



Miguel A. García Fuentes – **DIRECTION** - CARTIF

**EIP SMART CITIES AND COMMUNITIES ACTION
CLUSTERS: SUSTAINABLE DISTRICT
DIRECTION PROJECT EXPERIENCES**

KEY PILLARS & OBJECTIVES





Max.
60 KWh/m²yr





Electrical
& Thermal
saving





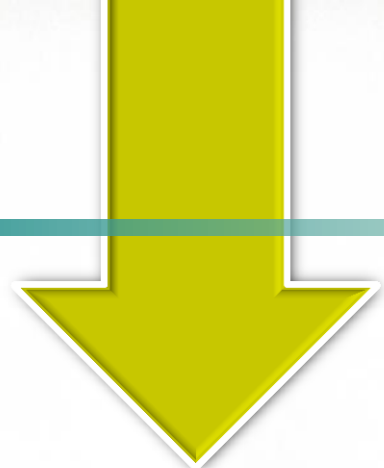
DEMO





Dissemination





DIRECTION
DIRECTION



DEMONSTRATION OF VERY LOW ENERGY NEW BUILDINGS

Key Words

Low consumption– below 60 kWh/m²year

New building – Tertiary sector

Integrated design

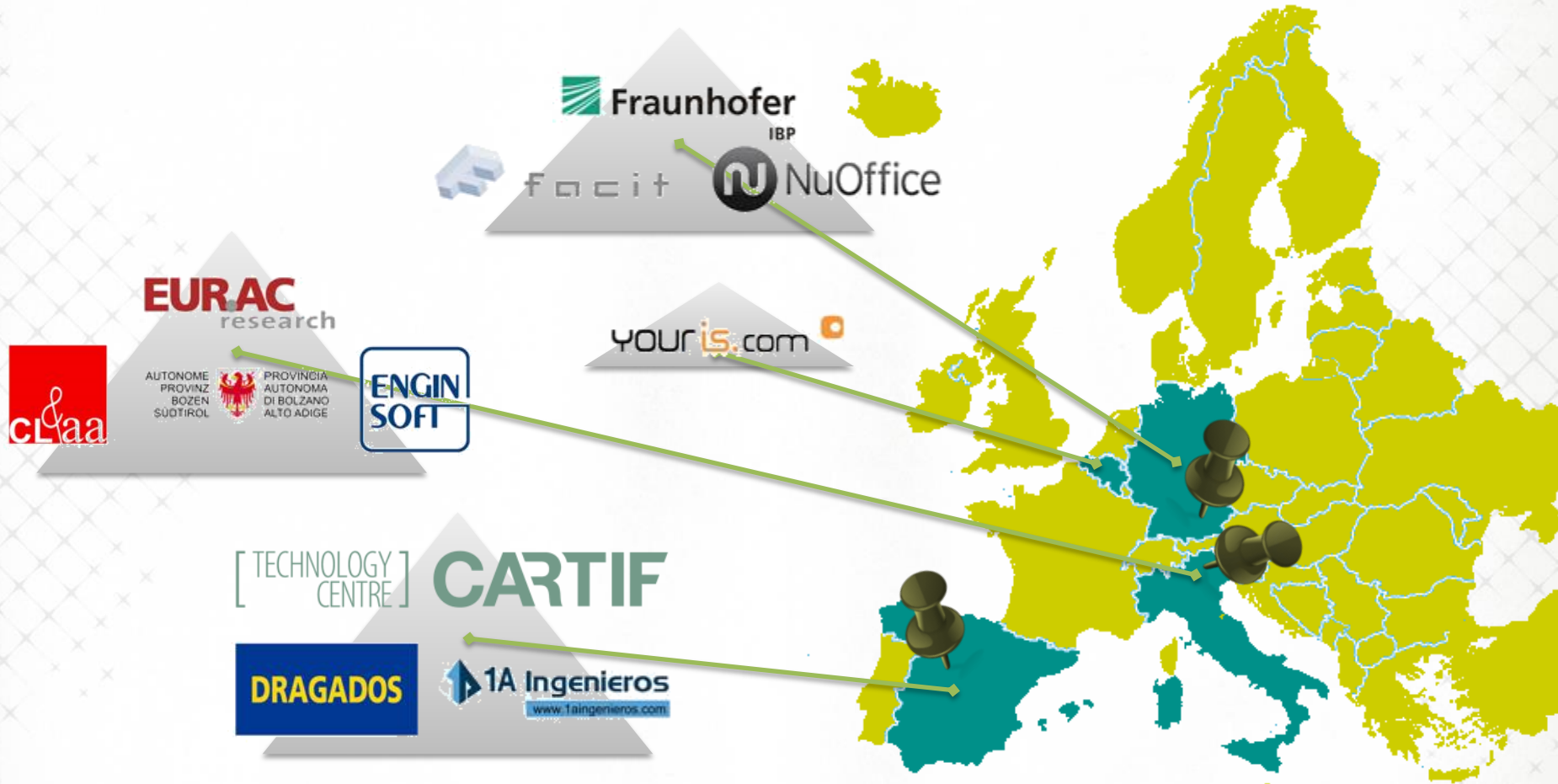
Demonstration

Monitoring & evaluation

Final user

European Dimension

Dissemination



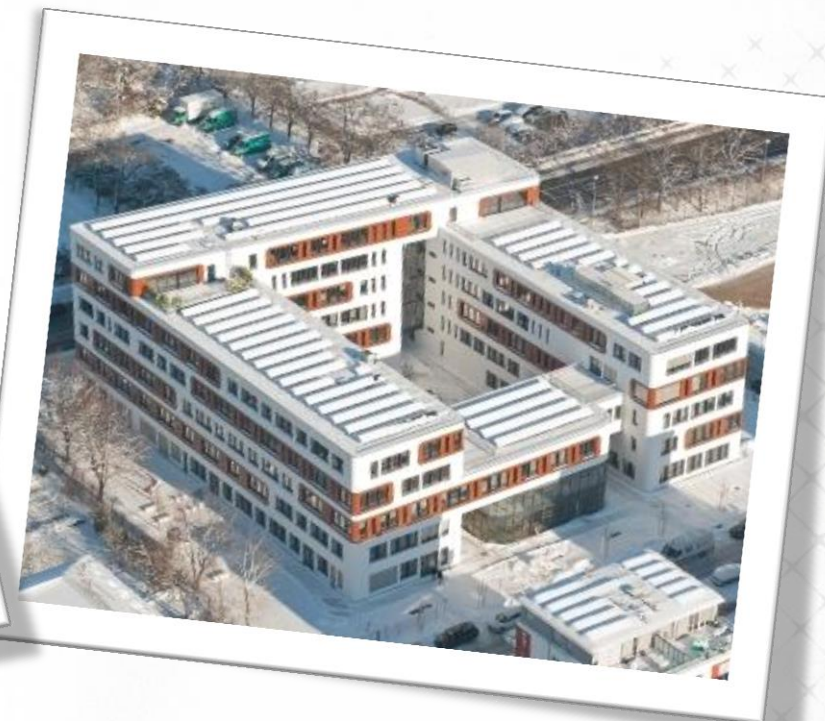
DEMONSTRATION



Demonstration



**BOECILLO,
SPAIN**



**MUNICH,
GERMANY**





Location: Boecillo, Valladolid (Spain)

Area: 4075 m²

Type: Offices and industrial zones

Energy Saving Measures

Glass Wall + Isolation + Louvers

Geothermal Heat Pump

High Efficient Lighting

Free-Cooling

HVAC Management (BEMS)

Variable flow ventilation (BEMS)

Lighting management (BEMS)



RES poligeneration Biomass + Geothermal

PV plant 45 kWhp (15 kWh/m²yr)



All foreseen energy saving measures implemented

Monitoring equipment implemented

Feasible monitoring data still being stored (more than 3 years so far)

KPI calculations running and still being stored.

First users feedback concerning comfort issues.

Improvements on installatio detected and done.

Demo-site II: NuOffice



Demo-site II: NuOffice



Location: Munich (Germany)

Area: 11130 m²

Type: Offices

Energy Saving Measures

Improve insulation

Triple glazing

Shading + electrochrome windows south facade

High Efficient Lighting

Lighting management

Demand controlled Ventilation

Free-Cooling

Absorption Heat Pump



Concrete core activation

District heating and Geothermal

PV plant (80000 kWh/yr) for building and mobility uses



All energy saving measures implemented

All monitoring equipment implemented

Feasible monitoring data delivered (excluding absorption heat pump due to warm winters 2013/2014/2015/2016)

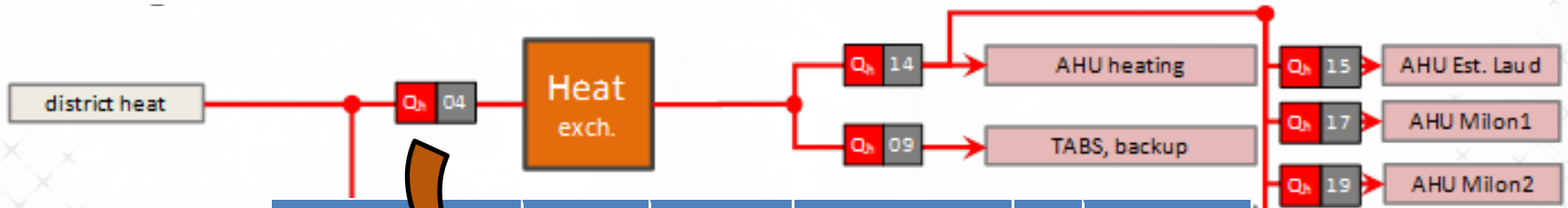
Real comparison actual consumption costs to incidental cost flat rate (2,17€/m² to 2,50€/m²)

User feedback concerning comfort issues.

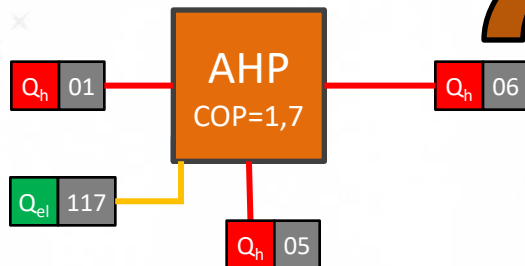
Knowledge transfer / exploitation from the experience with NuOffice 1 for NuOffice 2 and 3 concerning improved exterior insulation.

SOME OUTCOMES





	Heat	energy type	Device	counter as per scheme	unit	measurement interval
NEC Net Energy Consumed	Heating	thermal	district heat for direct use and absorption heat pump	$Q_{h,01} + Q_{h,04}$	kWh	15 min



$$COP_{AHP} = \frac{Q_{h,06}}{(Q_{el,117} + Q_{el,112.1.2.3} + Q_{h,01})}$$

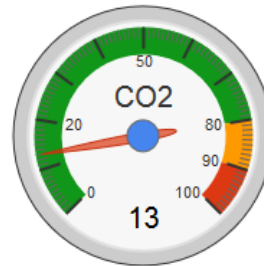
Performance evaluation

Primary Energy

CO₂ Emissions

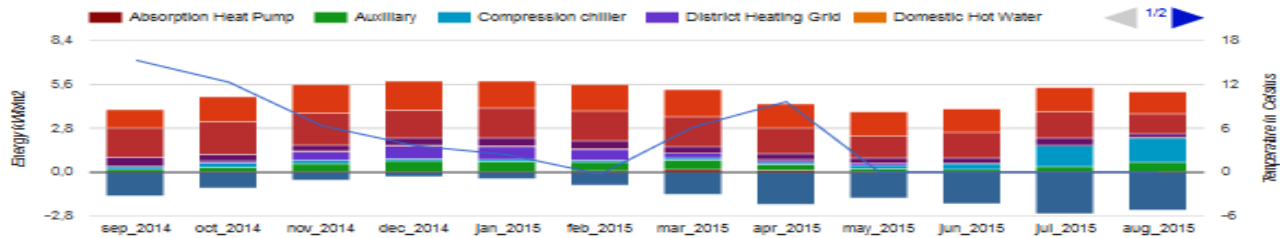


[kWh/m²year]

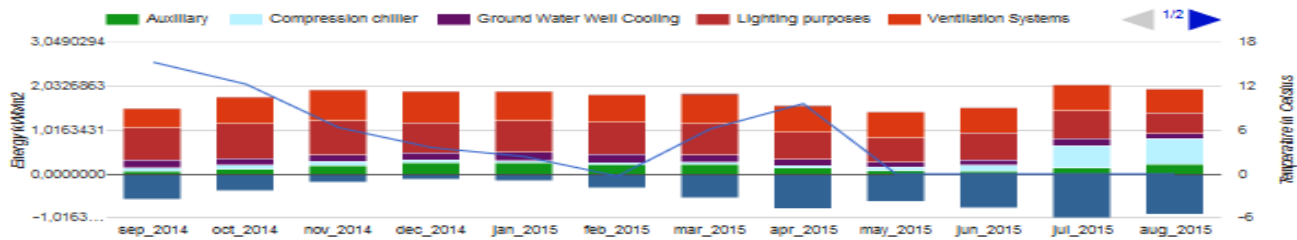


[gCO₂/m²year]

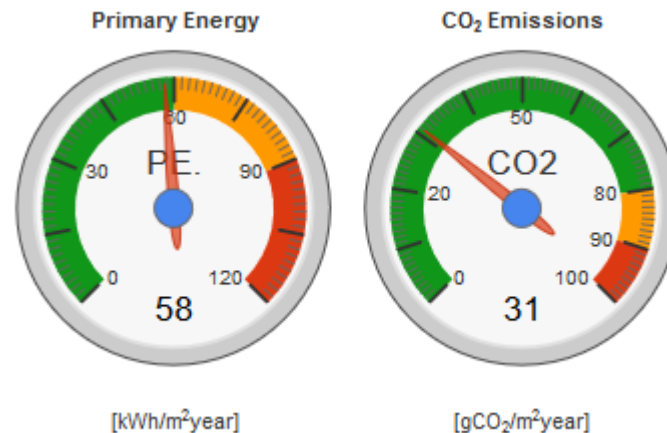
Primary Energy (kWh/m²)



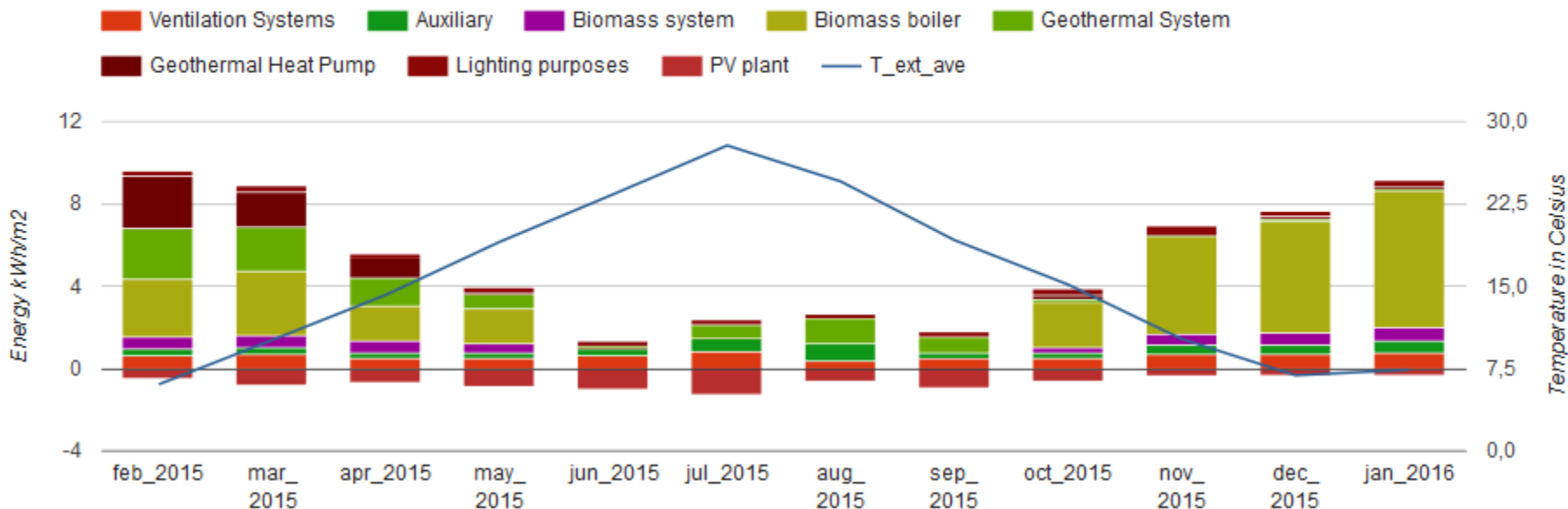
Delivered Electricity (kWh/m²)



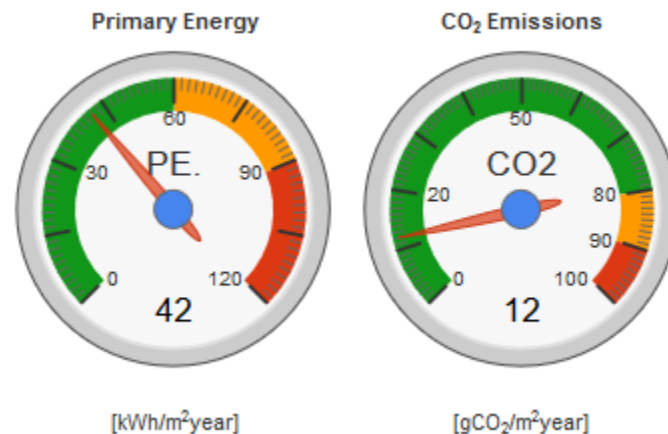
CARTIF III



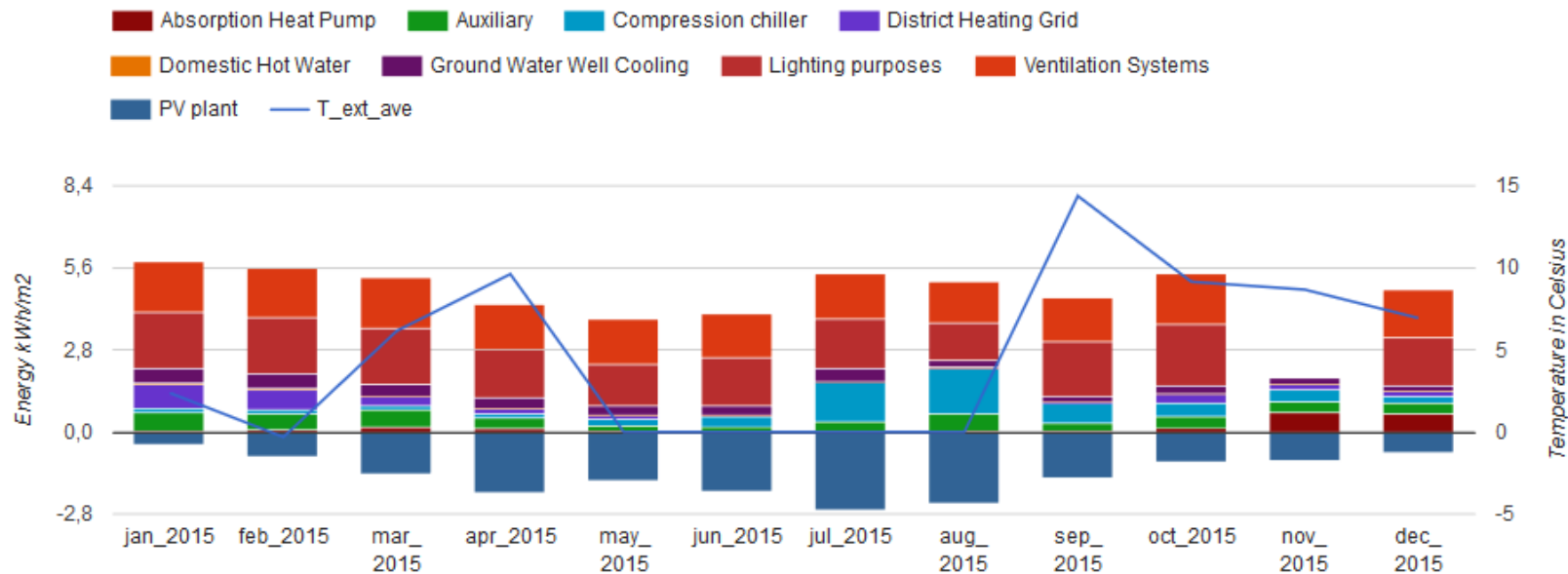
Monthly Primary Energy(kWh/m²)

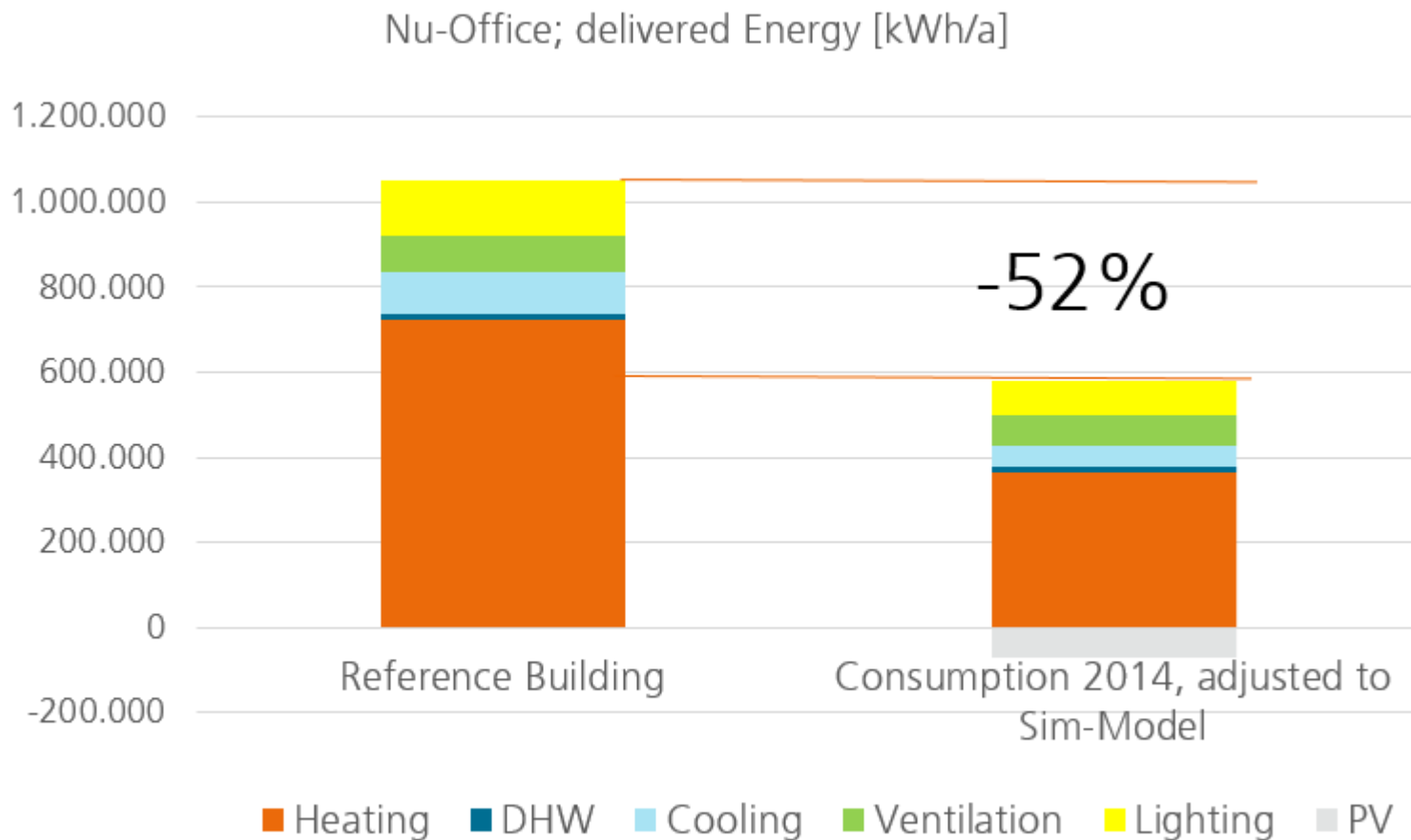


NuOffice

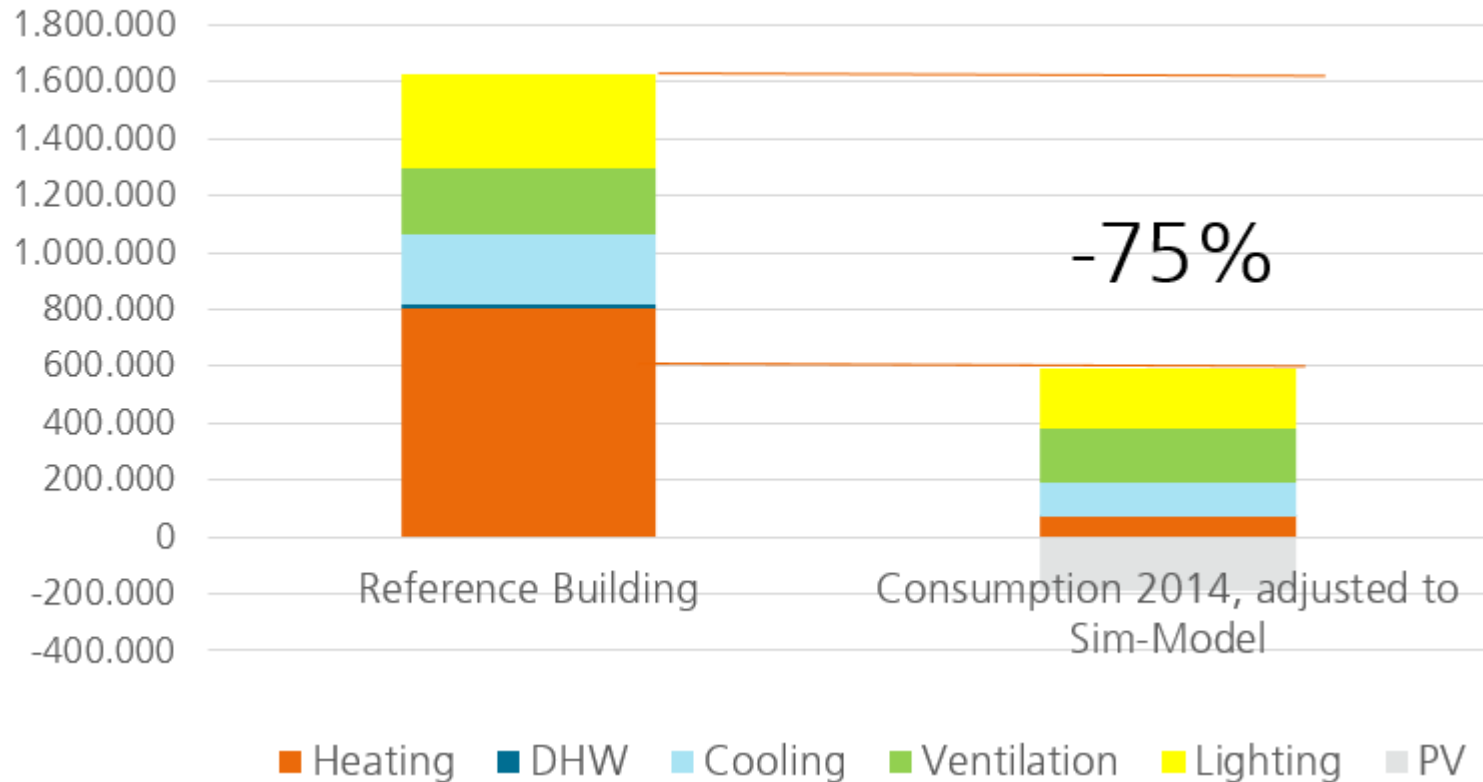


Monthly Primary Energy (kWh/m²)



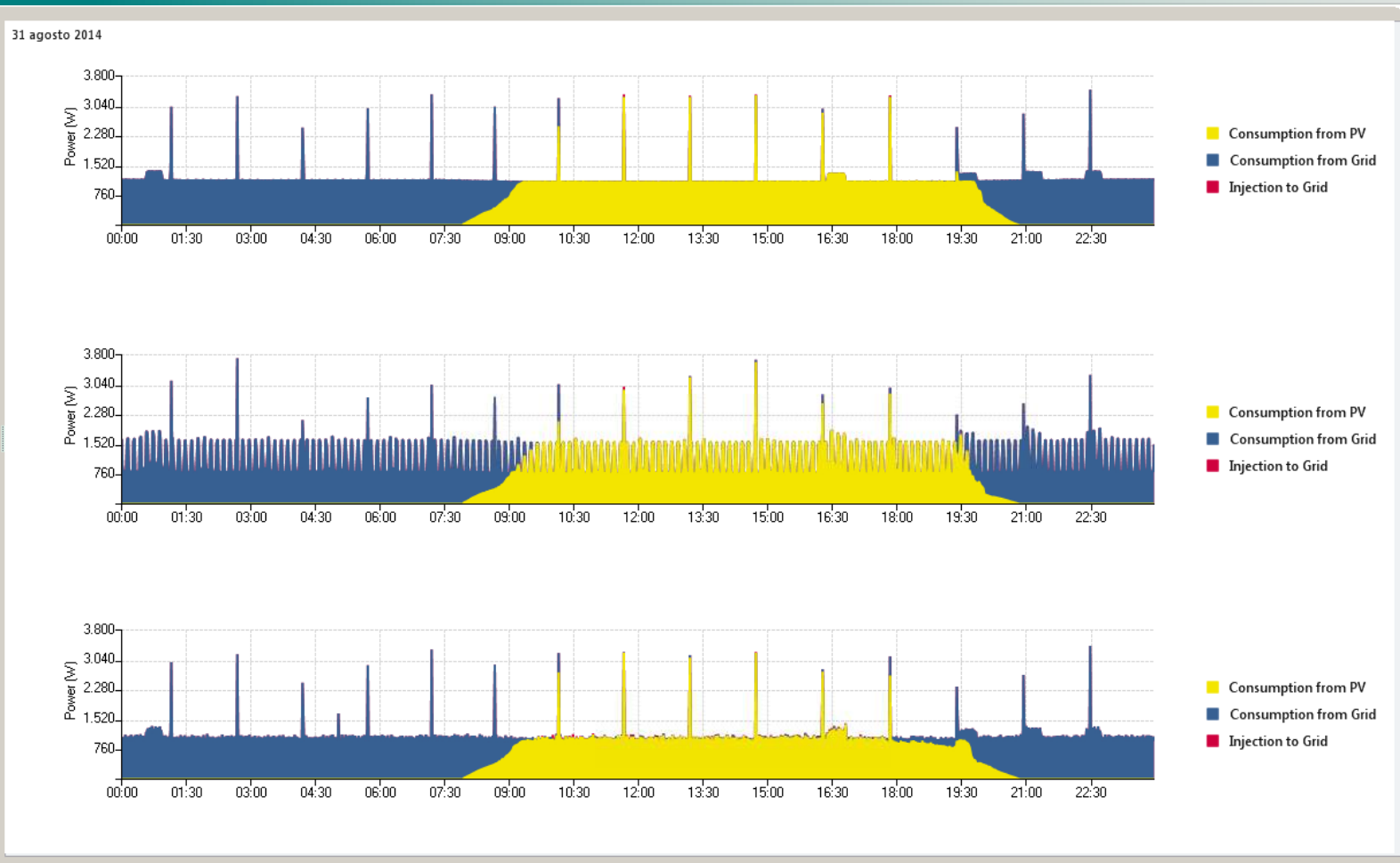


Nu-Office; primary Energy [kWh/a]



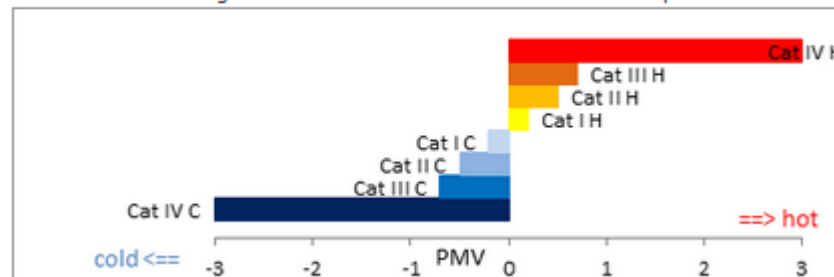


PV: impact of Spanish legislation

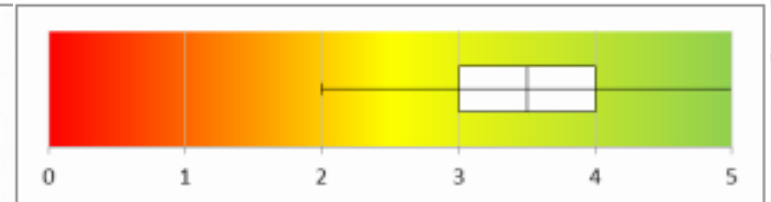
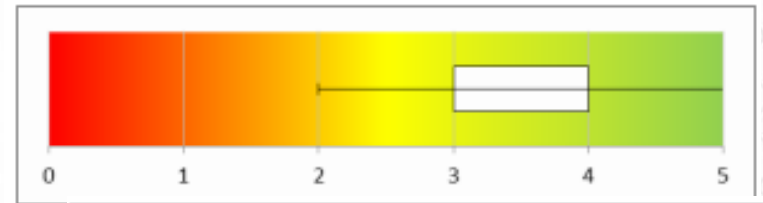
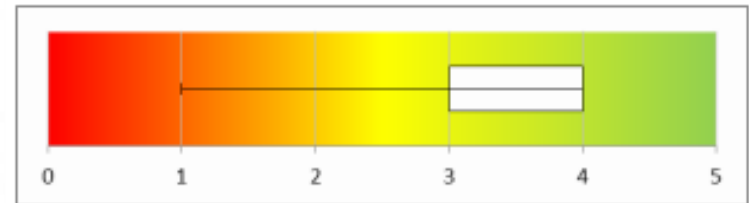
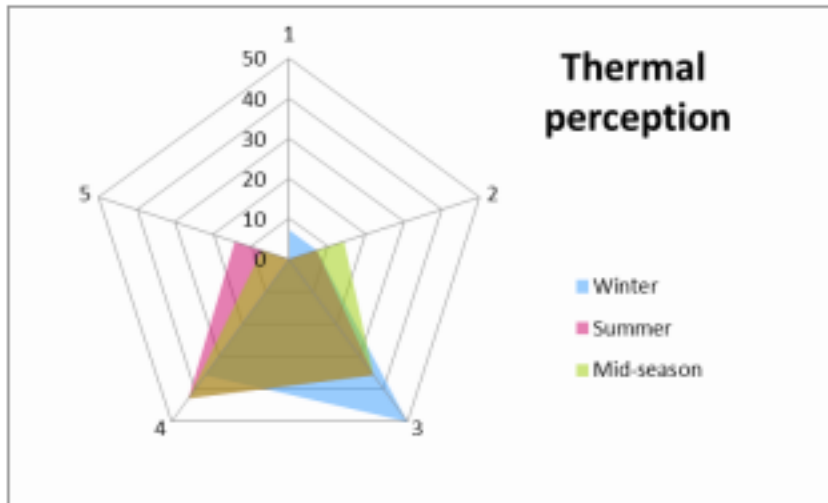




The categories are taken from ISO 7730 as shows the picture:

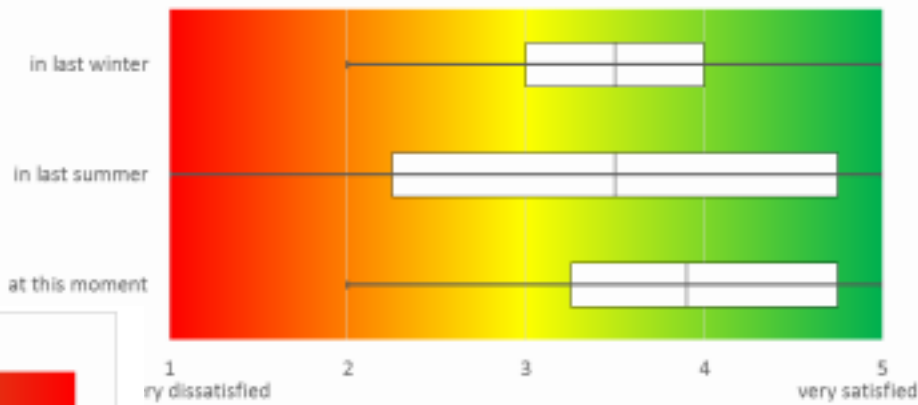


CARTIF III

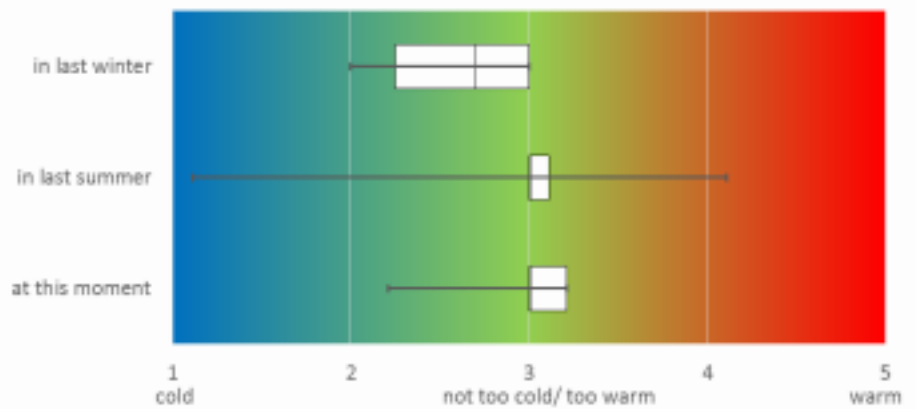


NuOffice

How dissatisfied or satisfied you are with the room temperature:



How do you perceive (did you perceived) the room temperature:



Website Technology visualization

Discover Munich building technology

Explore the main technologies and innovation applied in Munich's Nu Office. Click on the numbers to read a brief description the many novelties, such as heat insulation, innovative systems engineering, use of renewable energy, passive heating and cooling concepts as well as optimized daylight concepts and artificial light.

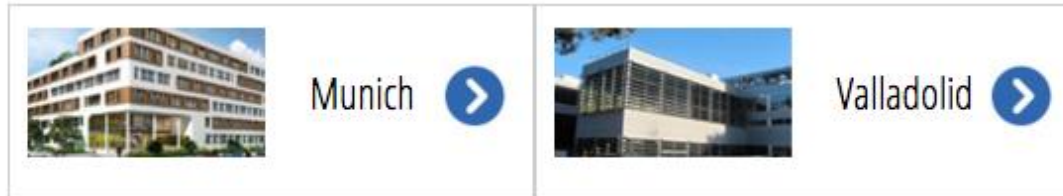


Technology

- Technology
- Energy Efficiency Measures
- Low Energy buildings requirements
- Modelling and Simulation
- Building monitoring
- Standards & regulations
- Discover Munich building technology



Website KPI visualization



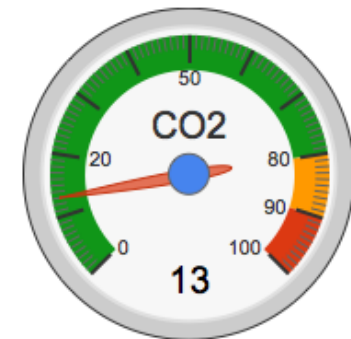
- **To inform on demonstrators efficiency and performances**
- Selected **KPIs** (defined in WP4) are displayed through the following **plots**:
 - Comfort (Thermal comfort and Indoor Air Quality)
 - Primary energy
 - Delivered energy
 - Building energy needs
 - CO₂ rating

Primary Energy



[kWh/m²year]

CO₂ Emissions



[gCO₂/m²year]



**Smarter design, technology and business
in very low energy new buildings**



A framework for achieving high performance based on real buildings and results

direction-fp7.eu

The graphic is adapted from the European Union's Smart Cities Mission Report for the smart buildings of tomorrow and the transition to a green economy (19 April 2016)

Who can benefit from DIRECTION?

For contractors, DIRECTION introduces a smart and integrated design-construction-operation methodology, which allows all involved stakeholders to work in a collaborative risk-shared environment. This reduces execution time and costs and generates a positive branding effect on all actors involved.

"The project has been all about delivering a better product, more efficiently. By joining the dots with the engineering and energy simulations, we can save money, indeed, but also focus on additional services and opportunities to stand out from the competition"

Carlos Bárcena, Dragados

For developers, control of costs during the building and operation phase is greatly enhanced by targeted and precise energy simulations. This gives an overview of all reimbursements across the entire life cycle of the building including cost shifts from the construction to operating or visa-versa.

"The benefits of additional product features and design – such as control of room climate, comfort design and high environmental performance certification – along with reduced incidental costs can be packaged and passed onto tenants"

Oliver Vietgen, Facit

For research centres and platforms, DIRECTION has generated a working methodology for building performance analysis – giving a real integration of different innovative or state of the art energy efficiency systems with different combinations.

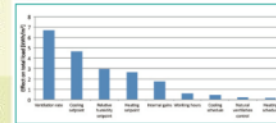
"Exhaustive live and stored data gives us a complete picture of a building's performance – with complementary calculations of representative key performance indicators and specific systems"

Julia Vicente Gomez, CARTIF

For engineers and engineers associations, DIRECTION gives KPIs for building performance evaluation and continuous improvement through real data acquisition. This facilitates integration of information into international databases and the ongoing economic analysis of energy efficiency and commissioning process.

"DIRECTION monitoring feeds the European Union's Smartcities subsystem and KPIs visualization system. An ongoing commissioning task which is the basis for continuous improvement has been designed under the ASHRAE guidelines for commissioning process. Each of them are sources of information which facilitate delivery and benchmarking amongst other benefits"

Narberna Gonzalez Hidalgo, 1A Ingenieros



Black Monolith, Bolzano design factors ranked by decreasing impact on total heating and cooling load

During the design phase, a sensitivity analysis helps to identify the building design parameters with biggest impact on energy consumption and comfort. Once identified, these parameters can be optimized, whereas other parameters can be neglected.

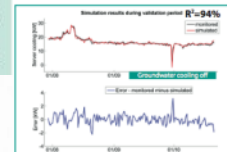
Building control and use optimisation can reduce the total annual primary energy consumption of the building by at least 5-10% without any major additional investment

Loads and energy: real and simulated results for the demonstrator "CARTIF III", Valladolid

Owners and energy managers of buildings can be informed about control parameters in need of constant monitoring and tuning as well as energy savings and benefits on comfort achievable by acting only on control, without having to invest in new infrastructure or components.

Optimization step	Heating load (MWh/a)	Cooling load (MWh/a)	Total (MWh/a)	Improvement (energy %)
Base CE configuration	234	49	283	—
Base real building configuration	162	39	201	29%
Free cooling control	162	32	194	31%
Optimized towers + Free cooling controls	132	32	164	42%
Current real configuration	128	28	156	45%

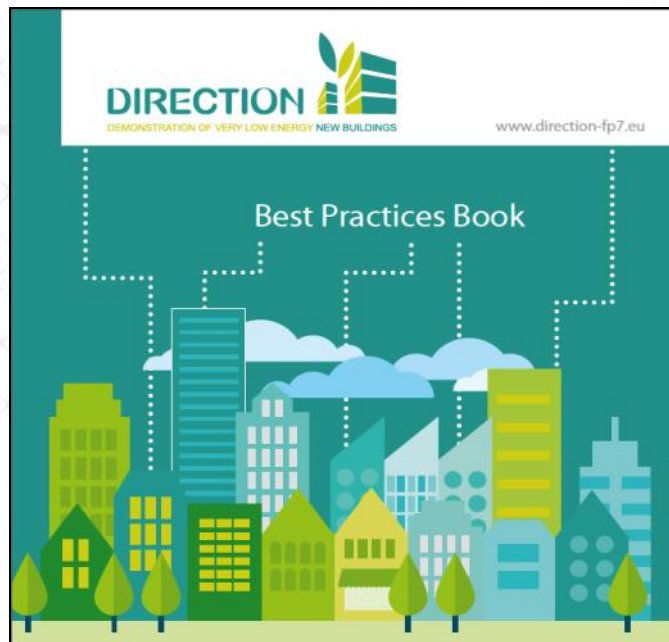
Faults in building operation detected with black box models based on monitored building performance



NuOffice, Munich server cooling fault detection

Black box models use empirical equations based on monitoring data. By comparing the building operation simulated with a validated black box model with the real building operation, potential faults can be detected automatically.

A short publication highlighting the results of the action under the form of best practices for wider adoption: key learnings, recommendations, replicability and impacts



Practice 7

Make the most of natural lighting

SUMMARY

Daylight has a series of physiological and psychological benefits for occupants' health and workers' productivity. Careful façade design supported by simulation makes the most of daylight; appropriate fenestration and shading solutions reduce cooling loads and visually difficult conditions. Simulation ensures good design of artificial lighting combined with natural lighting.

IMPACT RATING
Impact on a building's performance in terms of:

Comfort:	★★
Energy consumption:	★★★★
Environmental impact:	★★★★

REPLICABILITY
🏠🏠🏠🏠

Recommendations for Engineers/Designers and Architects

Our advice

- During design, aim at using as much natural light as possible;
- Define all the possibilities such as glazing, fenestration, etc. and study their impact.

Caution

- Avoid designing without paying attention to the cooling – heating loads.

For more information: www.direction-fp7.eu

Best Practices on Design 15

Dissemination materials



‘Most sustainable office in the world’

Distributed on July 1, 2013



‘A Smart Building to save energy’

December 11, 2014



‘Efficient Buildings Key to Reduce Climate Change’

November 30, 2015

Dissemination materials

The "DIRECTION" story
**A storytelling video, with a different video format, more
focused on the project and its outcomes**



The DIRECTION project - English

DIRECTION Project
DIRECTION

Dissemination materials

DIRECTION news are distributed to information multipliers and portals

We share our news on



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