PROJECT FEASIBILITY ASSESSMENT

MOLDOVA GRCF 2W1: BALTI DH – PHASE II

Final Report

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TABLE OF CONTENTS

SUMMARY OF GRAPHS

SUMMARY OF TABLES

SUMMARY OF FIGURES

ACRONYMS

ANRE	National Authority for Energy Regulation
CAPEX	Capital Expense
CHP	Combined Heat & Power
DH	District Heating
DHW	Domestic Hot Water
EBRD	European Bank for Reconstruction and Development
EUR	Euro
GCF	Green Cities Fund
GET	Green Economy Transition
GHG	Greenhouse Gas
HDD	Heating Degree Days
HoB	Heat only Boiler
IHS	Individual Heating Station
KPI	Key Performance Indicator
LHV	Lower Heating Value
MDL	Moldovan Lei
MIS	Management Information System
PIP	Priority Investment Program
SCADA	Supervisory Control and Data Acquisition
VAT	Value-Added Tax

Executive Summary

Based on the successful implementation of the Phase 1, CET-Nord approached the Bank to consider the possibility to extend a new loan to finance additional investments for CET-Nord and to settle the debt to Moldovagaz in the amount of 14 million € together with 3 million € resulting from a combination of grant and soft loans. The Bank proposes to finance both the Priority Investment Program (11.5 million €) and the financial debt to Moldovagaz (5.5 million €).

The situation observed during the past two decades put at risk the development of district heating on a sustainable basis in the City of Balti (as elsewhere in the neighbouring eastern European cities): equalization of gas price between domestic and industries (like CET-Nord) encouraged customers to disconnect from central heating for individual gas boilers. The design of vertical secondary systems in buildings inherited from Soviet times is not compatible with individual disconnections: individual disconnections are responsible for energy misbalancing and the system cannot regulate the energy to take into account the reduced demand for heat. Consequently, the quality of service became poorer each time a customer disconnected from the central system. In the end, CET-Nord (as many other companies in former CIS countries) lost one third of their customers but keeping the whole aged infrastructures to operate and maintain.

However, CET-Nord has one main asset: it can produce heat and power at a high efficiency performance (around 86% on average). Electricity produced by CET-Nord has a CO2 index of 0.23 tCO2/MWh which is two times lower than the imported electricity for Moldovan consumers.

In the last two years milder temperatures were recorded: the index for measuring the intensity of outside temperatures was less than 2,600 degree.days to compare with 3,000 degree.days observed earlier in 2018. But because the new gas engines were put into operation, CET-Nord managed to increase its production of electricity to balance the situation. Gas engines do not only have a high energy performance (88% against 82% in average for the steam turbines), they bring an excellent power to heat ratio compared to steam turbines: it can provide 3.5 times more electricity than the steam turbines for the same heat demand. The current tariff levels provided by ANRE clearly encourage the production of electricity by CHP.

The Priority Investment Program which is proposed here suggests continuing the deployment of individual substations in residential buildings initiated under Phase 1. However, CET-Nord commits to achieve further energy savings and is eager to implement horizontal networks equipped with individual heat meters and thermo-regulating valves in apartments. The objective of CET-Nord is to give the customer control over its energy consumption and as a consequence, the possibility to adjust the billed amount. In public surveys, pricing of energy services has generally been the main reason for dissatisfaction.

CET-Nord is seeking to develop additional energy services which could be economically profitable to the Company and to the population. That is why CET-Nord has decided to develop domestic hot water in buildings where horizontal networks are deployed. The cost for centralized domestic hot water is competitive against individual boilers, particularly when the boiler operates with electricity which happens more often in Balti. The additional heat demand –mainly in summer- will enable to produce more electricity under a cogenerated mode which will bring CO2 savings at the country level.

The Priority Investment Program which has been built here plans to equip around 166 buildings with new individual sub-stations and horizontal networks in 296 buildings (all equipped with individual sub-stations). For economic reasons, CET-Nord will select the largest buildings to serve up to 22,280 apartments with domestic hot water. Heat storage facilities will be developed to maximize the use of gas engines in summer. The water treatment will be modernized to provide reliable and automated operations. The Priority Investment Program does not finance only physical assets but also digital tools: a SCADA will be developed to improve the monitoring of the heating distribution network. CET-Nord will also be equipped with a hydraulic model which will be used to confirm the feasibility of connecting the stand-alone boilers houses -currently operated by Termogas Balti- to the central system supplied by the CHP and for new customers connected to CET-Nord.

Project Components	Amount, €	EBRD loan	Green Climate Fund	Investment Grant
I. CAPEX INVESTMENTS	**11,500,000**	**8,500,000**	**1,000,000**	**2,000,000**
1. Supply and Installation of Individual Heating Sub-stations	*2,900,352*	*2,900,352*		
2. Construction of Horizontal Networks in Buildings	*7,254,585*	*4,254,585*	*1,000,000*	*2,000,000*
3. Construction of Heat Storage (700 m3)	*588,000*	*588,000*		
4. Upgrading of the Water Treatment Facilities for the Steam (2x10 ton/h) and Network's Make-up Water (20 m3/h) Production	*420,000*	*420,000*		
5. Implementation of SCADA for Heat Distribution	*250,000*	*250,000*		
6. Supply of a Thermo-Hydraulic Model	*87,063*	*87,063*		
II. REFINANCING OF HISTORIC GAS DEBT	5,500,000	5,500,000		
GRAND TOTAL	17,000,000	14,000,000	1,000,000	2,000,000

The above Investment Program has a good environmental performance: it leads to an annual decrease of 23,681 tons of CO2 once the project has been implemented. The economic performance is also good with 45% of EIRR and a pay-back of 4 years.

The financial performance of CET-Nord improved in the recent past. Despite warm weather conditions, revenue increased by nearly 25% and reached 330 Million Lei in 2020. The EBITDA and cash improved also strongly: at the end of 2020 the cash level increased strongly and reached nearly 43 million MDL or 2.2 million euros.

This result was obtained with the strong increase of electricity production due to the utilization of 4 gas engines in the heating season and 1 gas engine in non-heating season. Electricity sales accounts for 50% of CET Nord revenue in 2020 against 30% in 2018, and this should still increase slightly in the future, as electricity production increases in the non-heating season thanks to the development of sanitary hot water supply.

A financial model has been developed for the project. Tariff calculations have been performed using the cost + fee methodology which take into account the Remuneration Asset Based approach set by ANRE. After an expected decrease in tariffs in 2021 as a consequence of the decrease of tariffs for gas, tariffs will slightly increase due to the remuneration of new assets financed by the PIP. The increase is however moderate: the annual increase should be around 5% per year until 2029 where the loan principal must be repaid. Considering the strong decrease (around 12%) expected in 2021 as a result of the new tariffs for gas, the affordability ratio for heating will go down to 5% (against 10% in 2018) and will remain stable in the next decade due to the effect of the inflation in the country.

More details are provided in the financial report annexed to this report.

In the longer term, CET-Nord will have to replace the aged steam facilities which have already exceeded their lifetime. Different options have been explored in the report. The Company shall also continue to implement individual heat substations. Beyond the PIP, CET-Nord will have to allocate not less than 10% of its turnover to get all facilities in place by 2035.

CET-Nord will soon have to conduct additional feasibility studies to address emerging issues: to improve the security of gas supply, CET-Nord needs to develop alternative fuel storage facilities. Different options can be explored, in particular for natural gas storage (above ground or underground storage) which require an in-depth technical and regulatory assessment. The liberalisation of the electricity market will soon create new constraints to CET-Nord on the stability of the electricity production to the national grid. Better forecasts (based on outside temperatures) combined with closer monitoring of the operating conditions of the DH system and CHP facilities (potentially supported by modelling tools) shall be performed to avoid costly penalties. In the longer term, potential synergies with the municipal wastewater and solid waste industry could be developed: a heat pump installed at the outlet of the wastewater treatment plant and a heat recovery system from a solid waste incinerator could be part of the future “energy mix” for district heating in the City of Balti.

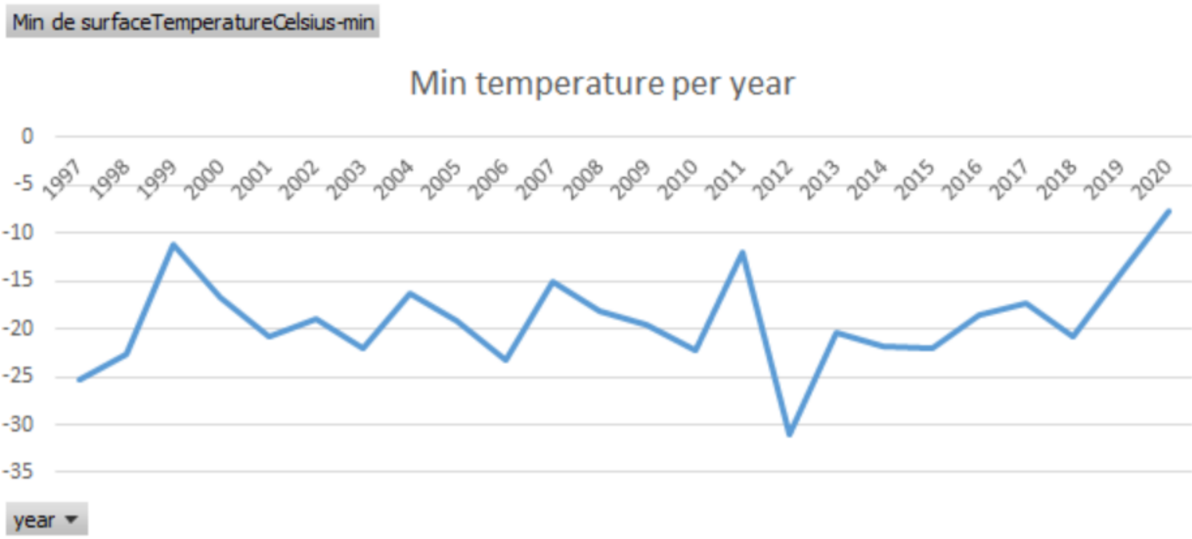
Termogaz Balti, the Municipal enterprise is not big enough to finance its development across the City. Then the project of merging Termogaz Balti with CET-Nord makes sense: some systems currently supplied by heat-only-boilers could be connected to the central system operated by CET-Nord: it will increase the heat demand for the CHP plant and be an opportunity for additional combined power generation. It will also enable us to develop synergies in technical and commercial operations. But over all, it will simplify the strategy for developing district heating services in the City of Balti. By its decision dated on April 27th this year, the City of Balti approved the principle of merging Termogaz Balti with CET-Nord and the transfer of all its assets (for free) to the State Property Agency.

Lastly, the report recommends extending the loan (in the amount of 5.5 million €) to settle the debt to Moldovagaz. The first benefit is related to the governance/management of the Company: it will put an end to the control by Moldovagaz of the financial management of the Company which was a clear constraint for making new investments under the Company's own financing. Given the long maturity provided by the EBRD loan (15 years), the annual repayment of the loan in the next 5 years will be significantly lower (compared to the amount which would have to be paid to Moldovagaz): the Company will be able to allocate more resources to finance capital expenditures in the near future.

1. Introduction

1.1 Geography

Bălți has a warm-summer and humid continental climate. The minimum temperatures registered in the City show −32 °C (during winter 2012/2013) but much warmer temperatures have been observed over the last two years.



Graph 1: Variation of minima of temperatures for the period 1997-2020

There are 450 to 550 mm of annual rainfall, mostly during summer and fall. Winds are generally from the north-east or the north-west at about 2–5 m/s.

Bălți is located in the Northern region. It is situated on the tops and slopes of three hills and in two small valleys. The land in the north of Moldova is very fertile, mostly consisting of black earth ("chernozem"). Several extraction sites for raw materials used in the construction industry are also found in the vicinity of Bălți.

The creeks Răuțel, Copăceanca, and Flămândă cross the territory of the municipality, and flow into the river Răut. Also, several lakes are situated in Bălți: City Lake, Komsomolist Lake, Hunters and Fishermen Lake, Strâmba Lake. Bălți means "swamp" when directly translated. This is because of the very watery soil in the land where the City is built. A major part of the underground network of CET-Nord is in direct contact with water.

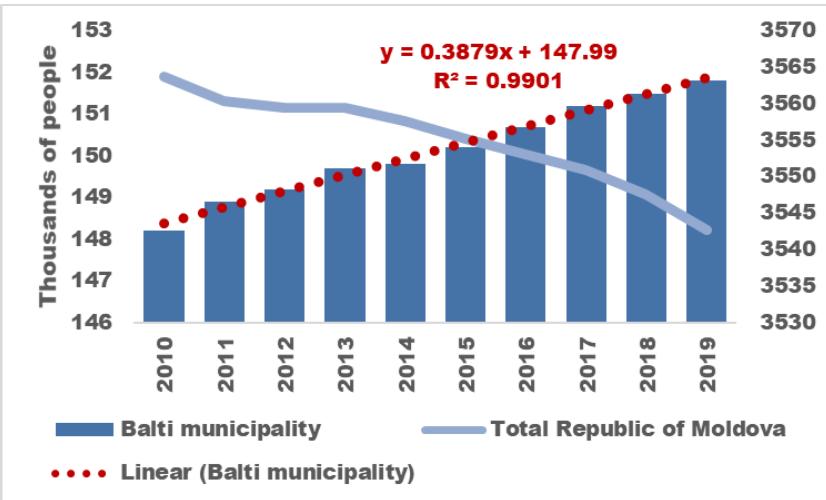
1.2 Population

In 2019 the resident population of Balti recorded 151.5 thousand inhabitants, that represented 4.3% of the total population of Moldova. The share of the urban population consisted of 96.8% of the population from the city, and 3.2% from the rural one.

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Dynamics (%)
Total Republic of Moldova	3563.7	3560.4	3559.5	3559.5	3557.6	3555.2	3553.1	3550.9	3547.5	3542.7	-0.59
Balti municipality	148.2	148.9	149.2	149.7	149.8	150.2	150.7	151.2	151.5	151.8	2.43
Balti City	143.3	144.0	144.3	144.8	144.9	145.3	145.8	146.3	146.6	146.9	2.51
Balti villages	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	0.00
	structure										
Pop Balti / total	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.3	4.3	4.3	0.126
Pop urban Balti	96.7	96.7	96.7	96.7	96.7	96.7	96.7	96.8	96.8	96.8	0.078
Rural pop Balti	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.2	3.2	3.2	-0.078

Table 1: Resident population of Balti municipality in the period of 2010-2019 (thousand inhabitants) – National Bureau of Statistics

Despite a deep demographic recession observed in the Republic of Moldova, over the last decade, the population in Balti increased continuously on (+0.25%/year average).



Graph 2: Population of the Republic of Moldova and Balti municipality (2010-2019) – from National Bureau of Statistics

There is a significant disproportion of population by gender criterion in Balti. The total population consists of 45.9% male, and 54.1% of female. However, the share of men and women are uneven depending on the age: men (51.5%) are more numerous than women under 19 while women above 60 years old represent (61.9%) of their category.

	Total			Urban			Rural		
	Both sexes	Men	Women	Both sexes	Men	Women	Both sexes	Men	Women
0-19	100.0	51.5	48.5	100.0	51.5	48.5	100.0	52.0	48.0
20-59	100.0	46.7	53.3	100.0	46.6	53.4	100.0	49.3	50.7

60+	100.0	38.1	61.9	100.0	38.0	62.0	100.0	39.8	60.2
Total	100.0	45.9	54.1	100.0	45.8	54.2	100.0	48.3	51.7

Table 2: The population of Bălți municipality by sexes and large age groups (from National Bureau of Statistics)

In the Republic of Moldova, data on household structure are obtained from household budgeting (CBGC) surveys.

	Moldova (%)	Balti Mun. (%)
1 person	30.7	29.8
2 people	32.1	31.2
3 people	17.9	14
4 people	12.7	14
5 people and over	6.4	4.8
Size medium of household	2.3	2.3
Median household size	2.6	2.6

Table 3: Household structure by number of persons in Balti Mun. (2019) – extrapolation from National Bureau of Statistics Data

The average size of a household in Balti is **2.3** inhabitants. However, around **30%** of the households are populated by a single person: that may affect the affordability for payment of the energy bills particularly with pensioners.

	Chisinau	North	Center	South
Employees	62.9	34.2	35.2	32.6
Self -employed workers in agriculture (farmers)	-	13.5	7.1	8.7
Self -employed in non-agricultural activities	5.3	5.2	7.9	7.7
Pensioners	24.5	35.6	34.5	39.2
Others	7.3	11.5	15.3	11.8

Table 4: Household structure by socio-economic status of members by statistical regions (2019) – from National Bureau of Statistics

The above table shows the high proportion (35%) of pensioners in the adult population.

The municipality of Balti, being the most important economic and social center in the North region, was not affected by a strong exodus of the population, and if certain trends of population emigration were manifested, they were compensated by flows of entry.

1.3 Role of women in decision-making bodies in Balti

The data on the presence of women in various administrative positions in Balti show that women here play a very important role in the decision-making process, both at the executive level and in the legislative process.

At the administration level of Bălți City Hall, out of the five management positions (mayor, deputy mayors, secretary of municipal Council), two positions are occupied by women: Deputy Mayor of the municipality and Secretary of the municipal council.

More than 60% of the positions of heads of subdivisions (departments) in the Balti City Hall are occupied by women, and in the case of an expansion at the section level, the share of women increases in proportion to the number of sections.

More than half (51.4%) of the total number of councilors of the Balti Municipal Council is represented by women. In the case of municipal enterprises, subordinated to the mayor's office, women are still well represented: the position of director in the 12 enterprises is held by 5 women (41.7%).

1.4 Economic activity

In the period 2013-2017, the Northern region registered an average share of about 17% and ranks second in terms of share in the gross domestic product of the Republic of Moldova.

	2013	2014	2015	2016	2017	Average annual growth
Moldova	119 532 871	133 481 634	145 753 643	160 814 563	178 880 890	10.6%
Municip. of Chisinau	66 623 825	74 828 867	83 096 637	92 664 577	104 077 184	11.8%
Northern Region	21 041 305	23 554 582	25 096 219	27 316 519	30 102 374	9.4%

Table 5: Regional Gross Domestic Product of the Republic of Moldova in current prices (thousand lei) – National Bureau of Statistics

According to the breakdown of the gross domestic product for the Northern region, agriculture predominates, which in 2017 represented about 26.7%. Agriculture is followed by manufacturing with a share of 16.7% and trade with 12%. The production and supply of heat and electricity placed the activity on the 10th place with a share of 3.3%.

Graph 3: The structure of GDP of the northern region by economic activities (2016, 2017) – From National Bureau of Statistics

Agriculture, which is an important activity in the Northern region, is not as specific for Balti municipality. In fact, half of the agricultural activity in Balti is concentrated in the 2 localities of the municipality (Elizaveta and Sadovoe villages).

At regional level (North region) Balti municipality registered in 2019 a share of about 45% of the sales revenues of the region. The specific activity developed in the City of Bălți, in 2019, mainly consists of manufacturing by 39.2%, commerce 30.7%. The production and supply of electricity and heat represents **14 8%** of the incomes generated in the City of Balti (as shown in the figure below).

Graph 4: The structure of Income from sales in Bălți municipality by economic activities (2019) – extrapolation from National Bureau of Statistics

The dynamics of the number of enterprises in Bălți municipality was similar to the dynamics per republic, registering in the last 5 years a stable growth of about +261 enterprises per year.

	2015	2016	2017	2018	2019	Growth rate (%)
Republic of Moldova	51 216	52 320	54 313	56 463	56 714	10.7
Chisinau municipality	33 279	33 916	34 902	36 011	35 445	6.5
North	6 301	6 402	6 706	7,046	7 287	15.6
Balti municipality	2 426	2,514	2,586	2,647	2 724	12.3
	structure					Share 2019/2015 percentage points (PP)
Chisinau municipality	65.0	64.8	64.3	63.8	62.5	-2.5
North	12.3	12.2	12.3	12.5	12.8	0.5
Balti municipality	4.7	4.8	4.8	4.7	4.8	0.1
Balti municipality to the north	38.5	39.3	38.6	37.6	37.4	-1.1

Table 6: Number of enterprises in the period 2015-2019 – Extrapolation from National Bureau of Statistics

In 2018, among the largest enterprises based in Bălți municipality were:

Name	Average staff number	number Sales revenue (Million MDL)
Intreprinderea cu Capital Strain "DRA DRAEXLMAIER AUTOMOTIVE" S.R.L.	3,062	705
SOCIETATEA PE ACTIUNI "RETELELE ELECTRICE DE DISTRIBUTIE NORD" in proces de reorganizare	1814	667
INSTITUTIA MEDICO-SANITARA PUBLICA "SPITALUL CLINIC MUNICIPAL BALTI"	1629	190
Societatea pe Actiuni "INCOMLAC"	829	721
Intreprinderea cu Capital Strain "MAXMANSERV" S.R.L.	709	299
Casa Comerciala "AQUATRADE" S.R.L.	512	485
Societatea pe Actiuni "FLOAREA SOARELUI"	489	821
SOCIETATEA PE ACTIUNI "CET-NORD"	465	242
SOCIETATEA CU RASPUNDERE LIMITATA "BALTI-GAZ"	423	116
SOCIETATEA PE ACTIUNI "BASARABIA-NORD"	310	213
Intreprinderea Municipala Regia "APA-CANAL-BALTI"	239	58
Intreprinderea cu Capital Strain "GG CABLES & WIRES EE" Societate cu Raspundere Limitata	224	1,058
SOCIETATEA CU RASPUNDERE LIMITATA "MAGDALINAS"	177	326
SOCIETATEA CU RASPUNDERE LIMITATA "VERIX-GRUP"	171	204
Societatea pe Actiuni "FURNIZAREA ENERGIEI ELECTRICE NORD"	99	1,892
SOCIETATEA COMERCIALA "PAVLIUDENIX" SRL	55	111
Societatea cu Raspundere Limitata "STROYLUX"	46	89
Intreprinderea cu Capital Strain "RSBAU" S.R.L.	6	79
intreprinderea cu Capital Strain Societatea "ADMINISTRARE IMOBILIARA" S.R.L.	1	63

The unemployment rate has been growing regularly since 2008 (from 7% to 15% of the active population). The unemployment rate for men is twice the women's.

1.5 INCOME DISTRIBUTION

The distribution of income categories of the population in urban areas of the Republic of Moldova, by income level, indicates that more than half of the specific income of all quintiles[1], the population of cities, comes from salary activity, and at the level of quintile It will exceed 2/3 of a person's disposable income (69.9%). 1/5 of the income of the first four quintiles is obtained from social benefits.

	Quintiles				
	I	II	III	IV	V
Disposable income - total	100.0	100.0	100.0	100.0	100.0
Salary activity	57.6	50.7	52.6	59.1	69.9
Individual agricultural activity	3.1	2.2	1.0	1.0	0.1
Income from individual non-agricultural activity	7.5	4.7	7.2	7.2	5.7
Income from the property	-	-	-	-	0.6
Social benefits	23.9	24.9	23.3	19.3	12.1
pensions	17.4	19.9	18.1	15.1	10.0
child allowances	2.3	2.4	3.1	1.5	1.6
social aid	0.8	0.1	0.2	0.1	0.0
Other incomes	7.9	17.4	15.9	13.4	11.6

[1] The quintile is a portion of the frequency distribution containing a fifth of the total population

remittances	4.0	11.9	10.6	8.7	7.6

Table 7: Average monthly disposable income per person by Quintiles and sources of income (%) – From National Bureau of Statistics

The highest average monthly disposable incomes per person are registered in Chisinau, followed by the central region. In the Northern district, **the average monthly disposable income per person was the level of 2,507 lei in 2019**. Since 2006, the household income has grown at around 9% per year.

The average monthly expenditure of the population of Balti for 2019 is given in the table below:

	Quintile I	Quintile II	Quintile III	Quintile IV	Quintile V
Average monthly expenditure (MDL)	1,418.1	1,901.1	2,370.8	3,058.7	5,547.7

Table 8: Average monthly expenditure of the population in Balti in 2019 (source: National Bureau of Statistic)

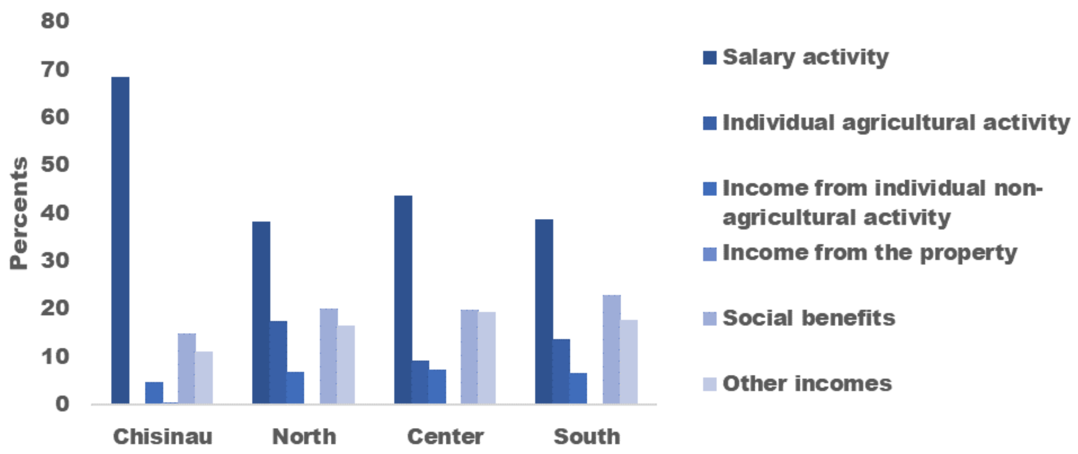
The structure of incomes in the regions (excluding Chisinau) shows insignificant differences on income categories.

The majority of the incomes mostly comes from the employment wage activity (about 38%), twice lower than in Chisinau. Another important source of income of the population in the North region is represented by the incomes from social benefits (about 20%), and in this category pensions predominate (15%).

	Lei, monthly averages per person					Percentage of total				
	North	Urban		Rural		North	Urban		Rural	
		Male	Female	Male	Female		Male	Female	Male	Female
Available income - total	2,507	3,147	2,918	2115.7	2192.3	100.0	100.0	100.0	100.0	100.0
Salary activity	964	2,168	1,479	859.0	708.1	38.4	68.9	50.7	40.6	32.3
Individual agricultural activity	442	28	17	385.0	282.8	17.6	0.9	0.6	18.2	12.9
Income from individual non-agricultural activity	176	210	151	167.1	61.4	7.0	6.7	5.2	7.9	2.8
Income from the property	5.4	6	14	8.5	-	0.2	0.2	0.5	0.4	-
Social benefits	507	440	662	385.0	561.2	20.2	14.0	22.7	18.2	25.6
.. pensions	393	343	542	289.8	416.5	15.7	10.9	18.6	13.7	19.0
.. child allowances	21	69	37	21.2	21.9	0.9	2.2	1.3	1.0	1.0
..social aid	17	3	2.9	12.7	24.1	0.7	0.1	0.1	0.6	1.1
Other incomes	412	292	595	308.9	578.8	16.5	9.3	20.4	14.6	26.4
.. remittances	345	185	408	268.7	515.2	13.8	5.9	14.0	12.7	23.5

Table 9: Average monthly available income per person in the Northern region by income source, averages and sex – From National Bureau of Statistics

The differences between men's and women's incomes by sources of income are also quite visible. Thus **the available income per person of men from wage activity exceeds by 1.5 times the income of women.**



Graph 5: The structure of the average monthly disposable income per person, by sources of income and statistical regions

In the breakdown of expenditures observed in the Northern region, the expenses for the obligatory needs predominate. Thus, in 2019, expenses for products in the North represented more than half of total expenses (42.7%), followed by expenses on home maintenance/utilities (17.2%) and for the purchase of clothing and footwear.

	Lei, monthly averages per person			Percentage of total		
	Chisinau	North	Balti Mun.	Chisinau	North	Balti. Mun
Consumption expenses - total	4038	2431	3637	100.0	100.0	100.0
Food	1388	1037	1300	34.4	42.7	36.5
Alcohol. tobacco	63	52	60	1.6	2.2	1.8
Clothing. footwear	384	259	353	9.5	10.7	9.8
Home maintenance	580	417	539	14.4	17.2	15.1
Housing equipment	188	134	175	4.7	5.5	4.9
Medical care and health	230	105	199	5.7	4.3	5.4
Transport	339	116	283	8.4	4.8	7.5
communications	170	115	156	4.2	4.7	4.3
recreation	206	39	164	5.1	1.6	4.2
lessons	79	16	63	2.0	0.7	1.7
Hotels. restaurants. cafes. etc.	229	26	178	5.7	1.1	4.6
miscellaneous	178	110	161	4.4	4.5	4.3

Table 10: Average monthly consumption expenditure per person by expenditure destination and statistical regions – From Bureau of National Statistics

1.5.1 Poverty level

The poverty rate of the population in Moldova has been relatively stable since 2015 (around 25%) which is one of the highest in Europe. A gap is observed between urban and rural areas. In Balti, the poverty ratio was 10.6 % in 2018.

The most recent official statistics regarding the level the poverty in the Republic of Moldova refers to 2018. the year in which **the threshold of poverty level was set to 1,998 lei per adult equivalent per month**. The threshold level for extreme poverty was set to 1,611 lei.

	Extreme poverty line	The poverty threshold level
Food component	871	1014
Non-food component	740	983
Total poverty line	1,611	1,998

Table 11: Extreme and absolute poverty lines for 2018 – From National Bureau of Statistics

In the Republic of Moldova. **the absolute poverty rate.** or the rate of people whose consumption expenditures are below the poverty thresholds. listed in Table 2.4. registers a general downward trend.

	2014	2015	2016	2017	2018
Threshold poverty absolute (lei)	1558	1709	1819	1939	1998
The absolute poverty rate (% total)	29.5	25.4	26.4	27.7	23.0
Big cities (incl. Balti)	8.3	5.2	6.5	8.4	6.7
Men	8.4	5.2	6.6	8.7	6.9
Women	8.2	5.2	6.4	8.1	6.5
Statistical regions					
North	31.9	26.5	30.5	31.1	28.4
Center	38.5	35.6	35.7	36.6	28.7
South	35.1	30.9	30.8	33.8	28.8
mun. Chisinau	10.7	6.9	6.5	7.5	4.7

Table 12: Absolute poverty rate in the Republic of Moldova. by areas and sexes – From National Bureau of Statistics

In Balti city, the poverty threshold level slightly reduces over the recent past: it now represents **6.7%** of the population. Men are slightly more affected by poverty than women (6.9% compared to 6.5%).

At the country level, the size of household is one of the indicators that determine the risk for poverty. Households with 5 or more people face a higher risk of poverty of about 42% or 2 times higher compared to the households consisting of one person.

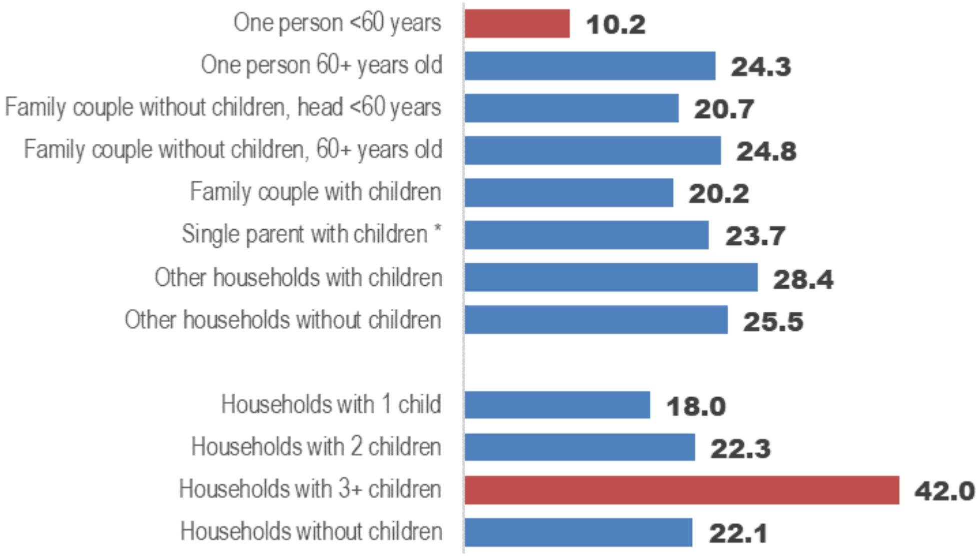
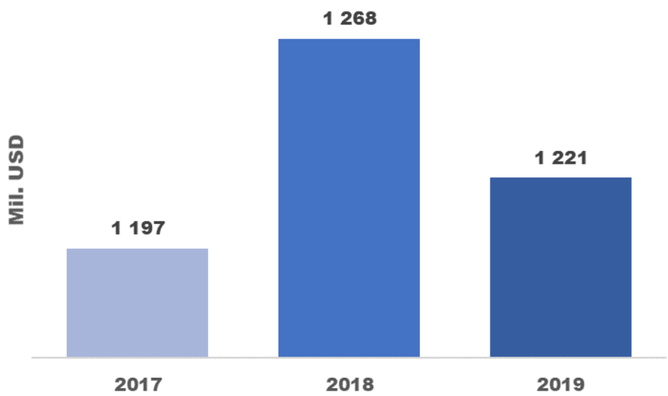


Table 13: Absolute poverty rate by type of household in 2018 – National Bureau of Statistics

Between 2017 and 2019, the transfer of funds from remittances amounted 1.2 billion USD per year which represented about **10%** of the total value of gross domestic product.



Graph 6: The value of remittances in the Republic of Moldova (2017-2019) – extrapolation from National Bureau of Statistics

One may observe variations during a year with higher transfers performed from May to October.

1.6 Presentation of the project area

CET-Nord is a joint stock company owned by the State and managed by the State Public Property Agency. While the Company was built to produce combined heat & power generation, it has enlarged its services to cover distribution and sales to end consumers. While 70% of the population live in buildings connected to the central district heating operated by CET-Nord, many apartments have gradually disconnected from the central DH system. Today, the overall population is 146,900 inhabitants but only around the 105,000 (70%) live in the operating area served by CET-Nord. In the service area, 27% of the population is disconnected (73% connected) in 2020. Consequently, the householders served by CET-Nord, accounts for around 76,700 inhabitants, 939 219m² of heated area.

At the same time, given that a significant part of the population of blocks of flats / apartments to which they are not connected to DH carry out their work activities in public buildings and economic agents connected to DH, it is estimated that the actual population facilitating DH is about 100,000 inhabitants in the Balti municipality.

Termogaz Balti is a Municipal enterprise. It operates small decentralized areas supplied from heat-only boilers. Today it serves a few thousands inhabitants for heating purposes only.

The map hereafter illustrates the operating areas of CET-Nord and Termogaz Balti.

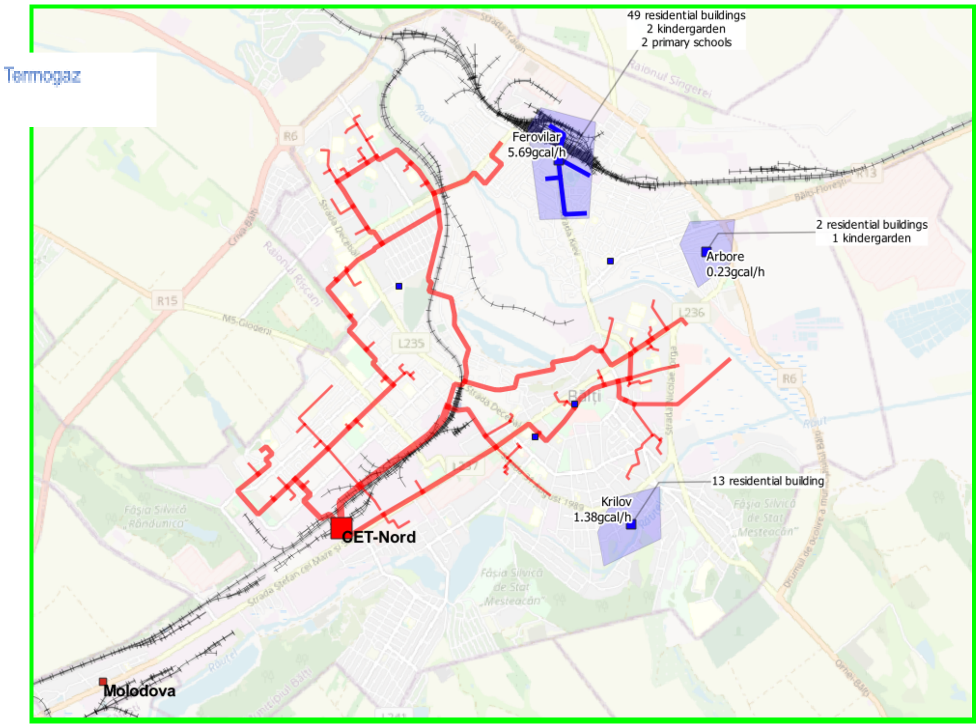


Figure 1: map showing the operating areas of CET-Nord and Termogaz Balti

The opportunity for merging the two companies has been analyzed in the section related to the organizational & institutional assessment. A preliminary technical assessment has been done to consider the opportunity for connecting some of the heat-only-boiler systems to the central system operated by CET-Nord.

1.7 Project objectives & key Moldovan strategy

1.7.1 Strategic priorities

The priorities set for the country with the Bank for 2017-2022 include the following main objectives:

- Improve governance and strengthen resilience by **enhancing energy security**: it means that any opportunity to reduce dependency from gas or electricity import shall be highly encouraged.

- **Enhance competitiveness**: increase energy efficiency to reduce the energy intensity (which exceeds by 29% the average of EU countries) and make the bill to end users (either for domestic or non domestic customers) lower.

- **Develop the economic transition towards lower CO2 emissions** to reduce vulnerability of the country to the climate change

At the municipal level, the City of Balti joined in 2019 the international green cities program with a commitment to implement projects for developing local economy under a sustainable and environmental friendly framework.

1.7.2 Project objectives

Considering the above objectives, a new Investment Program has been developed with the aim of improving energy efficiency by maximising the use of the highly efficient assets of the combined heat and power plant operated by CET-Nord. The new program intends to reduce gas consumption for space heating (through a better energy regulation in buildings) and to develop new services for providing sanitary hot water resulting in a displaced source of energy leading to significant savings of CO2 emissions.

CET-Nord wishes to contract a new loan to finance a priority investment program for the modernization of the service for space heating and sanitary hot water. That new loan would complement a first loan already signed between the Bank and the Government of Moldova. The first PIP consisted in:

- 4 new gas engines that can operate in cogeneration mode
- a new booster station equipped with three pumps and three frequency converters
- the replacement of the ventilation system for 2 steam boilers
- 169 individual substations.
- a new heat-only-boiler fueled with biomass (pellets) in an isolated area of the network.

Those investments have been recently implemented and are now in operation.

The first EBRD loan was of 7 **Million €** and is supposed to run until 2031. The total amount of the project was 10.7 Million €.

At present, the Bank and CET-Nord are eager to develop a second project that would again include investment components in the amount of **11.5 Million €** but also another potential additional loan to repay the remaining gas debt to “Moldovagaz”, the gas supplier of CET-Nord. By the end of 2020, the debt balance was around **7.5 Million €.** At the end of 2021 that amount is estimated at 5.5 million euros.

The feasibility study presented here in this report aims at developing a priority investment program with all necessary technical, economic, financial and environmental information to meet EBRD standards.

2. Technical assessment

2.1 Heat consumption

1,261 heat delivery points are registered by CET-Nord in 2020. In total, It represents a subscribed heat load of **96 Gcal/h**.

Type of consumers	Number of delivery points	Subscribed heat load [Gcal/h]
Residential	786 (incl. 45 with no consumption)	68.6
Commercial	343 (incl. 42 with no consumption)	7.9
Public administration	132 (incl.18 with no consumption)	18.7
TOTAL	1,261	95.2

Table 14: breakdown of consumers per category and subscribed heat load in 2020

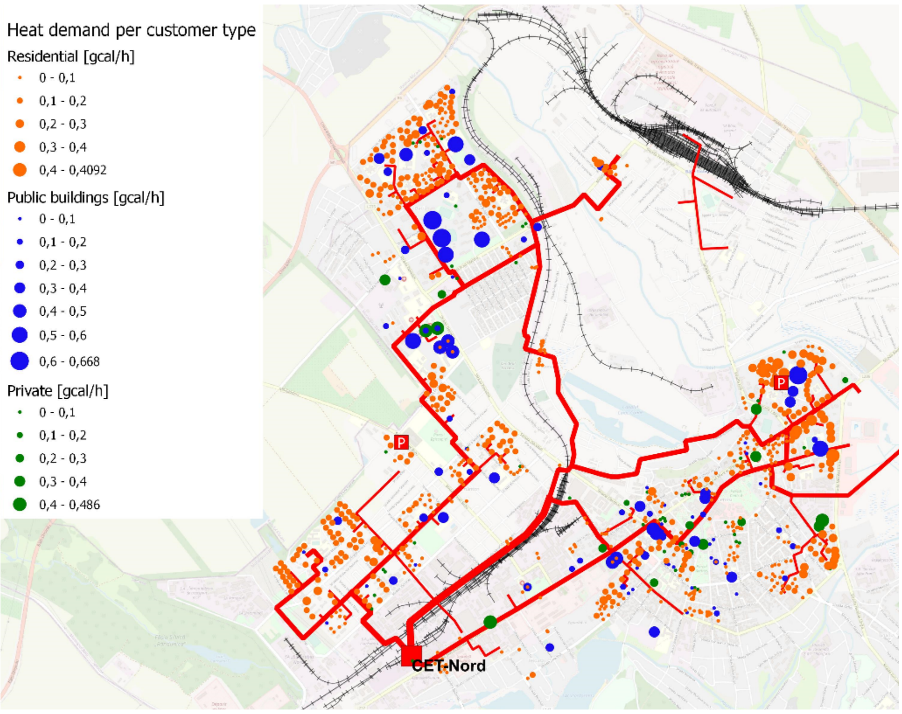


Figure 2: Map of buildings per category of activity and subscribed heat load

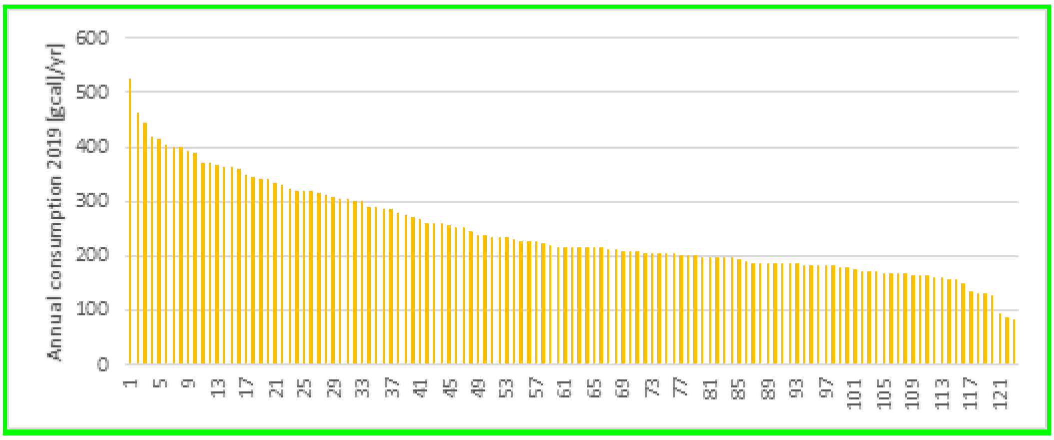
In the past years, the annual heat consumption billed by CET-Nord varied between **140,000 Gcal and 160,000 Gcal** according to weather conditions**.** In 2019 (all the IHS under the EBRD phase 1 project have been installed by 2018), customers with Individual Heat Substations already represented **24%** of the total heat consumption served by CET-Nord.

Calendar Year 2019, Gcal	Residential	Private	Administration	Total
IHS	31,236	214	1,465	32,915
Elevator	74,132	7,316	23,250	104,698
Total	105,368	7,530	24,715	137,613

Table 15: Breakdown of heat consumption per customer's category in 2019

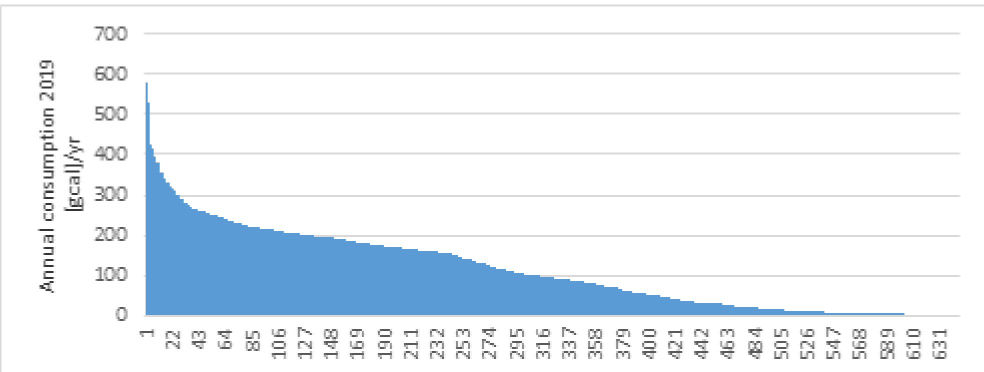
2.1.1 Residential buildings

Among the 130 buildings equipped with IHS, most of them have a consumption higher than 100 Gcal/year.



Graph 7: Distribution of residential buildings per level of heat consumption (equipped with Individual Heating Substation)

Among the residential buildings connected to the network without IHS, 150 still had a consumption higher than 200 Gcal/year in 2019.

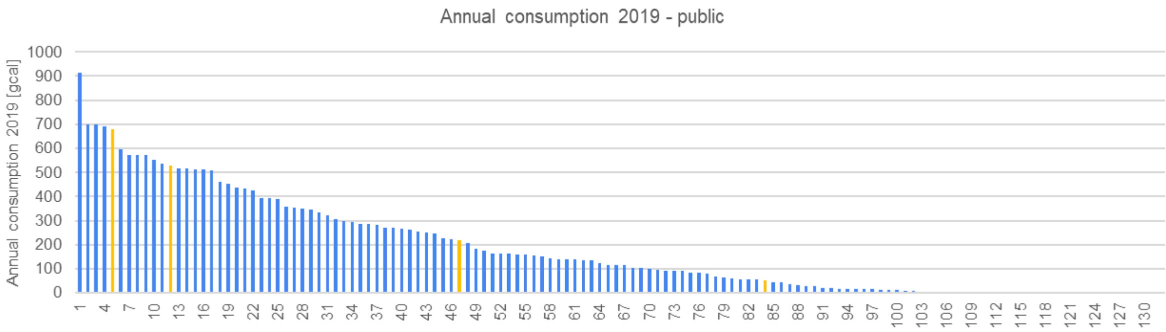


Graph 8: Distribution of residential buildings per level of heat consumption (equipped with hydro-elevator)

2.1.2 Public administration

129 public buildings are connected to the system operated by CET-Nord. 4 public buildings have been equipped with IHS and two of them are served with sanitary hot water since 2020. The consumption of public buildings represents **19%** of the total heat consumed in 2019.

The distribution of public buildings indicates that 70 of them have a consumption higher than 100 Gcal/year.



Graph 9: Breakdown of public administration buildings per level of heat consumption

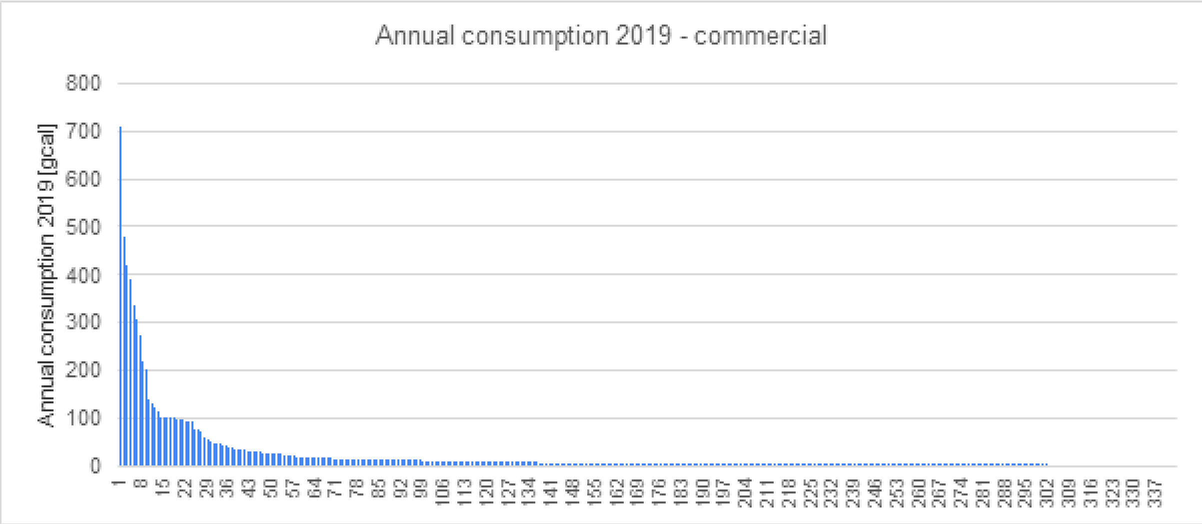
Number of buildings and related heat consumption level	Elevator	IHS
Consumption = 0 Gcal	18	0
Consumption < 1 Gcal	0	0
Consumption > 1 Gcal	107 (23,215 Gcal)	4 (1,450 Gcal)
Total (2020)	125 (23,215 Gcal)	4 (1,450 Gcal)

Table 16: Breakdown of public administration buildings per type of connection

2.1.3 Commercial entities

310 commercial (non-residential) buildings are connected to the CET-Nord system. The consumption of private buildings is 5% of the total heat consumed in 2019.

The distribution of buildings shown in the graph below indicates that only 25 of them have a consumption higher than 100 Gcal/year.



Graph 10: Breakdown of commercial buildings per level of heat consumption

The reduction of consumptions of heat energy for commercial buildings thanks to the installation of a IHS will be less significant than for public buildings (the last can afford regulating the temperature during week-ends and holidays). It will still help in reaching a decrease of consumption around 10% but has less impacts than for public buildings.

2.1.4 Building's Connections to the central heating network

Thermal energy used for space heating is currently delivered to buildings through two types of connections:

- For a large majority of buildings (around 85%), the primary and secondary networks are connected through hydro-ejectors (*elevator*). This system is composed of a by-pass between the supply and return pipes that enables to reduce the temperature of the supply pipe in order to avoid any risk of injury in the apartments and to avoid overheating in the apartments. However, the by-pass is not an automated regulation.

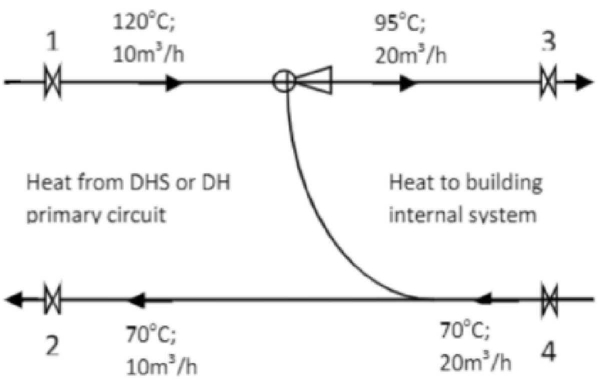


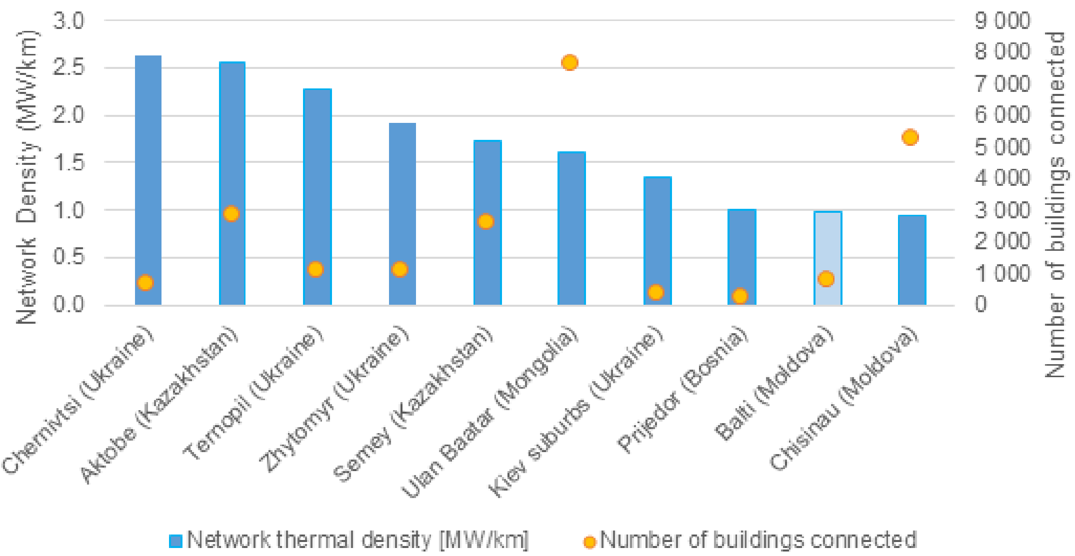
Figure 3: Scheme of an elevator system in Balti (source: feasibility study of Phase 1)

- 130 residential buildings have been equipped with Individual Heating Substations and 4 non-residential buildings had been equipped in 2020

In both cases heat energy is measured at the delivery point of the building.

In the past, group substations (CTP) were installed within the City for a specific number of residential and non-residential buildings to supply sanitary hot water. These facilities were abandoned in the late 90's and the main network is now directly connected to the customer's premises from the CHP to supply space heating only.

The heat density is estimated at 1.03 Gcal/h/km (ie **1.2 MW/km**). Such levels are comparable to the one observed in Chisinau, but still remain low compared to similar networks in the region. It is usually considered that a system with a heat density below 2 MW/km may lead to less efficient economic and operational performance.



Graph 11: Sample of a few urban DH networks in Eastern Europe and CIS countries

Balti city thus presents a relatively small network in terms of buildings connected (less than 1000 buildings). It is similar to networks in Ukraine (Zhytomyr, Ternopil, Chernivtsi). The density is comparable to Chisinau which has a much larger number of buildings connected to its network. Comparable programmes have been developed in these cities to improve the quality of service and the reliability of district heating networks. The Consultant uses its experience in these companies to adjust its recommendations.

2.1.5 Disconnections from the central heating system

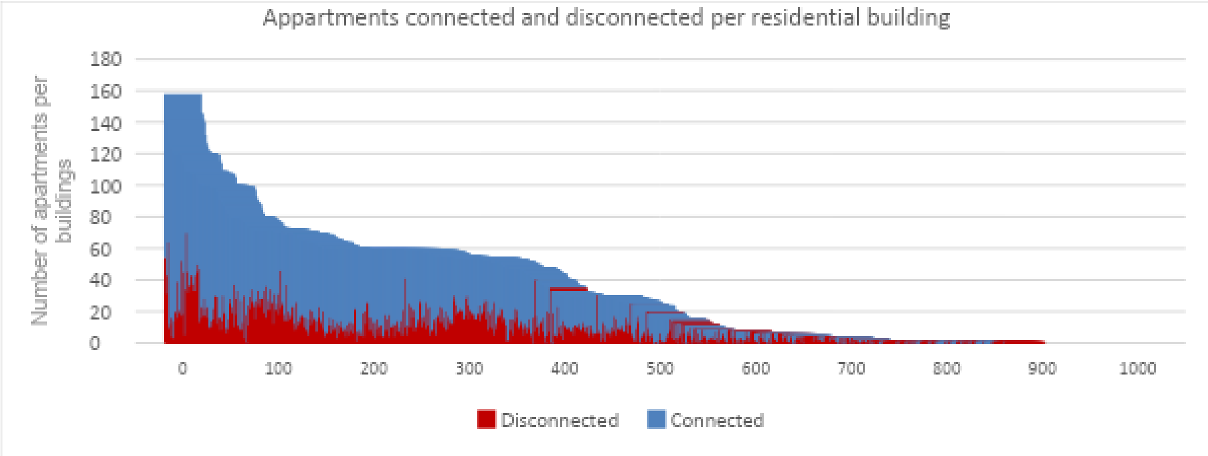
2.1.5.1 Domestic customers

According to commercial database, in 2020, CET-Nord serves 786 residential buildings for a total amount of 32,036 apartments:

The breakdown, expressed in surface area, is:

- 939 219 m² heated by CET-Nord (68%)
    - 845 418m² of apartments fully connected
    - 93 851m² of apartments partially connected

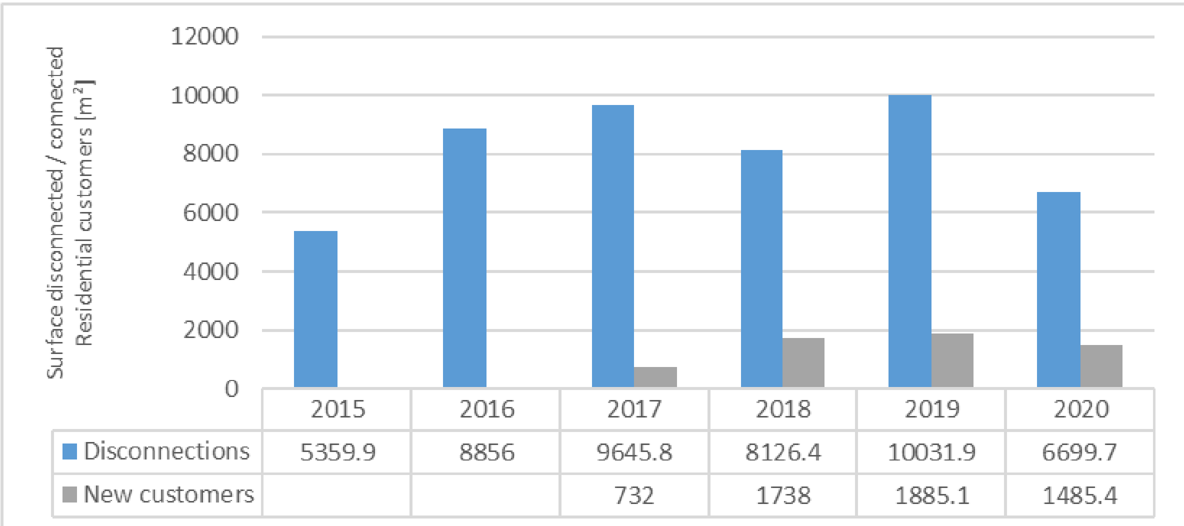
- 444 469 m² are fully disconnected (32%)



Graph 12: Breakdown of residential buildings per size and number connected apartments

The above graph shows **that the disconnection rates** (around 30% in average) **are evenly spread among buildings** and there is little impact of the size of the buildings. The reason for disconnections seems to be a general tendency observed over the past 10 to 20 years promoting individual heating infrastructures, lack of competitiveness against individual gas supply.

Since 2015, CET-Nord indicates that 45,916 m² of residential surface area have been disconnected from the district heating system. In the meantime, 2,470m² have been connected.



Graph 13: evolution of the number of connected/disconnected apartments from the central heatingsystem since 2015

Assuming an average of 40 m^2 by household, this lead to disconnections of an average of 190 households per year since 2017,

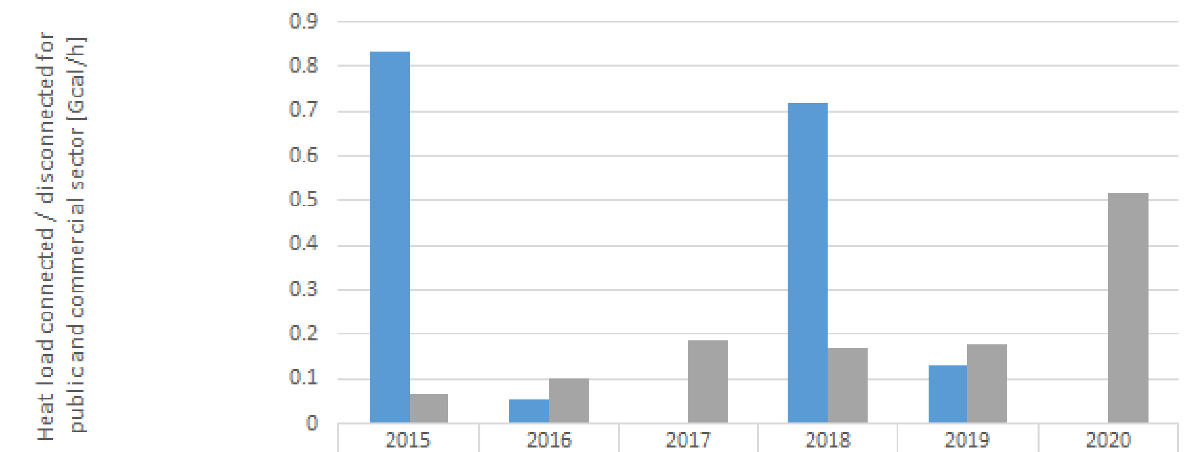
In 2016, the change in regulations enabled the disconnected customers to pay 10% (instead of 20%) of their surface equivalent. This led to a large increase of disconnected apartments in the City.

As shown below, higher disconnection rates can be observed in the Northern and Eastern part of the City.

Figure 4: map of disconnection rates per building across the City

2.1.5.2 Non domestic customers

For this type of consumers, the ratio of disconnection and connection is more balanced: over the 5 years, a load of 1.73 Gcal/h has been disconnected while 1.22 Gcal/h has been newly connected.



	2015	2016	2017	2018	2019	2020
Disconnections	0.834591	0.054212	0	0.719996	0.12959	0
New consumers connections	0.06541	0.102	0.18847	0.169836	0.179122	0.515

2.1.6 Structure of the secondary systems in residential buildings

Within the premises, the distribution of heat is mostly done according to **vertical distribution**. Only two buildings have been transferred to a horizontal distribution system in 2018 and 2019.

The following figures enable us to compare the two configurations for heat supply to end users.

- Vertical distribution does not facilitate individual metering per apartment and thus a detailed invoicing. For domestic billing, the total volume of energy is shared according to the surface of the customer: if an apartment is disconnected from the CET-Nord network, only 10% of its surface is considered. It has to be noted that this invoicing is considered by CET-Nord as under-evaluated.

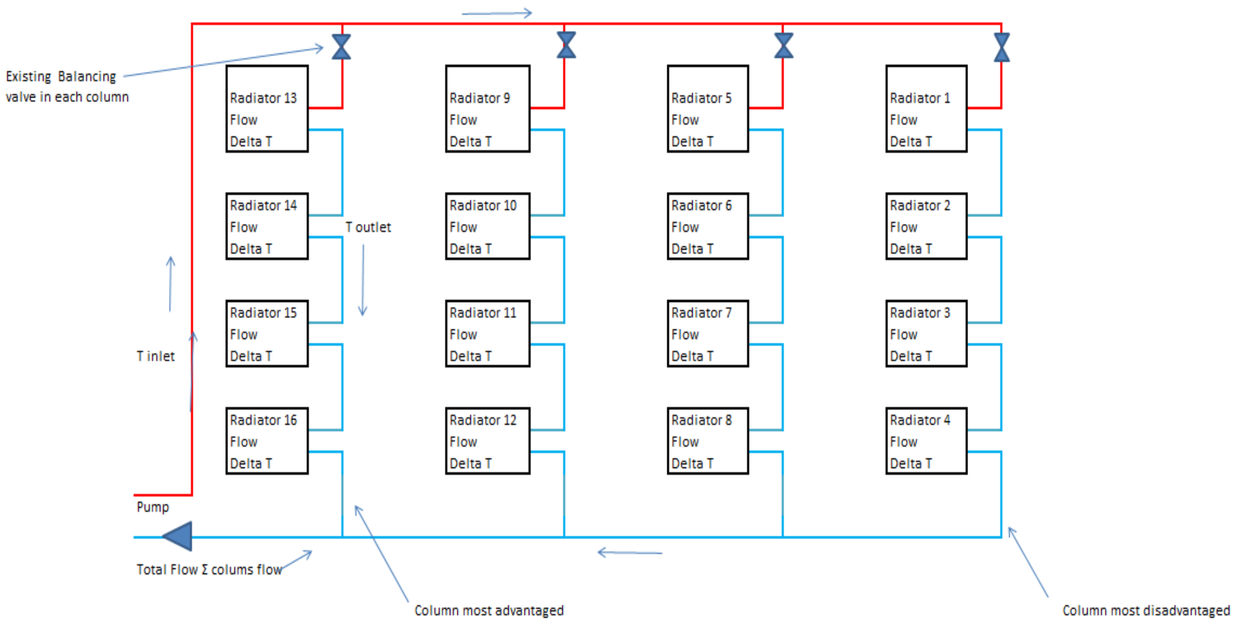


Figure 5: Vertical distribution system

- Shifting towards horizontal distribution enables CET-Nord to install a heat meter per apartment so that (with the help of Thermo-Regulating Valves, TRV) each customer can control its own consumption. It also contributes to improving the quality of service since it eliminates hydraulic misbalancing in the building which was generated and amplified after each disconnection.

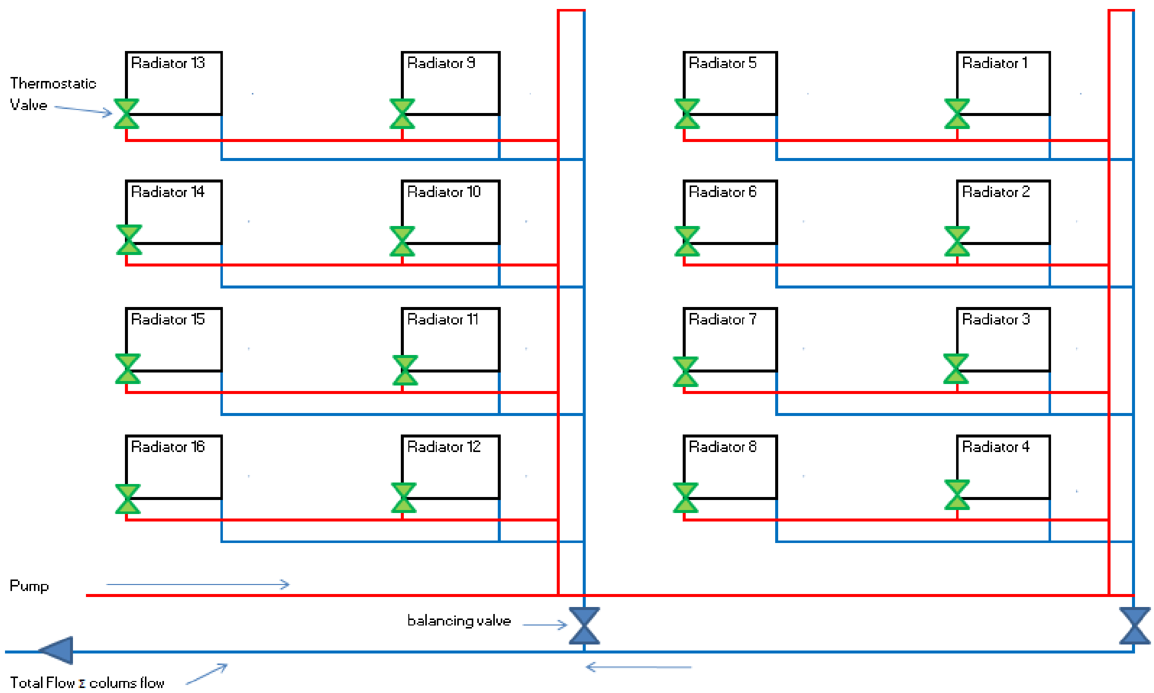
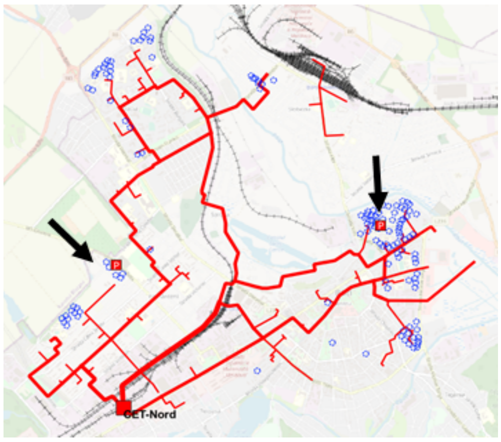


Figure 6: Horizontal distribution system



New horizontal distribution systems have been installed in three pilot buildings in the City (Suceava 14A and P. Botu 87, and lastly Ștefan cel Mare 140). Such installation was performed after the installation of the Individual Heat Substation.

However, such a solution requires changing the regulations since today, the responsibility of the Company ends at the delivery point to the building (after the IHS for residential buildings). It is confirmed yet that ANRE could accept to include any cost related to horizontal networks into the tariffs. Furthermore, it requires individual consumers to finance the renovation works into their apartments (internal piping system, thermos-regulating valves and in most cases heat radiators).

2.2 Distribution network

The feasibility study performed under phase 1 carried out a characterization of the network: the primary network was 92 km long in 2012. As of 2021, the total length of the network has increased to **96.5 km**.

DH networks are constructed either underground in ducts or above ground. Thermal isolation of the network is made of mineral wool covered by asbestos-cement mixture according to old soviet building norms. Since then, pre-insulated pipes have recently been installed in some specific areas (1km of network).

Paper based maps of the network are available. But not digital mapping nor accurate positioning of the network have been completed yet. Such a project is currently ongoing within the technical department and more accurate data should be available in 2021.

CET-Nord estimates that:

The primary network from the CHP up to the former central substations is **47.2 km long** (94.4 km of pipes).

The secondary network from the former central substations to the buildings is less known but is estimated at **49.3 km length** (98.6 km of pipes). The average diameter is estimated around 160 mm.

The total volume of the network can be estimated at 10,183 m^3 for a total length of 96.5 km.

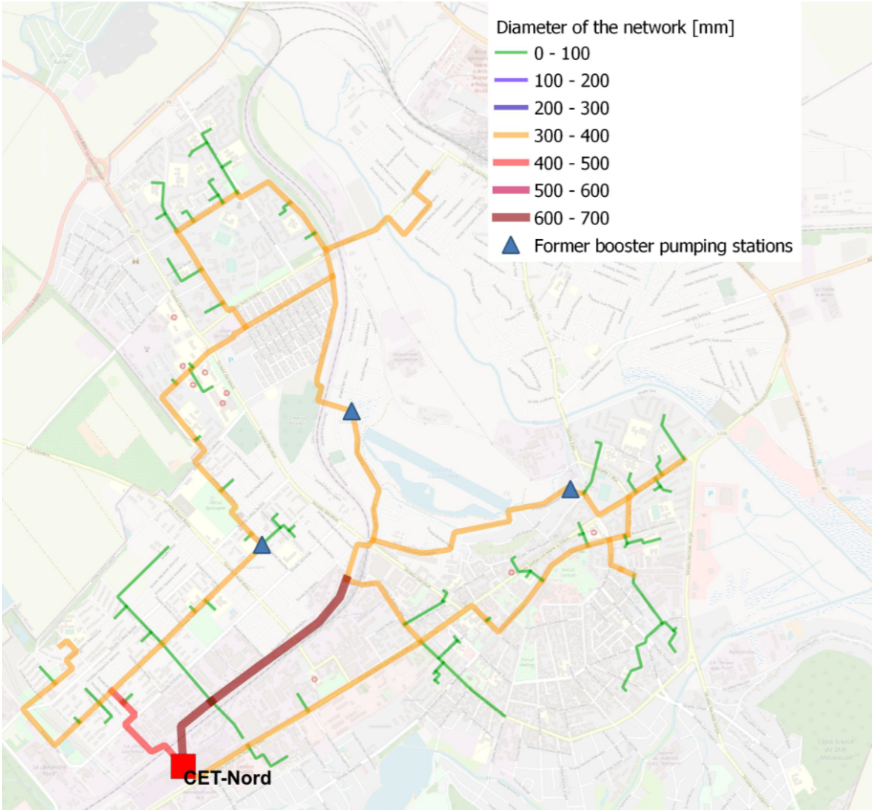


Figure 7: Map of the main district heating network operated by CET-Nord

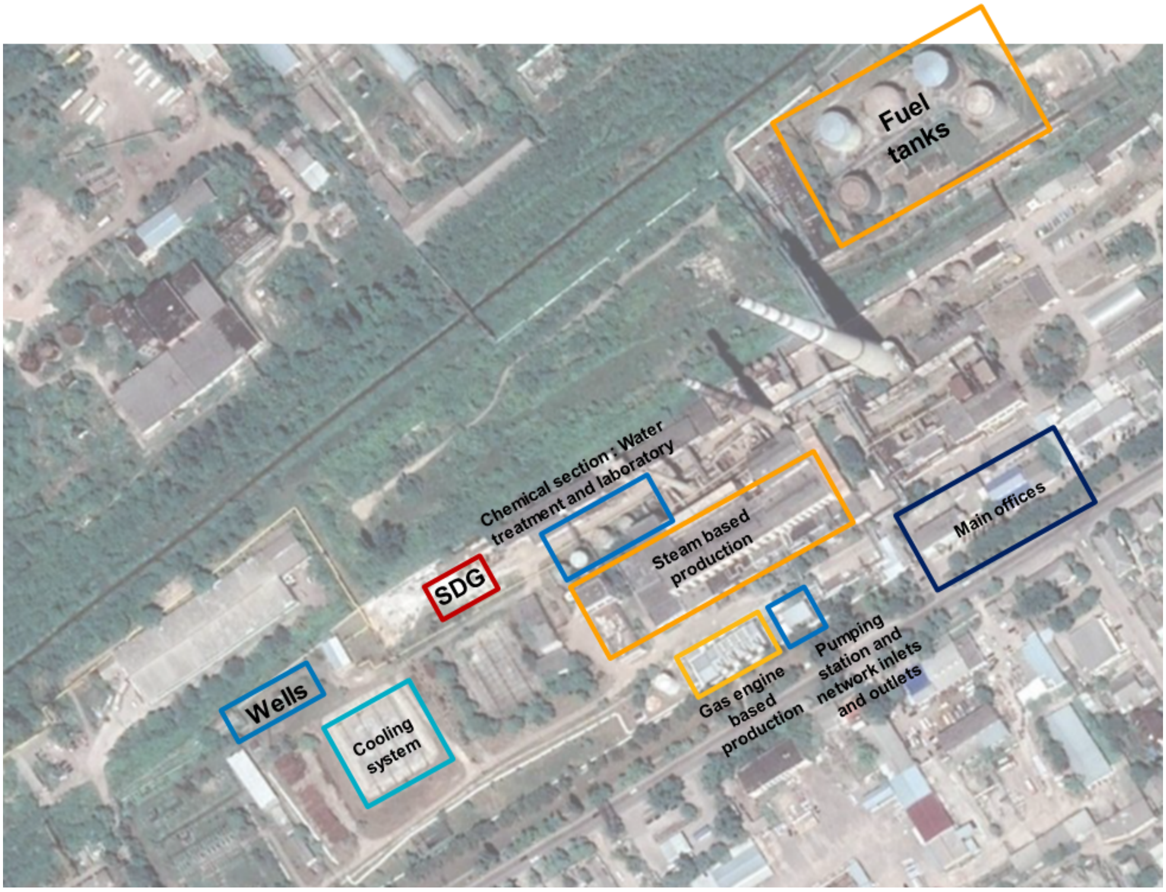
Asset inventory of the network should detail the characteristics of each pipe section and should be combined with operating data (leakages, pipe bursts…)

The network has a loop structure. There are few strategic valves to isolate some operating areas of the distribution network. The pumping stations are in working order and can be put into operation at any time. Their location corresponds to critical hydraulic points of the network (due to high ground elevation).

A previous study (in the Distribution department) of the network indicated a roughness within the pipes of 0.3 mm. This value is quite high and has to be validated through additional calibration study.

2.3 Heat & Power Production

The site of CET-Nord is large and part of its surface can be considered as a brown field (a former industrial site that can be converted to another activity). Originally designed to supply heat, electricity and steam to the population of Balti but also to the industrial surrounding areas, today some buildings could be decommissioned and investments rehabilitation of some parts could be planned.



2.3.1 Production facilities

Apart from the small Molodova Heat-only Boiler house, Balti central district heating network is supplied from a combined heat and power plant which has evolved recently following the first phase of EBRD project.

The CHP production can be divided in two systems:

- **A steam based production of heat and power:** this is the historical system of production of CET-Nord. The following materials are installed and currently in use.

5 steam boilers produce high pressure, high temperature steam (440°C / 39 bars) used to feed two steam turbines. Three additional are in reserve. These steam boilers are old, having been installed between 1957 and 1968 except for one boiler in 1994. Two of them have been in service for more than the designed working hours (220,000h).

- 2 steam turbines are currently in use out of 4 historically installed. The turbines provide the basis of power and heat to the City of Balti. They are fed by the steam boilers installed. Each of them has a capacity of **12 MWel** ; 71 Gcal/h th.
  - Turbine number 3 was installed in 1961 and replaced in 1995 and is getting close to the designed lifetime.
  - Turbine number 1 was installed in 1958 and replaced in 2005. It exceeds half of the designed lifetime.

Facilities	Types	Electric power (MWe)	Heat energy (Gcal/h)	Operating time (hours) by november 2020
Steam boilers	GM 40/39 N2		26	202 472
	GM 40/39 N3		26	166 928
	BKZ 75/39		49	247 873
	BKZ 75/39		49	242 983
	BKZ 75/39		49	203 520
	E75-3.9-440		49	39 203
Steam turbines	PT-12 / 13-3.4 / 1.0-1	12.0	71.0	
	PT-12 / 15-35 / 10-M	12.0	71.0	

Table 17: Technical characteristics of steam boilers and steam turbines

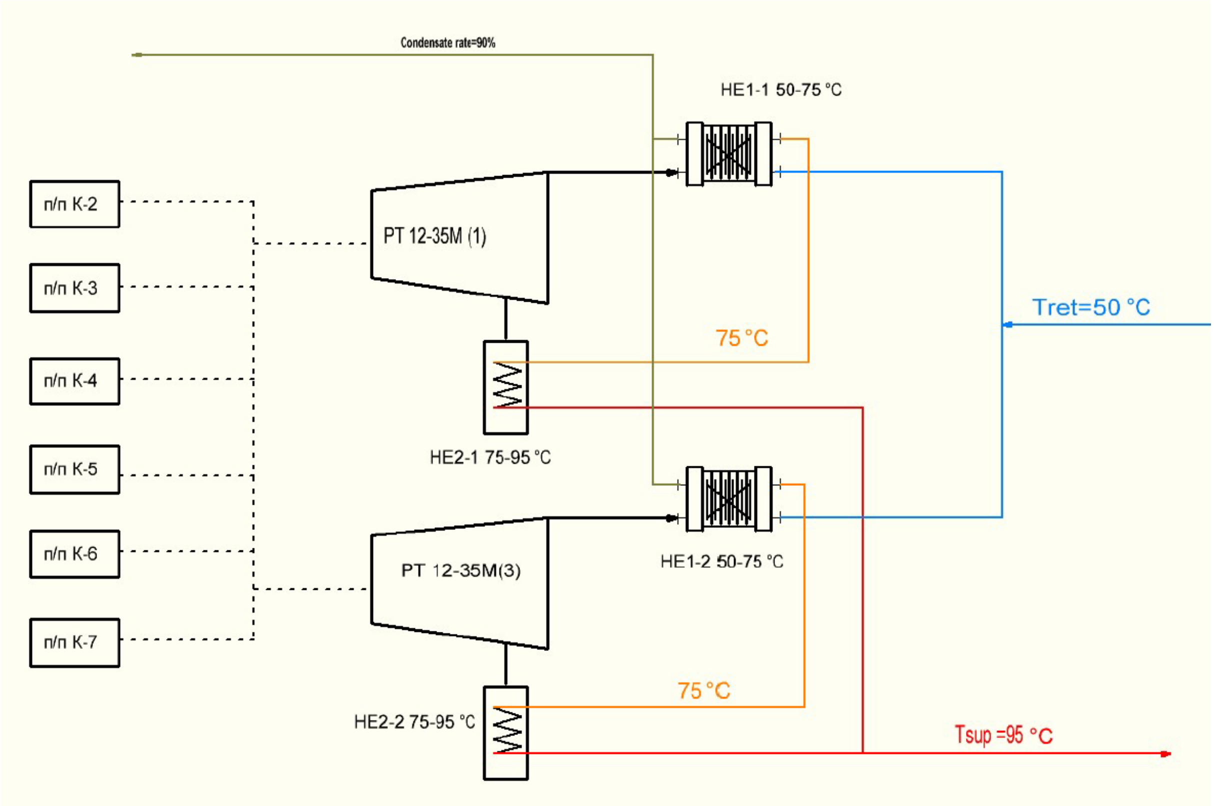


Figure 8: Conceptual scheme of steam production for heat and power generation

- **A gas engine based production** has been installed and commissioned in October 2019.

4 engines have been installed to increase the capacity of the overall generation system to better match the heat demand and to increase power generation to heat ratio during the high heat demand periods.

The four gas engines have the same characteristics.

Facilities	Types	Electric power (MWe)	Heat energy (Gcal/h)	Minimal load – (Gcal/h)	
Gas engines	JMS 620 GS-N.L.	3.354	2.688	50%	1.344

Table 18: Technical characteristics of gas engines

2.3.2 Fuels

Cogeneration of electricity and heat is done with natural gas. In 1990 a high pressure gas pipeline with a length of 11.9 km to SDG Balti (Gas distribution station) was built to supply the site of the CHP. The central CHP is supplied with natural gas. CET-Nord invested in 1990 in the creation of a high-pressure gas pipeline of 11.9 km, North of Balti.

It enables CET-Nord to purchase gas to the national company Moldovagaz at lower transmission cost levels (from 3,910MDL/1000Nm^3 by ANRE decision no. 396 of 28.10.2020 which entered into force on 03.11.2020).

The natural gas supply to CET-Nord has an average Lower Heating Value of 9.51 kWh/Nm^3 which has been used in the performance analysis.

In the previous years, CET-Nord relied only on steam boilers that could be fueled through natural gas and heavy fuel oil (HFO). HFO tanks became old and inappropriate for safe storage, the fuel tanks were cleaned and preserved and the fuel oil discharged.

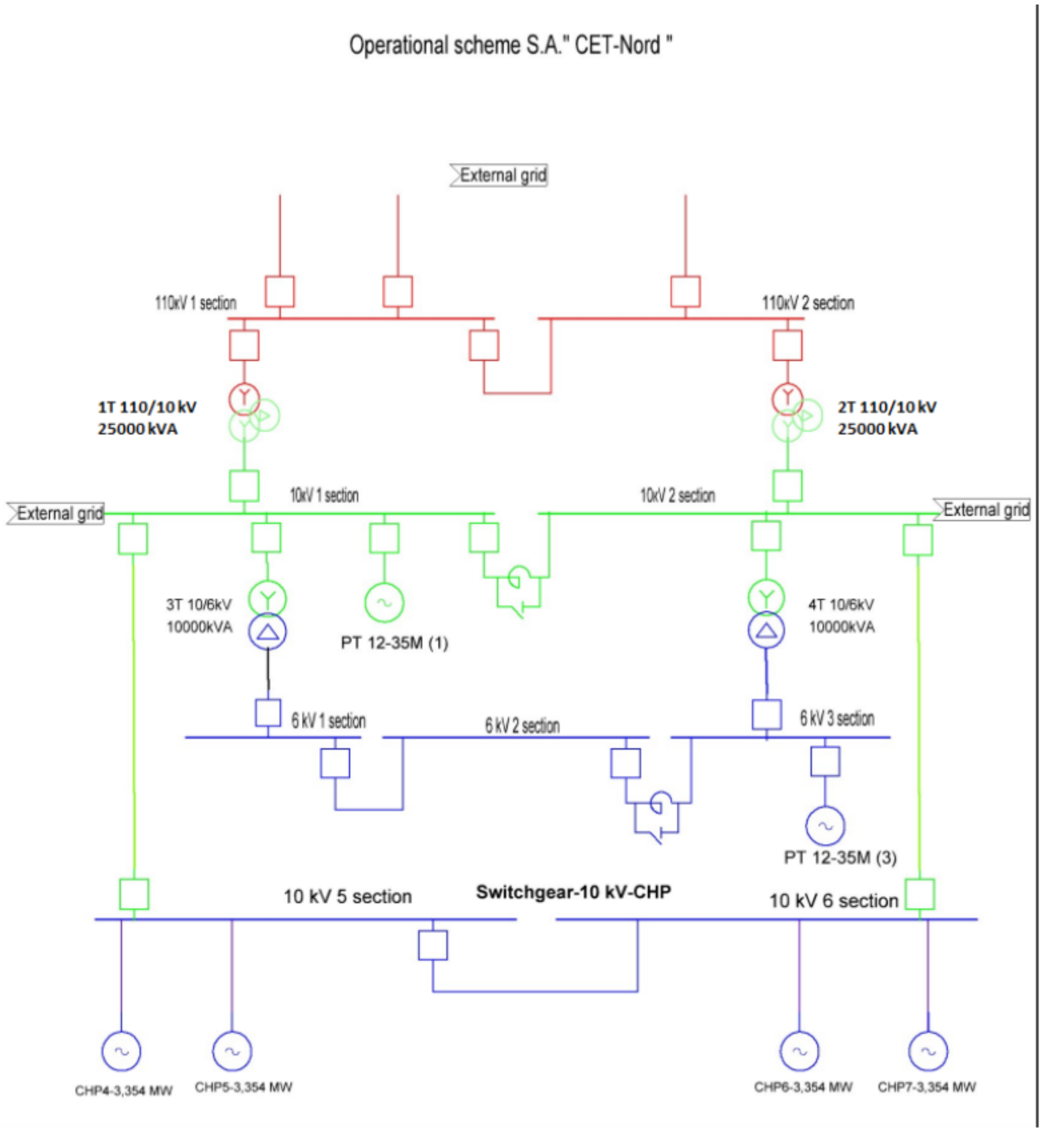
CET-Nord thus does not have access to a secondary source of fuel and could be at risk should the gas supply be interrupted. According to Moldovan regulations, the Company should have a 10-day reserve. Gas storage could be an option for such a reserve but **a specific detailed analysis should be conducted to assess the cost and the safety measures for fuel storage**.

2.3.3 Electrical facilities

The electrical production is currently evacuated through:

- 6 kV bus bar for the steam turbine n°3
- 10 kV bus bar for the steam turbine n°1 and the gas engines

Two 25 MVA step-up transformers enable the injection of CET-Nord production to the **110kV** network.



Graph 14: Electrical layout of the CHP

The current nominal electrical capacity of the system amounts **37.4 MWe**:

- 24 MWe from steam turbines
- 13.4 MWe from the gas engines

The peak power output observed to date was 34MWe. The capacity of the step-up transformers to export to the national grid (110kV) is **50 MVA** which means that there is room to further increase the installed power capacity to around 15 MWe. Export to the distribution (10kV) grid should be discussed with the Distribution System Operator.

2.3.4 Water quality

Due to the processes of heat and power production and distribution, CET-Nord requires water for steam production and network feed-in water.

Two types of water quality with different physico-chemical treatments are thus required and correspond to the existing water treatments systems. It has to be noted that this system had been originally designed for the production and delivery of steams in an open-system to industrial customers in the surrounding areas. Water sampling and analysis are not automated. These facilities are today oversized and require 30 full staff employees to run.

CET-Nord currently uses 5 wells installed on its perimeter for its own technological process . A regular reporting to the environmental Authorities is performed. Purchase of water from the municipal water system is currently considered due to possible evolution of permits for using groundwater resources.

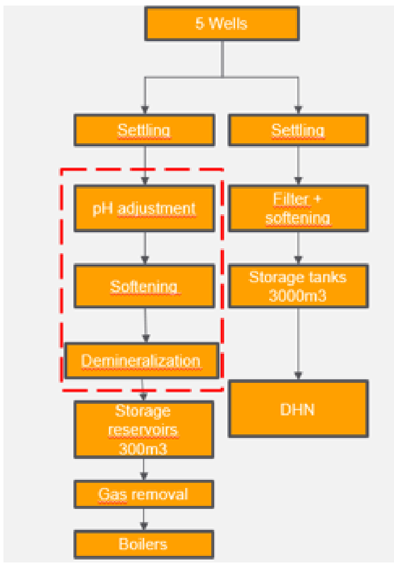
Figure 9: ground water intake and storage facilities

The laboratory and water treatment unit follows Moldovan regulations which consist in monitoring the following parameters:

Chemical parameters	Unit	Softened water	Feed-in water network	Steam boiler feed-in water	Raw water
pH	-	8.2	10.7	9.3	7.8-8.5
Alkalinity	mg-eq/l	0.20	5	0.25	9-11.5
Hardness	German degree	0.014	0.14	0.014	7-14
Dissolved Oxygen	mg/l	-	0.05	0.02	-
Iron (III)	mg/l	0.4	0.2	0.1	0.25
Total dissolved solids	mg/l	500	-	80	1,000

Table 19: Moldovan standards for water quality

The current water treatment is currently the following:



- For the network feed-in water: from the well, the water passes through the raw water heater (water temperature 35°C - 37°C), then passes to the settling tank where the process of flocculation and sedimentation of ions takes place - the water pretreatment process. (adding the flocculant and calcium hydroxide solution). The decanted water from the storage tank is filtered through a mechanical filter with anthracite coal, then passes through an R-Na ion filter where the water is softened to a hardness of 0.14° G. The water for adding the thermal networks is stored in three tanks of 1000 m3 each. The added water of the networks is estimated to be about 20 m3 / h (18.3 m3/h in average observed in 2018 and 2019).

The whole system is designed for a much larger capacity, which leads to unnecessary use of staff and space.

- For the boiler feed-in water and steam production: from the well, a settling tank and filter are installed. Water is then softened and demineralized using a resin's treatment in series.
- For the production of softened water for boiler supply: from the well, the water passes through the raw water heater (water temperature 35ºC - 37ºC), then passes to the settling tank where the process of flocculation and sedimentation of ions takes place - the water pretreatment process. (adding the flocculant and calcium hydroxide solution). The water decanted from the storage tank is filtered through a mechanical filter with anthracite coal, then passes through an R-H ion filter, to reduce the alkalinity, followed by decarbonization, R-Na ion filters where the water is softened to a hardness of 0.014ºG.

Two softened water storage tanks of 150 m^3 are installed. To reduce corrosion, the boiler feed water is degassed and treated with a mixture of amines.

The need for additional feed-in water for steam production is today estimated at around 25m3/h. The whole treatment line is designed for much higher capacity leading to unnecessary use of staff and space.

2.3.5 Molodova heat-only boiler system

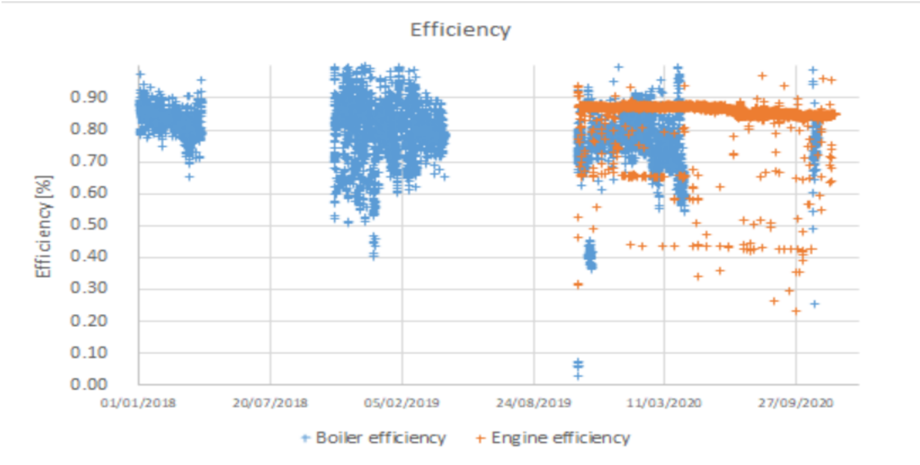
At the Molodova thermal power plant are installed 4 universal coal-fired boilers with a capacity of 0.5 Gcal/h and a biomass boiler with a power of 650 kW. It currently supplies a group of individual buildings located away from the city's networks. at a distance of 3 km from the CHP

2.4 Technical analysis of the system operated by CET-NORD

2.4.1 Heat & Power Production

The preliminary analysis of the primary energy source (natural gas) and the energy delivered to the network indicated a performance ratio that had been decreasing in average from 87% in 2017 to **85%** in 2019.

The on-site missions enabled us to collect primary data from Production units. The analysis of hourly time steps since 2018 enables to show the evolution of efficiency.

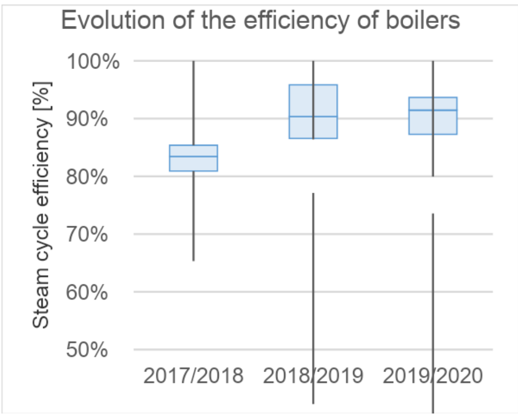


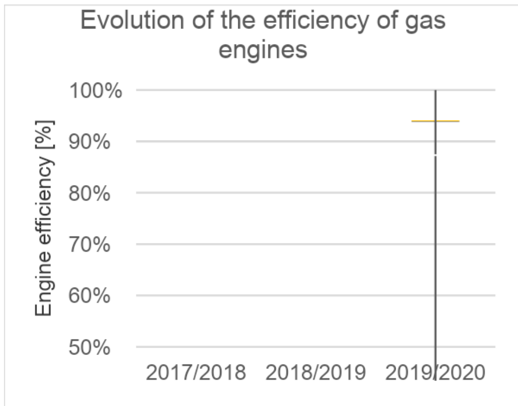
Graph 15: evolution of the energy efficiency for steam turbines and gas engines

Despite some irrelevant data (mainly at the beginning of the seasons), the following indicators can be calculated:

- The average efficiency of the **steam cycle** was **84% in 2017/2018**. It has decreased in 2018/2019 and again in 2019/2020 due to warmer winters and the introduction of gas engines which has decreased the load to steam turbines which were operated in parallel by CET-Nord. **The electricity to heat ratio was around 0.35**

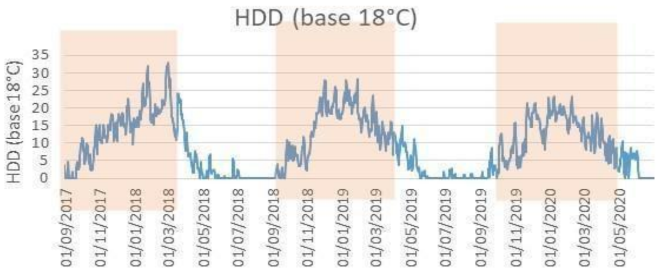
- The energy efficiency of **gas engines** is stable around **88%** working under a « base » mode. **The electricity to heat ratio was around 1.**





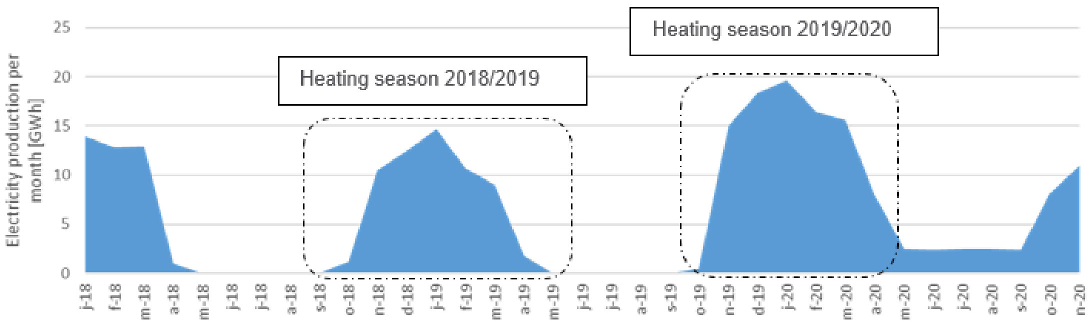
Graph 16: Energy efficiency for the three previous heating seasons (min, median and max)

The comparison of time series of winter shows that despite warmer temperatures observed in 2019/2020 (-12% of degree.days) compared to 2018/2019, the electricity production yet raised by 52% (60 GWh in 2018/209 against 91 GWh in 2019/2020)



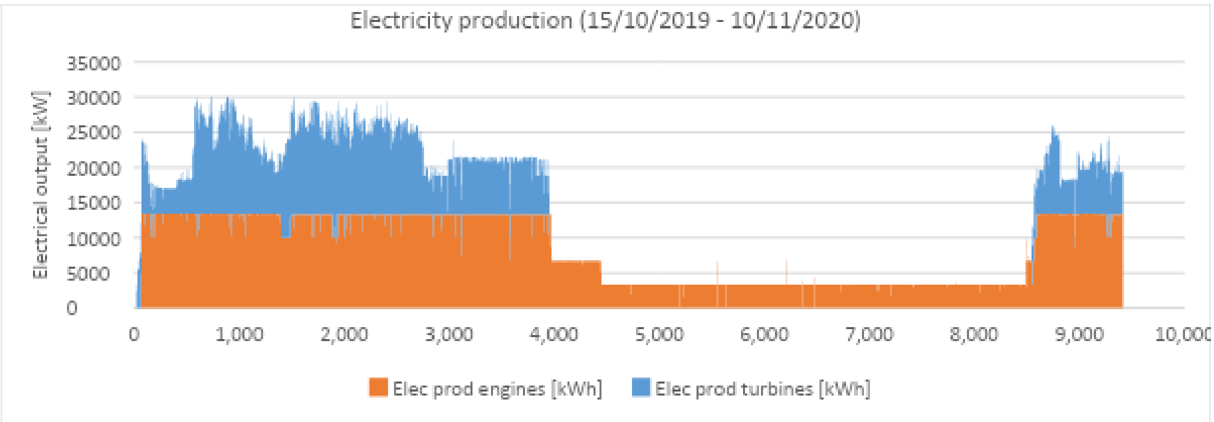
Heating season	Sum of HDD (base 18°C)
2017/2018	2,909
2018/2019	2,793
2019/2020	2,445

Graph 17: Temperature evolution in the period 2017-2020 and the corresponding degrees-days



Graph 18: Evolution of the electricity production since January 2018

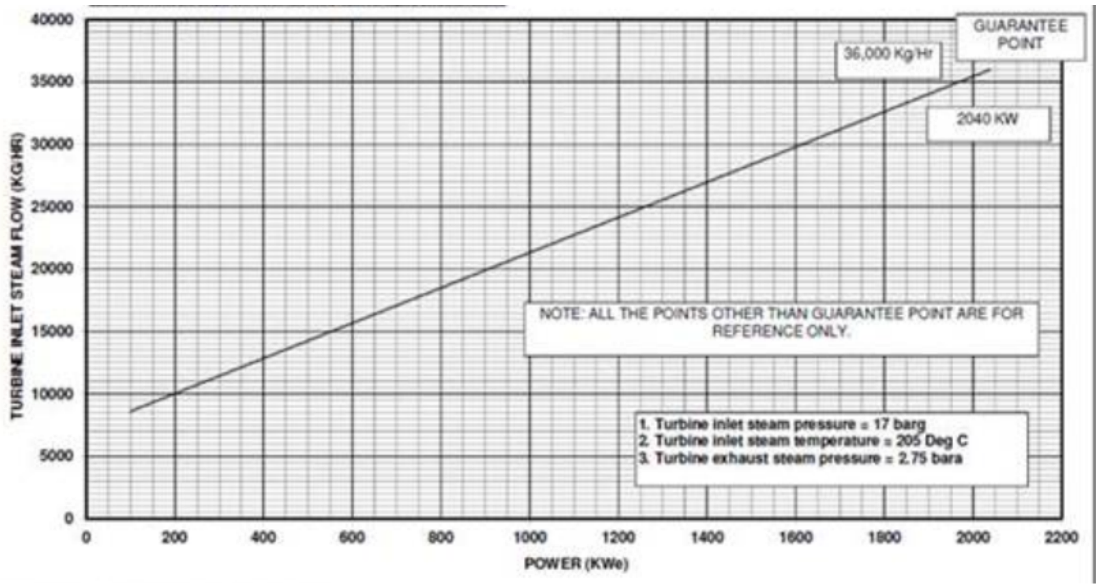
The newly installed production system enables it to have 13.416 MWe and 12.5 MWth of gas engines base capacity. Because of their higher power-to-heat ratio they contributed to **57 %** of electricity production in the last heating season (53 GWh from gas engines and 39 GWh from steam turbines).



Graph 19: breakdown of electricity production between steam turbines and gas engines

The reduction of load to the steam cycle (because of the new gas engines) requires closer monitoring of the turbines: they need to have a minimum load of 6 MWe (ie 50% of their nominal load). Below this threshold, the efficiency of the system decreases dramatically. With the current heat demand observed during the heating season, this threshold is reached during almost 150 hours at the beginning and end of heating seasons.

Currently CET-Nord usually operates two boilers and two turbines in parallel. The overall performance could be improved with a single turbine working during low load period (warm outside temperatures).



Graph 20: typical electrical yield versus inlet steam flowrate for a steam turbine

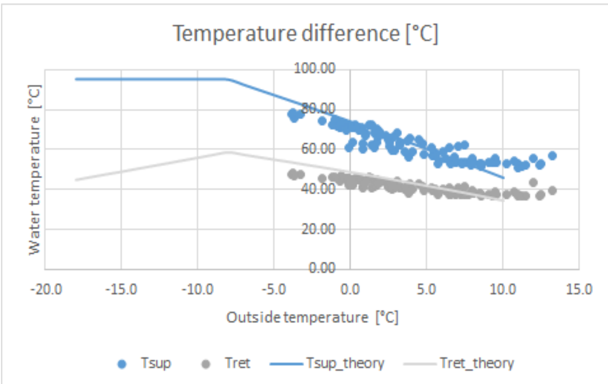
The above graph shows that the efficiency of electricity production decreases dramatically with the load factor (steam flow rate).

During the non-heating season, one gas engine runs and produces 3MWe permanently. The corresponding heat energy is used to provide Domestic Hot Water to 2 residential and 4 public buildings only.

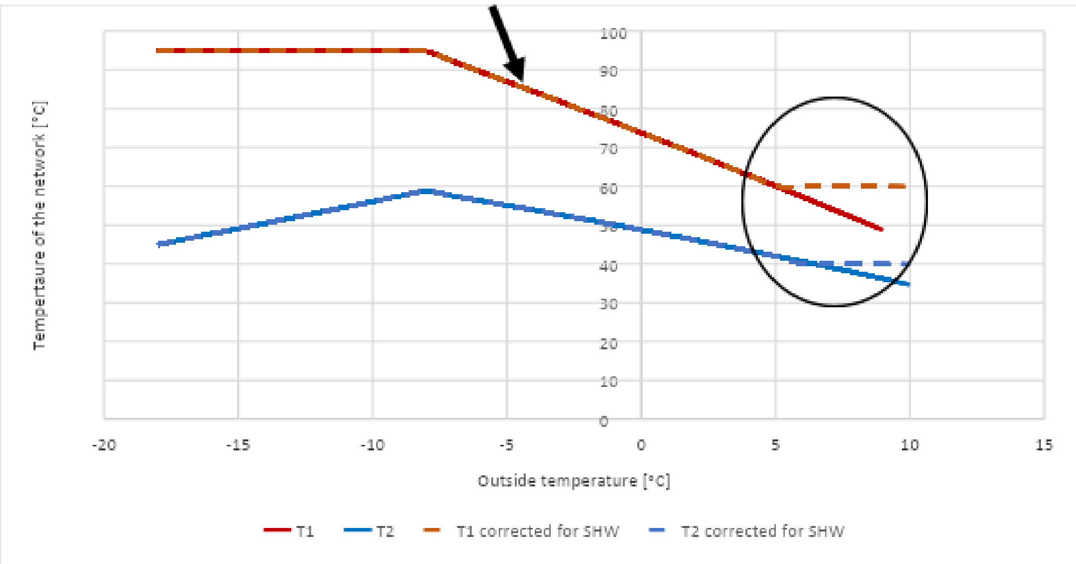
2.4.2 District heating network

2.4.2.1 DH network Temperature charts

The temperature difference between supply and return network depends on the heat demand and ranges from 12 to 30°C with an average of 21°C. It is in line with the temperature operating mode defined as a national directive. It seems to follow a **95°C/50°C** mode (initially a regime 120°C / 70°C limited to 95°C due to direct connections)



The CET-Nord's strategy to develop domestic hot water would require raising temperature levels in the system when outside temperature exceeds +5°C.



2.4.2.2 HYDRAULICS

Three booster pumping stations used to be installed in the network but are no longer in use. The supply of the system is performed by the central pumping station located at the CHP which has been upgraded as part of the first phase for the PIP with frequency variation.

There is a difference in ground elevation around **80 m** between the eastern and western part of the City. Critical hydraulic points of the networks impose the pressure level of the return pipes. This point is located in the Western part of City.

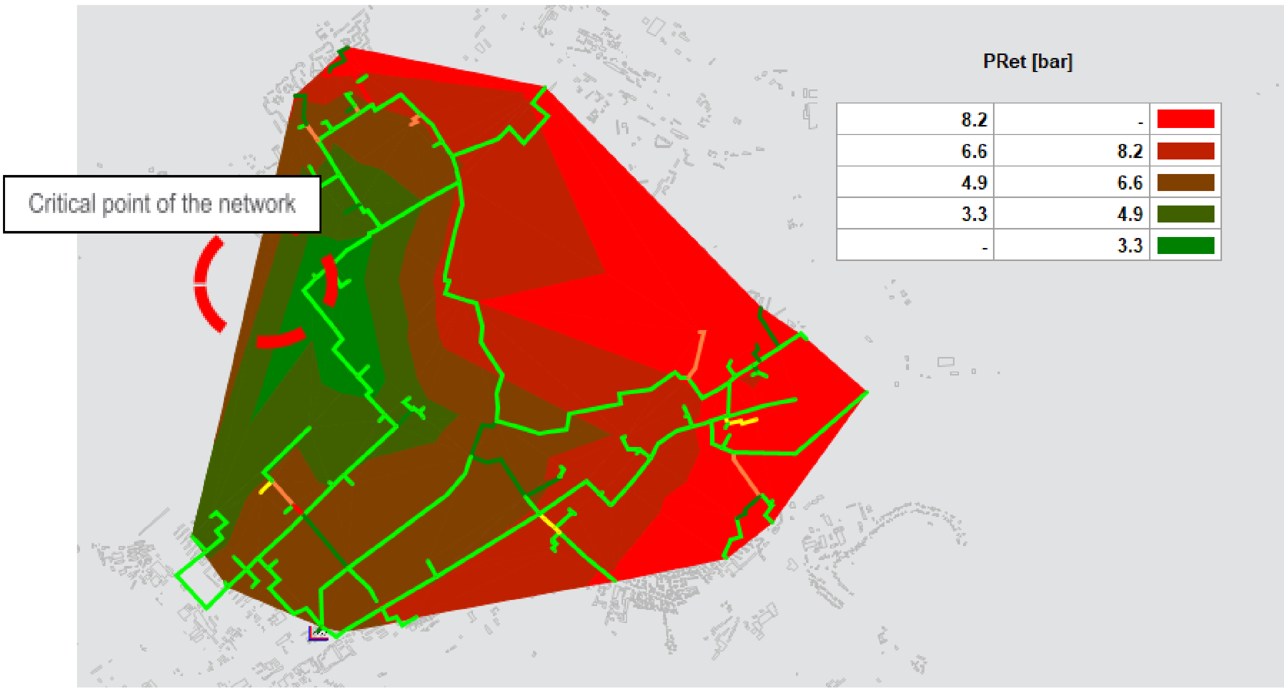


Figure 10: Pressure zones for the return pipes of the DH network

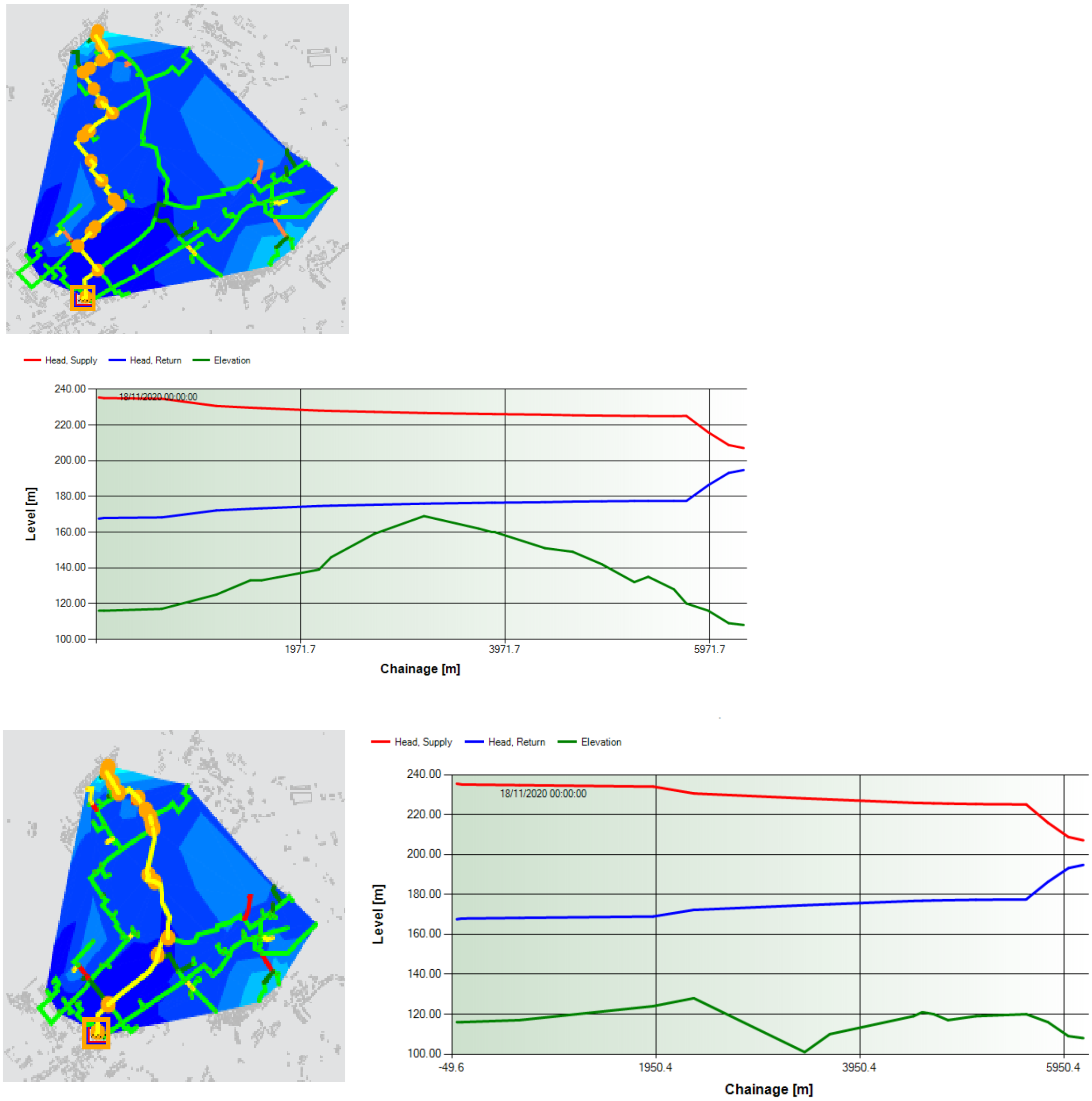


Figure 11: piezometric lines for supply and return pipes along the DH network

The network used to operate at constant pressure difference to be able to deliver heat to the critical points of the networks (around 8.2/8.3 bars between supply and return pressure levels). Variable speed pumps have been put into operation in October 2020 and operate for the first heating season. They will enable energy efficiency measures in the network and gradually reduce pumping costs when more buildings are equipped with Individual substations, in particular for large multi-storey buildings in elevated areas.

The thermal modelling performed as part of this feasibility study was based on available data and a set of hypotheses. As detailed below, there is a large room to improve the understanding of the network's hydraulic operating conditions. The commissioning of variable speed pumps will enable to reduce the electrical specific consumption and a dedicated return on experience at the end of 2020/2021 heating season will be interesting to assess its impact.

Major investments do not appear required at this stage. Focus should be done on the optimization of the current and future Individual Heating Substations and take into account the thermal requirements of the buildings.

2.4.3 Heat losses

CET-Nord indicates an average value of heat losses for the period 2017-2019 of **20.9%**. For a typical meteorological year of 2,750 HDD, CET-Nord and the Consultant agreed to estimate the total heat losses (considering the current situation) of 35,300 Gcal for the heating season: 32,000 Gcal due to losses by radiation and 3,300 Gcal due to the make-up water.

The following breakdown of heat losses can be made:

- **Heat losses through radiation losses and customer connections**: directly linked to the thermal insulation of pipes and the state of customer connections , this represents the main part of the heat losses in the network.

A thorough analysis could enable to assess more in details this level and its origins (representing today around 90% of total heat losses).

The technical losses are calculated based on the temperature chart of the heat distribution network and the size of the network. Among this total of heat losses, it is possible to identify the radiation losses. Uncertainty remains about the knowledge of thermal transfer coefficients. A more detailed analysis of the heat balance can improve CET-Nord's knowledge of its network's performance.

$$P_{radiation\ losses} = \lambda.L.\Delta T$$

Where:

$P_{radiation\ losses}$ Power lost by conductivity phenomenon [W]

ΔT Difference between the temperature of the hot water inside the pipe and the outdoor temperature [K]

Λ Heat transfer coefficient between the pipe and the outside environment. This coefficient depends on the type of insulation, the diameter of the pipe, the type of pipe laying, etc. [$W.m^{-1}.K^{-1}$]

L Length of the pipework [m]

The formula below will be used to assess the impacts of sanitary hot water delivery and the increase of radiation losses due to higher temperatures in the network.

- **Heat losses through make-up water**: as seen above, the renewal rate is quite low indicating a low level of losses within the primary network.

$$E_{make-up} = V_{make-up} * \left(\frac{T_{supply}+T_{return}}{2} - T_{cold\ water}\right)$$

Where:

$E_{make\text{-}up}$ Make-up losses [Gcal]

$V_{make\text{-}up}$ Volume of make-up water [m^3]

T_{supply} and T_{return} Average temperature of the supply and return network [°C]

$T_{cold\ water}$ Temperature of make-up water taken at 10°C all over the year [°C]

The make-up water added in the network in 2018 and 2019 was 73,200 **m^3 per year**. This represents a heat loss of 3,300 Gcal per year (ie 10% of total heat losses). The renewal rate of water when expressed in equivalent network volumes can thus be estimated at a ratio of 7.2. This ratio shows a small margin of improvement in terms of leakages within the network and a mastered hydraulic separation between heat network and end users with heat exchangers.

Improving this ratio of make-up water can be done by:

- Installing Individual Heating substations which will create a physical fence between the primary public distribution and secondary private networks.
- Pipe renewal should focus in areas where pipe bursts occur more frequently or in area prone to flooding (especially in the southeast part of the service area), Pre-insulated pipe shall be installed as part of these replacement works.

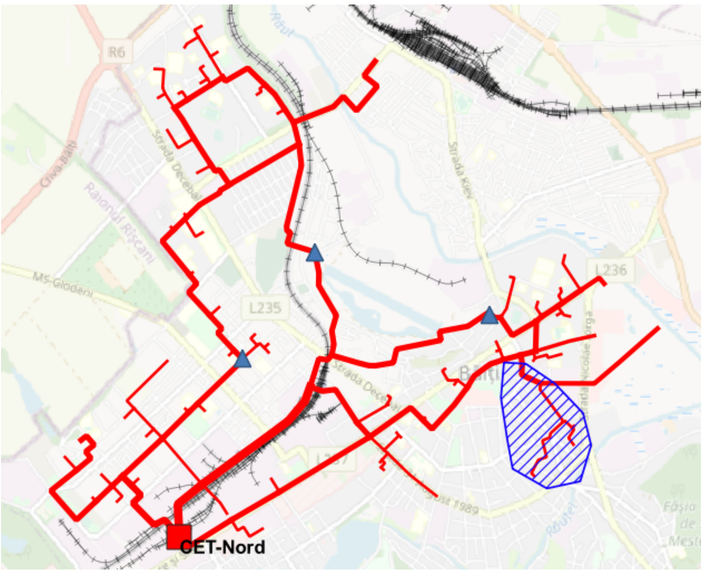


Figure 12: map of the primary DH network

2.4.4 Heat consumption pattern

Hourly data are available only at the outlet of the Combined Heat and Power Plant. Data have been collected for several years enabling access to the following regression analysis.

The analysis of winter 2020 (January - April 2020) operating conditions at the outlet of CET-Nord indicates that:

The correlation between peak heat load and outside temperature quantified through the R^2 indicator shows that the system could be better regulated than it is. Longer time series of production data statistically improve this correlation. However, the recent warm winters make it difficult for operators to accurately regulate the system.

The balance temperature indicates the outside air temperature above which the buildings do not require heating. For the CET-Nord system it is equal to **22.7°C** showing that heating within premises of the client shows potential for energy savings (between 18°C and 20°C).

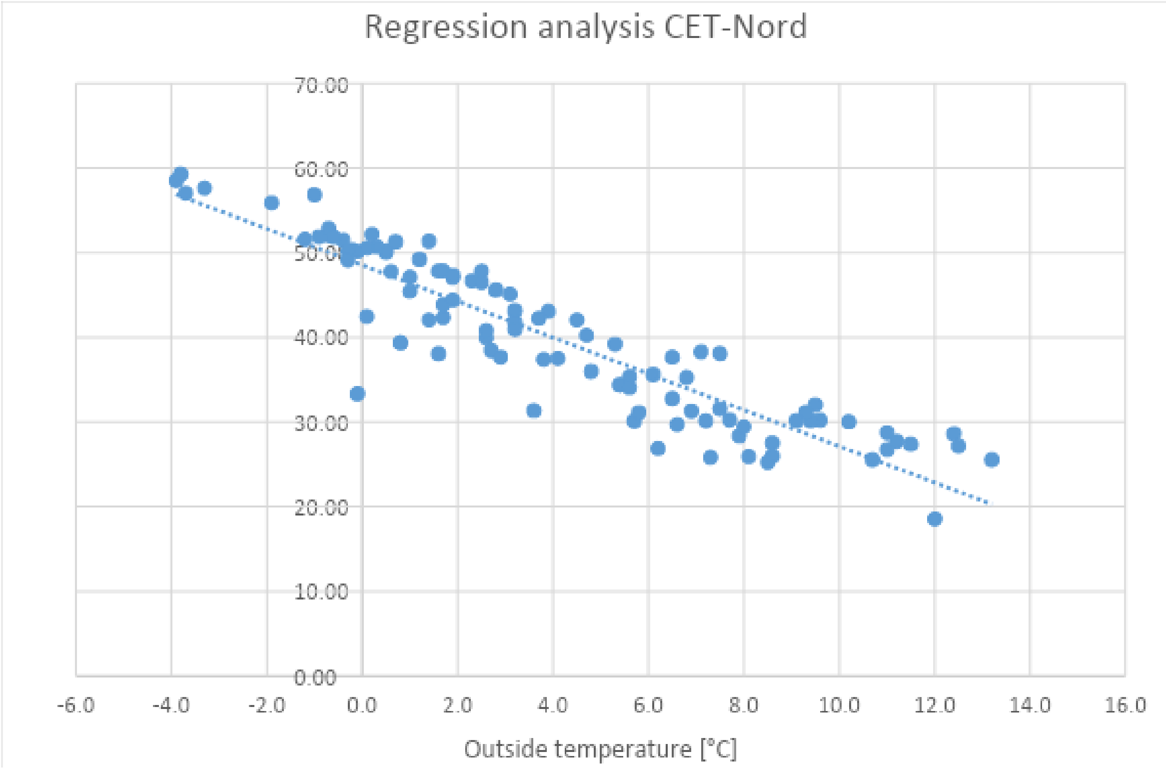


Figure 13: Statistic analysis of heat demand versus outside air temperature observed in the last heating season (January - April 2020)

According to regression analysis and by extrapolation the following relation can be established:

Tout [°C]	Heat load at production [Gcal/h]
0	49
-5	59
-8	66
-10	70
-15	81

2.4.4.1 Evolution of outside air temperatures in the recent past

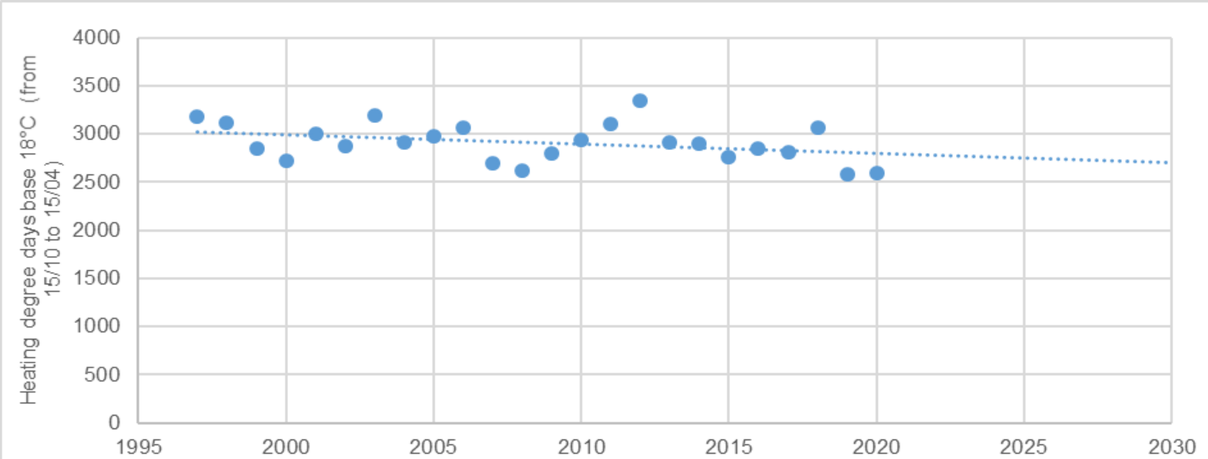
Over the last three heating seasons, the heating degree days have strongly decreased:

Heating season	Sum of HDD (base 18°C)
2017/2018	2,909
2018/2019	2,793
2019/2020	2,445

The heating degree days are calculated as per the following formula:

If $T_m \leq 15°C$ Then [HDD = $\sum_i(18°C - T^i_m)$] Else [HDD = 0] where T^i_m is the mean air temperature of day i

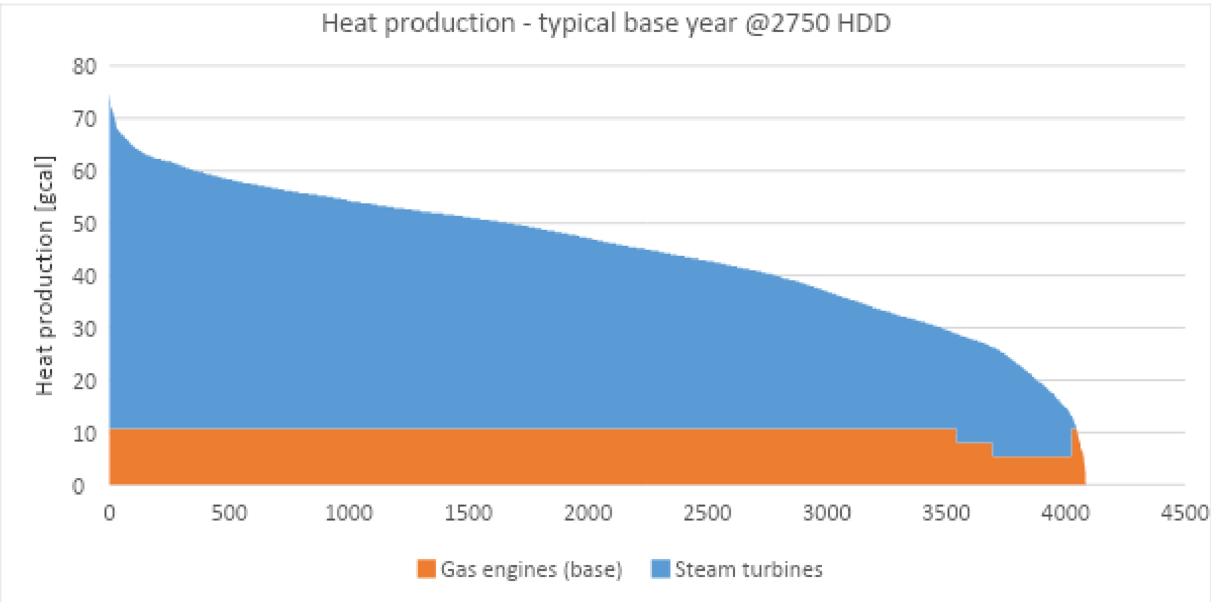
Analysis of longer time series of temperature indicates a general tendency to decrease (impacts of climate change and warmer winters in Moldova). The general tendency is thus a slight decrease of heating degree.days with yearly variations.



Graph 21: variation of heating degree.days since 1995

The analysis of previous heating seasons and the volume of heat produced enable to create a **standard meteorological year** for Balti city: it is proposed to consider a standard heating season of **2,750 HDD** which corresponds to the general tendency over the next 10 years.

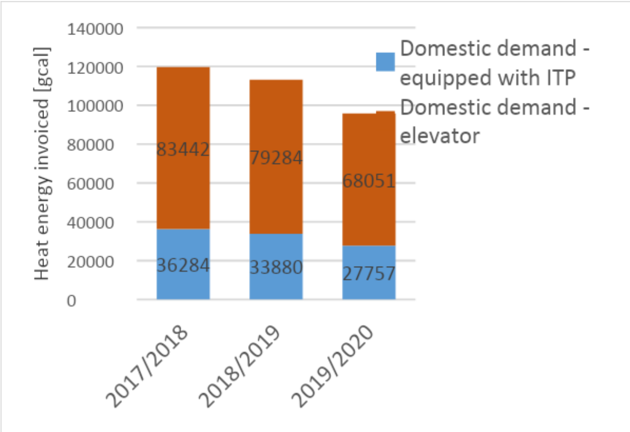
Thus, a theoretical heat demand (in Gcal) has been set based on 2,750 HDD to be used during the feasibility study. The distribution of temperatures of 2019 (every hour) has been retrieved. For each time step, the regression analysis applied and a correction factor has been calculated to reach the target value of 2750 HDD.

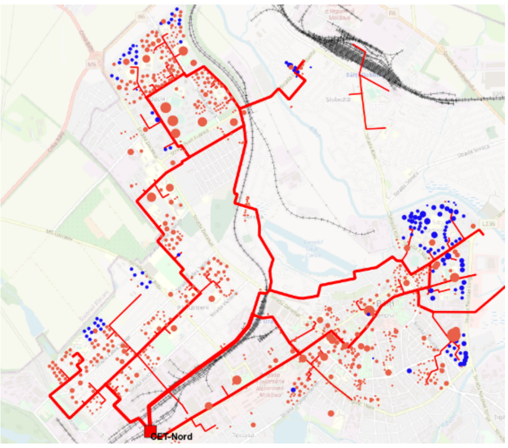


Graph 22: standard heat demand for Balti City based on average outside air temperature

2.4.4.2 Impact of IHS in the domestic heat consumption

Since 2018, IHS have been installed in Balti. 130 residential building are now equipped. The buildings equipped represented only 15% of the number of buildings served by CET-Nord but around 1/3 of the total heat consumption observed with CET-Nord.



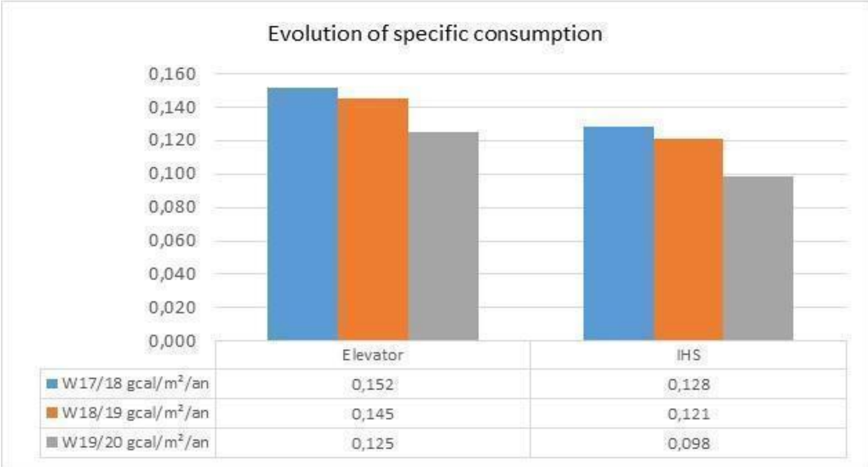


Graph 23: Evolution and breakdown of heat demand per type of connection Figure: Map of heat connection per type (IHS, elevator)

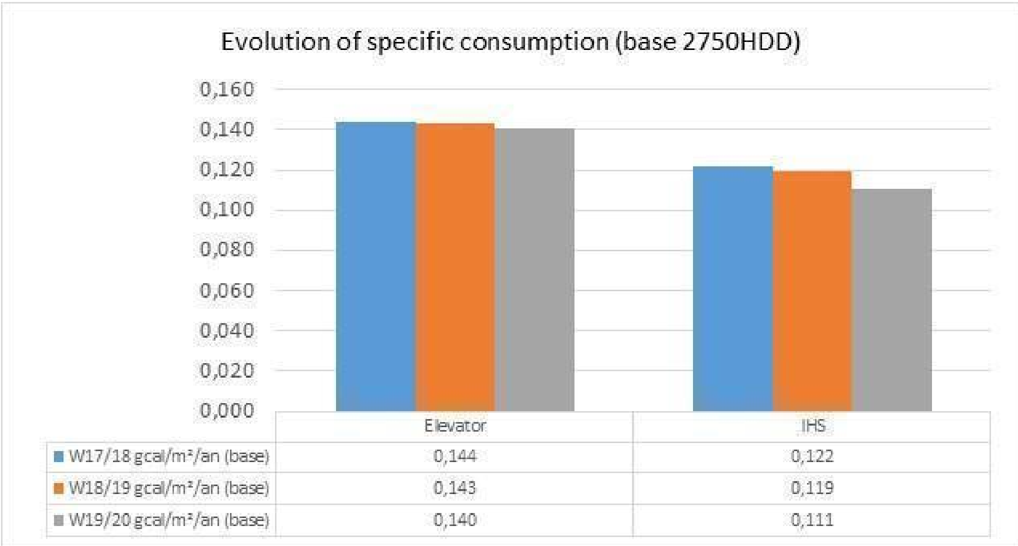
The IHS are currently located in the Eastern Part and in the Northern part of the City (in blue in the above map). They have been installed on large buildings having on average a consumption higher than **200 Gcal/year** (2019).

Their impact has been analysed over the three last heating seasons using the ratio of Gcal/m²/year:

- A general decrease of the specific heating consumption can be observed globally at City level (-2% after correction and adjustment to 2,750 HDD).
- A more significant decrease has been observed for buildings equipped with IHS (-8% of specific consumption)



Graph 24: comparison of specific consumption ratios using actual temperature conditions

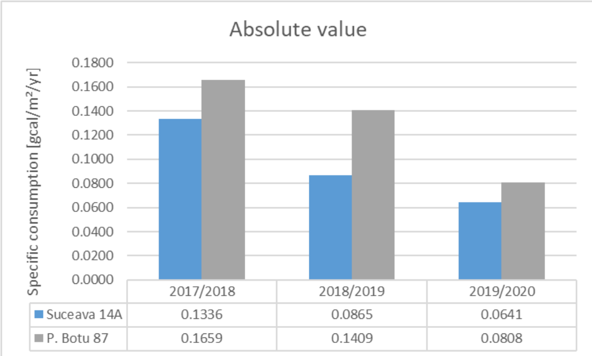


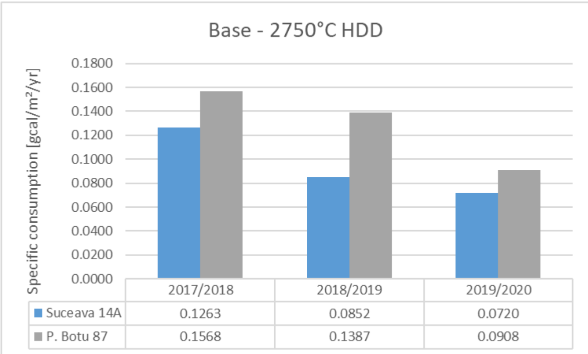
Graph 25: comparison of specific consumption ratios using similar temperature conditions

By correcting the impact of outside air temperature and to compare with buildings without IHS, the IHS enabled the decrease in specific heating consumption by **6%** to an average at the City level of 0.11 Gcal/m²/year observed in 2020.

2.4.4.3 Impact of horizontal distribution in the domestic heat consumption

With the two pilot buildings, the impact of horizontal distribution seems to be important. The specific consumption has strongly decreased after the installation of horizontal distribution to reach today **0.09** Gcal/m²/year.

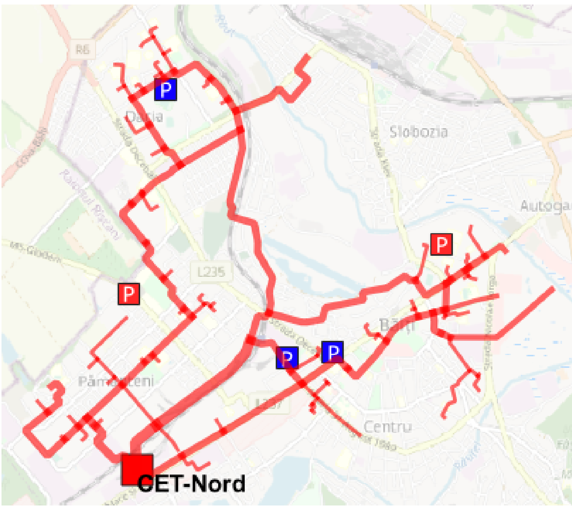




Graph 26: decrease of specific heat consumption ratio with gross and corrected temperature conditions

2.4.5 Sanitary hot water

Today only two residential buildings (in red in the next map) are supplied with Sanitary Hot Water (in the frame of deployment of horizontal networks) financed by CET-Nord. Additionally, four buildings (Penitenciarul nr.11 Bălți, Școala Profesionala nr.5, Brigada Infanterie motorizată din Bălți and the Bălți Police Inspectorate) have been equipped with sanitary hot water since 2020.



CET-Nord believes that if it can serve SHW it may regain new customers in buildings already connected to central heating systems with IHS (they may switch from individual boilers to heat supplied by the network). In particular, when or if the tariffs for gas to CET-Nord become much lower to the ones that apply to domestic customers (tariff for gas is currently under discussion with ANRE in order to allow CET-Nord to benefit from low gas transmission price levels).

Heat consumed by those new customers would contribute to increased electricity production (under the cogeneration mode) by CET-Nord.

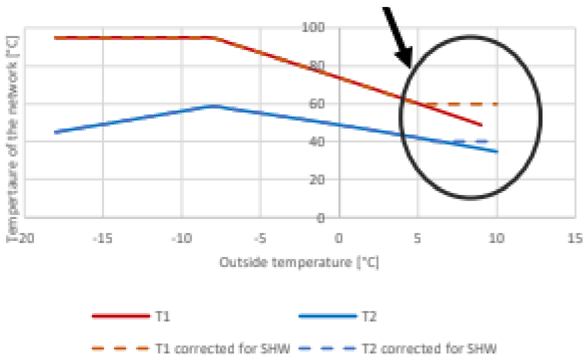
However today, the energy consumption due to SHW is extremely limited: 0.08 Gcal/month/connected apartment. The ratio observed is very low: less than 30 l/day/capita. With 45 apartments connected to SHW, the heat energy consumption is 4.14 Gcal/month.

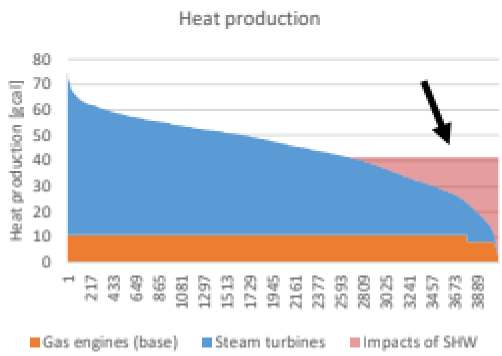
Today, when one gas engine operates in summer to provide SHW, most of the heat produced can be considered as **“waste heat”**.

Furthermore, the supply of SHW will be obliged **to increase the temperature of the primary network as soon as the outside temperature is above +5°C**. This corresponds to approximately 1,400 hours during the heating season. Consequently, the increase of temperature in the primary network will **increase the heat losses (by radiation) in the network**.

Impacts within the buildings: For buildings not equipped with IHS (85% of buildings in Balti are not equipped with IHS today), the heat delivered will increase since the flow inside the buildings cannot be regulated. It may result in complaints regarding the quality of service (overheating and thus over invoicing) in buildings without IHS.

The waste heat due to SHW supply for approximately 1,400 hours can represent up to 16,000 Gcal/year (part of the surface in red) during heating season.





Graph 27: *Estimated waste heat during heating season*

Increase of temperature in the primary network due to SHW

In total waste heat due to SHW represents nearly 28,600 Gcal/year:

- 12,600 Gcal (in summer) plus;
- 16,000 Gcal (during the heating season)

The supply of a very limited number of customers with SHW all year round using the central district heating network is highly questionable. However, when more customers will receive domestic hot water in the future, the volume of vented losses will decrease significantly.

2.5 Operational performance of the Moldova Heat-only-Boiler house

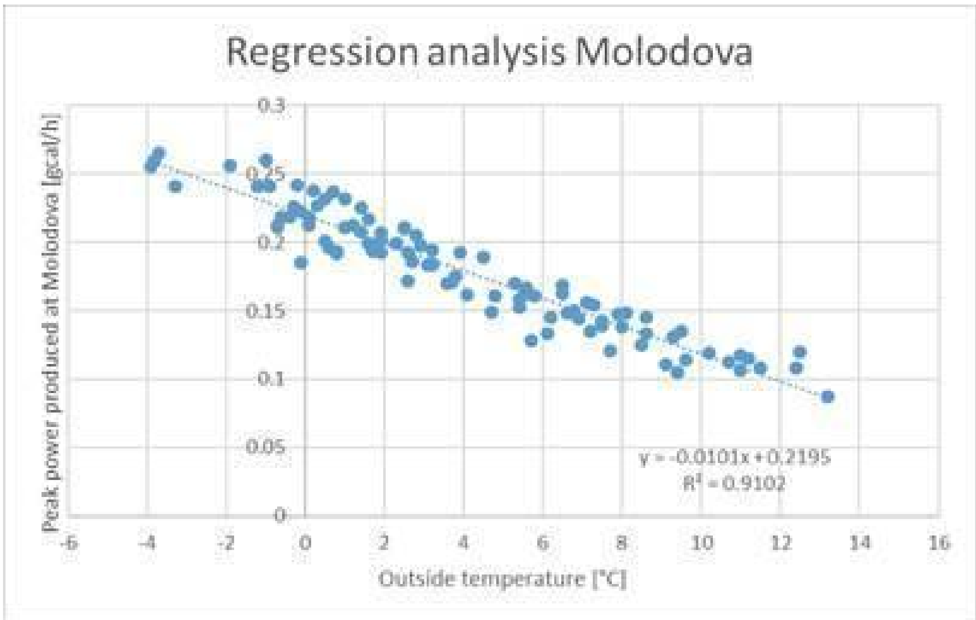
The rehabilitation and the upgrade of Molodova Thermal Plant by installing the biomass boiler in 2019 have increased the performance ratio: from 62% in 2018, it has now reached an average value of 84%.

The analysis of the operating conditions observed in 2020 at the outlet of HOB Moldova indicates that:

- The correlation between peak heat load and outside temperature quantified through R^2 shows that the system is well regulated. Longer time series of production data could statistically improve this correlation.
- The balance temperature indicates the outside air temperature above which the buildings do not require heating. For Molodova system it is equal to **21.7°C** showing that heating within premises of the client is acceptable.

The extrapolation of the regression analysis determines that:

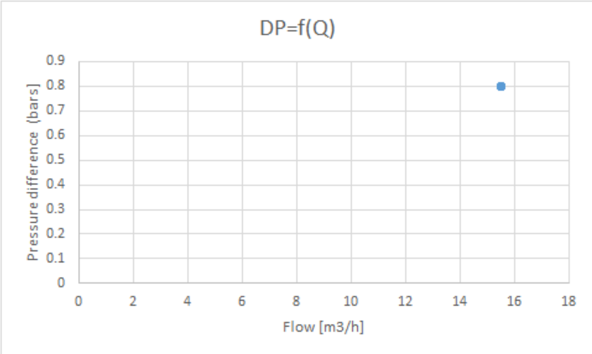
- For an outside temperature of (-5°C), the demand would be 0.27 Gcal/h
- For an outside temperature of (-8°C), the demand would be 0.32 Gcal/h.

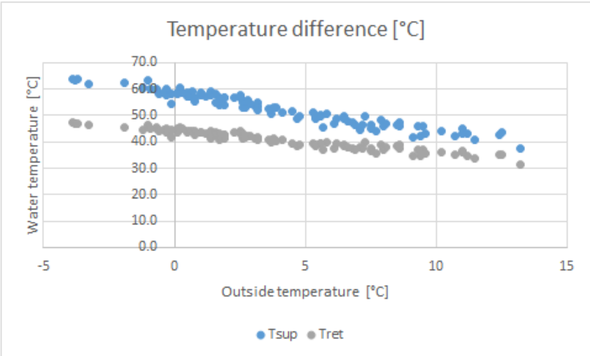


Graph 28: Regression analysis of the HOB Molodova (source: CET-Nord data)

The supply of heat to the network is made at constant pressure difference and flow (0.8 bar / 15.5 m^3/h).

The temperature difference between supply and return depends on the heat demand and ranges from 5 to 17°C with an average of 11.7°C.





Graph 29: operating conditions of the pumping station

Graph 30: temperature's chart of the local DH network

2.6 TERMOGAZ BALTI

Termogaz Balti operates 7 small heat-only boilers for a total heat capacity of **8 Gcal/h**.

Name of Boiler House and Corresponding network	Installed heat capacity (Gcal/h)	Number of customers
Feroviarilor 19a	5.7	• 49 residential buildings • 2 kindergarten • 2 primary schools
Krîlova 3a	1.4	• 13 residential building (2 currently in design stage)
Arbore 79	0.2	• 2 residential buildings • 1 kindergarten
Scola 3	0.2	
Scola 10	0.1	
Scola 15	0.2	
City Hall	0.2	
TOTAL	8	

Table 20: list of boiler houses operated by Termogaz Balti

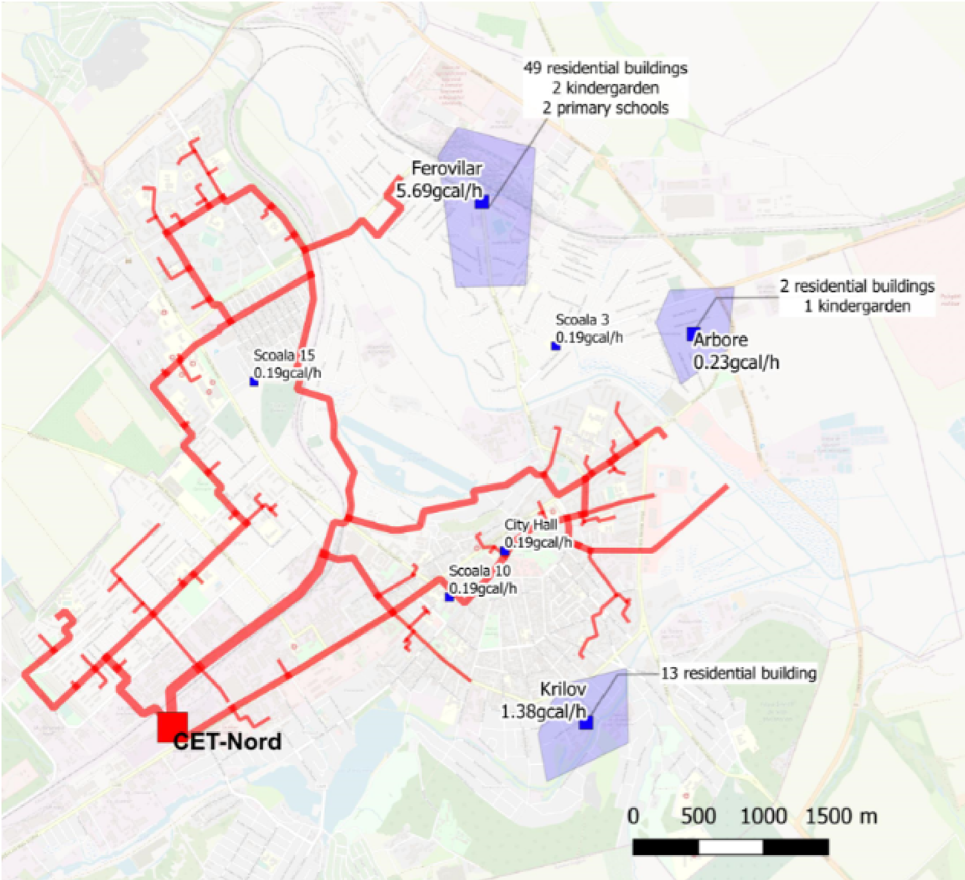


Figure 14: Location of the facilities operated by Termogaz to the central network operated by CET-Nord

Among the facilities operated by Termogaz it seems possible to connect the following entities:

3 facilities operated by Termogaz are within CET-Nord operating area and a connection of these buildings would be similar to a customer connection to the network (2 schools and the City hall)

Two networks are operated (Feroviarilor and Krîlov) and at a reasonable distance from the CET-Nord network. The possibility to connect these networks need to be assessed, through a modelling of the interconnection (between 500 and 600 meters each). This interconnection would need a detailed analysis of the hydraulics to connect the two systems.

Should the above buildings be connected to the central DH system, the small boiler units could be dismantled (and potentially sold on the second hand market) while the heat would be produced from the CHP.

In the eastern part of the facility, it may not be economically profitable to connect to the “Arbore” network and School 3 to the network operated by CET-Nord.

3. Organisational & institutional assessment

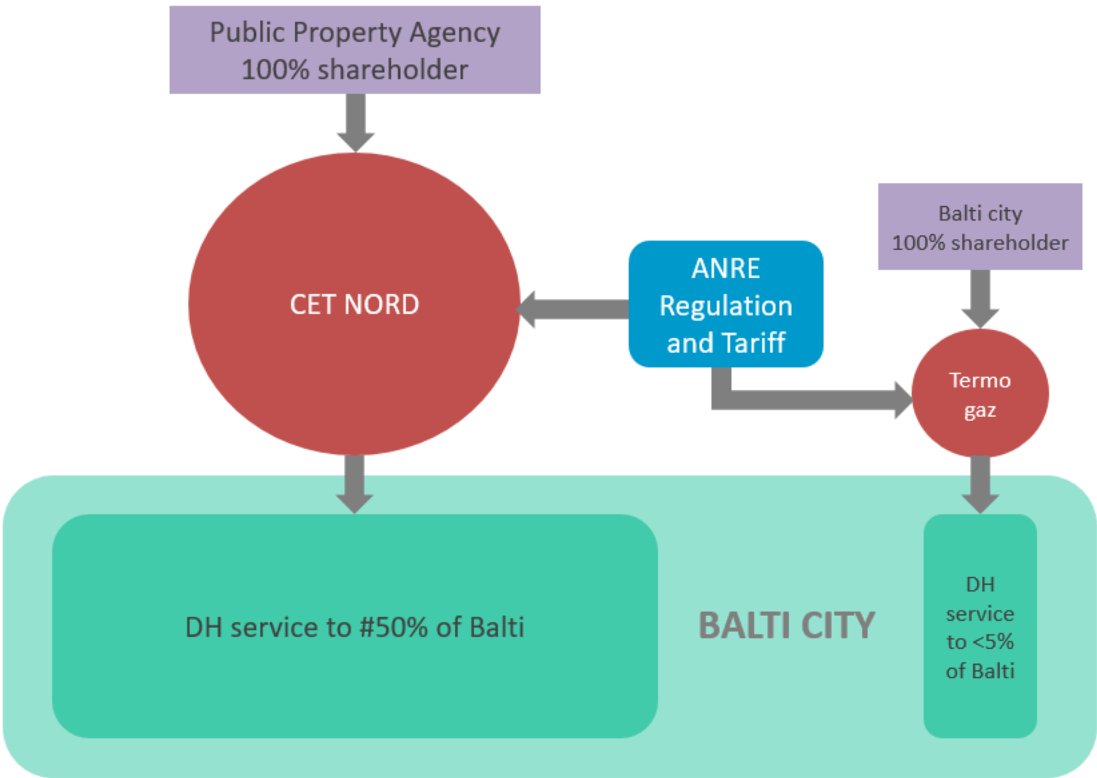
3.1 Organisational structure of CET-Nord

3.1.1 Governance

CET Nord was incorporated in 1997, under the Order of the Department "Energy, Energy Resources and Fuel" #60 of 10 July 1997. It is the successor of Balti City Power Plant which was founded in 1957.

The unique shareholder of CET Nord is the State, acting through the Public Property Agency which is a public structure subordinated to the Government.

The following scheme shows the main stakeholders of district heating in Balti:



CET Nord provides DH services to approximately 50% of the city of Balti, with nearly 24,000 clients. Termogaz Balti provides also DH services in Balti, but covers a much smaller area: less than 5% of the city with 1,200 clients.

The unique shareholder of CET Nord is the State. The unique shareholder of Termogaz Balti is the Municipal council of the City of Balti.

The two DH companies are regulated by the national regulator for Energy ANRE. The regulator is particularly in charge of setting the tariff of DH services.

The Company's activity of CET-Nord is regulated by the Law #1134/1997 on joint stock companies, which was updated by the Law #18/2020.

According to the charter, approved by the decision of the General Meeting of Shareholders of 17.12.2020 (Minutes no. 3), the management bodies are:

- Board of Shareholders
- The Company's Council;
- The Censors Commission;
- The Executive body;

The Board of the Company is in charge of strategic decisions and appointment of the General Director. It is composed of 5 members:

- The President who is Deputy General Director of the Public Property Agency;
- The Deputy Secretary General of the Government, at the State Chancellery;
- The Head of the Economic Security and Risk Management Department, at the Public Property Agency;
- The Head of the External Debt Section, at the Public Debt Department of the Ministry of Finance;
- The Head of the Institutional Management Department at the Ministry of Economy and Infrastructure.

The executive body of the Company is a one-person management body and is represented by the General Manager, who is elected by the Board of the Company, for a term of up to 5 years. The competence of the Executive Body is responsible for all matters governing the day-to-day operation of the Company, except for matters within the competence of the General Assembly and the Board of the Company.

The Censors Commission is an internal think-tank which is also in charge of the application of the Company's Statute; It is composed of 3 members:

- A Senior Consultant at the privatization and post-privatization department of the Public Property Agency;
- A Senior Consultant at the State Budget and National Public Budget Section of the Budget Policy and Budget Synthesis Department in the Ministry of Finance;
- A Senior Consultant at the Energy Policy Directorate of the Ministry of Economy and Infrastructure.

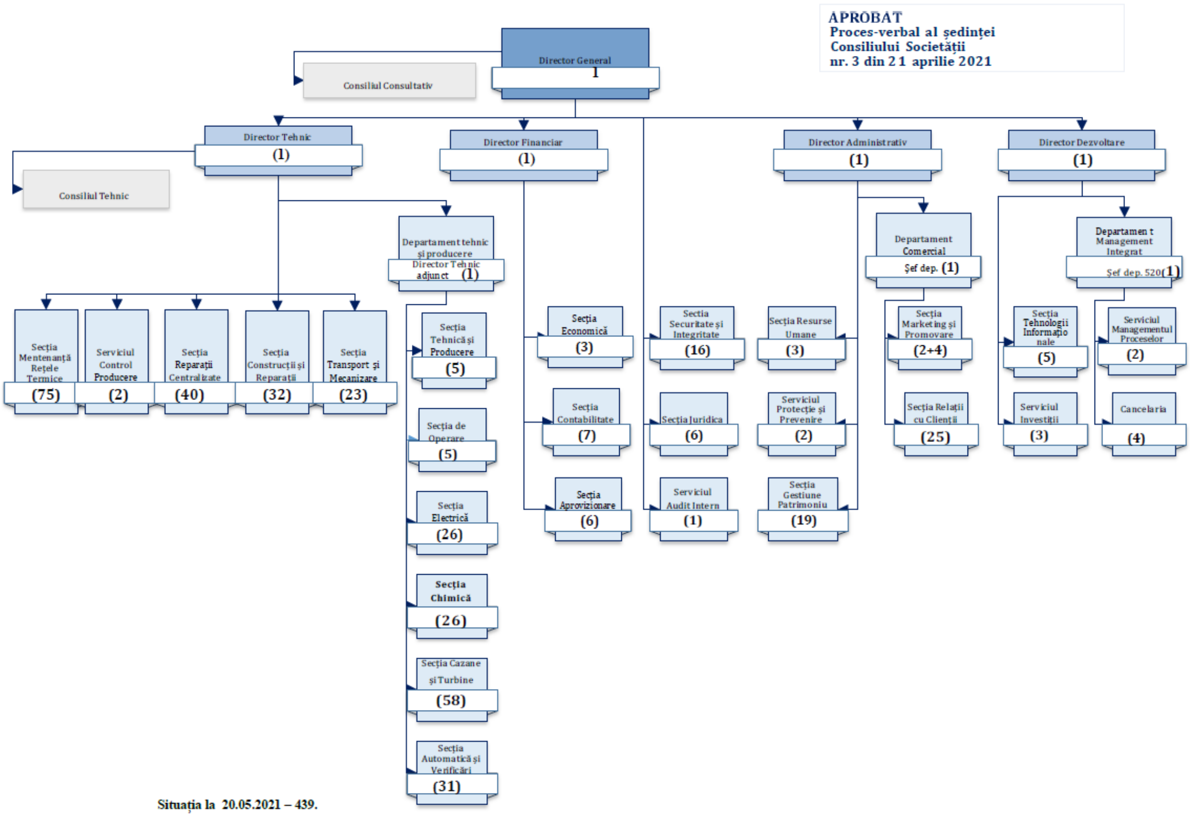
The Audit Committee is in charge of the control of the activity and performance of general director and other directors; is composed of 3 members:

- The Head of the State Capitalization Assets Section of the Corporate Administration, Methodologies and Regulations Department in the Public Property Agency;
- The Head of the State Assets Analysis and Regulation Service at the Ministry of Finance;
- The Deputy Head of the Policy Analysis, Monitoring and Evaluation Department at the Ministry of Economy and Infrastructure.

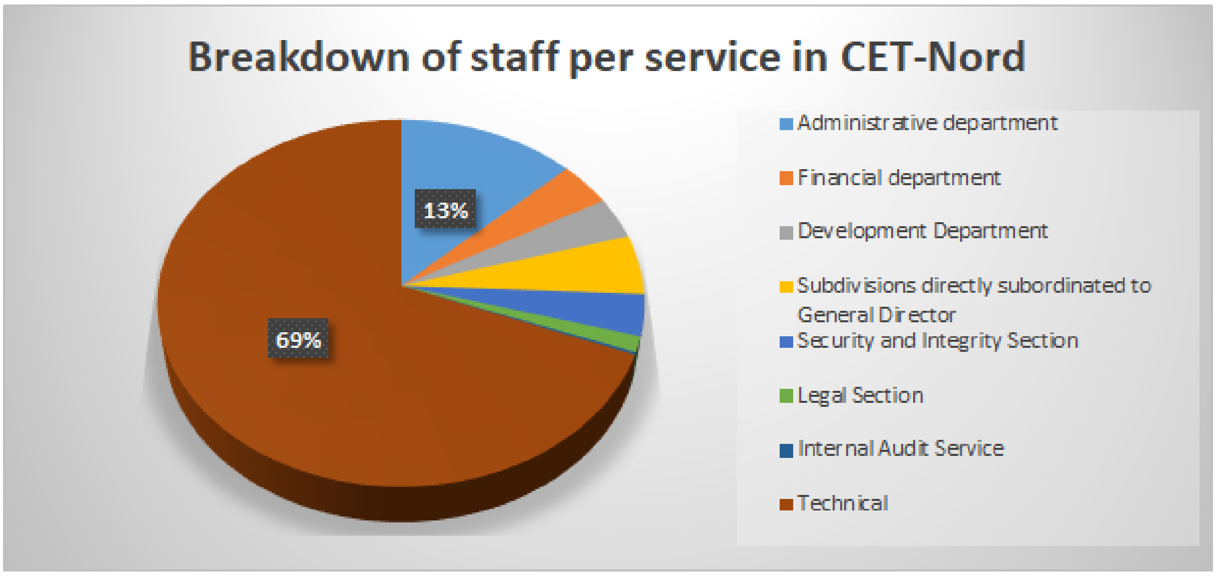
3.1.2 Organization

The current organizational chart of CET NORD, provided in the annex 1, was approved in the meeting minutes of the Company Council #3 of 21/04/2021.

The organization chart is shown hereafter:



The Company contracts around **439** employees in 2020. The **technical department** represents **82%** of the company's staff. Despite their limited size, the Financial, Administrative and Development activities are separate departments that report directly to the Managing Director.



3.1.2.1 Technical department

This department is composed of **323 employees** organized through 11 services.

Service	Functions	Number of employees	Hierarchy
Technical & Production	• Development of activities & coordination of the activities in order to ensure the reliable and economic operation of the equipment • Technical reporting and analysis of the activity of production plants • Preparation of technical materials (orders, instructions, minutes, reports,…) • Studies regarding mechanization and automation of production, development, reconstruction and modernization of equipment, and increase of labour productivity. • Organization and control the preparation of production plants for heating season. • Organization, standardization and improvement of operations of production plants. • Metrology in production plants. • Organization and monitoring of environmental protection measures.	**5**	**Deputy Technical Director**
Operations	• Maintaining high rate of availability for production equipment. • Performing switches, starts and stops. • Locating incidents and restoring functionality. • Preparation of repair works.	6	
Electrical Service	• Maintenance of electrical equipment, automation systems and protection relay. • Control of the quality of the electricity delivered to the network.	26	
Chemical service	• Operation of chemical treatment equipment. • Maintenance of chemical treatment equipment	26	
Boilers & Turbines	• Operation of boilers and turbines of CHP in accordance with the production plan • Maintenance of boilers and turbines of CHP, including identification and repairs of incidents and implementation of preventive maintenance plan	58	

Automation & control	• Maintenance of protection relay and signals • Metrology of network • Operation and maintenance of automation and control equipment • Data transmission to SCADA	31	
Network O&M	• Network inspection • Operations of network equipment, including ITPs	75	
Production control		2	
Centralized repairs		40	
Construction & repairs		32	
Transport & Mechanization		23	

3.1.2.2 Financial department

This department is headed by the financial director. This department is composed of **17 employees** organized through 3 services.

Service	Functions	Number of employees
Economics	• Economic studies regarding CET Nord activity • Planning, budget • Follow up of the revenues and the cost, reporting • Revision of tariffs	3
Accounting	• Accounting of operations • Cash management • Fiscal calculations • Financial statements, financial audit and certification of accounts • Production of payslips and payment of employees • .	7
Procurement	• Centralization of requests from different services regarding supply of goods and services • Stock management in storage sites. Purchase of goods and services through tenders	6

3.1.2.3 Administrative department

This department is headed by the administrative director. This department is composed of **57 employees** organized through 3 services and 2 other services placed under the authority of the manager of the commercial department who is subordinated to the administrative director.

Service	Functions	Number of employees

Customer service	• Meter reading, billing and collection of domestic and non domestic customers • Creation, modification and termination of contracts • Analysis and treatment of requests and complaints • Follow-up of ITPs and data collection	**25**
Marketing	• Definition and implementation of the communication policy of CET-Nord • Communication with the media and the public. • Promotion of services, and in particular ITPs and horizontal networks	6
Human resources	• Creation, modification and termination of employee' contracts • Organization & training	3
Protection & prevention	• Implementation and follow-up of health and safety rules inside CET-Nord	2
Property care	• Maintenance and small repairs in buildings of CET-Nord	19

3.1.2.4 Development department

This department is headed by the development director. It is composed of **15 employees** organized through 4 services.

Service	Functions	Number of employees
IT	• Maintenance of IT hardware and data services • Maintenance and development of the commercial IT system, and support to users • Replacement of the accounting system • Maintenance of other IT systems	**5**
Quality management	• Creation and maintenance of procedures • Certification of processes •	3
Investments	• Preparation of the investment plan • Relation with ANRE for approval of the plan •	3
Chancellery	• Administrative secretary for the general director • Response to written letters addressed to CET-Nord	4

3.1.2.5 Management Information Systems

Commercial system

The commercial system consists of 2 separate applications for domestic and non-domestic customers. The system for non-domestic customers was created in 1999 with Foxpro and uses the DOS operating system. The system for domestic customers was created by the Company in 2008.

The coexistence of these 2 systems is obviously not optimal. In addition, some functions are shared, such as billing because the old system for non-domestic customers cannot handle the new calculation methodology.

It must also be noted that basic functions such as the customer contact management, the late payment reminders and the collection procedure are not or insufficiently covered by these systems.

Improving commercial systems should therefore be a priority for CET-Nord. Even though the IT team is competent and can properly maintain the 2 existing systems, it would be a waste of time and resources to introduce progressive upgrades. The best option is certainly the replacement of the existing system by a new commercial system specialized in district heating activity and readily available on the market. In this matter, CET-Nord could take advantage of the experience gained by Termoelectrica in Chisinau where the Microsoft Navision and the add-on module Energia are used.

Accounting system

The accounting system (ComptReal) was developed in 1999 by a software company in Balti. It is maintained by a freelance programmer who intervenes every week and on demand.

This system is very old and it will be more and more difficult to make it work properly. In addition, functionalities are rather limited. As per the commercial system, it should be replaced by a system available on the market.

In this matter, CET Nord is considering the replacement of this system by 1C which is well-known, widely used in the region and has a good reputation.

3.1.2.6 Benchmark and perspectives

The following table provides a benchmark for the number of employees in modernized district heating companies:

Function	Benchmark	Long term target for Balti	
Operation and maintenance of production units	1 employee / 4 MW	230 MW	60
Operation and maintenace of network	1 employee / 5 km	187 km	30
Other staff	25% of the total	120	30
Total staff			120

At best, a company the size of CET-Nord could operate with 120 permanent employees while CET-Nord has 460 permanent employees in 2020. This comparison suggests that CET-Nord could progressively decrease the number of employees as new equipment is deployed and organization is optimized.

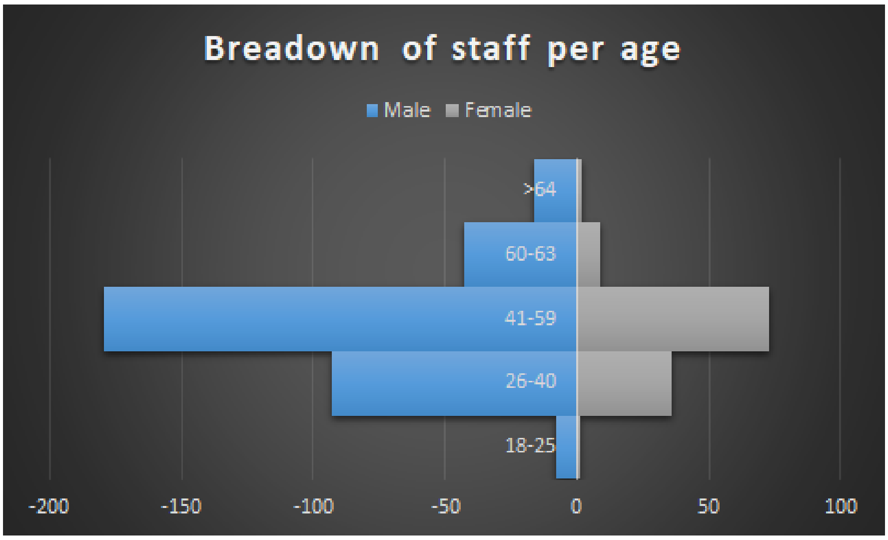
Organizational improvements can be obtained with the following actions:

- Automation of equipment and SCADA;

- Multi-skilled employees, provided by adequate training;
- Reduction of legal obligations for specific tasks which are not technically justified;
- Simplification of the organization and processes
- Development of seasonal contracts

A reasonable target in 10 years could be a reduction of the number of employees down to 300, provided that funds are available to realize the investments which will increase productivity.

The following table gives the breakdown of employees by age and gender in 2020:



The high share of technical staff in the Company explains why females represent only 25% of the staff in CET-Nord.

In the next 10 years, given the above age structure, around 70 employees over 60 years old in 2020 will leave the Company. Many others among the 252 employees in the range between 41 and 59 years will do so. The target of 300 employees can therefore be reached if the Company avoids to replace the employees who leave the Company. Training will be needed for the remaining staff to become more polyvalent, flexible and develop the ability to use digital support at work.

3.2 Key provisions

The regulation regarding the district heating sector is complex and involves many Laws and Decisions. The key provisions that impact the project are the following:

- CET-Nord is a joint-stock company managed by the Public Property Agency.
- Tariffs for heat and electricity applied by CET-Nord to customers are set by the regulator ANRE every year according to Remuneration Asset Based methodology; Tariff for gas applied by Moldovagaz to CET Nord is also set annually by ANRE.
- Billing is made on the basis of heat consumption measured at the entry of each building by a bulk meter;

All domestic customers have a contract with CET-Nord;

The invoicing of the consumers within the residential blocks is made on the basis of the heat consumption of the building, distributed between the apartments according to the heated surface.

The disconnected customers do not have a contract with CET Nord, but they are billed according to 10% of the surface only. (HG 191 19.02.2002)

Limit of responsibility is the connection point to the building.

Horizontal networks can be installed in domestic buildings on a voluntary basis only. ANRE considers that their cost cannot be included into the tariffs.

CET-Nord has signed a performance contract with the State through the Ministry of Economy and Infrastructure that includes performance indicators and performance targets.

The Municipality of Balti has no specific authority over CET-Nord, and is not directly involved in the review and approval of the investment projects and tariff levels;

Termogaz is a district company that supplies a few buildings in Balti, and represents approximately 5% of CET-Nord in size. The Company was founded and managed by the Municipality of Balti. The merger of CET-Nord and Termogaz is possible and envisaged.

3.2.1 Regulations related to energy sector in Moldova

The energy sector is regulated by Law 174/2017 on energy, Law 92/2014 on thermal energy and the promotion of cogeneration and government decision 434/1998 on the approval of the Regulation on the supply and use of thermal energy.

According to these normative acts, the regulatory authority in the thermal energy sector is ANRE. Thus, the Agency, through its acts, determines the activity rules of the energy sector companies, among which the main acts are:

- Decision and Methodology for calculating, approving and applying the regulated prices and tariffs for the production of electric and thermal energy, for the thermal energy distribution and supply services 396/2019 from 01.11.2019;
- Decision 484/2017 on the approval of the Regulation on quality indicators for thermal energy distribution and supply services
- Decision 23/2017 on the approval of the Regulation on the supply of thermal energy;
- Decision 136/2018 regarding the approval of the Technical Norms of the thermal networks;
- Decision 742 of 18-12-2014 regarding the approval of the Methodology for determining the normative values of thermal energy losses, of thermal agent and of the values of the normative indices of operation of thermal water networks.

3.2.1.1 Quality indicators

The quality indicators set in decision 484/2017 includes a number of indicators. Of particular relevance here are:

- The number of requests to realize a connection from the date of request is less than 15 days.
- The number and breakdown per cause of complaints (instrumentation, quality of thermal energy, interruption of service,…) that are justified;
- The percentage of complaints concerning the operation of meters and measuring equipment that were resolved in less than 5 working days.

3.2.2 Other Regulations applicable to CET-Nord

Then flowing regulations apply to CET-Nord:

- Civil Code of the Republic of Moldova no. 1107/2002;
- Law 845/1992 on entrepreneurship and enterprises;
- Law 1134/1997 regarding joint stock companies;
- Law 1402/2002 to the communal household public services, through which the supply of thermal energy is included in the category of communal household services;
- **Law on administrative decentralization** no. 435/2006, which assigns local public administrations of level I the function of approving the development and management of urban gas and thermal energy distribution networks (art. 4 paragraph (1) letter i)); The development and management of urban gas and thermal energy distribution networks (art. 4/1/i) are subject to the approval of the local public administrations of level 1.
- Law 436/2006 on local public administration, which distributes the functions in the field of organizing communal household services among the actors of local public administration;
- Law 75/2015 on housing;
- Government Decision no. 191 of 19-02-2002 on the approval of the Regulation on the provision and payment of housing, communal and non-communal services for housing, metering of apartments and the conditions for their disconnection from / reconnection to heating and water supply systems;
- **Law 913/2000 of condominium**: The condominium is constituted by the obligatory association of the owners of real estate, located on a certain territory, at the initiative of the owners, territorial privatization agencies or local public administration authorities.

This last law contains provisions on the delimitation point, which is for the central heating networks: the last flanges from the third and fourth valve after the block' elevator (art. 4/3/c).

Common property in the condominium includes all the parts of the property in common use: the land on which the block is built, the walls, the roof, the terraces, the chimneys, the stairwells, the halls, the basements, the cellars and technical floors, the garbage pipes, the elevators , the equipment and engineering systems inside or outside the dwellings (rooms), which serve several dwellings (rooms), the afferent lands in the borders established with greening elements, other objects destined to serve the real estate property of the condominium.

According to article 7, the share of each owner in the common real estate in the condominium is proportional to the share constituted by the total area (in square meters) of the dwellings (rooms) belonging to him in the condominium, if the decision of the general meeting of owners, adopted in accordance with the procedure provided for in Article 26 of this law, does not provide otherwise.

According to article 14, provision of services in the condominium is carried out based on the contracts concluded between the operators of the respective services and the housing fund manager (co-owners association or the enterprise) or, as the case may be, between operators and each apartment owner / tenant of the block of flats.

The invoice for the respective service shall be issued by the housing fund manager or, as the case may be, by the operator, indicating the term for its payment according to the clauses of the contract.

The bill for the maintenance and repair of the common property in the residential building is proportional to the share held by each owner / tenant of the dwelling and is determined according to the tariff approved in the established manner.

Non-payment by a part of the owners / tenants of the used services cannot serve as a basis for the total disconnection of the residential block from the electrical, thermal, gas, water supply and sewerage networks and installations.

Law 523/1999 regarding the public property of the administrative-territorial units;

Law 116/2012 on the industrial security of dangerous industrial objects.

Disconnection rules: according to art. 42, paragraph (8) of Law no. 92 of 29.05.2014 on thermal energy and the promotion of cogeneration, individual disconnections of apartments or parts of apartments located in residential blocks, supplied with thermal energy by collective system, regardless of the causes, must meet in the following cumulative conditions:

a) obtaining the technical conditions from the supplier;

b) the written consent of the administrator of the housing fund and of all the tenants, under the signature of their legal representatives, but not during the heating season.

The disconnection of services is also based on the provisions of Annex 7 to Government Decision 07191/2002 on the regulation of housing supply and payment, communal and non-community housing services, apartment metering and the conditions for their disconnection from / reconnection to heating and water supply systems.

All costs related to the future disconnection / reconnection of the rooms from / to the heating system will be borne by the consumer.

Disconnection / reconnection is carried out on the basis of a written request submitted by the consumer on behalf of the supplier (manager), who is obliged to examine the received request within 15 days and release the technical conditions to the consumer, with the obligation to present the reconstruction project the central heating system developed by the design institutions or individuals holding a license in this type of activity, based on the inventory data of the existing central heating system and coordinated in the established manner.

In case of complete disconnection from the central heating system, the consumer will pay for the heating in the amount of **10%of the cost of thermal energy calculated per square meter of** of the apartment (living room in the dormitory), taking into account the existence of normative losses of thermal energy in the technical rooms (technical floors and basements) that keep in operation the engineering systems of water supply and sewerage in the cold period, the need to heat the common places and impossibility of disconnecting the transient heating columns (pt. 8 of the annex).

The subsequent complete disconnection from the central heating system will be made only with **the written consent of all apartment owners** within the block of flats, habitable rooms in dormitories and the housing fund manager.

3.2.3 Regulation regarding natural gas

According to the Decision 88/2018 of the Board of Directors of ANRE dated 16/03/2018, the prices for natural gas supplied by Moldovagaz to district heating power plants and other licensees in the thermal energy sector for use in regulated activity are set at 4018 lei / 1 Nm3 without VAT, which is 8%, according to article 96 in the fiscal code of the Republic of Moldova.

Law 108/2016 on natural gas (replaced Law 123/2009) establishes the principles of organization, regulation, ensuring the efficient operation and monitoring of the natural gas sector to protect primarily the interests of consumers.

The regulated prices and tariffs in the natural gas sector are determined annually by the natural gas enterprises in accordance with the Methodology for calculating and applying the regulated natural gas tariffs and prices no. 678 of 22.08.2014 and the conditions established in the Regulation on the procedures for submitting and examining the applications of licensees regarding regulated prices and tariffs.

Code of natural gas networks, approved by Decision of the Board of Directors of ANRE 420/2019 dated 22/11/2019, transposes several European normative acts such as EU Regulation 2015/703, 2017/459 and 2017/460. Among other things, the Code provides that thermal power plants connected to a natural gas transmission or distribution network, which deliver heat to the central heating system are considered protected consumers.

The quality of natural gas supplied must comply with the provisions of GOST Standard 5542/87.

CET-Nord has officially requested ANRE to benefit from new tariffs for gas supply based on "transmission" tariff levels instead of "distribution" tariff levels which currently apply. Indeed, CET-Nord considers they are directly connected to the transmission gas system and should therefore benefit from such lower tariffs.

3.2.4 Legislation regarding other issues

Law 139/2018 on energy efficiency transposes EU Directive 2012/27 dated 25/10/2012 and creates the necessary legal framework for the promotion and improvement of energy efficiency through the implementation of action plans in the field of energy efficiency, the development of energy services, as well as by implementing other energy efficiency measures.

The law stipulates that an **efficient central heating** and cooling system is a central heating and cooling system that uses at least 50% energy from renewable sources, 50% residual heat, **75% thermal energy produced by cogeneration**.

According to article 27 of Law no. 27/2018, high efficiency cogeneration electricity producers benefit from access to electricity networks, in a non-discriminatory and regulated manner, at published, non-discriminatory tariffs, based on transparent and predictable costs, calculated and approved in accordance with Law no. 107/2016 on electricity.

High-efficiency cogeneration electricity producers are entitled to participate in the wholesale and retail markets, in the balancing electricity markets and to offer system operators other operational services, in compliance with the provisions of Law no. 107/2016 on electricity and under the conditions established in the Rules of the electricity market, approved by the National Agency for Energy Regulation.

The origin of the quantities of electricity produced in the high efficiency cogeneration regime, confirmed on the basis of the reference values mentioned in point 6 of Annex 1 to Law 92/2014 on thermal energy and the promotion of cogeneration, is demonstrated through the guarantee of origin, in accordance with article 14 of the Law.

When developing the methodologies for calculating, approving and applying regulated prices, as well as when examining and approving regulated prices on the retail electricity market, the National Agency for Energy Regulation may apply the following measures or categories of dynamic prices:

- Prices are set according to consumption hours;
- Prices are differentiated per peak hours;
- Prices are set in real time;
- Bonus system for reducing consumption during peak hours.

Law 128/2014 on the energy performance of buildings stipulates that the methodology for calculating the energy performance of buildings supposes the positive influence of the electricity produced in the cogeneration regime; In order to obtain construction permits, the design of new buildings must take into account the possibility of implementing cogeneration.

3.2.5 Control and regulatory agencies

3.2.5.1 ANRE

As national regulator for district heating, ANRE:

- Elaborates and approves the methodologies for calculation, approval and application of the regulated tariffs;
- Approves the regulated tariffs in accordance with the approved methodologies;
- Issues, modifies, suspends and withdraws licenses for thermal power units;
- Monitors the correct application by the licensees of the regulated tariffs and the conditions for carrying out the licensed activities;
- Supervises the observance by the licensees of the principle of the minimum necessary and justified costs when calculating and approving the tariffs for the regulated activities;
- Supervises, promotes, ensures transparency and monitors the competitiveness of the thermal energy sector;
- Establishes, respecting the confidentiality, the economic and technical information for the operation of the centralized thermal energy supply systems, which are to be published by the license holders;
- Monitors the effective unbundling of licensees' accounts and ensures that there is no cross-subsidization between heat generation, distribution and supply activities, establishes methods for keeping accounts in the thermal energy sector in accordance with national accounting standards, with the requirements for accounting reports, and with requirements for revaluation of fixed assets;
- Elaborates and approves the regulation regarding the procurement procedures of the goods, works and services used by the licensees;
- Supervises the commercial activities of the licensees, as well as the quality of the services provided by them;
- Establishes the terms, conditions and tariffs for connecting thermal power plants, district heating power plants, high efficiency cogeneration and thermal power plants and thermal power plants from renewable sources to the thermal network to guarantee their objectivity, transparency and non-discrimination;
- Ensures the protection of the rights and legal interests of consumers.

3.2.5.2 Energy efficiency agency

In order to increase energy efficiency in Moldova, the agency:

- Ensures the support of the specialized central body of the public administration in the thermal energy sector in creating the conditions for the promotion of the production of thermal energy in a highly efficient cogeneration regime and from renewable sources;
- Provides support to thermal energy units in the elaboration of their own energy efficiency plans;
- Consults the local public administration authorities and the thermal energy units regarding the use of high efficiency technologies and the transition to the production of thermal energy in a high efficiency cogeneration regime and from renewable sources;
- Ensures the awareness and consultation of consumers regarding the measures for conserving thermal energy and optimizing its consumption.

The local public administration authorities elaborate, approve and promote development policies, rehabilitation programs, extension and modernization of the thermal energy sector in the respective administrative-territorial unit, according to the state policy in the field, ensuring the accomplishment of these actions in a unitary conception and correlated with local plans, general urban plans and environmental programs.

3.2.6 Consumers' contracts

The legislation defines 2 categories of consumers:

- Household consumer;
- Non-household consumer legal person;

Consumers are connected to heat supply services under the concluded contract. The contract contains general provisions regarding the manner of providing the services, the rights and obligations of the parties, making payments, etc.

The contract with the local public administration is concluded in order to supply thermal energy to the buildings, managed by the authorities, such as administrative buildings, school, medical institutions, etc.

In connection with the implementation of its own project for the supply of thermal energy in three residential buildings through a horizontal thermal energy distribution system and the installation of individual measuring equipment for each consumer, in the absence of special legislative provisions governing this area, CET-Nord developed a contract for the supply of the heating agent with the final consumer which provides for the delimitation of the responsibilities of both the service provider and the consumer.

Approval of the special contractual clauses accepted by CET-Nord and its consumer, being the only solution to justify the calculation of thermal energy consumed, implemented for the benefit of consumers, system in which consumption is determined individually. Normative consumption only applies to calculate heating of common areas, through which the heating columns pass.

The general principles for determining the payment for thermal energy (heating) in vertical systems are determined by Government Decision 191/2002 including the conditions for their disconnection from / reconnection to heating and water supply systems.

Point 10 of the Regulation stipulates that the heating payment is calculated for one square meter of heated surface of the apartment.

The volume of thermal energy subject to payment by the population is established according to the data of the thermal meters installed in the residential buildings. As regards to heating in common parts, Law 913/2002 and Law 75/2015, stipulates that billing is done in proportion to the area of the property in the total area of the building.

Installation, operation (maintenance and repair), metrological verification, replacement (within the period indicated in the normative documents of the national metrology body) and sealing of thermal meters within the premises of the customer are performed at the supplier's expense.

3.2.7 Debts

The debt of companies with full public capital is regulated by Law 419/2006 on public sector debt and state guarantees.

According to article 43 of this normative act, the debt contracted by the companies with a majority of public capital does not constitute a state debt. At the same time, the external loans are to be registered at the Ministry of Finance. These companies submit, on a quarterly basis, to the Ministry of Finance the information necessary for monitoring the contracting, disbursement and servicing of unpaid public sector debt.

At the same time, if the external debt is requested to be contracted by the founder of the public capital company, this situation will be subject to another regulatory procedure. The ceilings of the state debt, as well as the ceilings of the state guarantees, at the end of the year, are established by the state budget law:

- The submission by the requesting authority to the Government of an application for the financing request;
- The Government evaluates the financing request in order to correspond it with the strategic development plans and in terms of the availability of budgetary resources and launches the procedure for negotiating and contracting loans;
- The international loan contracts are approved by the Parliament by organic law (art. 25)
- The debts are monitored quarterly by presenting the reports of the Ministry of Finance

In the case of issuing state guarantees, the procedure is similar.

3.2.8 Limit of responsibility

The current regulations do not allow the Company to take over the responsibility over the common parts in the buildings.

The ANRE decision 23/2017 stipulates that the delimitation point at the boundary of the enclosure is:

- At the limit of the boiler fence, in case of supplying the consumer directly from a thermal power plant or piped district heating system, which supplies him exclusively;
- At the limit of the consumer's premises, in case of supply through some central thermal points located outside his premises, and from which several consumers are supplied;
- At the limit of the wall of the individual thermal point (ITP), if the ITP is under the management of the supplier, located in the technical basements of the consumers;
- At the last flanges of the 3rd or 4th valve of the valve after the elevator node if they are under the management of the supplier;
- At the limit of the exterior wall of the building, in the case of buildings without a basement.

> A lawsuit was made in May 2020 between CET Nord and ANRE. At the moment, no hearing has taken place due to the epidemiological situation and the need of third parties participation in the hearing. The dispute consists in the non-acceptance by ANRE of the investments made for the implementation of the horizontal heating system as investment expenses and their inclusion in the tariff calculation. The reason for non-acceptance is the provisions of the legislation in force, which stipulates that the networks after the delimitation point are not managed by the Company, so the investments are not recognized.

CET Nord on the other hand invokes the right to expand networks (the law does not stipulate what the extension means - inside the building or as just connecting other buildings).

3.2.9 Metering

According to ANRE Decision 23/2017, the acquisition, installation, operation, maintenance and periodic metrological verification of measuring equipment shall be carried out:

- on household consumers by the distributor on account of the financial means provided for in the tariffs for thermal energy, and;
- on non-household consumers according to the terms of the contract between the consumer and the distributor. at the expense of the financial means of the non-household consumer.

For households the company is obliged to install the bulk (building) meter according to government decision 191/2002.

Investments in the construction of horizontal distribution facilities are not considered as an extension of the network, and therefore are not accepted by ANRE as an eligible investment to be included in the calculation of the tariff for delivered thermal energy.

3.2.10 Horizontal networks

With the lack of a new regulation on the delimitation of the thermal networks of the supplier / consumer, implementing a horizontal system depends on the common will of the building tenants to invest in modernizing the distribution system in their property, on their own.

A new horizontal system, implemented with the licensee's investments, will help to solve the problem of maintenance and repair of the existing internal secondary systems which are often found in poor conditions.

By article 48/3 of Law no. 75/2015, this task of carrying out maintenance and repairs belongs to the administrator of the buildings, which can be:

- Condominium / co-owners association;
- Enterprise established or contracted by the local public administration authority for the service and maintenance of the dwellings in the locality;
- Natural or legal person, including the administration organization contracted by the owner for the service and maintenance of the dwellings;
- The owner.

If the owners are usually eager to finance the maintenance and repair works, the quality of works when they are performed by the building's administrator is often poor resulting in a bad quality of service. All this leads to an increase in the number of disconnections of consumers while the supplier is unable to intervene due to the fact that the limit of his competences is the delimitation point.

Law 75/2015 stipulates that the administrator is responsible for the consequences of the administration of the common property in the residential block in violation of the technical norms and the rules of safe operation, in accordance with the provisions of the concluded management contract. In reality, the administrator is not held liable for non-execution or improper execution of his obligations. Completing the normative acts with express provisions regarding the sanctioning of the administrator will contribute to his responsibility.

3.3 Review of the Performance contract

3.3.1 Key provisions

The performance contract was signed in June 2017 for 15 years by the Government of Moldova represented by the Ministry of Economy, and CET-Nord.

As the sole shareholder of CET-Nord, the Ministry of Economy wants the Operator to provide operating, maintenance and management services as an independent, self-financed and transparent commercial entity.

Article 3 defines the services provided by CET-Nord and how they shall be provided:

- Operation of power plants and district heating network
- Implementation of good practices, i.e. definition and implementation of work procedures, utilization of manuals, annual planning, prudence-based approach of operations, compliance with laws and regulation, insurance contracts for assets and operations as required;
- Employees with proper qualifications and in sufficient number, contracted directly buy CET-Nord;
- Implementation of a reporting system of operational data.

Article 4 gives the following provisions:

- The shareholder must approve CET-Nord budget;
- In order to provide adequate level of service in terms of customer relations, CET-Nord must train employees, **implement proper commercial IT systems**, develop metering policy, analyse and respond to customer claims, and develop a public information program in key issues regarding district heating;
- All assets made available by the shareholder to CET-Nord or acquired by CET-Nord remain the property of the shareholder; **CET-Nord must keep an inventory of these assets and apply best practices for their operation and maintenance**;
- CET-Nord shall meet specific targets with regard to performance indicators that are set out in the annexe; these indicators are calculated at the end of the year.

Article 5 gives provisions regarding the tariff of services:

- Tariffs are set by ANRE and is subject to periodical modifications;
- By 30 September, CET-Nord shall calculate and transmit to ANRE a draft tariff application for the following year, based on the most recent approved methodology; by 30 November, ANRE shall approve the tariffs for the next year;
- If tariffs for gas or electricity increase by more than 3% during the course of the year, CET-Nord asks ANRE to increase the tariff in order to reflect the increase of cost.

The list of reports that CET-Nord must prepare for the shareholder is given in article 6:

- Budget: a draft annual budget for the year to come must be submitted 90 days before the end of the year for approval; After discussions and amendments as necessary, the shareholder shall approve the budget 30 days before the end of the year; During the course of the year, CET-Nord shall inform the shareholder of any significant deviation from the approved budget as soon as possible.
- Monthly operational reports: The monthly report must be provided within 10 days after the end of the month. The report shall give operational data regarding operations and maintenance, and will include information on volume of heat and electricity produced, operating hours, gas consumption, descriptions of incidents and their resolutions, progress of investments, actions of maintenance, and relation with employees. Monthly data will be analysed with regard with annual planning, data for the previous year and data for the previous month of the year. The report shall also provide a follow up of expenses incurred by CET-Nord during the month which will be analysed in the same manner as operational data.
- Annual report: the annual report must be before 60 days after the end of the year. The report shall have a similar content as the monthly report with annual data instead of monthly data. It shall also provide the level of performance operators set in the annexe of the performance contract. The report shall analyse the operational and economic performance of CET-Nord during the year. Significant progress shall be highlighted, and any significant deviation with regard to annual planning and expected performance levels shall be identified and analysed, with proposed remediation measures.

CET-Nord and the shareholder shall meet and discuss the report less than 30 days after issuance.

3.3.2 Performance indicators and targets

The annexe of the contract gives the list of the economic and technical indicators and the targets.

3.3.2.1 Economic indicators

The following table provides the list of economic indicators and targets:

Indicators	2016 baseline	2017	2018	2019	2020
Liquidity ratio	0.8	>1.1	>1.1	>1.1	>1.1
Collection rate	99%	>90%	>90%	>90%	>90%
Debt service coverage ratio	-	>1.1	>1.1	>1.1	>1.1
Debt rotation rate	2.2	<2.5	<2.5	<2.5	<2.5
Average debt recovery period	164	<155	<150	<140	<130
Average period of payment	382	<362	<350	<340	<330
Total debt / Total assets	0.6	0.5	0.5	0.5	0.5
EBITDA margin	-	>10%	>10%	>10%	>10%
Cost recovery	-	>110%	>110%	>110%	>110%
Labour productivity	411	447	470	470	478
Write off ratio	0%	<2%	<2%	<2%	<2%

- The collection rate is the ratio of annual collected amounts to annual billed amount (heat only).
- The debt service coverage ratio is the ratio of debt service to cash available to pay the debt service.
- The debt rotation rate is the ratio of receivables to payables (heat only).

- The average debt recovery period is the amount of receivables from customers expressed in days of turnover (360 x receivables / turnover).
- The average period of payment is the amount the ratio 360 x receivables / payables.
- The cost recovery is the ratio of turnover to total expenses (heat only).
- The labour productivity is the ratio of turnover to the number of employees (heat only), in 1000 MDL.
- The write off ratio is the ratio of bills written off during the year (bad debts) to turnover (heat only).

The **debt service coverage ratio** should be kept as it is often used by EBRD and lenders, with a target of minimal level of 1.1. It is also the case for the **net debt to EBITDA ratio** which should be added in the list with a target of maximal level of 4.

The collection rate and EBITDA margin are useful and should also be kept. The collection rate is above **95% in 2020** and the **EBITDA margin is around 20%** in 2020. It should be clear that the EBITDA margin is the ratio of (Turnover – OPEX) / Turnover. The collection rate has been high in the last years, and that most of the stock of receivables which relates to old customer debts will not be paid and should be written off.

The average period of payment and write off ratio relates to debt recovery and may not be very meaningful here. They could be replaced by other indicators related to a more detailed breakdown of collection rate per age of bill.

The definition of cost recovery should be clarified. The ratio of turnover to OPEX could be used.

3.3.2.2 TECHNICAL INDICATORS

The following table provides the list of technical indicators and targets:

Indicator	2016 baseline	2017	2018	2019	2020
Heat supplied in network in Gcal	204632	192431	211302	175220	175855
Gas consumption in 1000m3	37070	34297	38034	33755	41084
Production efficiency	86%	87	86	85%	81
Heat billed amounts	161039	149687	166100	137016	134641
Losses in network	20.39%	<21.28%	<20.79%	<21.09%	<22.82%
Connections equipped with heat meter	89%	89%	89%	100%	100%
Salary cost in tariff in %	15.8	<16	<16	<16	<16
Consumption of heating spaces (Gcal/m2)	0.188	0.117	0.117	0.117	0.117
Productivity of employees (Gcal/employee)	395	406	402	392	392
Gas cost in tariff in %	60%	60%	60%	60%	60%
Write off ratio	0%	<2%	<2%	<2%	<2%

The definition of productivity of employees should be clarified. The ratio of number of consumers to number of employees could be used.

The targets of production efficiency are too high. At present, the CHP efficiency is 84% which is good. The overall efficiency will increase with the start of new gas engines that have an efficiency near 88%. A target of 85% would be more suitable and realistic.

The definition of the salary cost in the tariffs should be clarified. The ratio of cost of employees to OPEX or to turnover could be used. The ratio of heat consumption per m2 could be complemented by heat consumption to the number of customers for domestic customers. This ratio is easy to calculate and quite telling.

For measuring the productivity of employees, the ratio of number of customers to employees could complement the existing ratio.

The definition of gas cost should be clarified. The ratio of gas cost to OPEX or to Turnover could be used. In order to measure customer care, the following ratio could also be used, provided that they can be calculated:

- The number of requests and claims received;
- The average time of response for requests and claims;
- The number of court cases received and closed for unpaid bills;
- The customer satisfaction, measured by a n annual satisfaction survey

To monitor the implementation of the PIP some indicators can be introduced such as: the % of buildings equipped with IHS, the number of flats equipped with horizontal networks, the disbursement rate of the budget.

Other indicators may focus on the effectiveness on the implementation of the PIP:

- The savings of energy consumption calculated from the demand side management (IHS) and transfer of energy consumption from individual boilers to central DH. That indicator will be quite complex to assess because the area of calculation shall include the existing energy consumption with individual boilers (electrical or gas boilers) to enable a fair comparison and the benefit of the additional electricity produced by CET-Nord to the national grid. A detailed presentation of the energy balance is made in section 6.2
- The water consumption (or savings) due to the new treatment facilities. Savings have been calculated in the environmental report (-9%).

3.4 Termogaz Balti

Termogaz-Bălți was founded by the Bălți Municipal Council in March 2003. The municipal council is the sole partner of the company, holding 100% of its share.

The company's activity is regulated by Law 246/2017 concerning the state and the municipal enterprises.

The governing body of the Termogaz-Bălți is the Board of Directors consisting of 5 persons:

- the Chairman of the Board and 4 members. The nominal composition of the bodies of the Board of Directors is approved by the Bălți Municipal Council by Decision 3/53 dated 25/06/2019:
- The chairman of the Board of Directors;
- Three members of the Board of Directors;
- A member of the Management Board.

According to the provisions of Law 246/2018 regarding the state enterprise and the municipal enterprise, the Bălți Municipal Council, as founder, has the following attributions:

- Approves the regulations of the board of directors and of the audit committee;
- Designates the nominal composition of the management and control bodies and their remuneration;
- Expresses prior agreement to the sale of the unused assets of the enterprise;
- Expresses the agreement to the transfer in lease / lease or loan of the assets not used in the activity of the municipal enterprise, decides the way of selecting the lessee and coordinates the lease / lease contracts and the loan contracts;
- Expresses the agreement for the scrapping of the goods related to the fixed assets;
- Expresses the prior agreement to pledge the assets of the state / municipal enterprise in order to obtain bank loans;
- Expresses the prior agreement to the acquisition by the municipal enterprise of the goods whose market value constitutes over 25% of the value of its net assets, according to the last annual financial statements, or exceed 400,000 lei;
- Confirms the audit entity selected by the board of directors;
- Approves the nomenclature and the tariffs for the services provided, except for those established by the normative acts in force;
- Assesses the activity of the board of directors and the administrator on the basis of the annual report on the activity of the board of directors, the administrator and the economic and financial activity of the enterprise;
- Approves the distribution of the annual net profit of the enterprise.

The number of employees of Termogaz is nearly **60**.

Consumers of thermal energy are domestic consumers in the residential sector, with **1,133** flats actually connected. The supply of thermal energy is based on the contract concluded with the individual owners of the real estate. The company also provides services to **16** non domestic consumers.

As observed with CET-Nord, the company also suffers from many disconnections.

Unlike CET-Nord, Termogaz has no historic gas debt.

3.5 Merging conditions between CET-Nord and TermogaZ

The merging process has been approved by the City Hall Decision no. 5/9 of 27.04.2021.

The procedure for reorganization by merger of legal entities is regulated by:

- The civil Code of the Republic of Moldova;
- The law on joint stock companies 1134/1997 (article 94);

- The instruction regarding the stages of the reorganization of the joint stock company, approved by the Decision of the National Securities Commission 43/9 dated 3/08/2006 regarding the approval, modification and abrogation of some normative acts.

The merger is carried out in the procedure of merger (creation of a new legal entity) or absorption (one of the companies is absorbed by the other one). The will of the founders is required to initiate the procedure of merger.

The State is the founder of CET Nord, represented by the **Public Property Agency**. The reorganization of CET Nord will be taken in the form of the **Government Decision**, according to article 27/g of the Law 98/2012 stipulating that central public administration can fund, restructure, reorganize and dissolve, state-owned enterprises, companies with full or partial state capital and state-owned holding under the law, as well as exercise functions of founder (co-founder) in their administration, based on a Government decision,

The founder of Termogaz-Bălți can adopt decisions regarding the reorganization of the enterprise by the Decision of the Bălți Municipal Council of Law 246/2017 (article 12/2).

As a result of a merger by absorption of Termogaz-Bălți, the Bălți Municipal Council may become the shareholder of CET Nord.

According to point 8.3.4 of the Instruction on the stages of reorganization of the joint stock company, it is stipulated that the share of the founders in the share capital of the merged company or of the acquiring company will be proportional to the value previously held by each in relation to the net assets of the merging company.

The merger of a joint stock company is authorized by the National Financial Market Commission (point 31 of the Instruction). The company shall submit the application within 6 months after the adoption of the reorganization decisions (point 35), but after the expiration of 2 months after the publication of the last notice on the reorganization of the company in the Official Gazette (Monitorul Oficial) of the Republic of Moldova (point 31). The authorization shall be issued within 30 days of the submission of the application, at the same time the share issue will be registered.

As the operation will impact the tariffs, it will be important to involve ANRE at an early stage to make sure that costs of the merged entity will be properly reflected in future tariff revisions.

4. Tariff setting

4.1 Tariff setting process

Tariff of heat and electricity applied by CET Nord to its customers is set by ANRE according to Decision #396 of 01/11/2019. The process includes a revision of the tariff structure every 5 years and an annual revision of the tariff itself. The revision of the tariff structure due in 2020 for tariff levels in 2021 is still ongoing.

CET Nord shall prepare and transmit to ANRE a project of tariff revision every year before May. In practice, both parties work on a complex Excel document that contains all technical and economic data that are used in the calculation of the tariffs. The tables show the data used for the previous tariffs and data proposed for the new tariff, based on assumptions regarding costs and sales for the next year.

The tariffs are obtained by dividing the expected (cost + fee + “deviation”) by the expected billed volume.

The **“cost”** component includes the operational cost and the depreciation. It does not include the payment of interests and the losses due to foreign exchange variations. Depreciation is based on the asset acquisition value and **does not take into account** the revaluations of assets nor **the assets financed by grants**.

The **“fee”, or profit level**, follows the **Remuneration Asset Based (RAB)** principles. It is a margin based on the residual asset value, excluding revaluation and assets financed by grants. Today, the margin allowed by ANRE is **9.8%** on assets acquired after 2004, and 5% for the assets acquired before.

The **deviation** is the difference in cost and revenue that can be observed between the forecasts taken into account in the calculation of the previous tariffs and the actual figures. This difference, positive or negative, is taken into account in the new tariffs. For example, larger billed volumes will generate higher profit than it should have been. This profit in excess will be taken back in the next year's tariffs. Conversely, lower than expected billed volume will generate a deficit that will be given back in the next year tariffs.

ANRE must respond within 6 months to the project of tariff revision provided by CET Nord and must provide a revised tariff until December 1st. This delay may be longer if ANRE requests additional information. A period of 1 month is allowed for further discussions between CET Nord and ANRE before the tariffs are eventually approved by ANRE. The tariffs apply from the official publication of the decision of ANRE, usually near the beginning of the year.

In case of a significant change of the tariffs for natural gas, ANRE can also decide and exceptional revision of the tariffs at any time within a short delay. Significant increase of other costs cannot justify a revision of the tariff outside normal tariff revision process.

In practice, CET Nord prepared projects of tariff revision for 2017 and 2019 only. Tariffs changed by the:

- ANRE decision no. 112 of 17.03.2017 (in force since 24.03.2017)
- ANRE decision no. 540 of 27.12.2019 (in force since 17.01.2020)

The calculation of the tariffs is made separately for heat and electricity, which requires a split of costs. Costs are usually separated on the basis of gas consumption for heat and electricity production, unless a more appropriate method can be used. For example, cost of employees who work on the DH network is taken into account only in the cost for heating.

It should also be noted that ANRE is responsible for setting the tariffs for gas between CET Nord and Moldova Gas. The setting of this tariff follows the same process with Moldova Gas and ANRE.

4.1.1 Investments

The investment program must be approved by ANRE in order to be taken into account in the tariff calculations (in the cost component through the depreciation and in the fee component through the net asset value).

The investment plan for next year is to be submitted for approval to ANRE by December 1. This plan will include only mandatory, necessary and / or efficient investments, detailed on investment projects to be carried out.

According to point 86 of the Methodology, the Annual Investment Plan includes:

- All investment projects related to the regulated activity, which the licensee plans to carry out in the next regulatory year;
- The informative note with motivated and substantiated arguments of each project, regarding the objectives of the investment plan;
- The source of financing and the calculations of the impact of the annual investment plan on the regulated tariffs / prices for electricity and thermal energy;
- By December 31st, the Agency will examine and approve or reject the Annual Investment Plan submitted by the Company, with the possibility of extending the examination period by a maximum of one month.

The Agency has the right to reject the proposed investments, if the plan is not submitted within the set deadline or if its compliance with the criteria of necessity, obligation and efficiency has not been demonstrated by the arguments presented.

During the year for which the Investment Plan was approved, the Company has the possibility to modify the plan, submitting a request in this regard, accompanied by the argumentation of the need for these changes, until November 1. The proposed amendment will be examined and approved or rejected by ANRE within 30 days.

The report on the implementation of the investment plan for the previous year is presented by March 31st. The Agency shall examine the Report on the implementation of the Annual Investment Plan for the previous regulatory year and shall approve, for tariff purposes, the value and amortization of the investments made.

4.2 Tariffs for the year 2019

The following table gives the calculation of the tariffs for heat and electricity in 2019:

		Heat	Electricity	Total
Heat production	Gcal	195 916		195 916
Losses + self-consumption	Gcal	42 724		42 724
Heat billed	Gcal	153 192		153 192
Electricity production	MWh		71 000	71 000
Losses + self-consumption	MWh		0	0
Electricity billed	MWh		71 000	71 000
Energy production	MWh	227 262	71 000	298 262
Energy billed	MWh	177 703	71 000	248 703
Gas consumption	1000 m3	19 527	21 235	40 762
Production cost	1000 MDL	105 011	111 359	216 370
Gas purchase	1000 MDL	78 460	85 323	163 784
Other consumables	1000 MDL	1 055	912	1 967
Amortization	1000 MDL	2 569	2 793	5 362
Employees	1000 MDL	16 206	17 624	33 829
Production expenses spread by gaz purchase	1000 MDL	4 016	4 367	8 383
General expenses spread by gaz purchase	1000 MDL	311	339	650
Other expenses	1000 MDL	114		114
Profit Anre	1000 MDL	525		525
Biomass production expenses	1000 MDL	1 756		1 756
Distribution cost	1000 MDL	36 519		36 519
Amortization	1000 MDL	5 326		5 326
Employees	1000 MDL	27 995		27 995
Electricity	1000 MDL	885		885
Material	1000 MDL	1 604		1 604
Other costs	1000 MDL	710		710
Other costs	1000 MDL	527	355	882
Total cost	1000 MDL	142 058	111 713	253 771
Fee	1000 MDL	3 651	571	4 222
Deviation / Adjustment	1000 MDL	41 186	3 822	45 008
Cost + Fee + Deviation	1000 MDL	186 894	116 106	303 001
Heat - Cost + Fee + Deviation	1000 MDL	186 894		186 894
Heat billed	Gcal	153 192		153 192
Heat tariff calculated	MDL/Gcal	1 220		1 220
Heat tariff applied	**MDL/Gcal**	**1 220**		**1 220**
Electricity - Cost + Fee + Deviation	1000 MDL		116 106	116 106
Electricity billed	MWh		71 000	71 000
Electricity tariff calculated	MDL/MWh		1 635	1 635
Electricity tariff applied	**MDL/MWh**		**1 700**	**1 700**

Table 21: breakdown of costs to set tariff levels for heat and electricity

All the figures given in this table are the forecasts used in 2018 for 2019.

The largest cost is by far the **gas purchase** which accounts for **65%** of the total cost for heat and power services.

Forecasts for gas consumption is **6.3 Gcal/1,000 Nm3** is based on a production efficiency rate of 77% which in reality is around 82% for steam boilers.

Forecasts for the heat billed volume in 2019 is 153,192 Gcal, which seems reasonable, compared with actual billed volumes of 150,889 Gcal in 2017 and 166,839 Gcal in 2018.

Forecasts for the electricity billed volume for 2019 is 71,000 MWh, which seems also reasonable compared to the electricity production of 66,067 MWh observed in 2018. Out of this production 53,863 MWh were sold and 12,204 MWh were used for self-consumption.

In the tariff calculations, the total consumptions / expenses for energy production and distribution are divided by the amount of useful energy delivered, so the difference between the quantity produced and the quantity delivered, which is its own consumption and regulatory losses, are recovered by the tariff and price approved by ANRE.

In 2019, auto-consumption was near 12,000 MWh, which is valued near 20 million MDL at the regulated tariff of 1,700 MDL/MWh. **CET-Nord should request ANRE to include the cost for electricity self-consumption into the tariff calculations or to consider the net balance of power energy in the revenues.**

The calculation considers that **52%** of the gas consumption is used to produce electricity. Yet, according to the forecasts, electricity represents only **24%** of the energy production and 29% of the energy billed during that year. It seems therefore that the cost of gas purchase is underestimated in the cost of heat, and overestimated in the cost of electricity.

Costs that can be clearly and directly attributed to the production of one type of energy or another, are automatically attributed depending on the energy produced, and costs that cannot be attributed to the production of electricity or heat (eg administrative expenses) are distributed proportionally to the consumption of natural gas for their respective level of production.

Since the costs are distributed depending on the share of natural gas consumption for the production of e / e and e / t, there can be no cross-subsidization, which is strictly prohibited by the methodology for calculating and approving tariffs.

Distribution costs are taken into account for heat only, which makes sense as electricity is sold in bulk to the electricity network, without any cost related to its distribution.

The “fee” component is calculated on the basis of a margin of 5% on residual asset value for assets acquired before 2004 and 9.8% for assets acquired after. It corresponds roughly to a net asset value of 60 million MDL, which means that around 1/3 of the assets have been built after 2004. However, it is small compared to 640 million stated in the balance sheet. That difference may be explained by asset revaluation which again cannot be taken into account when calculating the fee level.

Deviation accounts for nearly 45 million MDL overall of which 41 million MDL are for heat only. It includes 47 million of deviation minus 6 million of adjustment related to the calculation of profit on new assets. This unusual high deviation is the sum of deviations observed over the past years and which had not been integrated in the tariff yet.

	Heat services	Electricity	Total
Operating cost	142	111	**253 (84%)**
Fee component	3.6	0.5	**4.1 (1%)**
Deviation	41.1	3.8	**44.9 (15%)**
Total	**186.7 (62%)**	**115.3 (38%)**	**302**

Table 22: breakdown of costs used in the tariff calculation for 2019 in million MDL

It should be noted that the tariff set in 2019 also applied in 2020 while the share of electricity in the energy production increased significantly. The deviation also applied in 2019 and 2020 while it was meant to apply only once. It could therefore be expected that the amount of 45 million MDL will be taken back from the tariff calculation for 2021 if rules are to be respected.

The following table compares the tariff 2019 for heat and electricity:

	Heat MDL/Gcal	Heat MDL/MWh	Electricity MDL/MWh	Electricty / Heat
Tariff	1 220	1 052	1 700	162%

The tariff for electricity is 60% higher than the tariff for heat when all the energy is expressed in MWh. This is the result of the distribution of the gas cost between the heat and electricity production costs which is not done according to the quantity of energy produced.

The tariffs for electricity are relatively high, particularly when comparing with the European market which varies between 40 to 70 €/MWh over the same period. On one hand, it creates an opportunity for CET-Nord to quickly improve its financial situation in particular if new gas engines are procured to boost electricity production. On the other hand it may create a risk to lower the profitability of the investments implemented in the PIP (the previous one and the new one) but also to increase the tariff for district heating and further reduce the competitiveness against individual gas heating.

4.3 Actual costs and volumes in 2019

As shown in the table below, the heat production was 11% lower than expected because of warmer weather conditions observed in 2019. Electricity production was in line thanks to the operation of new gas engines which produced throughout the year at the expected pace.

		Forecast 2019	Actual 2019	%
Heat production	Gcal	195 916	175 222	-11%
Electricity production	Gcal	61 207	60 398	-1%
Heat and electricity production	Gcal	257 123	235 620	-8%
Gas consumption	1000 m3	40 762	33 884	-17%
Gas purchase	1000 MDL	163 784	136 018	-17%
Salaries	1000 MDL	61 824	55 275	-11%
Other OPEX	1000 MDL	17 476	30 107	72%
OPEX	1000 MDL	243 083	221 400	-9%
Billing	1000 MDL	303 001	266 674	-12%
OPEX	1000 MDL	243 083	221 400	-9%
EBITDA	1000 MDL	59 917	45 274	-24%

Table 23: comparison between forecast and actual production efficiency in 2019

The gas consumption fell by 17%, significantly more than energy production, due to (1) larger share of new and more efficient gas engines in the production mix and (2) overestimation of gas consumption per heat and electricity production. The following table gives the level of losses and efficiency taken into account for heat production:

		Forecast 2019	Actual 2019
Heat production	MWh	227 262	203 258
Electricity production	MWh	71 000	70 062
Heat and electricity production (a)	MWh	298 262	273 320
Gas consumption	1000 m3	40 762	33 884
Calorific power	kWh/m3	9,48	9,48
Energy equivalent (b)	MWh	386 551	321 322
Losses (b-a)	MWh	88 288	48 002
Losses %	%	23%	15%

Table 24: comparison between forecast and actual production efficiency in 2019

In the tariff calculation, the forecasts for the production efficiency were 77% in 2019 while it was actually 85%. As a result, the cost of gas consumption was overestimated.

Distribution losses observed for heat are slightly below the level of losses in the tariff calculation. As a consequence, the production of heat, and therefore the purchase of gas, is slightly lower, all other things being equal. For electricity, there are no distribution losses both in forecast and actual numbers.

		Forecast 2019	Actual 2019
Heat production	Gcal	195 916	175 222
Losses	Gcal	42 724	37 608
Heat billed	Gcal	153 192	137 614
% losses	%	22%	21%
Electricity production	MWh	71 000	70 062
Losses	MWh	0	0
Electricity billed	MWh	71 000	70 062
% losses	%	0%	0%

Table 25: comparison between forecast and actual distribution losses in 2019

The difference in the gas purchase between forecast and actual data is in line with the gas consumption.

Salaries were overestimated by 11% unlike other OPEX which were much higher than expected but their overall weight in the OPEX is low. As a result, the difference in OPEX is 9%, much lower than gas purchase because it includes many fixed costs that do not vary with the energy production which highly depends on the weather conditions.

Similarly, actual billing was 12% lower than expected billing because of lower heat consumption.

As a result, actual EBITDA was lower by 24% than the forecast. It was still at 45 million MDL, or 17% of the turnover. It reaches 67 million MDL and 22% of the turnover when other revenues are taken into account. This EBITDA including the other revenues is higher than the forecast of 60 million MDL.

4.4 Observations and recommendations

4.4.1 Tariff levels from 2019 to 2021

During the period from 2019 to the beginning of 2021, the tariffs have not been revised.

The analysis provided in the financial and analysis report shows that this tariff allowed CET Nord to improve its financial situation which is quite solid at the end of 2020, with strong EBITDA and cash flow. It should be noted that this result was obtained with a strong increase of sales, and in particular electricity sales which profitability is significantly higher than heat sales.

4.4.2 Annual revision of the tariff

According to the official methodology, tariffs should be revised every year in order to take into account:

- Changes for the upcoming year in the cost of supply, volume of billing and other commercial or technical parameters;
- Corrections for the current year between forecast and actual data.

The process of revision did not occur at the end of 2019. As a consequence, the tariffs for 2020 were the same as in 2019, and was based on assumptions taken at the end of 2018.

In this matter, it should be noted that the tariff for 2019 includes a deviation of 45 million MDL which is intended to compensate deviations in costs observed in the previous years and which had not been compensated yet. This deviation represents 15% of the expected overall revenue and accounts therefore for 15% of the tariff for 2019.

4.4.3 Gas consumption

The forecasts for gas consumption are based on the efficiency of the production unit. For CET Nord, the forecast is 77% in 2019 while it was actually 85%. This means that the cost for gas was overestimated by nearly 10%, all things being equal.

As the cost for gas accounts for 54% in the expected revenue (cost+ fee+deviation), the tariff of heat and electricity was overestimated by nearly 5% as a result.

4.4.4 Billed volume

The tariffs are calculated as the ratio of the expected revenues to the expected billed volumes. The forecasts for the expected billed volumes are therefore as important as the cost, fee and deviation.

The following table gives an example of the impact of difference between forecasts and actual billed volume on the revenue generated by the tariff with 2019 tariff data:

		Heat			Electricity			Total		
		Forecast	Actual	%	Forecast	Actual	%	Forecast	Actual	%
Billed volume heat	Gcal	153 192	138 044	-10%				153 192	138 044	-10%
Billed volume electricity	MWh				71 000	70 062	-1%	71 000	70 062	-1%
Revenue generated from tariff		Forecast	Recalculated	%	Forecast	Recalculated	%	Forecast	Recalculated	%
Gas purchase	1000 MDL	78 460	70 702	-10%	85 324	84 197	-1%	163 784	154 898	-5%
Salaries	1000 MDL	44 200	39 829	-10%	17 624	17 391	-1%	61 824	57 221	-7%
Other OPEX	1000 MDL	11 502	10 365	-10%	5 974	5 895	-1%	17 476	16 260	-7%
Amortization	1000 MDL	7 894	7 113	-10%	2 793	2 756	-1%	10 687	9 870	-8%
Profit	1000 MDL	3 651	3 290	-10%	571	563	-1%	4 222	3 853	-9%
Deviation	1000 MDL	41 186	37 113	-10%	3 822	3 772	-1%	45 008	40 885	-9%
Total	1000 MDL	186 893	168 413	-10%	116 108	114 574	-1%	303 001	282 987	-7%

Table 26: actual and forecast revenues and cost of CET-NORD in 2019

The revenues that must be generated by the tariff can be divided into components which are intended to cover OPEX, depreciation, profit and deviation.

As the actual heat billed volume was lower than the forecast by 10%, revenue was also 10% lower than expected. For example, the tariff was meant to generate 41 million MDL to cover the deviation which compensates deviations observed in the past year. Actually, the tariffs generated only 37 million MDL.

The financial consequence of overestimated billed volume is almost neutral when the revenue is based on a variable cost like gas consumption: In that case, the decrease of revenue is nearly matched by the decrease of the variable cost. This is however not the case for fixed costs which remain unchanged while the revenue that should cover them is lower.

In contrast to heat billed volume, actual electricity billed volume was near the forecast thanks to the new gas engines which were operated late 2019. As a consequence, the expected revenues for electricity were almost met. But the overall revenues for heat and electricity were 7% lower than expected with a loss of revenues of 303-282=20 million MDL.

Tariff setting methodology includes a deviation component that aims at compensating such a loss the following year, when tariffs are recalculated. However, **it creates a temporary cash deficit that the Company may have difficulty to deal with**.

The table below shows that the years 2019 and 2020 were **16%** warmer compared to 2018.

	2018	2019	2020
Degree.days	3,071	2,585	2,598

Table 27: evolution of the degree.days since 2018

It is therefore recommended to be particularly cautious regarding billed volume forecasts, as overestimation will have a mechanical negative impact on the finance of the Company, and any compensation will be received the next year at best. In this matter, it should be reminded that the tariff is sometimes not revised at all despite observed deviations and change in costs and volume.

In addition, it should be noted that **global warming creates a situation where billed volume forecasts based on historical data are generally overestimated**, and should therefore be systematically revised downward to a more realistic level for tariff calculation.

4.4.5 Calculation of the fee (profit)

The fee that is taken into account in the tariff calculation is based on the net asset value according to the following formula: Fee = margin x net asset value

For assets acquired before 2004, the margin is set at 5%. For assets acquired afterwards, the margin is set at 9.78%. These margins may change every year, but ANRE intends to keep a high margin for new assets in order to encourage investments in public utilities. Assets financed by grants are excluded from the calculation of the fee.

It should be noted that the existing and future priority investments programs financed by EBRD will be included in the calculation of the fee. Excluding the grant levels in the financing plans, the fee would be equal to approximately 9.78% x (20-5 million euros), or 1.4 million euros. This fee would decrease over the year with the depreciation of these assets.

It is also worth noting that any revaluation of existing assets is not taken into account in the calculation of the fee.

4.4.6 Deviation between forecast and actual data

Deviation is the difference between the forecast of costs included in the tariffs and their actual level. This difference should be included in the tariffs of the next year.

Deviation may occur for the following reasons:

- Unexpected change of unit cost;
- Unexpected billed volume;
- Unexpected gas consumption per unit of energy billed;
- Unexpected expenses.

Changes in unit cost may result from decisions that are not under the control of the Company, like an increase of regulated gas tariff or legal increase of wages. These changes shall be taken into account into the deviation for the next year. However, changes that result from a decision of CET Nord shall not be included, like an increase of salaries decided by the Company and above what was agreed with ANRE in the calculation of the tariff. In practice, deviation is taken into account when the unit cost change is above or below **3%** compared to the forecast. In addition, unexpected changes in the gas tariffs can be reflected in the tariff in the course of the year, without waiting for the annual tariff revision.

Changes in billed volume have been discussed in the previous section. It affects mostly the recovery of the fixed cost of the Company, with a deficit of revenue if volumes are lower and excess of revenue if they are higher. Fee and deviation are also affected in the same manner.

Gas consumption per unit of energy billed is determined by calorific power of gas, technical losses in the production units, technical losses in network and commercial losses (difference between volume consumed and volume billed.

It was not possible for the Consultant to differentiate the deviation that is generated during the year (by difference between the planned and actual data) from the “historical” deviation due to insufficient tariff levels observed in the past which are today responsible for the gas debt to Moldovagaz.

4.4.7 Arbitration between heat and electricity production

As seen above, the production costs between heat and electricity are shared almost equally in the calculation of the tariff while electricity accounts for only 25% of the overall energy production and 29% of the billed energy volume:

Forecast for 2019 for tariff calculation		heat	electricity	Total	% electricity
Energy production	MWh	227 263	71 000	298 263	24%
Billed volume	MWh	177 703	71 000	248 703	29%
Production cost	1000 MDL	105 011	111 359	216 370	51%

Table 28: forecast for 2019 for tariff calculation

As a result, the cost for electricity is much higher than it should be should the production cost be distributed more evenly, according to the energy production or the production cost. Alternatively, the tariff for heat is lower. As seen above, the tariff was 1,220 MDL/Gcal (w/o VAT) for heat and 1,972 MDL/Gcal for electricity in 2019.

This specificity of the tariffs creates a very strong economic encouragement for CET Nord to modify its production mix towards a stronger share of electricity over heat.

One can anticipate that if the tariffs for electricity are not changed in the near future, the financial performance of CET-Nord will strongly increase.

At present tariff conditions, the production of energy with gas engines seems very interesting.

In late summer 2019, 4 gas engines were installed and started. They were used at their full potential in 2020 and have provided 16% of the heat production.

The tariffs for heat and electricity have not changed, and the impact on the cash flow of CET Nord has been very positive.

However, there is a risk that ANRE takes into account the new cost structure and billed volumes related to the introduction of new gas engines to revise downward the tariffs in the next few years.

4.4.8 Debt service

In the calculation of the tariffs, the debt service, or reimbursement of capital and payment of interests of loans, is not taken into account explicitly. It is meant to be covered by:

- Asset depreciation for the reimbursement of the principal;

- Profit level for the payment of the interests.

Loans are used to finance the acquisition of new assets. Their full cost of acquisition, which corresponds to the amount of the loan and to the capital that must be reimbursed, is indeed included in the tariff progressively through the depreciation of these assets. It should however be noted that the schedule of amortization may not be in line with the schedule of the loan, which may create difficulties in terms of cash flow.

Cost of funding, and therefore payment of the interests of loans, is supposed to be covered by the profit. ANRE calculates the profit as a margin on the net asset value, excluding assets that are financed by grants. As said above, the margin that applies to assets acquired with EBRD funding is 9.8%, which is much higher than the applicable interest rate. For assets which amortization time is shorter than the loan, profit based on asset value will be 0 after full amortization while interest will still have to be paid. In the case of EBRD funding, the interest rate is low and the amount at stake, if any, will be marginal and shall not represent a risk for CET Nord cash flow.

5. Financial analysis of the company

The financial performance of CET-Nord improved in the recent past. Despite warm weather conditions, revenue increased by nearly 25% and reached 330 Million Lei in 2020 EBITDA and cash improved also strongly.

This result was obtained with the strong increase of electricity production due to the utilization of 4 gas engines in the heating season and 1 gas engine in non-heating season. Electricity sales accounts for 50% of CET Nord revenue in 2020 against 30% in 2018, and this should still increase slightly in the future, as electricity production increases in the non-heating season thanks to the development of sanitary hot water supply.

Installation of individual substations and development of horizontal distribution will have a major positive impact on the heat consumption, on the cost and on heat bills.

A major change will also occur in 2021 with a strong decrease of gas tariff, as the “distribution” component will no longer apply to CET Nord.

Due to a large historical gas debt of near 160 million Lei in 2020, which represent half of the Company’s revenue, CET-Nord’s bank accounts are sequestered. Any payment must be approved by the court. This very strong constraint creates many practical difficulties in daily management and considerably limits the development and modernization of CET Nord. In order to solve this issue in a short delay, a loan provided by IFIs seems to be the only realistic option. In this matter, CET approached EBRD for a long-term loan that could be disbursed in 2022. Furthermore, considering the maturity of the EBRD loan (15 years), lower annual reimbursement would result in higher financing resources to pay for capital expenditures in the DH network. It is estimated that around 500 k€ could be reallocated annually in the near future to finance additional investments for individual substations, horizontal networks and replacement of aged section of the heating distribution network.

As a result of the revised tariffs for gas, the cost + fee tariff will decrease in 2021 and in 2022, and increase moderately afterwards. Affordability will improve strongly, with the affordability ratio decreasing from near 10% in 2018 to less than 5% as from 2022. In this matter, it should be noted that affordability of heating for low-income customers is significantly improved by direct and well-targeted public subsidies that cover nearly 50% of the bills of 20% of the customers.

However, the cost + fee tariff is not sufficient to cover all cash requirements and the usual financial targets included into the loan covenants. The financial model shows that the “net debt to EBITDA ratio” is above the limit during the disbursement of the loan and the “debt service coverage ratio” is below the limit at the end of the reimbursement period. A cash deficit appears after in the longer term.

Yet, the cost + fee tariffs are not far from the level required to balance cash and meet financial targets. As there is some flexibility to apply the cost + fee methodology and affordability will remain acceptable, tariffs could be set easily at the proper compliant level.

If the economic environment degrades, in particular, the gas tariffs, the inflation, the financial situation of CET Nord will be affected. The “cost + fee” mechanisms will lead to a tariff increase that will partially compensate for the negative impacts. Moderate additional tariff increase will be necessary in order to balance cash and meet financial targets.

Increasing the tariffs above the level provided by the existing cost + fee calculation will therefore be an issue that could be resolved by including costs that are today excluded (interest rates, losses due to foreign exchange variations, unpaid debt), by raising the fee margin on the net asset value or by creating a new cost component in the form of exceptional adjustments to respond to specific constraints.

The following table shows the income statement and the balance sheets of CET Nord from 2016 to 2020:

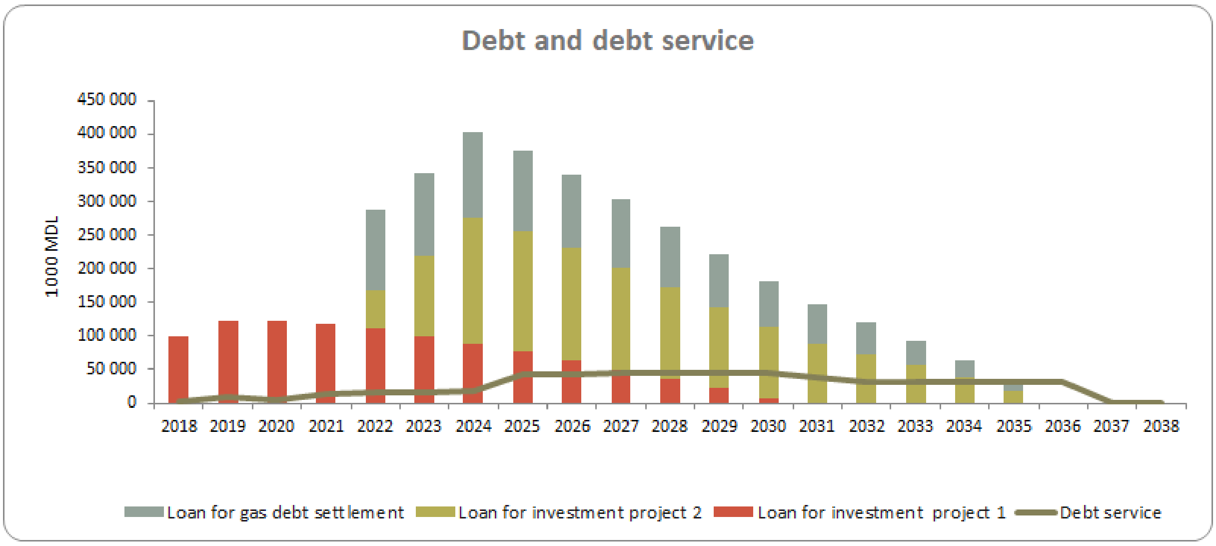
INCOME STATEMENT - 1000 MDL	2016	2017	2018	2019	2020	year-to-year mean dynamics
revenue from sales	245,734	242,069	296,866	268,287	330,095	9%
other revenue	6,851	3,705	10,401	19,690	49,838	94%
total revenue	**252,585**	**245,774**	**307,267**	**287,976**	**379,933**	**12%**
material	- 202,793	- 191,662	- 180,373	- 143,120	- 172,336	3%
salaries	- 40,742	- 42,281	- 45,240	- 45,176	- 51,309	-6%
social charges	- 11,130	- 11,548	- 11,779	- 10,099	- 11,430	-1%
amortization	- 34,751	- 34,947	- 32,801	- 41,124	- 73,869	-25%
other expenses	- 16,031	- 15,454	- 34,071	- 43,516	- 39,304	-34%
expenses related to non-core activities	- 86	- 327	- 971	- 25,621	- 34,518	-763%
total expenses	- **305,534**	- **296,218**	- **305,234**	- **308,656**	- **382,767**	**-6%**
profit	- **52,949**	- **50,444**	**2,033**	- **20,680**	- **2,834**	**-231%**

	2016	2017	2018	2019	2020
*rate MDL/EUR (first of August)	0.0454	0.0472	0.0523	0.0503	0.0513

ASSETS - 1000 MDL	2016	2017	2018	2019	2020	year-to-year mean dynamics
Long term assets	**484,544**	**455,811**	**585,577**	**641,543**	**581,482**	**6%**
material assets	484,313	455,596	585,387	641,263	580,846	6%
non-material assets	231	215	190	280	636	39%
Short term assets	**132,861**	**150,287**	**139,034**	**152,723**	**176,812**	**8%**
stock	12,628	12,717	21,840	32,235	33,904	31%
receivables from customers	108,610	103,017	94,698	92,220	95,278	-3%
other receivables	4,370	25,666	7,127	11,261	3,786	102%
other short term assets	336	1,438	1,304	1,198	1,329	80%
cash and equivaleut	6,916	7,449	14,065	15,809	42,515	69%
Total assets	**617,405**	**606,098**	**724,611**	**794,266**	**758,294**	**6%**
LIABILITIES - 1000 MDL	**2016**	**2017**	**2018**	**2019**	**2020**	
Capital and equivaleut	**277,650**	**239,451**	**275,396**	**363,074**	**281,230**	**3%**
Social equity	117,304	117,304	117,304	117,074	117,074	**0%**
reserve	35,160	35,160	35,160	27,304	27,304	**-6%**
correction over previous years	-	2,252	-	- 169,687	- 94	**inf.**
accrued profit	124,885	84,441	87,916	75,322	- 59,613	**-55%**
other equity	300	294	35,016	313,061	196,559	**3141%**
Long term liability	**153,380**	**167,767**	**242,265**	**176,924**	**227,731**	**14%**
bank loans LT	-	14,387	91,540	110,636	108,158	**inf.**
other long telm liability	153,380	153,380	150,726	66,288	119,149	**5%**
Short term liability	**186,375**	**198,880**	**206,949**	**254,268**	**249,333**	**8%**
bank loans ST	-	1,251	8,718	12,079	13,206	**inf.**
payables to suppliers	176,331	177,209	183,162	206,927	200,210	**3%**
other payables	4,234	10,943	4,705	14,251	17,629	**82%**
Other short term liability	5,810	9,477	10,364	21,012	18,288	**41%**
Total liabilities	**617,405**	**606,098**	**724,611**	**794,266**	**758,294**	**6%**

Impact on debt

The following graph gives the evolution of the debt and the debt service of CET Nord:

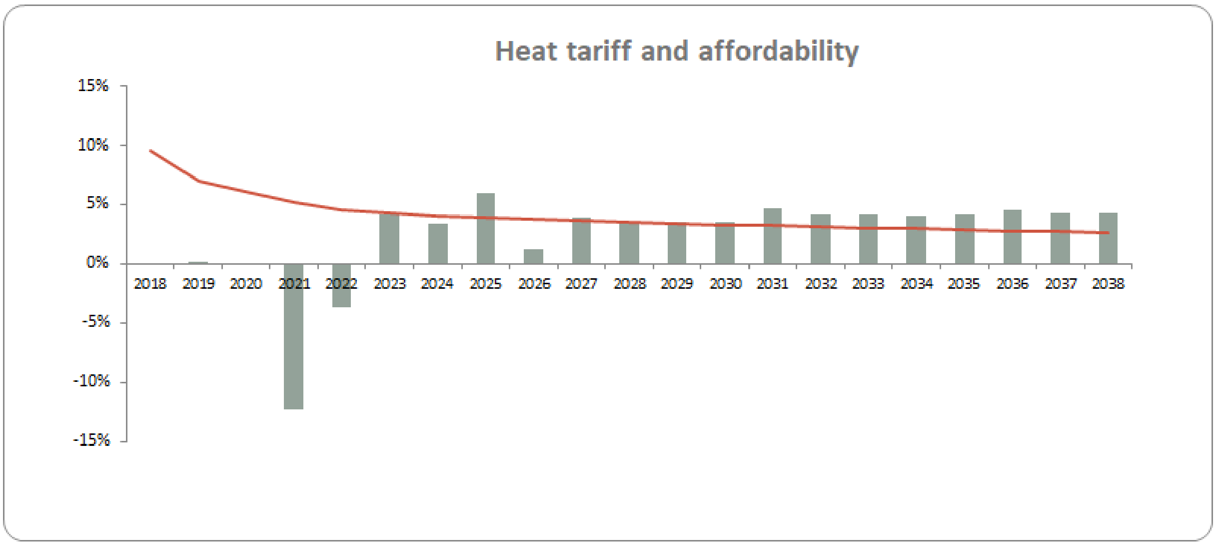


Reimbursements end in 2031 for the first investment project and in 2036 for the second investment project and the loan for gas debt settlement. Debt reaches a maximum in 2024 at 400 million MDL, which can be compared to a revenue and EBITDA near 300 million MDL and 70 million MDL in 2020.

Impact on tariff and affordability

The tariff is set by the regulator ANRE on the basis of cost + fee methodology. Investment programs will drive tariff upward through amortization and fee on net asset value basis for assets. In this matter, tariff calculation will exclude assets financed by grants. It should be noted that interests of loans have no effect on tariffs as they are not taken into account in the cost + fee calculation, unlike the reimbursement of capital. For this reason, the loan for gas debt settlement will also have no effect on tariff.

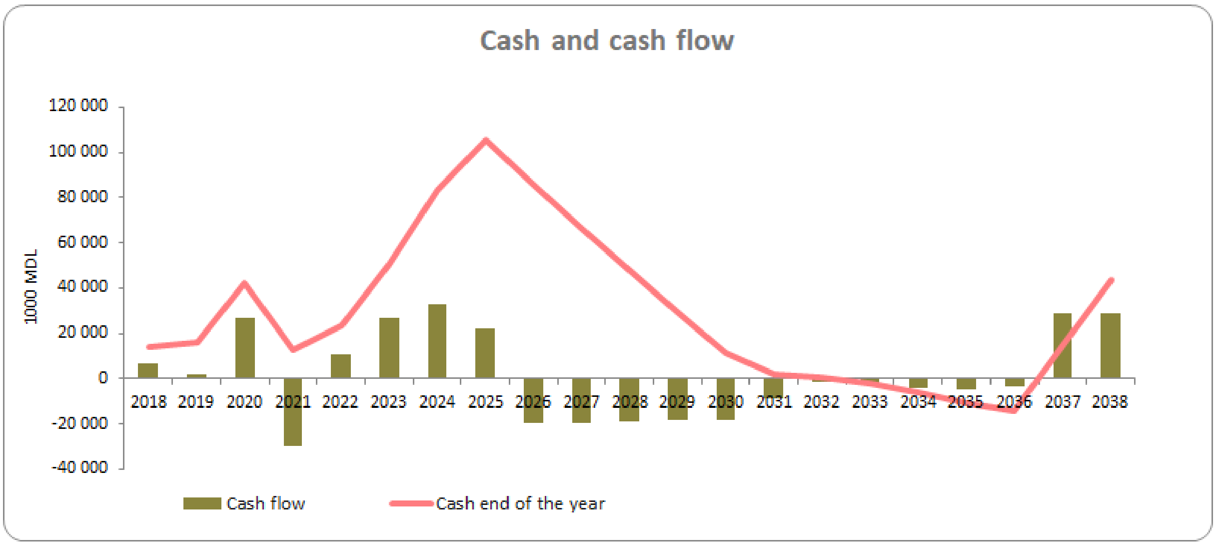
It can be estimated that the 14 million euros investments financed by loans will lead to an increase of cost + fee basis by nearly 300 million MDL spread over 15 years, or 20 million MDL each year (7% of 2020 revenue). This amount will be balanced by the gradual decrease of amortization and asset value of existing assets, and will be spread over billed volume that will increase significantly thanks to higher electricity production. Other factors like evolution of costs, mostly gas and salaries, will affect the tariff. Reduction of individual heat consumption will also drive down gas purchase and heat bills. The following graph gives the expected evolution of heat tariff by Gcal and affordability ratio:



Tariff should decrease in 2021 and in 2022 under the effect of a strong decrease of gas tariff paid by CET Nord. Afterwards, the annual increase should be near 5%. Affordability should improve, with a ratio decreasing from 10% in 2018 to less than 5% as from 2023.

Impact on cash

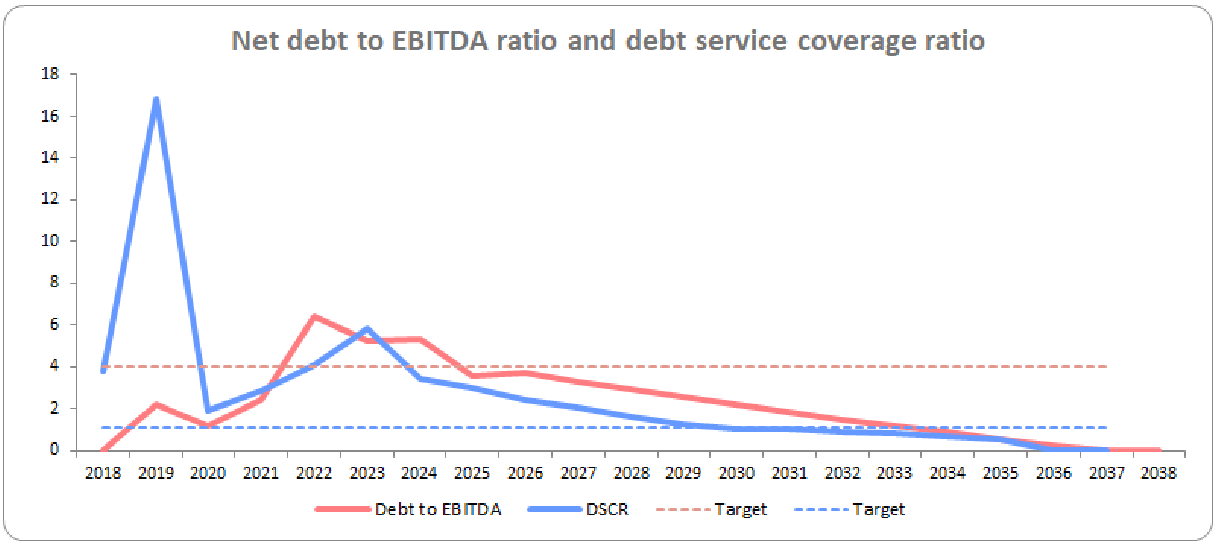
Cash will be affected by the investments program: negatively by the debt service related to the investment projects, nearly 300 million MDL spread over 15 years, and positively by the increase of tariffs related to the new assets. The following graph shows the evolution of cash flow and cash at the end of the year:



Cost + fee tariff leads to a strong increase of cash at the end of the year between 2021 and 2025 when it reaches a maximum near 100 million MDL. Afterwards, cash flows become negative and cash falls slightly below 0 between 2032 and 2036.

Compliance of net debt to EBITDA and DSCR

The following graph gives the net debt to EBITDA and the DSCR with the targets set in the loan agreement:



Net debt to EBITDA is not compliant between 2022 and 2024, when debt reaches higher level. DSCR is not compliant after 2033 when cash available is too low.

Main financial risks

Purchase of gas accounts for nearly 50% of the cost + fee basis. Strong increase of gas tariff is therefore a major financial risk as it would have a strong impact on heat tariffs, on affordability ratio and on collection rate. Increase by 25% and 50% of gas tariff leads to an increase of heat tariffs by 10% and by 20% and a similar reduction of affordability.

Devaluation of MDL against Euro is reflected in the tariff through amortization and fee on assets paid with loans in euro. The impact of devaluation by 25% and 50% is very moderate on the tariff. It is however more visible on cash which degrades significantly because of the increase of reimbursement of loans and payment of interest in euros.

Tariff is set by ANRE which is a state body exposed to pressure from the Authorities. Political and social considerations could therefore lead ANRE to set the tariff below cost + fee, that would create financial difficulties for CET Nord.

It should be noted that these risks are significantly reduced by the positive effects of the programs financed by EBRD. CET Nord financial situation will indeed be strongly reinforced by the reduction of individual heat consumption, by the development of hot water sales, by the increase of customer satisfaction and by the end of legal dispute with Moldovagaz.

Gas debt settlement

CET Nord has a debt of nearly 200 million MDL at the end of 2020, or nearly 10 million euros. As a comparison, the turnover and EBITDA of the Company were 328 million MDL and 67 million MDL in 2020.

This debt includes historical gas debt of 165 million MDL that corresponds to invoices generated before 2015. Since then, CET-Nord has paid regularly and fully gas to Moldovagaz. According to a legal decision, the debt does not bear any interest. All expenditures of CET-Nord must be formally approved by the Court until this debt is fully reimbursed. In practice, CET-Nord prepares every month a plan of expenditures which is submitted to the Court. Payments are executed only if the plan is accepted.

This situation is obviously not comfortable for CET-Nord and strongly limits its ability to make best use of financial resources in order to modernize operations. In this regard, it should be recalled that operations included in the EBRD investment programs are not affected by these restrictions, either for payment of suppliers and contractors or for debt service that is guaranteed by the State.

The following options have been explored to settle the debt to Moldovagaz:

- Repayment of the debt from the internal cash flow
- Increase of tariffs to reimburse the gas debt;
- Bond issuance;
- Long term loan provided by IFIs;

- Short term loan provided by commercial banks;
- State financial support.
- Change in ownership to let Moldovagaz enter into CET-Nord

The pros and cons have been summarized in the table hereafter:

Options	Comments
Short term loan provided by commercial banks	***Pros:* Possibility to contract a loan in Moldovan Lei.** ***Cons:*** Financing conditions are less attractive: ● Loan interest rate (in Lei): ~7% ● Maturity: 4-10 years ● Grace period: no ● Collateral requirements ● Conditionalities of the local commercial bank: unknown before the due diligence is done by the commercial bank
Long term loan provided by other IFIs (than EBRD)	***Pros:* Anticipated better financing conditions than local commercial banks.** ***Cons:*** Lack of prior experience with CET-Nord. Each IFI has requires specific ue diligence which also take time, delaying the historic debt settlement The amount required for the historic debt settlement (~EUR5mln) on its own may be too small for IFIs' interest. IFI's appetite is not tested or confirmed at present stage, and would also impliy delays related to the necessary due diligence by the IFI and uncertainties in the final financing package or conditionalities.

EBRD loan	***Pros:*** **Financing conditions are very attractive and competitive, given Sovereign transaction pricing:** ● **Low interest rate: 1%. Additioonally, it comes alongside a wider project blended with grants and additional concessional financing, making the blended weighted pricing event lower.** ● **Maturity: 15 years** ● **Grace period: 3 years** **No collateral or pledge requirements to the Company, as funding is provided on sovereign loan termsThe Company is already and existing client of EBRD which simplifies the ineratction with the Bank on the new financing package. A technical & financial due diligence on the envisaged Project has already been concluded and Project is ready to be proposed for the Bank's approval shortly.**
Bond issuance	***Pros:*** **Immediate settlement of the debt to Moldovagaz.** ***Cons:*** High cost for transaction intermediation. Expected perceived creditworthiness/credit rating (or rather lack of it) of the Company, which may push the coupon / interest rate up significantly. Lengthy process and to arrange and close bond issuance, plus related due diligence by arranger/lead manager or bond subscribers will translate in implementation (settlement) delays. Realistic achievable tenor and smooth repayment profile is questionable. Little appetite from foreign investors to finance the financial debt of a State owned enterprise in Moldova, while the domestic investors' market is untested and considered to have small appetite. Unlikely to obtain the approval from the agency for state properties. All risks are impossible to be fully estimated at this stage as each lead manager's may have specific requirements for such bond issuances.

Repayment of the debt from CET-Nord internal cash flow	***Pros:*** No need for contracting a new loan. ***Cons:*** Continuation of the existing situation (“Status quo”). High dependency on Moldovagaz which can remain in the future. Lack of autonomy in the financial management which is under the control of Moldovagaz. During that period, CET-Nord will have very little investment capacity while some Company’s assets are in critical need of investments/modernization (upgrading of steam turbine, alternative fuel supply, further deployment of heat substations).
Increase of tariffs to reimburse the gas debt	***Pros:*** No need for contracting a new loan ***Cons:*** The tariff methodology does not allow for increasing the tariffs for debt settlement: it is very likely to be rejected by ANRE. Higher tariffs may also affect Company’s collection rate and increase disconnections.
State aid	***Pros:*** Easy to implement ***Cons:*** No willingness/lack of available funding to finance gas debt from the state budget.
Ownership restructuring Transfer of debt to share in CET-Nord	Loss of control over strategic public assets.

CET Nord generated a large cash flow in 2020 thanks to the non-revised and rather favourable tariffs. If tariffs remain at current level or above, the Company could be able to reimburse 40 million MDL per year on internal cash flow if nearly all cash flow is channelled to this reimbursement. In this matter, it should be noted that CET Nord is committed to reimburse 45.3 million MDL in 2021.

In this regard, it should be recalled that the current regulation does not allow any revision of tariff based on the existence of the gas debt. According to ANRE, deviations due to insufficient tariff in the past years, which are at the origin of this debt, have already been integrated in the tariff, and there is no plan to do more in this area. Any need to generate enough cash to reimburse gas debt will therefore not be taken into account in future tariff revision.

In addition, it should also be taken into consideration that Moldovagaz is seeking a full reimbursement of the debt as soon as possible and is not interested in a reimbursement plan scheduled over many years. For this reason, monthly plans of expenditures approved by the Court are kept as low as possible so that most of internal cash flow is channelled to reimbursement of gas debt.

The possibility of issuing bond or share is very unlikely for a state utility in a country facing strong economic difficulties like Moldova where fiscal deficit has been constantly above 10% in the last years, the same goes with a bank loan, which could be proposed only at a high interest rate (around 7% when expressed in Lei) , with rather short maturity that would expose CET-Nord to some financial difficulties.

State aid does not seem to be a realistic option as Moldova's financial situation is in a state where support from international institutions is much welcome.

The only realistic option that would allow CET-Nord to settle the historic gas debt would therefore be a loan from IFIs.

For this matter, CET-Nord envisages to apply for a loan with EBRD in order to refinance the historic gas debt . Under this scenario, the legal and economic environment would become much more favourable for CET-Nord which would no longer suffer from limitation on bank accounts, administrative and financial scrutiny from Court and pressure with possible new legal actions from Moldovagaz.

As said above, a debt to EBRD is therefore better than the existing gas debt because it will lift practical and legal difficulties that CET-Nord is facing today with Moldovagaz in relation to this debt. The maturity and interest rate of the loan could be such that debt service will not create financial difficulties for CET-Nord.

However, it is worth reminding that the EBRD loans are taken in euro, which will create a risk related to foreign exchange rate variation.

The impact of a devaluation of MDL against euros will grow along with the amounts borrowed in euros, and must be considered. A sensitivity analysis on the exchange rate has been carried out by the Consultant and is provided in the section on financial modelling.

It must also be noted that the debt service corresponding to a loan used to refinancing of the historic gas debt does not correspond to any component of the tariff, unlike a loan used to finance investments. Only the fee component of the cost + fee tariff could be used to set the tariff at a level that will generate enough cash to finance the debt service.

In this regard, it should however be mentioned that the position of ANRE on deviation regarding the years when gas debt was created may also be revised in the coming years. If necessary, additional tariff increase could be implemented on the ground that the deficit due to insufficient tariff during these years was not fully taken into account in the last tariff revisions and that additional deviations should be integrated in new tariffs.

In addition, refinancing gas debt will allow CET Nord to spread this expense over a longer period and could allow it to redirect internal cash flow to investment that will reduce gas consumption. In the present economic condition, up to 30 million MDL per year could be invested in this manner, which would allow the installation of substations and horizontal networks in 70 buildings.

VAT

It is unlikely that VAT applies since international projects have been exonerated so far from VAT. However, should VAT apply (20%), and considering a delay up to 3 months for recovering VAT, this should not put at risk the cash situation of CET-Nord during the project implementation (2022-2024) particularly if the long term loan for the gas debt settlement is confirmed. Forecasts for cash at the end of the year show that the short term needs for VAT payment (up to 10 Million Lei) will still be lower than the cash available in CET-Nord during that period (40 million Lei in 2022 and more in the years to come).

6. Development of the Priority Investment Programme (PIP)

The Priority Investment Program has been developed in several stages and several scenarios were extensively discussed between the Consultant, the EBRD and CET-Nord. The main objectives of the company were to have investments related to demand side management: additional Individual Heating Substations and Horizontal Systems in the secondary network that would enable to implement energy efficiency measures and provide CO2 savings for the Company as well as to reinstate the delivery of sanitary hot water and benefit from the cogeneration mode of the gas engines during summer time.

To this end CET-Nord wishes to give priority to the largest consumers for Domestic Hot Water. That means that most of the district heating system would remain in operation during summertime since those big consumers may be found in different areas in the City. CET-Nord confirmed its wish to get horizontal networks financed for all buildings equipped with IHS (both under the first EBRD project or under the new EBRD project).

A specific budget is also dedicated to:

- the upgrading of water treatment unit
- the purchase and engineering study of hydraulic modelling of the network to optimize its performance
- the development of a monitoring tool and platform to centralize data and modernize the operation of the district heating network

6.1 Investment related to demand side management and domestic hot water

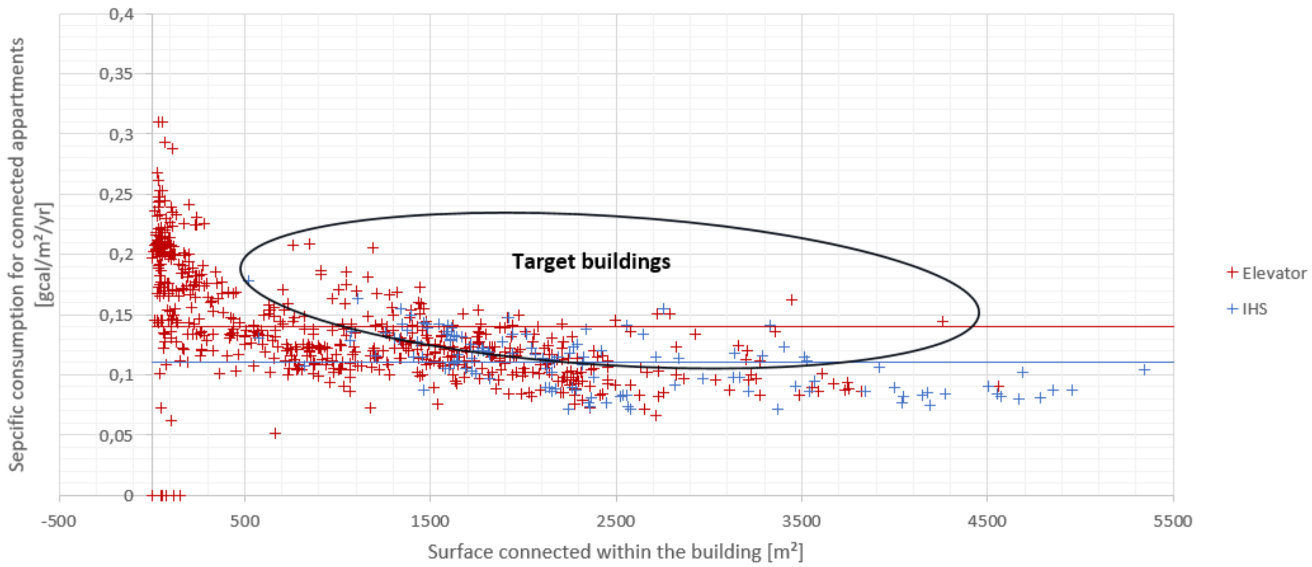
The following **sections** present the technical hypotheses considered for the elaboration of a Priority Investment Programme.

6.1.1 Individual substations

169 IHS have been already financed under the EBRD Project Phase 1. They have been installed in priority in large buildings with the aim of generating higher heat savings. They can be found in different areas of the City regardless of elevation constraints. On the buildings equipped with IHS, energy saving of 6% can be estimated from the commercial data of the Company.

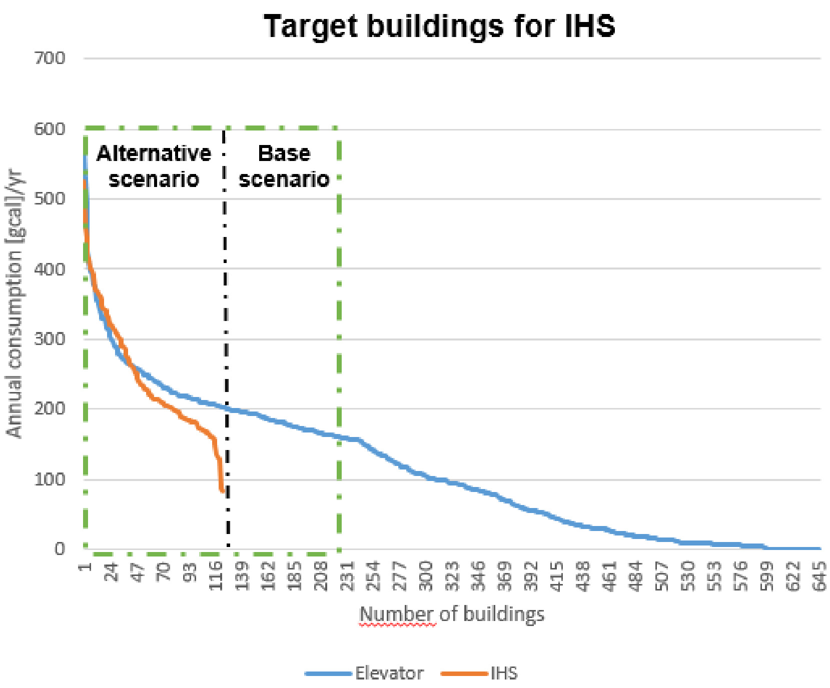
For the future installation of IHS and to maximize its benefits, a focus shall be made on residential buildings that can meet the following criteria:

- **>1,000 m2** of connected heated surface area and (ie with large number of customers)
- A ratio of specific energy consumption **>0.1 Gcal/m2/year**



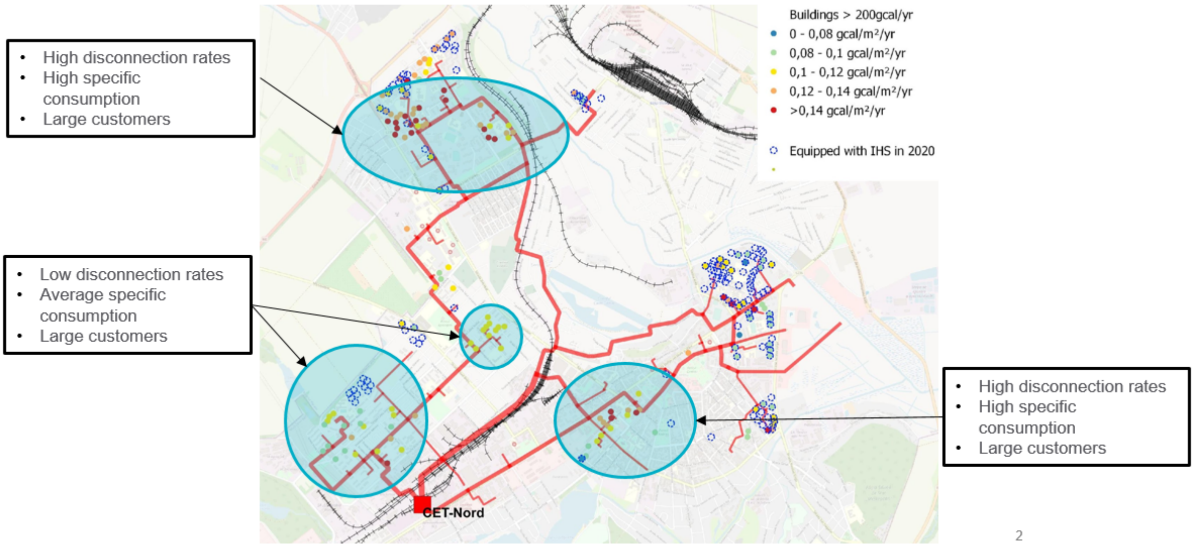
The graph below shows that:

- around 140 buildings with hydro-elevators have a consumption higher than 200 Gcal/year and;
- 240 buildings with hydro-elevators have a consumption higher than 150 Gcal/year.



Graph 31: list of buildings per annual energy consumption with/without IHS

Those buildings can be found on the following areas within the City:



The average cost for Individual Heat substation observed during the Phase 1 project was around **12.8 k€/unit.** As part of this second phase of the project and to take into account the future delivery of domestic hot water (additional heat exchanger) the average cost of a newly installed individual heating substation is 17.4 k€ (including contingencies).

In total, the cost for implementing 166 new individual substations under the PIP is **2.90 M€.**

6.1.2 Horizontal networks

As explained earlier in this report, the experience gained in Balti with 130 buildings under Phase 1, shows that energy savings with IHS in residential buildings should not be higher than 6%.

Theoretical target values sometimes refer to 15% but assume good hydraulic conditions and heat regulation within the secondary system. But in Balti, the secondary network consists of old vertical type networks with an average disconnection ratio between 27% (fully disconnected) to 39% (fully+partially disconnected) apartments leading to significant disbalancing where optimal savings cannot be achieved.

In order to achieve optimal savings with IHS, it is necessary to rebuild secondary systems with horizontal networks. Pilot projects have been conducted in Balti but also in Chisinau. In average, the combination of IHS & Horizontal networks leads to around 20% (0.94x0.9x0.95) of energy savings which can be divided between:

- 6% savings due to IHS
- 10% of additional savings due to elimination of hydraulic disbalancing
- 5% additional savings due to full consumption control by consumers (through Thermostatic Radiator Valves, TRV)

Horizontal networks are expected to provide **15%** of additional savings on top of IHS performance with vertical networks.

However, unlike IHS, a number of preconditions shall be met to allow the deployment of horizontal networks:

- The implementation of horizontal networks requires the formal approval from the association of owners.

The cost for renovation of the heat system into the apartment up to the connection shall be borne by the consumers. It covers : thermo-regulating valves, pipes and radiators. By doing so, the cost for an individual customer is estimated at around 250€/apartment. Such an investment will have a payback of **5 years** for the customer.

Unlike the experience with two pilot buildings in Balti, the cost for individual meters is deemed to be included by CET-Nord into the PIP. Heat meters and domestic hot water meters will be equipped with remote data reading systems. Detailed specifications will be further developed during the preparation of technical specifications to determine the communication infrastructures to be used (radio communication to a concentrator before sending a group of data by GPRS network,..).

The cost for developing horizontal networks is estimated at 326 €/apartment and covers here the cost for supply of horizontal networks for space heating and domestic hot water as well as the cost for individual heat meters. It does not include the cost for TRV and radiators which are deemed to be paid directly by the end user.

In total, the cost for implementing horizontal networks under the PIP in 22,281 apartments is **7.25 M€.**

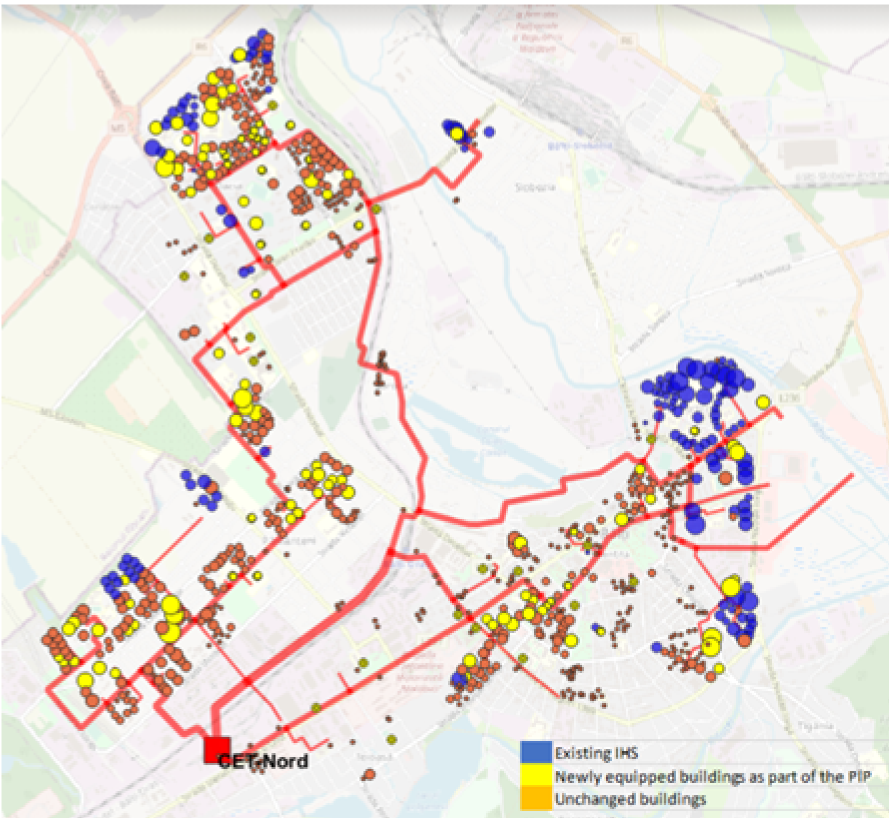
6.1.3 Domestic Hot Water

In order to calculate the thermal load of the reinstatement of domestic hot water service the following hypothesis are taken :

- A household consumes on average 100L per day of hot water (based on a ratio of 2.2 inhabitants per apartment)
- It is necessary to heat water from 10°C (cold water from drinking water network) up to 55°C
- Internal losses within the buildings are considered to increase the total energy needs by 50%

The selection of buildings to be equipped with horizontal networks has been driven by the potential for DHW sales.

The list of addresses can be adjusted during the preparation of tender books. The size of residential buildings is the criteria used to select the buildings across the City. The number of buildings has been determined so that the overall budget for PIP does not exceed 11.5 M€. The buildings selected for DHW can be found on the map below.



The 296 buildings sum up 22,281apartments which include 16,909 apartments that are already served with space heating during the heating season.

The supply of domestic hot water during summer period will be done by using 85% of the total network length that will enable to minimise the losses by radiation.

6.1.4 Thermal losses in the network

During the heating season, the Consultant assessed the impact of the increase of the temperature law to supply domestic hot water to customers. In order to be above the pinch temperature of the heat exchangers and be able to supply hot water at 55°C for the customers, it is necessary to maintain the temperature chart (temperature of the supply pipe) to a minimum level of 65°C in the distribution pipe when the outside temperature is above 5°C.

During the heating season and considering the typical meteorological year, an increase of the heat losses by 4% (ie +1,300 Gcal compared to the current situation) is considered.

During the non-heating season and to be able to deliver heat for the domestic hot water supply, it is considered that 85% of the total length of the network will be necessary. The temperature law will be maintained constant at 65/45°C. Considering the current average diameter and age of the network, a linear coefficient of heat losses of 55kW/km has been estimated by the Consultant and CET-Nord technical department.

Under these hypothesis, the thermal losses during non-heating season are estimated to be constant at 3.8 Gcal/h (ie 18 108 Gcal over the non-heating season)

6.2 Impact of the Project

A comparison has been made between the scenario without the Project and the scenario with the above PIP in terms of energy but also in terms of revenues and CO2 impact. Then a new economic analysis has been performed to quantify the benefit of the Project.

6.2.1 Energy savings generated by demand side management investments

Energy savings will be achieved with the supply of new IHS in 166 buildings and the implementation of new horizontal networks in 296 buildings:

As mentioned earlier in the draft final report, the savings can be estimated as follows:

- 6% of savings on the annual energy for space heating due to the IHS installation
- 10% of additional savings on the annual energy for space heating due to elimination of hydraulic misbalancing
- 5% additional savings due to full consumption control by consumers (through Thermostatic Radiator Valves, TRV)

The energy consumption for space heating for the selected buildings has been taken from the customer database for the Year 2019 and then adjusted to the normative year set for 2,750 degree.days:

Buildings	Number	Energy consumed in 2019, Gcal	Adjusted energy consumption for a normative year, Gcal	Savings due to demand side components	Savings in energy consumption, Gcal	Average heat load saved, Gcal/h
With new IHS	166	40,896	46,860	20%	9,372	2.1
With existing IHS	130	31,732	36,359	15%	5,454	1.2
Total	296	72,628	83,219	17.8%	14,826	3.3

The demand side investments in the project intend to generate 14,826 Gcal/year of energy savings which represents an average load reduction of 3.3 Gcal/h during the heating season. Those savings represent 17.8% of the energy consumed by the population covered by the PIP for space heating.

6.2.2 Heat losses generated by the supply of domestic hot water

The technical losses are calculated based on the temperature chart of the heat distribution network and the size of the network.

The temperature chart during the heating season depends on the outside temperature. However, when Domestic Hot Water is served during the heating season the temperature in the distribution network shall be raised to 65°C in minimum. An estimate of an increase of the losses during the heating season by 4.3% is considered (due to higher losses by radiation).

Outside the heating season, when the distribution network (supply/return) operates at 65°C/45°C, the average ratio of technical losses is 55 kW/km. The length of the distribution network is 96.5 km but we consider only 85% of this total length is operated (ie 82 km). As a consequence, the technical losses during the non heating season amount to 18,108 Gcal. As explained later in this note, 3 gas engines shall be operated at their full capacity to supply 16,909apartments with DHW. Under this configuration, there should be no vented losses. Additional stop and starts of the 4th gas engine shall be planned in order to meet the energy requirements of the network (on average 3,3 gas engines will be needed).

To compare, today 2 residential buildings and 2 non residential buildings are supplied by one gas engine which means that 99.8% of the heat energy is lost. Part of that energy is lost by radiation in the distribution network which has been isolated from the rest of the DH network and the rest is vented loss to the atmosphere.

	During the Heating season	Off the heating season	During the Heating season	Off the heating season
Configuration	Without new customers for DHW (current configuration)		With new customers for DHW (configuration after PIP implementation)	
Heat losses, Gcal/year	32,000	12,818	33,318	18,108
Heat losses, Gcal/year	44,818		51,426	

Heat losses will rise globally by 15% during the two configurations mainly driven by an increase of losses during the summer period and marginally during the heating season due to the increase of temperature law.

6.2.3 Heat Production

During the heating season, heat production has been calculated using the standard pattern for 2750 degree.days;

The heat pattern after the project implementation has been determined considering:

- Energy efficiency measures with the installation of IHS and horizontal network will reduce the heat consumption by 3.3 Gcal/h on average during the heating season.
- Supply of domestic hot water will increase the heat demand due to higher losses (+0.3 Gcal/h during the heating season and +1.13 Gcal/h off the heating season) and increase the heat consumption (+4.76 Gcal/h in average) all year round.

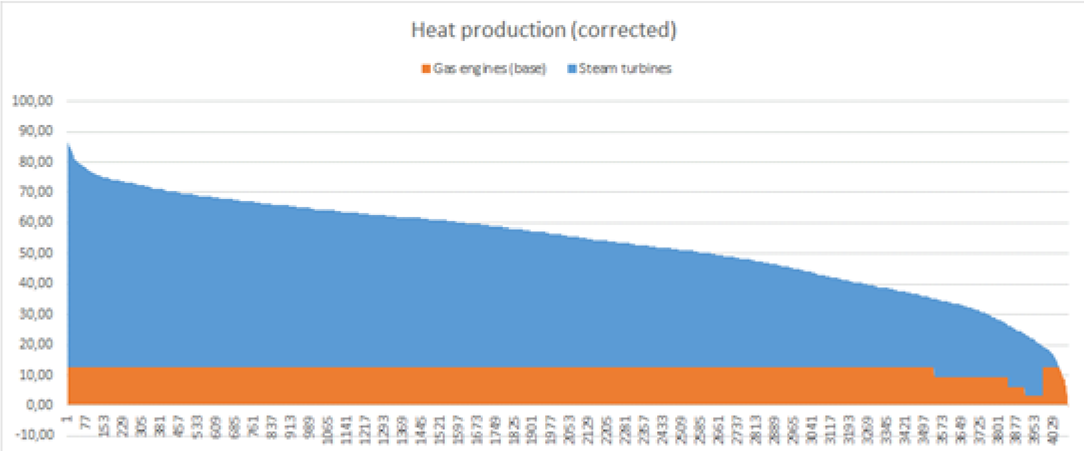
Number of apartments served with DHW	16,909
Daily consumption, in liter per apartment	100
Water temperature	10°C/55°C
Internal heat losses (looping)	50%
Total heat consumption for DHW, Gcal/day	114
Average heat load for DHW, Gcal/h	4.76

The energy consumption will increase by 26,176 Gcal/year as explained hereafter:

Net increase of consumption, Gcal/year	**+ 26,176**

Decrease in consumption due to IHS+horizontal networks, Gcal/year	- 15,477
Increase of consumption due to DHW, Gcal/year	+ 41,653

After the project implementation, the overall heat demand will amount to 188,998 Gcal during the heating season. It increases by 3.1% the heat consumption –during the heating season- before the project is implemented (for a normative year of 2750 degree.days).



The breakdown of production between gas engines and steam facilities has been set considering:

- The facilities should run so that the load should be not less than 50% of their nominal capacity.

	During the Heating season	Off the heating season	During the Heating season	Off the heating season
Configuration	Without new customers for DHW (current configuration)		With new customers for DHW (configuration after PIP implementation)	
Heat production from gas engines, Gcal/year	41,589	12,844	42,047	41,407

Heat production from steam facilities, Gcal/year	140,472		145,393	
TOTAL heat production, Gcal/year	**182,060**	**12,844**	**187,440**	**41,407**
TOTAL heat production, Gcal/year	**194,904**		**228,847**	

The annual heat production will increase by 17% (33,942 Gcal)

6.2.4 Electricity production

As shown in the earlier section, the placement of means of production between gas engines and steam facilities will determine the level of electricity production.

	During the Heating season	Off the heating season	During the Heating season	Off the heating season
Configuration	Without new customers for DHW (current configuration)		With new customers for DHW (configuration after PIP implementation)	
Electricity production from gas engines, MWh/year	50,403	15,560	50,956	50,163
Electricity production from steam facilities, MWh/year	46,677	-	48,312	-
TOTAL electricity production, MWh/year	**97,080**	**15,560**	**99,268**	**50,163**
TOTAL electricity production, MWh/year	**112,640**		**149,430**	

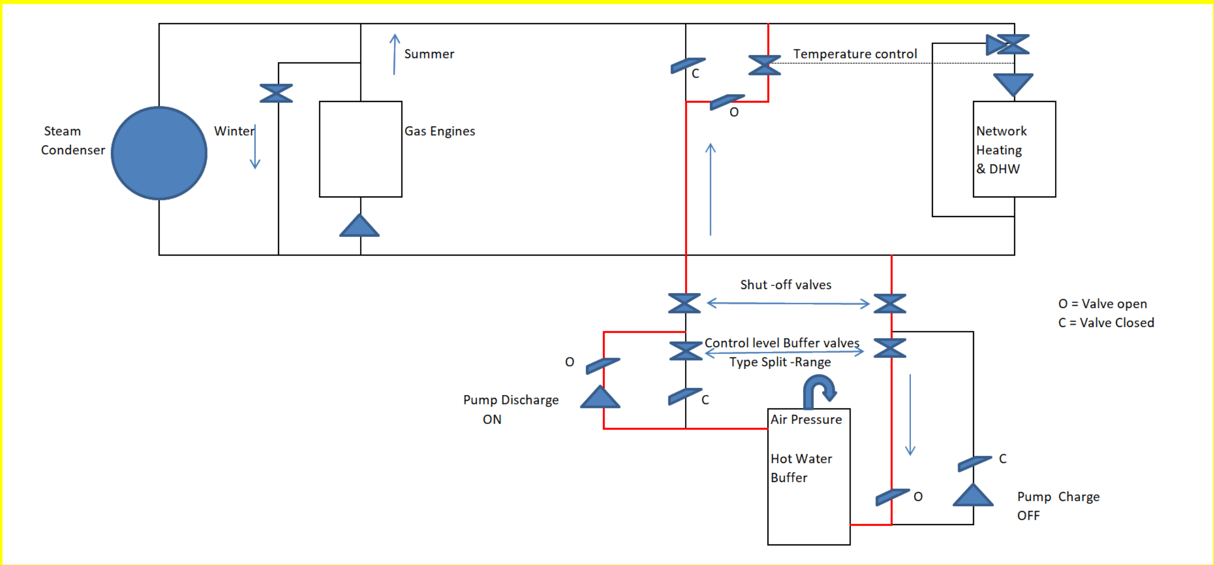
Since gas engines have a much higher ratio for electricity production compared to steam facilities, the 3 gas engines that operate during the 6.5 months off the heating season are responsible for the significant increase of electricity: +32% (36,791 MWh).

6.3 Heat storage facilities

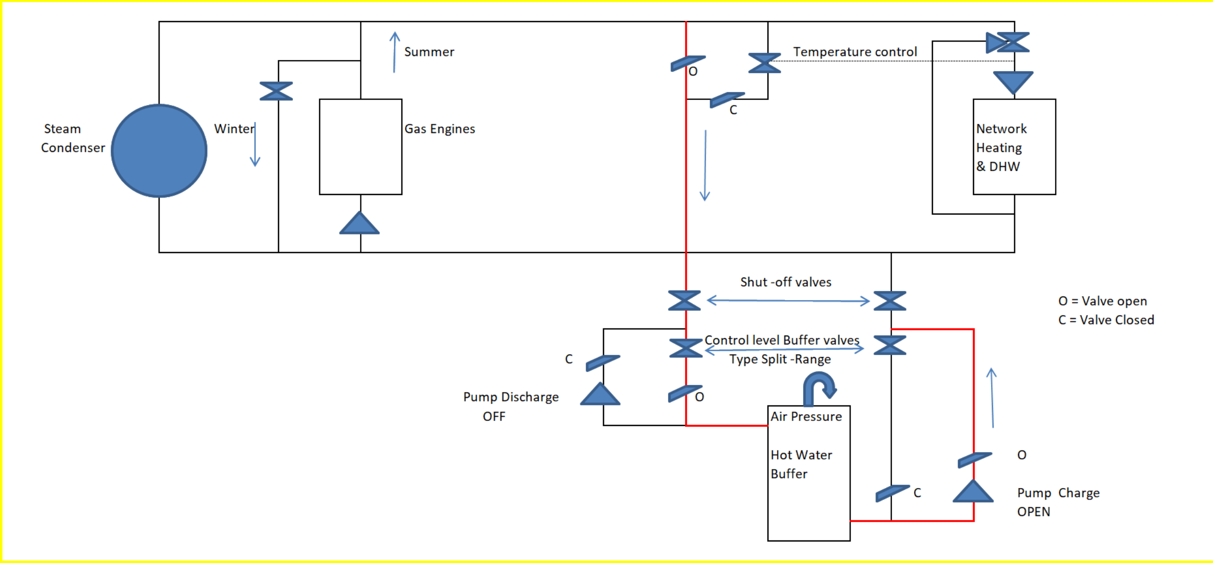
Two valves located on the by-pass of the supply pipe are controlled by temperature sensors which can be located on the return pipe at the inlet of the gas engines (before the dry cooling system). Alternatively, the valve can be set by a clock (if the consumption pattern is predictable).

Depending on the configuration, the heat storage tank will be charged or discharged with hot water:

1) When the temperature in the DH network is too low: the heat storage tank discharges hot water (from the top) to the supply network while colder water from the return system charges the tank.



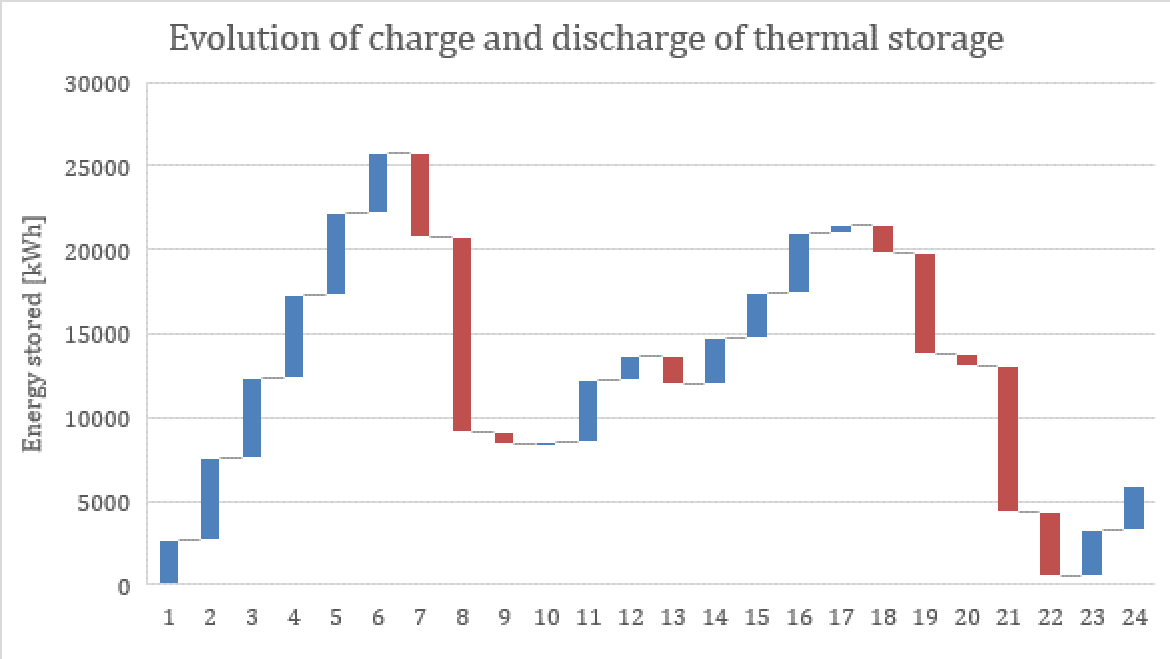
2) When the temperature is too high: the valve opens to fill the tank with hot water (from the top of the tank). At the same time colder water is discharged (from the bottom of the tank) to the return network.



In order to make savings, it is recommended to use the heat storage tank under atmospheric pressure (the thickness of walls is lower). To do so pumps are necessary to supply hot or cold water into the distribution network. Regulating valves control the level of water into the tank.

The geometry of the tank should meet the minimum ratio height/diameter of 1.5 between to offer good stratification of temperatures in the system.

The sizing of the heat storage has been determined on iterative calculations of the storage capacity so that the hourly charge/discharge volume of energy is addressed to meet the fluctuated energy demand for DHW of the 16,909 new customers in summer. The calculated energy capacity has been determined to 25,000 kWh. The nominal capacity has been set to 30,000 kWh. Considering a difference of temperature of 40°C (85°C/45°C), the storage volume is therefore 645 m3. For the PIP, a volume of 700 m3 has been proposed.



In total, the cost for implementing new heat storage facilities of 700 m3 under the PIP is **0.58 M€.**

6.4 Water treatment

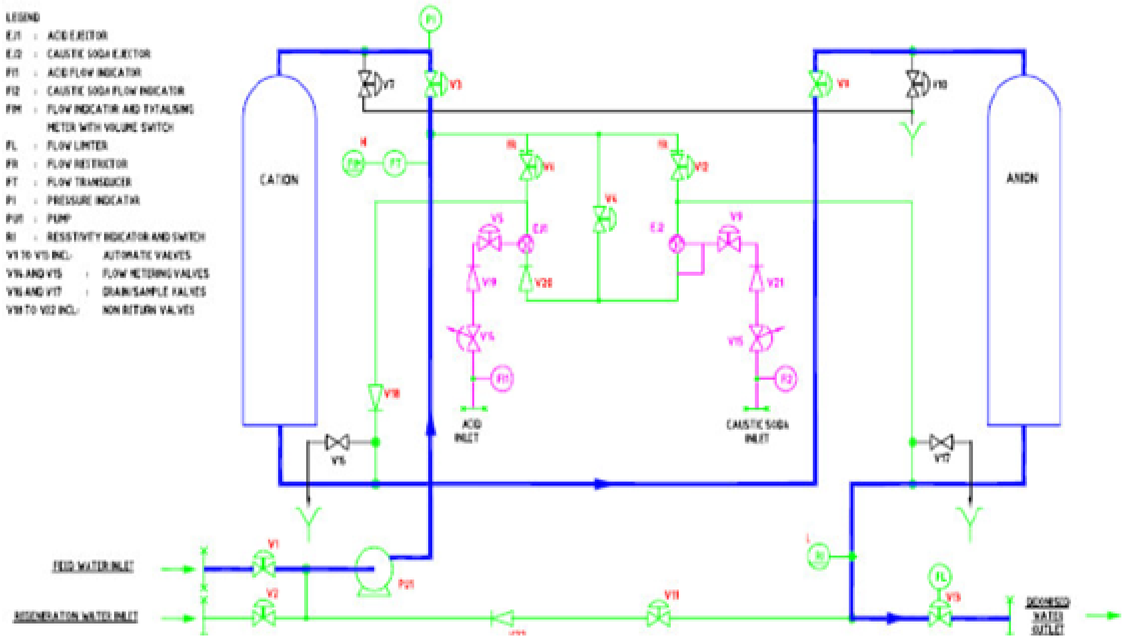
As shown in the technical diagnosis, the water treatment facilities are ageing and oversized. They are still efficient and the general process does not need to be reviewed.

The main purpose of this component is to increase automation of the treatment, deliver high quality water to meet with steam production and feed-in water requirements as per Moldovan norms and current ingoing water quality.

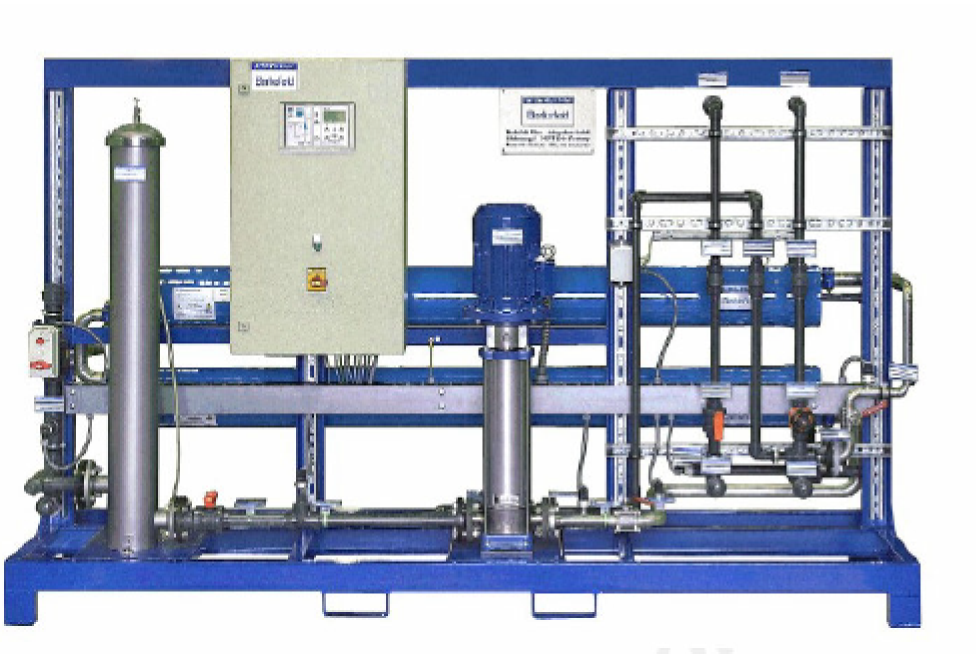
The level of purge for water treatment is high and a decrease of purge can be planned thanks to the upgrade of the water treatment system.

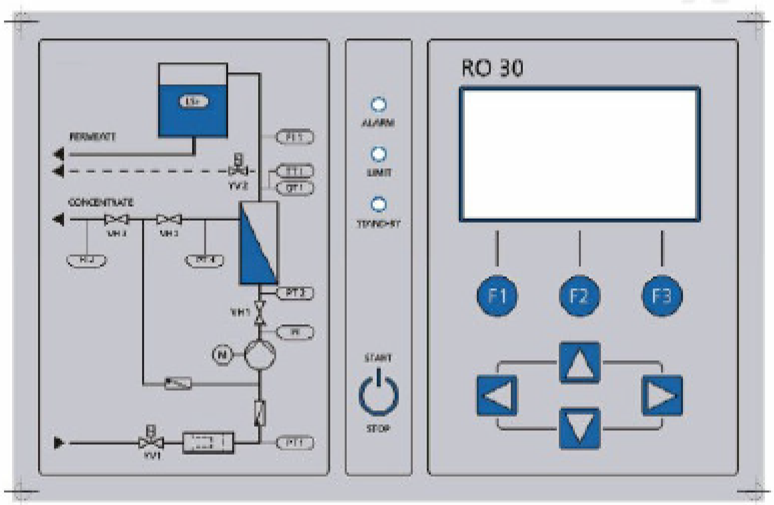
Two treatment units will need to be sized for the PIP:

- Treatment unit for softened water to be used as feed-in water in the network: the needs are estimated to range between 12 and 15 m3/h. To avoid scaling in the network due to the presence of Ca^{2+} and Mg^{2+} cations at high temperature. A capacity of 20 m3/h seems sufficient to cover the needs for make-up water (currently 5 m3/h but the system could further expand in the future).



- Treatment unfit for demineralized water to be used for steam production: the needs are estimated to range between 7 to 10t/h with the current water quality level (the ratio of steam purges will go down from 8% to 4%). The impacts of such installation will decrease the level of purge and thus reduce the water consumption for steam production. It can be planned that a reverse osmosis process will meet this requirement: 2 units of 10 ton/h.





In total, the cost for implementing new water treatment facilities under the PIP is **0.42 M€.**

6.5 Digital tools for smart District Heating network

In order to efficiently operate these investments and expand the modernization of the company, new digital tools have been proposed as part of this PIP.

The general objective of this component is to:

- Improve the monitoring of the network
- Improve the quality of service by automating the identification of pressure drops and inadequate temperatures

- Develop tools and methodology to modernize the network and benefit from all the investments to adapt heat demand and heat and electricity production.

6.5.1 Development of a supervision system

While some elements of the network have been –locally-automated during Phase 1 of the project (Gas engines, IHS) and a data remote collection system installed on a number of meters, there is currently no central remote control and monitoring system in place in the CET-Nord JSC network.

Without adequate monitoring systems reporting real time information back to a central interface, it will be difficult to efficiently operate the DH system, and particularly when the number of IHS deployed across the City will increase.

The installation of a remote control and monitoring system shall enable the CHP to get the following benefits:

- Automatic load regulation according to heat demand fluctuations.
- Better temperature regulation in the system to reduce heat losses;
- Increase the quality of service by monitoring that the operational parameters are under the set levels (supply temperature in secondary network).

The main purpose of the implementation of automation and control (SCADA) is to ensure continuous optimization of the heat-generating equipment and efficient remote control and management of district heating plants and systems in real time. The results are higher system efficiency, longer technical lifetime of the equipment and improved productivity of employees. In addition, the Company's management and administration will have easy access to comprehensive and consistent data from the SCADA system that can be used to make targeted decisions about maintenance, improvements and investments.

Part of the SCADA system, remote data collection systems shall be deployed over the buildings in order to detect rapidly any issues (temperature problem, disconnection) and be able to intervene to restore a quality service (e. g. quickly rebalance a building network after a disconnection).

CET-Nord intends to deploy this system on the distribution network and exclude the production part.

The system shall have the capacity to:

- Connect to the existing instrumentation at the pumping station and monitor hydraulic parameters (Tsup, Tret, Psup, Pret, Flow)
- Gather and process information from sensor's in the network: additional sensors should be deployed to have online monitoring systems (Tsup, Tret, Psup, Pret at critical hydraulic points of the network)
- Gather and process information from the substations currently recorded by the heat meters (energy invoiced, breakdown between space heating and sanitary hot water)

A system will have to be chosen to store and process all time-series data for District Heating Network and consequently constitutes the foundation for Smart monitoring system project.

A follow-up in real time of key indicators will enable us to minimize energy cost. Alarms above KPI thresholds could be automatically set up.

This component will consist in:

- An engineering phase about the needs assessment for the company and the assessment of available data and instrumentation on the network (estimated at 6 man/months).
- The definition of the instrumentation needs and IT architecture of the future system (possible communications between the components)
- The definition of the indicators to follow (principles of calculations, data source….)
- The supply and installation of the system: several systems can be purchased as part of a tender after the definition of the specifications.

An estimate of the budget of this component is 250k€ which covers both supply of equipment (mainly sensors/meters and communication modules, IT central database and software for processing data) and installation.

In total, the cost for implementing a SCADA for the heat distribution network under the PIP is **0.25 M€.**

6.5.2 Development of a hydraulic model

CET-Nord JSC does not have a digital database of their network and relies on hard copy drawings which do not give an overview of the complete network. Census of infrastructure and digitization of maps is ongoing.

The hydraulic modelling of the system will allow optimal selection and sizing of the equipment during rehabilitation: optimal diameters of the pipes during DH network rehabilitation (in a lot of cases such diameters will be lower than currently applied); optimal selection of the equipment due to hydraulic modes of the DH System (selection of the parameters of pumps, boilers, IHS and other equipment); detection of the conditions for new customer’s connection.

In addition, hydraulic modelling will allow optimizing hydraulic modes of the current networks (e.g. balancing of the network by detection of optimal places for installation of pressure drop equipment).

The functionality of the simulation tool enables calculating in each pipe of the network:

- Temperature.
- Pressure.
- Velocity.
- Mass and volumetric flow.
- Pressure losses

- Thermal losses
- Balance of the energy sources.
- Several types of simulation:
- Static (analysis on one single load at each simulation)
- Dynamic (analysis over several hours/days/months)
- Accounting for network inertia and transportation time
- Allowing analysis of different control set points (temperature and pressure supply)
- Real time: dynamic mode connected to SCADA values

The implementation of such project can be done in several steps :

- **Level 1 : Off-line analysis :**
    - Network path : Pipes layout (diameters, roughness, single losses, lengths)
    - Customer loads : Model for consumer loads
    - Energy metering : Calculating power loads and extrapolation function of outside temperatures
    - Installed / subscribed power : extrapolation function of outside temperatures
- **Level 2 : Integrating measured data in order to optimize network operation and design**
    - Better understanding on operation of the network
    - Define more precisely required pipe size, pump capacity
    - Define temperature supply curves,
    - Define set point for network pumps
    - Define which unit should produce and when
- **Level 3 : Integrating real time data in order to optimize network operation real-time (not included into the PIP at this stage)**
    - Get accurate view of network current state to manage operation schemes
    - Which unit depends on outside temperature/hour of the day?
    - Need to isolate some parts of the network to save energy on pumps?
    - Get real-time best value for supply temperature
    - Get real-time set point for network pumps according to:
    - Load prediction (thanks to Weather forecast),
    - Current state of the network,

- Constraints on plants (max flow, temperature, pressure)

As part of this PIP, Level 1 and 2 are considered through the purchase and training by the supplier of the software.

To reach level 3, it is advised that CET-Nord hires technical assistance to set up the accurate parameters in the thermal modelling. It should be done along the development of a planning department within the Company.

In total, the cost for supplying a hydraulic model under the PIP is **0.087 M€.**

6.6 CONCLUSION

The breakdown of the Priority Investment Program is provided hereafter:

Items	Unit	Quantities	Unit Price, €	Amount, €	EBRD loan	Green Climate Fund loan	EBRD Grant
Supply and Installation of IHS	Building	166	17,472	2,900,352	2,900,352		
Construction of horizontal networks in buildings	Apartment	22,281	326	7,254,585	4,254,585	1,000,000	2,000,000
Construction of Heat storage (700 m3)	m3	700	840	588,000	588,000		
Upgrading of the water treatment facilities for the steam (2x10 ton/h) and network's make-up water (20 m3/h) production	n.a.	1	420,000	420,000	420,000		
Implementation of a SCADA for heat distribution	n.a.	1	250,000	250,000	250,000		
Supply of a thermo-hydraulic model	n.a.	1	87,063	87,063	87,063		
Total				**11,500,000**	**8,500,000**	**1,000,000**	**2,000,000**

Different sources of funding can be mobilised here: a combination of grant sources as well as soft loans from the Bank and the Green Climate Fund loan.

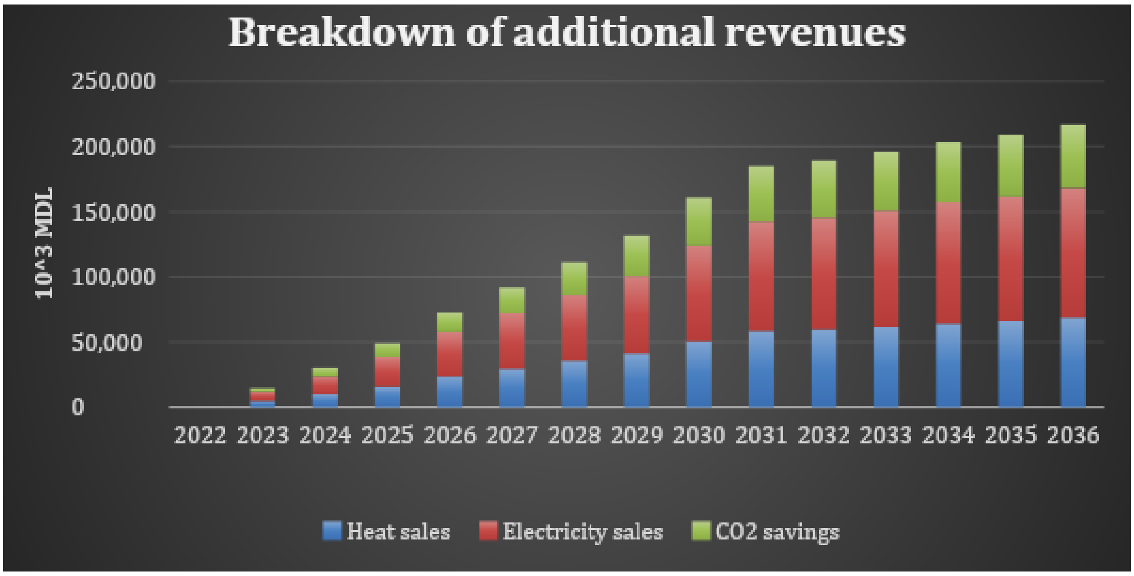
The horizontal networks and individual heat substations are the investments that most contribute to energy savings and consequently to the reduction of CO_2 emissions. The Green climate fund loan could contribute to finance those components.

7. Economic analysis of the PIP

The economic analysis has been conducted. It is based on the following hypotheses:

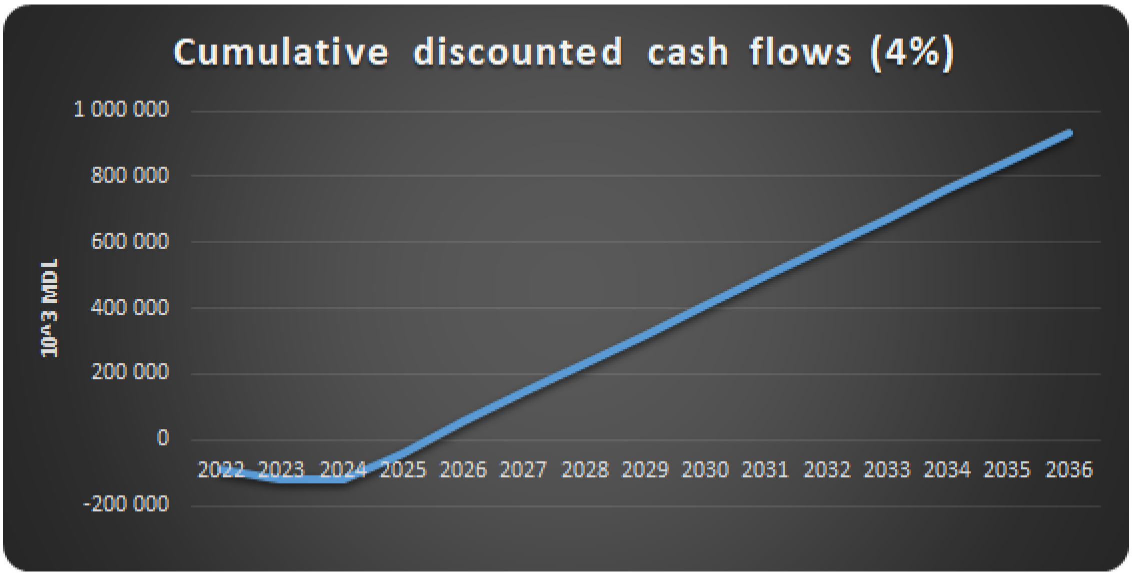
- The investment program (166 new IHS and HN for 296 buildings, one storage tank of 700 m3) is implemented over 3 years (2022-2024).
- Customers (only those already served with central space heating) receive Domestic Hot Water when horizontal networks are built. 16,909 customers receive DHW after three years.
- The production efficiency is supposed to be constant over time: 88% for the gas engines and 82% for the steam facilities.
- Gas price, tariffs for heat and electricity are slightly increasing over the project period (15 years) as shown in the table below.
- CO_2 savings are given a revenue equivalent based on the rate expressed in €/tCO_2 starting from 49€/tCO_2 in 2021 and 75€/tcO_2 in 2030.
- The gas engines are expected to operate for approximately 120,000 hours each. Considering the gradual connection of Domestic Hot Water, the overall operating time of the 4 gas engines will not exceed that level before the end of the project period. No provision has been considered in the economic analysis for replacement.
- The revenues calculated here are the additional revenues generated by the implementation of the above program (electricity and domestic hot water sales) plus the revenues equivalent from CO_2 savings.

- The graph below shows that electricity is the main source of revenues (46%) for the supply of Domestic Hot Water. CO_2 savings become the second largest source of revenues (21%). In the end, heat sales for DHW represent only 33% of the revenues.



As a consequence of the provision of domestic hot water, gas consumption is by far the largest operating cost.

When considering all the components of the PIP, the analysis of discounted cash flows over the period gives a Net Present Value of 935 Million MDL and a payback period of 4 years (2024). The Economic Internal Return Rate is good: 45%. The IRR which does not take into account the value of CO2 savings with 29% and a payback period of 5 years is still acceptable taking into account the funding conditions.



The analysis is based on the following hypotheses:

- The rise of temperature of the supply heat pipe during the mild season (when the outside temperature is above +5°C approximately) due to Domestic Hot Water will not lead to new disconnections of customers that do not benefit from regulating devices (IHS and Horizontal Networks).

- All the 166 buildings will approve the retrofitting of networks for horizontal networks and will also be able to bear the cost for renovation into their apartments (250 €/apartment).
- CET-Nord will actively promote an intense commercial activity to get all the potential 16,909 customers served with domestic hot water.

Sensitivity Analysis

A sensitivity analysis has been performed to assess the impact of variations (+/- 20%) of the following key parameters on the EIRR around the base case scenario: tariff levels, capital expenditures, gas price, price for CO2.

		EIRR
Base Scenario	0%	45%
Tariff levels	20%	56%
Tariff levels	-20%	34%
Capital expenditures	20%	37%
Capital expenditures	-20%	56%
Price of gas	20%	41%
Price of gas	-20%	49%
Price of CO2	20%	48%
Price of CO2	-20%	42%

The analysis shows that there is no “instability” in the calculation of EIRR: the impact is roughly linear with the variation of the key parameter.

8. CO2 AND WATER SAVINGS

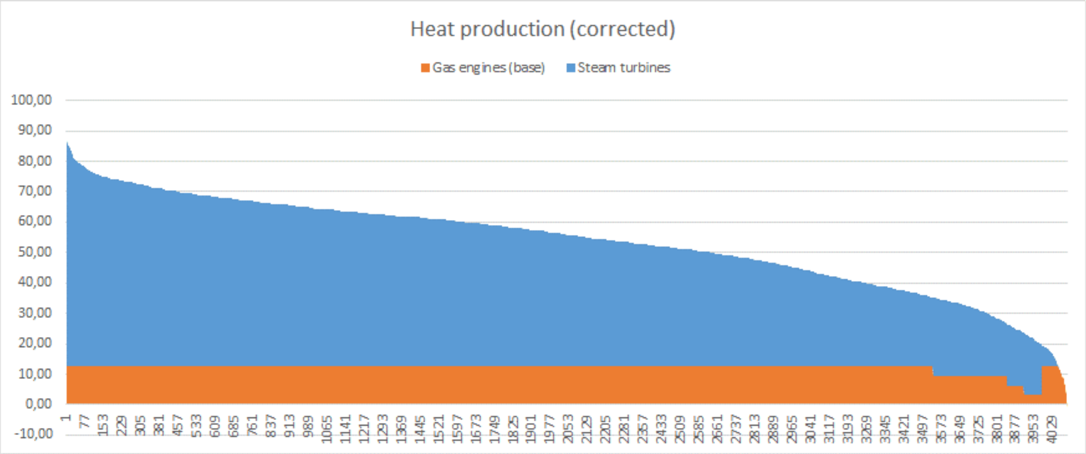
8.1 CO2 SAVINGS

On one hand, the implementation of Individual Heat Substations (IHS) and horizontal networks (HN) lead to a decrease of consumption, hence generating savings of CO2 emissions.

On the other hand, the development of Domestic Hot Water Services to 16,909 new customers, CET-Nord increases the energy production both thermal and electrical.

However, when electrical consumption (from electrical individual boilers) can be avoided or when CET-Nord can increase its electricity production, it is considered that any kWh saved from the national grid will lead to a gross reduction by 0.436 ton CO2/MWhe.

The breakdown of additional energy has been done between gas engines and steam turbines using the placement of means of production presented hereafter:



Graph 32: Simulation of the breakdown of heat production between steam facilities and gas engines during the heating season after project implementation

During the heating season, around 92% of additional required heat energy will be generated from the steam facilities. Off the heating season, the energy will be exclusively produced from the gas engines.

The specific production efficiency of the gas engines (88%) and the steam turbines (82%) has been considered and the emission rate (0.202 ton CO2/MWhgas) has been used to measure the impact on the energy balance.

During the heating season

Annual savings in heat demand due to IHS+HN, Gcal/year	-14 129
Increase of heat demand due to DHW, Gcal/year	19 460
Net Increase of heat demand, Gcal/year	5 379
Net Increase of heat energy from gas turbines, Gcal/year	458
Net Increase of heat energy from steam turbines, Gcal/year	4 921
% of marginal heat energy from gas engines	9%
Net increase of heat production, MWh/year	6 256
Production efficiency rate from steam turbines	82%
Production efficiency rate from gas engines	88%
Weighted efficiency	83%
CO2 emission rate, tCO2/MWhgas	0,202
CO2 emissions due to heat energy, tCO2/year	**1 532**
Net Increase of electricity production from gas engines, MWhe/year	533
Net Increase of electricity production from steam turbines, MWhe/year	1 635
% of marginal electricity from gas engines	25%
Net Increase of electricity production, MWhe/year	2 168
Weighted efficiency	83%
CO2 emissions due to electricity production, tCO2/year	**525**

Off the heating season

Increase of heat demand due to DHW, Gcal/year	28 563
% of marginal heat energy from gas engines	100%
Increase of heat production, MWh/year	33 133
Production efficiency rate from gas engines	88%
CO2 impact produced by CET-Nord, tCO2/MWhgas	0,202
CO2 emissions due to heat energy, tCO2/year	**7 606**
Increase of electricity production, MWhe/year	34 603
CO2 emissions due to electricity production, tCO2/year	**7 943**

Total additional direct CO2 emissions, tCO2/year	**17 605**

Most of the additional CO2 emissions occur during the summer period. Given the high ratio of electricity production of the gas engines, the increase of heat production in summer leads to higher levels of CO2 emissions.

However, higher levels of CO2 emissions will be avoided thanks to the production of DHW. When more electricity is produced by CET-Nord, then less electricity is imported from abroad. Considering the higher CO2 emission rate of the electricity transported in the National grid (0.465 tonne CO2/MWh), significant CO2 savings will be made.

It is estimated that 70% of the DHW produced in individual boilers is done through electrical boilers, the rest from gas boilers. Avoided gas and electrical consumption from individual boilers will also be responsible for savings of CO2 emissions.

Compensation of CO2 emissions

Annual consumption of DHW, Gcal/year	41 660
Estimated weighted consumption from individual electrical boilers	70%
Estimated weighted consumption from individual gas boilers	30%
Avoided consumption from electrical boilers, Gcal/year	-29 162
Boiler efficiency	70%
Avoided electrical consumption from electrical boilers, MWhe/year	-48 325
CO2 emission ratio from electricity mix in Moldova, tonne CO2/MWhe	*0,436*
Avoided CO2 emissions due to DHW from electrical boilers, tonne CO2/year	**-21 070**
Avoided consumption from gas boilers, Gcal/year	-12 498
Boiler efficiency	70%
Avoided heat consumption from electrical boilers, MWhgas/year	-20 711
CO2 emission ratio, tCO2/MWhgas	*0,202*
Avoided CO2 emissions due to DHW from gas boilers, tonne CO2/year	**-4 184**
Avoided electrical consumption from national grid, Mwhe/year	-36 771
CO2 emission ratio from electricity mix in Moldova, tonne CO2/MWhe	*0,436*
Avoided CO2 emissions due to additional electrical production, tonne CO2/year	**-16 032**
Total avoided CO2 emissions, tonne CO2/year	**-41 285**
Net savings of CO2 emissions, tonne CO2/year	-23 681
Cumulated CO2 emissions over the project lifetime, tonne CO2	-473 614
CAPEX for PIP, €	11 500 000
Ratio of CO2 avoided, €/tonne CO2 (PIP only)	**24**
Overall budget: PIP+ loan gas debt settlement	**17 000 000**
Ratio of CO2 avoided, €/tonne CO2 (PIP+gas debt loan)	**36**

In total, the Project will generate savings of CO2 emissions in the amount of 23,681 tonnes CO2/year.

When accumulated over the project lifetime (20 years), the ratio of CAPEX/CO2 savings is 24€/ton of CO2 avoided when considering the cost for PIP only (11.5 M€). The ratio goes up to 36 €/ton of CO2 avoided when the budget covers the PIP and the loan for gas debt settlement. When considering the loan values for both the PIP and the gas debt settlement (an EBRD loan of 8.5 M€ for the PIP and 5.5 M€ for the historic debt, along with the 1 M€ GCF loan), the cost of CO2 savings is 31 €/tonne.

This ratio is below the threshold required to be eligible for the Green Climate Fund (50€/ton of CO2 avoided).

The baseline emissions of CO_2 have been calculated both at the level of CET-Nord and also for the population covered by the PIP.

Baseline emissions of CO_2 (attributed to CET-Nord) as per the configuration in 2020:

Baseline emissions from CET-Nord (as per 2020 configuration)	
Production of electricity (as per 2020 configuration) from steam facilities, MWhe/year	46 677
Production of electricity (as per 2020 configuration) from gas engines, MWhe/year	65 963
Overall production of electricity (as per 2020 configuration), MWhe/year	**112 640**
Production of thermal heat from steam facilities (as per 2020 configuration), Gcal/year	140 472
Production of thermal heat from gas engines (as per 2020 configuration), Gcal/year	54 433
Overall production of thermal heat (as per 2020 configuration), Gcal/year	**194 904**
Energy efficiency from steam facilities	*82,5%*
Energy efficiency from gas turbines	*88%*
Overall production of raw energy, MWh gas/year	**400 799**
Overall production of raw energy, GJ gas/year	1 442 877
CO_2 emission rate from gas consumption tonne CO_2/MWh gas	0,202
Baseline emissions of CO_2 from CET-Nord (as per 2020) , tonne CO_2/year	**80 961**

CET-Nord will produce more energy after the PIP: the level of CO_2 emissions will increase by 22%. However, the energy produced by CET-Nord has a lower CO_2 footprint than the energy used to serve the population covered by the PIP with sanitary hot water and electricity.

The baseline emissions of CO_2 have been calculated for the population covered by the PIP. It takes into account:

- The emissions generated for space heating as per 2020 configuration
- The emissions generated by the energy consumption from individual boilers (either electrical or gas boilers).
- The emissions generated by the electricity consumed from the national grid in the amount equivalent to the future additional electricity production generated by the PIP (displaced consumed electricity from national grid to CET-Nord).

Average heat consumption for space heating for an apartment without IHS, Gcal/year/flat	4,4
Average heat consumption for space heating for an apartment with IHS without HN, Gcal/year/	4,1
Average heat consumption for space heating for an apartment without IHS, Gcal/year/flat	3,5
Number of flats benefiting from IHS + horizontal networks with the PIP	9 933
Number of flats benefiting from horizontal networks only with the PIP	6 976
Annual net savings of C02 emissions, tonne CO2/year	**23 681**
Baseline emissions from energy consumption (only for the population covered by the PIP)	
Configuration of 2020 (before the implementation of the PIP)	
Baseline emissions from individual electrical boilers for DHW, tonne CO2/year	21 070
Baseline emissions from individual gas boilers for DHW, tonne CO2/year	4 184
Baseline emissions from national power grid, tonne CO2/year	16 032
Baseline energy consumption for space heating supplied by CET-Nord, Gcal/year	72 307
Average heat losses in the distribution network	20%
Average heat demand for space heating, Gcal/year	90 384
Average production efficiency	84%
Heat production, MWh gas/year	124 815
CO2 emission rate from gas consumption tonne CO2/MWh gas	0,202
Baseline emissions from space heating supplied by CET-Nord (Def 1)	25 213
Baseline overall emissions of CO2 from current energy consumption , tonne CO2/year	**66 498**
% of CO2 emissions avoided	**36%**
% of overall baseline CET-Nord heat production share attributable to PIP specific baseline	46%
CO2 emissions attributable to PIP specific Baseline, tonne CO2/year (Def 2)	37 544
Baseline overall emissions of CO2 from current energy consumption , tonne CO2/year	**78 830**
% of CO2 emissions avoided	**30%**

Two definitions have been used to quantify the CO2 savings depending whether or not the CO2 emissions for the combustion of gas are split between the power and thermal energy (def 1) or exclusively attributed to the thermal energy (def 2), the last being more conservative for assessing the CO2 savings.

In any case, the PIP will lead to a significant reduction (between 30 to 36%) of the current CO2 emissions in the project area.

8.2 Water savings

The main benefit from water savings is due the reduced volume for steam purges and installation of new horizontal networks.

The current rate of steam purges has been observed at 8% of the total volume of steam while a ratio of 4% is expected with a better water quality when the new treatment facilities are implemented under the PIP. In other words, it means that half of the water consumed to compensate losses for steam purges will be saved: 8,549 m3/year.

The replacement of the aged secondary vertical network by new horizontal networks in buildings will lead to water savings resulting in lower make-up water. For the buildings already equipped with IHS (having already a physical boundary between the primary and secondary networks), the savings in the secondary network will not be "visible" for CET-Nord.

However, from the perspective of the project, the savings due to the horizontal networks can be valued. It is estimated that level of water losses in residential buildings represent 10% of the overall water losses. Considering that the PIP will equip 38% of the residential buildings with horizontal networks, the savings of water losses are estimated to 4% of the overall make-up water for the heat distribution network: 2,757 m3/year.

In total, the savings of water losses represent 13% of the current level for water production (11,301 m3/year).

9. Project implementation

9.1 Project implementation organization

9.1.1 Main responsibility of Project implementation Unit (PIU)

The PIU will be in charge of the timely, quality and in-budget implementation of the project. The PIU shall report directly to CET-Nord SA management in order to avoid administrative latencies in the approvals. It is thus advised that the head of the PIU is nominated among the key management of the Company.

The members of the PIU should have a well-defined role and a priority for the task. The numbers of PIU members should be limited, depending on individual skills.

The main tasks of the PIU are:

- launching of the procurement process (incl. drafting of the corresponding Terms of References, publication of the Tendering documentations, evaluations of the bids, selections and establishment of the selected bidders)
- follow-up of the contracts implementation (technical, financial and legal)
- daily administration of the project
- close reporting of the project to the management of the Company
- communication about the project

The PIU shall thus be in constant interaction with the corresponding departments of the Company (Director General, Technical department, Accountability department, Marketing and Communication department). It is advised that a liaison officer is nominated among the PIU for each department involved. It is preferable that skills in English are available within the PIU group.

A Project Management Consultant will be hired (granted by the Bank) to support the PIU on the preparation of tender documentation, evaluation process, and technical administration of the contracts.

It is advised to assign in the PIU permanent staff of CET-Nord in order to ensure capitalization of knowledge and timely operationalization of the members. An in-depth knowledge of the Company is required for the members of the PIU.

9.1.2 Management of the procurement process

The procurement process starts with pre-planning and based on the pre-planning elaboration of procurement documents shall be done (based on the procurement plan prepared within the feasibility study). During this process the PIU is entitled to:

- Ensure that the item to procure (Consulting services, goods or work) is available in a specific market (national, regional, international, etc.) with quality actors in it (experience, staff, means)
- **Produce the terms of reference** corresponding to the service/allotment. This set can be done directly by the PIU or through an external Consultant if the PIU lacks time/specific expertise. If the PIU drafts the TORs itself, it is advised that an external Consultant is hired to read and pre-validate the documents.
- **Set up the tendering documentation** with essential information as: form of the bids to be received, evaluation and selection criteria and process, form of contract agreements, budget

(if relevant).

- **Publish the Tendering documentations** in relevant media. Depending on the market identification findings, the PIU shall ensure that the publication strategy reaches the right target while respecting the Bank’s requirement and international standards in terms of visibility and fair competition.
- **Evaluate the bids.** This step is key in the procurement process. It is advised that several evaluators are appointed among the PIU for each evaluation process. External evaluators can be hired – no more than 1 external evaluator per tender). Evaluation shall be fair and transparent.
- **Select and establish the selected bidders.** Bidders shall be informed of the results at the end of the evaluation process, regardless of their position. The winner shall be invited to negotiation (if planned by the PIU) and signature of the contract. The PIU shall supervise the commencement of the service.

International Financial Institutions such as the EBRD require that international and competitive contract procedures are followed, being regulated by guidelines or other instructions (ex: open and fair competition; funds are used for the purpose intended; grant part of financing cannot cover duty and tax costs, The borrower shall contribute a significant proportion of the project costs; FIDIC1 or similar standard condition of contracts to be used for all contracts; currency exchange risk to be borne by the contractors, etc.)

The PIU Support Consultant will need to asses the market conditions and propose the most suitable procurement strategy which may include consolidation of certain contracts into bigger ones or the use of national procurement procedures for the low value contracts. No special consideration will be given to local contractors in accordance with EBRD rules.

9.1.3 Management of application for permits

Before, during and alter the implementation, the PIU shall take responsibility for the following items (if not included in the Contractor's scope of supply):

- technical specifications,
- design principals and other data required for obtaining ratification and expert evaluation;
- application to state, local authorities and institutions for ratification and expert evaluation;
- obtaining ratifications and construction permits;
- obtaining final inspection certificates

9.1.4 Contract management and administration

During the implementation period the PIU will be responsible for Contract management and administration including:

- Approvals and agreement of payment for completed work within strict protocols; coordination of the deliveries from different contractors;
- Completion of project deliverables to the quality and timescales set down in the contracts; reporting to EBRD on project progress and finances and specifically issue necessary documents for lifting of loan and grant parts. Borrowers are expected to be fully responsible for all aspects of the procurement process from the planning stage through to award.

To support the PIU during project implementation, and in order to mitigate the risks related to the project implementation (see the section related to the project risk analysis), it is expected that EBRD will provide funding for capacity building and training.

Payment under the contract will be made in the currency or currencies in which the tender price is stated in the tender of the successful tenderers.

9.1.5 Procurement Plan & time schedule

The procurement strategy is summarised in the table below:

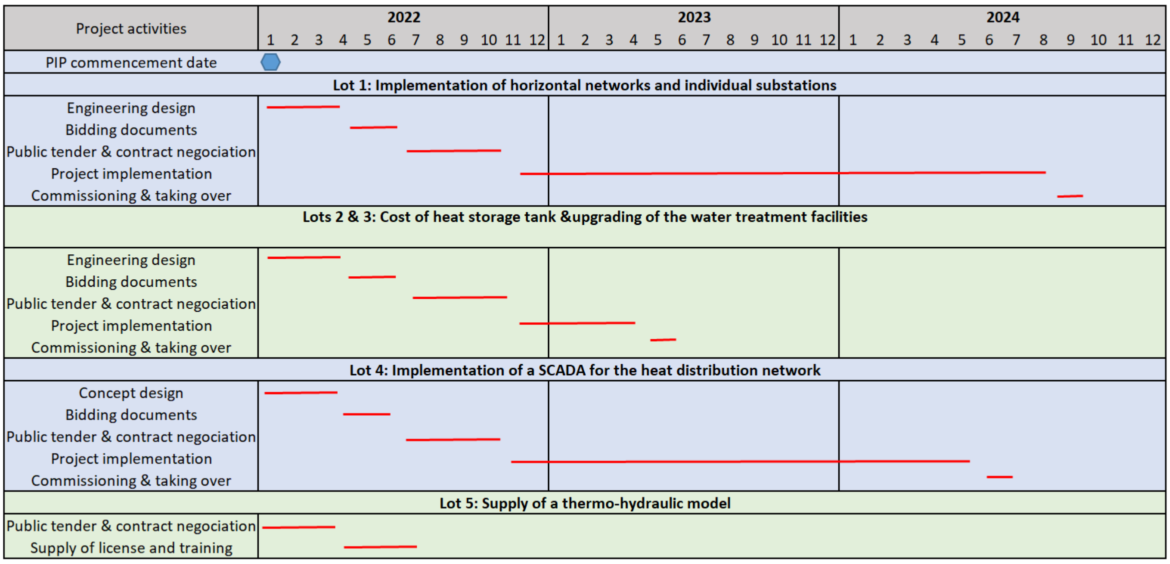
Balti DH Project
PROCUREMENT PLAN
Currency: Thousands EUR

									Time Schedule				
1	2	3	4	4	4	7	8	9	10	11	12	13	14
Nr.	Description	Estimated contrac value	Financing by EBRD	Financing by E5P grant	Financing by GCF loan	Contract type	Procurement method	Subject to Selective Review	Prequalification Invitation mmm/yy	Prequalification results mmm/yy	Tender Invitation mmm/yy	Contract Award mmm/yy	Contract completion mmm/yy
	CapEx												
1	Supply and Installation of IHS	2 900	2 900			Work	Open		NA	NA	janv-22	avr-22	oct-24
2	Construction of Horizontal Network in buildings	7 255	4 255	2 000	1 000	Work	Open		NA	NA	janv-22	avr-22	oct-24
3	Construction of Heat Storage (700 m2)	588	588			Work	Open		NA	NA	janv-23	avr-23	sept-23
4	Upgrade of the water treament facility	420	420			Work	Open		NA	NA	janv-22	avr-22	sept-22
5	Implementation of a Scada system for the DH network	250	250			Goods	Open		NA	NA	janv-22	mai-22	oct-22
5	Supply of hydraulic modeling licence for DH networks	87	87			Goods	Open		NA	NA	janv-22	avr-22	oct-22
	Total CapEx	**11 500**	**8 500**	**2 000**	**1 000**								
	Total:	**11 500**	**8 500**	**2 000**	**1 000**								

It is proposed to organized the Priority Investment Program into the following lots:

- **Lot 1**: Implementation of horizontal networks and individual substations
- **Lot 2** Construction of Heat storage facilities (700 m3)
- **Lot 3**: Upgrading of the water treatment facilities
- **Lot 4**: Implementation of a SCADA for heat distribution
- **Lot 5**: Supply of thermo-hydraulic model

As shown in the table below, the project is supposed to last for three years. The installation of individual substations and horizontal networks in one hand and the implementation of SCADA in the other hands are to be implemented over 36 months.



9.2 IDENTIFIED NEEDS FOR TRAINING

Based on our experience of the sector in the region, our observations of the management of the operations of the Company and discussions with company members, the Consultant identified the following training.

9.2.1 GIS and modelling

The utilization of the GIS (geographical information system) and modelling is indispensable to reach a satisfying level of performance in the district heating activity.
The GIS shall indeed collect all key data regarding the technical infrastructure and can therefore constitute a powerful basis for further asset management system. In addition, it is also a very operational instrument which provides practical assistance for the preparation and the realization of the interventions on-site.

The modelling complements the functions provided by the GIS, and gives the possibility to reach a complete understanding of how the DH networks work. It can be used to analyse anomalies and incidents, to revise the configuration of the networks and modify the mode of operations of the heat production units.

9.2.2 Quality of water

The analysis of the quality of water is indispensable because it may cause major economic impact of the energy production (in particular if steam turbines need to be changed). The treatment of water is also indispensable because it preserves the efficiency of the boilers and slows down the natural aging of the network.

The Consultant believes that the Company should continue to build capacity in this area, especially considering the investment to be implemented in the PIP for the improvement of the system. The Consultant recommends a training which would include the following:

- Impact of corrosions, scaling, sludge and deposits;
- Parameters that should be measured;
- Type of equipment;
- Type of analysis;
- Key parameters (hardness, alkalinity, PH, conductivity, silt density index, chlorides, dissolved iron, phosphates, silicates);
- Usual treatments (softening, decarbonation, demineralization, oxygen removal).

9.2.3 Detection and repair of water leakage

The water leakages in the district network are compensated by additional water that must be heated and injected in the network. As a consequence, it is a source of additional cost which include additional purchase of water and gas. In addition, the leakage on underground pipes may cause serious damages to roads and even buildings (when buried) with dangerous and costly consequences.

In this matter, the network department mostly reacts to information transmitted by the population and the authorities. Additional resources could be assigned to detect the leaks with on-site inspections carried out with appropriate equipment.

The Company should therefore develop capacity building on this issue and provide a training module that would include the following:

- Identification of priority sectors;
- Systematic inspection of manholes;
- Acoustic detection methods and material;
- Localization of the leaks by acoustic correlations;
- Organization of the leak detection campaign;
- Recording of the leaks in a leakage database;
- Good practices for pipe repairs.

Skills already exist inside the Company in this matter, and they could be developed within the network teams with specific additional training. The Company should also have recourse to external training for the acoustic methods of detection and localization. The supplier of leak detection equipment can provide this type of training as well as other DH companies which are more advanced.

9.2.4 Reporting of commercial and financial data

The data produced by the commercial department and the financial department need to be formatted carefully and recorded in such a manner that the data are easily accessible in a form that can be processed by any relevant party.

In this matter, the Company should focus on the following:

- Inventory of the monitoring data;
- Definition of each data;
- Methodology to calculate the data;
- Creation of templates to record the data;
- Calculation of the data for 2020;
- Presentation of the data to the Company;
- Follow-up of the collection and calculation of the data for 2021.

The templates must be designed for reporting by month, by quarter or by year according to the needs. The Company needs to maintain and develop this system with new data and tables as necessary.

In this matter, it should be noted that the employees who are involved in the monitoring of data must be comfortable with the utilization of business applications. It is therefore recommended for the Company to organize a training module in Excel for all relevant employees.

10. Long term investment strategy

The long term strategy for CET-Nord does not much differ from the short term one: the objective is to earn new customers through:

- The development and extension of the supply of domestic how water service;
- The individualisation of the energy consumption through the development of individual sub-stations and horizontal networks;
- The search for higher market competitiveness by reducing staff cost (combined with automated operations), improving energy production efficiency

However, a long term strategy needs to be developed based on long term goals to transform CET-Nord into an efficient and a sustainable business industry.

A provision of **10%** of the annual turnover of CET-Nord has been considered when performing the financial projections for CET-Nord in the long term. This represents around **1.7 million €** annually of capital expenditures.

10.1 Upgrading of the production facilities

The steam based facilities are old: most of the boilers and steam turbines have reached their lifetime. While the gas engines already represent more than a half of the electricity production, steam boilers still provide a high proportion of the heat demand.

CET-Nord needs to anticipate the need for renewing its major energy assets.

Peak load for heat supply under -18°C (outside temperature) is estimated to be around **85 Gcal/h** today.

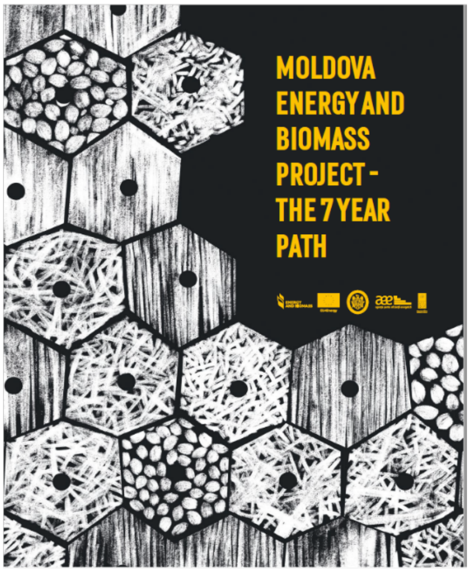
In the future additional customers or supply of domestic hot water may contribute to increasing the heat load. On the other hand, demand side management measures such as deployment of individual sub-stations and horizontal networks should lower the heat load although their main benefit/impact is expected during mild outside temperatures.

Existing gas engines may provide up to **10 Gcal/h** today. With 2 additional gas engines, it can represent up to 15 Gcal/h which is still far from the required load capacity (**21%**). It is therefore necessary to develop new production capacities to meet heat demand in the long term.

Different options have been explored. They assume that CET-Nord only get the existing 4 gas engines. The potential new gas engines proposed in the PIP have not been considered when sizing the different alternatives. The LTIP therefore considers that **a new installed capacity of minimum 75 Gcal/h** is necessary.

	Gas HoB	Biomass HoB	Gas engines	Gas steam CHP
Option 1	2 x 40 MWth			
Option 2	2 x 20 MWth	1 x 42 MWth		
Option 3				2 x 15 MWe
Option 4	2 x 15 MWth	1 x 40 MWth	2 x 3 MWth	

The option 3 will increase the capacity for power generation while all the other options will contribute to decrease the capacity for power generation compared to current levels. The options 2 and 4 will provide the highest CO2 savings since they will be based on large biomass heat-only-boilers. A sectoral review of biomass available in Moldova was done recently. The Study was financed by the UNDP.



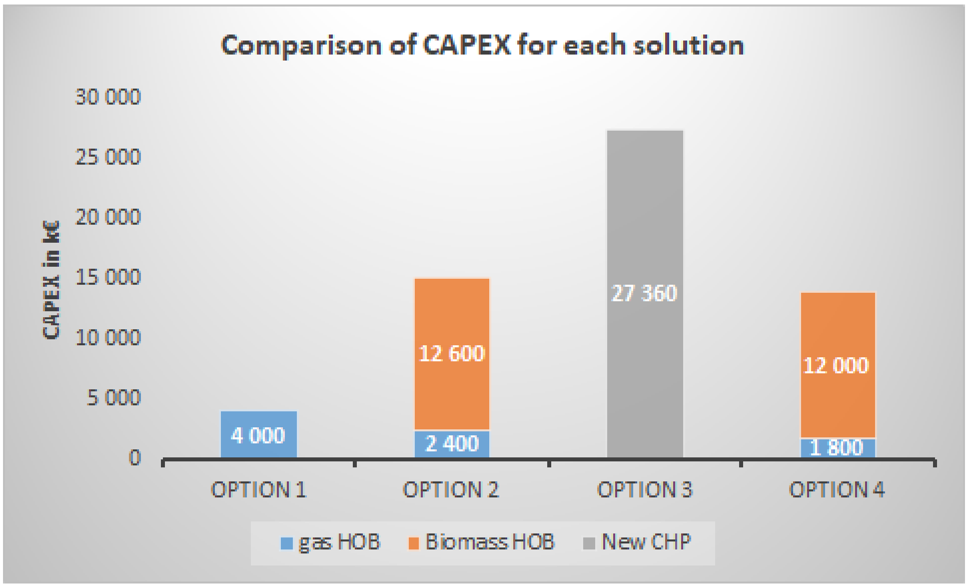
In 2017, public institutions consumed 33,000 tons/year while domestic households consumed 20,000 t/year.

The market for biomass production seems to be quite disaggregated with 84 local producers. The total capacity is estimated to be 87,000 t/years.

To compare, the production of 82% of the heat demand met by CET-Nord through biomass heat-only-boilers would need around 57,000 t/year of biomass. Alternatively, a 10 MW heat-only-biomass would need 10,000 tonnes/year of biomass (for 3,000 hours/year).

Today CET-Nord operates the very small Molodova heat-only-boilers of 0.5 Gcal/h load capacity with biomass (sunflower seed husk). Despite the low quantity of biomass (160 tonnes/year), CET-Nord faced some problems with biomass sourcing. The management of CET-Nord is therefore reluctant to further develop major biomass projects in Balti.

The graph below shows the large range of CAPEX which range from **4 million €** (gas HoB) to more than **27 million €** (gas steam CHP).



Graph 33: breakdown of CAPEX to replace existing the steam CHP

10.2 Deployment of Individual Heating Substations and horizontal networks

The two urban district heating companies in Moldova (Termoelectrica and CET-Nord) came to the same conclusion: in order to retain customers or even to get back former customers, DH Companies need to improve the quality of service and give the consumer control over its own energy consumption.

The long term investment program shall continue to deploy individual heat substation (IHS) and horizontal networks.

The base scenario proposed in the financial model (presented under a separate report) considers:

An objective of equipment of buildings with IHS from 17% in 2020 to 100% by 2033 with a linear growth in between. That represents around **38 IHS annually**.

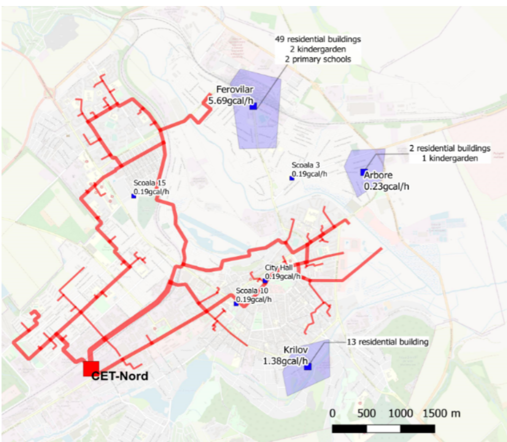
A similar target level is proposed with horizontal networks. However, since today there are very few buildings already equipped with horizontal networks, that requires installing horizontal networks in **53 buildings annually**.

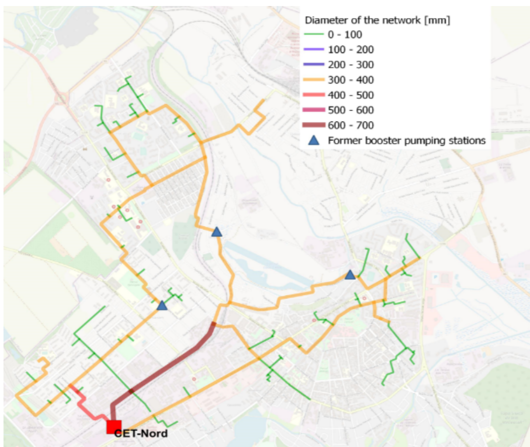
In total, the above investments represent around **930 k€/year** in average until 2033.

10.3 Expansion of the DH system and development of interconnection

In the future, assuming that the two DH companies will merge, CET-Nord should seek to connect the small DH networks operated by Termogaz Balti to the central heating system operated by CET-Nord.

While the buildings (Scola 10 and City hall) could be easily connected to the central system. But a more detailed analysis should be conducted for the connection of other stand-alone systems (Feroviarilor, Arbore, Krilova and Scola 15).





Piezometric lines should be determined under extreme outside temperature (-18°C) to size the diameters of the extension pipes and check if the hydraulic conditions can be met. An economic analysis should also be conducted to calculate the profitability of the connection works.

At first glance, the connection works (without any reinforcement of the existing primary network) could cost around **2.5 million €** to connect the different areas to the central systems

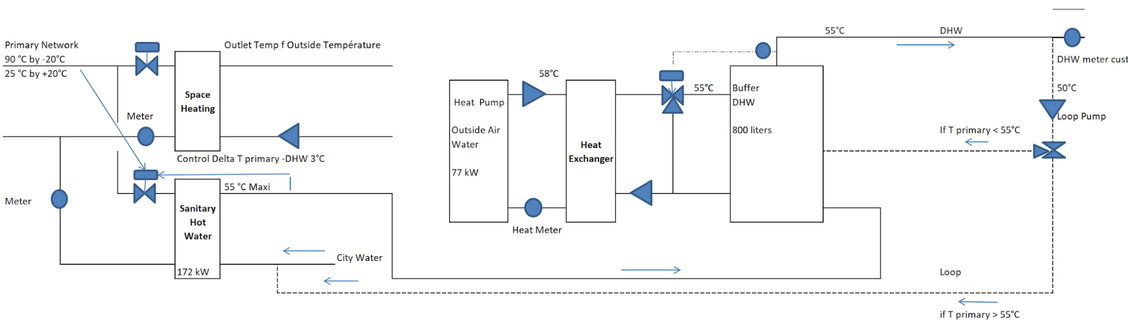
	Ferrovilar	Arbore	Krilov	Scola 15	Total	Unit cost k€/km	Cost, k€
DN100				0,5	0,5	200	100
DN200			1		1	540	540
DN300	0,75	1			1,75	1 067	1 867
Total						**1 807**	**2 507**

10.4 Development of decentralised solutions for sanitary hot water

The provision of SHW in summer (that lasts 6.5 months/year) and during mild temperatures of the heating season, lead to heat losses and are a source of CO_2 emissions.

An alternative solution consists of developing a hybrid solution for remote areas of the network that would combine a heat pump to produce until the outside temperature goes below +6°C. The coefficient of performance of such a heat pump is expected to be around 4.

The lay-out below describes the hybrid solution for producing SHW:



The above layout suggests the installation of two heat meters to monitor the energy consumption for producing the sanitary hot water (from the central system and from the heat pump). The cost for electricity (of the heat pump) shall be included into the tariffs.

For building with 40 apartments, the following assumptions have been made to estimate the average cost for a heat pump:

Number of apartments	40
Peak load capacity of the heat exchanger, kWth	172
Peak flow rate (during 10 minutes), l/apartment	20
Capacity of the buffer tank, liters	800
Weighting factor on the peak load	45%
Optimised load capacity of the heat exchanger, kWth	77
Average cost for heat pump (with hydraulic and electrical works), €/kWth	466
Cost for heat pump (77kWth), k€	**36**

10.5 Development of energy efficiency program for buildings

CET-Nord and the City of Balti are eager to jointly develop an energy efficiency program for both administrative and residential buildings.

Apart from a few public buildings which are to be connected in the near future to the DH system operated by CET-Nord, there is no detailed financed program of significant magnitude so far. The City of Balti is encouraged to develop a feasibility study to assess the priority buildings to benefit from energy savings and to quantify the economic and CO2 savings per type of investment (thermal insulation, heat regulation, …). A business model should also be developed to promote the ESCO (Energy Service Company) to encourage local private sector participation to invest and operate new facilities for achieving energy savings.

11. Project risk analysis

A risk analysis has been performed. The risks have been rated (H-high- M – Medium-, L –Low-) and mitigation measures have been proposed. The following table summarizes the critical risks of the project:

Risk Matrix

Type of risk	Description	Severity (H - M - L)	Mitigation
Project organisation	If the demolition and construction works are carried out during the cold season, it is possible that there are major interruptions in the heat delivery, creating a negative impact on the customers' well-being.	M	Close monitoring of the acitivity, work during the hot season if possible
Procurement	Cost over-run for investment components	L	Procurement method selected to enhance competitive bidding.
Procurement	Implementation capacity of the Company in carrying out large investment projects within an international environment may result in longer implementation period.	L	Limited contractors for project implementation: Maximum: 1 per lot.
Procurement	Delays in deliveries and installations caused by the contractor	M	Establishment of detailed time schedules during the planning process. Penalties for delays set in the contract.
Procurement	Approval process with authorities for the design and installations included in the Project difficult to control and may cause delays.	M	Starting of the approval process as soon as possible. Arrange contracts with various stakeholders. Introduce suitable provisions in the tender documents.
Procurement	Poor quality for goods and works may reduce lifetime or performance of new facilities	M	Detailed requirements on works and goods in the technical specifications. Strong resources assigned during site inspections and commissionning
Financial	Losses in EUR against MDL exchange rate during the loan reimbursment period	M	Set clauses in the loan agreement to anticipate loan reimbursment in case of sufficient cash available. Request exchange rate hedging contract to local banks and include the cost into the project overall cost.
Financial	Increasing gas prices	M	The variations of the gas price are supposed to be directly reflected into the tariffs
Regulatory	ANRE does not autorise the cost for horizontal networks into the tariffs	M	Investment programs financed by international loans are deemed to be repaid through the tariffs. However the risk exists that some contradictions in the tariff setting methodology prevent from considering all costs into the tariffs
E&S	Noise caused by the works may be significant close to the working areas. Also, if the work is done during the dry period, dust can be formed locally.	L	Supply of proper Protection Equipment to workers ; scheduling the working hours so that all the work will be carried during daytime.
E&S	During the demolition and construction work oil leaks from the machinery are possible, causing a risk of local soil contamination.	L	Careful inspection of machinery before use, oil immedialtely collected and disposed of by local waste management companies applying thermal desorption method.. ; sprinkling the working areas with water when needed
E&S	Construction waste, and demolition waste, including old steel pipes, mineral wool, concrete, and other metal waste. Is is likely that asbestos containing materials will be removed in the demolition work. Decommissioning of water treatment systems built in the 1970s – 1980s may generate PCB containing construction waste (sealants) and other hazardous waste (chemicals)..	H	Inspection of any ancient materials before decomissioning and lab analysis of a sample if needed
E&S	Construction may cause physical hazards to workers from noise and vibration, dust, handling heavy materials and equipment, falling objects, work on slippery surfaces, fire hazards, chemical hazards such as toxic fumes and vapors, and others.	M	Proper protection equipment to be given to the worker, training on health and saftey to be provided

Generally, it can be assumed that the project risks can be mitigated in an efficient way during the project implementation. The "high risks" listed here require special attention.

12. Environmental & Social assessment

The Environmental and Social assessment carried out by the Consultant in the framework of the Phase II of the Balti District Heating project did not highlight major gaps between the management of these aspects by CET-Nord and the Moldovan corresponding legal framework, nor international relevant standards. The environmental, health and safety processes are acceptable and are incorporated into CET-Nord SA’s management and operations to a necessary extent. CET-Nord has identified the major Environment, Health and Safety responsibilities and matters of concern. According to national and local regulations, the company's performance and practices are adequate; mitigation measures, monitoring, controlling and documenting are to be considered. No significant problem of EHS matters that can be any threat or risk for potential investors was identified.

Environmental management

In general CET-Nord SA activities are not considered as environmentally hazardous and risky. The environmental performance of CET-Nord SA demonstrates compliance with regulatory requirements.

However some new legal requirements (e.g. management of hazardous substances, like PCB or asbestos) that are not yet fully executed by the Ministry of Agriculture Regional Development and Environmentare not yet implemented by CET-Nord SA. This has not been surveyed and can therefore constitute a small risk.

No act for CO_2 and CO_2 equivalent emissions calculations and regulation are enforced in the country. As such, CET-Nord does not report its carbon footprint. A proper reporting could create opportunities for low-carbon and transition investments and position the company as an actor of Ecological Transition.

It is worth noting that the overall process efficiency of CET-Nord SA’s DH system is not good and needs to be improved. **Heat losses** have been identified at production (boilers) and distribution (pipelines) level. **Water losses** have also been identified in the pipelines and at the production level. The process could be optimized in order to **minimize use of natural resources.**

The Company could benefit in hiring an environmental engineer to plan and supervise environmental issues, and address permit-related management issues (planning, monitoring and reporting); setting up a proper **environmental management framework.**

Social management

CET-Nord SA can be considered as an **advanced company in terms of compliance and top management commitment to proper labour and human resources management.**

CET-Nord SA complies with the regulations on labour and human resources management. The

Company has also identified all relevant regulatory requirements (laws, sub-laws, rules and norms) and ensures compliance through regular checks, and training and information of personnel. There were no significant non-conformities revealed in inspections conducted by H&S authorities.

The Consultant identified that no complaint management procedure is currency implemented in the Company. This can be at risk for the employees, particularly the most vulnerable ones. **A proper grievance procedure should then be developed within CET-Nord.**

Gender aspects should also be assessed and better included in the management policies. As of today, only 20% of the highest managerial positions in the Company are held by women while 38% of the middle management are filled by women. Moreover, it has been observed that women are overrepresented in administrative and commercial functions and underrepresented in technical functions.

There is no employee (female or male) in the company who would address the gender issue and implement the policies, assist and advise on how to integrate gender issues in planning, implementation and monitoring. **The company should have a specific plan for implementing gender policies in the employment process.**

Stakeholders engagement

The Company already communicates through various channels: the Company's website provides some relevant and updated information, social media accounts are active and regularly updated, the Managing Director often spends time to receive customers, regular contacts exist with the press media, etc.

However, the communication should be structured: **a communication manager must be appointed** to administrate all communications (communication materials, administration of the Company's website, development of a "positive image" of the Company, etc.). A job description has been developed in annex to this Report.

The Company **needs to modernise its management systems**, in particular for customer relation management. Main technical specifications and cost estimates have been prepared that should be used by the Company to implement a Customer management system.

The Company must develop **its own vision** ("where the Company goes") and communicate with all stakeholders (including the Municipality).

An **annual activity report** should be prepared to summarise the activity (technical, financial, commercial, social, etc.) achieved by the Company. The performance should be also reported and the Company should highlight its vision.

The ESAP Report, the stakeholder engagement plan and the gender report are provided in the annexes.

ANNEXES

Annex 1 – Financial analysis

Annex 2 – Details of economic calculations

Data and hypotheses

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Assumptions & Parameters (nominal value)																
Gas price, MDL/1,000 Nm3	4199	4379	4558	4734	4908	5079	5248	5413	5575	5734	5889	6040	6187	6331	6470	6605
Tariff for electricity sales, MDL/MWh	1620	1620	1636	1685	1854	2076	2076	2076	2076	2242	2287	2333	2426	2523	2599	2703
Tariff for heat sales, MDL/Gcal	1220	1220	1232	1268	1393	1557	1557	1557	1557	1679	1714	1748	1817	1889	1945	2022
Cost of CO2 emissions, €/ton of CO2	**49**	52	55	58	61	64	66	69	72	**75**	77	78	80	82	84	86
Cost of CO2 emissions, MDL/ton of CO2	1008	1067	1174	1258	1342	1426	1510	1593	1675	1756	1808	1859	1909	1958	2006	2053
O&M cost ratio (versus CAPEX) for individual sub-stations & horizontal networks	**2%**	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
O&M cost for gas engines, €/MWhe	**11**	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
O&M cost ratio (versus CAPEX) for water treatment	**2%**	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Gross salary, MDL/year	**49 182**	51 291	53 380	55 445	57 483	59 490	61 463	63 400	65 298	67 155	68 969	70 740	72 465	74 143	75 775	77 359
Exchange rate MDL/EUR	**20**	20	21	22	22	22	23	23	23	23	24	24	24	24	24	24
Inflation in Moldova	4,5%	4,3%	4,1%	3,9%	3,7%	3,5%	3,3%	3,2%	3,0%	2,8%	2,7%	2,6%	2,4%	2,3%	2,2%	2,1%
Lower Calorific Value for gas (kcal/Nm3)		**8 175**	8 175	8 175	8 175	8 175	8 175	8 175	8 175	8 175	8 175	8 175	8 175	8 175	8 175	8 175
Lower Calorific Value for gas (MWh/10^3 Nm3)		9,48	9,48	9,48	9,48	9,48	9,48	9,48	9,48	9,48	9,48	9,48	9,48	9,48	9,48	9,48
CO2 emission ratio from electricity mix in Moldova, tonne CO2/MWhe		**0,436**	0,436	0,436	0,436	0,436	0,436	0,436	0,436	0,436	0,436	0,436	0,436	0,436	0,436	0,436
CO2 emission ratio, kg CO2/kWh gas		**0,202**	0,202	0,202	0,202	0,202	0,202	0,202	0,202	0,202	0,202	0,202	0,202	0,202	0,202	0,202
CO2 emission ratio, kg CO2/Nm3 gas		1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9
Duration of heating season, hours	**4 015**	4 015	4 015	4 015	4 015	4 015	4 015	4 015	4 015	4 015	4 015	4 015	4 015	4 015	4 015	4 015

PIP disbursment, 10^3 MDL	-73 384	-76 554	-77 956												
1 - Demand side management (individual sub-stations & horizontal networks)		50%	90%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Additional volume of heat sales, Gcal	0	16 971	30 548	33 942	33 942	33 942	33 942	33 942	33 942	33 942	33 942	33 942	33 942	33 942	33 942
Additional volume of electricity sales, MWhe	0	18 395	33 112	36 791	36 791	36 791	36 791	36 791	36 791	36 791	36 791	36 791	36 791	36 791	36 791
Additional revenues, 10^3 MDL	0	51 007	94 544	115 473	129 230	129 229	129 229	129 228	139 500	142 331	145 166	150 947	156 958	161 647	168 085
Additional volume of heat production from steam facilities, Gcal	0	2 461	4 429	4 921	4 921	4 921	4 921	4 921	4 921	4 921	4 921	4 921	4 921	4 921	4 921
Additional volume of heat production from steam facilities, MWh	0	2 854	5 138	5 709	5 709	5 709	5 709	5 709	5 709	5 709	5 709	5 709	5 709	5 709	5 709
Additional volume of electricity production from steam facilities, MWhe	0	818	1 472	1 635	1 635	1 635	1 635	1 635	1 635	1 635	1 635	1 635	1 635	1 635	1 635
Additional volume of heat production from gas engines, Gcal	0	14 511	26 119	29 021	29 021	29 021	29 021	29 021	29 021	29 021	29 021	29 021	29 021	29 021	29 021
Additional volume of heat production from gas engines, MWh	0	16 832	30 298	33 665	33 665	33 665	33 665	33 665	33 665	33 665	33 665	33 665	33 665	33 665	33 665
Additional volume of electricity production from gas engines, MWhe	0	17 578	31 640	35 156	35 156	35 156	35 156	35 156	35 156	35 156	35 156	35 156	35 156	35 156	35 156
Combustion efficiency of steam facilities	*82%*	*82%*	*82%*	*82%*	*82%*	*82%*	*82%*	*82%*	*82%*	*82%*	*82%*	*82%*	*82%*	*82%*	*82%*
Combustion efficiency of gas engines	*88%*	*88%*	*88%*	*88%*	*88%*	*88%*	*88%*	*88%*	*88%*	*88%*	*88%*	*88%*	*88%*	*88%*	*88%*
Additional volume of inlet thermal energy, MWhgas	*0*	*43 580*	*78 445*	*87 161*	*87 161*	*87 161*	*87 161*	*87 161*	*87 161*	*87 161*	*87 161*	*87 161*	*87 161*	*87 161*	*87 161*
Additional volume of gas consumption, 10^3 Nm3	*0*	*4 596*	*8 272*	*9 191*	*9 191*	*9 191*	*9 191*	*9 191*	*9 191*	*9 191*	*9 191*	*9 191*	*9 191*	*9 191*	*9 191*
Additional cost for gas consumption, 10^3 MDL	0	-20 126	-37 702	-43 512	-45 111	-46 686	-48 235	-49 755	-51 244	-52 701	-54 125	-55 515	-56 868	-58 186	-59 466
O&M cost of new facilities, 10^3 MDL	0	0	0	-4 754	-3 477	-455	-920	0	0	0	0	0	0	0	0
O&M cost for gas engines, 10^3 MDL	0	-4 134	-7 577	-8 557	-8 682	-8 794	-8 893	-8 980	-9 054	-9 117	-9 167	-9 207	-9 235	-9 253	-9 262
Total additional operating cost, 10^3MDL	**0**	**-24 259**	**-45 278**	**-56 823**	**-57 269**	**-55 935**	**-58 048**	**-58 735**	**-60 298**	**-61 818**	**-63 293**	**-64 721**	**-66 103**	**-67 439**	**-68 728**
Volume of CO2 savings (country level), tCO2/year	0	11 840	21 313	23 681	23 681	23 681	23 681	23 681	23 681	23 681	23 681	23 681	23 681	23 681	23 681
Revenues equivalent from CO2 savings, 10^3 MDL	0	13 901	26 811	31 783	33 773	35 754	37 720	39 665	41 584	42 812	44 018	45 202	46 362	47 499	48 611
Total additional revenues, 10^3 MDL	**0**	**64 908**	**121 356**	**147 256**	**163 003**	**164 983**	**166 948**	**168 893**	**181 083**	**185 143**	**189 184**	**196 149**	**203 321**	**209 145**	**216 696**
Annual cash flow, 10^3 MDL	**-73 384**	**-35 905**	**-1 879**	**90 433**	**105 733**	**109 048**	**108 901**	**110 158**	**120 785**	**123 325**	**125 891**	**131 428**	**137 217**	**141 706**	**147 968**
Discounted cash flows (with DR 4%), 10^3 MDL	-73 384	-34 524	-1 737	80 395	90 381	89 630	86 066	83 711	88 256	86 646	85 048	85 373	85 705	85 105	85 448
Cumulative discounted cash flows, 10^3 MDL	-73 384	-107 908	-109 645	-29 251	61 130	150 760	236 826	320 537	408 793	495 439	580 487	665 860	751 566	836 671	922 119
NPV with DR (4%), 10^3 MDL	**922 119**														
Economic Internal Return Rate after 15 years, %	**48%**														
Pay-back period, Years	**4,0**														

2 Upgrading of water treatment																
Investment, 10^3 MDL	**-8 607**															
Staff number in water laboratory	**30**	22	13	**5**	5	5	5	5	5	5	5	5	5	5	5	
Staff cost, 10^3 MDL/year	1 539	1 601	1 663	1 724	1 785	1 844	1 902	1 959	2 015	2 069	2 122	2 174	2 224	2 273	2 321	
Purge rate for steam production	**8%**	**4%**	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	
Average steam flow rate, t/h	**51**	51	51	51	51	51	51	51	51	51	51	51	51	51	51	
Ratio of loss of energy for steam purge, Gcal/(t/h)	**0,225**	0,225	0,225	0,225	0,225	0,225	0,225	0,225	0,225	0,225	0,225	0,225	0,225	0,225	0,225	
Energy losses due to steam purges, Gcal	3 686	1 843	1 843	1 843	1 843	1 843	1 843	1 843	1 843	1 843	1 843	1 843	1 843	1 843	1 843	1 843
Gas consumption for steam purge, Nm3	549 828	274 914	274 914	274 914	274 914	274 914	274 914	274 914	274 914	274 914	274 914	274 914	274 914	274 914	274 914	274 914
Annual savings in gas consumption, Nm3	0	274 914	274 914	274 914	274 914	274 914	274 914	274 914	274 914	274 914	274 914	274 914	274 914	274 914	274 914	274 914
Net CO2 balance, ton/year		**-527**	**-527**	**-527**	**-527**	**-527**	**-527**	**-527**	**-527**	**-527**	**-527**	**-527**	**-527**	**-527**	**-527**	**-527**
Savings from CO2 emissions, 10^3 MDL		618	662	707	751	795	839	882	925	952	979	1 005	1 031	1 056	1 081	
Cost savings in gas consumption, 10^3 MDL		1 204	1 253	1 301	1 349	1 396	1 443	1 488	1 533	1 576	1 619	1 660	1 701	1 740	1 779	
Savings in staff cost, 10^3 MDL/year	0	63	125	186	246	305	363	420	476	530	583	635	686	735	782	
Net annual savings, 10^3 MDL/year		1 885	2 040	2 194	2 346	2 497	2 645	2 790	2 933	3 059	3 181	3 301	3 418	3 531	3 642	
Annual cash flows, 10^3 MDL	**-8 607**	**1 885**	**2 040**	**2 194**	**2 346**	**2 497**	**2 645**	**2 790**	**2 933**	**3 059**	**3 181**	**3 301**	**3 418**	**3 531**	**3 642**	
Discounted cash flows (with DR 4%), 10^3 MDL	-8 607	1 812	1 886	1 950	2 006	2 052	2 090	2 121	2 143	2 149	2 149	2 144	2 135	2 121	2 103	
Cumulative discounted cash flows, 10^3 MDL	-8 607	-6 795	-4 908	-2 958	-952	1 100	3 190	5 311	7 454	9 603	11 752	13 896	16 031	18 152	20 255	
NPV with DR (4%), 10^3 MDL	**20 255**															
Economic Internal Return Rate after 15 years, %	**26%**															
Pay-back period, Years	**5,0**															
3 Digital investments, 10^3 MDL	**-6 907**															

4 Total

Calculation of EIRR (with the valuation of CO2 savings)																
Annual cash flows, 10^3 MDL	**-88 898**	**-65 636**	**-57 132**	**29 169**	**47 407**	**62 877**	**74 939**	**88 469**	**110 298**	**126 383**	**129 073**	**134 729**	**140 635**	**145 238**	**151 610**	
Discounted cash flows (with DR 4%), 10^3 MDL	-88 898	-63 111	-52 821	25 931	40 524	51 680	59 225	67 229	80 593	88 795	87 197	87 517	87 840	87 226	87 551	
Cumulative discounted cash flows, 10^3 MDL	-88 898	-152 009	-204 831	-178 900	-138 376	-86 696	-27 471	39 759	120 352	209 147	296 344	383 862	471 702	558 928	646 479	
NPV with DR (4%), 10^3 MDL	**646 479**															
Economic Internal Return Rate after 15 years, %	**25%**															
Pay-back period, Years	**7,0**															
Calculation of IRR (without the valuation of CO2 savings)																
Annual cash flows, 10^3 MDL	**-88 898**	**-69 343**	**-64 414**	**17 868**	**31 646**	**42 219**	**48 953**	**56 737**	**72 410**	**82 620**	**84 076**	**88 522**	**93 241**	**96 682**	**101 918**	
Discounted cash flows (with DR 4%), 10^3 MDL	-88 898	-66 676	-59 555	15 884	27 051	34 701	38 689	43 115	52 909	58 047	56 798	57 502	58 238	58 065	58 855	
Cumulative discounted cash flows, 10^3 MDL	-88 898	-155 574	-215 129	-199 244	-172 193	-137 492	-98 804	-55 688	-2 779	55 268	112 066	169 569	227 807	285 872	344 727	
NPV with DR (4%), 10^3 MDL	**344 727**															
Internal Return Rate after 15 years, %	**17%**															
Pay-back period, Years	**9,0**															

Annex 3 – ESAP and E&S Report

ANNEX 4 – PERFORMANCE REQUIREMENTS

ANNEX 5 – STAKEHOLDER ENGAGEMENT PLAN

ANNEX 6 – GET & OTHER MEASURING INDICATORS

Standard measuring indicators:

Sector	Indicator	Projected after implementation completion*
District Heating (obligatory)	Total population benefiting from district heating total In project area of the PIP	105,000 37,200
	Annual reduction in tonnes of CO_2 equivalent in project area.	23,681
District Heating (optional)	No. of people with metered supply at either building or flat level.	105,000
	Annual reduction in tonnes of CO_2 equivalent per person in project area (of the PIP).	0,64

GET impact indicators (as applicable):

GET impact indicator	Unit	Data point to be collected
Primary energy saved	GJ/yr	422 032
CO2 emissions reduced	tonnes CO2e/yr	Baseline CO2 emissions: 66,498 (CO2 footprint from CHP shared between heat and power production) or 78,830 (CO2 footprint from CHP attributed only to thermal energy) Project CO2 reduction: 23,681
Material savings	tonnes/yr	n.a.

Water saved	m3/yr	baseline water use: 90,288 m3/year project water savings: 11,301 m3/year

	Types of DH System						
Water Saving Measure	**Open System** - No IHS[2] - Building heating with network water - No hot water (possible theft of network water)	**Open System** - No IHS - Building heating with network water - Hot water directly drawn from network water	**Closed System** - IHS - Building heating hydraulically separate from network - No hot water	**Closed System** - IHS - Building heating hydraulically separate from network - Hot water generated at IHS	**Part-Closed System** - CHS[3] - Hydraulically separate secondary network for heating in multiple buildings fed from CHS - No hot water (possible theft of secondary network water)	**Part-Closed System** - CHS (4 pipe system) - Hydraulically separate secondary network for heating in multiple buildings fed from CHS - Hot water generated at CHS and distributed to multiple buildings	**Steam Networks** - Thermal energy transmission by steam rather than hot water
Network pipe rehabilitation - Reduced distribution water losses	n.a.	n.a.	Not covered by the PIP			n.a.	n.a.

[2] Individual Heating Substation (typically building level)

[3] Central Heating Substation (typically serving multiple buildings)

IHS installation and conversion to a closed system - Reduced theft of network water - CHS removal leading to reduced network length and reduced losses - Isolation and identification of building level water losses	n.a.	n.a.	Installation of 166 IHS under the PIP. Installation of horizontal networks in 296 buildings (38% of residential buildings). 2,757 m3/year	n.a.	n.a.
Improved network pressure control - Reduction in leakage due to overpressure	n.a.	n.a.	Level of reported make-up water already at a low level	n.a.	n.a.
Implementation of meter based billing and cost recovery tariffs - Reduced hot water consumption due to behavioural change - Reduction in theft of system water due to easier identification of system losses	n.a.	n.a.	100% metered billing already in place	n.a.	n.a.
Improvements to boilerhouse or CHP water preparation, treatment or heat rejection systems - Reduced water consumption at heat generation facilities	n.a.	n.a.	Upgrading of water treatment facilities (reduction of steam purge) 8,544 m3/year	n.a.	n.a.
Steam condensate return installation - Reduce or eliminate condensate going to drain	n.a.	n.a.	n.a.	n.a.	n.a.

Resource utilisation and GHG emissions table

Parameter	Comments	Current operation		Estimated performance (=reduction) post investment	
Fuel used		Amount (PIP area)	Unit	Amount	Unit
Gas	displaced energy from electricity consumption, reduction in heat consumption	1,185,115	GJ/year	422,032	GJ/year
Raw Materials and Resources used		Amount (whole system)			
Water	reduction of steam purges, development of horizontal networks	90,288	m3/year	11,301	m3/year
Air emissions					
CO2		66,498 (when CO2 footprint shared between heat & power) 78,830	tonnes/year	23,681	tonnes/year

Energy summary table (calculated for CET-Nord area)

City of Balti, Moldova	Units				
General numbers					
Population - total in the city	Number	151,800			
Population - served by the DH	Number	70,000			
Population - served by the DH/total in the city	%	46			
Population - project area	Number	37,200			
Population - project area/total served by the DH	%	53			
Baseline - DH current supply areas		CET-Nord	PIP area		
Total consumption of heat & hot water	MWh/y	180,871	83,876		
Total generated heat & hot water energy	MWh/y	226,089	104,845		
Total fuel consumption	MWh/y	267,519	124,057		
Total heat losses (incl. boilers efficiency)	MWh/y	86,648	40,181		
Baseline - DH after extension			PIP area		
Total consumption of heat & hot water	MWh/y		132,201		
Total generated heat & hot water energy	MWh/y		173,881		
Total fuel consumption	MWh/y		249,074		
Total heat losses (incl. boilers efficiency)	MWh/y		116,873		
Energy balance - DH current supply areas		Before project	After project	Savings %	
Fuel consumption (with displaced electricity consumption)	MWh/y	329,199	211,968	36%	
Electricity consumption	MWh/y				
Water consumption	m3/y	90,288	78,987	13%	
CO2 emissions	Tonnes/y	66,498	42,817	36%	
System efficiency	%				
Number of heat meters (either building or flat level)	Number	100%	100%		
Savings by project components (DH after extension)		Fuel	Electricity	Water	CO2
biomass boilers	%	NA	NA	NA	NA
connection of new customers	%	72%			72%
upgrade of water treatment	%			76%	
upgrade of existing substations	%	18%			18%

	replacement of existing pipes	%		NA	24%	NA

Note: Project financed by Grant to be presented in a separate table

Project and result matrix

District Energy

Principal Eligibility Criteria	***yes /no***	***Expected results & Achievements/Comments***	***Baseline data***
The district heating system is upgraded and/or extended: Indicator: Number of persons using modernised district heating.	yes	Supply and installation of IHS Installation of Horizontal Networks Incl. Domestic Hot water Building of Heat storage Upgrade of Water treatment facilities	37,200 inhabitants covered by the PIP
Improved district heating operations reduces carbon emissions. Indicator: Tonnes of CO_2 per year before and after project implementation	yes	Energy savings through installation of IHS and Horizontal Network	Before: 66,498 (when CO2 footprint is shared between heat & power) or 78,830 tonnes/year (when CO2 is exclusively attributed to heat energy) After PIP: reduction by 23,681 tonnes/year

ANNEX 7 – CALCULATIONS OF HEAT LOSSES

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