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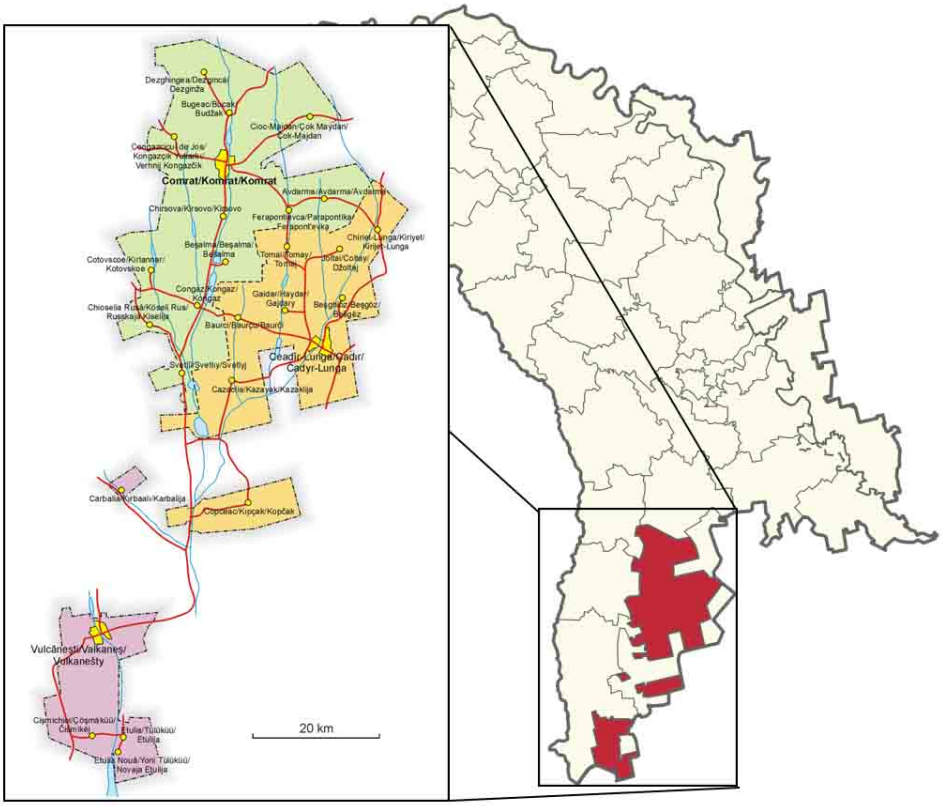
Sweden
Sverige

# Modernization of the Local Public Services in the Republic of Moldova




## Project Concept
## (report on walk-through energy audit)

## Theoretical Lyceum “V. Moshkov”, Ceadir – Lunga municipality

**May 2018.**

GUVERNUL ROMÂNIEI

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**Project partners:**

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



**Comrat, May 2018**

**Project Concept (report on the walk-through energy audit)**

Institution: Theoretical Lyceum “V. Moshkov”, Ceadir – Lunga municipality

Visited on 16.02.2018

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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

Theoretical Lyceum “V. Moshkov” was established based on one of the first school in Ceadir – Lung. Main building (A) was built in 1958. Nowadays, from Ceadir – Lunga municipality and nearest villages 746 pupils are studying in this lyceum. In the lyceum are working 87 employees.

*Photo 1 North-west facade of the Lyceum (building A), main entrance.*

In 2011, a new educational building (Б) was opened, the Center for Technological Education, in which the younger classes have the opportunity make the lessons, and to conduct the lessons of technological education in modern conditions.

*Photo 2 Building Б, south – east facade*


*Photo 3 Theoretical Lyceum "V. Moshkov" Orto photo (Scale 1:500), source www.geoportal.md*

Component buildings (as indicated in Photo 3):
А – Main building
Б – building for primary school
В – boiler house
Г – workshop and toilet rooms

## 2. Energy Consumption

The electricity consumption was 43 MWh in 2014 with a small increase to 43,8 MWh in 2016. Between 2014 and 2016, the average electricity demand was 43,4 MWh per year. It is observed a consumption of electricity of 33,2 kWh/m2, and this is a normal value for a school.
Gas consumption is constant from 35200 m3 in 2014 to 35165 m3 in 2016, or average consumption of 35165 m3 of gas per year, or approximatively 268 kWh/m2 per year, and this is a high value for a school.

*Table 1 Energy consumption*

| Energy | unit | consumption | | |
|---|---|---|---|---|
| | | 2014 | 2015 | 2016 |
| Electricity | kWh | 43146 | 43384 | 43791 |
| Gas | $м^3$ | 35200 | 35020 | 35165 |

## 3. General data on studied buildings

### 3.1 Heating system

The building is heated using a gas boiler house located in the western part of the territory (on the Photo 3 it is indicated as building В). The heating agent flows through the external heating network to the main building А and straight into the building Б.

### 3.2 Hot water supply system

Hot water is only available in the kitchen; the source is an electric boiler.

### 3.3 Fresh water supply and sanitation system

The building is supplied with cold water from the urban water supply system, sewage is diverted to the city sewage system.

### 3.4 Electricity consumption system

Electricity is provided by the local distributor.

### 3.5 Natural gas supply system

The source of fuel supply to the boiler house is the city's natural gas distribution system.

### 3.6 Previously implemented energy efficiency projects

In 2011, the building of primary school was capital refurbished. In 2012, new roof was installed. In the period 2011-2013, windows and interior lighting system were replaced. In 2014, the boiler room and radiators in the building were completely renewed.

### 3.7 Planned projects for the coming years

In the near future, implementation of measures related to energy efficiency are not planned.

## 4. Data on the proposed project

*Note*: In this project concept only the main block is considered.

### 4.1 Description of current situation

In spatial arrangement, the building reminds a U-shape, the central entrance is from the north-west side. The building was built in 1959. The central part of the educational building and its southern wing consists of two floors, where the classrooms are located. The north

wing, also has 2 levels and partly 3 levels, on the ground floor dining room and kitchen, and on the second floor with a high ceiling is a gym and auxiliary rooms to it.

## 4.2 Building proprieties (constructive part)

The foundation of the building consists of large limestone blocks. There is no basement in the building. Bearing walls are made of large limestone blocks with a width of 60-65 cm, the masonry is exposed on the exterior part. Interior partition walls are made out of limestone blocks.

## 4.3 Windows and doors

All the windows of the educational building are made out of PVC with double-glazed windows. All windows were replaced in the last few years. The same is for doors, all were replaced with PVC constructions. Slopes are not sealed, but there are no evidences of structural degradation of the windows. Experts think that replacement of the windows and doors in not necessary.

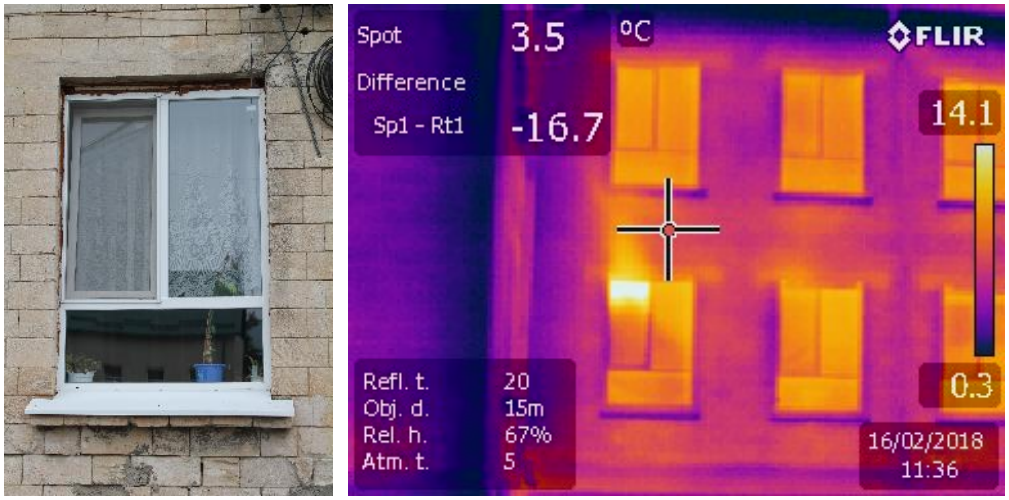


*Photo 4 Window of the central façade and it's visualization under the infrared camera*

## 4.4 Roof

The roof is double sloped, wooden framework of the roof is in good condition. Under the metal tiles covering, there are no waterproofing membranes, the structure of the roof provides the presence of clear lights, which are closed with grids. The snow holders are also installed. The joints of the edges are not executed well, because of this, during rains a little quantity of precipitations are going through. The insulation of the attic floor was not realized (1277 sq.m.). The rainwater management system is properly functioning.

*Photo 5 The attic*

## 4.5 Heating system

The building is heated by own boiler room. There are placed 3 boilers, all are connected to heating system 2 are in work, the third one is a reserve boiler. From the boiler room, thermal agent goes to external heating network, which is posed under the ground. Internal networks is cast-iron, radiators are aluminum ones installed in 2014.

*Photo 6 Boiler house and radiators*

## 4.6 Ventilation system

The building does not have a ventilation system. The natural ventilation is made manually by opening windows.

## 4.7 Hot water supply

For hot water there is used an electric boiler which is placed in the kitchen.

## 4.8 Lighting system

For lighting, fluorescent lamps and energy saving lamps are used.

## 5. Project Concept

### 5.1 Description of the proposed energy efficiency measures

The experts offer the following list of measures for the thermal rehabilitation of the building:

- Experts recommend the insulation of building facades with a layer of rock wool (1800, 26sq. m).

The plinth must also be insulated with a layer of XPS to prevent the penetration of the cold directly into the room and its base, as well as the creation of a barrier for ground moisture and water formed because of snow melting. Insulation with a thin layer of XPS is recommended. Its installation will require exposing the foundation walls to 50 cm from the ground level, the total height will be 1 m. After the installation, there is a need to restore the blind all over the perimeter of the building.

**Yearly savings** = **182 MWh/y**
**Estimated investment = 183 212 EUR**

- Experts offer insulation of the ceiling of the last floor. An insulating layer of 150 mm rock wool is recommended, with the laying of vapor and waterproof membranes. Roof junctures should be isolated additionally.

**Yearly savings** = **135 MWh/y**
**Estimated investment = 46 604 EUR**

### 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 2 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 |
|---|---|---|---|---|---|---|
| Insulation of the roof floor | 1310 | 135 | 4 819 | 46 604 | 27 | 12,4 |
| Insulation of exterior walls | 1545 | 182 | 6 495 | 183 212 | 36 | 36,1 |
| **Total** | **2855** | **317** | **11 314** | **229 816** | **63** | **26** |

## 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 4,71 mln MDL (**229 816 EURO**)[1].
The total investment costs were estimated to around
Refurbished floor area in m²: 2855 м².
When considering only the energy relevant investment the payback period is 26 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
- Insulation of the attic floor
- Insulation of exterior walls
- 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.

[1] Exchange rate: 1 euro = 20,50 MDL (average for 2017)

## 8. Conclusion

As a result of the proposed measures, the expected **energy savings will be 317 MWh/y**. Due to this saving, it is estimated that **emissions will decrease** by **63 t/CO2 per year**.

## 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 of the attic floor | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Task 14 | | Insulation of the external walls | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Task 15 | | Instalation of the additional ventilation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Task 16 | | Training, documentation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Task 17 | Acceptance | Final acceptance | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

estimated winter

estimated winter

*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 данных для диагностического анализа**
**сектора энергоэффективности в регионе АТО Гагаузии**

## I. Общие данные:

Название населённого пункта / района: Чадыр - Лунга

Название публичного учреждения: Теоретический лицей им. В.Мошкова

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

Год строительства здания публичного учреждения: 1907; 1959; 2011 г.

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 | 82 |
| 3. | Количество пользователей / бенефициаров (дети / студенты / пациенты / клиенты) | человек | 746 |
| 4. | Общая площадь здания | $м^2$ | 2623 |
| 5. | Количество этажей здания | единицы | 2 |
| 6. | Средняя высота каждого этажа | м | 3,5 |
| 7. | Общая площадь внешних стен здания | $м^2$ | 12039 |
| 8. | Количество окон | единицы | 109 |
| 9. | Общая площадь окон | $м^2$ | 261 |
| 10. | Общая площадь крыши | $м^2$ | 1276 |
| 11. | Тип крыши: | плоская крыша или скатная крыша | Шатровая |

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

| Тип источника энергии | Ед. изм. | Потребление | | |
|---|---|---|---|---|
| | | 2014 | 2015 | 2016 |
| Электричество | кВтч | 43146 | 43384 | 43791 |
| Дизель (исключить транспортные средства) | Литры | | | |

| | | | | |
|---|---|---|---|---|
| Натуральный газ | $м^3$ | 35200 | 35020 | 35165 |
| 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. <u>Центральное отопление Автономное</u>**

**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:***

□ <u>однотрубная система</u>

□ ***двухтрубная система***

***1.2. Укажите тип используемого топлива:***

□ Электричество

□ **<u>Натуральный газ</u>**

□ 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

□ **<u>Электрический бойлер</u>**

□ Нет горячей воды

□ Другой (укажите)_____

С.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)

□ **<u>Отсутствует вообще</u>**

***C.5. Есть ли центральная система вентиляции:*** □ Да; или □ **<u>Нет</u>**.

***Какова она?***

□ принудительный

□ естественный поток

***C.6. Система внутреннего освещения:***

| Показатели | Ед. изм. | Значение |
|---|---|---|
| Количество ламп | единицы | 233 |
| Тип ламп (светодиодные-LED, люминесцентные лампы, лампы накаливания) | Люминисцентные 173 шт. Лампы накаливания-60 шт. | |
| Средняя мощность ламп | W | 41,36 вт |
| система автоматизации освещения | **Да** / нет | ***Да*** |

**Part D. Описание бойлеров**

Количество бойлеров: **1**

Тип топлива, используемого для бойлеров:

- □ Электричество, Установленная мощность (кВтч): 220-240__ 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 **_2_** единиц

Тип потребляемой энергии:

- □ **Электричество**
- □ Газ
- □ Другое (просьба указать)

***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 энергоэффективности, внедренные в течение последних 5 лет? (если таковые имеются)**

| Проект | Год внедрения | Донор | Стоимость, тыс. лей |
|---|---|---|---|
| | | | |