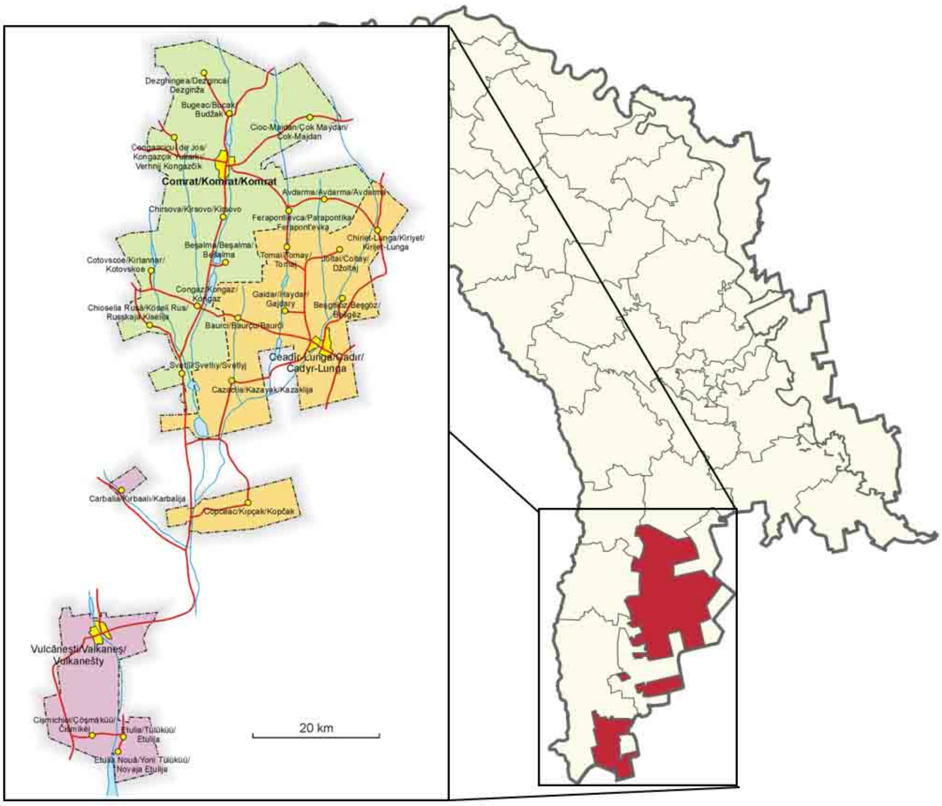
Modernization of the Local Public Services in the Republic of Moldova



Project Concept
(report on walk-through energy audit)

Sport Complex of the Comrat State University,
Comrat municipality

May 2018

Published by:

Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

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Prepared for:

The project 'Modernization of local public services in the Republic of Moldova' (MLPS) is implemented by the German Development Cooperation through GIZ in partnership with the Ministry of Agriculture, Regional Development and Environment of the Republic of Moldova and is financially supported by the German Ministry of Economic Cooperation and Development (BMZ), the European Union, the Swedish Government, the Romanian Government, and the Swiss Agency for Development and Cooperation (SDC).

Project Partners:

Ministry of Agriculture, Regional Development and Environment of the Republic of Moldova
North, Center, South and ATU Gagauzia Regional Development Agencies

The expressed opinions belong to the author(s) and do not necessary reflect the views of the implementing agency, project's funders and partners.

Comrat, May 2018

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Institution: Sport Complex of the Comrat State University, Comrat municipality

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Foreword

The main goal of the project concept is to increase the efficiency of the energy resources use at the regional level in ATU Gagauzia through the implementation of energy-saving measures and technologies in public buildings.

The objectives of the concept project are:

- *identification of energy saving potential for the specific institution;*
- *facilitation of the decision-making process of the responsible authorities and financial organizations when considering the possibility of investment.*

Specific objectives are:

- *Development and implementation of pilot projects for demonstration of the application of innovative energy efficiency in public buildings;*
- *Informing and training of local stakeholders on energy efficiency issues;*
- *Increase the involvement of the local public authorities and population in the initiatives related to energy efficiency sector;*

Developing of a monitoring and replication mechanisms to ensure the reproduction of project results in ATU Gagauzia and in entire country.

1. Introduction

The Sports Complex is part of Comrat State University, representing a separate building in the immediate neighbourhood to the central campus. The building accommodates a large sports hall and auxiliary facilities (locker rooms, showers, storage rooms, etc.). The complex is used not only for the needs of the university, but also for different kinds of training for the city residents, competitions of local and international scale.

Photo 1 Main access to the Sport Complex of the Comrat State University (from the west street side)

Photo 2 Sport Complex (Orto photo), Scale 1:500 . Source – www.geoportal.md.

Components (mentioned on the photo 2):

А – main block of the Sport Complex (gym)
Б – auxiliary block (locker rooms, showers, storage rooms, classrooms etc.)
В – boiler house.

The working stuff consists of 5 employers.

2. Energy Consumption

The electricity consumption was 8 MWh in 2014 with a big increase to 10 MWh in 2016. Between 2014 and 2016, the average electricity demand was 9 MWh per year. It is observed a consumption of electricity of 6,5 kWh/m2, and this is a low value for a school.
Gas consumption increased from 9000 m3 in 2014 to 12000 m3 in 2016, by 25%, or average consumption of 10000 m3 of gas per year, or approximatively 71 kWh/m2 per year, and this is a low value for a school.
Low energy consumption indicates low rate of usage of the building and low quality of services – this have to be changed after the implementation of project.

Table 1 Energy consumption

Energy	unit	consumption		
		2014	2015	2016
Electricity	kWh	8000	9350	10000
Gas	$м^3$	9000	9000	12000

3. General data on the studied building

3.1 Heating system

The building is heated by a boiler house located nearby. The thermal agent goes by the shortest path into the building.

3.1.1 Boiler house

The boiler house is supposed to provide heat only for the Sport Complex, it is powered by gas. The installed boilers are “Sime”, 2 pieces.

3.1.2 Heating system and network

Internal heating network was installed in 1986 and never changed from that moment.

3.2 Hot water supply system

Hot water is available in the shower rooms; it is provided by an electric boiler.

3.3 Fresh water supply and sanitation system

The building is supplied with fresh water from the urban water supply system, sewerage system is connected to urban sanitation system.

3.4 Electricity consumption system

The electricity supply is provided by the local distributor Gas Natural Union Fenosa.

3.5 Natural gas supply system

The source of natural gas supply into the boiler house is the city’s natural gas distribution system.

3.6 Previously implemented energy efficiency projects

In 2013 the flat roof of the building was refurbished, but in 2014 it was partially destroyed because of strong wind meteorological conditions.

3.7 Planned projects for the coming years

In the near future it is planned to refurbish the roof, at least the most affected part of it.

4. Data on the proposed project

4.1 Description of the current situation

The analyzed institution was built in 1986. In a spatial arrangement, the shape of the building resembles the shape of T letter, consisting from 2 parts – block A and B, connected with a common wall and corridors. Both blocks are one-floor, there is no basement or technical floor. The main entrance to the building is on the west side. To the north side of the building there is a boiler room.

Block A

The gym is suitable for all kinds of sports activities and competitions. At the time of the experts' visit, due to damage in the roof, it was clearly visible how gym is flooded with rainwater, which flows along the walls. Visible traces of degradation of load-bearing structures were not observed.

Block Б

In this part of the building there are auxiliary rooms are located: men's and women's locker rooms, showers, toilets, a sauna, storage facilities for sports equipment, as well as 3 classrooms. Same as previous, no visible signs of degradation of load-bearing structures were observed.

Table 2 Building area

	Block A	Block Б
Floor area	798 m^2	520 m^2
Total area of the building	1318 m^2	

4.2 Building proprieties (constructive part)

The foundation of the building consists of concrete blocks; the basement is missing around the perimeter.

The external walls of Block A are laid out of concrete slabs 300 mm wide, plastered from the external and inner sides. Bearing vertical elements consist of reinforced concrete columns with a cross section of 300 x 700. The ceiling consists of ribbed panels supported by precast reinforced concrete trusses.

External walls of block B are built from limestone, the width of the walls is 500 mm, including interior and exterior finish. The main internal walls are also made of limestone. Bearing vertical elements consist of reinforced concrete columns with a cross section of 400 x 400 mm. The overlap consists of hollow-core reinforced concrete panels. Internal partitions consist mainly of gypsum boards.

Table 3 Characteristics of the external walls

	Block A	Block Б
External walls area	780 m^2	196 m^2
Plinth area	42 m^2	30 m^2

4.3 Windows and doors

In the whole building wooden and metal doors and windows are installed, some are badly closed or have cracks along the perimeter, letting the outside air inside. The windows in the gym are in very poor condition, as they are exposed to moisture (rainwater is flowing directly from the damaged roof).

Table 4 Windows and doors in blocks A and B

	Block A and block Б
Number of windows	60 pcs
Number of doors	3 pcs
Windows area	295 m^2
External doors area	15 m^2

Photo 3 Wooden window, south façade

Photo 4 Auxiliary door, south facade

4.4 Roof

The roof of the whole building is flat with soft type of coating material. Under the roof there is no attic or technical floor. In Block Б, there are no roof leaking sings, in contrast to Block A, where this process is very easy to see. Water from block A is evacuated through a single drain or the precipitation is drained off the edge of the roof. Total rood area is 1400 m^2.

Photo 5 Rainwater drain, connection between block A and Б

4.5 Heating system

The building is heated by its own gas boiler house. In a stand-alone building (Block B) 2 boilers are installed. From the boiler house, the thermal agent is going through insulated pipes (about 10 m), passing above the ground, enters the building, where it is distributed throughout the system. At the time of the visit there were no events in the building, the temperature in the building was kept at a minimum level. The heating system is two-pipe, in the block A tubular radiators covered with wooden grilles are installed, in block Б - mainly cast-iron radiators are installed.

Photo 7 Boiler house

Photo 6 Tubular radiators in the gym

4.6 Ventilation system

There is no centralized ventilation system in the building. In the gym, the vents in the roof are blocked. The windows are at high altitude, which does not allow them to be used for mechanical ventilation of the room. In the auxiliary rooms, the forced ventilation system is also not provided, but the ventilation openings in the walls are present, having a direct output to the roof.

Table 5 Initial data for ventilation system calculations

	Block A	Block Б
Temperature requirements according to the norms	17-19 ˚C	19-21 ˚C
Heating volume	4788 m^3	1806 m^3

4.7 Hot water supply

One boiler with the capacity of 100 liters is used for the preparation of hot water, which is supplied to the shower rooms. Type of boiler - Thermex, power - 2 kW. For reasons of economy, the boiler is only used on demand. The possibility of preparing and supplying hot water from the boiler house is not provided.

According to the data received from the administration, 400 people visit the sports center every month, which means about 15 people a day, who potentially can need to use shower rooms. Taking in the consideration the specifics of the building, it is calculated that the amount of hot water required per day is approximately 1125 liters (75 l x 15 people, which on average use showers).

Photo 8 Electric boiler

4.8 Lighting system

In the block A, fluorescent lamps are used around the perimeter of the room for lighting. The illumination level is quite low, individual segments do not work.

In the block Б all the lights are incandescent.

Photo 9 Lighting in the gym

Table 6 Lighting devices in the building

	Block A and Block Б
Number of lighting devices	194 pieces
Average of the lamp power	40 W

5. Project Concept

5.1 Description of the proposed energy efficiency measures

The consultants propose the following list of measures for the thermal rehabilitation of the building:

- **Roof**

Due to severe damage, experts suggest a complete removal of the existing coating. For the subsequent operation it is proposed to install a new flat roof - an inversion combined coating, which is more resistant to problems of water leakage and turns a roof into an exploited space in case of need.
In this case, a concrete layer is poured directly onto the reinforced concrete slabs to create a slope, then two layers of waterproofing from the soft roofing material are installed and only after a 15 cm layer of extruded polystyrene or a layer of rock wool are putted on top. The next layer is laid with a film with high vapor permeability. The final layer is a clamping layer of gravel in 8 cm thick.
It is also necessary to ensure the evacuation of rainwater through drains. For the pipes that goes down, it is important to remove the end away from the building walls (according to the requirements) in order to prevent the destruction of the blind area along the entire perimeter of the building.

Annual energy savings= **144 MWh/y**
Estimated investment = **49 805 €**

- **Facades**

In block A, it is necessary to seal the joints of concrete slabs of walls and remove old cracked coating.

The facade method of thermos insulation of the walls is suggested. On the prepared surface, install a heat-insulating layer (10 cm of rock wool for block A and 5 cm of rock wool for block B), auxiliary layers (glue, fiberglass mesh, primer) and finish with the final decorative coating.
The plinth must also be insulated with a thinner layer of XPS to prevent the penetration of cold directly into the room and its base, as well as to create a barrier to ground moisture and water generated by precipitations. Its installation will require exposing the foundation walls to 50 cm from the ground level, that is, the total height will be 1 m. After installation, restore the blind on the entire perimeter, keeping a slope of at least 7 degrees from the walls of the building. A blind with a width of 70 cm should be framed with a curb, which allows drainage of rainwater.

Annual energy savings = **115 MWh/y**
Estimated investment = **115 738 €**

- **Windows and doors**

Replace obsolete windows and doors with PVC double glazed windows, in the northern part of the building energy-efficient glass Low-E could be used. Ensure embedding of slopes using insulating membranes. External (tin) and internal sills (plastic) should be replaced, also. The windows in the gym should be provided with the possibility of automatic remote opening in case of need for additional ventilation.

Annual energy savings = **35 MWh/y**
Estimated investment = **58 304 €**

- **Additional recommendations**

It is necessary to improve the sanitary conditions in the toilets and shower rooms, as well as in the locker rooms. After refurbishment of the roof of the gym, all the walls should be treated against mold and fungus and the interior coating of the walls should be renewed.

Hot water supply

The preparation and supply of hot water from the boiler room should be provided or solar panels on the roof of the building should be considered as a solution to provide shower rooms with hot water. Since hot water is required during peak hours in a larger amount, the hot water supply system should be considered with a storage tank to ensure maximum draw-off. To properly calculate the right amount of solar panels and the necessary load, to invite a specialist in heating technology.

Ventilation system

The ventilation should maintain the optimum temperature and the flow of fresh oxygen to the gym, and there should be no strong airflows in the room. The intensity of air exchange should be calculated based on current standards. To ensure comfort in the gym, it is recommended to restore the vents in the ceiling to drain condensate (natural ventilation system), equip them with a heater and pallets to drain the accumulated condensate.

Lighting

In all the building the lighting devices should be replaced. LED lamps are suggested to be used, in the gym it is necessary to provide partial lighting of the room (for training with the participation of a small number of people). Considering the fact that during the visit the impression of poor lighting in the gym was created, it was necessary to recalculate the necessary number of lighting devices and their location. In the corridors, use motion sensors to automatically turn off the lighting in the absence of movement.

Heating system

The current organization of the heating system does not allow the regulation of the heating supply for only one part of the building, therefore, the experts' recommendation is to install additional equipment to regulate the supply to different parts of the building, allowing to heat or disconnect unclaimed rooms or areas of the building.

5.2 Preliminary assessment of energy saving potential

The calculation of the preliminary final energy consumption for heating is based on a simplified calculation methodology according to the “Energetische Bewertung von Bestandsgebäuden”; provided by the German Energy Agency. The thermal conductivity of the building elements was estimated based on Moldavian standards and norms and on Consultants experiences.

The preliminary final energy consumption for heating and the estimated saving potential were calculated based on a reference climate, a standard indoor temperature and a basic air ventilation rate.

Note: the results do not necessarily reflect the actual energy consumption of the buildings due to the current poor heating/ventilation comfort in the buildings (e.g. shortened heating period, reduced indoor temperature, poor/no ventilation, etc.).

Table 7 The proposed energy efficiency measures and their characteristics

Proposed measures	Surface, m^2	Annual energy savings, MWh/y	Annual energy savings in €	Investments, €	Reduction of emissions t/CO_2 per year	Payback period, years
Thermal insulation and refurbishment of the roof	1400	144	5 151	49 805	29	12,4
Thermal insulation of the facades	976	115	4 103	115 738	23	36,1
Replacement of the windows and doors	295	35	1 237	58 304	7	60,4
Total	**2671**	**294**	**10 490**	**223 847**	**59**	**27,3**

6. Financial analysis

The estimation of the required investment costs was based on the Consultant’s experiences (specific investment costs per refurbished element). The Consultant did not request/receive offers from potential supplier’s/construction companies. All costs incl. VAT.

The total investment costs were estimated to around **4 588 863 MDL (223 847 EURO)[1].** The share of the energy relevant investments of the total investment is around 50 %. When considering only the energy relevant investment the payback period is **27,3 years.**

7. Preliminary project implementation plan

The description of the steps necessary to implement the described recommendations can be divided into 3 main stages: the development of energy audit of the building, preparation for the implementation of the project and the implementation process itself.

Each stage includes the following actions:

A. Development of energy audit of the building:

- Decision-making on financing of energy audit
- Development of the task of energy audit
- Tender & Energy Audit Contract
- Energy audit
- Designing a design task

B. Preparing for project implementation:

- Decision-making on investment
- Tender for the development of technical documentation
- Development of technical documentation, approval, tender documents
- Tender for project implementation
- Evaluation of offers, contract
- Coordination of the work plan

C. Implementation of the project:

- Preparation of the working field
- Thermal insulation and refurbishment of the roof
- Thermal insulation of the facades
- Replacement of the windows and doors
- Staff training, documentation

Upon completion of the implementation of these measures, the building can be put into operation.

The approximate timeframe for the project implementation plan is given in the annex 1.

8. Conclusion

As a result of the proposed measures, the expected **energy savings will be 294 MWh/y**. Due to this saving, it is estimated that **emissions will decrease** by **59 t/CO_2 per year**.

[1] Exchange rate: 1 EURO = 20,5 MDL (average value for 2017).

Annex 1

Draft Implementation schedule																														
Task No	Phase	Activities Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Task 1	Energy Audit	Funding decission for Energy Audit	■																											
Task 2		Preparation of the Task for Energy Audit		■																										
Task 3		Tender & Contracting Energy Audit			■																									
Task 4		Performing Energy Audit				■	■																							
Task 5		Preparation of the Task for Design						■																						
Task 6	Preparation	Funding decission for Investment							■																					
Task 7		Tender for full technical design								■																				
Task 8		Elaboration of the final design, authority approvals, tender book									■	■																		
Task 9		Tender procedure for implementation company											■	■	■															
Task 10		Assessment of proposals, contract														■														
Task 11		Work packages to be conducted by the institution														■	■													
Task 12	Implementation	Construction site preparation																■												
Task 13		Thermal insulation and replacement of the roof									estimated winter							■	■	■			estimated winter							
Task 14		Insulation of the external walls																		■	■					■	■	■		
Task 16		Replacement of the windows and doors																								■	■	■		
Task 17		Replacement of lighting devices																	■	■	■									
Task 18		Training, documentation																											■	■
Task 19	Acceptance	Final acceptance																											■	■

*Estimated non-working period caused by winter winter conditions; the correct time of this period can indicated earliest at the time of the funding decision

Annex 2.

Анкета

по сбору данныхдля диагностического анализа сектора энергоэффективности в регионе АТО Гагаузии

I. Общиеданные:

Название населённого пункта / района: мун. Комрат

Название публичного учреждения: Спорткомплекс Комратского Госуниверситета

Собственности (АТЕ 1-го / 2-го уровня)

Год строительства здания публичного учреждения: 1986год

Тип строительного материала общественного здания:

- ☐ **Бетонные панели**
- ☐ **Котелец**
- ☐ **Кирпич**
- ☐ Другой (укажите)_______________

II. Энергетическая ситуация в общественных зданиях

Part A. Общие данные об здании:

Укажите пожалуйста значение для следующих показателей:

	Показатели	Единица измерения	Значение
1.	Количество административного персонала:	человек	5
2.	Количество рабочего персонала:	человек	5
3.	Количество пользователей / бенефициаров (**дети / студенты** / пациенты / клиенты)	человек	400
4.	Общая площадь здания	$м^2$	1318
5.	Количество этажей здания	единицы	Одноэтажное
6.	Средняя высота каждого этажа	м	Высота зала -8м Вспомогатель -3м
7.	Общая площадь внешних стен здания	$м^2$	976
8.	Количество окон	единицы	60
9.	Общая площадь окон	$м^2$	295
10.	Общая площадь крыши	$м^2$	1400
11.	Тип крыши:	плоская крыша или **скатная крыша**	2-х скатная с малым уклоном

Part B. Потребление энергии за последние 2 года (по источнику):

Тип источника энергии	Ед. изм.	Потребление		
		2014	2015	2016

Электричество	кВтч	8000	9350	10000
Дизель (исключить транспортные средства)	Литры			
Натуральный газ	$м^3$	9000	9000	12000
Уголь	тонны			
Биомасса (древесная щепа, гранулы и т. д.)	$м^3$			
Централизованное отопления	Гкал			
Другой (укажите) ______________________				

Part C. Энергетические системы

C.1. Тип отопления в здании центральное отопление?

a. Центральное отопление

b. Электрические индивидуальные обогреватели для каждой комнаты

(Если «a» укажите ответы на вопросы 1.1, 1.2, 1.3, если «b» перейдите к вопросу № 2.

1.1. Если есть, укажите тип системы отопления:

- ☐ однотрубная система
- ☐ **двухтрубная система**

1.2. Укажите тип используемого топлива:

- ☐ Электричество
- ☐ **Натуральный газ**
- ☐ Уголь
- ☐ Биомасса (древесная щепа, гранулы и т. д.)

1.3. Укажите мощность(Гкал) _________

C.2. Если используются отдельные обогреватели, какого типа они?

- ☐ Электрические индивидуальные обогреватели
- ☐ Электрические радиаторы
- ☐ Кондиционер
- ☐ Другие (укажите)___________

C.3. Существует ли в здании центральная система горячего водоснабжения или используется ли отдельные бойлера?

- ☐ Центральная система горячего водоснабжения
- ☐ **Электрический бойлер**
- ☐ Нет горячей воды
- ☐ Другой (укажите)___________

C.4. ***Есть ли в здании центральная система кондиционирования воздуха или используется отдельная система для каждого помещения?***

- ☐ Центральная система кондиционирования (рабочая)
- ☐ Центральная система кондиционирования (нерабочая)
- ☐ Индивидуальная система в каждом помещении (рабочая)
- ☐ Индивидуальная система в каждом помещении (нерабочая)
- ☐ **Отсутствует вообще**

C.5. Есть ли центральная система вентиляции:☐ Да; или☐ Нет.

Какова она?

- ☐ принудительный
- ☐ **<u>естественный поток</u>**

C.6. Система внутреннего освещения:

Показатели	Ед. изм.	Значение
Количество ламп	единицы	194
Тип ламп(светодиодные-LED, **люминесцентные лампы, лампы накаливания)**	тип	194
Средняя мощность ламп	W	40
система автоматизации освещения	Да / нет	нет

Part D. Описание бойлеров

Количество бойлеров: ____1_____

Тип топлива, используемого для **бойлеров:**

- ☐ **Электричество, Установленная мощность (кВтч):** ___2квт_ эффективность (%)____
- ☐ Уголь, Установленная мощность (кВтч): _________ эффективность (%)____
- ☐ Газ, Установленная мощность (кВтч): _________ эффективность (%)____
- ☐ Мазут, Установленная мощность (кВтч): _________ эффективность (%)____
- ☐ Дизель, Установленная мощность (кВтч): _________ эффективность (%)____
- ☐ Биомасса, Установленная мощность (кВтч): _________ эффективность (%)____

Part E. Другие единицы потребления энергии

E.1. Духовки (кухни)

Количество духовок, используемых в здании __нет__ единиц

Тип потребляемой энергии:

- ☐ Электричество
- ☐ Газ
- ☐ Другое (просьба указать)___нет ничего ____

E.2. Существует ли стационарные группы двигателей внутреннего сгорания, электрогенераторы?

Количество электрогенераторов: ____нет________

Установленная мощность электрогенераторов (кВт): _____________

Средние рабочие дни для электрогенератора в год: ____________

III. Просьба указать, есть ли проекты энерго эффективности, внедренные в течение последних 5 лет?(если таковые имеются)

Проект	Год внедрения	Донор	Стоимость, тыс. лей
Отсутствует			