



Demonstration Of Models for Optimisation of Technologies for Intelligent Construction

Demostración de Modelos para la Optimización de Tecnologías para la Construcción Inteligente
[LIFE+ 09 ENV/ES/000493]

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Best practices

(Technology, methods and techniques
tested within the framework of the
project)

<http://www.lifedomotic.eu/>

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[Best practices applied within the framework of the project]



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1. Objective and methodology:

In the final phase of the project entitled "Best Practices" (BP), this document presents a synthesis of the technology, inmotic devices, work methods, tools and techniques tested within the framework of the project in its experimentation phase (applied measures) for each of the following three demonstration actions in which the inmotic and BMS systems making up the validated models have been implemented:

[3a] Installation and experimentation in "Education Centre"

Responsible: Foundation San Valero [FSV]

Place of implementation: facilities of the "[San Valero Foundation](#)" in Zaragoza

[3b] Installation and experimentation in "University"

Responsible: Foundation San Valero [FSV]

Place of implementation: "[San Jorge University](#)" in Villanueva de Gállego (Zaragoza)

[3c] Installation and experimentation in "Museum/Interpretive Centre"

Responsible: Natural heritage Foundation [FPN]

Place of implementation: "[Educational Environmental Proposals](#)" (PRAE) centre in Valladolid

It is arranged in a series of fact files covering the most important measures applied (BP) and showing the results achieved in the experimentation phase by the end of the project (consumption and GHG emissions reductions, environmental benefit ratios, potential economic returns and simple payback period.

Whenever possible and considered beneficial for transfer purposes, some BPs that actually form part of more complex systems are broken down into component parts (e.g.: common areas and classrooms integrated in KNX systems, or tested with several different types of luminaires or intensities of use).

In some cases, as an aid to transfer, the results have been based on average intensities of use under normal operating conditions, according to the uses and timetables of service of the tested buildings (for example, in lighting: 37%...: 3,240 hours/year, 43%...: 3,766 and 50%...: 4,380 hours/year). This has been done to standardize data and present it more clearly, to facilitate extrapolation to any other intensity of use requiring calculation, and to reduce the bias arising from the particular conditions of any demonstration action.

Intensity of use is a vital aspect to take into account when analysing the simple payback period, since the higher the intensity of use, the greater will be the saving and therefore the shorter will be the payback period. This is why a temporary reduction of the intensity of use may lengthen the payback period even beyond the expected useful life of the installations. However, it is also true that this lower intensity of use will usually increase the expected useful life.

For each of the technologies tested the consumption reduction percentages demonstrated within the framework of the project have been applied to the consumptions calculated, as described in the previous paragraph.

The criteria used to calculate simple payback periods were conservative, as we will see below. The pay back periods may be even more favourable if the project is transferred and the implementation costs are reduced, the cost of energy increases, or financial incentives are provided.



COSTS:

The cost of the design, integration, testing, monitoring and modelling common to any demonstration action have been excluded in order to establish the real approximate cost of a standard, non-experimental and non-demonstration installation, capable of being replicated on the basis of the validated models.

Also excluded are the costs of maintenance, servicing, adjustments, corrections, monitoring and evaluation required by the demonstration actions to validate the actions and the technology employed.

The gradual reduction in prices that some technologies are experiencing have also been taken into account, as their implementation becomes more widespread and competition increases (e.g. LED technology).

Costs relative to the entire standard implementation process have been kept in; i.e. design, licences, permits, labour and installer's profit margin. The costs attributable to the operational control and management, maintenance, repairs and replacement of the installations in operation have been projected over their estimated useful life (15 years).

FINANCIAL INCENTIVES:

Given the legal insecurity regarding the regulation of energy prices and the conditions affecting the renewables market, together with the prevailing uncertainty as to the renewal of any energy efficiency incentives that may have existed in the past, the rules governing which are continually being changed, even retroactively, no financial incentives have been included in the savings calculated. It is simply not possible to know how incentives or transmission charges are going to change the energy market scenario due to the need, among others, to cover the tariff deficit in Spain.

ECONOMIC BENEFITS:

Only the economic savings brought about by the direct reduction of the consumption of electricity, fuel oil and biomass have been considered. Biomass-related saving has been calculated in terms of equivalent fuel oil.

In this respect it should be noted that the payback (ROI) periods calculated are likely to be reduced in the medium and long term as a result of the also likely drop in the price of equipment and the highly probable rise in energy prices.

VAT has not been included in either implementation costs or reference prices.

What has been detected is a moderate downward trend in the price of some components of this type of installations, the consequence of a higher market volume and this market's reaction to prevent its decline in the current climate of economic crisis.



However, the need we all have to reduce consumption in the light of rising energy prices means that the drop in equipment and software prices is not as significant as it is in other sectors, since this very need causes the demand for this type of devices and systems to grow, which means that suppliers do not feel under any great pressure to drop prices further. That said, the more widespread use of this equipment and growing competition are factors that may exert a downward pressure on the market.

It is important to note that all the technologies, methods and techniques applied have shown significant consumption reduction potential, which in some cases have exceeded expectation.



In the "**Final publication**", which can be downloaded from the project's website, the technical and logical operational characteristics of the models implemented are described in greater detail.



2. Measures applied (BP tested):

 BEST PRACTICES IN THE ENERGY MANAGEMENT OF BUILDINGS Project LIFE DOMOTIC LIFE+09 ENV/ES/000493 	
Description of the action: FSV - Lighting in classrooms: KNX + DALI + HF luminaires [Savings...: >49% - ROI...: 15 years]	Testing action 3a FSV
Initial situation: <ul style="list-style-type: none"> - Luminaires installed: <ul style="list-style-type: none"> - Fluorescent: Lamps 2X58W AF (140W). - Manual switching, unsectorized and non-adjustable (100% of the installed power when in operation). - Total installed power: 24.35 Kw. - Operating regime (Intensity of use...: 37%): 3,240 h/year. 	Final situation: <ul style="list-style-type: none"> - Luminaires installed: <ul style="list-style-type: none"> - Surface luminaires 1X80W HFDALI C6 (88W) - Surface luminaires 1X54W HFDALI ASY (60W) - Surface luminaires 1X28W HFDALI C6 (32W) - KNX + DALI (Digital Addressable Lighting Interface) control + presence and brightness sensors, blinds control, on-site pushbuttons for scene definition, sectorization, manual brightness adjustment, communications for remote management and consumption control... - Total installed power: 16.83 Kw. - Operating regime: Unchanged for the calculation.
Initial consumption: 78,894 kWh/year (€13,333/year)	Final consumption: 37,836 kWh/year (€6,394/year)
Energy consumption reduction: 38,911 kWh/year (49.32%)	Investment: €98,187
Economic saving: €6,576/year	Return on investment: 15 years
Emissions reduction: 31 t CO2/year	Contact Email: nzubalez@svalero.com



		BEST PRACTICES IN THE ENERGY MANAGEMENT OF BUILDINGS			
Project LIFE DOMOTIC LIFE+09 ENV/ES/000493					
Description of the action: FSV -Lighting in classrooms: KNX + DALI + HF luminaires [Savings...: >49% - ROI...: 11 years]				Testing action 3a FSV	
Initial situation: <ul style="list-style-type: none">- Luminaires installed:<ul style="list-style-type: none">- Fluorescent: Lamps 2X58W AF (140W).- Manual switching, unsectorized and non-adjustable (100% of the installed power when in operation).- Total installed power: 24.35 Kw.- Operating regime (Intensity of use...: 50%): 4,380 h/year.			Final situation: <ul style="list-style-type: none">- Luminaires installed:<ul style="list-style-type: none">- Surface luminaires 1X80W HFDALI C6 (88W)- Surface luminaires 1X54W HFDALI ASY (60W)- Surface luminaires 1X28W HFDALI C6 (32W)- KNX + DALI (Digital Addressable Lighting Interface) control + presence and brightness sensors, blinds control, on-site pushbuttons for scene definition, sectorization, manual brightness adjustment, communications for remote management and consumption control...- Total installed power: 16.83 Kw.- Operating regime: Unchanged for the calculation.		
Initial consumption: 106,653 kWh/year (€18,024/year)			Final consumption: 54,052 kWh/year (€9,135/year)		
Energy consumption reduction: 52,601 kWh/year (49.32%)			Investment: €98,187		
Economic saving: €8,889/year			Return on investment: 11 years		
Emissions reduction: 41.98 t CO2/year			Contact Email: nzubalez@svalero.com		



BEST PRACTICES IN THE ENERGY MANAGEMENT OF BUILDINGS

Project LIFE DOMOTIC

LIFE+09 ENV/ES/000493



Description of the action:

FSV - Lighting in classrooms:

KNX + DALI + luminaires LED [Savings...: >72% - ROI...: 10 years]

Testing action

3a FSV

Initial situation:

- Luminaires installed:
 - Fluorescent: Lamps 2X58W AF (140W).
- Manual switching, unsectored and non-adjustable (100% of the installed power when in operation).
- Total installed power: 24.35 Kw.
- Operating regime (Intensity of use...: 37%): 3,240 h/year.

Final situation:

- Luminaires installed:
 - Symmetrical and asymmetrical LED (50W)
- KNX + DALI (Digital Addressable Lighting Interface) control + presence and brightness sensors, blinds control, on-site pushbuttons for scene definition, sectorization, manual brightness adjustment, communications for remote management and consumption control...
- Total installed power: 8.96 Kw.
- Operating regime: Unchanged for the calculation.

Initial consumption: 78,894 kWh/year (13,333/year)

Final consumption: 21,531 kWh/year (€3,639/year)

Energy consumption reduction: 57,363 kWh/year (72.71%)

Investment: €97,515

Economic saving: €9,694/year

Return on investment: 10 years

Emissions reduction: 45.78 t CO2/year

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BEST PRACTICES IN THE ENERGY MANAGEMENT OF BUILDINGS

Project LIFE DOMOTIC

LIFE+09 ENV/ES/000493



Description of the action:

FSV - Lighting in classrooms:

KNX + DALI + luminaires LED [Savings...: >72% - ROI...: <8 years]

Testing action

3a FSV

Initial situation:

- Luminaires installed:
 - Fluorescent: Lamps 2X58W AF (140W).
- Manual switching, unsectorized and non-adjustable (100% of the installed power when in operation).
- Total installed power: 24.35 Kw.
- Operating regime (Intensity of use...: 50%): 4,380 h/year.

Final situation:

- Luminaires installed:
 - Symmetrical and asymmetrical LED (50W)
- KNX + DALI (Digital Addressable Lighting Interface) control + presence and brightness sensors, blinds control, on-site pushbuttons for scene definition, sectorization, manual brightness adjustment, communications for remote management and consumption control...
- Total installed power: 8.96 Kw.
- Operating regime: Unchanged for the calculation.

Initial consumption: 106,653 kWh/year (18,024/year)

Final consumption: 29,106 kWh/year (€4,919/year)

Energy consumption reduction: 77,547 kWh/year (72.71%)

Investment: €97,515

Economic saving: €13,105/year

Return on investment: 7 years and 5 months

Emissions reduction: 61.88 t CO2/year

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BEST PRACTICES IN THE ENERGY MANAGEMENT OF BUILDINGS

Project LIFE DOMOTIC

LIFE+09 ENV/ES/000493



Description of the action:

FSV - Lighting in corridors:

KNX + DALI + HF luminaires [Savings...: >86% - ROI...: <10 years]

Testing action

3a FSV

Initial situation:

- Luminaires installed:
 - Lamps 2X58W AF (140W)
- Manual switching, unsectorized and non-adjustable (100% of the installed power permanently).
- Total installed power: 2.80 Kw.
- Operating regime (Intensity of use...: 37%): 3,240 h/year.

Final situation:

- Luminaires installed:
 - Surface luminaires 1x54W HFDALI ASY (60W)
 - Surface luminaires 1X28W HFDALI C6 (32W)
- Integrated control KNX + DALI (Digital Addressable Lighting Interface) + presence sensors, sectorization and communications for remote management...
- Total installed power: 0.95 Kw.
- Operating regime: Unchanged for the calculation.

Initial consumption: 9,072 kWh/year (1,533/year)

Final consumption: 1,246kWh/year (211/year)

Energy consumption reduction: 7,826 kWh/year (86.27%)

Investment: €12,233

Economic saving: €1,322/year

Return on investment: 9 years and 3 months

Emissions reduction: 6.25 t CO2/year

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BEST PRACTICES IN THE ENERGY MANAGEMENT OF BUILDINGS

Project LIFE DOMOTIC

LIFE+09 ENV/ES/000493



Description of the action:

FSV - Lighting in toilets:

Presence + timing + HF luminaires [Savings...: >45% - ROI...: <8 years]

Testing action

3a FSV

Initial situation:

- Luminaires installed:
 - Lamps 2X58W AF (140W)
- Manual switching, unsectorized and non-adjustable (100% of the installed power permanently).
- Total installed power: 1.4 Kw.
- Operating regime (Intensity of use...: 37%): 3,240 h/year.

Final situation:

- Luminaires installed:
 - Surface luminaires 1x54W HFDALI ASY (60W)
- Presence sensors, sectorization and timing.
- Total installed power: 0.36 Kw.
- Operating regime: Unchanged due to timetable.

Initial consumption: 4,536 kWh/year (€767/year)

Final consumption: 2,464 kWh/year (€416/year)

Energy consumption reduction: 2,072 kWh/year (45.7%)

Investment: €2,690

Economic saving: €351/year

Return on investment: 7 years and 8 months

Emissions reduction: 1.65 t CO₂/year

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BEST PRACTICES IN THE ENERGY MANAGEMENT OF BUILDINGS

Project LIFE DOMOTIC

LIFE+09 ENV/ES/000493



Description of the action:

FSV - Heating:

KNX + Sensors + Variable frequency drive [Savings...: >20% - ROI...: <9 years]

Testing action

3a FSV

Initial situation:

- The heating circuits pumped the water at a constant temperature of 90°C to the different rooms, only by programmable timer, with no possible flow regulation or weighted control of indoor and outdoor temperatures, which led to excessive fuel oil consumption and lack of comfort in certain classrooms.

The installation has 3 fuel oil boilers:

C1: Boiler ROCA TR-3-120.

C2: Boiler ROCA TD-200.

C3: Boiler ROCA AR-3.

- Total installed power: 754.6 Kw / 648.52 Kcal/h.
- Operating regime (Intensity of use...: 6%): 565 h/year.

Final situation:

- Integration of the system of heating in KNX system.
- Weather-compensated flow temperature by mixed return water.
- Supply flow dependent on weighted indoor temperatures (N-S) using variable frequency drive.
- Radiators turned off in common areas (corridors).
- Closure of blinds during the night.

- Total installed power: Unchanged.
- Operating regime: Unchanged due to timetable, depending on weather.

Initial consumption: 339,680 kWh/year (€28,109/year)

Final consumption: 270,450 kWh/year (€22,380/year)

**Energy consumption reduction: 69,230 kWh/year (20.38%)
6,501 l/year of fuel oil or 5,417 M3/year of natural gas**

Investment: €49,375

Economic saving: €5,729/year

Return on investment: 8 years and 7 months

Emissions reduction: 20.40 t CO2/year

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	BEST PRACTICES IN THE ENERGY MANAGEMENT OF BUILDINGS		
		Project LIFE DOMOTIC	
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Description of the action:		Testing action	
USJ - Emergency lighting: KNX + DALI [Savings...: >67% - ROI...: <6 years]		3b FSV in USJ	
Initial situation:		Final situation:	
<ul style="list-style-type: none"> - Luminaires installed: <ul style="list-style-type: none"> - Fluorescent: Lamps 1X49W AF (54W). - Manual switching, unsectorized and non-adjustable (100% of the installed power permanently). - Total installed power: 8.85 Kw. - Operating regime (Intensity of use...: 100%): 8,760 h/year. 		<ul style="list-style-type: none"> - Luminaires installed: <p>Retaining the luminaires, photocell controlled dimming ballasts are installed and integrated in a KNX system. This enables their brightness to be adjusted according to that contribution of daylight detected.</p> - KNX + DALI (Digital Addressable Lighting Interface) control including brightness sensors, with the possibility of scene definition, sectorization, manual brightness adjustment, communications for remote management and consumption control... - Total installed power: 8.85 Kw. - Operating regime: Unchanged due to regulations. 	
Initial consumption: 77,526 kWh/year (€13,102/year)		Final consumption: 24,956 kWh/year (€4,218/year)	
Energy consumption reduction: 52,570 kWh/year (67.81%)		Investment: €47,833	
Economic saving: €8,884/year		Return on investment: 5 years and 5 months	
Emissions reduction: 41.95 t CO2/year		Contact Email: nzubalez@svalero.com	



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BEST PRACTICES IN THE ENERGY MANAGEMENT OF BUILDINGS

Project LIFE DOMOTIC

LIFE+09 ENV/ES/000493



Description of the action:

USJ - Lighting in classrooms:

BMS + KNX + DALI [Savings...: 14% - ROI...: <3 years]

Testing action

3b FSV in USJ

Initial situation:

- Luminaires installed:
 - Fluorescent: Lamps 2X49W AF (108W).
- KNX control with scene definition and regulation, without remote management, in the Faculty of Health.
- Detected in BMS analysis: even when the classrooms are unused, the lighting is frequently left on until this situation is detected.
- Total installed power: 23.98 Kw.
- Operating regime (Intensity of use...: 37%): 3,240 h/year.

Final situation:

- Luminaires installed:
 - Remain unchanged.
- Integration in new BMS + KNX + DALI (Digital Addressable Lighting Interface) control system; with communications for remote management and consumption control...
- The duration of this type of incidents has been reduced to a minimum; as soon as such an incident is detected, classroom lighting is remotely turned off.
- Total installed power: 23.98 Kw.
- Operating regime: Unchanged due to timetable.

Initial consumption: 77,695 kWh/year (€13,130/year)

Final consumption: 66,818 kWh/year (€11,292/year)

Energy consumption reduction: 10,877 kWh/year (14%)

Investment: €4,783

Economic saving: €1,838/year

Return on investment: 2 years and 7 months

Emissions reduction: 8.68 t CO₂/year

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BEST PRACTICES IN THE ENERGY MANAGEMENT OF BUILDINGS

Project LIFE DOMOTIC

LIFE+09 ENV/ES/000493



Description of the action:

USJ - Lighting in toilets:

Presence + timing [Savings...: 20% - ROI...: <11 years]

Testing action

3b FSV in USJ

Initial situation:

- Luminaires installed:
 - Fluorescent AF (40W)
- Manual switching, unsectorized and non-adjustable (100% of the installed power permanently).
- Total installed power: 3.32 Kw.
- Operating regime (Intensity of use...: 37%): 3,240 h/year.

Final situation:

- Luminaires installed: Remain unchanged
- Presence sensors, sectorization and timing.
- Total installed power: 3.32 Kw.
- Operating regime: Unchanged due to timetable.

Initial consumption: 10,757 kWh/year (€1,818/year)

Final consumption: 8,606 kWh/year (€1,454/year)

Energy consumption reduction: 2,151 kWh/year (20%)

Investment: €3,813



Economic saving: €364/year

Return on investment: 10 years and 6 months

Emissions reduction: 1.72 t CO2/year

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		BEST PRACTICES IN THE ENERGY MANAGEMENT OF BUILDINGS			
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Description of the action:				Testing action	
USJ - HVAC:				3b FSV in USJ	
BMS + ARES+ Temperature sensors + METASYS + PowerStudio [Savings...: 35% - ROI...: <1 year]					
Initial situation:		Final situation:			
<ul style="list-style-type: none">- Chillers of the HVAC system: The supply flow temperature of the circuits of the 2 chillers was fixed (50°C in winter and 7°C in summer). Due to the flow of circulating water, at many times of the year the chillers were unable to reach these temperatures and, as a result, the 3-way valves that mix return water with the hot water were always wide open, so the mixing never took place and the demand on the chillers was at a maximum.- Total installed power: 240.48 Kw.- Operating regime (Intensity of use...: 27%): 2,418 h/year.		<ul style="list-style-type: none">- Chillers of the HVAC system: After analysing the information provided by the BMS implemented for consumption control purposes, software was designed and installed to program the supply temperature of the chillers using ramps that alter the supply temperature depending on the outdoor temperature. This means that the valves work properly and mix return water with the hot water, significantly reducing the demand on the chillers.- Total installed power: 240.48 Kw.- Operating regime: Unchanged due to operating timetable.			
Initial consumption: 581,481 kWh/year (€98,270/year)		Final consumption: 377,963 kWh/year (€63,875/year)			
Energy consumption reduction: 203,518 kWh/year (35%)		Investment: €26,199			
Economic saving: €34,395/year		Return on investment: 9 months			
Emissions reduction: 162.41 t CO2/year		Contact Email: nzubalez@svalero.com			



BEST PRACTICES IN THE ENERGY MANAGEMENT OF BUILDINGS

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LIFE+09 ENV/ES/000493



Description of the action:

USJ - Lighting, HVAC, phantom consumption and malfunctions:
BMS [Savings...: 40% - ROI...: <1 year]

Testing action

3b FSV in USJ

Initial situation:

- Without BMS (Building Management System) for consumption control, the periods of detection of and response to the following incidents detected were either excessively long or the incidents had remained undetected:
HVAC: Loss in one of the well pumps, with constant pumping.
HVAC: A distribution pump stayed on due to a malfunction.
HVAC: maximum demand on chillers due to non-mixing with return water.
Lighting: Lighting on in unused classrooms.
- Total installed power: Various power ratings depending on the system.
- Operating regime: Various different intensities of use and periods, depending on the systems affected and times in operation.

Final situation:

- The BMS implemented has, in its experimentation phase, enabled:
The detection of phantom consumption, considered normal at the time since it formed part of the established consumption baseline.
The early detection malfunctions; shorter response times.
The detection of excessive consumption that has been corrected.
The detection of improper usage of lighting, which can now be corrected remotely.
- Various power ratings depending on the system.
- Operating regime: Various different intensities of use and periods, depending on the systems affected and times in operation.

Initial consumption: 431,148 kWh/year (€72,864/year)

Final consumption: 258,260 kWh/year (€43,646/year)

Energy consumption reduction: 172,888 kWh/year (40%)

Investment: €26,199

Economic saving: €29,218/year

Return on investment: 11 months

Emissions reduction: 137.96 t CO₂/year

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The saving rates and therefore the payback periods may vary depending on the intensity of the analysis, the incidents detected and the solutions adopted. In this case, the result corresponds to USJ within the framework of the project.



BEST PRACTICES IN THE ENERGY MANAGEMENT OF BUILDINGS

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LIFE+09 ENV/ES/000493



Description of the action:

FPN - Lighting in corridors:

Sectorization, presence sensors and contracted power reduction [Savings...: 20% - ROI...: 8 years]

Testing action

3c FPN in PRAE

Initial situation:

- Luminaires installed:
 - Compact fluorescent (18-30W)
- Manual switching, unsectorized and non-adjustable (100% of the installed power permanently).
- Total installed power: 2.52 Kw.
- Total power contracted: 514 Kw (Price kWh...: €0.193/kWh)
- Operating regime (Intensity of use...: 43%): 3,767 h/year.

Initial consumption: 9,493 kWh/year (€1,832/year)

Energy consumption reduction: 1,899 kWh/year (20%)

Economic saving: €792/year

Emissions reduction: 1.52 t CO2/year

Final situation:

- Luminaires installed: Remain unchanged.
- Contracted power reduction (70%).
- 200% increase in headcount from (20 to 60 workers).
The luminaires are unchanged, sectorization is applied, and 35 presence sensors are installed: 24 infrared and 11 ultrasonic. The electrical power contracted is reduced, thereby significantly reducing the price per kWh.
- Total installed power: 2.52 Kw.
- Total power contracted: 150 Kw (Price kWh...: €0.137/kWh)
- Operating regime: Unchanged due to timetable.

Final consumption: 7,594 kWh/year (€1,040/year)

Investment: €6,325

Return on investment: 8 years

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With a 20% reduction in consumption, the economic saving is 43%, due to a reduction in price of each kWh by reducing the power contracted by 70%.



BEST PRACTICES IN THE ENERGY MANAGEMENT OF BUILDINGS

Project LIFE DOMOTIC

LIFE+09 ENV/ES/000493



Description of the action:

FPN - Consumption of electricity:

BMS+ ARES + Corrective measures [Savings...: 42.37% - ROI...: <2 years]

Testing action

3c FPN in PRAE

Initial situation:

- Luminaires installed:
 - Compact fluorescent (18-30W)
- Manual switching, unsectorized and non-adjustable (100% of the installed power permanently).
- Total power contracted: 514 Kw (Price kWh...: €0.193/kWh)
- Operating regime (Intensity of use...: 43%): 3,767 h/year.

Final situation:

- Luminaires installed remain unchanged.
 - Contracted power reduction (70%)
- The luminaires are unchanged, sectorization is applied, and 35 presence sensors are installed: 24 infrared and 11 ultrasonic. The electrical power contracted is reduced, thereby significantly reducing the price per kWh.
- Total power contracted: 150 Kw (Price kWh...: €0.137/kWh)
 - Operating regime: Unchanged due to timetable.

Initial consumption: 456,800 kWh/year (€88,162/year)

Final consumption: 263,254 kWh/year (€36,066/year)

Energy consumption reduction: 193,546 kWh/year (42.37%)

Investment: €75.582

Economic saving: €52,096/year

Return on investment: 1 year and 5 months

Emissions reduction: 154.45 t CO2/year

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With a 42% reduction in consumption, the economic saving is 59%, due to a reduction in price of each kWh by reducing the power contracted by 70%.



BEST PRACTICES IN THE ENERGY MANAGEMENT OF BUILDINGS

Project LIFE DOMOTIC

LIFE+09 ENV/ES/000493



Description of the action:

FPN - HVAC and Performance biomass boilers:

BMS + ARES, distribution boards, meters, sensors, Software... + ESE/ESCO [Savings...: 49.22% - ROI...: <3 years]

Testing action

3c FPN in PRAE

Initial situation:

HVAC by biomass boilers, solar collectors, absorption equipment, mechanical compression chiller, cooling towers, underfloor heating, fan-coils and independent air-conditioners.

- Two 150 KW biomass boilers, 30 t tank and two 2,500 l storage tanks, backed up by solar thermal.
- 180 Kw absorption chiller and two 1,500 l storage tanks.
- Distribution by variable flow pumps (variable frequency drive) to fan-coils and underfloor heating.
- 10 ATUs responsible for distributing the air-conditioning.
- Non-integrated control systems, making it difficult to monitor the production, consumption, or the interaction and optimization of the systems.

Operating regime (Intensity of use...: 100%): 8,760 h/year.

Initial consumption: 857,540 kWh/year (€71,176/year)

Final situation:

- Systems: Remain unchanged.
- Implementation of an integrated BMS (DESICAL + DEXCELL), which receives signals from the measuring and control devices installed, to enable the analysis of consumption and the optimization and monitoring of systems.
- ARES, production and consumption meters, temperature and air quality sensors are installed, sectorized and integrated in the BMS.
- Distribution boards controlling HVAC and renewable energy production systems are upgraded and integrated in the BMS.
- Permanent monitoring of renewable production and consumptions according to requirements and weather conditions.
- Contracting of ESE (ESCO) for maintenance and optimization.
- Operating regime: According to requirements.

Final consumption: 435,459 kWh/year (€36,145/year)

Energy consumption reduction: 422,081 kWh/year (49.22%)

Investment: €91,307

Economic saving: €35,031/year

Return on investment: 2 year and 7 months

Emissions reduction: 124.40 t CO₂/year

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The fact that the cost of maintaining the installations by ESE/ESCO is offset by the savings generated is of particular significance.



Demonstration Of Models for Optimisation of Technologies for Intelligent Construction

Demostración de Modelos para la Optimización de
Tecnologías para la Construcción Inteligente
[LIFE+ 09 ENV/ES/000493]



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3. Validation and results:

The results obtained from the project as a whole and in each of its actions attest to the validity of the technology tested and the inmotics and BMS models implemented, especially if it is taken into account that in order to ensure the replicability of the models, variability criteria were used from the outset in the selection of the buildings to be tested. These criteria were:

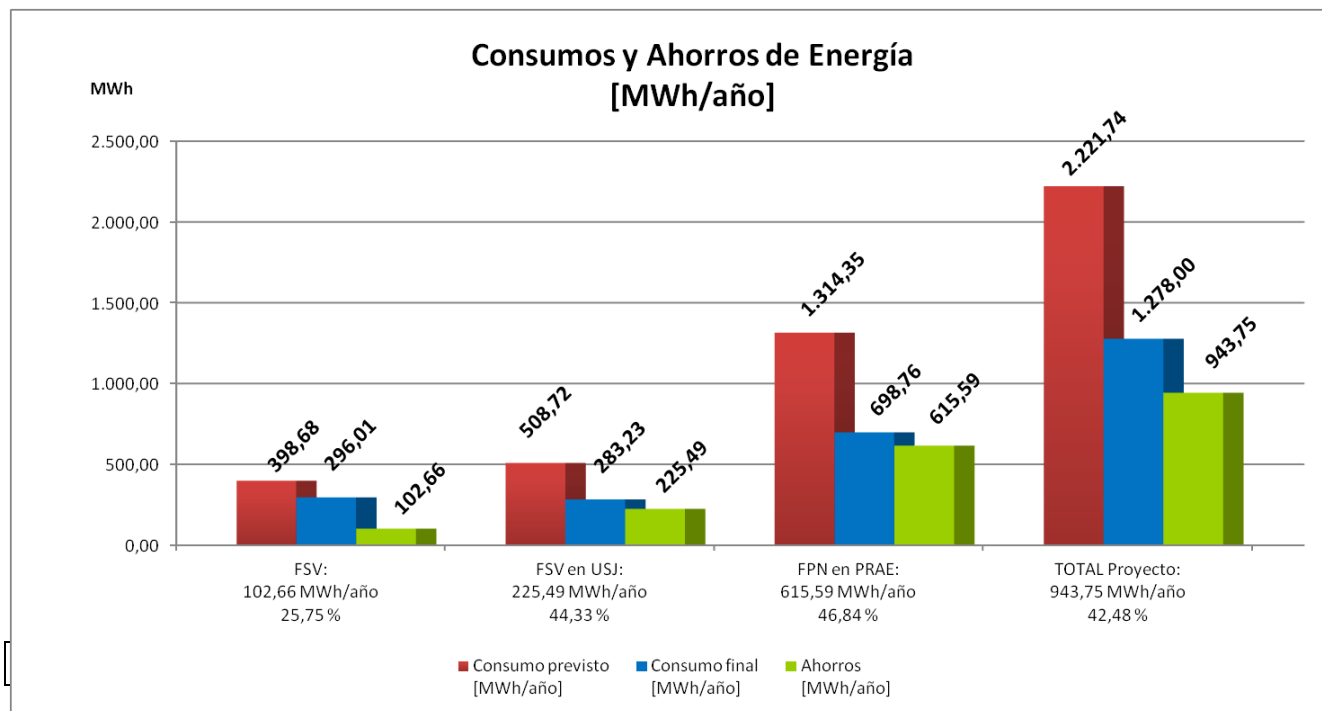
- By type of building: conventional, with active and passive energy efficiency measures, and bioclimatic with the aim of demonstrating sustainability and efficiency.
- By age: newly constructed and over 30 years old
- By use: Secondary and vocational education, university campus and environmental demonstration
- By intensity of use: all buildings with a footfall of over 1,000 persons/day)
- By diversity of technologies tested: KNX, DALI, AF, LED, VPN, partial and integrated BMS...
- By functional areas of implementation: lighting, emergency lighting, heating, HVAC and renewables.

Resumen de Consumos, Ahorros y Reducción de Emisiones de CO2 [Cálculo anual con base en experimentación]							
Tipo de energía	Consumos de energía [MWh/año...]		Ahorros de energía [MWh/año...]		Reducción de emisiones CO2 [tep & t CO2/año]		Ahorro Económico [€/año]
	(*) Energía Final Consumo previsto	Energía Final "Experimentación"	Energía Final Ahorros	% de Ahorro	Energía Primaria [tep/año]	Energía Primaria CO2 [t/año]	
Electricidad	1.024,52	572,05	452,46	44,16%	88,72	361,06	84.279,17
Centro de Formación (FSV)	59,00	25,56	33,44	56,68%	6,56	26,68	5.408,21
Universidad (FSV_USJ)	508,72	283,23	225,49	44,33%	44,21	179,94	38.108,14
Centro Interpretación (FPN)	456,80	263,27	193,53	42,37%	37,95	154,44	40.762,82
Gasóleo Calefacción (FSV-FPN)	1.197,23	705,94	491,28				
TOTAL Litros....	112.432,97	66.295,91	46.137,05	41,04%	47,32	144,80	40.759,23
En proyección a M3 de Gas natural....	93.708,90	55.255,30	38.453,60				
Centro de Formación (FSV)	339,68	270,45	69,23	20,38%	6,67	20,40	5.728,66
Centro Interpretación (FPN)	857,54	435,49	422,06	49,22%	40,65	124,40	35.030,57
TOTAL....	2.221,74	1.278,00	943,75	42,48%	136,04	505,86	125.038,40
Reducción de emisiones CO2 [Producción renovable de Electricidad y "Combustible equivalente"]....					53,89	174,16	37.066,37
Reducción TOTAL de Emisiones de CO2, Incluidas Renovables....					189,93	680,03	162.104,76

Factores de conversión EP/EF y Cálculo de emisiones: IDAE (Noviembre de 2010)

(*) Línea base: Proyectada a los años de experimentación.

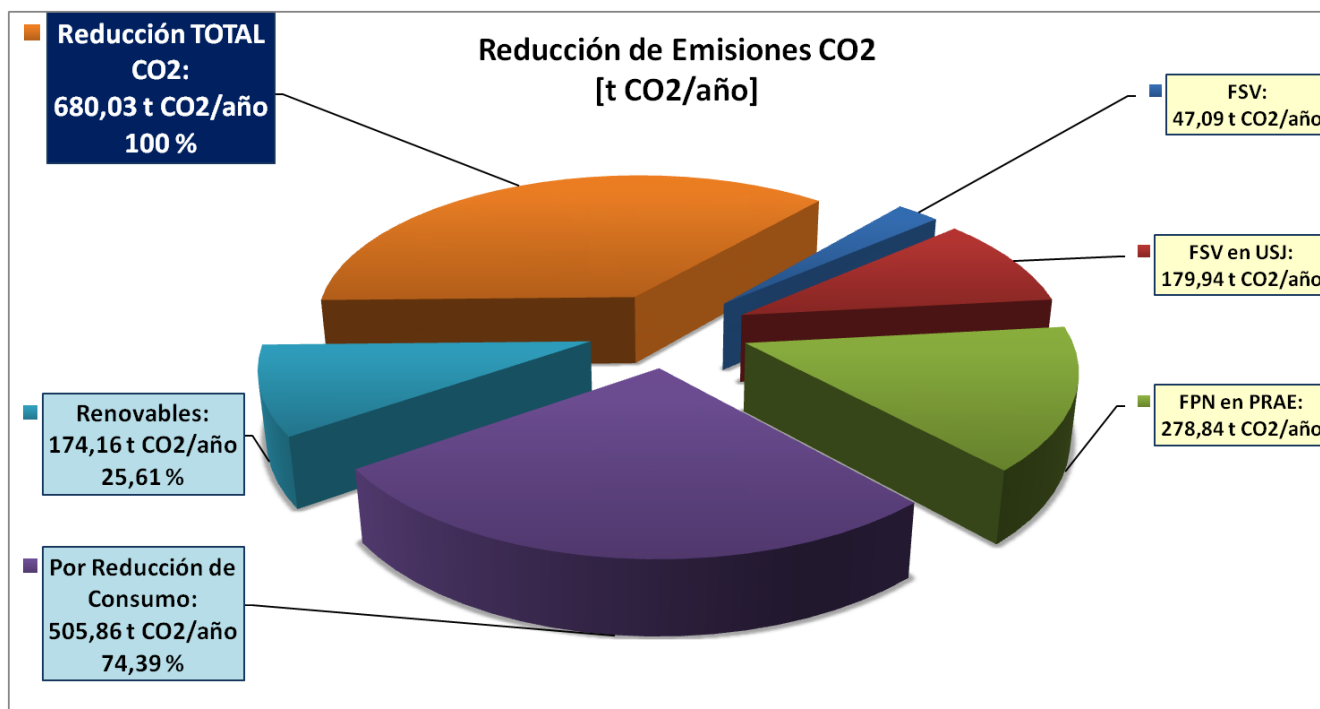
(**) Precios de referencia 2011: Electricidad (0,14 €/kWh). Gasóleo (0,082 €/kWh). Gas Natural (0,058 €/kWh) Pellets (0,021 €/kWh).





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Acción base para el cálculo Ámbito de actuación Tipo de instalación	Ahorro y Periodo simple de retorno...			"Reducción de emisiones" y "Beneficio ambiental"		
	Ahorro económico [€/año]	Periodo simple de retorno (Años)	Beneficio después de amortización (€/15 años)	Energía Primaria (Línea base) t CO2/15 años	[TOTAL] Reducción de CO2 t CO2/15 años	Balance de mejora ambiental [CO2 E.Primeria] (%/año)
Electricidad	17.776 €	4 años	197.581 €	2.594	1.146	44,16%
(FSV) Ámbito: ILUMINACIÓN "Cambio de luminarias" (DMT + DALI + AF & LED)	5.408 €	18 años	-17.064 €	706	400	56,68%
(FSV-Proyección) Ámbito: ILUMINACIÓN "Cambio de luminarias" (DMT + DALI + LED)	6.938 €	14 años	6.560 €	706	513	72,71%
(USJ) Ámbito: ALUMBRADO EMERGENCIA (DMT + DALI + AF)	8.889 €	5 años	85.508 €	929	630	67,81%
(USJ) Ámbito: ILUMINACIÓN y CONSUMOS (BMS + CTRL: HVAC)	29.218 €	1 año	412.078 €	5.161	2.070	40,10%
(FPN) Ámbito: CONSUMOS (BMS Integrado + CTRL: HVAC)	40.763 €	2 años	535.860 €	5.468	2.317	42,37%
Gasóleo Calefacción	20.371 €	3 años	235.222 €	2.646	1.086	41,04%
(FSV) Ámbito: CALEFACCIÓN (DMT + CTRL: Flujo y temperaturas)	5.729 €	9 años	36.555 €	1.502	306	20,38%
(FPN) Ámbito: CONSUMOS & HVAC (BMS Integrado + CTRL: Generación con Biomasa)	35.031 €	3 años	434.152 €	3.791	1.866	49,22%
TOTAL....:	38.147 €	4 años	432.803 €	5.240 €	2.231	42,48%



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Consumption reductions of between 20% and 72% have been demonstrated, depending on the systems and technologies used; **with a yearly average of over 42%** for the project as a whole. The potential **emissions reduction was up to 680 t CO₂/year** and the potential **economic saving was as high as €162,000/year**, with an average payback period of 4 years.