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DYNAMIC FACADE.
BUILDING ENERGY EFFICIENCY REHABILITATION.

1. Energy in the running costs of buildings.
2. The energy consumption of a building.
4. Dynamic Facade or WhatsApp.

1. Energy in the running costs of buildings.
In Spain, the office building construction costs around 1.000€/sqm above ground and 700€/sqm in basement in . When the building is finished the customer can hire the property or building around 15 y 25€/sqm office or carpet area. (This, do not include technical or publics areas likes toilets, pass, or lifts). If we reduce the energy cost we can reduce the running cost and we can increase net margin of benefits and add value about sustainability, preserving the environment and building energy qualification (Figure 1). If you have better energy qualification is the best way to sell quickly and better than your competitions.).

Figure 1: Building Energy certification
The energy renovation is a future business opportunity. The energy cost is the 30% of the running cost of a building. The energy rehabilitation is a business opportunity when we confirm running cost relative to overall operating running cost of a building, with the data provided by facility management companies, which can know what the importance of energy is, in the overall running cost of a building. In 2012 and represented a 30% of total operating cost of a building. If we consider that the growth rate of energy prices increase doubles the Consumer Price Index (CPI), it is conceivable that the importance of energy consumption will also continue to grow. It is expected that in 20 years constitute 50% of the operating costs of a building. (Figure 2)

As the price of energy grows, the Energy Certification is becoming a hallmark of quality. It is already used in many European countries, where the certificate is located at the entrance of buildings. This value gives us a scale of power quality and indicates the estimated consumption of the building and associated CO2 emissions.

2. The energy consumption of a building.

Before applying rehabilitation actions, we must carefully analyze the behavior of the building and its users. Energy audits that monitor energy consumption are an indispensable tool for knowing where and when to spend more. With the data from these Energy audits, or consumption provided by the building manager can implement an energy rehabilitation plan. This plan should provide information on possible actions to take, its price and return on investment.

How can we measure the sustainability of my building? Nowadays in Spain is already approved Royal Decree 235/2013 which was adopted on April 5 as the basic procedure for certification of energy efficiency in buildings. The energy rating is established by letters: from A (best) to G (worst), following the same criteria applied by the appliances. This certification allows concepts such as "sustainability", "green", "eco" and "efficient" can have real and target value. First, we need to confirm the building energy costs, after that we can improve the energy rating with energy rehabilitation. In Spain, we have a long way. While most of our appliances are all A, A + or A ++, 70% energy rating Spanish buildings have obtained the letter D or worse (E, F and G) in 2013.
In Spanish rules and regulations the energy rating A of a building is not the same that net zero energy building (NZEB). An energy rating is the first step to reduce consumption as the European demand that buildings are "almost zero consumption" involves consuming 0 kWh/m². Energy rehabilitation actions are aimed to this milestone: NZEB.

4 examples according to the uses of the buildings where the average consumption is determined:

- Hospital: use 24h, 300 kWh/sqm and year.
- Office: use 12h, 175 kWh/sqm and year.
- Museum: different use, 250 kWh/sqm and year.
- Residential: private use, 150 kWh/sqm and year.

The average consumption also vary depending on the geographical location and orientation of the building, used to have a reference scale current consumption and possible savings. An example:
The energy bill an office building with an area of 5,000 m² with an average annual consumption of 175 kWh/m² is:

\[ 5,000 \text{m}^2 \times 175 \text{kWh/sqm} \times 0,15 \text{€/kWh} = 131,000,00 \text{€} \]

3. Triangle: Facade – HVA – Lighting

Where is really consumption in a building? The following graph (Figure 4) compares the energy consumption of the various installations in an office building. Today the Heating, Ventilation and air-conditioning installations are the most energy consumption. Lighting is the second energy consumption in the building. So HVA and lighting are around 75% of the building energy bill. We need to control these two installations to achieve significant energy savings.
The CIF of a building as its acronym is explained: Heating, Ventilation and Air Conditioning (Climatization or HVA) - Lighting - Exterior. The design of the 3 important parts of the building in consumption will give us the balance between comfort and energy savings. The energy now provided in European projects is 50kWh/sqm. Nowadays, energy consumption is a new issue required by the customer in conjunction with the design, comfort, etc.

In Spain, the RITE (Regulation of Thermal Installations in Buildings) and RD 186/2009 since 2009 regulate the internal requirements of a building (temperature, humidity, etc.) that normalizes and conditions that must be respected by users and implemented by the responsible installations maintenance. Some commercial buildings already have this information visible to the consumer. (Figure 5)

These are the buildings thermal conditions in Spain:
- Temperature: Winter 21ºC – Summer 26ºC
- Humidity: Between 30 y 70%
- Lighting: 300-500 lux
The facade is the third fundamental element together with the HVA and lighting consumption in any office building. The facade is our first thermal level control, lighting, sound, security, solar radiation and energy saving. Its functions include determining the architectural relationship with the environment and articulate response to thermal level building, lighting and sound, as well as from the point of view of safety, tightness and solar radiation.

Usually an office building always needs cold. The computers, printers, lighting, photocopiers and people generate much heat, and we should keep out more heat from the outside as a result of direct sunlight. This ability to react in real time to changing external weather-use and makes internal distribution facades incorporating dynamic shading a fundamental aspect for achieving zero net balance.

4. Dynamic Facade or WhatsApp.

The facade is the first building energy control. The current and traditional facades have adapted to the place and built environment on climate although the place are seasonal facades. That is, the existing facades give a response in summer or winter to user needs depending on weather conditions. The new buildings almost zero consumption or NZEB need more than a facade seasonal ... need a dynamic facade that reacts in real time according to the needs of the outdoor climate and the needs of the user (inside the building). We propose the Dynamic Somfy Facade (FDS) WhatsApp type (Figure 6) with an immediate response (minute by minute) and can give maximum comfort and minimum energy consumption at each time of day.

The dynamic facades have 4 characteristics:
- **Immediate.** Instant reaction to the facade every minute adapting to climate change interior exterior and user needs. There is a seasonal facade that performs well in summer or winter ... in every moment brings the best choice of comfort and energy savings.
- **Flexible.** The facade may change with the change of use of the building only programming changes without works on the facade. The flexibility of encourage dynamic facades can be adapted to the processes of plant hire.
- **Invisible.** Respect the architectural and aesthetics of the facade as it only acts when necessary changes to improve the comfort and energy savings. If no need sun protection is hidden.
- **Integrated.** The dynamic facades can be integrated with the HVA and lighting in the same building management system (BMS) to reduce consumption of a building. The HVA and lighting are around 70-75% of the consumption of a building.
The dynamic facade mostly has a significant impact on the HVAC and lighting of the building. The benefits of dynamic facade are:
- Enhance natural light, reducing the consumption of artificial light and increasing the life of the lamps.
- Reduced consumption of HVAC. (Air Conditioning and Heating)
- Improve thermal-visual comfort of the user.
- Reduction of CO2 emissions and preserving the environment.
- Integrate the management of the facade into the building control system which will also be the lighting and air conditioning. (Figure 7)

![ANIMEO. MANAGER FACADES](image)

**Figure 7: ANIMEO. Dinamic Facade Somfy (DFS).**

The dynamic facade acts according to outside and inside building conditions always looking for the best option. If there is nobody in the office, the priority is the comfort but if there isn’t present the priority is the energy saving. Dynamic Facade is included in the Building Manager System and should always be integrated with the other installations (lighting, HVAC, etc.)

Dynamic Facade has 2 parts:
- **Animeo. Facade Management System.** The movement allows energy savings and comfort connected with the rest of the installations. The fixed or passive solar protection has limited its performance in terms of savings and comfort.
- **End product. Solar Protection** or external element depends on the facade architectural design. Depending on the design and composition of the facade you can install a type of sun protection textiles or exterior venetian blinds.

In the facade you can install solar protection on:
- **Outside o exterior.**
- **Between glasses or Intermediate or ventilated facade. (Only Complete Rehabilitation)**
- **Inside or Interior.**
The sun protection situation (Figure 8) is essential to achieve the goals of energy savings and maintenance cost. Attached is a table showing the advantages and disadvantages of solar protection based on the situation on the facade. The outside is the best position to energy saving.

![Figure 8: Solar Protection Situation](image)

5. Working example. 2010. Initial Situation

Example of action is an external energy rehabilitation project with a Dynamic Facade. Our Client, the Department of Rural Development and Environment, grouped all departments relocating to a new office building that the department had in different places in the capital of Navarra. (Figure 9)

![Figure 9: Building facades energy before rehabilitation.](image)
The plot of land where the building is located on the corner of Francis Bergamin Street and is rectangular. The office building has 5 floors in height (ground floor + 4) with an area of 6,043m² for offices, 240 underground parking spaces and neighborhood landscaping for public use area in the heart of the city of 1,500 m². The length of the facades are 50-58 x 17-22ml. Attach a plant type (Figure 10) office building with 2 vertical communication cores (stairs and elevators) on each side of the plant and a core of toilets forming a horizontal strip of services on the north facade of building.

![Figure 10: Current Plant building.](image)

The rest is a standard offices distributions, open work areas and meeting rooms. All rooms have natural light and the building has no nearby buildings. The whole have a high degree of TL (light transmittance) allowing great input of natural light and a cantilevered at fourth floor cover. The facade thick is 28mm with a distribution of a 4 +4 mm exterior glass + air chamber 12 mm + 8 mm inner glass. The building management system controls the air-conditioning, lighting and the alarms.


In 2011, Navarra’s Government after a year of operations looking for a solution to a number of drawbacks or deficiencies of comfort levels and lighting and air conditioning.

1. The interior lighting is producing excessive glare.
2. Solar radiation is excessive and is producing discomfort lighting and temperature increasing inside.
3. High consumption of air conditioning with peaks in electricity consumption because the internal temperature is excessive.
4. Daily complaints of users and services cleaning caused by the heat within the offices.

We propose a dynamic facade with an exterior venetian blind system. Be installed on the external glass an horizontal slat blinds (Venetian) steerable and retractable. The blinds move following parameters set by the client comfort inside the office about 21 °C in winter and 26 °C in summer with an average lighting in 500lx at workstation. These are connected to the system blinds Somfy Animeo that according to external climatic conditions make the louver ups, down or tilt in real time guiding parameters for the users comfort. (Figure 11)
Functional description of the dynamic facade:
The weather station (Figure 12) detects external conditions (sun, wind, rain, and temperature) and together with inside sensor (light and temperature) of the plant, that processes this information in the Building Controller (BuCo) of the building. (Figure 13) From the user's needs in terms of comfort and energy savings, the facade will move to the optimal position. Continuously the information is verified and updated the position of the sun protection to get the best choice of comfort and energy savings. The installation of the Dynamic facade reduced the indoor temperature on 6 °C improving user comfort and energy savings in air conditioning.
Navarra’s Government with this building opts for the use and intelligent resources management. This building has the most modern systems of solar air conditioning, lighting control, access control, security and management and recently joined the management and motorization of solar protection with the technology of the Dynamic Facade in their emblematic buildings. (Figure 14)

![Figure 14: Dynamic Facade with exterior venetian blinds](image)

7. Dynamic Somfy Facade like an option of energetic rehabilitation

The existing buildings have a proper architectural envelope for the thermal transmittance (U) but poor against the solar radiation (solar factor g). Especially the south and west facade. The cost of a new facade is about 800-900 € / m² glass surface. The rehabilitation of the facade carpentry, glass and opaque parts would may cost around 500-600 € / m² glass surface depending on the degree of activity. According Facility Management companies and ESCOS are very expensive reforms on current facades and the payback would exceed 10 years.

We propose not to reform the entire facade, only adding or complement it with a solar control (g) outer, intermediate or inner (Figure 15) to reduce the use of air conditioning and lighting and so enhance visual comfort-heat.

| Somfy Animeo Management System | 15 € / sqm of facade |
| Solar protection               | 110 € / sqm of facade |
| **DYNAMIC FACADE SOMFY**      | 125 € / sqm of facade |

This cost is very interesting because it has investment returns in 3-4 years facing facade south and west. We propose that the investor can renovate first south facade facing and begin to save energy. After 2 o 3 years with the money which he has saved he can renovate west facade facing. So the owner can renovate and payback his money step by step. So, this is a way to improve the existing building with simple solutions which increase the real estate value and reduce the energy consumption. We improve to arrive to Net Zero Energy Buildings.
The Dynamic Somfy Facade as a business opportunity for reducing energy consumption, reducing CO2 emissions and lower energy bill for zero consumption buildings together with a rational use of building and optimal maintenance program so convert to Somfy as a key player in achieving these objectives. Buildings energy rehabilitation is an opportunity because 85% the housing stock in Spain are E or less qualification. This is a summary about the existing buildings qualifications published.

**2013 July. Spain Energy Qualification (EXISTING BUILDINGS)**

- Qualification A: 0,2%
- Qualification B: 0,8%
- Qualification C: 4,0%
- Qualification D: 14,1%
- Qualification E: 48,3%
- Qualification F: 13,2%
- Qualification G: 19,4%

Improving the buildings energy efficiency is necessary to include the energy inside of project in architecture from the begining to achieve the new objectives of 2012/27/UE and RD 235/2013 in Spain. Teamwork is essential between facades, lighting and air conditioning companies, etc. collaboration with technicians, architects, engineers, interior designers, developers and government authorities are essential for the future. We propose the Dynamic Facade Somfy to improve energy efficiency in the buildings and get Net Zero Energy Building (NZEB).