OPET CHP/DH Project

WP 1: Improving CHP/DHC sectors in CEEC

Sector Level Report - Bulgaria

May 2004

European Commission (Directorate-General for Energy and Transport)
The project "OPET CHP/DH Cluster" has obtained financial support from the European Commission (Directorate-General for Energy and Transport) under the contract no. NNE5/2002/52 for Community Activities in the Field of the specific programme for RTD and demonstration on "Energy, Environment and Sustainable Development - Part B: Energy programme"

The responsibility for the content on this publication lies solely with the authors. The content does not necessarily represent the opinion of the European Community and the Community is not responsible for any use that might be made of data appearing herein.
Table of Contents

1 Introduction 4

2 DH/CHP Sector Organisation 5
  2.1 Review of Key Actors 5
  2.2 Company Structures 7

3 Heat Market 10

4 Technical Improvement of the DH/CHP Supply 12
  4.1 DH Boilers 12
    4.1.1 Current State of Boilers 12
    4.1.2 Indication of Suitable Projects 13
  4.2 DH Network Refurbishment 15
  4.3 Consumer Installations 16
  4.4 Research and Technological Development Activities 17
  4.5 Conditions for DH/CHP Investments 17
  4.6 Human Resource Development Needs 17
  4.6.1 DH Company Operations 17
  4.6.2 Project Cycle Management 18
  4.7 Needed Tools for DH/CHP Sector Development (Outlook for Phase 2) 18
    4.7.1 Technical and Organisational Development Tools 18

5 Developing Tools and Measures 19
  5.1 Overview of financing possibilities presently available for DH sector in Bulgaria 19
  5.2 Available financing schemes 20
  5.3 Infilenece of legislative and regulatory framework on financing of CHP investments in DH sector 22

6 Sources of Information 24

7 List of Annexes: 26
1 Introduction

The DH sector report outlines the key challenges connected with the development of the DH sector of Bulgaria and harvesting of the related energy efficiency and renewable energy potential.
2 DH/CHP Sector Organisation

2.1 Review of Key Actors

The organisation of the DH sector in Bulgaria differs to some extent from the one in the EU countries. One of the main reasons is that the sector is still state-owned and is managed by the Ministry of Energy and Energy Resources (MEER).

There is no DH association or a similar structure established in the country. At national level there is a division at the MEER called “Electricity and Heat production”. This division together with the managing boards of the DH companies discuss the problems of the sector and develop strategies for its development. Periodical meetings and seminars are held for this purpose, at the auspices of MEER.

There is a Branch Chamber of Energy Engineers established as a public body, where representatives of the DHC take active part in activities and management.

There is no Building Owners Association is Bulgaria. It is relatively complex to establish such a body as most of the DH supplied clients inhabit and owe one apartment in multi-storey residential buildings with 50-100 apartments each (these buildings are inherited from the building construction practices in the period 1950-1985). There are a lot problems and complex ones, and at this stage it is difficult to organise the establishment and functioning of an unifying structure. It is feasible to expect the establishment of such association when the intention of MEER is realised to introduce the practice of appointing a representative of the building to be responsible for the relations with the DH company. This representative will collect and perform the payments for consumed heat and will settle the questions and problems with the heat supplier and the “heat accounting” company. The common interests and activities of these representatives are most likely to enforce them to associate in a structure similar to Building Owners Association.

The owners of dwelling in DH buildings use the Consumers Federation in Bulgaria for protection of their interests. This Federation covers consumers of all kinds of goods and services and is very active in relation to energy producers and suppliers. There are cases of legal suits and procedures connected with the interests of heat consumers.
As already stated in several reports the DHC (21 in number) in Bulgaria are 100% state property. The only exception is DH Sofia (Toplofikacia Sofia) which is 59% municipal and 41% state property. Forthcoming is the privatisation process and the first 6 DHC (the smallest ones) are announced for privatisation and the state and the respective municipalities do not have any pretensions towards obtaining or preserving ownership.

It is foreseen in the future in the bigger DHC the activities of heat production to be separated from those of heat transmit. Similar to the electricity sector it is very probable to start with the privatisation of heat transmit and distribution in view of increasing the bill collection rates.

There are above 20 private heat accounting companies already active in Bulgaria. These companies also perform the installation of individual control and metering devices.

No doubt that the consumers attitude towards DH services is one of the main factors for the good image and effective operation of DH companies. Nonetheless that in isolated cases there are disputes and even legal suits, prevailing is the opinion that there is no conflict of interests and the two sides now their rights and obligations. This opinion is also proved by the sociological survey made in the beginning of the heating season 2002-2003 in the town of Bourgas (200 000 inhabitants). The prevailing assessments of the customers are positive, and all of them are aware of the comfort and advantages ensured by the district heating. For some consumers DH has no practical alternative (with the exception of electricity), as a big percentage of the heated dwellings are made of prefabricated panels, built at industrial scale and foreseen for DH supply. They do not have chimneys and storage places for solid or liquid fuels. Having in mind that there is no natural gas supply network in the town, and electricity is expensive, the only affordable space heating way is DH.

The main problem pointed in the survey which is also valid elsewhere, is the low solvency of a big part of consumers. For many clients the heating expenses in the season are over 50% of the household income. Due to this and in spite of the obvious advantages of DH, the consumers with lower income disconnect and live at a very low comfort level. This requires to speed up with the heat market liberalisation, cut of subsidies and redirect the state aid towards socially vulnerable population categories.

The public coverage of DHC activities is most widely developed in the press compared to other media. Usually the press stress on the negative results and conflict situations and as a rule take the side of the consumer, i.e. their readers. The other media seem to be more tolerant toward DHC and try to be impartial and reflect correctly any DH related event or decision.

It is quite common when a decision for price heat increase is taken, in the press to appear materials with estimates of how much will rise the heat expenses of a dwelling, how poorer will get people, etc. but the objective reasons of this increase (rise in fuel prices of cut of state subsidies) are not paid attention or even not mentioned at all.
In this respect it should be note that the DHC and their PR are quite passive and do not react adequately. It is necessary the DH companies to pay more attention to PR staff and to hire professionals and/or public faces in order to play active role in the media and thus improve their image.

2.2 Company Structures

There are 21 DHC established in Bulgaria in the towns of: Sofia, Plovdiv, Varna, Bourgass, Rousse, Pleven, Pernik, Sliven, Shoumen, Gabrovo, Vratsa, Kazanlak, Veliko Tarnovo, Razgrad, Lovetch, Jambol, Samokov, Trjavnna, Loznitsa, Pravets and Iskrets. All of them except Sofia are state-owned and are subordinated to MEER. Only in Sofia (where the municipality holds 59% of the shares) there is a Managing Board with three representatives of the Municipality and one of MEER and one of MF (Ministry of Finance).

In Annex 1 to the present report the most important characteristics of each DHC for the last three years (2000-2002) are given. It can be seen that they differ a lot according their size and coverage. No doubt that DH Sofia should be considered separately from the rest DH companies, as apart from the four main production sites (each of them bigger that any of the rest DHC) it has smaller heating stations, and some of these are also bigger than the other country-side DHC.

In the group of big DHC both regarding the installed capacities and regarding consumer coverage, the following companies should be included: Plovdiv (with two production sites), Pleven, Bourgas, Rousse, Pernik, Sliven and Varna. From these DHCs only Varna and Bourgas are not equipped with CHP. The DHC of Rousse – TPP Rousse, with electrical capacity of 400 MW (two units of 110 MW each are for only power generation and 180 MWe are for CHP) should be paid special attention. This TPP until not long ago was within National Electricity Company and was selling heat to DHC Rousse. It has been built mainly for power generation and therefore its electrical capacity is not related to the thermal capacity.

In the group of average-sized DHC in Bulgaria can be ranked: Shoumen, Gabrovo, Kazanlak, Vratsa and Veliko Tarnovo, and the first three have CHP.

The rest 8 DHC (Razgrad, Lovetch, Yambol, Samokov, Trjavnna, Loznitsa, Pravets and Iskrets) form the group of small DH stations with a limited coverage. Only in Pravets in 2000 a CHP gas generator with electrical capacity of 500 kW was installed under JI project with Netherlands.
The table below shows installed capacities of all 21 DHC in Bulgaria

<table>
<thead>
<tr>
<th>No</th>
<th>Site name</th>
<th>Electrical capacity (MWe)</th>
<th>Thermal capacity (MWt)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total for DHC Sofia</td>
<td>261</td>
<td>4881,1</td>
</tr>
<tr>
<td>1</td>
<td>TPP Sofia</td>
<td>75</td>
<td>1322,4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>624,6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>697,8</td>
</tr>
<tr>
<td>2</td>
<td>TPP Sofia-East</td>
<td>186</td>
<td>2014,4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1084,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>930,4</td>
</tr>
<tr>
<td>3</td>
<td>HS Zemljane</td>
<td>-</td>
<td>607,6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>26,1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>581,5</td>
</tr>
<tr>
<td>4</td>
<td>HS Ljulin</td>
<td>-</td>
<td>607,6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>26,1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>581,5</td>
</tr>
<tr>
<td>5</td>
<td>Regional HS</td>
<td>-</td>
<td>329,1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>86,4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>242,7</td>
</tr>
<tr>
<td>6</td>
<td>Total for DHC Sofia</td>
<td>85</td>
<td>660,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>660,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>TPP Plovdiv</td>
<td>85</td>
<td>67,4</td>
</tr>
<tr>
<td></td>
<td>HS Plovdiv – Jug</td>
<td>-</td>
<td>67,4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>9</td>
<td>Total for DHC Plovdiv</td>
<td>85</td>
<td>1089,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>740,1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>348,9</td>
</tr>
<tr>
<td>10</td>
<td>TPP Rousse-DH part</td>
<td>180</td>
<td>746,3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>630,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>116,3</td>
</tr>
<tr>
<td>11</td>
<td>TPP Rousse – Zapad</td>
<td>4</td>
<td>67,4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>67,4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>12</td>
<td>Total for DHC Rousse</td>
<td>184</td>
<td>813,3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>697,4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>116,3</td>
</tr>
<tr>
<td>13</td>
<td>TPP Pleven</td>
<td>36</td>
<td>512,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>279,4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>232,6</td>
</tr>
<tr>
<td>14</td>
<td>TPP Republika Pernik</td>
<td>80</td>
<td>502,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>502,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>15</td>
<td>TPP Sliven</td>
<td>30</td>
<td>464,6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>232,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>232,6</td>
</tr>
<tr>
<td>16</td>
<td>HS Bourgas</td>
<td>-</td>
<td>366,3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>17,4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>348,9</td>
</tr>
<tr>
<td>17</td>
<td>HS Varna</td>
<td>-</td>
<td>250,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>17,4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>232,6</td>
</tr>
<tr>
<td>18</td>
<td>TPP Shoumen</td>
<td>18</td>
<td>293,3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>177,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>116,3</td>
</tr>
<tr>
<td>19</td>
<td>TPP Gabrovo</td>
<td>18</td>
<td>159,1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>159,1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>20</td>
<td>TPP Kazanlak</td>
<td>12</td>
<td>197,1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>197,1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>21</td>
<td>HS Vratsa</td>
<td>-</td>
<td>175,6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>59,3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>116,3</td>
</tr>
<tr>
<td>22</td>
<td>HS Veliko Tarnovo</td>
<td>-</td>
<td>151,7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>35,4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>116,3</td>
</tr>
<tr>
<td>23</td>
<td>HS Razgrad</td>
<td>-</td>
<td>82,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>82,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>24</td>
<td>HS Lovetch</td>
<td>-</td>
<td>17,5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>17,5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>25</td>
<td>HS Yambol</td>
<td>-</td>
<td>128,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>128,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>26</td>
<td>HS Samokov</td>
<td>-</td>
<td>35,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>35,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>27</td>
<td>HS Trjavnna</td>
<td>-</td>
<td>29,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>29,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>28</td>
<td>HS Loznitsa</td>
<td>-</td>
<td>18,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>18,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>29</td>
<td>HS Pravets</td>
<td>0,5</td>
<td>26,5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>26,5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>30</td>
<td>HS Iskrets</td>
<td>-</td>
<td>13,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>13,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>31</td>
<td>Total for the country</td>
<td>724,5</td>
<td>10204,5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5309,8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4894,7</td>
</tr>
</tbody>
</table>
The enlisted in the table installed capacities include the following generating equipment:

- Steam generators, providing cogeneration of medium (3.9 MPa, 450º) and high parameters (10 MPa, 500º). Their installed capacity (steam generation capacity) is within the range from 35 t/hour to 220 t/hour.

- Steam generators of low parameters (1.3 MPa, 191º C) with steam generation capacity from 4 t/hour to 25 t/hours (the most common is 12 t/hours).

- Water heating boilers with thermal capacity 58.15 MWt and 116.3 MWt. There are 5 of the first type installed in the country, and 37 of the second type (out of which 24 are in Sofia).

- Steam extraction turbines with electrical capacity 25 MWe and 50-60 MWe

- Back pressure steam turbines with electrical capacity from 4 MWe to 66 MWe.

Heat transit and distribution is done by means of water pipeline networks (over 1830 km, of which 800 km are in Sofia), steam pipeline networks (315 km, of which 64 km are in Sofia), by means of over 22 thousands substations and by means of pumping stations.

The business relations among the key players in production, transit and distribution of heat were presented above.
3 Heat Market

The structure of heat market, main data about the production and transit of heat, as well as the share of CHP are given in Annex 2 of the present report (Tables from 1 to 4). The last three years are analysed (2000-2002) for all DHC in Bulgaria. The term “dwelling equivalent” refers to the public and administrative buildings district heated, equalised to an average dwelling (70 m², 200 m³). For comparison reasons in Table 5 are given some of the main DH indicators 10 years ago (1993), showing the market changes.

The analysed statistical data allow for the following main conclusions:

• Heat sales decrease. During the past three years the fall is by 11.3 %, and for the past 10 years (1993-2002) it is by 47.2 %.

• Much bigger is the decrease rate in industry – respectively 16.2 % in the period 2000-2002 and 60.4 % for 1993-2002 period. The main reason is the strong reduction in steam consumption for technological needs. Many of the DHC lost their industrial clients which industrial nomenclature changed drastically, and some of them stopped operation. For example in 1990 DHC of Gabrovo had 56 industrial consumers and at present they are only 3. Similar is the situation in the other towns, incl. Sofia.

• Smaller is the sale decrease in the domestic sector. For the period 1993-2002 it is 44.4 % which is due to clients disconnects because of heat price increase till 2000, when there was still no system for individual measuring and billing of heat consumption. During the past three years there is a 11.1 % reduction and it is highly influenced by the possibility of clients to regulate their heat consumption and consequently the heat bills.

• There is a tendency of stabilising of domestic heat market during the past 2-3 years. The number of disconnects is almost equal to this of newly connected clients (either re-connected old clients or new ones) mainly in big towns. At present DH systems cover about 1.4 million people or 18 % of the country population.

• The cogenerated electricity by the DHC in the past 3 years is relatively stable. It is in the range of 2300 mln. KWh/year and provide about 5.5, of the total electricity generation in the country. Nevertheless the share of cogen-
erated electricity is far from the satisfactory levels. For 2002 the cogenerated electricity is 28% of the heat production and it is due to the fact that many of the DH capacities (incl. in Sofia) do not have CHP equipment.
4  Technical Improvement of the DH/CHP Supply

4.1  DH Boilers

4.1.1  Current State of Boilers

In the DHC there are over 220 boiler aggregates and they can be classified according type and thermal capacity as follows:

- Energy steam generators providing CHP, with medium (3.9 MPa and 450° C) and high (10 MPa and 500/540° C) steam parameters and with productivity of 35 t/hour, 75 t/hour, 120 t/hour, 160 t/hour and 220 t/hour.

Industrial steam generators with initial steam parameters 1.3 MPa, 191° C and productivity from 4 t/hour to 50 t/hours. The most common is the type with 12 t/hour (8.72 MWt). In the bigger heating stations (equipped with only water heating boilers) these steam generators are mainly for meeting of site own demands of steam. In the smaller sites they are use to supply clients.

Water heating boilers for hot water production with heat capacities 8.72 MWt, 58.15 MWt and 116.3 MWt. The most commonly used are boilers with capacity of 116.3 MWt (there are 24 of them installed in Sofia only).

The above three types of boilers have been constructed during different periods within the past 50 years. Energy steam generators are the oldest as the construction of the DH systems started with them. Some of them have already been decommissioned due to full amortisation, and others have been operational for 30-40 years. Relatively newer are the water heating boilers installed at later stages of DH development. In the biggest DHC – DH Sofia (Toplofikacia Sofia), the boilers have been installed in the following order:

- Energy steam generators:
  
  3x170 t/hour – 1953 (already decommissioned);
  
  4x220 t/hours – 1964;
  
  2x220 t/hour – 1967;
1x220 t/hour – 1985;
1x220 t/hour – 1987;

- Water heating boilers (116,3 MWt):
  2 boilers – 1967;
  3 boilers – 1972;
  5 boilers – 1975/76;
  4 boilers – 1977/79;
  9 boilers – 1981/1982
  1 boiler – 1989.

The most common fuel used in DHC in Bulgaria is natural gas. Out of 10204,5 MWt total installed capacities 8224,2 MWt or 80,6 % are natural gas fuelled. 1439 MWt (14,1 %) are on coal, and 541,3 MWt (5,3 %) are on heavy fuel oil – mazout. It is foreseen in the following 2-3 years 65 MWt coal fired and 47 MWt heavy fuel oil fired to be decommissioned, and further 296 MWt to be refurbished to switch from heavy fuel oil to natural gas. Three TPPs will continue to use coal, with total heat capacity of 1364 MWt (Rousse, Pernik and Sliven) and only TPP Kazanlak (197,1 MWt) will be left on heavy fuel oil.

A big part of steam generators and water heating boilers initially heavy fuel oil fired, have undergone major refurbishments and modernisation after switching to natural gas (with membrane surfaces, low emission burners for NOx reductions, etc.) and are very good technical condition. Their coefficient of efficiency is within 89-92 %.

4.1.2 Indication of Suitable Projects

The analysis of operational DH boilers shows that there is a limited scope for their refurbishment. The following measures can be considered:

- Installation of low-emission gas burners at the boilers not equipped with such, in order to comply with the requirements of EU Directive 2001/80 for NOx emissions levels. This activity also currently underway, should be accomplished by 2007.

- Refurbishments of the steam generator with productivity 220 t/hour in TPP Sofia – replacement of heated surfaces, new burners, replacement of high pressure steam pipelines;
• Installation of a new energy steam generator 160 t/hour in TPP “Republica” (town of Pernik) for burning of high ash content brown coal in FBC to replace two steam generators of 110 t/hour each, that are to be decommissioned.

• Refurbishment of a steam generator of 220 t/hour in TPP Republica (town of Pernik) incl. mounting of a new electrical filter and installation for dry desulphurisation of flue gases.

The activities for replacement of existing burners with low-emission gas burners is being done mainly with own funds from depreciation and partially from major overhaul funds.

The financing and realisation of the project for refurbishment of the steam generator in TPP Sofia will be determined after accomplishing negotiations with the Municipality of Sofia and DH Sofia with a foreign investor for joint venture establishment. The contract is expected to be finalised shortly. It is foreseen the construction of a steam-gas CHP module with electrical capacity of 127 MW. It will be working in conjunction with a conventional module including the refurbished steam generator of 220 t/hour and one steam extraction turbine of 60 MW. It will also be a new one and should replace the existing worn-out turbine of the same type.

For meeting the peak heat loads will be used the existing 6 water heating boilers of 116,3 MWt each, that are in good technical condition.

The financing of the two projects in TPP Republica (Pernik) has not been secured. The investment is assessed to 37 M€uro, of which 30 M€uro are for the new FBC boiler and 7 M€uro are for the reconstruction of the existing steam generator of 220 t/hour. The intentions are to try to use ISPA funds in combination with governmental support from Germany.

Apart from the expected environmental benefits from reduction of emissions of SO\textsubscript{2} and dust, it is expected to realise profit from electricity sales. The two steam generators (new and refurbished) will feed two turbines (55 MWe and 25 MWe) with an annual electricity output of about 400 GWh and sales (net output) of about 340 GWh. The profit per sale of 1 MWh will be of the range of 15 Euro, i.e. an annual profit of about 5,1 M€uro is expected. The simple payback, therefore will be about 7 years not taking into account the environmental benefit and emissions trade benefit.

The most attractive projects at the DH sites are related to construction of steam-gas or gas-turbines CHP modules. Apart from the above mentioned project in TPP Sofia investigations have been made for the following sites:

<table>
<thead>
<tr>
<th>DH Zemljane (DHC Sofia)</th>
<th>86 MWe</th>
</tr>
</thead>
<tbody>
<tr>
<td>DH Ljulin (DHC Sofia)</td>
<td>43 MWe</td>
</tr>
<tr>
<td>DH Ovcha Kupel 2 (DHC Sofia)</td>
<td>6,4 MWe</td>
</tr>
</tbody>
</table>
For some of the above mentioned sites (especially those in Sofia) there is interest on behalf of investors – Bulgarian and foreign (Germany, UK, Finland, Greece). These potential projects are reviewed in more details in the company level survey.

### 4.2 DH Network Refurbishment

The rehabilitation and refurbishment of the DH networks and substations is a complex of measures of the same importance as production sites refurbishment. These include the following measures:

- Full replacement of all old direct substations with new automated indirect ones. This is ongoing in all DH companies in Bulgaria.
- Replacement of pipes laid in concrete foam with pre-insulated pipes. The measure is on-going, too.
- Insulation improvements of underground or overhead pipelines;
- Replacement of sliding with expansion joint compensators
- Variable speed drives of network pump motors;

The above are included in the three-year business plans of the DHC. Necessary investments have been determined for each site, as well as the economic and environmental benefits, paybacks and credit service terms.

In order to assess the scale of rehabilitation and modernisation works on DH networks, some major parameters of DHC Sofia business plans for 2003-2006 are shown below:

**Necessary investments:**

<table>
<thead>
<tr>
<th>Description</th>
<th>Costs (MEuro)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refurbishment and replacement of 8030 substations</td>
<td>58,55</td>
</tr>
<tr>
<td>Replacement of 76 km heat transmission networks, compensators and fittings</td>
<td>34,25</td>
</tr>
<tr>
<td>Replacement of heat insulation</td>
<td>2,55</td>
</tr>
<tr>
<td>Variable Speed Drives at Network Pump Motors</td>
<td>7,00</td>
</tr>
</tbody>
</table>
Accomplishing works on new heat transmission main pipelines \hspace{1cm} 0.50 \text{ MEuro}

Close-down of 4 heavy fuel oil fired regional heating stations and transferring of their clients to TPP Sofia \hspace{1cm} 4.15 \text{ MEuro}

Total 107.0 \text{ MEuro}

The necessary investment will be provided from different from the following financial sources:

- EBRD loan: 30 \text{ MEuro}
- WB loan: 26 \text{ MEuro}
- EBRD grant: 30 \text{ MEuro}
- Own Funds: 21 \text{ MEuro}

Economic effect:

- From substations replacement: 16.6 \text{ MEuro}
- From replacement of pipelines, compensators and fittings: 7.8 \text{ MEuro}
- From variable speed drive application: 2.7 \text{ MEuro}
- From closing down of 4 HS: 2.0 \text{ MEuro}

Total 29.1 \text{ MEuro}

The above data show that the simple payback of the two loans (without payments of interest) is below 4 years. The following benefits should be also noted:

- Provision of security and operational safety of the system;
- Enlargement of the DH network coverage and connection of new clients;
- Annual emission reduction of CO$_2$ with 356,000 tones and of SO$_2$ with 1000 tones.

4.3 Consumer Installations

The improvements of consumer installations are directly connected with the replacement and automation of substations as the latter reflects directly on decrease of consumption and bills.

Additional effect was gained by the introduction of devices of individual control and measuring of consumption in the dwellings. In 2002 the consumers realised about 12 savings average for the country without lowering the comfort levels in dwellings.
Still open is the question of building refurbishment and improving of their thermal characteristics, especially for pre-fabricated panel type buildings. This would require significant investments, that are not affordable for a big part of population. In the draft Energy Act and draft Energy Efficiency Act there are some preferences and promotional activities foreseen in this respects, e.g. Soft loans, price promotions for the citizens deciding to take over building refurbishments.

4.4 Research and Technological Development Activities

4.5 Conditions for DH/CHP Investments

The rehabilitation and modernisation of DHC require significant investment. As it was already mentioned these could be secured in the following ways:

- Own funds (they can cover relatively small share of necessary investments);
- Grants (from foreign governments and/or banks);
- Credits from national and foreign banks;
- Joint venture creation where DHC participate with contribution in kind (building terrains, facilities and infrastructure) and the investor provides the funds for new construction;
- Construction of independent energy site by an external investor, that produces and sells electricity to the transmission/distribution company in compliance with the Energy Act, and heat – to the regional DHC;
- JI projects implementation and green certificate trade.

4.6 Human Resource Development Needs

4.6.1 DH Company Operations

Rehabilitation and modernisation works should be actively supported by the DHC themselves, and the following factors are of great importance for this:

Availability of developed concepts and mid-term (3-5 years) business-plans of the companies;

Clear strategy and policy for the development of DH sector at regional and national level;
Approved legal and regulatory framework – the new Energy Act, the new Energy efficiency Act (both from 2003) and related regulatory documents;

Availability of highly qualified managerial and executive staff with long record of experience in the DH sector;

Knowledge and utilisation of the domestic and foreign experience in the DH field, about DHC management and about development and realisation of new energy projects;

Settled in the Energy Act relationships with the customers and fuel supplies;

Positive image in mass-media;

4.6.2 Project Cycle Management

As it was already mentioned all major DHC during the past 7-8 years have been continuously in touch with international institutions and external experts connected with identification, planning and appraisal of investment projects. Such institutions are the World Bank, EBRD, World Energy Council, and companies from USA, U.K., Germany, France, Japan, Denmark, Finland, Russia, Italy, etc.

In general it can be affirmed that the human resource potential in the Bulgarian DH sector is big and fully matching the activities of investigation, planning, technical and economic appraisal, execution and management of energy investment projects.

4.7 Needed Tools for DH/CHP Sector Development (Outlook for Phase 2)

4.7.1 Technical and Organisational Development Tools

Guidelines for introduction of CHP in existing DH systems, especially regarding financing issues.
5 Developing Tools and Measures

The phase 1 survey at sector level in Bulgaria has shown clearly that the future sustainability and competitiveness of DH sector in Bulgaria is directly related in introduction of CHP as a major energy efficiency and environmental protection measure. Therefore the main effort of Phase 2 has been placed on overview of financing options for financing CHP projects in Bulgarian DH companies.

5.1 Overview of financing possibilities presently available for DH sector in Bulgaria

At present there are limited possibilities of the Bulgarian state to directly finance investments in the energy sector and therefore in the policy and strategy documents it is forseen to rely upon attracting foreign investments. However, due to the specifics of the DH sector, it has been recommended to utilise state resources for energy efficiency measures in this sector, as the economic benefits are significant, but in this transition period the legal, regulatory and other barriers make investment in DH still not attractive for private foreign capital involvement. Currently the foreseen measures include rehabilitation of heat transmission and distribution network in DH Sofia funded by EBRD, WB and other international donor plus own funds, rehabilitation of DH Pernik – network and production unit for which a WB loan has been agreed and the procedure for co-financing with ISPA funds is at advanced stage, and the project for rehabilitation and automation of substations currently under way.

Another promising direction for increasing energy efficiency at the production sites of the DH sector is the introduction of CHP in district heating stations. The efforts of the Ministry of Energy and Energy Resources will be directed towards finding possibilities to finance introduction of CHP in DH of Bourgas, DH Varna, DH Plovdiv (one of the units – Plovdiv-Jug), DH Veliko Turnovo, DH Kazanlak. As these are relatively big investment projects (about 25-40 MEuro) financing possibilities should be searched among different sources in order to share the associated risks – i.e. JI scheme, soft loans, EU financing programmes (Phare and ISPA), etc.
5.2 Available financing schemes

So far the two major DH investment donors in Bulgaria have been EBRD and WB (mainly by means of loans). As mentioned above the major DH network rehabilitation projects are being executed with the support of these funding institutions. It should be mentioned that such big investments are as a rule secured with a state guarantee on the funds provided by the donors.

- **ISPA** (Instrument for Structural Policies for Accession) fund is one of the main pre-accession investment instruments open for Bulgaria at present and it is devoted to environment and transport. It is operational till 2006. At the end of 2003 all allocated ISPA funds related to the environment for 2000-2003 has been absorbed in the form of projects mainly waste treatment and management (incl. landfills for solid municipal wastes, water treatment stations, etc.). Up to now there are no major investment projects in the DH sector, financed by this mechanism. Having in mind that many DH related projects have significant environmental benefits, ISPA can be treated as a promising financing source for future projects in the DH sector of Bulgaria.

- **PHARE.** The active financial support of Phare has recently been directed mainly toward institution strengthening/building, such as strengthening of SERC and energy efficiency agency in Bulgaria. Real investment opportunities could be sought in the Kozloduy International Decommissioning Support Fund, managed by the EBRD. In March 2002, the Bulgarian Parliament ratified the framework agreement between Bulgaria and the EBRD concerning the activities of the Fund. In November 2001 and June 2002, the Fund held meetings of the Assembly of Contributors, who formally approved the installation of a Project Management Unit on the site of the Kozloduy Nuclear Power Plant and the construction of a dry spent fuel storage facility on site. In addition, funding was granted for projects designed to support efficiency measures in the energy sector in Bulgaria. Through this the Fund contributes with 30 MEuro to the rehabilitation of the Sofia District Heating network, in which other international institutions also participate. This should bring improvements in the living conditions of around 900 000 people living in Sofia. The main contributor to the Fund is the European Community represented by the European Commission. Several other donors, including some Member States, also contribute to the Fund.

- **EU Structural and Cohesion Funds** are open only to member-states, so they should be viewed only as a future opportunity for financing investment in DHC. In view of Structural funds utilisation a Strategy for Participation of Republic of Bulgaria in EU Structural and Cohesion Funds has been developed. Complementary to the strategy a National Plan for Economic Development of Bulgaria 2000-2006 has been recently developed with the main aim to set the priority sectors of development in view of greater utilisation of EU Structural and Cohesion Funds at the time when these will be open for Bulgaria (2007). There are chapters dedicated to energy development where the priorities direc-
tions and possible needs of financing are outlined. The outcomes of this National Plan are used for prioritising the state needs to benefit from pre-accession instruments such as Phare and ISPA, and will be used as a basis for prioritising of EU Structural Funds in the future (after 2007 – forseen year of Bulgarian accession to the EU). In Indicative Programme “Increase of Competitiveness of Bulgarian Economy” the energy sector development is one of the four priorities for development. The main directions are: (1) Security of supply; (2) Energy market liberalisation and (3) Reducing of energy intensity by improving energy efficiency. The modernisation of exiting heat production units with CHP introduction (mainly based on natural gas) is set as an important way to achieve the targets in the energy development. Another priority area regarding the DH sector is achieving energy efficiency in district heat supplies. These outcomes form the basis for financing possibilities of big DH sites in the future.

- **Joint Implementation Mechanisms under Kyoto Protocol**

Another feasible opportunity to co-finance projects in DH sector of Bulgaria is the utilisation of the flexible mechanisms envisaged in Kyoto Protocol, i.e. JI mechanism and utilisation of Prototype Carbon Fund. At present there are three operational facilities for cooperation under JI mechanism in Bulgaria, as follows:

- A Memorandum of Understanding between Republic of Bulgaria and Kingdom of Netherlands in the field of greenhouse gas emissions reduction, in compliance with Article 6 of Kyoto Protocol;

- A Memorandum of Understanding for mutual cooperation for JI project implementation between Republic of Bulgaria and Republic of Austria

- Memorandum of Understanding between the Government of the Republic of Bulgaria and the Government of the Kingdom of Denmark on Co-operation under Article 6 of the Kyoto Protocol to the UN Framework Convention on Climate Change

- A Memorandum of Understanding for mutual cooperation for JI project implementation between Republic of Bulgaria and Switzerland

Forthcoming is the Memorandum of Understanding with Germany.

There is a JI Unit established at the Bulgarian Ministry of Environment and Waters to coordinate on the above mechanisms application and JI project execution in Bulgaria.

DH sector projects that are eligible to be implemented under the JI mechanism are:

- Replacement of fuel base;
o Introduction of CHP in heating stations;
o Rehabilitation of heat networks related to reduction of losses;

A Framework Agreement between Republic of Bulgaria and World Bank as a trustee of the Prototype Carbon Fund has also been concluded and a project for biomass utilisation for CHP in a Bulgarian cellulose industry has been financed under this mechanism.

- **Privatisation of DH companies** is also viewed as possible option to inflow “fresh money” in the sector, and at present there are 6 regional DH companies put forward for privatisation - these are with least heat capacities with no CHP and are not subsidised by the state budget.

- **Energy Efficiency Fund**

  In the new Energy Efficiency Act it is provided for the establishment of an Energy Efficiency Fund with the financial aid of GEF and WB. This will be a revolving Fund giving grants and “soft loans” for energy saving measures incl. in DH sector, and at present the procedure of setting up its mechanism, principles and organisation is under way in Bulgaria.

- ** Tradable Green Certificates**

  Another option with long term perspectives, related to DH investments in CHP introduction is the Green Certificates scheme and the prodecure and mechanisms for their trade. The new Energy Act provides for compulsory purchase of co-generated electricity till the time when a system for issuing of and trade with green certificates will be established. The rules and conditions for issuing of green certificates and trade with them will be settled in an ordinance, issued by the Minister of energy and energy resources. The scheme will cover electricity from RES and co-generation. The Minister of energy and energy resources will specify the minimum quantities of electricity from combined production as a per cent of the total annual production of each producer for 5 years period commencing at the date of introduction of the system for issuing and trade with green certificates. Each producer meets his obligation for co-generated electricity if he presents to the Minister of energy and energy resources green certificate(s) on his name or bought (one or more) by another producer of electricity, indicating the quantity of combined electricity production, being his obligation. The introduction of TGC scheme will allow for separation of the “green” part of the cogenerated electricity and for its trade, i.e. making money on it, thus providing a stimulus for introduction of CHP in heat energy suppliers.

### 5.3 Influence of legislative and regulatory framework on financing of CHP investments in DH sector

It should be noted that closely connected with financing issues are the regulatory issues such as prices and tariffs of CHP electricity from DH sector, licensing regime, practical arrangements of schemes for green certificates trade, etc.
It has been proved, that these issues directly influence the economic and financial results of CHP investments, and therefore the profitability and return on investment, which in all cases is very important for any potential financier of such projects. As it was already mentioned, the efforts of Bulgarian policy making and regulatory bodies at present are directed towards development of effective and non-discriminatory regulations suitable for liberalised energy market to become effective after 2007.
6 Sources of Information

The main sources used for the preparation of the present report are:

1. Energy Act (2003);
2. Operational account data of the DHC for the period 2000-2002;
3. Short-term and medium term business plans of the DHC;
4. Studies by local and foreign companies about the development of different DH sites;
5. Preliminary offers of equipment suppliers;
7. Contracts concluded for supplies and credits;
8. Reports from different local and international conferences and seminars.
9. Presentations and discussions at Workshop for Promotion of Cogeneration in Bulgarian DH Sector, held on 27 May 2004 in Sofia.
7 List of Annexes:

Table 1 Production and sales of electricity and heat for the period 2000-2002

Table 2 Connected and disconnected dwellings for 2000-2002

Tables 3 and 4 Bill collection ratio for years 2001 and 2002

Table 5 Comparative data of DHC for 1993

Table 6 Investment projects for CHP gas turbine modules application