# Overview of R&D performed at FCBA in timber construction: examples, thematic areas, partnerships.


**Frédéric Staat**

**FCBA**

**Timber Industries Construction Director**


**12th Japan-France Building and Housing Conference – Tokyo May 9, 2019**

- Part 1: FCBA Presentation
- Part 2: French Timber Construction Sector: today and tomorrow
- Part 3: Research and collective studies by FCBA
- Part 4: Partnerships
- Part5: Future is today

# I.
# FCBA Presentation

FCBA

# Reinforcing the industrial competitiveness of the

# Forestry, pulp & paper, Timber-construction, Furniture sectors

# facing globalization and inter-materials competition

# FCBA Professional sectors

Advanced Forestry
Biotechnologies

**Forestry**

**1st transformation**

**2nd transformation**

Harvesting

Pulp & paper
Sawmilling
Panel industry
Packaging

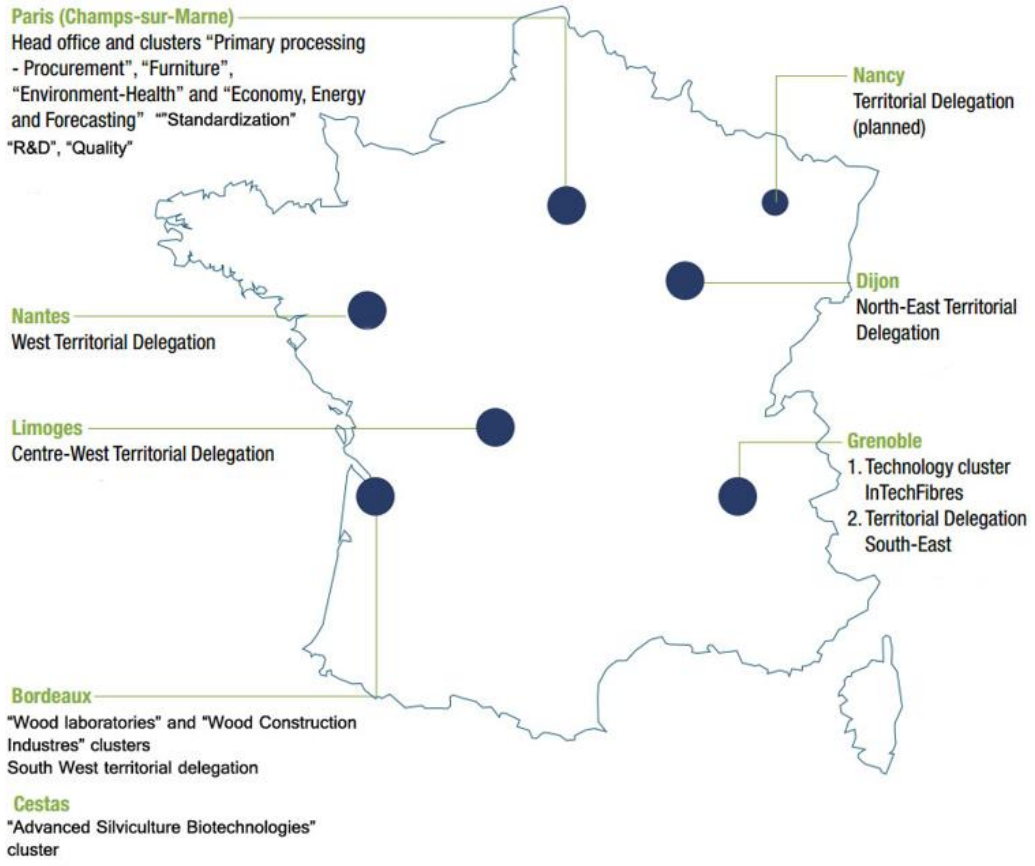
Furniture

Construction

Bioenergy

# FCBA Locations

334 people working for the industries of the forestry, pulp & paper, construction and furniture sectors

# FCBA Activities

## Acquire, develop, manage, disseminate the scientific and technical information

| | | |
|---|---|---|
| R&D | Economical, reglementary and technological watch | Documentations - publications |

## Put our knowledge and our skills at the disposal of companies

| | | | | | |
|---|---|---|---|---|---|
| Technological transfer | Consultancy | Technical Assistance | Tests | Training | Information |

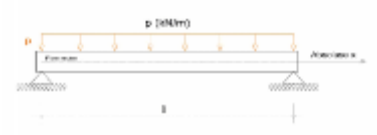
## Support professionals on their markets

| | | | |
|---|---|---|---|
| Normalisation | Quality | Certification | Advanced technologies Innovation |

# II.
# Timber Construction Sector in France: today and tomorrow

# Why should we build with wood?

- 1 m3 of wood stores 1 tonne of CO2 → a timber house stores 20 tonnes of CO2 (equiv. to 150 000 km of a car)



- A beam with a span of 3m designed to carry a load of 200 kN will weight 60 kg in wood, 80 kg in steel, 300 kg in concrete

- Energy consumption for producing timber construction components is 4 times less than for concrete, 60 times less than for steel, and 130 times less than for aluminium

- Building a timber frame house will last 2 times less than for concrete

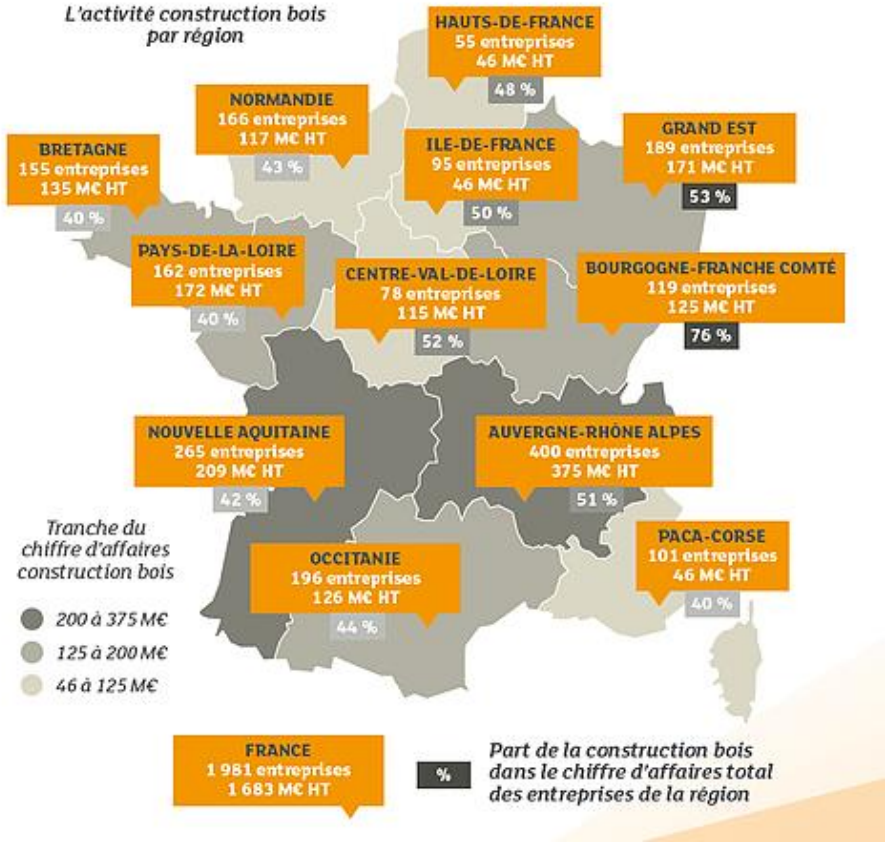
- It will require 5 times less trucks to bring the materials to the building site

- Heating a timber frame construction will save 30% of energy consumption

# Key economic figures

- **Wood in construction: 27,5 billions €**
  - 6,3 billions € in products manufacturing
  - 15,1 billions € in site operations
  - 6,1 billions € in trading

- **Wood based construction**
  - 1,7 billions €
  - 1981 companies
  - 27 420 employees




FBF/Codifab/2017

# Market share of wooden constructions

## LODGINGS

- 9 % of individual housing (=)
- 4 % of collective housing (↗)

## BUSINESS BUILDINGS

- 11 % of working buildings (↗)
- 17 % of industrial buildings (↗)
- 26 % of agriculture buildings (=)

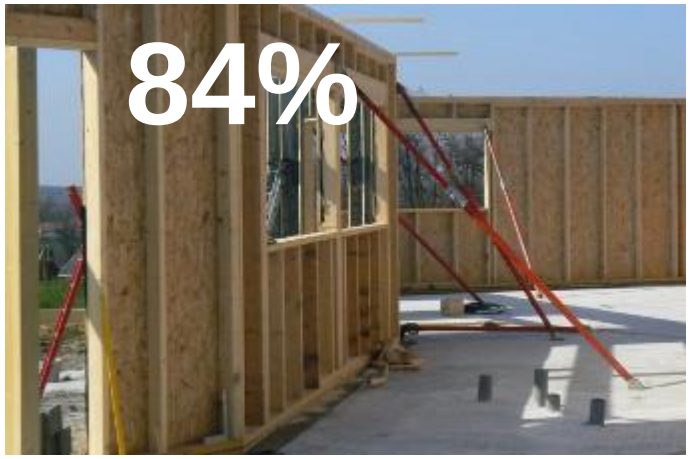
# Construction systems: market shares


Log House


Beams & Columns


Traditional half-timbered house


CLT

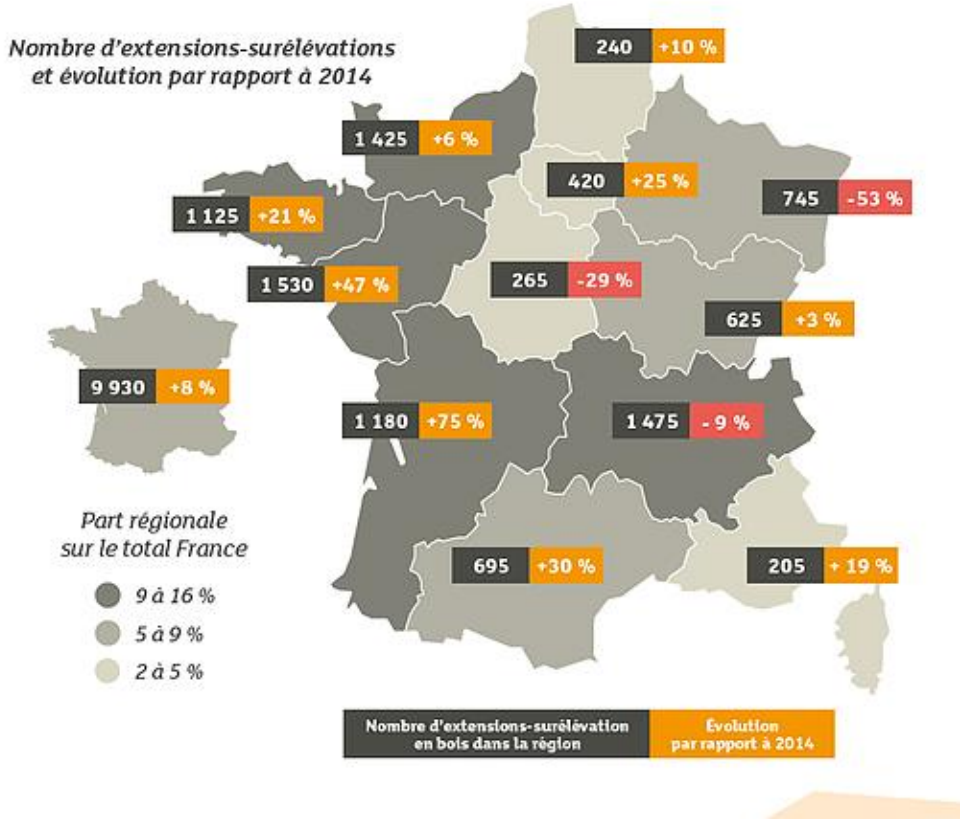



Timber frame

# From Yesterday to tomorrow: building with wood in France…

# An emerging market: houses extensions

- **28% of houses extensions are made with wood**




FBF/Codifab/2017

Cmp Bois/2017

# A challenge for the future: High Rise Construction (in France)

OK

- Hyperion Tower
- 18 stories, 12 519 m²
- Building system: Central core concrete, CLT floors, timber frame walls, composite steel timber posts
- Bordeaux
- Architects: Jean-Paul Viguier et associés – Laisné Roussel
- Owner: EIFFAGE IMMOBILIER SUD OUEST
- Contact: Marc SIMON

# A challenge for the future: High Rise Construction (in France)

OK


- Silva Tower
- 17 stories, 9 010 m²
- Posts & beams + CLT
- Bordeaux
- Owner: Kaufman & Broad
- Architects: Art and Built / Studios Bellecour
- DCHARVET@ketb.com

# A challenge for the future: High Rise Construction (in France)

OK

Cité du Vin – BORDEAUX (33)

Maître d'Ouvrage :
**Ville de Bordeaux**

Maitre d'Œuvre :
**X-TU Architecture**

Structure Bois :
**Arbonis**

Mandataire :
**GTM Bâtiment Aquitaine**

**12 000 m²** de surface développée.
Tour haute de **50 m.**

PRIX NATIONAL CONSTRUCTION BOIS

PRIX RÉGIONAL CONSTRUCTION BOIS Nouvelle-Aquitaine

Contact : Marc VANDEVELDE
mvandevelde@arbonis.com

www.arbonis.com

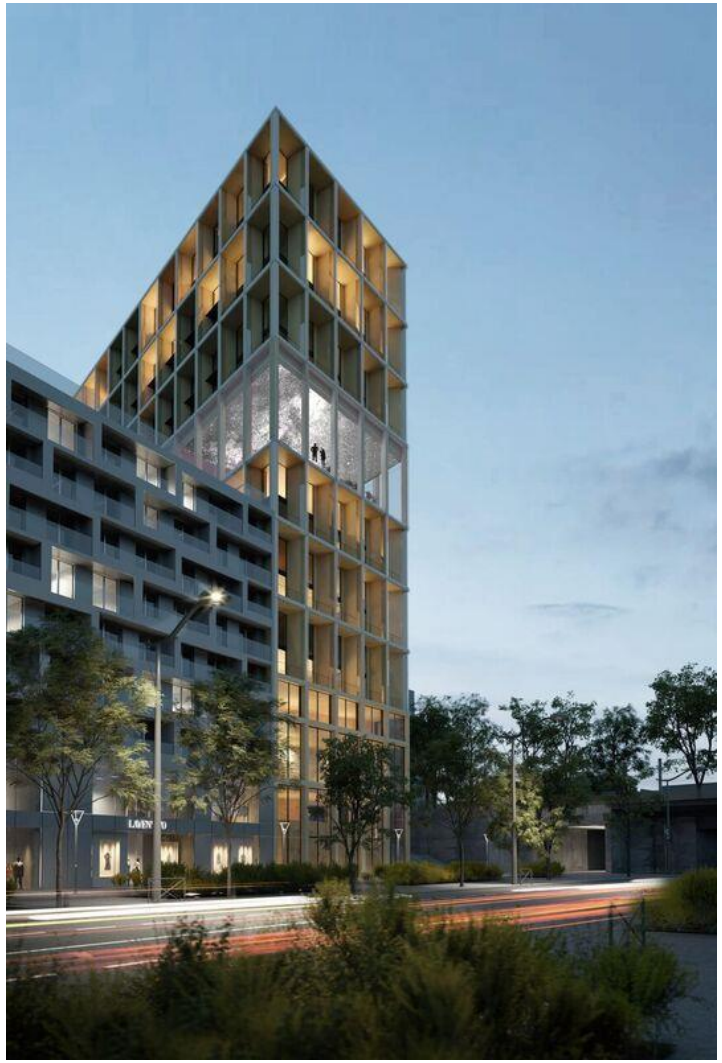
# A challenge for the future: High Rise Construction (in France)

OK

- Biosource
- 12 stories, 9 533 m²
- Building system: CLT
- Strasbourg
- Owner: Bouygues Immobilier
- Architects: KOZ Architects
- julie.bauvais@koz.mygbiz.com

# A challenge for the future: High Rise Construction (in France)

OK

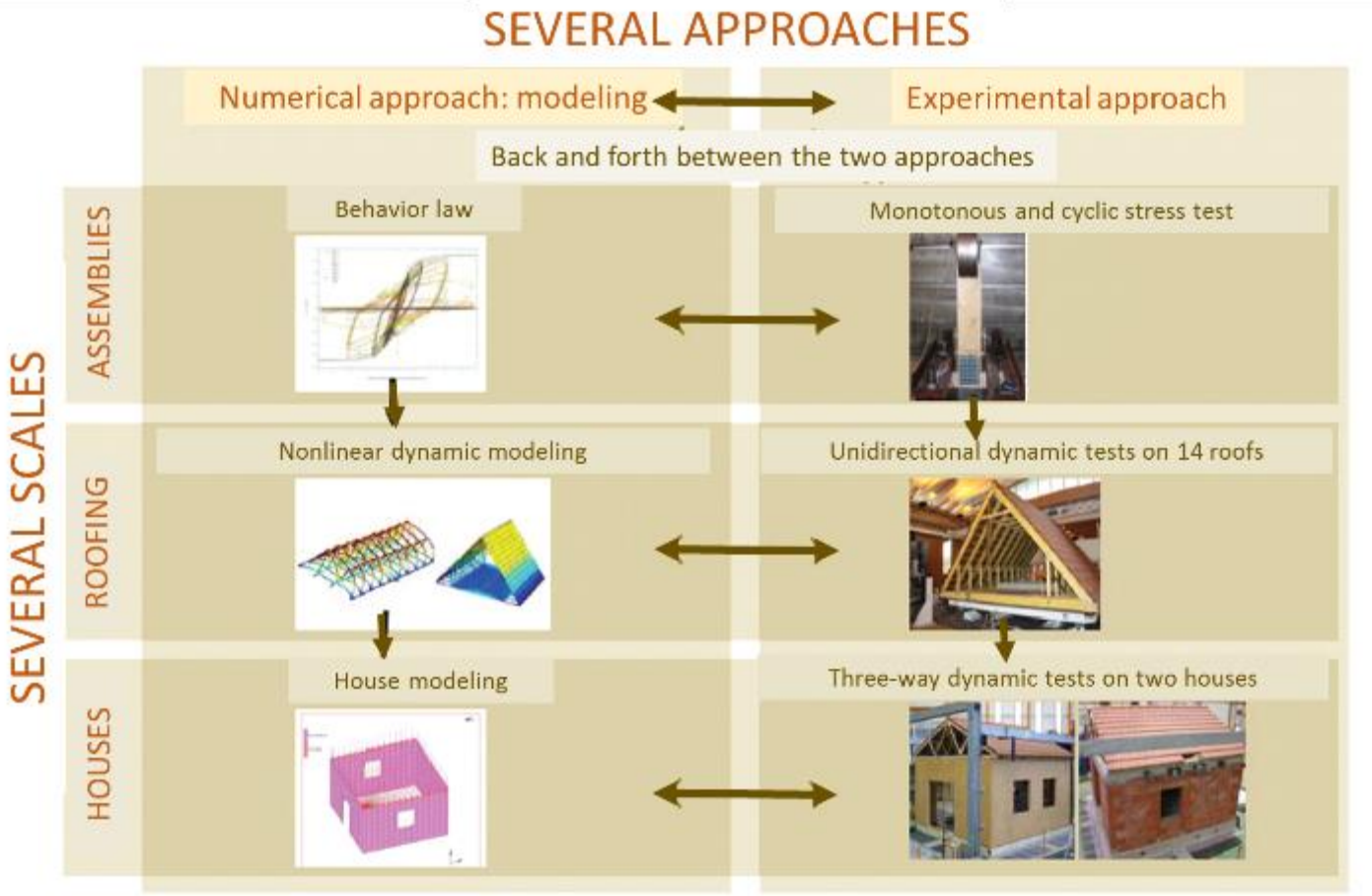


- Wood Up
- 18 stories
- Surface: 7600 m²
- Building system: Posts & Beams + CLT
- Paris 13
- Owner: REI Habitat & Compagnie de Phalsbourg
- Architects: LAN Architectes
- svial@reihabitat.com

# III.
# RESEARCH AND COLLECTIVE STUDIES

# Research issues: Structural Safety

- **Seismic design**



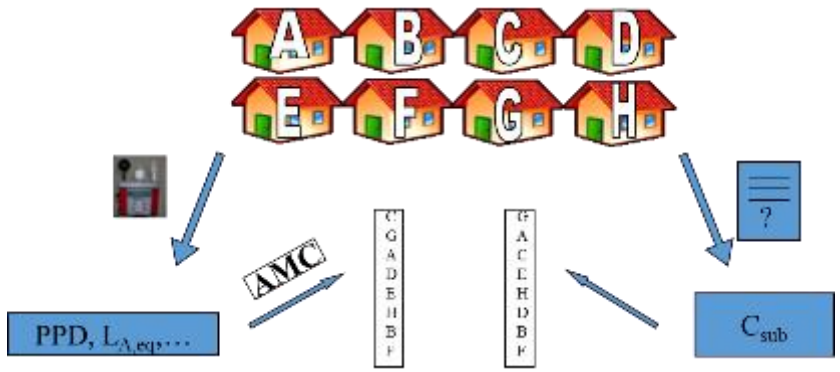

FCBA/2017

# Research issues: Fire behaviour

- **Fire behaviour**
  - **Reaction to fire**
  - **Resistance to fire**
  - **Fire propagation**
    - Testing
    - Modelling

# Research issues: Comfort and health

- Vibrational behaviour at low frequencies
- Indoor Air Quality = barrier effects, modelling.
- Summer comfort of Wooden-Buildings
- Multi-criteria comfort (acoustics, temperature & humidity, lightening)



# Research issues: Durability

- **Durability**
  - **Against fungi & insects**
  - **With various climate (UV & Humidity)**
- **Wood modification and treatment : heat treatment, silicone and silicate treatments**
- **Performance improvements by physical and mechanical behaviour understanding of coating films tensile tests)**
- **Artificial weathering**

# Research issues: Environment

- Sustainable forestry & wood procurement
- Green gluing, green coatings, green preservatives
- LCA of building components and systems
- Circular economy for wood products
- Energy consumption

  (passive & positive energy houses)
- Building sites optimization






# IV.
# Partnerships

## French Partnerships

- DHUP (Direction de l'habitat, de l'urbanisme et des paysages)

Direction de l'habitat, de l'urbanisme et des paysages (DHUP)
Sous-direction de la qualité et du développement durable dans la construction (QC)

MINISTÈRE
DE LA TRANSITION
ÉCOLOGIQUE ET SOLIDAIRE
www.ecologique-solidaire.gouv.fr

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MINISTÈRE
DE LA COHÉSION DES TERRITOIRES
ET DES RELATIONS AVEC
LES COLLECTIVITÉS TERRITORIALES
www.cohesion-territoires.gouv.fr

- CSTB (Scientific and Technical Center for Building)

CSTB
le futur en construction

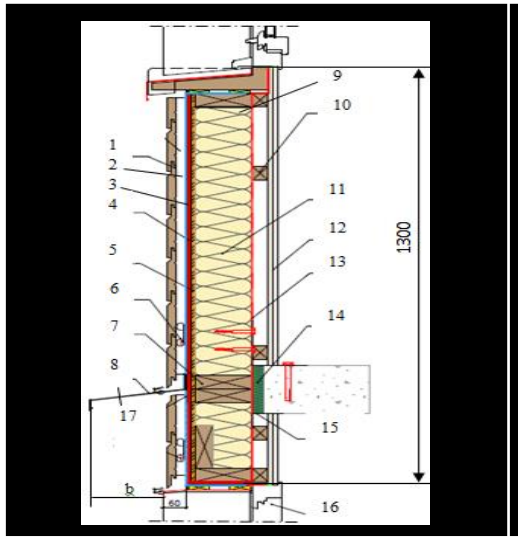
# French professional and public authorized wood plan

- **Three wood plans in a row:**
  - **2009/2014 Wood Plan I**
  - **2014/2017 Wood Plan II**
  - **2017/2020 Wood Plan III**

**With actions continuity to promote timber construction with the following objectives :**

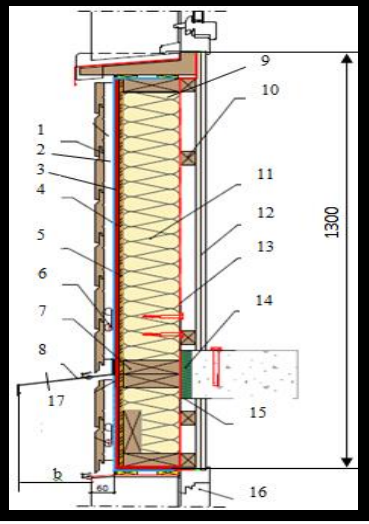
- ✓ Characterize wood technical performances for construction (fire reaction and resistance, acoustics, thermic and hygrothermic, …)
- ✓ Propose to contracting bodies and architects and engineering new numeric tools
- ✓ Enhance environmental advantages of wooden buildings

# National Research Project 2012-2018
## LEPIR2 Full Scale Fire Tests



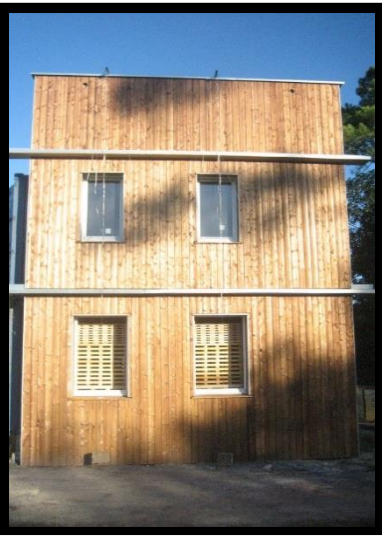

| Test reference | N°1 – 11/06/2012 | N°2 – 04/04/2014 | N°3 – 11/06/2014 |
|---|---|---|---|
| Ventilated cladding [1] | Horizontal – Douglas – min 14mm/max 21mm | Horizontal – Spruce – min 18mm/max 25mm | Horizontal – Douglas – min 18mm/max 26mm |
| Cladding support [5] | OSB 3 - D-s2, d0 – 9mm | Fermacell (Left) – Plywood B-s2, d0 (Right) | Gypsum board 12,5mm + Particleboard P5 12mm |
| Cavity barrier [6] & [17] | 30mm overhang in Aluminum | 100mm overhang in Steel + Fire stop (Left) or intumescent paint for steel overhang (Right) | 200mm overhang in Steel + Fire stop (Left) |
| Insulating material [11] | Stone Wool (Left) – Glass Wool (Right) | Stone Wool | Glass Wool |
| Window Sill | Aluminum 15/10 | Aluminum 15/10 +Fermacell | Aluminum 15/10 + Gypsumboard |

# National Research Project 2012-2018
## LEPIR2 Full Scale Fire Tests

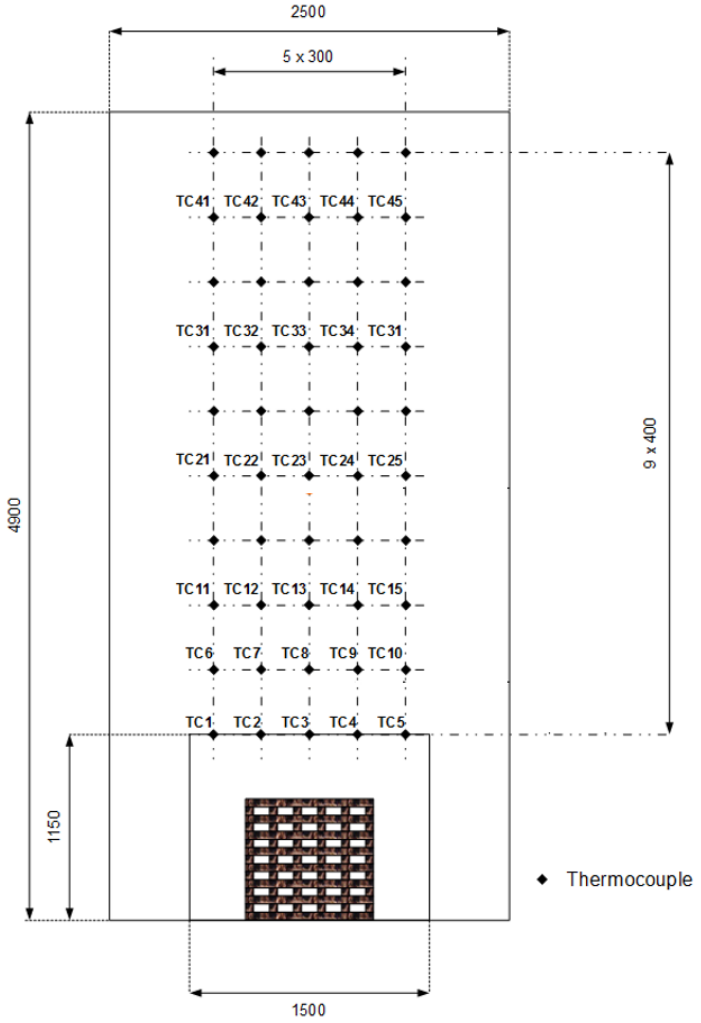


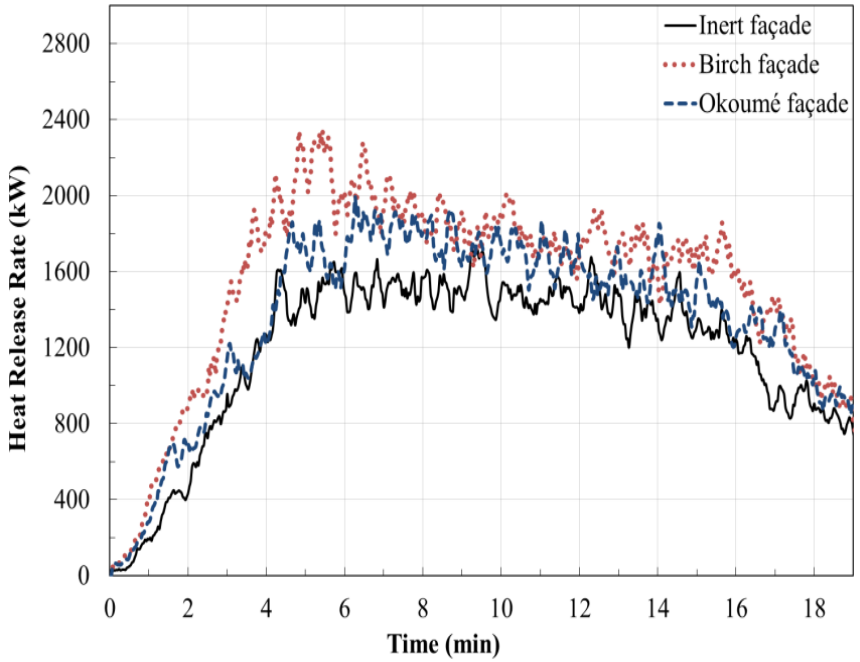

| Test reference | N°4 – 15/10/2014 | N°5 – 23/04/2015 | N°6 – 03/09/2015 |
|---|---|---|---|
| Ventilated cladding [1] | Vertical – Douglas – min 18mm/max 26mm | Plywood – B-s2, d0 – 18mm – Closed joints | Vertical (Left) & Horizontal (Right) – Douglas – min 18mm/max 27mm |
| Cladding support [5] | Stone Wool 60mm 40kg.m$^{-3}$ + Particlebaoard P5 12mm | Stone Wool 60mm 40kg.m$^{-3}$ + Particlebaoard P5 12mm | Stone Wool 60mm 40kg.m$^{-3}$ + Particlebaoard P5 12mm |
| Cavity barrier [6] & [17] | 50mm overhang + 300mm overhang above windows (Left) 200mm overhang (Right) + Fire stop (Left & Right) | 40mm overhang in Steel + Fire stop (Left) | 250mm overhang in LVL B-s2, d0 57mm + Fire stop (Left) 150mm overhang in LVL B-s2, d0 57mm + Fire stop (Right) |
| Insulating material [11] | Glass Wool | Glass Wool | Glass Wool |
| Window Sill | Aluminum 15/10 + Fermacell | Aluminum 15/10 + Fermacell | Steel 15/10 + Fermacell |

# National Research Project 2012-2018
## LEPIR2 Full Scale Fire Tests

|  |  |  |  |
|---|---|---|---|
| N°7 – 15/10/2015 | N°8 – 06/07/2017 | N°9 – 05/10/2017 | N°10 – 22/03/2018 |
| HPL Polyrey – B-s1, d0 – 8mm – Closed joints | Vertical<br>Spruce – 18mm (Left)<br>Larch – 21mm (Right) | Vertical<br>Spruce – 20mm | Tiles |
| Plywood B-s2, d0 (Left) – Fermacell (Right) | Gypsumboard 12,5mm | Gypsumboard 12,5mm | Stone Wool 60mm 40kg.m$^{-3}$ + Particlebaoard P5 12mm |
| 50mm overhang in Steel | 150mm overhang in solid wood B-s2, d0 45mm (Left)<br>200mm overhang in solid wood B-s2, d0 45mm (Right) | 200mm overhang in wood LVL B-s2, d0 45mm with Fermacell protection | 20mm overhang in Steel<br>+ Fire stop (Left) |
| Loose fill cellulose insulation | Glass Wool | Glass Wool | Glass Wool |
| Steel 15/10 + Fermacell | Steel 15/10 + Gypsumboard | Steel 15/10 + Gypsumboard | Steel 15/10 |

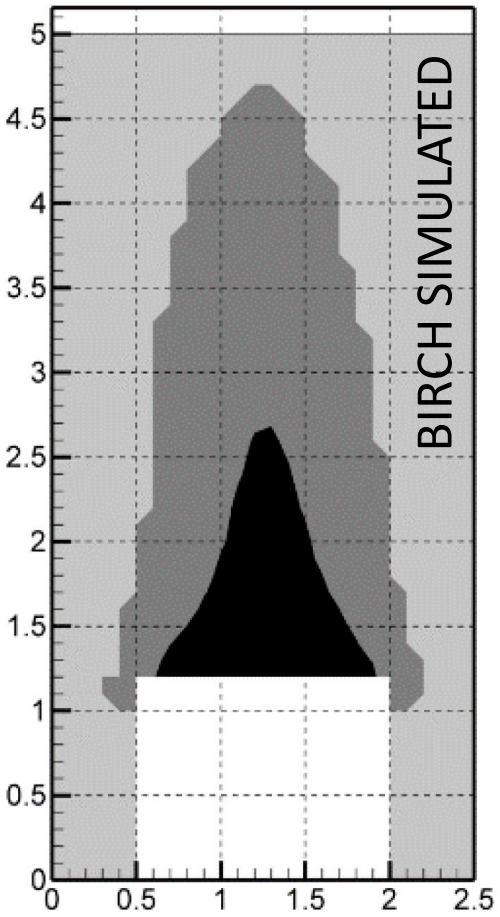
# Intermediate Fire Tests

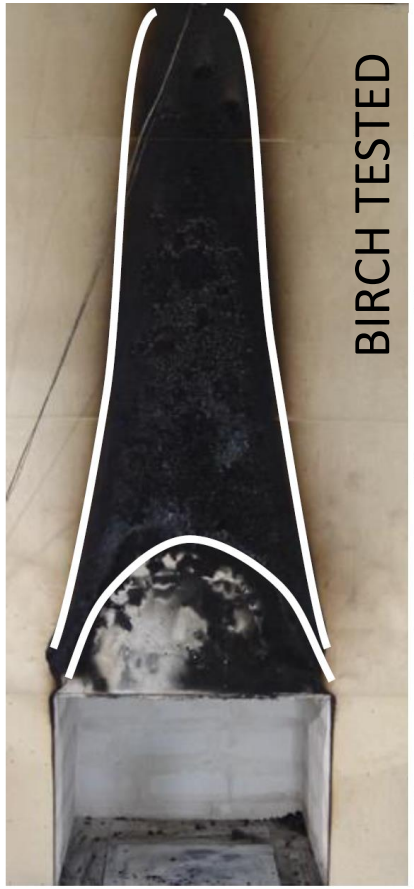


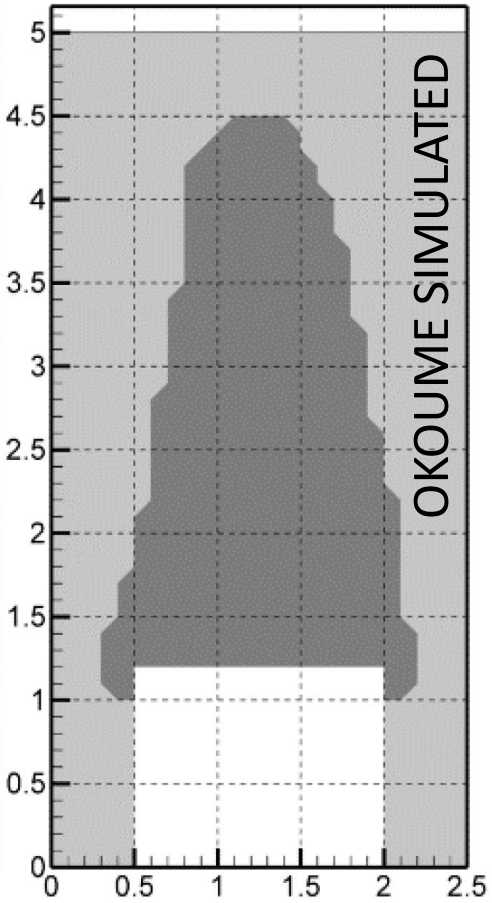




**HRR contribution of the wooden façade around 500 kW (25% of the total HRR)**

# Development of numerical model to predict ignition and extinction



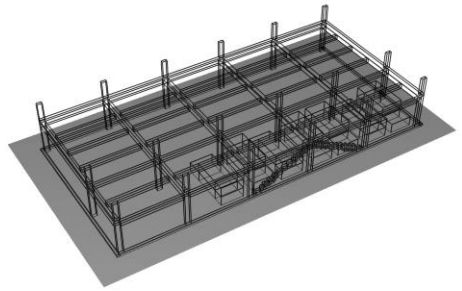


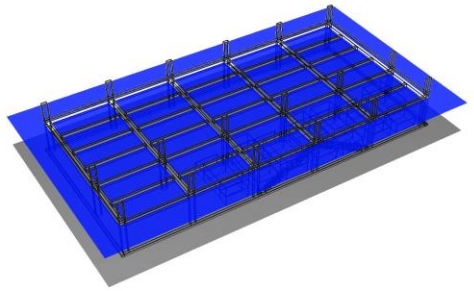
Color representation in the simulation
Grey: Charred area
Dark: Completely burnt area

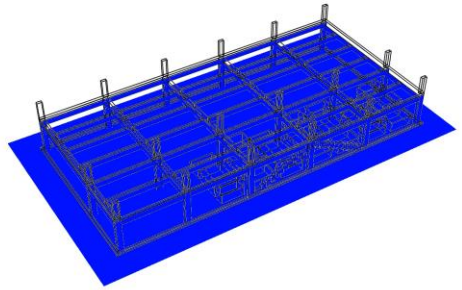
Simulated Model $T_{ig} = T_0 \cdot e^{-\dot{q}_{net}/\dot{q}_0}$

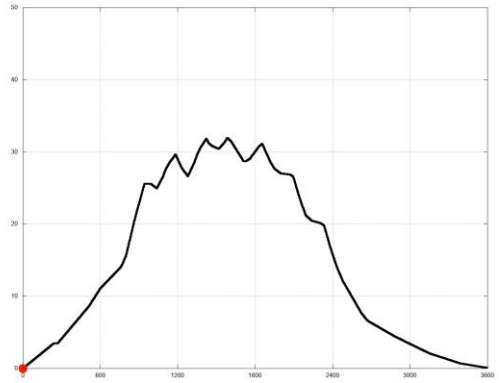
# Acquire new skills and know-how trough scientific excellence: Fire Safety Engineering

**Can we demonstrate the self-extinguishment capacity of wood structure as a function of the thermal action without any intervention of fire brigades?**









https://www.youtube.com/watch?v=9j-PIl5inZE&list=PLM4Nv5rFKZABBIB9dPOQuITZICamSvDBf

# Acquire new skills and know-how trough scientific excellence: Structure

## How to predict the dynamic response of tall wood buildings against wind?

**European Project DynaTTB: 3 year project**

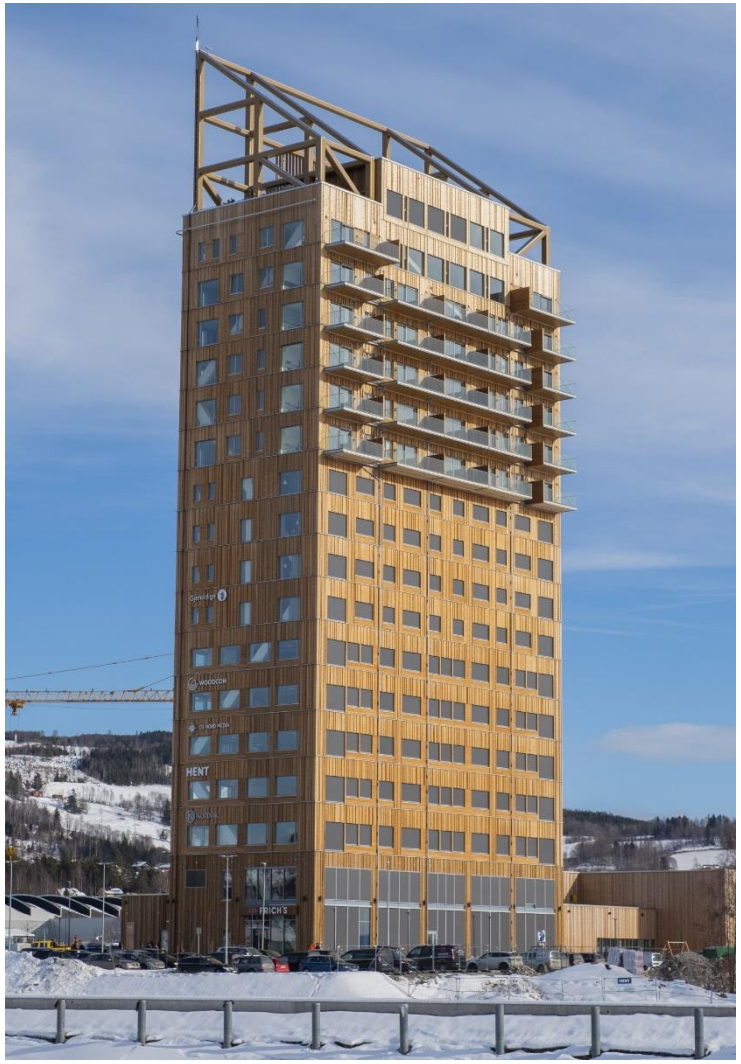
*Overall objective of the project*:

To identify experimentally a number of full-scale TTB (Tall Timber Buildings) structures and, based on these, develop reliable dynamic models for predicting the dynamic performance of TTBs exposed to dynamic loading due to wind.

*Kick-off meeting in Brumunddal, Norway 27-29 March 2019*

*Involved Partners:*

| | |
|---|---|
| France: | CSTB, ARBONIS, GALEO, EIFFAGE IMMOBILIER |
| Norway: | NTNU, SWECO, Moelven |
| Slovenia: | University of Ljubljana, InnoRenew |
| Sweden: | RISE, Linnaeus University |
| UK: | University of Exeter, Smith and Wallwork Engineers Ltd |




Mjösa Tower, Brumunddal, Norway

## International Partnerships

- FPInnovations – Canada

- NICE - Japan

# FPInnovations

- **Montreal, Quebec - November 16, 2015 -** FPInnovations, a Canadian technology research institute and world leader in research and development of solutions for the forest sector, and the FCBA Technological Institute (Forest Cellulose Wood-Construction Furnishing), Technical Center French industrialist of the wood forest furniture industry, are proud to announce that they have signed a memorandum of understanding for the development of exchanges and partnerships between the two organizations.

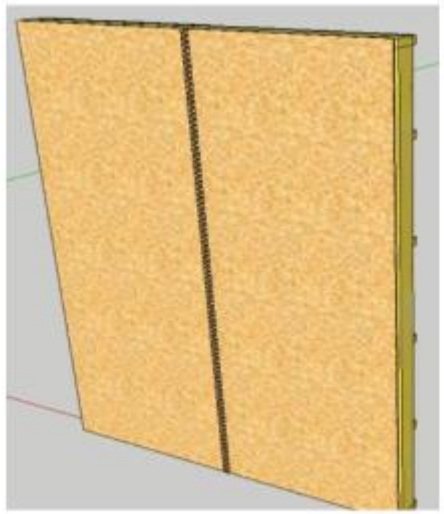
FCBA
INSTITUT TECHNOLOGIQUE

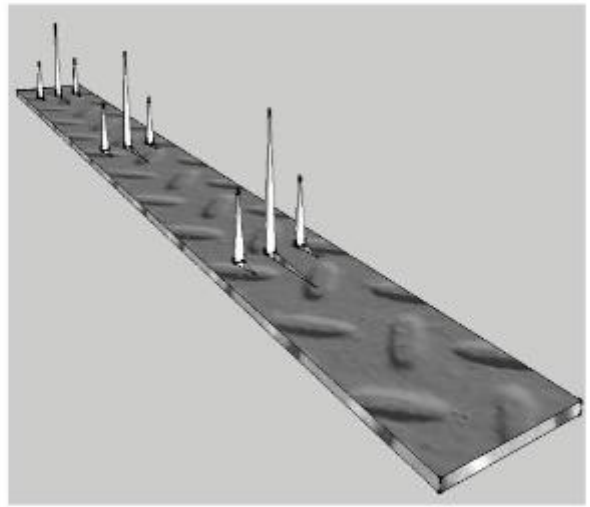
FPInnovations

# FPInnovations

- Recessing and recycling of wooden timber materials

- High rise building





Frame facade wood-connectors; steel strips and nails

# Health, comfort and well-being

We at Nice Corporation work with our customers to build the homes of their dreams.

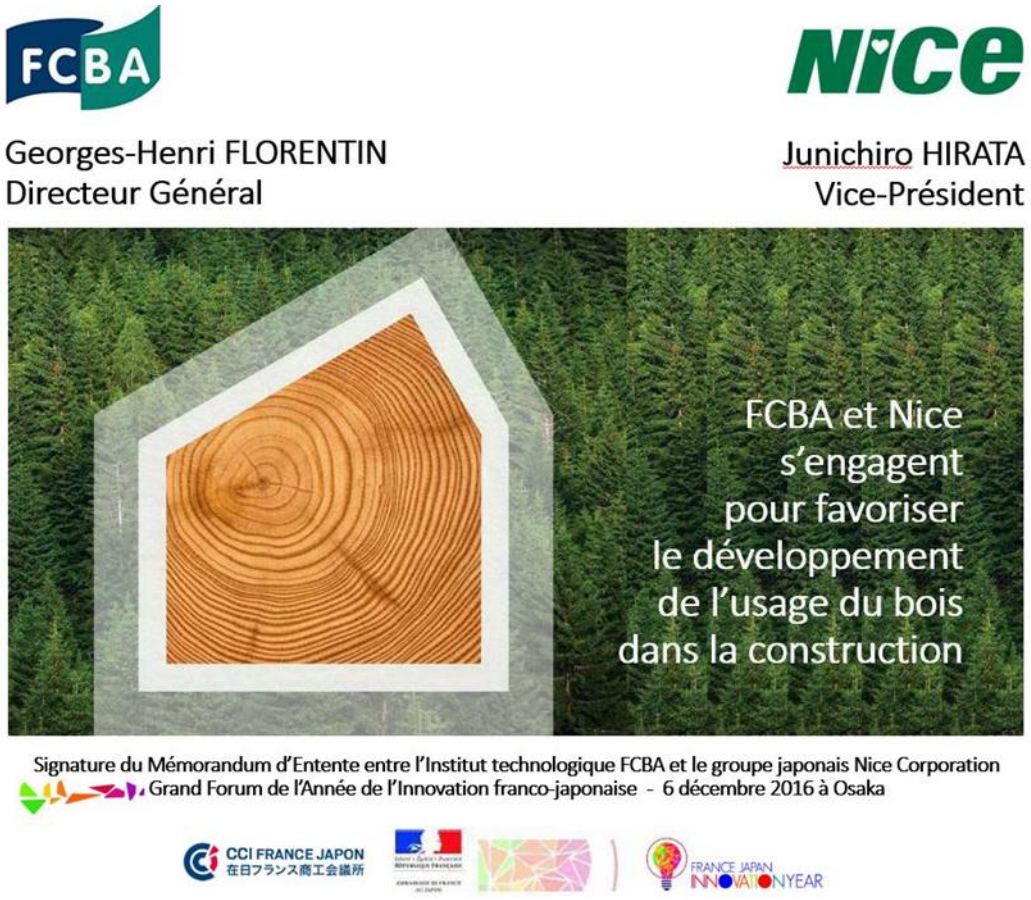
INSTITUT TECHNOLOGIQUE

**Memorendum Of Understanding**

Development of timber construction in Japan and France through the setting up of common actions and objectives.

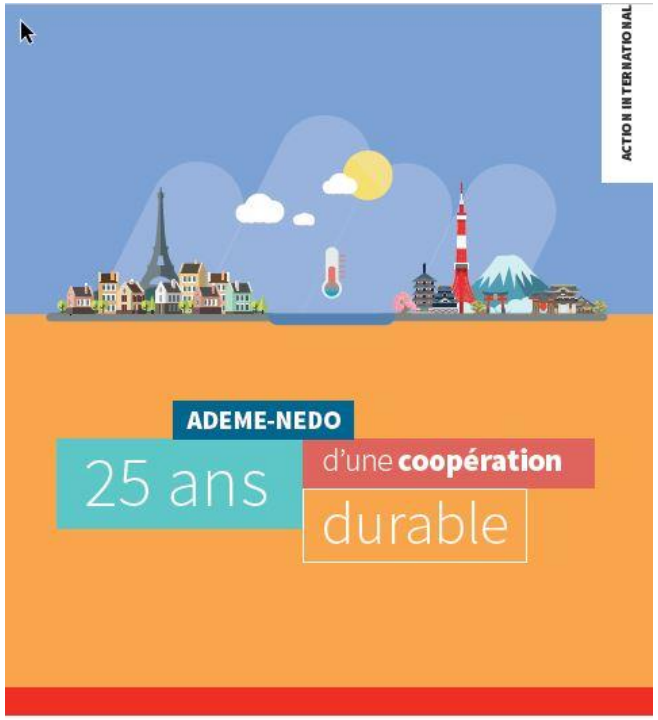
Develop and initiate collaborative projects on two themes:

- Mid-rise and high-rise wood buildings
- **Quality of life and well-being in wood constructions**




www.fcba.fr

# Workshop ADEME International / NEDO March 29th 2019




Innovations for the bioeconomy: France-Japan cross-visions at the ADEME-NEDO 2019 seminar (Sustainable Development Pole - Tokyo SER)

Presentations by the ADEME and NEDO agencies, the Japanese Ministry of Economy, Trade and Industry, and French (Veolia, Engie, Naskeo, Global Bioenergies) and Japanese (Shimadzu, Synplogen, Kaneka, Nice Corporation, Fuji Clean, Japan Agricultural Cooperatives Akan, IHI).

Topics covered:

Session 1: National Bioeconomy Policies
Session 2: Innovation in biomaterials
Session 3: Bioenergies

**Nice Corporation has presented on behalf FCBA the City Zen Wood project in the framework of the two entities partnership**

Olympic stadium of Tokyo

# V.
# Future is Today

# A. High rise wooden construction issue

- **The international WOODRISE initiative**
- **The French ADIVBOIS initiative**

# Program axes

WOODRISE R&D

- Coordination of the Woodrise Alliance:
- R&D projects according 4 themes:
  - Building essential requirements
  - Quality of use and comfort
  - Environment and stored carbon
  - Circular economy and recycling

WOODRISE EVENEMENT

- Organization of events in 3 formats
  - International Congress
  - National meetings
  - Public Festival


WOODRISE PUBLICATION

- Valuation by different media
  - Scientific publication
  - Woodrise paper
  - Article specialized press

WOODRISE EXPORT

- Bilateral collaboration agreements
- International business mission
- Support for strategic development

A shared common tool

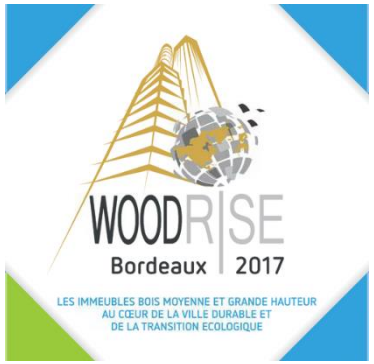
**WOODRISE.org**

# WOODRISE 2019 Quebec, Canada


More information:
https://woodrise2019.ca/en/

# Woodrise

2017 : 1st CONGRESS WOODRISE
Bordeaux, France




**FCBA,**
**FPInnovations,**
**BRI**

2019 : 2nd CONGRESS WOODRISE
Quebec, Canada


**FPInnovations,**

2021 : project for the 3nd CONGRESS WOODRISE
*Place to be defined*


Wood industry is part of the "Industry of the Future" French government plan.

It is a project to support the development of industry, from upstream (forest) to downstream (construction and furniture industries).

The project is supported by 4 ministries.

The objective is to raise the brakes for an innovative concept.


**La ville durable grandit avec le bois**

# LE PROJET ADIVbois

- Objective: develop and support demonstrator projects
- 2020: 10 to 18 levels ... 2024 ... 20 to 30 levels by 2030
- Combine structure & living environment, architecture & design, construction & furnishing
- A new generation of buildings responding to a new market and to the challenges of the planet
- A resource center and exchanges between professionals

**ADIVbois, vers un nouveau marché immobilier Bois**

ADIVBOIS
ASSOCIATION POUR LE DEVELOPPEMENT DES IMMEUBLES À VIVRE BOIS

*Docks Libres, Marseille. Architecte : CARTA & associés*

# Actions taken

**2016: Studies**
Benchmarking, costs, structure, needs,…

**2017: A national competition**
Vade-mecum, expertises, laureates

**2018: Support for demonstrator projects**
Construction team coaching

**2019 - 2020: Start and construction of demonstrator projects**

**Tomorrow, wood for the benefit of all actors**

FRANCE BOIS 2024

ADIVBOIS
ASSOCIATION POUR LE DEVELOPPEMENT DES IMMEUBLES À VIVRE BOIS

# B. Paris 2024 Olympic Games issue for Timber Construction Economy

# France Bois 2024 / Wood France 2024

Olympic Games Objectives in 2024 :

- 55% reduction in the carbon footprint less than London Games, (including 30% for construction).
- An Olympic Village program with
  - 100% wood : buildings up to 8 levels
  - 60% wood for buildings above 8 levels
- A start up timber construction field in France

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# Thank you for your attention

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