INOGATE Textbook

REGULATORY IMPLICATIONS OF DISTRICT HEATING

2011

Textbook developed for the INOGATE Programme

“Capacity Building for Sustainable Energy Regulation in Eastern Europe and Central Asia”

by the

Energy Regulators Regional Association (ERRA)

Authors:
Mr. Valdas Lukosevicius, Lithuania
Mr. Luc Werring, The Netherlands

www.inogate.org
www.erranet.org

This document has been prepared by ERRA. The findings, conclusions and interpretations expressed in this document are those of ERRA alone and should in no way be taken to reflect the policies or opinions of the EU.
PREFACE

Dear Colleagues:

I am honoured to present to you a series of regulatory textbooks prepared by the Energy Regulators Regional Association (ERRA) within the frame of its INOGATE project called “Capacity Building for Sustainable Energy Regulation in Eastern Europe and Central Asia” – funded by the European Commission. The project embraces energy regulators, ministry officials and other relevant energy industry stakeholders from Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Tajikistan, Turkmenistan, Uzbekistan and Ukraine. The key objective of the textbooks is to strengthen the institutional memory of the project by recording the expertise accumulated during the activities of the project. The regulatory experience and knowledge on important topics, while extensively covered in the workshops, also calls for a written approach that provides the ability to analyze the issues in a more complex and in-depth manner.

The textbooks extensively rely on the different project programmes organised on four main themes: (1) Renewable Energy Regulation, (2) Regulatory Implication of Energy Efficiency Policies, (3) Vulnerable Customers and Possible Support Schemes, (4) Regulatory Implication of District Heating. The aim of the textbooks is to present a good overview of the relevant policies of the European Union (regulation, directives and targets), national action plans, and case studies if available – together with applicable policy instruments. In particular, the text tends to focus on possible regulatory concepts and regulatory tools. The information in the textbooks attempts to present not only the role of the regulators but also the role of utilities in the above four main areas and the benefits of the available policies to consumers and utilities. The publications strive to focus on the possible barriers when implementing these policies in countries with transition economies and on the potentials for removing these barriers. They are based on relevant international and European regulatory good practices while taking into considerations the current state-of-play and the opportunities of the Inogate Partner Countries, and done by coupling these factors with recommendations for good regulatory practices.

I would like to draw your attention to the possible overlapping topics between these four publications. Although, we tried to avoid any possible overlaps, since the issues are so interrelated it is impossible not to cite the same directives, policies, practices and sometimes even to draw the same conclusions. We attempted to cross-reference the textbooks in these overlapping areas but I would like to suggest that you read all four publications in order to have a complete picture.
This particular publication focuses on *Regulatory Implications of District Heating.* District heating has significant role and weight in the energy sector in many of the new EU member states and in the Inogate Partner Countries, so it needs to be considered as important part of energy policy and as a sector, which has influence on the overall energy efficiency and energy security of the countries. In addition, district heating is a technology that can save a lot of energy when it is applied according to certain quality criteria. Thus, it has many advantages as regards local resource efficiency, local environment protection and global climate change measures as well. Government and energy regulators have an important energy- and climate change policy role providing the adequate incentives for this sector and its investors.

Energy regulators in the new EU member states played a serious role in ensuring the proper economical basis for operation of district heating utilities which were not attractive for investors without sufficient regulation. Regulators have made unpopular and painful economic decisions balancing the short (low prices; high political sensitivity) and long term interest (heat supply security; necessary investment climate) of customers in the process of reforms was essential in many countries.

Most of the Inogate Partner Countries have huge energy saving potentials in their inefficient elements of the heat supply chain (district heating technologies, facilities and customer’s appliances). In some of these countries the regulatory framework, which should provide sufficient incentives for the energy companies to increase their efficiency in operation and maintenance and for the investors to upgrade the district heating facilities are missing.

The aim of this publication is to provide knowledge regarding increase of efficiency of district heating systems, support schemes applied and possible perspective for future development of the system. Furthermore, various technical and regulatory aspects of the technology will be addressed in detail.

I am personally very proud of these four publications and I am convinced that they will be useful and relevant not only for the purposes of Inogate Partner Countries but for many other regulators and government officials from countries with emerging economies. ERRA will do its best to promote the publications to this audience and present these textbooks to future stakeholders of ERRA.

I am also very pleased with the work of the authors. The list of authors represents internationally acknowledged experts of the specific themes, many of them are practising or former regulators which brings a special value to the textbooks. Most of the authors were involved in all of the meetings, workshops and training courses implemented under the umbrella of the project. Their participation enabled them to learn about the main regulatory features and policies of the Inogate Partner Countries. In addition, I am proud of our expert team verifying the content of these textbooks. ERRA has invited the Hungarian, the Polish, the Romanian and the Turkish regulators to appoint experts in order to make sure that the publications truly represent the current regulatory situation of the listed countries and of Europe in general. In the case of the textbook on District Heating we were fortunate to have the Finish utility, Fortum to evaluate the content. The piece on Vulnerable Customers was read and
commented by select staff persons of the Energy Community. I am particularly grateful for the dedication and voluntary work of all these experts.

Finally, I would like to take this opportunity and thank the European Commission for supporting this initiative and contributing to the birth of these basic publications. I look forward to other successful joint initiatives in the future.

Sincerely:

[Signature]

dr. Gábor Szörényi
Chairman
ERRA
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>INOGATE Textbook ...........................................................................</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>PREFACE ..........................................................................................</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>LIST OF ACRONYMS ...........................................................................</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>EXECUTIVE SUMMARY .........................................................................</td>
<td>9</td>
</tr>
<tr>
<td>1.</td>
<td>THE GENERAL CONTEXT FOR DISTRICT HEATING .......................................</td>
<td>10</td>
</tr>
<tr>
<td>1.1</td>
<td>The concept of sustainable development ........................................</td>
<td>10</td>
</tr>
<tr>
<td>1.2</td>
<td>A guiding principle .........................................................................</td>
<td>10</td>
</tr>
<tr>
<td>1.3</td>
<td>Energy and sustainable development ...............................................</td>
<td>11</td>
</tr>
<tr>
<td>1.4</td>
<td>Energy efficiency as the most important element of a sustainability strategy</td>
<td>12</td>
</tr>
<tr>
<td>1.5</td>
<td>District heating supporting energy efficiency and sustainability ........</td>
<td>13</td>
</tr>
<tr>
<td>2.</td>
<td>TECHNICAL EFFICIENCY AND FLEXIBILITY OF CENTRALISED HEATING SYSTEMS ...</td>
<td>13</td>
</tr>
<tr>
<td>2.1</td>
<td>Technical reliability and safety, fuel flexibility and environmental benefits</td>
<td>13</td>
</tr>
<tr>
<td>2.2</td>
<td>Energy and economic efficiency of centralized heat production and distribution scheme</td>
<td>15</td>
</tr>
<tr>
<td>2.3</td>
<td>Complex efficiency of district heating and cogeneration ..................</td>
<td>17</td>
</tr>
<tr>
<td>2.4</td>
<td>Integration of district heating schemes in the local energy infrastructure of modern cities</td>
<td>19</td>
</tr>
<tr>
<td>2.5</td>
<td>General understanding and utilization of district heating benefits .......</td>
<td>21</td>
</tr>
<tr>
<td>3.</td>
<td>STATUS AND SITUATION OF DISTRICT HEATING SECTOR IN COUNTRY GROUPS ....</td>
<td>22</td>
</tr>
<tr>
<td>3.1</td>
<td>District heating sector in the old member states of European Union ....</td>
<td>24</td>
</tr>
<tr>
<td>3.2</td>
<td>Development of district heating in countries with transition economies and the new Member States of European Union</td>
<td>27</td>
</tr>
<tr>
<td>3.3</td>
<td>Present situation of district heating in the INOGATE partner countries</td>
<td>29</td>
</tr>
<tr>
<td>3.4</td>
<td>Summary, conclusions ......................................................................</td>
<td>30</td>
</tr>
<tr>
<td>4.</td>
<td>LEGAL, REGULATORY AND BUSINESS ENVIRONMENT OF THE DISTRICT HEATING SECTOR IN COUNTRY GROUPINGS</td>
<td>31</td>
</tr>
<tr>
<td>4.1</td>
<td>Basic principles of supervision of district heating utilities as a local and natural non regulated monopoly in countries with a stable economy</td>
<td>32</td>
</tr>
<tr>
<td>4.2</td>
<td>Generalities and peculiarities of national legal/regulatory framework in countries with a high density of regulation</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>© ERRA Copyright 2011</td>
<td></td>
</tr>
</tbody>
</table>
4.3 Main trends in the district heating sector: reforms in a transition period........35
4.4 Legal framework and institutional model in a state controlled district heating sector .................................................................36
4.5 Ownership and operation of district heating assets ...........................................40
4.6 Competition in the district heating sector ..........................................................42
4.7 Competition with other heating methods ............................................................44
4.8 Licensing and related obligations ......................................................................46
4.9 Heat price setting procedures ...........................................................................48
4.10 Dispute settlement in district heating .................................................................53
4.11 Planning and approval of investment .................................................................54
4.12 Promotion of the district heating and cogeneration ...........................................56
4.13 Some general legal/regulatory principles applied in district heating sectors of INOGATE partner countries ............................................................60
4.14 Summary, conclusions......................................................................................62

5. ECONOMY OF CENTRALISED HEAT SUPPLY, COST ADJUSTMENT, PRICING AND PAYMENTS ..............................................................................................63
5.1 Economic viability of district heating enterprises and regulated income ..........64
5.2 Cost structure and classification of heat supply expenses .................................65
5.3 Cost identification and approval methods ............................................................66
5.4 Cost allocation between heat and electricity in cogeneration plants .................68
5.5 Regulation of profit in the district heating service .............................................70
5.6 Heat pricing as part of general regulatory regime .............................................71
5.7 The main pricing methods in district heating sector .........................................72
5.8 Structure and differentiation of heat prices and tariffs ......................................76
5.9 Heat price regulation and monitoring .................................................................78
5.10 District heat price level ......................................................................................80
5.11 Financing and development of district heating schemes ..................................81
5.12 Connection to the district heating system - network fees ................................83
5.13 Billing, payments and social protection of vulnerable consumers ....................84
LIST OF ACRONYMS

CEE – Central and Eastern Europe
CHP – Combined heat and power
DH – District heating
E&P – EUROHEAT & POWER
GJ – Gigajoule
IEA – International Energy Agency
INOGATE – Interstate Oil and Gas Transport to Europe
MS – Member states
MSW – Municipal solid waste
MW – Megawatt
MWh – Megawatt-hour
PJ – Petajoule
PS – Post-socialist (countries)
TW – Terrawatt
TWh – Terrawatt-hour
VAT – Value-added tax
WACC – Weighted Average Cost of Capital
Executive Summary

Energy efficiency (EE) is the most important element of a sustainability strategy. District heating technology is a very useful solution for current energy related challenges. However, old Member States of the European Union, except Scandinavian countries, still have a small DH market share and cannot utilize the potential benefits.

District heating schemes and cogeneration plants are widely spread in formerly planned economy countries; this was due to its technical and economic advantages. The transition period in the post-socialist countries resulted in significant damages to the DH sector in these countries. Despite these economic difficulties new Member States of the EU managed to save relatively large district heating schemes and to gradually modernize them. There is however, a much more difficult situation is in the district heating sector of transition countries which are still in the beginning of their energy sector reforms (particularly most INOGATE programme partner countries).

District heating service quality in the competitive markets is ensured mainly by market driven forces (except Denmark) and this is common in West European countries where district heating sector was developed to attract new clients. Different situations exist in countries with a background in central planning, where district heating was always regulated and supervised by the state, this approach is still embedded in the regulatory framework.

Generally, the experience of countries which have passed the transition stage toward market based economies, has been positive with reforms. They can provide examples of approved regulatory solutions to countries following their lead.

The establishment of an independent and competent energy regulator, able to monitor and analyze the environment in the DH sector, assist the creation of a regulatory system, and implement long term objectives, could all be key factors ensuring the economic viability of the transition DH sector. Different regulation systems and tested methods are covered in this textbook.

The theory and practice of district heat prices, tariffs setting methods and procedures – which are extremely important for transition period, are described here. The main objectives of DH and the chosen pricing system are illustrated. If a DH scheme is technically and economically efficient then the regulatory regime should provide incentives and adequate price signals for its gradual renovation and development.

New incentives for European energy policy, presented in the textbook, demonstrate that centralized heat production (including electricity and cooling) and distribution should be promoted and expanded due to the possibilities of technical and economic improvement of the existing national energy infrastructures. Experience of DH reforms in transition economies have highlighted administrative and regulatory mechanisms which could be useful for rehabilitating existing DH systems, as well as for the development of a much bigger district heating sector in the European Union.
INTRODUCTION

This textbook intends to provide an overview of recent developments and the role of regulation in the district heating (DH) sector in Europe and neighbouring countries. The purpose is to review DH in the current and future energy market, this includes looking at the problems in this sector and the solutions. It provides an understanding of the market and regulatory implications for DH. The report aims to consider the district heating sector of European countries from a regulatory point of view and highlight practices in the real world compared to a more theoretical approach and how these influence the operation for state administrators in this sector.

1. THE GENERAL CONTEXT FOR DISTRICT HEATING

1.1 The concept of sustainable development

The Earth provides the necessary environment for human existence. We all depend on nature and on the ecosystem for a decent, healthy, and secure life.

Man’s impact on the ecosystem has grown tremendously in recent decades to meet the exponential growth required for resource based services and goods. All these services are provided by natural resources, like water, energy, biomass, and minerals.

However, the current pace of development cannot be maintained, it is not sustainable. The Earth’s ecosystem is being significantly damaged, threatening the survival of all species. The rate of present development is unsustainable, this is demonstrated by the extinction of species, depletion of natural resources, the pollution of the environment. The effects of climate change are the most threatening consequence of this unsustainable development: posing a long term risk to human life on the Earth.

If the present, unsustainable development continues, the growing human population will meet its limits by the disappearance of a healthy environment.

1.2 A guiding principle

The significant risk of a global climate catastrophe is confirmed by most scientists; however, science has not clarified completely its content, timing, and occurrence. That is why the precautionary principle that seeks to avoid further damage should be applied. Policies have to be introduced, which mitigate the effects of climate change.

Currently, there is no effective World-wide governance structure that could lead a concerted effort by nations to stop environmental destruction. Climate change mitigation ini-
tiatives of individual countries and World organizations, such as the IPCC\(^1\), do help. The question is, whether the present level of action is enough to avoid disastrous climate change.

### 1.3 Energy and sustainable development

#### Threats to sustainable development

The consequences and symptoms of unsustainable development can be seen in a number of areas, including:

- deterioration of ecological systems
- depletion and deterioration of natural resources
- regional overpopulation
- exponentially growing human impact on Earths natural systems
- social inequality

The Earth is the source of energy and also the dumping ground for the waste from energy production. Of the many threats, energy usage is tightly connected to unsustainable, as well as sustainable growth, therefore sustainable ‘green’ solutions in the energy sector are central in solving the present path of unsustainable development.

#### Supply side: the depletion of fossil energy sources

More than 80% of the world’s primary energy demand is met by fossil fuel sources, and no significant change is expected within the next two decades. Oil is, and will be, according to many reference scenarios, the largest fuel in the fossil energy mix. Consumption-based models envisage oil demand of 85 million barrels per day in 2008 will continue to go up to 105 million barrels per day in 2030.\(^2\)

There is no proof that present levels of oil production can be increased by a quarter within 20 years - to meet this growing demand. On the contrary: independent experts warn that the production of conventional oil, a finite resource, will peak, and subsequently decline. After the peak there will still be plenty of oil available, however, the projected daily market needs will not be fully met. The exploration of unconventional oil resources, such as oil sands, may negatively impact the environment.

Some theorists predict that peak oil will cause a global energy crisis, and trigger a collapse in the primary structure of the current energy system, particularly if efforts at further energy savings and energy efficiency cannot balance or reduce the current growth in energy

---

\(^1\) The Intergovernmental Panel on Climate Change (IPCC, [www.ipcc.ch](http://www.ipcc.ch)) is the leading international body for the assessment of climate change. It was established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) to provide the world with a clear scientific view on the current state of knowledge in climate change and its potential environmental and socio-economic impacts. The UN General Assembly [endorsed the action by WMO and UNEP in jointly establishing the IPCC](http://www.ipcc.ch). The IPCC is a scientific body. It reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change. It does not conduct any research nor does it monitor climate related data or parameters.

\(^2\) IEA
demand. There is no common understanding on the timing and consequences of the impact from peak oil.

**Emission side: climate change**

Climate change is 80% caused by the use of fossil fuels.\(^3\) Climate change is here according to the best scientists who work on mathematical models that predict the evolution and impacts of climate change. If the dynamics of the process is more or less in line with the models, immediate and decisive action is necessary. Most climate mitigation plans, such as the defined 'Roadmap' of the EU, include a serious cut of GHG emissions by 2050.

**1.4 Energy efficiency as the most important element of a sustainability strategy**

Energy efficiency (EE) is the most important element of a sustainable energy strategy. The reasons for this are EE:

- reduces GHG emissions, helps mitigate climate change;
- slows down the depletion of conventional energy sources, giving more time to build another energy system;
- slows down the depletion of other natural resources, such as iron and rare metals, which are extensively used in energy infrastructure.

On the local level EE helps increase the social welfare and the competitiveness of the economy through reduced energy bills and creates job opportunities. It is worth remembering that saving a unit of energy through insulation of buildings, optimization or upgrading of end-use energy systems cost less but requires more labour, than producing an additional unit of energy. Decreased energy production also leads to reduced environmental impact, with less air pollution and water use.

Many countries in the world, including some INOGATE Partner Countries, are net importers of energy. Energy efficiency reduces import dependency, and helps address winter energy shortages. For these countries, which have growing electricity and gas demands, EE also offers opportunities to fix system capacity shortages until new generation facilities or import potentials are created or built. Energy Efficiency can even postpone or make unnecessary costly capacity expansions.

From the perspective of the electric and gas systems EE reduces demand in general, and can also shift demand. Lower demand means lower load on the infrastructure, on the generation capacities, the transmission, and distribution networks.

---

\(^3\) IPPC and many other sources
1.5 District heating supporting energy efficiency and sustainability

District heating is a technology that can save a lot of energy when it is applied according to certain quality criteria. Therefore the application of high quality district heating is extremely important in order to face challenges described above. Moreover, it has many advantages regarding local resource efficiency and the local environment. In the following chapters the technical and regulatory aspects of this technology will be addressed in detail.

2. TECHNICAL EFFICIENCY AND FLEXIBILITY OF CENTRALISED HEATING SYSTEMS

2.1 Technical reliability and safety, fuel flexibility and environmental benefits

Centralized production and the delivery/distribution of thermal energy is a well known technology which connects to various types of heat sources with different heat consumers. Large heat production facilities in district heating schemes, compared to a small local heating units, utilize relatively cheap low grade fuels, city garbage, waste thermal energy from power plants or industrial enterprises etc. District heating (DH) becomes very important in the pursuit of sustainable energy systems due to efforts to reduce carbon dioxide emissions, increasing problems with the reliability of fossil fuel supplies and cost, urban pollution and other factors. Some countries, situated in cold climate zones, demonstrate clearly the advantages of using district heating technology.

District heating enterprises usually tend to use local fuels or sources that would be otherwise wasted, like cogeneration heat, industrial waste energy or other types of sources. These features of district heating lead to lower levels of energy imports, an increase in energy independence and improved energy security, thus creating significant macroeconomic effects. More than 75% of district heat used in the 27 European member states is recycled heat from electricity production (CHP), waste -to-energy plants and industrial processes [1]. Estimates made by Euroheat\(^4\) states that if all heat wasted in condensing power plants of the EU would be delivered to district heating systems no imported fuel would be necessary for heating purposes.

**Main technical-economic benefits of district heating:**

1. A few large heat production sources are usually more cost efficient than lots of smaller heating units in buildings or in apartments;
2. Large heat production (boilers) burn low quality fuels and ensure efficient combustion process with minimal and controlled emission level;

\(^4\) A pan-European trade association of district heating operators and related companies and associations
3. Flue gas cleaning systems including carbon capture can be installed in centralized plants and emissions are spread in the higher atmospheric layers (through a chimney);

4. Due to several types of fuels able to be burned in centralized plants, this allow for the selection of a feasible and secure fuel supply system;

5. Generally, centralized heat production provides the possibility to utilize city waste and can solve garbage storage problems;

6. Large heat production plants contribute to cleaner environmental and sanitary conditions in cities.

District heating sectors are widely spread and cover about 50% or more of the heat demand in mainly the former socialist countries and in Nordic countries (Denmark, Finland, Iceland and Sweden). Energy policy in many European countries tends to promote DH technology but this deployment process is rather difficult and slow. It is estimated that about 75% of the European population lives in cities that are responsible for 80% of pollutants. Centralized energy production could be a powerful tool in mitigating some of this pollution, thereby reducing environmental problems.

Experience from Scandinavian countries shows, if available, people prefer efficient district heating. Users in well functioning DH systems appreciate this heating method due to the following reasons:

1. DH is a much safer heating mode compared to individual combustible heat sources;
2. No heat generating facilities and no related capital and operational cost on the consumer premises;
3. No nearby chimney, no fuel supply or storage facilities, better surrounding, less pollution and noise;
4. Heat supply is available all year and the heat supplier takes care of everything;
5. Together with the heat supply, a cooling service can become available in some cases.

If district heating schemes are well designed than the heating cost for final consumers are usually lower than alternative thermal energy sources. According to the Finnish Energy Industries the reliability of district heat supply in Finland is 99.98 percent and a district heat customer is likely to have his heat supply disrupted for two hours a year on average. A majority of the outages are planned, i.e. the client is notified in advance. During the last few years the authorities usually receive 3-4 complaints annually [2].

District heating service quality in the competitive markets is ensured mainly by market driven forces. This is common in Western European countries where the district heating sector has been developing as fast as it attracts clients. However a different situation exists in countries with a central planning background, where district heating was always regulated and supervised by state agencies, with a different approach in the regulatory framework. Technical standards, operational rules, planning, construction, maintenance and repair tend to be detailed and described in normative documents. This leads to formal procedures in some cases. Different state institutions like energy inspectors and other authorities participate in the supervision of the district heat supply process in these countries. On the other hand, this approach attempts to secure a minimum quality of service in the DH in post-socialist countries.
and could be acceptable for a transition period. State control and supervision system could be replaced by market based mechanisms like DH companies that are incentivized, provide insurance services, consumer protection system etc. over the long term.

2.2 Energy and economic efficiency of centralized heat production and distribution scheme

Large district heating boiler plants usually have higher overall (seasonal) efficiency than small building or apartment-level boilers because of more sophisticated technologies, continuous monitoring, adjustment and regular maintenance. These plants also include: economizers, combustion air preheaters, modern control and regulation systems, which all ensure a very high efficiency level in at required thermal loads, even when operating on “difficult” fuels to burn, like coal, heavy fuel oil or straw. This includes plants based on cogeneration or heat-only boilers. Small boilers could have high efficiency as well, but their operation is periodical so stand-by heat losses become significant. Seasonal energy production efficiency of the gas firing individual boilers are usually in the range of 75%-85% (calculated on low calorific value) so even well designed and centralized plants can reach 90% annual efficiency. Even higher differences are found in the case of wood fuels or the burning of light oil. However, even in large centralized DH systems, thermal losses occur when hot water is lost due to leakages, thus impacting the system's efficiency.

Installation of a single larger boiler plant is usually cheaper than hundreds or thousands of small boilers due to the large scale effect. The same can be applied to maintenance and operation of these facilities. Installation of large gas distribution networks with lots of additional equipment is also more expensive than a single pipe laid to a centralized plant. An advantage of a centralized plant against individual boilers is even more evident when “difficult to burn, but cheaper” fuels are used (such fuels like brown coal or heavy fuel oil can hardly be utilised in small boilers).

The main disadvantage of district heating, which is considered when planning or selecting heating methods, is the existence of complicated pipeline networks where part of the thermal energy is lost and there is an additional cost for installation and operation. Physically thermal energy losses in the pipelines, which reflect the quality of a DH network, can be compared using technical characteristics. For example DH networks built decades ago use thermo insulation (lambda) with corresponding criteria of 0,04-0,175 watts per meter Kelvin (W/mK), nowadays modern DH systems can have an insulation with lambda values between 0,02-0,03 W/mK for insulation of new DH pipes. Such criteria directly affects heat losses in the network. Heat distribution losses caused by thermal energy flow through insulation or hot water leakages can be controlled and minimized using modern pipeline construction and diagnostic technologies.

Relative heat losses in a DH network depends mainly on the volume of heat transported per pipeline system, which is related to the density of consumers per unit of served
area (heat load), climate conditions, water temperature regime etc. The percentage of lost heat largely depends on the number of heat consumers, thermal energy usage regime (demand profile), parameters etc. Many of these factors depend on city size, consumers type and density. Specific situation exists in transition economies where district heat sales dropped significantly during reforms period due to uncontrolled disconnections, failed industrial consumers and therefore the saving were lost on the consumer side. Together with high temperature regimes and poor quality pipelines this has caused heat losses valued at up to 30 % and more of the delivered heat.

Due to the above reasons a basic regulatory approach to the district heating networks of transition economies must be rather specific, estimating past, recent and future perspectives of DH schemes. Experience from countries, which already have passed a period of reform provide examples of how DH networks can be improved:

1. Low efficiency, minimally loaded and not proportional DH schemes (or separate pieces) were decentralized by the installation of local heating sources by consumers;
2. Even large and DH schemes were left without regulation and support by the state due to large number of disconnections, therefore becoming infeasible, unreliable resulting in collapse, causing valuable assets to be lost;
3. DH networks have been saved, gradually modernized and are now integral and useful energy infrastructure;

Experience of DH reforms in countries with transition economies demonstrate that administrative and regulatory bodies have to be in close cooperation with each other and coordinate their actions in DH planning and regulation. If a DH scheme is technically and economically efficient and proportional, a regulatory regime should provide incentives and adequate price signals for its gradual renovation and development. For instance, the proper regulation of the Lithuanian district heating sector encouraged the reduction of measured heat transmission losses from 32,3 % to 15,7 % in the period of 1996-2009 y.

Several factors should be considered when energy and economic efficiency of alternative heating methods are compared with DH system:

1. Possible fuel types, their availability and future prices;
2. Fuel diversification and adequate national strategy;
3. Existing fuel supply market, development of national and local energy infrastructure with future projections;
4. Heat consumer density and possible changes of consumer portfolio in the future;
5. Environmental or other requirements for specific fuel types, social and public interest, others issues.

District heat distribution losses are still significant in many transition economies and this makes district heating service barely competitive against natural gas fired individual boilers (when natural gas is available). Regulatory institutions should introduce measures for harmonization of energy sector regulation in order to optimize the energy mix and avoid missed investment opportunities.
The biggest problem in the selection of heating technology types is the different interest or approach of alternative heat suppliers, consumers, local and state institutions. If a final decision is made by a consumer itself his/her solution is based on an investment plan which considers “only” his/her own finances and the feasibility of investment. Other factors (such as environmental protection, climate change) are normally left outside any considerations. The state can influence this process by using administrative means or financial instruments in order to form optimal local and state energy infrastructure. Energy regulators have to assist implementation of state or municipal plans in the heating systems of buildings in different jurisdictions. Direct regulatory involvement in investments and in investment decision making should be avoided!

Modern district heating tubes (Figure 1) with good thermal characteristics and rather low installation cost allow the building of long pipelines. There are examples in Europe when district heating pipelines with length up to 50 km connect separate cities, incorporating large incinerating or industrial plants and form very economically efficient DH schemes.

2.3 Complex efficiency of district heating and cogeneration

The term “cogeneration” is the technological process where parallel generation of both electric and useful thermal energy takes place at the same time. Combined heat and power plants, where heat produced and delivered to district heating systems or for other purposes, are often referred to as Combined Heat and Power (CHP) plants.

Heat is required for heating needs only at the coldest time period (except hot water supply), and electricity is used throughout the year, so the cogeneration benefits are limited for a definite time-period, although this energy production method is very efficient. Energy efficiency of cogeneration can be demonstrated if compared with separate production. By thermodynamics, electricity generation using fossil, nuclear or renewable fuel energy inevitably looses part of the thermal energy to the surroundings. The biggest portion of electricity
produced in Europe is generated using high pressure and temperature steam boilers along with turbines (however new gas turbine units with CHP technology have spread widely in the last decade where heat losses are lower but still significant). Power plants based on this technology, where steam powered turbines emit (waste) the processed condensed heat into the surrounding environment, are called condensing power plants.

Usually an assumed amount of thermal energy released during fuel combustion is equal to 100% of low heat value (LHV) is based (primary energy) on the estimation of energy effectiveness. If heat is produced separately, almost all fuel energy (about 90%) is normally converted to thermal energy. Introducing additional flue gas cooling surfaces, then efficiency can be increased even more. Meanwhile, if electricity is produced separately, between 45-70% of primary energy – depending on technology and plant parameters, is lost. Even in very good condensing power plants only about 40% of primary fuel energy is converted to electricity (Figure 2). This is a huge volume of energy that is wasted in Europe, as well as in the rest of the world. For example, combustion of 1 m³ natural gas (at reference conditions), will produce 3.72 kWh of electricity while the remaining 5.57 kWh of thermal energy will be heat loss - heat emitted into the environment.

![Figure 2](image.png)

*Figure 2. Energy efficiency in plant. A – condensing power plant, efficiency 40 %. B – Combined Heat and Power plant, efficiency 80 %.*

In case of dual production of electric and thermal energy (cogeneration) part of the generated electricity is slightly less but overall efficiency of a plant becomes 80-90%. So, cogeneration is a very effective technology for energy efficiency and primary fuel savings. Unfortunately, in most EU countries there exist little potential to deliver the produced heat to final consumers (because of a lack of the necessary heat distribution systems and consumer interest). This is possible if district heating networks are developed and connected to a cogeneration plant (CHP plant). As an alternative, cogenerated heat can be utilized for use by the producer itself. This is common for industrial and agricultural CHP plants but their share in total electricity balance is rather small.

It is clear that low grade heat (less 100 °C) extracted from power plants is a very suitable heat source for heating buildings and for hot water preparation. Heat distribution losses could be much lower than thermal energy lost in power plants. Overall energy efficiency of district heating schemes and cogeneration plant complexes depend on part of the available
heat delivered to final users. This is related to climate conditions, consumer density and other factors. The Development of efficient district heating and cogeneration systems require good coordination between the electricity sector, policymakers and institutions responsible for local infrastructure. Governments and national energy regulators should create incentives for market players to develop efficient complexes for district heating and cogeneration.

2.4 Integration of district heating schemes in the local energy infrastructure of modern cities

Large district heating systems allow the integration of various thermal energy producers, thereby solving indirect problems like the utilization of city waste, protection of the environment, assistance in local economic growth. The most common example is the utilization of municipal solid waste (MSW) for heat and electricity production. This is becoming more necessary in many countries throughout the world as land-fill sites for household rubbish become overfilled. An additional motivation is the utilization of MSW emissions of methane (greenhouse gas) from landfill storage.

Figure 3. Municipal solid waste (MSW) in a landfill storage.

Municipal solid waste in many countries is still disposed in garbage dumps or in landfills. The garbage in the dumps creates a danger of toxic gases and chemicals, which can be emitted into the groundwater or atmosphere. By burning the garbage in combustion plants, this danger can be avoided and the energy created in the burning process can be captured and re-used.

Waste incineration can represent a safe disposal method. Incineration plants are technologically comparable to conventional coal-fired power stations. Many plant components are the same. The capacity or the size of an incineration plant is however limited to the amount of garbage that can be burned per year. A mid size plant will burn on average 200,000 tones of garbage per year.
Waste-to-energy is the pre-eminent method of waste disposal in Europe because of its ability to reduce the volume of waste, generation of valuable energy, and the reduction of GHG emissions. In the Netherlands, 2535 GWh electricity was produced in 2004 from MSW of which 78% has been delivered to the grid or to other installations. As can be seen in Figure 4, waste share in the total DH sector in Norway in 2009 was near 35% [1].

Utilization of city waste for energy production correspondingly can reduce traffic flows, eliminate part of the demand for natural gas or demand in other fuel supply systems. These and similar indirect effects should be reflected in price and tariff systems and or in support schemes applied by regulators, governments or market players.

Large district heating schemes provide the technical possibilities to accept thermal energy from other unconventional sources. According to experience obtained in varies countries it could be industrial heat generated by cooling of chemical or ceramic products, varies combustible wastes in wood or food processing factories, firing of biogas produced in sewage treatment plants or utilizing agricultural products and refuses and so on. Recently, very high fossil fuels prices on the World market make feasible the relatively new heat production technologies. This could be applied to solar collector plants, heat pumps with varies primary energy sources, seasonal and daily heat accumulation systems and other systems. This provides new opportunities for businesses and with new types of generation technologies for heat production.

The above examples demonstrate that district heating networks should become regional systems where local market participants can exchange (sell or buy) available energy flows in the form of heating or cooling. DH schemes could be very important to local energy networks with a structure and configuration which allows them to utilize existing and potential energy sources, thus ensuring optimal regional infrastructure and the achievement of national energy targets. Awareness and access to the DH networks require appropriate actions of regulatory and planning institutions. For instance, it would be reasonable to organize tenders
for required new heat production capacities instead of simply building a new boiler in the ex-
isting DH company.

2.5 General understanding and utilization of district heating benefits

The benefits of DH have to materialize by using effective methods to retain and de-
velop DH schemes. These methods are slightly different in different countries with stable and
transition economies, but the main target is the same: DH utilities have to be economically
viable, capable to invest and modernize existing systems thus expanding access for new heat
suppliers, producers and consumers with a focus on national interests like energy efficiency,
fuel diversification, decarbonisation, and energy independence.

**The main advantages of DH systems which policymakers and energy regulators should
evaluate when energy regulatory and pricing systems are formed:**

- Heating, cooling and electricity can be produced together if centralized energy plants and
district heating/cooling network are available. Multi-energy generation is more efficient
for the usage of primary energy, reduces fuel consumption and therefore produces less
CO₂ emissions, NOₓ, SO₂ and other pollutants. Flue gas cleaning systems, to reduce
emissions, can be installed only in large centralized plants.

- A wide range of fuels – fossil and renewable fuels, municipal solid waste, environment
and industrial waste energy could be employed for district heating. DH helps to ensure
the diversification of fuels and flexible adaptation to the fuel market, supplying heat to
consumers at the lowest cost.

- About 75% of the population in EU lives in cities. DH helps to decrease the production of
decentralized heat sources and eliminate the need to provide them with fuel, reduces the
volume of traffic and environmental pollution. Since more than 80% of environmental
pollution is generated in urban centres, the district energy production and supply is be-
coming increasingly indispensable technology in various countries.

- DH systems can use the latest technologies, such as seasonal heat and cold storage, neu-
utralization of carbon dioxide (decarbonisation ), and others.

The DH benefits are gradually, but slowly being implemented in West European coun-
tries, this process is mainly based on market driven forces. District heating sector in transition
economies - especially in those, which traditionally introduced this technology several deca-
des ago - is often considered controversial due to recent financial difficulties and monopolis-
tic structures. Often these systems are managed in a supply driven manner with less focus on
customer demand and interest. In both cases it seems very important to have a deep under-
standing of district heating possibilities, the role in the national energy system and a future
perspective. Planning of local networks are usually under municipal control but state energy
policy is directly related to the district heating sector. So coordination of local and federal
authorities is a key factor for the successful development of district heating schemes and the
utilization of the overall benefits.

© ERRA Copyright 2011
The institutional framework in district heating administration of EU countries – where this sector is well established or successfully renovated, is generally structured in the following manner:

1. Analytical, advising state institution which permanently collect and analyze information and provide recommendations for legislative and executive powers. Usually this is an energy agency or similar authority outside political influence;

2. Policy makers and government administration who create the legislative basis and promotional measures for implementation of a national energy strategy in district heating sector (ministry or special department);

3. Municipalities or other local administrations who are responsible for the organization of heating, planning of local infrastructure, approval of investment, permissions for construction and other practical actions in organization of centralized heat supply;

4. Energy regulators in the countries where DH is regulated or a general market supervising institution which controls dominance of the monopolistic enterprises. The regulator usually controls the development of DH companies according to national energy strategy, their economic viability and monitor their investment and legal-economic actions;

5. Varies state or commercial institutions which are responsible for specific fields of district heating like environmental regulation, technical safety standards etc.

Administrative structure and functions of institutions differ from country to country but in all cases the main targets are similar:

1. To ensure safe, reliable and efficient district heat supply;

2. Balance economical interest of consumers and heat suppliers;

3. Implementation of national interests and requirements in the district heating sector;

More detail functions and instruments applied in regulation of district sector will be discussed below.

3. STATUS AND SITUATION OF DISTRICT HEATING SECTOR IN COUNTRY GROUPS

District heating is a significant energy sector in most transition economies in those regions, where this technology has a tradition and where the climatic situation requires it, so it needs to be considered as part of the overall energy security strategy. Unfortunately, district heating is still based mainly on very expensive fuels – natural gas in many post-socialist countries, and strongly depends on prices in the international fuel market. If governments subsidize natural gas prices for affordability reasons, individual heating can be destructively competitive against DH, especially if heat distribution/transmission losses are significant and their financial value becomes very high due to expensive fuels.
The importance of DH technology for national energy systems is caused by heating demand (climate conditions), volume of supplied thermal energy through DH networks, historically formed social-economic situations, and existing administrative systems.

The volume of thermal energy supplied via DH networks in these countries is similar or even higher (Baltic countries) than the total amount of electricity consumed by end users. So, the district heating sector in these countries is a good basis for development of cogeneration, introduction of renewable energy sources, consumption of low quality fuels, utilization of wastes. The opposite situation is in most other Western European countries, despite large absolute volumes of sold district heat, the DH sector covers only 10-20 % of total heat demand, or it is just at the very beginning of its formation.

Germany, Poland and Sweden have the biggest DH sectors in the EU and sell more than 50 terawatt hours per year ($TWh/a$) of heat. The largest demand for DH is highest in Scandinavian countries (except Norway).
District heating enterprises in old member states (OMS) of the European Union (EU) have been developing without disruption, however, in post-socialist (PS) countries they are affected by dramatic socio-economic changes in these states.

It seems, there is significant difference between district heating reforms in post-socialist countries, which are new Member States (NMS) of the EU and post-socialist countries outside the EU. A further overview of DH development and analysis of the appropriate regulatory systems are classified according to common country groupings.

3.1 District heating sector in the old member states of European Union

District heating schemes in the old member states (OMS) of the EU were built and gradually developed according to consumers' heat demand and were based mainly on competitive principles without significant disturbances from the legal, regulatory or economic environment. This allowed forecasts to be developed and to predict operational costs and to expand existing systems by following economically feasible connections to new consumers.

Well established, and wide spread DH sectors exists in 3 Scandinavian countries. Sweden and Finland are typical countries where the DH sector has minimal influence from state regulation. Probably, most consumers, whose connection is economically justifiable and feasible are already are clients of DH companies. According to statistics provided by Euroheat the total amount of sold district heat in these countries is rather stable in the period 2001 to 2007 [1]. In contrast, the total amount of sold heat in the regulated DH sector of Denmark grew about 50 % in the same period. Such processes could be related to the strong and favourable regulation of heating methods i.e. subsequent energy taxation in favour for district heating and obligatory connections to the DH networks in certain zones in Denmark.
In Sweden, DH companies work in a competitive manner and are consequently free to set prices. The market is, however, under the surveillance of both the Swedish Energy Market Inspectorate and the Swedish Competition Authority. The Swedish district heating market had a market share at almost 42% of total demand of domestic heat in 2009 and consumption of district heat has increased substantially during the last 40 years with consumption just above 10 TWh in 1970 to 50 TWh in 2009. During the past 40 years, since 1970, Sweden has reduced its use of oil as a fuel for district heating generation dramatically, from over 90% to below 5% in 2007. The oil has predominantly been replaced by bio fuels. Municipally owned companies dominate with 74% of the networks and 66% of the heat deliveries [2]. District heating is available in almost all cities and towns of Finland and in 2009 approximately 2.6 million Finns lived in a building heated by district heating. The Finnish district heating market is similar to the Swedish in many respects with no price regulation and access to alternative systems especially for smaller, individual houses. About 49% of households are connected to the DH. District heating companies, are owned mainly by municipalities (95%), the privatization of these companies was stopped, and around 30% of heat is produced by external heat sources (non DH enterprises) [2].

Finland and Denmark are examples of how DH schemes assist in the development of cogeneration. More than 30% of electricity in these countries is produced in the form of cogeneration. In Sweden this part is lower due to the competitiveness of nuclear and hydro power plants. Cogeneration in the rest OMS of the EU covers far smaller parts in the electricity production balance. Low penetration of district heating technology in most EU countries is one of the main barriers for development of efficient cogeneration and requires new incentives in the promotion of cogeneration at the EU level. Denmark and Finland have the most extensive use of CHP for district heat production, with a share of approximately of 75-80%.

Scandinavian countries clearly demonstrate another benefit of well developed DH infrastructure – more than 30% of supplied heat is produced using renewable and waste fuels. For Scandinavian countries expanding heat production from local fuels, does not depend so much on natural gas imports, as compared to EU countries where gas heating is dominant. The district heating sector creates significant macroeconomic and environmental value when imported fuels are replaced by local renewable and waste fuels. Fuel diversification creates a more reliable energy system.

Austria could be considered as a country in the EU where district heating sector holds an important status. There is steady growth and a constant increase in importance, so much so, that in 2007, there were close to 400 district heating plants. DH demand is covered mainly by municipal utilities and exists mainly in the metropolitan areas of Vienna, Graz, Linz, and in other locations. DH in Austria is, by comparison, a small sector of the total heat market, around 20%. Total DH sales in 2009 was 18 TWh and total installed DH capacity is around 8200 MWth. Austria has lots of small, bio-fuelled plants serving limited areas especially during the winters. There is no obvious legislation, or special authorities involved in the district heating market, at least not at the national level. At the regional level there do exist some legislation and there are subsidy systems promoting district heating in certain areas [2]. The volume of DH grew by 50% from 2001 to 2007 according to Euroheat.
The biggest district heating sector in the EU is **Germany**. The country has a market share of 13.3% relating to all occupied accommodations. At the same time, increasing numbers of buildings are undergoing energy-saving refurbishment, and solar thermal energy is increasingly being used to generate heat. The result: a reduced demand for heating [4].

District heating status in the old member states of the European Union can be characterized by the following characteristics:

1. DH is the dominate heating method in three Scandinavian countries;
2. Cogeneration related to district heating potential is being utilized in Denmark and Finland;
3. The highest degree of utilization of renewable and waste resources (above 30% in primary fuel balance) is being reached in Scandinavian countries;
4. Except Denmark, development of district heating in old member states of the EU is based on free market conditions with minimal state supervision and control;
5. Energy efficiency (energy saving) programs and the deployment of individual solar heating systems could reduce the heat demand of DH systems at present and in the medium term if new connections are not developed.

In a study made by Urban Persson [5] he concludes that the territories of around 60% of large European cities should be heated in a centralized manner. This would be the optimal solution corresponding with present and short-term price levels. Heat market shares in urban areas of 60% would be a cost efficient. However, to-date there are hardly any urban regions in the EU with this level of penetration. DH penetration is only close to this amount in Denmark, Finland and Sweden. So the potential of district heating technology is under utilized in most of the old EU Member States. The examples above, of the penetration of cogeneration and RES demonstrate the usefulness of DH. Most Western European countries are considering plans and apply varies measures for the promotion and expansion of district heating networks. Expansion of the DH market is promoted mainly using subsidies from specialized funds. Often the construction of new DH networks in urban areas encounters varies technical and legal difficulties.

**Old EU countries – except Scandinavian, still have limited DH and cannot utilize the potential benefits of this technology. More and more politicians and officials understand DH systems can be a very useful tool for fulfilling European and national energy policies. Strong political attention was paid to district heating in EU political debates related to the new Directive on Energy Efficiency, the Directive on Cogeneration will be revised. Mayors Covenant and some other European initiatives have arisen in order to promote district heating and utilize the benefits. Many OMS of the EU have developed national plans and introduced promotional instruments aimed to significantly expand the DH sector. More state and regulatory attention is given to the DH sector when planning city infrastructure, the introduction of renewable energy sources, diversification of fuels, CHP penetration, and environmental improvements all occur.**
3.2 Development of district heating in countries with transition economies and the new Member States of European Union

District heating schemes widely used in former socialist countries are mainly situated in cold climates. Development of city infrastructure were carried out according to complex plans, this planning created the possibility to build large district heating schemes with a combination of cogeneration, diversified fuels and other sources. However, the situation has changed radically in the last decade of the twentieth century when these countries, and their energy sectors, have been affected by dramatic economic and social transformations. District heat suppliers have lost many consumers, heat sales have dropped significantly and many heat production and distribution facilities have become oversized. The DH sector was forced to convert from subsidized social service to a self-financing business model. Poor technical characteristics, low purchasing power of consumers, high thermal energy consumption in old style buildings and growing prices have made the DH sector very sensitive from the social and political point of view.

Due to the lack of clear political will in the initial period of reforms, unfair competition with alternative heating methods occurred. Typically, these alternatives are mainly building or apartment-level natural gas boilers; other factors have had an impact such as, subsidies for natural gas prices at household end-users, unregulated disconnections, low investment levels, poor quality management and services in district heating have also played roles in causing lost market share [6].

Experience of the last two decades shows many common solutions in this group of countries, but each state has a slightly different method and speed of reform in the district heating sector. Despite of drastic changes in the DH sector of transition economies new member states of the EU have managed to save district heating schemes and gradually modernize them. Heat sales have stabilized, regulation of the sector is leading to a cost based provision of services, this attracts investments and serves as a basis for further development of this technology in the relevant group of countries.

District heating is an important energy sector in most post-socialist countries. In new Member States of the EU, DH covers 40-60% of total heating and hot water demand. The biggest changes and reforms are already past; district heating enterprises are now working in more stable regulatory environments which ensure payments for operational cost and partly meets investment needs. However, due to the social and political sensitivity of district heating sector in EU NMS, these companies are still subject to different political pressure. District heating enterprises have established national associations and put lots of efforts to establish a detailed legal basis for financial viability, further development of the sector and avoidance of influence or pressure from various social and interest groups. Most national DH associations are active members of the European confederation of national DH associations - EURO-HEAT & POWER.

Technical conditions and energy efficiency of DH schemes have been improved significantly in the appropriate countries during the last two decades. More common technical
conditions are implemented in the DH systems of progressive new member states, these include:

1. Heat production sources adjusted to present heat delivery needs: reserve boilers or even boiler plants have been conserved, heat production is concentrated in the larger and more efficient facilities, introduction of summer operational equipment, dry and condensing economisers have been installed in existing and new boilers, frequency converters applied for electrical transformers, introduction of updated control systems and software, watertube boilers replaced by firetube type boilers and various other measures. These improvements drastically reduce heat production cost and fixed cost remain stable for several years in spite of significant inflation in these countries.

2. Heat transmission networks have been optimized by the decentralization of hot water preparation (shifted to buildings), some 10-30 % of old pipelines have been replaced by pre-insulated pipes, introduction of modern diagnostics of heat losses and hot water leakages, temperature regulation converted gradually to create the possibility of varying flow rate etc.

3. Heat substations with modern control systems and meters measuring the heat consumption of buildings have been installed almost in all buildings; remote control and readings of information from substations are common practice in many cities.

In spite of the significant improvement in the district heat supply chain, high consumption still occurs in the buildings of old blocks of flats with very low heat insulation. The low economic power of most consumers still remains the biggest problems in access to district heating in the NMS of the EU. One of the main problems is that in absolute terms (€/MWh), DH is more expensive in the Nordic countries but in relative terms (bill/income), DH is the most expensive in those Eastern European countries where the district heating fuel mix is dominated by globally priced natural gas [33].

### Several principles for good administrative and regulatory frameworks apply to the district heating sector in new Member States:

- Establishment of independent regulator;
- Establishment of social support scheme that is different from energy supply, including eliminating direct heat production subsidies;
- Insist on good payment discipline through legislation and enforcement;
- Require meters at the inlet to all buildings and large consumers;
- Develop policies to promote demand-side energy efficiency;
- Establish conditions that allow for full cost recovery;
- Remove barriers to unregulated wholesale competition;
- Involve the private sector through privatisation or public-private partnerships.

- Establishment of independent regulator and well-considered long-term regulatory objectives;
- Establish conditions that allow appropriate commercial financing schemes.

*Source: International Energy Agency [6]*
It should be noted that most of these reforms/developments have been implemented or at least tested in EU countries. However their implementation should be adjusted to national characteristics, state administration traditions and even mentality.

**District heating systems in transition economies are, by and large, over-served by capacity. In other words, their supply infrastructure is larger than necessary to meet current demand.** Despite these obstacles new EU Member States have saved district heating schemes and gradually modernized them. **Decline of heat sales have stabilized, regulation of the sector is leading to a cost based economy, this attract investments and serves as a basis for further development of this technology, all in the relevant group of countries.** Generally, Central Europe and the Baltics have managed to maintain their district heating systems in relatively good operational condition compared to other countries with historically wide-spread DH systems.

### 3.3 Present situation of district heating in the INOGATE partner countries

The DH sector in the INOGATE partner countries are in a different condition. In some countries DH was partially destroyed due to varies reasons, now it is gradually being rebuilt. In other cases, it was significantly worn out and was not modernized due to financial difficulties. In most other cases, the DH connection to industry, resulted in both economic difficulties and lack of funds for modernization and requires legal/regulatory reform to prompt investment.

Most INOGATE countries have a warmer climate than new EU Member States. Consequently, heating plays a smaller role in energy consumption. The DH sector has historically been smaller than in more northern countries. However, DH systems do exist in many cities and towns along this southern tier of countries, and these systems deserve to remain operational where they are economically viable.

**The basic situation of district heating in Inogate partner countries can be characterized by the following:**

1. District heating collapsed due to the significant drop in supplied heat volumes in most Inogate countries (even large DH systems are closed). Often the technical-economic situation of district heating enterprises is difficult due to “below cost-recovery”, meaning that applied tariffs do not cover all the justified cost. These do not allow the modernization of existing systems. Minimum renovation takes place which are financed by external sources.

2. Subsidies, little economic incentives, strong political influence, unpredictable regulations, poor economic viability and low competitiveness of the district heating sector dissuade private investors.

3. High energy consumption in buildings of blocks of flats – with poor insulation, no possibility to regulate heat consumption and low purchasing power of most end-users, make district heating barely accessible, as a result this service is still subsidized in various forms. Heating bills do not correspond to the living standards of many customers.
Widespread disappointment with this type of a situation creates a negative opinion towards district heating technology.

4. Systematic planning of local energy infrastructure is still rare. Unregulated disconnections makes the situation even worse for existing DH consumers. Renovation of building (heat insulation with energy saving purposed) is carried out at a slow pace. DH companies can not compete with more flexible and relatively cheaper individual heating options especially with individual natural gas boilers.

5. Political decisions or new obligations to DH sector are often not supported by the necessary financial resources. Speculative and populist decisions in the district heating sector are common occurrences. There are very few successful examples of private capital participating in the district heating business.

Experts and chief specialists in the relevant institutions involved in DH, usually understand the necessity for reforms and try to initiate some changes, however, these usually result in painful mistakes and occurred because of insufficient knowledge of privatization options, management approaches, innovative pricing and financing mechanisms etc. District heating in the Inogate partner countries still strongly depends on state policy so political will is key to progressive reforms.

Many district heating systems in INOGATE countries have ceased providing services, fully or partially. The main reason for declining production or the complete disintegration of district heating systems is lack of financial resources, which leads to insufficient investment in maintenance and renovation. Non-payments due to energy poverty are a major reason behind the financial problems of district heating companies; state owned end-user entities are often the worst customers in this respect. Tariffs for the population are below production costs. Gas or electricity prices remain heavily subsidised while heat tariffs are liberalised or receive significantly smaller subsidies, it is difficult for district heating to compete. In many cases, rehabilitating ageing district heating systems is economically viable because district heating generally has comparative advantages in urban areas with cold winters.

3.4 Summary, conclusions

District heating has been developed gradually in Western European countries. This is based on market driven forces with minimal state participation. Denmark is an exception there are strong regulations with an administrative system for the district heating sector. Current experience in post-socialist countries – new EU Member States demonstrate that the 'Danish' model of regulation is more acceptable for a transition period for creating efficient market conditions in Central and Eastern European countries that must renovate their widespread DH systems and adjust consumers and operators to new social-economic conditions. A combination of regulated energy infrastructure, economic incentives and state support instruments are key factors assisting the rapid upgrading of old district heating systems.

Continuously maintained or well established DH systems are a good basis for implementing new targets in energy policies, including: energy efficiency, utilization of renewable and waste energy, fuel diversification, and for environmental solutions. Many European coun-
tries apply or are trying to introduce new mechanisms for the promotion and development of DH technology.

The district heating sector, which were not maintained in transition economies, failed in a large number of cities (including cities in Armenia, Georgia, Moldova). This failure may also be a result of a reduced heating market due to the lack of political will, adequate legal/regulatory framework and support schemes, pricing regime, non-payments, disconnections etc. Small district heating schemes are under construction again, now that in some places, the is greater local stability. Poor economic regulations and subsidies (which are often insufficient) lead to very minimum renovation in the DH sector. Investors and consumers are both discouraged by high heat losses and the poor financial situation of DH companies. Ukraine, Belarus, and Central Asian Republics – still have a very high share of district heating along with a need for reforms in order to make heating service cost effective; this is due to local climate conditions, high population density, growing housing stock and industrial heat demand.

Administrative intervention, economic regulation, planning and justified cost based price regulation allowed DH to survive in transition economies. The district heating sector has been gradually modernized and adopted to present needs of societies. The CEE and Baltic countries, which are now EU Member States, were more successful in reforming and restructuring the district heating and cogeneration field.

4. LEGAL, REGULATORY AND BUSINESS ENVIRONMENT OF THE DISTRICT HEATING SECTOR IN COUNTRY GROUPINGS.

Centralized generation and distribution of heat, cooling and power is a very advanced technology that can meet current and future public demand. Importantly, it can create an effective and efficient energy infrastructure in urban areas. However, only 3 countries in continental Europe (Denmark, Finland and Sweden) have well established and significant (above 50%) DH systems that can meet emerging energy challenges. The remaining European countries either have relatively small DH sectors, or need to overcome transition problems. In both cases it is necessary to improve legal, regulatory and business frameworks for the successful development and utilization of DH.

Present regulatory regimes and corresponding institutional structures related to the district heating sector can be classified in 2 basic groups:

1. Operational and development in free market conditions, with minimal state intervention (Finland, Sweden, and most other old Members States of the European Union);
2. Tight regulation and state control (common in Denmark and most new Member States and transition economies with historical DH systems).
The tight regulatory regime could be divided into types:

- economic approach of regulation (applied mainly in new Member States of the EU);
- socially orientated (affordability-driven) regulation which still dominates in the Inogate partner countries and other transition economies outside the EU.

These principles approaches depend on the socio-economic situation in a country and have a slightly different form depending on the general administrative system, historic tradition, mentality, the general belief in market economy and other factors. A fuller overview of administrative regulation of district heating will be split in two basic systems:

- functioning of free market with minimal state influence; and
- a regulatory regime with detailed state participation in most aspects of district heating.

4.1 Basic principles of supervision of district heating utilities as a local and natural non regulated monopoly in countries with a stable economy

In most Western European countries district heating schemes were formed in normal free market conditions. As described above, there is a meeting of interests, as it is attractive for potential clients and interesting for private or public investors. If DH services satisfy consumers’ needs, it does not necessarily require special state involvement. The need for intervention by the authorities mainly arises in the case of doubts of abuse of strong market power. This assessment is usually determined on case by case basis. However, in the long term users of DH networks become dependent on actions of the heat supplier especially if there are no other options available in the energy infrastructure. For a variety of reasons regulatory oversight may be necessary, such as: the presence of different national (energy and climate change policy) targets, local infrastructure plans, obligations and requirements related to consumer protection. In these cases, even commercial district heating utilities come under the jurisdiction of state administration.

Generally, the functioning of district heating in free market conditions has many advantages because efficiency and optimal heat prices are ensured by competition with other methods of heating. The DH sector is attractive for investors due to a clear and predictable business environment.

On the other hand, district heat suppliers are interested in “feasible” consumers (whose cost of connection to the DH systems is paid back in an acceptable period). This means operating DH networks that are not regulated - however, this may be unfeasible for consumers and the risk of a natural monopoly still exists. In the case of unregulated networks, there may be less possibilities to plan and develop DH networks according to municipal infrastructure or to implement state energy policy via the DH sector. Mainly economic incentives, promotional
instruments can be applied when the DH sector functions on a market basis. These reasons explain that a “non-regulatory” regime of district heating is common and seems suitable for countries with old traditions of free market relations and a stable (functioning) market economy.

Mechanisms to enhance more effective competition in local heating markets can include:

- access to alternatives e.g. gas network, ground heat pumps, pellet boilers;
- non-discriminatory zoning policy; voluntary and easy DH connection and disconnection;
- elimination of unjustified or unfair price support or investment subsidies;
- fair and equal taxation (VAT, energy and carbon taxes);
- transparency of cost of alternatives (energy prices, investment costs etc): information on full cost and risks should be provided to consumers when alternative heating methods are considered;
- equal customer incentives for energy savings.

For example, the district heating market in Austria is not subject to any direct legislation or federal regulation. However, Austria has some legislation at the local authority level. The energy regulator in Austria, E-Control, does not regulate, investigate or have any surveillance duties over the district heating market. Instead, with respect to legislation, the district heating market is indirectly affected through legislation on the electricity market thereby affecting the conditions for the CHP-plants [2].

In Finland, the regulatory supervision is based mainly on competition legislation and partly on the Electricity Act. In Finland the authorities’ surveillance of the district heating market is primarily based on both the competition law and the law regarding the electricity market. The position of the consumers is also protected through the consumer protection law. According to the Finnish competition authority a district heating company has a dominant position with respect to its customers. Regulation of the DH sector in Finland is minimal and based on the supervision by the Energy Market Authority which considers DH as “dominant player on the market”. The principle task of the Energy Market Authority is to supervise the pricing of transmission, distribution and other network services. Heat tariffs and connection fees are set by DH companies on a non-discriminating basis [7]. This regulatory attitude is similar to the electricity market (so called light handed regulation). The Finnish Competition Authority monitors DH price development and potential abuse of dominant position and market power.

In Germany, the current situation is that all Federal states are considering the possibility of enacting legislation to make the connection to, and use of, district heating systems compulsory, whereby the state of Bavaria is alone in its intention to restrict this to new buildings and rehabilitated areas [4]. In practice, however, it has become increasingly rare for local authorities to take the step of introducing a compulsion to connect and use district heating systems. Introduction of such compulsion leads to an obligation to connect consumers and
secure the supply of heat, but at the same time, it also creates a monopolistic situation, making necessary the monitoring of heat prices. This is not attractive for local administrations.

In **Sweden**, the district heating law aims to maintain an unregulated heat market at the same time as the consumer’s position is strengthened. The district heating market in Sweden has no price regulation. The companies are assumed to work in a businesslike manner and are consequently free to set prices. The market is, however, under the surveillance of both the Swedish Energy Market Inspectorate and the Swedish Competition Authority. In Sweden **Energy Market Inspectorate** (EMI) supervises district heating, but will not supervise issues under civil law (claim for damages, disconnection in case of non payment, compensation for outages, disputable debts), energy efficiency, climate, fuel issues etc. The main regulatory tasks are price presentation and comparison, annual reports, negotiation and mediation between both parts (customer and DH company) [19]. In 1996, the DH market of Sweden was reformed, and district heating firms could be privatized and operated according to a profit oriented principle [20]. Relations between district heat suppliers and consumers in the unregulated market is based on bilateral contracts mainly, but still various disagreements can arise. Some procedures or practices for disputes settlement or negotiations exist in relevant countries.

For example for complaints, **Finland** allows consumers to file complaints about unfair prices and market activities with the Finnish Competition Authority. **Sweden** has introduced an independent district heating board that mediate in issues between companies and their customers in accordance to the district heating law. The Swedish Competition Authority has investigated occurrence of excessive pricing. A quality committee within “REKO fjärrvärme” handles complaints from customers. These cases concern dissatisfaction with the product and breach of contract. According to the Swedish District Heating Association many disputes are usually sorted out locally between the customer and the district heating company. The Swedish Competition Authority upholds the competition act that contains prohibitions against anticompetitive co-operation and abuse of a dominant position. The Act also contains rules governing concentrations between undertakings [2].

Experience from Finland and Sweden demonstrates that the DH sector in certain conditions (to be analysed later) can be developed and cover a large share of heating demand on a free market basis. Such circumstances like cold climate conditions, large territories and limited access to natural gas networks, along with the early development of DH technology in these countries were the reasons district heating was attractive in Scandinavian countries. However, the DH sector is rather small in most Western European countries, for further development it needs stronger state intervention. The situation in the district heating sector of transition economies is rather different, and here the process of gradual renovation or even survival, is under way.
4.2 Generalities and peculiarities of national legal/regulatory framework in countries with a high density of regulation

In former socialist countries essential economic reforms took place and the DH sector was significantly affected. Describing the situation over the last two decades in the DH sector in these countries is complicated. Former socialist countries had no experience in the conversion of DH as a public service to a financially viable business concern. The experience in these countries is marked by vague final targets of changes in the DH sector but the methods and speed of reforms are specific in each country. As a result, reforms in transition economies varies from the collapse of former large district heating schemes to effectively upgraded and efficient district heating sectors in some countries. Successful developments illustrate that purely free market approaches are hardly acceptable in a transition period, while more suitable elements are taken from the “Danish” regulatory system of the DH sector. Denmark, together with the most former socialist states, can be considered as countries where state and municipal influence in the district heating sector is rather high. This is why regulatory components and administrative systems in the district heating sectors of these countries should be considered in parallel.

4.3 Main trends in the district heating sector: reforms in a transition period

District heating sector reform in transition economies basically means changing from a “socially orientated” service to an “economically regulated business”. The process of restructuring the DH sector includes ownership and organizational changes along with economic transformation supported by technical modernization. This can all lead to a decrease in heat supply costs owing to energy savings, as well as to a decrease in environmental pollution, an increase in heat supply reliability, and an improvement in customer service quality. Viability of the DH companies is strongly dependent on heat price levels and heat sale, as well as heat supply costs.

The process of district heating reforms in the new Member States of the EU, implemented in the last two decades, consists of the following actions:

1. Ownership of district heating enterprises was moved from federal state control to local governments (cities, municipalities) and in some cases into private strategic investor hands (e.g. Hungary);

2. Department responsible for the DH policy is set in the responsible ministry;

3. Separate institutions - Energy regulator (ER) - has been established in most cases with the role of economic and legal regulation of the DH utilities (technical issues covers in some countries as well). The general energy policy issues and support schemes remain in government hands;

4. General subsidies were gradually removed from the DH sector and social support systems based on individual consumer approach were introduced;
5. Heat volume consumed in certain buildings have to be measured and paid by consumers situated in particular buildings (installation of building level heat meters obligatory by law and price authority have to ensure required resources). Heat consumers have to cover real cost required for operation and renovation of the DH scheme they are connected;

6. General regulatory (tariff authority) principles: setting of heat prices and tariffs must ensure economic viability of DH operators and financing of long-term stability and modernization of DH systems. Pricing regime should give adequate incentives for DH companies to increase their efficiency;

7. Municipalities (cities) can sell or lease DH enterprises to private business if it’s feasible or necessary;

8. All participants in the regulated DH sector have to ensure implementation of state policy in this sector;

After reforming DH regulation the main results were achieved: implementation of technical-economic parameters of DH schemes were improved significantly, the DH sector became economically viable, attractive for investments and now further modernization of the DH systems is taking place. Heat prices for final users increased significantly during reforms (because the pricing authorities accepted all of the justified cost elements and in spite of these changes, done for objective reasons, heat consumers were/are usually not satisfied). Some consumers may try to find alternative heating methods. Despite successful reforms some of the problems remain, like very high thermal energy consumption in buildings. The highly specific heat demand resulted in relatively high energy bills, especially compared to household income. Most consumers cannot install individual heating systems that regulate heat demand; high heating bills do not match the low economic power of most users. In addition, the renovation rate of older buildings that improves the insulation capacity of older buildings is slow, therefore energy demand will remain high in the near future.

4.4 Legal framework and institutional model in a state controlled district heating sector

The International Energy Agency (IEA) and other authoritative organizations suggest the DH sector of transition economies need to be well described in legal and normative acts. However legislation and policy are significantly lacking in most transition economies. The few pieces of legislation that do exist in the region are often problematic as they do not meet current economic challenges; they rarely consider the full impact and synergy between district heating and the rest of the energy sector, particularly electricity. The need for legislation could be satisfied either through dedicated district heating laws or concrete, well-developed legal articles within a package of broader energy legislation [3].

Legislation should cover at least several important elements:

1. The role and function of district heating should be clearly spelled out in national energy policy to ensure that benefits are integrated into the broader local, regional and national energy system.
2. A requirement to conduct least-cost energy planning for district heating systems on a regular basis. The planning should compare district heating with less centralized forms of heat supply, benefits of cogeneration, waste heat recovery etc.

3. Introduction of commercial principles into district heating systems so that prices cover justified costs and bills would be based on metered consumption at least at the building level.

4. Provisions to allow private sector involvement in district heating, though national governments and cities should maintain some flexibility in determining the timeframe and best approach.

5. Institutional structure and responsibilities should play an important role in district heating policies.

Tariff, reflecting the justified cost will give correct market signals for customers and DH operators about the efficiency and competitiveness of district heating.

District heating sectors, left without governmental attention, or were transferred completely to the municipal control, often suffered in "the long lasting technical and economic agony," as stated by the IEA [6].

Evaluating the energy sector over 20 years of reforms in transition economies, demonstrates there are good practices models for district heating institutions. This includes that the basic distribution of functions, among state institutions, is similar in most new EU Member States.

State (federal) institutions generally are responsible for energy policy formation and implementation or the regulatory principles, standards and requirements. Among the main functions are:

1. Formation, implementation and monitoring of state (energy, climate change) strategy in the DH sector;
2. General rules for licensing, contracting, planning etc.
3. Requirements and control of technical, environmental and sanitary standards.
4. Social support mechanisms for vulnerable consumers;
5. Control of different aspects of regulated activities and timely correction of energy policy.

State institutions (energy agency, research institute or similar) are important because they continuously and independently (usually free from political influence) collect and analyse information related to DH development. They submit recommendations for properly regulating the district heating sector to politicians and company executives.

The key issue in DH reforms of transition economies is the establishment of an independent energy regulator (ER) which is responsible for implementing the legal and economic regulatory framework of different energy sectors – including district heating. The main functions assigned to the ER are described here:
1. Harmonization of suppliers and consumers economic interests;
2. Ensure economically reasonable background for the heat supply business;
3. Avoidance of political influence and speculation;
4. Protection of heat consumers from monopolistic actions;
5. Licensing and control of DH companies;
6. Recommendations for state policy and municipal solutions;
7. Heat price setting or control of set and applied heat prices and tariffs if pricing is assigned for other subjects;
8. Dispute settlement, complaint handling etc.;

Energy regulators in the transition period play an important role ensuring an economic basis for the operation of district heating utilities which may not be attractive for consumers (politicians as well) because of necessary economic reforms. Regulators make unpopular painful economic decisions; therefore a reduction of political influence in the reform process may be essential in many countries. At the same time, the regulator plays a role as a consumer representative for the protection of legal and economic interests.

Independence of energy regulators is secured by using a special legal status and powers fixed in the main laws, such as: using special appointing and dismissing procedures of the president or commissioners, independent financing of this institution and some other methods applied in various countries. Energy regulators have been established in all countries of the EU, but only some have authority over the DH sector – usually dependent on the situation in the heating market. Regulators who have regulatory functions in the DH sector exist in the following countries: Check Republic, Denmark, Estonia, Greece, Latvia, Lithuania, Poland, Luxemburg, Malta, Slovakia, Slovenia, Sweden, Hungary, Bulgaria and Romania.

The energy regulator (with pricing authority) has to balance the economic viability of DH suppliers with the protection of consumers, they must ensure the optimal heat supply process is economically justifiable. Sometimes energy regulators assist municipalities and DH enterprises in implementing reforms, such as promoting best practises and approving of investment programmes. Energy regulators monitor and collect data from various DH enterprises and report about the situation in the DH sector and separate enterprises; these reports go to interested state institutions, municipalities, public associations. The energy regulator, as an expert in district heating technology and finances, is often asked to assist in the preparation of required legal acts, methodologies and other documents necessary for the heating sector.

Ensuring customer protection is one of the regulator’s statutory duties which could cover:

- develop ex ante a system of rewards/penalties based on customer satisfaction metrics;
- adjust revenues for the next regulatory period at the ex post review;
• develop rules for transition to the new regulatory regime and revenue re-profiling tools that the company can use in setting prices

• ensure that the regulatory process is transparent, with customers able to comment on the proposed framework through a customer representative group.

Regulatory policy should not be seen as a simple solution for affordability concerns, as this requires careful design and merits in-depth engagement by DH companies.

*The main challenges arising when national or regional regulators set prices for district heating utilities:*

1. Some consumers (and some politicians) do not trust heat prices and regulation – they have to be well presented in the regulatory process which has to be transparent, predictable, non-discriminative and well described in legal acts;
2. The regulator has to be well protected legally and economically due to the social and political pressure and need to make unpopular decisions;
3. Regulatory staff must be of high competence and should have suitable tools for monitoring and controlling DH enterprises. The needs often do not correspond to the financial requirements;
4. Personnel working in such institution have to resist influence of financial groups and be competent enough to discuss varies issues of regulation. It is difficult to ensure such conditions sometime;
5. Regulatory measures for incentivizing over-performance and penalizing underperformance are not well developed (few exceptions e.g. Lithuania).

*Local governments* (city or municipal council, administration etc.) play an important role in DH regulation, due to direct responsibility for local planning and heat supply organization. *Functions usually assigned for a local government are:*

1. Planning of local energy (including DH) infrastructure in the respective territory;
2. Appointment and control of administration in the municipal DH enterprises;
3. Permission for constructions including district heating facilities;
4. Privatization, leasing or concession agreements related to municipal assets and enterprises;
5. Approval of investment plans in accordance with territory planning and other factors;
6. Primary control of district heat supply efficiency, capability of management etc.;
7. Licensing and setting of heat prices for DH utilities if such are functions assigned;
8. Other functions related to the heat supply organization in the respective area.

For example, in Lithuania the main authorities regulating the energy sector are the Government, the Ministry of Energetics, the Ministry of the Environment, the National Control Commission for Prices and Energy (NCC), the State Energy Inspection and the Council of the 60 Municipalities in Lithuania. *The Ministry of Energetics* implements the State policy in the energy sector, drafts and approves legal acts regulating the DH sector. *The Ministry of the Environment* decide on issues relating to environmental protection, construction and fulfil
functions, organise and carry out monitoring of environmental effects in increased pollution areas of the energy sector. The National Control Commission for Prices and Energy (NCC) approves methodologies and procedures for setting state regulated prices and must set heat prices if the municipality does not, or sets incorrect prices; approve charges for connection of energy facilities; grant licenses for DH companies. The State Energy Inspectorate exercises state control over energy facilities and establishes the technical reliability standards for equipment and; the management of the energy sector at the municipal level, is allocated to the individual Municipalities. Within their respective territory, municipalities organize the supply of heat to customers including heat price setting, according to methodology issued by NCC. [2].

In Slovenia, regulatory powers are shared between state and local communities in the field of district heating:
- The government defines conditions covering licenses, energy permits, pricing policy, concentration of capital, competition, security of supply, technical standards etc.;
- Municipalities define the manner of implementing public service obligations, approving energy prices for district heating, and ways of energy supply in specific areas of local communities [28].

In Hungary, recently the licensing, monitoring and pricing authority functions (in 2011) moved from local authorities to the Regulator and Minister responsible for Energy issues.

Generally, the regulated district heating sector is affected by many other specialized state and social structures like consumer protection organizations, inspections, associations etc. In transition economies, district heating is regulated, but national laws and secondary legislation do not always cover district heating in detail. This mean much room is left for interpretations, subjective decisions and miss-actions. This is changing as progressive countries understand that poor co-ordination in the district heating sector does not allow them to utilize the benefits of this very expensive infrastructure.

4.5 Ownership and operation of district heating assets

There are different approaches regarding participation of private capital in the district heating business, which is socially very sensible. For example, in Denmark, DH utilities are mainly owned by the consumers directly (as consumer co-operatives) or indirectly (as municipial enterprises). Many municipally owned DH systems are successfully operated together with privatized DH enterprises in former socialist countries. On the other hand, there have been cases, when weak private operators of DH utilities failed due to low financial and managerial capabilities. Some leasing contracts were disrupted by the intervention of municipalities as owners of the district heating assets. Participation of private capital should be well grounded and properly described in the relevant agreements. On the other hand, state strategies, policy, legal and regulatory frameworks can significantly affect the relations of partners
in DH services, notably the perspectives of the private capital in this segment of the energy sector.

The experience of Central and East European countries shows that when public heat suppliers are in difficult situations, and in desperate need for cash and investment, experienced private partners with capital are very useful and desired. Investors normally are seeking higher profits, so the DH regulatory system must create conditions for investors to earn money by increasing efficiency, reducing losses and through other actions, but not by abusing their monopolistic position in the market. Private operators should follow clear and detailed plans regarding investment, improvement of efficiency, upgrade of the main assets etc., which have to be fixed in appropriate agreements [3]. When the economic situation in the DH sector has been stabilized and DH enterprises have a good perspectives for profitable operations, private capital is often considered a disadvantage due to monopolistic market position. For example, in Lithuania new leasing agreements in the DH sector were discontinued in 2004 when the regulatory system assured the economic viability enterprises operating in this sector. There are examples, illustrating very low competence of the municipality in the privatization process. A poorly prepared tender, specification or a contract can become a long-term disadvantage for the local community.

In some countries better results of modernizing and commercializing DH were achieved by leasing of heating enterprises to private entities. In this case, the municipality remains involved through terms and conditions attached to the lease contract such as provisions based on: tariff calculation rules, investment requirements, service quality and reliability indicators, accounting provisions, reporting directions, oversight, timeframes, fees, and other factors.

Equity participation (selling shares) does not necessarily mean improving the district heating company if the pricing/tariff system does not allow new owners to invest and develop the DH asset. Full privatization of DH enterprises leads to interest in share trading but could result in only with a minimum investment in renovation of the main facilities (such as in Latvia). On the other hand, there are good results with private investments as well (examples exist in Hungary).

Privatization in the district heating sector could be controversial and frequently accompanied with disputes and conflicts, usually resulting from the improper preparation of the process and a lack of experience. The privatization processes takes different form depending on the limitations set by legislation and the authorities in charge of the privatization. (For example, in Lithuania municipalities have to keep 100 % ownership in DH transmission networks and no less than 30% in heat production facilities (Heat Law) in order to secure the heat supply process.)

In contrast, promotion of private capital participation in the heat production can form the basis for wholesale competition with the licensed district heating company. If the DH strategy is clear and appropriate, investors are interested in the development of CHP plants, waste incinerators and other business related to DH schemes. Regulation and pricing systems should promote such competition.
Experience from transition periods illustrates some challenge related to participation of private capital in the DH activity:

1. Increased pressure on regulator due to private operators interest to receive a reasonable profit;
2. Risk of reduced quality and reliability of heat supply process in order to increase profitability especially when “price cap” pricing methodology is applied (if service quality requirements are not set properly!);
3. Consumers usually have less trust in energy companies with technical/legal monopoly based on private capital.

To avoid conflicts after privatization or lease agreements, contracts should include clauses on financing investments and ownership of new or reconstructed assets, operation and maintenance performance specifications, policy specifics on pricing, connections and disconnections, role and rights of the municipality, environmental, sustainability and planning strategies, exit strategy and emergency plan in case of under-performance of the operator, with the designated successor to take over after contract termination and other important for both sides issues [3].

Where the private sector is not ready to take larger risks, a management contract would be an optimal interim solution. One of possible solutions to attract private capital in transition countries is municipal ownership of DH networks with involvement of private companies for long term operations. Private companies, especially from Western Europe, are more active in forming a sustainable economic background for the district heating sector, through activities like lobbying for the appropriate legal acts. Private investors working fast and with innovative investment projects demonstrate examples of technological progress for the state/municipally owned companies. So, economically strong and competent investor can speed up legal, economic and technological improvements not only in the certain DH enterprise but also in the sector. This side-effect is one of the benefits of involving private investors. *The regulatory system and especially pricing methodology should estimate existing potential and the activity of private capital and should direct these efforts in achieving the best results for all players in the sector. Regulation should be non-discriminative (ownership neutral).* Improvements on performance, collection rates and financial situation should be shared between investor and heat consumers in certain term periods. In Western European utility regulation, such periods typically vary between 5-8 years.

4.6 Competition in the district heating sector

*Competition in the district heating sector is rather different from those in electricity and natural gas sectors.* Operators of DH networks must ensure temperature, flowrate and pressure regimes at the inlet to each heat consumer. Many of these parameters related to weather conditions, significantly varies during the day etc. Large DH systems are inert, storage or accumulation of thermal energy is expensive so many technical decisions have to be made in advance. Third party access to the DH networks is theoretically possible, but not used due to these and similar reasons.
It’s not rational to develop two competing district heating networks, however, wholesale competition is realistic and can be introduced in district heating schemes. There are many examples of good practice in this field. Licensed DH companies have an obligation to purchase heat from independent heat producers (IHP), if it mostly reduces price for the final heat consumers. For example, about 20% of district heat sold in Lithuania is produced in external sources. With the installation of gas motors based CHP plants (by private investors) more and more DH suppliers buy heat energy from IHP in Hungary.

Basically, total heat prices from alternative third party heat sources should be competitive with variable prices of existing production that is replaced. In addition, alternative heat source should include other benefits e.g. energy efficiency, sustainability or lower marginal cost than increasing existing capacity when heat demand is growing.

Competition in the district heating sector during the transition period has some specific features. When the main heat supplier is economically weak, worn out (the main facilities), competing investors can replace existing heat production facilities. Such process is possible if cogeneration is a feasible business in the particular country, if renewable energy and CHP are significantly promoted. In such situations, IHP could sell heat to the DH network and could sell electricity at a lower price, thereby receiving income from the emissions trade system or produce another non-regulated market product. On the other hand, DH enterprise loose the possibility to earn money from additional products or services, stay economically weak and have to maintain and renovate DH piping systems while ensuring a reliable heat supply. IHP usually cannot ensure long term and predictable heat supply regime because they are often related to other markets. So, the main heat supplier still has to maintain some heat production facilities and all these costs have to be paid by the final consumers. Competition in wholesale thermal energy should be carefully considered and regulated. Lost profits for the main heat supplier, lost possibilities to earn additional income from unregulated products or services, weakens the DH enterprise. Additional costs may arise due to the existence of IHP, but obligations for licensed DH enterprises to secure reliable heat supplies (maintenance of reserve production capacities, storage of reserve fuels and similar) sometimes leads to the situation when heat consumers pay more for unfair competition. Due to the necessity of large investments into the old type DH networks, competing parties must participate in this process and heat production price differentials between the DH enterprise and IHP has to be compensated. On the other hand, IHP investors and operators create competition (as new entrants) and can demonstrate the weakness of historically dominant DH companies – especially on the production side. IHPs are good for regulators creating benchmarks for heat production costs!

Experience demonstrates competition in the wholesale heat market of the DH system can be the most favourable form if it is well designed. Energy regulators have to form methodologies and instruments which ensure the background for rational competition and prove useful for the final consumers over the long term.
4.7 Competition with other heating methods

Another important issue in regulation of district heating is competition with alternative heating methods (natural gas heating mainly and partially heat-pumps). In most West European countries DH schemes had been developing in parallel with alternative heating methods. So competition was natural and energy infrastructure was adequately formed, because it is not economically logical to develop two competing heating systems such as parallel gas and district heating networks.

In the beginning of reforms in the transition period (due to increasing prices, cross subsidies and lack of regulation) many large consumers or even residents switched from DH to gas heating technologies, making the state of the district heating in some countries critical. Temporary difficulties can make long-lasting structural problems in the formation of energy infrastructure. Experience shows some elements of competition between alternative heating methods can be useful for the final users as well as for entire energy system.

Countries where the rate of consumer switching from DH networks has been particularly high include Romania, Bulgaria, Estonia and Latvia. For example, up to 30% of residential consumers have disconnected from district heating in Bulgaria. In Hungary, Lithuania and a few other countries, the share of district heating in the residential heat market was rather stable over the last few years. The DH sector has been growing in Lithuania during the last decade due to construction boom and very few disconnections.

Zoning of territories according to heating methods usually means specification of areas where DH is the least-cost option and other, less densely-populated areas where gas or other heat sources offer the lowest cost. Denmark, Lithuania, Latvia and Estonia have introduced such planning obligation or leave it to local governments to decide district heating zones in their jurisdictions. Legal basis for zoning means that there are legal/regulatory provisions allowing (or requiring) municipalities to establish zones where only one heat source is allowed.

Other countries, like Germany and the Netherlands, do not ban heat source competition but effectively restrict it when a single company usually supplies both gas and heat. In the Netherlands, district heating typically only serves new developments and gas is usually not extended to these areas where district heating is available.

Zones eliminate the possibility of retail competition in the heat market, but this is in the interest of consumers in general. This lower cost reportedly comes from economies of scale: elimination of duplicative investments, which combined with the purchasing power of larger district heating companies, allow these companies to produce or buy heat at the cheapest price. Zoning can be an effective tool for initially establishing district heating in areas of new development, even if the international evidence indicates that zoning does not result in lower costs when it is mandated over a long period.

In Estonia and Lithuania, municipalities can now mandate district heating zones as means of preventing the decline in district heating sales. The logic in these cities is that dis-
trict heating is the least-cost option in the long term, but that rapid shifts in market share (switching customer to individual gas-based heating) could cripple the industry in the meantime [6].

In the planning process and taking into consideration existing systems, new construction, and density, a municipality can divide its territory into heating zones and determine the “best” heat supply method for each zone, depending on local characteristics and conditions:

- **DH zone.** A high density area, where DH is economic or required by environmental considerations. The high density of the buildings should result in DH being the most economic and efficient source of heating. With this consideration and particularly for DH systems experiencing high growth and new development; planning is essential. The planning of DH zone(s) should identify areas with existing DH systems, new developments requiring DH, and estimated heat volume that would be transmitted.

- **Gas zone.** A low density area (usually individual houses) that is not economic for DH and where gas heating is environmentally acceptable.

- **Competitive zone.** In an area where alternative heating methods are possible and reasonable, consumers should have the right to choose the heat supply method and supplier based on competition.

In **Estonia** the District Heating Act sets out that a local government has the right to determine district heating regions within the boundaries of its administrative territory. Only district heating may be used in a district heating region (except for persons who did not use district heating at the time a district heating region was established) and the consumers may not choose an alternative way of heating (e.g. local electric heating, geothermal heating, stove heating, etc.). The local municipalities may establish the DH zones, where the DH is the single heating source in that zone.

In **Denmark**, in municipal heat planning, the zoning can be regarded as a result of a co-ordinated competition between the district heating company and the gas company. The alternative would be competition that could result in an uneconomic network, duplication of investments, bankruptcy and a loss of assets at DH companies. Denmark has the most extensive legislation concerning district heating, including an obligation to connect new and existing buildings to public supply, a ban on installing electrical heating in new buildings, and in existing buildings with water based central heating and tariff regulation. In Denmark it is crucial that district heating plants also produce electricity, hence the large proportion of CHP plants. This results in a strong position for district heating plants in a position of natural monopoly.

In **Lithuania**, the heating sector is managed by the Municipality according to specific plans for the heat sector that are approved by municipal councils. The main task of the plans is to satisfy the consumer at the lowest cost and within the allowable range for negative impacts on the environment. The specific plans for the heat sector are reviewed at least every 5 years, depending on heat production and development of technology, environmental pollution and changes in other factors relevant to spatial planning. Heat supply in the concrete municipality is organized according to general planning documents or a specialized local Heat Plan. District heat supply and competition zones are drawn in the territory of municipality and the
only licensed company in the DH zone must connect all new heat consumers; connection cost is included in the general heat price or paid by special fee. Heat consumers in the competition zone could be connected and heat supplied on the basis of individual cost and prices.

**Zoning and planning of heating methods reduce risk of disconnections and over-investments into the energy infrastructure and could be useful tool for expansion of district heating schemes in the countries where this technology is not widely deploye, but in certain cases needs to be increased, therefore it is essential to secure long term investments.**

### 4.8 Licensing and related obligations

District heating schemes are considered an important service for large groups of the population and potentially risky in cold climate countries. Therefore, they must be operated properly. This is due to the necessity to ensure safe, reliable nonstop operations. Otherwise huge material, physical losses along with and the social impact would be severe if shut down during winter time. Suitable corresponding, technical, financial and human resources must be available for the companies involved in this business. That is why DH enterprises are licensed and controlled very carefully to secure their working capability. Staff of the DH enterprises are periodically examined by specialized state institutions in some countries. Permission for operation is issued when a company is capable of carry out the service. On the other hand, the district heating scheme is a natural local monopoly and has some market privileges which can be utilized in various forms. Risks related with the capabilities of DH companies are even higher in transition periods, when human and financial resources usually are limited and regular scheduled programs of repairs, renovation or investment could be interrupted due to a shortage of financial or human resources.

There are different licensing approaches for district heating in Europe. Where the DH sector is market driven, there may be no licensing (municipalities have access to roads and they control permissions to build networks.). If the DH industry is regulated, then the regulatory authority and/or municipality are also responsible for issuing the license. For example, in **Lithuania** DH license for the companies who sell above 10 GWh of heat per year are issued by the energy regulator, amounts below this level are done by the municipality.

Licensed DH Companies must ensure a reliable heat supply to the consumers, to properly operate a network and to regulate the heat supply regime. Licensed DH companies have many other obligations and requirements, like purchasing heat from independent heat producers (IHP), transparent accountancy and pricing systems, public openness etc. Disputes between DH companies and other parties are resolved by energy regulators and /or customer safety authorities in a juridical process.

Public and private companies are licensed according to the common rules irrespective of ownership status. Licensees get various obligations which can be reissued by the Regulator or other competent institutions. For example, **Estonian** Competition Authority (ECA) grants a license for transmission, distribution, public supply and the independent supply of energy. According to the District Heating Act an activity license is required for the production of heat
if the projected annual production volume exceeds 50,000 MWh per undertaking, or if the undertaking produces heat in the process of combined heat and power production.

**Denmark** has the most extensive legislation concerning district heating including an obligation to connect new and existing buildings to public supply. In Denmark the regulating body (energy regulator) gives the district heating company license to sell heat at a price which is below guaranteed price.

However, even if there is more than one institution assigned with licensing authority, there are national principles and requirements for license conditions and administration that apply to all government agencies that issue and monitor licenses.

In **Bulgaria**, heat producers are licensed by the National Energy Regulatory Commission if installed capacity is greater than 5 MW. In **Hungary**, the Hungarian Energy Office provides DH establishments an operations licenses for CHP units exceeding 50 MW. It also provides DH supply licenses for the operators of CHP units supplying heat directly to consumers. The town clerk provides DH establishment and operation licenses for other types of production units exceeding 5 MW, and for all other types of supply licenses \[\text{[22]}\]. Based on the amendments of law on district heating supply from 2011 the Regulator issues licenses for all generators/producers selling heat to DH companies and for DH supply companies. In **Latvia** according to the law On Regulators of Public Services, a license to supply heat is required if the heat is produced in a boiler house with the total installed capacity exceeding 1 MW or if the sales of heat to any consumers exceed 20 000 MWh per year \[\text{[21]}\]. In **Lithuania** heat supply licensing rules establish the rights and obligations of heat suppliers. Providers that have heat production units or heat distribution networks (or both) can obtain licenses for supplying heat from the responsible institution. If the provider can supply more than 10 GWh/year, it is licensed and supervised by the National Control Commission for Prices and Energy (NCC); if less than 10 GWh/year, by the Municipality\[6\].

Accession to the district heating market in the **Czech Republic** is regulated by the Energy Regulatory Office; issuing licenses on generation and distribution of heat.

The Heat Law in **Lithuania** came into force in 2003 and split responsibilities between energy regulator and municipalities. Licensing rules approved by the government describe all aspects of license conditions, termination etc. A licensee in the district heating sector must fulfil certain obligations:

1. Should have technical, economical and managerial potential to carry out duties related to licensed activity;
2. Ensure continuous supply of thermal energy; meeting customers’ demand. Must connect all new heat consumers in the DH zone; connection cost is included in the general heat price;
3. Purchase of heat from independent producers if it reduces heat prices for final users;

---

\[6\] Source: The National Control Commission for prices and energy (www.regula.lt) & Vilnius city municipality (www.vilnius.lt).
4. Be ready to restore outages and to compensate losses to heat consumers in case of supply disruption or failure in parameters;

5. Licensed activity must be accounted separately and regularly reported;

6. Fulfil other legal, economic requirements of sector regulation;

In Estonia, if an activity license expires or the Energy Market Inspectorate revokes an activity license, the Inspectorate shall, where necessary, decide on the measures which must be applied in order to ensure the continuation of the activity carried out on the basis of the activity license and the preservation of the assets needed to continue such activity. Upon expiry of an activity license or in the event of the revocation of an activity license, the holder of the activity license shall, if the Inspectorate so requires, continue to perform the obligations arising from legislation and the license conditions for a period of time determined by the Inspectorate.7

In Hungary, the Hungarian Energy Office is authorized to withdraw the license and appoint another license holder to perform the licensed activity; ensuring continuous heat supply for end-users.

According to the Energy Law of Poland, a separate license is obligatory for heat producers in heat sources with total capacity over 1 MW, for heat transmission and distribution in DH network if heat demands of connected customers exceed 1 MW and heat trade (without limitation of a turnover).

Regulators can use the licensing process to ensure least cost heat supply. In case of a licensee failure to carry out corresponding duties, the institution responsible for the organization of district heat on the respective territory (usually municipality) must find a solution (to form another DH enterprise or invite alternative operator to secure heating process etc.). Licensing as the legal procedure to enter or to leave the DH market should be well described in legal acts however there is little experience regarding actions, after a license is cancelled.

4.9 Heat price setting procedures

Heat price setting procedures depend on the general regulatory system in the district heating sector of a particular country. In the “non-regulated” DH sector heat prices are set by a heat supplier itself and occasionally controlled by the competition authority (other competent state or municipal institutions) and consumer protection associations, mainly in the case of complaints. The heat supplier is expected to explain the reason of changes in prices or services, if any, and negotiates new prices with large clients. In case of disagreements, various schemes of mediation, juridical investigation or state influence are applied.

In case of “affordability led ” regulatory approaches, heat prices (tariffs for heating) are set by federal, regional or local government authority uniformly for the entire territory (region, city etc.) on a “socially acceptable level”. Unpaid heat supply cost is covered using

7 Source: [http://www.konkurentsiamet.ee/?id=11927](http://www.konkurentsiamet.ee/?id=11927)
external sources. Usually, this is municipal or federal budget. Sometimes income from the electricity sector or other sources, are used for subsidizing heating expenses.

When “economically orientated” regulation dominates, at a minimum the methodology of pricing is set by a national (regional) energy regulator. Concrete prices and tariffs could be set by the enterprise itself or a local authority (city or municipality) by strictly following instructions and based on regulated normatives. There are countries where the Regulator or the Minister directly set prices for the DH utilities. This could be the case as well in small countries (when the number of DH companies is low) or for certain limited number of DH enterprises, which are specific, for example:

1. Big DH companies who serve a large number of consumers;
2. For the companies who produce heat and electricity, due to control cost allocation;
3. Where heat prices are the highest or similar.

Companies that are classified as small in some countries tend to be multiservice (providing heat, water, sewage treatment, waste disposal, and the like), and their tariffs are set by municipalities given that their income and financial viability depend on the decisions made by municipalities. Larger DH providers that supply heat—one of which may also own CHPs—have a greater impact at the national level and are regulated by government institutions at the national level or provincial-regional level, depending on the size and characteristics of the country.

Examples of the institutional structure in the heat price setting and control system are presented in the Table 1.

In the Danish district heating market, both production and network companies are monopolies and regulated as non-profit undertakings. The energy regulator monitors the DH companies prices and delivery terms, takes regulatory action if the prices and terms of the network companies are not in line with the non-profit regime or if they are unfair in any other way. All commercial contracts are subject to the supervision of Danish Energy Regulatory Authority (DERA), which can intervene if necessary. The DERA continually benchmarks monopoly companies, all tariffs must be submitted annually to DERA.

Heat pricing systems must be transparent, simple and understandable for consumers, so they can have trust in the pricing and tariff setting procedure. On the other hand, as the only income (if no subsidies) DH pricing system must ensure the following targets:

1. Secure safe, reliable and efficient heat supply process with existing DH scheme;
2. Ensure continuity of operation, maintenance and development and modernization of the main assets;
3. Expansion of DH scheme, connection of new heat producers and consumers, if this is feasible or obligatory
4. Implementation of national (municipal) targets (cogeneration, renewables, utilization of city waste, fulfil environmental requirements and similar).
Experience from the transition period, demonstrates the desired regulatory principles in the district heating sector: **municipal property and the organizer of heat supply are separated from economic regulation.** This eliminates political influence on economic decisions and should assist to form economic background. In the opposite situation, political interests dominate economic ones often. This leads to low profit or unprofitable operations, a lack of capital for renovation and development, or even to the degeneration of district heating in some countries (cities).

In **Poland**, the licensed DH companies are obliged to send their applications for heat tariffs to the Energy Regulator Office (ERO) regional offices for approval. The first step in the procedure of heat tariff approval includes analyses to see if it is in accordance with the regulations in force (including costs accounting, unit cost as well as prices and rates, calculation etc.). The second step of the heat tariff approval procedure is connected with verification of the planned fixed and variable costs (including costs of modernisation, development and environment protection) as well as the level of the average index prices and rates. It usually takes time because some additional information or answers to the ERO questions have to be prepared by the DH company. The final steps of the tariff approval process are investigations of the financial effect of the new tariff on particular customer groups (the heat bill’s increase or decrease) as well as defining the correcting indexes, which are the main tool of the heat price regulation. These correcting indexes and the yearly inflation rate in the previous year determine the permissible increase of the average index heat prices or rates [36].

Pricing and the tariffication system should reflect the real situation in a country and the targets to be achieved. Statistical information from DH enterprises required for benchmarking include: analysis and elaboration of varies methodologies, normative documents, statistical criteria for price setting, decision making, recommendations for state policy. Reliable data collection and submission of it to the regulator should be obligatory for licensed DH enterprises. The energy regulator has to be competent; this includes fostering an analytical institution capable to implement optimal regulation regime and a pricing system to secure high quality operation and development of DH companies as part of the national energy complex.

**Table 1** provides a comparison of different pricing principles in selected countries.

For example, in **Lithuania** the long-term heat price (basic) are set by municipalities for a 3-5 years period. The energy regulator (NCC) sets the heat price in case of incorrect setting and the heat price is adjusted every year with consideration given to fuel price (allowed every month), inflation, sold heat volume, other objective factors. The DH provider is allowed a maximum profit of 5% on the regulated asset value (using WACC).

**Table 1.** The heat price setting and control systems in selected countries [23].

<table>
<thead>
<tr>
<th>Heat price procedures</th>
<th>Denmark DH market under regulation</th>
<th>Finland Free DH market</th>
<th>Lithuania DH market under regulation</th>
<th>Poland DH market under regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methodology (determined by)</td>
<td>DERA</td>
<td>non applicable</td>
<td>NCC</td>
<td>ERO</td>
</tr>
</tbody>
</table>
In all the modes of regulation it would be useful to have the publication of data which demonstrates efficiency of different DH companies. This could create a good Benchmark basis and could form some pressure for other companies to increase their efficiency. Incentive instruments and figures could be derived from benchmarking analysis as well. After an analysis of the economic efficiency, an announcement of ineffective companies by the regulator could be considered. ERRA together with FORTUM created a Benchmarking analysis which is a good basis for this issue.

In Denmark, in order to secure a more efficiency-based development of the sector, DERA is working on a benchmark model for the heating sector [24]. Any attempt to “smooth out” prices over time by increasing prices one year is not allowed, but each district heating company is allowed, after approval from the regulator, to save (accumulate) excess “profit” for five years in order to make necessary future investment [25]. The main objective of regulation is to secure the implementation of the energy policy decided by the Parliament. This includes targets, like high energy efficiency, high security of supply, high utilization of renewable energy sources, low environmental impact and economical implementation [22].

In Estonia, the regulatory authority Estonian Competition Authority approves DH tariffs for large DH companies (with the sales above 50 GWh/y). The tariff is set for a pricing period, maximum 3 years, and is based on justified cost, asset and return WACC on RAB [27].

In Hungary, DH tariffs are based on justified costs and reasonable profit on invested capital (WACC). Allowed return on equity is under development by Hungarian Energy Office (HEO). In Hungary, one important driver for lower heat prices is cross-subsidy from electricity revenues [27].
In the DH sector in Latvia, the tariff regulation system – Public Utilities Commission (PUC) and Regional Regulators. Regional regulator regulates tariffs of public services (heat, water, waste water, municipal waste). The regulator is independent from municipalities and is financed by public service companies (0.4% of tariffs) [28].

In Lithuania, a National Control Commission for Prices and Energy (NCC) has an important role in heat pricing. The Heat Law regulates the activities and responsibilities of state institutions, relations between heat suppliers and consumers, heat price setting procedure and other issues of regulation [2]. The Commission is obliged to create and approve pricing methodologies and to control the implementation of them. It controls prices which are set by municipalities.

In Poland, price regulation is governed by the Tariff Methodology established by the Energy Regulatory Office (ERO) and includes setting and approving allowed revenues and tariff rates. In this category, the main responsibilities important for DH are: approval and supervision of application of heat tariffs, including the analysis and verification of the costs.

In Slovenia, tariffs and prices of district heating are regulated by governmental decree, although the Energy Law transfers regulation to the local authorities. District heating companies thus have to seek approval from local authorities as well as the government. The aim of the decree is to enhance the efficiency of DH systems through the pricing model [22].

The energy regulator as a final decision maker in the district heat price setting is an essential factor to ensure the economic viability of DH enterprises in the transition period. This allows the ability to set and adjust prices to ensure reasonable prices. If a municipality is responsible for district heating on the respective territory, including the form of administration of DH utilities, the national or regional energy regulator using benchmarking can evaluate economic and the technical situation in the enterprise. This should qualify the result of the municipal strategy and type of control (when municipality owns DH company and approves the strategy). In the case of private operators, the energy regulator is more competent to control actions and to form economic incentives for the licensed company. On the other hand, the local administration usually knows better facts in the DH scheme operating on their territory. Experience shows, double control and participation in the heat price setting procedures (when municipality set the prices and the ER controls – if it is according to relevant methodology and criteria) in the transition period makes this process more transparent, balanced. The result is that heat consumers, in many cases, trust more unpopular and painful increase in heating costs.

A workable compromise would be that the national regulator develops the methodologies and procedures for price or tariff setting and other issues, while local regulators (administration) monitor compliance by the DH companies. The national regulator (or an additional arbitrator) only would be involved in cases of a dispute between the municipal regulator and the DH company. This regulatory scheme could be reasonable in large countries where big numbers of regulated enterprises exists.
Varies forms of state control are applied to the DH sector in the countries past a transition period:

1. Licensed entities, have to present annual economic-financial reports to energy regulators or other responsible institutions;
2. According to license conditions DH enterprises must carry out an annual audit of the licensed activity and to present conclusions to the relevant authority;
3. Technical, safety, environmental, and accountancy institutions control varies aspects of district heating activities;
4. Efficiency of monitoring and control depends mainly on the capabilities of the responsible institution; different methods are identified.

The experience of the CEE countries show – an efficient way to monitor the situation of the DH companies is to “put” them into the informational and benchmarking system (IBS) and compare them with similar companies. Benchmarking the different efficiency and financial ratios allows the Regulator to take immediate actions required to strengthen the analysed DH companies or to replace the DH operator (such as to avoid bankruptcy). So, a suitable institutional system covering the responsibility, required competence, enforcement etc. should be established by general legislation.

Data collected and analyzed using a benchmarking system, could be utilized by the energy regulator for assessment of different DH enterprises and to demonstrate administrative capability of a particular city or municipality to manage district heating on the respective territory.

4.10 Dispute settlement in district heating

If disputes between heat suppliers and consumers are not solved on a negotiated bases then there must be a legal system for investigation and resolution. The general court system is not suitable for specific energy sector issues, so special systems are usually set up for such purposes.

In Denmark, the Energy Supplies Complaint Board has a mandate to handle disputes arising from the contractual relationship between energy consumers and energy (including district heating) supply undertakings. Yet, another level of appeal is possible with the Energy Board of Appeal, which is an independent appeal board under The Ministry of Climate and Energy. The Energy Board of Appeal is the final administrative appeal body for decisions by public authorities under various laws governing the energy sector. The decisions that are subject to appeal will in most cases, have been handed down by the Danish Energy Regulatory Authority, the Danish Energy Authority or one of Denmark’s 98 municipalities [2].

In Lithuania, the National Control Commission for Prices and Energy (NCC) has responsibility for pre-court considerations of complaints. The complaints of domestic consumers for power purchase or service contracts are handled by the State Consumer Rights Protection Authority under the Ministry of Justice. Complaints regarding technical issues, energy
accounting and payment for energy are under the responsibility of the State Energy Inspectorate.

Settlement procedures of disputes, principles of penalties on end-users and companies in the energy sector are defined in the Energy Law of Poland. Seminars and conferences are organized each year and give the opportunity for the exchange of views on critical issues between ERO specialists and representatives of heat suppliers and consumers. Occasionally, ERO specialists are invited by organizations representing heat suppliers and consumers to discuss specific (more complicated) situations and to seek effective solutions [22].

In Hungary, consumer protection is regulated in general law. Certain aspects of consumer protection, in respect of district heating are included in the district heating law. They are delegated to the ministry, municipality councils and municipal clerks. The energy regulatory office of the Czech Republic is empowered by the Energy Act to form decisions of ordinary and extraordinary appeals, in compliance with rules of the Administration Code.

Generally consumer’s approach to the district heat suppliers remains very skeptical or negative in the transition period. Particularly where heat prices are not subsidized and heating cost is relatively high compared to family income. Most of complaints simply express their dissatisfaction with a heating bill. Large groups of consumers do not trust the necessity of heating costs, efficiency of regulation, thermal energy allocation between customers etc., in the regulated DH market. Information about capital and operational expenses, simple pricing methodology and clear reasons of heat price changes can assist in solving many disputes between heat suppliers and consumers. Usually the energy regulator is an institution which has reliable information on these issues (or can obtain it from regulated enterprises) and competent enough to describe or to solve a problem of the appellant. So, in most post-socialist countries the energy regulator is the main pre-court institution which settles disputes related to economic or legal aspects of district heat supply activity. If an appellant is dissatisfied with the conclusions, further disputes are considered in the usual administrative court. There are energy arbitrages or similarly specialized appeal institutions which deal with the matter of energy complaints in some countries.

In the EU countries there exist various state established institutions and public associations whose main target is to protect consumers, especially users of monopolistic services. These organizations assist a lot in communication between heat suppliers and consumers. A shortage of marketing and consumer focused activities is still a common feature in the DH sector of many post-socialist countries. It is a key factor to have detailed descriptions of rights and obligations for heat consumers and suppliers in order to avoid misunderstandings and unnecessary disputes. Regulated relations between heat providers and users could be described in the Heat Supply Rules or other regulatory documents.

4.11 Planning and approval of investment

District heating systems, like other energy infrastructure, is rather expensive and a long lasting installation which is interrelated with many other objectives and territories. So
they must be carefully planned and coordinated with general development of the respective territories, heat producers and consumers. Under-investment leads to risk of heat supply reliability and missed investment opportunities while over-investment increases heat prices for the final users. As the energy regulator is partially responsible for implementation of the national energy strategy and through price regulation influencing the economic situation of the regulated enterprises it could be useful if it has to participate in the process of planning and approval of investments, along with other interested institutions.

In Denmark, all energy projects with a capacity of more than 20 MW need to be approved by the energy planning authorities before implementation. The evaluation and approval of heating projects is conducted by the local municipality, but the Danish Energy Agency (DEA) has to be informed and can intervene if necessary. A project applying for a grant according to a specific act has to be approved directly by the DEA.

For example, in Poland, the companies operating district heating networks are obliged to work out a development plan for heat supply on their territory of activity. The plan should be based on the expected development of particular towns and villages, defined in documents prepared by local authorities. Planning of DH systems development is coordinated by regional authorities (regional councils and “voivodes”), since heat supply planning is the task of the municipalities. Special attention should be given to the scope of combined heat and power production, as well as waste heat utilization from industry [36].

In the planning process of investment the district heating company - which has detailed information on the assets and their technical conditions - has a key role. Coordination with national institutions like the energy regulator or ministry and local administration is logical when developing strategic investment projects like construction or expansion of pipelines, conversion from one fuel type to another and similar. There are countries, where the investor has freedom and the responsibility of selecting the type of fuel, site, technology and mode of operation; the regulator has no competence regarding planning.

In cases, when the regulator is involved in the planning process all investment activities in the district heating sector could be classified into 4 main groups from a regulatory point of view:

1. If financing from savings is realistic pricing system should promote incentives of DH managers so they can make decisions by themselves (such as efficiency measures, cost savings, and with consideration for payback periods for investments within a regulatory period). As an example of such regulatory promotion, it could be a long-term regulatory period (3-5 years). If efficient investment was done in the beginning of this period savings are left for the enterprise and converted to the consumers from the next regulatory period. Some regulators leave bonuses for energy savings but it is difficult to control such rewards. In most cases, there is no necessity for approval or control for relatively small investments.

2. Investments required to ensure safety and reliability, to meet environmental standards and similar standards have to be decided by the DH company and approved by responsible state authorities. As these cost usually increase heat price they have to be finally approved by the energy regulator and paid by heat consumers.
3. Investments in the city energy infrastructure (construction of new pipelines, for example) are to be coordinated and decided by the municipality. In some cases municipal budget or other external resources have to be involved in financing if it is risky and can increase heat prices. Combined financing (DH company, municipality, new consumers etc.) is often an option and should be adjusted with the energy regulator due to balancing the interests of participants and the payment scheme.

4. Investment required for implementation of national (regional) energy targets (e.g. construction of cogeneration plants or waste incinerators, introduction of renewables etc.) and if these increase district heating prices such projects should be approved by municipal (regional) government as well as by energy regulator and other responsible institutions. Necessary and adequate financing should be arranged before construction started.

Complicated and expensive energy projects have to be carefully analyzed before public discussions and the approval process. Skilled consultants should be involved and adequate resources for such services should be foreseen in the budget of those energy regulators, who have this responsibility.

The regulatory regime should provide incentives to an operator of transition DH schemes to invest quickly into the energy saving or other means of reducing costs. Generated benefit should be engaged in the further modernization process in order to receive bigger scope of efficiency and fast modernization process with less external financial resources, which are usually related to additional cost (interest rate, cost of administration etc.). Experience shows, a long-term pricing regime with “price cap” for fixed cost increases economic incentives and possibilities to reinvest and utilize extra benefits. Longer regulatory periods provide more possibilities for an operator to reduce costs and to modernize assets. In Estonia and Lithuania, the DH regulatory pricing period is not less than three years.

4.12 Promotion of the district heating and cogeneration

District heating represents a significant part of GDP in many post-socialist countries. District heating can help promote growth of the national economy if it is well managed and adequately structured. On the other hand, because of its size, when the sector has serious problems, it can drag down the economy both on the local and national scales. A well-designed district heating policy makes tremendous sense from an economic point of view. It is as much a part of economic policy as any other large sector [22].

In the early years of the transition period, national, regional and local budgets financed most investments in district heating, along with additional support from special government funds and programs, international financial institutions and bilateral donors. Since then, many countries, particularly in Central Europe and the Baltics, have made significant progress in attracting private capital and commercial financing. Today, numerous district heating projects in these countries could finance their operation and development without government guarantee or international assistance [6]. On the other hand, renovation using only commercial resources, in many cases increases heating prices for final users. Recent increases in world fuel prices, in combination of renovation costs, makes final heat prices unacceptably high in post-
socialist countries because the purchasing power of consumers has dropped due to the recent economic crises and due to relatively low income levels. In addition, the conversion to local renewable energy sources and reduction of heat consumption are related to high investment costs. So, external resources for renovation of DH schemes become very important for all transition economies where district heat production is still based on imported fossil fuels.

Efficient district heating systems reduce or allow for the avoidance of external costs and generate positive macroeconomic effects. Support mechanisms to the DH sector should estimate expected benefits due to be expansion of cogeneration, utilization of waste heat and heat from renewable sources, which are the most effective for energy savings and climate protection. However, very limited national and EU funding for energy saving through district heating are available. Some good practices are illustrated below. Among other reasons to support district heating and cogeneration technology are:

- District heating-related cogeneration provides the most efficient and quickest way for energy savings and the reduction of CO$_2$;
- District heating provides the largest heat market for cogeneration in many countries;
- District heating-related cogeneration needs substantially less budget subsidies than all other tools related to emission reductions for protection of the climate;
- Fuel diversification into local and renewable fuels e.g. biomass, waste, biogas, even peat that are available in DH schemes can increase energy supply security and independence and reduce heat price volatility;
- Energy efficient and economically viable utilization of small scale electricity production;
- Cogeneration units can produce multiple products from one plant: heat/steam, electricity, cooling and waste incineration service;
- Decentralized energy may be cheaper than centralized in a short term perspective so this has to be balanced between short and long term interests. District heating should be considered in the wider scale of energy sector development.

In Austria, there is a special governmental subsidy for investment in heat extraction equipment in biomass CHP covering between 15% and 30% of the investment cost. In addition to the federal legislation and support schemes Austria also has some legislation on the länder level. Every länder has its own scheme regarding the subsidization of investment costs of heating systems mainly for renewable but some länder also provide subsidies direct for district heating. In 2008, the National Council amended a new law for expansion of district heating and district cooling networks providing state aid of 50 million Euros per year for building new district heating and cooling infrastructure [2]. Due to strong promotion the Austrian DH sector is growing most rapidly in the EU.

In Denmark, the district heating companies (commercial, cooperatives etc.) are subject to a nonprofit regulation, (Act on heat supply, chapter 4). Any attempt to “smooth out” prices over time, by increasing prices in one year is not allowed, but each district heating
company is allowed, after approval from the regulator, to save excess “profit” for five years in order to make necessary future investment [2].

In Poland, energy related issues are strongly pronounced in the National Development Plan developed for the years 2007 - 2013. Its priorities in the area of DH related issues are:

- Support of investments dealing with the development of fuel and energy transfer, increasing of storage capacity and infrastructure that is indispensable in the operation of energy markets;
- Support to investments contributing to production efficiency, supplies and utilization of fuels and energy, promotion of CHP and dispersed sources, promotion of demanded attitudes of recipients;
- Support of the development of utilization of renewable sources of energy (RES): wind, hydropower, biomass, solar and geothermal energy, alternative fuels for vehicle drive (LNG, biofuels).

Possible financing can come from the following resources like structural funds, integrity fund (aimed at environmental protection and transport infrastructure, annual allocation for Poland in years 2004-2006 amounts to 4178,6 mln EUR), National Fund for Environmental Protection and Water Management, Bank of Environmental Protection, commercial banks and private and own funding [21].

A very important investment funding source in the DH sector of new EU Member States, is structural funds which are partly allocated for replacement of pipelines, conversion to biofuels etc.

District heating networks provide a major opportunity for CHP deployment. DH with CHP can provide the double benefit of reducing costs and impacts of both electricity generation and heat supply. Countries have taken different approaches in the promotion of district heating and cogeneration, the main principles are shown in Table 2.

**Table 2.** The main steps of promoting DH and cogeneration.\(^8\)

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning – Heat planning and/or zoning</td>
<td>Strategic energy planning, probably at municipality level. May include encouraging or even enforcing particular energy solutions (zoning). <em>Currently applied in Germany, Denmark, Spain, France, Italy, Lithuania, Norway, and United Kingdom.</em></td>
</tr>
<tr>
<td>Support – Investment grant, DH distribution</td>
<td>Financial support for district heating pipes through provision of grants, probably from governments, but other sources also possible. <em>Currently applied in Germany, Spain, France, Italy, Lithuania, Norway, Romania, and the United Kingdom.</em></td>
</tr>
<tr>
<td>Planning – National energy policy</td>
<td>The framework, within which relevant legislation, possibly including measures on this list, may be framed. <em>Currently applied in the Czech Republic, Germany, Denmark, Croatia, Lithuania, and Norway.</em></td>
</tr>
<tr>
<td>Support – Operation support.</td>
<td>Supporting CHP through regulatory means, one prominent example being by means of a Feed In Tariff or a CHP bonus.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHP including feed-in tariff</td>
<td>Currently applied in the Czech Republic, France, Italy, Lithuania, and Romania.</td>
</tr>
<tr>
<td>Support – Investment grant, DH connection</td>
<td>Financial support for connecting customers to existing main networks through provision of grants, probably from governments, but other sources also possible. Currently applied in Germany, France, Denmark, Finland, and Sweden.</td>
</tr>
<tr>
<td>Burden – Carbon tax</td>
<td>Implementing a tax penalty on fossil fuels proportional to its fossil carbon emissions. Applicable to all energy systems (energy efficient approaches like district heating would prosper). Currently applied in Denmark, Norway, and Sweden.</td>
</tr>
<tr>
<td>Support – Favourable loans</td>
<td>Providing low interest loans to finance the capital cost of establishing, extending or refurbishing district heating. Currently applied in Germany and Croatia.</td>
</tr>
<tr>
<td>Support – Investment grant, CHP</td>
<td>Financial support for CHP through provision of grants, probably from governments, but other sources also possible. Currently applied in Germany and Ireland.</td>
</tr>
<tr>
<td>Support – Tax deduction, DH</td>
<td>Implementing a tax benefit for district heating schemes. Currently applied in Finland, France, Italy, Lithuania, and Norway.</td>
</tr>
<tr>
<td>Planning – Building regulations</td>
<td>Using existing regulatory framework to encourage deployment, and in to ensure unnecessary barriers are removed. Currently applied in Ireland, France, Norway, and United Kingdom.</td>
</tr>
<tr>
<td>Support – Investment grant, renewables</td>
<td>Financial support for renewables through provision of grants, probably from governments, but other sources also possible. Currently applied in Germany, France, Croatia, Ireland, Norway, and Sweden.</td>
</tr>
<tr>
<td>Planning – Waste planning &amp; landfill bans</td>
<td>Promoting in a strategic way the disposal of waste, so that energy can be recovered and put to use in district heating schemes. Currently applied in Denmark and Norway.</td>
</tr>
</tbody>
</table>

Investment is, in general, very difficult in declining markets. Venture capital investors will have little or no interest in DH markets in the absence of substantial potential for revenue growth, which will be limited in transition economies with a reduced industrial demand for heat. Among the major heating markets – of the countries with historical background of DH system, Lithuania and Poland experienced growth in heat demand in recent years. The heat demand in other formerly planned economies has stabilized and even indicate a small growth trend in demand for district energy after 2000 [3].

Policy makers take care about cogeneration and energy efficiency, usually, but little attention is paid to district heating. Many transition economies have significant potential for improving their energy efficiency shifting separate production of heat and power to cogeneration. Huge potential exist by improving the demand side for heat. Heat insulation of old blocks of flats could save a lot of energy, and reduce heat demand of DH systems. However, very clear promotional signals must be introduced for market players and a real economic background for growth formed to secure feasible investments into this sector and connected to the local regulatory environment. The energy regulator should evaluate the most effective measures for the local market and introduce them in order to combine global, national and local interests.
4.13 Some general legal/regulatory principles applied in district heating sectors of INOGATE partner countries

The district heating sector of most former socialist countries outside the EU (Inogate partner states considered here), still are in the beginning of structural reforms. The specific situations differ from country to country. Existing laws and secondary legislation are too general and flexible, too much space is left for personal interpretation. The regulation of the DH sector still mainly belongs to state institutions. For example, a typical institutional model can be seen in Uzbekistan:

1. Ministry of economy: strategic planning of DH development and approval of investment projects;
2. Ministry of finance: development of state tariff regulation policy, formation of methodology for pricing, setting heat tariffs by itself or through its regional departments;
3. State antimonopoly committee: control observance of antimonopoly legislation, control over application of tariffs and service quality standards, protection of consumer rights, dispute settlement and etc.;
4. State energy inspection “Uzgosenergonadzor”: control over observance of technical safety and industry efficiency standards and norms;
5. Municipalities: control over DH company’s administration, permission for constructions, primary control over district heat supply efficiency, local solutions related to heat supply systems, planning of local infrastructure.

In Belarus there are no special laws on the energy sector. State decisions are made by Presidential decrees and by the orders of ministries. Heat price setting is under the responsibility of ministries of energy and housing. Domestic consumers pay around 30% of real heat supply costs and the rest is partly subsidized by the government. District heating schemes in Belarus have been saved, operated and gradually renovated. In spite of installed heat meters in buildings consumers pay by the heating area. Financial resources for renovation of DH systems are funded by the state mainly.

In Azerbaijan, district heating enterprises are owned and regulated by the state. Different heat tariffs are set for commercial, budgetary and domestic users. In Kyrgyzstan almost all regulatory functions (DH policy, planning of investments, control over tariffs, quality of supply) are in the competence of the Ministry of Energy.

National regulators have been established in some countries outside governmental institutions. For example, in Armenia, the Public Services Regulatory Commission sets the heat tariff for boiler houses where capacity is above 5.8 MW. Smaller DH schemes are not subject of regulation at all. In Moldova regulation of district heating tariffs by the National Energy Regulatory Agency started in 2009.

In Kazakhstan, district heating is regulated by the national regulator. Investment programs are being approved by the regulator if installed capacity in the DH scheme is above 120
MW, if less under supervision of ministries. The regulator forms the normatives for heat pricing and sets formal heat prices. End-user heating tariffs often are low due to subsidies from municipalities. Heat metering is obligatory by law but only 37% of buildings are equipped. Heating tariffs are differentiated according to categories of consumers.

Planning or the regulation of DH network development is based on general city planning principles. There are no competition zones or regulated markets. Individual approaches exist regarding disconnections or connections of new consumers, including how to treat large consumers that go bankrupt or switch to other suppliers; this causes the DH systems to have large unused capacities. The lack of alternative suppliers is an important factor in the low disconnection rate. In Kazakhstan, where there is no natural gas supply infrastructure in population centers, district heating companies have no competitive pressure from natural gas suppliers. More competition from natural gas on the residential heat is found in Moldova, Ukraine and other countries where gas networks are widely available.

Large problems arose in the transition period when state controlled district heating companies where placed in the hands of municipalities. Large DH enterprises were reorganized into smaller companies and price regulation was moved to the local administration. As a result of these changes financial, technical and management capabilities were lost in many cases, “social” interest took over economic logic in many cases. Shortage of financial resources caused unreliable and inefficient operations, and resulted in very slow renovation rates.

Heat price regulation was carried out by municipalities. Prices were based on “socially acceptable levels”, but in fact “political” prices were set and the income for the supplied heat only covered part of the real expenses. The shortage of financial resources is covered mainly by state or municipal budgets. Cross subsidies are still common in some countries. For example, domestic consumers pay 0.9 USD per Gcal only, but industry and commercial consumers pay 26 USD per Gcal in Tajikistan (2010 y.). Heat price and tariffs are set by the Ministry of Economic Development and Trade. Heating tariffs do not cover costs in Kyrgyzstan: losses due to supply of heat are covered at CHP plants by income from the export of electricity, but in boiler houses the expenses are taken from local or state budgets.

Low collection rates, worn out assets and other problems create uncertainty in the future of DH companies. Private investors are sceptical about participating in the operation and renovation of such DH systems. Access to specialized federal funds is complicated, therefore the lack of investment is a major problem in the sustainability of the DH sector in some Inogate countries.

Building-level heat metering is installed in buildings. Heat billing is mainly done by square meters or the number of people living in the apartments. Energy losses are converted into the norms of heat consumption and paid by the final users. Owners of privatized apartments in multi-flat buildings do not care about the common infrastructure of the building, so heat consumption is enormous and will not be reduced in the near future. Hot water supply systems have been removed from residential buildings in some cases.
Social support systems have been introduced which assist poor people to pay for heating, hot water supply and other communal services. There is a lack of efficient communication between DH companies and the customers. The customers are usually poorly informed about the real cost of the service they receive [9]. Social support schemes are integrated into DH billing (compensations for heating needs of low-income population are paid via DH companies). Social assistance to low income consumers is provided by the state budget. Collection of payments and services are mainly carried out by the heat supplier.

District heat systems have been decentralized in many towns of Inogate countries and mainly remain in the largest cities. The DH market has now dropped significantly and the potential for cogeneration is largely lost. New small separate DH networks are under construction. In some Inogate countries cogeneration plays a significant role in the electricity sector (for example, in Belarus. The General situation in the district heating sector of Inogate partner countries differs but such features like economic challenges and low progress in technical rehabilitation are common in all the states.

4.14 Summary, conclusions

The main principles of the legal, regulatory and business environment of the district heating sector in selected countries are shown in Table 3. All analysed countries are divided into four main groups, according to divisions in the DH sector: legal, technical and economic.

Table 3. Legal, regulatory and the business environment of the district heating sector in groupings of countries.

<table>
<thead>
<tr>
<th>The main principles of regulation</th>
<th>Basic groups</th>
<th>Transition economies (Inogate)</th>
<th>New members of EU (regulated DH sector)</th>
<th>Old EU countries (free market conditions in DH sector)</th>
</tr>
</thead>
<tbody>
<tr>
<td>regulatory approach</td>
<td>Weak</td>
<td>Strong regulation</td>
<td>Light –handled</td>
<td></td>
</tr>
<tr>
<td>Legal basis</td>
<td>State orders and rules</td>
<td>Rules</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Ownership</td>
<td>State/ Municipality</td>
<td>Municipality/ Privat</td>
<td>Municipality/ Privat</td>
<td></td>
</tr>
<tr>
<td>Competition in DH sector</td>
<td>Rare</td>
<td>In the development</td>
<td>Strong competition</td>
<td></td>
</tr>
<tr>
<td>Licensing DH companies</td>
<td>State/ Municipality</td>
<td>Municipality/ Independent Regulator</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Approval of investments</td>
<td>State/ Municipality</td>
<td>Municipality/ Independent regula-</td>
<td>Investor-owner</td>
<td></td>
</tr>
<tr>
<td>The promotion of DH and CHP</td>
<td>In development</td>
<td>High</td>
<td>Weak (under market development)</td>
<td></td>
</tr>
</tbody>
</table>

The main legal and regulatory issues in the DH sector in countries with planning (economy) history is summarised as follows:
• **Heat Law** – Government must stand up and accept the Heat law which will create a background for the efficient development of the country’s DH sector.

• **Energy Planning** – lack of integration of the heat sector into the energy policy agenda, for example by including urban heating into local energy planning and mandating connection to DH systems;

• **Independent regulator** – in Inogate countries independent regulators do not really exist, or exist just formally, without any significant powers. The regulator should be empowered to supervise and control the energy sector (in this case-DH). The regulator conducts a transparent heat supply review for both consumers and suppliers. There is good experience with this method in new EU Member States;

• **“Political” pricing** – in most Inogate countries the state or municipality set tariffs for DH and in most cases prices are lower than actual cost. In such cases an independent regulator is the best option, if authorized;

• **Competition in the DH sector** – while in the DH sector of new EU members competition is promoted (by the government) and developed in the Inogate countries it is rare (state monopoly still exist). Competition is possible only if DH sector regulation and price setting procedures are clear and legally supported.

Generally, the positive principals of district heating regulation are drawn from the experience of countries passed the transition period. Methods for implementation vary depending on the specific situation in each country and to be acceptable to local society and to meet global energy challenges.

One possibility for regulatory development is to establish special regulatory conditions on a case by case basis to set-up a pilot DH scheme as pilot study, e.g. include whole DH schemes or new building areas where consumers’ ability to cover DH cost is higher than average.

5. ECONOMY OF CENTRALISED HEAT SUPPLY, COST ADJUSTMENT, PRICING AND PAYMENTS

Regulations applied in the district heating sector directly affect principals of pricing and the economic conditions of the DH utilities. In any case, district heating prices and regulation have to ensure the economic viability of a DH enterprise over the long-term, including its continuous modernization and expansion.

There are three main ways that heat pricing or tariff settings are used in European countries: free market conditions (alternative heating methods), independent energy regulator or municipality/state institution. In countries where the DH sector is not regulated the pricing of heat is not regulated as well. Prices are set by suppliers and the consumer decides whether the price is acceptable to them or not. Theoretically, a consumer can have an influ-
ence on the heating method if the price is not acceptable, but in reality when the user is connected to the DH network substitution is rather complicated. That is why district heating naturally becomes a monopolistic service and some form of state supervision is necessary.

State regulation and pricing system were common in Socialist countries with planned economies, and in combination with municipal regulation which are still left in some countries. Heat prices are set (controlled) by an independent regulator in most transition countries and in new EU Member States. In this case heat pricing has to be transparent, predictable and legalized, also it needs to be attractive for investors. Normative profit margin should ensure a return on efficient capital investment and provide sufficient incentives to participate in the district heating business.

There are circumstances under which regulated tariffs may be necessary: where there is no effective competition to district heating, where competition does not create a well-balanced market, or where it would be politically difficult to move to full competition in the short term. Affordability aspects could strengthen politicians to maintain price regulation. In most transition economies, where energy markets are still undergoing reform, the most common approach is to regulate tariffs in order to protect consumers against monopolistic prices, while enabling district heating companies to cover their justified (accepted by price authority) costs [6].

5.1 Economic viability of district heating enterprises and regulated income

District heating technology is specific due to the very costly heat transportation and distribution network built, maintained and operated. This is caused by the relatively large diameter of pipelines, high pressure and temperature heat carriers, corrosion risk etc. Expensive heat generation facilities, pipelines, substations and other equipment are designed for the maximal demand which only occurs in the coldest periods. This complex must be operated all year around to enable consumers to access thermal energy any time. All justified expenses required to operate this system even thermal energy, even if not used at all, are labelled as fixed costs and should be clearly reflected in the transparent pricing system. The justified/expected cost related to heat losses in the network depend on the temperatures inside and outside the pipelines, but they are still necessary for assurance of a continuous heat supply so they are often considered as “relatively fixed cost”.

Another expense related to energy consumption, by final users is called variable cost. This includes: the corresponding amount of consumed fuel, electricity and water. Fixed and variable costs in the district heating business reflect the difficulty to separate these items. Regulators should form clear definitions for comparison and control. The proper DH tariff regimes are made at least of two tariff components: a fixed tariff element based on the floor space or the cubic capacity of heated air or water (EUR/m², EUR/m³), and a variable tariff element that is based on the energy use (EUR/GJ, EUR/MWh). Tariffs should be able to collect enough revenues to cover the full justified cost of the product or service and the approved
rate of return on investments. Properly designed tariffs should reflect justified cost of service and not hide the information from end-users and thus avoid inefficient decisions on operation or investment. However, the fix (capacity) element is often criticized by customers especially in summer time-period.

5.2 Cost structure and classification of heat supply expenses

Each regulator could have some specific definitions in cost identification depending on a local accountancy system applied generally in the energy sector. In all cases, the target is to identify real costs, to connect them, and to compare them with similar efficiently managed systems, so as to evaluate their necessity and to reflect them in the tariff system.

For example, in Latvia, all expenses are considered to be controllable or uncontrollable. Uncontrollable expenses are expenses for fuel, heat losses, transportation losses, expenses for electricity, taxes required by the law, and unexpected expenses. Controllable expenses are salary - together with salary taxes, amortization, repair expenses, spare parts, other fixed costs, bank loan yield, and necessary real profits [29].

In Lithuania, the DH expenses are divided into three main parts: variable cost, fixed cost, and administrative expenses. Variable cost includes fuel costs, which is usually the largest, so as electricity, water, purchasing energy costs, etc. Fixed cost includes repair, material costs, amortization, labour costs, taxes and loan yield. A separate group of expenses includes amortization, labour, and material costs; these occurred outside heat production or transportation departments and reflect common cost which are used to administer (service) the DH enterprise in general.

In Denmark, the DH include costs deriving from: fuels, installations, grids and pipelines, buildings and inventory, installation and grid maintenance, operation/administration salaries, insurance, depreciations, CO₂ taxes, energy taxes, and sulphur taxes on fuels. The consumer price is made up of a fixed tariff that is independent of the amount of heat consumed, i.e. payment for being connected and a variable tariff covering variable costs, calculated per unit of heat consumed [23].

Basically, expenses are related to operating and maintaining the utility plant and providing the utility services to customers. These consist mainly of the costs of purchased power, fuel, wages, maintenance, supplies, and other necessary expenditures. There are two main groups within these costs: operations and maintenance costs are those expenses that can be directly assigned to particular operating functions (e.g. generation, transmission or distribution), such as fuel, maintenance related to specific equipment or direct labour costs. Operating expenses also include technical and non-technical losses, and a provision for uncollectible accounts. Administrative and general costs, however, cannot be easily distributed among operating activities that is why these are often not split among the main activities of district heating companies or distributed proportionally to some criteria. For example, administrative and general cost could be allocated to heat production and transportation activities proportionally to the value of assets and salaries budget of the respective activity.
Depreciation is one of the most important items in the revenue requirement. District heating equipment and plants might have service lives for 30 or more years. The depreciation policy of the company is of major importance from the regulator’s point of view, as the depreciation figure might affect revenue requirement to an extent as much as 30%. An authority evaluates depreciation with scrutiny and adjusts its value when necessary. In many countries a minimum period of depreciation is regulated by the law.

The value of assets left from the Socialist era is hard to ascertain when the cost of assets is not reflected in the real (e.g. replacement based) value. In these cases, the book value is usually low and depreciation included in the price varies from 1 to 30% of total DH supply cost. The lower limit is common for old asset based DH utilities, while the upper could be seen in modernized enterprises where a big share of the new facilities were recently bought at market prices. If the profit in the district heating service is regulated and is often at a very low depreciation cost, then it becomes the main internal source to cover the demand for investments. Re-evaluation of the main assets in the DH sector is often politically unacceptable and companies are left with very low possibilities to increase investments. This is very common in the transition countries outside the EU. In such situation investment are minimal and financed mainly from external sources (municipal or federal funds, special programs, international aid etc.). If commercial credits are limited, or there are no private investors available, DH utilities are renovated slowly and due to high inefficiency consumer payments are wasted for a long time. The regulator, in its understanding of the real situation and active intervention in the pricing policy is central in ensuring the economic viability of DH enterprises.

Different kinds of taxes have to be considered more than just the cost structure. An essential issue becomes cost of purchasing CO\textsubscript{2} allowances in the countries which participate in the Emission Allowances Trading Scheme. Many other small expenses could also be covered but it is not worth to analyze or regulate them often. So each regulator usually makes a system of cost classification, which could be different from official accountancy system but related to it due to easy formation and control of expenses when long or short term heat prices are set.

Different kind of payments made by the regulated company due to penalties or sanctions could not be included in the cost structure, but covered by profit (if it exists). On the other hand, lost money due to poor management damages the financial characteristics of the monopolistic enterprise and could cause harm to final consumers. The regulator should estimate these circumstances and take adequate decisions.

5.3 Cost identification and approval methods

Main factors affecting heat supply cost could be classified into 3 groups:

1. **Objective historical circumstances** (size of DH scheme, heat production mode, configuration and load of piping system, size and density of heat consumers and similar);
2. **Administrative regulation of district heating sector in general** (connections/disconnections, zoning, planning, economical regulation and support, competition with other heating methods, different obligations, etc.);
3. **Actions and quality of management** (improvement of heat supply process, selection of fuel type, implementation of new technologies, rational decisions, marketing etc.);
In the regulated district heating market periodical price setting requires detailed cost analysis and adjustments. One of the most important tasks for the regulator/price authority to evaluate is if certain costs are unavoidable or due to poor management and how to stimulate DH enterprise to optimize these costs. District heating schemes in the transition countries, due to oversize and low efficiency, usually have a huge potential for improvement. Efficient cost analysis and comparison (benchmarking) with similar activities could be the first step in this direction.

**Identification of data for cost analysis in the district heating utility:**
1. **Documented technical characteristics and expenses** (fuels, goods and services bought on the market);
2. **Parameters regulated by legal normative documents** (depreciation rate, salaries level, inflation, environmental requirements);
3. **Factual and calculated characteristics related to concrete DH scheme** (heat losses in a DH piping system, heat load, allocation of heat production among several existing boiler-plant);
4. **Criteria drawn from “benchmarking”** (real lifetime of facilities, energy efficiency, indirect cost).

Regulators do not always accept and/or approve all costs, in the justified (accepted) part. For example, a regulator assumes theoretical heat losses in the pipelines. If real losses are higher than calculated, a supplier has to reduce them to a certain level (Lithuania) otherwise they loose money. This is considered an economic pressure on the heat supplier to increase efficiency. Such actions should be related to real possibilities of DH enterprise. If a long-term pricing system is applied, a DH enterprise has time to reduce heat losses and to recover invested money due to energy savings. If annual cost adjustments are applied, a targeted plan of heat loss reduction should be assumed and required resources have to be included in the heat price budget of the next regulatory period. Often, tariff calculation methodologies have a pre-approved list of normative components, which do not include all necessary cost, such as required investments, repayment of borrowed capital, bad debts etc. Tariff approvals usually follow a long, time-consuming process with the involvement of the stakeholders as well, and tariff components are sometimes approved after several month.

The district heating business in transition economies is rather specific and different because it depends on national circumstances. In any case a regulator has to be competent enough to understand real reasons of the technical-economic expenses, and to evaluate realistic possibilities for heat suppliers to meet targets set by the regulator. However, when cost adjustment is carried out annually and formally, it is rather difficult to establish optimal economic balance between DH supplier’s needs and consumer’s wishes. A solution could be a prolonged regulatory period (3-5 years) during which management of the company could introduce varies measures to meet set cost levels or to compensate losses due to incorrect targets by other achievements. In this case the problem occurred with the rapidly changing fuel market prices (e.g. gas) so adjustment of specific price component could be allowed within a regulatory period. The regulator should not replace administration of a DH company in formation of technical policy and an investment program.
5.4 Cost allocation between heat and electricity in cogeneration plants

Energy regulators and/or pricing authorities – in case of regulated heat prices – [the same is related to EU members, such as Denmark] often have difficulties and pressure from interest groups due to heat and electricity cost allocation in the cogeneration plants. It is even more important when the heat price is state regulated but electricity is sold in the non-regulated liberalized market. To make generated electricity more competitive, cogeneration producers are likely to opt for allocating most costs to heat. However, heat prices are very sensitive in the post socialist countries and should “protect” them from additional cost, if legal/regulatory framework makes it possible.

Generally acceptable cost allocation between heat and electricity criteria could be described as follows:

- Cost recovery of both products - impact on heat prices and on exposure to electricity price volatility
- No-cross subsidization - impact on cost allocation methodology
- Affordability of heat - impact on heat vs. alternative heat production methods
- Complexity - transparency and practicality of selected approach

Approaches to cost allocation recently differ from one country to another. It is difficult to determine accurately which shares of common costs of a cogeneration plant are attributable to each of its products. Several different methods of cost allocation between power and heat may be used [6] but all of them in fact are subjects of agreements.

- Physical (or energy) method: variable costs are allocated to electricity and heat in relation to the produced energy products, or power-to-heat ratio. This method is easy to apply, but it tends to discriminate against heat.
- Method of alternative heat production: the costs of cogenerated heat are fixed at the level of alternative heat production costs (at heat-only boilers); the remaining costs are allocated to electricity.
- Method of alternative electricity production: same principle as in the previous method, but using electricity costs (or market based price) as the basis.
- Benefit distribution method: fuels used in cogeneration are allocated to electricity and heat in proportion to the amount of fuel consumption that would be necessary for alternative forms of heat and electricity supply (heat-only boilers and condensing power plants) to produce the same output as the cogeneration plant. This is a relatively new method.

Some countries have a standardized methodology, so all producers are required or recommended to set heat and electricity tariffs according to established cost allocation rules. For example, the Latvian methodology is based on the alternative heat production method, allocating all benefits of cogeneration to electricity. Other countries have no specific rules and each company sets tariffs for electricity and heat according to its own methods of allocating costs to the two products.
Cost allocation between power and heat production discriminates against heat in many of the states of the former Soviet Union, particularly in Belarus, Kazakhstan, Latvia, Russia and Ukraine. All (or most) benefits of cogeneration are allocated to electricity, therefore heat produced at cogeneration plants is sometimes more expensive than that produced at heat-only boilers [6].

Experience from new EU members, who accepted EU energy Directives, demonstrates very important factors affecting philosophy of cost allocation in CHP plants when DH activity is regulated but the electricity market is liberalized. This is related to the electricity market structure and competitiveness of the electricity produced in varies categories of CHP plants. In all cases it is quite reasonable to separate cost between heat and power using “alternative heat production source” which simulate cost of the same capacity of the “heating only boiler plant” as an alternative to the heat supply from the CHP plant based on the same fuel. Several classified cost components can be set by the energy regulator for simulation of such boiler plant. They depend on fuel type, capacity range and possible some other criteria. After such separation is formed the electricity price is compared to the market price level. Depending on the situation varies scenarios are possible, for example:

1. If cogenerated electricity sales can ensure a profitable annual business, profit/losses from the electricity sales could be split between heat production and electricity generation activities by clear criteria, for example, proportionally to value of assets allocated to heat and electricity production or simply according to some proportions set by the regulator;

2. If cogenerated electricity is not competitive on the market but the CHP plant must be operated due to stability of the electricity system, for the future needs etc. electricity must be supported. Usually this is done by allocation of production quota and feed in tariffs (bonus) applied for the cogeneration electricity. In this case heat consumers pay for heat, like it would be produced separately and electricity users pay for electricity plant via a public service obligation fund or similar;

If both, heat and electricity markets the regulated cost allocation method could be selected according to the desired influence for final users. District heating users living in the old uninsulated, inefficient heated buildings, who cannot regulate heat consumption, then heating cost might be unfairly high, therefore someone has to bear the cost not covered by heat tariffs; social founds, electricity consumers, which are not accepted by the pricing authority through tariffs. This is reasonable if there is an intention in the country to support development of the district heating schemes. Depending on the general situation and future perspectives of the CHP plants in the national energy system, the optimal cost allocation method should be used by the government/energy regulator in order to assist implementation of social policy and the energy strategy in a particular country during the transition period.
5.5 Regulation of profit in the district heating service

Initial district heating prices are formed as summary of adjusted cost and regulated (normative) profit in almost all pricing systems. Planned (expected) profit levels should ensure a return on efficiently invested capital, the regulatory approval of the renewal of the DH, modernization and expansion of DH systems etc. These systems should be attractive for potential investors who would like to enter into the DH sector.

Two main methods are applied for the planning of normative (regulated) profit in the district heating sector of transition countries:

- **profit fixed as percentage of turnover** – most simple method related to turnover of the DH enterprise still common in the countries where main investments are financed by external subsidies and it is difficult to use assets base in principal. Pricing system usually applied in this case is simple “cost-profit approach” with annual revision of cost and setting of tariffs. This principal could be used in separate activities where little material facilities engaged and there is no assets base (in the billing business, for example, if it is carried out by a licensed company).

- **profit as percentage of regulated value of assets** – normally the regulated asset base represents the value of investments on which a utility is given an opportunity to earn a reasonable rate of return. The valuation of the utility’s physical assets (plant and equipment) is by far the largest component of the rate base, which in part explains why the determination of rate base has historically been one of the most important and most difficult problems that regulatory bodies face. However, the value of the main assets is still not clear in the district heating sector of the post socialist countries because the biggest part of installations are left from the “old” time and their value could be estimated artificially in some way. If a regulator has a legal basis and possibility to regulate value of assets, the normative profit could be formed as percentage from the regulated asset base and its value should secure profitable operation of the enterprise.

Re-evaluation of the assets in the district heating sector is often unpopular due to political and social sensitivity of heat prices and often restricted by legal regulation. Low value of assets causes very low depreciation costs, which are included in the heat tariffs and are meant to be the main source for the replacement of the worn out facilities or renovation.

When subsidies are not available or small, for DH enterprises main investment projects, these have to be financed using commercial credits or similar resources and to pay the interest rate for borrowed capital. In transition district heating enterprises, long term debts are relatively high (more investments, higher debts). In such situations, WACC method (weighted average cost of capital) become more popular in the setting of normative profit for regulated DH enterprises. The cost of borrowed capital is the interest expense, while the return to the equity owners should be commensurate with the returns on investments in other enterprises with similar risks (the opportunity cost). In this way the utility can continuously acquire credits and attract capital for financing purposes [30].
Profit in the district heating activity is regulated or at least defined as “should be reasonable” or “average in the industry” almost in all countries due to its monopolistic nature. Heat producers cannot make a profit in Denmark, so they sell the heat at prices that are based on cost alone [6]. In Finland, where DH is not regulated, companies offer heat price to consumers based on costs including a “reasonable” profit. In some countries it is common to use 1 or 2 limits for factual profit. Profit is revised after a regulatory period, and excess fully or partly transferred as an income to the next regulatory period.

In a study [26], made by Fortum, the profitability of DH companies were analyzed with two measures: return on capital employed (ROCE) and return on equity (ROE). These results were presented for Lithuania, Estonia and Finland. The measured profitability indicates huge variance between years and companies. As a conclusion, made in the study, DH companies are meeting a financing challenge for daily operations and long term investments. The DH sector in a transition period needs high and fast investments due to the possibility to improve efficiency but consumers are financially weak, profit levels should balance investment intensity and consumers’ possibilities. On the other hand, DH schemes in post socialist countries have large potential for savings, a regulatory regime should stimulate companies’ activity to earn a profit on efficiency improvements and to avoid overinvestment. In some countries, the allowed profit margin is specified in legislation.

### 5.6 Heat pricing as part of general regulatory regime

The pricing system in the transition district heating sector should be adjusted to the general regulatory regime, which should balance consumers protection and investment protection. In fact, there are more functions in the district heating sector which should be secured by a regulatory regime which includes a pricing system. This is due to the reason that district heating schemes are a significant part of the local energy infrastructure which have to implement national or regional targets, described as the following:

1. Secure safe, reliable and efficient heat supply process with an existing DH scheme;
2. Ensure continuity of replacement and modernization of the main assets;
3. Development of DH scheme, increase the number of heat producers and heat consumers;
4. Implementation of national (municipal) targets (cogeneration, renewables, utilization of city waste and similar);
5. Transparency and access to district heating and similar.

An optimal, well-functioning district heating system is often the best way to ensure consumers’ economic interest. Social support to vulnerable consumers should be based on individual approaches only. However, in reality regulators often are not fully independent and competent enough to protect economic interests from social political influence and real regulation still is some kind mixture of varies approaches. The regulatory and pricing system tends to provide a long-term economic background for the development of centralized energy supply systems in modern urban areas.
5.7 The main pricing methods in district heating sector

Regulation usually is considered as the key method to protect consumers from unjustifiably high prices. In practice, however, the effect can be the reverse. Poorly designed tariff regulation that does not provide incentives for cost reduction may result in unnecessarily high tariffs for consumers. By contrast, open competition in balanced markets generally encourages efficiency improvements and cost reduction, and results in lower prices. Thus, competition is in principle a more effective tool for consumer protection. Where competition cannot be introduced, the role of regulation should be to mimic the effect of a competitive market by creating effective incentives for cost reduction. Not all approaches to tariff regulation can achieve this. The approaches include cost-plus regulation, substitution-based regulation, price cap regulation and benchmarking regulation [6]. In most countries the cost-plus method in DH is applied.

The cost-plus regulation is the most common approach in most transition economies, although countries such as Estonia, Denmark, Hungary, Lithuania and Poland have introduced some form of incentive regulation. Cost-plus regulation allows companies to include in their tariffs those costs that the regulator considers necessary to ensure an adequate level of service to end-users. The regulator periodically reviews the company’s expenditure and approves its tariffs based on the total heat production, transmission and distribution costs that it deems appropriate. The regulator also estimates an appropriate profit margin.

There are a few main issues with cost-plus regimes:

- **WACC**: lack of transparency in estimation, lack of relevant market data on financing costs, lack of consensus on risk profile of DH
- **RAB**: unclear rationale for valuation standard, unclear regulatory commitment to the RAB, high one-off tariff increases when assets are replaced
- **Benchmarking**: little effort to capture exogenous factors, differential treatment of operational expenditure/ capital expenditure (OPEX/CAPEX),
- **Incentives**: lack of clarity on treatment of under-/overspend, lack of clarity on duration of regulatory period, lack of clarity on what needs to be delivered in the price control.

Source: Business models today and tomorrow – regulatory regimes affecting the price strategies, 2011 [31].

In the regulated DH markets of the European Union cost-plus approach with elements of benchmarking (in cost adjustment) and economic incentives ("price cap" for part of cost) are applied mainly.

In Estonia, the DH companies can initiate a review when they consider it necessary (there is no fixed duration for the price control). A DH company wishing to obtain a price review must submit its cost estimates in accordance with regulatory guidelines. The regulator can disallow cost items deemed inefficient (typically 10% of submitted costs). The RAB is typically based on depreciated historical costs (including working capital) but the guidelines allow companies to use the replacement costs of assets – or their market value, as an alterna-
tive. Certain cost items can be designated as uncontrollable and treated as pass-through (e.g., taxes) - the allowed return is normally based on the WACC and may include a measure of country risk [31].

In **Lithuania**, price regulation is based on cost-plus approach and benchmarking. Companies are required to submit their cost estimates in accordance with regulatory guidelines. The regulator benchmarks these costs, controlling for differences in company sizes (measured by output volumes). The price ‘baseline’ is typically agreed upon for a duration of three to five years and is updated annually (to reflect changes in inflation and volumes), and monthly (to reflect changes in fuel prices). The price baseline is assessed primarily by reference to costs and volumes recorded over the previous three years, but may also take into account of planned investment and efficiency measures for the duration of the price control period. The regulator also regularly verifies that companies have sufficient financial resources to carry out their licensed activities. The Regulatory Asset Base (RAB) is based on depreciated historical costs and includes mandatory fuel stocks. The allowed return on equity includes a measure of country risk (the spread between Vilibor and Euribor), but no specific measure of the business risk of DH. The allowed return has recently been reduced from 8% to 5% without any economic justification [31].

In **Latvia**, as in Lithuania, price regulation is also based on a cost-plus approach and benchmarking. The companies or the regulator, can initiate a review when necessary (there is no fixed duration for the price control). Companies submit their cost estimates and the regulator benchmarks these costs between companies. The regulator might also perform some ad hoc control cost item by cost item and its approach is typically very intrusive. The RAB is based on the book value of equity and debt. The allowed return is fixed at 10% (nominal, pre-tax) and the depreciation and return allowances are normally based on historical rather than forecast capital expenditure [31].

In **Denmark**, the DH companies submit their cost estimates in accordance with regulatory guidelines and the regulator operates random checks. Companies are required to return any profits made to customers in the form of lower tariffs or to reinvest profits in the business (subject to agreement with the regulator). The DH companies can defer cost recovery (i.e., defer depreciation) in the initial stages of a project to ensure competitiveness [31]. All reasonable costs and investments can be covered by payments from consumers and national regulator DERA may after negotiations order changes of tariffs, cost distribution or other conditions.

In **Hungary**, the district heating sector in non-residential heat price is not regulated; residential heat price is regulated by the Municipality. DH tariffs are set according to the price cap model, price caps are defined for 5 categories. Requirements towards residential DH price, according to the relevant DH act is that the heat price must encourage the production and supply of heat safely and on the least cost principle; encourage the use of capacities efficiently; inspire to spare with DH; take into consideration the reasonable cost of continuous and secure operations; reflect the benefits deriving from the support of CHP operation (obligatory take-over of electricity). The heat tariff structure in Hungary is a capacity fee for
heating (HUF/air-m³/year), for heating fee (HUF/GJ) and water warming fee (HUF/water-m³) [32].

In Western Europe, companies usually set their prices using a combined cost and substitution approach: district heating tariffs cover costs and are adjusted close to, but lower than, the next alternative cost of supplying a particular customer with heat.

Under the substitution-based approach, the regulator allows a district heating company to set tariffs no higher than the price of competing heat sources, such as individual gas boilers. Substitution-based tariffs are market-oriented and have no direct relationship with costs. They should therefore encourage cost reduction, which allows the company to increase profits. However, fair consumer protection is difficult under this approach. If the price of an alternative energy source is very high, district heating suppliers can also charge unnecessarily high prices, even if their supply costs are relatively low, thus generating extraordinary profits for themselves. If alternative fuel prices are low, the danger is that heat prices will be set below cost, thus generating losses for the company. Substitution-based pricing can work well where the costs of both district heating and alternative heat sources are reasonable, but the two do not directly compete in a given market. Due to above reasons this approach is seldom in the regulated district heating markets of Europe.

International experience in the electricity, heat, gas and water supply sectors shows that price-cap regulation (also known as RPI-X, where RPI stands for retail price index) can be a viable and better alternative to cost-plus regulation. This form of incentive regulation restricts changes in the price that the regulated company can charge and allows it to temporarily retain some (or all) of the benefits from efficiency improvements. This gives the company an incentive to reduce costs but allows prices and revenues to exceed costs temporarily. Prices are set to cover historical costs, including a return on investment, minus a given fraction, X, of this cost with a view to encouraging efficiency gains. If costs are reduced by more than X, the company is allowed to retain the additional profit. Yet if costs are reduced by less than X, it must bear the losses. A typical example of this approach is the RPI-X regulation of utilities in the United Kingdom where it has generated significant utility cost reductions. Many other countries use it now as well, including some transition economies. In the Czech Republic, the Energy Regulatory Authority can apply price-cap or cost-plus regulation. In general, it applies the price-cap approach (RPI-X) and sets caps for the maximum annual price increase allowed. These caps were formerly specified as a percentage of the retail price index. The percentage was lower than inflation. Yet the cap defined in these terms led to increasingly large tariff differences between companies: utilities that initially had higher tariffs (because of higher costs) were allowed a bigger tariff increase in nominal terms than utilities with lower initial costs. The price differential is now decreasing: utilities with lower prices are allowed higher caps than those with higher prices. Exceptional price increases are allowed for utilities that undergo major reconstruction such as fuel switching or refurbishment of the heat distribution system [6].

Another approach to incentive regulation is benchmarking (or yardstick) regulation. A utility is allowed to set tariffs that are related not only to its own costs but also to the costs
incurred by other companies in providing the same service. This “competition by comparison” approach induces utilities to compete with one another for cost savings even when they are not operating on the same local market. It also provides a benchmark that is not influenced by the regulated company. Another advantage is that it reduces the scope for large price differences between companies and areas unless these differences are justified by different costs of production: companies are assessed against their peers [6]. However, this regulatory tool have and some disadvantages. Firstly, comparing many DH companies is difficult. Secondly, the companies make up a heterogeneous mixture (technology used; accounting standard differs between companies; policy of depreciation and how to make appropriations differ between companies; diversity of fuel-types used and etc.).

For example, in Lithuania DH prices are regulated based on cost-plus approach and benchmarking. Each licensed DH company reports to NCC quarterly data on prices of purchased fuels-for readjustment of heat prices every two months. After financial (calendar) year is finished, each licensed company presents detailed data of technical reliability, efficiency, operation cost, economic situation etc. in certain forms. Relative criterion determined and applied later for setting long-term prices and data used to estimate economic viability, presented to municipalities, state institutions, consumer organizations, etc.

Table 4 provides a comparison of different approaches to tariff regulation. These assessments are theoretical, based on best cases worldwide. In reality, much depends on implementation details and the actual situation in each transition country. Moreover, only two options – cost-plus and price-cap regulation – have been used in transition economies for regulating heat tariffs; so assumptions regarding the other two options are based on experiences in other countries or other sectors.

Table 4. Comparison of Different Approaches to Tariff Regulation [6].

<table>
<thead>
<tr>
<th>Priorities</th>
<th>Regulatory Options</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cost-plus</td>
</tr>
<tr>
<td>Covering operational costs</td>
<td>+</td>
</tr>
<tr>
<td>Covering capital costs</td>
<td>+</td>
</tr>
<tr>
<td>Improving competitiveness</td>
<td>-</td>
</tr>
<tr>
<td>Encouraging cost reduction</td>
<td>-</td>
</tr>
<tr>
<td>Encouraging energy efficiency</td>
<td>-</td>
</tr>
<tr>
<td>Simplicity of implementation</td>
<td>+</td>
</tr>
<tr>
<td>Transparency for customers</td>
<td>+</td>
</tr>
</tbody>
</table>
5.8 Structure and differentiation of heat prices and tariffs

One of the most important aspects in the achievement of regulatory targets is correct prices and tariffs structure (differentiation). The definition of “heat price” is usually understood as the price of an energy unit, while “heat tariff” is defined as payment for some service which payment is related to measurement criteria of a received service. For example, tariff for heated area, tariff for installed capacity and similar. Often, heat price are set as initial indicator of cost and all tariffs are derived from the price of heat unit.

Heat prices for the produced and distributed thermal energy are separated as a minimum in most countries. Announced heat production cost (fixed and variable parts separately), could serve as an indicator for competition with outside heat suppliers (independent heat producer IHP).

The heat distribution price must cover the cost for heat delivery from own sources or other producers to the final consumers. Heat transportation from generation sources to the distribution system or to final consumer is highly capital intensive with a large proportion of fixed costs, and this service depends on a limited amount on demand. Summarizing, these price components of final heat price are fixed at inlet to the building. If DH enterprise supplies heat to the apartment level additional payment (heat price component or separate tariff) is fixed for those heat consumers. Separate heat prices can be set for preparation of hot water and its circulation inside buildings.

Most common is to regulate the monopolistic district heat supply process at the inlet to the buildings (heat metering point), another legal entity (billing company or similar) distribu-
brates heat among separate apartments. In some countries (Lithuania, Latvia) the DH supplier, as default heat distributor, has to supply heat and hot water to each apartment. A separate tariff for this service is set. Additionally, separate fees for apartment level hot water and heat meters or allocators could be set for the consumers wanting such a service. Operation and maintenance of the heating and hot water systems inside buildings usually are paid by separate fees. This service could be provided by DH supplier as well as by other companies.

Regulatory methodologies require avoiding cross subsidisation and call for transparency when heat prices and tariffs are set. As a result of such approaches many different components are set and many combinations of final heat price occur. For instance different payments could be if heat is supplied via group heat substations or building heat substations. Heat prices are lower if the heat substation in the building is owned by owner(s) of the building and another price is applied if there is a heat supplier own substation in the houses.

In Poland, heat tariffs consist of heat production cost (tariff for ordered output; heat price; heat carrier price); heat transmission and distribution cost (rate for transmission services; lump sum for customer service; connection fee); heat trade cost (rate for customer service (condition of heat producer prices and heat distributor charges in the heat bill). Calculation of the particular prices and rates are based on justified fixed and variable costs of heat production by different heat sources and cost of heat transmission and distribution based on the place of heat delivery. The rate for transmission services is a fixed charge calculated based on the total justified cost of heat transportation, according to the place of heat delivery [29].

In Denmark, consumer price is made up of a fixed tariff that is independent of the amount of heat consumed, i.e. payment for being connected and a variable tariff covering variable costs, calculated per unit of heat consumed [24].

Allowed profit, is calculated separately (production, transportation and realization). Heat production and transportation profit is calculated on the base of assets and reserve fuel value (all the additional assets, not used directly in production or transportation are not included.

Heat prices have to be uniform or differentiated by consumer groups according to clear criteria. A connection fee for new consumers is applied and a mainly uniform fee or special rate for “unfeasible” users. Special tariffication can be set for new clients, for large users etc. Differentiation of heat prices and tariffs could be an important regulatory tool for achievements of varies targets, like the following:

1. Transparency of cost in separate activities of regulated enterprise;
2. Avoiding cross subsidies among activities;
3. Separation of monopolistic regulated and competitive market driven activities;
4. Clearer and accurate basis for benchmarking of regulated enterprises;
5. Promotion of competition is certain phases of activity;
6. Easier and accurate cost adjustment and price setting;
7. Promotion of marketing in the competition markets and attraction of new consumers, etc.

*Heat price and tariff differentiation could promote improvements in the separate DH enterprise or city if properly designed and applied in the regulatory system.* However this instrument is applied formally and not effectively and is used in most of transition economies. Complicated heat and tariff systems are usually not acceptable for regular consumers and utilization of its possibilities becomes minimal.

## 5.9 Heat price regulation and monitoring

*The most important role in the heat price setting procedures has a national energy regulator in a majority of post-socialist countries NMS of EU.* Setting procedures are defined in legal acts and methodologies. Responsible institutions involved in tariff approvals request can report on regulated activity, at different frequencies; it can be monthly, quarter and yearly. The Regulator provides accounting templates which differ from statutory accounting accounts, which are also presented. Almost in all countries generation, transmission, distribution and retail activities are separated and the accounts are split. Regulated utilities, in many countries, should present accounting information during spring or until spring. In accordance with presented information, the Regulator or another competent institution (usually municipality) sets final prices. Some characteristics of heat price administration are illustrated in Table 5.

<table>
<thead>
<tr>
<th>Significant political price regulation</th>
<th>Heavy touch price regulation (ex-ante)</th>
<th>Light touch regulation (ex-ante/post)</th>
<th>Pricing primarily based on alternatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>DH prices are based on normative costs but decided with political consideration and subsidies</td>
<td>State price authority (government or regulator) sets DH prices. In some countries political consensus is needed</td>
<td>DH prices decided by company but controlled by regulator/competition office</td>
<td>DH prices are set against customer’s next best alternative</td>
</tr>
<tr>
<td>No or strictly limited profit making</td>
<td>Strong cost and profit monitoring and restriction of allowed returns</td>
<td>Lightly regulated profit making. Focus on cost plus pricing principle</td>
<td>Profits are based on market conditions</td>
</tr>
<tr>
<td>Russia, Romania, Belarus, Russia and Ukraine</td>
<td>Estonia, Latvia, Lithuania, Poland, Hungary, Slovakia, Bulgaria</td>
<td>Austria, Finland, Sweden, Germany, Czech Republic, Denmark, France</td>
<td>Netherlands and Norway</td>
</tr>
</tbody>
</table>

In *Denmark*, every heat supplier applies for heat tariffs to the DERA. The regulatory agency does not approve tariffs, but if customers are not satisfied, the DERA verifies accountings and requires the use of the correct tariff [23].

In accordance with the *Estonian* District Heating Act the maximum price of heat must be set for each network region, separate price analyses and decisions for price approval are made for the network regions of both undertakings. Most maximum prices of heat are calculated on the basis of a formula which, on the request of a heating undertaking, is used for the approval of the maximum heat price if factors which are beyond the control of the heating
undertaking and which affect the price of heat become evident (especially if fuel prices change) [8].

In Latvia, tariff applications cover fixed and variable costs in the tariff calculation as well as the necessary return of capital. The last component of a tariff is not always supported by local regulators, which means that individual regulators could behave differently in their activities. This, in turn, does not guarantee equal primary principles for commercial enterprises in different regions or municipalities. As a result, the tariffs on heat energy, which cover the necessary maintenance and operation costs only, do not allow many heat supply enterprises to invest in the fixed capital renovation [21].

In Lithuania, each heat price project is presented to the municipality and to the National Control Commission for Prices and Energy (NCC) at the same time. Both institutions analyze the calculations, but first the decision of approval has to be made by the Municipal Council. The municipality approves the heat tariff (for a DH company or operator) according to the methodology and figures set by NCC, and then the Energy Regulator checks the result. If there are any miscalculations, NCC asks the municipality to correct the heat tariff. If the municipality does not change the heat tariff, the NCC sets a final heat tariff. If a DH company/ operator do not agree with the tariff set by the municipality, the dispute is brought to NCC who makes the final decision. If the municipality or the DH operator does not accept the heat tariff, they have to apply to an Administrative Court and start a legal procedure.

According to the Energy Law, heat tariffs have to be approved by the Energy Regulatory Office (ERO) in Poland. The Regulator analyzes and audits applied tariffs. Once this is done, the Regulator uses the correction index, which is the main economic regulation tool. If a company’s heat tariff is higher than average, the Regulator proposes modernization tasks and if a company does not do it, the Regulator approves a lower price. Energy companies fix a basic heat tariff for a 5-year period (general case). The Regulator has the right to establish basic tariffs for one to five years, according to the cost accounting system of DH companies [29].

In the transition economies outside the EU, district heat price regulation and control are allocated to governmental or municipal authorities, consumers can sometimes participate in this process.

In Azerbaijan, the Tariff (Price) Council (TPC) has the main responsibilities (including possibility to improve existing principles and the normative and legal bases) to supervise tariffs. The tariff review procedure lacks clarity and public disclosure of decision processes is limited. There is no appeal process for tariff decisions and for penalties for violations and there is no mechanism for challenge.

In Belarus, heat price setting is under ministries for energy and housing. In Kyrgyzstan DH and hot water supply tariffs are approved by the decree of Executive council of State department on Fuel and Energy Complex regulation under the Kyrgyz Republic Ministry of Energy. In Tajikistan, tariffs for heat are approved by decree of the Ministry of Economic Development and Trade on Tariffs for Electricity and Heat. In Uzbekistan the Minis-
try of Finance develops state tariff regulation policy and methodologies and sets heat tariffs by itself or through its regional departments; only approved norms of the main cost components can be included in a heat tariff. Tariffs can be revised not more than twice a year.

Heat price setting and monitoring system in post socialist countries can be split into 2 basic groups. In the countries where district heating regulation is under the responsibility of state or municipal institutions, heat pricing and monitoring system are simple and not transparent. If a national regulator is involved in district heating, its procedures are similar to the regulatory framework of electricity and gas sectors which are influenced by the legislation of the European Union. The national regulator usually organizes and administers price setting and monitoring procedures around the country. It covers public hearing procedures, approvals, control and monitoring systems, appeals, disputes settlements and other activities. Experience shows, in the transition economies there is useful participation by the national regulator and municipalities (both) in the unpopular heat price regulation, this is in order to make the result more acceptable to the final consumers.

5.10 District heat price level

The average district heating price in a country reflects the general situation in the district heating market, which is caused by many factors including energy policy and the regulatory regime. In absolute terms (EUR/MWh), DH is most expensive in the Nordic countries. Within the Nordic countries, DH is most expensive in the countries where there is price regulation. In Denmark DH prices are the highest in Europe, 104.3 EUR/MWh (Figure 7). One of the main reasons is DH regulatory policy and a high level of living, in spite of nonprofit DH activity. In relative terms (bill/income), DH is most expensive in the Baltic countries and Poland. Highest growth of DH prices is in the Baltic countries (mainly due to increase in gas prices).

In the subsidised district heating sectors heat prices are far lower than in the cost based DH sector of the EU. In Uzbekistan, the average price of thermal energy (around 8 EUR/MWh) is included in the heating tariff [18]. In Tajikistan domestic consumers pay only 0.65 EUR/Gcal, budgetary institutions 4.89 EUR for Gcal but the main consumers (industry, commercial structures, etc. – 18.71 EUR for Gcal (without VAT) [16].

© ERRA Copyright 2011
Statistics in the district heating sector are not fully correct due to accountancy differences but they reflect general price levels. In states where DH prices are very low (sector controlled and heavily subsidised by the state or municipalities) all equipment and materials are purchased on the market and enterprises are interested to “boost” cost in order to get more subsidies. As subsidies are regulated and usually pushed down, district heating utilities in these countries are in the stagnation due to the imbalance in financial resources. Low heat prices are attractive for consumers, it ensures social stability but the renovation rate of DH facilities is still rather slow. Having an uneconomic pricing regime restricts progress and can lead to the deterioration of existing infrastructure, as has happened in some transition economies.

5.11 Financing and development of district heating schemes

Financing of investment in the DH sector of transition period is rather complicated due to the reason that most consumers cannot accept high heating prices. Renovation of the main assets is gradual, despite prioritization of efficiency and cost reduction. Development and expansion of DH schemes is financed by internal (consumer regular payments) and external (subsidies and commercial credits) resources.

Regulators in transition period, which try to establish pricing methodologies adjusted to the financing of investment needs, usually meet the problem of relatively low value of the existing old and worn out assets. As a result, depreciation cost and profit do not cover capital needs. Different approaches to solve this problem have been utilized in post-socialist countries. Depreciation cost can be increased by the reduction of the amortization period (if it’s not restricted by law) or by re-evaluation of old assets. A separate “investment additive” above basic heat price for financing of concrete projects can be included or an additional premium (bonus) added to the normative profit rate in some cases.

Significant investment is required to attract commercial credit. Policy has an impact on the availability of commercial financing for energy efficiency, modernization and other improvements. Macro-economic and finance sector policy obviously play a large role in this,
but so do policies specifically relating to DH. Tariffs that do not cover costs and the lack of legal mechanisms to enforce payments are two examples of policies that can deter investment. Tariff regulation that allows companies to retain profits from efficiency improvements (such as price capping) tends to attract investment. The same is true for policies involving the private sector in district heating through privatization and various forms of management [6].

To facilitate commercial financing of district heating projects, governments should focus on the following measures:

- Developing tariffs that cover costs and provide a return on investment;
- Instituting stable and predictable legal and regulatory frameworks;
- Encouraging district heating companies to focus on customers and reduce overcapacity;
- Enforcing payment discipline and setting up targeted subsidies for poor households;
- Pursuing overall reforms in the financial sector;
- Establishing clear accounting standards and financial reporting requirements for companies;
- Involving the private sector.

State support instruments applied to the district heating sector are common in many countries. Some of this support is targeted directly for development of DH schemes, another measures like promotion of cogeneration, renewable energy or similar come to the DH sector indirectly.

For example, in 2003 Austria introduced its Eco-Power Act aiming to support the use of renewable energy sources and includes uniform, subsidized, purchasing obligation from suppliers supplying power from biomass, landfill gas, sewer gas and bio gas. This activity is funded by an extra charge on the electricity price. In 2008, the National Council amended a new law for expansion of district heating and district cooling networks providing a state aid of EUR 50 million per year for building new district heating and cooling infrastructure [2].

When value of the assets is low some DH enterprises have limited possibilities to borrow and states have to form some mechanisms to solve this problem or to attract private capital in varies forms. Some new EU Member States have special financial programs based on EU support resources for renovation of DH networks, conversion of fossil fuel to renewable etc.

There are more options for financing district heating improvements, not all of which are optimal from a policy perspective:

- Equity investments
- Commercial bank loans
- Loans or guarantees from development banks, or local, regional or International funds
- Third-party financing
- Municipal or corporate bonds
- Targeted budget financing
- Grants or subsidies
- National and International Public Financing Schemes.
Additionally, most of the post socialist countries have put in place national and/or regional schemes to facilitate district heating financing and sector restructuring. A number of successful projects began with a limited amount of government or international support. This has encouraged commercial banks to provide loans for district heating projects in much of Central and Eastern Europe and the Baltics.

Table 6. Some examples of investment financing in selected countries.

<table>
<thead>
<tr>
<th>Source</th>
<th>Russia</th>
<th>Poland</th>
<th>Lithuania</th>
<th>Denmark</th>
<th>Finland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depreciation</td>
<td>Low value</td>
<td>Low value</td>
<td>Low value</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Investment component in the heat price</td>
<td>“Supplement for investment”</td>
<td>-</td>
<td>Extra component in the profit</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Subsidies from the federal budget</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Subsidies from the specialized funds and programs</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Credits from financial institutions</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>

Low depreciation value could be considered if it is not sufficient for long term replacement of the main assets and a DH company’s debts is continuously increasing due to investment needs.

Financing of investments in the transition countries meets 3 basic problems: lack of equity, lack of customer finance, and lack of access to capital markets. Access to finance depends on the credit-worthiness of the borrower, the financial parameters of the project. Multi-lateral development banks, donations or other external resources can finance only a tiny fraction of the region’s needs, it is necessary to attract the local and foreign private capital through commercial lending, credits, Private Public Partnership or similar. Regulators have to ensure return on invested capital and secure development of efficient DH schemes and appropriate regulatory mechanisms have to be introduced.

5.12 Connection to the district heating system - network fees

Connection fees could be an important issue in most of Central and Eastern Europe (CEE) when new multi-flat buildings areas are developed. Due to increasing competition from individual heating systems, supplied by natural gas, suppliers tend to offer district heating without fees or even participate in the construction of heating systems inside buildings. For example, DH suppliers install individual heat meters and allocators in each apartment under agreement with the construction developer when a DH service is selected. The Regulator or municipality can approve such investments if it reduces cost for all heat users and allows these expenses into the heating supply budget. If heat zoning takes place, a connection fee is applied in the competitive zones because the Regulator has to control cross-subsidies from regulated activities to non-regulated business. All new consumers inside DH territories (zones) are connected without special payment or use a regulated fee.
In West European countries where there is a low number of new consumers the connection fee is more a marketing problem rather than a cost issue. In Western Europe it usually means the cost to connect from the customer’s facility to the next distribution line. In practice it covers the cost of equipment that cannot be used by the DH company if the consumer disconnects. However, connection fees are not always asked for. Connection costs can also be included in the capacity charge, either because the heat supply company never requests connection fees as a one-time payment, or because it is a temporary marketing measure.

In the colder regions of Eastern Europe and Asia experiencing fast urbanization, connection fees are an important issue. District heating is usually the sole affordable heating system in these areas, leaving DH companies without competition and free to request a connection fee. Moreover, connection fees can be an important and indispensable financing tool for companies that usually do not have sufficient access to commercial loan financing. The question arises whether and how connection fees affect the heat tariffs. Connection fees can be treated in an accounting system one of two ways. One is to treat connection fees as reductions to overall investment costs, with depreciation charges and tariffs going down correspondingly. The other is to view connection fees as a cash inflow that will be dissolved (amortized) as revenue over a period that corresponds to the service lifetime of the respective investments. Therefore in cases where the tariff is based solely on cost, the connection fee does not affect the tariff and the DH company realizes an extra profit.

The connection policy of new consumers should be coordinated among state institutions, the energy regulator, municipalities and DH enterprises because it is a part of energy strategy and situation could be different in each municipality (city). Expansion or additional load to the existing DH schemes (most of them are oversized) could be useful from an economic point of view. In the long term perspective, a larger district heating market could be very suitable for development of cogeneration, utilization of wasted energy or local fuels and similar. The Regulator or other institution responsible for approval of investment programs should carefully analyse possibilities to use the connection fee as a tool for promotion of district heating development. It might be quite feasible to provide subsidies for connection of new consumers if it is reasonable and promotes the implementation of the national energy strategy.

5.13 Billing, payments and social protection of vulnerable consumers

Most countries use a dual fee structure except the Baltic countries and Norway (commodity fee only) [31]. In case of two-component tariff, the fixed part of the payment is usually related to heated area ($EUR/m^2$) or installed thermal capacity, average consumed thermal flow or just fixed payment per month. Variable component is based on consumed (measured or calculated) heat ($EUR/MWh$). In case of three component heat pricing, an additional payment for consumed flow is introduced, $EUR/m^3$. As an incentive to cool down heating water another component for temperature level of the return flow ± $EUR/kWh/C$ is applied (in Denmark).
Customers pay a fixed charge every month, quarter or year when a flat fee is applied. This method is simple but does not encourage the saving of thermal energy. Many complications occur when heat is delivered to the building and must be allocated for many different domestic or commercial consumers resident in the multifloor buildings. Special methods for heat allocation have to be prepared in this case or individual rules for heat distribution can be agreed by consumers themselves.

**Heat tariffs can have a one two or three-part** structure. The most popular are two and three component tariffs when consumers pay a fixed customer fee (independent on consumption), demand (capacity) charge for the capacity (peak or contracted) measured in kW or similar and energy charge per unit consumed. Residential consumers usually do not pay a demand charge. It is assumed that this type of tariff, if properly designed, fairly reflects the costs of the service provider. In order to support low income residential consumers and to encourage savings the block (rising) tariffs are applied. For the first block (certain low level, like 100 kWh per month) consumers pay less than for the next, and the major consumers are paying the most. Various analysis have shown that block tariffs are a useful tool protecting low income customers in transition economies, nevertheless it should be a temporary measure as it is not well targeted (some rich consumers may consume a little and be subsidized).

Tariff structures may depend on the type of consumer. A tariff with a relatively high capacity charge can be justified or even optimized for industrial customers with large heat consumption. Giving customers the choice between a one-part tariff based on consumption and a two-part tariff with a capacity charge seems to be a sustainable approach. Customers with low and/or changeable heat consumption would opt for consumption-based tariffs, and customers with high and predictable consumption would opt for the tariff that includes a capacity charge. Experience in Lithuania and several OECD countries where customers have such a choice shows they exercise it, though not all customers pick the same option. Residential customers often prefer a consumption-based tariff, while industrial customers often choose a two-part tariff with a charge for guaranteed heat capacity. District heating companies may argue that this regulation is favourable to customers but unfair to suppliers. Giving customers a choice of tariff structure, however, may increase their satisfaction and reduce their incentives to switch, which is positive for the companies [6].

An alternative to the fixed or capacity charge can be a **minimum charge**, or a fixed floor below which a household heating bill may not fall. This means that the household has to pay a certain amount even if it does not consume any heat or consumes very little (e.g. when using an apartment only occasionally). The rest of the heat bill, if any, is based on consumption. The minimum charge ensures that the district heating supplier’s revenue does not fall below a critical level, and it removes most of the negative effects that a fixed or capacity charge may have. Nonetheless, a minimum charge should be set very low to avoid becoming a de facto fixed charge and to provide energy efficiency incentives for consumers with small needs [6].

**Recommendation:** the district heating tariff as a whole should cover full supply costs. Tariff structure, however, should depend on the policy priorities as well as on the type of cus-
customer. To provide incentives for energy efficiency and give residential and commercial customers more control, thus discouraging them from switching, preferable options are a one-part consumption-based tariff or a two-part tariff with a relatively small minimum charge. Tariffs with a capacity charge can be a better option for large industrial consumers [6].

Unmetered billing for heat based on living space is neither transparent nor sustainable in many cases. It removes incentives for households to save energy: they cannot regulate heat consumption, and efforts to reduce heat waste (e.g. by improving insulation or installing modern, double-glazed windows) do not reduce heat bills. This creates incentive for many households to switch to other heat options. Also, with cost-plus tariffs, heat suppliers have no economic reason to decrease heat losses: without measuring heat consumption, it is impossible to know the exact amount of heat losses during transmission and distribution. District heating companies usually estimate the amount of heat consumed by a building and base the tariff on these estimates. In most cases they overestimate consumption and underestimate real heat losses. This means that consumers have to pay for losses that the regulator might otherwise consider the responsibility of the supplier.

Heat metering is by far the better approach and it is essential for consumption based billing. **Tariffs based on heat metering are more transparent and encourage both consumers and suppliers to be more energy-efficient** [6]. However, in most transition and INOGATE countries buildings are in poor condition, the renovation rate is slow.

Collection and payment for district heat is not a big issue in old member countries of the EU. While in transition and INOGATE countries the economic situation is weak or poor and district heating is either the dominant or a major heat source for residential customers in most transitional economies.

District heating companies, on the other hand, often also have little influence on their customers’ payment behaviour. **In transition period, utilities are not legally allowed to disconnect customers in arrears or use other payment enforcement measures.** Some countries, however, are making progress in this area. Polish regulation allows companies to deduct heating debt directly from the pay checks of customers in arrears. In Lithuania, district heating companies can prosecute customers who do not pay for more than six months, and the court can decide to expel them from their dwelling [6].

Non-payment for energy services was a major problem in transition economies in the 1990s, particularly in the former Soviet Union and South East Europe. Its origins lay in the significant drop in household revenue and a simultaneous rapid increase in electricity and heat prices, together with a lack of payment enforcement. The problem has decreased significantly in recent years. However, outstanding debts remain from this period, which inhibits system development. In many countries, utilities cannot write off this accumulated bad debt.

In Armenia, for instance, customer arrears to district heating companies are estimated at about 7 to 9 million EUR a year, and local governments ultimately have to cover these debts.
District heating companies use different methods to improve payment discipline. In Russia, for example, some utilities hire private collection agencies, others create lotteries for consumers who have paid on time, introduce “amnesties” for paying past bills without penalties or publish the names of customers in arrears in the local press. Installing meters generally improves payment discipline as consumers know that they pay only for heat consumed.

The collection rate has improved significantly in recent years in most of the Central Europe and the Baltic countries. In Estonia, for example, non-payment in big cities has been reduced to 2-3%. However, in some small systems, up to 20% of households still do not pay for district heat in time while the average national non-payment rate is 4-5%.

5.14 Accessibility to the district heating

High district heat prices in transition economies are caused by relatively expensive fuels (especially natural gas) and low efficiency of district heating systems in many cases. Old blockhouses are designed on poor energy efficiency plans and consume 2-3 times more thermal energy than newly built houses. As most multi-flat buildings do not have individual control over their heating, and low economic power of many heat consumers, they can hardly pay full price for their heating. Payments for heating of relatively large but not efficient apartments in the cold countries do not correspond to the living standard of many users.

In Scandinavian countries, the average annual consumption of thermal energy is 70-140 kWh/m² while in Ukraine and Baltic states this index exceeds over 200 kWh/m².

![Figure 8](image)

Figure 8. Average bill of heat for average customer (60 m² apartment) per year (2009) in selected countries [28].

In this case heating bills for customers in some NMS of EU are higher than in economically developed countries. As seen in Figure 8, the highest bill for heat is in Lithuania, where average customer are paying about 900 EUR per year for heating of 60 m² apartment (due to expensive natural gas used for DH), while in Sweden average customer are paying about 320 EUR per year.
A study made by Oxera [33] shows on average annual heating bill as GDP per capita in selected North countries. This rate varies between 2\% - 9\%, however district heating is the most expensive (as GDP per capita) in the Baltic countries and Poland (Figure 9). So, question of DH accessibility is still relevant for many transition economies and at least a reduced VAT tariff is applied in order to reduce real heating bills.

![Figure 9](image)

**Figure 9.** Average heating bill as % of GDP per capita. Source: Oxera [33].

Due to increasing fuel prices in recent years, the real cost of heating has risen but economic growth has not kept pace. The ability of people to afford heating has been generally declining. Average household expenditures on central heating range from 1\% to 18\% in post socialist countries, while the general consensus on the limit of affordability for heating is 10\% [3]. Low affordability of DH has been a primary reason for the rapid growth of other heating alternatives. The transition economies include some of the poorest countries in Europe and heating bills are a major burden on household budgets.

**Transition economies use a wide range of support mechanisms:**

- Direct Subsidies to Utilities;
- Cross-subsidies;
- Poor Enforcement of Payment;
- Price Discounts for Privileged Groups;
- Burden Limit (or Housing Subsidy);
- Non-earmarked Cash Transfers;
- Lifeline tariffs.

*Source – Coming in from the cold, 2004 [6].*

Basically **most NMS of the EU have gradually eliminated general heat subsidies.** These are replaced by targeted subsidies or applied in exceptional cases (in some municipalities) only. **Figure 10** illustrates gradual phase-out of DH subsidies in **Poland.**
Romania is in a gradual transition process from national subsidies (national reference price fixed below cost recovery levels) to prices reflecting the real costs of heat generation and supply at each locality (local reference price). Nevertheless, the municipality may still establish the local reference price below a cost-recovery level, or provide fuel subsidies to the DH company. A transition is being made to a targeted subsidy mechanism, this is already in place but will have to be developed further.

In Moldova, subsidies are formed from the difference between the specific consumption of fuel for each type of energy adopted when the tariff was approved, and also calculated in accordance with technical-economic indicators of the plant (CHP). Subsidizing heat at the expense of increasing consumption of fuel for generation of electricity is conducted on the level of an enterprise [15]. In Hungary, a new system of subsidies were adopted in 2007. According to this new system, subsidies on the basis of social need – depending on the income of the household, increase in proportion to the decrease in income. There are four groups of eligible households (defined by income categories) and the number of consumers in each household is taken into account when applying subsidies. The subsidy has an upper limit. In Lithuania social protection is implemented through compensations (e.g. compensation of district heating expenditures exceeding 20% of the household’s income). Money is allocated from the state budget and administrated by municipalities. Such schemes are not very well targeted and administration is costly, the scheme was recently changed to evaluate the householders personal estate [34].

When cross subsidies are paid by commercial consumers and they have to pay much higher tariffs than residential consumers, the number of disconnections increase and larger commercial users tend to build individual heating units.

The elimination of heat subsidies should be accompanied with targeted programs for the vulnerable consumers or households, allowing heating bills to be reduced in the long-term. For example, in Bulgaria, low-income families receive heating aid from the “Winter Supplement Program” (WSP). In reality all post socialist countries apply varies forms of individual social support in order to ensure energy accessibility. Regulation should promote a trend to convert general subsidies for district heating into individual social support programs.
Replacement of heat subsidies with targeted social aid and implementation of energy efficiency programs for low-income households generally represent best practices in countries which have passed district heating sector reforms.

5.15 Summary, recommendations

Governments should carefully consider how they can improve regulations to better promote efficiency, fairness, least-cost supply, full cost recovery and transparency, and then act diligently to make these improvements. To make regulation as effective as possible, policy makers should take several issues into account. First, regulatory independence is important as it helps ensure that tariffs are based on the long-term economic health of the district heating system, rather than short-term political agendas. Second, cost recovery should include provisions for necessary investment, depreciation, bad debt and other costs of operating a sustainable business, as well as a reasonable rate of return. Third, regulators should avoid cost-plus tariffs because they are a major disincentive against energy efficiency investments. Fourth, regulators should make sure that cost allocation at cogeneration plants does not discriminate against either heat or electricity. The complexity of regulation can be reduced gradually as the economic situation stabilizes and the market becomes more balanced.

A district heating enterprise shall become a self-financing unit in the long term. There are a couple of lessons learned that should be considered while designing the retail heat tariff and the steps of tariff system transition.

The heat tariff should be designed according to the six principles listed below:

1. Full cost coverage: The tariff should include all justified costs predicted for the near future and a reasonable profit. The tariff should be based on predicted rather than historical costs in order to be up-dated. The tariff should cover the capital costs based on depreciation of the fixed assets evaluated on a realistic level. Often the capital values are too low, which results in insufficient depreciation levels;

2. Cost structure reflective: The tariff components should be based on the real cost structure. The variable fee should cover variable costs, such as fuel and energy purchase costs and the fixed fee capital and staffing costs. One-component tariffs risk causing financial instability for the DH enterprise, when customers start saving energy.

3. Competitiveness: the heat tariff should offer a competitive option for those customers which are economically attractive for district heating;

4. Incentive to cost reduction: For the DH enterprise, there should be an incentive to reduce costs by competing against gas/oil heating, or by regulatory means;

5. Incentive to energy conservation: For the heat customer, there should be an incentive to reduce the required water pressure, supply and return water temperature and the water flow, which all add up to energy conservation. One way is to bind the fixed charge to the ordered water flow. Thus, when the customer is motivated to reduce the water flow, he is working for saving energy and increasing cooling of the return water;

6. Simplicity: The heat tariff should be easily understandable to the customers: Customers not familiar with the energy business and the technology should clearly be able to read from the tariff and how he may influence the components of his heat bill.
Pricing system is the key regulatory component in the district heating sector and must be properly designed and applied in order to create a long term economic background for the heat industry.

6. CLIMATE CHANGE POLICIES AND ENERGY EFFICIENCY POLICY INSTRUMENTS IN THE EU

6.1 The place of district heating in EU energy policy

The EU has no specific legislation in the field of District Heating. However, this technology is addressed in several other legal acts dealing with energy efficiency, therefore it is useful to describe the EU policy in this field in more detail.

As indicated in the first chapter, the reason for worldwide promotion of energy efficiency is that it is the answer to two big global challenges:

- It is difficult to supply the world with enough energy\(^9\)
- Climate change

Conventional oil supply is reaching its peak nowadays and only by mobilising unconventional oil (e.g. shale oil), future global growing demand van be fulfilled. After the Japanese earthquake and the following nuclear disaster also a further growth nuclear energy is doubtful. Gas, including unconventional gas, will take over a part of the oil functions and the share of renewables will also grow, but not enough to supply the world when energy efficiency is not deployed sufficiently. As an example for the great impact of energy efficiency on demand it can be demonstrated that if the EU had not decoupled the growth of energy consumption from the growth of the economy in the seventies, then it would consume now around 60 % more energy.

Climate change is at longer term an even greater problem than the security of energy supply. It will be a serious threat to the life and welfare of billions of people. It is clear that climate is changing. It is almost sure that the disturbing of the balance of greenhouse gases in the atmosphere by human activities is one of the main causes. It seems that the overall effect of climate change could make the planet a very unpleasant place to live. The EU wants to play a leading role in mitigation of global climate change. Common efforts are needed and energy efficiency is a no regret policy to combat climate change.

\(^9\) Although fuel producing countries may like the idea of increasing fuel demand and therefore may have the tendency to be less interested in global energy efficiency, it is at least a good policy for themselves to reduce domestic energy use because this would leave more fuel available for export.
Energy efficiency, including district heating, is very often cost effective which in theory would mean that market forces would stimulate and create it. However, the invisible hand of the market is not working sufficiently in this case because of several market imperfections. Therefore it is the task and duty of governments to intervene and to lay down measures that repair these market imperfections.

6.2 EU legislative process and policy tools

Energy efficiency is a main policy of the EU as will be described hereunder. In order to understand the instruments that the EU could use to realize this policy it is useful to recap some of the basics about the functioning of the EU processes.

The EU (Brussels) is a complex of institutions which work together in a delicate balance of power. The most important are:

- **European Council**\(^{10}\) (heads of state or government) that meets 4 times a year to set political directions and priorities.
- **Council of the EU** (different settings of national ministers) to adopt legislative acts, in most cases together with EP
- **European Commission** (27 appointed Commissioners + EU’s civil service) to propose legislation, to manage the money, safeguard Treaty and implement legal acts
- **European Parliament** (736 elected members + staff) to adopt legislative acts and budgetary provisions
- **Court of Justice**\(^{11}\) (27 judges + staff) to rule on cases related to EU law such as not correctly applying EU law

In short, the procedure to produce European legislation is that the Commission makes a proposal that is discussed and often amended by the appropriate Council of ministers (for instance the ministers of energy) and the European Parliament. When these two bodies come to an agreement the proposal is adopted and becomes EU law. This EU law very often has the format of an **Directive** addressed to the Member States that have a certain time to implement this Directive in their national law. The European Commission has the task to control if this implementation is done correctly. In case of failure of a Member State to implement a Direc-

---

\(^{10}\) Not to confuse with the **Council of Europe** which is an international organization in Strasbourg promoting cooperation between all countries of Europe in the areas of legal standards, human rights and democratic development and has nothing to do with the EU. The Council of Europe was founded in 1949, has 47 member states with some 800 million citizens, and unlike the EU, it cannot make binding laws

\(^{11}\) Not to confuse with the **European Court of Human Rights** which is an international court set up in 1959. It rules on violations of the civil and political rights set out in the European Convention on Human Rights which is an international treaty of the Council of Europe.
tive, an infringement procedure is started which finally will be brought to the Court of Justice in Luxembourg.

Most of the legal instruments to realize energy policy in the EU are such Directives. In some cases another legal instrument is used which is called a Regulation. The decision making process of a Regulation is the same as for a Directive, but the difference is that a Regulation does not need to be transposed in national legislation as it is directly applicable in the format as it has been adopted.

6.3 The EU definition of energy efficiency

Energy efficiency in the strict sense means using less energy input for an equivalent level of economic activity.

As described in chapter 3, Energy efficiency is often measured by improvement of energy intensity, the amount of energy needed to produce a certain amount of product or per unit GDP. However there are autonomous developments that lead to less energy intensity like economic development, structural changes in the economy that make it difficult to use this indicator to measure progress or to set overall political targets. Therefore targets are more often expressed in energy savings.

Energy savings is an absolute decrease of the energy used and could be realised by energy efficiency but also by other events like declining economic activity and behavioural changes. Political targets in the EU are expressed as energy savings, but the clear aim is to reach these targets mainly by mobilizing the untapped potential of cost effective energy efficiency.

The main difficulty for an energy savings target is to define the baseline (business as usual) from which these savings are being calculated. It is possible that an energy savings target that was intended to be ambitious enough to realize a structural change in energy consumption, now appears to be rather easy because of an economical decline.

6.4 The EU climate and energy package of 2008

The EU wants to play a leading role in combating the climate change and at the same time is subject to a growing dependency on imports of fossil fuels. Moreover the EU wants to develop its global competitiveness. This has led to the proposal of the EU climate and energy package including the so-called 20-20-20 targets.

The 20-20-20 targets were adopted in 2008, reconfirmed in later European Council meetings and implemented by legal acts proposed by the Commission and adopted by European parliament and Council of ministers. These targets imply:

- reducing greenhouse gas emissions by 20% compared to 1990 levels (binding target)
- increasing the share of renewables in final energy consumption to 20% (binding target)
moving towards a 20% increase in energy efficiency (non-binding target) in national legislation

It is fair to say that the climate change may be the biggest global challenge but the security of supply appeared to be at least as important as a driver for EU targets in these fields.

6.5 Current legislation related to the 20-20-20 targets

The three targets are clearly interconnected. Achieving 20% less greenhouse gases implies a fuel switch to low carbon fuels like renewables and application of energy efficiency. If the overall consumption is reduced by energy efficiency then it is easier to achieve a 20% share of renewables in final consumption. Still the main operational legal policy instruments that were used until now to realize the 20-20-20 targets can easily be assigned to one of the three policy aims:

For the 20% reduction of greenhouse gases (GHG) (and indirectly the achievement of 20% renewables and 20% energy efficiency):

- Decision 406/2009/EC on the effort sharing of Member States to reduce greenhouse gas emissions in the non-ETS sector.

For the achievement of 20% renewables (and indirectly the reduction of GHG):

- Directive 2009/28/EC on the promotion of the use of energy from renewable sources (replacing 2001/77/EC and 2003/30/EC)

For the achievement of 20% increase in energy efficiency (and indirectly the reduction of GHG):

Energy supply efficiency:
- Directive 2004/8/EC on cogeneration including later decisions on reference values and methodology

Energy end use efficiency:
- Directive 2010/30/EU on labelling of energy related products
- Regulation 1222/2009 on labelling of tyres
- Regulation (EC) No 2422/2001 on a Community energy-efficiency labelling programme for office equipment (energy star)
- Directive 2009/125/EU on eco design of energy related products
- Directive 2002/91/EC on the energy performance of buildings to be repealed on 9.2.2013 by its recast Directive:
- Directive 2010/31/EU on energy performance of buildings
  Directive 2006/32/EU on energy end use efficiency and energy services.
6.6 The 20 % reduction in greenhouse gases

The two instruments for achieving the 20 % reduction in GHG emissions by 2020 cover in principle all emissions of the EU divided in two sectors: the ETS sector and the non-ETS sector.

The EU emission trading system (ETS) is a market based policy tool to reduce the emissions of greenhouse gases (GHG) and includes around 10,000 installations (about 45 % of all GHG emissions in the EU) that have to render emission allowances for every ton of CO₂ and two other greenhouse gases that they emit. The total amount of allowances in the system is limited and will gradually be reduced. Allowances can be traded, so those emitters that have not enough allowances have to buy them from those that have emission allowances left. This generates a market price for the allowances and that price should also make it interesting to reduce emissions by efficiency measures and low carbon production methods in the sector. Theoretically the market forces will take care of the reduction in the ETS sector as the price of an allowance will go up when emissions approach the ceiling as set in the Directive. However, in the latest energy efficiency action plan published in 2011 the Commission seems to be unsure to rely only on the ETS as it considers from 2013 binding efficiency targets and mandatory application of BAT for authorization of new permits and permit updates for installations that fall under the ETS sector.

For all GHG emissions that are not covered by the ETS system (e.g. small combustion, land and sea transport, agriculture) every Member state was attributed a separate target in the effort share Decision. These targets vary from a reduction of 20 % compared to the emissions in 2005 to an allowed small increase in case of countries that still have to build up their industry, but the total reduction in this sector for all Member States together is 10 % compared to 2005.

As stated before, energy efficiency is the main contributor to reducing GHG and the legislation that will be discussed hereunder contributes to the achievement of the GHG reduction target in the ETS sector (e.g. deployment of CHP, reducing use of electricity) and/or in the non ETS sector (e.g. energy performance of buildings, better boilers, better tyres).

The target on renewable energy has no direct influence on energy efficiency policy but it has the same impact: using less fossil fuels and therefore less emissions and less dependency on import. Furthermore cogeneration will be discussed separately as the main current policy on supply efficiency and finally the list of Directives and regulations that address energy end use efficiency. The last chapter is on the recent proposal of the Commission for an overall Directive on energy efficiency.

6.7 Renewable energy policy

Renewable sources of energy – wind power, solar power (thermal, photovoltaic and concentrated), hydro-electric power, tidal power, geothermal energy and biomass – are essential alternatives to fossil fuels. Their use reduces our greenhouse gas emissions, diversifies our
energy supply and reduces our dependence on volatile fossil fuel markets (in particular oil and gas). The growth of renewable energy sources also stimulates employment, the creation of new technologies and improves the trade balance. Renewable energy industries has a great potential for creating jobs, for equipment manufacturers, installers, technicians, builders and engineers. The industry currently employs in the EU over 1.5 million people and by 2020 could employ nearly 3 million more, according to latest studies.

In the EU the development of renewable energy has been an active policy since the mid-nineties but only in the last decade this was done by concrete legal instruments.

In 1997 The European Commission proposed that the EU should aim to reach a 12% share of renewable energy by 2010. The first two Directives were adopted in the renewables sector were on green electricity in 2001 and on transport (biofuels) in 2003. In these two EU there are laid down indicative, non-binding targets for 2010 for two sectors: electricity adding up to 21% green electricity in the EU and for transport fuel a share of 5.75%.

In the electricity sector, only seven out of 27 Member States have met these 2010 targets. In the transport sector, nine have met the 5.75% targets. The EU as a whole reached just over 18% for the share of renewable energy in the electricity in 2010 rather than the target of 21%. For transport, the EU reached 5.1% instead of 5.75%.

Therefore, the Community has in 2009 agreed to the new more ambitious renewable Directive that includes electricity, transport and also heat with compulsory national targets for 2020 resulting in an legally binding overall target of 20% for renewable energy's share of energy consumption in the EU. In doing so, the EU has provided the business community with the long term stability it needs to make rational investment decisions in the renewable energy sector so as to put the European Union on track towards a cleaner, more secure and more competitive energy future.

6.8 Combined heat and power generation

Cogeneration (CHP) is a technique to produce electricity and heat in one process. It ensures that electricity can be produced in a process where a very high part of the energy content of a fuel is utilised. When electricity is produced separately, around half of the energy within the fuel is lost. Cogeneration provides a process with two products: electricity and heat - or more specifically electricity and heat at conditions where the heat can be used either for industrial purposes or for heating of buildings. Cogeneration is not a specific technology since a number of different technologies fulfil the criteria of cogeneration. Cogeneration is not linked to one type of fuel - all kind of fuels can be used for cogeneration. However in the context of this chapter, cogeneration is connected to combustion of fossil fuels.

The promotion of cogeneration is part of the strategy for the efficient use of energy and is supplementary to the strategy of increased use of renewables. However, cogeneration is not a target in itself but can be an efficient tool to generate energy savings and to pursue the targets of reductions in CO2 emissions by replacing separate production of heat and electricity. Cogeneration in combination with district heating is a very powerful energy savings policy especially in those countries where district heating has a long tradition.
Already in the cogeneration strategy from 1997 the EU Commission identified the advantages and possibilities of an increased use of cogeneration in EU. An overall indicative Community target of doubling the share of electricity production from cogeneration in total EU electricity production from 9% in 1994 to 18% by 2010 was put forward. Nevertheless, despite the promising potential for cogeneration, no significant increase in the share of cogeneration was seen. Cogeneration was furthermore reiterated in several action plans and finally the Commission proposed the Directive on “the promotion of cogeneration based on a useful heat demand in the internal energy market” that was adopted by the Council and the European Parliament as Directive 2004/8/EC.

The three cornerstones of the Directive 2004/8/EC are:

- The relation to the internal energy market notably the electricity market.
- A harmonised definition of high efficiency cogeneration;
- A common understanding of the term "useful heat demand";

Where Directive 2003/54/EC defines the general rules for the internal electricity market, the Cogeneration Directive provides the necessary common concept of electricity from cogeneration, which is necessary because cogeneration is an energy efficient and environmental friendly technique, but vulnerable to changes in market prices of fuels and electricity because of the relatively larger investment needs. Therefore cogeneration needs economic support under some circumstances within the frame of state aid rules under which it is allowed to support high efficiency cogeneration. When a producer of cogenerated electricity puts one kWh on the market and claims a certain amount of support it is important that "high efficiency cogenerated electricity" is clearly defined in order to avoid market distortions by support to cogeneration processes that do not provide for energy savings.

A common definition of high efficiency cogeneration was one of the hardest on which to find a compromise in the decision making process. The Directive contains two paths to qualify a given cogeneration process as high efficiency. It is an assessment of the cogeneration process that leads to the qualification.

The main road to qualification as cogeneration goes via a two-step procedure. Step one is to isolate the cogeneration process and identify the amount of electricity and heat coming from the cogeneration process. Step two is to calculate the primary energy savings obtained in comparison with a production of the same amount of heat and electricity in separate productions i.e. heat from a heat-only boiler and electricity from a conventional power-station according to agreed reference values. If the energy savings are above 10% then the cogeneration is qualified as “high efficiency”.

A common understanding of the term “useful heat demand” is linking together the production of heat and electricity, it is important to ensure that the produced electricity and heat meet real demands. The electricity can be transmitted into a market place and sold where it is needed, the heat however cannot easily be transported or stored and therefore the cogeneration process must be based in time and place of a real need for heat. The real need for useful
heat is the cornerstone of efficient cogeneration, because if the produced heat is not meeting a real demand the advantages of cogeneration disappear. Furthermore, the promotion of cogeneration should not lead to encouragement of increased heat consumption.

6.9 The labelling Directives

The energy demand in households accounts for 25% of the final energy needs in the EU. Electricity used for domestic appliances in households show the sharpest increase. Higher standards of living and comfort, multiple purchases of electric appliances and the growing need for air-conditioning are main reasons for this trend to prevail. Energy consumption by consumer electronics and new media as Internet is also steadily growing.

The most common market failure that has to be addressed in order to achieve cost effective energy savings is a lack of information to consumers. To this aim the EU has three groups of labelling Directives:

1. Directive 2010/30/EU on labelling of energy related products

The Directive currently applies to the following types of household appliances, even where these are sold for non-household uses:
- refrigerators, freezers and their combinations;
- washing machines, dryers and their combinations;
- dishwashers;
- ovens;
- water heaters and hot-water storage appliances;
- lighting sources;
- air-conditioning appliances.

2. The Regulation 1222/2009 on labelling of tyres

Today's technology makes it possible to significantly reduce the tyre share in vehicle fuel consumption allowing a driver to reduce his/her fuel bill by up to 10% between the best and the worst set of tyres available on the market. However, lack of reliable and comparable information on the performance of tyres makes it currently difficult for consumers to take these elements into account in their purchasing decision, in particular when the time comes to replace a used set of tyres. Therefore there exists a clear market failure arising from the lack of information for end-users on tyre fuel. This is especially true for the replacement market, constituting 78% of market share.

In order to repair this market failure the EU adopted on 25 November 2009 a Regulation imposing a compulsory labelling scheme for tyres.

The European Energy Star Programme is a voluntary energy labelling programme for office equipment. The Energy Star logo helps consumers identify office equipment products that save them money and help protect the environment by saving energy. Office information and communication technology equipment (computers, monitors, printers, fax machines, copiers, scanners and multifunction devices) is responsible for a growing share of electricity consumption in the EU.

6.10 The Eco-design Directive

There are two complementary ways of reducing the energy consumed by products: labelling to raise awareness of consumers on the real energy use in order to influence their buying decisions (such as the above described labelling schemes for domestic appliances), and energy efficiency requirements imposed to products from the early stage on the design phase.

The production, distribution, use and end-of-life management of energy-using products (EuPs) is associated with a considerable number of important impacts on the environment, namely the consequences of energy consumption, consumption of other materials/resources, waste generation and release of hazardous substances to the environment. It is estimated that over 80% of all product-related environmental impacts are determined during the design phase of a product. Against this background, Eco-design aims to improve the environmental performance of products throughout the life-cycle by systematic integration of environmental aspects at a very early stage in the product design.

The EU adopted a very important Directive 2009/125/EU on establishing a framework for setting Eco-design requirements (such as energy efficiency requirements) for all energy using products in the residential, tertiary and industrial sectors. Coherent EU-wide rules for eco-design will ensure that disparities among national regulations do not become obstacles to intra-EU trade. The Directive does not introduce directly binding requirements for specific products, but does define conditions and criteria for setting requirements regarding environmentally relevant product characteristics (such as energy consumption) and allows them to be improved quickly and efficiently.

The following implementing regulations containing Ecodesign requirements were until now adopted by the Commission:

- Commission Regulation (EU) No 1016/2010 with regard to ecodesign requirements for household dishwashers
- Commission Regulation (EU) No 1015/2010 with regard to ecodesign requirements for household washing machines
• Commission Regulation (EU) No 347/2010 with regard to ecodesign requirements for fluorescent lamps without integrated ballast, for high intensity discharge lamps, and for ballasts and luminaires able to operate such lamps.
• Commission Regulation (EC) No 641/2009 with regard to ecodesign requirements for glandless standalone circulators and glandless circulators integrated in products.
• Commission Regulation (EC) No 642/2009 with regard to ecodesign requirements for televisions (Text with EEA relevance).
• Commission Regulation (EC) No 278/2009 of 6 April 2009 with regard to ecodesign requirements for no-load condition electric power consumption and average active efficiency of external power supplies.
• Commission Regulation as regards the ecodesign requirements on ultraviolet radiation of non-directional household lamps.
• Commission Regulation (EC) No 244/2009 of 18 March 2009 implementing with regard to ecodesign requirements for non-directional household lamps.
• Commission Regulation (EC) No 107/2009 with regard to ecodesign requirements for simple set-top boxes.
• Commission Regulation (EC) No 1275/2008 with regard to ecodesign requirements for standby and off mode electric power consumption of electrical and electronic household and office equipment.

6.11 The Building Directive

On 18 May 2010 Directive 2010/31/EU on the energy performance of buildings was adopted. This new Directive is a recast of the previous Building Directive 2002/91/EC in order to strengthen the energy performance requirements and to clarify and streamline some of its provisions. This recast will replace the current Directive by implementation in the Member States as from 9 January 2013.

The energy consumption of buildings in the EU varies enormously; whilst new buildings can need less than 3 to 5 litres of heating oil or equivalent per square meter floor area and year, the existing buildings stock consumes, on average, about 25 litres per square meter, some buildings even up to 60 litres. Available construction products and installation technologies can drastically improve the building's energy performance – and so reduce its energy consumption– and create net benefits: the annual energy cost savings are exceeding the annual capital costs for the investments. The best moment for energy improvements is when buildings are constructed or they are anyway renovated.

The current Energy Performance of Buildings Directive 2002/91/EC establishes four basic requirements to be implemented by the Member States:

• Member States are required by the Directive to ensure the setting of minimum energy performance requirements. It is important in this context to note that the level of these
requirements is left entirely up to the Member States. These minimum standards are to be set in a flexible and integrated way so that designers and builders are able to meet energy efficiency requirements in the most cost-effective way. The standards shall also take into account climatic differences and may allow a differentiation to be made between standards for new and for existing buildings.

- These standards have to be applied to most new buildings and to existing buildings larger than 1000 m² when larger renovations are undertaken. These standards are to be reviewed at the most every 5 years to update them to reflect new technologies and technical advances.

- Member States must ensure that when buildings are constructed, sold or rented out, an energy performance certificate will be made available to the owner or by the owner to the tenant or potential buyer. The certification shall also include advice on how to improve energy performance. Certificates provided should not be more than 10 years old when transactions take place. Member States may also choose to require larger public buildings to provide for the display of the current temperature and of the recommended indoor temperature, mainly as a means of increasing public awareness of inefficient and wasteful management of cooling and heating systems. This is, however, an optional measure.

- Finally the Directive lays down requirements for the regular inspection of heating and cooling systems, with the frequency of the inspections being based on the effective rated output of the boiler or air-conditioning system. A one-off inspection of the entire heating installation is required if the boiler is older than 15 years. This assessment will include advice on possible replacement or modifications of the boiler, including the use of alternative energy solutions.

The recast Directive that will come into force on 9 January 2013 will helps citizens even better to improve the energy efficiency of their houses and construction industry to build better quality buildings. The macroeconomic estimated impacts are also significant: 5-6% less energy will be used in EU in 2020 (which equals the total current consumption of Belgium and Romania) and about 5% less CO₂ emissions will be emitted in the whole EU in 2020.

The new Directive contains the following extra provisions:

- The energy performance certificate becomes a real, active energy label of houses. For instance, the certificate has to be included in all advertisements for sales or renting. Also, the certificate with its energy saving recommendations has to be part of the sales and renting documents. Inspections of heating and air conditioning systems will advise consumers to use better these appliances or improve their operation, even replacing if need be. Member States have to ensure a good quality of the certificates and inspections.
• The scope of the Directive is broadened and from 2013 all existing buildings when they undergo a major renovation should meet certain efficiency levels and not only those buildings that are larger than 1000 m².

• Member States are obliged to develop plans for increased numbers of low or zero energy and carbon buildings, such as passive houses. The public sector should show a leading example investing in such buildings.

6.12 The energy efficiency and energy service Directive

Directive 2006/32/ on energy end-use efficiency and energy services includes an indicative energy savings target for the Member States, obligations on national public authorities as regards energy savings and energy efficient procurement, and measures to promote energy efficiency and energy services. The objective of the Directive is to promote energy efficiency and energy services and to develop the markets for these as a means of contributing to environmental protection as well as to the security of energy supply. This Directive is designed to help remove informational, financial, institutional and other barriers that prevent the realisation of the significant energy savings potential that exists in all the Member States. It does this by laying down the following provisions:

• A general energy end-use savings target for Member States of 1% per year for 9 years, covering the period from 1 January 2008 until 31 December 2016. The overall target of 9% is to be met by the 9th year and will include an intermediate target covering the third year of application of the Directive. The basis for the calculation of the energy savings is 1% of the average amount of energy consumed during the most recent five years for which statistics are available. The savings can be realised from the following sectors: households; agriculture; commercial and public sectors; transport and industry, with a few exemptions. All types of energy will be taken into account, from electricity and natural gas to district heating and cooling, heating fuel, transport fuels, coal and lignite, and biomass.

• A public sector obligation. Member State public sectors shall fulfil an exemplary role and fulfil a number of obligations to contribute to reaching the overall savings target. The public sector will need to ensure the availability and publication of public procurement guidelines that take into account energy efficiency. Alternatively, they may choose to use energy audits and apply the resulting recommendations or apply financial instruments such as energy performance contracting.

• A supply-side obligation concerning the offer of energy services and other energy efficiency measures to customers. Energy distributors and retail energy sales companies will have to ensure that their customers are offered competitively priced energy efficiency improvement measures or services when they are supplied with energy. These measures may, however, be implemented by any competent market actor such as energy service companies, installers and energy advisors. Alternatives in form of contributions to funds and voluntary agreements are also possible.
• **A harmonised method for calculating improvements in energy efficiency** will be developed by the Commission and a committee composed of Member State experts. The measurement system will include benchmarks, energy efficiency indicators and bottom-up measurements.

• **Member States will report regularly** on their progress in meeting targets, using national Energy Efficiency Action Plans. These plans will be assessed by the Commission and reported on. If insufficient progress is being made, additional measures will be proposed by the Commission. Examples of eligible energy services and energy efficiency improvement measures are set forth in the Directive.

This Directive is intended to serve as an “umbrella” to complement and improve the implementation of existing EU energy efficiency legislation, including the Energy Performance of Buildings Directive, the Combined Heat & Power Directive and the Directives on the energy labelling of appliances.

## 7. THE PROPOSAL FOR A NEW EU DIRECTIVE ON ENERGY EFFICIENCY

### 7.1 Introduction

The latest estimates made by the Commission, on the basis of the national energy efficiency targets for 2020 that Member States have set for themselves in the context of the Europe 2020 strategy, show that the EU will not be able to achieve its objective.

Therefore the Commission has made on 22 June 2011 a legislative proposal for a Directive on energy efficiency which builds upon the existing Directives for Cogeneration and Energy Services and merges them into one comprehensive legal instrument addressing energy efficiency in energy supply and in final energy consumption.

The Directive also foresees that the Commission will make in 2014 an assessment of the progress made towards the EU’s 20% energy efficiency objective for 2020 and, if necessary, bring forward a further legislative proposal to set mandatory national energy efficiency targets.

Aim of the proposal is to save more energy and to reach the target the EU has set itself: By 2020, the EU wants to cut energy consumption by 20 percent. In absolute terms – calculated in million tons of oil equivalent (Mtoe)– this are 368 Mtoe in 2020 compared to projected consumption in that year of 1842 Mtoe. This needs to be achieved by the EU as a whole.

At the moment – with all the measures on EU and national level in place so far – the EU would only reach 1678 Mtoe, or 9% of savings.

---

12 See chapters 7 and 9.4
7.2 The key measures of the proposed Directive

- (Article 3) Member States have to set **national targets** for 2020 that should lead to the 20% efficiency target for the EU. These proposed targets are a follow up to the (9% saving targets for 2016 that were already established in the current Energy services Directive 2006/32/EC). Like in this current Directive these national targets have no compulsory character but by 30 June 2014, the Commission shall assess whether the Union is likely to achieve its target of 20% primary energy savings by 2020 and if necessary propose binding targets.

- (Article 4) From 1 January 2014, 3% of **public buildings** should be renovated each year, with the clear aim to save energy. Currently, the same percentage is renovated per year but in only half of the cases energy efficiency improvements are included (1, 5% energy related renovation rate. In many cases a cost optimal renovation can bring up to 60% energy savings. The benefit of this measure can be estimated to 6 Mtoe in 2020. This article is a new and very specific obligation to public sector.

- (Article 5) It will become a legal obligation for the public sector to **purchase energy efficient** buildings, products and services. This article is a stronger wording than in the similar Article 5 of the current Directive.

- (Article 6) Member States have to set up an **energy efficiency obligation scheme**. This scheme shall ensure that either all energy distributors or all retail energy sales companies operating on the Member State's territory achieve annual energy savings equal to 1.5% of their energy sales, by volume, in the previous year in that Member State excluding energy used in transport. To achieve these savings the energy companies concerned would have to work with the final energy users (e.g. individual house owners, supermarkets, hospitals) to implement energy savings. In order to allow for sufficient flexibility, Member States have also the possibility to propose alternative
energy savings mechanisms that lead to the same results but are not based on obligation on energy companies. The similar existing provisions in the current Directive (where such obligations are only one of the options provided to Member States to ensure that energy utilities achieve savings in end-use sectors) will by this proposal be reinforced.13

- (Article 8) Member States shall ensure that final customers for electricity, natural gas, district heating or cooling and district-supplied domestic hot water are provided with individual meters that accurately measure and allow to make available their actual energy consumption and provide information on actual time of use. This should be done not later than 1 January 2015 for electricity, natural gas; hot water and centralised heat. In a longer term, this may require introduction of intelligent metering although in the shorter term, frequent billing can be based on self-reading of existing meters by the consumers themselves. The potential savings that could be reached through improved information provided through more adequate metering and billing are estimated at the level of around 80 Mtoe. This provision exists already in the current Directive (Article 13) but apparently was not enforced sufficiently.

- (Article 10) The proposes Directive requires that by 1 January 2014, the Member States have established a national heating and cooling plan as a basis for a sound planning of efficient heating and cooling infrastructures, for developing the potential for the application of high-efficiency cogeneration (CHP) and efficient district heating and cooling.14 Moreover Member States shall ensure that all new thermal electricity generation installations with a total thermal input exceeding 20 MW are provided with equipment allowing for the recovery of waste heat by means of a high-efficiency cogeneration unit and are sited in a location where waste heat can be used by heat demand points. This proposed Article goes clearly further than the provisions in the current Directive 2004/8/EC where Member States are only invited to report on the potential of CHP in their territory.

7.3 Relation to the two existing Directives

The scope of two existing Directives: the Cogeneration Directive (2004/8/EC) and the Energy Services Directive (2006/32/EC, ESD) clearly overlap with this Proposal. Therefore, it is proposed that these two Directives are repealed when the new Directive enters into force, except for Articles 4(1) to (4) and Annexes I, III and IV to the ESD. These provisions concern the achievement by 2017 of an indicative energy saving target of 9% of the final energy consumption of each Member State in the 5 years before the implementation of the ESD. This target – albeit different in scope and level of ambition - contributes to the realisation of the EU's 20% energy efficiency target by 2020, and should therefore be maintained.

13 The district heat and power sector wants to clarify in this obligation that also a connection to and upgrading of district heating and cooling installations qualify as such energy efficiency improvement
14 The definition in the proposal of 'efficient district heating and cooling' is: a district heating and cooling system using at least 50% renewable, waste or cogenerated heat or a combination thereof and having a primary energy factor, as referred to in Directive 2010/31/EU of maximum 0.8
7.4 Timing and procedure for adoption of the proposal

As explained in chapter 5.2 a proposal of the Commission will only become European legislation after adoption of the European Parliament and the Council of (energy) Ministers of a compromise text.

Especially as regards the contents of the proposed Article 3 (targets), Article 6 (obligations for energy companies) and Article 10 (compulsory recovery waste heat) here are strong on-going discussions with in general the EP willing to go further than the Council. Therefore it is at this stage not possible to predict how much of the proposal of the Commission will be turned into EU law and at what stage that will happen.

The foreseen timing for adoption and implementation of the proposal is as follows:

- **Until December 2011**: Discussions in the Council working groups and in the relevant Committees of the European Parliament.
- **Jan-June 2012**: A political agreement between the European Parliament and Council on the basis of a proposal of the rapporteur of the European Parliament (Claude Turmes of the Green Party) and a political orientation in the Energy Council in November 2011
- **June-Dec 2012**: Finalization of the legislative text under the Presidency of Cyprus
- **End of 2012**: Entering into force of Energy Efficiency Directive
- **June 2014**: Assessment of progress towards 20% saving objective

Until this proposed Directive is adopted the two current Directives 2004/8/EC and 2006/32/EC will remain in force and these give plenty of opportunities to those Member States that are willing to progress substantially in Energy efficiency to go ahead.

8. WHITE CERTIFICATES, GUARANTEES OF ORIGIN AND ENERGY AUDITS

8.1 Introduction

District heating, under good conditions can be an important contributor to energy efficiency. Improving energy efficiency is in the interest of society. Some energy efficiency measures are subsidized using public funds (from taxpayers or ratepayers). It is therefore of utmost importance to spend the money allocated for energy efficiency in the most effective way. This is why a market based approach is generally preferred, as the market is believed to allocate resources at the lowest cost. In order to create a supportive framework, or incentives for market actors to implement energy efficiency measures, governments or government bodies use instruments generally called “energy efficiency mechanisms”.
In the context of district heating the relevant energy efficiency mechanisms that are being addressed in EU legislation are: tradable (white) certificates, guarantees of origin and energy audits.

*In the current EU Directives 2004/8/EC and 2006/32/EC the following definitions are used for these three instruments:*

- **White certificates**: certificates issued by independent certifying bodies confirming the energy savings claims of market actors, usually due to actions of the energy efficiency improvement measures;
- **Guarantee of origin**: proof to be issued by the producer of electricity that the electricity that is sold is produced in a high efficiency cogeneration process.
- **Energy audit**: a systematic procedure to obtain adequate knowledge of the existing energy consumption profile of a building or group of buildings, of an industrial operation and/or installation or of a private or public service, identify and quantify cost-effective energy savings opportunities, and report the findings;

### 8.2 White certificates

One of the most well-known market instruments for energy efficiency is the system of [Tradable White Certificates](#). In this system selected market players, such as the energy utilities are obliged either to execute energy efficiency measures, or pay other players, who implement energy efficiency measures.

A white certificate is both *an accounting tool*, which proves that a certain amount of energy has been saved in a specific place and time, and a *tradable commodity*, which belongs initially to the subject that has induced the savings (implemented a project) or owns the rights to these savings, and then can be traded according to the market rules, always keeping *one owner at the time*. As for renewable electricity certificates (a.k.a. green certificates), the value of the white certificate is different from the economic value of the saved energy (Euro/kWh).

White certificates systems have five key elements:

1. The *creation and framing* of the demand (government sets the overall target). This could be for instance in the format of energy-savings quota (obligation) for some category of operators (distributors, suppliers, consumers, etc.). The quota is achieved by energy savings associated to energy efficiency projects.\(^\text{15}\)

2. Institutional *infrastructure* and processes (measurement and verification) to support the scheme. Projects savings are verified by the regulator and certified by means of the so-called “white” certificates (certificates for energy savings).

3. the *cost recovery* mechanism, in some cases.

4. A system of *sanctions* in the case of non-compliance

---

\(^{15}\) In principle a white certificates system can also be established for a [voluntary market](#) (this is happening in the US).
5. The *tradable instrument* (certificate) itself and the rules for issuing and trading.

The TWC schemes are quite similar to the Tradable Green Certificate schemes applied in some EU Member States and some states of the US. Both tradable certificate schemes are based on the assumption that the EE or RE measures will be implemented by the most competitive players, who can generate energy savings at the lowest cost level. This way the money allocated by the society for EE is spent the most efficiently.

The current Directive 2006/32/EC on energy services addresses in its Article 6 par 2 the option for Member States to install a system of white certificates to be complied with by *energy distributors*, distribution system operators and/or retail energy sales companies. In case such an option is chosen, also companies providing district heating would be subject of such a system.

**Directive 2006/32/EC Article 6 par 2**

*Member States shall:*

(a) choose one or more of the following requirements to be complied with by *energy distributors*, distribution system operators and/or retail energy sales companies, directly and/or indirectly through other providers of energy services or energy efficiency improvement measures:

["list of optional measures such as energy services, energy audits and funding mechanisms"]

(and/or)

(b) ensure that voluntary agreements and/or other market oriented schemes, such as white certificates, with an effect equivalent to one or more of the requirements referred to in point (a) exist or are set up. Voluntary agreements shall be assessed, supervised and followed up by the Member State in order to ensure that they have in practice an effect equivalent to one or more of the requirements referred to in point (a).

Until now tradable certificates have been introduced in Italy, in the UK, and in France. These white certificate systems currently in operation in Europe differ considerably in their basic design features:

- UK and France have chosen to impose the obligation on suppliers and Italy on distributors (grid owners).
- Certificate trading is taking place only in Italy, where projects are implemented by *ESCOs*. There is limited trading in France as suppliers prefer to implement the projects themselves through agreement with equipment suppliers and installers. Certificate trading is not a main feature of the scheme in the UK and no formal certification of attained savings takes place.
- The three schemes are dominated by measures with *standardized saving factors*, especially in the residential sector (UK scheme only in the residential sector). This is done because transaction costs for real measurement could be very high.

---

16 Energy Service Companies
In the new proposal for a Directive on energy efficiency the Commission has concluded that energy saving obligations have the scope to achieve significant savings but that the existing provisions in the current Directive (see article 6 above) where such obligations are only one of the options provided to Member States to ensure that energy utilities achieve savings in end-use sectors, should be reinforced. The level of energy savings required from energy utilities was proposed at an annual final energy reduction of 1.5%. Furthermore it was decided that certain key features need to be harmonised at the EU level (targeted sectors, level of ambition and counting methods) but that Member States should have the possibility to adjust the schemes to their national circumstances or retain their current schemes, to a large degree. The proposal to introduce a European system of tradable white certificates was also considered, but rejected for the same reasons as the option to completely harmonise all design features of the scheme.

8.3 Energy audits and Guarantees of origin

In the current Directive 2006/32/EC Article 6.2 the making available of energy audits is only one of the options that an energy distributor can choose to fulfill their obligations.

The newly proposed Directive on energy efficiency goes much further and includes a specific Article 7 that obliges Member States to ensure that such energy audits are available. Furthermore energy audits should be made mandatory and regular for large enterprises, as energy savings in that sector can be significant.

Guarantees of origin for district heating in the proposed Directive applies – without major changes, the approach of the current Directive 2004/8//EC on cogeneration:

<table>
<thead>
<tr>
<th>Article 10 (10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>On the basis of the harmonised efficiency reference values referred to in Annex II (f), Member States shall ensure that the origin of electricity produced from high-efficiency cogeneration can be guaranteed according to objective, transparent and non-discriminatory criteria laid down by each Member State. They shall ensure that this guarantee of origin complies with the requirements and contains at least the information specified in Annex IX.</td>
</tr>
</tbody>
</table>

It is explicitly stated in the recitals of the proposed Directive that guarantee of origin schemes do not by themselves imply a right to benefit from national support mechanisms and should be distinguished from exchangeable (white) certificates.
9. THE EU ENERGY ROADMAP FOR 2050

At the end of 2011, the Commission will release its Energy Roadmap 2050 in which the Commission explores the challenges posed by delivering the EU’s decarbonisation objective while at the same time ensuring security of energy supply and competitiveness.

At the time of writing this textbook the roadmap is still not officially adopted but the main message for the road towards the 2050 energy system for Europe is planned to reinforce existing policies. They will however still be insufficient to achieve the EU's 2050 decarbonisation objective of 80 % reduction. If additional policies are not put in place, only less than half of the decarbonisation goal will be achieved in 2050. This gives an indication of the level of effort and change, both structural and social, which will be required to make the necessary emissions reduction.

On the basis of a number of scenarios the Commission has identified ten structural changes for the energy system of the post 2020 period:

1. **Electricity plays an increasing role**
   All scenarios show electricity will have to play a much greater role than now (almost doubling its share in final energy demand from current levels to 36-39% in 2050) and will have to contribute to the decarbonisation of transport and heating/cooling. Electricity would provide around 65% of energy demand by passenger cars and light duty vehicles in all decarbonisation scenarios.

2. **Decentralisation and centralised large-scale systems depend on each other**
   Decentralisation of the power system and heat generation increases due to more renewable generation. However, as the scenarios show, centralized large-scale systems and decentralised systems will increasingly have to work together. In the new energy system, a new configuration of decentralised and centralised large-scale systems needs to emerge and will depend on each other, for example, if local resources are not sufficient or are varying in time.

3. **Energy savings throughout the system are crucial in all scenarios**
   Very significant energy consumption reductions would need to be achieved in all decarbonisation scenarios. Primary energy demand drops between 32% to 41% by 2050 as compared to peaks in 2005-2006.

4. **Renewables rise substantially in all scenarios**
   The share of renewable energy (RES) rises substantially in all scenarios, achieving at least 55% in gross final energy consumption in 2050, up 45 percentage points from today's level at around 10%.

5. **Carbon capture and storage has to play a pivotal role in system transformation**
   Carbon Capture and Storage (CCS), if commercialised, will have to contribute significantly in most scenarios with a particularly strong role of 32% in power generation in the case of constrained nuclear production.
(6) **Nuclear energy provides an important contribution**
Nuclear energy will be needed to provide a significant contribution in the energy transformation process in those Member States where it is allowed. It remains a key contributor to CO2 emission reductions.

(7) **Higher capital expenditure and lower fuel costs will occur**
All decarbonisation scenarios show a transition from today's system, mainly based on high fuel and operational costs, to an energy system based on higher capital expenditure and low fuel costs. This is also due to the fact that large shares of current energy supply technologies come to an end of their useful life. This would have an impact not just on the energy sector, but also on households, services, construction, transport and agricultural sectors. It would create major opportunities for European industry and service providers to satisfy this increasing demand.

(8) **Electricity prices rise until 2030 and then decline**
Most scenarios suggest that electricity prices will rise to 2030, but fall thereafter. In the High Renewables scenario, which implies a 97% share for renewable sources in electricity consumption, electricity prices continue to rise but at a decelerated rate - due to *high capital* (also for balancing capacity) and *grid investments*.

(9) **Household expenditure will increase**
Expenditure on energy and energy-related products (including for transport uses) is likely to become a more important element in household expenditure, rising to as much as 15% of households’ income in 2030, and 16% in 2050.

(10) **Decarbonisation is possible – and can be less costly than current policies in the long-run**
The scenarios show that it will be possible to achieve decarbonisation of the energy system. Moreover, the costs of transforming the energy system do not differ substantially from the Current Policy Initiatives scenario that is based on a continuation of current policies.
LITERATURE

5. Urban P. ”The future competitiveness of district heating“. Paris, May 9-10, 2011
15. “Status of Regulation of District Heating and CHPs in the Republic of Moldova“. 2010
17. Lukosevicius V. “Regulation of Ukrainian district heating sector”. July 17, 2008
18. Djalalov I. “District heating systems in Uzbekistan”. 2010
27. Blumberga D. “Latvia’s tariff and regulatory system”. 2004
29. COWI Baltic. “Šilumos kainų nustatymo metodikos atitikimo Europos Sąjungos ir Lietuvos teisės aktų reikalavimams, metodikos reglamento tvirtinimo analizė ir rekomendacijų dėl šilumos kainodaros teisinio reglamentavimo tobulinimo parengimas”. 2008
30. Péter Kaderják P., Kiss A. and Co. Textbook “Regulating our energy supply: A prime objective in serving our people”.
33. OXERA. “Assessment of regulation and competition in district heating”. 2011