INNOVATIVE METHODS TO ENCOURAGE BUILDING ENERGY EFFICIENCY IN FRANCE

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Final Energy Use in France
Final Energy Use in Buildings

1973: 56.4 MTOE

- Oil 54%
- Gas 9%
- Renew & Waste 2%
- Coal 13%
- Electricity 22%

2013: 68,7 MTOE

- Electricity 37%
- Gas 32%
- Renew & Waste 13%
- Oil 18%
- Coal 0.4%

Rakennusten energiaseminaari Finlandia-talossa 8.10.2015
CO₂ Emissions in France

Agriculture
Industry
Energy transformation
Transport

Building Sector (23%)
Net Absorption of Biomass

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The Existing Building Stock

A high variety of architecture.
Structure of the French building stock

- **The housing sector**
  - 32,6 millions of residences (2.4 billions m²)
    - 15,5 millions individual houses
    - 12 millions multifamily buildings
    - 3.2 millions secondary residences
    - 1.9 millions vacant

- **Tertiary buildings**
  - 904 millions m²

<table>
<thead>
<tr>
<th>Sector</th>
<th>Heated surface (Mm²)</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial</td>
<td>203.749</td>
<td>22.5%</td>
</tr>
<tr>
<td>Offices</td>
<td>198.765</td>
<td>22%</td>
</tr>
<tr>
<td>Schools</td>
<td>180.584</td>
<td>20%</td>
</tr>
<tr>
<td>Health</td>
<td>104;041</td>
<td>11.5%</td>
</tr>
<tr>
<td>Sport</td>
<td>66.850</td>
<td>7.4%</td>
</tr>
<tr>
<td>Hotel -restaurant</td>
<td>62.378</td>
<td>6.9%</td>
</tr>
<tr>
<td>Community buildings</td>
<td>62.364</td>
<td>6.9%</td>
</tr>
<tr>
<td>Transport</td>
<td>25.109</td>
<td>2.8%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>903.840</td>
<td>100%</td>
</tr>
</tbody>
</table>

64,5%
The real challenge: existing stock

- 65% of this stock has been built before 1975 (First building energy regulation in France)
- The average new construction ratio is about 1%
- The average primary energy demand is 250-260 kWhpe/m² year
- With the actual tendency, we will reach 160-180 kWhpe/m² year in 2050, the target is around 50 !!!!!!)
- 55% of individual houses have not been rehabilitated in the last 20 years
2007: A political issue

By 2012, all new buildings built in France should comply with the so-called "low-consumption" standards; and by 2020, all new buildings should be energy positive, that is, they should produce more energy than they consume.

**Factor 4:**
France has to divide by 4 its CO$_2$ emissions before 2050.
Transition to NZEB, a long process speeding up now in France

- Energy consumption target (kWh\textsubscript{pe}/m\textsuperscript{2} Year) for Heating, Cooling, Ventilation, Domestic Hot Water, Lighting & Auxiliaries

<table>
<thead>
<tr>
<th>Building period</th>
<th>Fossil energy</th>
<th>Electricity</th>
</tr>
</thead>
<tbody>
<tr>
<td>avant 1975</td>
<td>400</td>
<td>650</td>
</tr>
<tr>
<td>1975-1982</td>
<td>200</td>
<td>300</td>
</tr>
<tr>
<td>1983-1988</td>
<td>170</td>
<td>220</td>
</tr>
<tr>
<td>1989-2000</td>
<td>145</td>
<td>175</td>
</tr>
<tr>
<td>2001-2005</td>
<td>125</td>
<td>150</td>
</tr>
<tr>
<td>2006-2010</td>
<td>106</td>
<td>125</td>
</tr>
</tbody>
</table>

Business as usual
Dynamics after the “Grenelle pour l’Environnement” (2008)
## The main steps

<table>
<thead>
<tr>
<th>Year</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>Effinergie association creates « BBC » Label for new and renovated buildings</td>
</tr>
<tr>
<td>2013</td>
<td>New building regulation RT2012</td>
</tr>
<tr>
<td>2013</td>
<td>2 New voluntary labels: EFFINERGIE+ &amp; BEPOS Effinergie</td>
</tr>
<tr>
<td>17/08/2015</td>
<td>new law « Energy Transition &amp; Green Growth »</td>
</tr>
</tbody>
</table>

**Main target**: 50 kWh pe/m² Year for Heating, Cooling, Ventilation, Domestic Hot Water, Lighting and Auxiliaries. Control of Airtightness .6 m³/h.m² at 4 Pa

**Main target**: mandatory extension of BBC label to all new buildings from January 2013

**Main target**: -20% RT2012 & positive energy balance associated with PV integration

**Main target**: • 1 million buildings (new or renovated) with high energy standards each year from 2017 • Nearly Zero Energy Building Sector by 2050
A new EPB regulation RT-2012

Maximum Primary Energy Consumption (50 kWh pe/m² Year) for
• Heating,
• Cooling,
• Ventilation,
• Domestic Hot Water,
• Lighting
• Auxiliaries.

CONTROL OF AIRTIGHTNESS

Mandatory for any new building since January 1st, 2013
Development of Positive Energy Buildings Label (BEPOS EFFINERGIE, 2013)
National Observatory For Low Energy Buildings

Created in October 2009

Objectives: Promote Low Energy Buildings in France

- Analyzing good practices
- Evaluating technical and economical solutions
- Documenting a large sample of buildings
- Preparing the next regulations (NZEB)

http://www.observatoirebbc.org/
333 projects of positive energy buildings (BEPOS) in 2015, 69 fully documented
Few Examples: Mediterranean Region

School building F. Mitterrand in Montpellier
2 buildings, 3558 m².
Cost: 1545 €/ m²

Predicted consumption: \(-16.3 \text{ kWh pe/m}^2\).Y

Measured consumption: \(-8.3 \text{ kWh pe/m}^2\).Y

- Production locale d'électricité
- Éclairage: 4.8
- Ventilation: 11.7
- Chauffage: 24.6
- Production: 53.50 kWh/m².an
**Main Characteristics**

- **External walls**
  Concrete-external insulation (20cm of rock whole)

- **Roof**
  Terrace, 24 cm of polyurethane

- **Floor:**
  on grave, 10cm Polyurethane

- **Windows:**
  Low emissivity double glazing with Argon, aluminium frame, movable solar protection

- **Air tightness**
  0.52 m³/h.m² at 4 Pa

- **Heating**
  Condensing gas boilers (2X70 W)
  Radiators

- **Ventilation**
  Mechanical extraction with humidity control + Natural ventilation

- **DHW**
  Gas+ accumulation for restaurant and sanitary rooms

- **Lighting**
  High efficiency lamps (T5) 8W/m² in classrooms

- **Renewable energy:**
  PV: 400 m² directly injected in the network

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Few Examples: North-East Region

Residential building “Héliades”, St Dié (Vosges)
2 buildings, 2230 m². 17 apartments
Cost: 1834€/ m² (including PV system)

Predicted consumption: -14,5 kWh pe/m².Y
Measured consumption: +3,6 kWh pe/m².Y
Main Characteristics

External walls
Wooden frame, 30cm glass wood

Roof
40cm glass wood

Floor:
Wooden Floor, 40 cm glass wood

Windows:
triple glazing

Air tightness
0.28 m$^3$/h.m$^2$ at 4 Pa

Heating
Direct electric heating + radiant panels

Ventilation
Double flux Mechanical ventilation+ heat recovery

DHW
Solar DHW + Gas cogeneration with condensing boiler.

Lighting
High efficiency lamps (fluo compacts)

Renewable energy:
PV: 465 m$^2$ directly injected in the network 
+ 33 m$^2$ water solar collectors.

Objectives:

- **Building a state of the art of existing Low Energy Buildings/Comfort & IAQ:**
  - Use and working of the buildings, equipment and systems
  - IAQ levels
  - Comfort evaluation (thermal, visual, acoustic)

- **Identifying improvement strategies for the design, construction and management of Low Energy Buildings**

- **Since 2013, 150 buildings are being collected: 132 residential, 9 schools and 8 office buildings**

- **In 2015 the interpretation of results is still going on. However the first results are encouraging.**
A strong support by incentive measures

- **Tax reduction:**
  - Insulation, efficient systems (condensation boiler, heat pumps, heat & power generation, connection to district heating, PV, solar DHW,……)
  - Certified Company (RGE)
  - 30% of the investment up to 16 000 € in reduction of the income tax
  - Reduced VAT (5%) on the total cost

- **Zero rate loan**
  - For new owners (new or existing building)
  - Up to 50 000 € depending on the location
  - Income conditions modulate the duration and volume of the loan
A strong initiative in certifying the professionals

- **RGE Label:**
  - Certified qualification after one week individual formation
  - Certified Company (RGE)
  - Applies to a large spectrum of activities (building works, electricity, plumbing, integration of renewables, design, ……..)
  - RGE Label is mandatory for any company to get tax reductions or zero rate loan
Development of third party investor

- **ARTEE Initiative in Poitou Charentes Region**:  
  - Regional Agency for Technical and Financial Support of building renovation  
  - Mixt Economy Society (Private & public funds)  
  - Third party investor as well as technical consulting and confidence third party  
- **Targets**:  
  - Identify a unique partner to owners in order to speed up the renovation process  
  - Improve the access to incentive measures for individual owners,  
  - Secure the owners decision to invest.
A strong support to innovation

- Tax reduction for research
  - A bonus when collaborating with a public laboratory (University or Technical research centers up to 60% in tax reduction)
  - 50% support for a company hiring a PhD Student (Cifre grant)
- National and regional research programs launched by ANR, ADEME or within the objective contract between the regions and the state supported by FEDER.
- A specific target on buildings: Building Technology Platforms development
Building Technology Platforms

- OPECST report (2009)
- Scientific Committee for Sustainable Building Development report (2011)
- Need for innovation development in the building sector
- Need for improving the technical assessment of innovations.

Call for technology platforms
- 9 projects,
- 5 projects in development
Tipee Platform project in La Rochelle Technology & Innovation Platform for Environmental Efficiency

- Granted in 2012 as “Investment for future” (19,3 M€)
- A group of industrial partners
- Incubated at LaSIE (University of La Rochelle)
- Independent company in 2016.
- High performance renovation of an industrial Hall in a Zero Carbon Urban project
- Final delivery, April 2016
New Test Facilities:
- Materials
- Components
- Systems
- On Site Measurements

Research & Engineering
- Innovation partnership
- Innovation evaluation
- Assistance to project developers
- Expertise in IEQ, Green building development, NZEB

Teaching for Professional
- Development of teaching platforms (simulation, BIME, techniques....)
- Partnership with building federation and existing centers
Test facilities

**Envelope Test Facility**
- Five Cells
- Façade tests
- Roof tests

**From material to component laboratory tests**
- Thermal characteristics,
- Radiative properties,
- Humidity transfer

**IEQ Laboratory**:
- Comfort,
- IAQ, pollutant transfer (ground, ambient air),
- Conditioning systems

Delivery April 2016

Delivery April 2016

Delivery November 2015
The building sector appears as “the” strategic sector for the Green Growth Strategy in France,
The overall objective is to reach a nearly zero carbon emission building sector by 2050,
Innovation development appears to be strategic in this domain,
For new buildings, incentive measures combined with regulation evolution and voluntary labels will do the job,
For building renovation, the main problem is to convince the owners to make the renovation decision,
Incentive measures, third party investors and qualification of the professionals are the first targets.