 70-80% of the housing stock in Russia. In Russia alone, there are some 50,000 DH systems (Bashmakov, 2004). Some 60% of the Russian population have DHW supply from DH.

The high market share equals to a population of almost 100 million heated by DH systems in Russia.

Types of DHC consumption

The bulk of DH service comprises two products, SH and DHW, both of which are distributed with four-pipe networks from the group substations to apartments. DHW is heated either at the heat source (open systems) or at the group substations (closed systems), the latter one being the governing one.

Selected technologies with customer connections

DH is distributed by means of 4-pipe systems, group substation with and without heat exchangers for SH and in most cases with DHW through heat exchangers. The hydroelevators (jet pumps) are common in mixing the primary side supply water with the secondary side return at the constant mixing ration in order to provide secondary side supply water meeting the heating norms.

Heat metering rate

Heat metering depends on the type of customers. Often heat metering exists at commercial and industrial customers in large and medium cities, but not in small towns. Residential customers are mainly metered in Moscow but rarely elsewhere in the country. However, heat metering is expanding due to the new Heat Law. In Khanty –Mansisk, for instance, all new buildings will be equipped with heat metering both on building and apartment level. In practice it means that there are two heat meters in each building entrance, one for room space heating (SH) and the other one for domestic hot water (DHW). The same approach with two meters is used in apartment entrances as well. In old buildings, on the other hand, customers have started to install heat meters individually as a way to reduce their heating costs.

Market expanding/shrinking

The market of the DH systems is declining. The outdated DH systems require major rehabilitation in order to become competitive in case the heating market fully opens for competition.

The results of the previous energy strategy until year 2020 have been unsatisfactory. Over the past period the technical situation in the DH sector has worsened despite of the adoption of a whole array of progressive decisions that, however, were not backed up by appropriate organizational and financial measures. For instance, during the past period the wear-out indicators (fully amortized) of

[50] CENEf/WB/IFC 2008

[51] CENEf/WB/IFC, 2008

key heat supply facilities rose from 65% to 70%, the length of the DH networks shrank by 7% equivalent to some 14,000 km, losses in DH networks increased from 14 % to 20%, and electricity consumption of DH pumping increased to 10 kWh/GJ.

The core problems are:

- The unsatisfactory technical condition of DH systems, which is characterized by the high wear-out rate of key facilities, particularly heat supply networks and boilers, the inadequate reliability of operation, large energy losses and polluting impact on the environment;
- The need to make heavy investments to ensure reliable heat supply and concurrently curb a rise in the cost of services;
- The need for the entire heat supply system to undergo institutional restructuring to get out of the economic crisis and operate successfully in market conditions.

Local DHC association

There is the DHC association at the moment in Russia, which exists as a non-profit association "NP Rosteplo" (http://www.nprt.rosteplo.ru/) . The members of "Rosteplo" had played a significant part in developing the new Federal Law "On Heat Supply" approved in the middle of 2010. About ten years ago such an organization worked inside the national power company, RAO-UES. At present, there is also a non-profit engineering association ABOK. Russian Association of Engineers for Heating, Ventilation, Air-Conditioning, Heat Supply and Building Thermal Physics, http://www.abok.ru/eng/. The association works in accordance to the Federal Law 131. There are also many local organisations, working in this sector, such as the so called "competence of the local level", which means many organisations can influence local regulations.

14.2 Legal and Regulatory Framework

National policy

The new Energy Efficiency Strategy of Russia until year 2030 endorsed by the Russian Federation Government (Ordinance #1715-r) in November 13, 2009 sets the strategic goals of developing DH supply in particular as follows:

- To achieve a high level of comfort in residential, public and industrial premises, including a quantitative and qualitative rise in the bunch of heat supply services (heating, cold supply, ventilation, conditioning, hot water supply) matching the high level of leading European countries at affordable costs;
- To ensure a drastic rise in the technical standard of heat supply systems based on innovative, highly efficient technologies and equipment;
- To slash non-production losses of heat and fuel;
- To ensure the manageability, reliability and efficiency of heat supply;
- To reduce the negative impacts on the environment.

Energy conservation in heat supply will be pursued in the following key directions:

- In heat production, efforts will be taken to raise the efficiency of boiler units, central heating and other plants based on modern fuel burning technologies, CHP, boost thermal capacity utilization ratio, develop distributed heat generation systems involving renewable sources of energy in heat supply, enhance technical standard, automation of small heat sources, fit them out with heat metering and regulation systems;

- In heat transmission systems, efforts will focus on reducing heat losses and leaks of water as a result of remodeling heat supply networks based on prefabricated pipelines and automatic control systems;

- In heat consumer systems, emphasis will be put on heat metering and controlling, erecting energy efficient buildings.

These efforts are expected to result in reduction in DH network heat losses from 19% to 8 - 10 % by the end of 2030, which will ensure the saving of no less than 40 million tons of reference fuel.

The projected development of heat supply will call for pushing through measures such as forming a competitive heat market, supporting efforts to create advanced Russian equipment manufacturing, updating management of these systems, and lending support on the part of the state and regional government parts in order to provide necessary investments in the DH sector.

In the first stage in the Strategy implementation it is essential to draft and begin consistently enacting a set of program measures to drastically upgrade heat supply by means of:

- Creating favorable conditions for attracting private investments in heat supply, including efforts to employ a method of economically warranted return on the invested capital;

- Optimizing a system of tariffs (transition to obligatory application of two-tier tariffs, application of long-term tariffs under bilateral contracts) by meeting the interests of both producers and consumers of heat;

- Drafting mandatory requirements to the equipment being produced and used as well as to raising the energy efficiency of buildings;

- Employing in a reasonable manner instruments of state support and using this practice also within the framework of private-public partnership (PPP).

The second stage in implementing this Strategy is expected to show large-scale remodeling and re-equipment of key facilities, including economically justified replacement of DH networks and network equipment in regions. De-centralized (individual) heat supply systems, including those using renewable sources of heat, may see large-scale development at the new technological level. A heat market will be created, and the relations between its actors will be streamlined.

At the third stage the DH supply is expected to reach high levels of energy, economic and ecological efficiency. The DH sector is expected to ensure a high level of heat comfort for the population matching the development level of countries with similar natural-climatic conditions (Canada, Scandinavian countries).

In technical terms, the Strategy promotes modern DH and CHP development by nominating:

- Mini size CHP plants of module type;

- New heat generation and distribution systems to reduce energy losses;

- Modularized combined gas and steam cycle CHP plants with electric capacity of 100 MW to 170 MW and electric efficiency factor of 53% to 55%;

- Condensing heat recovery boilers fuelled by gas;

- Production of equipment and automatic systems for control and management of heat consumption

- Low-temperature DH systems with demand driven control properties and decentralization of peak-load heat production capacities;

- Substations both for DH and DC for large social and industrial heating and cooling customers;

- Automatic monitoring systems for large DH systems;

- Upgrading technologies for industrial production of preinsulated pipelines and closing valves with automatic drives.

According to the Strategy, the role of heat-only-boilers will decline due to expansion of CHP systems (gas turbines with waste heat recovery boiler). By year 2030, the share of heat produced at the existing CHP plants will shrink from 43% (2005) to 35%. This cap will be filled by gas turbine driven CHP units and autonomous plants.

The following key tasks need to be tackled to achieve the strategic goals of the sector development:

- To develop heat supply of Russia and its regions based on modern economically and ecologically efficient CHP plants of a wide range of capacity;

- To spread the CHP applications in forms of steam-turbine, gas-turbine, gas-piston and diesel plants to medium and small DH systems;

- To ensure optimal combination of centralized and de-centralized heat supply with heat zoning;

- To tap to the maximum extent the potential of geothermal energy industry to provide heat supply to isolated regions rich in geothermal sources (the Kamchatka Peninsula, Sakhalin Island, Kuril Islands);

- To develop thermal power centralized-distributed generation systems with various types of sources located in areas of heat consumption;

- To upgrade CHP plants operating modes with a view to scaling down the condensation cycle and to increase operation in CHP mode;

- To modify the structure of heat supply systems to include rational combination of redundancy, automatic control systems and measuring instruments as part of automatic monitoring over normal and emergency operation modes;

- To remodel CHP plants, boilers, DH networks, pursue thermo-hydraulic adjustment of regimes, boost the quality of construction-and-installation and repair work, execute on-line monitoring measures, supply consumers with both stationary and mobile heat supply plants as reserve and (or) back-up sources of heat supply;

- To work out regulatory-legal base ensuring effective interaction of heat producers, organizations involved in its transmission and distribution, as well as consumers in commercial market conditions.

The share of heat-only-boilers is expected to drop from 49% to 40% by the end of 2030.

There are 10 nuclear power plants operating in CHP mode in Russia. According to the current strategy, no more CHP type nuclear capacity will be erected.[52]

In addition to the latest Strategy, during 2007 – 2008 the Ministry of Energy has developed “roadmaps” of heat supply business development in Russia. Major provisions and objectives of these roadmaps are contained herein in order to demonstrate general direction of heat supply business development, which will be observed by federal energy authorities, as follows:

- Transformation of heat supply into an effective business sector in the Russian economy. Establishment of heat supply processes’ management system, including scientific research, design, technology and equipment, development and operation of DH market;

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[52] Ms. Marina Velikanova, Feb. 17, 2011

- Creation of long-term municipal energy plans and heat supply schemes including determination of economic heat transmission distance, heat supply centralization degree, back-up capacity reservation as well as possible fuel switching in the DH systems;

- Development of appropriate heat market models, change of institutional framework of contract relations between market actors with strong involvement of municipal governments;

- Change of planning (zoning and indicative planning) and tariff formation approaches, introduction of municipal standards of heat supply services and follow-up of their functioning, change of heat supply investment support systems;

- Defining the residential organizations as DH customers. Separation of two types of heat supply services – provision with heat resources and provision of heat comfort: temperature, humidity, continuous running of warm water, etc.;

- Creation of funding for modernization investments in heat supply systems and in enhancement of buildings' energy efficiency;

- Transition, where practical, to consumption based billing and adjustment of heat consumption standards for those customers, who do not have heat meters;

- Corporatization of municipal DH enterprises and actively attracting private heat supply companies, having maintenance companies as operators of rural heat supply systems;

- Transition to economically differentiated tariffs on heat nodes with consequently removed of cross-subsidies;

- Transition from "costs plus" tariffs to stable boundary tariff levels corrected on the basis of established "price formula" and formation of heat "tariff menu" for final consumers;

- Development of the "Menu of Technical and Management Solutions" on modernization and reforming of heat supply systems; and,

- Creation of intellectual heat supply systems through the development of:

    - automation of heat generation, transmission and distribution processes in accordance with customer's requirements, securing of reliability and service quality;
    - remote control and management of municipal buildings; and,
    - database of the entire heat supply business.

The energy strategy of the Russian Federation has estimated that the development of the DH systems will require US$ 70 billion during 2003-2030, equal to US$ 2.6 billion a year, and such funds will be collected from the budgets of the oblasts and municipalities, heat sales to customers and from investors (Energy Charter, 2004). It has been estimated by the official that the investment value will reach the level of RUR 10,500 billion by year 2020, equivalent to US$ 370 billion[53].

Laws

The DH sector as the largest in the world so far highly impacts on the country's economy and the people's welfare. The Federal **Law on Heat Supply** of RF № 190 – FZ dated 27.07.2010 (the Heat Law) was finally approved after more than eight years of debates[54].

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[53] On measures to implement the Law on Energy Conservation and on enhancing energy efficiency, Moscow, Dec. 3, 2009, Deputy Director O.P. Tokarev, Department of state energy policy and energy efficiency.

[54] Russian Energy Agency, Dr. Nelly Segizova, March 2011.

The new Federal Law regulates the production, transmission and consumption of heat energy, heating capacity, the heat-transfer media used in the heat supply systems, and the functioning and development of such systems. It also defines the regulation and oversight powers of the state and municipal authorities in this sector, and the rights and obligations of consumers, heating providers, and heating supply network operators.

The law regulates the following activities:

– Sales of heating resources and heat-transfer media;

– Provision of heating resources and energy transmission services;

– Provision of reserve heat production capacity.

The law defines specific terms such as thermal energy, heat supply quality, heat energy source, heat-consumer installation, heating system, heating capacity, load on the heating system, heat consumer, and others that have not been defined before.

One of the main innovations of the Law is the priority given to the CHP heat production compared to heat only boilers as the part of development and approval of settlements heat supply schemes.

The economically justified cost method will be used as the method for regulating tariffs, along with the method of guaranteed return on invested capital and the equivalent comparison method. The long-term tariff setting is considered important to support the policies set both by the strategy and leeaw.

The law sets the basic principles for heat tariff regulation and self-regulation in the heating supply sector. It sets provisions on relations between heat suppliers, heat network operations, and heat consumers. Furthermore, it also sets out the particular provisions regulating contractual legal relations between these actors.

The law also regulates issues such as the particular provisions applying to heating supplies for apartment buildings, preparations for the heating season, and procedures for ensuring proper maintenance and functioning of heating supply systems.

From authorities’ task allocation point of view tariff regulation system has remained almost the same as before. The government sets the laws and regulations, tariff structures and policies. The Federal Tariff Service (FTS of Russia) sets the levels of the CHP tariffs. The municipalities as regulators assess the investment plans, provide investment subsidies and set the tariffs including connection fees for the local DH services.

The FTS sets price caps (boundary tariff) levels for heat generated by CHP plants; sets minimum and (or) maximum tariff levels for heat supplied by energy supply organizations to customers. In practice such levels are set as growth indices of average heat tariff for end customers.

Under the Federal Law the local authorities may be authorized to regulate end-user heat tariffs.

Nevertheless, it is however interesting to note that the new heat law allows a more liberal tariff regulation if there is a possibility to transform an individual heating system from the monopolistic to a market based competitive activity. In such transformations, tariff regulation in such a competitive system could be abolished.

Amendments introduced by the Federal Law of RF N 281-ФЗ dated 25.12.2008 into the system of notions of the Federal **Law on State Regulation of Electricity and Heat Tariffs** introduced three separate terms:

- “heat” is a commodity characterized by heat carrier consumption and change of its thermodynamic parameters (temperature, pressure);
- “heat capacity” is the amount of heat which can be generated and (or) transmitted via heat supply grids per unit of time;
- “heat load” is the amount of heat which can be received by the customer per unit of time.

Present amendments allow two-tier tariff systems for DH.

On November 18, 2009 the Federal Assembly passed the **Law on Energy Saving and Improving Energy Efficiency**. In general its provisions apply to all energy activities. Thus, among other things, the rules of the Law cover DH and DC as well.

The Law introduced the rules of ensuring obligatory energy metering and application of energy meters as the basis of billing for energy consumption. In compliance with Article 13 of the Law all the produced, transmitted, consumed energy resources must be measured.

The requirements of the above-mentioned Article pertaining to organization of energy metering do not apply to ramshackle, breakdown objects, objects requiring dismantling or capital repair until January 1, 2013, as well as the objects with the load of electricity consumption less than 5 kW or the thermal energy less than 0.2 Gcal/h (=0.84 GJ/h).

Until July 1, 2010, the organizations – the suppliers of gas, water, *heat*, electricity - had to offer to install energy meters to their clients. Such organizations shall not be entitled to refuse to the request of a consumer to install the energy meter.

The Law prescribes the obligation for the state and local authorities, owners of buildings, structures and other objects as well as for owners of dwelling homes, countryside and garden cottages which are mentioned in the law to install meters of used water, natural gas, thermal energy, electric energy, as well to put the meters into operation within the period set forth in the law.

The Law supports the new Strategy 2030 presented earlier by setting the framework for the following business opportunities:
1) investments into modernization of housing;
2) investments into industrial modernization;
3) investments into modernization of heat supply and electricity transmission infrastructure;
4) production of energy efficient products and equipment, including thermal insulation materials and other energy-saving materials and equipment for buildings;

The FSE **Russian Energy Agency (REA)** was established under the Ministry of Energy on Dec. 22, 2009 to be responsible for the implementation of the Energy Efficiency Act. The REA comprises 70 regional offices with 2,000 staff. REA is a centre for information exchange, analytic research, encouragement, examination and implementation coordination of project related to energy efficiency, energy saving, renewable energy sources and innovations. REA is the single platform for interaction between energy market actors, including the foreign ones.

Program activities are expected to reduce energy intensity of GDP and primary energy not less than 7.4% equivalent to 85 million tons and 13.5% equivalent to 170-180 million tons of fuel, during Phase I (till 2015) and Phase II (2020) of the Program, respectively.

According to the Law on Energy Savings, the regional and municipal administration should:

- Develop energy efficiency improvement programs with targets for energy consumption reduction. These programs must address 1) housing 2) heat supply systems 3) state or municipal organizations 4) transport and other sectors.

- Not allow additional heat generation capacity be constructed if the need in heating energy can be met with existing generation facilities.

The Law sets targets and incentives of EE for public buildings as follows:

- Reduction of energy consumption (15% for 5 years)

- Organizations are allowed to retain the savings from reduced energy consumption (for 5 years) Energy service contracts are encouraged as a means to finance EE investments in such buildings.

The package of other laws and regulations of DH supply comprise:

- Federal Law dated 30.12.2004 № 210-ФЗ «On Fundamentals of Tariff Regulation of Utilities Complex Organizations" (since Federal Law № 190-FZ approved provisions of this Law are no longer cover DH regulation).

- Resolution of the Government of Russian Federation dated 14.07.2008 № 520 "On Fundamentals of Price Formation and Procedure of Tariffs, Surcharges and Boundary Indices Regulation in the Sphere of Utilities' Activity". (According to the Immediate plan for the Federal Law "On Heat Supply" the new Fundamentals… regarding heat supply are to be approved by the middle of 2011).

- Resolution of the Government of Russian Federation dated 26.02.2004 № 109 “On Price Setting Regarding Power and Heat in Russian Federation” together with the “Fundamentals of Price Formation and Procedure of Tariffs, Surcharges and Boundary Indices Regulation in the Sphere of Power and Heat” and the “Rules of State Tariff Regulation and Power and Heat Tariffs Application in Russian Federation”.

- Resolution of the Government of Russian Federation dated 22.08.2005 № 533 “On the Approval of Regulation on Interaction of the State Authorities of Constituent Entities of Russian Federation Implementing Regulation of Tariffs for Goods and Services of Utilities Complex Organizations with Local Authorities Exercising Regulation of Tariffs and Surcharges of Utilities”.

- Resolution of the Government of Russian Federation dated 07.04.2007 №208 “On Resolution Procedure of Disputes Occurring between the Authorities Implementing Regulation of Tariffs and Surcharges for Goods and Services of Utilities”.

- Resolution of the Government of Russian Federation dated 24.05.2007 №316 “On the Approval of Rules of Definition of Operation Conditions for Utilities, Objective Change of which Influences upon the Cost of Goods and Services of such Organizations”.

- Resolution of the Government of Russian Federation dated 23.07.2007 №468 “On the Approval of State Control Implementation Rules for Tariffs and Surcharges Regulation” (in the wording of the Resolution of the Government of RF # 474 dated 26.06.2008).

- Order of the Ministry of Regional Development of Russian Federation dated 14.04.2008 №48 “On the Approval of the Monitoring Methodology of Production and Investment Programs Implementation by Utilities”.

- Order of the Ministry of Regional Development of Russian Federation dated 10.10.2007 №99 “On the Approval of Methodological Recommendation on the Development of Investment Programs for Utilities Complex Organizations”

- Order of the Ministry of Regional Development of Russian Federation dated 10.10.2007 №101 “On the Approval of Methodological Recommendation on the Development of Production Programs for Utilities”

- Order of the Ministry of Regional Development of Russian Federation dated 10.10. 2007 г. №100 “On the Approval of Methodological Recommendation on the Preparation of Terms of Reference on the Development of Investment Programs for Utilities”

- Order of the Federal Tariff Service dated 26.01.2007 г. № 12-э “On the Approval of Procedure and Basis for Preliminary Approvals of the Decision of the Executive Authority of Constituent Entity of Russian Federation on the Approval of Boundary Indices for Municipal Units, Tariffs for Goods and Services of Utilities on the Level Higher Than Maximum and (or) Lower Than Minimum Boundary Index Stipulated by the Federal Executive Authority regarding Tariffs and Surcharges Regulation for the Constituent Entity of Russian Federation.

According to the Immediate plan for the Federal Law №190 “On Heat Supply” the following regulations are to be approved in 2011:

1. Resolution of Government of Russian Federation introducing amendments to certain acts of the Government of Russian Federation with division of heat supply power between federal executive authorities.
2. Resolution of Government of Russian Federation on procedures of heat equipment renovation and withdrawal and on financial compensation to owners if suspending is caused by authorities decision under the threat of heat deficit no longer than 3 years.
3. Resolution of Government of Russian Federation on access to heat supply system.

4. Resolution of Government of Russian Federation on adjustment and approval of heating supplier investment program.
5. Resolution of Government of Russian Federation on standards for information disclosure by heat suppliers and regulators.
6. Resolution of Government of Russian Federation on fundamental of price formation in the sphere of heating.
7. Resolution of Government of Russian Federation on long term regulation characteristics to heat suppliers.
8. Resolution of Government of Russian Federation on calculation the assets cost and invested capital, separated accounting in RAB regulatory heat tariffs.
9. Resolution of Government of Russian Federation on adjudicate the dispute between regional or local regulators and consumers in designing, establishing and updating heating project.
10. Resolution of Government of Russian Federation on heat safety system, prevention and elimination of emergence heat supply accident.
11. Resolution of Government of Russian Federation on antimonopoly regulations and control.
12. Resolution of Government of Russian Federation on requirements for heating projects.
13. Resolution of Government of Russian Federation on heat tariff approval procedure by regional regulators in case of some consumers are provided by heating supplier from another region.
14. Resolution of Government of Russian Federation on long term contract with additional implemented after 01.01.2010 consumers by agreement tariff for heat and heat-transfer agent.
15. Resolution of Government of Russian Federation on control under using of investment resources included in a heat tariff.
16. Resolution of Government of Russian Federation on standards of function for regional regulator.
17. Official regulatory jurally acts of heat and heat-transfer agent metering regulation (Order of FTS of Russia).
18. Official regulatory jurally acts of heating season readiness rules.
19. Official regulatory jurally acts of accident investigation procedures.
20. Resolution of Government of Russian Federation on heat and heat-transfer agent process losses standard, standard of fuel consumption per unit, fuel margin standard excepting combined production.
21. Official regulatory jurally acts of heat and heat-transfer agent process losses standard for heat supplier operated in the area with population more than 500 thousand and in the cities: Moscow and St. Petersburg.
22. Official regulatory jurally acts of regional energy balances.
23. Official regulatory jurally acts of regional (local) heating projects and integrated heating suppliers.
24. Official regulatory jurally acts of procedures heat tariff making.
25. Official regulatory jurally acts of united cost grouping system, separated accounting and reporting system for federal, regional and local regulator.
26. Official regulatory jurally acts of accepting the method of guaranteed return on investment capital (RAB) or refusing it.
27. Resolution of Government of Russian Federation on procedures for federal regulator of settlement the differences of regulation method choice between regulator and heat supplier.

28. Resolution of Government of Russian Federation on procedures of dispensing fuel consumption per unit to electricity or heat generation in combined production.

At the moment (March, 2011) all regulations mentioned above are still being developed thus almost the entire system of heat market regulation in Russia is still under construction.

Tariff regulation takes place on four organization levels such as the federal, executive authorities, regional and the municipal level. Here only the latter one is described as follows:

The municipal authorities:

- approve development programs for communal infrastructure systems in accordance with the documents of territorial planning of municipal units;

- approve investment programs of Utilities on communal infrastructure development; and,

- set prices (tariffs) for customers (according to the new Russian legislation, all public utilities tariffs regulation authorities were passed to the Regional and Federal levels, in some cases utilities tariffs regulation authorities can be given to the municipal level by special motivated Regional Governments decision).

Building regulations

The average space and water heating intensities in Russian buildings are much higher than what could be achieved. The Russian average heating energy intensity for multi-family, high rise buildings is 229 kWh/m^2/year. The heating energy intensity for new, multi-family high rise buildings in Russia is 77 kWh/m^2/year of heat.[52] Rehabilitating existing housing stock can yield energy intensities of some 150 kWh/m^2/year.[55]

The greatest potential to improve the efficiency of final energy consumption lies in Russia's residential, commercial, and public buildings, where energy efficiency investments could save up to 68.6 mtoe per year. Energy use in buildings (144.5 mtoe) has been directly responsible for more than one-third of energy end-use in Russia. Two-thirds of the potential energy savings in this sector can be achieved through the reduction of DH use for existing space heating and hot water customers.

Price regulation

The tariffs are below the real costs, but still there is a large affordability problem in paying the heat bills. The regulator hesitates to raise the tariffs in order to avoid larger social problems to emerge. On the other hand, though, higher prices would make the rehabilitation investments profitable, that would reduce the need of price increases.

Under the current regulatory framework, the following approaches for tariff setting can be applied:

1. Cost regulation (cost of service regulation): Under this scheme the tariff will be approved each year in accordance with the (justified) costs of heat supply. Cost increases due to investment measures will only be considered if they have been approved in advance. The regulatory period for this approach is one year. Another tariff check can be requested if a cost item (such as fuel) has increased by at least 15%, but cost increases lower than that will not be considered.
2. Indexation method: A baseline tariff is approved for a period of three years. During this period cost items can be increased according to the respective input prices. As under the cost of service regulation, additional cost caused by a non approved investment program will not be considered.

[55] CENEF/WB/IFC 2008

3. Investment cost method: A surcharge on the baseline tariff, which is determined according to method a) or b), can be approved to cover the additional costs caused by the investment program. The regulatory period is 3-5 years with annual adjustments.
4. Method of comparison of analogs: a method applied to a setting long-term parameters of regulation, based on comparison of indicators of activity of the organization which are carrying out adjustable activity with the similar indicators of other organizations comparable to it on economic and technical characteristics (has never been used in Russia yet).
5. The first method is a typical cost of service approach, which does not provide any reasonable incentives to improve the efficiency and performance of the DH system.

The first method is a typical cost of service approach, which does not provide any reasonable incentives to improve the efficiency and performance of the DH system.

The second and third method can be seen as examples for an incentive regulation. They allow the investor to retain profits for cost saving measures for a period of up to three years.

The third method is definitively the preferred one for investors. As it is only a surcharge, it has to be combined with one of the other two methods. However, the surcharge will allow the investors a reasonable payback of their investments within a certain period of time.

Besides justified costs, the tariff may also include a profit. For the profit margin, the DH company may suggest a proportional surcharge upon the expenses. The regulator then may decide whatever profit can be justified, based on the real expenses and the previous year performance of the DH company. Basically, there is also a risk that the regulator will reduce the tariff if the costs due to reduced employment and losses have dropped much and are not sufficiently compensated by the repair fund and depreciations.

Based on the latest heat tariff booklet[56] there is an energy based heat tariff in terms of RUR[57]/GJ of sold heat energy. The tariff, however, has been traditionally used on normative basis: the produced heat energy has been allocated to the heated floor area connected to the system and the number of registered people living in apartments, without heat metering. Based on the already installed heat meters, however, the heating service provider is forced to apply the heat energy fee directly in metered consumption based billing.

The commercial interface with customers is cumbersome at the moment. Expanding heat metering combined with consumption based billing and one-tier tariff effectively motivate customers to save energy, thus reducing heat sales. Moreover, the current tariff may be based on underestimated network losses, and after metering completed, the company has to pay for the excess heat losses, thus also reducing the income from heat sales. In both ways the revenues of DH services will fall faster than the costs, which will lead the DH company to serious financial problems. Such an experience has been demonstrated by some DH companies in Poland about ten years ago. The only remedy was to introduce a two-tier heat tariff and set the level to cover the real costs. The commercial interface also requires effective collection practices to be adopted.

Regional Energy Committee sets the final tariff (as well as general price caps for heat from CHP). The regulator tries to keep the heat tariffs at low level in order to protect the customers, the voters, and to follow political decisions of Federal Government.

Competition

There is already some little competition on the heating sector, since DH has lost customers, probably prosperous ones, to gas heating. In general, however, but DH is in the monopolistic position in the urban areas where DH exists already. The same monopoly applies on new urban areas to be built.

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[56] Analiz tarifnovo regulirivania teploenergetyki v. 2007 po ystanovlenio tarifov na 2008, issued by administration of Khanti-Mansisk Autonomus Okrug in year 2008.

[57] RUR – Russian Ruble

Feed-in tariffs

There is FIT neither for CHP nor RES in Russia.

Emission trading scheme

There is no national emission trading in Russia.

Carbon tax

There is no carbon related tax in Russia but only VAT is applied to energy products.

Investment support

The existing legislation has made possible to invest in electricity and heat generation, but the effect of such investments has been very low, especially on the housing and communal sectors.

The Federal and local project beneficiary budgets to support the US$ 270 billion investments in energy efficiency by year 2020 amount to US$30 billion US$34 billion equivalent, respectively. The balance of US$206 billion is expected from other sources: mainly from investors and international financing institutions[58].

14.3 Customer

Customer rights

The municipality as the owner of the DH services hesitates increasing the tariffs to real cost covering level, thus financially protecting residential customers. The residential customers do not have any incentive to reduce heat losses because of low and lump sum type tariffs and missing heat control systems.

A social support system for low-income citizens in Russia regarding municipal services (including heat) is governed by Article 159 of the Housing Code of RF (FL № 188 dated 29.12.2004) and regulatory acts of governments adopted in execution thereof. For example, under Resolution of the Government of RF # 541 dated 29.08.2005, the federal standard of maximum permissible share of citizens' own expenses for the payment for residential premises and municipal services in total family income was set on the level of 22%.

There are two major barriers for performance improvement of DH systems: (I) Customers do not have power to influence on their heating bill, which does not provide any incentive to energy saving on the demand side. (I) The lump sum tariffs based on both cost plus and regulated financial return principle do not motivate the DH companies to efficiency improvement.

In practise, there are no disconnections because the customer does not have an alternative with a lower heat price.

Service quality

Service quality is poor, sometimes over and the other times underheating. The customer does have no influence on the quality other than by opening windows or dressing up better.

The DH company does not have individual service contracts with its customers.

The heat supplier has the right to interrupt or restrict heat supply in following cases:

- customer has defaulted payments on heat supply

[58] O.P. Tokarev on Dec. 3. 2009 in Moscow.

- unauthorised connection or additional heat consumption from the heating network,
- unauthorised heat off-take or water off-take or leakages
- in emergency situations

Billing

Billing of residential customers is mainly based on lump sums, but with other customers often based on metered heat consumption.

Billing is the area of the main commercial risks for heat supply enterprises. Payment of municipal services, such as heating, by citizens does not exceed 87% totally in Russia and it forms considerable accounts receivable, which is hard to collect.

14.4 Ownership

Municipality role

In Russia, the boiler houses and district heating networks and usually the DH substations, as electricity distribution networks and all other infrastructure, are basically under municipal ownership.

A problem is the divided corporate responsibility between heat transmission and distribution, which hampers holistic optimization of the integral DH/CHP systems. In the distribution side in particular, there prevails poor heating specific know-how, because the staff has to take care of all facilities related to buildings and courtyards, heating as one of many.

The DH companies are operation and maintenance organization whereas investment decisions and financing is carried out by the municipality, the owner. Billing and collection is often carried out by the municipality together with other utility bills, and sometimes by an intermediate billing company, but not by the DH company.

The border of responsibility in heat supply between the DH company is usually the outlet valves of the group substations (Ufa and Taganrog, for instance), but sometimes the DH company owns the secondary networks until the building entrance (Bashkirenergo, for instance).

The indoor piping is sometimes owned by the customer but usually maintained by the municipal service company regardless the ownership.

Private sector involvement

There are private companies involved in DH (and CHP) rehabilitation and operation. Such companies are Bashkirenergo, the Finnish Fortum (TGK-1[59] partly and TGK-10 wholly) and the French Dalkia, for instance. The latter one has a joint venture with TGK-4. In all TGK systems there is DH production and transmission included.

There is no third party access in energy production. However, the Energy Strategy until year 2030 suggest legislative support to the transparent and non-discriminatory arrangement of access for all market participants to energy infrastructure (trunk pipelines, electricity and heat supply networks) and tightening anti-monopoly legislation to preclude cartel collusions and technological monopolies.

The investor has no rights on heat tariffs and a little influence on the collection rate, which makes it difficult to invest in DH. The situation should improve as the new heat laws are going to be promulgated.

[59] TGK – Territorial power generation company

Synergy allocations

The CHP plants (energo's) do not have heat sales directly to end-users but to heat distribution companies (teplosets). Teploset has the option to use the heat-only-boiler or to buy heat from energo. In such a case the CHP heat shall be cheaper than the total costs of the heat-only-boiler.

14.5 **Planning**

Integrated resource planning

Traditionally, integrated resource planning has worked rather well in Soviet Union and resulted in comprehensive and integral DH and CHP systems. In the soviet era, however, the economy was neglected, and therefore, construction of the DH and CHP system has used excess materials and operation excess fuel consumptions.

Updated IRP based on real economic facts would result in optimal refurbishment programs.

Heat and urban planning

There has been little planning so far, and therefore, sometimes DH has expanded to areas which may not have been economic in the long term. As a result of financial problems of the companies, the total network length has shortened in the past decade. Customers have been likely switched to gas heating in low heat load density areas and the outdated DH networks sections of poor quality have become idle. The new Strategy emphasizes zoning of the areas for centralized and decentralized energy systems. The new Federal Law "On Heat Supply" lays emphasis on heat supply schemes development for the settlements, and gives priority to the CHP heat. All heat supply schemes are to be approved by the Regional governments or Ministry of Energy (for settlements with population exceeding 0.5 million). Heat schemes development as a part of integrated resource planning should be aimed at energy savings and energy improvement

14.6 **Technical**

Technical standards and design conditions

Technical standards are still based on old practices and technologies. Old soviet era technologies were not reliable. Therefore, doubling was used to ensure reliable operation. It is not uncommon that there are up to 10 DH circulation pumps in an old CHP plant, for instance, whereas in modern plants in Europe there are only one or two circulation pumps. An excess number of pumps causes additional investment and operation costs. Similar doubling and tripling of equipment applies to boilers, heat exchangers, valves, blowers and fans. Connection of several redundant equipment require additional piping, again more valves and pumps to additional pipes, etc.

Automatic control of such complicated systems would be more difficult and expensive compared to modern and relatively simple, though sophisticated, systems. Electrification would be more complex and costly as well.

Refurbishment strategies

Roughly half of Russia's potential energy savings can already be achieved through financially viable investments. Yet even financially viable investments have slow uptake. For example, in the manufacturing sector, 80 percent of energy efficiency potential is financially attractive, but few companies take advantage of all those opportunities[60].

Based on vast experience from transition economies, the refurbishment and reform must start from the customer side: customer definition and contracting, heat tariff reform, installing building level substations (ITPs) with heat metering and temperature control and removing group substations (CTPs), replacing 10-20% of the pipelines of worst technical condition by means of preinsulated pipelines. More on rehabilitation measures and obtained benefits are presented in Appendix 1 that comprises the input and output of the World Bank supported comprehensive DH rehabilitation program in Poland. Similar experiences have been obtained everywhere when comprehensive system level rehabilitation programs have been completed. Such countries are also at least eastern states of Germany (previous DDR), Estonia, Lithuania, Latvia, Bulgaria, Check Republic and Croatia.

Before refurbishing, there should be a sophisticated feasibility study prepared showing, for instance, what would be the optimal size of the new equipment and systems after the customers have saved ordered heat load and reduced their heat consumption.

14.7 Local Example 1 - Mytishi

DH system rehabilitation has taken place in a relatively small number of cities in Russia, one of them being Mytishi located in Moscow region with population of 160,000.

In 2000, the total network length was 182 km, some 95 km and 48 km of it being for distribution of space heating and DHW, respectively, and the balance of 49 km for heat transmission.

Altogether 236 compact building level substations were installed in Mytishi in the World Bank financed Municipal Heating Project to eliminate the group substation and DHW distribution networks and 60 km of new distribution networks were built. In addition, modern pumps were installed. The economic benefits of Mytishi component were consistent to those presented in Annex 1 for Polish projects and summarized in Table below.

Table 14.1: DH refurbishment experience from city of Mytishi, Russia.[61]

	Unit	Before 2002	After 2006	Change
Number of network damages	#	194	110	-43 %
Make-up water consumption per heat energy ratio	m^3/GJ	0,4	0,1	-67 %
Fuel consumption per heat energy ratio	kg/GJ	45,9	40,4	-12 %
Electricity consumption per heat energy ratio	kWh/GJ	10,0	4,8	-51 %

14.8 Local Example 2 - Taganrog

Taganrog Teplo Energo (district heating company of Taganrog) as TE located in the south on Rostov region is one of the first DH companies in Russia that was privatized. Initially TE was established in 1997 as a local branch of the regional heat enterprise. In 1997 it became a joint stock company. In an open competition taken place in 2004 the Central Invest Bank (CIB) succeeded to buy 49% of TE, the rest was given to the employees. By buying additional shares from the employees, CIB's share increased to 70%. In addition Gaszprom purchased 16 %.

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[60] CENEF/WB/IFC 2008

[61] Implementation Completion and Results Report (IBRD-46010) on a Loan in the Amount of US$85 million to the Russian Federation for a Municipal Heating Project, Report No: ICR0000881, Dec. 10, 2008

TE covers 57% of heat of heat supply and about 75% of DHW supply in Taganrog. Heat is generated in 50 boiler houses (additional three boiler houses are outside Taganrog in the region) with approximately171 boilers. The total installed capacity is 360 MW, whereas 260 MW is the normative peak capacity connected to TE's DH networks.

CIB as the main shareholder is a successful Russian Bank. CIB is partly owned by EBRD and has used lending of both EBRD and IFC for energy efficiency investment in the region. It was likely the influence of the CIB's experience in commercialization that made TE one of the most successful DH companies in Russia. TE is well organized, has already gained experience in rehabilitation and modernization and has reasonable visions about the expansion of the business. Moreover, TE offers the lowest heat tariff in the city.

The TE's management qualification obviously derived benefit from the private ownership aiming to convert the old-fashioned DH service into a commercial business. DH companies all over Europe are mostly municipal owned and key management positions are usually filled due to political deliberations and general directors typically have only a rough idea about the business. This is completely different with TE. The general director, for instance, is an experienced DH expert, who is well informed about the technical and financial aspects of his business. The competence, experience, and also commitment of the overall management seem generally to be at a very high level. Definitively, the "human capital" is one of the biggest assets of TE.

TE has a positive attitude to foster energy efficiency on the demand side. TE would be interested to invest in and promote energy efficiency measures on the demand side, but the current institutional framework does not allow this. TE's responsibility ends at the point of delivery that is a shut-off valve somewhere in the network. Thereafter pipes are typically owned by building owners and maintained by the municipal housing management company. The promotion of energy efficiency can only be achieved indirectly, through a joint program with CIB for provision of loans to TE's customers for energy saving measures, such as insulation of walls, new windows and doors installation, heat meters, heat-adjusters.

14.9 Local Example 3 - Bashkirenergo

Bashkirenergo (BE) is one of the privately owned power and heating companies in Russia. The controlling shareholder of BE with over 50% of shares is Sistema, the largest public diversified financial corporation in Russia and the CIS. BE operates in Bahshkortostan Republic located 1,600 km east of Moscow west to the Ural mountains. The capital of the Bahshkortostan is the city of Ufa with the population of about 1 million. In the region the ambient temperature may drop as low as to -35°C.

The production capacity of BE amounts to 4,200 MW of power capacity and 15,691 Gcal/h (18,250 MW) of heat production capacity. The total length of heating networks, operated and maintained by Bashkirenergo in Ufa, amounts to about 900 km (route length). The networks include 425 km two-pipe networks for heat transmission and distribution, and 451 km 4-pipe networks for the supply of heat and hot water from group substations (CTP's) to buildings.

The municipal heating services in Ufa and other towns are structured as follows:

- Heat is produced and distributed by OAO "Bashkirenergo", which owns and operates the heat sources and transmission and distribution networks.
- The Municipality of Ufa owns the group substations (CTP) and the heat and hot water supply networks between the CTP's and buildings. However, also the CTP's and supply networks are operated and maintained by BE.
- Inside the buildings, the heating systems are owned by the Municipality (municipal housing funds). The internal heating systems are operated and maintained by the municipal company called as MUE UZH.
- The border of responsibility in heat supply between BE and MUE UZH is at the entrance to the building, technically defined at the first flange at the pipeline entering into the building.

BE provides heating services to over 5.5 thousand entities (buildings) with over 30 thousand points of supply (mainly apartments). Almost 50% of heat consumers are located in Ufa, and the rest in 8 other cities and towns of the Bahshkortostan Republic.

Heat is supplied through about 300 CTP's, about 250 of which serve municipal residential buildings. In addition, BE has about 900 direct customers which receive heat through individual heating points (ITP), located inside the buildings.

The invoicing of residential heat consumption is carried out by ERKZ, a filial of MUE UZH, together with all utility bills in the city. ERKZ pays to the service providers for the services: heat, water, and housing services.

In 2011, BE has the one-tier tariff, which ranges from 573.6 to 696 RUR/Gcal (equal to 4.6 to 5.6 US$/GJ) without VAT. Tariffs are affirmed by bodies of executive power in the area of state tariff regulation (Federal Tariff Service of Russian Federation and State Commission on tariffs of Republic of Bashkortostan).

The exceptionally low heat tariffs make investments into CTP's less profitable. Moreover the local authorities rent out more and more CTPs to BE.

93% of heat sales (RUR) are currently based on consumption based billing with heat metering and the balance of 7% on the traditional normative non-metered lump sum payments (RUR/Gcal or RUR/m^2). BE plans to have all customers with heat metering by year 2011.

14.10 Local example 4 – Chelyabinsk (Fortum)

Chelyabinsk – is the city in South-Urals region with a population more than 1.2 million. In the region the ambient temperature may drop as low as to -45°C.

OAO "Fortum" (formerly – OAO "TGK-10") is the power and heating company, which was acquired by Finnish power corporation Fortum in 2008. Together with its heat transmission and distribution subsidiary OAO "UTSK" Fortum is the main heat supplier with the market share more than 80%. OAO Fortum also operates in Ozersk - city north-west to Chelyabinsk (99% of market share).

Unlike the other TGKs, in OAO " TGK-10" heat production and heat transmission/distribution were legally separated in 2008 by foundation of subsidiary allied company OAO "UTSK" (Urals Heat Transmission Company).

Now structure of heat supply system of Chelyabinsk is following:

1. OAO Fortum operates main heat sources in Chelyabinsk and Ozersk (1106 MW of power production capacity and 5558 MW of heat production capacity), all CHPs are powered mainly by natural gas.

   OAO Fortum sells all the heat generated to the OAO "UTSK" at CHPs collectors or to other heat distribution companies in Ozersk DHS.

2. OAO "USTK" operates and maintaines 369,3 km of heat pipes, with average diameter as of 500 mm and total volume as of 187,2 th.m^3, 8 high voltage pumping stations, 25 central heating substations (CTP). The newest pumping station was commissioned in September 2009.

   OAO "UTSK" also has its own production units (heat only boilers – two in Chelyabinsk, and one in Verhniy Ufaley town) with total heat production capacity of 1741,5 MW. OAO "UTSK" also buys heat from other heat producers (more than 30 small municipal and industrial HOBs), and pays transmissions fees to other small heat networks.

   OAO UTSK sells both purchased and generated heat to the final customers with different tariffs. Thus the problem of cross – subsidies between industrial and residential consumers still exists in Chelyabinsk.

   In 2011, UTSK has the one-tier tariff, which ranges from 633 RUR/Gcal (equal to 5.2 US$/GJ) for the residential consumption to 1035 RUR/Gcal (equal to 8.3 US$/GJ) for industrial consumption (all without VAT).

   Tariffs are approved by bodies of executive power in the area of state tariff regulation (Federal Tariff Service of Russian Federation and State Committee "United Tariffs Body of Chelyabinsk region).

The invoicing of residential heat consumption is carried out by GZNKP of Chelyabinsk (city united billing centre for utilities), together with all utility bills in the city.

Industrial heat sales are mostly covered by consumption based billing with heat metering. Although most of the residential consumers (served by housing maintenance companies – formerly “zekhs”) rely on the traditional normative non-metered lump sum payments (RUR/Gcal or RUR/m^2). Fortum plans to have all customers with heat metering by year 2013.

The border of responsibility in heat supply between UTSK and consumers is usually at the building walls as UTSK owns the secondary networks.

High heat tariffs for industrial consumptions had forced many of them to disconnect from DH system and install their own hear sources. Therefore over the period of 1992-2002 more than 660 MW of heat load had been detached from Chelyabinsk DHS that reduced CHP efficiency and made heat relatively more expensive. Nevertheless regional authorities and Fortum have a scheme of cross-subsidy removal by year 2014. Reduction or complete removal of cross-subsidisation between groups of consumers will make CHP heat production more competitive compared with gas powered HOBs.

OAO Fortum and Chelyabinsk Region Authorities have agreed on extensive cooperation in the area of energy efficiency. The largest operation in the programme is the automation and upgrade of the Chelyabinsk DHS, which will reduce energy losses in the area by over 30% as well as significantly decrease fuel consumption and emissions.

The main idea of the project is to interconnect the three heat sources including one HOB into one integrated scheme that will allow to produce heat in the most cost – optimal way (CHP) and deliver the heat to customer at any place of the city. A new heat substations are to be installed as well. A project this size is unique in Russia and will be partly funded by rising heat tariffs. Once completed, consumers will be provided with uninterrupted and more affordable supply of district heat.

14.11 Recommendations and Good Practices

In Russia, the main process should be to gradually convert the entire DH industry from the supply driven, socially oriented and norm based operation to demand driven, commercially oriented and measurement based one in order to provide incentives to all actors, the customers and heating service providers, to improve overall economy (energy and water efficiency and) and technical performance (preventive maintenance, optimal rehabilitation investments). In practise it means actions listed as follows:

Legal and regulatory framework

Issue	National Energy Policy
Problem	Current federal and regional legislation on energy efficiency is largely declarative and does not address key barriers such as lack of information and insufficient access to long term funding. Measures to remove these barriers and stimulate uptake of financially viable energy efficiency projects are essential to realizing Russia's energy efficiency potential and avoiding the consequences of continued high-energy intensity at higher tariffs.[62] Without strong support from the Government, it is hard to expect a comprehensive DH rehabilitation will start any time soon.
Recommendation	REA with substantial budget funds and the international co-operation being under establishment to support implementation of the Law on Energy Saving provides promising views to DHC and CHP sector development. On the other hand, traditional bureaucracy, largest country in the world, problems with investor related institutional framework hinder such development. An Action Plan including financial resources to the DH strategy and DH law should be prepared, approved and implemented.
Good practice	Bulgaria (Chapter 6), Poland (Appendix 1)

Issue	Price regulation
Problem	The most significant barriers to energy efficiency in the heat supply sector relate to the application of tariff methodologies, the legal structure of municipal utility providers, and a lack of sectoral information and coordination.
Recommendation	The solution requires substantial reform of the heat tariff system with two-tier tariffs to reflect the cost structure, realistic depreciation rates to collect funds for refurbishment, subsidies targeted to poor rather than to all heat customers; , Better collection of statistical information, and development of a heat supply plan would support the refurbishment.
Good practise	Kosovo, Bulgaria, Denmark, Finland, Germany (Chapter 6), Poland (Appendix 1)

Issue	Building regulations
Problem	The energy efficiency potential in end-use sectors is enormous. In fact, the financially viable **potential in end-use sectors is four times higher than that in electricity and heat supply systems**. Moreover, end-use savings are accompanied by an additional decrease in primary energy consumption (94 mtoe) across the entire energy value chain. For example 1 kWh of reduction of consumption in the residential sector will lead to a 5 kWh reduction in primary supply.[62]
Recommendation	Consumption billing and cost covering tariffs as essential parts of the Tariff reform would mobilize energy efficiency improvements in the residential sector. Revolving funds would help financing the indoor installations.
Good practise	Nordic Countries, Germany, Bulgaria (Chapter 6), Poland (Appendix 1)

[62] CENEF 2008, Introduction Chapter

Issue	Competition
Problem	With current poor technical service quality and cost covering tariffs DH would not be commercially competitive to individual gas heating. Missing competition is one more reason to keep the DH sector passive towards any reforms. High heat tariffs for commercial consumers due to cross-subsidies are making DH even more non-competitive.
Recommendation	Municipalities should consequently implement their local heat plans Price distortions between DH and electricity created by subsidies have to be eliminated
Good practise	In Poland and Bulgaria (Appendix 1 and Chapter 6), for instance, the DH sector became active to reforms and refurbishment as the heating market opened for competition. Market opening caused customer escape flow from DH to gas heating. In one Polish company 25% of DH customers left in one year’s time. Later on, after the DH system refurbishment was underway and heat tariffs reformed, the customer flow turned back to DH. In the turn, the hiking gas prices and occasional explosions of old gas installations had strong influence as well.

Issue	Feed-in-tariffs for CHP or renewables
Problem	There is overwhelmingly CHP already, but th plants run at low efficiency and the CHP share in DH production constantly declines.
Recommendation	CHP with and without RES should be supported in order to improve overall energy economy.
Good practise	

Issue	Emission trading scheme
Problem	Lack of funding for DH refurbishment. Ministry of Economy is against emission trading, since fossil fuels are economic but RES would need financial support..
Recommendation	Emission trading could be a way to co-finance DH refurbishment.
Good practise	

Issue	Carbon tax
Problem	Lack of funding for DH refurbishment. Ministry of Economy is against emission trading.
Recommendation	Carbon tax would be a way to promote renewable energy adoption in DH and CHP systems.
Good practise	

Issue	Investment support
Problem	Municipalities as owners of DH systems do not have financial capabilities for the time being. DH Companies are usually financially too weak to finance larger investments by themselves or even by normal bank loans.

Recommendation	Long term contracts are needed with municipalities, heat customers and heat suppliers in order to create a solid basis for commercial borrowing.
Good practise	Bulgaria (Chapter 6), Poland (Appendix 1)

Customer issues

Issue	Customer definition and rights
Problem	Apartment owner is DH customer. However, DH company owns the heat transmission up to group substations (CTP), whereas the maintenance company operates and maintains the secondary networks, owned by municipality, up to apartments. The customer has no means to control the heat supply. Heat tariffs are kept artificially low in order to protect customers. Despite low tariffs, collection rates are low. The DH companies have little power to use court support in order to improve collection rates.
Recommendation	Long term contracts should be made with customers and the company customer relation should be made fully commercial. Customer definition should be reconsidered. Apartment owners creating house owner associations as DH customers should financially benefit for such measures.
Good practise	Bulgaria, Finland and Denmark (Chapter 6) and Poland (Appendix 1)

Issue	Service quality
Problem	The DH systems are (i) oversized, which causes both investment and operation costs; (ii) the customers are without any control device to regulate the heating quality; (iii) long maintenance breaks ins ummer time leave the customers without DHW.
Recommendation	Modern substations and better gate valves in the networks would (i) allow interconnection of DH systems, (ii) modern substations on building level would provide good heating comfort and energy savings to customers; (iii) modern preventive maintenance practices would reduce technical problems and speed up repairs.
Good practise	Bulgaria is one of the few transition countries that has implemented quality of service standards for heat

Issue	Billing
Problem	Billing based on lump sums that do not fully cover the costs of DH services effectively prevents any modernization of the DH systems. It is hard to find financing under such desperate conditions.
Recommendation	Consumption based billing with full cost covering tariffs is the only way to motivate the actors to reduce energy consumption. Long term contract with municipality, customers and heat suppliers would attract financing for refurbishment.
Good practise	There is vast experience in consumption based billing in EU, South

	Korea and in the North America. Bulgaria (Chapter 6) and Poland (Appendix 1) provide examples of recent changes from lump-sum to consumption based billing with good results. Croatia and Macedonia (Skopje) already apply consumption based billing. Skopje/Macedonia applies a clear and consequent collection policy that is supported by the courts.

Ownership issues

Issue	Municipality role
Problem	Municipality as owner intervenes operative decision taking of the heating companies (teplosets) and the maintenance companies (zekhs). Therefore, the DH enterprises do not have a possibility to act as commercial and efficient business units but stay as social service offices of the municipality dedicated to provision of heating services.
Recommendation	The goal has to be transformation of municipal and social heat suppliers into commercial entities, which are able to co-finance a substantial part of the refurbishment investments by themselves. The municipality shall remain a strategic owner and all operative decisions shall be left to the DH companies.
Good practise	Bulgaria and Finland (Chapter 6), Poland (Appendix 1)

Issue	Private sector involvement
Problem	Financial conditions and institutional framework for tariff setting provides little if any incentive to private investors.
Recommendation	Reforming the tariff system and improve the financial conditions of the DH Company before privatizing them.
Good practise	Taganrog City, Fortum/TGK-10 and Baskirenergo in Russia Toplifikacija Skopje, for instance, has been able to finance all investments without grant money IFI loans.

Planning

Issue	Integrated resource planning
Problem	Integrated resource planning (IRP) is restricted to current fossil fuels and existing spread organization units, which has created suboptimal solutions: DH spread to areas that are not economic, no RES used at all; EE principles virtually missing, etc.
Recommendation	Urban plan should use IRP to optimize the mix of the various local energy companies and fuels, including renewable energy sources while using high energy efficiency, sustainability and reliable operation as ultimate goals.
Good practise	Denmark, Finland, Germany

Issue	Heat and urban planning
Problem	Traditionally, all buildings in urban areas have been connected to DH systems. Consequently, sometimes DH systems have expanded to areas that may be more economic for individual heating types.
Recommendation	Least-cost planning should be carried out when expanding/ refurbishing DH systems as a means to economically optimize the approach.
Good practise	Municipalities in Denmark have used heat planning to zone the districts to DH and non-DH areas in a successful way (Chapter 6). DH companies in Finland have done it on commercial bases, thus reaching financially successful DH systems. (Chapter 6)

Technical

Issue	Technical standards and design conditions
Problem	A number of technical standards and norms are outdated in view of new, modern technologies.
Recommendation	Review the technical standards and compare them with those applied in EU
Good practise	New European standard for design outdoor temperatures and using modern practices

Issue	Refurbishing strategies
Problem	Rehabilitation and modernization programs have hardly started in Russia in secondary networks and building sector, where the highest potential for EE prevails.
Recommendation	Rehabilitation and modernization programs are badly needed in Russia. Tariff reforms and ownership clarifications should be fostered in order to phase out the main barriers. Properly developed heat plans should show whether the rehabilitation of exiting DH systems is viable. Based on this analysis, the government should provide soft loans or grants.
Good practise	Poland (Appendix 1), Sofia (Bulgaria), Subotica (Serbia)

14.12 Information sources

- CENEF: Energy Efficiency in Russia – Untapped Reserves, study prepared by CENEF to the World Bank and IFC, 2008;
- IEA: CHP/DH Country Profile: Russia, The International DHC/CHP Collaborative.

15 Serbia

15.1 Features and Extent of DHC/CHP

History

One of the first local DH systems was constructed in the City of Niš in 1930, to supply the buildings of a Health Centre, Theatre, Business Academy, and Employment Office. It was operated with low-pressure steam like other early systems.

The history of large centralized DH systems starts after the World War II, in the early 60ies. The urgent necessity was to build new apartments. In Belgrade, the first district heating plant was built in 1961 as a means to provide effective heating to the newly built suburbs of Novi Beograd. Since then more plants were built to heat the steadily growing city. Later CHP facilities with a total electric capacity of 105 MW were constructed, but as a high-pressure gas pipeline could not be constructed for safety reasons, the plant was rarely working.

At the same time, district heating in Novi Sad, the second largest city in Serbia, started its operations based on a heat development plan that is still in use. The third largest city, Nis, also established a DH Company a DH Company in the early 60ies.

The table below shows the installed capacities and connected loads of the four biggest cities.

Table 15.1: DH load and production capacities in Serbia.

City	Installed heat generation capacity MW	Connected load MW
Belgrade	2.837	3.263
Novi Sad	653	845
Nis	236	451
Kragujevac	369	186

Natural gas used to be the most important fuel since the beginning of centralized DH. Nowadays, the DH sector consumes about ¼ of the total gas consumption.

Natural gas supply started in 1952 to supply domestically produced gas in Vojvodina (Northern part of Serbia). Gas production, transportation, distribution and consumption, was mainly developed between 1963 and 1975. The gasification program YU-916 enabled the import of natural gas from the USSR via Hungary, by 1978, and development of the gas system.

The natural gas system was developed under a state-owned company “Nafta Industrija Srbije” (NIS) and several smaller companies for local gas distribution networks, mostly on municipality based ownership.

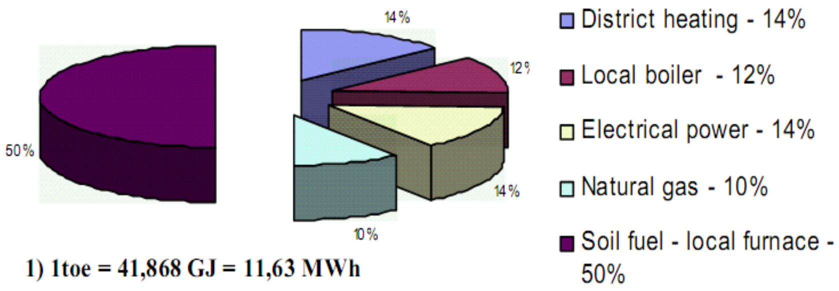
Statistics from past year

There are no official DH statistics, but the DH Association collects some basic data from its members, which comprise practically all DH Companies.

DH and CHP market shares

There are about 2.65 million dwellings in Serbia from which 50% are in urban areas. About 400,000 apartments are supplied by DH and about 260,000 apartments are supplied by local boilers. About 870,000 dwellings are supplied by electric heating, which means that there is usually no indoor piping for centralized heating installed.

The figure below shows the decomposition of energy carriers used for heat.



Source: Dimitrije Liliü, Energy Efficiency in the Building Sector in Serbia

Figure 15.1: Decomposition of the consumption of energy carriers for heating (use of direct energy carriers) in Serbia in 2005.

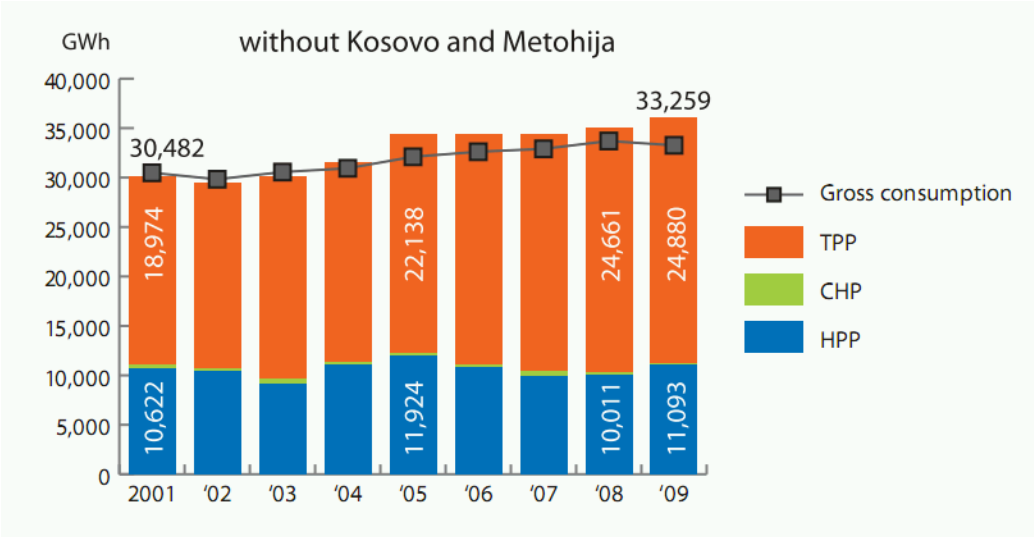
Only 14% of the households in Serbia are connected to DH, 12 % consume heat from local boilers sources using fossil fuels, mainly heating oil and coal.

When electricity was still cheap, many newly built buildings were equipped with electric heating devices (most electric storage heaters). The electricity consumption for heating was again increased by the fuel supply problems starting in the 90ies and electric for space heating became the only option for many households in the urban areas, even when they were connected to DH. A couple of years ago, it was found out that nearly 400 000 flats consumes more than 3000 GWh per year for space heating. In the nineties of the last century and early years of the current century, difficulties with providing alternative fuels for space heating, as well as the unsatisfactory operation of municipal heating plants caused serious problems, when people were obliged to use electricity. In addition, many public and commercial buildings consumed about 1600 GWh per year, also for space heating.

Nowadays, most DH companies were able to solve the fuel problem and can provide normal heating services allover the completely heating season. There are, however, some cases where the DH Companies have problems to buy sufficient fuel. The reasons are mostly financial ones such as very low collection rates and old debts to the fuel supplier (which have to be paid back first). In such cases, the DH Companies call for help from municipalities to avoid cold apartments in winter. Another reason was the stop of gas supply, which happened last year due to the dispute between Russia and Ukraine.

CHP used to play a minor role and the few that used to supply heat to DH have mostly stopped operation. CHP plants were owned either by the Electricity Company (now EPS) or by industrial companies. Figure below shows the structure of electricity production of EPS, the national electricity company. The share of electricity produced in CHP is extremely low. The annual report of 2009 does even not mention the heat sales. The operating CHP plants are located in Novi Sad, Zrenjanin, and Sremska Mitrovica; total capacity is 353 MW(el).

Besides the plant operated by EPS, there were some industrial CHP plants supplying local DH networks. One example is the city of Bor, where the Copper Mine operated a CHP plant, but CHP operation has stopped and heat is delivered by heat-only boilers now. Another example is Kragujevac, where ZASTAVA (producer of the YUGO car) operated a small CHP plant. The turbines were damaged during the war. The energetic department was separated and established as an independent DH Company, which intends to rehabilitate the turbines.



Source: EPS Annual Report 2009

Figure 15.2: Structure of electrify production and consumption in Serbia.

Types of DHC consumption

In the past, several DH systems have been created by supplying heat from industrial boiler houses (e.g., Trstenik) or CHP (e.g., Bor and Kragujevac) plants. The industrial enterprises needed steam for production processes and hot water was produced as a by-product. In the last decade, however, the DH branches have been separated and have been established as separated companies mostly owned by the Government. Nowadays, there are only a few DH Companies that continue to supply steam to industrial companies. One example is the DH Company "ENERGETIKA" in Kragujevac. The energy department was separated and established as a DH Company, which continued also to supply steam to industrial consumers. However, steam demand is decreasing continuously. Likely, steam supply is no longer viable, but the company is forced to supply steam, as this is vital for the respective industrial companies.

Nowadays, residential customers are the most important consumer group followed by commercial customers and budgetary (administrative and social institutions) customers.

Selected technologies with customer connections

Most of the DH Systems used to apply the same basic technologies as in WEC. That means, boiler houses used to be equipped with economizers and preinsulated pipes have been used in many cities since the 70ies. Moreover, typically building substations have been installed. However, many DH Companies complain about poor quality of pre-insulated pipes installed in the 70ies and there were practically no control and regulation devices in the substations, which used to be equipped with traditional shell and tube heat exchangers. Temperature control and heat metering was practically absent in substations. Even boiler houses have often not been equipped with heat meters.

The figures below show the load duration hours of the installed capacities and connected loads of 18 companies, which represent some 85% of the total DH market.

Load duration hours are of course low, because most DH Companies do not supply DHW. In the few cities, where DHW is supplied (such as in Novi Sad, Bor), only a small fraction of DH customers receive also DHW.

As it can be seen from the figure below, full load duration hours of the installed capacity below 800 hours per year are quite common. Load duration hours of connected load reaches in some cases hardly 600 hours per year.

Both numbers indicate a significant oversizing of the DH systems. There are various reasons for oversizing, caused by factors such as

- designers who want to be on the sure side and therefore have added some excess reserves;

- plans for expansion that have never realized leave the constructed system oversized: and,
- daily operation time of 16 hours, which requires larger reserves for heating up in the early morning compared with 24 hour heating.

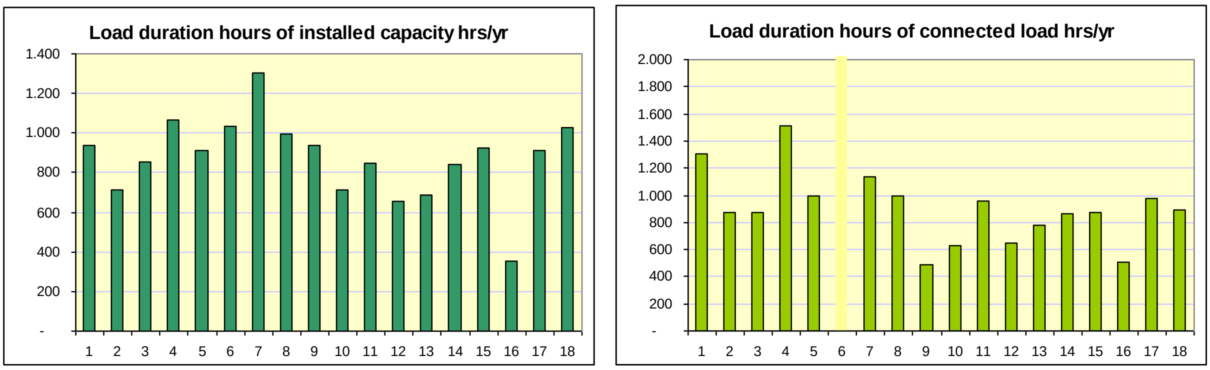


Figure 15.3: Full load duration hours in Serbia.

Heat metering rate

Heat metering started only a few years ago, mainly in the framework of the various KfW-Programs, where investment programs included heat meters. Subotica was likely the first city that has installed heat meters in most substations and implemented consumption-based billing. Nowadays, data about actual heat consumption is available from a number of cities, but there are also examples where heat meters have been installed but not read and evaluated.

According to the Energy Law, DH consumption should be metered. However, there is no secondary legislation and municipalities (as the supervisors of DH Companies) were usually not interested to enforce the installation. Nevertheless, the number of companies installing heat meters is steadily increasing, but for the time being only a small fraction is used for consumption-based billing.

Market expanding/shrinking

The DH market is expanding in most cities for two reasons. First, new buildings are constructed, mostly residential and commercial ones. As the DH tariff is still attractive, most of the building owners apply for DH. However, in cities where natural gas is available, commercial customers start to refuse DH and even existing customers disconnect due to the high tariff (which is 2-3 times higher than for residential customers).

Second, building and apartment owners in buildings with electric heating have started to apply for DH connections, even if they have to invest in in-house heat installation (pipes and radiators).

DH development is still closely linked to Urban Planning, which determines the new construction areas that shall be equipped with DH. Actually, the DH Companies have to follow these plans and corresponding instructions. Based on the plans, DH Companies tend to provide very optimistic numbers about the potentials for new connections, but real results are different from the ambitious visions. The heated area has increased in the recent years (2006-2008) by some modes 4-5% or 1.5% per year.

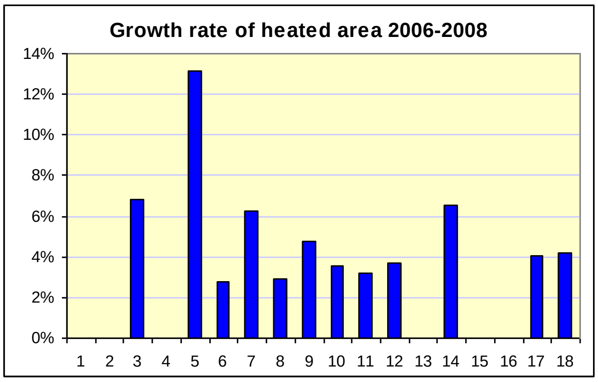


Figure 15.4: Growth rates of heated area 2006-2008 in Serbia.

In some cities, disconnection became a serious issue. There are no rules for disconnections and even individual flat owners can disconnect. There are no comprehensive statistics on disconnections. The main reason for disconnections is said to be the affordability problems. However, disconnection rates are obviously not linked with incomes, but rather with service quality. There is anecdotal evidence that disconnections started to go up, when service quality drops, which is often due to a change in the management.

The most important market drivers are, however, building and apartment owners of new buildings and existing buildings that shall be connected to DH. There are many applications from commercial companies, who want to be connected despite the high tariff. As this tariff is significantly above the production costs, DH Companies can generate some profits by acquiring new commercial companies. On the other hand, there is a tendency to disconnect when natural gas becomes available. Therefore, in the short-term, requesting high tariffs may be tempting, but in the longer run they will dispel the source of income.

Most DH Companies charge connection fees from new customers. The connection fees do not reflect the proper connection costs (i.e., costs of installing a connection between the building and the closest distribution pipeline), but constitute an investment contribution covering more or less the customer's proportion in total investment costs of the DH system. Connection fees are fixed by the municipalities. There is however, no guarantee that the connection fee will be transferred to the DH Companies.

The connection fees do not include the costs for installing the in-house centralized heating system, which is required if electric heating was the main heating source. Despite the high connection and conversion costs, many households want to connect to DH. Typically, the heated area increased by about 4-5% in the last few years 82006-2009)

Although disconnections became a serious problem, there are no rules for disconnection nor do the customers have to pay any fee. Although a number of cities have heat plans, they are sometimes not controlled or followed by the local authorities. Therefore, it can happen that in buildings connected to DH some residents have installed their own autonomous gas-heating system.

<u>Local DHC association</u>

There is the national DH Association (TOPS), which represents practically all DH Companies in Serbia.

15.2 Legal and Regulatory Framework

National policy

The strategy regarding DH was described in the Energy Strategy from 2005. Recently, the Serbian Deputy Prime Minister for EU integration Bozidar Djelic explained that Serbia needs a new energy strategy because the strategy that was adopted in 2005 has become completely outdated. However, it is not clear whether and to what extent if relates also to DH.

The basis of the energy policy is incorporated in Serbian Energy Law and Energy Development Strategy. The main pillars of the Serbian Energy Policy towards a sustainable development are:

- Competitive energy markets
- Environmental protection
- Energy efficiency and use of renewables

The Energy Strategy emphasizes the large potential for energy savings in the DH sector. The district heating systems in Serbia are oversized, have low overall efficiency, and heat from CHP is hardly utilized even if available.

To improve the efficiency on the demand side is the responsibility of the DH Companies, while the Serbian Efficiency Agency (SEEA) is in charge of improvements in efficient use of final energy and giving incentives for the rational use of energy sources. The Agency proposes changes in legislation, technical and other regulations that may bring an increase in energy efficiency, prepares and implements programs for saving, rational and efficient use of final energy in industry sector, transport, households, building stock as well as in the field of production, transport and distribution of electric power and promotes projects within renewable energy sources.

Regarding DH, the Energy Strategy identifies a number of priorities:

The key short-term priority is to undertake detailed repairs of district heating systems to increase the reliability of equipment and availability of plants. This will help to provide a safe heat supply and reduced heat and water losses, which are critical for keeping high residential heating standards and also for protecting the electricity generation and distribution systems, due to massive use of electricity for additional space heating.

In both the short and medium-term an independent Energy Efficiency Agency is needed with corresponding financial funds for the first phase of its operation and transitional measures in the ambient where, the lack of market mechanisms in the energy sector is present. This Agency would promote legislative, institutional and technical measures technical in order to provide energy saving results on cost-effective manner.

With new prices and tariff systems for electricity and heat, the appropriate scheme of subsidy for protecting the poorest segments of the population, against the impact of these prices, will be formulated and introduced by the Government, coordinated by the Ministry of Social Affairs: The possibility of using energy vouchers will be considered.

Long-term measures: For municipalities, in the building sector, energy saving measures must be concentrated on the current refurbishment work on public and residential buildings and energy source facilities. The investment in building envelopes in order to improve insulation of windows, as well as insulation of outside walls and roofs, could provide the largest possible impact on heat losses. Besides the evident energy saving effects, such activities can provide employment opportunities and promote the recovery of domestic industrial activities.

The Master Plan for Municipalities Heating Plants rehabilitation should include: improvement of C & I system by implementation of modern devices for water flow (and heat) control in distribution networks in order to provide proper water and heat distribution in the whole network reduction of heat losses by the replacement of existing pipe insulation being in poor condition using pre-insulated pipelines, reduction of heat losses by the replacement of old head exchangers using new technology; reduction of water and/or steam leaking (in heal exchangers, boiler tube leak, valves and other fittings), adjustment of boiler firing system from both fuel and air side, in order to maintain proper conditions for optimal combustion process in the furnace.

The most important improvements towards energy efficiency can be achieved by implementing combined heat and power production in district heating plants. Existing steam boilers can be sometimes reconstructed into CHP units by adding of a steam turbine generating facility. However, CHP production in modern terms means all kind of gas technologies such as gas turbines and gas engines (reciprocating motors), combined cycle gas, and steam turbine technology, using natural gas as a fuel.

Implementation of the program and realization of the objectives is significantly lagging behind expectations.

Legislation

The most important law is the Energy Law. The Law focuses on Electricity and Gas, but some general stipulations are also valid for heating, such as for prices and tariffs. The management of DH Companies is regulated by the Law on Public Companies. The Law deals with the establishment, the internal organization, and the operation of Public Companies.

Building regulation

Existing building codes are outdated and need to be revised.

The Ministry of Environment and Spatial Planning is preparing Energy Efficiency Rules, according to which each new building that will be granted an operating permit will also need to have an "energy efficiency passport". The energy passport will include data on energy consumption, energy savings, characteristics of the building, location, heating costs, etc. Oonly companies with proper certificates or licences granted by the Ministry of Environment will be able to issue the so called passports or energy identity cards. The owners of flats will have a full record of their energy consumption and of how much they can save monthly or annually. She also said that a preliminary preparation of detailed reports on energy efficiency for the newly constructed buildings will be required. The situation for the existing buildings will be somewhat different, because the state is going to try to stimulate people through subsidies, so that they would begin insulating their houses in order to save energy.
According to the Ministry of Environment and Spatial Planning insulation of a house in the size of 100 m^2 with materials of domestic production costs about € 2500. Some 300,000 to 400,000 houses in Serbia were said not to be sufficiently energy efficient, because their walls are not insulated. The experts highlighted that Serbia's energy consumption per person for heating and cooling is 40 percent higher than the European average.

Price regulation

The Energy Law required the establishment of an Energy Regulatory Agency (AERS) – Energy Agency of the Republic of Serbia). The Agency is not in charge of DH. Heat and electricity prices from CHP shall be regulated by the Agency, but so far, a corresponding regulation has not been published.

While electricity and gas prices are regulated by the Energy Regulatory Agency, DH tariffs are determined by the respective municipalities. Tariff setting is the responsibility of the Municipalities. An initial draft of the Energy Law intended to transfer the tariff setting responsibility to the future Energy Regulatory Commission, but this stipulation was finally removed from the law.

There are no special rules and procedures prescribed for DH. Despite these powers of Municipalities, there are two factors limiting the powers of the Municipalities. First, the limited price increase set by the Ministry of Finance and second, the requirement of the Energy Law, which requires actually consumption-based billing. The first factor limits tariff increases, which may not exceed the inflation rate. The second factor means the replacement of the lump-sum tariff system.

In principle, the municipalities should follow the stipulations of the energy law. Article 66 of the law stipulates:

The tariff system shall define the elements for, method of calculating energy delivered to tariff consumers, as well as the elements for, and methods of calculating services rendered to eligible consumers.

> The tariff elements for calculating energy delivered and services rendered shall contain the justified operating costs comprising the costs of depreciation, maintenance, construction, rehabilitation and modernization of facilities, insurance, fuel, environmental protection and other operating costs that ensure an adequate term and rate of return of investments in energy facilities.
>
> Tariff system elements shall be expressed in tariff rates based on which the taken over energy, i.e. services rendered in energy activities shall be calculated. The tariff system may establish different tariff rates, depending on the quantity and type of taken over energy, power and other characteristics of the energy taken over, the seasonal and daily delivery schedule, takeover point and measuring method. .

The following article stipulates:

> "The tariff system shall determine the tariff rates for calculating the following prices:
>
> ….
>
> 4) heat distribution, distribution system operation, and delivery of heat."

Heat generation has not been mentioned explicitly in the paragraph.

However, there are no rules how to calculate and to structure the tariffs. Moreover, neither the Energy Law nor a secondary legislation set any deadline for implementation. Usually, the DH Company will elaborate a methodology, which has to be approved by the city assembly (but which could ignore the decision in the next tariff round). Moreover, the city assembly cannot be enforced to approve a cost-covering tariff. Accordingly, one can expect that the well-known practice to keep tariffs low will continue, particularly before elections.

As powers to set heat tariffs have been given to the Municipalities by the Energy Law, there is no uniform, mandatory procedure. Nevertheless, DH Companies will prepare a so-called one-year business plan as stipulated by law, which means a budget proposal for the coming heating season. This one-year business plant includes financial projections of the costs for the coming heat season. Based on this the revenue requirements are calculated and a tariffs proposal derived.

In the end, however, prices are controlled by the Government. The Government put limitations on possible tariff increases in communal sector. In line with the government instructions, the tariffs may be increased up to the level of projected inflation for the respective year. As this restriction is not applied for the other energy carriers, DH companies can generate big losses if fuel price increases exceed the general inflation rate.

This restriction is not only an obstacle for cost covering tariffs, but also for consumption-based billing. Consumption-based billing will typically provide incentives for energy savings, which will ideally result in lower heat bills (provided that fuel price incentives do not offset the savings), but the capacity charge (or fixed charge) will increase due to the investment costs. In the end, the average heat price (composed by energy and capacity charge) in terms of RSD/kWh may increase, although the total bill will decrease due to lower consumption. It would be more reasonable, to couple the restriction for price increase to the average heat bill (RSD/m², yr) rather than to the unit price (RSD/kWh).

Lump-sum tariffs are still predominant in Serbian DH system. Most residential customers pay equal rates per square meter and month. Non-residential customers also pay either a lump-sum tariff or according to the consumption. The lump-sum tariff is either per square meter or per cubic meter. For consumption-based billing, different types of tariffs are applied. There are both one-part tariffs (RSD/kWh) and two-part tariffs. The two part-tariff consists of the energy charge (RSD/kWh) and the capacity charge (RSD/kW,yr) or fixed charge (RSD/m²,yr)

Nevertheless, consumption-based billing is progressing. A number of DH Companies has already installed metering devices in substations and evaluated the heat demand of the connected buildings to get a reliable basis for tariff calculation. Typically, it was found that the actual final heat demand was significantly lower than the normative heat demand. The actual heat demand is typically in the range between 120 and 140 kWh/m², yr. These numbers relate to the heat measured in the substations (which is usually identical with the building entry), which usually have to be modernized and automated.

There is also a number of DH Companies that intend to implement consumption-based in the coming heating season 2010/2011 and they have submitted tariff proposals to the city assemblies and some of them have already been approved.

It should be noticed, that implementation of consumption-based billing was a prerequisite for participation in the KfW and EAR projects. This request supported extensive discussions amongst all DH companies. Now, even companies that have not participated in these programs, want to implement consumption-based billing; however, lacking financing for heat meters can constitute serious obstacles. Consumption-based billing is also promoted by the Serbia DH Association.

As already mentioned, CHP does not play a tangible role in the Serbian DH sector. There is no special cost-allocation methodology in force. Those CHP plants that deliver heat to local DH systems are operated by EPS, the national electricity company. It would be the task of the Energy Regulatory Agency (AERS), which was established by the Energy Law of 2004, to determine prices for heat and electricity generation in CHP, but so far, a methodology has not yet been published.

Social considerations are not an issue for DH Companies and they do not have any obligations to offer special tariffs for some privileged consumer groups. Municipalities, however still continue to request lower tariffs for residential consumers at the costs of commercial customers. The lower tariff is usually justified by an alleged affordability problem. However the problem of direct subsidies is well-known and the average share of heating costs in disposable household income is reasonable, there are, of course, some sub-groups of residential customers that earn much less than the average consumers. These sub-groups should receive targeted subsidies, but so far, there are no special programs for heating costs in place.

For the time being, there are no direct subsidies of the Central Government for DH. Municipalities used to provide subsidies for fuel purchases and investments. Such decisions are taken case by case and there is no obligation to provide such subsidies.

A serious problem is constituted by low collection rates and the resulting cash flow. Collection rates were generally very low some 10 years ago, but meanwhile a number of DH Companies succeeded to achieve reasonable collection rates of 90% and even higher. There are, however, several companies, also amongst the larger ones, with low collection rates. The DH Company in Kragujevac, for example, had collection rates of some 100% some years ago, which dropped since then and were only 75% in 2008. There are likely various reasons, but one reason is the separation of billing and collection services out of the company and transferring this task to a separate enterprise owned by the company. Such practice is applied in various cities including Belgrade. Typical results of the outsourcing are low collection rates. Moreover, the companies are plagued by high fees for this service; fees are connected to the tariffs rather than to the costs of the service.

Competition

The following table illustrates the competitiveness of DH against other energy carriers. The table shows the energy costs for heating a 60 m^2 apartment throughout the heating season, by different energy carriers, for the same heat quantity and quality of heating such as district heating (heating for the entire apartment at 20^oC, 16 hours a day throughout the heating season).

Table 15.1: Competitiveness of DH to other heating modes in Serbia.

	Price	Unit	Quantity/ yr		**Din/year**
Banovici coal	10.285	din/t	3,9	t	**40.400**
Vreoci dry coal	8.430	din/t	4,2	t	**35.000**
Raw coal – lignite	4.050	din/t	7,8	t	**31.000**
Fuel oil (price on October 10, 2009)	67	din/l	1394	liter	**93.500**
Natural gas	36,7	din/m3	1387	m3	**51.000**
Propane butane	73,4	din/kg	1005	kg	**73.800**
Wood (depot price)	4.495	din/m3	11,8	m3	**53.100**
Central heating (Belgrade)	64,4	din/m2	39,3	GJ	**46.400**
Electric heater (low cost night charging)	2,97	din/kWh	10920	kWh	**32.400**
Electric heater (additional day charging)	4,27	din/kWh	10920	kWh	**46.600**
Electricity – heating appliances and boilers	8,84	din/kWh	10920	kWh	**96.500**

Source: AERS

The competitiveness of DH would look a little bit different, if total costs were compared. However, private households usually make their decisions first of based on the running costs, i.e., fuel costs.

Despite the low prices, the use of solid fuels in multi-apartment buildings is not a serious alternative due to safety reasons (if used in individual heaters) and also due to environmental reasons. Therefore, alternative decentralized natural gas systems will be the most serious competitor of DH. At the same time, natural gas is already the most important fuel in the DH sector and its share will increase in the future due to the ongoing gasification program. That means, different technologies using natural gas have to compete.

Natural gas companies have already started in some cities to penetrate the traditional DH service areas. This can even happen if a heat development plan exists. It happens in some cities, that the local authorities ignore such plans and give permissions to install gas distribution lines in existing DH service areas. There is no absolute guarantee to prevent such practice, but Banks and other donors could require the protection of vested rights, i.e. the exclusive right to supply the service areas by grid-bound energies for heating purposes.

The gasification program that is actively supported by the government shall also allow the replacement of dirty fuels used by DH, such as coal and mazut. However, this could be a Trojan horse once natural gas is established in the local area and starts to compete with DH. The Government can hardly prevent this, so local governments have to engage in developing and updating heat plans and to implement them consequently.

Feed-in tariffs

Feed-in tariffs for small power generation facilities using renewable energy came into force in 2010. There are no corresponding regulations for heat producing facilities, except for gas-fired CHP plants. The table below shows the feed in tariffs. As the regulation is rather new, its impact cannot yet be assessed.

Table 15.2: Feed-in tariffs in Serbia.

--	Power Plant Type	Installed Capacity (MW)	Incentive Measure – Purchase Price (c€/1 kWh)
1	**Hydroelectric Power Plants**		
1.1		up to 0.5 MW	9.7
1.2		from 0.5 MW to 2 MW	10.316 – 1.233*P
1.3		from 2 MW to 10 MW	7.85
1.4	on the existing infrastructure	up to 2 MW	7.35
1.4	on the existing infrastructure	from 2 MW to 10 MW	5.9
2	**Biomass Power Plants**		
2.1		up to 0.5 MW	13.6
2.2		from 0.5 MW to 5 MW	13.845 – 0.489*P
2.3		from 5 MW to 10 MW	11.4
3	**Biogas Power Plants**		
3.1		up to 0.2 MW	16.0
3.2		from 0.2 MW to 2 MW	16.444 – 2.222*P
3.3		over 2 MW	12.0
4	**Landfill Gas Power Plants and plants using gas generated out of municipal waste water treatment plants**		6.7
5	**Wind Power Plants**		9.5
6	**Solar Power Plants**		23
7	**Geothermal Power Plants**		7.5
8	**Fossil Fuel Cogeneration Power Plants**		
8.1		up to 0.2 MW	C_0 = 10.4
8.2		from 0.2 MW to 2 MW	C_0 = 10.667–1.333*P
8.3		from 2 MW to 10 MW	C_0 = 8.2
8.4	on the existing infrastructure	up to 10 MW	C_0 = 7.6
9	**Waste Power Plant**		
9.1		up to 1 MW	9.2
9.2		from 1 MW to 10 MW	8.5
	Adjustment of purchase price for natural gas cogeneration power plants	$C = C_0 *(0.7* G/27.83+0.3)$ C – new purchase price of electricity C_0 – reference purchase price defined based on price of natural gas for sale to energy entities for natural gas retail trade for tariff customers, which doesn't include expenses relating to use of the natural gas transport system of "Srbijagas" Novi Sad under the tariff item "energy carriers" of 27.83 din/m^3 G (din/m^3) – new price of natural gas for sale to energy entities for natural gas retail trade for tariff customers which doesn't include expenses relating to use of the natural gas transport system of "Srbijagas" Novi Sad under the tariff item "energy carriers"	

Emission trading scheme

Serbia signed the Kyoto protocol on 2007. Carbon credits from Serbia can be purchased by the Multilateral Carbon Credit Fund established by the EBRD.

Fuel and carbon taxes

VAT is applied with two rates, i.e. 18% and 8%. According to the VAT Law from 2004, the reduced tax rate has to be paid for utility services and natural gas delivered to individual producers through the gas distribution network. A carbon tax is not levied for the time being.

Investment support

Municipalities used to provide two types of financial assistance:

- payments for fuel to ensure heat delivery during the coldest days of the heating season
- payment for investment measures

Municipalities are, however, not obliged to provide any financial assistance. In face of the financial situation of municipalities, larger financial support can hardly be expected.

In the past, DH enterprises used to act as operators of the assets owned by municipalities (later owned by the government). Investment decisions and financing was the responsibility of the municipalities. In principle, the situation is still the same and municipalities decide on the investment programs and provide financing if available. However, the readiness to provide financing for investment in DH is dropping due to decreasing incomes. Practically, municipalities can nowadays only provide some smaller contributions to the investment programs., which can also be provided by own funding in form of works done by the DH Company itself.

Financial support for DH investments has been quite limited in the last decade (see chapter about financing). Some municipalities continue to finance investments, although these budgetary contribution are becoming smaller and smaller. Investment subsidies came mostly from abroad in the last 10 years. There are various financial support programs:

- Programs of the Energy Efficiency Agency, EU, EAR which have finance EE project by several million Euro
- IA loan of $25 million for the period 2004-2010 and $ 30 million IDA/IBRD loan thereafter
- National EE program with 1 million from the Ministry of Science and Environmental Protection
- Various programs financed by the Environmental Protection Fund, Ministry of Education, Ministry of Health
- For DH several programs were available (EAR: € 22 million for five Cities)
- KfW (in total € million) 17.7 million as grant and 27.5 million soft loan (loan blended with grant)
- New KfW Program up to € 55 million for v various cities (prefeasibility studies have been performed for 18 cities)
- EBRD/SIDA (EBRD loan of 20 million, SIDA € 2 million grant for consultancy services)
- Various donations from different countries

Under current conditions, financial means for new connections has to come from connection fees and subsidies from the municipality. However, due to the bad financial situation of the municipalities prospective for such subsidies are worsening and opportunities to get longer-term credits from banks are almost zero due to the lacking guarantees that the DH companies can offer.

15.3 Customer

Customer rights

According to the Energy Law, rights and responsibilities of customers should be stipulated in supply contracts. For the time being, only a few DH companies have started to develop such contracts. The essential question is, whether contracts should be concluded with the collective building owner (e.g., a condominium association or housing association), with the individual flat owners or with both. Most DH Companies prefer contracts with collective building owners, but legislation is weak in this respect, and there are only a few functioning condominium or housing associations.

Service quality

DH Companies are obliged to supply heat allowing sufficient indoor temperatures during the regulated heating period (typically from Oct, 15 to April 15). There are no general rules how to handle complaints. Customers are usually not compensated for bad service quality. Low collection rates have often been explained with low service quality.

Billing

Billing is still based on lump sum except in Subotica where consumption based billing has been used for a couple of years already.. Other cities are increasingly adopting consumption billing as well.

15.4 Ownership

Municipality role

The central government is the owner of the DH assets, but the operating and managing tasks have been delegated to municipalities. Therefore, the important difference to being owner of the assets, is that municipalities may not sell the assets.

Actually, the Government has no direct means to intervene in the DH business. There is, however, one example of a very important intervention. This is the prohibition to increase tariffs above the inflation rate. This prohibition is exercised indirectly, i.e., through its power to approve municipal budgets.

The “Law on public self government” transfers the responsibility for DH to the municipalities:

> A municipality, through its bodies and in accordance with the Constitution and law, shall …regulate and ensure functioning and development of utility services, …, steam and hot water production and supply,

DH Companies (like other Public Companies) have to submit their budgets to the founder, i.e. the municipality, which has to approve the budget. Moreover, the founder also nominates the General Director. In this way, the Company is under full control of the Municipality. De facto, the municipality has only the right to propose a tariff, as the Government has to approve it. The government prohibited tariff increases exceeding the inflation rate.

DH Companies are controlled and supervised by the respective municipalities. This gives many powers to the municipality and hardly any to the management. The municipality nominates the general director and approves the annual budget. The General Director of the company will typically be replaced after a local election independently of this qualification. Such practice leads often to a penalization of the company’s managements weeks or even months or even months before the election and in practice to a discontinuity of the management methods and objectives. Moreover, discussions in the city assembly about tariff approvals are usually taking into account the coming elections.

This discontinuity in the company management and tariff approval is definitively one of the bigger problems of the Serbian DH sector.

Private sector involvement

The Republic of Serbia is (mostly the sole) owner of the DH system and the DH companies and is therefore entitled to sell shares or privatize DH Companies. Recently, the Government announced its intention to privatize the DH Companies. For the time being, however, there is no official, published concept or policy how to involve the private sector in DH. For new CHP plants, private-public partnership is already envisaged (e.g., for the new CHP plant in Novi Sad).

An important barrier is the mentioned restriction for tariff increase. Tariff increases are not allowed to exceed the envisaged inflation rate for the respective year, even if fuel price increases are higher.

According to the Law on Local Self Government is DH is the responsibility of the municipality, which establishes a company, which operates on a lease basis. That means, for the time being there is no room for private investors. Private investors can, however, have their own heat sources and are free to negotiate the terms of delivery with the DH Company. There are , however, no rules for third party access in the DH sector, but different models can be applied. For the construction of a new CHP plant, a consortium will be established comprising EPS, the Municipality, and the future private investor. For DH, similar cases are not known.

Principles of third party access are described in the Energy Law. Regulated third party access has to be developed by the Regulatory Agency for electricity and natural gas networks and gas storage facilities. The Energy Law defines also "privileged producers", which use renewable energy or waste and who will give priority for supplies.

The current approach to tariff setting does not offer any incentive for investors, who request a transparent and reliable method to have planning security. Although municipalities apply in principle cost-based tariff, actual results are different. As a uniform methodology and procedure is missing, actual approaches and procedures differ city by city. The same is true for cost coverage. There is no guarantee that cost-covering tariffs will be approved and if so, they may be outdated before having been approved.

Synergy allocation

The only major DH system that is currently supplied by CHP is in Novi Sad. Due to the particular contract stipulation, heat from CHP is actually more expensive than self-produced heat. The Company has tried to negotiate the contract. Although it is the duty of the Regulatory Agency, as regulation for determining heat prices from CHP has not yet been issued.

15.5 Planning

Integrated resource planning

Elements of integrated resource planning can be found in the urban development plans, which comprise the energy supply systems of the city.

Heat and urban planning

DH is local business and responsibilities have been delegated to the respective municipalities, although the assets are still owned by the Government. Most municipalities have a strong interest to develop the DH systems. Urban development plans shows the envisaged potentials for DH and DH Companies are expected to build the networks and connections.

Heat planning used to be and still is quite familiar. In Novi Sad, the DH system is based on a heat plan prepared in the early 60ies of the last century and is, basically, still valid. Nevertheless, the DH Company intends to upgrade this plan.

While in the past, heat plans were practically mandatory for investors, they have nowadays only an indicative character and neither the DH Company nor the Municipality can enforce its implementations. Moreover, municipalities may later ignore the plan, even if it has been developed only a few years before.

As long as natural gas is not available, there is practically no alternative except to connect to DH. Accordingly, DH companies in cities without natural gas, are still successful in selling new connections to commercial customers despite the high DH tariff. However, in cities with natural gas, DH Companies are facing growing competition from gas companies. In some cities, natural gas is even penetrating traditional DH service areas, as they have been allowed by the municipality.

15.6 Technical

National technical standards and design conditions

The standards for DH design are outdated and need to be revised to take into account the effects and possibilities of new technologies. Amongst others, design outside temperatures should be adjusted, which would reduce investment costs and abundant capacities.

Refurbishing and developing strategies

DH systems in former Yugoslavia used to be designed in accordance with Western European Standards. Building substations and larger shares of pre-insulated pipes are common, but maintenance was neglected for a longer period due to lacking funds. The larger DH Companies in Belgrade, Novi Sad, Nis and other cities have received significant grants and soft loans for rehabilitation and modernization measures. A new program initiated by KfW will also comprise a number of smaller cities. Nevertheless, there are still a large number of DH Companies which urgently need financial support.

15.7 Local Examples

Valjevo

The municipality of Valjevo is situated in Western Serbia and is the centre of the Kolubara District,. According to the census in 2002, Valjevo had 96,761 inhabitants, of which 61,270 were urban. There used to be a small DH network that was operated by an industrial company, until the energy part was separated and transferred to the DH Company. Another part of the city was supplied by heating through various local boiler houses and boiler rooms either supplying single buildings or various buildings via small local networks. There were some 90 such boiler-houses with capacities from 150 kW to 3,500 kW. Most of them used coal and the others heavy fuel oil with a high sulfur content. This situation caused strong air pollution in winter. The average age was 20 to 25 years. Regular maintenance of these old boilers and liquid fuel burners was affected by the lack of original spares.

In this situation, a feasibility study for a centralized DH system was prepared under EU financing and later on, some larger investments have been financed by EAR. A centralized boiler and a distribution network were installed allowing eliminating numerous local boilers. The new central plant is designed for mazut and gas, but natural gas will not be available in Valjevo for at least next 3 – 5 years. In the past heating season, 92% of the total of 39 TWh of fuel was mazut and 8% coal.

In the past heating season, 126 000 m2 out of the total heated area of 198 500 m2 was served by the new main boiler plant and the balance of 72 500 m2 by 25 small boiler houses. The average size of the small boiler houses amounts to 300 kW only. The plan envisaged to connect about 112.000 m2 to the centralized DH system allowing eliminating 64 smaller boilers with a total capacity of 37 MW,

In addition, natural gas is not yet available, but some positive results have already been achieved.

The typical efficiency of the coal-fired boilers was 60-70% while this suing heavy fuel oil was about 75%. The new plant has an efficiency of 92%, which can even be increased to 96-98% with gas and flue gas condensing. The improvement of air q1uality is visible in winter and can be smelled.

Subotica

Subotica is a city and municipality in northern Serbia, in the Autonomous Province of Vojvodina. It is located about 10 km from the border with Hungary.

The local DH Company was the first that installed comprehensively heat meters in substations and implemented consumption-based billing for residential customers. Consumption-based billing was not uncommon for commercial and public customers, but not used for commercial customers.

Practically all substations serving residential customers have heat meters. Since Dec. 1, 2005, the heat meter readings have been used for billing. The heating costs of the single buildings are distributed by two methods, per consumption or per area. Consumption is measured indirectly by heat cost allocators, which have to be financed by the customers. The other method is distribution by heated areas of the apartments. More and more consumers recognized the advantages of the heat cost allocators and nowadays about 30% of the apartments are equipped with them.

15.8 Recommendations and good practises

Legal and regulatory framework

Issue	National Energy Policy
Problem	DHC, CHP, EE and RE are prioritized in the national policy, but implementation is slow. The DH sector has actually been neglected by the Governments in last decades.
Recommendation	A proper DH strategy for the country including an action plan should be prepared
Good practice	Chapter 6 (1) , Poland (Appendix)

Issue	Building regulations
Problem	Building regulations are outdated
Recommendation	The development of the building passport is a good step forward, but cannot replace more demanding building codes.
Good practise	See chapter 6 (2)

Issue	Price regulation
Problem	No uniform rational methodology, tariffs are set by municipalities which causes a problem of conflict if interest between owner regulator, a political body whose voters are also customers of the DH Company.
Recommendation	Clear and transparent methodology for setting cost covering tariff should become mandatory. It could be developed by the Energy Regulatory Agency
Good practise	See chapter 6(3), Kosovo, Macedonia FYR

Issue	Competition
Problem	The biggest competitors to DH are natural gas and electricity. Both endanger the sustainable development of DH
Recommendation	Municipalities should consequently implement their local heat plans Price distortions between DH and electricity created by subsidies have to be eliminated
Good practise	See sector 6 (4)

Issue	Feed-in-tariffs for CHP or renewables
Problem	Feed-in tariffs for electricity produced by small-scale facilities using renewable energy are in place, but not for heat
Recommendation	Stimulate the use of renewable energy for heat production
Good practise	See chapter 6 (5), Germany

Issue	Emission trading scheme
Problem	
Recommendation	

Good practise	The European Union, See chapter 6 (6)

Issue	Carbon tax
Problem	A carbon tax does not exist. A carbon tax would increase electricity prices. Electricity prices are low and still not cost covering
Recommendation	Adjust electricity prices to real costs before introducing a carbon tax for this industry
Good practise	See chapter 6 (7)

Issue	Investment grants
Problem	Municipalities as the owners of DH systems do not have the financial capabilities for the time being. Many DH Companies are usually financially to weak to finance larger investments by normal bank loans
Recommendation	Continue with current practise to link the provision of soft loans with the request for institutional reforms.
Good practise	See chapter 6 (8)

<u>Customer issues</u>

Issue	Customer definition and rights
Problem	The common practise to allow cross-subsidies should be abolished. It stimulates commercial customers to disconnect
Recommendation	Gradually eliminate cross subsidies
Good practise	See chapter 6 (9), The European Union

Issue	Service quality
Problem	There are only a few basic quality standards defined in existing regulation and some of them are outdated.
Recommendation	A system of service quality standards similar to that applied for electricity should be developed by the Energy Regulatory Agency.
Good practise	See chapter 6 (10), The European Union, USAm, Canada

Issue	Billing
Problem	d. While the Energy Law requires consumption-based billing based on metering, implementation is lagging behind. e. Low collection rates. DH Companies are complaining about insufficient support of courts when suing non-paying customers
Recommendation	3) A corresponding secondary legislation needs to be developed 4) Accelerated legal proceedings for non-paying customers
Good practise	See chapter 6 (11), The European Union, South Korea, USA, Canada, Kosovo

Ownership issues

Issue	Municipality role
Problem	There is a clear conflict of interest. The municipality is owner of the DH Company, Tariff Regulator, and as a political body looking for voters who are also customers of the DH Company. DH Company tends to become the game balls of local politicians.
Recommendation	Separate ownership and regulatory responsibility. The latter could be shifted to the regulatory agency.
Good practise	See chapter 6 (12), The European Union

Issue	Private sector involvement
Problem	Financial conditions and institutional framework for tariff setting do not provide any incentive to private investors.
Recommendation	Reforming the tariff system and improve the financial conditions of the DH Company before privatizing them.
Good practise	Fortum and Bashkirenergo (Russia), Skopje (Macedonia), see chapter 6 (13)

Issue	Synergy allocations
Problem	To promote CHP, clear rules for feed-in tariffs are required. The current feed-in tariff system considers only small scale CHP plants fuelled by renewable energy and natural gas
Recommendation	Determine feed-in tariffs for larger CHP plants or a corresponding cost-allocation methodology for heat and electricity
Good practise	See chapter 6 (14)

Planning

Issue	Integrated resource planning
Problem	Integrated planning is in principle applied by the Energy Strategy, but has not been copied to the towns.
Recommendation	Urban plan should use IRP to optimize the mix of the various energy carriers. Based on this, heat plans should be developed.
Good practise	The European Union, South Korea, see chapter 6 (15)

Issue	Heat and urban planning
Problem	Heat planning used to be common in former Yugoslavia, but has lost its role. Heat planning based on Urban planning and IRP would allow improving the development of local heating systems. Existing heat plans are often either ignored or not updated

Recommendation	To reduce electricity consumption for heating and avoid unhealthy competition by natural gas, municipalities should develop or update their heat plans in compliance with the energy strategy. This will, however require technical assistance and financial support.
Good practise	See chapter 6 (16)

Technical

Issue	Technical standards and design conditions
Problem	A number of technical standards and norms are outdated in view of new, modern technologies.
Recommendation	Review the technical standards and compare them with those applied in EU
Good practise	See chapter 6 (17), new European standard for design outdoor temperatures and using modern practices

Issue	Refurbishing strategies
Problem	Rehabilitation and modernization programs have successfully started in a number of cities, but there are still a number of smaller cities which did not receive any financial or technical assistance.
Recommendation	Properly developed heat plans should show whether the rehabilitation of exiting DH systems is viable. Based on this analysis, the government should provide soft loans or grants.
Good practise	See chapter 6 (18), Poland (Appendix), Sofia/Bulgaria (Chapter 6), Mytishi (Russia), Subotica (Serbia)

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16South Korea

16.1 Features and extent of DHC/CHP

History

DH was introduced to Korea as late as in 1985. Public utilities like KDHC (Korea District Heating Corporation) and municipal governments were the initial suppliers of heat until private companies started to enter the market in 2000 and thereafter. At the moment there are sixteen companies or entities operating DH business including KDHC, and two municipal businesses. KDHC alone represent some 60% of the DH market in the country. There are 34 business sites, some 16 of which operated by KDHC. Other 20 companies prepare for future business in other 28 new sites.

Statistics from past three years

The share of DHC in Korea is about 3% of primary energy consumption only. The heat demand of DH has increased at some 3-4% a year recently. In year 2009, there were 13,250 MW of total installed DH capacity, some 4,700 km of the length of DH networks and 142.5 Mm^2 of heated floor area, according to the 2009 survey of Euroheat &Power. Moreover, about 200 PJ heat was delivered, some 22.6% of which was based on CHP.

The capacity of DC services is 880 MW, the largest in the world after Japan.

DHC and CHP market shares

The market share of DH is about 13% on the country level. This is equal to 1.87 million apartments out of 14.4 million countrywide connected to DH systems. Using the average size of apartments being some 106 m^2, the floor area connected to the DH systems amounted to180 million m^2.

The share of CHP of the total power generation balance amounts to 8% (2008).

Types of DHC consumption

The heat supply is operated at temperatures of 75 ~115^oC and the return at a temperatures of 40~65^oC with an operating pressure of less than 1.6 MPa. Typically both DHW and SH are supplied by the DH systems except in older commercial building in which only SH. Electricity is used for DHW supply in older commercial buildings, because the consumption of hot tap water is so local in the toilets in floors. Almost all SH is of floor heating type.

On the other hand, the DC systems are very sophisticated and serve commercial and public buildings only. The capacity of the DC systems on the country level is rather low, so they are not significant to be separately presented in the national energy statistics.

Selected technologies with customer connections

The Ministry is responsible for publicly announcing the technical criteria of constructing and operating the integrated energy systems.

The customer border is in the main valves of the building level substation. The substation comprises plate heat exchangers separately for SH and DHW, heat metering and weather controllers. The customer is responsible for the substation and the indoor heat circulation.

The operation of substations is fully automatic. Due to dominating floor heating, the supply temperatures could be rather low, but the DHW services keep them relatively high all year round.

Heat metering rate

All heat sources and buildings are with heat metering, often the households as well.

Market expansion/shrinking

The DH market it still growing at some 3-4% a year, but the growth rate is becoming slower because of slower building sector expansion.

Government plans call for another 0.67 million households to use DH by 2013 to meet stricter environmental targets. The number of households using DH will grow by 36%, by having almost one of six households to use DH by the end of the current CHP development phase.

The government plans to extend DH to 2.54 million households, which is a big increase in only three years.[63] Most of the new customers live in the Seoul-Incheon area as the climate is cold there and the population density is high.

South Korea's electricity industry is dominated by coal fired generation and nuclear energy, which, according to KEEI, together counted for more than 70% of the total 403 TWh generated in 2008. Liquefied natural gas (LNG) accounts for a further 20% of power generation while CHP accounted for 8%, most of which is based on DH applications. The government plans to increase the share of nuclear power in the country's energy mix and wants to increase the share of LNG for heating and electricity generation, including LNG use in CHP plants.

Local DHC association

There is no DHC association in Korea, because all DHC operations are rather centralized already.

16.2 Legal and Regulatory Framework

National policy

In Korea, DHC and CHP are officially considered as energy saving activities supported by the Government.

The major driver for DH development is the zoning system, which exclusively designates the particular construction area for DH supply. This is to ensure effective and optimal development of integrated energy systems to reduce total energy consumption, energy related emissions and to minimize life-cycle costs of energy supply.

The DH service provider must have a license, which is approved by the Ministry of Knowledge and Economy (MKE).

Every 5 years the Government formulates and publishes the updated master plan for Integrated Energy Supply (IES). The master plan is rather policy related and general, neither enforcing. It covers mainly a household construction plan.

CHP plants with the power capacity 10 MW_e or higher are exempted from the Environmental Impact Assessment. The exemption is to speed up CHP expansion in the country.

The DH supplier is enforced to use clean fuels (LNG) due to air pollution regulation.

The heating season in Korea is relatively short, due to its location on a peninsula and the capital Seoul situated on the sea coast. The seasonal variation is strong which hinders investment economy: high heat load in winter and low in summer.

The debatable issue of wholesale heat pricing between KEPCO (Korea Electricity Corporation) as heat producer and KDHC as bulk heat purchaser is important for the DH economy on the market. The debate takes place only between the companies without governmental involvement. However, the chosen price influences on the costs of supply, which is the major component of the consumer tariff to be approved by the Ministry.

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[63] Mr. Chul Jong Yoo, Senior Manager of KDHC's Global Business Team, South Korea targets CHP expansion, FLSmith Innovations in Ash Handling, Oct. 2010

In summer, heat load drops dramatically, and therefore, the CHP plants cannot be operated appropriately. Therefore, special measures to encourage the rational use of the facilities are required.

The key law is the Integrated Energy Supply (IES) Act, which comprises the issues as follows:

- General provision of Integrated Energy Supply,
- Permission of projects,
- Supply terms and Conditions, etc.,
- Establishment and operation of facilities,
- Korea District Heating Corporation (KDHC)
- Master plans for IES
- Consultation concerning IES
- Designation of districts subject to IES
- Support of funds,
- Permission for projects
- Supply obligations
- Charges for construction costs
- Accumulation of costs for the installation of supply facilities.

The Ministry of Knowledge and Economy (MKE) is responsible for energy policy, led by its Director General of the Energy Industry. MKE deals with energy policy planning, energy industry regulation, climate change issues, energy sector reform and energy price control. MKE's Korea Electricity Commission is in charge of regulating the power sector.

Local governments are responsible for regulating retail energy supply, covering roughly the same tasks that MKE has nationally. The MKE has a central role in developing and supporting new and efficient energy technologies, including CHP. It is therefore responsible for various support mechanisms.

The Government regulates the selection of the heating source in order to protect environment and to have less polluting fuels such as natural gas or renewable energy to meet environmental criteria in particular in and near urban areas.

Any organization regardless being a public organization, government-invested institution or local government has to consult with the Ministry while doing spatial planning in their region whether adoption of integrated energy supply in terms of DHC/CHP would be rational. In case it is rational and based on the public hearing of various parties involved, the Ministry will publicly announce that particular region will be subject to integrated energy supply.

In case the investor plans to substantially extend the existing DHC system, it needs to have a permission from the Ministry.

In case the investor needs to use public land (on or below of a road, bridge, river, sewer, bank or other land), the manager of the land is forced to allow such use if there no a specific reason to refuse.

In case the investor (the DH company) uses another's land, he is required to consult with the land owner. In normal conditions he is allowed to install and maintain pipelines on other's land.

<u>Building regulations</u>

Building regulations were not available.

<u>Price regulation</u>

The government has a strong position while regulating the DH in the country: price cap system, designation (zoning) of areas for DH in cities, licensing of DH operators, approving the terms and conditions of provided heating services.

The tariff committee of MKE approves the DH tariffs. The oil prices are based on the market. The city gas is regulated as well. The city gas is used for cooking, but if used for heating, a higher gas price is applied. The price difference between cooking and heating depends on the city, varying from 0% to 11% of the cooking price.

The electricity pricing is based on the system marginal price, SMP, and controlled by KPX.

The DH companies design the tariffs based on the price cap system for the Tariff Committee to be approved. The regulated DH prices are kept about 20% below its theoretical competitor, the costs of individual heating based on LNG.

The DHC sector has changed from the average cost pricing to the price cap pricing system. An Operator who has a newly modified heat tariff should report to Ministry of Knowledge and Economy. The Ministerial order of the district heat tariff (MOTC) declares to set a tariff cap of the new operator on the basis of its estimated long-term full costs (LFC) but it does not provide specific rules such as implementation procedures yet. The Tariff Committee of the Ministry sets the maximum charge level. It therefore has the actual authority to control the heat price.

Two tier tariffs are applied for heating throughout the country with the basic charge (fixed) an d the variable (energy) charge. The basic charge is based on heated areas (m2), 49 won/m2 a month equal to €0.4/m2 a year, whereas the energy charge may vary according to the season, separately for winter, spring, summer and autumn with some 60 to 70 won/Mcal, equal to €50-61/MWh or €14-17/GJ.

The customer is responsible for investing in the substation. Moreover, the customer is responsible for paying the construction fee based on heated area (article 18 of IES). Disconnections do not take place in Korea.

Competition

Due to mandatory heat zoning, from the customer point of view, there is no competition on the heat market. Nevertheless, there is some competition in the construction phase, whether KDHC or a private operator will be responsible for heat production.

In case there would be no DH, the customers would need to use gas and coal boilers for SH and solar collectors for DHW preparation.

KDHC has obtained the licence for small-scale power generation for about 10 years ago and for large-scale CHP some two years ago. The CHP generated power must be sold to KPX (Korean Power Exchange) that is responsible for power trading in the country.

KDHC has to compete with private sector about which company gets the new construction area to be heated in the future.

Regarding third party access, there is no third party access allowed in the regulation of DHC, but one service provider per designated area.

Feed-in tariffs

There are no FIT systems applicable in Korea for the time being.

Emission trading scheme

There is no emission trading at the moment.

Carbon tax

The introduction of carbon tax is under consideration by the Government. No energy related taxes prevail except the VAT of 10%.

Investment grants

No grants are used to support DHC and CHP investments.

16.3 Customer

Customer rights

High technical quality of DH and the prices lower than with the theoretical competitor motivate the customer. Governmental regulation of the heating sector protects the rights of the customers.

The customer has to invest rather much to the DH connection, both the substation and the construction charge. The indoor piping costs might not be needed either if apartment level gas heating would be used instead of DH.

The heat supplier is obliged to submit the mandatory Terms and Conditions of the provided DH services to the MKE as a condition for having a continuous operation licence. The Terms and Conditions stipulate the technical parameters, rights and responsibilities of the supplier and customer.

No disconnections have taken place and neither expected to take place in the future. The customer does not have any real alternative to DH due to district zoning, and on the other hand, the customers seem to be satisfied with the DH services due to high reliability and pricing 15-20% lower than with the theoretical alternative.

According to the Supply Obligation (Article 16) the heat supplier is not allowed to refuse supply DHC for users in his supply district. The heat supplier is responsible for guaranteeing the quality of heating services at all times.

Service quality

In general, there is no problem with the service quality.

Billing

Billing and collection is based on metered heat consumption.

Low income households may be exempted from paying the basic charge of heat tariff . Other fuel related poverty problems in market and transition economies: The Government issues energy discount coupons on power and gas charges for low income households but disregarding DHC. The Government has programs which have a grace period to avoid interruption of energy supply in power and gas if not paid by the customers. The grace period is not valid for DHC, but the supply can be cut according to the valid Terms and Conditions of Heating. The Government also allows distribution of coal briquettes free of charge to low income households. This is applicable mainly in urban areas having no DHC access.

16.4 Ownership

Municipality role

The municipalities are well aware and interested to start/extend DHC. The municipality does not have any significant role in DHC anymore, but they used to be the initiators in starting the DH operations some 25 years ago.

The municipality completes the heat zoning in the city, according to the principles set by the MKE, which is compulsory for the heating service providers and customers to obey.

Private sector involvement

The CHP plants are owned by KDHC (new), private companies and KEPCO (old). The networks are owned by the heating service provided, usually KDHC. The substations are always owned by the customers as well as the internal installations. The corporate type of DH companies from year 2008 is presented in Table below. KDHC as the public company dominates the statistics.

Table 16.1: Ownership of DH companies in Korea.

	Public Company	Local Government	Public + Private	Private Company	Other
Share	69%	11%	3%	16%	1%

The rights are restricted by regulated heating tariffs, but rather no competition exists after the system has been commissioned. The investor may own both the energy source and the networks until the customer substation.

By permission of the Ministry the investor is allowed to extend the system. The investor may require that a part of the investment costs shall be paid by the end-users of energy, in the form of a connection fee, for instance. However, there is no general rule how such cost should be determined, but a Presidential Degree is needed to justify collection of connection fees.

There used to be low interest loan (4.0% per year) available for the investments in integrated energy systems such as DHC and CHP compared to the commercial loans with higher interest rate of 7-8% some 5 to 6 years ago. Today, however, no such difference in the interest rates prevails but IES investments are based on commercial loan conditions.

The investment in energy saving, covering DHC and CHP as well, benefit from the tax deduction for some portion of new / replaced investment. The deduction means that up to 10% replacement investment can be used to reduce the corporate tax in the same year of investment. For instance, if the investment is allocated to three years, such deduction can be done each ear based on the investment costs of the particular year.

In Korea, the corporate tax is about 25% for high profit and 13% for low profit companies.

Synergy allocations

The costs and emissions of CHP are allocated to the products relative to their alternative production methods, condensing power plant and a heat-only boiler.

16.5 **Planning**

Integrated resource planning

Basically, the MKE is considered the integrated resource planner while acting as regulator.

Heat and urban planning

According to the IES, the MKE implements the zoning of the heating areas in the cities. In the zoned area the DH company has exclusive rights to run the DH business.

16.6 **Technical**

Technical standards and design conditions

Technical standards of DH are modern and very much consistent with the north European ones.

The investor, e.g. the DHC company, is entitled to check that the customer’s indoor installations meet the technical criteria set by the Ministry.

Refurbishment strategies

There is not need to refurbish because the DHC systems are modern.

16.7 Local Example - KDHC

There is a high residential heat demand in Seoul metropolitan area. The heat load density is very high, which economically supports the use of integral energy systems such as DHC and CHP. In Seoul, for instance, the heat load density is as high as 8 MWh/m of the network length.

The government is KDHC's largest shareholder with a 34.5% stake, while the state-owned Korea Electric Power Company (KEPCO) holds 19.6% and the government-owned Korea Energy Management Corporation (KEMCO) 10.5%. The fourth shareholder is Seoul metropolitan government, which owns a 10.4% interest.

KDHC was established as public utility in November 1985 to supply DHC. Since then, it has developed into the world's largest modern DH energy provider, as having had been endeavoured to make efficient use of energy and improve atmospheric environments, thus contributing greatly to the nation's economy.

KDHC has reported annual revenues of US$1.2 billion from assets worth $2.6 billion in 2009 and a net income of $132 million for the year.

The company sells over 11.6 TWh (42 PJ) of DH a year, about 90% of which is used by 1,094,950 households. By the end of 2009, KDHC has built the DH network of 1,515km length.

By year 2015, KDHC plans to pursue new DH businesses and to diversify into the electricity business and the new and renewable energy business, with the goal of providing DH and DC services to 2 million households nationwide and generating annual sales of 2.6 trillion won, equivalent to USD 2.5 billion.

KDHC currently supplies district cooling to 321 building complexes of various sizes and with various technical schemes. Most commercial buildings are department stores, hospitals and government buildings.

KDHC plan to use wood chips in the very small 3 MW CHP plant in Daegu. The plant was commissioned in early 2011. Renewable energy production is a part of KDHC's social obligation as DH supplier. Under the Renewable Portfolio Standard (RPS), the government has stipulated that in case a new CHP facility will be built, one has to install a renewable energy facility somewhere and not necessarily connected to CHP.

The technical design of the DHC and CHP systems is carried out by Korean District Heating Engineering Corporation (KDHEC), the daughter company of KDHC.

The adopted modern technology is based on the northern Europe practice, to which consulting and technical assistance of the Finnish Pöyry Energy Ltd has been constantly contributing since year 1983 already.

16.8 Recommendations and good practises

Legal and regulatory framework

Issue	National Energy Policy
Problem	No problem
Recommendation	

Good practise	See Chapter 6 (1)

Issue	Building regulations
Problem	(iv)
Recommendation	
Good practise	See Chapter 6 (2)

Issue	Price regulation
Problem	No problem
Recommendation	
Good practise	See Chapter 6 (3)

Issue	Competition
Problem	No problem
Recommendation	
Good practise	

Issue	Feed-in-tariffs for CHP or renewable
Problem	The share of CHP and renewable fuel is still low in Korea and CHP and DH could be substantially increased due to densely populated urban areas.
Recommendation	Fit would be an effective way to raise the commercial attractiveness of CHP.
Good practise	Germany, See Chapter 6 (5)

Issue	Emission trading scheme
Problem	The share of CHP and renewable fuel is still low in Korea and CHP and DH could be substantially increased due to densely populated urban areas.
Recommendation	Emission trading would be another way to attract DH and CHP.
Good practise	The European Union, See Chapter 6 (6)

Issue	Carbon tax
Problem	The current pricing of conventional energy does not include externalities.
Recommendation	Carbon tax would effectively address the externality problem in energy pricing.
Good practise	Sweden, See Chapter 6 (7)

Issue	Investment grants

Problem	Not needed.
Recommendation	
Good practise	See Chapter 6 (8)

Customer issues

Issue	Customer definition and rights
Problem	No problem
Recommendation	
Good practise	See Chapter 6 (9), the European Union, USA, Canada

Issue	Service quality
Problem	No problem
Recommendation	
Good practise	See Chapter 6 (10), The European Union, South Korea, USA and Canada

Issue	Billing
Problem	No problem
Recommendation	
Good practise	See Chapter 6 (11), The European Union, South Korea, USA and Canada

Ownership issues

Issue	Municipality role
Problem	There are still large and densely built areas at least in Seoul metropolitan area that are not served by DH.
Recommendation	Municipalities could be initiative while expanding DH to areas where individual heating solutions prevail.
Good practise	See Chapter 6 (12), The European Union

Issue	Private sector involvement
Problem	Private sector involvement in DH and CHP could be stronger than it is at present.
Recommendation	FIT, Carbon tax and Emission trading would effectively attract private sector to boost DH and CHP expansion.
Good practise	Toronto (Ca), Southampton (UK), Bashkirenergo and Fortum (Russia), See Chapter 6 (13)

Issue	Synergy allocations
Problem	
Recommendation	
Good practise	

Planning

Issue	Integrated resource planning
Definition	No problem
Problem	
Recommendation	
Good practise	The European Union, South Korea, See Chapter 6 (15

Issue	Heat and urban planning
Problem	No major problems.
Recommendation	
Good practise	

Technical

Issue	National technical standards and design conditions
Problem	No problem
Recommendation	
Good practise	

Issue	Refurbishing strategies
Problem	Not applicable
Recommendation	
Good practise	

16.9 Sources of information

- IES Integrated Energy Supply Act, amended on June 9, 2009, http://elaw.klri.re.kr/kor/

- KDHC http://www.kdhc.co.kr/eng/
- KDHEC Korean District heating Engineering Corporation Ltd
- KEMCO Korean Energy Management Corporation

17Ukraine

17.1 Features and Extent of DHC/CHP

History

In Ukraine, establishment of the DH and CHP has taken place in parallel with Russia.

DHC and CHP market shares

According to the national statistics report "Housing Fund of Ukraine in 2008", the total area of residential premises in housing buildings, non-housing buildings and dormitories on Jan 1 2009 amounted to 1,064,966,652 m^2, of which equipped with heating total area of residential premises in housing buildings, non-housing buildings and dormitories was 624,488,405 m^2. Thus, the market share of DH amounted to 58.6%.

Ukraine is one of the largest DH countries in Europe. Currently almost 80% of urban housing is supplied with DH through extensive grids of hot water pipes. The DH sector is rather saturated and customers are either adopting apartment level gas boilers or even remain without heating, thus enjoying on the heat losses penetrating to them through walls free of charge from their heated neighbours. Even the municipalities are offering investment subsidies to the apartment owners to purchase apartment level gas boilers while disconnecting the DH services. Therefore, the DH market share may have been even declining due to struggling competition to gas heating.

Many old CHP plants have shrunk to heat only boiler plants. The electricity generation of large CHP plants has faded due to technical reasons, and some few steam boilers are used for heat supply. This is a common situation in Ukraine having practical examples from Odessa and Shostka, in which due to industrial collapse, the need of steam and electricity, the initial reasons for the large CHP plants to exist, have vanished. The same operational shrinking has taken place with large industrial boiler plants in Izium and Uman, the industrial heat load of which has faded.

Such practices have led to extremely poor quality of DH services: low water and room temperatures as well as periodical heating are used to minimize fuel costs.

There are coal (and anthracite) mines in Ukraine, but little used for providing fuel for DH: Most DH is based on natural gas imported from Russia. The costs of gas comprise 50-70% of the DH, which explains why the DH is vulnerable to gas price changes.

Types of DHC consumption: The old DH systems are with four pipe systems and group substations, as used to be typical in Central Europe and sill is in Russia, for instance. Therefore, basically both DHW and SH could be served in case the systems are fully operational and no restrictions, neither economic nor technical, apply to fuel supply.

Selected technologies with customer connections: Predominantly, the group substations supply heat to some 20-30 buildings through tube heat exchangers and secondary networks comprising four pipes in parallel, two for SH and the other two for DHW. In the building basement, there should be a hydroelevator or balancing valve to adjust the water flows of the buildings close to the balance, but usually such equipment have been removed since having been blocked due to poor quality of water. Both heat metering and weather controlling on customer side are rare.

Ukrainian heat generating facilities are ineffective for many reasons. The most important reasons are as follows:

- technology used for heat generation is outdated and inefficient;
- key assets are heavily deteriorated;
- equipment is being used in a switching mode on unspecified fuel;
- delays and failures to carry out regular repairs.

According to the Ministry of Fuel and Energy, more than 90% of energy units have worked out their projected service life (100 000 hours), more than 60% have been in service longer than 200,000 hours.

Statistics from past year

In 2009, based on the State Statistics Bulletin on Boiler Houses and Heat Supply Network Performance, 8,250 companies have been operating 32,725 boiler houses (a complex of appliances that are located in special premises and serving for transforming of chemical energy of fuel into heat energy of steam or hot water) in Ukraine (Table 4). As of the end of 2009, the total boiler houses' capacity was 130,374 Gcal/h.

According to the same Bulletin, in 2009, there were almost 98 mln Gcal (equal to 410 PJ) of heat energy produced of which 83.8 mln Gcal (350 PJ) were supplied to own customers. Heat that was produced by these companies was mostly supplied to residential customers. 52, mln Gcal (217 PJ) or 62.1% of total supplied heat was delivered to the own customers, 26.5% to other customer groups and 11.4% was produced for internal production purposes. So, the majority of operators are supplying heat for the needs of residential use.

Table 17.1: DH statistics of 2009 in Ukraine.

Performance Indicators	Unit	2009
Total number of boiler houses (by end 2009)	#	32,700
Total capacity of boiler houses (by end 2009)	MW	151,655
Number of installed boilers (power installations) by end 2009	#	75,800
Length of heating and steam networks in route lengt (by end 2009)	km	34,600
Heat energy generated	PJ	410.2
Heat energy received from other sources	PJ	34.8
Heat energy used for boiler house needs	PJ	13.4
Heat energy supplied to own customers	PJ	350.9
including to households	PJ	218.1
Heat energy losses	PJ	51.5
% of the HE produced	%	13.5
Use of equivalent fuel	PJ	447.7

Source: State Statistics Bulletin on Boiler Houses and Heat Supply Network Performance in 2009

Types of DHC consumption

In most cases both DHW and SH are served by DH systems. In eastern cities, due to affordability reasons, heat supplies are delivered part time only, and DHW have been shut down for summer time.

Selected technologies with customer connections

DHW connection is made with tube heat exchangers that separate the primary and secondary network water circulations. The SH has originally been made with hydroelevators, but often the elevators have been removed and the reduced temperature of the primary network water flows directly from the heat sources to the radiators. The hydroelevator was to mix the primary network water of up to 150^oC temperature with the secondary network return water in order to supply up to 90^oC temperature water to the room radiators. At present, having the hydroelevators been removed, the supply water temperature does not exceed 90^oC between the heat source and the room radiators.

Heat metering rate

Often the heat sources are with heat meters but the customers rarely.

According to the Ministry of HCE[64], as of 1 January 2010, out of 229,411 residential buildings that should be equipped with meters and regulators, the residential housing stock is equipped as follows (Annex B):

- Building heat meters – 34,304 buildings or 15.0% of the total;
- Building hot water meters – 9,563 buildings or 4.2% of the total;
- Building temperature regulators – 1,424 buildings or 0.6% of the total.

Thus, the Programme implementation has been rather unsatisfactory. Local executive authorities, that are supposed to fulfil the above measures, explain such low equipment rate by the critical lack of local funds and insignificant allocations provided for this purpose from the state budget.

Market expanding/shrinking

The market share has been slightly declining since no new customers are connected to the DH systems but the existing customers have started to look for alternatives.

Disconnection of the customers is a serious problem of the DH systems in Ukraine. This is particularly serious in the eastern cities of the country, in which some 30% of the DH load is disconnected. First such customers have left that afford buying a gas boiler and the poorest ones that cannot afford even the subsidized DH services. The kind of medium class remain hanging on to the DH systems, but constantly considering some alternatives. The fixed costs of centralized DH systems are high. Therefore, after the bulk of customers have left the system, the fixed costs have to be allocated among fewer customers, which sets pressures to an increase in the price. But the price increase would encourage more customers to disconnect, and a vicious circle is there.

Local DHC association

There is an inter-regional association «Ukrteplokomunenergo” http://utke.houa.org working on the national level to represent the DH industry.

17.2 Legal and Regulatory Framework[65]

National policy

Basically, the heat supply law and the National Commission for Regulating Communal Services Market (NCRCSM) exist.

Table 17.2: Structure of district heating sector in Ukraine.

Activity	Companies	Description
Production of heat/licensed type of activity	Thermal power stations, nuclear power stations, combined heat power plants, renewable energy sources	Mostly state or privately owned.
	Boiler plants , individual heat generators	Mostly communally owned.
Transportation of heat/licensed type of activity	The networks are mostly operated by the companies that are producing heat energy	Mostly communally owned.
Supply of heat/licensed type of activity	This activity mostly performed by the companies that are producing and transporting heat energy -	Mostly relate to the activity on the sale of heat energy to customers (including providers of centralized heating and hot

64 GTZ/MDI Report 2010, Chapter 1.2.2.1.

65 GTZ/MDI report (sub sections :National policy, Laws, Price Regulation)

		water supply services).
Provision of centralized heating and hot water supply services/not licensed type of activity/	Heat producers/suppliers or housing maintenance companies (e.g. ZhEKs)	Local self governments define the provider of services in multi storied buildings and set retail tariffs

The State Targeted Economic Program of Modernization of District Heating Sector for 2010-1014 assumes that during 2010-2011 there are being developed regional programs for the modernization of heat supply systems and the rules on how they should be approved by the Council of Ministers of ARoC, oblast, Kyiv and Sevastopol municipal state administrations and agreeing them with the Ministry of Housing and Municipal Services of Ukraine.

Laws

The roles and responsibilities for the heating sector management are split between the national, regional (oblast, rayon and Autonomous republic of Crimea) state authorities and local self-governments, and they are similar to the ones that are in the water supply and wastewater disposal sector.

The split of responsibilities between the authorities of various levels for heating are defined in such laws of Ukraine:

- Law of Ukraine “On National commission of regulating the market of communal services of Ukraine”,
- Law of Ukraine “On Housing and Communal Services”,
- Law of Ukraine “On Heat Supply”,
- Law of Ukraine “On Natural Monopolies”,
- Law of Ukraine “On Antimonopoly Committee of Ukraine”
- Law of Ukraine “On Licensing of Certain Types of Economic Activities”,
- The Law of Ukraine «On Combined Generation of Thermal and Electric Energy (Co-Generation) and Use of Spill Energy» (April 5, 2005, #. 2509-IV)
- Law of Ukraine “On Local Self-Government in Ukraine”,
- Law of Ukraine “On Local State Administrations”.

The Law “On Privatization of State Property” stipulates that utilities and municipal facilities including networks, structures and equipment for supplying water, gas and heat, for discharging and treating sewage cannot be privatized.

The Law “On Renting of State and Municipal Property” stipulates that the property that cannot be privatized according to the Law “On Privatization of State Property” also cannot be rented.

The Law “On Mortgage” stipulates that state property that cannot be privatized neither can be mortgaged.

Building regulations

Standards for new buildings meet EU thermal insulation requirements.[66]

Price regulation

On July 9, 2010, the Law of Ukraine “On National commission of regulating the market of communal services of Ukraine" #2479-VI was adopted. The Law moved the rights of setting tariffs

[66] Ms. A. Babak,MDI, Dec.2010

for heating services from the local self governments to the National Regulator (National commission of regulating the market of communal services of Ukraine). According to the Law, the regulator should have been formed by January 1, 2011. Meanwhile, the regulatory functions should be carried out by the existing National Electric Energy Regulating Commission (NERC). These functions include licensing, tariff setting and setting the norms for water losses.

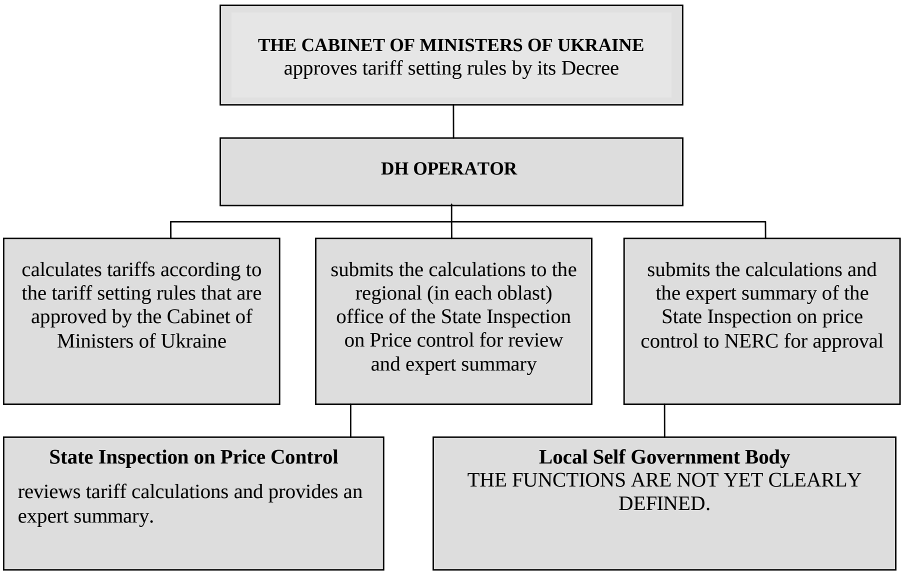


Figure 17.1: Heat tariff setting procedure in Ukraine.[67]

Local self-governments of cities, villages, residential settlement, rayon, oblast and Cabinet of Ministers of Autonomous Republic of Crimea are the owners (primarily) of infrastructure.

Heating systems' operators (of various ownership forms operating based on a charter, or PPP type contract-lease or concession) operate infrastructure to produce, transport and distribute heat to residential, commercial and budgetary customers.

There are two-tier tariffs since 2001 in about 60 municipalities already, but the bulk of municipalities are with lump sum heating tariffs,[68]

Other functions in the sector - regulation and management - are split in the following way between national and local authorities in Table below.

Table 17.3: Roles of actors being involved in DH regulation in Ukraine.

Function	The way it is carried out
Regulators and Permit Issuing Authorities	*Tariff setting* ▪ Until January 1, 2011: National Electric Energy Regulating Commission (NERC). ▪ After January 1, 2011, National commission of regulating the market of communal services (NCRCSM) ▪ Ministry of Economy of Ukraine (State Inspection for Price Control (SIPC) with its territorial departments in each oblast centre) has special role in the water supply and wastewater services tariff regulation. The SIPC checks calculation of water (wastewater) tariffs before they are submitted for approval by the

[67] GTZ/MDI report

[68] Ms. A. Babak, MDI, Dec.2010

Function	The way it is carried out
	national regulator. ▪ Local self-governments - for utilities that have installed capacity of less than 20 Gcal/hour.
	Licensing of centralized water supply and wastewater activity ▪ Until January 1, 2011: NERC. ▪ After January 1, 2011, NCRCSM ▪ oblast state administrations, utilities that have installed capacity of less than 20 Gcal/hour (25 MW);
Other Administrative functions	▪ Local self governments set hot water consumption norms for un-metered consumption of residential customers[69]; ▪ Local self governments approve schemes of heat supply and revise them every 5 years; ▪ Local self governments define the model for provision of heating services and hot water supply in multi-storied buildings (model 1: either the services are provided by the producer of heat or model 2: by the housing maintenance company that have to purchase heat from the producer and sell the service to individual residential customers). ▪ Ministry of Regional Development and Construction of Ukraine develops and submits proposals concerning de-concentration and decentralization of power of central and local executive authorities and organizes the design of state, regional and international programs. ▪ Antimonopoly Committee of Ukraine carries out state control over the implementation of the requirements of the legislation regarding protection of the economic competition, prevention, detection and termination of violations of the law on protecting economic competition. It also controls concentration, cooperative actions of the legal entities and tariff regulation for products and services that are produces (sold) by the natural monopolists.

Due to low tariff levels, low level of billing collections and due to poor quality of services, the payments for natural gas for the heating season of 2009-2010 were lower than Ukraine average (91%) in the following oblasts: AR of Crimea – 74%; Dnipropetrovska – 73%; Odeska – 70%; Donetska – 65%; Zhytomyrska – 61%; Zakarpatska – 47%l; Luhanska – 47%; city of Sevastopol – 56%.

Competition

Individual and autonomous heating in every apartment seems the most favourable option for consumers in Ukraine. In such a case they do not pay for heat and hot water but only for gas and cold water. In addition, they can regulate temperature in their apartments and do not suffer from overheating in spring and insufficient heating in winter. But sometimes it is impossible to install autonomous boilers in every apartment, because there is not enough space for heating equipment and the vertical ventilation ducts are not designed for flue gases. Therefore, it would be appropriate to install one boiler for the whole building (several apartments) or several buildings. Another

[69] This means that the regulator approves the volume of water to be billed by the water operator per customer without a meter per month.

problem for individual and autonomous heating is that in case of gas supply interruption there is no reserve fuel resources to continue heating. Reserve fuel can be provided only for centralized DH.

The outdated DH struggles in competition with modern gas heating, even gas heating supported by the municipalities in some cities (Rovenky, Sverdlovsk, Krasnodon).In many cities, all possible problems that one can imagine are with the DH: outdated and inefficient technology, high losses of water, fuel and electricity, stopped supply of DHW due to quality and cost reasons, SH supply available only during some hours of day depending on the weather conditions and fuel availability, only poor management available since educated staff have left the company due to unpaid/low salaries, unpaid customer bills and high level of receivables from customers, high level of payables regarding unpaid fuel bills, disconnected customers, etc.

Feed-in tariffs

There is no feed-in tariff for CHP in general. In Odessa, however, a feed in tariff has been granted to the old CHP plant. The power generation capacity of 16 MW only is low compared with the heat production capacity of almost 1000 MW, so the FIT does not have much practical impact at the national level. In 2006, the FIT of Odessa plant was as high as about €50/MWh.[70]

Emission trading scheme

There is not emission trading scheme inside the country.

Carbon tax

Neither carbon nor emission charges exist on fuels and energy products in Ukraine.

Investment grants

Except some EU grants, no national investment grants are available to support DH and CHP development.

For financing DHC development, there are little local financing resources and incentives available. The main investors so far have been the World Bank in Kyiv during the past ten years as well as EBRD and the Nordic Investment Bank currently in Odessa. Several feasibility studies have been prepared to many other cities under donor financing but with little implementation output. Such studies with little or no physical output have been made to Donetsk, Dnepropetrovsk, Kharkiv, Rovenky, Sverdlovsk, Uman, Shostka,Nizhyn, Priluky, Romny, Izium, Krasnodon and Alchevsk, for instance. In Alchevsk, in particular, there is a huge steel mill in the city and very old municipal boiler plants to supply heat. However, no industrial waste heat has been used for city heating that would have been provided benefits for both the industry and the city. The Alchevsk case is just one more example that the existing opportunities are not used due to lacking incentives.

17.3 Customer

Customer rights

Due to production driven operation, the customer has neither technical means nor economic incentive to influence on EE. Price regulation of the existing national regulator (NERC or NCRCSM) is to defend customer rights in heat pricing.

There are many privileged customer categories that enjoy reduced costs of DH services. In Odessa, for instance, 25% of the customers in year 2006 enjoyed such privileged heating prices. Their

[70] Odessa District Heating Project, Feasibility Study, AEAI, Inc. for EBRD, Authors files, 2006.

billings were decreased by 20, 30, 50, 75 or even 100%, which effectively destroys the business opportunities of DH.

Service quality[71]

The technical condition of the boiler houses and heating networks of the existing heating supply system is unsatisfactory (Table 17.4). More than 20% of the boilers that have been used for more than 20 years and their operation is quite inefficient.

Natural gas is the main type of fuel that is used for district heating in Ukraine. As of 2009, 69% of boiler houses were using natural gas and 30% - coal.

The Ukrainian utility heat generation system uses on average 168.6 kg of equivalent fuel to produce 1Gcal of heat. This represents 84-86% of the boilers' efficiency rate.

A considerable problem of the heating sector is the low reliability of the heating mains and their bad heat insulation. Heating networks are mainly deployed in solid reinforced concrete ducts of various configurations with mineral cotton insulation. They are not protected from the penetration of soil and water from the adjacent communications, which results in the destruction of heat insulation, intensive external corrosion of the pipe metal, which consequently damages and ruins the pipelines.

As of the end of 2009, 5,491 km of heat and steam networks (or 15.9% of their total length) were fully deteriorated (for comparison: in 2005, 13.1% of networks did not meet the requirements of technical operation).

Table 17.4: Development of the Technical Conditions of Boilers and Heating Networks in Ukraine (as of the beginning of the year) in Ukraine.[72]

Indicators	Unit	2005	2006	2007	2008	2009
Number of boilers installed	units	65161	65408	69801	72298	75831
Out of them in use for more than 20 years	units	15641	16363	16546	16468	16254
% of the total number of boilers	%	24.0	25.0	23.7	22.8	21.4
Length of heating and steam networks in the double-pipe expression	km	37385	36708	35754	35834	34626
Including those in a dilapidated and emergency condition	km	4910.5	5499.6	5185.4	5620.7	5491.4
% of the total length of networks	%	13.1	15.0	14.5	15.7	15.9

A few years ago, namely on January 22, 2006 at 1 a.m. and at an exceptionally low outdoor temperature of - 28^{o}C, a serious accident happened in the heat supply of Alchevsk, that raised public attention all over the country and involved substantial evacuation of people to Crimea amongst others. A pipeline with a diameter of 500 mm broke in the frozen soil about 3 meter deep. The first indication at Vostochnaya boiler plant about that something serious had happened was that the make-up water consumption instantly increased from 40 m^3/h to 200 m^3/h. Thereafter the pressures vanished from the network. Simultaneously, the electricity supply failed and stopped pumping of water. It took about 4 hours to locate the network damage. Excavation took time owing to frozen soil. As there is neither ventilation nor drainage in the DH channel any water or moisture entering the channel in the prevailing hot and salty environment would damage the pipe sooner or later. The concrete plates covering the channel were not likely water tight, and therefore,

[71] GTZ/MDI Report 2010, Chapter 1.2.1

[72] GTZ/MDI Report 2010, Table 1.3

allowed external water to enter the channel. It is considered probable that the location of the DH pipe below a main water distribution pipeline caused the condensing water of the water pipe to enter the channel and during many years, slowly damage it.[73] Similar accidents become more likely unless DH rehabilitation is boosted in the country.

Billing

Billing is based on lump sum payments in accordance with the heated floor area (SH) and the registered number of inhabitants per apartment (DHW).

17.4 Ownership

Municipality role

Among such specifics of the sector operations are the existing requirements for approving the heat supply schemes. Pursuant to the Law of Ukraine "On Heat Supply" there is set a requirement for the local self-governments to approve such schemes and revise them every 5 years. Such schemes should be used as the bases for economic justification of design and construction of new capacities, expanding and modernization of existing sources of heating energy and heating networks and allowing for reasonable coexistence of the centralized systems, moderately centralized and decentralized heat supply systems.

Pursuant to the Law of Ukraine "On Local Self-Government in Ukraine" local governments are authorized to select the service providers, enter into contractual relationship with service providers of various forms of ownership for centralized heating and hot water supply service provision to consumers.

Private sector involvement

Objects of district heating infrastructure can not be privatized.

The assets are operated by the operators of all ownership forms. When the operators are private, they operate the facilities based on the PPP type contracts – mostly lease or concession agreement.

There are several concessions in the district heating sector: in the city of Artemovsk (Donetsk oblast) and the city of Severodonetsk (Luhansk oblast). Quite a lot of lease contracts exist in the heating sector with the terms of lease that vary from 3, 5 and more years.

Synergy allocations

In CHP, costs of fuel (gas) are allocated to heat and electric energy production based on approved proportion of gas consumption by a specific cogeneration facility on electric and heat energy production (the proportion is determined in consumption of m^3 gas/hour). Normally, State Inspection on Energy Saving (regional department) conducts the testing of the operated facility and determines this proportion.

A recent case may illustrate the approach. For a certain CHP it was determined that 43% of the fuel has to be allocated to electric energy production and the remaining 57% to heat production. This allocation was determined based on the State Inspections' approved data on consumption of gas, which was 210 m^3 of gas/hour, including 120 m^3/hour for heat production and 90 m^3/hour for electric energy production.

17.5 Planning

Integrated resource planning[74]

[73] Authors files

[74] European Union, Municipal Services Project for Ukraine, 2006 (Author's files)

There are serious lacks in IRP when the municipality as the owner of the DH services supports individual gas boilers to be installed in apartments connected to DH systems.

The figure below shows how the individual boilers had expanded in DH connected apartments in 10 cities in Ukraine. The cities were Alchevsk, Izium, Krasnodon, Nishin, Pryluky, Romky, Rovenky, Shostka, Sverdlovsk and Uman. The Figure indicates that the individual boilers have reached quite a high market share in heating in some of the cities, in Pryluki and Sverdlovsk in particular, and the expansion seems to continue, since supported by the municipality.

In many cities, in Sverdlovsk and Pryluky in particular, if such a policy were to continue, most apartments would have an individual boiler. Therefore, no DH would be needed anymore. The least cost analysis clearly indicates that the individual boiler option implemented on a large scale is the most expensive option to the customers in the future.

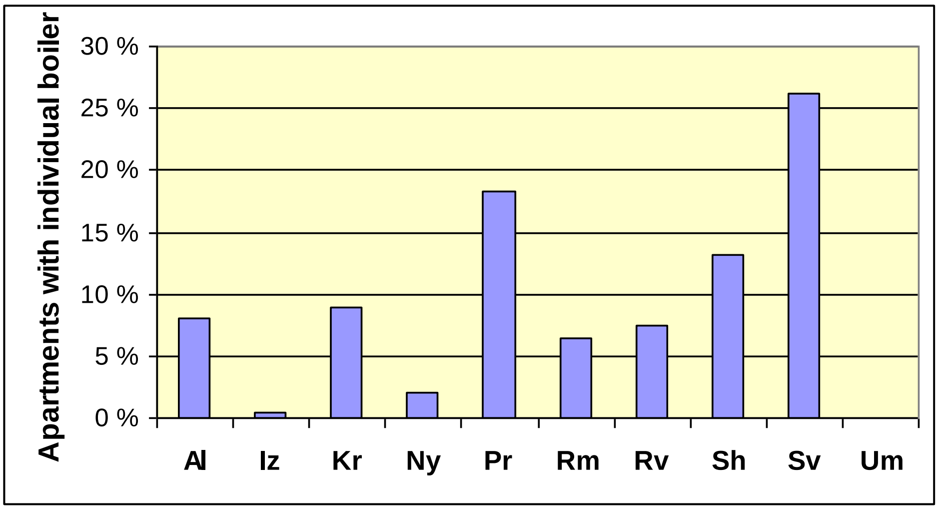


Figure17.2: Disconnected apartments in some Ukrainian cities in 2006.

Cities located near or even above coal mines have converted their heating systems to use solely natural gas. In other words, there is no redundancy for fuel supply or price problems, but both the customer and municipality are fully bound and responsible for covering gas price increases. Such cities are Rovenly, Krasnodon and Sverdlovsk.

Regarding industrial and municipal co-operations there seems to be much to improve. In Alchevsk, for instance, there is one of the largest steel mills in Ukraine, but no waste heat was used by the municipality at least by year 2007.

Heat and urban planning

Municipalities carry out heat planning, but based on above, the results are not sustainable and optimal. The municipalities tend to take urgent decision that are not sustainable in the long term.

17.6 Technical

Technical standards and design conditions

Technical standards of DH are still outdated. As one indication, there was a building level substation case in Ukraine, in which an EU manufactured substation price was twice as high as in the country of origin. The reason for the doubled price could not be fully analyzed but some reasons were import taxes and doubled pumps and heat exchangers, but those components did not fully explain the difference.[75]

[75] Author's files

Refurbishment strategies

Prior studies of MDI, which were carried out during 2009-2010 indicate that for district heating sector investment needs are mostly in reaching energy efficiency. Given the fact of increasing price of natural gas, the heating service affordability becomes a major issue for the national decision makers to solve. Energy saving potential in the DH system of Ukraine is 45-50% of the fuel energy potential, in particular (a) at the stage of generation – 4-8%; (b) at the stage of transportation – 5-6%; (c) at the stage of consumption – 34-37% of fuel potential.

To realize this estimated potential it is necessary to implement the following energy saving measures:

- thermal modernisation of all residential and public buildings;
- full replacement of duct and overland pipelines by the pre-insulated ones;
- arrangement of modern heating entry notes with seasonal regulation in all buildings;
- heating insulation of hit water pipelines in boiler houses and buildings; and
- upgrade of boiler houses to achieve no less than 90% of the average annual heat generation performance index.

The cities have some resources to finance some of these implementations, which may come from tariffs (depreciation funds or planned profit) or from the local budgets (local development funds). There is no national statistics on the amount of investment into infrastructure by sectors. But the experience shows that actual investments are minor compared to the needs (less than 10%[76].

Several feasibility studies have been financed by EBRD and EU with donor money, but they have not led to implementation. Such studies exist for Donetsk, Dnepropetrovsk and Harkiv, for instance. Such studies should be updated and used to justify financing of DH system rehabilitation. The municipality should take over the project ownership.

17.7 Local Example – Odessa

In Odessa, in the a multicultural and touristic city with population of over one million and located on the coast of the Black Sea, the Company, "Teplopostachannia Mista Odessa", (TMO) as Municipal Public Utility Company of the Heat Supply Network supplies heat to most inhabitants with space heating and domestic warm water.

Currently the district/centralized heat supply in Odessa is carried out by two companies: Municipal District Heating Company "Teplopostachanya mista Odesi" (TMO) covering about 80 % of total heat generation, and "Odeska TEC" (CHP). Odesskaya TEC heat supply is transmitted through 218 km of distribution network pipes that belong to TMO. Approximately 2800 buildings are connected to the TMO district heating network. TEC provides heat to about 1 000 buildings.

TMO operates under a charter, which defines its rights and obligations. It is, essentially, independent in its operational management but the Director is appointed by the City.

There is an ex-official Board of Directors comprised of the Director of the Company and his direct reports. This group has a Chairman. However this group is not an entity in the defined in the TMO's Articles of Association but it does appear to have an advisory/strategic role in the management of the Company.

Almost all residential consumers are billed by lump sum tariffs according to the heated area and residents living in the apartment

According to a decision of the mayor, TMO had to outsource the responsibility for collections to the private company GERTS Ltd, which performs also collection services for other utilities. The

[76] GTZ/MDI report

company has established about 300 offices all over the city, where consumers can pay their bill in cash. Outsourcing billing and collecting is usually a demotivation factor to the company management to improve overall performance.

All DH assets, except the small Shkolnaya system, that was renovated by SIDA for almost ten years ago, are about 30 years old and in poor technical condition, thus requiring urgent rehabilitation. At the moment a rehabilitation project jointly financed by the NIB and EBRD is underway to improve technical performance of the boiler plants and networks.

17.8 Recommendations and good practises

In Ukraine, several institutional actions shall be implemented. Such recommended actions are as follows:

- Strengthen the political and financial support to the municipalities and DH companies
- Strengthen the municipal support to DH company development in cases it is economically and physically justified;
- Update the technical code regarding DHC equipment in order to have modern and good quality equipment at lower costs;
- Allow customs and tax exemptions for importing of goods that are aimed at improving energy efficiency;
- Stimulate introduction of renewable energies as a means to reduce dependence on natural gas:
- Extension of consumption based billing based on heat metering and two-tier tariffs first in pilot areas and later on countrywide in order to involve both the companies and customers to save energy.
- Improve the investment climate through legislation in order to attract foreign manufacturers to start local production of modern DHC equipment and systems;
- Improve the investment climate through legislation in order to attract private sector both local and foreign to start operation of the local DHC systems in an efficient and sustainable way.

Legal and regulatory framework

Issue	National Energy Policy
Problem	The national policy should clearly support development of sustainable energy solutions in order to face out the current problems of customer disconnections, dependence on natural gas, spreading of individual gas boilers in DH connected apartments, etc. There are serious problems with integrated resource planning, which has caused exclusive dependence on natural gas, even though redundant primary energy sources (coal. lignite, biomass, waste heat) would be locally available.
Recommendation	The DH strategy is under preparation in Ukraine as a multi-ministerial approach and it should be ready in fall 2010. CHP development is in the focus of the strategy. There has also been comprehensive framework support initiated by USAID, EBRD and EU to reformulate the national energy policy, including DHC and CHP. It is uncertain now how much the political election of April 2010 will influence availability of such foreign technical assistance in the years to come. The strategy should be supported by appropriate laws. Such strategy

	should be based on improved EE goals, sustainable heating and CHP solutions using locally available primary energy sources, preferably bio mass and waste heat.
Good practice	Denmark, Finland (see Chapter 6)

Issue	Building regulations
Problem	Building regulations are updated according to EU thermal requirements but verification of their realization is poorly managed.
Recommendation	The development of the building passport is a good step forward, but needs metered verification to be effective..
Good practise	Denmark, Finland (see Chapter 6), Germany

Issue	Price regulation
Problem	Tariff regulation seems to be still based on cost plus, which does not provide incentives to EE, neither to service provides nor to customers.
Recommendation	Regulation should be based on price cap methodology.
Good practise	Kosovo

Issue	Competition
Problem	The biggest competitors to DH are natural gas and electricity. Both endanger the sustainable development if DH
Recommendation	Municipalities should consequently implement their local heat plans that are based on long-term least costs analyses and redundancy assessments. DH is the only heating mode to offer both flexibility on primary energy sources and opportunityof high-efficient CHP.
Good practise	Denmark, Poland (Appendix 1), Bulgaria, (see Chapter 6)

Issue	Feed-in-tariffs for CHP or renewables
Problem	There is no incentive to extend CHP. Therefore, most existing CHP plants are deteriorating. Typically, the old CHP plants were established to serve the local heavy industry (Shostka, Izium, Odessa), but after the industry vanished, the CHP capacity has remained idle. Problem – absence of demand from absence of hot water supply, due to deteriorated inter building networks hot water supply was ceased
Recommendation	Stimulate the use of renewable energy for heat production Increase demand for centralized heat – cooling and hot water supply
Good practise	Germany (Chapter 6)

Issue	Emission trading scheme
Problem	
Recommendation	Emission trading would help develop DH and CHP systems in a cost effective and sustainable way.

Good practise	EU and Kioto Protocol Some examples of Protocol application exist in Ukraine: Kramatorsk. E.g.

Issue	Carbon tax
Problem	A carbon tax does not exist. A carbon tax would increase electricity prices. Electricity prices are low and still not fully cost covering.
Recommendation	Adjust electricity prices to real costs before introducing a carbon tax for this industry
Good practise	Denmark, Finland

Issue	Investment grants
Problem	Municipalities as owners of DH systems do not have financial capabilities for the time being. DH Companies are financially too weak to finance larger investments by normal bank loans.
Recommendation	Continue with current practise to link the provision of soft loans with the request for institutional reforms.
Good practise	Targeted international investment grants and soft loans are welcome (Shkolnaya/SIDA in Odessa) to provide demonstration effects.

<u>Customer issues</u>

Issue	Customer definition and rights
Problem	The common practise to allow cross-subsidies should be abolished. It stimulates commercial customers to disconnect.
Recommendation	The company – customer relation should be based on contracts that guarantee the service quality.
Good practise	Denmark, Finland (Chapter 6), Poland (Appendix 1)

Issue	Service quality
Problem	The service quality of DH is extremely poor in the eastern cities, and not good in other parts of Ukraine either. Therefore, customers intend to switch to individual gas heating as affordable or remain unheated (disconnected). When disconnected, heat flow from heated neighbours through walls keeps indoor temperatures tolerable.
Recommendation	A system of service quality standards should be enforced.
Good practise	Bulgaria is one of the few transition countries that has implemented quality of service standards for heat.

Issue	Billing
Problem	Current billing based on lump sums eliminates all incentives to improve the DH system performance.

	Technical ly indoor networks require comprehensive modernization to allow apartment level regulation of heat consumption, that is costly.
Recommendation	Consumption based billing should be introduced. Therefore, heat metering of buildings should be done as priority. Rather the apartment owner association should be the customer rather than the individual apartment owners.
Good practise	Poland (Appendix 1) Croatia and Macedonia (Skopje), for instance, are already applying consumption based billing. Skopje/Macedonia applies a clear and consequent collection policy that is supported by the courts.

<u>Ownership issues</u>

Issue	Municipality role
Problem	The municipalities tend to take panic decisions to address the heating problems, the decisions which have even worsened the situation.
Recommendation	Based on the strategy to be introduced, the municipalities should develop sustainable heating solutions (DH and CHP) based on locally available energy sources to reduce dependence on imported fossil fuels, improved EE. The existing requirement to prepare a heating scheme should be updated and re-launched accordingly.
Good practise	Kosovo, Denmark, Finland, Germany, Poland (Appendix 1)

Issue	Private sector involvement
Problem	Financial conditions and institutional framework for tariff setting do not provide any incentive to private investors.
Recommendation	Reforming the tariff system and improve the financial conditions of the DH Company before privatizing them.
Good practise	Toplifikacija Skopje was able to finance all investments without grant money IFI loans. In Canada (Toronto) and USA (St Paul), after municipal initiation, a private DH operator has taken over the DH services and extended them further. In Russia, Fortum is investing in DH rehabilitation in several cities east of Ural mountains. Dalkia operates DH systems owned by municipalities worldwide.

Issue	Synergy allocations
Problem	
Recommendation	Allocation of more benefits of CHP to DH would help DH to develop and create heat load for CHP expansion. Determine Feed-in tariffs for larger CHP plants or a corresponding cost-allocation methodology for heat and electricity
Good practise	Denmark (CHP benefit allocation), Germany (FIT) in Chapter 6

Planning

Issue	Integrated resource planning
Problem	IRP has not been successful in Ukraine, since customers escape the DH systems. DH systems are exclusively dependant on mainly imported natural gas while neglecting local resources, support is given to individual systems (gas boilers) but forgetting collective and sustainable solutions (DH), etc.
Recommendation	Urban planning should use IRP to optimize the mix of the various energy carriers, primary energy sources, flexibility of fuel supplies. Based on this, new sustainable heat plans should be developed.
Good practise	Denmark, Finland

Issue	Heat and urban planning
Problem	Heat planning used to be common in former Yugoslavia, but has lost its role. Heat planning based on Urban planning and IRP would allow improving the development of local heating systems. Existing heat plans are often either ignored or not updated.
Recommendation	To reduce electricity consumption for heating and avoid unhealthy competition by natural gas, municipalities should develop or update their heat plans in compliance with the energy strategy. This will, however require technical assistance and financial support.
Good practise	Denmark (chapter 6)

Technical

Issue	Technical standards and design conditions
Problem	A number of technical standards and norms are outdated in view of new, modern technologies.
Recommendation	Review the technical standards and compare them with those applied in EU.
Good practise	New European standard for design outdoor temperatures and using modern practices as used by Poland (Appendix 1) and Bulgaria (Chapter 6), for instance.

Issue	Refurbishing strategies
Problem	There is no strategy to rehabilitate the DH and CHP systems. Therefore, individual solutions take over markets and make the rehabilitation prospects even worse. Frequent failures in the heating systems as a result of outdated equipment and poor funding are still common throughout the country. Some service breaks in coldest winter times have caused serious impacts on human life already (Alchevsk 2006).
Recommendation	Rehabilitation and modernization programs are needed in Ukraine

	based on the several feasibility studies already completed. Properly developed heat plans should show whether the rehabilitation of exiting DH systems is viable. Based on this analysis, the government should provide soft loans or grants.
Good practise	Poland (Appendix 1), Mytishi (Russia), Sofia (Bulgaria), Subotica (Serbia)

17.9 Sources of information

- GTZ/MDI: Overview of the Status in the Public Utility Sector in Ukraine, Legal Framework as well as Proposals as to Improvement of Laws and Regulations Prepared for Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), Under Contract #83066677 of July 23, 2010, by the Municipal Development Institute (MDI), Ltd.
- NERC - National Electricity Regulation Committee: www.nerc.gov.ua
- Viachaslau Herasimovich: Ukrainian Heating Sector Review, Center for Social and Economic Research (CASE), September 1, 2008
- Anna Tsarenko: Overview of Heating Sector in, Ukraine Center for Social and Economic Research (CASE), Kyiv 2007
- Brown, A. C.: Regulation of Communal Services in Ukraine, Policy paper on Issues and Options, USAID, January 2010

18USA

18.1 Features and Extent of DHC/CHP

History

First commercial applications in the U.S. date back as far as 1876. By the 1880's, DH systems had been formed to serve a number of U.S. cities, including New York, Boston, Chicago, Detroit, Philadelphia, and Baltimore. Those early downtown electricity systems often relied on centralized steam generation for electricity production. This enabled them to boost profitability by offering both electricity to various applications and steam for heating. The first DC system was established in Hartford in 1962.

The IDEA estimates that there are over 2,500 district energy systems in the U.S. Of the total estimated building space served, 25 % is served by private district energy companies, 36 % through university DHC systems, 20 % in military bases and the remainder in hospital and industrial complexes.

The predominant fuel is natural gas, providing 77 % of total fuel, with coal a distant second at 15 %. Oil, biomass and other fuels are currently minor sources, collectively providing 8 %. The IDEA estimates that GHG emissions by district energy systems total 57 million metric tons, or 1.0 % of total U.S. energy-related GHG emissions.[77]

U.S. DHC systems range significantly in size, serving from as few as 3 or 4 buildings in the early stages of new system development to the largest system served by Con Edison in Manhattan. The downtown DHC/CHP system in New York City – Con Edison managed steam system – is the World’s largest steam system with 1,850+ customers. There are 7 generating facilities to supply over 169 km (105 miles) of underground network. The customers use approx. 500 ktons in steam-driven chillers, displacing 350 MW_e peak demand on grid. The CHP of 600 MW_e capacity provides 60% of the total annual steam.

In the table below there is a sample of few large DHC systems in U.S. having CHP included.

Table 18.1: A sample of four large DHC companies in U.S.

Location	Company	Ownership	Steam peak/capacity k tonnes/h	CHP capacity MWe
New York City	Consolidated Edison	Private	3901	600
Philadelphia, PA	Trigen Philadelphia	Private	1043	170
Indianapolis, IN	Citizens Thermal Energy	Public	1111	15
Washington, DC	General Services Administration	Governmental	762	17

Sources: IDEA Enwave Report 2005 and Con Ed Annual Report 2008.

In general, however, DHC together with CHP has been tragically underutilized as a tool to combat climate change, to reduce life-cycle costs of energy supply and to defend energy independence in the USA. The IDEA estimates that with supportive policies, district energy can make significant further contributions to GHG reduction. Total district energy output could grow 5 % annually through 2020, resulting in a total growth of about 80 % over the year 2008. An additional 8,000 MW of CHP capacity could be integrated into existing district energy systems to displace currently used fossil fuels and to support growth. Bioenergy, including biomass combustion to displace current coal use and biogas and bioliquids to displace natural gas and fuel oil, will be an important element in reducing the carbon footprint of a growing district energy industry.[78]

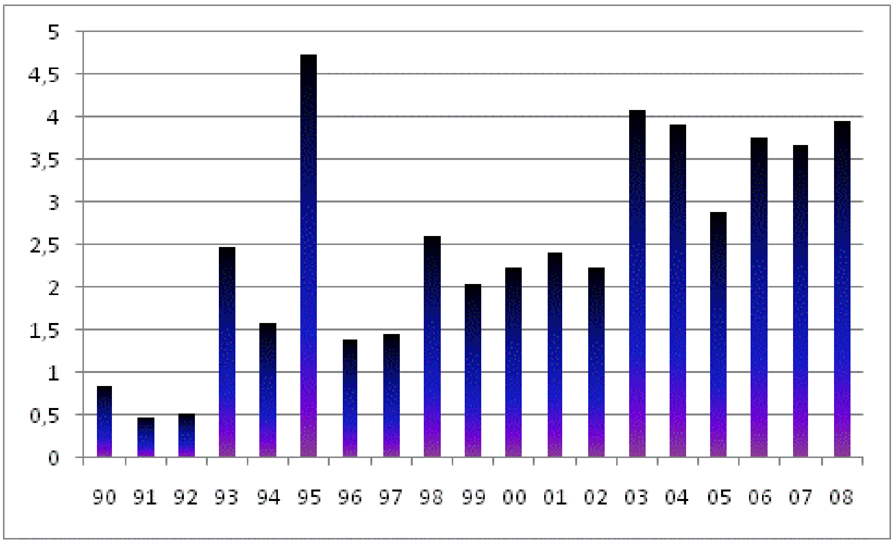
[77] District Energy magazine, Mark Spurr, IDEA Legislative Director, Fourth Quarter 2009.

[78] Id.

Statistics from past three years

Comprehensive DHC statistics are not currently being collected in the USA. However, studies are periodically undertaken, with the latest published in 2007.[79] _Comprehensive DHC statistics are not currently being collected in the USA. However, studies are periodically undertaken, with the latest published in 2007.[80]

Figure below illustrates the growth of DHC in the USA in the past two decades, during which some 47 million m^2, equal to 468 m sq ft have been connected.



Source: DOE/EERE

Figure 18.1: Heating area aggregate connected to DHC as "reported" since 1990 – 47 million m^2.

DHC and CHP market shares

Currently, DHC serves 780 million m^2 (equal to 8.4 billion square feet) of building space, equal to 12 % of total commercial floor space. About 13 % of DHC systems incorporate CHP. Because it is the larger systems that tend to install CHP, these sources provide a higher percentage (20 %) of the total district heat production.[81]

Types of DHC consumption

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[79] Final Report, District Energy Services Commercial Data Analysis for EIA's National Energy Modeling System, by Energy and Environmental Analysis, Inc. and International District Energy Association for the U.S. Energy Information Administration, August 2007.

[80] Final Report, District Energy Services Commercial Data Analysis for EIA's National Energy Modeling System, by Energy and Environmental Analysis, Inc. and International District Energy Association for the U.S. Energy Information Administration, August 2007.

[81] Id.

Of the total U.S. DHC thermal output, 80% is heating and 20% is cooling. Steam is currently the typical heating distribution medium. Most DHC consumers are commercial or institutional buildings; there is little residential heat load.

Selected technologies with customer connections

Most heating and cooling customer connections are indirect, i.e. with a heat exchanger. Some district cooling connections are direct if hydraulic conditions are appropriate.

Heat metering rate

Most DHC consumption is metered; however, many institutional DHC systems do individually meter all users.

Market expanding/shrinking: Countrywide, the DH and DC markets are expanding at 3-4%/a and up to 10%/a, but almost solely on campuses, hospitals, military bases and in the downtown commercial and public buildings. The problem of attracting residential customers is mainly economic:

- Connection of existing buildings while removing the existing gas boilers has a relatively long pay-back time. The DH connection would include the substation, heat metering and connection piping, whereas the energy cost benefits to natural gas remain low. The connection costs are relatively higher for small than large buildings.
- Connecting of new building would be easier but they are rarely erected in the dense city areas where the DH may exist.

Local DHC associations

The International District Energy Association (IDEA)[82] , established in 1909, is a trade association representing over 400 district energy systems owned by municipalities, utilities, universities, hospitals, military bases, privately-owned entities, and airports in 38 states and around the world. IDEA's mission is to facilitate the provision of reliable, economical, efficient, and emission-reducing DH, district cooling, and cogeneration of electricity and thermal energy. IDEA is an active lobbyer of DHC and CHP legislation and has been pivotal in proposing and passing federal legislation benefiting DHC and CHP in recent years.

Another association, the U.S. Clean Heat and Power Association (USCHPA[83]) brings together diverse market interests to promote the growth of clean, efficient local energy generation in the U.S. It is a private, non-profit trade association, originally formed in 1999 to promote the merits of CHP and to achieve public policy support for CHP.

Both associations participate in federal agency programs to promote DHC, CHP, waste energy recovery, and other forms of clean distributed energy.

18.2 Legal and Regulatory Framework

National policy

There is no federal policy to support DHC and CHP at the moment. Constraints to significant expansion of district energy and CHP include:

- The current lack of economic value in the energy marketplace for the environmental, grid support, energy security and local economic development benefits of district energy systems,

[82] www.districtenergy.org

[83] www.uschpa.org

- Relatively high project development costs due to the variety of institutional, legal and technical issues which must be addressed, and
- High costs of debt service, particularly in the early years of systems development before a broad base of customers have connected.

There was a National CHP Roadmap for the years 2001-2010 that aimed at doubling the CHP capacity in the country to add 46 GW_e of new CHP capacity, equal to 4.4% of the 1,046 GWe total generation capacity in winter 2010[84] This roadmap consisted of three main actions: raising awareness, eliminating regulatory and institutional barriers, and developing markets and technologies.

The DOE National CHP Roadmap states that increased regional CHP outreach and assistance could help increase the deployment of CHP opportunities in the U.S. In response to the National CHP Roadmap, DOE established a network to promote CHP technologies and practices, serve as a central repository and clearinghouse of CHP information, and identify and implement regional CHP projects.

The eight DOE Clean Energy Regional Application Centres (RACs) lead CHP deployment by publicizing the benefits of CHP in their own regions (Pacific, Northwest, Midwest, Northeast, Mid-Atlantic, Southeast, Gulf Coast and Intermountain) in order to reduce perceived implementation risks, working with several audiences including end-users in targeted market sectors, local architect and engineering communities, state regulators and policymakers, and power planning organizations. Educational resources and case studies are distributed through websites, workshops, and training. The DOE Clean Energy RACs also provide project level support in the form of site evaluations and technical or financial analyses.

The DOE Office of Energy Efficiency and Renewable Energy (EERE) of DOE focuses on technology R&D investment in clean energy technologies that strengthen the economy, protect the environment, and reduce dependence on foreign oil. In year 2010 the total budget of EERE amounts to US$ 2.2 billion, in which DHC and CHP are not explicitly included.

In 2009, following the passage of the American Recovery and Reinvestment Act (discussed below under DHC Legislation and Regulation), the DOE issued $156 million grants for DHC/ CHP/ Waste Energy /Industrial Efficiency to be used in “shovel ready” projects on both institutional and public sectors. After the solicitation was closed on July 14, 2009, in total 359 proposals were submitted to DOE with the total value of $9.2 billion. Out of that the federal share would have had been $3.4 billion compared to the offered $156 million. Therefore, the rate 25:1 from the need to the available grant funds emphasizes the strong interest in the energy market in DHC and CHP.

The National CHP Roadmap (2001) has identified the most pressing regulatory and institutional barriers faced by CHP as follows:

- Onerous and irregular interconnection requirements;
- Unjustified and costly standby and backup power charges;
- Prohibitive stranded cost-recovery charges and exit fees;
- Air regulations that do not recognize the environmental superiority of CHP;
- Irregular environmental permitting procedures;
- Time consuming and confusing site permitting (e.g., zoning, building, fire, and safety codes); and,
- Tax treatment and depreciation policies that discourage investment in capital-intensive infrastructure such as DHC.

The local electric distribution companies (LDCs) sometimes recognize that DHC can be a means to reduce the summer peak and to release transmission and distribution capacity to other electric applications that have more even consumption during the year.

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[84] Energy Information Administration- EIA

In U.S. the DHC legislation is in a dynamic stage. Some limited legislation benefitting DHC has been enacted. Concerns about climate change and rising interest in renewable energy sources and energy efficiency have created opportunities for stronger DHC legislation.

Current federal laws relevant to DHC.

CHP Investment Tax Credit. The Internal Revenue Code 26 USC Section 48 provides a 10% investment tax credit for the first 15 MW of CHP capacity. This law defines CHP property eligible for the credit as a system which produces:

- at least 20 % of its total useful energy in the form of thermal energy which is not used to produce electrical or mechanical power (or combination thereof), and
- at least 20 % of its total useful energy in the form of electrical or mechanical power (or combination thereof),
- the energy efficiency percentage of which exceeds 60 %, and
- which is placed in service before January 1, 2017.

As discussed below, the IDEA and USCHPA have advocated that the 15 MW cap be lifted to 50 MW.

Energy Sustainability and Efficiency Grants and Loans. The Energy Security and Independence Act (EISA) of 2007, passed by the Congress and signed by the President, authorizes a program for Energy Sustainability and Efficiency Grants and Loans for Institutions [Section 471 of Public Law 110-140, incorporated as Section 399a in the Energy Policy and Conservation Act (42 U.S.C. 6371h-1)]. Appropriation of $750 million annually for 5 years was authorized for implementing or improving sustainable energy infrastructure, including district energy systems, facilities for production of energy from renewable sources, CHP, waste heat recycling or natural sources of thermal energy. Eligible public sector entities include institutions of higher education, local governments, municipal utilities, public school districts or designees of these institutions.

Waste Energy Recovery Incentives. Sections 451-453 of EISA authorize a program to encourage the recovery of industrial waste heat and recycling it into useable heat and electricity. This provision establishes a program to provide waste energy recovery grants at the rate of $10/MWh- of electricity or $2.92/MMBtu of useful thermal energy.

In the U.S. legislative process, a program must first be *authorized*, then funds must be *appropriated* for the program. For both the Energy Sustainability and Efficiency Grants and Loans and Waste Energy Recovery Incentives programs, no funds have been appropriated as of March 2011.

Tax-Exempt Financing. The Internal Revenue Code (U.S.C. 26 Section 142) provides for tax-exempt bonds (exempt facility bonds) for financing a range of facilities with public benefits, including airports; facilities for the furnishing of water, electric energy or gas; and local DH or cooling facilities. The interest rate on tax-exempt bonds is lower because bondholders do not have to pay income tax on the interest. “Local district heating or cooling system" is defined as “any local system consisting of a pipeline or network (which may be connected to a heating or cooling source) providing hot water, chilled water or steam to two or more users for residential, commercial, or industrial heating or cooling, or process steam.”

As described below, legislation has been introduced that would expand eligibility for tax exempt bonds to include district energy plant and building connection assets as well as distribution piping.

Current state laws relevant to DHC.

Portfolio Standards. Thirty states have a mandatory renewable portfolio standard (RPS), which requires that a growing percentage of electricity sold by retail electric utilities comes from renewable sources. Another four states have voluntary RPS goals. In addition, 22 states have enacted energy savings goals or energy-efficiency resource standards (EERS). Similar to an RPS, an EERS requires that electric utilities meet a growing percentage of their requirements through efficiency. Twenty states have a mandatory EERS, and five states are in the process of enacting an

EERS. Of importance for district energy systems is that 13 states include CHP in their mandatory portfolio standards, and another four include CHP in voluntary goals.[85]

Proposed federal laws pertaining to DHC

Economic stimulus legislation. After successful advocacy by IDEA, $1.5 billion in appropriations for the Energy Sustainability and Efficiency Grants and Loans for Institutions program was included in both the House and Senate economic stimulus bills in early 2009. In a normal legislative process, that would be the end of the story: The conference committee, formed to work out the differences between the bills, would include this common provision in the final legislation.

However, the economic stimulus bill was truly an extraordinary piece of legislation, not only in size and scope, but also in the speed with which it was finalized. Literally overnight, the $1.5 billion provision was eliminated from the final $787 billion American Recovery and Reinvestment Act in the process of cutting costs to make room for a large measure with strong support: the $70 billion alternative minimum tax (AMT) 'patch,' which would reduce the number of taxpayers affected by the AMT (a provision in the tax code designed to ensure that wealthy taxpayers don't avoid paying taxes through sophisticated tax strategies).

Despite the setback on the Energy Sustainability and Efficiency Grants and Loans for Institutions program, the stimulus bill did provide opportunities for district energy. Some district energy and combined heat and power projects were funded out of the $3.2 billion included for Energy Efficiency and Conservation Block Grant funding for local units of government and states.

Thermal Energy Efficiency Act[86] *of 2009.* This legislation was introduced during Congressional consideration of a variety of bills addressing climate change. This law would dedicate 2% of revenues from climate change legislation to fund combined heat and power, waste energy recovery, and district energy projects. Based on various estimates, this could mean roughly between $1 billion and $1.5 billion per year for clean energy infrastructure. The Thermal Energy Efficiency Act would provide 40% of its funding for institutional entities (defined as public or non-profit hospitals, local and state governments, school districts and higher education facilities, tribal governments, municipal utilities, or their designees), 40% for commercial and industrial entities, and 20% to be used in the discretion of the Secretary of Energy to fund institutional entity projects, commercial and industrial projects, or federal facility projects. A match is required of all non-federal applicants, starting at 25% from 2012-2017, and rising to 50% from 2018-2050. The breakdown of how the money would be used is 75% for construction of infrastructure, 15% for planning, engineering, and feasibility studies, and the remaining 10% to be used at the discretion of the Secretary for either infrastructure or planning, depending on the need.

The American Clean Energy and Security Act (H.R. 2454 – ACES).[87] Also known as Waxman-Markey Climate Change Bill, the ACES was passed by U.S. House of Representatives on June 26, 2009. No companion legislation was passed by the Senate, so this legislation was not enacted into law.

The ACES would establish an 'economy-wide' cap-and-trade program starting in 2012. Allowances for capped sources, constituting 85 % of total GHG emissions, would be reduced by the following percentages from 2005 levels by the years indicated: 3 % by 2012; 17 % by 2020; 42 % by 2030; and 83 % by 2050. If the capped sources cannot make the reductions at their own facilities, they can purchase allowances from other capped sources or via offsets from projects that reduce emissions in non-capped sources. Capped sources ('covered entities') in the ACES can be summarized as follows:

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[85] "Portfolio Standards: Status and implications for district energy", Mark Spurr, *District Energy* magazine, published by the International District Energy Association, Second Quarter 2010.

[86] Bill Full-Text: *http://www.govtrack.us/congress/billtext.xpd?bill=s111-1621*

[87] This summary was drawn from "Climate Change Legislation in Dollars and Cents" by Mark Spurr, *District Energy* magazine, published by the International District Energy Association, Third Quarter 2009.

1. Electricity sources (facilities with one or more ‘utility units’ producing electricity for sale, including CHP units supplying more than one third of its potential electric output capacity and more than 25 MW for sale).

2. Industrial sources in specified industries or if the resulting GHG emissions are more than 25,000 tons of CO2e.

3. Producers of a variety of specified industrial gases.

4. Producers or importers of any petroleum-based or coal-based liquid fuel, petroleum coke or natural gas liquids, the combustion of which would emit more than 25,000 tons of CO2e.

5. Local natural gas distribution (LDC) companies delivering more than 460 million cu ft of natural gas annually.

More simply, power plants and industrial plants would have to surrender allowances at the emission site, whereas the cost of CO2 for natural gas, fuel oil and gasoline for other users would be built into the consumer price because the suppliers of those fuels would be covered entities that must submit allowances. Power plants would have to submit allowances starting in 2012, whereas compliance by most industrial sources is delayed until 2014 and compliance by natural gas LDCs is put off until 2016.

In the ACES, district energy systems are not directly covered entities unless they qualify as ‘electricity sources’ as defined above. District systems would be covered indirectly through the costs of allowances built into the prices of purchased fuel oil, or natural gas if purchased from the gas LDC. However, gas purchased on the wholesale market or coal users not qualifying as an electricity source would not be required to submit allowances.

This is a fundamentally good framework for DHC with the exception of concerns about CHP systems as discussed below. However, if in the future this legislation is reconsidered with modifications that make many district energy systems covered entities, the IDEA believes that it is critical that changes in allowance allocations be made as discussed below. For example, if the final climate change bill regulates all sources with emissions greater than 25,000 metric tons CO2e (the threshold generally used in the ACES as well as a number of past bills), over 70 % of DHC systems and over 95 % of DHC output would be capped. To mitigate the impact on energy consumers and competitive impacts on industry, the ACES allocates allowances for free to a range of capped sources. Over time, the amounts allocated free would decline, and an increasing percentage of the allowances would be auctioned.

How would the ACES affect the district energy industry in dollars and cents? This is not a simple question to answer. There are many variations in district energy system characteristics. In addition, the provisions of the ACES are complex, and the effects of the ACES will change over time as allowance allocations are phased out. The following comments provide some examples of the estimated effects of this highly complex legislation in the year 2020 based on allowance prices projected by the EPA.

Starting in 2012, power plants, including district energy/CHP plants qualifying as ‘electricity sources,’ would be required to submit allowances. As noted above, CHP plants are excluded except those supplying more than one third of their potential electric output capacity and more than 25 MW for sale. This would affect a relatively small number of district energy systems but potentially a large percentage of electricity production in the district energy industry.

Through 2025, the power sector would be partially insulated from the impacts through significant levels of free allowances, which would be distributed according to a complex set of formulas in the following priority order:

1. Long-term contract generators. This includes plants with long-term power purchase agreements including ‘qualified cogeneration facilities’ as defined under the Federal Power Act [16 U.S.C. 796(18)(B)].

2. Merchant coal generators.

3. Electricity local distribution companies (LDCs).

Between 2025 and 2030 the power sector allocations would be phased out.

The ACES requires that allocations to electricity LDCs be used to provide rebates to reduce customer rates, but the extent to which the allocations to long-term contract generators or merchant coal plants will result in lower electricity costs is not prescribed. Presumably, however, these allocations will be used by contract generators and merchant plants to improve their competitive position by defraying the cost of GHG compliance.

CHP plants that have a direct compliance obligation but do not receive allowances will be placed at a significant competitive disadvantage. For example, the marginal emissions of a district energy system using combined cycle gas turbine CHP (i.e., the additional emissions compared with producing only heat) are only 0.25 metric tons of CO_2 per MWh of electricity generated. In contrast, a coal-fired merchant power plant emits about 1.11 metric tons CO_2 per MWh.

There is assessment work under way about how many district energy CHP facilities that would be covered entities would qualify to receive allocated allowances by meeting the criteria for a 'qualified cogeneration facility' as defined above. It is likely that only some of the largest CHP facilities would qualify to receive allowances.

In competition with grid power plants receiving generous allowances in ACES, CHP systems could be shut down. Unless allowances are allocated to the district energy CHP system it will have to purchase allowances for all gas consumed in the facility, resulting in an additional cost equal to 15 percent of the average 2007 wholesale power price ($57 per MWh) at the $16 per metric ton allowance price projected by EPA for the year 2020. In contrast, the merchant coal plant will only have a GHG allowance cost of only 5 percent of the average 2007 wholesale power price because allowances will be allocated for nearly all (83 percent) of its emissions.

Faced with this huge competitive disadvantage in the marginal cost of power generation, some existing CHP facilities will shut down and construction of new CHP plants will be choked off.

Starting in 2016, natural gas LDCs would be required to submit allowances for gas sold to non-capped sources, and would pass along the cost to consumers to the extent that the costs are not covered through free allowances. From 2016 through 2025 gas LDCs would receive an allocation of 9 percent of total allowances, with the amount gradually dropping to zero by 2030. LDCs would be required to use at least one-third of the value of these allowances for energy-efficiency programs benefiting their customers, with the remainder used to reduce the costs of costs of delivered gas as regulated by state regulatory authorities.

District energy systems buying gas from LDCs can expect to see prices increase by an amount equal to at least one-third of the market price of allowances through 2025, reaching 100 percent of the allowance price by 2030. At the price of $27 per metric ton CO2e projected by EPA for 2030, the GHG cost would be $1.42 per million Btu of fuel. Generally , the competitive alternative to DH is a building boiler fueled by natural gas purchased from an LDC. In this case, the ACES would provide a competitive advantage to DH systems using natural gas at an incrementally higher efficiency than a building boiler.

American Clean Energy Leadership Act (ACELA). This legislation, introduced in June 2009, establishes a Renewable Electricity Standard which requires electric utilities nationwide to meet 15% of their electricity sales through renewable sources of energy (e.g., the sun, the wind, biomass, geothermal energy, hydropower) or energy efficiency by 2021. However, up to 25% of this requirement can come from efficiency measures, including CHP. ACELA includes a range of other energy efficiency measures, focusing on efficiency in buildings and industry.

Thermal Renewable Energy and Efficiency Act of 2010 (TREEA). This legislation was introduced in both the House and Senate in July 2010, with the goal of stimulating increased use of renewable energy sources and recovered waste heat for heating and cooling buildings. S. 3626 is a bipartisan bill sponsored by US Sens. Al Franken (D-Minn.) and Kit Bond (R-Mo.). The House companion was introduced by Rep. Betty McCollum (D-Minn.), with Reps. Jay Inslee (D-Wash.) and Paul Tonko (D-N.Y.) as original co-sponsors.

The bill has three provisions:

- Provide a production tax credit for renewable thermal energy;
- Expand the applicability of tax-exempt financing for district energy facilities; and
- Modify a law authorizing a program of grants for institutional district energy systems.

Thermal Energy Production Tax Credits

The Internal Revenue Code (U.S.C. 26 Section 45) provides a Production Tax Credit (PTC) for the generation of electricity using certain renewable resources. Wind, geothermal, and "closed-loop" bio-energy (which is powered by dedicated energy crops) are eligible for PTC of 2.2 cents per kilowatt-hour (kWh) of electricity produced. Other technologies, such as "open-loop" biomass, incremental hydropower, small irrigation systems, landfill gas, and municipal solid waste, receive 1.1 cents per kWh.

The Act expands the PTC to the production of renewable thermal energy. By limiting PTCs to electricity only, we are significantly limiting our ability to shift to a low-carbon sustainable future. There are substantial opportunities to expand the use of renewable resources to meet thermal energy needs (space heating, air conditioning, domestic hot water, and process heating and cooling). There is support for this concept. For example, renewable thermal energy production tax credits were included in S. 1370, the Clean Energy Investment Assurance Act of 2007, sponsored by Senators Maria Cantwell, D-Wash.; John Kerry, D-Mass.; and Gordon Smith, R-Ore. A renewable thermal energy PTC would provide an important investment incentive, accelerating our Nation's transition to a low-carbon future.

Expansion of Tax Exempt Bonding

The Internal Revenue Code (U.S.C. 26 Section 142) provides for Exempt Facility Bonds for financing a range of facilities with public benefits, including airports, facilities for the furnishing of water, electric energy or gas, and "local district heating or cooling facilities" (defined as "a pipeline or network (which may be connected to a heating or cooling source) providing hot water, chilled water, or steam to 2 or more users for residential, commercial, or industrial heating or cooling, or process steam."

The Act enables tax exempt bonds to be used for financing district energy plant and building connection assets as well as distribution piping. The capital costs of district energy systems include not only the piping distribution systems but also the plant facilities for producing thermal energy and the equipment for transferring thermal energy to building heating and cooling systems. Potential plant investments provide key opportunities for increased efficiency, use of renewable energy and reduced carbon emissions. By reducing interest costs, tax exempt financing reduces debt service costs and thus stimulates increased application of these low-carbon systems and the public benefits they provide.

Energy Sustainability and Efficiency Grants for Institutions

The Energy Independence and Security Act of 2007 authorized the Energy Sustainability and Efficiency Grants for Institutions program. In conjunction with efforts to appropriate funds for this program, the Recycled Energy and Renewable Thermal Energy Act would amend the authorization to eliminate constraints that impair the effectiveness of the program.

The Act addresses these problems by:

- Raising the cap on the program's grants to $20,000,000 (while increasing the local cost-share requirement from 40% to 70%);
- Increasing caps on technical assistance grants (while retaining local cost-share requirements);
- Increasing the authorized annual funding for the grant program to $500,000,000;
- Extending program eligibility to not-for-profit district energy systems; and
- Extending the time period of the grant and loan program through FY 2015.

The increase in the cap will enable grants to larger projects with greater efficiency gains, and the increase in authorized funding will result in an increased number of beneficial projects. These increases are consistent with the characteristics of projects submitted in response to a DOE solicitation using $156 million in ARRA funds. In this solicitation, which was oversubscribed by a 25:1 ratio, the maximum requested federal share was $60 million, with an average of over $10 million. The time extension will allow Congress to appropriate funds to this program—which remains to be done. These changes will expand the ability of this program to reduce GHG emissions, create jobs, increase grid reliability, and enhance energy security.

<u>Building regulations</u>

In the table below, the estimated specific heat consumption of the buildings served by DH and constructed before 1980 are presented in three equivalent units.

Table 18.2: Specific heat consumption of buildings connected to DH in USA.

Year	th Btu/sq foot	MJ/m^2	kWh/m^2
1979	53	602	167
1983	65	738	205
1986	89	1 011	281
1989	96	1 090	303

Source: DOE/EIA 1993

Price regulation[88]

The FERC[89] regulates power and gas prices but not DHC.

Many older DH systems in the USA evolved out of the electric utility business in areas near large generation plants. These systems were operated as rate-regulated businesses and continue as such today. Of the 50 states in the USA, only 10 states regulate the rates of DH service: Alabama, Colorado, Michigan, Missouri, New Hampshire, New York, Ohio, Oregon, Pennsylvania, and Rhode Island. Only two states (Ohio and Colorado) regulate chilled water (DC) rates.

Most DHC in the United States operate commercially in the competitive environment and are not regulated. The argument for this form of business is simple: end users have choice. The utility infrastructure in most USA cities includes mature electric, natural gas, water and sewer systems. Building developers are not wanting for readily accessible energy supplies for their building needs. When DHC is available, it must compete head-on with conventional building heating and cooling systems. DHC services in the USA is typically provided under 20 to 30 year contracts with terms designed to recover up-front capital costs, operating costs and escalators for labor, fuel and taxes.

Most DHC systems in the USA operate under a franchise agreement. In many cases some type of franchise fee is paid, generally as a percentage of gross revenues and in a few cases per lineal foot of public right of way used. As noted above, the district energy systems that are rate-regulated are so because they were originally developed by regulated electric or gas utilities. Rate regulation has had a heavy negative impact on district energy systems because of the expense of complying with all of the procedural requirements of regulation, including regular financing reporting and periodically preparing and arguing rate cases before the regulatory commission.

Franchising fees have in some cases have resulted in a competitive disadvantage for district energy systems. Franchising fees are generally 4% or less. In some cases, when district cooling was implemented the district energy company successfully made the argument that the normal utility tax rate is inappropriate because district energy gross revenues include many costs beyond fuel or electricity inputs; they also include costs for capital, labor and maintenance. Therefore, a lower percentage fee level is appropriate to avoid competitive distortions with other alternative means of cooling (such as individual building electric chillers).

The heat tariffs are set in companies and the rates are usually published.

There is a wide variety of approaches to rate design. The following discussion summarizes the typical approach, in which there is both the fixed and the energy rate. The fixed rate is applied to the contracted capacity provides, and covers the connection costs, as well as financing costs, fixed operating costs and profit. The fixed rate can be adjusted annually with the CPI (Consumer Price Index) or some other price escalator factor. The energy rate is applied to metered energy consumed, and may be a pass-through tariff with no profit or provide for some margin above costs. Generally, invoices are paid on a monthly basis.

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[88] This section based on research by FVB Energy Inc., personnel communication, Mark Spurr, Sept. 6, 2010.

[89] Federal Energy Regulatory Commission - FERC

Connection costs comprise the connecting pipeline, the heat meter and the shut off valves. The connection costs will be spread over the contract period. The disconnection costs to be paid by the customers are based on the remaining contract duration.

Competition

The utilities are empowered to provide customers with gas and electricity at the lowest costs possible. Economic drivers support the selection of the proper technologies, and the state regulators ensure that the system availability and safety are maintained at all times. The selection of the technologies is left to the utilities. Natural gas is widely available in most urban areas of the country, which is a challenge for other heating modes to enter the market. To substitute for natural gas, DHC based on biomass and/or CHP is a welcome option, but faces a number of barriers.

In St. Paul, for instance, there is some struggling with the local gas company about new customers. In an example, the city is building a light railway to a new district to which a DH pipeline to be installed along the rail route would be a viable option. The gas company, however, opposes the idea. The case is still open but is descriptive about the competition situation.

Feed-in tariffs

In general there are no feed-in tariffs in the USA.

Emission trading scheme

Emission trading is not implemented for the time being.

Carbon tax

Emission fees are not common in the USA. Usually, there are no fuel related taxes other than a sales tax in the USA.

Investment grants

There are no investment grants to DH and CHP.

18.3 **Customer**

Customer rights

On the customer side, the ownership border is generally behind the last gate valves and energy metering. The pressure reduction valves (PRV) and heat exchangers generally belong to the customers.

From a customer perspective, there are a number of advantages to connecting a building to district energy service, including:

- Ease of use and simplified building operations;
- Avoided capital costs for in-building heating and air conditioning equipment;
- Reduced labour, repair and maintenance expenses;
- Space is made available for alternative uses and other income activities;
- Highly reliable energy services; and.
- Less fuel and chemicals stored and combusted on-site.

For commercial real estate developers, especially in dense urban settings where real estate acquisition and construction costs are high, economics demand high yield from every available square foot of leasable space. DHC services displace large mechanical equipment and eliminate the need for stacks and flues throughout the building core. Valuable rooftop or penthouse space can be reclaimed from noisy and unsightly rotating equipment and structural loads for equipment can be reduced. Moreover, by removing aging or operational boilers and chillers from existing buildings, usable space can be reclaimed and the electrical capacity of building transformers and vaults can be freed up and re-used for tenant electrical demands.

There is no problem with disconnections as in parts of Europe and Asia.

Service quality

In general, there are no problems with the DHC service quality.

Billing

Billing and collection is always based on heat meter readings.

18.4 Ownership

Municipality role

Most DHC systems are owned by non-profit organizations, including universities, municipalities, state and federal government, or hospitals.

The municipalities are well aware and interested in starting/extending DHC to reduce GHG emissions. Financing is the bottle neck, since the municipalities have very limited financing resources and limited power on city development. Ordinary people are not aware of DHC, since it is rather invisible (with underground pipes, a few chimneys, focused on public and commercial but not residential buildings).

Private sector involvement

Although there are relatively few private DHC companies, they have generally the largest systems.

Synergy allocations

No common CHP cost allocation approach was identified.

18.5 Planning

Integrated resource planning

The stakeholders of DHC and municipal CHP are fragmented which makes any integrated planning a huge challenge. Without such planning and other support measures, it is difficult for the district energy systems to expand on the energy market.

Heat and urban planning

The municipalities generally have no authority over energy efficiency/use other than in enforcing the building code. At the municipal level, the driver for DHC is the reduction of the GHG emissions. Many municipalities have set voluntary targets for the reduced GHG emissions. DHC systems are sometimes recognized as a potential measure to achieve the targets. It is difficult for the private sector to invest in new DHC systems, because starting these systems is risky: long pay-back times ranging beyond 10 years, limited access to municipal property, and challenging contracting of municipal and federal buildings.

18.6 Technical

Technical standards and design conditions

Due to small market share, there is no national standard for DH per se.

Refurbishment strategies

Conversion of some DH systems from steam to hot water might make sense in the long term. For small steam distribution systems this would require a life-cycle analysis and an action plan if found economic. In case of large systems such as in Manhattan, for example, such conversion implementation would be highly challenging if even economic.

18.7 Local Example – District Energy in St. Paul, Minnesota

In St. Paul the DH company started in the middle of 80's with strong financing support from local, state and federal governments, a strong support from Sweden. There were both Swedish staff members and consultants heavily involved with starting the DH business. In the middle of the 90's the business was extended to DC. More recently, biomass and CHP has been introduced.

The DH and DC networks are about 33 and 11 km long, respectively. The DH sales were about 354 GWh in 2008, which is equal to the heat sales density of 11 GWh/m of network length being ideal for DH development. The physical capacity of the CHP plant is 33 MW electric, of which 25 MW is commercially contracted. In 2009, power generation amounted to 153 GWh. The turbine is of a back pressure type with having a cooling tower in use when the DHC load is insufficient for the power needs.

The staff of St. Paul Company amounts to 75, some forty of which work with DH.

The business is based on 20 year franchising contract with the municipality. Based on the contract, the Company pays an annual fee for the municipality and is allowed to have free access with the pipelines to the public land, the streets and the parks. Another 20 year contract was signed in 2009.

In St. Paul, the heat sales tariff comprises the fixed charge (demand rate) based on the peak demand as well as the energy charge (energy rate). The latter one is pass-through of the energy costs and first one covers all other costs as well as the profit. There is no connection fee, but the Company offers connection credits for 1-2 decades (previously even to 3 decades), during which period the customer shall pay for the connection costs. The amount of connection credit will be negotiated case by case. The energy charge is constant for everybody regardless the type customer whether DHW is included or not. There is a reduced energy fee for snow melting applications when heat is taken from the return line at low temperature.

In case the customer wants to disconnect and resolve the connection contract, which was made for a long period of time, the Company will charge for disconnection relative to the remaining years and the monetary value of the contract.

18.8 Recommendations and good practises

Federal Government

The federal government should incorporate clear incentives for DHC and CHP in energy and climate policy. The following recommendations address this need in the context of broader types of legislation, as already suggested by IDEA:

Capital investment incentives. It is critically important for the federal government to implement measures to encourage capital investment in DHC infrastructure including the use of renewable, CHP and waste heat energy sources. These measures should address the needs of both the private, for-profit sector and the public and non-profit sector.

- Enact the Thermal Renewable Energy and Efficiency Act or other legislation that provides tax credits for renewable thermal energy, expands the applicability of tax-exempt financing for DHC to include plant and building interconnection investments, and modifies the authorization for the Energy Sustainability and Efficiency Grants for Institutions program.
- Appropriate funds to implement the Energy Sustainability and Efficiency Grants for Institutions program and the Electric and Thermal Waste Energy Recovery Award program authorized in the Energy Independence and Security Act of 2007
- Provide investment tax credits for plant modifications and thermal distribution infrastructure for recovering and distributing industrial waste heat.

Cap and trade. There are many potential approaches to structuring the U.S. cap and trade legislation, so it is difficult to comment succinctly about recommendations relative to DHC and CHP. However, several broad recommendations are summarized below.

- If only large point sources of GHG are regulated, the legislation should include other strong measures to increase efficiency in non-regulated entities (such as building boilers), so that GHG regulation does not burden district energy systems with the costs of allowances but allows 'business as usual' for building boilers.
- To the extent that emission allowances are allocated rather than auctioned, they should be allocated based on total useful energy output, including both power and heat from combined heat and power.
- A portion of allowances should be auctioned to make funding available for district energy systems to provide thermal energy from local sources such as CHP, renewable energy and industrial or municipal waste heat. For example, the 'Thermal Energy Efficiency Act of 2009' requires that 2 percent of allowances under any GHG cap and trade system established under federal law be auctioned to provide competitively-procured, cost-shared grant funding for district energy and CHP systems.

Portfolio Standards. Include CHP in any Renewable Electricity Standard, and ensure appropriate recognition for energy savings from CHP systems regardless of whether the CHP power is used by the generator or sold to another party.

Green Building Rating Systems. Any systems of ratings or requirements for "green" buildings should recognize and credit the energy and environmental benefits of DHC as an alternative to individual building heating and cooling systems.

General recommendations.

- Include DHC and CHP systems in provisions that promote, demonstrate and create incentives for energy efficiency activities.
- Make DHC and CHP systems eligible for any broader energy efficiency or renewable energy grant program to be administered by the federal government or by states.
- As a part of smart grid initiatives, require load-serving entities to consider thermal energy storage as a peak demand reduction strategy.

<u>State governments</u>

State governments should act to encourage DHC and CHP through state energy agencies as well as through public utility commissions (which regulate the operation of investor-owned electricity and natural gas utilities).

- State energy agencies should include DHC and CHP in programs to encourage energy efficiency and renewable energy, including information, education, research and development, demonstration, grants and loans.
- Public utility commissions should require electric utilities to: 1) connect CHP facilities to the power grid expeditiously and without onerous technical or cost barriers; 2) purchase CHP power based on long-run marginal cost; and 3) provide back-up power at reasonable rates.

<u>Municipalities</u>

Municipalities should enact a range of measures to encourage development and growth of DHC, including:

- Identifying high-priority areas for potential development of DHC based on building density, anticipated real estate development and redevelopment, access to renewable or waste heat energy sources and other factors.
- Encouraging or requiring that new or renovated buildings be designed to be compatible with district energy service.
- Developing a plan for district energy service franchising including a competitive procurement process and appropriate franchise fee structures.
- Providing density bonuses for buildings connecting to district energy.
- Leading by example by connecting municipal buildings to district energy.
- Integrating planning of infrastructure, including coordination of district energy piping construction with other street work, as well as consideration of integration of district energy production with other utilities including water, wastewater and solid waste.

Legal and regulatory framework

Issue	National Energy Policy
Problem	National policy should set targets for energy saving and emission reduction, and include DHC and CHP as tools of implementation. Since this is not the case, developers of DHC and municipal CHP face an uncertain market for their service. Without a decent DHC policy, the building developers continue choosing energy systems with lowest investment costs (electricity, gas) and without fuel flexibility, whereas building occupants would have had preferred low life-cycle costs (DHC) with high fuel flexibility.
Recommendation	National policy should explicitly support DHC and CHP development as a means to meet the ambitions GHG emission target and to increase fuel flexibility.
Good practise	See Chapter 6 (1)

Issue	Building regulations
Problem	
Recommendation	
Good practise	See Chapter 6 (2)

Issue	Price regulation
Problem	No problem
Recommendation	
Good practise	See Chapter 6 (3)

Issue	Competition
Problem	CHP plants using renewable fuels have problems with grid connection, both institutional and economic ones.
Recommendation	There should be an obligation for all utilities to grant priority grid access to green energy projects, including DHC and CHP. Utilities shall be entitled and empowered to recover all related costs. Related

	costs are to be spread equally across the entire rate base.
Good practise	FIT in Germany , See Chapter 6 (5)

Issue	Feed-in-tariffs for CHP or renewable
Problem	DHC and CHP development is slow.
Recommendation	FIT would strengthen the competiveness of DHC and CHP and attract communities and utilities to invest.
Good practise	FIT in Germany, see Chapter 6 (5)

Issue	Emission trading scheme
Problem	There is no price for emissions at the moment.
Recommendation	GHG emissions having a commercial price and the allowance trading scheme would both stimulate and optimize the investments in emission reductions. This would support DHC and CHP development as low carbon technologies.
Good practise	The European Union, See Chapter 6 (6)

Issue	Carbon tax
Problem	Fossil fuel prices are relatively low, which hinders adoption of renewable energies, DH and CHP. The low price of conventional energy does not reflect the external costs of the damage it causes to the environment.
Recommendation	Carbon emission based tax is an effective way to stimulate bio energy, DHC and CHP expansion in the market.
Good practise	Sweden, See Chapter 6 (7)

Issue	Investment grants
Problem	Investment grants may be justified when emerging technologies need to have faster access on the market as demonstration cases.
Recommendation	Tax exemption can be considered for energy efficient technologies such as DHC and CHP for a limited period of time.
Good practise	See Chapter 6 (8)

Customer issues

Issue	Customer definition and rights
Problem	No problems
Recommendation	
Good practise	

Issue	Service quality

Problem	No problems
Recommendation	
Good practise	

Issue	Billing
Problem	No problem
Recommendation	
Good practise	

<u>Ownership issues</u>

Issue	Municipality role
Problem	Municipalities are rather poor and weak, but they have an important role in DHC introduction stage
Recommendation	Municipalities need policy and sanction support in order to initiate DHC schemes in the densely built city areas.
Good practise	See Chapter 6 (12), Enwave/Toronto, The European Union

Issue	Private sector involvement
Problem	In general, private sector lacks incentives to participate in DHC and CHP development. Prices of fossil fuels are relatively low, pay-back times of DHC system construction are 10 years or longer, etc.
Recommendation	The St. Paul case can be replicable: the municipality starts with DHC supplies on a small scale, after having had increased to a commercial level, the private sector may take over, supported by institutional financing.
Good practise	Enwave/Toronto, Southampton (UK), Bashkirenergo and Fortum (Russia), See Chapter 6 (13)

Issue	Synergy allocations
Problem	Without carbon taxes or emissions trading it is difficult to have DHC and CHP expanding in the USA.
Recommendation	As one more measure, the allocation of CHP costs in such a way that power would cover most of the costs, would stimulate DHC development. The DHC or industrial heat loads are the preconditions to CHP.
Good practise	Denmark allocated most of CHP costs to electricity, thus making DH a very competitive product on the heating market. In such a way, DH has reached a 50% market share in the country.

Planning

Issue	Integrated resource planning
Problems	The stakeholders of DHC and municipal CHP are fragmented. Municipalities, the provincial and federal government, utilities, developers, builders, building owner and building occupants all have different interests in energy efficiency and planning. The developers are interested in low investment costs e.g. electric and even gas heating, whereas the building occupants interests lie in low life-cycle costs (DHC, CHP), but having the developer as the decision maker. Therefore, using electricity and natural gas as the heating source of buildings does not have any redundancy but the occupant is bound with increasing heating costs. Also local industry may have heat load or excess heat that could benefit the community but is not used.
Recommendation	Coherence is needed between energy and other policies in order to phase out market barriers faced by DHC and CHP. Integrated resource planning to be carried out by the governments would optimize the energy systems as a part of the community development. For instance, combining industrial heat load and heat production with nearby municipal heat loads would provide synergy benefits for the community. Moreover, logistics of renewable fuels would generate work opportunities to farmers. DHC and CHP system could use a variety of fuels, thus providing heating and electricity services at stable prices and at high reliability.
Good practise	The European Union, South Korea, See Chapter 6 (15)

Issue	Heat and urban planning
Problem	Heating of municipalities is not integrated in urban planning. Therefore, electricity, oil and gas heating have largely spread in urban areas, thus eliminating any flexibility on fuel switching and CHP.
Recommendation	Heating shall be better integrated with urban planning in order to obtain benefits of integrated resource planning.
Good practise	See Chapter 6 (16)

Technical

Issue	National technical standards and design conditions
Problem	
Recommendation	
Good practise	

Issue	Refurbishing strategies
Problem	n.a.
Recommendation	

Good practise	

18.9 **Sources of information**

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19Uzbekistan

19.1 Features and extent of DHC/CHP

History

The history of DH and CHP in Uzbekistan is originated from the Soviet Union time and is similar to the Russian one.

In the country, there are 33 heat supply companies.

The heating plants comprise 973 boiler houses in total, including 71 large-scale DH plants and central heat supply boilers (connected to heat mains and distribution networks) as well as 902 local boilers, from where household and business consumers are also served. The overwhelming majority of boilers run at low efficiency and are outdated (average gas consumption - 135-140 cub.m / Gcal, equal to 80-83% efficiency at the LHV of gas of 37.4 MJ/m^3).

Regarding heat supply networks, the total length of transmission and distribution networks is 4.992 km, some 1,770 km (35 %) of which are in an unsatisfactory condition and requires replacement (capital rehabilitation).

Statistics from past year

Energy statistics was not available.

DHC and CHP market shares

Some 10 companies of 33 in total are CHP producing companies. Detailed share of CHP energy is not available.

Types of DHC consumption

Both SH and DHW are covered by DH systems.

Selected technologies with customer connections

The bulk of the customers are directly connected. In other words, there is a mixing loop that mixes the return water of the secondary side with the supply water of the primary side in order to produce water to the radiators (SH) and taps (DHW). Such a direct connection requires a massive water treatment system, and since not sufficient, the poor water quality causes serious corrosion inside the pipes and armatures.

Heat metering rate

There is practically no heat metering at residential customers, but only at commercial and industrial ones.

Market expanding/shrinking

The market is relatively stable.

Local DHC association

No DH association exists.

19.2 Legal and Regulatory Framework

National policy

The Ministry of Economy is responsible for strategic planning of DH development and approval of investment projects.

The Ministry of Finance is responsible for:

1) Development of state tariff regulation policy;

2) Formation of methodology for pricing;

3) Setting heat tariffs by itself or through its regional departments.

The State Antimonopoly Committee is responsible for:

1) Control over observance of antimonopoly legislation;

2) Control over application of tariffs and service quality standards;

3) Protection of consumer rights;

4) Dispute settlement, etc.

State Energy Inspection "Uzgosenergonadzor" is responsible for control over observance of safety and industry efficiency standards and norms.

Regulation

According to the Law on Natural Monopolies, heat production and distribution fall under the list of natural monopolies. Therefore, activities of these companies are subject to state regulation through setting tariff limits and quality standards.

Building regulations

The building code was not available for assessment.

Price regulation

Main principles of the heat pricing system are as follows:

- Tariff consists of economically justified costs and net profit;
- Only approved norms of the main cost components (fuel, electricity, water, depreciation, labour, heat losses) can be included in the tariff;
- Net profit is limited up to 10% from production costs;
- Additional profit is granted as a bonus, if a company manages to reduce material or energy costs from the normative level (similar to price-cap methodology);
- Tariff may not be revised more than twice a year;
- Level of tariffs is the same for all consumers (household and business).

The cost breakdown of 2010 heat tariff was as follows:

- fuel - 44%
- labour – 13%
- electricity – 12%
- repair and maintenance – 11%
- administration and operation expenditures – 9%
- chemicals and other materials – 4%

- depreciation – 4%
- net profit – 2%
- other costs - 1%

Both the depreciation and net profit levels are low, which makes funding of replacement investments a challenge.

More than half of the tariff eligible costs stem from energy: fuel and electricity (56%).

Cost of labour is relatively high when 13%. Usually, it is below 10% of the total costs.

Competition

There is no competition on the heating side but the heating mode of customers is decided by the authorities.

Feed-in tariffs

There is neither FIT for CHP power nor for RES.

Emission trading scheme

There is no national emission trading scheme.

Carbon tax

No carbon related tax exists in the country.

Investment financing

DH refurbishment financing is mostly dependable on governmental budget funds, which are restricted. Private sector involvement is limited as well. Therefore, international development banks should be involved to start DH system refurbishment as a show case to local private sector.

19.3 Customer

Customer rights

Technical rights of the customers are non-existing, since there is neither incentive nor technical tools to control heat consumption of the apartments other than opening windows or dressing up better/lighter.

From legal and tariff setting point of view, the Antimonopoly Committee is responsible for customer protection, which indicates that heat pricing is not cost covering. Only low depreciation rates and profit margins are allowed, which is inadequate to finance replacement investments.

Service quality

Due to direct connections, the actual service quality is expected to be poor: poor quality of DHW, frequent operation breaks due to corroded pipelines.

Billing

Lump sum payment for most customers but consumption based on those commercial and industrial ones that have heat metering.

19.4 Ownership

Municipality role

There are no municipality owned DH companies in Uzbekistan. Neither has the municipality mandates for tariff regulation.

Municipalities, however, are left with responsibilities for:

1) Control over DH company's administration;
2) Permission for constructions;
3) Primary control over DH supply efficiency;
4) Local solutions related to heat supply systems;
5) Planning of local infrastructure.

Private sector involvement

Some 9% of the DH companies are private, whereas 58% are joint-stock companies with the state as share holder. The balance of 33% of companies is entirely state owned.

Synergy allocations

As long as all energy industry is regulated by the government, it does not matter much how the CHP benefits are allocated to its products. However, as the market will be liberalized, more benefit should be given to heat side in order to modernize and extend CHP.

19.5 **Planning**

Integrated resource planning

The government bodies carry out strategies, planning and regulation of DH and CHP centrally. Therefore, one may assume that some integrated resource planning is in place.

On the other hand, central planning does not allow competition. Lack of competition usually causes inefficient and costly operations.

Heat and urban planning

Ministry of Economy together with municipalities carries out urban and heat planning. Basically densely built areas are for DH and the other for individual heating modes.

There are indications that the DH systems have spread out to far to be economic. Conversion of uneconomic DH branches to individual heat supplies is part of the strategic plan of the government.

19.6 **Technical**

Technical standards and design conditions

Basically, the technical standards allow modern preinsulated pipelines and compact substations to be installed. Due to financial reasons, however, not much has been done so far.

Refurbishment strategies

The actual refurbishment plan includes refurbishment of DH in 30 large cities. This includes:

- Modernization and capital reconstruction of heating plants, heating mains and distribution networks;
- Capital reconstruction of in-house heating networks:
- Transition to local heating systems, where it is economically and technically feasible;
- Transition to closed-circulation heating systems (installing heat-exchanger stations in houses);
- Installing modern metering devices in entrance points of heat consuming buildings;

- Realization of projects with the application of CHP generation technologies (gas turbine plants) in four cities (Tashkent, Buhara, Samarkand and Nukus).

There are no group substations. Therefore, the conversion of the house connections from direct into indirect ones is relatively simple, just requiring a modern substation in each building basement and equipped with heat metering, two plate heat exchangers and two temperature control systems.

19.7 Local Example

No local good practice example was identified.

19.8 Recommendations and good practises

Policy

Issue	National Energy Policy
Problem	There is a sound policy to technically refurbish the DH and CHP systems.
Recommendation	Institutional reforms (pricing, privatization) seem inadequate to ensure implementation of the plans.
Good practise	See Chapter 6 (1)

Issue	Building regulations
Problem	n.a.
Recommendation	
Good practise	See Chapter 6 (2)

Issue	Price regulation
Problem	Cost-plus pricing of heat does not provide sufficient incentive to EE even though the company may earn a bonus for its EE achievements that exceed the norms.
Recommendation	Price-cap pricing should be introduced as a means to motivate the DH companies to improve their overall efficiency.
Good practise	See Chapter 6 (3)

Issue	Competition
Problem	n.a.
Recommendation	
Good practise	

Issue	Feed-in-tariffs for CHP or renewable
Problem	Only 9 of 33 DH companies are with CHP.
Recommendation	Feed-in tariff for CHP would be a tool to support CHP expansion to

	cities where it does not exist at the moment.
Good practise	Germany, See Chapter 6 (5)

Issue	Emission trading scheme
Problem	Financing of energy sector development is inadequate.
Recommendation	National trading of emission allowances would optimize the environmental investments, likely supporting DH and CHP developments.
Good practise	The European Union, See Chapter 6 (6)

Issue	Carbon tax
Problem	The energy sector is dominated by fossil fuels and relatively few CHP companies with outdated CHP technologies.
Recommendation	A carbon related tax would foster modern CHP development and use of renewable fuels as a means to address Climate Change and economy of district energy services.
Good practise	Sweden, See Chapter 6 (7)

Issue	Investment grants
Problem	No grants are available and the investment financing in general is a serious problem.
Recommendation	Financing for DH and CHP refurbishment should be sought from private sector and international development banks.
Good practise	See Chapter 6 (8)

<u>Customer issues</u>

Issue	Customer definition and rights
Problem	Without technical control systems and heat meters, the customers have little if any possibilities at all to control their heat consumption.
Recommendation	Installing modern substations and introducing consumption based billing would dramatically strengthen the customer rights to regulate their heat consumption according to their affordability and wishes.
Good practise	See Chapter 6 (9), the European Union, USA, Canada

Issue	Service quality
Problem	Due to direct customer connections, high corrosion of pipes and armatures as well as poor reliability due to frequent breaks prevail.
Recommendation	Modern compact heat exchanger stations in building basements is a technical priority as a means to improve technical service quality (constant room temperatures) and to reduce losses of water, heat and electricity.

Good practise	See Chapter 6 (10), The European Union, South Korea, USA and Canada

Issue	Billing
Problem	Lump-sum billing does not provide EE incentive to actors.
Recommendation	Conversion to consumption based billing would motivate all actors (DH companies, heat customers) to improve energy efficiency.
Good practise	See Chapter 6 (11), The European Union, South Korea, USA and Canada

Ownership issues

Issue	Municipality role
Problem	Municipalities should remain as partners to DH companies while creating optimal schemes for DH to work and expand at a sustainable way.
Recommendation	
Good practise	See Chapter 6 (12), The European Union

Issue	Private sector involvement
Problem	Only 9% of DH companies are privately owned. The share could be much higher in order to organize refurbishment plans in a sustainable and commercial way.
Recommendation	Long term agreement with customers and cost covering tariff setting with price-cap principle is a tool to attract private sector.
Good practise	Bashkirenergo and Fortum (Russia), Skopje (Macedonia FYR), See Chapter 6 (13)

Issue	Synergy allocations
Problem	DH pays for CHP heat as much as for boiler heat, thus not benefiting from CHP.
Recommendation	Offering substantial benefits of CHP to DH would be an effective way to extend CHP to other cities and to modernize CHP in those where it exists already.
Good practise	Germany, Denmark (Chapter 6)

Planning

Issue	Integrated resource planning
Problem	Implementation of the governmental plans is uncertain.
Recommendation	Private sector involvement should be strengthened to implement the refurbishment plans. Renewable energy should be introduced in the

	plans as an alternative to fossil fuels.
Good practise	The European Union, South Korea, See Chapter 6 (15)

Issue	Heat and urban planning
Problem	No major problems.
Recommendation	
Good practise	See Chapter 6 (16)

Technical

Issue	National technical standards and design conditions
Problem	Oversized DH systems and partly outdated technical standards provide expensive solutions that are not economically optimal.
Recommendation	Peak load definition should be based on 12 or 24 hour continuous operation history of really cold days in the past 5-10 years in order to prevent oversizing of the DH system. Modern compact substations based on European practice should be possible in customer connections as such.
Good practise	New European standard for design outdoor temperatures and using modern practices, See Chapter 6 (17)

Issue	Refurbishing strategies
Problem	Financing and prioritizing the refurbishment strategy
Recommendation	From technical point of view, experience shows the most economic refurbishment approach is to start from the customers: install modern building level substations to building basements. Thereafter, gradual rehabilitation of indoor piping and installing thermostatic radiator valves and heat cost allocators to apartments, provided horizontal instead of vertical indoor piping is used. In transmission and distribution networks, rehabilitation 10-15% of worst pipelines would provide substantial benefits in terms of reduced heat losses and extended lifetime of the network assets. In heat sources, some 50% of the real peak load should be designated to base heat load and be refurbished to work at high efficiency and reliability. The remaining heat sources shall remain peak load and back up sources. From financial point of view, long-term tariff and operation contract should be created in order to attract private capital to finance optimized refurbishment programs.
Good practise	Bulgaria (Chapter 6), Poland (Appendix 1), Mytishi, Russia (Chapter 14), Subotica, Serbia (Chapter 17)

19.9 Sources of information

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20Links to other Implementing Agreements

By reviewing the current list of implementing agreements at www.iea.org, we have identified the following links to other implementing agreements that may benefit from the report at hand:

IA Climate Technology Initiative (CTI)

IA Energy Technology Systems Analysis Programme (ETSAP)

IA Energy Conservation in Buildings and Community Systems Programme (ECBCS)

Within this IA, an annex is included, which is almost a definition of district heating:

Annex 37. Low Exergy Systems for Heating and Cooling: Investigate the potentials for replacing high valued energy (fossil fuels and electricity) by low valued energy sources and to assess its impact. Assess existing technologies and components for low exergy heating and cooling.

IA Demand-Side Management

Within this IA, we have found two annexes, which could benefit from the proposed project:

Annex 9. The Role of Municipalities and Energy Efficiency in a Liberalised System:
Investigate how the roles of local authorities in DSM are affected by liberalised markets and prepare guidelines for improving their service delivery.

Annex10. Performance Contracting:
The objective of this work is to facilitate the greater use of Energy Performance Contracting (EPC) and other Energy Service Company (ESCO) financial options and services. It is a business-to business task, limited to efforts involving the performance contracting arrangements and other ESCO-related financial options and services between client, businesses and all types of companies offering these services.

However, cooperation with these IA annexes was not foreseen in the budget of the project.

Moreover, the work has been closely linked to the ECOHEAT4EU project in 2010. The ECOHEAT4EU has identified and assessed the institutional policies hampering/promoting DHC in the selected countries of EU, and Croatia being a common benchmarking country for both projects.

21Conclusions

21.1 DHC and CHP as readily available tool to reduce emissions

DHC and CHP represent a mature technology, but they could be used much more to reduce emissions and to improve overall energy efficiency. CHP is the most efficient way to produce electric energy, regardless of the fuel -- fossil, biomass or even nuclear.

In year 2009 in Finland, for instance, thanks to comprehensive DH and CHP systems, some 7.2 million tonnes of CO_2 emissions have been avoided, equal to 1,400 kg of CO_2 savings per capita! Such an opportunity is widely available everywhere in the northern globe, where heating is constantly needed. Therefore, for instance, the EU has issued a CHP Directive to strengthen CHP expansion in the EU. Moreover in China, in order to improve energy efficiency the share of CHP is expected to increase from 29% to 50% of the DH production, the growth of DH which already booms more than 10% a year.

21.2 Emerging countries

In USA and Canada there is common interest on the political level to provide incentives to strengthen the development of DHC and CHP.

Municipalities are relatively weak but could initiate the DHC with small applications. Private sector and institutional financiers are needed for further development and expansion. The DHC and CHP cases in St Paul (USA) and Toronto (Canada) are good examples.

Supporting governmental/state policies would help DHC expand. DHC and CHP should be officially acknowledged as green energies. DH is the only way to have a large variety of fuels available for the heating of the building stock. Moreover, DH is needed in order to achieve benefits of CHP that is the only way to generate electric power from any solid, liquid and gaseous fuels at such a high efficiency of about 90%.

21.3 Expanding countries

In China, DHC and CHP are expanding fast as a means to eliminate small polluting boilers in the existing building areas as well as to create new building areas for population massively moving from country side in to cities. Such a DHC and CHP boom is strongly supported by the Chinese government. Strengthening the housing reform would motivate the customers to save energy as well.

With building level substations instead of the currently used group substations the life cycle costs of heating would be lower in most cases, but in order for the benefits to materialize, institutional changes in the border between the DH company and the developers are required. Also familiarization with the building level substations and new network designs would be needed among design institutes, heating companies and developers.

Heat metering combined with two-tier tariffs and consumption-based billing would motivate the customers to save energy. Heat metering and consumption-based billing would also motivate the heating company to save energy in production and distribution.

In South Korea, modern DHC development is based on North European practice. Strong governmental support has helped DH expand in the down town areas of Seoul and other main cities. The objective has been primarily to reduce pollution but also to achieve energy savings. Recently new measures were taken by the government to extend the DH sector further and to build more CHP capacity in the country to meet the increasing needs of heating and power in a sustainable way.

21.4 Refurbishing countries

In Russia, Kazakhstan, Ukraine, Uzbekistan and the Balkan countries, there is an urgent need to proceed with comprehensive rehabilitation of the outdated DH and CHP systems. In Russia and the Balkan countries such rehabilitation is under way but has hardly started in Kazakhstan, Uzbekistan and Ukraine.

In Russia, the ongoing energy sector restructuring will force the investors to improve economy and reliability of the CHP plants and the heat transmission lines until the group substations. The main problems of the Russian DH, however, are in the secondary side, between the group substation and the room radiators, which section remains rather untouched.

Approval of the Russian draft Heat Law is still pending from year 2002 but should be updated and finally approved in order to require heat metering of customers, and further on, to proceed with consumption based billing. According to vast experience in similar cases, this would be the measure with highest economic return: reduced fuel and electricity consumption, smaller size of replacement investments to meet the real and reduced heat load, etc.

In Kazakhstan and Uzbekistan the strategies exist but funding of refurbishment is inadequate. Price cap system, long term agreement with customers and authorities would attract private sector to extend their activities in DH refurbishment.

In Ukraine, the DHC and CHP situation is rather desperate, but new supporting laws and policies are underway.

Least costs analyses should be carried out in order to determine in which parts of the cities DH will be the least cost solution. Thereafter, heat planning and zoning should be applied to prevent overlapping heating solutions in DH designated areas.

RES should be supported in order to substitute imported fossil fuels of hiking prices and problematic availability. RES development would also help local economies to develop while reducing fuel import costs, creating local work opportunities in RES logistics and fighting Climate Change.

In Serbia, the DH system rehabilitation is under way but institutional reforms are needed: tariff reform to introduce two-tier tariffs and consumption-based bilking country wide would motivate both the companies and the customers to save energy. Serbia is one of the few countries where DHW is not served by the DH system, which makes the CHP developments economically challenging. In Valjevo and Subotica heat metering and substation modernization are already completed. In Subotica consumption based billing is underway already and should be extended to other cities as soon as possible.

In Kosovo, the opportunities are a little more positive than in Serbia. The CHP may become true in Pristina, the largest of three DH systems in the country. Pristina is interested in the demonstration of DHW services after the CHP connection has materialized. Heat metering is almost completed. The regulator works well as well, thus offering a good regulatory practice to other countries to follow.

In FYR Macedonia, privatization and competition are organized in a sound way, thus providing a good practice for other countries to follow. DH refurbishment is underway without external financing.

In Bosnia & Herzegovina, DH refurbishment has taken place in Sarajevo only. but is still pending in other cities. Consumption based billing with modern computerized customer database was initiated in 1999, but has since taken steps back. Now billing has returned back to lump sum one.

In Croatia, being the benchmarking country with Heat4EU Project, DH refurbishment is well underway, and heat metering of customers is already completed. Consumption based billing is used as well.

Appendix 1 Summary of Polish DH rehabilitation projects 1991-2000

Appendix 2 List of Experts Interviewed per Country

Appendix 1

Summary of Polish District Heating Rehabilitation Projects During 1991-2000[90]

Background

DH is the governing heating mode in Northern and Central Europe, mainly because of the extensive use of highly efficient co-generation of heat and electric power. In some countries, however, DH systems are still inefficient due to obsolete technologies and years of only minor investments. Such a poor efficiency combined with the low level of co-generation has negatively affected the competitiveness of DH on the local heating markets, thus causing customers to switch to gas heating. Several Central European countries have started the optimization of widely spread DH systems, with assistance of the World Bank. Especially Estonia and Poland have achieved encouraging results in terms of improved economy, ecology and competitiveness of DH. DH customers in these countries have benefited the most from the optimization investments, because the costs of heating of one square meter of living floor area have dropped, in Poland, for instance, about 60% from 1991 to 1999 in the real terms corresponding to the cost level of the year 1999. In Poland, the World Bank has recently completed DH rehabilitation programs in five large cities covering about 20% of the DH market in the country, as presented in Table 1.1. The program completion costs amounted to US$530 million, of which US$328 million was financed by the five Polish DH enterprises (DHEs) and the balance by the World Bank loans. The DH system rehabilitation as a way to a greener future in Europe was successfully demonstrated in Gdansk, Gdynia, Katowice, Krakow and Warsaw.

The Polish energy sector was brought to the forefront of the World Bank-Poland dialogue in the late 1980's. The DH sector was at the core of these inefficiency problems. For a considerable period of time, the DHEs suffered from a lack of funds to effectively operate, maintain and renew their infrastructure. This resulted in major heat and hot water losses because of serious corrosion caused by poor water quality and water leakage, and lack of insulation. The decentralization of ownership combined with the phasing out of investment subsidies and the lack of long-term financing for infrastructure exacerbated the financial problems of the DHEs. The local authorities did not have the technical or financial resources to address these problems.

90/ *The Paper is based on the Implementation Completion Reports (World Bank, 2000 and 2001) and the presentation given by Mr. Nuorkivi at Euroheat&Power Conference in Gdynia, Poland, in June 2001. The World Bank's key team members in project supervision have been as follows: Mr. Rachid Benmessaoud, Senior Energy Specialist and Team Leader, has been responsible for the energy program assistance in Poland, covering preparation of the five Polish programs and implementation supervision of the programs in Gdansk, Gdynia, Krakow and Warsaw; Mr. Enar Wennerstrom, Financial Analyst, who has been responsible for program implementation supervision and financial analysis in Katowice. Mr. Arto Nuorkivi, District Heating & Power Specialist, has supervised the technical implementation of the projects and has carried out the environmental and economic analyses in all the aforementioned cities.*

Table 1.1. Background data of DH in Poland.

	Gdansk	Gdynia[1)]	Katowice[2)]	Krakow	Warsaw	5 Cities	Poland	5 Cities
Population (million)	0.5	0.3	0.7	0.7	1.7	3.9	38	10 %
Market								
Heat Sales (TWh)	2.3	1.5	2.4	2.9	10.6	19.7	90.0	22 %
Sales Revenues (M$)	57	38	50	77	257	479	2 334	21 %
Implementation Costs	75	46	60	72	278	470	M$	
Investments	74	45	59	71	276	467	M$	
Technical Assistance	1.4	0.7	0.8	0.5	1.2	3.8	M$	
Financing								
Five DHEs	35	21	23	47	203	328	M$	
World Bank	40	25	37	25	75	202	M$	
Total financing	75	46	60	72	278	530	M$	

1) Gdynia heating covers Rumia, Wejherowo and a part of Sopot.
2) Katowice heating covers five towns such as Swietochowice, Siemianowice, Chorzow, Myslowice and Katowice.

What Was Done

During the program period, 24% of the total network length, consisting of 972 km of poorly insulated and leaking pipes, was replaced with preinsulated pipes. About 50% of all substations were fully modernized and an additional 20% were partially modernized, through the installation of 35,000 new heat exchangers and 3,000 compact substations. Network sectioning, automation and remote metering systems were installed, and all heat supply sources and consumer substations were equipped with heat meters. In addition, 561 coal-fired heat-only-boilers (HoBs) with a capacity of 517 MW were eliminated and the customers connected to the DH networks. A further 185 HoBs with a capacity of 103 MW were converted into natural gas or oil fuel. Foreign consultants, manufacturers and other DHEs provided substantially training for institutional building of the five DHEs in Poland. The topics of training covered marketing and customer care, financial planning, economic analysis, quality assurance, environmental management, preventive maintenance, technical design and economic operation, thus changing the organizational attitude and behavior towards customer oriented and more efficient operation.

Achievements Met Objectives

The key results related to competitiveness and environment protection of DH are highly satisfactory and surpass early expectations as summarized below:

Substantial Subsidies Were Phased Out Fast: Investment subsidies were eliminated, and household subsidies phased out gradually from a nationwide average of 78% of the heating bill in 1991 to zero in 1998.

Consumers Benefited in Reduced Heating Costs in Real Terms: The efficiency gains resulting from the Government's energy pricing policy and achieved by both the DHEs and the combined heat and power plants greatly benefited the DH customers through a 56% lower price for heating one square meter (m2) of floor area (from 54.5 PLN/m2 in 1991 to 24.0 PLN/ m2 in 1999, at 1999 prices), as presented in Fig. 1.1.

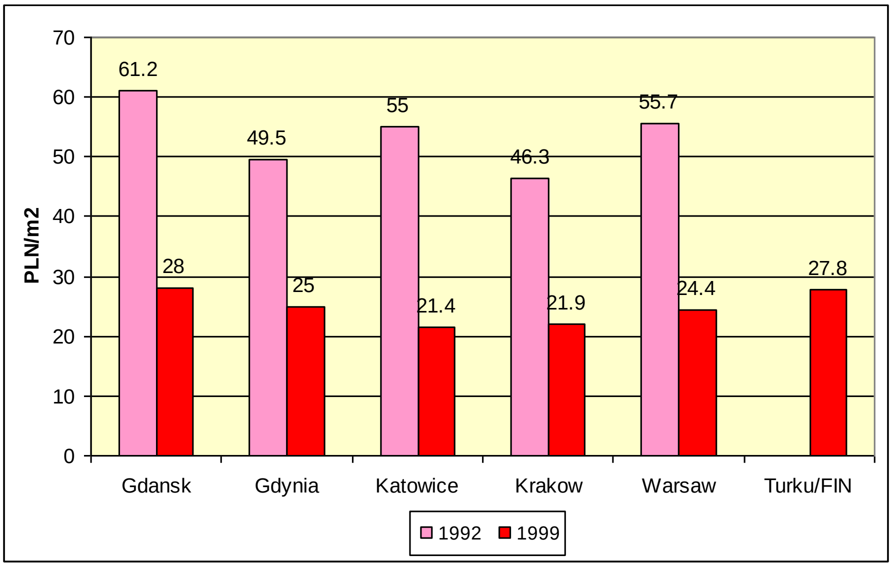


Figure 1.1. Heating costs per floor area in real terms (1999 price level).

The customers did not see the price drop in full because the VAT was added to the heat price in the course of the program.

Practically most of the economic benefits of the program were given to the customers in terms of low heat tariffs, as demonstrated above. This was the reason that little economic benefits remained in the DHEs. Therefore, some of the DHE's had to operate under extremely tight financial circumstances during the years of program implementation and still be able to finance at least 30% of the total costs of the program.

Efficiency Gains Provided Energy Savings: 22% energy savings in the five cities amounting to 1,200 Gg of coal a year was achieved and valued at US$60 million per year. The achieved savings were 35% more than 900 Gg expected in 1990 when the program was started. The Bank-financed investments were focused on sustaining the least-cost heat solution, with significant benefits for the environment.

Competitiveness to Gas Improved: due to DH system rehabilitation, competitiveness of DH has improved in terms of lower costs and higher quality of service. Therefore, customers who used to escape to gas are now returning to DH.

The DHEs Started to Generate Own Funds for Investments: Despite the reduction in their profit margins due to real tariff decreases, the enterprises were able to generate cash internally of 62% of capital investments, exceeding the minimum level of 30% required under the financial covenants of the World Bank loans.

Technical Rehabilitation Enabled Customers to Control and Meter Their Heat Consumption: Control of the DH systems was automated and changed from production control to demand control, thus giving the customer the possibility to regulate their heat consumption.

Environmental Benefits Gained from Rehabilitation: The citizens benefited from improved air quality through reduction in gaseous and dust emissions. Due to both HoB elimination and energy savings achieved in the DH system, the annual emissions were reduced substantially as follows:

Reduction of 26 Gg of SO_2 out of the initial 102 Gg in 1992 was based on the energy savings of coal of 0.7% S-content on average and having no desulphurization plant available at any plant during the program;

Reduction of 9.5 Gg of NO_x of the initial 37.7 Gg was based on the reduced coal consumption and having no low-NO_x burners available at any plant, even though some burners of such type may have been installed on the later years of the program to the CHP sources but not being financed by the program on hand;

Reduction of 3.2 Tg of CO_2 out of the initial 12.7 Tg is based on reduced coal consumption (below); and

Reduction of 6.7 Gg of dust out of the initial 15.5 Gg is based on HoB elimination program only (below). The CHP sources have had electric precipitators all time long and possible changes in their efficiency were excluded from the analysis.

The DHE of Krakow was officially eliminated from the list of heavy air polluters, thanks to the boiler elimination and coal-to-gas conversion programs. The Polish economy also reduced its contribution to greenhouse gases (mainly from carbon dioxide emissions).

The DHE of Gdansk started to implement a modern Environmental Management System in their organization, according to the international ISO 14000 standard, to better serve their customers in environmental improvement. The Environmental Management System was later being integrated to the Quality Assurance System, that was initiated in 1995 and certified according to the ISO 9002 standard by year 1999, likely as the first certified Quality Assurance System at any DHE in the Central and Eastern Europe. Later on, other DHEs in Poland have started implementing such systems.

Water consumption in the five DHEs dropped substantially, as presented in Fig. 1.2, thus saving both energy and raw water.

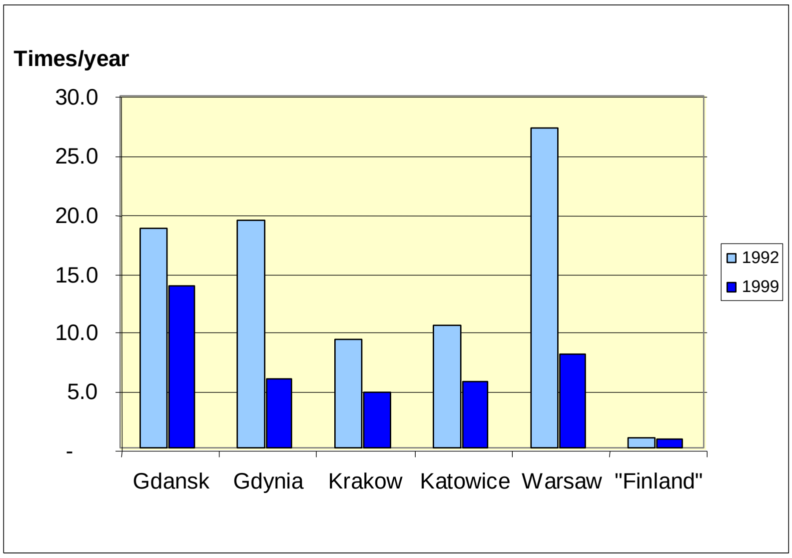


Figure 1.2. Replacement of network water.

Due to DH system modernization, the share of CHP generated heat out of total heat supply increased during the years, as shown in Fig. 1.3 below. In Gdansk and Katowice, new CHP capacity was implemented during the course of the program but not financed by the program. The share of CHP in Helsinki is given as reference.

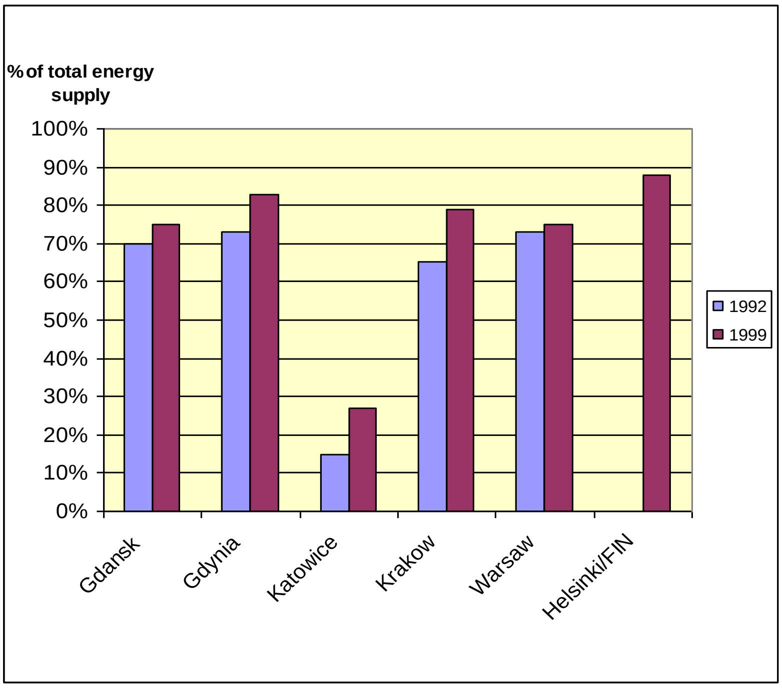


Figure 1.3. Heat energy supplied by CHP sources as percentage of the total heat supply.

A summary of the obtained benefits is presented in Table 1.2.

Table 1.2. Key performance indicators of the DH rehabilitation program.

Indicators		Gdansk	Gdynia[3]	Katowice[3]	Krakow	Warsaw	Total
Coal Savings	(Gg)	125	125	118	215	630	1,213
	% reduction	23%	25%	24%	25%	21%	22%
Metering of sales	Before	14%	15%	30%	16%	24%	21%
	After	100%	100%	100%	100%	100%	100%
Reduction in Water Losses		26%[2]	69%	45%	48%	69%	65%
Reduction in Number of Staff		30%	33%	3%	35%	30%	32%
Increase in Productivity (MWh sales/employee)		11%	60%	-7%	21%	38%	34%
Reduction in Air Pollution (various emissions)		26-52%	30-42%	21%-31%	27-53%	25-42%	26%-45%
Internal Cash Generation as % of Investments		49%	52%	46%	74%	64%	62%
Technical Assistance (man weeks)		295	225	230	170	330	1,250

2) Average of 1998 and 1999 values
3) the DH systems in Gdynia and Katowice cover also some neighboring cities and towns.

Conclusion

In 1999, the five DHEs of Poland in Gdansk, Gdynia, Katowice, Krakow and Warsaw have sold about 20 TWh of heat to their customers, representing about 20% of the entire DH market in Poland. Rehabilitation of their DH systems was demonstrated in full scale and with achievements exceeding early expectations in improved economy, energy savings, environmental protection, financial performance and in customer orientation. Therefore, the Polish example offers a considerable solution to rehabilitate the DH systems in the Central and Eastern Europe, where the DH is the governing heating mode and most often the least cost solution in the long term, but simultaneously suffers from inefficiency, deterioration and poor competitiveness on heating market.

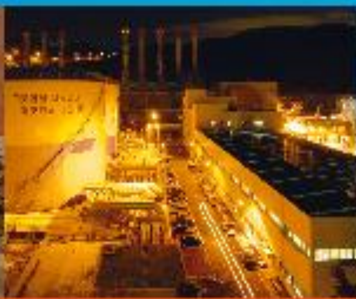
Appendix 2

Experts interviewed by the Team

Country and person	Occupation	Organization
Bosnia		
Mr. Mirzo Hadzialic	General Director	DH Company Sarajevo
Mrs. Narcisa Poturak-Dönmez,	Project Coordinator	KfW Office
Canada		
Mr. Ken Church	Team Leader - Communities	Canmet Energy, Natural Resources of Canada, Ottawa
Mr. Michael Wiggen	Senior Advisor	Office of Greeening Government Operations, Ottawa
Mr. Andrew Wilcox	Manager, Business Development	Enwave Energy Corporation, Toronto
Mr. Brent Gilmour	Director, Urban Solutions	Canadian Urban Institute, Toronto
China		
Mr. Gailius Draugelis	Acting Country Sector Coordinator - China Energy, Senior Energy Specialist	The World Bank, Beijing
Mr. Tan Xin	Executive Director	HRBEE Office of MoHURD
Croatia		
Mrs. Jadranka Maras Abramovic	DH Expert	Energy Institute Hrvoje Pozar
Mr. Mico Klepo	DH Regulator	HERO (Croatian Energy Regulatory O
Mr. Pekka Salminen	Task Team Leader of Croatia DH project	The World Bank
Kazakhstan		
Mr. Viktor Loksha	Consultant	The World Bank
Mr. Bartiyar I. Atalykov	Chief expert in DH regulation	Agency for Regulation of Natural Monopolies
Kosovo		
Ms. Fellanze Pula	General Director	DH company (Termokos) of Kosovo
Mr. Driton Hyseni	Technical Director	Termokos
Mr. Astrit Saragini	Regulator for DH	ERC
Macedonia		
Mr. Peter Johansen	Sr. Energy Specialist	The World Bank
Prof. Jordan Pop-	Eneryg expert	Macedonia Academy of Science and Arts/Research Center for Energy, Informations and Materials
Prof. Natasa Markovska	"	
Prof. Gligor Kanevce	"	
Ms. Verica Taseska	"	
Dr. Dimitar Hadzi-Misev	General Direktor	Toploficacia Skopje

Country and person	Occupation	Organization
Russia		
Ms. Nelly Segizova	Expert	Russian Energy Agency
Mr. Sergey Andreychik	Head of tariff setting group	OJSC Fortum, Russia
Ms. Marina Velikanova	Expert	Rosatom
Mr. Kochetkov	Head of Investor Relations	JCS Bashkirenergo
Serbia		
Mr. Lecic	Chairman	TOPS (Serbian DH Associaztion)
Mr. Pero Rickic	Generak manager	JKP Sdubotica
Mr. Vlaidmir Pavicevic	Energy expert, Former DH expert in the Ministry of Mining and Energy	Independent
Mr. Rajakovic	State Secretary	Ministry of Mining and Energy
South-Korea		
Mr. Seok-Mann Yoon Ph.D	District Heating Technology Research Institute	Korea District Heating Corporation
Mr. Jorma Kotakorpi	Vice president	Korea District Heating Engineering Co.,Ltd
Mr. Ha Soo Kang	DH & C Team Chief Engineer	Korea District Heating Engineering Co.,Ltd
Ukraine		
Ms. Alyona Babak	Senior Expert	Muncipal Development Institute - MDI
Mr. Pekka Salminen	Sr. Energy Specialist	The World Bank
USA		
Mr. Douglas Kaempf	Program manager, Industrial Technologies Program	U.S. Department of Energy; Washington, D.C.
Mr. Robert P. Thornton	President	International District Energy Association (IDEA)
Mr. Bruce Hedman	Vice President	ICF International, Arlington, VA
Ms. Patricia Garland	Technician, Industrial Technologies Program	U.S. Department of Energy; Washington, D.C.
Mr. Mark Spurr	President	FVB Energy Inc.
Mr. Michael J. Burns	Energy Services	District Energy St. Paul, Minnesota
Uzbekistan		
Mr. Ilhom Djalalov	Head of Department	Ministry of Finance






IEA DHC|CHP

International Energy Agency
IEA Implementing Agreement on District Heating and Cooling, including the integration of CHP

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Photographs: Iqaluit, Nunavut: installing piping for the new northern system that feeds the hospital, Canada - Hamilton Community Energy plant under construction, Canada - Bundang Plant, South Korea - Avedøre CHP plant, Denmark, photo: DONG Energy