Acciona experience in High Rise Building – good practice and R&D

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Head of Sustainability and Eco-Efficiency area

International conference:
HIGH-RISE BUILDINGS
September 20, 2010 PRAGUE

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- Company Presentation.
- Experience in high rise building construction.
- Experience in Energy Efficient Buildings
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- Research project on Energy Efficiency for High Rise Buildings.

Acciona: Our business areas

Civil Engineering
Construction
Facilities
Concessions

Real State
Heritage
Promotion

Energy
Eolic
Other renouvelable

Logistics
Airports
Transmediterránea
Other logistic services

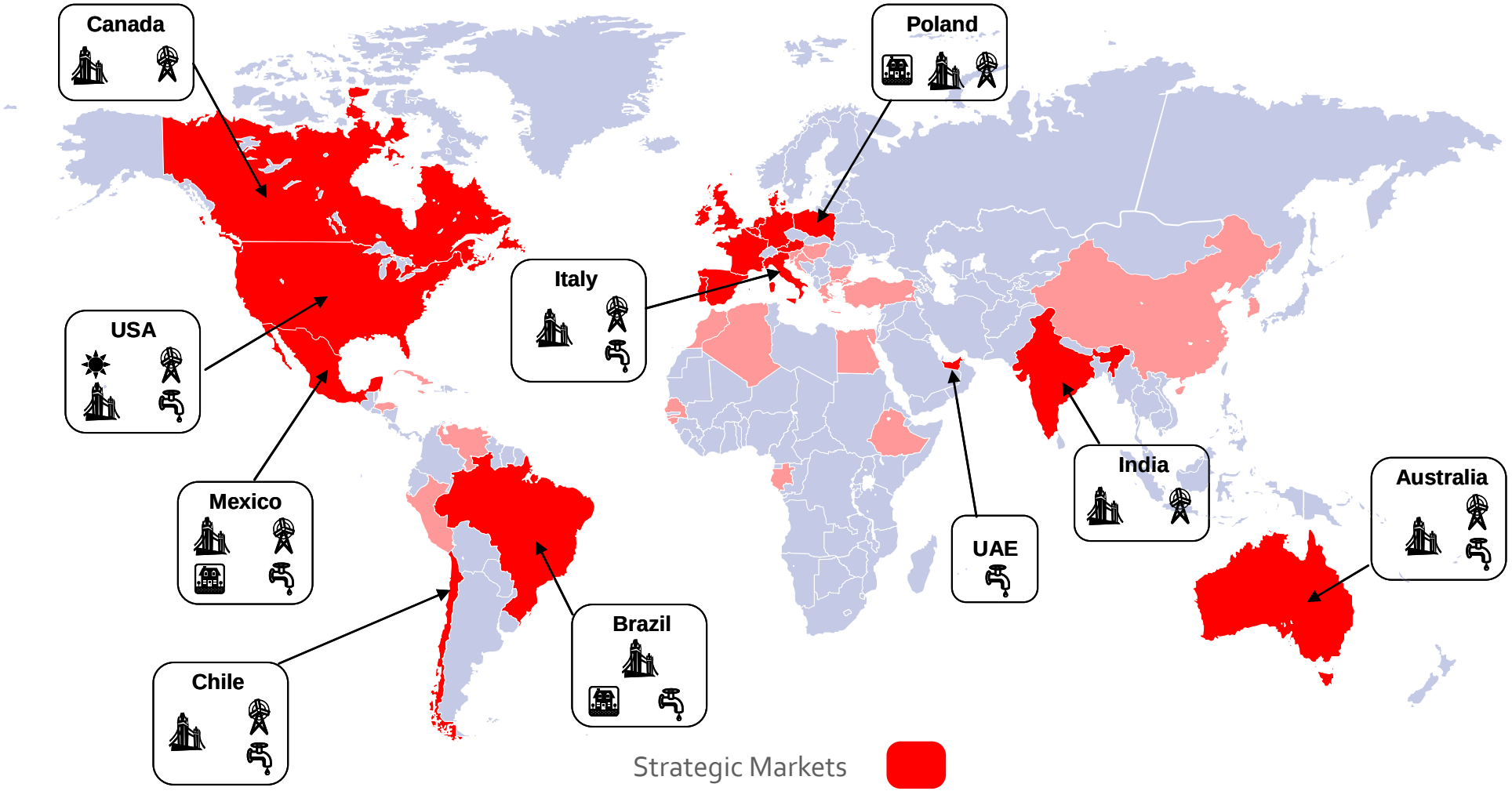
Urban Services
Facility Management
Hospital Services
Waste management

Water
Reverse Osmosis Desalination

Other
Bestinver
Hijos de Antonio Barceló
GPD




- International Network



ACCIONA and Sustainability

Development on a global scale in balance with the environment

- ACCIONA announced its strategic commitment to being **pioneers in development and sustainability** in 2004.

- ACCIONA's capabilities are focused on designing and delivering innovative solutions to meet three of society's greatest needs: **energy, water, and infrastructure.**

- ACCIONA embraces a "triple bottom line" aimed at generating **economic growth, social progress and environmental balance.**

- Our business model allows ACCIONA to **create shareholder value while fulfilling its responsibility to future generations.**

Experience in high rise building construction.

Acciona has more than 100 year of experience in constructtion

The mosto significative high rise building projects executed by the company are:

Torre Europa Building.
Madrid
113m

Headquarters of BBVA
Madrid
108m

Experience in high rise building construction.

Acciona has more than 100 year of experience in constructtion

The mosto significative high rise building projects executed by the company are:

Ministerio de Industria.
Madrid

Mafre Tower
Barcelona
153m

Experience in high rise building construction.

Acciona has more than 100 year of experience in constructtion

The mosto significative high rise building projects executed by the company are:

Parque reforma building.
Mexico DF.

Lolmas Tower
Mexico DF

Experience in high rise building construction.

Acciona has more than 100 year of experience in constructtion

The mosto significative high rise building projects executed by the company are:

Petronas tower .Intallation design.
452m
Malaysia

Experience in energy efficient buildings.

- ACCIONA has constructed over 1,100 eco-efficient homes, and has built the first Zero Emissions commercial building in Spain.

- Sustainable infrastructure addresses economic, social and environmental factors.
  - Environmental – CO2 emissions, waste management, water and energy usage, and materials selection.
  - Economic – energy, maintenance, and repair costs.
  - Social – interior air quality, accessibility, living quality, and external integration with surroundings.
- During construction, avoids toxic materials and pollutants, and optimize energy and water use.

- Homes have more efficient water consumption and cost less to run. Buildings consume half the usual energy, covering all energy demands with solar and biomass renewable sources.

- ACCIONA is leading the Energy Efficient Buildings Association (E2B) formed to represent the interests of private industry in Europe, defining the strategic research agenda for energy efficient buildings and districts.

Experience in energy efficient buildings.

- First Zero Emissions Commercial Building in Spain - ACCIONA Solar Headquarters
  - Consumes half the usual energy of an equivalent conventional building
  - Covers all its energy demands with solar and bioenergy renewable sources

Experience in energy efficient buildings.

Measures Included

Conserve Energy

Architectural (passive):

- Building orientation and form factor analysis
- Insulation optimization
- Optimize % of facade glass openings (for HVAC and lighting demands)
- Facade shadings
- Best design for each facade orientation
- Cross ventilations

Efficient Energy Usage

Installations:

- Optimize HVAC distribution: variable flows and temperatures, active demand management
- Analysis of chiller and boiler seasonal efficiency
- CHP and trigeneration analysis
- Control of lighting

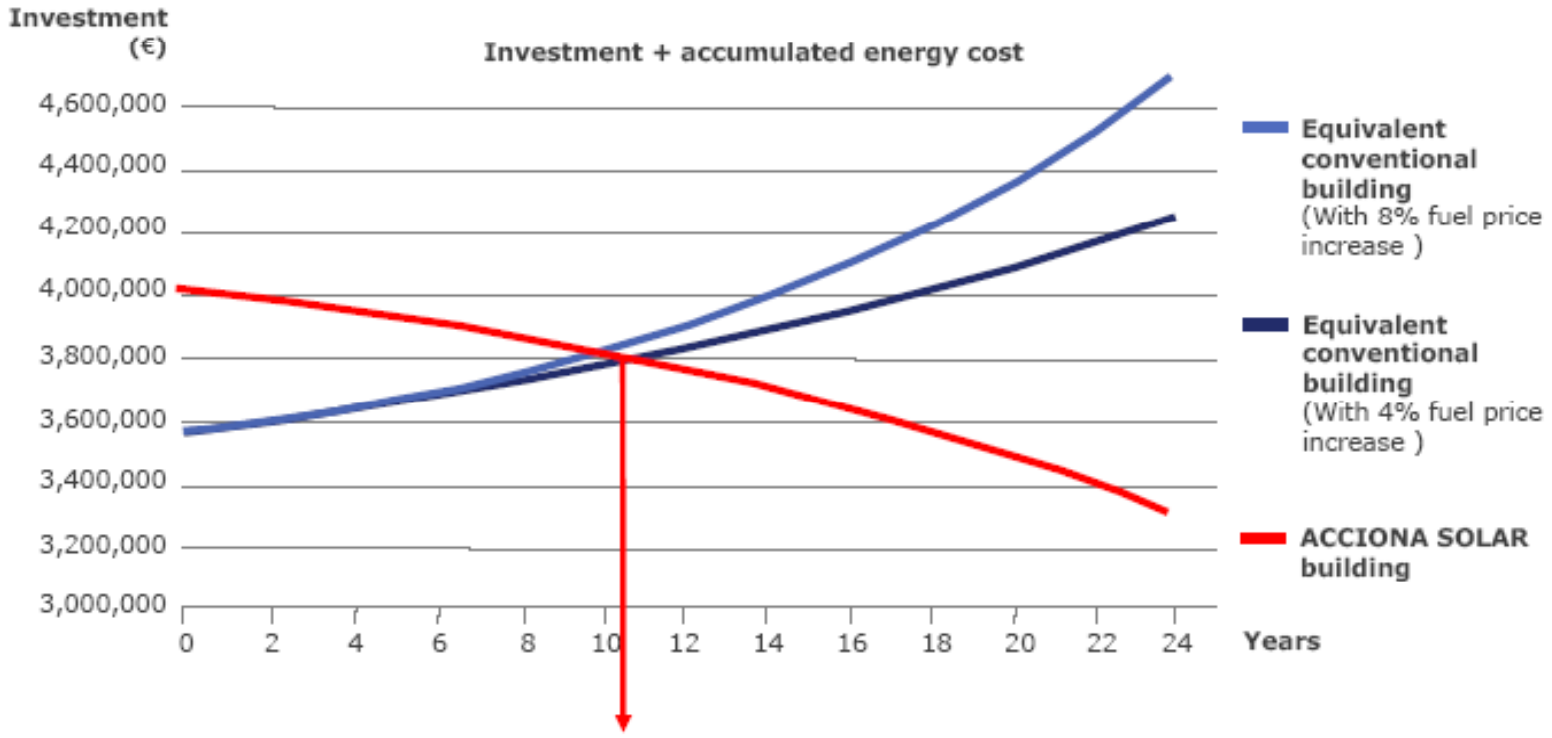
Renewable Energy

Energy sources:

- Biomass
- Solar thermal
- Solar photovoltaic
- Geothermal
- Integrated wind energy

Experience in energy efficient buildings.

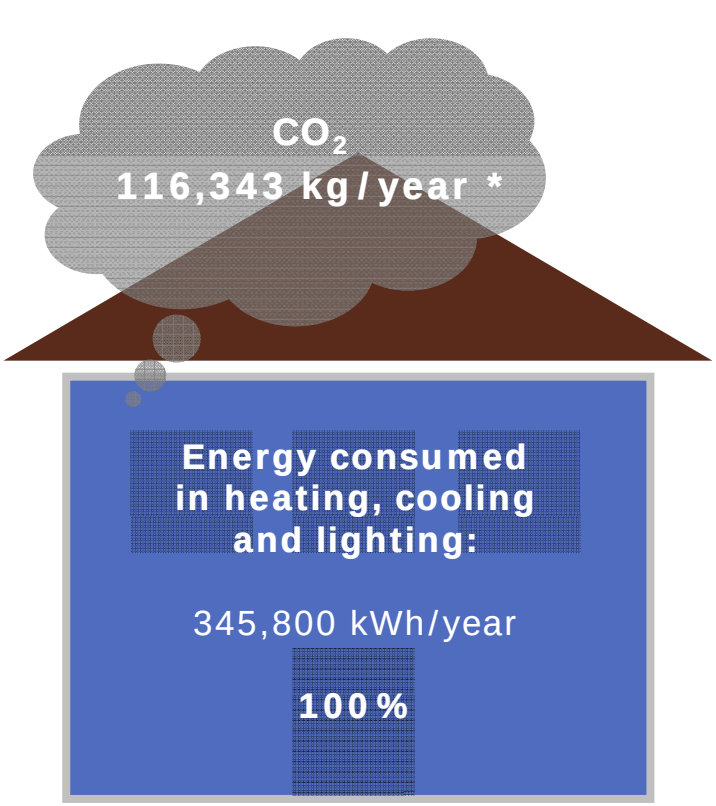
Economic Efficiency



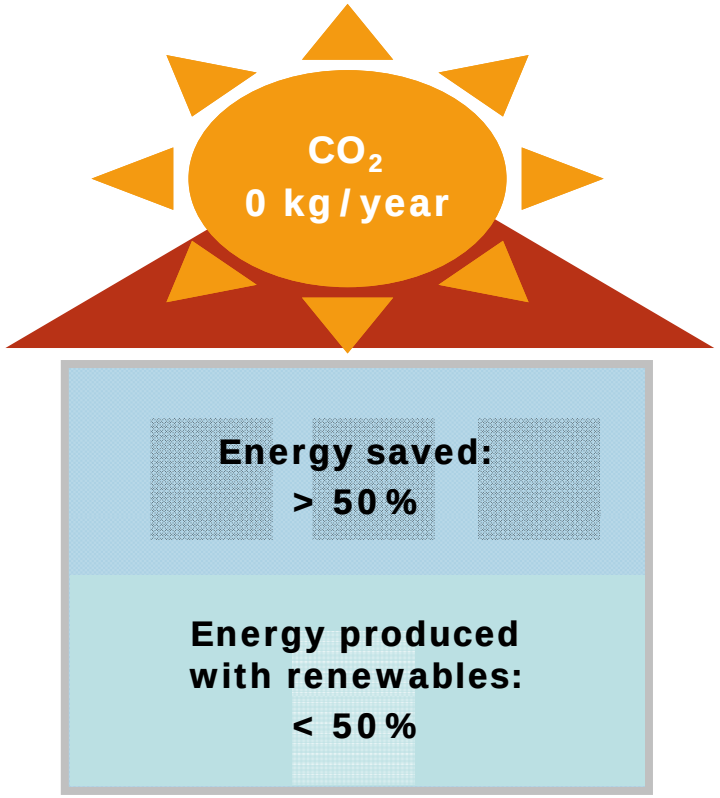
Additional investment (13%) can be recovered in about 10 years.

Experience in energy efficient buildings.

Comparative balance of CO2 emissions



CONVENTIONAL BUILDINGS



ACCIONA SOLAR BUILDING

(*) Source: IDAE (Spanish Institute for Energy Saving) 2007

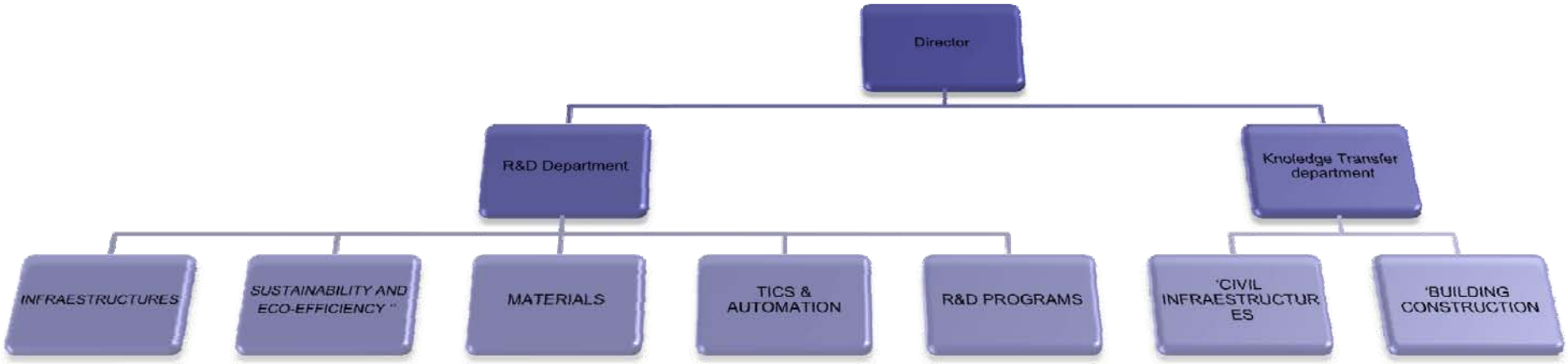
New Structural Organization

to boost the innovation activities …

R&D Technological Center of ACCIONA in MADRID

- **Over 150 well skilled professionals**.
- International and multidisciplinary professional team.
- **Civil engineering company leader in R&D in Europe**: more than 15 years developing new technologies and materials in the construction sector.
- First civil engineering company with **its own technological center**:
    - ***3.500 m²*** *of surface (4 storey building)*
    - ***11 R&D laboratories*** *full equiped.*
    - ***Production workshop with 1.200 m²*** *for prototyping*

Madrid Technological Centre



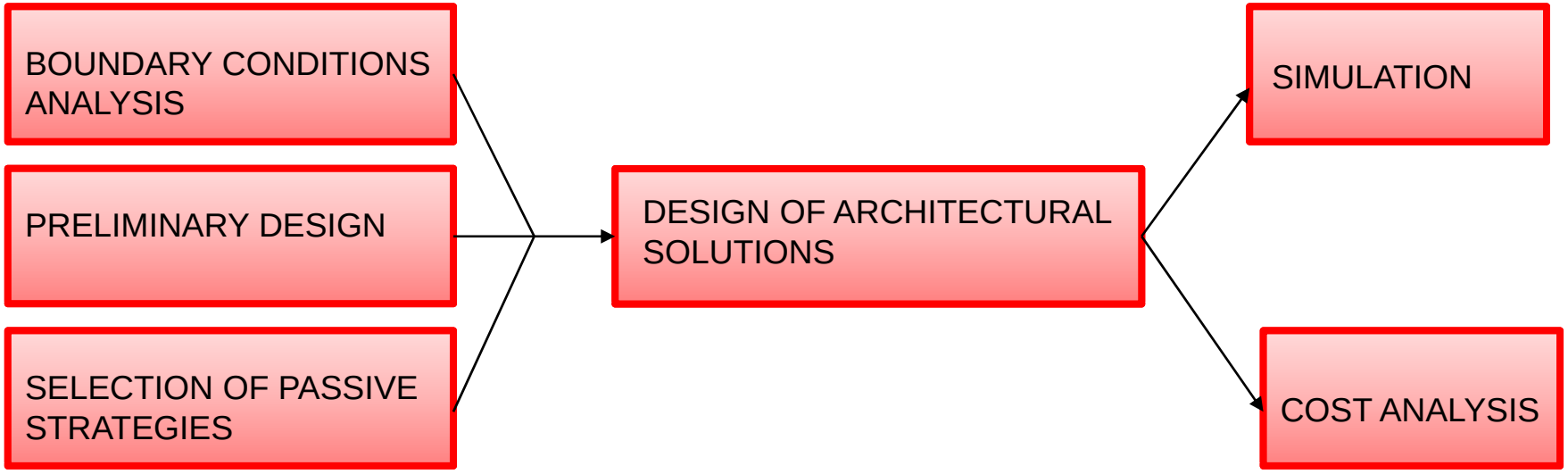
- 14 research groups, associated in four areas where develop technology
- 1 area of programs to obtain founds and monitor international relationships
- 1 department of knowledge transfer with direct contact with technology and business.
- 3 horizontal areas for financial, IPR and HHRR.

Activities covered in the area

- Reduction of building energy demand (passive strategies).
- Energy efficient installations (active strategies).
- Reduce fossil fuels power generation (energetic refurbishment).
- Increase the use or R.E.S. (new technologies and integrated concepts).
- Use of energy fluxes within and trough building.(new concepts)
- Active management of the building (BMS).
- Involvement of inhabitants for eco-energy consciousness (dissemination)

All the Energy Efficient actions has to ensure at least the same indoor comfort conditions (light, heating, cooling, air quality, services and safety)

ACCIONA R&D DESIGN APPROACH

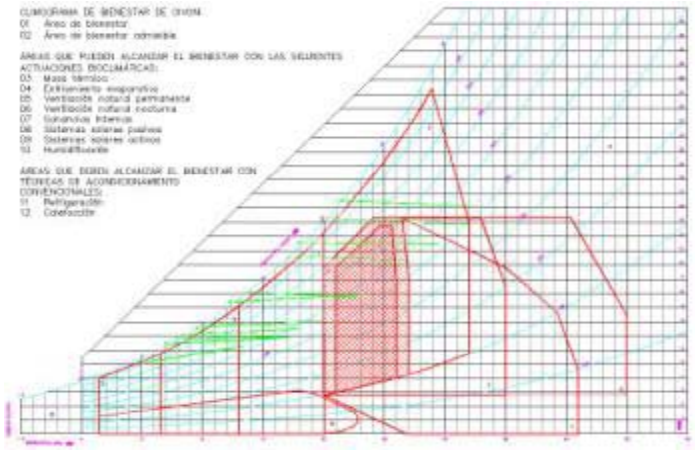


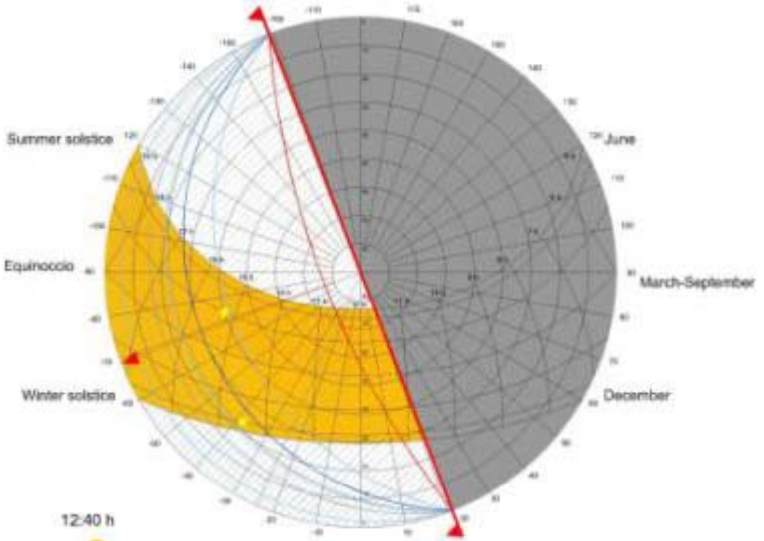
Boundary conditions analysis

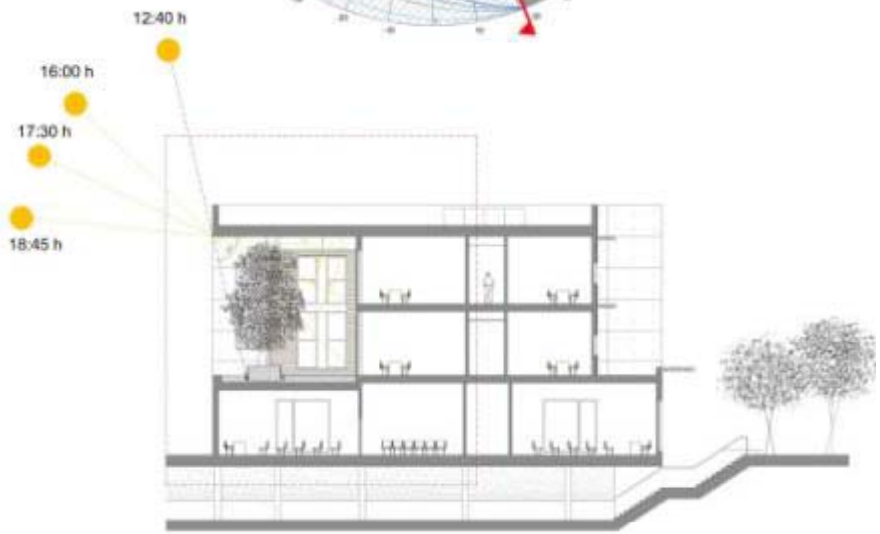
ANALYSIS OF

- **Location and climate**
- **Geographical conditions**
- **Microclimate**

➔Determines the passive strategies to be adopted in order to optimize the energy efficiency of the building







Preliminary design

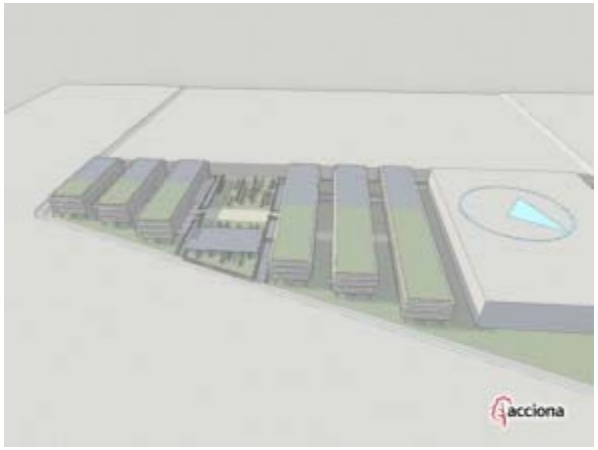
Building form: Rate linking external surface/volume. Influence in the energy exchange of the building with the outside

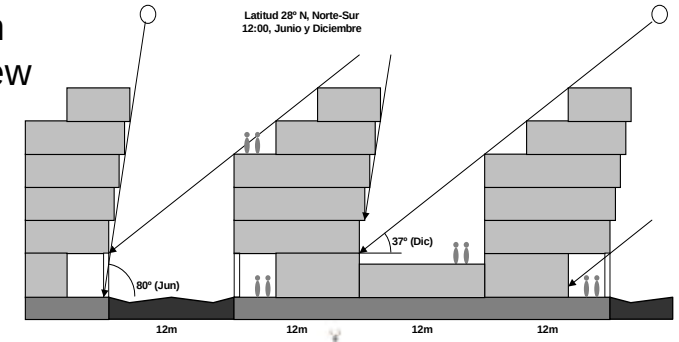
Orientation: Obtaining maximum radiation in winter and minimum in summer

Spatial distribution: rooms with less occupancy to be located in most thermally exposed building zones

Volume: Façade protected from solar radiation through setbacks

Surroundings: Analysis of the influence of green areas, open areas, other buildings, etc, on the building. Foresight of the new high rise building impact in the area.





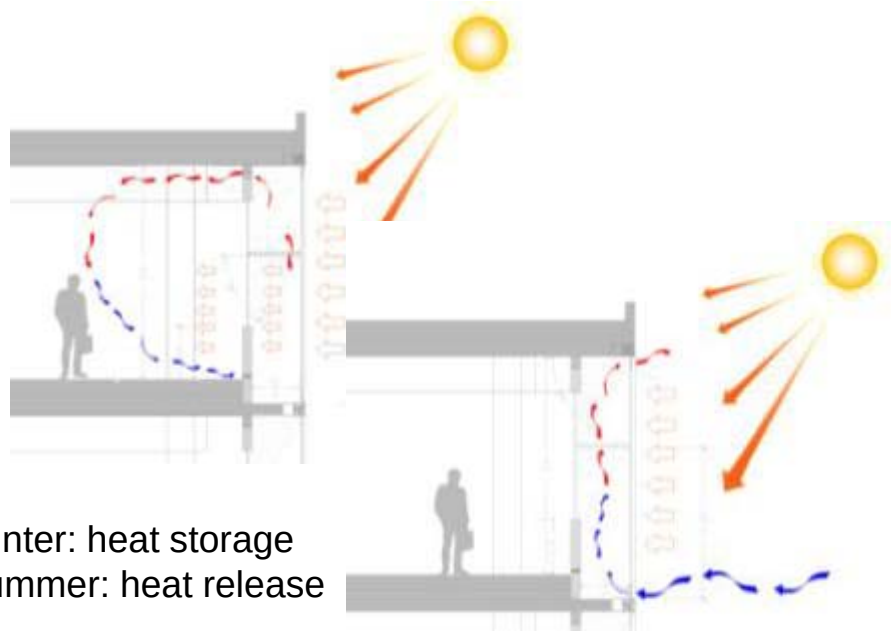
Passive strategies to be adopted

Building envelope:

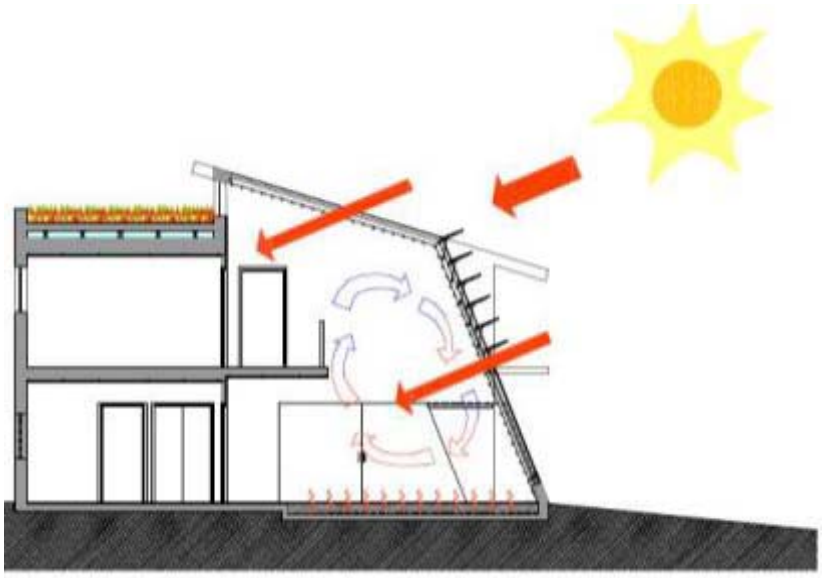
High rise buildings challenge: small roof area. Façade has to be carefully designed and used for passive strategies.

WINTER
heat storage systems
heat circulation
greenhouse effect
windows location

SUMMER
Shadowing
Natural ventilation (ventilated façade)
Vertical gardens
Light colors



Winter: heat storage
Summer: heat release



Passive strategies to be adopted

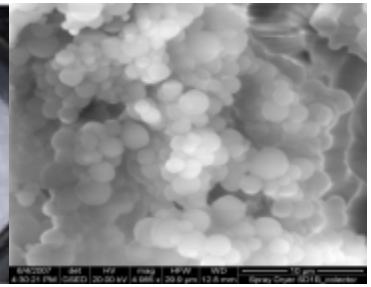
Materials:

- Selection of materials with thermal properties
-Innovative envelope design
-Cost analysis





Use of PCM’s to increase thermal inertia without increasing the thermal mass

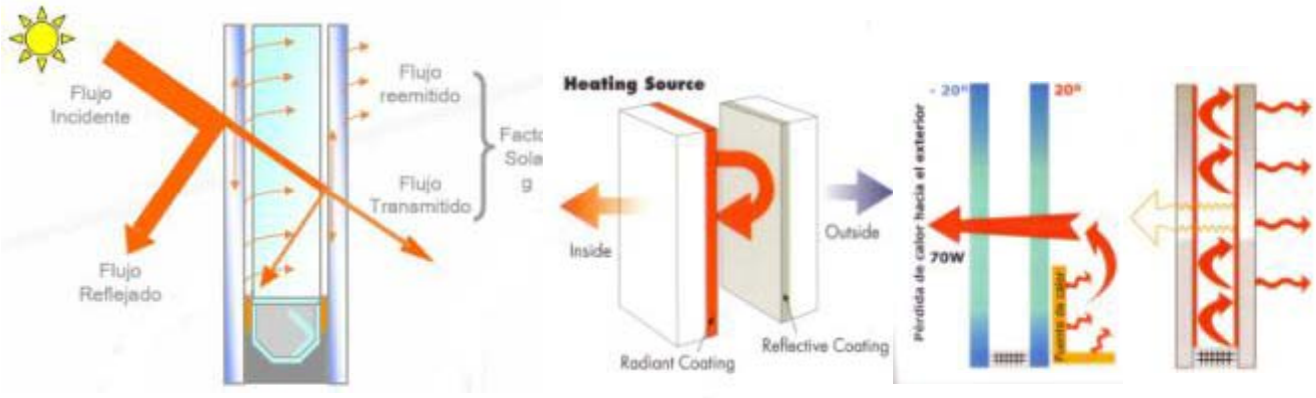
Passive strategies to be adopted

Glazings:

Key element for high-rise buildings: large % of façade surface covered

1. Analysis of heat gains and losses through glazings
2. Determination of internal demands for heating and cooling

➔ Choice of the most adapted solution according to the project characteristics and needs, and cost analysis



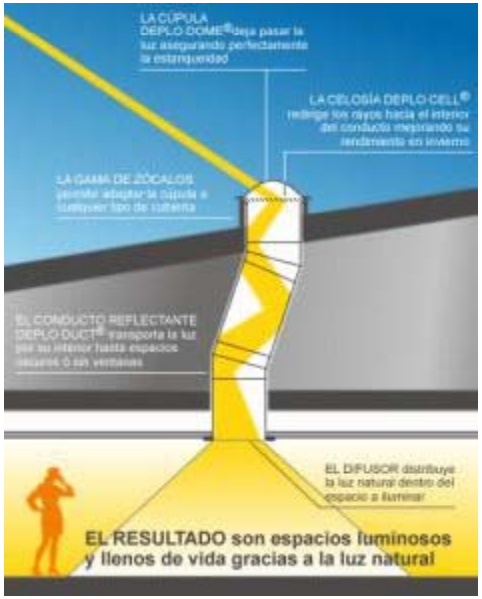
Passive strategies to be adopted

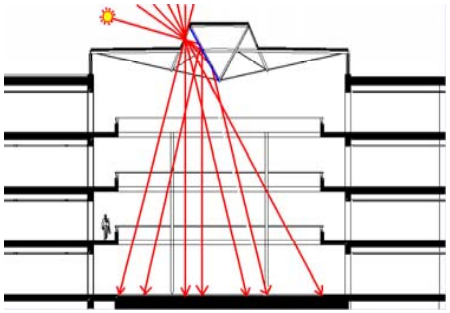
Lighting

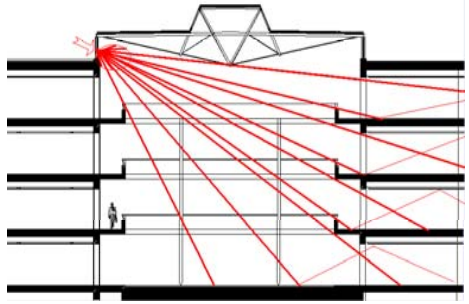
Design criteria

- light quantity
- light distribution

Innovative technologies: natural light ducts





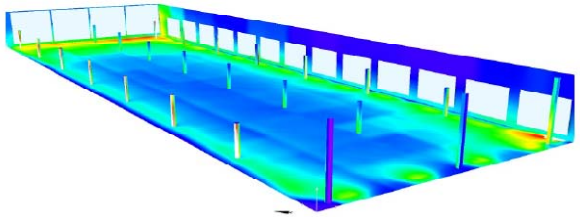


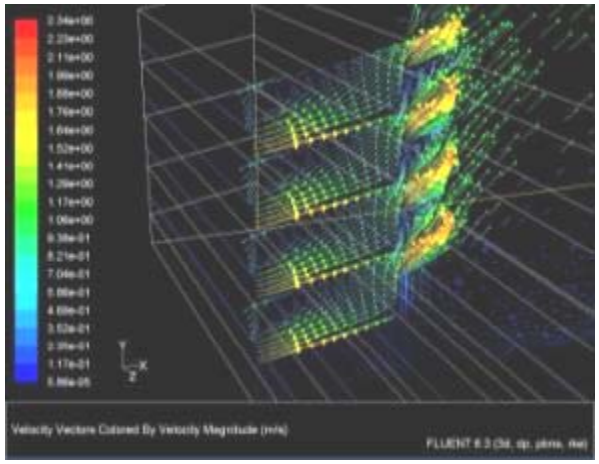
Simulation tools

OBJECTIVES

- Test the efficiency of proposed solutions
- Quantifications in terms on energy demand reduction
- Design support system

TOOLS





Energy+

TRNSYS

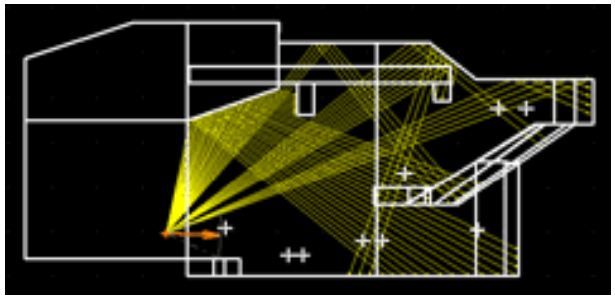
Ecotect

FLUENT

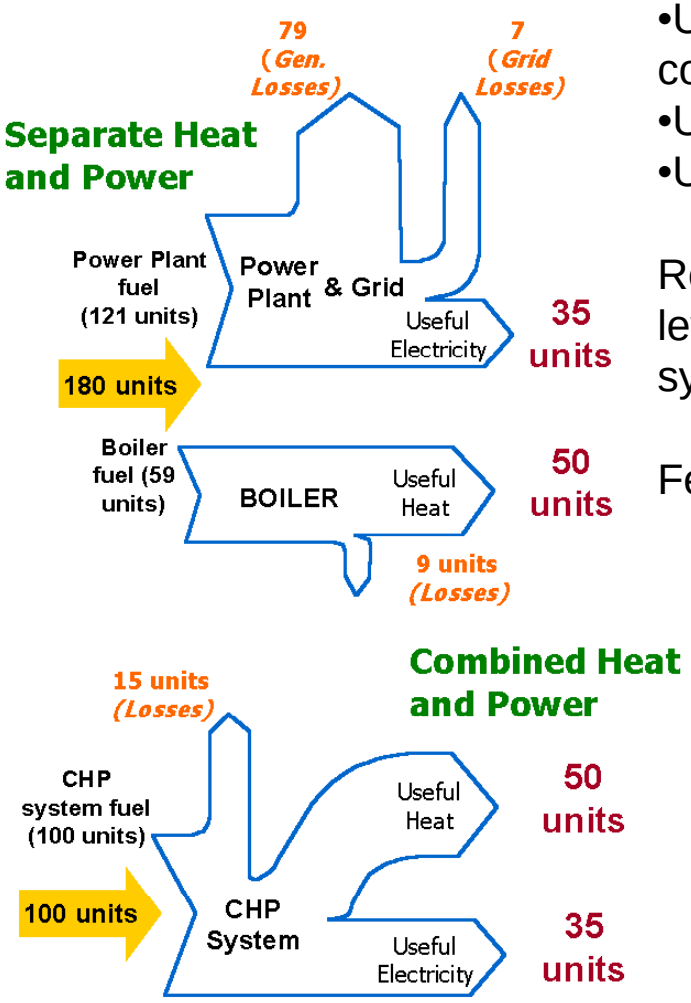
Dialux

Acous-Stiff

Acoubat



Active solutions: COGENERATION

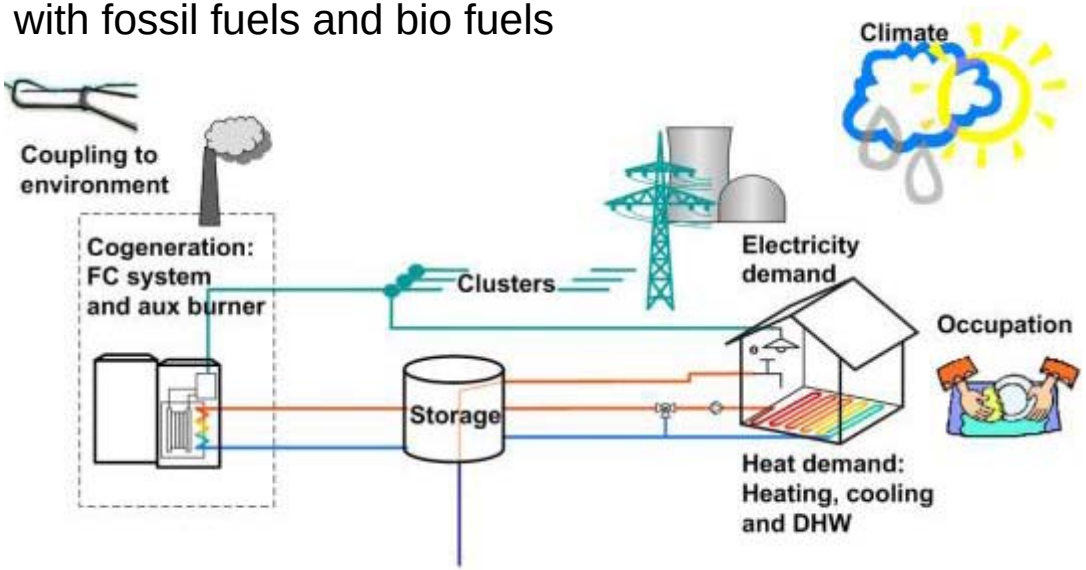


Trigeneration system:

- Combined production of heating, DHW, cooling and electricity.
- Used in combination with absorption chiller, cover the base consumption of multi-dwelling building with centralized system.
- Used in parallel with traditional heat generators
- Use of electricity to self sustain the process

Requires a high impact refurbishment – new technologies at level of heating terminals, heat generation room and control system.

Fed with fossil fuels and bio fuels

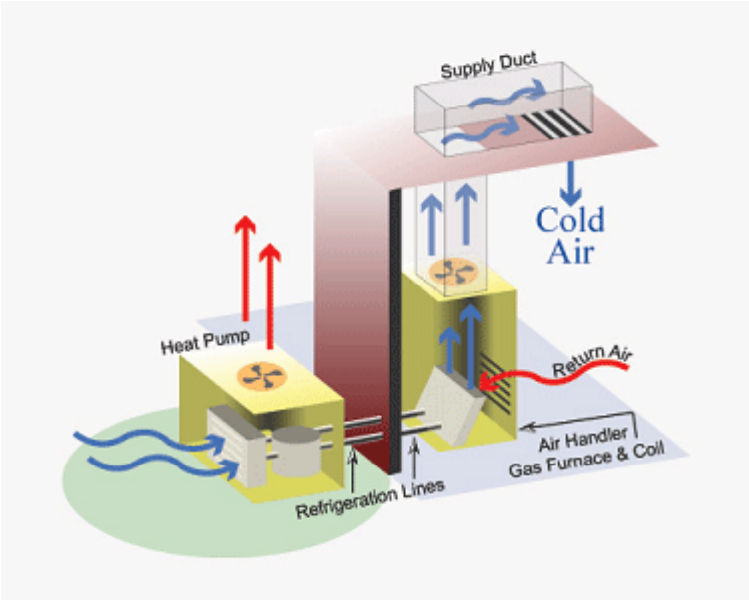


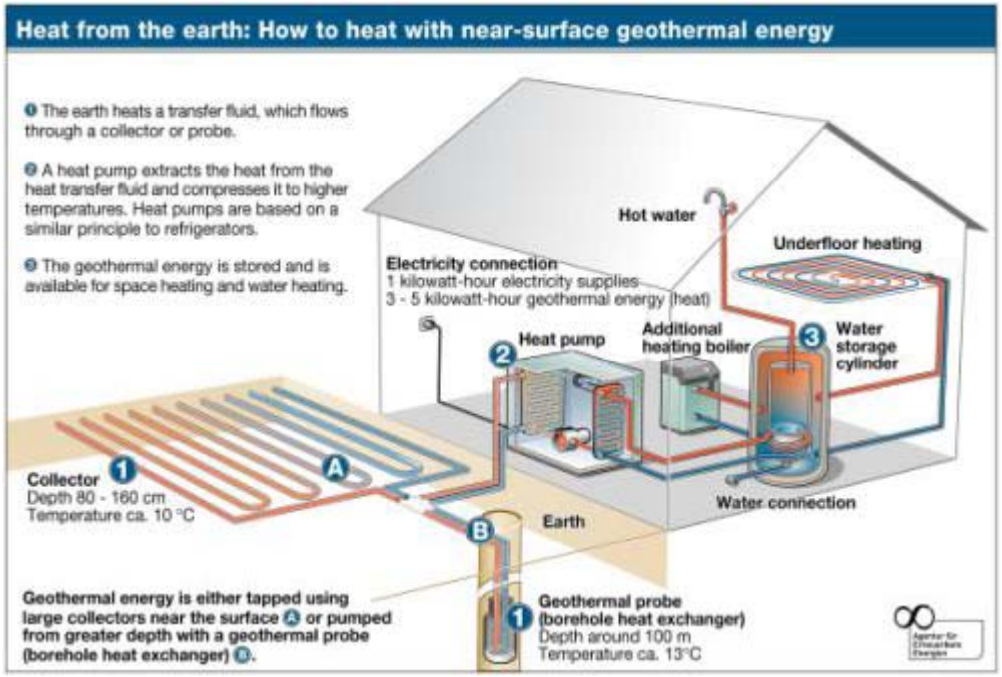
Active solutions: HEAT PUMP

High efficiency heat pump:

- Alternative production of heating, DHW and cooling.
- Used in combination with heating generators, can be used in modular or centralized applications.
- Multi fed system, move energy from place to another by electricity consumption.
- Can be coupled with RES like: geothermal, solar thermal, PV and biomass burners
- Provide heat at low temperature
- Can work with COP up to 5 or more.

Requires a low impact refurbishment – new technologies at level of heating terminals, heat source and control system.



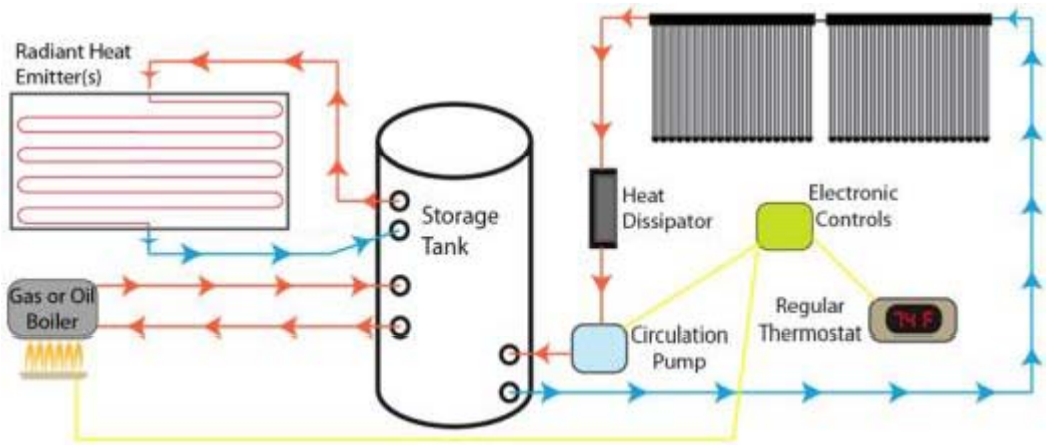


Thermo solar:

•Production of hot energy for DHW at high temperature and low temperature free heating.
•Used in combination with heating generators, can be used in modular or centralized applications.
•Can be coupled to existing facilities to cover a percentage of heat consumption or to feed them.
•Low cost, high surface, simple installation, high integration.

Requires a low impact refurbishment – new technologies at level of heating terminals, heat source and control system.

Solar heating

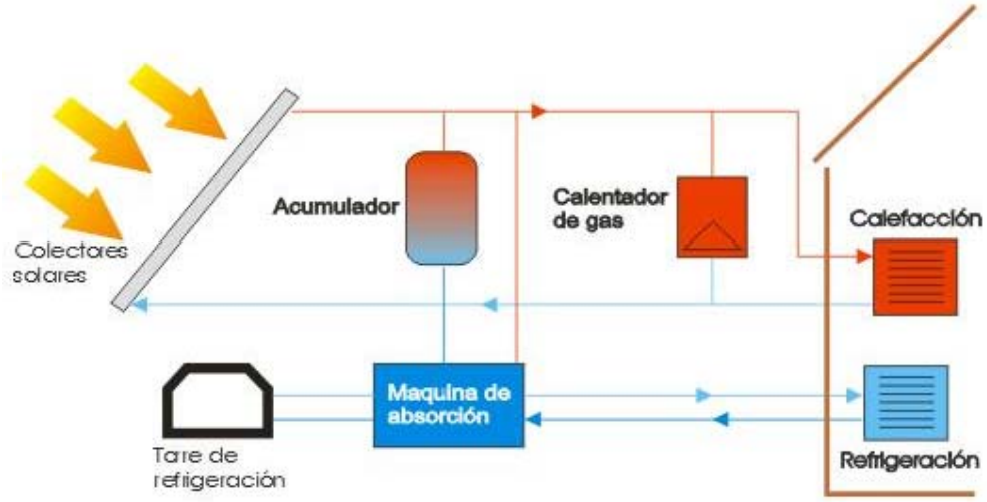


Absorption process:

•Production of cold energy from hot source.
•Exploitation of solar power during cooling period.
•Can be coupled to existing facilities to cover the whole cooling energy demand.
•High cost, high surface, complex installation, high integration, dual use (winter – summer).

Requires a high impact refurbishment, integration with thermo-solar, high level control.

Solar Cooling



Efficient Recovery

Ventilation heat recovery:

•Possibility to recover part of heat dissipated by ventilation.
•Integration with traditional and Renewable energy generators.
•Can be coupled to existing facilities to cover the whole cooling and heating energy demand.
•Low cost, high impact, complex installation, high integration, dual use (winter – summer).

Requires a medium impact refurbishment, high level control, is used as support to conventional generators for conditioning.

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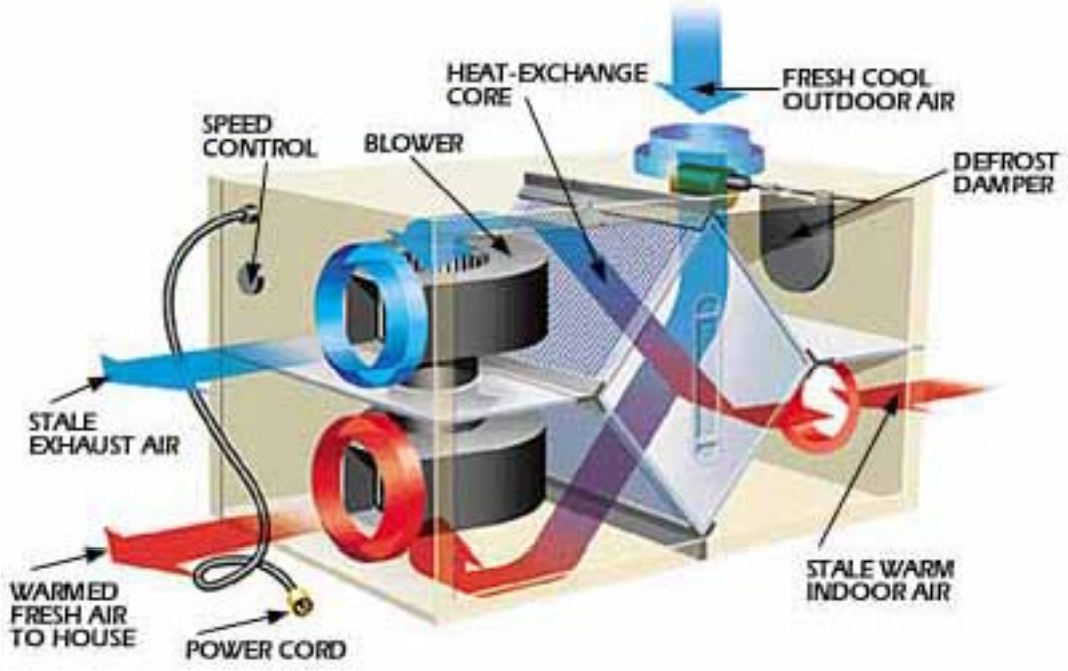
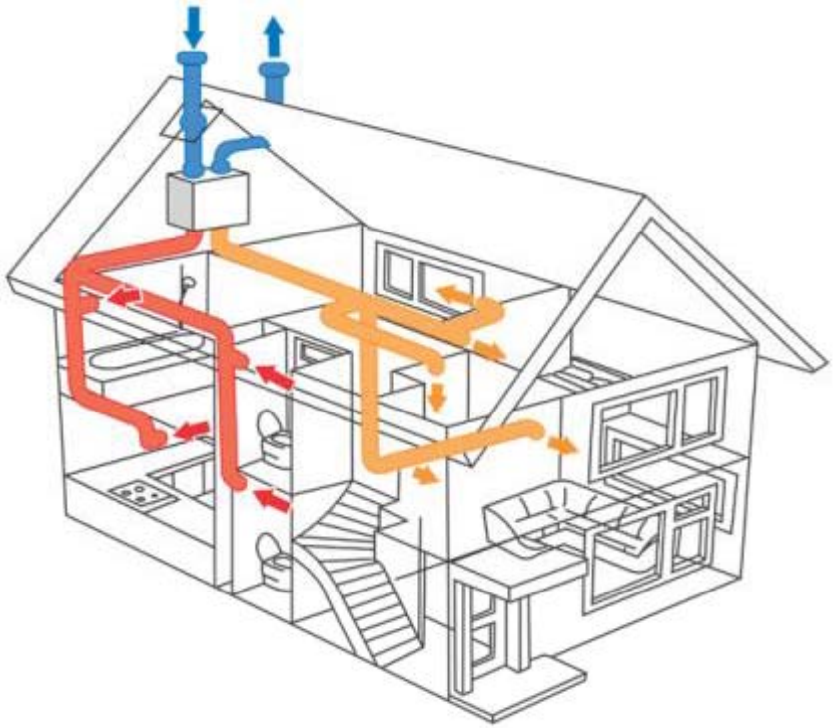




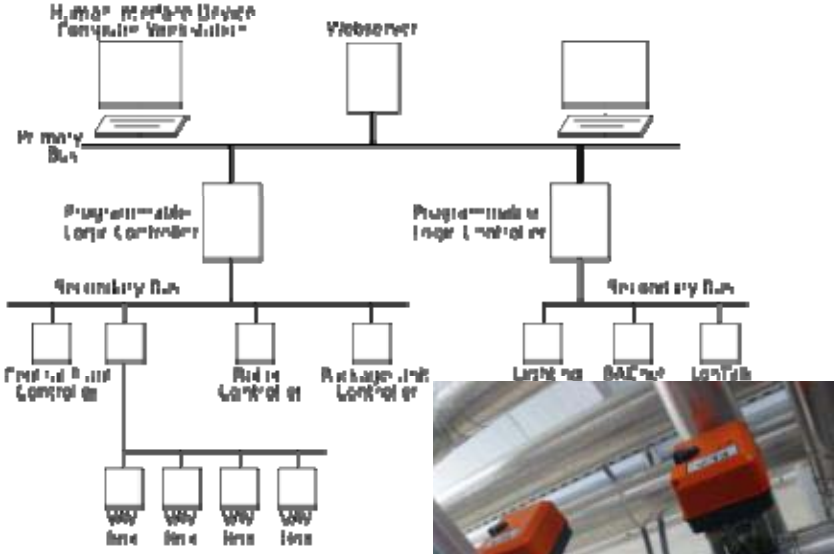
Building Management System

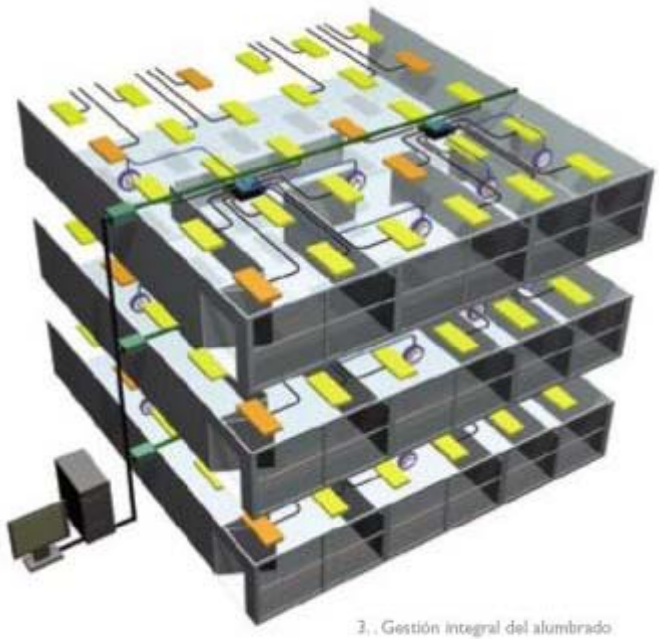
Eco efficienct solutions

→ ***integral BMS:*** manage all installations and facilities of the building in a centralized way, including: light, ventilation, heating, cooling, additional services and safety issues.

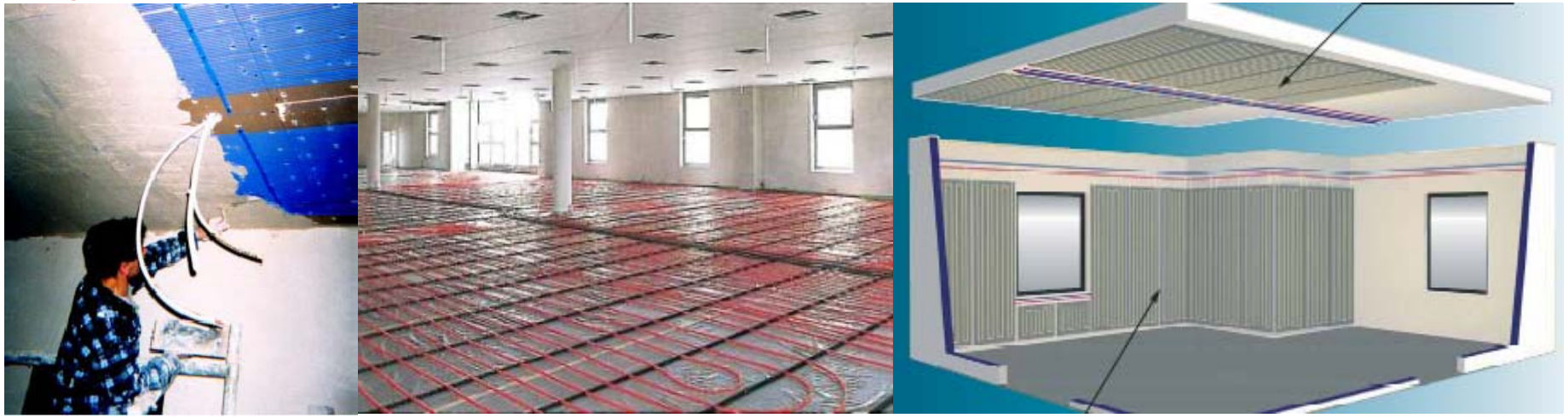
→Implement advanced control strategies, in order to get the maximum efficiency and the maximum energy savings at the same comfort conditions.

→Energy consumption on time monitoring and management

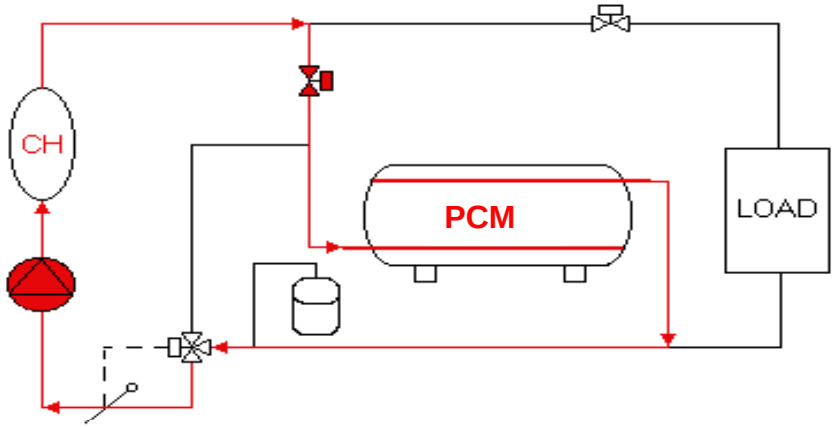




Heating terminals and storage systems

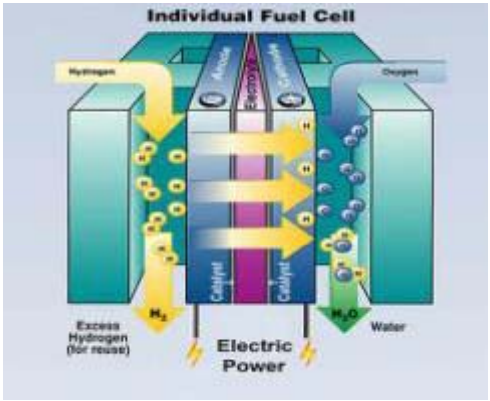


Low temperature radiant terminals



Heat storage with Phse Change Materials

Flywheel



Fuell Cell

High Rise Building European Project – Cost Effective

- In the *Cost Effective* project, 26 European partners cooperate to develop concepts and components therein to convert the facades of existing “high-rise buildings” into multifunctional energy gaining entities, aiming to have a substantial effect on the energy conservation potential in the EU25 and the associated CO_2 mitigation.

- In ’high rise’ buildings, the area of the roof does not suffice for renewable energy sources to contribute substantially to the total energy demand of the building. Hence it is necessary to use the façade, in addition to the roof, for energy conversion.

acciona

Fraunhofer ISE

SEVENTH FRAMEWORK PROGRAMME

Cost-Effective

Initial position

40% of the CO_2-emissions in EU25 are caused by buildings

- the use of renewables has to be increased, especially in large non-residential buildings
- net-zero energy buildings are the target

Haus der Zukunft, Regensburg
project team: Sonnenkraft, fabi architekten, Hochschule Regensburg, Fraunhofer ISE

Large non-residential buildings

Tour Carpe Diem, Paris. Stern Architects, NY
Source: Emmer Pfenninger Partner

Vision:

Converting facades of existing high rise buildings in energy gaining components

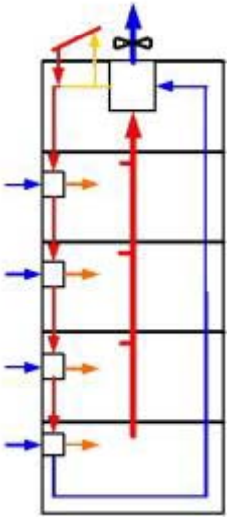
Building categories	Post-war, reinforced concrete structure with massive facade	Reinforced concrete with (precast) concrete façade	Skeleton construction with precast concrete panels (strip windows)	Skeleton construction with curtain-wall façade
Image				
category	1	2	3	4
time line	1945-1965	1960-1980	1975-1990	1975-1995
main construction	reinforced concrete	reinforced concrete	reinforced concrete	reinforced concrete
precast	no	possible	possible	no
facade	load bearing	load bearing	non bearing	non bearing
stability	facade	facade/core	core	core
material facade	massive brick, brick cavity wall	brick, natural stone, stucco, ceramic tiles, glass cladding	concrete, metal cladding	metal profiles, metal cladding
glazing	single	single/double	double	double
windows	openable	openable	openable	openable/closed
floor plan	lineair cell structure	lineair cell structure	core cell structure	cell/open structure
air-conditioning	no	no	no	no
Façade therm. Insulation	no	in cavity 30-60mm	in cavity 30-60mm	in closed partition 30-60mm

Technology under development

transparent solar thermal collector for glazing integration

glare protection BIPV-component

facade integrated natural ventilation system with heat recovery



air-heating vacuum tube collector

unglazed solar thermal collector plus heat pump

THANKS

MADRID SKYLINE