Improving the energy management in an academic library: the case of the Rector Gabriel Ferraté Library

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Abstract: *Despite an architectural design that facilitates a high energy expend in a context characterized by a huge economic and environmental crisis, the Rector Gabriel Ferraté Library (BRGF) at the Polytechnic University of Catalonia (UPC) has managed to save 43% of its electric energy consumption.*

The main aim of this paper is to describe in detail the actions taken under the internal plan that has made this saving possible, and also to inform about the collaborations and expenses required, the difficulties met, or the prospects for the future in this area in the BRGF and UPC libraries.

Considering libraries as a possible model of a sustainable service that can be exported to any kind of institution or company, we stress the importance of this topic – currently ignored in the librarianship literature – and, especially, in the hope that some of the measures taken in the BRGF could be interesting and applicable in other libraries, both in universities and elsewhere.

Keywords: Energy efficiency, energy saving, library buildings

Introduction

At the Biblioteca Rector Ferraté (BRGF), we consider the current energy context and its influence on the climatic change as an opportunity to improve the energetic efficiency. From this point of view, the financial difficulties, shared by the whole public Catalan university system, of the Universitat Politècnica de Catalunya – Barcelona Tech (UPC) facilitates the promotion of an energy-saving policy.

For the last years, the BRGF is trying to actively collaborate with that policy convinced that a responsible consumption is important for a fair management of the public funds we receive. We try to do so with the lower possible investment in a time when the library has been increasing its services and premises, and avoiding a negative impact of the measures in the assessment of the library by the users.

Finally, to rapidly contextualize what we have been doing it will be useful to know that the BRGF is the biggest library at the UPC, with a surface of more than 6600 m2 and more than 430000 users during 2012. The library building consists of six floors, four of them with walls made of glass -the main façade is built in that material- which implies that the work rooms receive a lot of natural light and heat, usually too much.

What has been done?

In 2009 a team of UPC students, involved in the workshop *Consumint Barcelona* [*Consuming Barcelona*], showed that the BRGF was the fourth most energy-consuming building in the North Campus of the UPC –the biggest one of the university- and decided to carry on a

collaborative research project in order to reduce the emissions of CO2 in a 20% of the total.

Joining the students, the other partners in the project were the maintenance service of the campus, the UPC Institute for the Sustainibility (IS.UPC) and the BRGF. Consequently, a specific Energy Optimization Program (EOP) for the library was defined. The following sections detail the areas and the actions implemented from then on in the framework of the resulting EOP.

Equipments and spaces management
Based on the idea of adjusting the offer of spaces and equipments to the real needs of the users a set of decisions were implemented.

Spaces management according to the occupation of the work rooms
Previous to the EOP, the library was opening all the spaces during all opening hours, but the stats show how academic libraries are more used during some specified periods of time – basically coinciding with the exams- and are considerably less used when there is no academic activity in the campus.

Combining the academic schedule of the university with the occupation data of the library, the BRGF reduces now the open floors and equipments according to the previewed demand. That means that during some months the expenditure in lighting and air-conditioning is radically reduced, and we can already say that this measure has proved to be the most effective to save electrical energy.

Operation of the elevators according to the number of users
In the BRGF we have two elevators that operate simultaneously. Following the same saving-schedule described in the previous paragraph, when the library is not intensively used one of the lifts is unplugged.

It is relevant to point out that this action is only effective when implemented during a long period of time –minimum one month- and, to avoid any inconvenience to the users, only if the other elevator can immediately be switched on when necessary –for ex. when the working one gets damaged-.

Equipment management according to the occupation of the work rooms
The BRGF offers free access to 47 computers for a broad range of uses –from OPACs to Skype videoconferencing-. When not controlled it is very usual to have all those computers switched on, because users forget to switch them off when they finish to use them. To avoid the consequential energy waste, the BRGF staff keeps the computers switched off except when needed.

In addition to that, the computers and screens of the library staff are switched off when they are not working. With this measure, we try to avoid the expenditure caused by the *stand by mode* that can significantly affect the electrical consumption.

Dedicated software to power management in the UPC computers
From November 2010, when the library was selected to test software that allows saving energy in the UPC computers, the BRGF is using Granola, a tool scheduling machines and monitors to go to *sleep* when they aren't being used and that controls the velocity and consumption of the CPU in real-time, without interfering other softawe or deteriorate the

computer perfomance.

The posterior assessment showed that the energy consumption has been reduced by a 38% in the computers using Granola.

Reducing air-conditioning consumption
Reducing air-conditioning consumption was crucial to our aims because it means almost half of the total electrical expenditure of the library.

Adjusting the expenditure to the real needs
Using the above mentioned schedule (see *2.1.1 Spaces management according to the occupation of the work rooms*) the maintenance service of the campus is able to plan the automatic swicht on and off in exact accordance to the opening hours and the open spaces of the BRGF–for example, if the library closes at 9 pm, the air-conditioning system is scheduled to be switched off at 8:30 pm, because the building will keep by itself good climatic conditions until 9 pm-.

Reducing air-conditioning consumption in the group work rooms
There are 16 group work rooms located in 3 different floors of the library. We decided to install independent air-conditioning equipment in each room –in order to switch on only the one(s) needed-, and to have a restricted access to the switchs and to the thermostats that control the temperature in the rooms. We didn't find another way to make possible for the library staff to maintain the set point temperature in these rooms-.

Adjusting and optimizing the temperature set point
With the aim to know the divergences between the temperature set point[1] and the actual temperature in the library rooms, a DEXserver network was installed for some months in order to have on display the climatic conditions of the various spaces in real time throught a wide range of sensors.

That network allowed us find outthat influx of users is a parameter at least as important as the external climatic conditions. This finding helped us to establish different set point temperatures according to the season, the floor and the occupation at a given time.
Additionally there were established instructions about the group study rooms and their climatic maintenance that intent to improve their behaviour from the climatic point of view while saving electrical energy.

Solar energy management through solar laminates and trees
As we have already said, the building of the BRGF is characterized by large glass façades that usually generate too much heat inside the work rooms. To reduce the resulting excess of heat, thin-film solar laminates were placed on the parts of the main façade more exposed to the sun, substituting at the same time the former inner curtains that, in fact, acted as real heater devices when receiving too much solar energy. Another marginal benefit was achieved because from then on exterior views can be enjoyed from the inner rooms.

To complement the previous measure, some evergreen trees were planted close to the same façade and exactly in the places were they can help to avoid the reception of too much solar

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[1] We understand by "temperature set point" the standardized temperature that is considered to offer the best balance between the comfortability of the user and the required expenditure

heat. Again, a marginal benefit was obtained with that action because the monotony of the outside of the building –with the concrete as the only material- was broken and the views from the interior were improved.

Saving lighting consumption
Traditionally, the BRGF had all the lights switched on from very early in the morning –when the cleaning staff arrives- to night –when the services are closed-. The EOP included a survey over the real needs of lighting in the various zones of the library and concluded that a reduction of the consumption was necessary.

We'll now describe the measures related to this line of action and others that, without differencing zones, are useful for the whole of the library.

Reducing general lighting
As with the climatisation, the automation of the lighting system was adjusted through a very restrictive schedule for every day and every floor.

Reducing consumption at the book storage zones
The book storage rooms at the BRGF are closed to the general public and scarcely accessed by the library staff. The transit within its more than 1000 m2 isn't homogeneous and the time invested there is very fluctuating, depending on what you're going to do there.

To solve the different situations a multiple lighting system was designed and implemented:
• on/off switch controlled by presence detectors for the central aisle that crosses all the floor and leads to all the rooms
• manual on/off buttons, but with an automatic system that switches the lights off after a few minutes for the small aisles that lead to the shelf rows
• manual on/off buttons for the less busy zone but where, at the same time, long tasks are performed.

Optimizing natural light in the work rooms
Previously to the OEP, the lights in the floors 1 and 2 of the library were always switched on, regardless the light filtered through the large windows of the façades. After a brief survey, it was decided that all the lighting equipment next to the windows was going to be controlled by the general light sensor of the campus so that those lights are only switched on when the natural light is actually insufficient –for example, on a cloudy day-.

The same action was taken in the floor 3 of the library, where the natural light is coming mainly from the roof, after acquiring a specific sensor for that floor –it was not possible to use the general one of the campus, for technical reasons -. The cost of installing that sensor has been already amortized by the electrical energy saved from then on.

Reducing light consumption in the elevators
In a similar way to other places of the BRGF, a new lighting system, based on presence detectors, has been installed also in the elevators. That means that the lights remain switched off if nobody is using the lift and they are automatically switched on when someone enters the elevator.

Additionally, the lift for internal use that connects floor 0 with floors -1 and -2 doesn't return anymore to floor 0 after a few seconds at idle. Now the elevator car remains at the last floor

until the next call for service from another floor.

Reducing light consumption using LED lamps
A process to substitute other kinds of lighting systems by LED lamps has been started following the EOP recommendations. It's generally known that LED lights ensure a considerably lower waste of energy while keeping the same lighting level.

Evolution of energy consumption at BRGF: analysis and assessment of results
The BRGF, as other UPC buildings, has installed SIRENA, its own information system. Through specific sensors SIRENA allows to gather real-time data on electric consumption. In addition to that, as we have seen, the network DEXserver reported information on temperature, humidity and luminosity. Crossing the information reported by DEXserver and SIRENA we have obtained data that facilitates a more objective perception of the interior comfort, while reducing energy consumption. In addition to that, SIRENA allow us to see the evolution of energy consumption of the library in order to assess whether the measures we are implementing represent real saving during this period.

May 2010, when the library EOP started, marks the point at which comparisons make sense and allows us to assess if the measures described have supposed any saving. Thus, in these three years of experience we can conclude that we have achieved very important average annual saving compared to the period of the last three years. In 2012, the last year of which we have complete data, the building had consumed 43% less energy than the average of 2007-2009, when no monitoring or saving action was taken (remember that the initial objective was to achieve a 20% saving). This consumption is equivalent to savings of about € 42,000 and 274 tonnes less CO_2 in comparison with the average consumption during the immediate previous years.

Finally, the percentage of reduction in energy consumption acquires more value if taking into account the refurbishment in the library building that took place in August 2010. That refurbishment led to the expansion of the used area of the library and, therefore, the expansion of the surface where heating, air conditioning and lighting are needed. All those improvements were acquired without affecting the quality of our services: in the satisfaction surveys conducted in 2011, the latest available, students gave better marks to the degree of comfort in air conditioning and heating reached by the BRGF.

Energy management at UPC libraries
In 2011, UPC launched a widespread EOP in order to reduce energy consumption through a series of measures in line with much of the measures taken in the BRGF. Within this plan, the UPC has encouraged energy efficiency by returning to the buildings that took part in those actions the 25% of the achieved saving. The refunded money has to be used for reinvestment in more efficient systems that allow further increase in the energy expenditure restraint. Actions in this area have achieved significant amounts of energy saving in the medium term.

In that context, the UPC Library Service, in its strategic plan *Digital! (2012-2014)* includes the aspects discussed in this paper as its own goals under the section "Adoption and active promotion of a culture of sustainability and energy saving in order to lower costs and reduce the ecological footprint of UPC libraries".

The successful case of the BRGF has been followed by other libraries. A *Guide to energy saving at UPC libraries* has been just published. The guide, prepared collaboratively between

librarians from each of the libraries in our system, has counted on the advice of the staff of the Sustainable Management and Equal Opportunities Office, the current unit responsible for the subject at the University. One of its aims is to become a useful document both inside and outside the UPC, helping to place the UPC libraries as leaders in adopting a proactive approach to improve the conditions imposed by the economic and environmental crisis, without compromising the services offered to our users.

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