Université Paul Verlaine - Metz Nancy-Université Université Paul Verlaine - Metz Nancy-Université Université Paul Verlaine - Metz

Université Paul Verlaine - Metz Nancy-Université Université Paul Verlaine - Metz Nancy-Université

Nancy-Université Université Paul Verlaine - Metz Université Paul Verlaine - Metz Nancy-Université Nancy-Université

UNIVERSITÉ DE LORRAINE | IUT Henri Poincaré LONGWY

Université de Lorraine

# *Recherche en énergétique @ Longwy*


**Professor M. El Ganaoui, University of Lorraine, France**

Mohammed.el-ganaoui@univ-lorraine.fr

CNRIUT'2019
Congrès National de la Recherche des IUT
IUT Toulon

# University of Lorraine

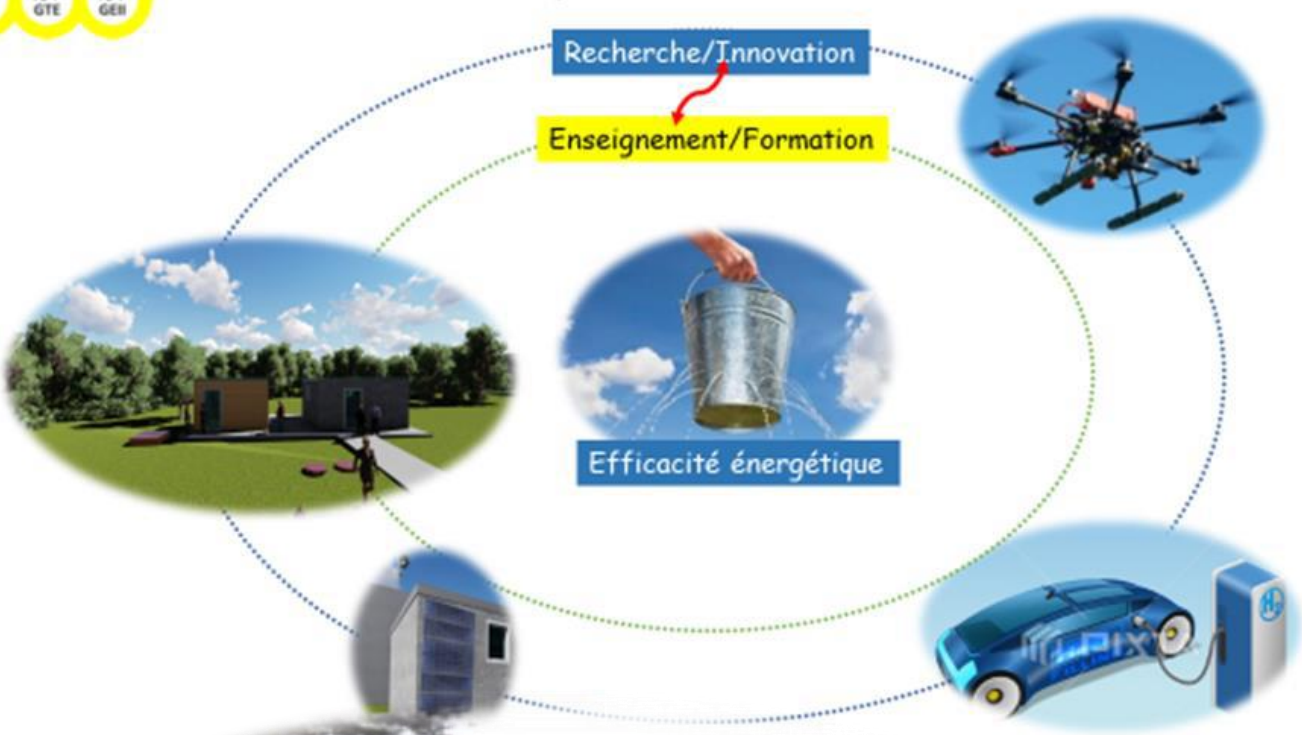
UNIVERSITÉ DE LORRAINE

Longwy

Nancy

Epinal

Projets fédérateurs



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# Plate forme partagée Pédagogie Recherche appuyée du projet Master@Longwy

Marouane ALMA[1], Rachid BELKACEM[2], Olivier DI PILLO[3], Rabah DJEDJIG[4], Damien GUILBERT[5], Mourad RAHIM[4], Angel SCIPIONI[5], Harouna SOULEY ALI[1], Mohammed EL GANAOUI[4]

[1]Université de Lorraine, IUT de Longwy, Laboratoire CRAN/GEII
[2]Université de Lorraine, IUT de Longwy, Laboratoire 2L2S/GEA
[3] Université de Lorraine, IUT de Longwy, Département GEII
[4] Université de Lorraine, IUT de Longwy, Laboratoire LERMAB/GTE
[5]Université de Lorraine, IUT de Longwy, Laboratoire GREEN/GEII

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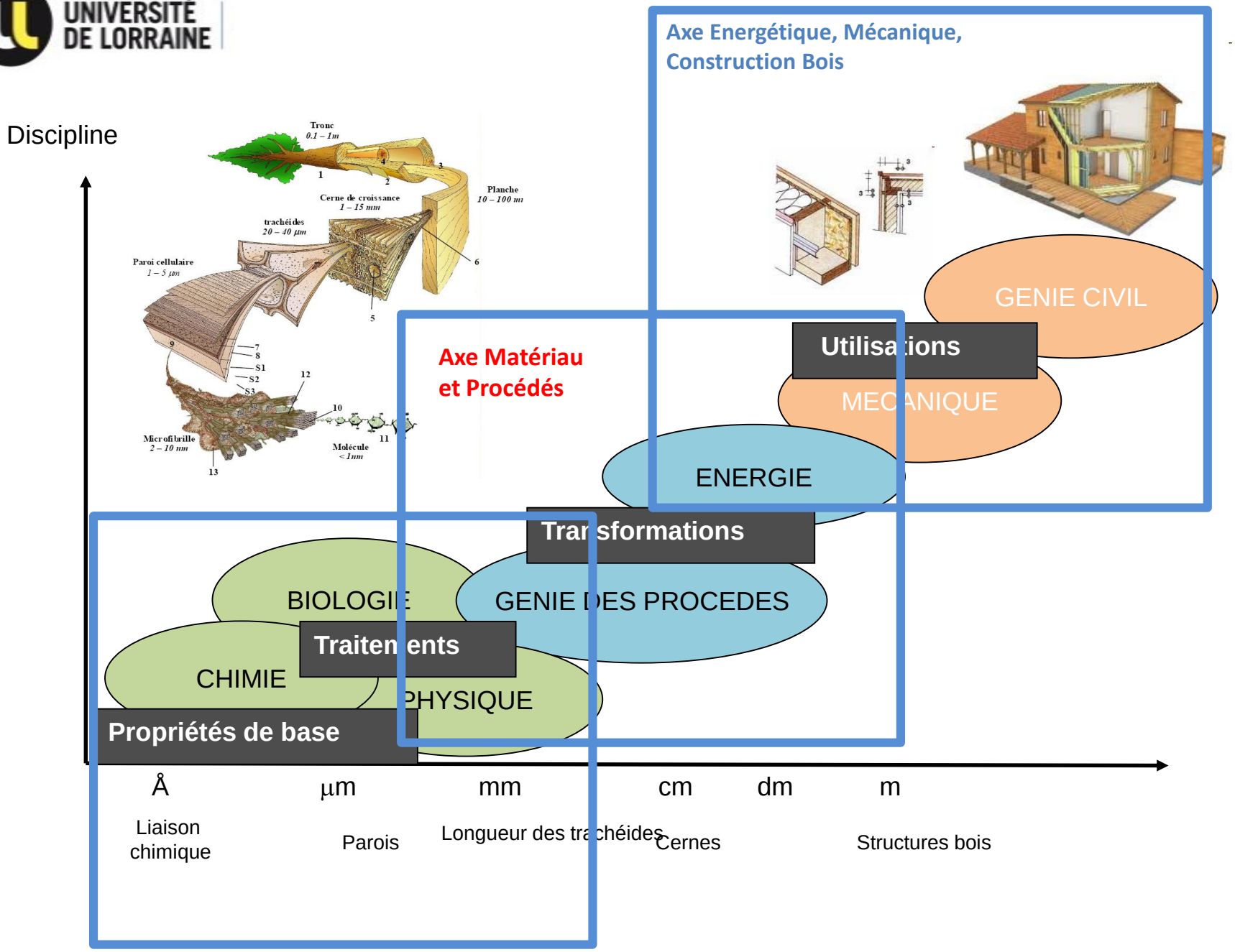
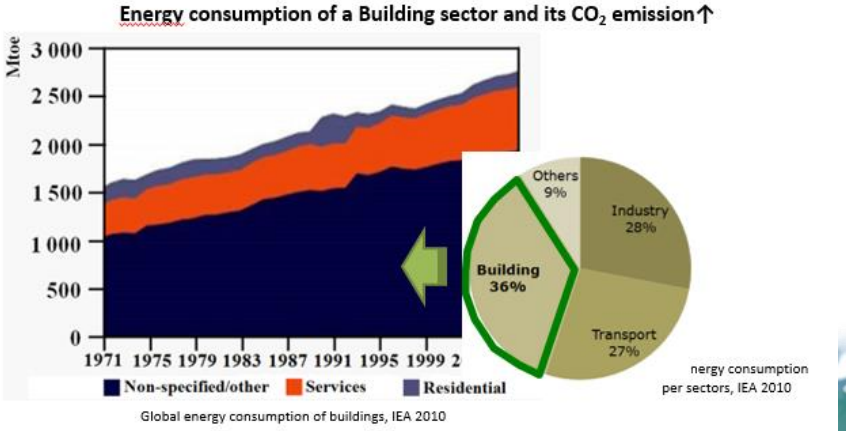

Axe Energétique, Mécanique, Construction Bois
Discipline
Tronc
0.1 – 1m
Planche
10 – 100 mm
Cerne de croissance
1 – 15 mm
trachéides
20 – 40 µm
Paroi cellulaire
1 – 5 µm
Microfibrille
2 – 10 nm
Molécule
< 1nm
GENIE CIVIL
Utilisations
MECANIQUE
Axe Matériau et Procédés
ENERGIE
Transformations
BIOLOGIE
GENIE DES PROCEDES
Traitements
CHIMIE
PHYSIQUE
Propriétés de base
Å
µm
mm
cm
dm
m
Liaison chimique
Parois
Longueur des trachéides
Cernes
Structures bois



From Protective to adaptative

*Nature exhibits many possibilities of adaptation that architects and specialists on buildings are considering*

# Wood promising material

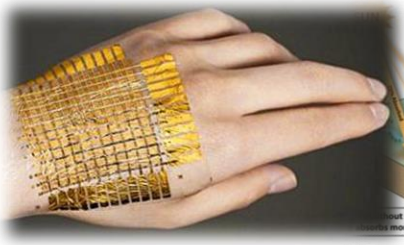
**Grâce au bois lamellé-collé, le Canadien Michael Green envisage de construire des immeubles de 30 étages**

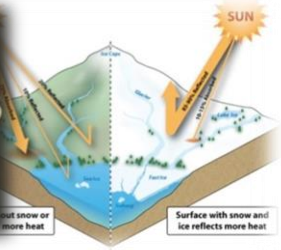
Architect Andrew Waugh Immeuble Londonien 9 nv

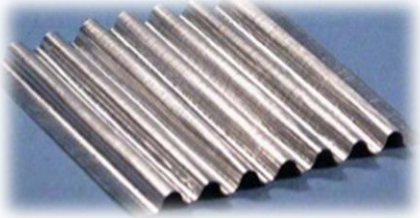
700 caissons de bois et paille constituent les parois de cet immeuble de 8 niveaux. Ils sont protégés d'un pare-pluie (rouge), puis d'un bardage de tuiles en terre cuite. Les 26 logements seront prêts en 2014.

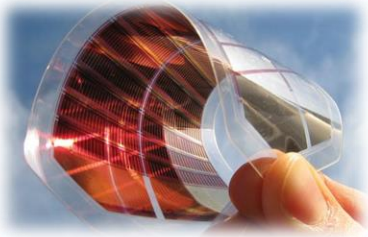
Fermer ✖

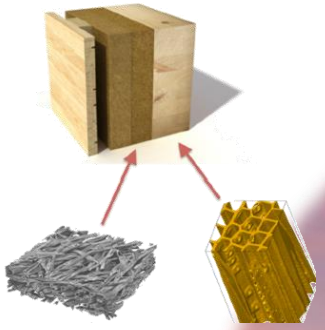
St Dié 8 nv Straw

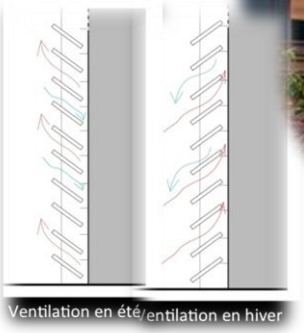


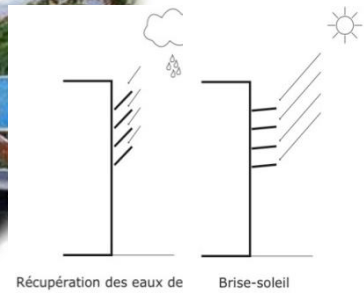

SUN
Surface with snow and ice reflects more heat



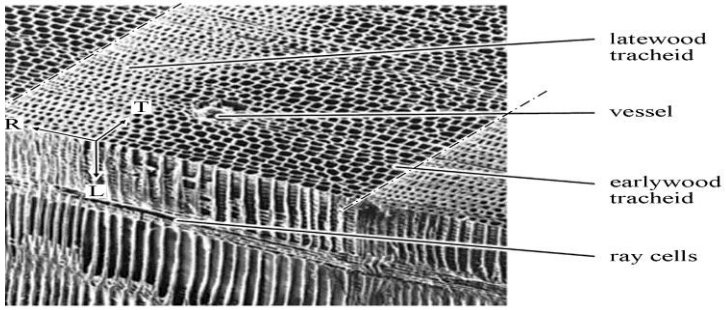


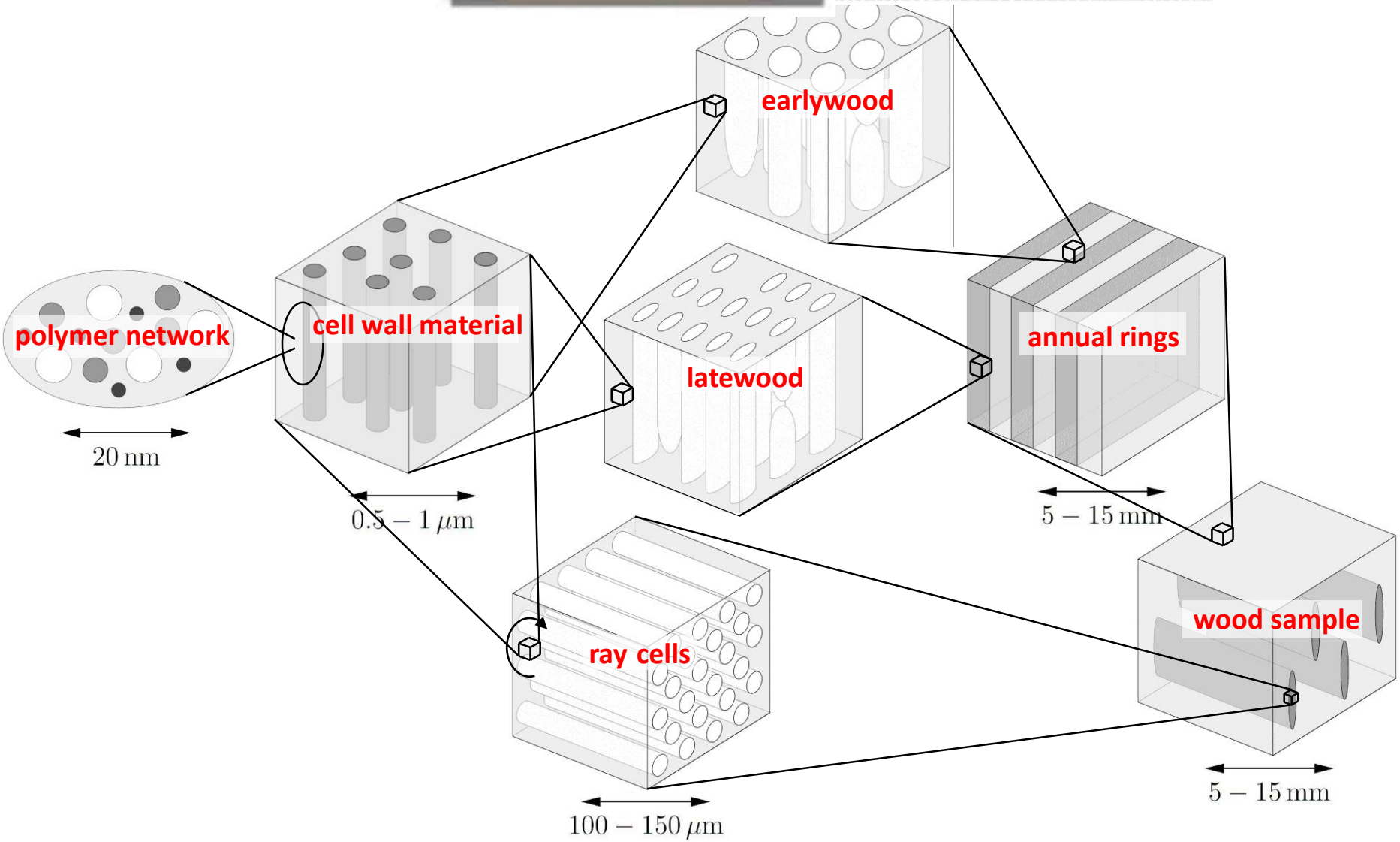



Ventilation en été
entilation en hiver


Récupération des eaux de
Brise-soleil

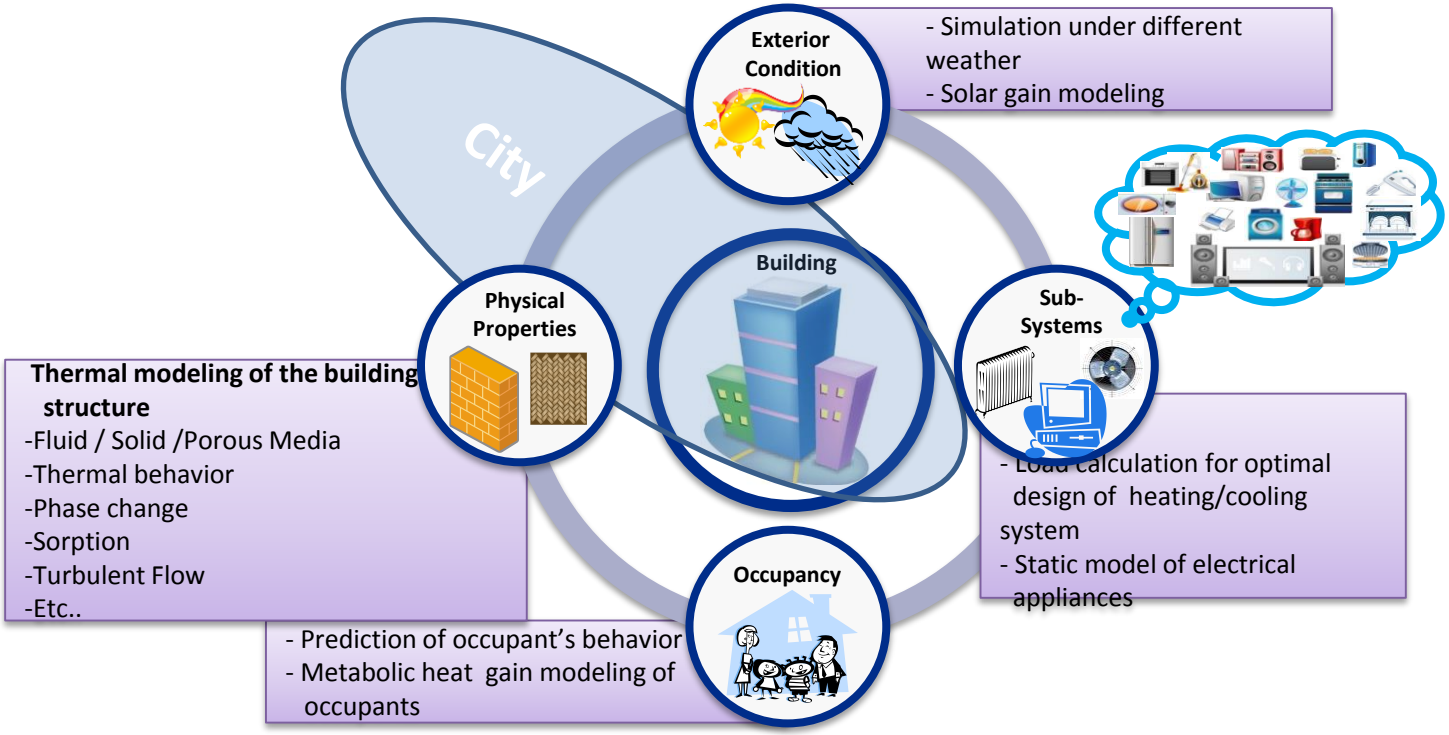
Heat & Mass Transfer / Wood



# Background

- Problematic Issues:
  - **Dynamic Interactions of a Building**



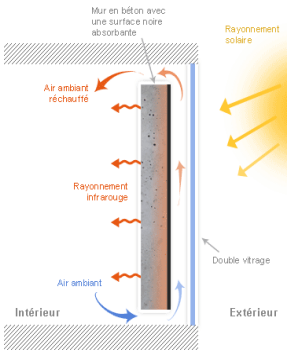

Dynamic interactions of a building

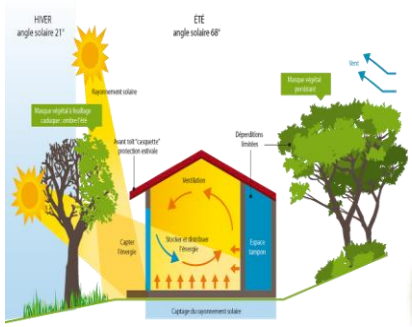
Energy and Buildings 62 (2013) 335–342

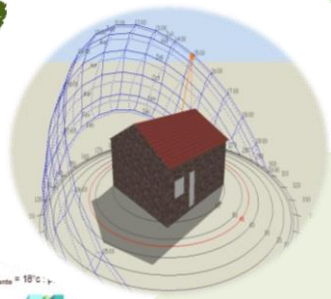
Collaboration with

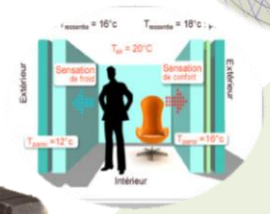
UNIVERSITÉ DE LORRAINE

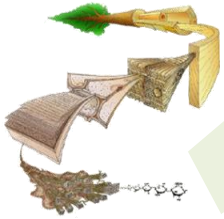
Passives Solutions

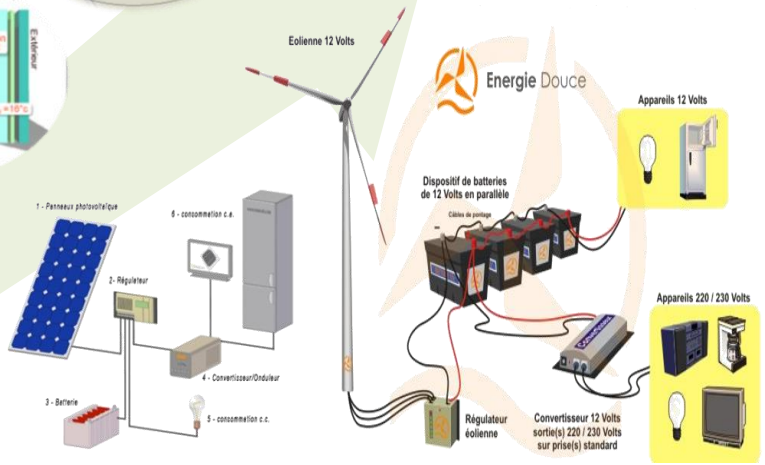











Active Solutions

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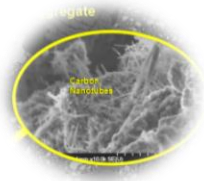
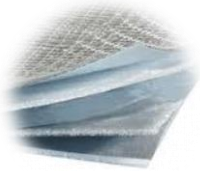
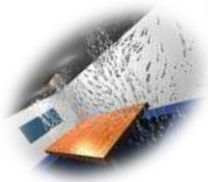
Energy

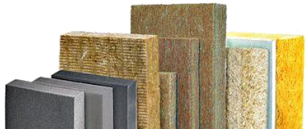
From wall to Eco-village







Materials



UNIVERSITÉ DE LORRAINE Laboratoires

Expertis Industrielle

Commune Nouvelle

iut Assemblée des Directeurs d'IUT

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Université de Liège ULg

UGR

CNRIUT'2019
Congrès National
de la Recherche des IUT
IUT Toulon

**PHC -MAGHREB 30257TE**

**Production d'énergie (froid et chaleur) et intégration dans un édifice résidentiel ou industriel**

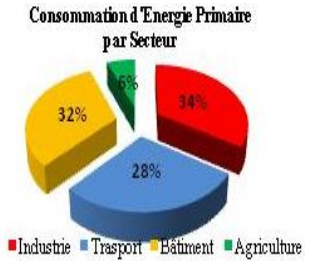
**Coordination Projet Pr. M. El Ganaoui (FR)**

**Par Pays :Prs. R. Bennacer (FR) – S. Gabsi (TN)H. Kahalerras (AL) – A. Mimet (MA)**

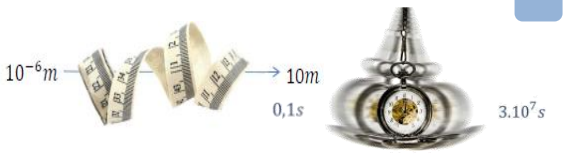
**Doctorants & stagiaires :** H. Boushaba, I. Fersadou, I. Fellak, N. Guilen, N. Himrane, Y. Kharbouch, L. Khatra, K. Lahmer, Y. Maoudj, F. Mnasri, L. Ouhsaine, A. Saad, A. Zerria

**Permanents :** K. Abahri, B. Chouachi, R. Djedjig, S. Messai, A. Scipioni,

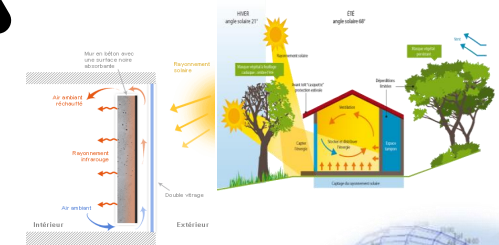

# Exemple de projet coopératif international

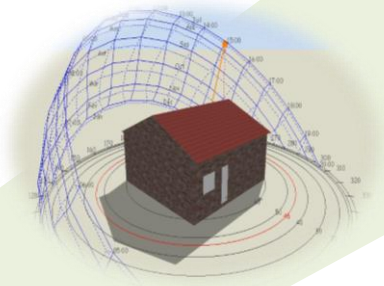


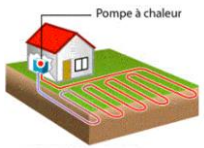

La maîtrise des coûts et l'optimisation des ressources (valorisation des forêts cultivées, emploi de faibles sections, recyclage des déchets...) amènent les prescripteurs et les professionnels du secteur à utiliser le bois sous forme transformée ou dérivée comme élément renouvelable pour la construction.

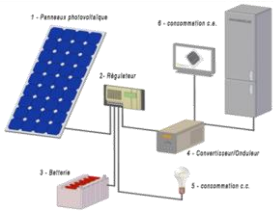



## Solutions passives

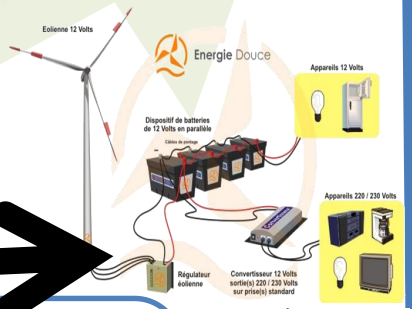




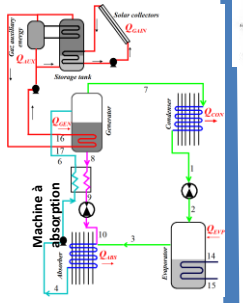



## Solutions actives




L'intégration des systèmes de chauffage ou de refroidissement dont les énergies renouvelables est la source est aussi une solution alternative à l'usage de la biomasse afin de baisser la facture énergétique d'un habitat.




**Caractérisation des matériaux par élaboration de bancs expérimentaux**

**Suivi expérimental de bâtiments à échelle réelle**

*Remerciements (Aide technique – secretariat – finances) : Mmes Reuter, Dinnocenzo, Mouritany, Mrs. Bordet, Dauphin, Moneret, Schneider.*

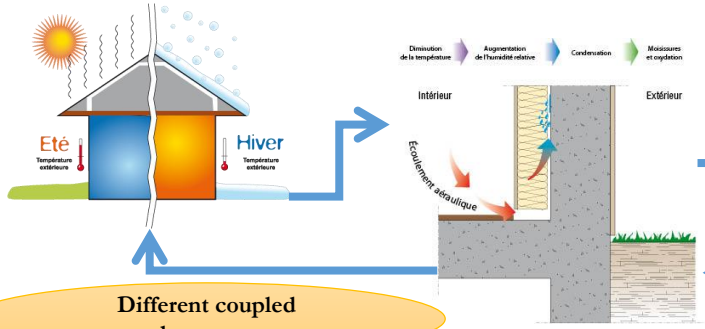

**Partenaires méthodologiques**

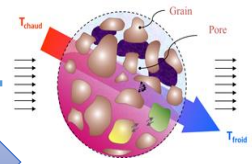
**Laboratoires/industriels**

# Performance Of Biobased Materials In The Realization Of Sustainable Structures

Dr. MNASRI Faiza
Process and Product/
Energy Engineering

- Analysis of coupled heat and mass transfers in building materials.
- Improving the energy performance of a building






Different coupled phenomena

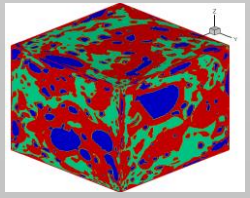
(m) ← Different scales linked → (µm)

✓ *The thermos-hydro behavior of the material was evaluated experimentally at material scale.*
✓ *The properties were used for numerical modeling at building scale.*

## Microstructural Characterization

➔ **Measuring equivalent properties:**

✓ *Characterization at the microscopic scale .*
✓ *Modeling of thermohydric properties using numerical computation (3D reconstruction).*



*Orient the design of a new structure with controlled parameters.*

**LI Mengya**
**Doctorant en Science de bois**

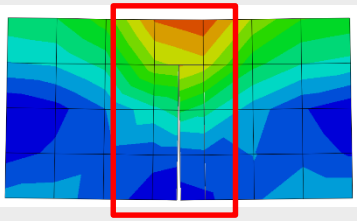

# Caractérisation expérimentale et modélisation des panneaux composites bois-ciment

**Copeaux de bois**
**Ciment**

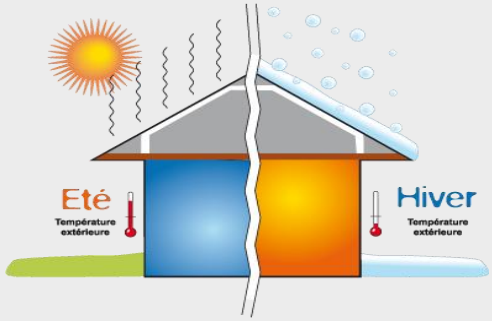
**Composite bois-ciment**

**Coffrage permanent**

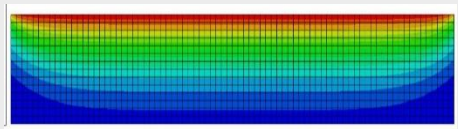
**Comportement mécanique**



**Comportement hygrothermique**

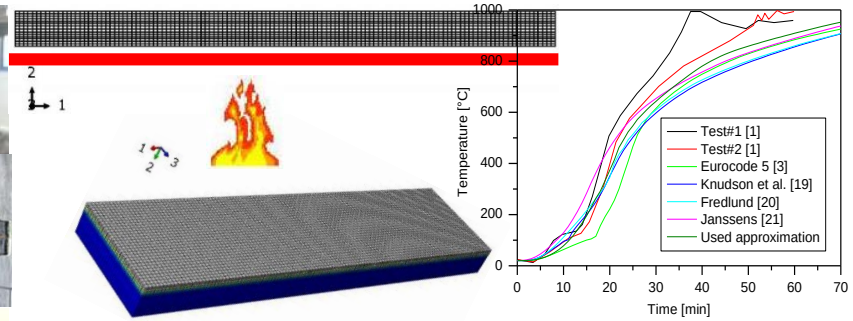


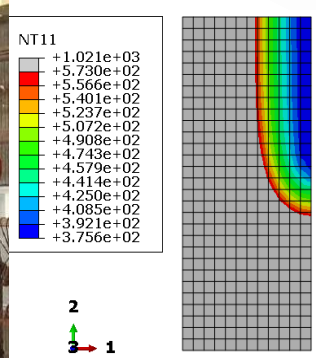

**Comportement au feu**

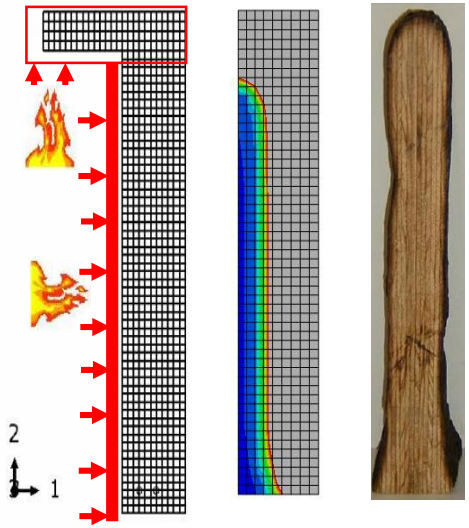


Dr. Thi Van Diem

Pdoc



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arbre

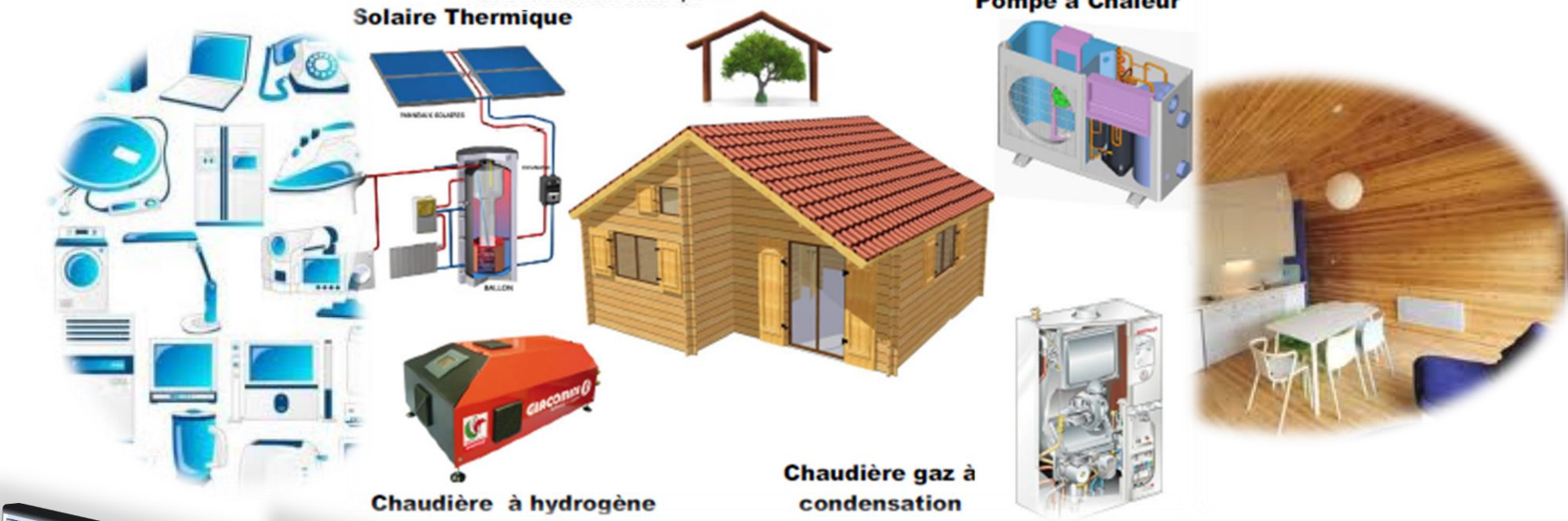
UGR UNIVERSITÉ DE LA GRANDE RÉGION UNIVERSITÄT DER GROßREGION

*Projet ECO-Chalets de Longwy*
*Vers l'échelle 1*
*Coordinateur : Pr. M. El Ganaoui*

UNIVERSITÉ DE LORRAINE | IUT Henri Poincaré LONGWY | lycée général technologique professionnel Alfred Mézières | académie Nancy-Metz | lermab | CRAN | G.R.E.E.N. | Laboratoire Lorrain de Sciences

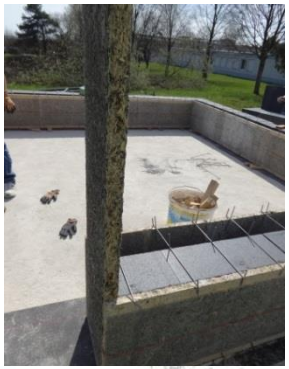
*Intérieur*
*Mix energétique*
*Paroi intelligente*
*Occupants*

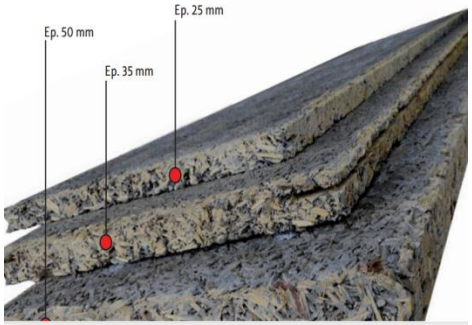
IsolHabitat sprl ecochalet

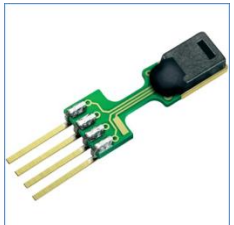



Efficacité Energétique | Automatismes | Mix Energétique | Eco-Matériaux | Couche GTC intelligente | Socio-Economie

ENS CACHAN | UGR Université de Grande Région Universität der Großregion | Université de Liège | UNIVERSITÉ DU LUXEMBOURG | Queen's University | TJFU | INFO→ ÉNERGIE en LORRAINE | PHC Maghreb | UNIVERSITÉ DE SHERBROOKE




Ep. 50 mm
Ep. 35 mm
Ep. 25 mm



# Understanding phenomena by modeling and simulation

Codes industriels
Strutures, CFD, CHT

LBM (Gaz sur Réseau)

Tests de Validation

Num. Classique (FV, EF, ..)

Analytique

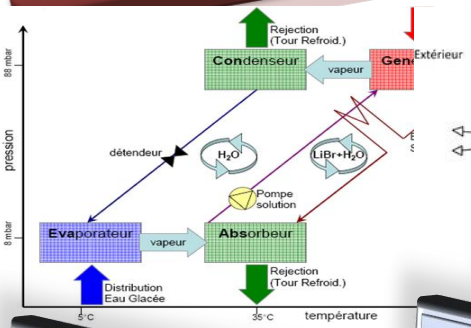
Knowledge Mutualisation

HMT

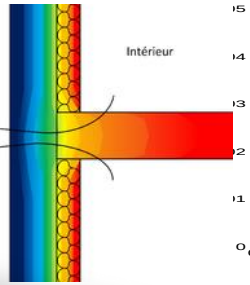
Mechanics

Products

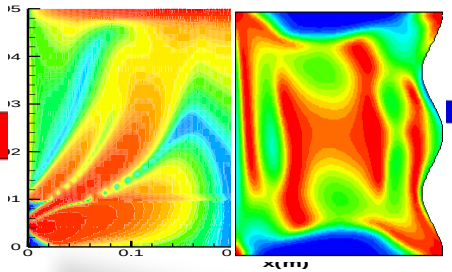
Algorithms & Coupling



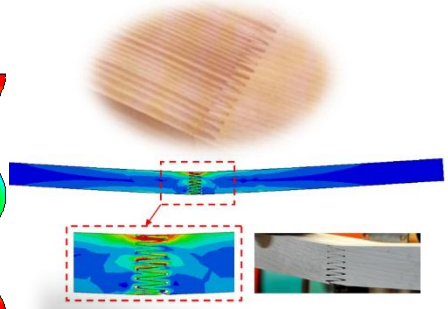

Themodynamique
Prod. Froid



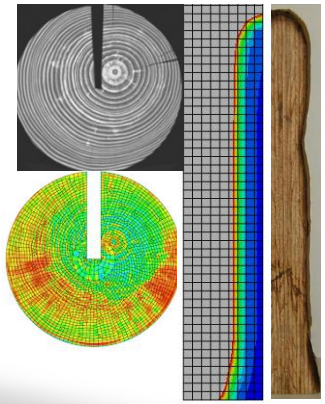

Transfert dans les parois




Convection, M. Flu.
Qualité des ambiances

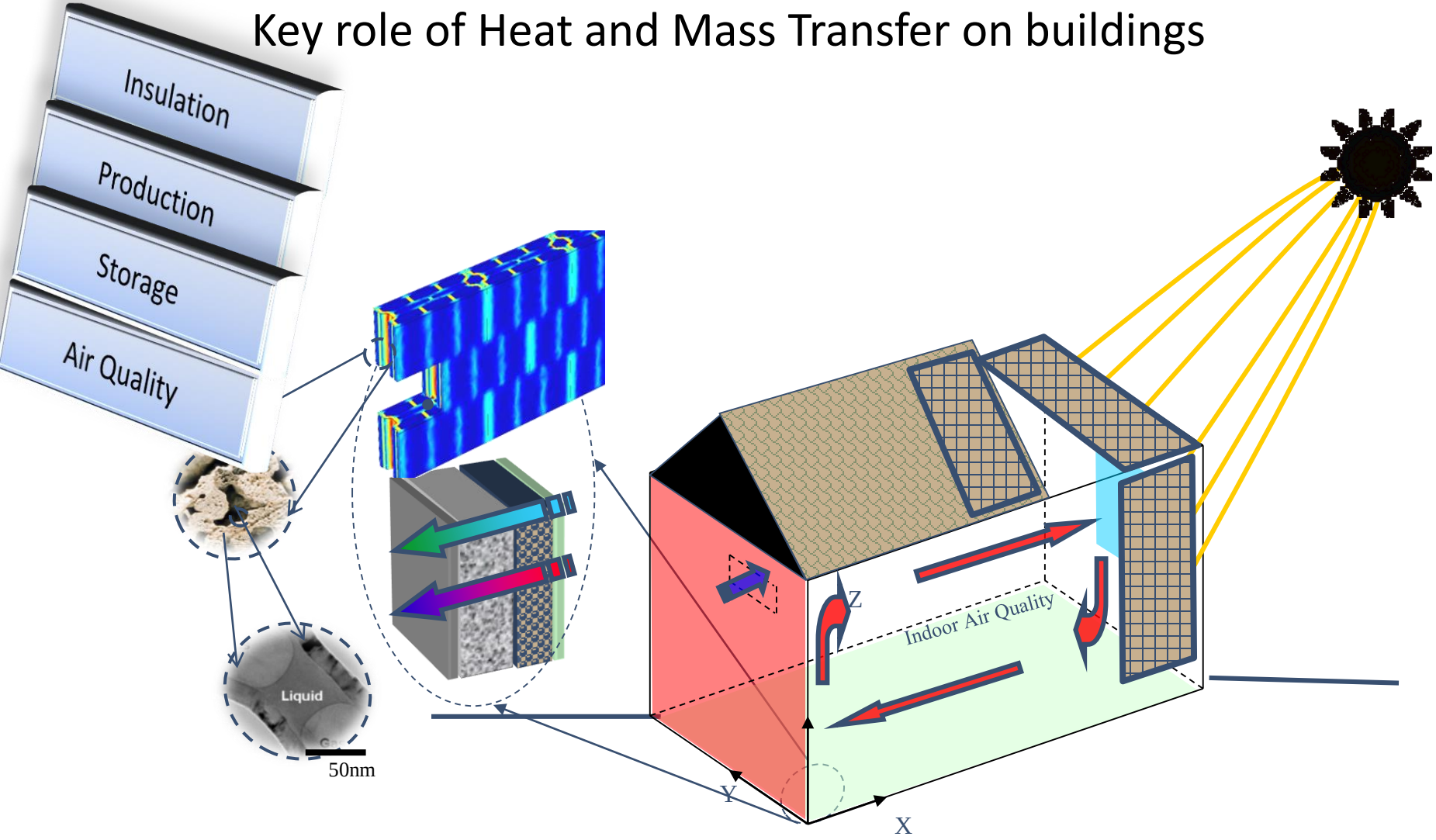


Thermo-Mécanique

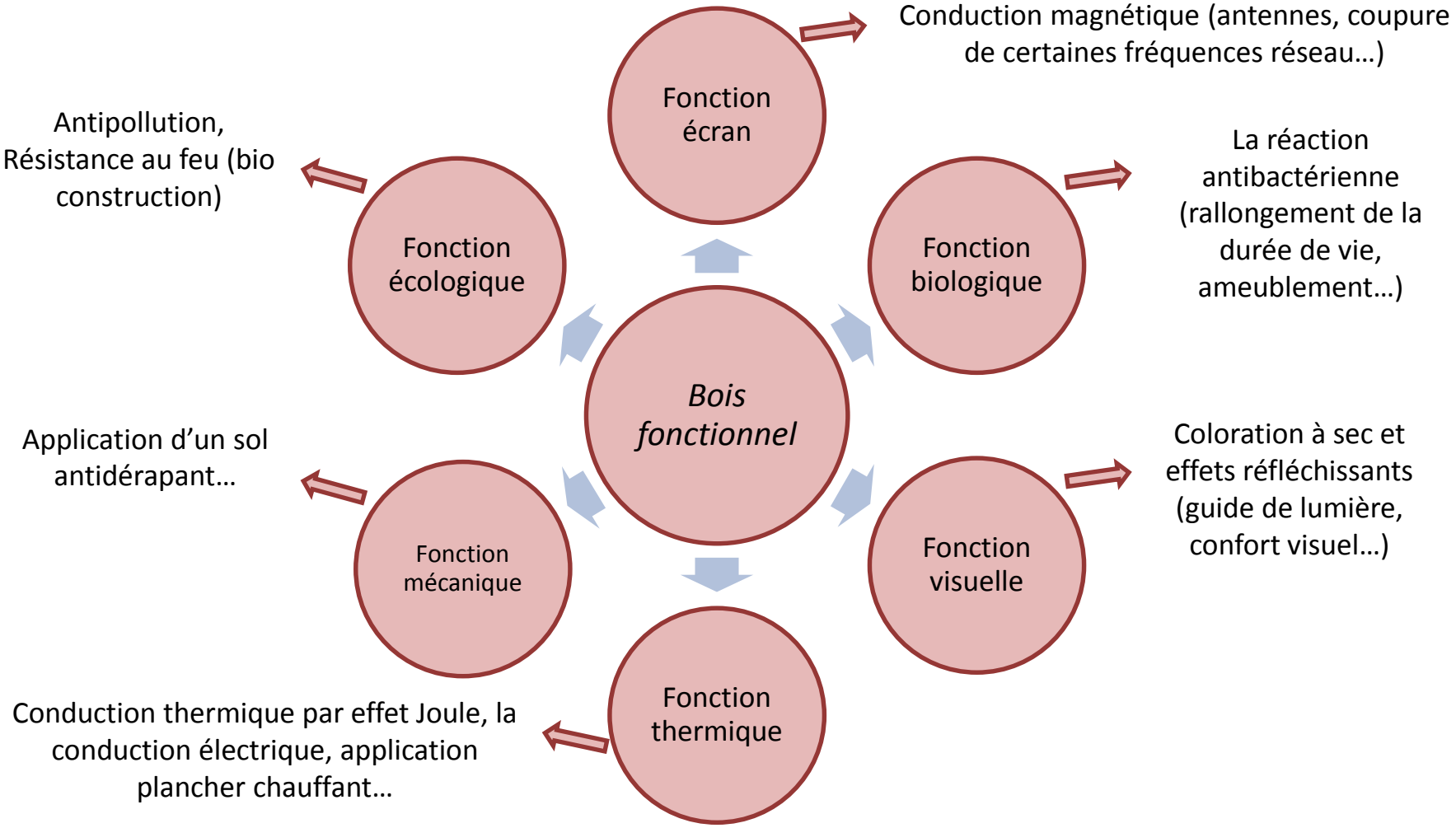


Propagation de fronts

# Key role of Heat and Mass Transfer on buildings

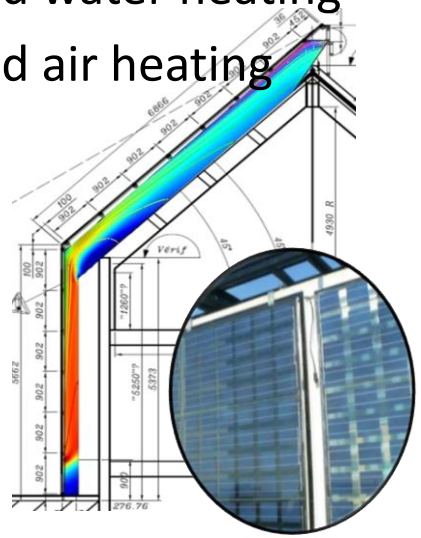



Collaboration with

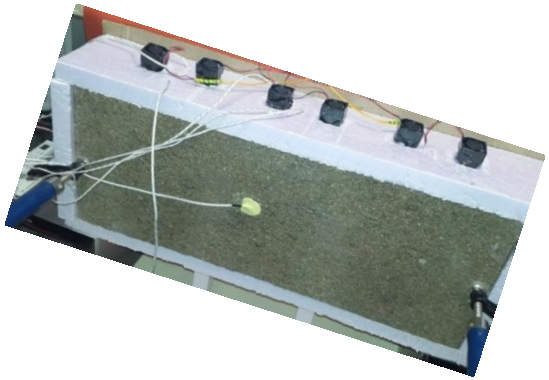

Bois fonctionnel
Fonction écran
Conduction magnétique (antennes, coupure de certaines fréquences réseau…)
Fonction biologique
La réaction antibactérienne (rallongement de la durée de vie, ameublement…)
Fonction visuelle
Coloration à sec et effets réfléchissants (guide de lumière, confort visuel…)
Fonction thermique
Conduction thermique par effet Joule, la conduction électrique, application plancher chauffant…
Fonction mécanique
Application d'un sol antidérapant…
Fonction écologique
Antipollution, Résistance au feu (bio construction)

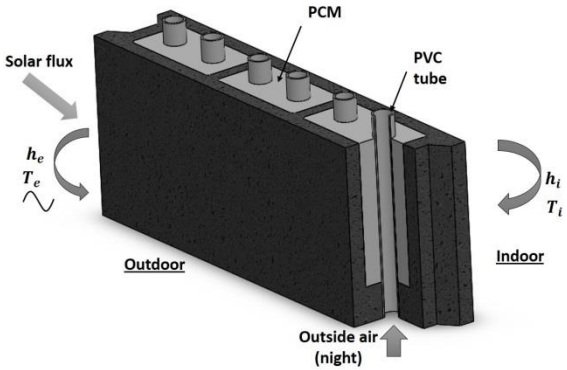
# Integrating production and Storage

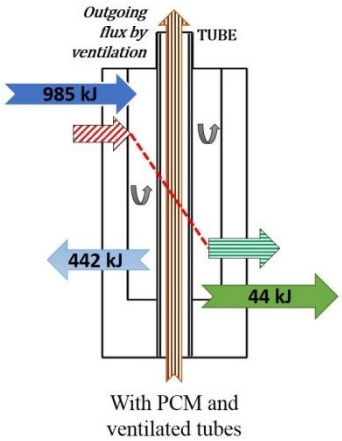
- Electricity production and water heating
- Electricity production and air heating



## Reactive wall by storing energy (PCM)






Collaboration with

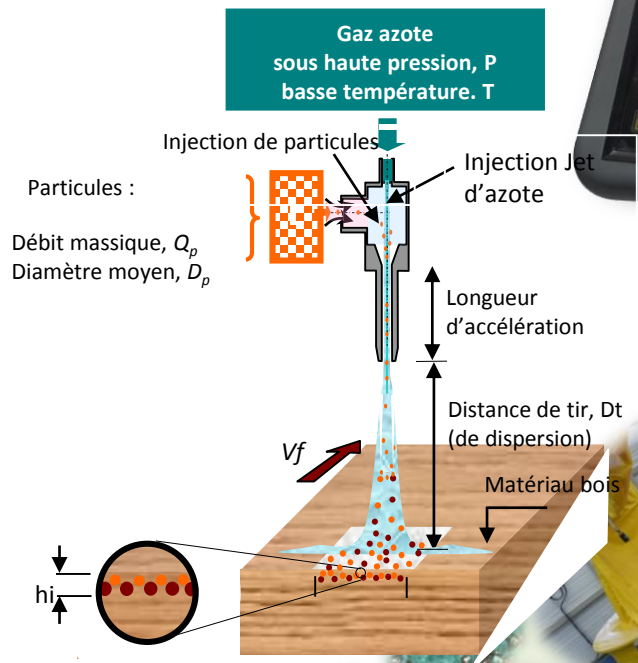
# Fonctionnalisation du bois par incrustation de particules

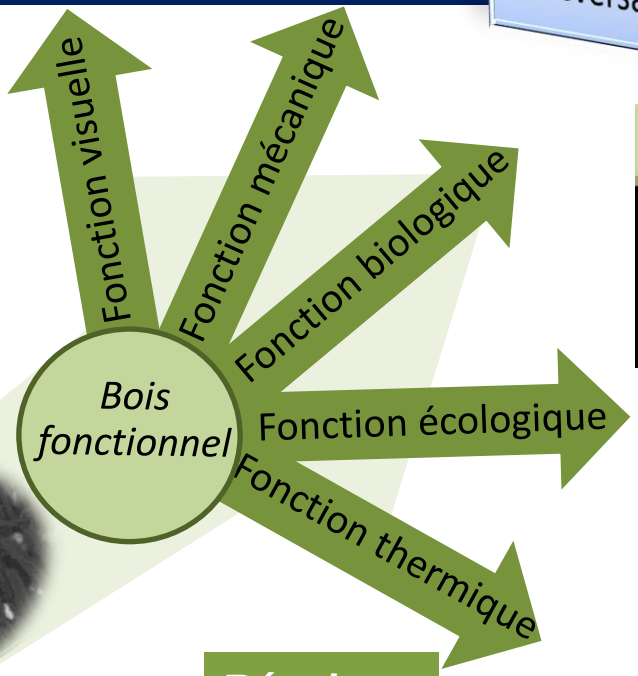
Transversal Axes 1 - 3

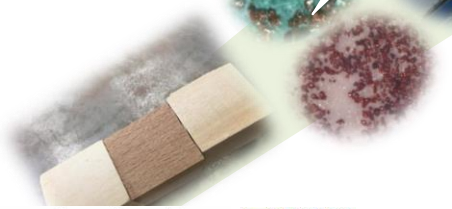
Ch. Gérardin/M. El Ganaoui

**Doctorat Mlle A. Zerriaa, en cours**

## Méthode et procédé







## Résultats

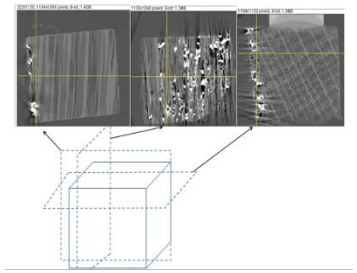
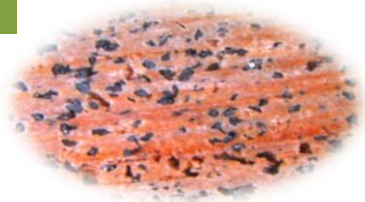
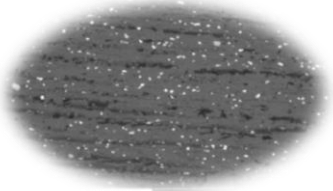


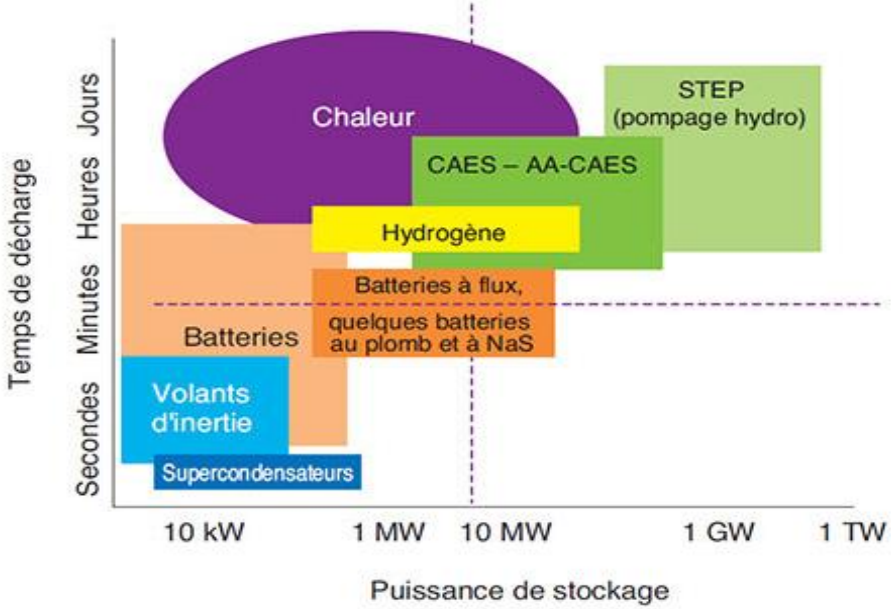
Image par Tomographie

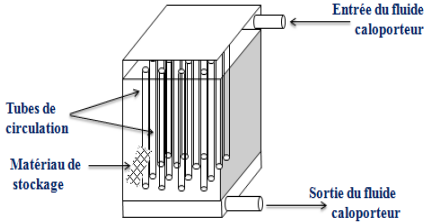


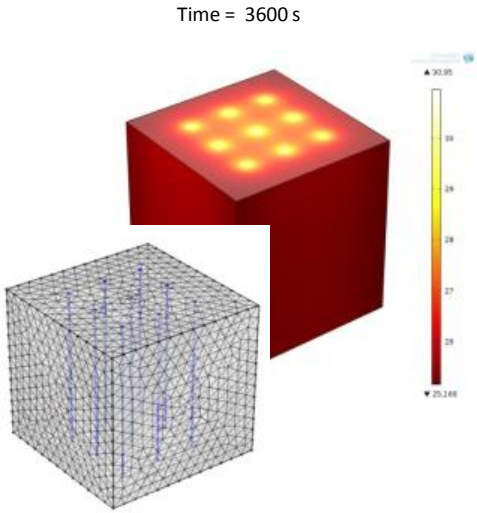
Sapin + Grenaille



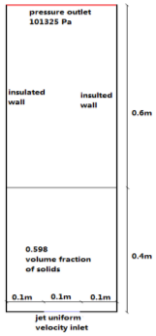
Peuplier + Cuivre

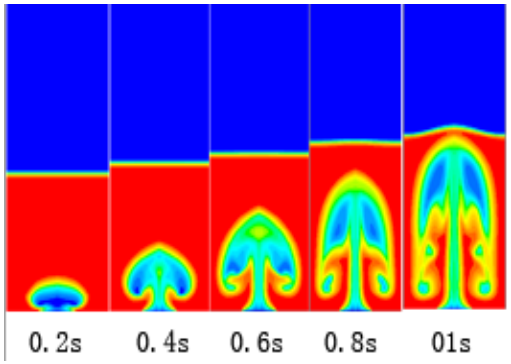


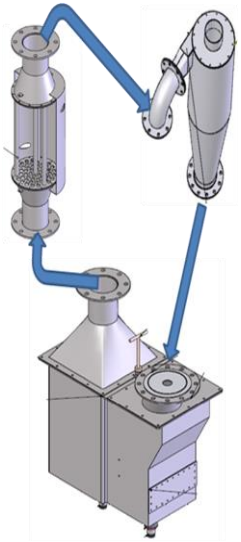



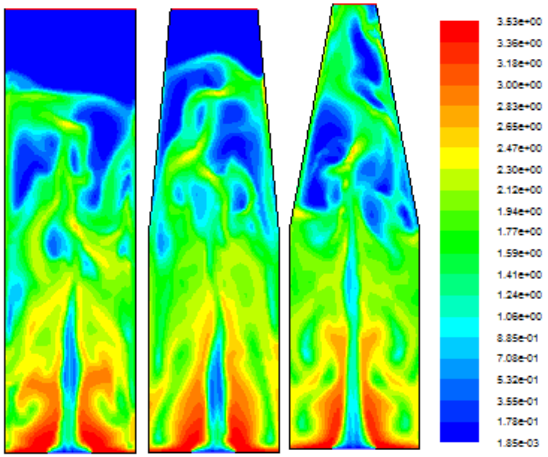



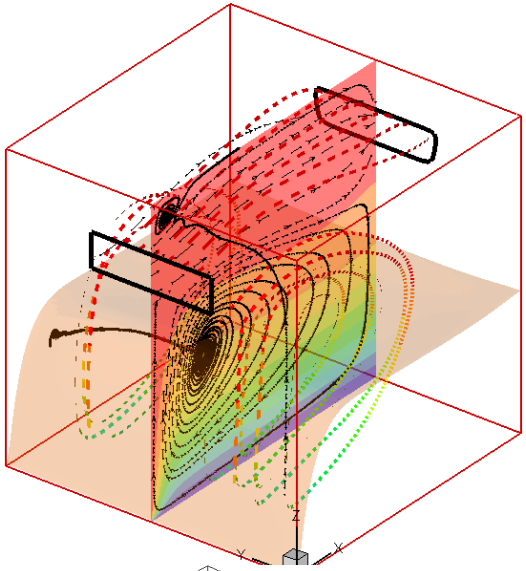

# Heat Storage

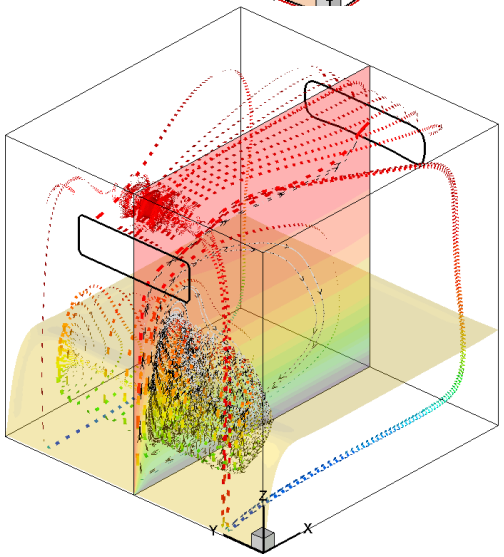


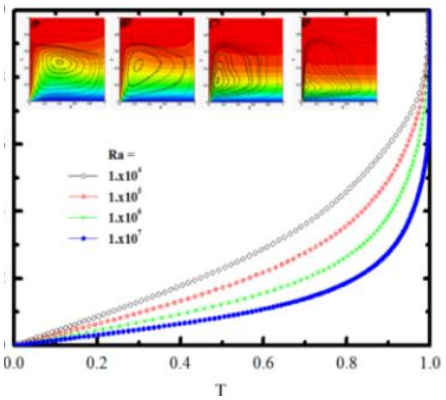



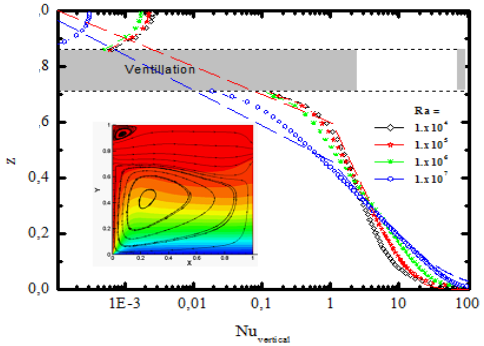


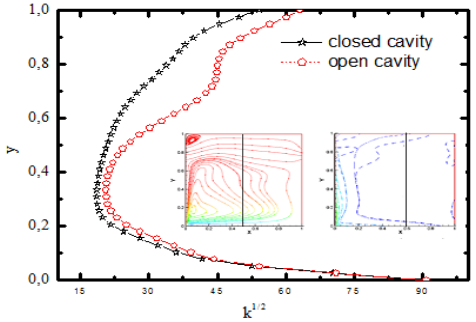









[Morsli et *al* « **Small to large scall mixed turbulent convection: buildings application** » article soumis à International journal of numerical methods for heat and fluid flow, 2017 ]



Collaboration with LCOMS

# Plate forme partagée Pédagogie Recherche appuyée du projet Master@Longwy

Marouane ALMA[1], Rachid BELKACEM[2], Olivier DI PILLO[3], Rabah DJEDJIG[4], Damien GUILBERT[5], Mourad RAHIM[4], Angel SCIPIONI[5], Harouna SOULEY ALI[1], Mohammed EL GANAOUI[4]

[1]Université de Lorraine, IUT de Longwy, Laboratoire CRAN/GEII
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[4] Université de Lorraine, IUT de Longwy, Laboratoire LERMAB/GTE
[5]Université de Lorraine, IUT de Longwy, Laboratoire GREEN/GEII

Mohammed.el-ganaoui@univ-lorraine.fr

# Merci

UNIVERSITÉ DE LORRAINE | IUT Henri Poincaré LONGWY | école normale supérieure paris–saclay | université PARIS-SACLAY | MATERIALS & ENERGY