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Energy & Utility Consulting

Final Report

Taganrog District Heating Company

Business Plan 2007-2012

Taganrog, 30/07/2007

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Abbreviations

Abbreviation	Explanation
CHP	Combined heat and power
DHW	Domestic hot water
HoB	Heat only boiler
TE	Taganrog TeploEnergo (district heating company of Taganrog)
Rb	Ruble (Rouble), Russian currency

1 Executive summary

1. TE is one of the first DH Companies in Russia that was privatized. Initially TE was established in 1997 as a local branch of the regional heat enterprise. In 1997 it became a joint stock company. In 2004 the Center-Invest Bank (CIB) succeeded to by in an open competition 49% of TE, the rest was given to the employees. By buying additional shares from the employees. CIB's share increased to 70%. In addition Gazprom purchased 16 %.
2. TE covers 57% of heat of heat supply and about 75% of DHW supply in Taganrog. Heat is generated in 50 boiler houses (additional three boiler houses are outside Taganrog in the region) with approximately171 boilers. The installed capacity is 310 Gcal/h and 225 Gcal/h is the normative peak capacity connected to TE's district heating networks. There is one main boiler house with an installed capacity of 110 Gcal, 7 regional boiler houses with capacities from 15 to 24 Gcal/h and the remaining boilers are small. 21 boiler houses are built-in mini boiler houses located in the cellars of the buildings and have been converted from previous coal fired boilers. The boilers are not very efficient and are equipped with obsolete technology without control and weathering regulation devices. Those boiler houses are the primary target of TE to be replaced by merging into few, large, modernised boiler houses and/or connection to the main DH network if possible.
3. The main shareholder of TE, CIB, is a successful Russian Bank. It was likely the influence of the Bank's experience in commercialization that made TE one of the most successful DH companies in Russia. TE is well organized, has already gained experience in rehabilitation and modernization and has reasonable visions about the expansion of the business. Moreover, TE offers the lowest heat tariff in the city. TE's consumers do however not fully benefit from this low tariff, as the Municipality calculates an average heat price that is significantly higher the TE's tariff.
4. The company's management qualification obviously derived benefit from the private ownership aiming to convert the old-fashioned district heating service to a commercial business. District heating companies all over Europe are mostly municipal owned and key management position are usually filled due to political deliberations and general directors typically have only a rough idea about the business. This is completely different with TeploEnergo. The general director is an experienced district heating expert, who is well informed about the technical and financial aspects of his business. Although not all of the managers mentioned in Table 2 have been met by the consultant, the competence, experience, and also commitment seems generally to be on a very high level. Definitively, the "human capital" is one of the biggest assets of the company.
5. TE has a positive attitude to foster energy efficiency on the demand side. TE would be interested to invest in and promote energy efficiency measures on the demand side, but the current institutional framework does not allow this. TE's responsibility ends at the point of delivery that is a shut-off valve somewhere in the network. Thereafter pipes are typically owned by building owners and maintained by the municipal housing management company. The promotion of energy efficiency can only be achieved indirectly, through a joint program with Center-Invest Bank for provision of loans to TE's customers for energy saving measures, such as insulation of walls, new windows and doors installation, heat meters, heat-adjusters.

6. Both authors have worked with many DH Companies in CEE Countries to prepare loans financed by international financial organizations, banks, and development agencies. From our point of view, this is one of the best, if not the best organized company, which was asking for such a loan.
7. The proposed project aims to continue the rehabilitation and modernization of the existing service areas and additional ones to be acquired soon. In the past, TE has already achieved significant energy and cost savings and this process is expected to continue with the proposed project. As for the DH system Taganrog is typical for many cities in Russia, the project will serve as a model for other cities and could also initiate discussions about beneficial changes in the legal and regulatory framework.
8. TE is owner of all the main equipment (assets) used for DH supply, except secondary networks, which are typically owned by the owners of the connected buildings. Besides this, TE is owner of real estate of 21.800 m?and land of 60.100 m?(with all the corresponding property rights).
9. The investment project has to focus on a part of the supply system due to institutional reasons. TE owns the heating plant and the primary network. Primary and secondary network are only separated by a shut-off valve, but constitute hydraulically one system. According to the contract signed with the municipal housing management administration, TE delivers heat only to this point. Accordingly, TE does not bear any responsibility for the heat quality in the buildings. Therefore TE has neither a mandate nor an incentive to invest behind the delivery boundary. This could change in the future when the secondary networks would be transferred to the DH suppliers like in most other CEE Countries, but so far there is no such indication.
10. The project comprises the following components. (i) Rehabilitation and replacement of boilers in the existing service areas amounting to about ˆ 11.8 million. This will increase the average boiler efficiency from 80% to 90%. (ii) Rehabilitation and replacement of seven local DH systems currently operated by the municipal DH Company. TE will take over the service. Similar efficiency gains as in TE’s service areas can be expected. (iii) A small CHP Plant (400 kW electric) will provide electricity for own consumption and partially through the grid (and/or neighbouring industrial customers). A larger unit would be more advantageous (much lower specific investment costs and significantly higher efficiency), but due to uncertainty about feed-in electricity price TE prefers to start with a small unit. (iv) Building substations (including heat meters) for those buildings that are going to be supplied directly by TE. The respective buildings will sign a contract with a subsidiary of TE, which will be in charge of maintenance the secondary network and other services.
11. The proposed project has an IRR of 15%. The IRR of the single components are: (i) Rehabilitating the existing boiler and network systems with IRR 15%, (ii) Acquiring seven municipal heating systems and installing new HoBs and networks with IRR=14%, (iii) Implementing a small scale CHP plant to replace purchased electric energy with IRR=8%, and (iv) Installing mixing loops with weather controllers in the building basements as substations with IRR=14%. The above IRR values are based on the existing prices of resources and revenues, except the gas price that is expected to be 40% higher than in summer 2007 in compliance with assumptions for the financial projections.
12. The financial forecast considers two financing options. The first option is a ˆ 15 million EBD loan. The second option is a ˆ 10 million EBRD loan plus a ˆ 5 million equity investment by the EBRD. The second option results in slightly lower tariffs for the final consumers and an improved cash flow. The profit (net income) is

almost the same under both options. The main reason is that under the current regulatory framework the profit is linked to expenses and not to capital (equity).

13. A larger thread to TE is the current tariff setting system. Tariffs have to be approved annually by the municipal and regional regulatory entities. This is still a common practice in a number of new EU members. Others however, have started to move towards an incentive regulation. Whether the new heat law is expected to pass the Russian Parliament soon, will promote such incentive a regulation is not yet clear. The draft law, at least, extends the minimum regulatory period to three years. If this will be combined with the “investment method” (Allowing a guaranteed pay back of the investment period over a relatively short period of time), the method would provide some incentives for investors.

14. Consumption-based billing could help to offset the effect of necessary tariff increases (in terms of RB/GCal) by reducing the (billed) energy consumption. Consumption-based billing can so far only be implemented on a voluntarily basis with approval of the respective building owners. Moreover, this would only apply to the buildings that are envisaged to sign a contract with the Housing Management Services Company. The short term projection amounts to about 7% of the buildings. Even if the share would be much larger, only a regulation requiring consumption-based billing would be able to implement effectively consumption based billing, but this is beyond the competence of TE.

15. In general, TE has a high potential to expand its scope of businesses. The human capital and the financial background of the owners could support this strategy. Expansion means mainly:

    - Expanding geographically the existing district heating systems by connecting new consumers;
    - Acquisition of other DH systems inside and outside Taganrog. The most challenging project is definitively the envisaged acquisition of a district heating system in Sochi, host city for the XXII Olympic Winter Games in 2014. This would not only support the efforts of the authorities to improve the local infrastructure, but would also support the company’s efforts to disseminate the new business concepts for revitalizing DH all over Russia.
    - Provision of added value services, i.e. service provided beyond the contractual point of delivery. Besides offering traditional maintenance services for the secondary networks and building internal heating systems (both owned by the building owners), the company would offer metering, meter reading, and cost distribution services. Moreover, this could also comprise installation of thermostatic valves, bypasses (in case of a one-pipe heating system) and heat cost allocators or apartment meters;
    - Engineering and installation services for other district heating companies. At least in the region this could become an interesting, as TE has become a pioneer in new district heating technologies and operation.

16. A driving for the expansion is the chairman of the board. At Prof. Vysokov’s initiative, Center-Invest Bank dedicated substantial resources to developing energy efficiency finance as a product and promoting it in Southern Russia. Center-Invest Bank took a US$4m dedicated energy efficiency loan from IFC in April 2006 and within a month had used all of the funds for energy efficiency. The bank’s clients have been diverse -- a pig farm, candy factory, vegetable oil producer, printing company, and a couple of bakeries, to name a few. The average payback for these investments was about two years, and the projects financed to date generate 15,757 tons of CO_2 savings per year. Center-Invest Bank continues to finance projects on its own account and currently has a deal pipeline of about

US$10m. In addition, the bank had an investment in the heating company in the city of Taganrog that is improving the supply of heat to residents while lowering prices due to investments in energy efficiency equipment. Prof. Vysokov estimates that the bank5 could allocate another US$ 80m to energy efficiency finance in the next few years in Southern Russia.

2 Current role of the company

Heat in Taganrog is generated by 16 competitive DH operators whereof the largest companies are the following:

- TE (OAO TEPTS TE covering 57% of the heating market and about 75% of domestic hot water market, and
- MUP “Taganrogenergo”, a municipal operator, covering abut20% of the heating and domestic hot water market.
- Other companies sharing the remaining market are (starting from the largest)
- OAO Krasnyi Kotelnik, private producer of large steam boilers
- OAO Tagmeg pipe plant
- FGUP Zavod Priboy
- OAO Krasnyi Gidropress
- OPB TPTU, etc

Some of the remaining companies are very small supplying only a few buildings in total.

OJSC TEPTS TeploEnergo (hereinafter referred to as TE), is one of few completely private large companies operating in district heating sector in Russia. TE supplies 456 residential buildings with about 34,000 apartments, 41 schools and 15 hospitals. 250 to 300 buildings are 9-stories buildings with approximately 240-250 apartments, almost everywhere supplied with domestic hot water corresponding to about 25% of total number of buildings. Remaining buildings are mostly 5-stories buildings with a minor number of buildings lower than 5 stories. The total structure of the buildings is suitable for district heating services and the least cost option of the DH system and its monopolistic position has never been doubted in Taganrog. Gas is the only fuel and all boilers have been converted from other fuels a long time ago.

TE covers 57% of heat of heat supply and about 75% of DHW supply in Taganrog. Heat is generated in 50 boiler houses (additional three boiler houses are outside Taganrog in the region) with approximately 171 boilers. The installed capacity is 310 GCal/h and 225 GCal/h is the normative peak capacity connected to TE’s district heating networks. There is one main boiler house with an installed capacity of 110 GCal, 7 regional boiler houses with capacities from 15 to 24 GCal/h and the remaining boilers are small. 21 boiler houses are built-in mini boiler houses located in the cellars of the buildings and have been converted from previous coal fired boilers. The boilers are not very efficient and are equipped with obsolete technology without control and weathering regulation devices. Those boiler houses are the primary target of TE to be replaced by merging into few, large, modernized boiler houses and/or connection to the main DH network if possible.

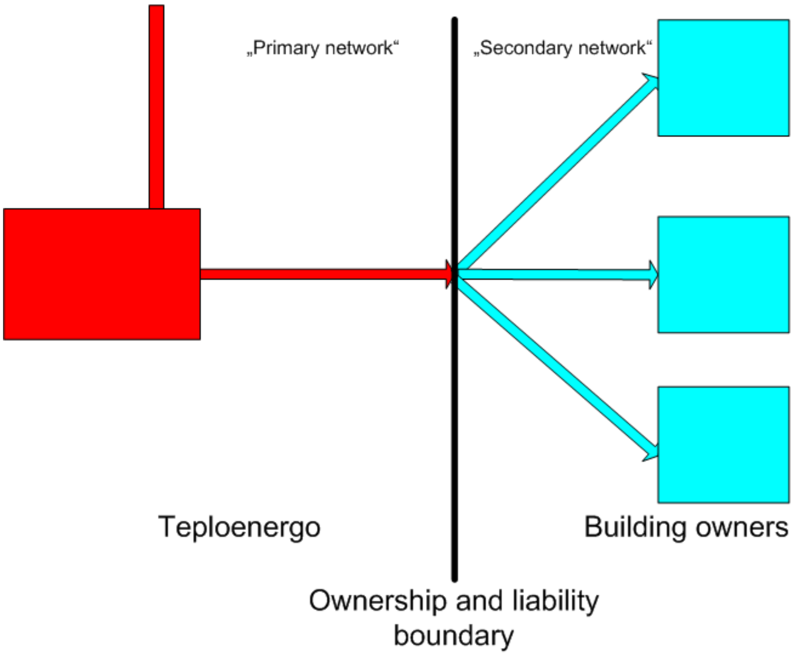
TE has already replaced some of the small boiler houses and modernized new and larger boiler houses with good financial results. Actual figures from these restructuring projects show that the energy cost per unit has been decreased by 40-50% and the pay-back of the investment is about 8 to 12 years. TE’s experience of the reconstruction is good and the future investment projects might be even more profitable as the equipment may be provided at better prices with economy of scale.

TE has only a limited role in DH supply. The liability for rendering the services ends as stipulated in a contract with the municipal housing management administration (MUP

ZHEU) at the point of delivery, which is a shut-off valve somewhere in the network (see scheme in Figure 1). TE does not bear any responsibility for heat losses in the secondary system or within the served buildings. Also, TE is not responsible for guaranteeing a certain heating comfort, such as maintaining a certain indoor temperature. In the past the heat delivery obligations were controlled by the respective gas consumption. Nowadays some of the boilers are equipped with heat meters.

It is obvious that under this contractual framework, TE does not have any incentive to improve conditions in the secondary network or buildings. TE, however, intends to expand its activities to the secondary system (that is, the network beyond the shut-off valve) and to housing management.

Figure 1 Current ownership and liability boundary



3 Strengths and weaknesses

This chapter focuses on the current strengths and weaknesses of TE, while other sections below will deal with the opportunities and threads.

3.1 Strengths

- Heat production costs: TE's production costs are significantly lower than those of the municipal district heating company. TE's costs for operation vary for each boiler house, but are in general set up by the Central Tariff Regulator at 657.60 RB/GCal. The corresponding tariff of the Municipal Heating Company is significantly higher. The average level of tariffs in Taganrog for residential consumers is 755.00 RB/GCal excluding VAT for 2007 (or 891.60 RB with VAT), which has been calculated by the Municipal Housing Management Administration as the average costs of the total heat supply (heat is supplied by various companies). This includes also a small fee for maintenance services of the secondary Experience in rehabilitation and modernization of DH system:
- TE has already gained substantial experiences in the rehabilitation and modernization of its heating systems resulting in considerable efficiency improvements and cost reductions. This experience will constitute an excellent basis for the proposed investment program.
- Management information system: Although it was not possible to assess the management information system in detail, an efficient system has been set up by TE. Significant information is stored in the computer systems and is available in very short time. This comprises both financial data and physical data.
- Billing and collection: TE has taken over the billing and collecting services from the municipal enterprise. This step helped to improve the collection rate significantly. It confirms the experience from other CEE countries where DH companies are often complaining about the performance of such municipal entities.
- TE intends to expand its business in the housing management service sector (which includes the secondary network system), which is currently dominated by the municipal enterprise. In this way revenues will be increased.

3.2 Weaknesses

- The current DH system is substantially oversized. In compliance with the traditional norms, the installed capacity of all boiler houses amounts to 310 GCal/h, while the connected load is only 225 GCal/h. The difference was needed for providing reserve capacity. With modern DH technologies and by interconnecting networks, the reserve capacities could be substantially reduced.
- The heating system is scattered and consist of about 50 local boiler houses with small networks. The biggest boiler plant has a capacity of 110 GCal/h, which is about 1/3 of the total installed capacity. Such structure does not allow exploiting economics of scale. Opportunities for interconnecting at least some of the system should be explored. This would also help to make better use of a future CHP plant.
- Tariff system: A typical weakness of the DH business in most CEE countries refers to the tariffs. Tariffs are subject to the approval of the municipal and regional (Oblast) regulatory authorities. In theory the approved tariffs should cover all (justified) costs.

In practice, however, delays in the approval procedures and rejection of certain costs will reduce profits or could even cause losses.

- Unaccounted heat consumption: Unaccounted heat consumption amounts to about 5% of the calculated sales. As not all sales are metered at the building level, it is difficult to assess whether this is illegal (unregistered) heat consumption or whether heat losses have been underestimated. Due to relative compact heating networks, heat distribution losses outside the buildings are likely relatively small. Accordingly, a substantial part of this amount is due to non-registered heat consumption which could be caused by high domestic hot water consumption. As in other CEE countries, the number of people living in the flat may be too low. In addition, building extensions, increasing the radiator size, and other measures may constitute to this phenomenon.
- Shrinking market within existing service areas: It is a common problem of DH systems in CEEC that with the beginning of rehabilitation and modernization measures the heat demand has gone down substantially, which is for a larger part due to energy saving measures undertaken by consumers (effect of consumption-based billing, insulation of buildings). It usually takes years to compensate this trend by new connections, but in practice this does not allow to off-set the reductions. New buildings within the existing service areas have typically a much lower demand than the old buildings even when they are larger.
- Competition by decentralized gas heating systems: TE pays 1,797 RB per 1000 m3 natural gas without VAT, inclusive the transport to the heating plant. Residential consumers pay 1,699 RB per 1000 m3 gas which is lower than for TE. Although investment costs for individual gas heating could be quite high (Typically about ˆ 1.000 per apartment in CEE Countries, including horizontal pipes), richer customers may want to switch. This would increase costs for the remaining customers and in this way, disconnections could be accelerated. Gas pricing based on real costs would help to stop such tendency, but gas pricing is beyond the competence of the DH Company. So far disconnections are not a serious problem due to institutional barriers, but this could change in the future.
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4 Scope of services and product development;

4.1 Short history of the company

Taganrog TeploEnergo was established in 1977, when a number of industrial companies located in Taganrog transferred their district heating assets to a newly formed enterprise –Taganrog TeploEnergo. At that time the enterprise was owned by RostovoblTeploEnergo, a regional heat producer and distributor. In 1997 Taganrog TeploEnergo was transformed into a Joint Stock Company. The enterprise was then included in the regional privatization list. In line with the privatization plan 40% shares were sold to the workers of TE, 49% were retained by the Oblast and 11% sold though an open action and bought by TE's management. On 19 November 2002 Oblast sold its shares (49%) at the open auction in line with the requirements of the federal legislation. The information on the auction was published in regional press (Fond Imushestva Bulletin). There were 2 bidders: (1) IFK Selmash-Invest and (2) Rostov – Invest, a shareholder of Center-Invest Bank. Rostov-Invest won the auction, offering the highest price for the shares. The results of the auction were then approved by the antimonopoly committee.

During the next couple of years Center-Invest Bank and its main shareholders purchased additional 28% shares in the secondary market. In parallel to Center-Invest, a Gazprom daughter company - MezhregionTeploEnergo purchased 16% of shares in the secondary market. The balance of TE shares is still owned by company workers.

4.2 Owners of the company

The main shareholders are given in the table below.

Table 1 Shareholders

No.	Shareholder's Name	Share Type	No. of shares	%
1	Center-Invest Bank	Ordinary	1 057 757	42.74%
		Preferred	494 379	19.97%
2	MezhregionTeploEnergo[1]	Ordinary	418 326	16.90%
3	Mr. Vysokov	Ordinary	184 700	7.46%
4	Ms Vysokova	Ordinary	184 710	7.46%
	Total			**94.53%**

The rest of the shares is in free float.

The shareholders of CIB are

- EBRD (27.45%),
- DEG (22.45%),
- Prof. Vysokov's family (17.85%),

[1] *Gazprom-controlled thermal energy firm*

- Firebird (9.9%),
- Renaissance Capital (8.15%),
- Raiffeisen Landesbank Oberosterreich (3.58%)

4.3 Structure of the company

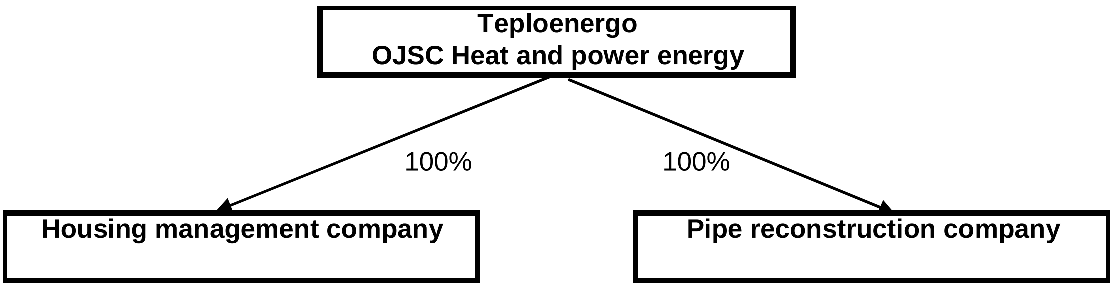
TE has three main businesses

- heating services
- building management services performed by the subsidiary company “Zodchy”
- design and construction of boiler houses and heating performed by the subsidiary company “Teplostroy” LLC

TE has received the following licenses:

- maintenance activity on explosive premises – issued by the Federal Service for Mining and Industrial Supervision
- maintenance activity on heating networks - issued by the Ministry of Power Engineering
- building construction of I and II responsibility levels - issued by the Federal Agency for Construction and Utility Sector

Figure 2 Structure of the TeploEnergo Holding



While TE needs a license to operate the DH system, the child companies do not require a license and are not subject to tariff regulation. In this way, the housing management company can supply services that are be beyond the licensed heating business and the respective tariffs or prices do not require the approval of the regulatory entities. Amongst other activities, TE intends to allocate the heat metering business to this child company. In this way the risk will be avoided that the additional costs of heat metering will not be approved as justified costs by the regulatory entities.

4.4 The board of the company

The board of the company consists of the following persons

- Chairman – Vasily Vysokov (President of Center-invest Bank)
- Tatjana Vysokova (Chairman of Auditing Committee of Center-invest Bank)
- Anna Shtabnova (Chairman of the Board of Center-invest Bank)
- Tamara Miroshnichenko – Corporate Secretary

- Viktoria Sadokova – (MezhregionTeploEnergo[2])

The chairman is an acknowledged economic and financial expert. He used to be assistant professor, senior lecturer, and associate professor of the department of national economy planning of the Rostov State Institute of National Economy. In 1995 he upheld a thesis for a doctor's degree in the Central Institute for Economics and Mathematics. From 1991 he served as head of the Center for Economic Support to Transfer to Market Economy under administration of Rostov Region. During 1997-1998 he served as general director of the federal fund for the support of small and medium sized enterprises in Moscow. From 1992-2002 he was deputy chairman of the board of directors of ISC Center-Invest Bank. Since 2002 he is chairman of the board of directors of the bank, vice-president of the chamber of industry and commerce, member of Rostov region governor's council for banking activities, member of Krasnodar region governor's investment council, and member of Rostov region council for small enterprises.

4.5 Management of the company

The company's management qualification obviously derived benefit from the private ownership aiming to convert the old-fashioned district heating service to a commercial business. District heating companies all over Europe are mostly municipal owned and key management position are usually filled due to political deliberations and general directors typically have only a rough idea about the business. This is completely different with TeploEnergo. The general director is an experienced district heating expert, who is well informed about the technical and financial aspects of his business. Although not all of the managers mentioned in Table 2 have been met by the consultant, the competence, experience, and also commitment seems generally to be on a very high level. Definitively, the "human capital" is one of the biggest assets of the company.

[2] *Representative of one of the share-holders*

Table 2 Management of TeploEnergo

Position	Education	Profession	In company since	In heat industry since	Start of current position
General Director - Dvorianinov Gennady Valentinovich	Higher education Polytechnic Institute, Novocherkassk in 1998	Engineer of heating power station	OJSC TEPTS TeploEnergo - since 1999.	In heat supply industry since 1989.	Position of the general director since 2004.
Chief engineer - Sapoznikov Andrey Eduardovich	Higher education Soviet Union Correspondence Polytechnic Institute in 1991.	Heat and power engineer „Industrial heating energy“	OJSC TEPTS TeploEnergo - since 2004.	In heat supply industry since 1988.	Position of the chief engineer since 2004.
Deputy director, production and marketing– Vasilenko Vladimir Aleksandrovich	Higher education Lvov State University in 1993.	Radio physicist (radio physics)	OJSC TEPTS TeploEnergo - since 1994 to 2003 and since 2004.	In heat supply industry since 1994.	Position of deputy director since 2004.
Head of economic planning department- Buvalka Elena Andronikovna	Professional education Aircraft technical school, Taganrog in 1982.	Technician (Programming Machine Maintenance and Setting)	OJSC TEPTS TeploEnergo since 1986.	In heat supply industry since 1986.	Position of the head of economic planning dpt since 2004.
Chief accountant – Cherednichenko Tatiana Urievna	higher professional education Taganrog Pedagogical Institute in 1983.	Teacher of physics and maths (Physics and Maths)	OJSC TEPTS TeploEnergo since 2004.	In heat supply industry since 2003.	Position of chief accountant since 2004
Head of Personnel Department– Kolomiytseva Svetlana Aleksandrovna	Professional education Technical school of marine instrument engineering in 1987.	Technician planner (Planning in machine engineering enterprises)	OJSC TEPTS TeploEnergo since 1995.	In heat supply industry since 1995.	Position of the head of personnel since 2004.

4.6 Heating business

The heating business of TE is so far focused on the city of Taganrog, which receives about 99% of the total heat sales. In addition, a small DH system in the city of

Matveev Kurgan is operated. TE supplies currently about 34.400 apartments and a number of nor-residential consumers with space heating and domestic hot water (see Table 3.)

The heat supply to residential consumers is based on a contract with the Municipal housing management enterprise. According to the contract between TE and municipal housing enterprise, TE has to deliver a certain amount of heat (both in terms of capacity and energy) to the delivery boundary, which is equipped with a shut-off valve. This is also the ownership boundary of TE. Pipes beyond this point are typically owned by the building owners. The first part of the network, which could be called primary network, has about 88 km of pipes (single length). The second part, the secondary network, comprises about 250 km of pipes. Primary and secondary networks constitute, however, a common hydraulic system

Table 3 Breakdown of customers

	Area			Heat sales in Gcal/yr			Sales in 000 Rb		
	2005	2006	2007	2005	2006	2007	2005	2006	2007
Non-metered consumption									
Residential consumers	1,490,000	1,495,375	1,490,184	322,111	324,275	320,696	206,099,509	226,807,792	248,850,804
Apartment owner associations	-	-	-	-	-	-	-	-	-
Budgetary units	-	-	-	-	-	-	-	-	-
Industrial	-	-	-	-	-	-	-	-	-
Self-sustained organizations	-	-	-	-	-	-	-	-	-
Metered consumption									
Residential consumers							-	-	-
Apartment owner associations				25,797	28,061	28,802	16,506,547	19,627,005	22,349,252
Budgetary units				52,654	52,055	54,318	33,690,189	36,409,277	42,149,076
Industrial				5,145	4,143	4,595	3,292,441	2,897,682	3,565,759
Self-sustained organizations				9,821	8,687	8,922	*6,283,887*	*6,076,334*	6,923,311

Most residential consumers (comprising the total of the first consumer group in the above table) are billed by a lump sum tariff. Space heating is charged according to the apartment area on a monthly basis and payments are distributed over a period of 12 months. Domestic hot water is charged according to the number of registered people living in the apartment on a monthly basis. All consumers pay the same tariff. A small number of the consumers receive, however, a special subsidy from municipal ad regional budgets.

All other customers are billed in accordance with the metered consumption. The price is the same for all consumers

Residential consumers are billed by TE, although a supply contract is signed with the municipal housing administration. This entity purchases heat from various heating companies. Each of the companies has its own tariff approved by the regulatory entity. The housing administration calculates a weighted mix of the heat prices that has to be paid by all consumers living in the respective buildings. The current price is 891 Rb/GCal, while the TE price is 775 Rb/GCal. TE can, however, retain only its own tariff. The difference is transferred to compensate the other supply companies.

Table 4 Tariffs for the various consumer groups (06/07)

Item	Unit	Excluding VAT	Incl. VAT
Lump sum tariffs			
Residential consumers	Rb/m?, month	9.82	11.59
Apartment owner associations	Rb/m?, month	-	-
Budgetary units	Rb/m?, month	-	-
Industrial	Rb/m?, month	-	-
Self-sustained organizations	Rb/m?, month	-	-
Domestic hot water	Rb/Person, month	94.45	111.45
Category 1	Rb/Person, month	75.55	89.15
Category 2	Rb/Person, month	80.85	95.40
Category 3	Rb/Person, month	52.89	62.41
Category 4	Rb/Person, month	103.52	122.15
Category 5		94.07	111.00
Consumption-based tariff			
Residential consumers	Rb/GCal	657.60	775.97
Apartment owner associations	Rb/GCal	657.60	775.97
Budgetary units	Rb/GCal	657.60	775.97
Industrial	Rb/GCal	657.60	775.97
Self-sustained organizations	Rb/GCal	657.60	775.97

The special domestic hot water tariffs apply only for non-metered residential consumers. The different categories relate to different types of DHW equipment.

Tariffs are theoretically equal for all consumer groups both for metered and non-metered customers. The lump-sum tariffs for the residential customers are calculated based on the respective consumption norms for space heating and domestic hot water applying the same price for the heat. Consumption norms have only been determined for residential consumers (see Table 5).

Table 5 Consumption norms for residential consumers

Item	Unit		Unit	
Space heating				
Residential customerrrs	Gcal/m?, mon	0.130	Gcal/m?, year	1.560
Domestic hot water				
Gcal/person, month	Gcal/person,	0.120	Gcal/person,	1.440
Gcal/person, month	Gcal/person,	0.100	Gcal/person,	1.200
Gcal/person, month	Gcal/person,	0.107	Gcal/person,	1.284
Gcal/person, month	Gcal/person,	0.070	Gcal/person,	0.840
Gcal/person, month	Gcal/person,	0.095	Gcal/person,	1.140
Gcal/person, month	Gcal/person,	0.137	Gcal/person,	1.644

TE has taken over the billing and collecting services a few years ago with the effect of a tangible improvement in collection rates. Current collection rates are shown in table 5. Such high collection rates are rare in the DH sector of CEE Countries.

Table 6 Collection rates in 2007

Consumer group	2004	2005	2006
Residential consumers	88.0%	86.9%	99.5%
Building societies and Habitation owners associations	93.0%	95.6%	101.9%
Budgetary entities	125.0%	99.5%	99.4%
Industry	101.0%	149.8%	130.5%
Self-sustained organizations	81.0%	97.9%	95.5%

Space heating is only delivered during the heating period. The normative heating period last 167 days, but the actual number varies with the outside temperature. During the last years a substantial fluctuation was observed (see Table 9). In the last three years the number of degree days was 24-11% below the design figures. That means, that in a "normal" year the heat consumption would have been 24-11% bigger, The "normal" degree days amount to 2.073; this number correspond to the long-term historical average. Whether the last three years deviate due to global warming or are just a statistical slip cannot be determined. Larger deviations from the normative parameters incur a high risk for the supplier under a lump-sum tariff systems and a one part energy tariff system (for details see chapter on tariffs below).

Residential consumers constitute the most important group both in terms of revenues and heat sales (see Table 7). Total sales differ by 5% from the theoretically calculated ones (by applying the normative consumption figures); probably due to un-accounted heat consumption and larger heat distribution losses than estimated.

Table 7 Decomposition of heat sales by customer base

Consumer grouo	Unit	2005	2006
Taganrog	Gcal/yr	411,185	412,911
Residential consumers	Gcal/yr	322,109	324,274
Building societies and Habitation owne	Gcal/yr	25,798	28,061
Local budget	Gcal/yr	28,498	26,789
Federal budget	Gcal/yr	12,833	12,543
Regional budget	Gcal/yr	8,333	9,737
Industry	Gcal/yr	5,146	4,143
Self-sustained organizations	Gcal/yr	8,469	7,365
Matveev Kurgan	Gcal/yr	4,337	4,304
Country-side	Gcal/yr	1,436	1,323
Local budget	Gcal/yr	2,901	2,981
Self-sustained organizations	Gcal/yr	6	6
Total	**Gcal/yr**	**415,528**	**417,221**

Table 8 Decomposition of connected load by customer base

Consumer group	2006	2007
Residential consumers	172.2	171.6
Space heating	128.5	128.1
DHW	43.7	43.5
Non-residential consumers	52.7	53.4
Space heating	45.6	46.1
DHW	7.1	7.3
Total	224.9	225.0
Space heating	174.1	174.2
DHW	50.8	50.6

Table 9 Climate data 2005-2007 and design parameters

Item	Unit	2005	2006	2007	Design
Heating period	d/year	170	163	167	167
DHW period	d/year	360	360	360	360
Hours of operation	hours/day	24	24	24	24
Outside temperature during heating period	co	3.1	1.3	0.4	-0.4
Design Indoor temperature	oC	-22	-22	-22	-22
Design indoor temperature	oC	18	18	18	18
Degree days	oC	2,533	2,722	2,939	3073
As percentage of normal year	%	76%	82%	89%	100%
Heat load factor	/ - /	0.3725	0.4175	0.44	0.48

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4.7 Housing Management Services Company

The Housing management services company “Zodchi” is 100% owned by TE. Its main business is provision of housing management services to customers’ facilities. TE started operations on March 1, 2007. So far a contract has only signed with one single building.

4.8 Boiler and Pipeline Reconstruction Company

The Boiler and Pipeline Reconstruction Company “Telstra” is 100% owned by TE. Its main business is currently pipeline repair and replacement for outside companies. So far the only customer is the municipal heating company. Table 10 shows the income statement for 2005 and 2006. The revenues of the subsidiary account to only 1-2% of the total revenues of TE

Table 10 Income statement of PRC

Item	Unit	2005	2006
Revenues	000 Rb	5,484	2,974
Operational expenses	000 Rb	4,427	2,170
Management expenses	000 Rb	96	-
Other expenses	000 Rb	3	15
Profit before tax	000 Rb	958	789
Profit tax and other taxes	000 Rb	659	207
Retained earnings	000 Rb	299	582

5 Regulatory framework

5.1 Heat tariff regulation

Under the current regulator framework, the following approaches for tariff setting can be applied:

a) Cost regulation (cost of service regulation): Under this scheme the tariff will be approved each year in accordance with the (justified) costs of heat supply. Cost increases due to investment measures will only be considered if they have been approved in advance. The regulatory period for this approach is one years. Another tariff check can be requested if a cost item (such as fuel) has been increased by at least 15%. Lower cost increases will not be considered.

b) Indexation method: A baseline tariff is approved for a period of three years. During this period cost items can be increased according to the respective input prices. As under the cost of service regulation, additional cost caused by a non approved investment program will not be considered. The regulatory period is three years.

c) Investment cost method: A surcharge on the base line tariff, which is determined according to method a) or b), can be approved to cover the additional costs caused by the investment program. The regulatory period is 10 years.

The first method is a typical cost of service approach, which does not provide any reasonable incentive for investors to improve the efficiency and performance of the DH system. The draft Heat Law that is expected to be approved by the parliament in July 2007 requires that the baseline tariffs should be valid for at least three years. That means the first method would be abolished.

The second and third method can be seen as examples for an incentive regulation. It allows the investor to retain profits for cost saving measures for a period of up to three years

The third method is definitively the preferred one for investors. As it is only a surcharge, it has to be combined with one of the other two methods. However, the surcharge will allow the investors a reasonable payback of their investments within a certain period of time.

Besides justified costs, the tariff will also include a profit. For the profit margin TE proposes a proportional surcharge upon the expenses and the regulator decides what ever profit is justified, based on the real expenses and the previous year performance of TE. Basically, there is also a risk that the regulator will reduce the tariff if the costs due to reduced employment and losses have dropped much and are not sufficiently compensated by the repair fund and depreciations.

5.2 Subsides and social assistance

There is a system for social assistance in place to support low income households and certain privileged consumers. This group receives subsidies of up to 50% of the heating costs depending on their household income. Under this program 10% will be paid by the municipal budget. From the remaining 90% half (or 45% of the total heating bill) will be covered by the regional sources. Due to the income increase in the last years the number of recipients has substantially decreased in the last years and in 2007 all customers pay 100% of their total heating bill.

6 Technical assessment of the DH systems operated by TeploEnergo

6.1 Heat generation

TE operates currently about 50 boilers of different sizes. The large boilers are old but considered being in good technical condition with efficiencies of around 90 %. Rehabilitation of the larger boiler houses is considered to be of modernization character and include introduction of control equipment and replacement of district heating pumps with new pumps equipped with frequency converters.

Two boiler plants are completely new:

A. The boiler plant at Anton Glushko street (No 14 in the map) with 2 times 1.2 MW gas boilers. While establishing the boiler new plant, 3 small boiler plants were eliminated and the networks were merged.

B. The boiler plant at Frunze street (No 4) with one 0.225 MW gas boiler supplying the hospital and the operation secured with a power aggregate. The old boiler plant nearby was eliminated.

Out of 59 boiler plants in operation TE has converted:

- 28 district heating circulation pumps to frequency controlled ones in 19 boiler plants, including 8 small boiler plants
- 19 DHW pumps to frequency controlled ones in at 8 boiler plants and at 10 substations.
- 32 flue gas and combustion air fans in 8 boiler plants

At present, TE is rehabilitating one of the large boilers of the Chuchuvo plant with new tubes and automation. The other 30 GCal/h boiler units were rehabilitated in year 2006 already and the third of 50 GCal/h capacities is planned for rehabilitation in the year of about 2012.

TE plans to continue boiler plant rehabilitation at the speed of 2-3 plants per year.

6.2 Networks and substations

The total length of the network is 43.55 km (length of route) with the average size of DN 200. About 50% of the pipes are underground, placed in concrete channels without ventilation appearing severe damages on insulation causing vast heating losses. The remaining part is installed above ground.

TE has already replaced 19% of the network, 17.1 km out of 87.26 km (single pipe), with underground pre-insulated pipelines and with mineral wool insulated above ground steel pipelines. In some cases the aboveground pipelines have been converted to an underground one. The large pipelines are with steel and the small ones with plastic inner pipe.

Table 11 Replacement of TE's heating networks 2004-2007

Year	Total	Above ground	Underground Plastic SH	Plastic DHW	Steel
	km	km	km	km	km
2007	9,00	1,70	0,80	1,50	5,00
2006	5,05	0,00	0,32	2,40	2,34
2005	2,30	0,00	0,00	1,40	0,91
2004	0,75	0,00	0,00	0,44	0,31
Total	17,10	1,70	1,12	5,74	8,55

The thermal losses of the networks are estimated by TE at 10% of the produced heat energy, which seems a reasonable estimate for two reasons: (i) the networks are relatively short and with little 4-pipe systems only; and (ii) the worst pipeline sections covered by 17.1 km have already been rehabilitated by the end of year 2007 and the better ones have remained.

There are 10 group substations out of which 8 are already automatic without permanent staffing. TE plans to have all substations remote monitored at the control centre by the end of year 2007. The total capacity of the group substations amounts to 34 GCal/h, which is about 10% of the heat production capacity and 15% of the heat load.

The types of customer connections existing in TE's system are presented in Figure 3 and the breakdown in Table 1.

Figure 3 Types of customer connections

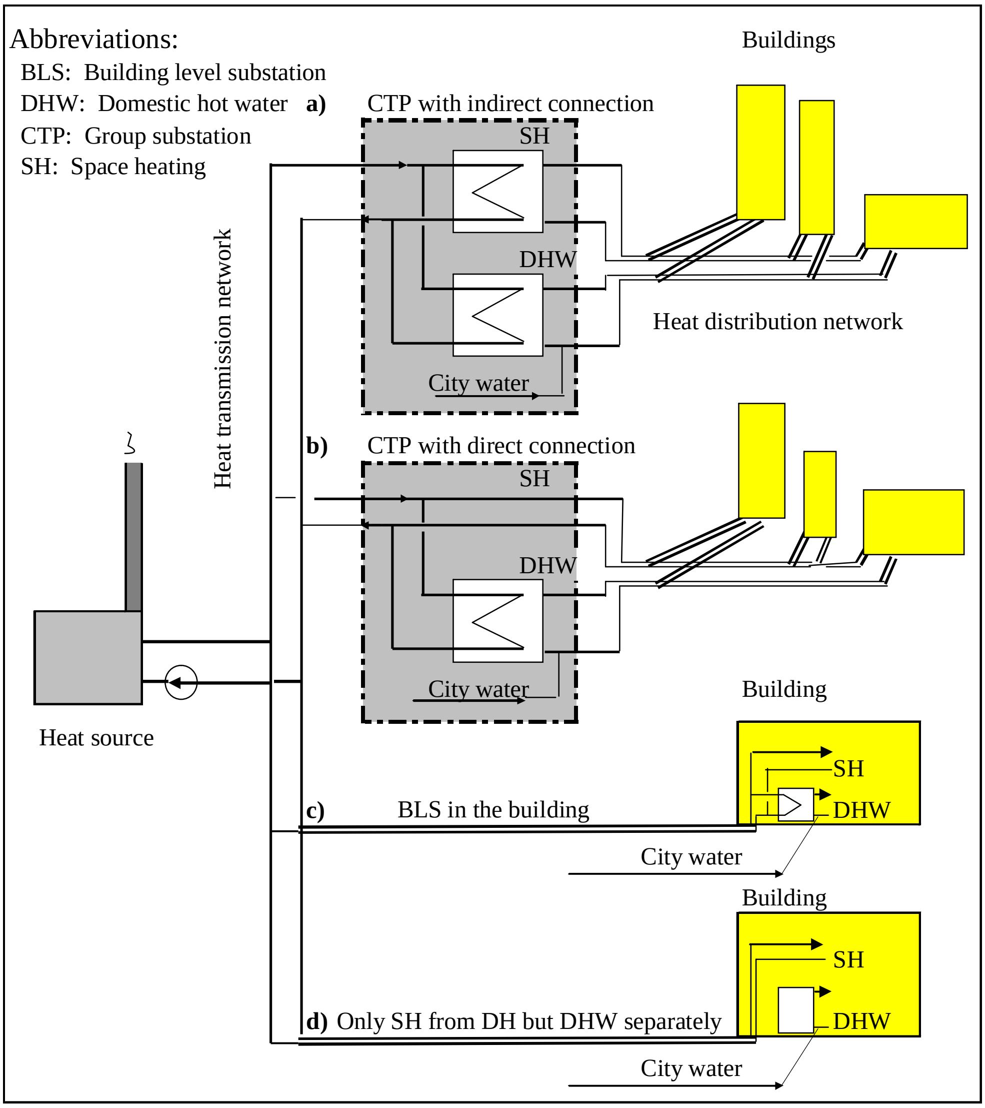


Table 12 Customer connections in TE (ref. to Figure 3)

Customer connections	Gcal/h	#	kW/ building
a)	3.0	16	221
b)	123.5	154	933
c)	80.1	130	717
d)	19.6	523	43
Total	226.2	823	320

6.3 Heat metering

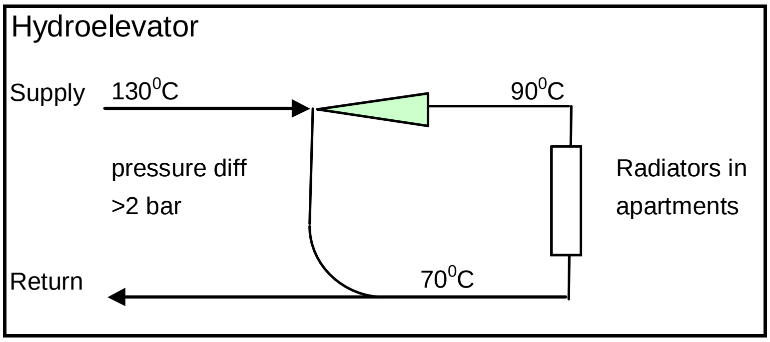
In heat production, only little heat metering exists so far and the heat production is calculated based on the measured fuel consumption and the analyzed efficiency of the boiler. In the proposed project, all boiler plants that will remain in operation after 2011 will be equipped with heat meters. About 90% of the budgetary buildings, such as hospitals, kindergartens and schools are with heat meters, after a particular project completed a few years ago.

In general, residential customers do not have heat meters.

6.4 Indoor installations

About a half of the house connections are equipped with hydro elevators but the other half remains without any control or adjustment equipment. No mixing loops exist in TE system so far. Therefore, there is no way to the building and the apartments to control their heat consumption other than opening windows while excess heating and putting on more clothes while deficit in heating.

Figure 4 Scheme of a hydro elevator



6.5 Water treatment

TE takes the DH make-up water from the rivers Don and Mius as well as from the ground water, the water source depending on the boiler plant location.

At the boiler plants, the water will be mechanically filtered, chemically softened and thermally degasified.

Table 13 Quality of raw water in three sources

Property		Mius	Don	Ground
Hardness	mg eq/l	20	9	16
Alkalinity	mg eq/l	6,2	4,2	5,4
Substances	mg/l	2,5	1,0	1,7
Na	mg/l	0,48	0,14	0,34
Ka	mg/l	0,2	0,1	0,18
Mg	mg/l	0,12	0,048	0,084

The circulation water meets the requirements of the Russian standards. The allowed O_2 content is 0.06 mg/l, whereas the real content is well below. The carbonate content is allowed to be 0.6 mg/l, whereas the real one varies between 0.3 and 0.4.

6.6 Analysis of two boiler rehabilitation cases

TE is already well experienced in DH system rehabilitation. During the past four years, 39% of the DH network has been already rehabilitated, mainly with modern pre-insulated pipelines. Additionally, TE has already modernized one of the three main boilers in the largest boiler plant and rehabilitation of the other boiler unit is currently underway. Moreover, two brand new boiler plants have been installed, simultaneously having had replaced four existed small boiler plants.

The latter boiler replacements, located in Frunze and Anton Glushko streets, have been recorded in two Tables presented below.

Table 14 Benefits of replacing three small boiler plants with a new gas boiler plant of 2.4 MW in Anton Glushko Street

Cost components		Eliminated				New	Diffe-
		Old HoB 1	Old HoB 2	Old HoB 3	3 old HoBs in total	HoB	rence
Gas fuel	th. RUR	137.1	503.3	337.6	977.90	822.00	-16 %
Electricity	th. RUR	34.5	64.3	55.1	153.90	124.90	-19 %
Water	th. RUR	1.77	3.98	2.86	8.61	8.61	0 %
Repairs	th. RUR	17.8	71.2	53.4	142.40		-100 %
Taxes of salaries	th. RUR	108.7	108.7	108.7	326.10		-100 %
Expences of other departments	th. RUR	28.5	28.5	28.5	85.50		-100 %
Emergency repairs	th. RUR	338.7	338.7	338.7	1016.10	210.20	-79 %
Management	th. RUR	220.7	220.7	220.7	662.10	157.70	-76 %
Total expenses	th. RUR				3372.61	1323.41	-61 %
Total revenues	th. RUR				2234.00	2234.00	0 %
profit/loss	th. RUR				-1138.61	910.59	
Heat energy delivered	Gcal				3397	3397	0 %
Unit cost of heating	**RUR/Gcal**				**992.82**	**389.58**	**-61 %**

The investment costs of the investments were RB 13.7 million, thus resulting in a pay back time of 6.7 years. The unit costs of heating, excluding the capital costs, have dropped 61% from 992 to 390 RB/GCal.1

Table 15 Benefits of replacing an old boiler plant with a new gas boiler plant of 0.225 MW in Frunze Street

Cost components		Eliminated Old HoB	New HoB	Diffe- rence
Gas fuel	th. RUR	73.90	61.13	-17 %
Electricity	th. RUR	13.78	13.78	0 %
Water	th. RUR	1.71	1.71	0 %
Repairs	th. RUR	17.80		-100 %
Taxes of salaries	th. RUR	108.70		-100 %
Expences of other departments	th. RUR	28.48		-100 %
Emergency repairs	th. RUR	338.70	64.36	-81 %
Management	th. RUR	220.70	48.27	-78 %
Total expenses	th. RUR	803.77	189.25	-76 %
Total revenues	th. RUR	196.60	196.60	0 %
profit/loss	th. RUR	-607.17	7.35	
Heat energy delivered	Gcal	299.04	299.04	0 %
Unit cost of heating	**RUR/Gcal**	**2687.83**	**632.86**	**-76 %**

The investment costs of the investments were RB 5.0 million, thus resulting in a pay back time of 8.2 years. The unit costs of heating, excluding the capital costs, have dropped 76% from 2688 to 633 RB/GCal.

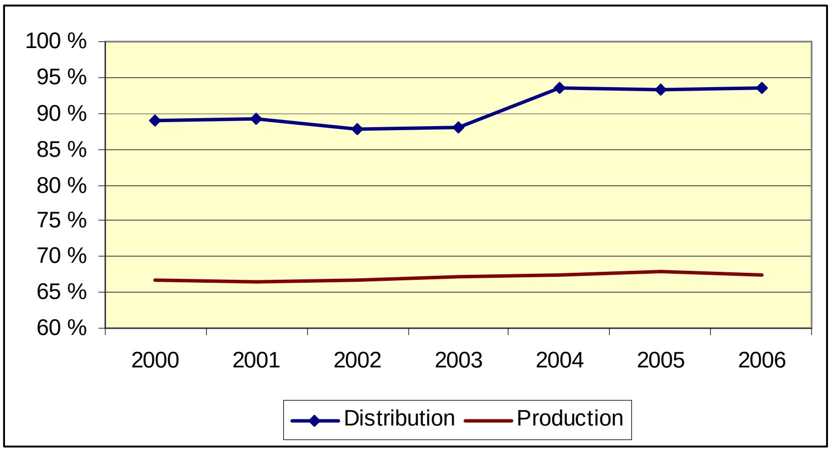
Based on the above, TE has a solid basis for both investment cost and benefit estimates regarding the DH system rehabilitation to continue.

6.7 Other benefits already achieved by TeploEnergo

TE has already carried out a number of rehabilitation measures, as described above. Therefore, since year 2004 until 2008, TE has achieved substantial benefits already:

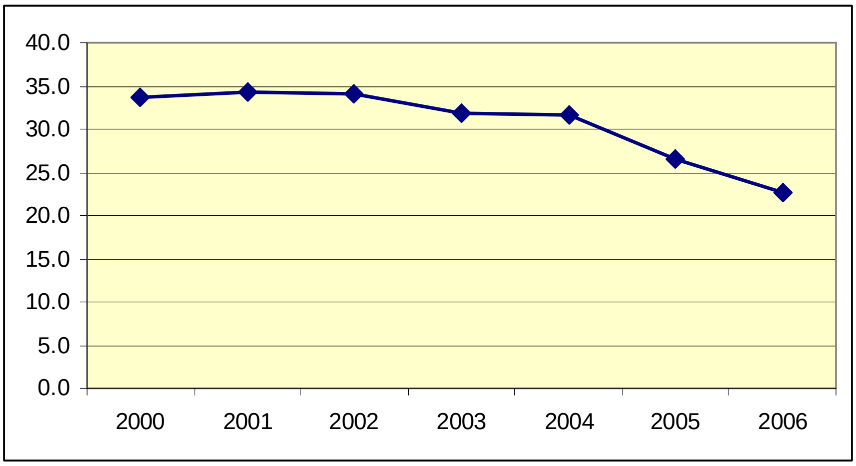
- Both the heat distribution and production efficiencies have improved, first one due to rehabilitated networks and the latter due to rehabilitated boilers. The distribution efficiency has risen from 88 to 93% and the production efficiency about 0.5-1.0% from some 67%. The percentage values above are based on calculations of TE, because no on-line metering is available except for gas consumption**.**

Figure 5 Heat production and distribution efficiency at TE



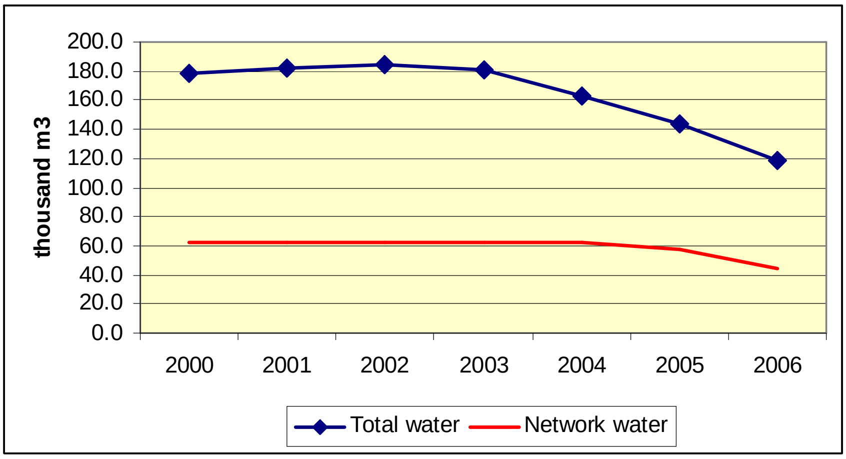
The electricity consumption has declined. The electricity per delivered heat energy (kWh/GCal) has declined 33% from 33.6 to 22.6 kWh per GCal of heat delivered. This based on replaced pumps and fans as described above.

Figure 6 Electricity consumed per delivered heat energy.



The water losses have declined. Both the total water losses as well as those leaked in the network have declined, the latter due to having had 39% of the network length rehabilitated. The DH water replenishment rate has dropped 29%, from 21 to 15 network water volume replacements a year. The overall water consumption has dropped 33% due to works in boiler plants and substations (new plate heat exchangers) as well.

Figure 7 Water losses both in total and those caused by the DH network



6.8 Least cost heating option

In practice, no alternative fuels to natural gas are available in Taganrog region. Taganrog is considered a green region with many forests. Bio fuel has not been used, and due to still low price of gas, is not economically feasible by far.

In other CEE Countries disconnections from DH and conversion to individual heating system has been a common practice. The time being, some institutional barriers prevent larger disconnections. Individual customers who want to disconnect need to get an approval of the building owner and of the gas company, which is difficult to acquire. So far, disconnections are not a serious problem in Taganrog.

7 Investment program

7.1 General

The investment costs of TE from year 2006 were updated to 2007 level by using 10% inflation. The investment costs of TE were used in the Life-cycle analysis, since TE has recent and data about the real costs. An exchange rate of 34.5 RB to EUR was used.

7.2 Heat generation plants

7.2.1 Existing services areas

In the beginning, TE had 60 HoBs. By eliminating small ones and merging networks, the current number of HoBs amounts to about 50. In the future, e.g. around year 2010, TE plans to have only 30 HoBs in the existing supply area in operation. TE plans to merge individual boiler networks to much larger ones in order to reduce costs. Simultaneously, operation of the old small boilers would discontinue.

Total investment costs amount to ˆ 11.8 million (in prices of July/2007).

7.2.2 Acquisition of additional service areas

In addition, TE plans to take over seven small and old boiler plants with the corresponding local networks. TE would install its own remote controlled new boiler plants instead. The heat load of the buildings amounts to 19 MW, equal to 16.4 GCal/h. .

TE plans to take over 50-60 buildings currently served with heating by the municipal housing company and supplied by six small and old boiler plants. TE would install its own remote controlled new boiler plants instead.

This component will only be included into the investment program, if an agreement on the acquisition of the heating system will be signed with municipality in due time.

The heat load of the buildings amounts to 16.8 MW, equal to 14.4 GCal/h. The investment costs are RB 100 million, equal to ˆ 3 million.

7.3 CHP plant

In order to collect experience, TE plans to install a small CHP plant with two units of about 0.4 MW electric and 0.6 GCal/hr thermal in total and with a total efficiency if 70%. The location of the CHP plant would be either Lomakina 9 or Chucheva 3, the first one being the address of the headquarters and a HoB of TE and the latter being the address of the largest HoB of TE.

The CHP plant would supply electric power primarily to the HoBs of TE, and if something excess occasionally may remain, to the grid.

Between the general director of TE and the director of the local electricity distribution company, there is a verbal agreement upon which says that the electricity generated by the new small CHP plant can be transmitted to the other boiler plants of TE. The power company would charge for the electricity distribution fee only. It was mentioned that the variable costs of electricity generation are about a tenth of t<he purchase price, and with the distribution fee, would increase to about a third of the purchase price.

Most of the electricity generated by the C HP plant can be consumed by TE itself. Based on the total electricity consumption of about 10.4 MWh/yr, it is assumed that 3.2 GWh of it can be supplied by the CHP plant of 0,4 MW. If any excess electricity is produced at low consumption periods, it can be either sold to the local grid, which was reported to badly suffer for insufficient electricity supply capacity, or remain not produced with little impact on the viability.

As specific costs of a small CHP are very high and efficiency is low, a larger unit could be considered as an alternative. In case of a larger CHP plant, the CHP plant should be sized to supply DHW all over the year. The largest single DH system, the boiler plant located on Chucheva Street and operated by TE is served by three boilers (30+30+50 = 110 GCal/h boilers). The connected load is about 80 GCal/h); the HoB produces about 40% of all heat energy of TE. In Northern countries the summer load is typically up to 10% of the winter load and would accordingly amount to 8 GCal/h, thus sufficient for the small CHP plant. In summer, TE would combine networks in order to supply the DHW load by the CHP plant and leave the others plants switched off. Therefore, from the heating point of view, the CHP plant could be substantially larger than the one suggested in the project.

Due to the current institutional problems for determining the feed-in tariff and reach a supply contract for the surplus electricity, only the small CHP plant has been included in the proposed investment program. It is, however, be recommended to keep a larger unit in consideration.

The variant with the small CHP (400 kW el) has investment costs of about ˆ 860.000.A larger variant with a capacity of 6 MW el would cost about ˆ 4.2 million.

7.4 Network

TE operates 88 km of pipes (single pipes). Some 7 km of the pipes equal to 3.5 km of pipelines are planned to be replaced annually by pre-insulated pipes; plastic for smaller diameters and steel for larger. Experience from the replacement is good but the investment is expensive and is done with detailed focus on economic profitability.

Out of the 88 km of pipelines, about 40% were estimated to need urgent replacement. In 2005 TE started the replacement program. So far about 17.1 km equal to about 20% of the total length have been replaced. The program is expected to be finished in 5-6 years.

The costs are not covered by the investment program but by the budget for repair costs. In principal these costs have been approved to be included into the tariff. Accordingly, there is no need to include this program into the investment program to be financed under the EBRD loan.

Table 16 Pipe replacement 2005-2007

Item	Unit	2,005	2,006	2,007	2,008
Repair costs	000 Rb	1,509	146	140	
Replacement cost	000 Rb	2,988	10,463	12,157	20,000

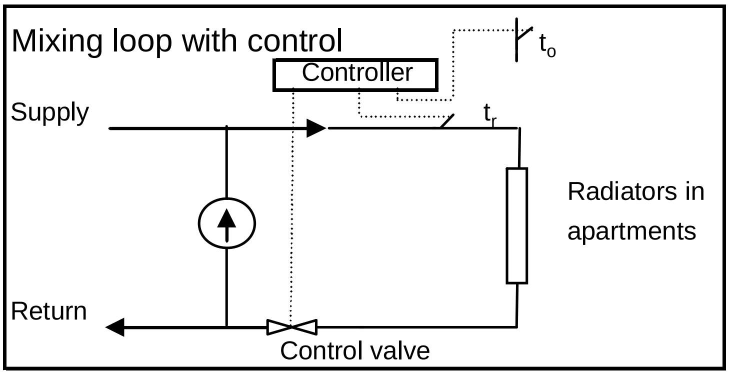
7.5 Substations

In type “b” and “c” connection of customers (see Figure 3), 284 mixing loops would be candidates for reconstruction, the number of type “b” and “c” connections being 154 and 130 respectively. The mixing loops are with weather controllers thus regulating the heat consumption of the building according to the outdoor temperature and the building specific features. The loops will be installed in 55 relatively small buildings of 250 kW on average.. In such a way, 5% of the heat energy for space heating purposes delivered by TE would be regulated in the buildings.

Based on experience in the Central Europe, such control reduces energy consumption of the building by about 15%.

The networks are relatively small and therefore, heat exchangers were not considered necessary.

Figure 8 Scheme of a mixing loop with weather control



Due to the existing institutional frameworks that fix the delivery and responsibility boundaries of TE far away from the residential buildings, only the 50-60 buildings that are expected to signed a contract with the Housing Management Services company should be considered.

Consumption-based billing would ideally require a two-part tariff to avoid financial losses for TE, when consumers start to save heat energy to a larger extend. TE should evaluate, whether a two-part tariff system could be applied. In practice this could mean that consumers pay a monthly fixed charge (per m?or kW) to cover the fixed costs of the new equipment and an energy charge lower than the maximum tariff. Such project could be a model for other cities.

Total investment costs would be about ˆ 330.000.

7.6 Heat meters

In the course of the proposed project, all HoBs and substations of TE will be equipped with heat meters. Heat metering of buildings can be easily done by means of the mixing loops above.

The current heating law requires heat energy to be metered but does not state by which date it should be done.

There are two reasons for TE to start with heat metering:

- While keeping the current lump sum tariff, TE would benefit from the energy savings of the customers: Billed revenues would not change much but the energy costs of TE would drop about 15%.

- Having heat meters in the early stage, would help TE collect information on real consumption compared with the normative one.
- Heat metering, as actually required by the law, would set TE to a forerunner as provider of modern heating services. In all Central European countries, for instance, heat metering at building level is mandatory and many countries has started with heat cost allocators in room radiators (Bulgaria, Poland, Lithuania, Denmark, Germany, Austria).

No separate apartment level metering is included in the program, because such real metering has not been done anywhere in the world in large scale for two reasons:

- Instead of expensive real heat meters, heat cost allocators based on evaporation of liquid proportional to the heated radiator have been widely used in Europe. In Taganrog, Heat cost allocators can be demonstrated later on once experience on consumption based billing has been collected.
- Any metering or heat cost allocation in apartment level is always an approximate approach, because heat is transferred between apartments through internal walls. Such transfer cannot be measured in a reliable way

7.7 Demand side measures

The subsidiary housing management company could in future offer services to distribute the costs within the buildings according to the consumption. The consumption would be allocated according to the readings of heat cost allocators.

According o this added-value service, TE would have to pre-finance thermostatic valves and heat cost allocators. In compliance with a proven business model of respective service companies, the consumers would pay back these investment costs within a period of 1-5 years.

Experiences from a number of CEE countries demonstrate that heat energy savings of 20-30% can be achieved. In Romania, a DH rehabilitation program (co-financed by EBRD) was combined with the implementation with such a program. The program comprised several thousands of apartments. The average heat energy saving amounted to 25%.

In Bulgaria, for example, the DH system rehabilitation had started about 8 years ago with the demand side management (DSM) measures. First, all the building level substations were equipped with heat meters, totalling up to over 22.000 meters. Second, the substations were equipped with temperature control systems, and in cases were the existing tube heat exchangers were worn out, with plate heat exchangers. Simultaneously, the private sector was offered an opportunity to agree with the house owner associations or building administrators on installing thermostatic valves and cost allocators to radiators in apartments and organizing the allocators reading and invoicing of heat bills according to the readings. Such a PSP approach was supported by a strong public information campaign. Based on the PSP in DSM development in Bulgaria, the heat energy consumption of the apartments has dropped some 25% compared with earlier times without DSM in total. Simultaneously, the connection rate had risen from the level of 50-80% in 1999 to almost 100% in 2003.

Demand side measures are not included in the investment program. This will become the business of the Housing Management Services Company and depends on the interest of the flat-owners of the 50-60 buildings.

7.8 Other measures

TE is underway to develop the brand new control centre, which already monitors two newest boiler plants, to cover all substations and most of smaller boiler plants.

7.9 Summary of investment costs under the EBRD loan

Figure 9 compiles the investment costs adjusted to current prices.

Figure 9 Investment costs in 2007 prices (in 000 ˆ)

Item	2008	2009	2010	Total
Boilers existing service areas	2,185	4,976	4,821	11,981
Boilers new service areas	-	1,768	1,125	2,893
CHP plant (small variant)		860		860
Substations (50-60 buildings)	66	99	165	333
Total	2,251	7,703	6,110	16,064

7.10 Benefits of the investment program

7.10.1 Gas

Depending on the boiler case, the savings in natural gas vary between 5% and 19%, the latter having been demonstrated by a real case already. In the life-cycle analysis, 10% reduction in gas consumption has been used for the overall HoB rehabilitation program equal to 6.5 thousand m^3 of gas a year. This achievement is based on two main assumptions:

- For small boilers, elimination of small ones and building a new one, the efficiency improvement can be up to 20%, as evidenced by the real case with 19% improvement already.
- For large boilers, replacement of the burner and improving automation are expected to improve the efficiency from the level of 80-85% to 90-95%, thus with 5-10% units.

With the weather controllers in 55 relatively small out of 284 buildings, that represent 5% of space heating energy, 5.0 GWh of heat energy would be saved equal to and 0,5 million m^3 of natural gas.

On the other hand, acquisition of about 20 MW of heat load from the municipality and installing new boilers and networks instead will require additional fuel energy from TE even though the overall fuel consumption in Taganrog would decline, due to improving overall efficiency of the heating services provided to the customers currently served by the inefficient municipal boiler systems. Using 90% efficiency for the new boilers, the incremental increase in TE's gas consumption amounts to about 44 GWh, equal to about 4,4 thousand m^3 of gas.

Moreover, introduction of small scale CHP plant with 0.4 MW electric and 0.6 GCal/h district heating capacity requires incremental fuel energy from TE to run the plant, even though fuel consumption elsewhere in the region to produce the same amount of electricity and heat may decline. For TE, the incremental fuel energy amounts to 8.6 GWh. For TE, this incremental fuel consumption is based on the difference of the fuel consumption of the CHP plant of 13.2 GWh (70% overall efficiency) and the alternative HoB of 90% efficiency, 4,6 GWh.

In overall, about 19 GWh of gas fuel equal to 1,9 thousand m^3 and 4% of the current fuel consumption can be saved after the Priority Investment Program has been completed by year 2011.

7.10.2 Replacing electricity purchase with CHP generation

Based on remote control, frequency controlled pumps and fans in the new and rehabilitated HoBs, the reduction in electricity consumption is expected to continue at percentage of 14% during the program implementation, equal to 1.5 GWh a year out of the current 10.4 GWh.

Installing the weather controllers to all buildings, would reduce the water flow and the pressure level, thus reducing about 30% of the electric energy needed for pumping. Such an expectation is well supported by the experience from the district heating rehabilitation programs completed in the Central Europe. In this case of Taganrog, however, some 50-60 out of 284 buildings with “b” and “c” type connection representing 90% of the space heating energy, that would be equipped with weather controllers and mixing loops, gives an electricity saving of 0,2 GWh, which is 2% of the actual electricity consumption of 10,4 GWh.

On the other hand, acquisition of the municipal systems and installing seven new boiler plants will increase electricity needs of TE. Based on assumption of 15 kWh/MWh of heat, which is a typical value for new DH systems, the incremental electricity consumption would be 0,7 GWh a year.

Altogether, about 1,1 GWh out of the 10.4 GWh electricity purchased in 2006 can be saved by year 2011 by means of the Investment Program.

The arithmetical average of the three price levels prevailing in three supply areas assume the unit price be 2050 RB/MWh to quantify the benefit of electricity savings.

7.10.3 Replacing electricity purchase with CHP generation

The remaining electricity consumption is expected to be partly covered by the CHP plant. About 3,3 GWh, which is based on 8200 hours of peak production, out of the remaining 9,0 GWh of electricity can be generated by the CHP plant of 0.4 MW capacity. The financial benefit of converting the purchase to own production is based on the assumption of the production and distribution unit costs being 30% of the average purchase price of

7.10.4 Water

In the DH network the water volume is replaced 15 times instead of 21 times four years ago. The reduction has materialized due to new plate heat exchangers in substations and new pipelines in the network.

A further reduction is expected due to new pipelines, but drastic reduction could take place only with heat exchangers located in building basements. Due to relatively small network sizes, however, the heat exchangers are not considered necessary. Moreover, even though 20% of the heat energy produced for space heating will be covered by the investments in the building connections, still about 93% of the number of buildings will remain without investments in the connections.

7.10.5 O&M personnel and materials

In 2007, the number of staff in operation and maintenance (O&M) employed by TE is 580, comprising 156 seasonal and 424 full-time staff. Therefore, the equivalent number of full staff amounts to 502, when the seasonal are considered as half-timers.

In 2011, after the project completed, TE plans to have no seasonal anymore and the total O&M personnel comprising full-timers only is planned to be 252 in total.

In the two realized boiler rehabilitation cases, substantial benefits were recorded in maintenance and administration costs. In the new cases included in the Priority Investment program, ? of the relative benefit potential is expected to materialize. For instance, the benefits of emergency repairs in Table 14 were RB 274 thousands (338-64) in the real case. In the planned cases of the Investment Program, 75% of 274 thousands equal to 206 thousands were considered the benefit in a similar single boiler replacement case. The factor of 75% was considered a reasonable value in order to prevent exaggeration of the benefit. The similar approach was used for management and repair benefits.

7.10.6 CO2 savings

As only natural gas is used in Taganrog, the factor of 202 kg of CO_2 per MWh of gas consumption has been used. Therefore, the CO_2 emissions are proportional to fuel consumption with and without the Investment Program.

For energy production of TE, the CO_2 emissions in 2011 would be 4% lower than in 2006, equal to 3,4 thousand tonnes less. For the overall region, on the other hand, provided that electricity generation in power-only plants alternative to the CHP plant would be with 42% efficiency and the old boilers of the municipality would currently run at 75% efficiency, the CO_2 emission reduction would be 6.8 thousand tonnes a year.

7.11 Life-cycle analysis

The life cycle analysis indicates an IRR of 15% to be achieved with the ˆ 16.4 million investment program in rehabilitating the existing boiler and network systems (IRR 16%), acquiring seven municipal heating systems and installing new HoBs and networks (IRR=14%), implementing a small scale CHP plant to replace purchased electric energy (IRR=8%), and in installing mixing loops with weather controllers in the building basements as substations (IRR=14%).

The above IRR values are based on the existing prices of resources and revenues, except the gas price that is expected to be 40% higher than in summer 2007.

7.12 Conclusions and technical recommendations

It is expected that the Priority Investment Program will save about 11% of fuel, 17% of electricity and some amount of water in the current service area of TE. It will also improve the quality of heating services provided to the consumers. The project will serve as an example of complete district heating systems operated with modern technology and will gain important experience showing the right way forward for other regions in South Russia.

The priority investment program comprises four elements, as follows:

- Elimination of 17 small HoBs by means of integrating the small networks and constructing 7 new and larger HoBs;

- Installing weather controllers to 60 buildings, which cover 5% and 7% of the heat energy delivered to space heating purposes and the number of buildings respectively;
- Acquisition of seven municipal heating systems of about 20 MW load and installing new boilers and networks into them; and,
- Introducing small scale co-generation of heat and power (CHP) to cover about a third of the electric energy needed by TE in year 2011

In the course of the Program, heat metering of 30 HoBs, 10 substations and 60 buildings will be done in order to collect information for the consumption based billing to come.

The building connections are suggested with mixing loops only, because the networks are relatively small and because 93% of the customers corresponding to 95% of the heat energy sold to space heating purposes will remain outside of the Investment Program.

Regardless having some customers with heat meters at the end of the project, the billing should not be converted to consumption based until (i) sufficient information is available about the real losses and sales and (ii) the tariff with two tiers and on appropriate level has been approved.

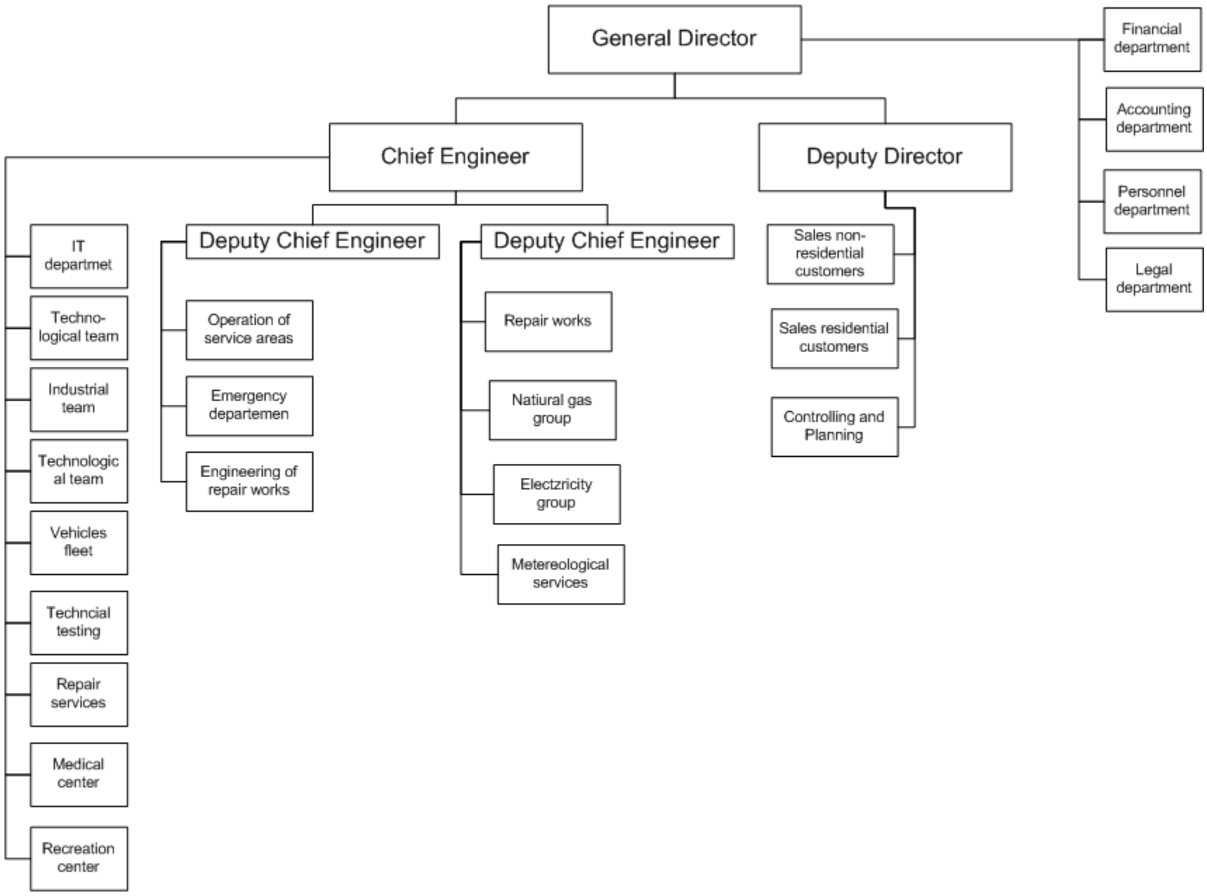
The Priority Investment Program, as described here has excluded the network replacement. By means of the repair funds, TE plans to continue with fast replacement of networks, from the current 20% to 100% in a couple of years to come. The incremental benefit of additional network investments will decline, provided that the worst pipelines covering 20% of the total length have been rehabilitated already. Therefore, further rehabilitation could take place in a pace lower than planned, in next ten years instead of the planned few years, for instance.

8 Organization and staffing

8.1 Current internal organization and staff of the company

Figure 10 illustrates the organizational structure of TE. The focus on technical functions is reflected by the many departments subordinate under the chief engineer. Besides the Chief engineer, a deputy director is in charge of sales, controlling and planning. The financial departments (including accounting and personnel) are directly subordinated to the general director.

Figure 10 Organizational structure of TE



The environmental issues in particular are managed by the main chemist in the technological team.

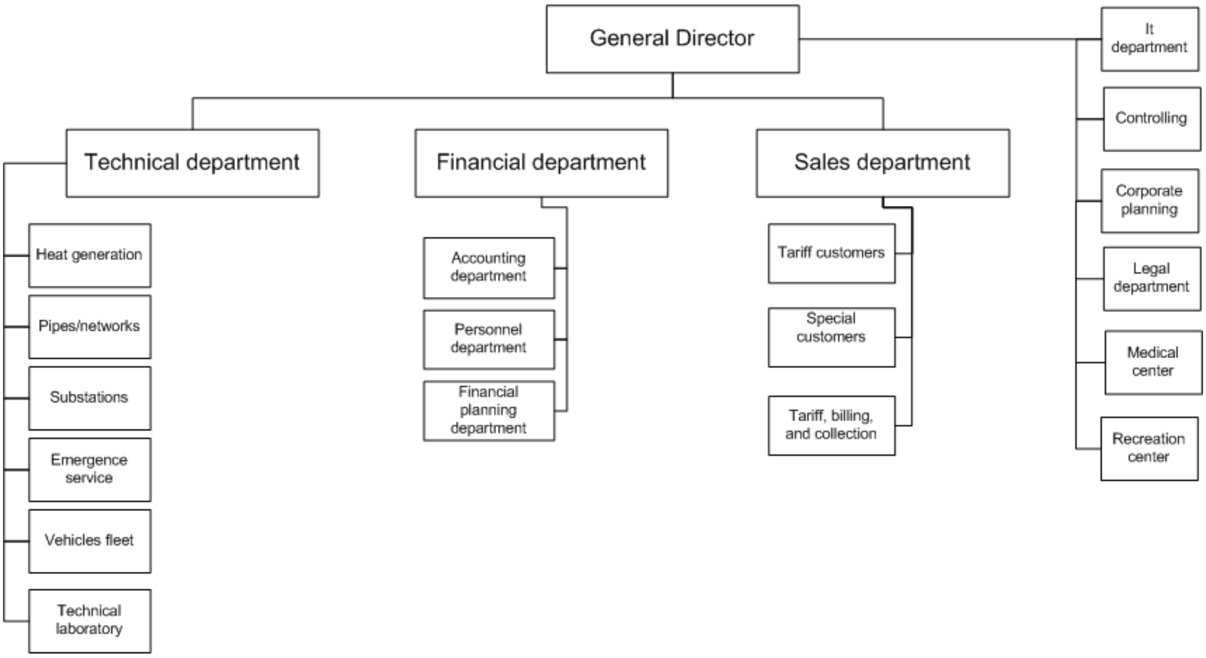
The office staff of 96 comprises 51 and 39 specialists with high and middle level education respectively and the balance of 6 other educations.

8.2 Proposed future organization

The current organizational structure reflects the traditional focus ion operations and maintenance, which used to be the main task of a DH company in the past, while essential financial and other non-technical issues used to be decided outside the company. Understanding that the current owner of the DH company wants to commercialize the DH business, more attention should be drawn to the financial issues, company and corporate development and customer relations. TE will become more and more responsible for the financial health of TE and in a competitive environment, good customer relations are a prerequisite for expanding the business.

Figure 11 shows an organizational structure that could better address the future challenges in a competitive market. The main functional divisions are (i) the technical department being in charge of operation and maintenance, (ii) the financial department, and (iii) the sales department. Essential key functions that supply services to all three divisions are directly subordinated to the top management of TE.

Figure 11 Future Organizational structure of the Company



TE plans to reduce the personnel from the current 580 to 252 by year 2011. In order to make it, remote monitoring of the boiler plants and substations is a key issue. In 2011, there would be no seasonal staff anymore, and the number of other staff categories mentioned in Chapter 9.1 is expected to decline as well.

9 Development of the heating business

9.1 Expanding the scope of services

So far, the responsibility and liability of TE ends at the section valve. Neither the secondary network nor the building-internal installations are under the control of TE. With the help of the child company, the Housing Management Services Company, TE intends to extend its business and take over the obligation for the operation and maintenance works of the “secondary” network as well as building internal maintenance work. The future structure is illustrated by Figure 12.

It is the current intuitional framework that makes it reasonable to operate the primary and the secondary networks by different companies. However, as one company is the child company of the other, coordination of the respective activities should be no problem and in fact both companies can act as one unit providing services from the heat generation up to the building entrances. This corresponds to the traditional scope of services of DH Companies in Europe, where secondary networks are typically owned by or have been transferred to the DH Companies. Whether and when such ownership transfer will happen in Russia, is not known, but taking over the responsibility for the secondary networks goes actually to the same direction.

Besides taking care of the secondary networks, the child company also intends to provide maintenance services within the building. Both activities should, however, be clearly separated and accounts should be unbundled. Also a legal separation of both businesses should be considered; operating and maintenance could be performed by the “Network Company” (See Figure 12).

Figure 12 Future ownership and liability boundaries

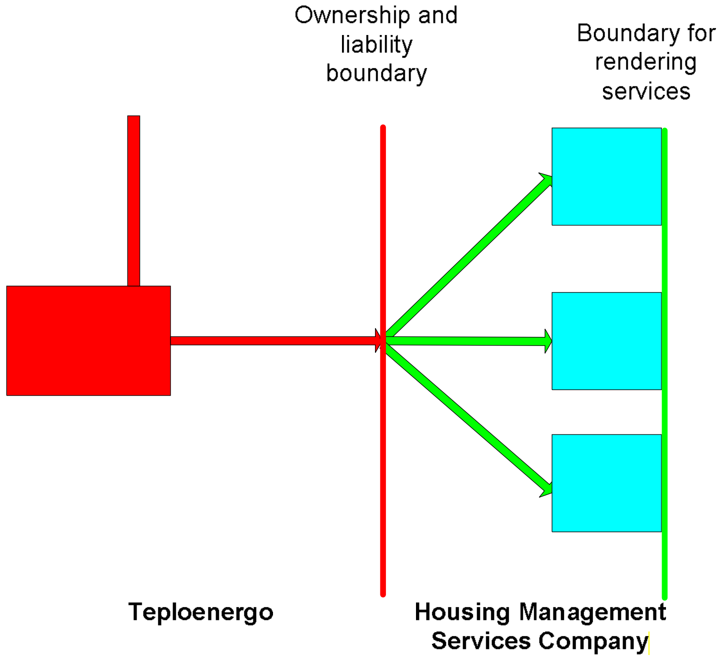
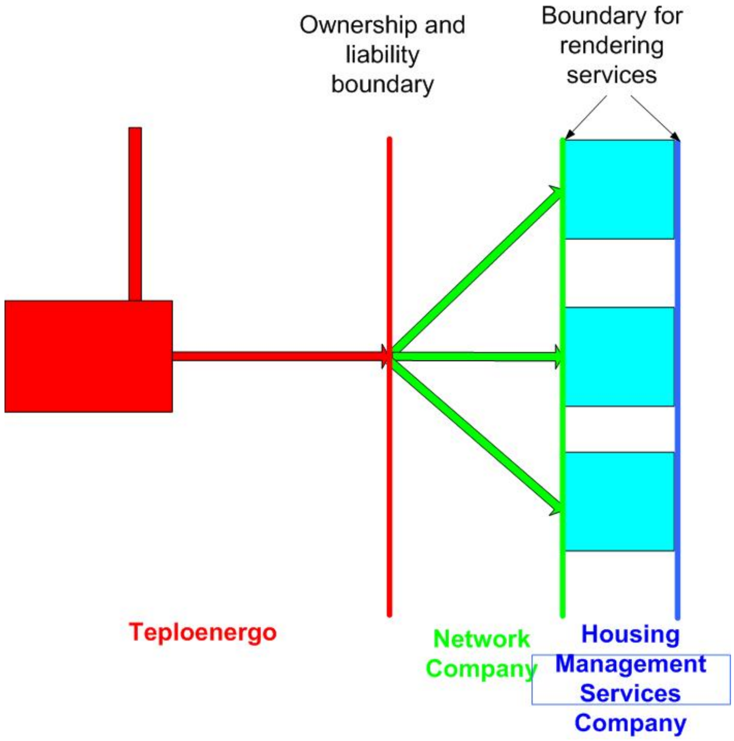


Figure 13 Alternative future ownership and liability boundaries



While in principle TE could also provide the services of the “Network Company”, it could be required or reasonable to have a separate “network Company” due to the existing institutional framework. This could be an issue at least as long as there will be two classes of customers, i.e. one class being directly served by TE and another class indirectly served via the Municipal Housing Management Administration.

Expanding the business as described before, will change the role of the company substantially. So far, TE was used to be a mere heat producer who had to deliver a certain amount of heat to a certain point. In future, the company will offer comprehensive heating services.

9.2 Improving the heating comfort

Experience from other CEE countries show that competition from centralized natural gas heating could become a serious thread for district heating resulting in increasing numbers of disconnections. As mentioned before, real cost gas pricing would stop or at lest substantially slow down such process, but gas pricing is beyond the competence of a district heating company.

It can be assumed that the slightly lower gas price for residential consumers is not the determining reason to switch to decentralized gas heating. Actually, gas heating may be quite expensive. Lower efficiencies (partially due to longer stand-by times) will offset this cost advantage and fixed costs due to the relatively high investment costs (heater plus horizontal piping) are relatively high also. A more important reason is the better flexibility of gas heating. Consumers can easily switch on and off heating according to there need and financial capabilities. Electric heating offers similar advantages.

Decentralized heating systems are typically more expensive when calculated based on normative consumption. However, decentralized heating systems allow consuming less heat then under a district heating system and accordingly costs can be reduced.

Only if district heating offers a similar flexibility and comfort it can compete with decentralized heating system in the longer run. TE should create the foundation for an improved service by installing heat meters and promoting consumption-based billing.

9.3 Payment methods

Currently, customers pay in equal instalments per months. With a computer-based billing system it would be easy to offer alternative payment methods. Some customers may prefer to pay in advance (with a bonus), others could prefer to pay late (even with an extra charge), and again other may prefer to pay according to the monthly heat consumption instead by equal monthly instalments. Offering alternative options would help to improver customer’s satisfaction without adding costs to TE. The scope of payment options could comprise:

- Equal monthly instalments. In case of metered consumption the instalments are determined according to last year consumption, a balancing payment will be calculated after the end of the heating season.
- Payment according to the monthly estimated or metered consumption
- Advance payment with a rebate
- Delayed payment with a surcharge.

9.4 Distributing heating costs within residential buildings according to consumption

Distributing the heating costs within the building by heat cost allocators has proved to be an efficient means to promote the rational use of heat on the demand side on the one hand and to create a new market for corresponding service companies on the other hand.

Due to relatively high investment costs, heat meters can only be applied for apartments in case of horizontal piping, that means one pipe circuit supplies one apartment. A cheap alternative are heat cost allocators (evaporation devices and electronic heat cost allocators). Whether heat meters or heat cost allocators are used is more a question of availed funds rather than of accuracy. Heat meters can (more or less) correctly measure the heat supplied via the supply pipe to and apartment, but they can not measure the building internal heat gains or losses (heat transmission between single rooms and apartments) that can constitute a considerable part of the heat supplied to a single apartment.

Installing thermostatic valves and heat cost allocators, providing reading and cost distribution service could become an interesting new business or TE , which should be performed by a child company preferably in collaboration with a correspondingly experienced service company.

9.5 Customer services

So far, TE does have a special department that is in charge of customer relations. There is only an office building (combined with the boiler control centre) outside the headquarter, which is located within the city centre, where customers can pay their bills. Either here or in an other building within the city centre a customer service centre should be established. The main functions of this centre would be:

- explain bills and tariffs
- discussion different payment methods, particularly in case of payment delays

- dealing with complaints of customers
- providing advice on energy efficiency measures and corresponding financing
- provide advise for new connections and disconnections

Besides that, the customer service centre should also have a show-room for example

- results of TE's efforts to modernize the DH systems
- examples for energy saving measures

10 Other development strategies for the development of the company

Various ideas developed by TE aiming to extend the business have not been taking into account by the financial forecast, mainly because they are so far based on speculations and foundations for their development have not yet been created.

In general, TE has a high potential to expand its scope of businesses. The human capital and the financial background of the owners could support this strategy. Expansion means mainly:

- expanding geographically the existing district heating systems by connecting new consumers
- acquisition of other DH systems inside and outside Taganrog
- provision of added value services, i.e. service provided beyond the contractual point of delivery. Besides offering traditional maintenance services for the secondary networks and building internal heating systems (both owned by the building owners), the company would offer metering, meter reading, and cost distribution services. Moreover, this could also comprise installation of thermostatic valves, bypasses (in case of a one-pipe heating system) and heat cost allocators or apartment meters.
- Engineering and installation services for other district heating companies. At least in the region this could become an interesting, as TE has become a pioneer in new district heating technologies and operation.

A driving force for the expansion is the chairman of the board. At Prof. Vysokov's initiative, Center-Invest Bank dedicated substantial resources to developing energy efficiency finance as a product and promoting it in Southern Russia. Center-Invest Bank took a US$4m dedicated energy efficiency loan from IFC in April 2006 and within a month had used all of the funds for energy efficiency. The bank's clients have been diverse -- a pig farm, candy factory, vegetable oil producer, printing company, and a couple of bakeries, to name a few. The average payback for these investments was about two years, and the projects financed to date generate 15,757 tons of CO2 savings per year. Center-Invest Bank continues to finance projects on its own account and currently has a deal pipeline of about US$10m. In addition, the bank had an investment in the heating company in the city of Taganrog that is improving the supply of heat to residents while lowering prices due to investments in energy efficiency equipment. Prof. Vysokov estimates that the bank5 could allocate another US$ 80m to energy efficiency finance in the next few years in Southern Russia.

10.1 Expansion of district heating services

TE plans to expand its services beyond the boundaries of the current service areas and also beyond the city boundaries. In case that these additional heat systems can be acquired at a reasonable price, there is a good prospective that the service would be profitable for TE. Currently, heat supply costs of the municipal company are significantly higher than those of TE.

A major step to realize this strategy is the intended acquisition of a district heating system in Sochi, host city for the XXII Olympic **Winter** Games in 2014. This would not only support the efforts of the authorities to improve the local infrastructure, but would also support the company's efforts to disseminate the new business concepts for revitalizing DH all over Russia.

10.2 Housing management services company (HMSC)

So far, almost all buildings that are supplied by TE are managed by the Municipal Housing Company. One of the subsidiaries of TE, the Housing Management Services Company, intends to take over a substantial part of this market. So far, TE has concluded a contract with only one building, but it envisages the potential market share in a first stage to be 50-60 buildings.

Besides the traditional services (such as maintenance works) of housing management companies, this subsidiary company will supply added-value services that are services beyond the current scope of services provided by traditional DH Companies. This encompasses heat metering and consumption-based billing.

Heat-metering is typically an indispensable activity to be undertaken by the heat supplier, who measures the heat quantity supplied at the delivery boundaries (usually the building entrance). The advantage of outsourcing this service to a subsidiary is that the service will not fall under the competence of the regulatory agency, i.e. the price for the service has not to be approved by the regulatory agency and can be freely negotiated. The disadvantage, however, is that consumer will regard heat metering as an additional cost rather than as an indispensable part of the heat supply. In this way, heat metering can only be applied on a voluntarily basis rather than becoming a mandatory activity. Provided that the costs of heat meters will be regarded by the regulatory agency as justified costs of heat supply, they should be included in the tariff.

In order to make the competences of the various stakeholders transparent and clear, powers and liabilities should be defined as follows:

- TE will deliver heat up to the building entrance. Heat will be measured by meters owned by TE and the corresponding costs will be included in the tariff.
- HMSC offers services behind the heat meter that is within the building. Besides maintenance services it could, for example, comprise heat cost allocation services within the buildings. Like many other service companies in CEE it could pre-finance thermostatic valves and heat cost allocators to individual consumers and/or housing associations, perform meter readings and building-internal billing services. It is recommended performing such business in close cooperation with an experienced corresponding service company.

TE expects to sign contracts for housing management service with 50-60 buildings. This would be potential for consumption-based billing as described above. However, so far experience about the interest and readiness of residential consumers in consumption-based billing on a voluntarily basis is not available and it is not clear whether and when consumption-based billing will become mandatory. Therefore, the real market potential for these services is hard to determine and has not been included in the financial forecast.

10.3 Boiler and Pipeline Reconstruction Company (PRC)

PRC provided installation services for repairing and replacing pipes. So far, the Municipal District Heating Company is the only customer. TE expects to expand the business beyond the city boundaries. Although TE seems to have an advantage due to some experience in such works, the business is usually a competitive one and other companies, even without specific experience in DH, will start to provide such services once the market grows. The time being, neither the actual market potential nor the scope of competition can be assessed. While the technical market potential can easily roughly be estimated, it is hardly possible to assess the financial sources. Therefore, an expansion of this business has not been taken into account the financial forecast but offers a good opportunity to expand the business.

11 Risks

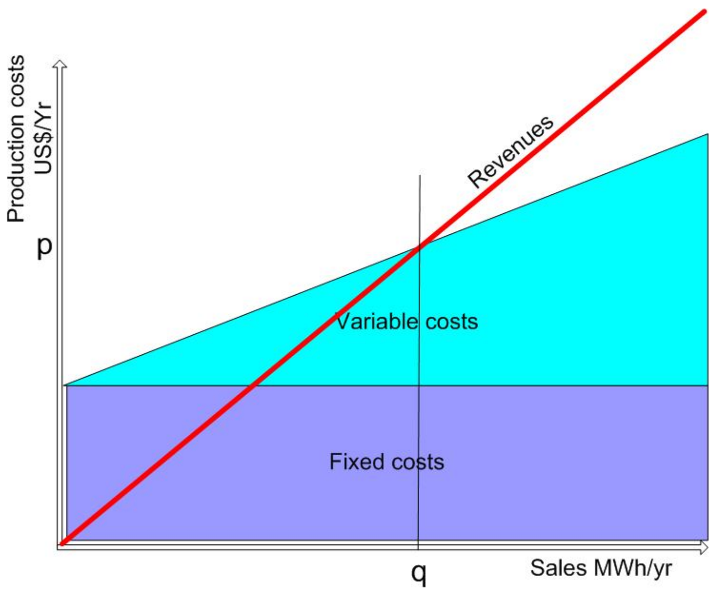
The proposed investment project and the development of TE are faced with several risks:

11.1 One-part tariff

The one-part tariff offers a big incentive for consumers to save heat energy, but would at the same time result in loss-making for the heat supplier. A one-part tariff is calculated by dividing the approved costs with the expected, forecasted sales. If the real sales are lower than the expected ones, revenues will not cover the costs. As illustrated by Figure 2 costs and revenues will be equal if sales are equal to “q”. Typically real sales are smaller, as distribution losses are underestimated. Accordingly, TE would make a loss, even if the consumers have not saved any heat energy: Once consumers start to save energy, the loss will even increase.

Such financial losses can be decreased by assuming from the very beginning higher distribution losses and accordingly lower final consumption and sales (the expected sales would be left of “q”) and tariffs would be higher. However, it is doubtful whether the regulatory entity would accept this approach as long as the DH Company cannot proof the higher losses; this would require a comprehensive metering program or a serious loss analysis.

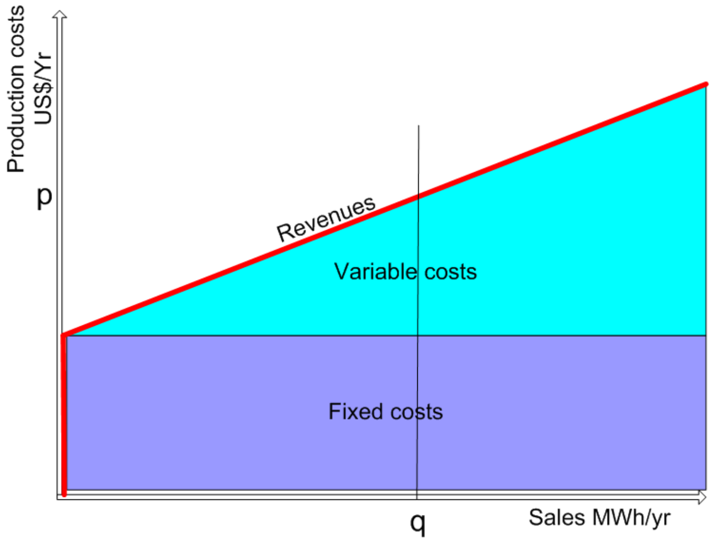
Figure 14 One-part tariff



A two part tariff system would avoid such mismatch between costs and revenues (see Figure 15). Costs and revenues would always be balanced. The energy charge would have to cover the variable costs, while the capacity charge would have to cover the fixed costs.

Whether a two-part tariff system will be approved by the regulator has to be investigated.

Figure 15 Two-part tariff system



11.2 Heat metering and consumption-based billing

Installing heat meters at the customers' facilities has various advantages.

- It provides the right information about losses and actual sales. So far, the largest part of the heat sales or not measured; both could only be estimated on the basis of normative numbers. This would allow identifying the locations in the network which need urgent rehabilitation and improves transparency of operation.
- It creates the basis for consumption based billing

Consumption-based billing provides tangible incentives for final consumers to save energy. In concert with the installation of (thermostatic) valves and heat cost allocators, consumers will get a comfortable and flexible heating system. Like individual heating systems (fuelled by gas or electricity) consumers would be able to regulate the heat supply according to their comfort requirements and financial capabilities.

However, as mentioned above, this would under a one-part tariff system bear the risk of making losses, unless the tariff is not properly and frequently adjusted, that is, the tariff has to be increased according the lowering consumption. Even if heating bills will go down, permanently increasing the tariff will consumers make believe that they are punished for energy savings. A two-part tariff would avoid this problem.

Another problem associated with consumption-based billing is the linkage between profits and costs. Profits will decreases when costs go down, which happens when consumer save energy and fuel costs (and other variable costs) will go down. Linking the profit to the capital would avoid this problem.

Summarizing, consumption-based billing bears a risk for the heat supply company as long as a one-part tariff system is applied and tariff adjustments are done with a significant delay. However, installing heat meters would nevertheless be recommended to make the energy flows visible, improve energy and operational efficiency and to be prepared for a future consumption based billing system.

11.3 Regulatory risks

A Heat Law is expected to pass the Parliament in July 2007. Although in its current shape it does not have a radical change, secondary legislation could bring some changes and modifications which are currently not predictable.

11.4 Collection

Collection rate have significantly improved when TE took over the collection business from the municipal housing management administration. Collection rate went up from 70% to 93%. Relations with the administration are based on annual contracts. Therefore, there is the risk that the administration will reclaim the business and that collection rates would go down again.

12 Financial projections

The financial forecast applies nominal prices. Current prices are inflated by the consumer price index if not by special price indices. Special price indices are associated with:

- Wages and salaries
- Fuel (natural gas)
- Electricity

The financial projections are based on a number of assumptions: The most important refer to:

- Demand forecast
- Impacts of investment measures
- Tariff level

12.1 Demand forecast

The demand forecast is based on actual demand of metered consumers and the normative consumption of non-metered, residential consumers. The implementation of consumption-based billing is assumed to promote substantial heat energy savings which are typically 20-30%. The model assumes that in compliance with the implementation of heat metering, savings of 20% for metered buildings will finally be achieved. This development will also have a tangible impact on the heat load (peak load) due to lower coincidence factors, lower indoor temperatures in some rooms (e.g., sleeping rooms), and additional low-cost energy saving measures installed by the customers.

The model assumed that in the first three years 50-60 buildings will sign a contract with the housing management services company and that these buildings will be equipped with heat meters; this would correspond to about 7% of the currently connected buildings and heated residential area.

12.2 Impacts of investment measures

Investment measures will generate certain costs savings or incremental costs. Cost saving are usually achieved in case of replacement investments, e.g. by replacing an old boiler by a new one. Incremental costs are typically incurred in case of a system expansion. This could refer either to new connections or a new business, such as CHP. If a CHP is replacing heat-only boiler generation, more fuel is needed and accordingly costs will increase.

The following cost savings have been considered in case of replacement investments:

- savings of fuel due to efficiency improvements of boilers,
- savings of heat supplied due to loss reduction of pipes and substations
- electricity savings due to improved boilers and pumps
- water savings
- maintenance cost savings due to the replaced equipment
- personnel cost reduction due to staff reduction

In case of new, added equipment the corresponding additional costs are taken into account.

12.3 Tariff level and revenues

The models uses the following tariff options:

- Option 1: Economically justified tariff (total expense for heat supply divided by supplied heat)
- Option 2: Cost plus with investment surcharge
- Option 3: Indexation plus investment surcharge
- Option 4: Only upwards indexation
- Option 5: Indexation plus investment surcharge
- Option 6: Only upwards indexation
- Option 7: Inflation only

In addition the model allows delaying the new tariff setting by a certain period (to be defined by the user). The investment surcharge is calculated according to an repayment period of 10 years. The financial model, however, allows to consider other periods.

12.4 Profit

In accordance with the current regulatory framework tariffs include a profit that is related to expenses.

12.5 Investment programs

The total investment program comprises the following components:

- The project financed by the EBRD loan as described above
- Finalizing the pipe replacement program aiming to replace 40% of the existing pipes for the coming 4 years. Investment costs are estimated to amount to RB 25 million per year.. The cost for these measures are booked as maintenance costs (in the spreadsheet they are allocated to the cost item “planned maintenance”).
- Annual replacement investments are calculated according to the service lifetime of the equipment. If the investment costs of the other two programs are higher than the calculated replacement investment costs, it is assumed that no such replacement investments are implemented in addition to the other investments in the corresponding year.

12.6 Financial forecast

12.6.1 Main assumptions

Tariffs are calculated in accordance to total production costs, which includes:

- Fuel
- Electricity
- Water

- Labour costs including surcharges
- Other materials
- Maintenance (distinguishing between “maintenance costs” for pipe replacement and other maintenance costs)
- Depreciation charges
- Interest payments
- Other costs

To calculate the baseline tariff, the revenues from other businesses are subtracted. These are the revenues from

- activities of the two subsidiary companies
- revenues from electricity sales: This means that the respective price of heat is calculated as so-called residual costs. If costs would be calculated by the physical method (which is a method frequently applied in Russia) the heat production costs of the CHP would be much larger. If, however, electricity feed-in prices will be negotiated the outcome would currently hardly predictable.

The income of the Housing Management Services Company is based on the assumption of signing contracts with 50-60 buildings (with an average heated area) and the current tariff for the respective services. According to the General Director of TE this additional work volume could be managed with the current (permanent) staff.

The income of the Boiler and Pipeline Reconstruction Company has only slightly been increased for the future, as a larger extension would cause also larger additional costs /labour, machinery, and others).

It is assumed that by the end of the investment program, seasonal workers are no longer needed (in the staff numbers they have been counted as 0.5 staff member.

Three tariff models have been applied:

- a cost-plus tariff, which covers all economically, justified costs (as described above) including a profit on these costs.
- the indexation method, which can be applied for a period of three years. While at the beginning the tariff is equal to the cost-plus tariff, for the succeeding year the various cost-items are multiplied with the factor

  $T_i = T_o * p_i / p_0$

  Where

  T_i = tariff in year i

  T_o = baseline tariff (cost-plus tariff in year 0)

  p_i = input price in year i

  p_0 = input price in year 0

The indexation method is combined with the investment cost method, which adds a surcharge to the tariff covering the total investment costs distributed over a certain period of time (the model assumes 1 a period of 10 years).

In addition to the pure cost-plus tariff, this tariff is also combined with the investment surcharge.

12.6.2 Financing

Two different options have been considered:

- A ˆ 15 million loan of EBRD
- A ˆ 10 million loan plus an ˆ 5 million equity investment of EBRD

Table 17 shows the terms of the loan that is used for the financial forecast.

Table 17 Finance of capital expenditures

Item	Unit	
Margin	(% p.a.)	3.0%
Commitment Fee	(% p.a.)	0.5%
Front end fee	%	1.0%
Loan Repayment Period	Years	10
Grace on Principal	Years	3
First Drawdown		2007
Number of repayments		7

12.7 Results of the financial forecast

12.7.1 Overview

The following tables compile the most important inputs and outcomes results of the financial forecast for both financing options.

Table 18 Overview on option: ˆ 15 million loan

FRM presentation						
Base case	2008	2009	2010	2015	2020	2024
Real GDP growth	5.00%	5.00%	5.00%	4.50%	4.50%	4.50%
Local inflation rate	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%
EUR inflation rate	1.90%	1.90%	1.90%	1.90%	1.90%	1.90%
Nominal wages growth	10.80%	10.80%	10.80%	9.20%	9.20%	9.20%
Exchange Rate RUR/EUR	36.00	36.00	36.30	37.00	37.00	37.00
Billed GCal						
	2008	**2009**	**2010**	**2015**	**2020**	**2024**
Residential consumers	311,035	323,860	335,171	319,043	304,538	292,133
Apartment owner associations	28,802	28,802	27,938	24,482	23,042	21,890
Budgetary units	54,318	54,318	52,688	46,170	43,454	41,282
Industrial	4,595	4,595	4,457	3,906	3,676	3,492
Self-sustained organizations	8,922	8,922	8,654	7,584	7,138	6,781
Total	**407,672**	**420,497**	**428,909**	**401,185**	**381,848**	**365,577**
Working capital						
	2008	**2009**	**2010**	**2015**	**2020**	**2024**
Overall collection rate	99.1%	99.1%	99.1%	99.1%	99.2%	99.2%
Debtors days	86	80	79	93	113	116
Creditors days	60	60	60	60	60	60
Inventory days	17	15	15	15	15	15
Capital expenditures in RUR '000						
	2008	**2009**	**2010**	**2015**	**2020**	**2024**
PIP	-	-	-	-	-	-
CAPEX from FCF	-	-	70,310	(7,073)	19,034	25,676
Average utility tariffs (excluding VAT), RUR/Gcal						
Tariffs	**2008**	**2009**	**2010**	**2015**	**2020**	**2024**
All tariffs	949.7	1,037.0	1,076.9	1,168.9	1,181.0	1,333.0
Affordability Ratio						
	2008	**2009**	**2010**	**2015**	**2020**	**2024**
Average Household						
Household income per capita RUR	15,604	21,516	23,818	34,846	34,846	-
Consumption per capita, GCal	1.03	1.03	1.03	1.03	1.03	1.03
Affordability	7.39%	5.85%	5.43%	4.27%	4.36%	0.00%
Low income hosuehold						
Household income per capita RUR	7,802	10,758	11,909	17,423	17,423	-
Consumption per capita, GCal	1.03	1.03	1.03	1.03	1.03	1.03
Affordability	14.78%	14.64%	13.57%	8.89%	8.23%	9.29%

Table 19 Overview on option: ˆ 10 million loan plus ˆ 5 million equity

FRM presentation						
Base case	**2008**	**2009**	**2010**	**2015**	**2020**	**2024**
Real GDP growth	5.00%	5.00%	5.00%	4.50%	4.50%	4.50%
Local inflation rate	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%
EUR inflation rate	1.90%	1.90%	1.90%	1.90%	1.90%	1.90%
Nominal wages growth	10.80%	10.80%	10.80%	9.20%	9.20%	9.20%
Exchange Rate RUR/EUR	36.00	36.00	36.30	37.00	37.00	37.00
Billed GCal						
	2008	**2009**	**2010**	**2015**	**2020**	**2024**
Residential consumers	311,035	323,860	335,171	319,043	304,538	292,133
Apartment owner associations	28,802	28,802	27,938	24,482	23,042	21,890
Budgetary units	54,318	54,318	52,688	46,170	43,454	41,282
Industrial	4,595	4,595	4,457	3,906	3,676	3,492
Self-sustained organizations	8,922	8,922	8,654	7,584	7,138	6,781
Total	**407,672**	**420,497**	**428,909**	**401,185**	**381,848**	**365,577**
Working capital						
	2008	**2009**	**2010**	**2015**	**2020**	**2024**
Overall collection rate	99.1%	99.1%	99.1%	99.1%	99.2%	99.2%
Debtors days	87	80	81	93	112	116
Creditors days	60	60	60	60	60	60
Inventory days	17	15	15	15	15	15
Capital expenditures in RUR '000						
	2008	**2009**	**2010**	**2015**	**2020**	**2024**
PIP	-	-	-	-	-	-
CAPEX from FCF	-	-	(54,886)	11,368	19,033	25,674
Average utility tariffs (excluding VAT), RUR/Gcal						
Tariffs	**2008**	**2009**	**2010**	**2015**	**2020**	**2024**
All tariffs	942.9	1,034.7	1,046.6	1,159.2	1,181.0	1,333.0
Affordability Ratio						
	2008	**2009**	**2010**	**2015**	**2020**	**2024**
Average Househoold						
Household income per capita RUR	15,604	21,516	23,818	34,846	34,846	-
Consumption per capita, GCal	1.03	1.03	1.03	1.03	1.03	1.03
Affordability	7.34%	5.70%	5.32%	4.27%	4.36%	0.00%
Low income hosuehold						
Household income per capita RUR	7,802	10,758	11,909	17,423	17,423	-
Consumption per capita, GCal	1.03	1.03	1.03	1.03	1.03	1.03
Affordability	14.67%	14.61%	13.19%	8.82%	8.23%	9.29%

12.7.2 Expenses

The forecast shows a substantial increase of the expenses, mainly due to the increase of

- gas price
- personnel costs (real income goes up significantly). The impact could be reduced by reducing the staff number
- depreciation
- maintenance costs due to extended pipeline expansion program. The impact could be reduced by slowing down the program

The following pictures show the expenses for both financing options. Due to the lower interest payments, the option with the equity investment results in slightly lower expenses

Figure 16 Development of expenses (base case scenario, tariff model 2, loan ˆ 15 million)

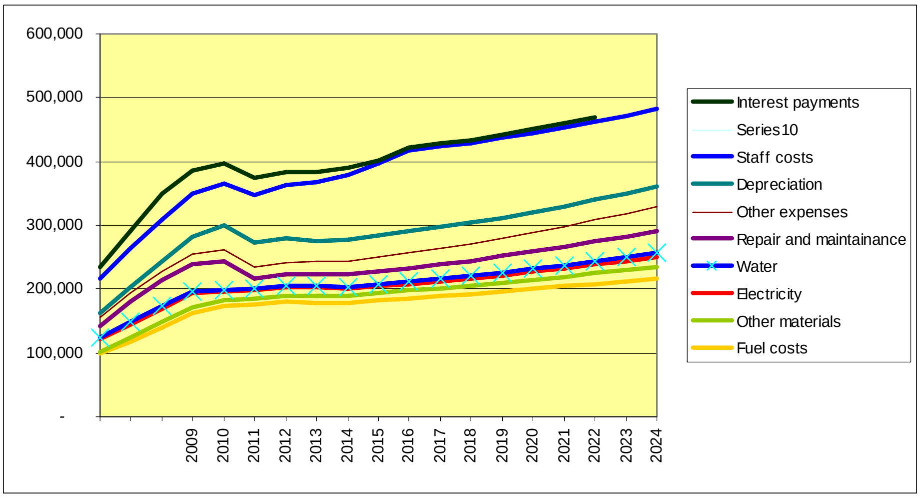
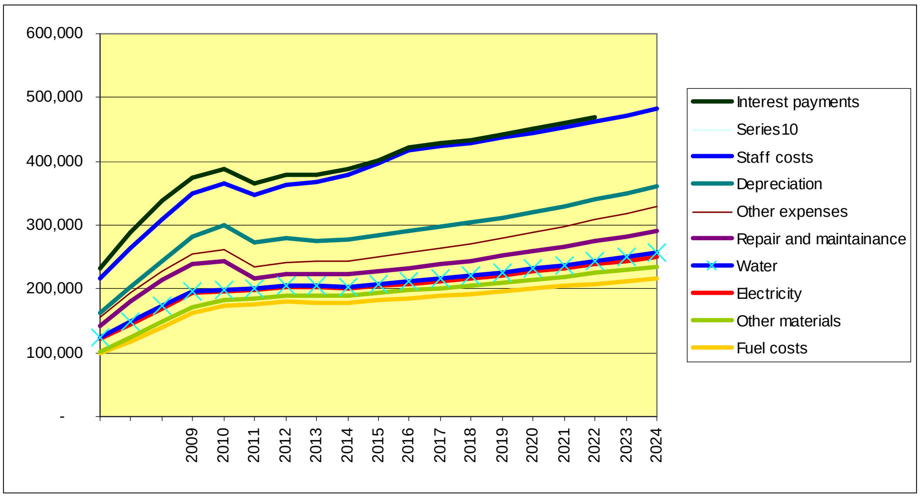
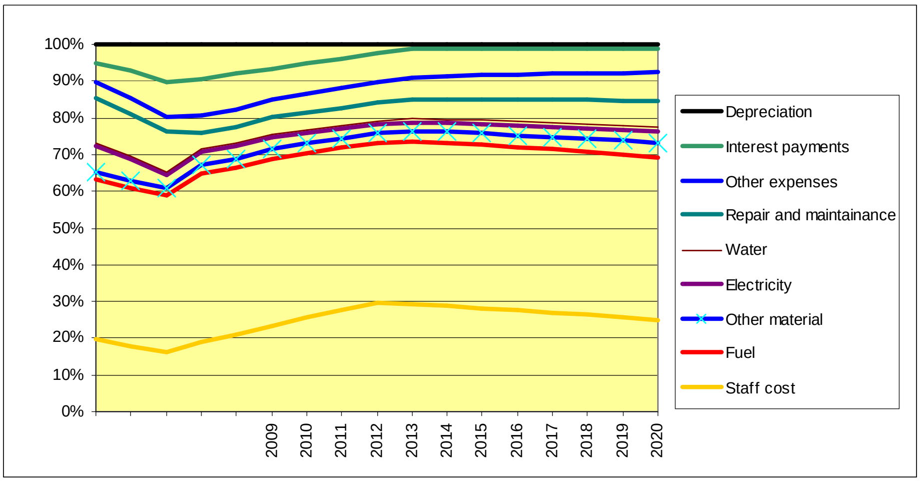


Figure 17 Development of expenses (base case scenario, tariff model 2, loan ˆ 10 million plus ˆ 5 million equity)



In course of time, significant changes in the breakdown of expenses are generated. As differences are very small, the breakdown is only shown for the ˆ 15 million loan option.

Figure 18 **Shares of cost items in total expense** (base case scenario, tariff model 2, ˆ 15 million loan)



12.8 Cash flow

In case of the ˆ 15 million loan option there is a small negative cash for the period 2011-2017 amount in a decreasing accumulated cash flow (cash balance carried forward, see Figure 19). In case of the equity option, a negative cash flow occurs only in one year (see Figure 20).

Figure 19 **Cash balance carried forward** (base case scenario, tariff model 2, ˆ 15 million loan)

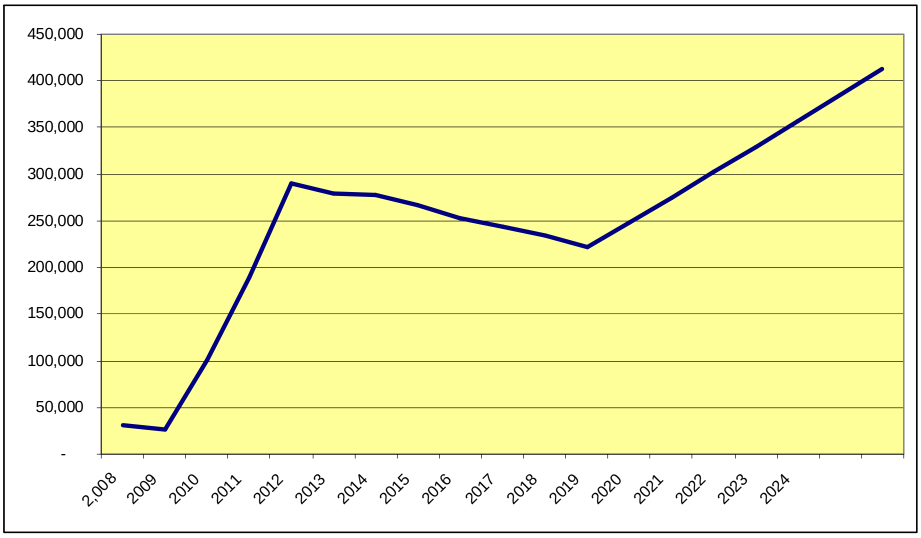
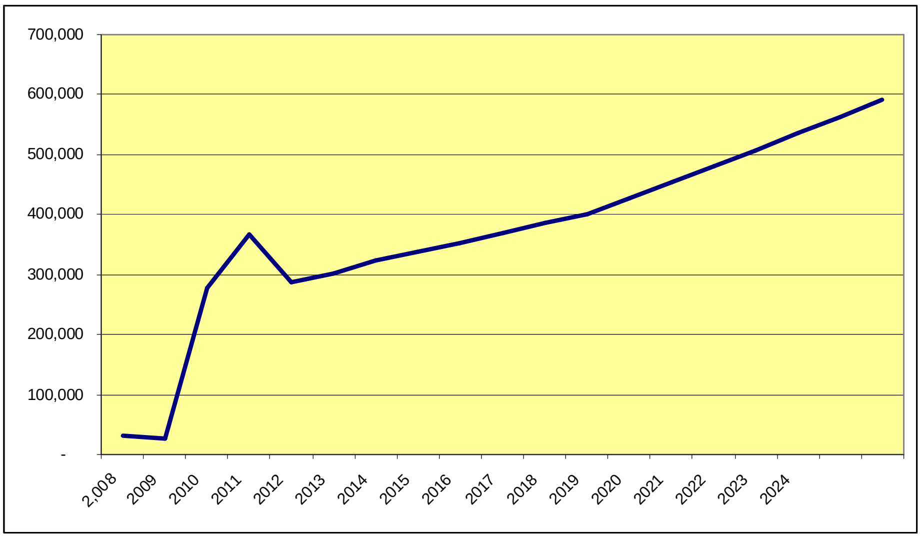


Figure 20 **Cash balance carried forward** (base case scenario, tariff model 2, ˆ 10 million loan plus ˆ 5 million equity)



12.9 Tariffs

Table 20 and Table 21 show a significant increase of all seven tariff options after 2007. The main reasons for the increase for the cost-plus tariff have already been explained above (first of all due to gas price increase). Options 2, 3 and add the investment surcharge, which results in a tariff increase of 15-16% above the cost-plus tariff.

It is however not clear whether the approval of an investment surcharge really allows charging depreciation of the same investments during the validity period of the investment surcharge. If this would be excluded, the difference between the options with investment surcharge and cost plus would only be about half of the difference shown by the table.

While the magnitude of the difference between the cost-plus tariff the actual 2007 tariff is similar to the cost increase of the previous years, the cost increase between options 2 and 3 on the one hand and the 2007 tariff would amount to 45 %. For residential consumers the impact would, however, likely be smaller as the municipality calculates an average tariff.

An important result is that despite considerable increases the tariff options 1-6 are significantly below a tariff that would be increased to normal inflation rates (consumer price index).

Table 20 **Development of tariffs (baseline scenario, ˆ 15 million loan)**

Option	Unit	2005	2006	2007	2008	2009	2010	2015	2020	2024
1: Economically justified tariff	Rb/GCal	479	540	648	814	901	941	1,077	1,181	1,333
2: Cost plus investment surcharge	Rb/GCal	479	540	648	950	1,037	1,077	1,213	1,181	1,333
3: Indexation plus investment surcharge (3Y)	Rb/GCal	479	540	648	950	1,022	1,146	1,271	1,181	1,325
4: Only upwards indexation 3Y	Rb/GCal	479	540	648	950	1,022	1,146	1,271	1,271	1,325
5: Indexation plus investment surcharge (5Y)	Rb/GCal	479	540	648	950	1,022	1,160	1,334	1,201	1,325
6: Only upwards indexation 5Y	Rb/GCal	479	540	648	950	1,022	1,160	1,334	1,412	1,412
7: Inflation only	Rb/GCal	479	540	648	950	1,007	1,059	1,445	1,653	2,087

Table 21 Development of tariffs (baseline scenario, ˆ 10 million loan plus ˆ 5 million equity)

Option	Unit	2005	2006	2007	2008	2009	2010	2015	2020	2024
Option 1: Economically justified tariff	Rb/GCal	479	540	648	807	899	911	1,072	1,181	1,333
2: Cost plus investment surcharge	Rb/GCal	479	540	648	943	1,035	1,047	1,208	1,181	1,333
3: Indexation plus investment surcharge (3Y)	Rb/GCal	479	540	648	943	1,015	1,145	1,261	1,181	1,325
4: Only upwards indexation 3Y	Rb/GCal	479	540	648	943	1,015	1,145	1,261	1,261	1,325
5: Indexation plus investment surcharge (5Y)	Rb/GCal	479	540	648	943	1,015	1,158	1,326	1,201	1,325
6: Only upwards indexation 5Y	Rb/GCal	479	540	648	943	1,015	1,158	1,326	1,410	1,410
7: Inflation only	Rb/GCal	479	540	648	943	999	1,051	1,434	1,639	2,070

12.10 Affordability

Based on the financial forecast, the affordability of the heating services has been assessed. Affordability is here indicated by the share of the heating costs in the total disposable household income. There are no official statistics about household income available. This report estimated the household income to be 15.604 RB, based on an average income of 7.802 RB per person and the assumption of two earners per household. A poor household is assumed to have half the income available.

The heating costs are determined by two factors. First by the tariff: Second by the heat consumption. As described before, the heat demand forecast has assumed that due to the installation of heat meters, the annual heat consumption goes down. Experiences from various CEE countries show energy savings of typically 20-30%. Accordingly, in case of increasing tariffs, the effect on the heating bill can partially or totally be compensated by lower heat consumption.

Due to mentioned institutional problems (TE not responsibly to deliver heat up to billings and lacking obligation for consumption-based billing).Accordingly, TE does not have any mandate nor incentive to install meters and implement consumption-based billing. An exemption is the buildings served by TE's Housing Management Service Company, where heat meter can be installed. Consumption-based can, however, only be implemented by approval of the building owners.

Therefore, forecasted energy saving effects that are typical for consumption-based billing are projected to be very low, only affecting these 50-60 buildings. Accordingly, the heating bill of most consumers (those who are not billed according to consumption) will increase with the tariff and the increase will not be offset by a reduction of the consumption.

Figure 21 shows the same for tariff model 3. Results are similar to tariff model 2. Figure 22 shows the share of heating costs for tariff model1. The shares are significantly lower than for the other models, because the tariff does not include an investment surcharge.

Figure 21 shows decreasing shares of heating costs in household income for the coming ten years (thereafter slightly increasing ones), as the tariff increases will be compensated by income increases.

The average low income households have to pay up to about 15% of their income. As this number refers to the average of the group there might be a larger number of households with significantly higher shares, which could again require some financial assistance.

Figure 21 shows the same for tariff model 3. Results are similar to tariff model 2. Figure 22 shows the share of heating costs for tariff model1. The shares are

significantly lower than for the other models, because the tariff does not include an investment surcharge.

Figure 21 Share of heating costs in household income (tariff model 2)

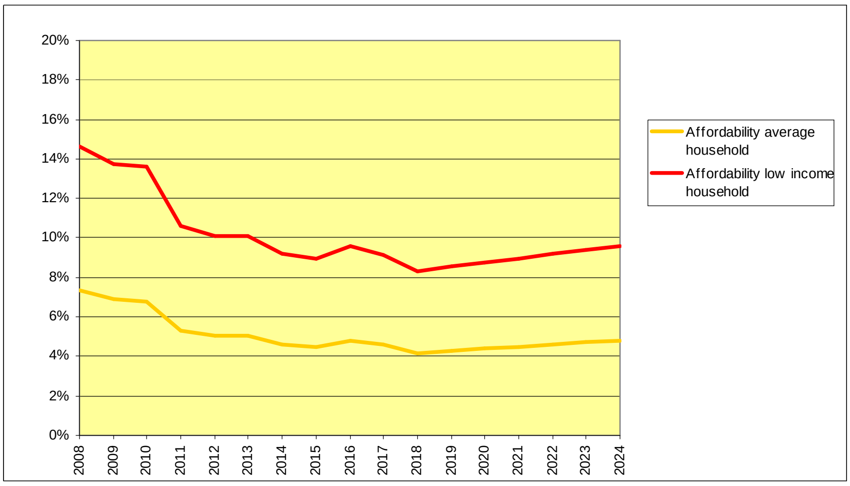


Figure 22 of heating costs in household income (tariff model 3)

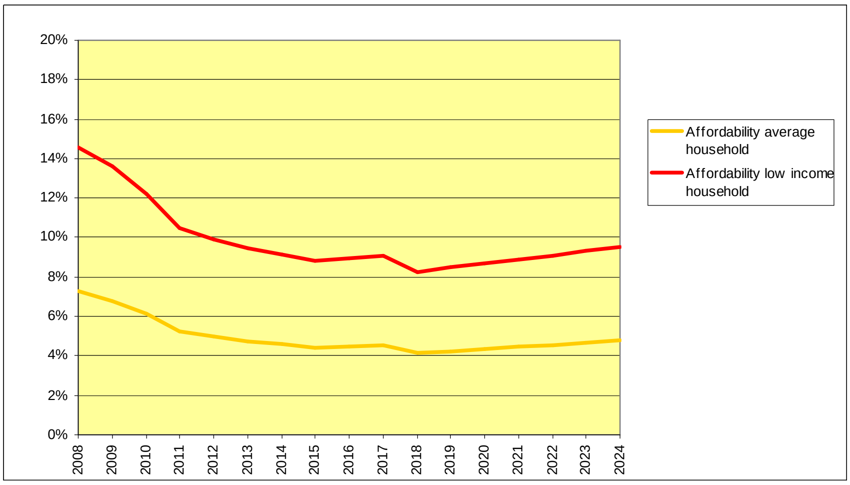
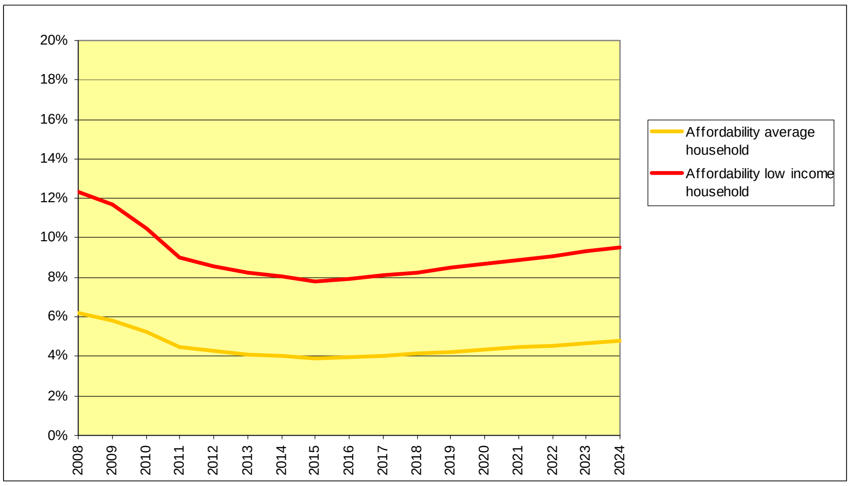


Figure 23 Share of heating costs in household income (tariff model 1)



13 Action and Implementation Plan

The action and implementation plan aims at transforming TE from a mere heat producer to a service provider offering comprehensive services along the whole value chain.

The action and implementation plan consists of various elements:

1. Investment project implementation
2. Marketing for at least 50-60 contracts for the Housing Management Services Company within the next three years
3. Installing heat meters and performing a comprehensive heat metering program
4. Marketing for consumption-based billing in buildings being under a contract with TE.
5. Building up a service unit for pre-financing and installing heat cost allocators and thermostatic valves, reading and billing (i.e., cost distribution within TE) services.
6. Develop and agree with the regulatory authorities on a mandatory heat metering and consumption-based billing program for the whole city
7. Extend consumption-based billing to all buildings supplied by TE.
8. Market reading and billing services (cost distribution within the buildings) and sign service contracts.

14 Annexes

14.1 Internal rate of return of the total investment program

ehabilitation of energy system **Overall investment program**

		2008	2009	2010	2011	2012	2013	2014	2015	2020	2025	2030
ıel savings												
Cost savings	kRUR	0	-3826	-2440	4470	4470	4470	4470	4470	4470	4470	4470
Fuel energy	GWh		-15.8	-10.1	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5
Unit cost of fuel	RUR/MWh	242	242	242	242	242	242	242	242	242	242	242
lectric energy savings												
Cost savings	kRUR		759	1333	2084	2186	2186	2186.13	2186.13	2186.13	2186.13	2186.13
Energy	GWh		0.4	0.7	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Unit cost	RUR/MWh		2050	2050	2050	2050	2050	2050	2050	2050	2050	2050
lectricity purchase converted to CHP generation												
Cost savings			4707	4707	4707	4707	4707	4707	4707	4707	4707	4707
Energy			3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Unit cost			1435	1435	1435	1435	1435	1435	1435	1435	1435	1435
lectricity sales												
Incr revenues	kRUR		0	0	0	0	0	0	0	0	0	0
Sold energy	GWh		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incr net fee	RUR/MWh		679	679	679	679	679	679	679	679	679	679
axes of staff												
Cost savings	kRUR		1010	4210	7011	7011	7011	7011	7011	7011	7011	7011
anagement												
Cost savings	kRUR		811	3379	5628	5628	5628	5628	5628	5628	5628	5628
mergency repairs												
Cost savings	kRUR		2138	8797	14256	14256	14256	14256	14256	14256	14256	14256
epairs												
Cost savings	kRUR		2971	12540	20778	20778	20778	20778	20778	20778	20778	20778
un boiler replacement												
Incr revenues	kRUR		3024	12095	30238	30238	30238	30238	30238	30238	30238	30238
O2 cost savings	kRUR		0	0	0	0	0	0	0	0	0	0
CO2 unit price	RUR/ton		0	0	0	0	0	0	0	0	0	0
CO2 savings	tonnes		-1613	-664	4956	4980	4980	4980	4980	4980	4980	4980
CO2 emitted per fuel	kg/MWh		202	202	202	202	202	202	202	202	202	202
otal												
Benefits	kRUR	0	11593	44621	89172	89274	89274	89274	89274	89274	89274	89274
vestments (2007)												
554191	kRUR	-77649	-265741	-210802	0	0						
16064	kEUR											
et cash flow	kRUR	-77649	-254148	-166180	89172	89274	89274	89274	89274	89274	89274	89274
	IRR:	**15%**										

14.2 Internal rate of return of the boilers already operated by TE

Rehabilitation of energy sources **Own HoBs of Teploenergo**

		2008	2009	2010	2011	2012	2013	2014	2015	2020	2025	2030
Fuel savings												
Cost savings	000 RUR	0	2324	9686	16129	16129	16129	16129	16170	16721	19943	19943
Fuel energy	GWh		*9.6*	*40.0*	*66.7*	*66.7*	*66.7*	*66.7*	*66.8*	*69.1*	*82.4*	*82.4*
Unit cost of fuel	RUR/MWh	*242*	*242*	*242*	*242*	*242*	*242*	*242*	*242*	*242*	*242*	*242*
Electric energy savings												
Cost savings	000 RUR		1025	2050	3075	3075	3075	3075	3075	3075	3075	3075
Energy	GWh		*0.5*	*1.0*	*1.5*	*1.5*	*1.5*	*1.5*	*1.5*	*1.5*	*1.5*	*1.5*
Unit cost	RUR/MWh		*2050*	*2050*	*2050*	*2050*	*2050*	*2050*	*2050*	*2050*	*2050*	*2050*
Electricity purchase converted to CHP generation												
Cost savings			0	0	0	0	0	0	0	0	0	0
Energy			*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Unit cost			*625*	*625*	*625*	*625*	*625*	*625*	*625*	*625*	*625*	*625*
Electricity sales												
Incr revenues	000 RUR		0	0	0	0	0	0	0	0	0	0
Sold energy	GWh		*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Incr net fee	RUR/MWh		*679*	*679*	*679*	*679*	*679*	*679*	*679*	*679*	*679*	*679*
Taxes of staff												
Cost savings	000 RUR		1010	4210	7011	7011	7011	7011	7011	7011	7011	7011
Management												
Cost savings	000 RUR		811	3379	5628	5628	5628	5628	5628	5628	5628	5628
Emergency repairs												
Cost savings	000 RUR		2250	9379	15619	15619	15619	15619	15619	15619	15619	15619
Repairs												
Cost savings	000 RUR		3128	13035	21707	21707	21707.1	21707	21707	21707	21707	21707
Mun boiler replacement												
Incr revenues	000 RUR			0	0	0	0	0	0	0	0	0
CO2 cost savings	000 RUR		0	0	0	0	0	0	0	0	0	0
CO2 unit price	RUR/ton		0	0	0	0	0	0	0	0	0	0
CO2 savings	tonnes		2183	8573	14196	14196	14196	14196	14196	14196	14196	14196
CO2 emitted per fuel	kg/MWh		202	202	202	202	202	202	202	202	202	202
Total												
Benefits	000 RUR	0	10548	41739	69169	69169	69169	69169	69209	69761	72983	72983
Investments (2007)												
413336	000 RUR	-75372	-171655	-166309	0	0						
11981	kEUR											
Net cash flow	000 RUR	-75372	-161107	-124570	69169	69169	69169	69169	69209	69761	72983	72983

IRR: 16%

14.3 Internal rate of return of the additional boiler houses

ehabilitation of energy sources **Acquisition of seven municipal HoBs and constructing new HoBs**

		2008	2009	2010	2011	2012	2013	2014	2015	2020	2025	2030
uel savings												
Cost savings	kRUR	0	-4306	-10765	-10765	-10765	-10765	-10765	-10765	-10765	-10765	-10765
Fuel energy	GWh		*-17.8*	*-44.5*	*-44.5*	*-44.5*	*-44.5*	*-44.5*	*-44.5*	*-44.5*	*-44.5*	*-44.5*
Unit cost of fuel	RUR/MWh	*242*	*242*	*242*	*242*	*242*	*242*	*242*	*242*	*242*	*242*	*242*
ectric energy savings												
Cost savings	kRUR		-410	-1025	-1435	-1333	-1333	-1332.5	-1332.5	-1332.5	-1332.5	-1332.5
Energy	GWh		*-0.2*	*-0.5*	*-0.7*	*-0.7*	*-0.7*	*-0.7*	*-0.7*	*-0.7*	*-0.7*	*-0.7*
Unit cost	RUR/MWh		*2050*	*2050*	*2050*	*2050*	*2050*	*2050*	*2050*	*2050*	*2050*	*2050*
ectricity purchase converted to CHP generation												
Cost savings			0	0	0	0	0	0	0	0	0	0
Energy			*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Unit cost			*625*	*625*	*625*	*625*	*625*	*625*	*625*	*625*	*625*	*625*
ectricity sales												
Incr revenues	kRUR		0	0	0	0	0	0	0	0	0	0
Sold energy	GWh		*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Incr net fee	RUR/MWh		*679*	*679*	*679*	*679*	*679*	*679*	*679*	*679*	*679*	*679*
axes of staff												
Cost savings	kRUR		0	0	0	0	0	0	0	0	0	0
anagement												
Cost savings	kRUR		0	0	0	0	0	0	0	0	0	0
nergency repairs												
Cost savings	kRUR		-113	-469	-781	-781	-781	-781	-781	-781	-781	-781
epairs												
Cost savings	kRUR		-156	-339	-434	434	-434	-434	-434	-434	-434	-434
un boiler replacement												
Incr revenues	kRUR		3024	12095	30238	30238	30238	30238	30238	30238	30238	30238
O2 cost savings	kRUR		0	0	0	0	0	0	0	0	0	0
CO2 unit price	RUR/ton		0	0	0	0	0	0	0	0	0	0
CO2 savings	tonnes		-3693	-9232	-9329	-9304	-9304	-9304	-9304	-9304	-9304	-9304
CO2 emitted per fuel	kg/MWh		202	202	202	202	202	202	202	202	202	202
otal												
Benefits	kRUR	0	-1961	-503	16824	17794	16926	16926	16926	16926	16926	16926
vestments (2007)												
99800	kRUR	0	-61000	-38800	0	0						
2893	kEUR											
et cash flow	kRUR	0	-62961	-39303	16824	17794	16926	16926	16926	16926	16926	16926
	IRR:	**14%**										

14.4 Internal rate of return of the mini CHP plant

Rehabilitation of energy sources				**Mini CHP**								
		2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2020**	**2025**	**2030**
Fuel savings												
Cost savings	kRUR	0	-2086	-2086	-2086	-2086	-2086	-2086	-2086	-2086	-2086	-2086
Fuel energy of HoB	GWh		4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Fuel energy of CHP	GWh		13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
Fuel energy savings	GWh		*-8.6*	*-8.6*	*-8.6*	*-8.6*	*-8.6*	*-8.6*	*-8.6*	*-8.6*	*-8.6*	*-8.6*
Unit cost of fuel	RUR/MWh	*242*	*242*	*242*	*242*	*242*	*242*	*242*	*242*	*242*	*242*	*242*
Electric energy savings												
Cost savings	kRUR		0	0	0	0	0	0	0	0	0	0
Energy	GWh		*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Unit cost	RUR/MWh		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Electricity purchase converted to CHP generation												
Cost savings	kRUR		4707	4707	4707	4707	4707	4707	4707	4707	4707	4707
Energy	GWh		*3.3*	*3.3*	*3.3*	*3.3*	*3.3*	*3.3*	*3.3*	*3.3*	*3.3*	*3.3*
Unit cost	RUR/MWh		*1435*	*1435*	*1435*	*1435*	*1435*	*1435*	*1435*	*1435*	*1435*	*1435*
Electricity sales												
Incr revenues	kRUR		0	0	0	0	0	0	0	0	0	0
Sold energy	GWh		*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Incr net fee	RUR/MWh		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Maintenance												
Cost savings	kRUR		-213	-6	-6	-6	-6	-6	-6	-6	-6	-6
CHP units	kRUR		*248.4*	*7.2*	*7.2*	*7.2*	*7.2*	*7.2*	*7.2*	*7.2*	*7.2*	*7.2*
HoB alternative	kRUR		*34.9*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*
CO_2 cost savings	kRUR		0	0	0	0	0	0	0	0	0	0
CO_2 unit price	RUR/ton		0	0	0	0	0	0	0	0	0	0
CO_2 savings	tonnes		-152	-152	-152	-152	-152	-152	-152	-152	-152	-152
CHP units	tonnes		2672	2672	2672	2672	2672	2672	2672	2672	2672	2672
Alternative HoB	tonnes		930	930	930	930	930	930	930	930	930	930
Alternative electricity	tonnes		1590	1590	1590	1590	1590	1590	1590	1590	1590	1590
CO_2 emitted per fuel	kg/MWh		202	202	202	202	202	202	202	202	202	202
Total												
Benefits	kRUR	3	2407	2614	2614	2614	2614	2614	2614	2614	2614	2614
Investments (2007)												
29670	kRUR		-29670	0	0	0						
860	kEUR											
Net cash flow	kRUR	3	-27263	2614	2614	2614	2614	2614	2614	2614	2614	2614
	IRR:	**8%**										

14.5 Internal rate of return of the building level mixing loops on space heating side (substations)

Rehabilitation of energy system **55 building level mixing loops on space heating side**

		2008	2009	2010	2011	2012	2013	2014	2015	2020	2025	2030
Fuel savings												
Cost savings	kRUR	0	242	726	1192	1192	1192	1192	1192	1192	1192	1192
Fuel energy	GWh		*1.0*	*3.0*	*4.9*	*4.9*	*4.9*	*4.9*	*4.9*	*4.9*	*4.9*	*4.9*
Unit cost of fuel	RUR/MWh	*242*	*242*	*242*	*242*	*242*	*242*	*242*	*242*	*242*	*242*	*242*
Electric energy savings												
Cost savings	kRUR		144	308	444	444	444	443.625	443.625	443.625	443.625	443.625
Energy	GWh		*0.1*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*
Unit cost	RUR/MWh		*2050*	*2050*	*2050*	*2050*	*2050*	*2050*	*2050*	*2050*	*2050*	*2050*
Electricity purchase converted to CHP generation												
Cost savings			0	0	0	0	0	0	0	0	0	0
Energy			*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Unit cost			*625*	*625*	*625*	*625*	*625*	*625*	*625*	*625*	*625*	*625*
Electricity sales												
Incr revenues	kRUR		0	0	0	0	0	0	0	0	0	0
Sold energy	GWh		*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Incr net fee	RUR/MWh		*679*	*679*	*679*	*679*	*679*	*679*	*679*	*679*	*679*	*679*
Taxes of staff												
Cost savings	kRUR		0	0	0	0	0	0	0	0	0	0
Management												
Cost savings	kRUR		0	0	0	0	0	0	0	0	0	0
Emergency repairs												
Cost savings	kRUR		0	0	0	0	0	0	0	0	0	0
Repairs												
Cost savings	kRUR		0	0	0	0	0	0	0	0	0	0
Mun boiler replacement												
Incr revenues	kRUR			0	0	0	0	0	0	0	0	0
CO_2 cost savings	kRUR		0	0	0	0	0	0	0	0	0	0
CO_2 unit price	RUR/ton		0	0	0	0	0	0	0	0	0	0
CO_2 savings	tonnes		49	147	241	241	241	241	241	241	241	241
CO_2 emitted per fuel	kg/MWh		202	202	202	202	202	202	202	202	202	202
Total												
Benefits	kRUR	0	385	1033	1635	1635	1635	1635	1635	1635	1635	1635
Investments (2007)												
11385	kRUR	-2277	-3415.5	-5692.5	0	0						
330	kEUR											
Net cash flow	kRUR	-2277	-3030.1	-4659.29	1635.28	1635.28	1635.28	1635.28	1635.28	1635.28	1635.28	1635.28
	IRR:	**14%**										

14.6 Financial projections: Macroeconomic assumptions

Base Scenario - EBRD		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Nominal GDP ($ per capita)	USD	6,026	7,437	8,677	9,648	10,866	12,191	13,569	15,030	16,649	18,442	20,428	20,428	20,428	20,428	20,428	20,428	20,428	20,428	20,428
Real GDP growth (%)	%	6.7	7.0	6.4	6.0	5.0	5.0	5.0	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
CPI (% change, annual average)	%	9.70	8.00	7.50	7.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
LCU/$ (Annual average)	RUB/USD	27.20	25.50	25.00	25.50	25.20	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
RER vs $(% +=appn)		10.40	13.20	7.00	2.40	4.70	4.30	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
LCU/EUR (Annual average)	RUB/EUR	34.20	34.20	35.50	36.50	36.00	36.00	36.30	36.50	36.50	36.80	37.00	37.00	37.00	37.00	37.00	37.00	37.00	37.00	37.00
RUB vs EUR(% +=appn)	RUB/EUR	12.40	6.00	1.50	2.20	5.30	4.10	3.30	3.30	4.00	3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.30
Nominal wages ($ per month)	USD	383.00	477.00	549.00	605.00	678.00	757.00	838.00	924.00	1,019.00	1,123.00	1,226.00	1,226.00	1,226.00	1,226.00	1,226.00	1,226.00	1,226.00	1,226.00	1,226.00
LCU wages growth (%)	%	21.80	16.60	12.90	12.40	10.80	10.80	10.80	10.20	10.20	10.20	9.20	9.20	9.20	9.20	9.20	9.20	9.20	9.20	9.20
Real LCU wages growth(%)	%	11.00	8.00	5.00	5.00	4.50	4.50	4.50	4.00	4.00	4.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
EUR/USD (annual average)	EUR/USD	0.80	0.75	0.70	0.70	0.70	0.69	0.69	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
US CPI (% annual average)	%	3.20	1.90	2.50	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40
EU CPI (% annual average)	%	2.20	2.00	2.00	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90

Pessimistic Scenario - EBRD	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Nominal GDP ($ per capita)	6,026	7,437	7,844	8,187	8,462	8,747	8,953	9,211	9,476	9,749	10,081	10,081	10,081	10,081	10,081	10,081	10,081	10,081	10,081
Real GDP growth (%)	6.7	7.0	5.0	4.0	3.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
CPI(% change, annual average)	9.70	8.00	18.00	16.00	14.00	12.00	12.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
LCU/$ (Annual average)	27.20	25.50	30.00	34.60	39.30	43.90	49.00	53.40	58.30	63.60	69.00	69.00	69.00	69.00	69.00	69.00	69.00	69.00	69.00
RER vs $(% +=appn)	10.40	13.20	(2.00)	(2.00)	(2.00)	(2.00)	(2.00)	(1.50)	(1.50)	(1.50)	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)
LCU/EUR (Annual average)	34.20	34.20	42.50	49.50	56.20	63.20	71.00	78.00	85.10	93.40	102.10	102.10	102.10	102.10	102.10	102.10	102.10	102.10	102.10
RER vs EUR(% +=appn)	12.40	6.00	(7.00)	(2.20)	(1.50)	(2.20)	(2.20)	(1.70)	(1.00)	(1.70)	(1.20)	(1.20)	(1.20)	(1.20)	(1.20)	(1.20)	(1.20)	(1.20)	(1.20)
Nominal wages ($ per month)	383.00	477.00	498.00	515.00	532.00	550.00	569.00	585.00	602.00	619.00	640.00	640.00	640.00	640.00	640.00	640.00	640.00	640.00	640.00
LCU wages growth (%)	21.80	16.60	22.70	19.50	17.40	15.40	15.40	12.20	12.20	12.20	12.20	-	-	-	-	-	-	-	-
Real LCU wages growth(%)	11.00	8.00	4.00	3.00	3.00	3.00	3.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
EUR/USD (annual average)	0.80	0.75	0.70	0.70	0.70	0.69	0.69	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
US CPI (% annual average)	3.20	1.90	2.50	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40
EU CPI (% annual average)	2.20	2.00	2.00	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90

Optimistic Scenario - EBRD	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Nominal GDP ($ per capita)	6,026	7,437	8,556	9,788	11,175	12,758	14,538	16,566	18,823	21,487	24,528	24,528	24,528	24,528	24,528	24,528	24,528	24,528	24,528
Real GDP growth (%)	6.7	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
CPI(% change, annual average)	9.70	8.00	6.00	5.00	4.50	4.20	4.00	3.80	3.70	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
LCU/$ (Annual average)	27.20	25.50	25.10	24.70	24.20	23.60	23.10	22.50	22.00	21.40	20.90	20.90	20.90	20.90	20.90	20.90	20.90	20.90	20.90
RER vs $(% +=appn)	10.40	13.20	4.90	4.40	4.20	4.20	4.00	4.00	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
LCU/EUR (Annual average)	34.20	34.20	35.70	35.30	34.60	34.00	33.40	32.80	32.00	31.50	30.90	30.90	30.90	30.90	30.90	30.90	30.90	30.90	30.90
RER vs EUR(% +=appn)	12.40	6.00	(0.50)	4.20	4.70	4.00	3.80	3.80	4.20	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
Nominal wages ($ per month)	383.00	477.00	543.00	622.00	696.00	780.00	872.00	976.00	1,088.00	1,213.00	1,352.00	1,352.00	1,352.00	1,352.00	1,352.00	1,352.00	1,352.00	1,352.00	1,352.00
Nominal wage increase	27%	25%	14%	15%	12%	12%	12%	12%	11%	11%	11%	0%	0%	0%	0%	0%	0%	0%	0%
LCU wages growth (%)	21.80	16.60	12.40	12.40	9.70	9.40	9.20	9.00	8.90	8.70	8.70	8.70	8.70	8.70	8.70	8.70	8.70	8.70	8.70
Real LCU wages growth(%)	11.00	8.00	6.00	7.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
EUR/USD (annual average)	0.80	0.75	0.70	0.70	0.70	0.69	0.69	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
US CPI (% annual average)	3.20	1.90	2.50	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40
EU CPI (% annual average)	2.20	2.00	2.00	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90

14.7 Financial projections: Input price assumptions

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Gas price scenario												
Base	20%	15%	5%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Pessimistic	20%	20%	10%	8%	8%	8%	8%	8%	8%	8%	8%	8%
Electricity price scenario												
Base	7%	8%	14%	15%	13%	12%	6%	6%	6%	6%	6%	6%
Pessimistic	11%	12%	19%	20%	20%	14%	11%	11%	11%	11%	11%	11%
Water price scenario												
Base	2%	2%	2%	2%	4%	2%	6%	6%	6%	6%	6%	6%
Pessimistic	4%	4%	4%	4%	4%	4%	11%	11%	11%	11%	11%	11%
Euribor scenario												
Base case	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
Pessimistic	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%
Collection rates												
Base case	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
Pessimistic	99%	98%	97%	96%	95%	95%	95%	95%	95%	95%	95%	95%
Bad debts												
Base case	4%	3%	3%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Pessimistic	5%	5%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%

14.8 Environmental action plan

1. Environmental Audit of TeploEnergo in Taganrog - Russia

1.1. Background of TeploEnergo (TE)

TE is one of the first DH Companies in Russia that was privatized. Initially the company was established in 1997 as a local branch of the regional electricity company. The main shareholder of TE is a CIB, a successful Russian Bank that strongly supports TE to become a model for the Southern Russia.

TE operates 50 heat only boiler plants (HoBs) with 310 Gcal/h total capacity, about 55 km of heating networks and 10 central heating points (CTPs) in Taganrog. The only fuel is natural gas with the GHG emissions of 136 thousand metric tonnes recorded in year 2006.

The total staff of TE is 580, out of which about 180 are seasonal and the balance of 400 permanent ones.

Since 2004, TE has already worked hard for rehabilitating the DH system. One of the largest boilers with 30 Gcal/h has been partly rehabilitated in year 2005 and rehabilitation of another one is underway. About 20% of the total network length has been replaced with modern pipes already and the repair funds of TE are planned to be used for further replacements in the years to come. The target is to have all networks new by year 2015. Additionally three small boilers had been eliminated and two new ones had been built. All HoBs and CTPs will be linked with the remote control and monitoring system that allows on-line monitoring of GHG emissions and enables fast corrective measures in case the measured GHG indicators deviate from the target values.

Therefore, TE is already experienced in system rehabilitation and is strongly driven both by the management and the owner to foster the rehabilitation process in order to become a good model for the customers in Taganrog as well as to other companies and authorities elsewhere in South Russia.

1.2. Legal framework and regulating bodies

1.2.1. Federal/local legal framework

The following laws and regulatory acts govern relations in the field of environmental protection when implementing the Project.

The measures incorporated in the draft EAP to be presented later in the document summarize and complement these regulations.

• Constitution of the Russian Federation (1993)

• Law on Protection of People's Health (1993).

• Law on the State Environmental Expertise (1995)

• Law on Protection of Environment (2002);

• The Land Code of the Russian Federation (2001);

• Law on specifically protected environmental territories (1995);

• Law on of underground resources (1992);

• Law on the Safety (1992);

• Law on the Urban Construction Basis (1992)

• Law on Architectural Activities (1995)

• Law on Health and Epidemiological Status of People (1991)

• Order of the State Committee of the Russian Federation for Protection of Environment № 372 dated 16/05/2000 “About Approval of the Provision on Assessment of the Impact of the Designed Economic and All Other Activities to Environment of the Russian Federation.

The system of the Federal bodies of executive power, which regulate relations in the field of natural resources use, environment/public health protection, environmental safety and monitoring, includes:

• Ministry of Natural Resources of the Russian Federation (MNR of RF);

• Ministry of Health Protection of the Russian Federation (State Sanitary-Epidemiological Service);

• State Committee of the Russian Federation for Housing and Construction Policy (Rosstroi);

• State Committee of the Russian Federation on Land Policy;

• Federal Service of the Russian Federation for Hydrometeorology and Environmental Monitoring (Hydromet);

• State Committee of the Russian Federation for Standardization; (ROSSTANDARD);

Ministry of Natural Resources of the Russian Federation is in charge of conservation and protection of natural resources (including ambient air, earth interior, inland surface water) and for environmental safety. In view of this the Ministry shall develop and implement federal level target programs, both regional and for separate natural resources.

The authority of the Ministry encompasses:

• development of the schemes of the integrated use and protection of water resources (both river basin schemes and regional);

• maintenance of the state record of water use and State water cadastre (jointly with Hydromet) and Russian register of hydraulic facilities;

• licensing of water use (water extraction from the surface and ground sources); setting water extraction limits for the Subjects of the Russian Federation and subjects of the economic activity (including Vodokanals);

• setting standards for: permissible emissions to ambient air and discharges to water bodies, wastes generation and disposal;

• organization of the state ecological expertise of the projects related to construction and reconstruction of the objects of the economic activities;

• monitoring of the environmental pollution sources;

• state control over use and protection of the ambient air, water bodies; lands.

The Ministry shall develop proposals on the procedure of pricing/collection of payments in terms of the water bodies use and environmental pollution.

The Ministry has authority to terminate, suspend or limit the right of water bodies use as well as economic activity in case it is effected with breach of RF environmental norms and regulations, requirements of the State ecological expertise/legislation requirements related to natural resources use and environment protection. The Ministry has authority to ban commissioning of the sites should their construction/reconstruction be fulfilled with breach of the environmental norms/regulations and provisions of the state ecological expertise.

The state Sanitary Epidemiological Service of the Russian Federation encompasses the following:

• Sanitary-epidemiological department of the Ministry of Health of Russia;

• Federal centre of the state sanitary-epidemiological surveillance and its affiliates in Subjects of RF on water and air traffic;

• State centres of sanitary-epidemiological surveillance under the federal bodies of executive power

The State Sanitary Epidemiological Service of the Russian Federation shall maintain the state sanitary/epidemiological norms-setting, sanitary/epidemiological surveillance (including control over adherence to the sanitary regulations and norms) under:

• design, construction/modernization and commissioning of buildings, works, engineering facilities;

• selection of water sources to be used for centralized water supply;

• selection of arrangements on prevention of water bodies pollution;

• water supply for drinking, household, and industrial needs;

• implementation of measures on prevention of ambient air pollution.

The Service shall issue Certificates for the following projects: construction/reconstruction, modernization/commissioning of the sites, buildings, works as well as for special water use, draft norms for ambient air pollution emissions and waster water discharges.

State Committee of the Russian Federation on Housing and Construction Policy shall develop and agree upon the construction norms and regulations. These norms/regulations are binding under design, construction/reconstruction of the objects of economic activities. The norms shall be developed based on the environment protection requirements.

State Committee of the Russian Federation on Land Policy is responsible for organisation of land conservation and land resources protection. It shall maintain the State land cadastre and state control over protection of lands.

Federal Service of the Russian Federation for Hydrometeorology and Environmental Monitoring (Hydromet) shall maintain monitoring, assessment and forecast of condition of the atmosphere, surface waters, marine environment, soils, and environmental pollution. The data acquired by Hydromet serve as the official document for assessment of the environmental condition and pollution level.

Alongside with the foregoing Hydromet shall maintain the register of surface waters in terms of the qualitative and quantitative indicators and the State water cadastre (jointly with MNR of Russia).

Hydromet shall maintain publication of the urgent information concerning the dangerous natural phenomena and environmental pollution, which can pose threat to life and health of population and may be detrimental for environment.

State Committee of the Russian Federation for Standardisation shall develop and approve the state standards, including standards related to natural resources use and environment protection, accreditation of the laboratories on analyses of the environment components. The Committee shall develop norms and regulations for the products, work, services and corresponding methods of control.

The state standards for new technique, technologies, materials, substances, technological processes should incorporate environmental concerns.

The abovementioned federal bodies of executive power and the subordinated regional and territorial organizations will supervise implementation of all aspects of the Plan within their authority.

Performing excavations and other related necessary repair and rehabilitation activity requires clearance from the engineering services of the local Heating Networks and Power Supply Company, federal and local agencies of Communications, and from local Traffic Police of Home Ministry of the Russian Federation. Special clearance from the Sanitary Epidemiological Inspection (Ministry of Health) is also required prior to putting newly installed pipes into operation.

In course of preparation of the project documentation for implementation of the Priority Investments Program there will be developed (in line with the Article 32 of the Federal Environmental Law) a special section of this documentation “Environmental Impact Assessment” (EIA).

In line with the Article 12 of the Federal Law on Environmental Expertise, the project documentation, which will incorporate EIA, will be furnished to the Committee of Natural Resources of the Bashkortostan Republic in order to perform the state environmental expertise.

1.2.2. Structure of local authorities

Officer on environmental protection and natural resources use in City Administration of Taganrog shall perform control over implementation of environment protection measures by city enterprises (including heating companies).

1.2.3. Applicable requirements and standards of EU and World Bank.

The EBRD applies similar screening practices and categorisation of projects./EBRD Environmental Policy July 2003/ as do the European Investment Bank (EIB) and the World Bank.

The task of the EIB, the European Union's financing institution, is to contribute towards the integration, balanced development and economic and social cohesion of the Member Countries. To this end, it raises on the markets substantial volumes of funds which it directs on the most favourable terms towards financing capital projects according to the objectives of the Union.

Outside the Union the EIB implements the financial components of agreements concluded under European development aid and cooperation policies. Outside the EU, the main focus of the Bank’s lending is in the Accession countries, in the partner countries in the Mediterranean region and in the Balkan in the context of the post-war reconstruction and development. It also operates in Africa and South Africa, the Caribbean and the Pacific Regions and in Latin America and Asia.

EIB finances a broad range of projects in energy, infrastructure and industrial sectors. To be eligible, such projects have to contribute to EU economic policy objectives.

The EIB supports among others energy -production, transfer and distribution (power gas heat etc.) as well as schemes for more efficient energy use and alternative energy supplies (wind power, etc),

The World Bank /The World Bank Operational Manual OP 4.01/ requires environmental assessment (EA) of projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable, and thus to improve decision making.

EA is a process whose breadth, depth, and type of analysis depend on the nature, scale, and potential environmental impact of the proposed project. EA evaluates a project's potential environmental risks and impacts in its area of influence; examines project alternatives; identifies ways of improving project selection, siting, planning, design, and implementation by preventing, minimizing, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts; and includes the process of mitigating and managing adverse environmental impacts throughout project implementation. The Bank favours preventive measures over mitigatory or compensatory measures, whenever feasible.

EA takes into account the natural environment (air, water, and land); human health and safety; social aspects (involuntary resettlement, indigenous peoples, and cultural property); and transboundary and global environmental aspects. EA considers natural and social aspects in an integrated way. It also takes into account the variations in project and country conditions; the findings of country environmental studies; national environmental action plans; the country's overall policy framework, national legislation, and institutional capabilities related to the environment and social aspects; and obligations of the country, pertaining to project activities, under relevant international environmental treaties and agreements. The Bank does not finance project activities that would contravene such country obligations, as identified during the EA. EA is initiated as early as possible in project processing and is integrated closely with the economic, financial, institutional, social, and technical analyses of a proposed project.

The Pollution Prevention and Abatement Handbook describes pollution prevention and abatement measures and emission levels that are normally acceptable to the Bank. However, taking into account borrower country legislation and local conditions, the EA may recommend alternative emission levels and approaches to pollution prevention and abatement for the project. The EA report must provide full and detailed justification for the levels and approaches chosen for the particular project or site.

Depending on the project, a range of instruments can be used to satisfy the Bank's EA requirement: environmental impact assessment (EIA), regional or sectoral EA, environmental audit, hazard or risk assessment, and environmental management plan (EMP). EA applies one or more of these instruments, or elements of them, as appropriate. When the project is likely to have sectoral or regional impacts, sectoral or regional EA is required.

The Bank undertakes environmental screening of each proposed project to determine the appropriate extent and type of EA. The Bank classifies the proposed project into one of four categories, depending on the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts.

(c) Category C: The proposed project is classified as Category C if it is likely to have minimal or no adverse environmental impacts.

Beyond screening, no further EA action is required for a Category C project.

1.3. Technology and Emissions Related Issues

TeploEnergo is a heat production and distribution company, the largest in Taganrog. All fuel is natural gas.

In discussions with the management, no environmental problems have been identified. This can be justified, because:

• Heat production is 100% based on natural gas, the most friendly fossil fuel. The CO2 emissions are relative low compared to other fossil fuels and no transportation of fuel or ashes is needed compared to solid fuels.

• No renewable fuels such as bio mass and waste fuel are realistic in the medium term in Taganrog. In a long term, a small part of the city may be heated with renewables after both the financial situation has improved, since waste incineration is expensive to invest, and gas prices have increased, since bio mass as a labor incentive and a restricted fuel resource is costly and its logistics takes several years to organise.

• Neither excess industrial heat other than already used, is available in Taganrog to substitute gas fuel.

• In general, the chimneys are taller than the nearby buildings, thus emitting no flue gas to high located apartments.

• Network repair works are necessary in order to maintain heat supply. Any disturbance to the traffic is intended to be minimal. About 50% of the network is underground, but the other 50% in aboveground, mainly on industrial areas. TE is working on converting the above ground sections to underground while rehabilitating the network sections. While being underground, any accidental burst of hot water will not cause immediate danger to people. Annual maintenance work is carried out mainly in summer during 2-3 weeks when the network is out of operations and cold.

• Central heating points, CTPs, are located in separate buildings, which are locked. Only staff of TE can have access to CTP buildings. Annual maintenance work is carried out mainly in summer during 2-3 weeks when the CTPs are out of operations and cold.

• In consumer connections in buildings, the network water is 90 oC at highest, as stipulated by the technical Snip standard of Russia, but usually lower. Extremely seldom any instantaneous bursts take place in consumer equipment, but the problems start with small leaking, that can be and has been safely repaired after early notice.

• Old house installations of gas heating have sometimes exploded and even resulted in human casualties, but such is rather impossible with district heating house installations.

In year 2006, based on the CO2 emission factor of natural gas of 202 kg/MWh of fuel, the CO2 emissions of TE were 138 thousand metric tonnes. TheCO2 emissions are not measured on-line , but the fuel consumption is measured. Therefore, the emissions calculation has to be based on the fuel specific emission factor and the measured fuel consumption.

1.4. Site Visit

The Consultant paid a site visit to three HoBs, the largest HoB located in Chuchevo 3 street and two small and modern ones at Frunze and A. Glushko streets.

Any particular risks neither for environment nor for health were identified, but the new HoBs seemed to be professionally established and all three operated and maintained in an appropriate way.

In the latter case, three very small boilers discontinued operation and the boiler equipment will be removed. The physical size of the small boilers is about 2 -3 m3 added with connection pipes of a few meters length each, just to describe the small size of the maneuver.

The released space of the old boiler houses will be either rented out or sold.

1.5. Organisation of Environment Management

Under the Chief Engineer of TE, all environmental matters are organized (See the organization chart below):

• The Chemist is responsible for flue gas emission (CO2) calculation and reporting, waste material management, water quality and waste water issues

• The Department of Civil Defense is responsible for working safety of the staff of TE as well as for public health when heating business is concerned.

• In the HoBs, the chief of the HoB is responsible for safe and clean operation of the boilers.

Due to the computerized database included in the remote monitoring and control system of the HoBs and CTPs, the quality of environmental management will be substantially improved: on-line monitoring of the emissions and immediate corrective actions to be taken if sudden deviations of the measured environmental indicators may occur.

2. Environmental Management Plan

2.1. Boiler Rehabilitation to Reduce Emissions

After the proposed Priority Investment Program, the number of the HoBs of TE is expected to reduce from 50 to 30, since small, old, inefficient and polluting HoBs will be closed down and new larger ones with higher efficiency will be installed instead.

Therefore, the emissions being proportional to the natural gas consumed, will decline.

2.2. Consumer Substations to Reduce Emissions

With the project, TE will introduce modern substations in building level (ITP), which are expected to reduce energy consumption of the buildings by 15% on average. This will be result in reduced fuel consumption, and further to reduced flue gas emissions.

The substations will be equipped with temperature control systems and heat energy metering. Therefore, the obtained energy savings can be measured.

2.3. Remote Monitoring with Emissions in Database

TE is underway to establish a computerized remote monitoring and control system for the HoBs and the CTPs. At present, two newest HoBs are remote monitored already. The only control measure is to shut of the gas inlet to the boiler plant in emergency situation. Therefore, the system is mainly collecting information to the dispatch centre which is manned 24 hours a day all year round.

The system will record the fuel consumption, measured energy production and a number of parameters on temperatures, water flows and pressures. It will record the operation/stand-by hours. based on the measured fuel and heat production measurements, the boiler efficiency can be monitored on-line. If there is a sudden change in the efficiency in any of the HoBs, it is an indication that something is wrong and must be corrected. Thus, the emissions which directly depend on the fuel consumption and efficiency, can be monitored on-line and the corrective actions can be taken immediately if found necessary.

This will have an important role in monitoring and reducing the emissions of the HoBs.

2.4. Carbon Trading

Due to expected emission reduction of TeploEnergo in the current business area, without system expansions, the carbon trading would be possible. The baseline criteria can be based on the measured degree days, the fuel consumption of the current business area measured in the HoBs - separated from the needs of the new areas (excluding seven currently municipal owned boilers and the CHP plant) and the relatively constant building stock (verified with the customer database).

In the current business, the expected emission reductions amount to 14.4 thousand tones a year. The monetary value crucially depends on the market price of trading while committing the contract.

2.5. TeploEnergo as Modern Model to South Russia

The Center-Investment Bank (CIB) as the main owner of TE supports TE to become a model for South Russia of modern district heating system. The modern system will be characterized by overall customer focused operation including consumption based billing and modern tariff system, improved overall efficiency due to reduced losses of fuel and electricity, higher production of personnel, improved quality of heating due to avoiding the summer time breaks of few weeks duration and offering the buildings and apartments with technical means to control thei heat consumptiomn, to offer incentives to the customers to save energy.

The proposed PIP is well in line with such an objective, and is actually, a continuation to work already started in TE regarding network and HoB rehabilitation. Already 20% of the network length has been modernized with preinsulated pipelines and two out of 50 HoBs are brand new. Rehabilitation of one of the largest boilers of 30 Gcal/h in Chuchevo HoB is underway and another one has already been rehabilitated two years ago.

The chairman of the Board of TE and simultaneously the president of CIB, expressed the willingness to organize comprehensive training in Taganrog to other companies about the way to proceed. in addition to local experts, some distinguished international experts of district heating would be also used in training. Discussions for donor financing for such training had taken place with some countries already, for instance, with Finland on the Minister of Foreign Trade level already.

2.6. Public Outreach about Benefits of Modern Heating

Liquidation of three small and inefficient HoBs and installing new and efficient instead, that has been completed already, has been mentioned in the local newspapers.

While implementing the PIP the customers will be, and have already been informed, on the lower cost level of TE compared with the other DH companies operating in Taganrog. TE is actively attracting and acquiring inefficient parts of neighbor companies to their system in order to modernise them and to reduce costs of heating.

In course of the model system implementation the public audience will be informed about the approach and the performance in order to develop market of TE for further acquisitions.

3. Environmental Action Plan

3.1. Summary

With the proposed project, 16 small boilers would be eliminated and 7 new boilers would be built to integrate the networks, 284 weather regulators would be installed in building basements to reduce heat losses of buildings, heat metering would be installed to about 30 HoBs, 10 CTP and to 284 buildings, 35% of the total number of the buildings. TeploEnergo is strongly committed to boiler system modernization and to become a forerunner in modernizing the district heating systems in Southern Russia. The main owner of TeploEnergo, CIB, strongly supports TE in meeting such a goal.

Only natural gas is used in the boilers, which is the most environmentally friendly fossil fuel. Introduction of bio fuels and renewables cannot change the heating fuel issue in next ten to twenty years.

No steam boilers are used but only water boilers with 120 oC water temperature at highest.

There is no sludge coming out from the natural gas fueled boilers or the district heating pipelines to be handled.

Eventually, asbestos has been used in some of the small boilers that are planned for elimination. In such a case, appropriate removal methods have to be used to prevent free fiber in the air.

3.2. Operational context

3.2.1. Purpose and need

TeploEnergo plans to continue and strengthen the centralized energy supply system development in order to reduce losses of fuel, electricity and water and to increase productivity of their staff.

3.2.2. Legal and institutional framework

The Russian bank “Center-Invest” has been the first bank partner of the IFC in the program of stimulation of investments in energy saving inn Russia. In year 2004, “Center-Invest” has become the main share holder of TeploEnergo with 77% of the shares, but has co-operated with TeploEnergo for five years already.

The OJSC “heat and power energy”, TeploEnergo, works under the registration No. 492 of Taganrog municipality, dated June 26, 2002. According to the registration, the main responsibilities of TeploEnergo are production, delivery and distribution of heat energy including all works related to carry out the activities.

3.2.3. History of the operation including alternatives considered

In January 1, 1977, the “heat and power engineering” enterprise was established in Taganrog. In the beginning, the enterprise ran 17 small boiler houses at 15.4 GCal/h capacity in total and 6.1 km of heating networks. Until Feb. 1997, it operated as a regional property and as a part of RMPS “Rostov Heat Energy” organization. Since March 1997, with the resolution of the head of Rostov region Administration, No. 54, dated Nov. 26, 1996, the enterprise became an open stock company. At present, TeploEnergo is the main heat service provider in Taganrog.

TeploEnergo has not been allowed to have large scale CHP, which would have had made sense while designing the heating system in the first place. At present, due to high price of purchased electricity, TeploEnergo plans to expand their operation to small scale CHP generation. The electricity to be generated would be used in the boiler plants of TeploEnergo in order to avoid the problem of uncertain expectations of excess electricity sales to the local power grid.

3.3. Description of the operation

The district heating supply takes place all year round, except a period of 1-2 weeks in summer when the system is cold and under annual maintenance.

In summer neighboring networks will be interconnected in order to have better use of the boilers and to minimize the duration of the maintenance period, thus minimizing the harm caused to the customers.

All new boilers and the existing CTPs will be remote controlled from the new control centre, in which 2 latest boiler plants are already monitored with cameras and data acquisition. Only closing the gas flow to the boiler plants can be done from the control centre in the remote mode.

3.4. Description of the existing environment

3.4.1. Climatic conditions

The design temperature of the heating systems is -22 oC and the average outdoor temperature prevailing during the heating season of 167 days is -0.4 oC. Taganrog is located on the coast of the Asov Sea, and therefore, strong winds from between south and west are common.

3.4.2. Geomorphology and geology

The land is mainly sand without rocks and clay.

3.4.3. Surface and ground water quality

3.4.4. Landscape

The land is relatively flat with few hills. The main hill is in the city canter on the bank of the sea bay.

3.4.5. Ecology and biotic resources

Taganrog is located on the Coast of Asov Sea, thus being windy. In the future, some bio fuel could be taken from the nearby forests to address the climate change in addition to the energy savings that are expected to materialize after the project.

3.4.6. Air quality

A sample analysis of the air quality in the city centre in June 2007 is presented Table below.

3.4.7. Noise

Noise is not considered an issue. The gas fuelled boilers are silent since the pumps and fans are all indoor in the boiler houses. No fuel or slag storage outside to cause noise. In the network, all CTPs are with separate buildings including the pumps.

The new substations planned to 55 buildings are silent as well. In EU, for instance, the normal practice is to have the substation in the building basement in a separate locked room.

During rehabilitation of network parts, cranes and trucks are needed in the streets. Such a noise can be considered to be a part of normal noise of the day-time traffic.

3.4.8. Ground conditions

Mainly sand land prevails in Taganrog. Such a sand functions as additional thermal insulation of the networks while being dry.

3.4.9. Socio-economic and cultural issues

Since the price of gas fuel is expected to substantially increase in the few years to come, the current pricing being about a fourth of the price paid by the EU countries, the increasing gas prices will put strong pressure on increasing the heat tariffs accordingly.

While stressing the affordability of poorest customers, the municipality (and the government) may need to subsidy in a way or another to smoothen the impacts of high heating costs.

In such a case, the subsidies should be socially targeted instead of subsidizing the tariff. The latter subsidy approach would benefit more those who live in large than those living in small apartments, in other words, the tariff subsidies would support more rich than poor.

3.4.10. Land use and settlement patterns

The existing land of the boiler plants is used while investing in rehabilitation. In a few cases a new boiler house will be built when 1-3 smaller houses will be eliminated and any of the eliminated house of boilers is not appropriate for the new and larger boiler. This issue related to small boilers in individual cases only.

3.5. Description and assessment of the significant environmental impacts of the proposed operation at the local, regional and global levels

3.5.1. Impacts associated with construction

Normal construction practices will be used to HoBs and ITPs, which are not expected to cause any problems.

3.5.2. Impacts associated with operation

With remote control and automation, the impacts will be positive: improved efficiency of energy and human resources.

The CO2 emissions, for instance are expected to reduce from the 138 thousand tonnes recorded in year 2006.

Since only natural gas is used in Taganrog, the factor of 202 kg of CO2 per MWh of gas consumption has been used. Therefore, the CO2 emissions are proportional to fuel consumption with and without the Investment Programme.

For energy production of TE, the CO_2 emissions in 2011 would be 3% lower than 138 thousand tonnes in 2006, equal to 3.4 thousand tonnes less. The reduction is relatively small, because the project includes business expansion (i) to acquisition of municipal systems and (ii) to introduction of CHP that both would increase TE's emissions. For the current type of business without expansion, the annual CO_2 emissions would reduce 11% equal to 14.4 thousand tonnes.

For the overall region, on the other hand, provided that electricity generation in power-only plants alternative to the CHP plant would be with 42% efficiency and the old boilers of the municipality would continue run at 75% efficiency as they do now, the CO_2 emissions with the project would be 15.8 thousand tonnes a year less than without the project.

Due to expected emission reduction of TeploEnergo in the current business area, without system expansions, the carbon trading would be possible. The baseline criteria can be based on measured degree days, fuel consumption separated from the needs of the new areas (excluding seven currently municipal owned boilers and the CHP plant) and the relative constant building stock.

3.5.3. Impacts associated with closure and decommissioning

The boiler houses, in which the boilers will be eliminated, will be either sold or rented out. The boilers to be eliminated are small, up to about 2 MW only. Therefore, decommissioning can be considered a minor environmental issue compared to the large benefits of improved efficiency and fuel savings.

3.5.4. Identification of key uncertainties and data gaps

Not identified any.

3.5.5. Comparison of impacts associated with alternatives, including the do-nothing alternative

Do-nothing will loose energy (fuel and electricity) and keep both the heating costs and flue gas emissions on higher level than with the project.

3.5.6. Summary of least-cost analysis of alternatives

Alternative investment options face substantial institutional problems:

- Acquisition of 6-7 municipality owned boilers: the agreement was not available by the date of the report.
- Installation of a large CHP unit using natural gas: substantial institutional challenges regarding the conditions and pricing of selling electricity to the grid. In the long term, a CHP substantially larger than included in the PIP offers promising financial benefits to TE and economic benefits to the Rostov region.
- Using condensing boiler technology will become actual in the future when the gas prices have increased more and a new large heat production unit will be implemented.

With such a technology, the thermodynamic efficiency can be raised close to 100%, and the measured production of heat per consumed fuel even higher than 100%.

3.6. Description of mitigation measures and/or measures to enhance environmental benefits

The project it self will reduce gas consumption by about 11% and electricity consumption by 17%, both reducing emissions related to energy production in the current business area. Expansion with (i) CHP introduction and (ii) acquisition and modernization of the inefficient municipal heating systems will reduce the overall emission of the Rostov region.

3.7. Outline of an environmental monitoring plan

3.7.1. Monitoring during the construction phase

Normal boiler construction material and methods will be used, as being supervised by the Chief engineer of TE. While installing weather controllers and heat meters, locked rooms/cabins will be used to avoid misusing them.

3.7.2. Monitoring during operation

By means of the remote monitoring and control system being under implementation, the emission levels will be monitored on-line. Any sudden deviation in the real emissions relative to set target values will give an impulse for immediate corrective actions.

4. Names of responsible officers for preparing EA

In the municipality of Taganrog, the Environment Protection Office with Ms. Galina Aleksanrovna Tkacheva, and in TeploEnergo, the senior engineer and chemist, Ms. Lilija Ivanovna Kotenko, are responsible for environmental assessment of the heating operations.

5. Appendices

A. Least cost analysis of the Priority Investment Program including GHG emissions with and without the project

B. TeploEnergo 30 years brochure