SMART LIGHTING

by Somfy & Philips

Photo credit: Onix Building, Lille - Architect: Dominique Perrault

How the combined management of solar protection with natural and artificial light can help improve a building's energy efficiency

ONIX office building, Lille

& User feedback
Impact on energy efficiency

Light Balancing

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Foreword

This document gives a brief summary of the results of a pilot project into whether it would **be useful to combine shutter and lighting management when renovating an office building.** This combined management has made it possible not just to improve the occupants' comfort, but also the building's energy efficiency.

More broadly, this experiment demonstrates our work and research into building and furnishing the structure with a view towards sustainable development. Recall that one of the major issues in our society is to change and adapt our lifestyles to considerably reduce our energy consumption and environmental footprint. Engaging in these activities is everyone's duty in order to take part in the global drive for energy efficiency.

For this reason, Somfy & Philips, two major players in the construction industry, took the initiative to combine their skills and expertise in managing light, and launched a life-size experiment with a partner well-known in the building trade, the Rabot Dutilleul Group. To model the frame and interior window bays of the building, Somfy & Philips enlisted the Serge Ferrari Group, a leader in composite membranes, so as to preserve the aesthetics of the architect's signature façade, while adding remarkable energy characteristics.

> "Action from industry will be key to easing unwillingness to change and to guiding these transitions along."

Convinced that the future of their respective trades lies in expanding into other fields, Somfy & Philips have published this white paper to share the findings of their joint solution by illustrating the results of the pilot project, the ONIX Building in Lille, France, designed by the renowned architect and urban planner Dominique Perrault.

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1. 2020 Challenges: Energy renovation: A challenge for smart buildings

> Digital technology is a formidable opportunity for the construction industry. Considered a cost center until recently, the building may become a profit center owing to the aggregation of many efficiency- and wellness-generating services for users. In this context, the SBA has defined its Ready2Services© reference base, a prerequisite for a building open to multiple services that rely on open, interoperable systems.
>
> Emmanuel François, President of the Smart Building Alliance*

Construction is far ahead of transportation, industry, and agriculture as the leading driver of energy consumption in Europe; in France, it represents nearly one-quarter of all greenhouse gas emissions.(*) Corporate real estate professionals as well as office landlords and tenants, are seeking solutions to lower energy consumption in order to adapt to these challenges without diminishing the comfort of the occupants.

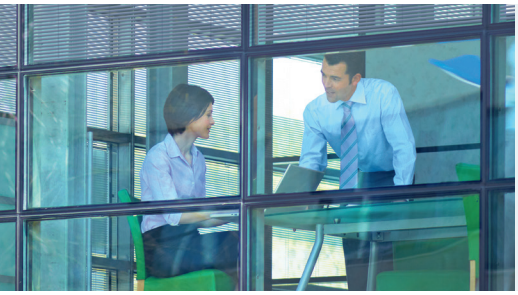
New regulatory restrictions, standards, and environmental labels combined with changes in the energy market are leading to lower consumption and more diverse resources.
The 21st century has seen the emergence of a multitude of topics and priorities for companies seeking to organize their workspace. The transition from the analog age to the digital age has been a major upheaval, but also an immense opportunity. With the convergence of digital, electrical, and energy technology, the smart building revolution is underway.

Attaining these ambitious goals requires three major conditions:

More intelligence in the building

The building must react to its environment and its users' behaviour in order to optimize energy consumption.
The building's systems must be upgradable, interoperable, and connected. In this matter, SOMFY & PHILIPS particularly support the Ready2Services© (R2S) reference of the Smart Building Alliance ([a]).

([a]) www.smartbuildingalliance.com



Upgradable, reliable, and effective applications.

The digital revolution cannot take the place of physical realities; rather, it must rely on high quality equipment that can deliver the promised service throughout the lifespan of the building, particularly automated lighting and solar protection systems.

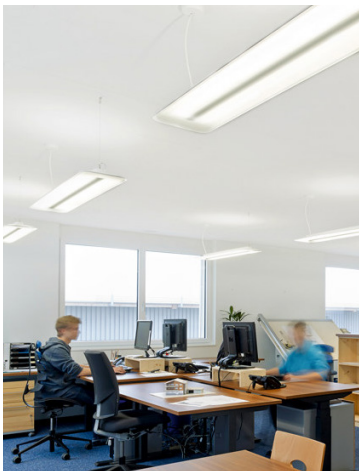
Life-cycle cost of the building

Total operating costs over time are much greater than construction costs. It is therefore important to invest in effective, upgradable solutions as early as the design phase, which will enable simple, inexpensive management.

(*) source ADEME Agence de l'environnement et de la maîtrise de l'énergie www.ademe.fr

The study covered three scopes

Lighting



Even today, almost 18% of primary power is used for lighting.
Artificial light is a very significant driver of energy consumption in office buildings: Since the arrival of LEDs, it has become an unparalleled source of energy savings.
In the commercial sector, 80% of light fixtures are obsolete, and over 70% of the power used by buildings' interior lighting is consumed in the daytime. **The use of LEDs combined with presence detection and adjustment to natural light may enable savings of up to 80%.** However, the LED does so much more. As a digital component by nature, it makes it possible to easily automate lighting, and as such connects every space in the building together.

By nature, as lighting is present throughout the building, connected lighting forms an exceptionally dense communication network with no further infrastructure needed.

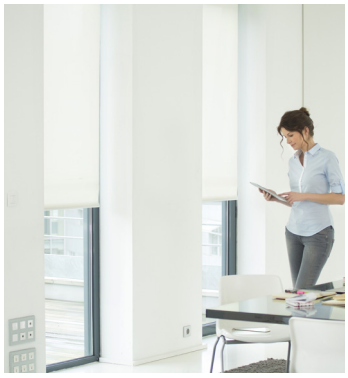
To learn more about light beyond illumination

Automating blinds

The smart, connected façade is no longer a static membrane; instead, it is becoming one of the key components of buildings to help make them more energy-efficient. Automating blinds and managing them based on the presence and position of the sun and the shadows that are cast, is in line with improving comfort for occupants and saving energy, by making it possible to heat and cool the environment while limiting the use of air-conditioning and heating systems.

Strategy to automate solar protection

Up to 20% savings in kWh/m²/year consumption with the automation of solar protection
(Pouget Consultants study, 7-floor office building)

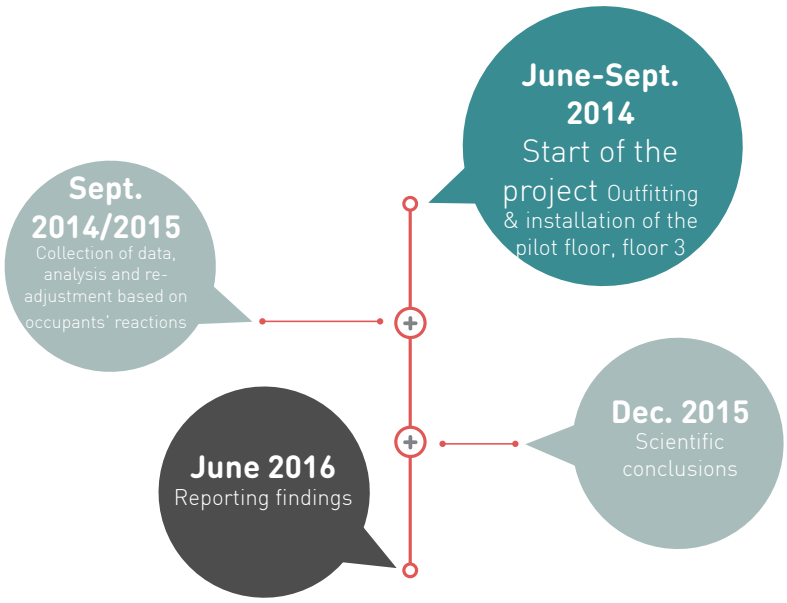


Thermal performance of screens

Thermal performance, reduced consumption, protection from heat and light, comfort for everyday work, transparency of the façade solutions: All these goals will need to be met in the future.
An effective, airy screen blind blocks enough heat and light, while allowing a view of the outside, and adapting to the different orientations of a building. It also enables a comfortable working environment close to the windows, in both summer and winter.

A 5-point gain in bioclimate needs (BBio) thanks to a low-emissivity solar protection screen
(Pouget Consultants study, 7-floor office building)

2. Enhancing a commercial building with energy renovation



The project: The ONIX Building

Reasons and motivation for choosing the pilot building: In 2014, the Rabot Dutilleul Group, out of a desire to deliver buildings that fit into a sustainable development approach, launched "Imagine 2014", a company project relating mostly to sustainable development.

For this reason, the ONIX building was audited with the goal of improving the comfort of its occupants and leading to a reduction in energy consumption (lighting/heating/ventilation).

"We hope that the buildings we construct and those in which we work are energy-efficient and equipped with solutions that help to balance and optimize energy."

Carole Catry, Secretary General of the Rabot Dutilleul Group

Description of the building

The Onix building, designed by architect Dominique Perrault, was delivered in 2011. It was designed to RT 2005 thermal regulations, which do not require automated management of solar protection and lighting. It is located in the business district of Euralille. The Rabot Dutilleul Group, a general construction firm, decided in 2011 to lease three floors in this recent building to serve as its head office.

Once they had moved in, the occupants soon encountered discomfort as a result of three specific issues:

- Visual discomfort, due to very high glare
- Thermal discomfort in the summer, with the sensation of hot walls on sunny days
- Thermal discomfort in the winter, with the sensation of cold walls.

Furthermore, the existing lighting, which used non-dimming fluorescent fixtures, did not allow users to choose the proper level of illumination.

At a meeting between Rabot Dutilleul and Somfy, the proposal to carry out a pilot project to assess the efficiency of the "Light Balancing" system drew the attention of Mr. Deborre, the group's Director of Sustainable Development. This system makes it possible to jointly manage lighting and blinds in order to have more energy efficiency and greater comfort.

Onix Building, Lille. Architect: Dominique Perrault

Rodolphe Deborre Director of Sustainable Development at the Rabot Dutilleul Group

"The benefit of carrying out the pilot with Somfy & Philips was to see how renovating a floor with solutions that don't directly impact the façade could solve the dilemma of addressing user discomfort by offering comfort scenarios while also adjusting energy efficiency."

Pilot study

One complete floor was equipped with the Light Balancing solution and with motorized interior blinds equipped with low-emissivity screens.
For one year, this pilot floor was compared to a reference floor that kept its original equipment. Both floors are occupied by the same company, Rabot Dutilleul, for equivalent job positions and uses. Somfy and Philips assigned all of the energy and comfort studies, and the analysis of the results, to their partner IES. The goal was to measure and study the impact of the Light Balancing solution on the following criteria:

- Visual comfort
- Thermal comfort
- Energy consumption of lighting & HVAC installations

The third floor pilot floor

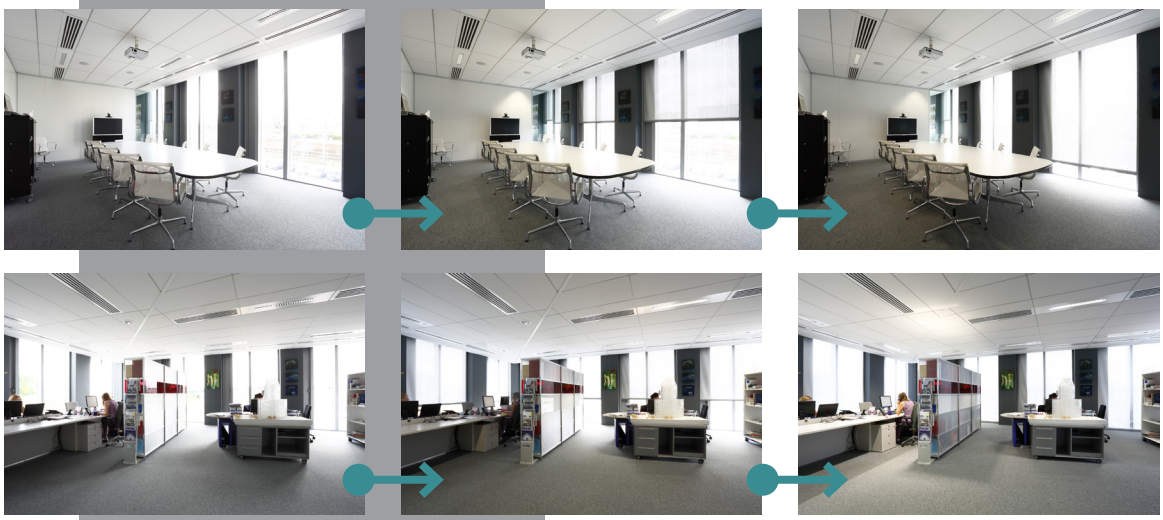
2

- Installed interior, automated blinds, equipped with Soltis 99 LowE low-emissivity screens
- Added multipliers (presence detection and photoelectric cell).
- The motorized blinds & lighting are piloted by the Light Balancing system using the KNX protocol.

The fourth floor reference floor

3

- Vertical interior manual blinds (with a chain) equipped with Soltis 99 screens.
- T5 fluorescent lighting with no dimming, turned on and off by hour-based timers.



How does it work?

Basic strategy for optimizing daylight and artificial light.
Keeping variations in light and temperature below a comfort threshold for occupants.

An integrated approach is paramount

Light and temperature interact

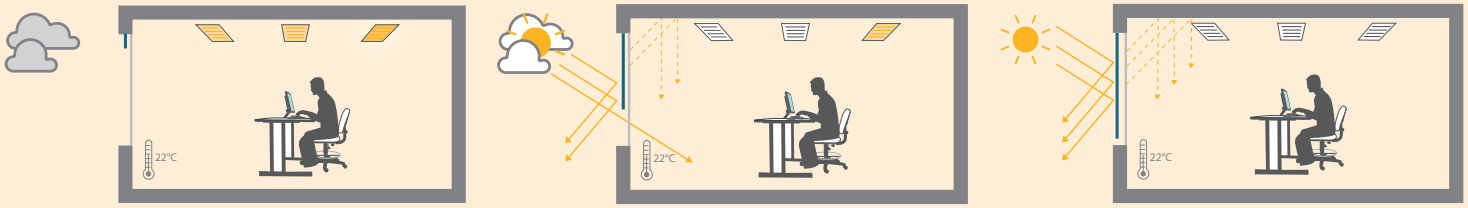
Outside	Envelope of the building	Interior
Variable weather Sunlight Thermal radiation Temperature	Automated protection that filters light and temperature	Conditions required Level of lighting Temperature

Defined by legislation
Preferences
Cost-cutting objectives

- Maximum daylight penetration to minimize the energy consumed by lighting and increase the view of the outside.
- Manage sunshine to reduce glare and minimize thermal solar heating in summer while making use of it in winter.

Operating principle

COMFORT mode (office occupied)
- No glare
- Optimal light levels
- Optimal visual contrast
- Optimal thermal comfort



Little sunlight, cloudy

Blinds raised:
Natural light maximized
Average artificial lighting:
Complement to natural lighting

Partial sunlight, some clouds

Blinds lowered 50%:
Natural light optimized
Low natural lighting:
Complement to natural lighting

Heavy sunlight

Blinds 100% lowered:
Block heat and glare
Artificial lighting: *off*

ECO mode (office unoccupied)
- No artificial lighting
- Minimal heating and air conditioning

Summer strategy
Block solar thermal heat
Artificial light off

Winter strategy
Use solar thermal heat
Artificial light off

Light Balancing
PHILIPS | somfy

The Light Balancing solution is the result of joint efforts by two experts for intelligent synergy between natural and artificial light. This means setting up Smart scenarios for lighting the workspace based on usage and climate conditions, thereby making it possible to maximize the building's comfort and energy savings.

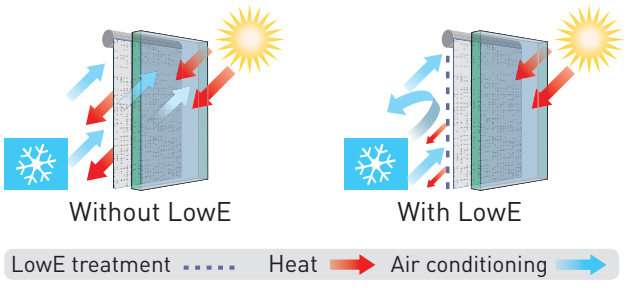
Automated screen blinds

Adding manual blinds without effective screens is not enough to address visual and thermal discomfort. Automating the blinds ensures that they are used correctly. The screens initially implemented as part of the Onix project are Soltis 99 screens without low-emissivity treatments. To improve the thermal comfort of occupants, limit the sensation of hot walls (summer) or cold ones (winter), improve the building's energy performance (fewer consumption peaks), effective automated Soltis 99 LowE screens with a special low-emissivity treatment were installed on the façade.

Concept of the Serge Ferrari LOWE screen

Screen effect or thermal barrier. Solar radiation causes the material to accumulate heat while releasing only a tiny portion towards the interior. Similar behaviour in winter with cold, very little of which is given off.

Being mindful of the light source alone (natural or artificial) isn't enough.



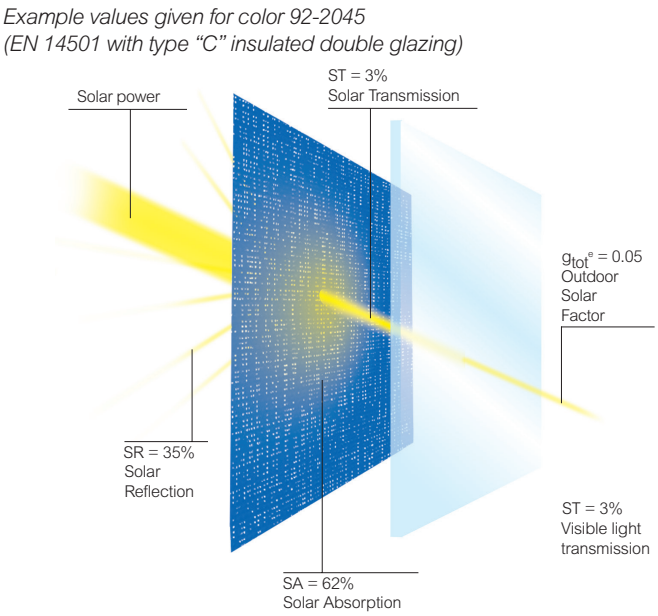
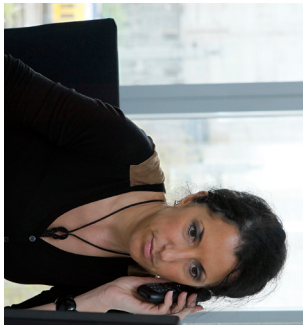
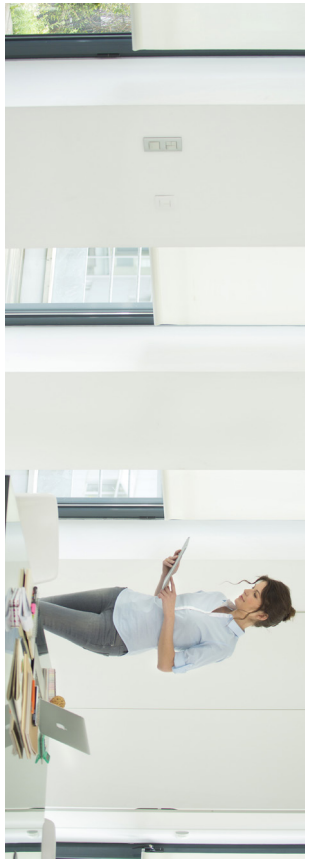


Photo credit: ONIX Building - Architectes Dominique Perrault

Photo credit: ONIX Building - Rabot Dutilleul Group





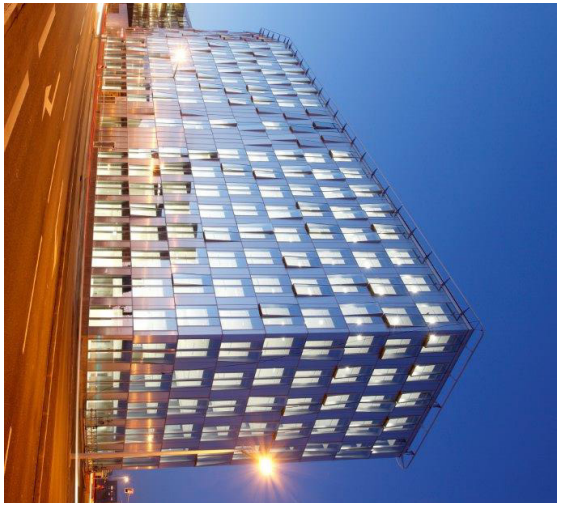


Photo credit: ONIX Building - Architectes Dominique Perrault

3. Findings of the study: Balance between comfort and energy efficiency

The reported findings are centered on three studies

1. **Consumption** consommation: **thermal & energy balance – lighting & HVAC (carried out by IES based on actual operating data: lighting, blinds, ambient temperature of the room)**

2. **Visual and thermal comfort** balance **(carried out by IES & the CSA Institute based on user surveys and face-to-face interviews)**

3. **Financial** balance **in return on investment (with the help of evidence provided by the building manager BNP Paribas)**

IES is an expert that offers a wide range of services, including energy and natural lighting modeling, CFD* analysis, certifications, and smart energy management.

(*) Computational fluid dynamics

Energy consumption results

Reducing energy consumption over a full year

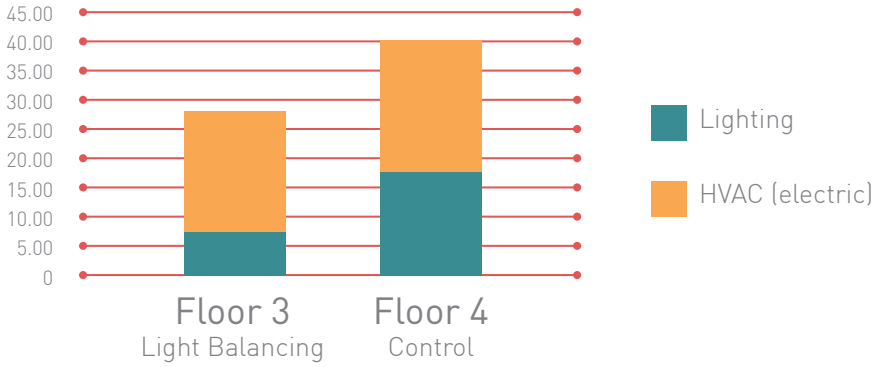
54% energy consumed by lighting

10% energy consumed by heating, ventilation, and air-conditioning.

29% total energy consumption

With respect to HVAC: · in the summer, air-conditioning consumption is reduced by an average of **14%** due to the automation of blinds, peaking in August 2014 at **19%**.
· in the winter, a minor impact was noted on reducing consumption.

Reduction in consumption measured over 1 year (KWh/m²/year)



"The average consumption of commercial buildings in France varies between 250/300 Kwhep/m²/year.[a]"

The results achieved are even more noteworthy given the fact that by converting this actual electrical consumption into equipment primary energy, the performance attained by the pilot floor qualifies for the most ambitious energy renovation standards, i.e. below 80 KWhep/m²/y (*)

Primary energy consumption based on actual usage profiles.

	3rd Pilot floor	4th Control floor
KWhep/m²/y	**78,04**	**108,27**

(*) including domestic hot water estimated at 4.5 KWhep/m²/y and noting that the calculations of RT2012 are performed on theoretical usage profiles, not actual ones as in the present case.
(kilowatt-hours/primary energy/m2/year).

LEDs: The standard for lighting

Office lighting is too often composed of energy-inefficient, uncontrollable solutions, as was originally the case in this building.

Combining energy efficiency with an exceptional lifespan, LED lighting solutions are now fully mature for any application. They make it possible to routinely achieve lower usage costs over time than conventional solutions, at an equal or greater level of comfort.

As a reminder, the methodological choices of the study aimed to assess only the impact of combined management, as the T5 fluorescent fixtures were retained in order to not hinder the comparative study and to elicit findings that related to combined operation of "blinds & lighting".
Energy savings of 50% would have been obtained by switching the office light fixtures to LEDs, as in the example below:

Philips PowerBalance LED lights
Le Village by CA (Crédit Agricole), Rue de la Boétie, Paris

This additional operation would have helped save:

79% on lighting

40% on the total consumption of the pilot floor, and a performance of < 67 KWhep/m²/y

[a] source 2012 - French Ministry of the Environment, General Commission for Sustainable Development

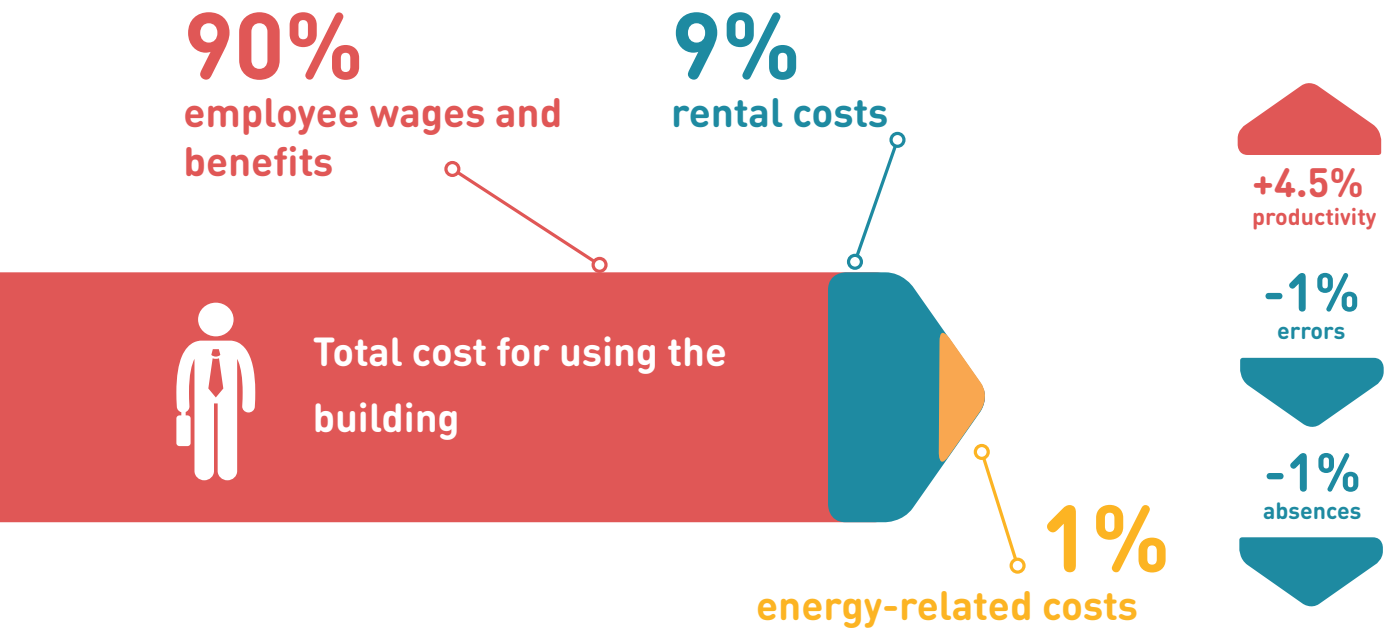
Improved thermal and visual comfort

Besides energy savings, this pilot showed a significant increase in employee comfort.

Their productivity is the primary factor in the building's operational performance.

A good lighting solution has a deep impact on people's vision, and therefore their well-being and performance.

An appropriate lighting solution focused on the needs of people adds



[a] LIGHTING EUROPE - Human Centric Lighting - Lighting designed to benefit human health and well-being

Smoothed-out, better-managed temperature

Achieving uniform temperature in the offices

- The study showed that for the most exposed façades, temperature variations are smoothed out on the pilot floor.
- Peaks of hot and cold are smoothed out due to the double skin created with the low-emissivity screen. There is therefore less demand for heating/air conditioning, and occupants' feeling of comfort is improved.
- The comparative measures of the "Light Balancing" solution show that uniform temperatures, lower peaks, and therefore better thermal comfort have been achieved.
- The thermal amplitude on the 4th floor without blinds **and without management is 3.4°C**
- The thermal amplitude on the 3rd floor with blinds **and "Light Balancing" management is 2.3°C**

Creating a double skin

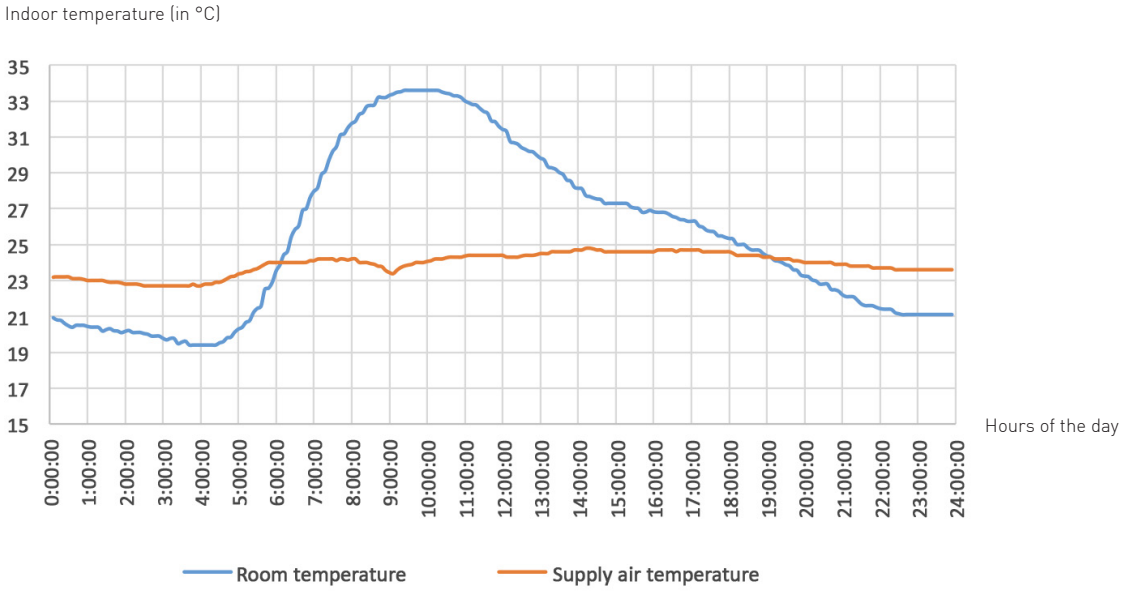
Comparing the temperature readings between the third and fourth floors shows that for the same temperature set point, namely 23°C:

- in a third-floor office, the occupant does not feel the need for heating or air conditioning.
- whereas in a fourth-floor office, the observed temperature peak shows that the user felt a sensation of cold and increased its heating temperature.

This uniformity of indoor temperature means fewer thermal shocks for the user and less of a sensation of adding and removing clothing, which increases comfort.

Hot-wall effect sharply limited

The phenomenon is the same for warm periods of the year or day.
Heat is filtered by this double skin, and it is also kept in the screen, without being rereleased to occupants (the famous "radiator" effect)



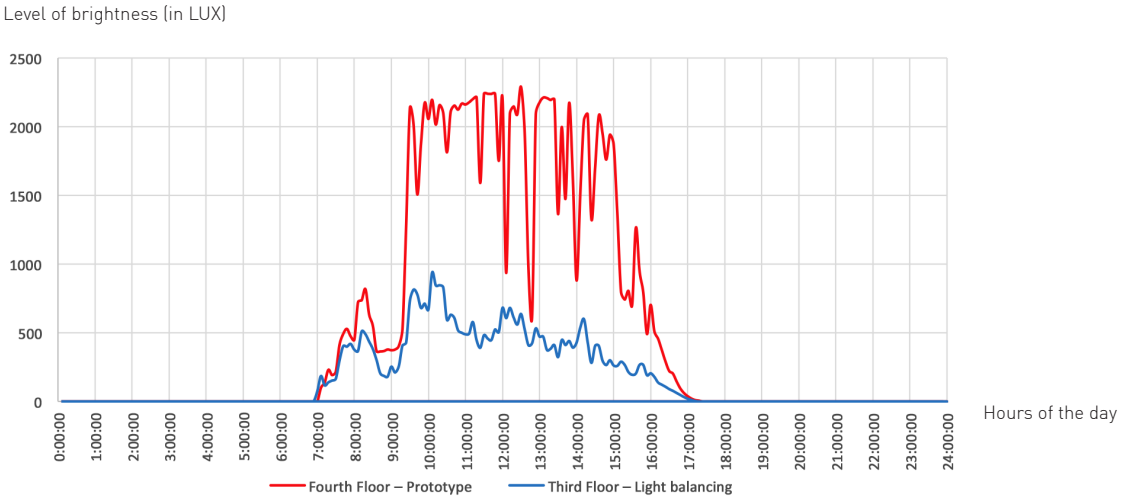
Source: IES study, impact on comfort and energy consumption in the ONIX demo building

Performance of blinds

By comparative measurements of the Light Balancing solution for visual comfort

The data recorded on the 4th floor shows that the occupants are subject to potential glare for a period of longer than six hours in the daytime.
The data recorded on the third floor, equipped with the Light Balancing solution, illustrate its effectiveness and the fact that it contributes to a sizable improvement in visual comfort:

- **Reducing brightness** with a level of glare below 1200 lux at its peak and 700 lux on average, thereby reducing the risks of glare in the offices.
- **Uniformity of brightness:** In the 3rd-floor office, the amplitude of variation is **600 lux on average, while it is 1800 lux** in the 4th-floor office. It is clear that the Light Balancing system correctly regulates the added natural light in order to keep the user from being exposed to situations of visual discomfort.



Source: IES study, impact on comfort and energy consumption in the ONIX demo building

Solving visual discomfort involves regulating the brightness of artificial light based in the presence of natural light, in order to achieve an improvement and an average level of light based on the recommendations of the AFE[a]

(average level of 600 lux, less than 800 lux)

Financial and human impacts

> **The energy savings mentioned above are reflected in substantial savings on the electrical bill, in the amount of 29%, which comes to 2€/m²/year**(*)

(*) Based on the electric rate in effect in this use case of 0.17/kWh

Financially, an attractive result

Investment

The pilot solution deployed on the third floor of the ONIX Building, ideal for a new project, consists of a technical management system on a KNX bus that allows:

- connection to the BMS* and coupling to the HVAC
- reorganisation of spaces without rewîring
- local control by the user via virtual remotes (on smartphones, tablets, PCs, etc.)

The total "turnkey" budget (*) of a KNX solution is between €50 and €60/m²

(*) budget for blind & lighting automation equipment, sensors, radio remotes, electrical wiring, KNX integration, system configuration.

For a low-cost limited renovation project, with no coupling to or modification of the BMS*, we recommend an autonomous management solution (at most 30 light fixtures and 32 blinds per autonomous space).

The total "turnkey" budget (*) of such a solution is between €20 and €25/m²

*BMS Building Management System

Renovating existing equipment

The financial impacts of such a project cannot ignore the value of the assets resulting from such improvements. The building with this equipment is:

- more economical to use
- more comfortable
- more attractive because it meets performance thresholds

The buildings renovated in this way will assuredly be easier to sell or lease.

Photo credit: ONIX Building, Lille - Architectes Rabot Dutilleul

Financial and human impacts

How did users react?

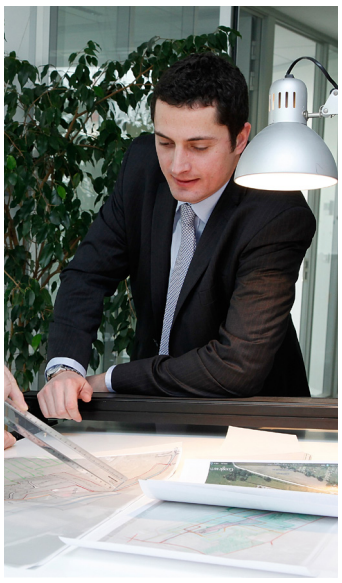
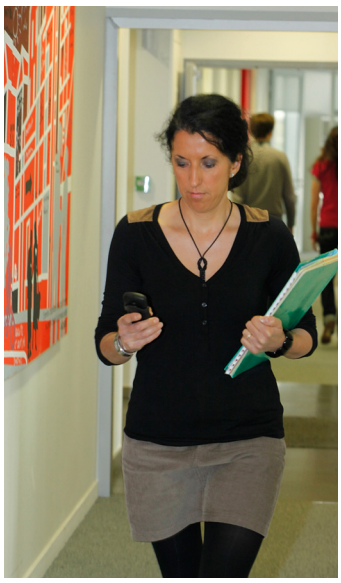


Photo credit: ONIX Building, Lille - Architectes Rabot Dutilleul



This system was chiefly perceived as an energy efficiency solution!
The users of the pilot floor said that they were ready to accept a change to their work environment and habits as long as it would save energy. They are mindful of sustainable development, due to their company's clearly shared policy, and are disposed towards adopting positive behaviour.

It did take some time for them to learn, and for the stress of automation to disappear.
Any automatic system, no matter how powerful it may be, cannot perform to its fullest until users have been trained in its basics and how to use it. This means that the users must be given guidance and clear information so that they can learn the system on their own.

That said, users quickly adjusted to the new features, to the point that they no longer noticed the blinds moving.
There is no universal operating rule that works for everyone, so it is essential to be able to adapt the system's parameters to the usage of the company that occupies the premises. For this reason, it is critical to retain the ability to temporarily override the automation manually. Essential for the feeling of comfort and provides assurance that things are under control.

4. Recommendations and conclusions

The completion of this pilot project has made it possible to qualify the actual contributions of automated, combined blinds-and-lighting management.

The context of achieving regulatory energy performance and digitizing commercial buildings is undeniably transforming how those buildings are being designed, furnished, and managed.
For this reason, thermal regulations state that to define a building's performance, passive elements must be incorporated that enable the optimization of the frame (envelope + insulation + windows + dynamic solar protection).

Photo credit: ONIX Building, Lille - Architect: Dominique Perrault

Furthermore, with the coming of digital solutions, the operating information of the main primary energy consuming equipment (air conditioning, heating, lighting, etc.) now travels throughout the building in intelligent ways, much like information travels over the Internet. In order to make the building intelligent, all of these systems must be detected, exploited, and correlated.

We propose a solution that correlates active elements (lighting) and passive ones (blinds) which affect the comfort of occupants and the building's performance.

We have demonstrated that when light and solar protection become intelligent, Light Balancing solutions are able to regulate peaks in power consumption from season to season by tying light to outside climate conditions (sunshine, temperature). These results are only achievable if the type of solar protection is effective and automated.

Combined automation of solar protection and lighting thereby helps reconcile occupants' comfort and limit the building's energy consumption all year round.

As a result, in Lille, the occupants of the 3rd floor of the ONIX building:
- have a comfortable building in both summer and winter
- receive artificial and natural lighting, which lights what is needed at the right time
- while consuming 29% less energy compared to the control floor.

After analyzing the occupants' perception, we therefore recommend:

- For new buildings: Incorporating "passive" blinds and lighting systems as an additional system for managing the building's comfort and energy
- For renovations: Taking note of this streamlined, simple-to-implement solution that does not require direct alterations to the building frame.

> Energy efficiency does not necessarily go hand-in-hand with complex, costly systems

Through this project, besides the energy saved and comfort afforded, we want to emphasize the value of the asset gained through the Light Balancing solution.
A high-quality, well-situated building will be even more attractive if its energy performance and level of comfort are guaranteed over time.
The adaptability of this type of solution leads to greater flexibility of use, making it possible to expand the potential user base.
Light Balancing therefore offers a simple-to-implement option that helps make commercial buildings more attractive.

A building's total cost of ownership over its full life cycle is more closely tied to its usage and operation costs than to the initial cost of construction.
In order to achieve ambitious performance goals and meet the environmental challenges of tomorrow, a long-term vision is fundamental.

Current projects, however, still make too much of a distinction between construction and operation. It is our responsibility to propose alternative models that commit the solution provider over time.
An intelligent, communicating system like the one put in place at ONIX provides functionality throughout the life cycle of the building, so it must also be available as a service with a quality commitment that is maintained over time.

With respect to renovation, European office buildings represent more than 1.3 billion m² of office space, with a replacement rate of 2.8% per year. 50% of this space is over 30 years old, and is therefore totally obsolete in terms of comfort and/or energy performance.
It is possible to act by combining investment and operation. It is desirable to institute savings in the form of functionality:

Light Balancing as a Service!

5. About the partners

PHILIPS | somfy

Since 2010, the organizations of Somfy and Phillips began developing an industrial and commercial partnership to better take into account the contributions of natural light in commercial buildings. Several factors explain this collaboration:
Unique know-how and technology from two leaders in their respective markets
A desire to anticipate future changes in thermal regulations
A shared vision on the need to bring building trades together over energy efficiency

somfy

Historically located in Cluses, Haute-Savoie, it is now the world leader in the motorized and automatic control of openings and closures in homes and buildings. With a presence in over 50 countries, including 8000 employees, the group reached sales of €1 billion in December 2015.
To achieve the goals of comfort and energy performance in commercial buildings, Somfy designs and develops automated management systems for solar protection, a form of "integrated intelligence" built into façades. From design to implementation, Somfy accompanies construction and real estate professionals in this approach as a genuine partner in each project.

PHILIPS

Philips Lighting is the leader in lighting solutions, systems, and services in France and around the world. With its knowledge and proficiency in technology and digital matters, Phillips Lighting designs and manufactures innovative products and systems intended to improve human comfort and living conditions, while offering new light experiences. Philips Lighting is present in the professional and residential markets, and is also the leader in the LED technological revolution thanks to solutions that prioritize energy efficiency, sustainability, and lower operational costs.
Stimulated by the emergence of the Internet of Things and connected light, Philips Lighting is transforming home, office, retail, and urban lighting. In 2015, Philips Lighting achieved sales of 7.4 billion, while employing 33,000 people worldwide.

Serge Ferrari

The Serge Ferrari Group designs, manufactures, and distributes environmentally responsible, highly technical, flexible composite materials in a global market that the company estimates to be €3.1 billion. The unique properties of its products make it possible to implement applications that meet technical challenges in three fields: Architecture, professional specialities, and composite panels for consumer markets. Its main competitive advantage comes from its unique Précontraint® technology and the corresponding proprietary industrial know-how.

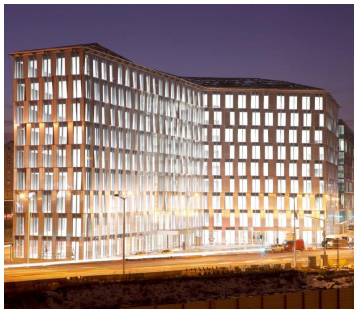


Photo credit: ONIX Building, Lille - Architect: Dominique Perrault

Solar protection for commercial buildings is one of the company's most dynamic markets, and it invests a great deal in research and development in order to address exterior thermal impact issues.
The Group has three production sites: One in La Tour du Pin, France in the Rhône-Alpes region, and two in Switzerland.
At the end of 2015, Serge Ferrari's sales were €148.5 million, more than 75% of which comes from 80 countries outside France, and it had over 600 employees.

Rabot Dutilleul

An independent, international family-owned developer and builder, Rabot Dutilleul is now one of the 10 leading French players in the construction and public works industry. Founded in Lille in 1920, Rabot Dutilleul has developed its skills in complementary fields related to the world of construction, thereby acquiring a near-complete understanding of all aspects of real estate. It cultivates values that rely on team performance with its 1850 employees and on the establishment of lasting relationships with its partners. With a presence in France, Belgium, and Poland, Rabot Dutilleul is 85% owned by the Dutilleul family and 15% by its employees.

Acknowledgments

Somfy & Philips would like to thank everyone who actively contributed their expertise to this project

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