

## District Heating Systems in Republic of Moldova: Reality and Perspectives

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**Abstract.** The article presents the history of centralised district heating systems in Republic of Moldova, evolution, current state and prospects for short-term investments financed by raising funds from external creditors. Centralized heating in the Republic of Moldova is analyzed in the light of the activities of the license holders, regulated by the National Energy Regulatory Agency, particularly of those from mun. Chisinau and mun. Balti. In most cases, this centralized heating supply systems are in operation over 50 years already, so their rehabilitation is very appropriate considering their over dated lifetime period, and the moral and physical wear. At the level of heat sources, the physical wear of the fixed assets is about 70%. The heat transportation and distribution networks are being now renovated, using pre-insulated pipes from expanded polyurethane, at the level of 10%, and the growth of the renovated pipes share will lead to the lowering of the energy losses in this systems. The scope of the paper is the analysis of the key technical indicators and the description of the experience regarding the projects related to the enhancement of energy efficiency of centralized heating systems in mun. Chişinău and mun. Bălţi, projects that are carried out in the last years, and implemented with the financial support of the foreign partners. Are analyzed main functioning indicators of the centralized heating systems for the period 2015-2018 years, inclusive production volumes, supply, and level of heat losses. A short analysis regarding centralized heating in some European Union countries, has been presented, as well.

**Keywords:** centralised district heating system, heating networks, heat energy, central district heating plant, individual heating plant.

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### Sistemele centralizate de încălzire în Republica Moldova, realitate și perspective

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**Rezumat.** Articolul prezintă file din istoria sistemelor de alimentare centralizată cu energie termică în Republica Moldova, evoluția, starea actuală și perspectivele investiționale pe termen scurt, finanțate din fonduri externe. Încălzirea centralizată în Republica Moldova este analizată prin prizma activității titularilor de licență reglementați de către Agenția Națională pentru Reglementare în Energetică, în deosebi al celor din mun. Chişinău și mun. Bălţi. Sistemele de alimentare centralizată cu energie termică, în majoritatea cazurilor, funcționează de peste 50 de ani, iar renovarea lor este foarte actuală prin prizma duratelor utile de funcționare expirate, respectiv uzura fizică și morală al instalațiilor. La nivel de surse de energie termică uzura mijloacelor fixe constituie circa 70%. Rețelele termice de transport și distribuție, în prezent, sunt renovate cu utilizarea conductelor preizolate din poliuretan expandat, la nivel de circa 10%, iar creșterea procentului de renovare al rețelelor termice va conduce la diminuarea nivelului de pierderi de energie în sistemele de alimentare. Scopul lucrării constă în analiza indicatorilor tehnologici și descrierea experienței privind realizarea proiectelor de îmbunătățire a eficienței energetice al sistemelor centralizate de încălzire din mun. Chişinău și mun. Bălţi, proiecte aflate în derulare pe parcursul ultimilor ani și realizate cu suportul partenerilor financiari externi. Sunt analizați indicatorii principali de funcționare al sistemelor pentru perioada anilor 2015-2018, inclusiv volumele de producere, livrare, nivelul pierderilor de energie termică. Indicatorii tehnologici sunt analizați în secțiune pe fiecare titular de licență, de asemenea, per sistem. Prezentată o analiză succintă privind încălzirea centralizată în unele țări din Uniunea Europeană.

**Cuvinte-cheie:** sistem de alimentare centralizată cu energie termică, rețele termice, energie termică, punct termic central, punct termic individual.

## Централизованные системы теплоснабжения в Республики Молдова, реальность и перспективы Леу В., Черней М.

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**Аннотация.** В работе представлена краткая информация о истории и развитии централизованных систем теплоснабжения в Республики Молдовы, также представлено сегодняшняя ситуация и краткосрочные инвестиционные перспективы, финансируемые с привлечением внешних кредиторов. Централизованные системы теплоснабжения в Республике Молдова рассмотрены в контексте деятельности экономических агентов, лицензированные Национальным Агентством по Регулированию в Энергетики, в частности, в мун. Кишинев и мун. Бэлць. Рассмотренные централизованные системы теплоснабжения, в большинстве случаев, работают более 50 лет, а их модернизация очень актуальна в контексте истекания полезных сроков эксплуатации оборудования, также морального и физического износа основных фондов и технологий. На уровне источников тепловой энергии износ основных фондов составляет порядка 70%. Магистральные и распределительные тепловые сети, на данный момент, заменены на уровне 10% с применением предварительно изолированных полиуретановых труб, а их модернизация приведет к уменьшению тепловых потерь в данных системах. Цель работы состоит в анализе технологических параметров функционирования и описание опыта внедрения проектов по повышению энергоэффективности централизованных систем теплоснабжения муниципалитетов Кишинев и Бэлць, проекты, находящиеся в стадии реализации в последние годы при поддержке внешних финансовых партнеров. Проанализированы основные показатели работы систем за 2015-2018 годах в разрезе каждого предприятия и в целом по системе, в том числе, объемы производства тепловой энергии, продаж, тепловых потерь. Представлена краткая информация о централизованных системах теплоснабжения в некоторых стран Европейского Союза.

**Ключевые слова:** централизованная система теплоснабжения, тепловые сети, тепловая энергия, центральный тепловой пункт, индивидуальный тепловой пункт.

### I. CHAPTERS OF THE CDHS HISTORY

The centralised district heating systems (CDHS) in the Republic of Moldova had known a positive evolution with the period 1990-ies, due to intense urban development, industrial development, policies in the energy sector and low prices for energy resources. The heating system reached the 75% level of coverage of heat energy consumption in Chisinau City in the early 1990-ies. Further evolution of the CDHS was strongly influenced by the then economic condition in the country, sharp turnabout in prices for imported energy resources, promoted tariff and subvention policy, governmental policy in the energy sector and quality of the services rendered by heat energy suppliers [1]. All such factors led to drastic growth of the prices for heat energy, decrease of the services quality and, as a consequence, to massive disconnection of consumers from the CDHS, significant reduction of the volume of energy supplied and, in many cases, to insolvency of the enterprises. Only the CDHS from Chisinau Municipality and Balti Municipality managed to resist almost wholly in that struggle for survival. But the remaining part of the enterprises had rather limited geographical servicing areas, so heat energy was supplied only to preschool establishments, school

establishments and other budget-funded consumers but not to residential ones.

Although the CDHS had many both financial and technical difficulties, it had operated almost to the fullest extent till 2000 when, according to the provisions of Ordinance of Government no.438 of 10 May 2000 [2], Termocomenergo Republican Production Association and its subunits were divided and their property was transferred into ownership of the administrative-territorial units of the first level. According to that Ordinance, the local public authorities:

- should found municipal heating enterprises based on the property handed over to them, within a 10-day period of the day of handover and acceptance of such property;
- should approve and apply the tariffs for heat energy produced and supplied by the heating enterprises within the administered territory, in conformity with the Methodology for Tariff Calculation and Application, adopted by the National Energy Regulatory Agency.

The majority of the local public authorities were not able to ensure operational state and continuity of centralised district heating services and the reasons therefor were of financial nature, caused to a great extent by vulnerability of their consumers, and of technical nature, conditioned by physical depreciation and obsolescence of the production plants, heat transmission networks,

and heat energy distribution and use plants. The heating system of Chisinau Municipality, which is the first CDHS in the country (district heating plant no.1 was run into production in September 1951), has been continuously evolving and extending its servicing area since its foundation that took place more than 65 years ago. Presently, circa 70% of the inhabitants of Chisinau Municipality are provided with heat energy through this system. Circa 200 thousand apartments are connected to this system for the purpose of using the heating services, and 120 thousand apartments use the warm water supply services. Presently, only circa 1700 dwelling buildings use warm domestic water.

As of the year of 2000 (excluding Chisinau Municipality and Balti Municipality), there were operating 189 CDHS and consumers were provided with heat energy from 121 heating plants of the central district using the fuel based on natural gases, from 46 plants using the heavy fuel oil and from 22 more plants using the coal. The total number of boilers constituted 553 pieces and their aggregate installed capacity had the power installed of 1299.4 Gcal/h. The aggregate heat load of consumers connected to had the value of 375.542 Gcal/h. From the point of view of space heating, the majority of consumers were the dwellings, preschool establishments, school establishments and health establishments. Heat energy produced in 2000 had the value of 1.31 million Gcal.

As the years passed, particularly starting with 2001, the consumers have been continuously disconnected from the CDHS, either in part, or in full. As for Chisinau Municipality, circa 24.1 thousand apartments (circa 11% of the total number of apartments) with the heat load of 85.2 Gcal/h have been disconnected from the CDHS by the present moment. The maximum number of disconnections took place from 2003 to 2005, respectively: 5581 apartments (2003), 5442 apartments (2004) and 2744 apartments (2005).

The first unit of thermal energy production having the capacity of 4 MW and steam boiler no.1 having the output of 20 t/h was run into production in December 1956 heating plant at the central district in Balti Municipality. Presently, the installed electrical capacity makes 24.0 MW and the installed heating capacity has the power installed of 342.0 Gcal/h. The total length of heating networks makes 205.7 km, including the primary circuit of 92.6 km and the secondary circuit of 113.1 km.

As for Balti Municipality (area of control of CET-Nord JSC), the aggregate heat load of consumers connected to the CDHS had decreased from 148.7 Gcal/h to 104.76 Gcal/h from 2001 to 2014. Such a decrease was specific to all categories of consumers: residential sector – from 104.5 to 75.57 Gcal/h, budget-funded entities (preschool establishments, school establishments, health establishments and so on) – from 31.3 to 19.73 Gcal/h, economic subjects – from 12.9 to 9.46 Gcal/h. We shall state the dynamics of disconnections for all categories consumers: the dwelling fund disconnected apartments either partially, or wholly, starting using the suspended-type unit heaters; the budget-funded entities built individual heating plants for their relevant facilities; and the economic subjects had to get disconnected due, to a great extent, to suspension (or limitation) of their business activities or to pass to self-governing heating systems. If considering 753 dwelling buildings with the total area of 1,536,674.7 m<sup>2</sup>, 29.03% of their area is disconnected from the heating system but only circa a half of them have other self-governing heating systems – heating plants based on the natural gases.

Initially, each building had only one heating system, however, disconnections resulted in appearance and existence within a dwelling building of several heating sources. So, the heating system was modified and, as a consequence, deregulated from the hydraulic point of view but the quality of services was affected and degraded. The Law on Heat energy and Cogeneration Promotion [3] sets the legal framework for efficient operation and regulation of the centralised district heating systems, for cogeneration promotion based on useful heat energy demand and for determining the principles of conduct of activities specific to the centralised district heating systems, under conditions of accessibility, availability, reliability, continuity, competitiveness and transparency, subject to abundance by the quality, security and environmental protection standards when producing, distributing, supplying and using heat energy. According to this Law, the heat energy sector is governed by the National Energy Regulatory Agency.

In most Member States of the European Union were adopted a series of measures to encourage investment in renewable energy sources and cogeneration heat and power plants. Directive 2004/08/EC on the promotion of cogeneration and Directive 2012/27/EU on energy efficiency,

established the political framework that allow the expansion of the cogeneration implementation in the Member States [4-6].

The Danish district heating sector has for many years been the centre of attention for a lot of district heating producers and experts from around the world. Today DH has a total market share of 63% of the heating market and is mostly powered by non-fossil energy sources. The history of DH in Denmark has not peaked yet and the market share is expected to grow in the future. An important factor for this development is a strong support from central authorities. Not support through price subsidies or artificial regulation, but by following a clear and steady energy policy with a green and cheap energy-mix as a goal. The role of the municipalities in the implementation of the national energy policy is very important, as the municipalities have a natural interest in developing a good local district heating system for the benefit of the inhabitants in the urban areas. The district heating network is regarded as a natural part of the urban infrastructure, through which all buildings in districts with sufficient heat density (i.e. sufficient population density) are supplied. Similarly, heat planning is an integral part of urban planning. Urban development areas are therefore provided with district heating as well as water, sewage and other services. Less densely populated districts are supplied directly with gas, whereas buildings supplied with gas might shift to district heating in the course of time, as the urban heat density increases [7,8].

You may find a district heating system, which, one could say, is typical for the Danish approach today; however, there are no obligatory norms and standards that specify detailed technical solutions and design criteria which have to be followed. On the contrary, the technological development is very dynamic and you will find a huge variety of technical solutions. Installations which are more than 30 years old and which still operate are, of course, different from the new installations, but even new installations may be based on different solutions adjusted to the local conditions and the opinion of the local decision makers.

In Romania, the National Energy Regulation Authority regulates the centralized heating supply systems [9,10]. At the moment are operating approximately 50 centralized systems, which are supplying heat to over 1,15 million flats. The biggest systems are located in Bucharest and Iași. The majority of this systems are managed by the

local authorities, the attraction of investments for modernisation of this systems is of current interest, both at the level of generation sources, and at the level of transportation and distribution of heat.

In the same time there are examples of modernization of this kind of centralized heating supply systems, inclusive in related to fuel switch to biomass, e.g. Suceava [11,12].

In Hungary there are about 650 thousand apartments in 95 towns supplied by district heat. Approximately 80% of the thermal energy delivered of centralized heating systems are consumed by households (for heating and hot water consumption). District heating services are local public utility services [13,14].

The participants of the sector are district heat suppliers, district heat generators (generally acting as traders) and district heat traders (those who do not generate heat, but purchase it and sell it to suppliers).

In general, one district heat supplier operates in each town.

There are, however, several towns with more than one district heat supplier holding an operating license, and there are companies that provide district heating supply in more than one town. Those suppliers engaging in district heat generation as well (either via cogeneration and/or using boilers) hold a generating license in the town supplied by the service.

In Lithuania [15,16], in the heat energy sector the NCC was regulating 49 heat suppliers (35 were controlled by the municipalities, 14 were the undertakings operating on the basis of leasing (concession) agreements.

The NCC performs the regulation of the heat energy suppliers producing over 10 GWh of heat energy per year; the smaller heat supply undertakings are regulated by the municipalities. In 2016, the NCC was also regulating 43 independent heat producers and 21 non-regulating independent heat producers.

The heat suppliers regulated by the NCC produced 8 973 GWh of heat energy and serviced 702 thousand customers. In the market structure of the fuel used for the heat energy production the share of natural gas constituted 39,5 percent, the market shares of biofuel – 58,7 percent. Among 60 municipalities of Lithuania, in 6 municipalities natural gas constituted more than 50 percent in the structure of the fuel used for the heat energy production, and in 54 municipalities the respective percentage was made up by biofuel.

## II. CONDITION OF THE FOR CENTRALISED DISTRICT HEATING SERVICES

In 2016, the centralised district heating services were provided by 7 licence holders governed by the Agency and conducting their

activities on above services rendering in municipalities, cities and towns [17].

The evolution of the 2016 to 2018 heat energy balance is presented in table 1 and the dynamics of heat supplies in the period 2015-2018 is presented in table 2.

Table 1. Evolution of the 2016 to 2018 heat energy balance

Name of the enterprises	Heat energy supplied within the network, ths. Gcal			Heat energy losses, ths. Gcal			Useful supplies to final consumers, ths. Gcal			Share in the total amount of supplies, %		
	2016	2017	2018	2016	2017	2018	2016	2017	2018	2016	2017	2018
Termoelectrica JSC	1698,7	1635.8	1710.1	324.3	349.6	335.8	1374.4	1286.3	1374.2	86.3	86.5	86.3
CET-Nord JSC	205.1	192.9	211.8	43.3	42.5	45.0	161.8	150.4	166.8	10.2	10.1	10.5
Apa-Canal Chisinau JSC	26.7	25.1	28.2	2.4	2.7	3.2	24.2	22.4	25.0	1.5	1.5	1.5
Termogaz-Balti Municipal Enterprise	11.7	11.2	12.4	1.3	1.2	1.3	10.5	10.1	11.0	0.7	0.7	0.7
Comgaz Plus JSC	8.8	7.4	7.1	1.4	1.0	0.9	7.4	6.4	6.2	0.5	0.4	0.4
R.C.T. Comrat Municipal Enterprise	7.5	7.0	7.9	0.2	0.3	0.3	7.3	6.7	7.6	0.5	0.5	0.5
"Thermohouse" LCC	5.5	3.5	0.0	0.8	0.5	0.0	4.6	3.0	0.0	0.3	0.2	0.0
Glodeni Municipal Enterprise	2.1	2.1	2.0	0.1	0.2	0.1	2.0	1.9	1.9	0.1	0.1	0.1
<b>In total for regulated enterprises</b>	<b>1966.2</b>	<b>1885.1</b>	<b>1979.5</b>	<b>373.8</b>	<b>398.0</b>	<b>386.7</b>	<b>15923</b>	<b>1487.2</b>	<b>1592.8</b>	<b>100</b>	<b>100</b>	<b>100</b>

In the total volume of heat energy supplied by centralized district heating and thermal power plants of the regulated enterprises from the heat energy sector (excluding technological consumption and their own consumption) made 1,979.5 thousand Gcal in 2018, having increased by 94.4

thousand Gcal, or by 5.0 %, if compared to the previous year. Thus, there was kept the tendency of growth started in 2016 when the amount of heat energy produced increased too – by 13.3 thousand Gcal (0.7 %) in comparison with the preceding year.

Table 2. The dynamics of heat supplies in the period 2015-2018

Name of the enterprises	Useful supplies to final consumers, ths. Gcal				Changes, %		
	2015	2016	2017	2018	2016/2015	2017/2016	2018/2017
"Termoelectrica" JSC	1302.6	1374.44	1286.27	1374.24	5.52	-6.41	6.84
"CET-Nord" JSC	156.73	161.81	150.37	166.84	3.24	-7.07	10.96
"Apă-Canal Chişinău" JSC	23.00	24.24	22.41	24.97	5.39	-7.55	11.39
Î.M. "Termogaz-Bălţi"	10.51	10.47	10.07	11.05	-0.38	-3.82	9.73
"Comgaz Plus" JSC	7.37	7.42	6.36	6.23	0.68	-14.29	-1.97
R.C.T. Comrat Municipal Enterprise	5.95	7.29	6.71	7.61	22.52	-7.96	13.33
"Thermohouse" LCC	0.00	4.63	3.03	0.00		-34.56	-100
Glodeni Municipal Enterprise	1.89	2.02	1.92	1.90	6.88	-4.95	-1.05
<b>In total for regulated enterprises</b>	<b>1513.3</b>	<b>1592.3</b>	<b>1487.1</b>	<b>1592.8</b>	<b>5.22</b>	<b>-6.61</b>	<b>7.11</b>

So, functioning of the enterprises in 2018 was rather equal to their operation in 2017. The increase of the amount of heat energy produced was conditioned by the environmental temperatures registered in 2018 and being significantly lower than before.

Technological consumption and effective heat energy losses made 386.7 thousand Gcal in 2018, this making 19.5 % of the heat energy volume delivered from the network.

The evolution, description and priority investments into the centralised district heating system (CDHS) from Chisinau Municipality were thoroughly analysed by the local and international experts and were described in the relevant studies [1, 18]. The Study [18] regarding Identification of Near-Term Priority Investments and Preparation of Their Technical Specifications and Tender Documents, realised by the Swedish Company – Sweco International AB Stockholm, served as a basis for implementation of the Project on Centralised District Heating Improving Efficiency. That project is realised based on the Funding Agreement between the Republic of Moldova and International Bank for Reconstruction and Development for Realisation of the Project on Improving Centralised District Heating Efficiency [21].

The project [18] foresees a range of priority investments aimed to heating networks modernisation and to use of pre-insulated pipes, transition from plants of central district heating to up-to-date individual ones, so that heat energy and warm water would be supplied to final consumers in a more qualitative and efficient manner. The specific objectives of project implementation are: improvement of availability, quality and efficiency of heating services in Chisinau.

The detailed information on realisation of investments within Chisinau Municipality CDHS is presented in [19, 20]. Such investments are focused on assurance of operational durability and efficiency of “Termoelectrica” JSC by granting funds for:

- Rehabilitation of some segments of heat distribution networks, in order to ensure continuous CDHS operation under secure conditions and to reduce heat energy and warm water losses.
- Reconnection to the CDHS of circa 40 buildings and complexes of public buildings (disconnected before), in order to improve CDHS operation.

- Modernisation of the main pumping plants – SP-8, SP-12 and SP-13, in order to reduce electrical power consumption and to propose a pattern of up-to-date and effective operation with a variable flowrate within the CDHS.
- Replacement of old and inefficient thermal energy distribution systems used in centralized heating systems with fully automated individual ones and installed at the building level, so that they can provide thermal energy to final consumers in a more efficient, safe and accessible way.

Three projects based on the project mentioned in [22] were selected within the framework of CET-Nord JSC to take part in the investment program supported by the loan granted by the European Bank for Reconstruction and Development. Such projects are:

- Increase of the installed capacity of CET-Nord by installing three gas engines that will enhance the electrical power production by circa 60%.
- Replacement of existent pumps and fans that are physically depreciated and obsolete with high-performance plants equipped with frequency converters, this leading to reduction of the need for extra electrical power by circa 30%.
- Replacement of coal-fired boilers from the central district heating plant with pellet-fired ones.
- Mounting of 169 individual heating plants in 120 buildings, inclusively for preparation of warm domestic water, and arrangement of the automated data collection system of SCADA type.

Such investments shall be funded from a loan from the European Bank for Reconstruction and Development, amounting to 6,100,000 EUR, and from a grant amounting to 3,550,000 EUR from the part of the Eastern Europe Energy Efficiency and Environment Partnership. Realisation of these investments and, as well, identification and attraction of other ones within the CDHS framework will allow to increase reliability, electrical power production, heat energy production, operational durability and energy efficiency.

### III. CONCLUSIONS

1. The CDHS are operational from the technical point of view, however, considering their general physical depreciation and obsolescence, they are lagging the pre-sent-day energy technologies and installations.

2. It is required to develop the energy strategies for localities, precisely stipulating a real short-term and long-term actions plan aimed to CDHS development and modernisation, taking into account innovative practices in the field of thermal energy insurance.
3. Abidance by the fundamental regulation principles is a precondition for assurance of CDHS functionality and reliability, inclusively for modernisation of the heat energy plants infrastructure.

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