Interreg Sudoe

EUROPEAN UNION

COLEOPTER

European Regional Development Fund

E.1.6.2 – ENERGY AND WATER AUDIT REPORT

DEMONSTRATOR BUILDING OF CHÉNÉRAILLES

SEPTEMBER 2021

RURENER

adene Agência para a Energia

cetenma

UPC UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH

Comunidade Intermunicipal do Ave

Ayuntamiento Cartagena

PÓVOA DE LANHOSO Município

FST - CREUSE développement

AUTHORS: SYNDICAT EST CREUSE

CITATIONS: Methodology for energy-water nexus audit

The electronic copy of this report can be downloaded at www.coleopter.eu.

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COLEOPTER PROJECT

The COLEOPTER (*COncertation LocalE pour l'Optimisation des Politiques Territoriales pour l'Energie Rurale*) project develops an integrated approach to the energy efficiency of public buildings that links technical, social and economic challenges. COLEOPTER addresses two energy efficiency challenges in buildings: difficulties for rural municipalities to act and carry out work despite the positive local impact (i.e., energy savings and local employment) and a lack of awareness of building challenges, which leads to irrational use of energy/water and low renovation rates.

The COLEOPTER approach has three components:

1. Territorial dialogue with local actors to co-construct work plans of public buildings.
2. Use of Building Information Modelling (BIM) as a collaborative tool to support the dialogue.
3. Consideration of water efficiency issues along with energy challenges to better consider usage.

The approach will be tested on four public buildings, three to be renovated (in Póvoa do Lanhoso, Portugal; Cartagena, Spain; and Creuse, France) and one new building (in Creuse, France). It will be replicated in Escaldes-Engordany (Andorra) to validate its transferability.

The main contributions of the project, namely the COLEOPTER approach and the work conducted on the test sites, will benefit municipalities, citizens and small and medium-sized enterprises (SMEs), leading to better planning of energy and water efficiency policies and increased public and private renovation rates.

The COLEOPTER project (SOE3/P3/F0951) is financed by the Interreg Sudoe Programme that supports regional development in Southern Europe, financing transnational projects through the European Regional Development Fund. The Programme promotes transnational cooperation to solve common problems in Southern Europe, such as low investment in research and development, weak competitiveness of small and medium-sized enterprises and exposure to climate change and environmental risks.

Project leader	Céline Seince – contact@rurener.eu
Axis 3	Low-carbon economy
Objective 4C1	Improving energy efficiency policies and the use of renewable energy sources in public buildings and housing through the implementation of networks and joint experimentation
Total eligible cost	1 454 944.07 €
ERDF Grant	1 091 208.06 €
Duration	36 months (01/10/2019–30/09/2022)

Partners

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*Agência para a Energía (*ADENE)
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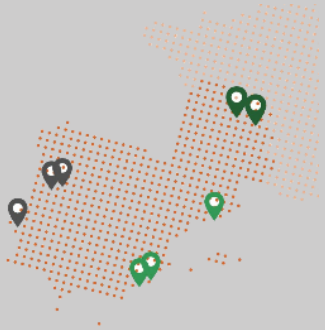

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INTRODUCTION

This report presents the results of water energy audit in the youth and children building located in Chénérailles, France.

The data collected during the energy and water audit made it possible to evaluate the performance of the building. The main results of the energy and water audit will be presented and the identification of energy and water efficiency improvement measures that can be implemented.

It should be stated that a walkthrough audit does not yield as much data as a complete audit, and will be completed at least by the project management and architect team.

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CHARACTERIZATION OF THE BUILDING

GENERAL DESCRIPTION OF THE BUILDING

The Youth activities center is located at Route d'Aubusson 23130 Chénérailles, Creuse, France. It's an old factory and will be used for multiples activities dedicated to the children and youth, during extra-school time.

Table 1: Building identification

Building identification	
Address	Route d'Aubusson, 23130 CHENERAILLES
GPS coordinates	46.110849, 2.177088
Type of building	Old factory
Name of the building	Chlidren and youth building of Chénérailles

The building has the following time frame usage:

	Morning period	Evening period	Night Period	Notes
Monday to Friday	7:00	18:00	--	Nursery
Wednesday and holidays	7:00	18:00		Children and youth activities

Figure 1: Aerial photo

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The roof of building is orientated in an East-West line, following the main façades. There is two thermic parts : The north part is an old building conception (1948, stone walls) and the south part is a more recent conception (after 1948, blocks walls). The ground area is 142m².

The cover and equipment of the building has this current features :

- Roof : Convertible attics without any insulation
- Walls : North part - Stone walls without insulation, South part – blocks wall with a 6cm rockwool insulation
- Doors & Windows : Old One-glass wood equipments
- Heating : No system
- Ventilation : Natural

ENERGY AND WATER AUDIT

ENERGETIC CHARACTERIZATION

Electrical installations

There's no data available for the electrical part, the building is not in use since a long time. We made a simulation of consumption of 7100 kWh to establish a reference data, of 2485 annual kWh for lighting, 1775 for hot water, and 2840 annual kWh for specific uses.

The current state of the building enforces to work about the hole electric installation during the architect process.

Exhaust Ventilation

The building works today with a natural ventilation, but it needs to include a mechanical ventilation in the project.

WATER FIXTURE CHARACTERIZATION

Due to the actual state of the building, and its change of destination, the auditor can't measure the type and quantity of water equipment. Currently, there's a few, inoperant water circulation system in the building, which needs to be totally replaced.

The future use of water equipment is mainly toilets and sinks. The number of equipment is currently unidentified. The hot water production is estimated at 1775 kWh, produce by a mix between heating system (heating season, from September/Octobre to May) and electrical storage tank (June to September).

ENERGY AND WATER CONSUMPTION

The building is the not in use for approximately 10 years and didn't have a youth and children use. So, the auditor mainly estimate data with the characterization of building and ratios about consumption in this type of equipment.

ENERGY CONSUMPTION

Electricity

Currently, the building is not in use and has a totally different use (manufactory), so the auditor can't make a precise estimation. For an estimation, we use the actual thermic performance of the building and ratio based on a children and youth occupation.

So, for this audit, the electricity consumption is estimated at 7100 annuals kWh, split in three parts :

- Hot Water : 25% - 1775 kWh
- Lighting : 35% : 2840 kWh
- Specific uses (office automation, domestic appliances...) : 40% - 2840 kWh

The electric cost is estimated around 0.17€/kWh, for an annual bill of 1 207€ in electricity.

Heating

Due to the inoccupation of the building, there is no data available about heating consumption, and currently no heating system. Based on ratios and comparative with other buildings, the total heating need is estimated at 46 216 kWh, mainly during September – May period.

The main energy loss in heating are :

- Walls 43%
- Ceiling 25%
- Ventilation : 14%
- Doors & Windows : 11%
- Floor : 7%

The needs of power for the heating system is estimated between 25 and 30 kW.

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WATER CONSUMPTION

Water

Due to the lack of data, the water consumption was estimated by ratio with the use of building and its future welcome capacity.

With a hypothesis of 30 users (children, youth...), for 250 days a year, the auditor estimates the water consumption at 150 m3 per year.

This water will be mainly use on toilets and washing machines.

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MEASURES TO IMPROVE THE ENERGY AND WATER EFFICIENCY

For the water efficiency, there's no improvement measure due to the lack of equipment. The main recommendations are:

- Install double flush toilets
- Install individual reductors of consumption or choose equipment with an output control system

For the electricity efficiency, there's no improvement measure due to the lack of equipment. The main recommendations are:

- Choose low-consumption domestic equipments
- Choose, with care of the chlidren needs, low-consumption lighting equipments
- Install presence detector systems to swhitch on/off the lights.

For insulation and heating : with the estimated consumption in actual state of the building, the auditor recommend the following measures:

Improvement measures	Est. Cost	Energy gain	€/year
Insulation of attics floors (R=6)	14 200 €	78%	2 516 €
Installation of a double-flow controlled mechanical *Electrical Power absorption : 0,35 W/(m3/h)*	5 112 €		
Installation of double-glass doors and windows Uw ≤ 1,3 W/m².K et Sw ≤ 0,35	13 600 €		
Insulation of external walls R=3,7	40 500 €		
Insulation of floors R=3	11 360 €		
Installation of a high performance gas boiler and the related heating system (with insulation)	21 000 €		
TOTAL	**105 772 €**		

INSULATION OF ATTIC FLOORS

Technical criterions: Thermal resistance R = 6. W/m².K,

Material recommendations: wood wool or cellulose wadding

CONTROLLED MECHANICAL VENTILATION

Technical criterions: Double-flow, Maximal electrical power absorption = *0,35 W/(m3/h)*

Other recommendations: Attention about the localisation and the installation of the equipment (access, suspension…)

WINDOWS AND DOORS

Technical criterions: Double-glass type. Uw (Indicator of Thermal transmission) ≤ 1,3 W/m².K, Sw (indicator of solar transmission) ≤ 0,35

Material recommendations : Wood or PVC type, with attention about the fitting.

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INSULATION OF EXTERNAL WALLS

Technical criterions: External insulation, with minimal R (thermal resistance) of 3.7 W/m².K

Material recommendations: Woodwool or rockwool

INSULATION OF FLOORS

Technical criterions: Minimal R (thermal resistance) of 3 W/m².K

Material recommendations: Wood wool or rock wool

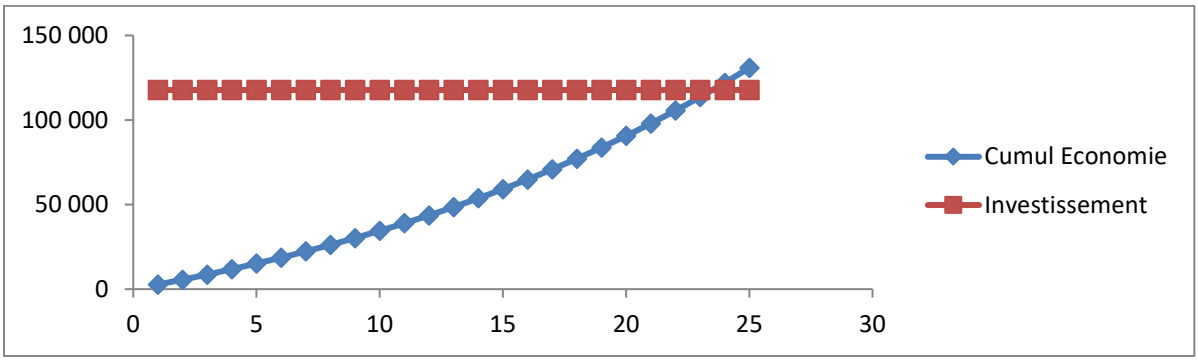
INSTALLATION OF BOILER AND HEATING SYSTEM

Technical criterions: Gas (or geothermic) system

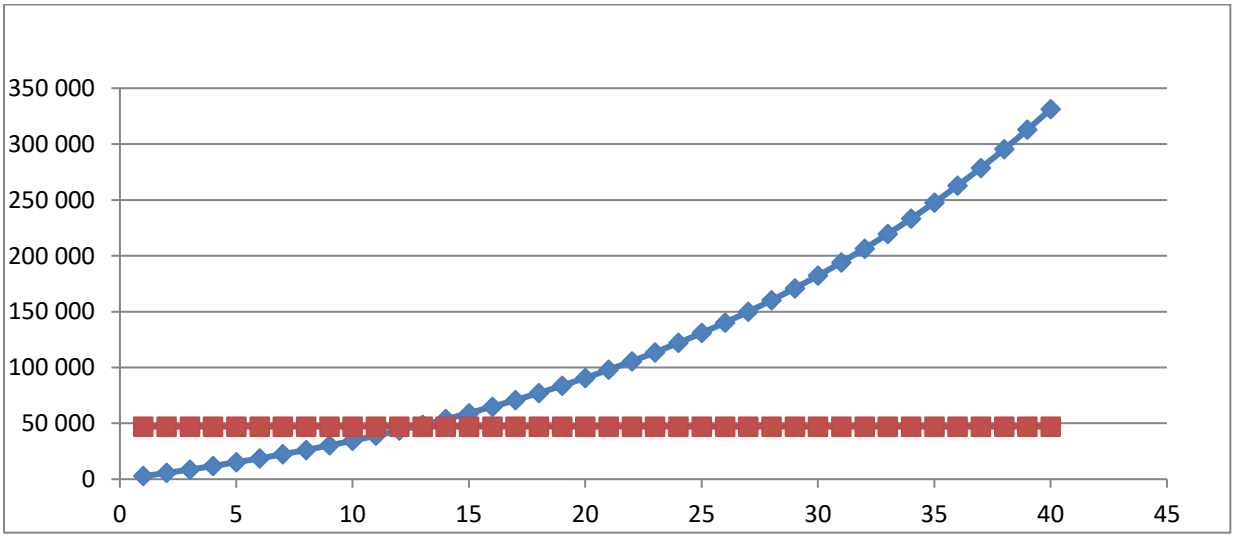
Material recommendations: Insulation of the heating pipes, high performance radiators

ECONOMICAL VIABILITY OF HEATING AND INSULATION MEASURES

From the estimated initial state, with an actualisation of 5% per year of energy costs, the time of return on investment (economies / investment) is about 23 years without subsides.



With 60% of subsides, the time of return on investment is about 13 years



IMPLEMENTATION OF A PHOTOVOLTAIC SYSTEM

The building presents reasonable energy consumption, and the exposure (183m²) is an approximate West-East line, which is compatible with an self-consumption project.

The future installation of photovoltaic systems depends on non-energetic aspects :

- The authorization to bring a photovoltaïc system on an chlid and youth building, for security reasons
- The authorization to bring photovoltaïc close to the listed historic monument Church of Chénérailles, in architectural project
- The needs of roof works. If the roof doesn't need works on the architectural project, there is no interest to bring photovoltaïc system because of a lack of economical interest. This project needs to include photovoltaic installation in a roof refection in order to diminue work costs.
- The capacity of the structure to support installation, mainly on its frame.

In the case where these conditions allow to bring photovoltaic installation, the technical points are mainly about the method of installation and the self-consumption format:

- Include solar cells as a part of the roof, that offer scale economies about work on the roof part (ex : BarSun technology)
- Bring cells both on East and West parts of the building, to produce on the morning and the evening.
- Conclude a resale contract for the not-use electrecity. There's no intersting consumers closes and legally allowed to use this production
- The installation may have an economical viability linked to the resale contract, which the prices are is based on the installed power. In fact, this is more determinant than the consumption to size the installation.

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FINAL CONSIDERATIONS

The report presents some measures to optimize the energy and water consumption in the future building and Chénérailles. Due to the lack of information (no consumption data available) and the totally refunding of the building, the audit is mainly based on simulation and ratios in order to determinate a consumption of reference.

The key points of this audit and the improvement measures are :

- To be careful with the choice of low consumption equipment in the water and electrical systems (taps, toilets, washing-machines, lighting...)
- To conduct a global renovation of the building in order to improve its thermal caracteristics :
    - Insulate ceiling, walls and floors, preferably with eco-responsible materials
    - Change doors and windows with double-glasses wood or PVC equipments
    - Create an heating system with a high performance gaz boiler
- Ask on architectural project the technical faisability of photovoltaïc self-consumption installation, which economical aspects are link to the capacity to make scale economie on the conduct of roof works.

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