CLIMA 2016 - proceedings of the 12th REHVA World Congress

volume 1

Heiselberg, Per Kvols

Publication date:
2016

Document Version
Publisher's PDF, also known as Version of record

Moulins Multimedia Library: An Exemplary Renovation

José Naveteur[1], Alain Rousset[2], Jean-Pierre Thierry [3]

[1]*Senior engineer, EDF R&D Energy in Buildings and Territories Department. Site des Renardières, Ecuelles, 77818 Moret-sur-Loing, France. jose.naveteur@edf.fr*

[2]*EDF - Sales management, Rhône - Alpes Auvergne, for Local Communities. 64, rue des pêcheurs. 03006 Moulins, France*

[3]*Jean-Pierre Thierry, General Manager of Technical Services, Urban Area Community of Moulins. 8 place Maréchal de Lattre de Tassigny, 03016 Moulins, France*

Abstract:
In 2009, the Community of Moulins decided to renovate its library (area = 3315m²) which was built in the 1980s. The renovation of the building had two main objectives: Energy-efficient Renovation (Label refurbishment with Low consumption Building) and use of local resources such as the use of local ground water. The cost of the renovation was 1397 €/m². The cost of heating, ventilation, cooling and the room for local computers servers was 200 €/m².

In 2014, the building consumed 92kWh/m², or 54% less than it consumed before the renovation! Heating requirements are only 35kWh heat/m², which are a result of the building's good level of insulation, and cooling requirements are 13.6kWh/m² (excluding those needed for the computers). The heat pump's COP for heating(a) is 4.02, which translates to a cost of 29€/MWh of heat. CO_2 emissions are 84% less than if a gas boiler had been used. Cooling needs are 13.6kWh cold/m². The COP for geocooling(b) is 18, the cold cost per MWh produced is 7.5 €/MWh. The total annual operating cost is 9.5 €/m², of which over 50% is attributable to local computer servers and the air handling unit for the computer room and conservation of antique books.

(a) COP for heating = kWh Hot consumed by the building/kWh Electric consumption by heat pump and drilling pumps.
(b) COP for geocooling = kWh Cold consumed by the building/kWh consumption by drilling pumps.

Key Words: geothermal heat pump, energy efficiency, COP, ground water, reduce ***CO2 emissions***

1. Introduction

In 2009, the Community of Moulins decided to renovate its multi-media library (area = 3315m^2), commissioned in the 1980s with older electric floor heating.

Moulins selected EDF R&D, given its experience[1 and 2], to undertake a mission of Assistance to Energy Project Ownership (AEPO) and energy monitoring of the site for a minimum of two years.

The technical service of the urban community was heavily involved in the project and ensured that the operation led to the mastery of work and supervised the technical monitoring facilities. The aim is to provide comfort to users while controlling energy costs. This also allows a good knowledge of the facilities but especially to be reactive during work.

2. Building description and technical installations

The architectural competition for the building renovation has two major objectives: make Low Consumption Building (LBC) renovation and use local resource that is water in the ground water. Note that as part of the renovation, it was decided the creation of stores in which are kept under conditions of temperature and humidity, all the ancient manuscripts of the local community. (Photos 2 from inside the building).

(a) COP for heating = kWh Hot consumed by the building/kWh Electric consumption by heat pump and drilling pumps.
(b) COP for geocooling = kWh Cold consumed by the building/kWh consumption by drilling pumps.

Mid 2011, the architectural firm Basalt is retained (photo 1: Building exterior and photo 2: Building interior).

Step 1: Reduce the need for good insulation

-Double glazing 4/16/4 Argon;

-8cm insulation on the walls and 20cm on the roof.

a. Description of HVAC system

b.

Step 2: Installation of an efficient HVAC system

Hot and cold are produced by:

-3 Air Handling Units (AHU) dual-flow with rotary heat recovery made by CIAT (type Floway) whose flow rates are:

- 6000m^3/hr for the library part and entertainment rooms,
- 3000m^3 /hr for open space and training, and
- 800m^3/hr for the administrative part.

(a) COP for heating = kWh Hot consumed by the building/kWh Electric consumption by heat pump and drilling pumps.
(b) COP for geocooling = kWh Cold consumed by the building/kWh consumption by drilling pumps.

-2 Eurovent-certified CIAT LGP 200 heat pumps (photo 3) with the following characteristics:

-Heating capacity = 2 * 75kW hot (48W/m²)
-Power consumption = 2* 17kW
-COP for heating = 4.16

In winter, the heat pumps operate using groundwater. The heat is supplied in the AHU and floor heating/cooling is made by REHAU.
In summer, cooling is provided by geocooling (via an exchanger) which feeds the CTA and the floors.

The rooms that conserve (target temperature and humidity) old books are cooled by an independent air conditioning system.

The local computer (the urban community) is cooled by an independent dual type cooling fluid. The cold is first produced by the groundwater (geocooling) and is complemented by an independent chiller.

-All pumps have variable speeds.

The system is controlled by a building management system.

Description of the groundwater system:

The pumping system includes:
-two 219mm-diameter stainless steel wells pumping 316L at depths of 17m and 20m each with 10m^3/hr flow rates,
-one PVC discharge drilling, 400mm diameter, 11m deep, 30m^3/hr flow rate.
-two Filters (300 microns),
-one water meter measuring the volume of water pumped

(a) COP for heating = kWh Hot consumed by the building/kWh Electric consumption by heat pump and drilling pumps.
(b) COP for geocooling = kWh Cold consumed by the building/kWh consumption by drilling pumps.

Step 3: Install measuring devices

Concerned with controlling energy consumption and measuring the energetic performance of the building, the urban community decided to invest in metrology superior to that mandated by French regulatory requirements.

3. Label and Costs

Compared to French law, the calculations show that the building is 41% more efficient, allowing it to get the label Low Consumption Building (BBC in France).

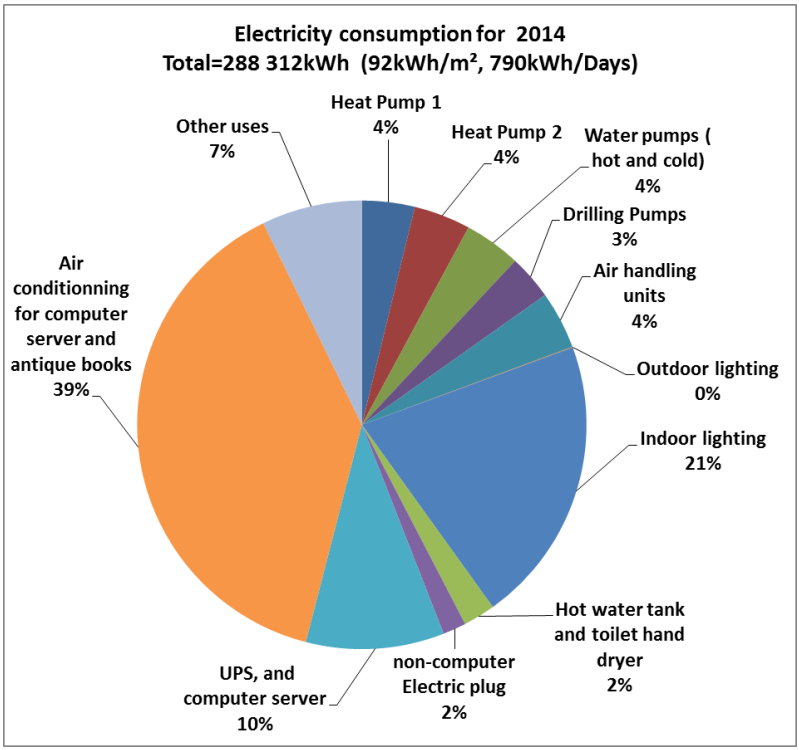
The cost of the renovation is €1397/m². The cost for the entire HVAC system is €200/m².

NB: All costs exclude taxes

(a) COP for heating = kWh Hot consumed by the building/kWh Electric consumption by heat pump and drilling pumps.
(b) COP for geocooling = kWh Cold consumed by the building/kWh consumption by drilling pumps.

4. 2014: Excellent Results from the First Year of Operation

The building consumes 54% less energy than it did before renovation (for identical energy uses). The consumption of all uses is 92kWh/m², the part under French thermal regulations (HVAC, lighting and auxiliary) is only 37.5kWh/m², or 41% of total consumption.



The operating cost of all uses is 8.88€/m², of which nearly 50% is attributable to computer rooms and packaging system of local environments for the conservation of old books.

(a) COP for heating = kWh Hot consumed by the building/kWh Electric consumption by heat pump and drilling pumps.

(b) COP for geocooling = kWh Cold consumed by the building/kWh consumption by drilling pumps.

Heating needs are only 35kWh heat/m², which is a result of the building's good level of insulation.

The Heat Pump has a COP for heating[(a)] of 4.02, which means that the hot product is 75% renewable energy.

The cost of hot product MWh is 29€TTC/MWh hot. The savings from the heat pump to produce heat compared to a gas boiler solution (95% average efficiency) is €2,651/year or €0.85/m². CO_2 emissions are 84% less than they would be if a gas boiler had been used.

The cooling needs (excluding computer room) are 13.6kWh cold/m² and are met by geocooling with a COP of 18 in geocooling[(b)], yielding a very low cost per MWh of cold (€7.5/MWh), representing a cost of €0.064/m².

5. The keys to success

A good project driven by a motivated management team that saw the advantage of being accompanied by the R&D department of an experienced energy company having accomplished years of work in the energy efficiency field for highly ambitious renovation projects.

Of targeted investments:

-1) A good building conception to limit energy needs.

-2) From technology to limit consumption:

Air handling with heat recovery, ground water heat pump, geocooling, underfloor heating refreshing, variable speed pumps, lighting, management, metrology ....

-A meticulate implementation thanks to the active involvement of competent project managers and contractors.

-Succesful commissionning thanks to accurate metrology

-Energy monitoring by EDF R&D with the involvement of Dalkia (heating operator).

(a) COP for heating = kWh Hot consumed by the building/kWh Electric consumption by heat pump and drilling pumps.

(b) COP for geocooling = kWh Cold consumed by the building/kWh consumption by drilling pumps.

6. Conclusion

The renovation of the building has dramatically helped to reduce energy consumption while increasing occupants' comfort.
The performance of the heat pumps is excellent; they reduce CO2 emissions by 84%. The geocooling provides a comfortable environment in the building during the summer at a low cost.

References

[1] A geothermal heat pump, since 2008, heating the swimming pool in Moulins (France). Average 2008-2012- 11th IEA Heat Pump Conference 2014- EA 087018

[2] CAF de Lyon: A geothermal thermo frigo pump for 10 years.Congres Clima 2010.File 0153

(a) COP for heating = kWh Hot consumed by the building/kWh Electric consumption by heat pump and drilling pumps.
(b) COP for geocooling = kWh Cold consumed by the building/kWh consumption by drilling pumps.