



liten
cea tech

The key role of Large Research Infrastructures for innovation: Illustration with European projects using CEA INES facilities



**SUSTAINABLE
PLACES**
2016 June 29-July 1, 2016
Anglet, France

*Etienne Wurtz, research director
Anglet June, 29*



ines
INSTITUT NATIONAL
DE L'ENERGIE SOLAIRE

INES : A large coverage of the solar field

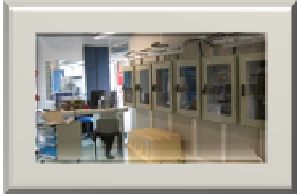


Solar mobility

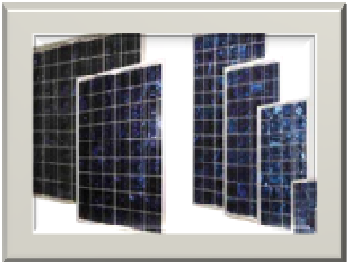
Solar buildings

Smart electrical systems / smart grids

Certification of modules & systems

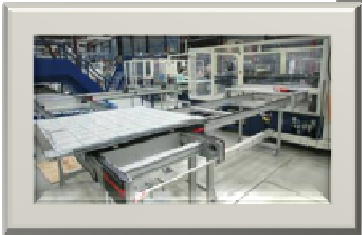
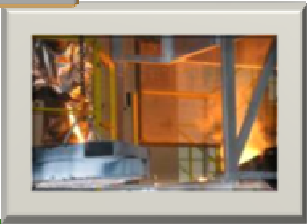


Solar modules



Solar cells

Silicon



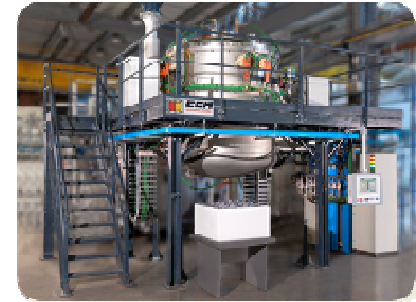
INES : Industrial Collaborations / Si material

Metallurgical charge

FerroPem
Groupe « FerroAtlántica »
EFD
INDUCTION
APOLLON SOLAR
energies
edf nouvelles

Si Ingot

ECM
TECHNOLOGIES
MERSEN
VESUVIUS
b.e.a



Si wafering

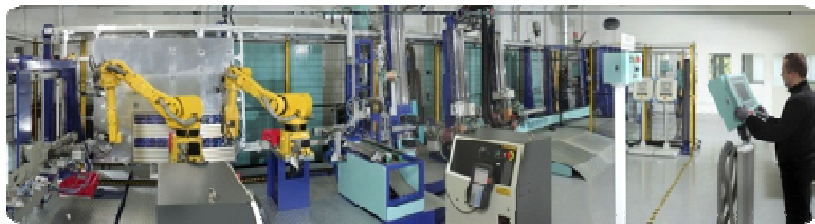
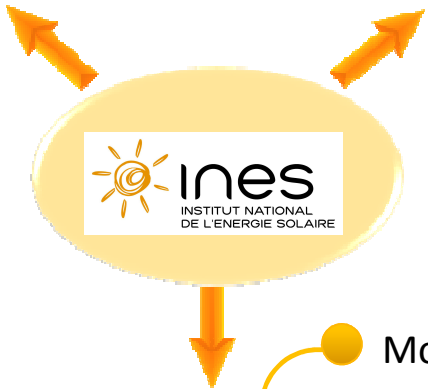
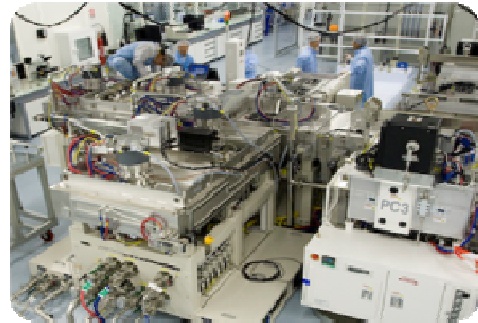
ECM
TECHNOLOGIES
THERMOCOMPACT
APPLIED MATERIALS

INES : Industrial Collaborations / PV cells and modules

PV Homo junction



PV Hetero junction



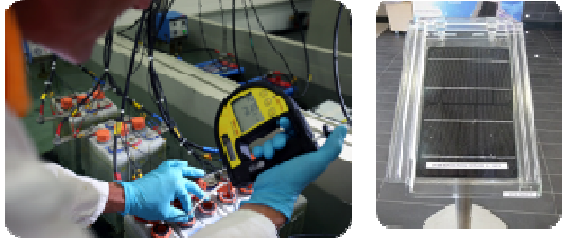
Modules

INES : Industrial Collaborations / PV Systems

Balance of system



BIPV

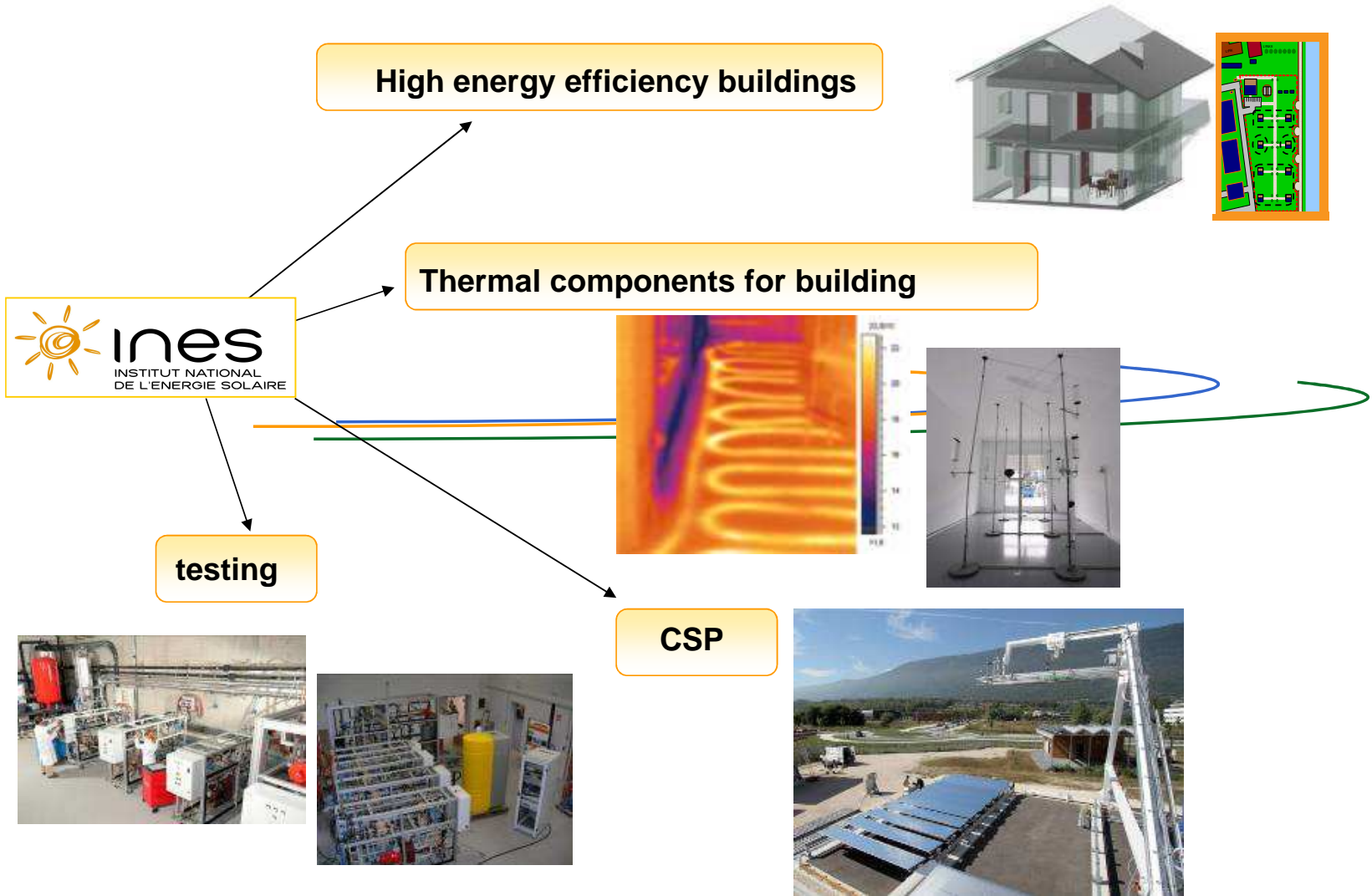


Solar mobility

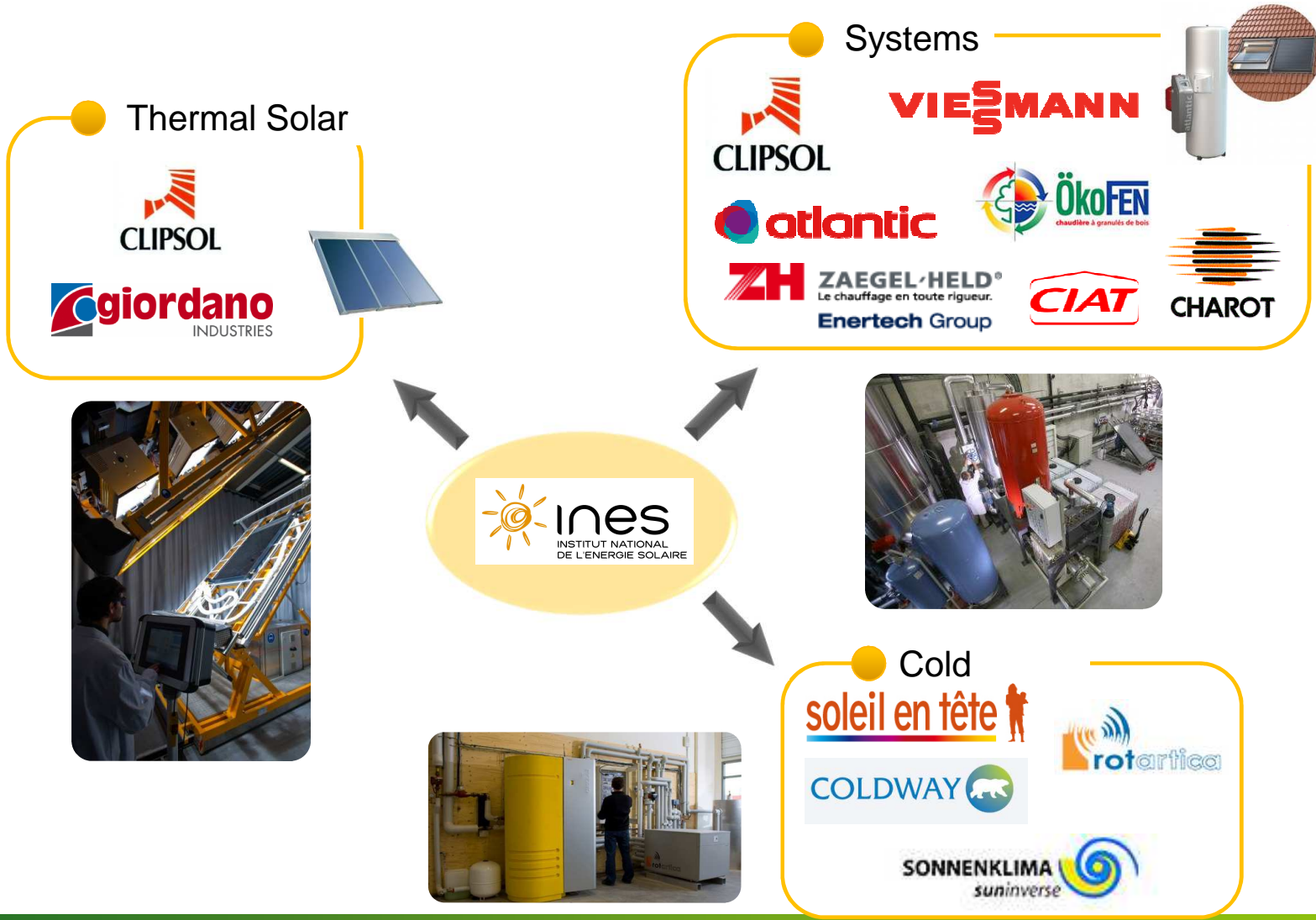


Smart Grid and storage

Thermal solar activities



INES : Industrial Collaborations / Thermal solar



INES : Industrial Collaborations / Concentrated Solar

CPV



CSP



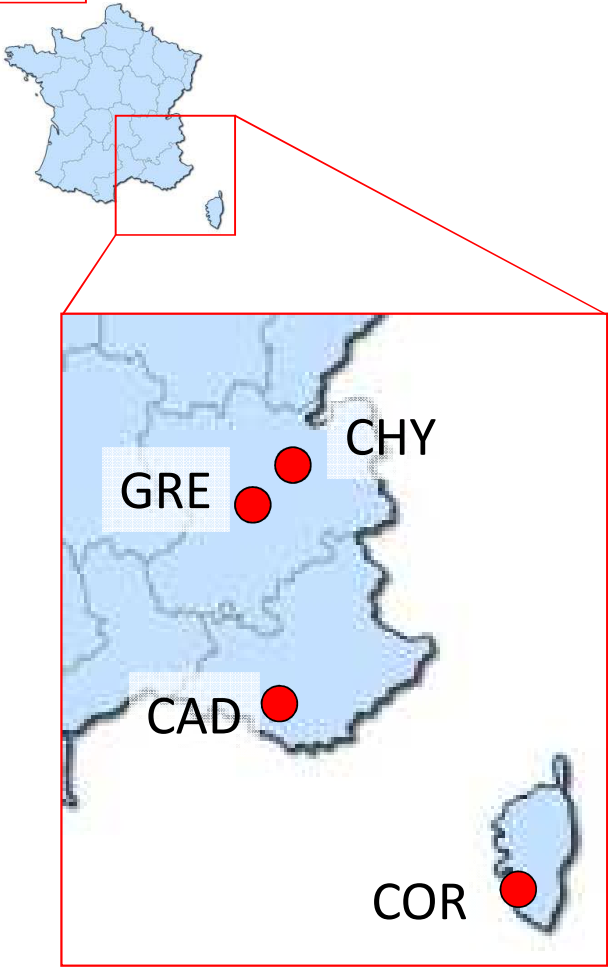
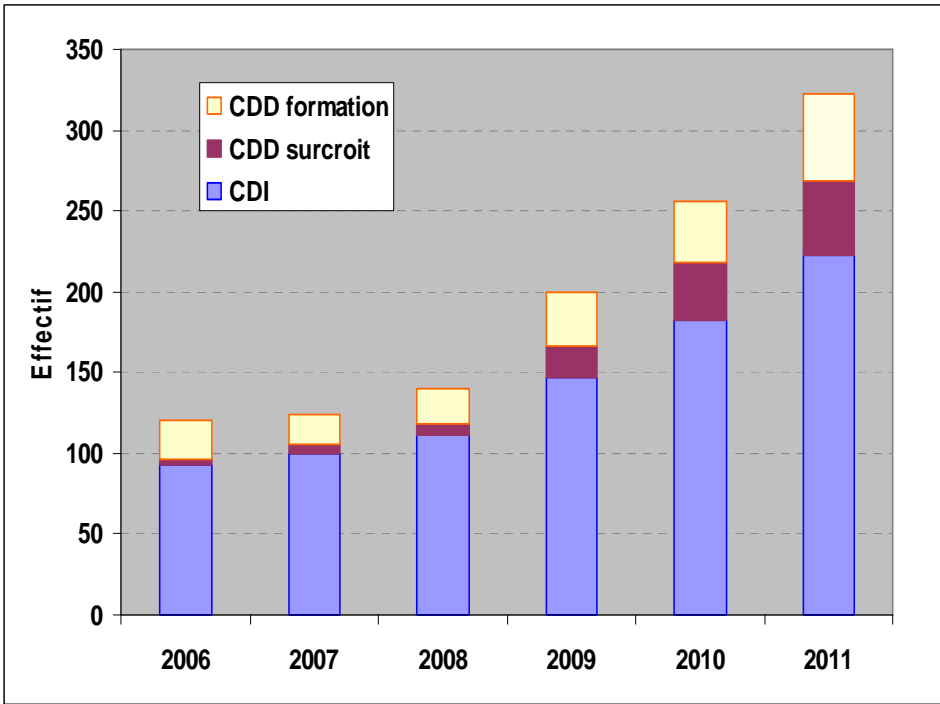
Megasol platform



Thermal Stockage

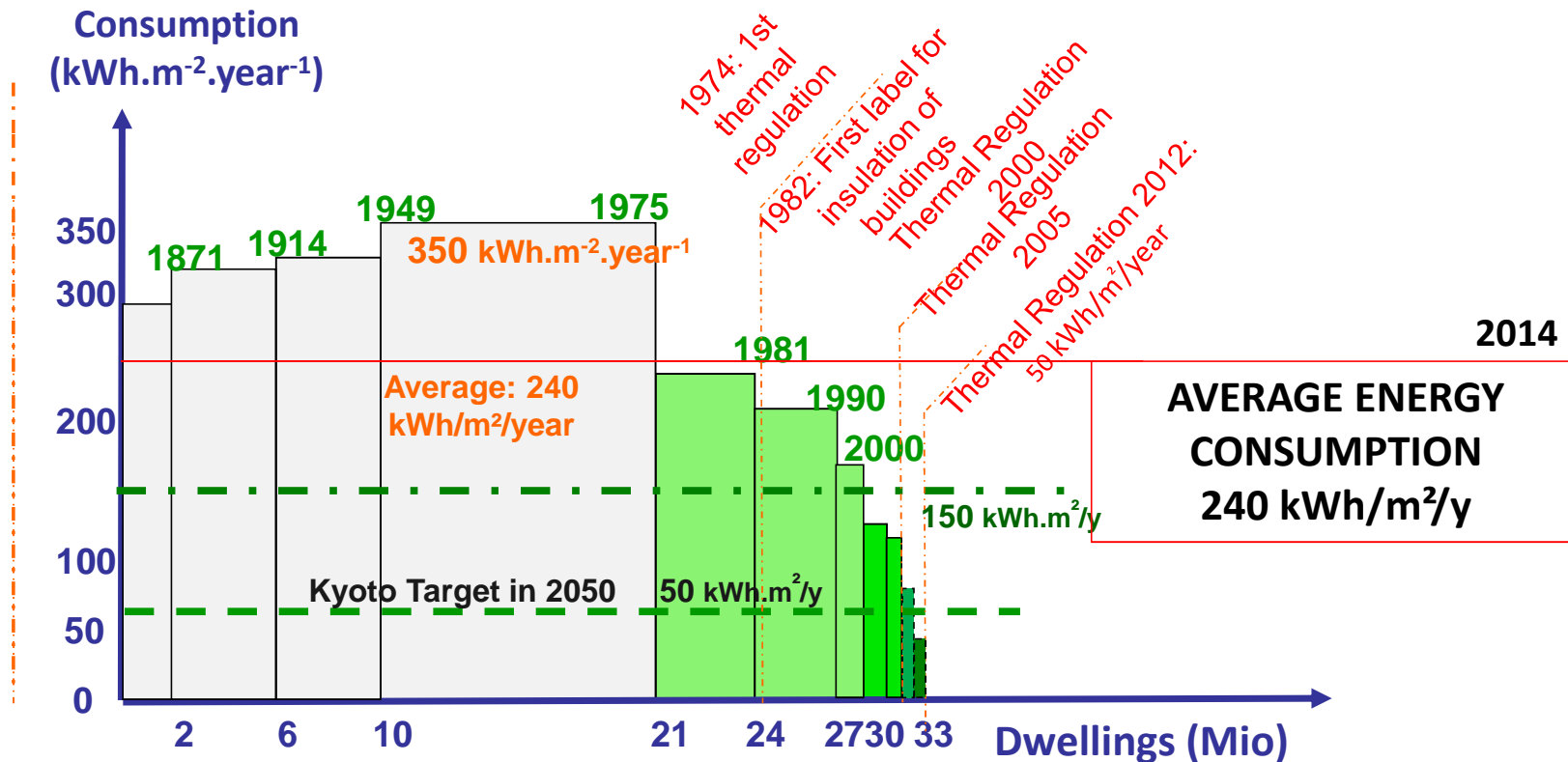
INES : Human resources

INES : 330 people



AMBITION AND NECESSITY OF BUILDING RENOVATION

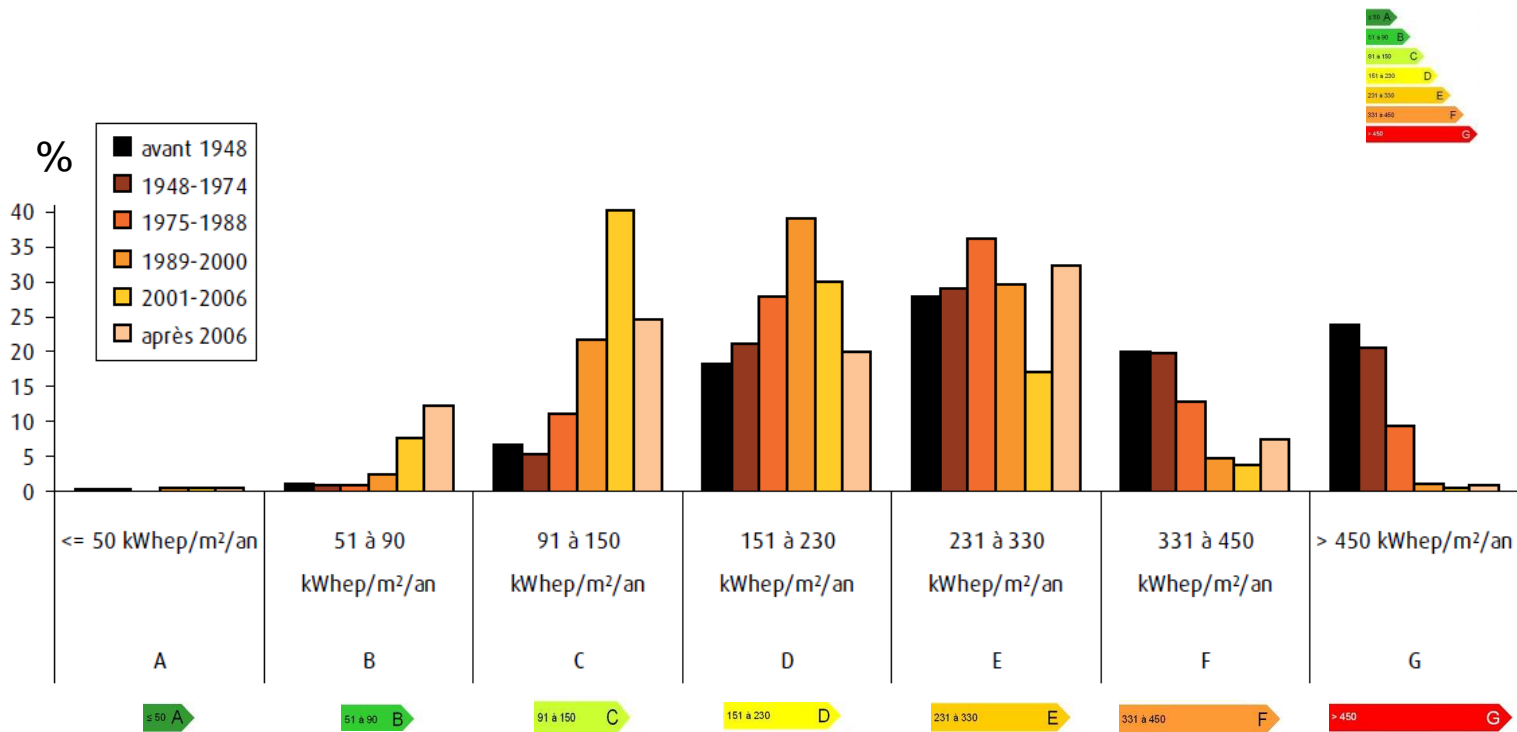
BUILDING STOCK PROFILE IN FRANCE



A small minority of buildings ≤ 50 kWh/m²/y

STOCK PROFILE vs ENERGY DEPENDING on BUILDING CONSTRUCTION PERIOD

A large effort of renovation is needed

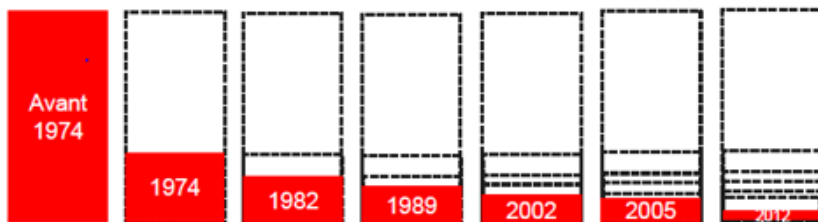


Even recent buildings consume more than 50 kWh/m²/y

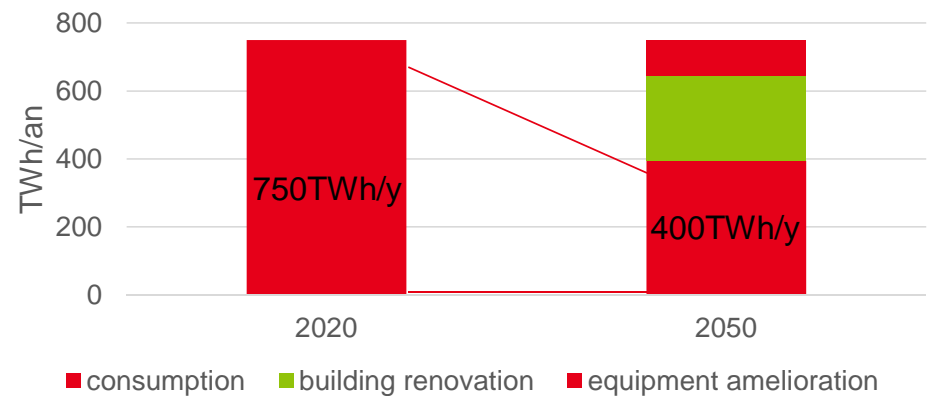


RESEARCH ACTIVITIES DONE BY INDUSTRIAL PARTNERS ARE MOSTLY FOCUSED ON REGULATION WHICH AIMS ONLY THE NEW BUILDINGS

Consumption evolution for new buildings



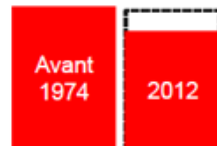
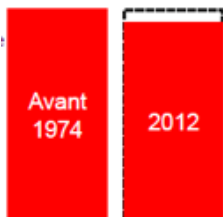
Renovation impact for consumption



Consumption evolution for old buildings

Houses

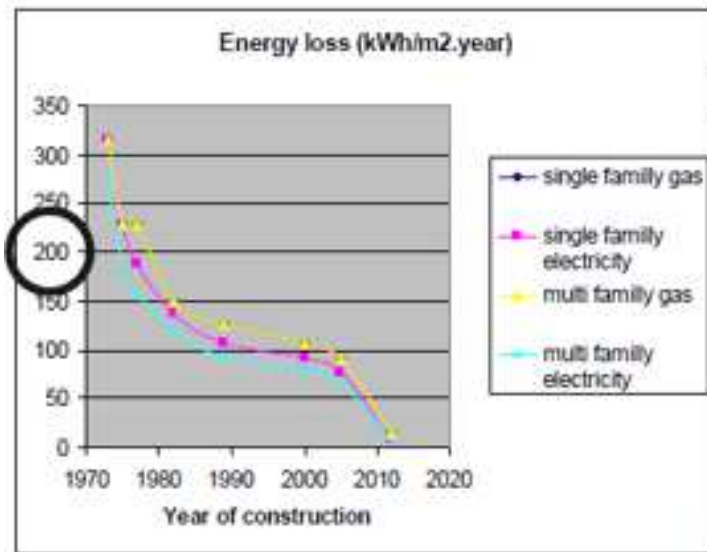
Collective buildings



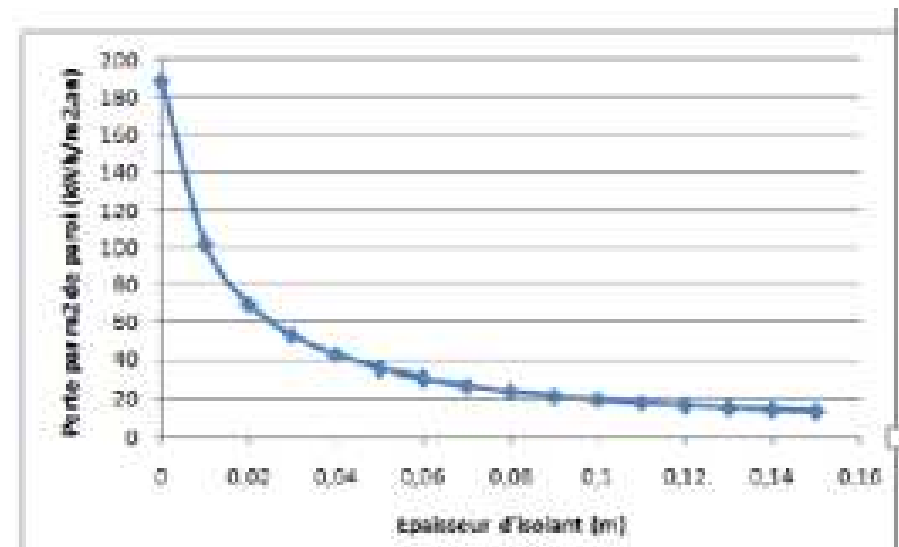
Reduction of consumption from 50% allows to increase renewable energy proportion
Insulation effect >> energy saved by HVAC



ENERGY DECREASING : ONE YEAR GAIN FOR NEW BUILDINGS CORRESPONDS TO 15 YEARS GAINS OF OLD BUILDINGS RENOVATION



Energy loss evolution during 40 last years for new buildings



Energy loss vs insulation width:
Interest for the first cm and very low conductivity

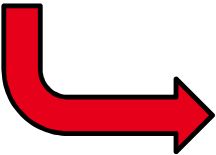


A FOCUS ON BUILDING ENVELOPE

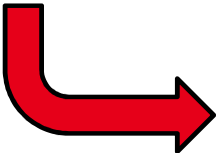
Many topics are related to research in building energy:
Optimization of control, summer comfort, smart grids, energy production, renewable energies, ventilation

BUT

Building energy corresponds to 44% of total final energy in France

 58% for heating



 82% of consumptions are linked to envelope losses and 73% to blind walls

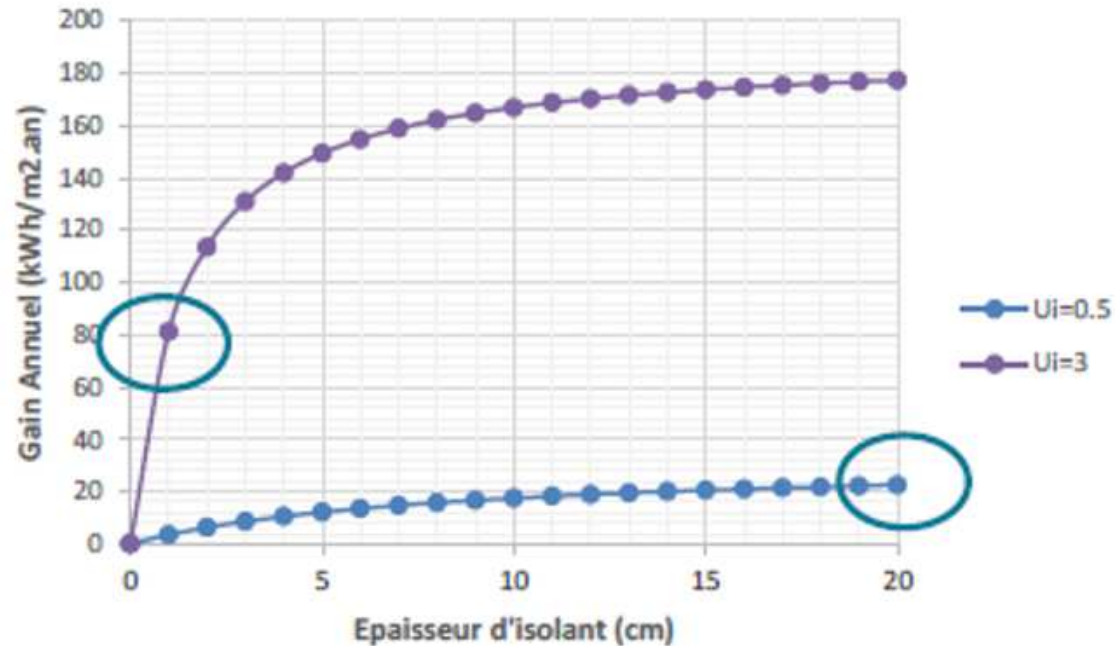
Source: ADEME, EDF R&D



- Why we need research for very high insulated materials



ANNUAL ENERGY GAIN AFTER RENOVATION OPERATION



We can see that energy gains depend mostly on initial heat thermal resistance of the wall:

Importance to find a high quality solution

Easy to fix, esthetic, large scale development, universal ...



INES Large Research Infrastructures and wall high insulation innovation

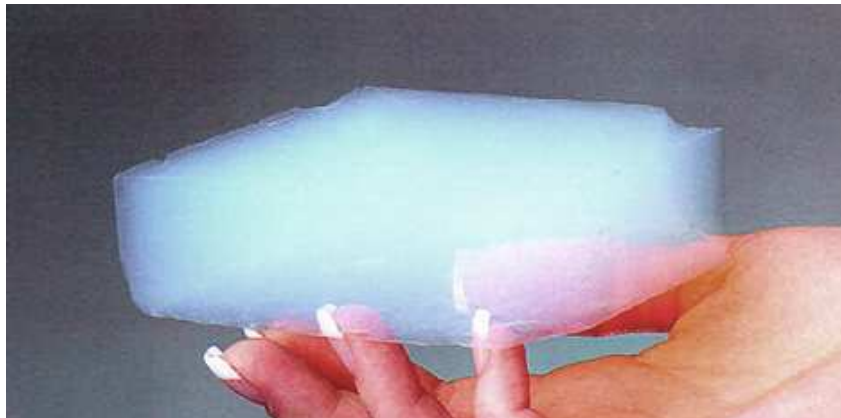


LARGE RESEARCH INFRASTRUCTURE TO DEVELOP NEW TECHNOLOGIES OF HIGH INSULATION

PAREX.IT : a French project to develop a coating with aerogel

HOMESKIN : an European project to develop aerogel panels for internal thermal insulation or external thermal insulation

WALL-IN-ONE : an European project mixing aerogel with plaster to increase surface temperature and decrease radiative walls emission



AEROGEL-BASED RENDERING TESTED

- An insulating rendering based on silica aerogels
- Prepared on-site through mixing with water
- Applied through projection onto the facades (4 cm)
- Thermal conductivity of around 0,026W/(mK)
- For old buildings rehabilitation





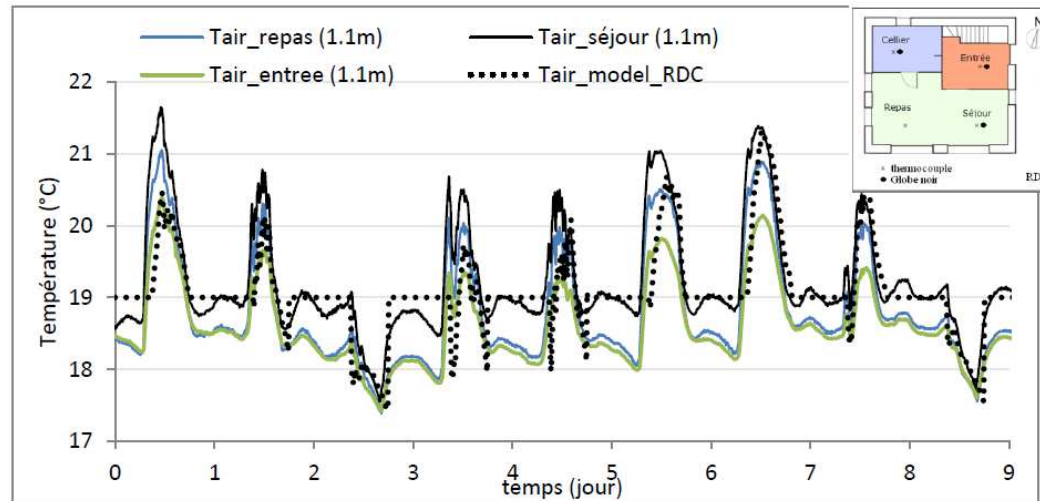
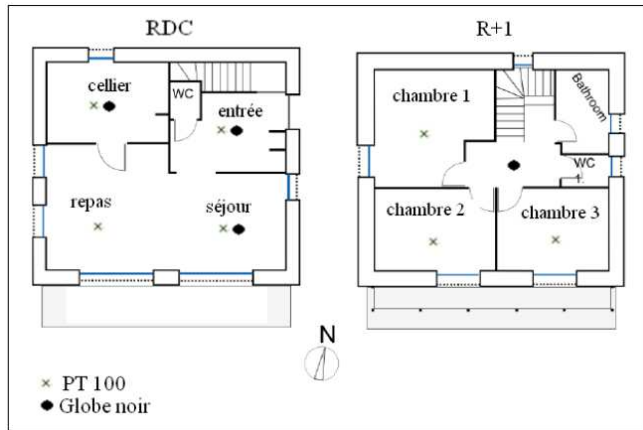
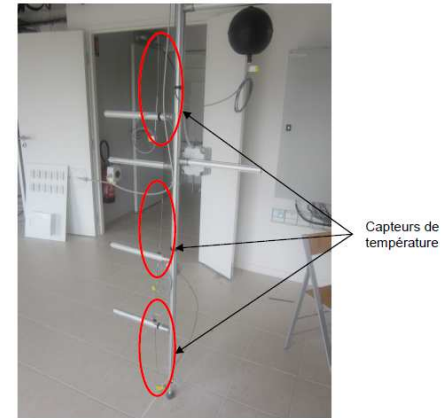
AEROGEL-BASED RENDERING TESTED DURING FEW YEARS ON AN EXPERIMENTAL HOUSE

Applied and tested on a full scale experimental house at INES experimental field



COMPARISON BETWEEN EXPERIMENTAL DATA AND SIMULATION

➤ EnergyPlus numerical model calibration



ADVANCED AEROGEL-BASED COMPOSITE INSULATION TESTED IN PASSYS CELLS

HOMESKIN project

- ❑ New multi-layer composite insulation systems based on silica aerogel
- ❑ Develop affordable and high replication products throughout Europe

Advantages

- Reduction in thickness of insulation
- 3 times higher efficient than standard insulation products
- Suitable for old and new buildings
- External and internal applications
- Eco-friendly products and systems
- Improved durability and sustainability



HOMESKIN AABC

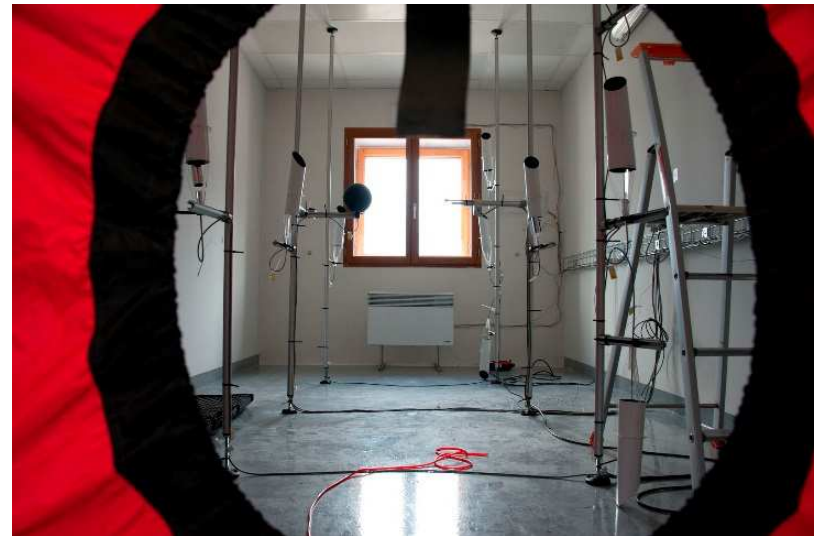


ADVANCED AEROGEL-BASED COMPOSITE INSULATION TESTED IN PASSYS CELLS

HOMESKIN project

Testing and characterization in two identical adiabatic PASSYS test cells:

- One test cell with the outside thermal insulation system
- Another test cell with the inside thermal insulation system





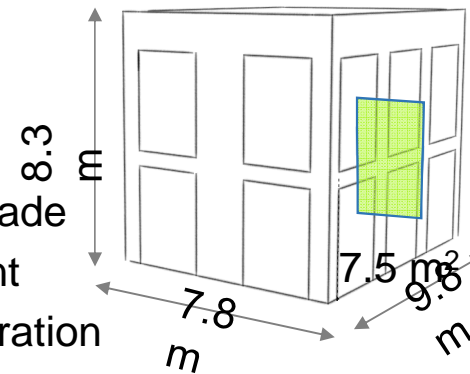
NEW EFFICIENT INSULATION SYSTEMS TESTED IN FACT

WHAT IS FACT ?

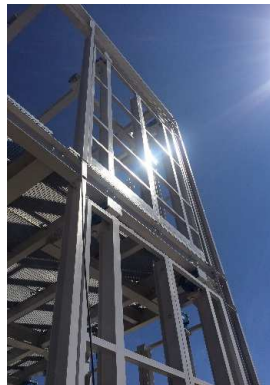
> “FACADE TOOL”

➤ A modular 1:1 outdoor test facility which allows:

- To characterize *dynamic* system and *adaptive* façade
- To validate simulation tool of advanced component
- To find solutions to technological problem of integration



> Building envelope measurement + Indoor Environment Quality Evaluation



FACT

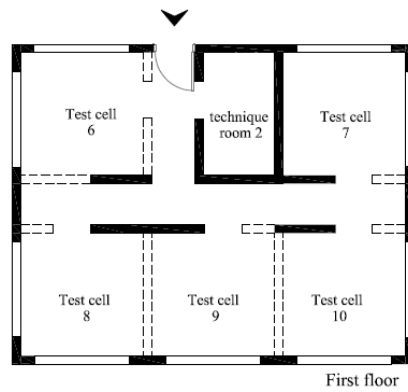
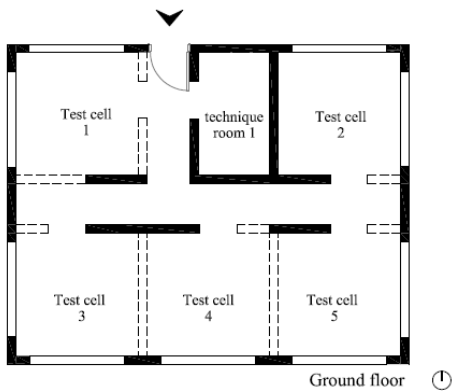
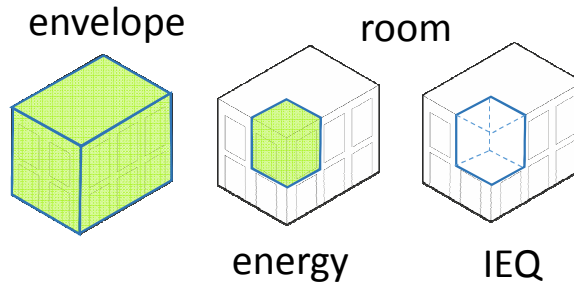


TEST OF PLASTER AEROGEL FOR INSIDE WALLS

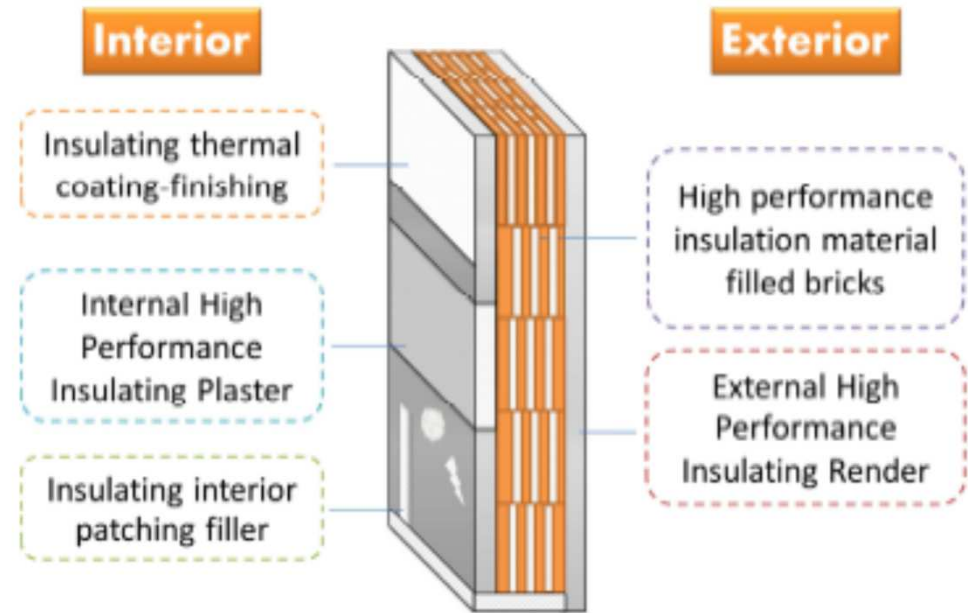
FACT CONCEPT and PROJECT

> FACT geometry is flexible
From 1 to 10 test cells:

- 2 floors
- 4 orientations
- 2 technical rooms
- 9 m² test cell floor area**



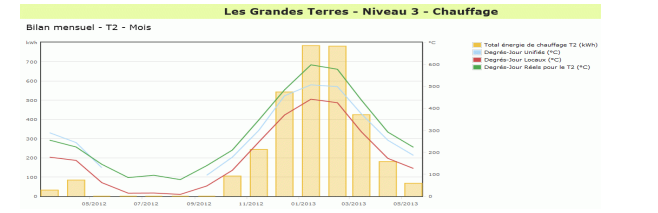
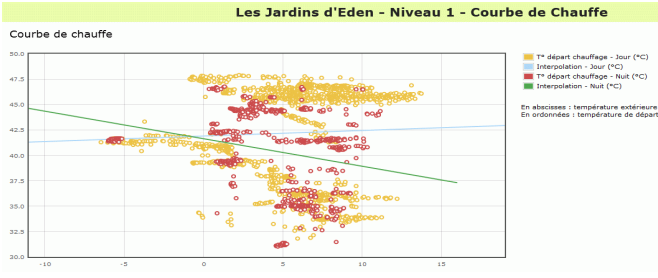
H2020 WALL IN ONE Project New Efficient Systems



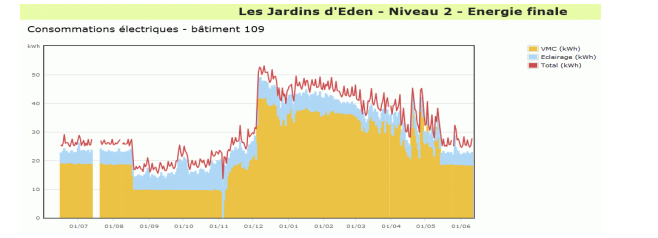
Companies : Ennersens, Toutpret, Vimark and Quickmix



REAL SCALE EXPERIMENTATIONS TO GET RELIABLE RESULTS FOR EACH TECHNOLOGY



ENERGY PERFORMANCE INDICATORS
HUMAN TO MACHINE INTERFACE
INSTRUMENTATION
METHODOLOGY
ENERGY PERFORMANCE GUARANTEE



Stade Isère - Niveau 1 - Fonctionnement

Niveau de température de l'ECS (sur retour bouclage)	● Seuil min et tolérance	Valeur min rencontrée	Test sur la température de retour
	50 °C (-10 °C)	31.21 °C	

Les Grandes Terres - Niveau 1 - Fonctionnement

Fonctionnement ECS T2	● Seuil min et tolérance	Valeur min rencontrée	Test de la valeur quotidienne maximum mesurée en cas de soutirage
	50 °C (-5 °C)	60.32 °C	
Fonctionnement ECS T3	● Seuil min et tolérance	Valeur min rencontrée	Test de la valeur quotidienne maximum mesurée en cas de soutirage
	50 °C (-5 °C)	47.17 °C	

To take into account user behavior which get more and more important with high efficient buildings





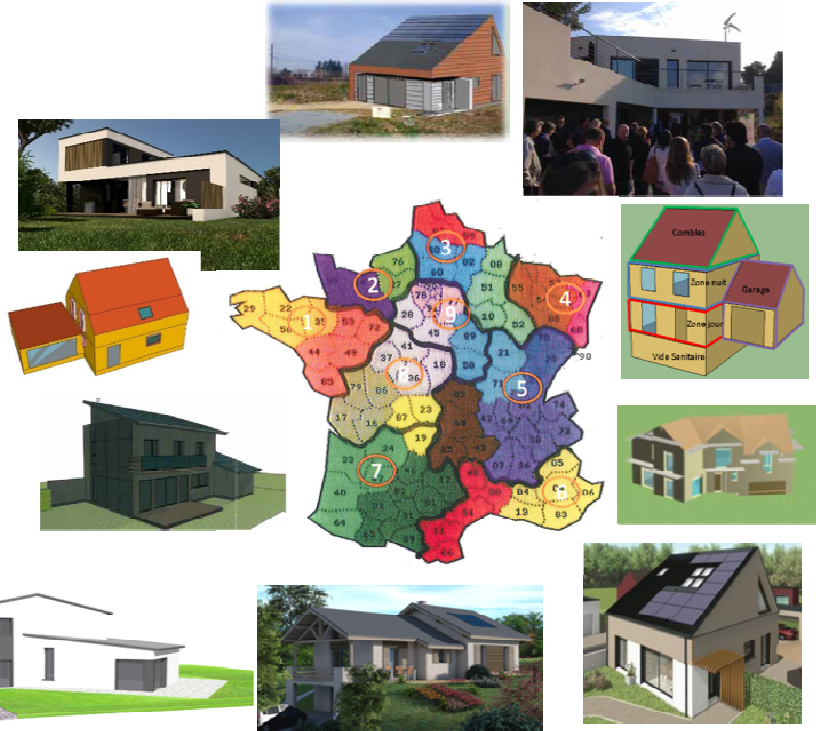
MONITORING BUILDINGS IN SITU



Different scales
Different levels
Different precision



To increase simulation tools reliability and decrease uncertainties



COMEPOS project : Monitoring all over the country for different climates, behaviors, technologies, geographical context

Monitoring to optimize control, to validate innovation and to evaluate users behavior influence
To shift from 0-energy building to 0-energy users



THANK YOU FOR YOUR ATTENTION

