This project has received funding from the under the European Union's Horizon 2020 research and innovation programme under grant agreement No. 754159.
ALDREN Training Workshop

Feedback & proposals for the training program

ALDREN

ALliance for Deep RENovation in buildings

REHVA Brussels Summit, Brussels
12 November 2018
## AGENDA

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:30</td>
<td><strong>Warm-up live poll</strong></td>
<td></td>
</tr>
<tr>
<td>11:40</td>
<td><strong>Introduction to ALDREN</strong></td>
<td>Johann Zirngibl</td>
</tr>
<tr>
<td>11:55</td>
<td><strong>EVCS ratings</strong></td>
<td>Jana Bendžalová</td>
</tr>
<tr>
<td>12:05</td>
<td><strong>Live poll session 1 and open discussion</strong></td>
<td></td>
</tr>
<tr>
<td>12:30</td>
<td><strong>Lunch</strong></td>
<td></td>
</tr>
<tr>
<td>13:30</td>
<td><strong>Energy performance verification</strong></td>
<td>Mathieu Rivallain</td>
</tr>
<tr>
<td>13:40</td>
<td><strong>Health &amp; well-being</strong></td>
<td>Tiziana Buso</td>
</tr>
<tr>
<td>13:50</td>
<td><strong>BRP &amp; renovation strategies</strong></td>
<td>Mathieu Rivallain</td>
</tr>
<tr>
<td>14:05</td>
<td><strong>Live poll session 2 and open discussion</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Chairs
Andrei Litiu, Tiziana Buso
Warm-up live poll
Introduction to ALDREN, ALLiance for Deep energy RENovation in buildings

Johann ZIRNGBL, ALDREN coordinator
Johann.zirngibl@cstb.fr
8 European partners are working together:

- CSTB (research)
- DTU (research)
- Politecnico Milano 1863 (research)
- Certivea (certification)
- Instituto Valenciano de la Edificación (certification)
- ENBEE (Environment & Building Energy Efficiency)
- Verco (application)
- REHVA (Federation of European Heating, Ventilation and Air Conditioning Associations)
ALDREN Resume – Why ALDREN?

➢ Create a European quality benchmark, based on EU CEN standards
   (Building professionals are asking for: comparability, transparency and quality)

➢ Offer support to policy i.e. EPBD
   (Help Member States to fulfil the revised Directive on Energy Performance in Buildings, building stock observatory, cost effective approaches, building passport, evidence based of expected energy savings, wider benefits, health + well-being)

➢ Work out a common language
   (supporting the holistic approach in deep renovation)
   How can a thermal bridge talk to a banker?

➢ Set up an ALDREN ALLIANCE among buildings stakeholders
   (Nobody can trigger building energy renovation alone)
   The building owner needs the financial sector, the professionals, etc.
The ALDREN Outcomes / Results

6 tasks for consolidation and adaptation of an EVCS (European Voluntary Certification Scheme) based on common language

- T2.1 Overall integration of components in the EVCS based language
- T2.2 Energy rating & targets
- T2.3 Addressing the gap between calculated & actual EP
- T2.4 Addressing health & wellbeing
- T2.5 Linking EVCS to the financial valuation
- T2.6 Rendering of the collected data and results in a building passport
Amended EPBD and ALDREN outcomes (policy support)


<table>
<thead>
<tr>
<th>Art 1 Amendments Directive 2010/31/EU</th>
<th>T2.1 EVCS</th>
<th>T2.2 Measured energy</th>
<th>T2.3 Health Wellbeing</th>
<th>T2.4 Financial evaluation</th>
<th>T2.5 Building passport</th>
<th>T2.6 Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘(1) Article 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>‘(2) Article 2a Long-term renov. Strategy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>'1 highly energy efficient and decarbonised building stock by 2050,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) cost-effective approaches considering potential relevant trigger points</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) introducing an optional scheme for building renovation passports;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(f).... skills and education in construction and energy efficiency sectors;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(g) evidence of expected energy savings and related to health, and air quality.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ALDREN outcomes are related to 17 paragraphs of EPBD amendments
How to implement the outcomes
> ALDREN operational procedures

- Articulate the protocols with the deep renovation stages
- Identify the data to be collected
- Specify responsibilities
- Mention or detail reference documents/procedures

ALDREN uses as much as possible existing know-how
Tasks outcomes

Individual tasks outcomes

- T2.2
- T2.3
- T2.4
- T2.5
- T2.6

**EVCS, Energy rating procedure**
(Indicators, targets, scales, reference, tools, template)

**Offering**
- ✓ Comparability
- ✓ Transparency across EU!
Tasks outcomes

Individual tasks outcomes

- **T2.2**
- **T2.3**
- **T2.4**
- **T2.5**
- **T2.6**

**Performance verification protocol**

(Measurement, metering & verification plan / Analysis of the gap / Predicted energy use under actual conditions / performance target)

**Offering**

- ✓ Confidence (Got what has been promised!)
- ✓ Enhanced building value
- ✓ Management tools

### Performance Verification Table

<table>
<thead>
<tr>
<th>End use</th>
<th>EVCS - actual conditions</th>
<th>Measured</th>
<th>Variance (kWh)</th>
<th>Variance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space Heating</td>
<td>8,775,673</td>
<td>5,072,482</td>
<td>-3,703,191</td>
<td>-43%</td>
</tr>
<tr>
<td>Hot water</td>
<td>674,887</td>
<td>826,326</td>
<td>151,440</td>
<td>18%</td>
</tr>
<tr>
<td>Refrigeration</td>
<td>2,136,180</td>
<td>2,340,840</td>
<td>204,660</td>
<td>9%</td>
</tr>
<tr>
<td>Fans</td>
<td>121,605</td>
<td>102,209</td>
<td>-19,397</td>
<td>-16%</td>
</tr>
<tr>
<td>Pumps</td>
<td>1,430</td>
<td>1,421</td>
<td>-9</td>
<td>-1%</td>
</tr>
<tr>
<td>Controls</td>
<td>1,128,920</td>
<td>980,400</td>
<td>-148,521</td>
<td>-13%</td>
</tr>
<tr>
<td>Humidification</td>
<td>1,007,449</td>
<td>1,073,800</td>
<td>66,351</td>
<td>6%</td>
</tr>
<tr>
<td>Lighting (Internal)</td>
<td>774,040</td>
<td>822,385</td>
<td>48,345</td>
<td>6%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>14,620,184</td>
<td>11,219,664</td>
<td>-3,400,521</td>
<td>-25%</td>
</tr>
</tbody>
</table>

**RED+**

- x > +25%

**AMBER+**

- 10% < x < 25%
- <= +10% (Green)
- >= -10% (Yellow)
- > x > -25% (Red)
Tasks outcomes

Individual tasks outcomes

T2.2

T2.3

Health and well-being Evaluation protocol
(Indicators describing IEQ, predicted comfort levels, satisfaction with IEQ by the occupants, recommendations, ratings, verifications)
Offering
✓ Performance indicators
✓ Benefits on IEQ (non-energy benefits)!

T2.4

T2.5

T2.6
T2.4 Integration of indoor air quality, comfort and health in the scope of deep energy renovation

Deep energy renovation $\rightarrow$ Energy + Non-energy benefits
Example

- Energy renovation actions
- Avoidance of overheating
- Improved work performance and sleep
Tasks interactions / integration
(example of the ALDREN common language)

From “energy simulation” to “health & well-being”
to “economic/financial assessment”
(e.g. how a thermal bridge talks to a banker)

- T2.2
  Energy rating, consumption per energy carrier, etc.
  + **Air and operative temperatures**

- T2.3
  Indoor Environment Quality
  Linking temperatures + productivity

- T2.4

- T2.5
  Economic and financial valuation
  Linking productivity to building valuation (global costs, risks)

- T2.6 – Building Renovation Passport
Market uptake and roll-out – ALDREN “in-side”

➢ Can be up taken as a energy module by existing schemes (energy rating, EP verification, health & well-being, financial valuation, ALDREN Building renovation passport A-BRP)

- HQE (CERTIVEA is in the ALDREN consortium),
- IVE (IVE in the ALDREN consortium),
- BREEAM,
- DGNB,

➢ Can be up taken as a mandatory EPC by EU Member States
OPPORTUNITIES FOR STAKEHOLDERS

BUILDING OWNERS, INVESTORS, DEVELOPERS
• gain recognition for good performance by EU quality mark
• take advantage of comparability, reliability, risk elimination

FINANCIAL SECTOR
• financing instruments for energy efficiency investments
• harmonized procedures based on reliable benchmark rules

THE BUILDING PROFESSIONALS, INDUSTRIALS
• harmonized procedures (training, tools)
• harmonized databases (industrials, building owners)
• A coherent and transparent level playing field (technology neutral).

PUBLIC AUTHORITIES
• Policy support, (save money, common EU approach)

ALDREN ALLIANCE
• Effective vehicle for future cooperation and communication

This project has received funding from the under the European Union’s Horizon 2020 research and innovation programme under grant agreement No. 754159
European Voluntary Certification Scheme ratings and targets

Jana BENDŽALOVÁ
bendzalova@enbee.eu
The ALDREN EP rating methodology

- Provides direct comparability of EP and transparency across the EU for **EU buildings stocks management**
- Takes into account in the same way the **innovative solutions** and all technical systems
- Brings together **societal and building owner interests** (environment ↔ costs)

**EVC** = advisory tools for building owner, tenant, financial institutions and policy makers.

Asked by EPBD for subsidies before – after renovation
Stand alone or energy module in other scheme
Calculation of EP indicators

Building Modelling

Data collection
- Provided by building owner
- Collected by expert on-site, fieldwork
- Check the parameters influencing EP (materials, systems, time schedule, temperature set points)

Number of input data depends on software used (may be less for hourly method than for monthly)

Calculation methodology
- **CEN / ISO standards 2017** (M/480)
- Default choices in ANNEX B
- **Hourly** calculation step
- National use patterns
- EU primary energy factors (**comparability before-after renovation for subsidies**)
- Climate of the specific location instead of national standard climate (JRC hourly climate data)

Source:
Report from cost optimal level calculation 2013 Germany
Buildings Modelling

CALCULATION OF EP INDICATORS

Software tool

✓ Based on the set of CEN / ISO EPB standards (M480) = the reference methodology

✓ Software with an hourly calculation step allowed (it should be proved in the future during software accreditation if the results are close to the CEN EPB standards)

✓ Today we use CYPETHERM COMETH

✓ Tomorrow we will have the Italian software
INDICATORS

THE MAIN INDICATOR
= non-renewable primary energy balance with compensation by exported energy

THE ADDITIONAL INDICATORS
• Total primary energy
• Final energy
• Delivered energy per energy carrier
• Share of renewables
• Heating and cooling needs
• CO₂ emissions (environment)

Indicators needed for existing certification schemes (DGNB, HQE, BREEAM, BES-IVE) included (potentially used as energy module)

Based on Public consultation, Tender No. ENER/C3/2015-545, 2016
THE ENERGY PERFORMANCE RATING SCALE

Relative scale - the ratio to the „reference“

Reference = value expressed in kWh/(m².a)

Class „A“ - approximation to the NZEB definition

Identification of relative EP targets, renovation actions (step-by-step) towards deep renovation (60% savings or NZEB)

Different efforts needed from different pre-renovation stages

≈ Cost optimal level (2013)
The Scale
Reference point

<table>
<thead>
<tr>
<th>Class</th>
<th>Energy classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy + EP &lt; 0</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>0 Ref ≤ EP ≤ 0,35 Ref</td>
</tr>
<tr>
<td>B</td>
<td>0,35 Ref &lt; EP ≤ 0,50 Ref</td>
</tr>
<tr>
<td>C</td>
<td>0,50 Ref &lt; EP ≤ 0,71 Ref</td>
</tr>
<tr>
<td>D</td>
<td>0,71 Ref &lt; EP ≤ 1,00 Ref</td>
</tr>
<tr>
<td>E</td>
<td>1,00 Ref &lt; EP ≤ 1,41 Ref</td>
</tr>
<tr>
<td>F</td>
<td>1,41 Ref &lt; EP ≤ 2,00 Ref</td>
</tr>
<tr>
<td>G</td>
<td>2,00 Ref &lt; EP</td>
</tr>
</tbody>
</table>

Proposal for EVCS

Fixed values
- Offices: Ref = 120 kWh/(m².a);
- Educational buildings: Ref = 120 kWh/(m².a);
- Retail trade buildings: Ref = 240 kWh/(m².a);
- Wholesale buildings: Ref = 150 kWh/(m².a);
- Hotels and restaurants: Ref = 160 kWh/(m².a);
- Assembling halls: Ref = 140 kWh/(m².a);
- Hospitals: Ref = 240 kWh/(m².a);

Review of Reports from cost optimal level calculation in 2013 (offices and hotels):

Different type of PE, floor height, temperature set-points, with and without cooling ...

Note: MSs may report the EP of existing building in different quantities (e.g. for UK it is a total measured energy)
TEMPLATE OF EVC
✓ Common template
✓ Energy performance class
✓ Award (e.g. gold, silver, bronze)

NEXT PAGES
✓ Delivered energy per carrier (costs)
✓ Description of constructions / systems
✓ 1 page per each ALDREN task (measured energy, well-being, financial valuation) - optional
✓ Recommendations for improvement with potential energy savings – link with the building renovation passport - optional

Based on Public consultation, Tender No. ENER/C3/2015-545, 2016
Connection with other ALDREN tasks

- Energy rating & targets (T2.2)
  - Outcomes from EP calculation as inputs in other tasks
- Measured performance verification (T2.3)
- Health and well-being (T2.4)
- Linking EVCS to the financial valuation (T2.5)
- Building Renovation Passport (T2.6)

- Comparison of EP under standard and real conditions
- Hourly IEQ data: air/operative temperature, humidity, mold risk, light
- Direct cost savings due to renovation (energy costs, maintenance costs)
- Data collection in BRP, renovation actions towards 60% savings / NZEB
Live poll & open discussion
Energy Performance Verification

Mathieu RIVALLAIN
mathieu.rivallain@cstb.fr
Rapporteur for Verco team
Task 2.3: Energy performance verification

This ALDREN task is about the verification of energy performance and includes:

- A **protocol** to follow which documents the renovation process on an individual project
- A **verification tool** to capture monthly predicted and measured performance by energy end-use
- A **translation** of the verification tool into multiple European languages
Task 2.3: Energy performance verification

1: Decision (Set requirements)
- Lens A: Existing building predicted EP

2: Develop Design
- Lens C: Existing base building operational performance
- Lens B: Existing building predicted EP

3: Detailed Design
- Lens D: Design of renovated building predicted EP
- Lens E: As constructed renovated building predicted EP

4: Works
- Lens F: As constructed renovated building predicted EP

5: In use
- Lens G: Base building operational performance after renovation

Calculated energy use - standard conditions
- Predict performance under ‘real’ conditions

Calculated energy use - actual conditions

Measured energy use
## Design for testability protocol tool

<table>
<thead>
<tr>
<th>1: DECISION (SET REQUIREMENTS)</th>
<th>2: DEVELOP DESIGN</th>
<th>3: DETAILED DESIGN</th>
<th>4: WORKS</th>
<th>5: IN USE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stakeholder commitment</td>
<td>Calibrate model</td>
<td>Final design</td>
<td>Defend against value engineering</td>
<td>Track metered against predicted performance or apply QUANTUM testbench</td>
</tr>
<tr>
<td>EU CEN standard simulation</td>
<td>Agree improvements</td>
<td>Metering plan or application of QUANTUM testbench</td>
<td>Handover and commissioning</td>
<td></td>
</tr>
<tr>
<td>Energy audit</td>
<td>Dynamic modelling or QUANTUM</td>
<td>Develop Description of Operations</td>
<td>Finalise Description of Operations</td>
<td>Diagnose and implement improvements</td>
</tr>
<tr>
<td></td>
<td>Outline Description of Operations</td>
<td></td>
<td>Calculate asset rating</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Set performance target</td>
<td></td>
<td>Intensive fine tuning against Description of Operations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Independent design review</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Outline

<table>
<thead>
<tr>
<th>Description of Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: DECISION (SET REQUIREMENTS)</td>
</tr>
<tr>
<td>2: DEVELOP DESIGN</td>
</tr>
<tr>
<td>3: DETAILED DESIGN</td>
</tr>
<tr>
<td>4: WORKS</td>
</tr>
<tr>
<td>5: IN USE</td>
</tr>
</tbody>
</table>

### 1: DECISION (SET REQUIREMENTS)
- Stakeholder commitment
- EU CEN standard simulation
- Energy audit

### 2: DEVELOP DESIGN
- Calibrate model
- Agree improvements
- Dynamic modelling or QUANTUM
- Outline Description of Operations
- Set performance target
- Independent design review

### 3: DETAILED DESIGN
- Final design
- Metering plan or application of QUANTUM testbench
- Develop Description of Operations

### 4: WORKS
- Defend against value engineering
- Handover and commissioning
- Finalise Description of Operations
- Calculate asset rating
- Intensive fine tuning against Description of Operations

### 5: IN USE
- Track metered against predicted performance or apply QUANTUM testbench
- Diagnose and implement improvements
Performance verification tool

- To be used in parallel with the Design for testability protocol
- Tracking tool to signpost and monitor energy performance at multiple stages of the renovation
- Is a repository for predicted and measured energy consumption throughout the ALDREN process
- Calculates the performance gap at the decision stage and the in-use stage
## Performance verification tool (hotel example)

### Energy end uses

<table>
<thead>
<tr>
<th>Energy End use</th>
<th>May-17</th>
<th>Jun-17</th>
<th>Jul-17</th>
<th>Aug-17</th>
<th>Sep-17</th>
<th>Oct-17</th>
<th>Nov-17</th>
<th>Dec-17</th>
<th>Jan-18</th>
<th>Feb-18</th>
<th>Mar-18</th>
<th>Apr-18</th>
<th>Annual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elec Space Heating (hosting functions)</td>
<td>-20%</td>
<td>235%</td>
<td>-65%</td>
<td>536%</td>
<td>52%</td>
<td>-26%</td>
<td>225%</td>
<td>1589%</td>
<td>1332%</td>
<td>233%</td>
<td>6%</td>
<td>548%</td>
<td>92%</td>
</tr>
<tr>
<td>Elec Hot water (hosting functions)</td>
<td>-7%</td>
<td>-56%</td>
<td>-71%</td>
<td>151%</td>
<td>-29%</td>
<td>-19%</td>
<td>460%</td>
<td>5%</td>
<td>-32%</td>
<td>-91%</td>
<td>100%</td>
<td>-49%</td>
<td>-13%</td>
</tr>
<tr>
<td>Elec Refrigeration (hosting functions)</td>
<td>410%</td>
<td>77%</td>
<td>-61%</td>
<td>500%</td>
<td>52%</td>
<td>219%</td>
<td>223%</td>
<td>-98%</td>
<td>-63%</td>
<td>46%</td>
<td>8572%</td>
<td>468%</td>
<td>-6%</td>
</tr>
<tr>
<td>Elec Fans (hosting functions)</td>
<td>87%</td>
<td>-82%</td>
<td>20%</td>
<td>-87%</td>
<td>3128%</td>
<td>-96%</td>
<td>23%</td>
<td>-22%</td>
<td>2058%</td>
<td>44%</td>
<td>-19%</td>
<td>-70%</td>
<td>-10%</td>
</tr>
<tr>
<td>Elec Pumps (hosting functions)</td>
<td>81%</td>
<td>-27%</td>
<td>321%</td>
<td>46%</td>
<td>8999%</td>
<td>-36%</td>
<td>-28%</td>
<td>-14%</td>
<td>-30%</td>
<td>-45%</td>
<td>-81%</td>
<td>-28%</td>
<td>11%</td>
</tr>
<tr>
<td>Elec Controls (hosting functions)</td>
<td>-25%</td>
<td>50%</td>
<td>-41%</td>
<td>133%</td>
<td>5%</td>
<td>1915%</td>
<td>-96%</td>
<td>68%</td>
<td>-99%</td>
<td>-14%</td>
<td>188%</td>
<td>3%</td>
<td>-2%</td>
</tr>
<tr>
<td>Elec Humidification (hosting functions)</td>
<td>-16%</td>
<td>-70%</td>
<td>-84%</td>
<td>-5%</td>
<td>502%</td>
<td>-5%</td>
<td>3%</td>
<td>-28%</td>
<td>223%</td>
<td>-22%</td>
<td>-40%</td>
<td>49%</td>
<td>1%</td>
</tr>
<tr>
<td>Elec Lighting (hosting functions)</td>
<td>-38%</td>
<td>118%</td>
<td>-32%</td>
<td>45%</td>
<td>599%</td>
<td>-13%</td>
<td>-12%</td>
<td>-7%</td>
<td>57%</td>
<td>-6%</td>
<td>50%</td>
<td>268%</td>
<td>14%</td>
</tr>
<tr>
<td>Elec Plug loads (hosting functions)</td>
<td>19%</td>
<td>-55%</td>
<td>-4%</td>
<td>310%</td>
<td>67%</td>
<td>-35%</td>
<td>12%</td>
<td>5%</td>
<td>55%</td>
<td>-2%</td>
<td>-75%</td>
<td>62%</td>
<td>-8%</td>
</tr>
<tr>
<td>Elec Vertical Transport (lifts &amp; escalators)</td>
<td>89%</td>
<td>37%</td>
<td>-12%</td>
<td>260%</td>
<td>492%</td>
<td>3558%</td>
<td>24%</td>
<td>-90%</td>
<td>-44%</td>
<td>133%</td>
<td>9419%</td>
<td>-4%</td>
<td>28%</td>
</tr>
<tr>
<td>Elec Catering (hosting functions)</td>
<td>24%</td>
<td>22%</td>
<td>1122%</td>
<td>-69%</td>
<td>9%</td>
<td>25%</td>
<td>-68%</td>
<td>56%</td>
<td>16%</td>
<td>-32%</td>
<td>-59%</td>
<td>65%</td>
<td>2%</td>
</tr>
<tr>
<td>Elec Car park ventilation and lighting</td>
<td>80%</td>
<td>148%</td>
<td>-42%</td>
<td>37%</td>
<td>33%</td>
<td>-26%</td>
<td>-58%</td>
<td>91%</td>
<td>117%</td>
<td>-91%</td>
<td>66%</td>
<td>-51%</td>
<td>1%</td>
</tr>
<tr>
<td>Elec Lighting (External)</td>
<td>31%</td>
<td>70%</td>
<td>-52%</td>
<td>293%</td>
<td>94%</td>
<td>-16%</td>
<td>133%</td>
<td>-35%</td>
<td>78%</td>
<td>4%</td>
<td>84%</td>
<td>153%</td>
<td>11%</td>
</tr>
<tr>
<td>Elec Spa</td>
<td>172%</td>
<td>-44%</td>
<td>2-4%</td>
<td>11%</td>
<td>111%</td>
<td>-31%</td>
<td>-54%</td>
<td>6451%</td>
<td>233%</td>
<td>78%</td>
<td>94%</td>
<td>76%</td>
<td>34%</td>
</tr>
<tr>
<td>Elec Swimming pool</td>
<td>24%</td>
<td>-51%</td>
<td>211%</td>
<td>514%</td>
<td>94%</td>
<td>-82%</td>
<td>334%</td>
<td>-97%</td>
<td>2385%</td>
<td>550%</td>
<td>19%</td>
<td>-16%</td>
<td>27%</td>
</tr>
<tr>
<td>Elec Sauna</td>
<td>-97%</td>
<td>43%</td>
<td>-9%</td>
<td>162%</td>
<td>32%</td>
<td>1481%</td>
<td>24%</td>
<td>7%</td>
<td>-9%</td>
<td>-99%</td>
<td>-5%</td>
<td>-7%</td>
<td>8%</td>
</tr>
<tr>
<td>Elec Gym</td>
<td>-59%</td>
<td>-22%</td>
<td>-54%</td>
<td>-2%</td>
<td>0%</td>
<td>4262%</td>
<td>-73%</td>
<td>166%</td>
<td>-65%</td>
<td>-88%</td>
<td>-6%</td>
<td>-23%</td>
<td>9%</td>
</tr>
<tr>
<td>Elec Kitchen</td>
<td>-50%</td>
<td>-8%</td>
<td>-54%</td>
<td>-56%</td>
<td>-56%</td>
<td>-30%</td>
<td>206%</td>
<td>108%</td>
<td>50%</td>
<td>24%</td>
<td>88%</td>
<td>5%</td>
<td>17%</td>
</tr>
<tr>
<td>Elec Laundry</td>
<td>176%</td>
<td>60%</td>
<td>100%</td>
<td>118%</td>
<td>126%</td>
<td>1023%</td>
<td>17%</td>
<td>8%</td>
<td>-90%</td>
<td>6%</td>
<td>60%</td>
<td>14%</td>
<td></td>
</tr>
<tr>
<td>Elec Other Electricity use</td>
<td>-70%</td>
<td>120%</td>
<td>8%</td>
<td>433%</td>
<td>3%</td>
<td>-4%</td>
<td>101%</td>
<td>90%</td>
<td>-40%</td>
<td>-46%</td>
<td>-52%</td>
<td>-91%</td>
<td>-4%</td>
</tr>
<tr>
<td>Elec Space Heating - Fossil</td>
<td>-17%</td>
<td>-37%</td>
<td>10%</td>
<td>60%</td>
<td>55%</td>
<td>-34%</td>
<td>18%</td>
<td>9%</td>
<td>62%</td>
<td>-12%</td>
<td>-29%</td>
<td>67%</td>
<td>1%</td>
</tr>
<tr>
<td>Elec Hot water - Fossil</td>
<td>-36%</td>
<td>-79%</td>
<td>84%</td>
<td>-7%</td>
<td>27%</td>
<td>140%</td>
<td>-54%</td>
<td>-12%</td>
<td>33%</td>
<td>-80%</td>
<td>-49%</td>
<td>6%</td>
<td>-10%</td>
</tr>
<tr>
<td>Elec Spa - Fossil</td>
<td>-122%</td>
<td>-6%</td>
<td>32%</td>
<td>-50%</td>
<td>6%</td>
<td>206%</td>
<td>108%</td>
<td>50%</td>
<td>24%</td>
<td>88%</td>
<td>5%</td>
<td>17%</td>
<td></td>
</tr>
<tr>
<td>Elec Swimming pool - Fossil</td>
<td>-50%</td>
<td>69%</td>
<td>12%</td>
<td>-22%</td>
<td>50%</td>
<td>-3%</td>
<td>114%</td>
<td>129%</td>
<td>111%</td>
<td>-50%</td>
<td>87%</td>
<td>100%</td>
<td>14%</td>
</tr>
<tr>
<td>Elec Sauna - Fossil</td>
<td>2267%</td>
<td>36%</td>
<td>-31%</td>
<td>372%</td>
<td>1176%</td>
<td>-70%</td>
<td>-31%</td>
<td>438%</td>
<td>176%</td>
<td>-10%</td>
<td>288%</td>
<td>-47%</td>
<td>37%</td>
</tr>
<tr>
<td>Elec Gym - Fossil</td>
<td>296%</td>
<td>8%</td>
<td>-70%</td>
<td>72%</td>
<td>409%</td>
<td>-32%</td>
<td>-89%</td>
<td>-29%</td>
<td>235%</td>
<td>623%</td>
<td>155%</td>
<td>-9%</td>
<td>14%</td>
</tr>
<tr>
<td>Elec Kitchen - Fossil</td>
<td>-91%</td>
<td>146%</td>
<td>39%</td>
<td>-3%</td>
<td>-4%</td>
<td>-70%</td>
<td>-49%</td>
<td>210%</td>
<td>-57%</td>
<td>-78%</td>
<td>-92%</td>
<td>-99%</td>
<td>-50%</td>
</tr>
<tr>
<td>Elec Laundry - Fossil</td>
<td>-40%</td>
<td>-60%</td>
<td>30%</td>
<td>-77%</td>
<td>32%</td>
<td>-97%</td>
<td>148%</td>
<td>72%</td>
<td>55%</td>
<td>-65%</td>
<td>121%</td>
<td>-90%</td>
<td>-11%</td>
</tr>
<tr>
<td>Elec Retail inc Food &amp; Bever (open to public)</td>
<td>158%</td>
<td>1133%</td>
<td>4%</td>
<td>92%</td>
<td>-72%</td>
<td>-52%</td>
<td>82%</td>
<td>17%</td>
<td>67%</td>
<td>0%</td>
<td>13%</td>
<td>270%</td>
<td>48%</td>
</tr>
<tr>
<td>Elec Other Fossil Fuel use</td>
<td>989%</td>
<td>88%</td>
<td>-31%</td>
<td>31%</td>
<td>-63%</td>
<td>161%</td>
<td>2139%</td>
<td>-87%</td>
<td>-2%</td>
<td>-40%</td>
<td>-84%</td>
<td>-85%</td>
<td>-2%</td>
</tr>
<tr>
<td>DH Space heating - District heating</td>
<td>-95%</td>
<td>-76%</td>
<td>126%</td>
<td>-59%</td>
<td>82%</td>
<td>-24%</td>
<td>85%</td>
<td>39%</td>
<td>289%</td>
<td>-84%</td>
<td>378%</td>
<td>-35%</td>
<td>9%</td>
</tr>
<tr>
<td>DH Hot water - District heating</td>
<td>-82%</td>
<td>-92%</td>
<td>51%</td>
<td>100%</td>
<td>-8%</td>
<td>-6%</td>
<td>104%</td>
<td>-80%</td>
<td>45%</td>
<td>230%</td>
<td>-17%</td>
<td>55%</td>
<td>-5%</td>
</tr>
<tr>
<td>DC Refrigeration - District cooling</td>
<td>-71%</td>
<td>17%</td>
<td>-27%</td>
<td>28%</td>
<td>2%</td>
<td>19%</td>
<td>2%</td>
<td>5%</td>
<td>2%</td>
<td>-1%</td>
<td>1%</td>
<td>-5%</td>
<td>1%</td>
</tr>
</tbody>
</table>

### Variance to calculated energy performance

- **Utility totals**
  - **Above 25%**: +10% to 25%
  - **+-10%**: -10% to -25%
  - **Below -25%**: -25%
Health & Wellbeing

Tiziana BUSO

tb@rehva.eu

Rapporteur for DTU team
Non-energy benefits constitute dominant costs of running buildings

10% Variation
A 10% variation applied equally to each cost has a far from equal impact

- +/− 0.1% Energy costs
- +/− 0.9% Rental costs
- +/− 9.0% Staff costs

Framework for integration of indoor air quality, comfort and health in the scope of deep energy renovation

Energy renovation actions → Change in conditions defining indoor environmental quality as a result of energy renovation actions → Improved health, well-being, work performance and sleep quality → Estimation of economic benefits
IEQ parameters, selection

- Energy renovation actions
  - IEQ parameters changed in connection with energy renovation
  - IEQ parameters NOT changed in connection with energy renovation
- Estimation of economic benefits
- Classification of IEQ
IEQ parameters
Impacted by energy renovation actions

- **General and local thermal environment** (air temperature, mean radiant temperature, radiant asymmetry, reduced cold draft, reduced risk of overheating/overcooling and free cooling): thermal rehabilitation (insulation) of envelope, roof, ground floor, etc., new low-energy windows, installation of low temperature heating and high temperature cooling hydronic systems, air-based cooling and heating systems, improved control of heating/cooling systems, installation of sunscreens

- **Mold**: thermal rehabilitation (reduced cold bridges), installation of ventilation system

- **Moisture levels**: installation of ventilation system

- **Radon**: thermal rehabilitation of ground floor and cellars

- **Ventilation and air quality**: installation of ventilation system, low-emitting materials

- **Penetration of ambient pollution, airtightness**: tightening of envelope, thermal rehabilitation of envelope and new windows, installation of ventilation system

- **Ambient noise penetration**: new windows, tightening of envelope and thermal rehabilitation of envelope

- **Daylight**: skylights, new windows

- **Visual environment, illuminance**: renovation of low-energy artificial lighting system

- **Glare**: installation of sunscreens

- **No impact on IEQ**: use of renewable energy sources, heat pumps, more effective boilers, connection to district heating, etc.
List of IEQ parameters to be measured in connection with energy renovation (proposal)
<table>
<thead>
<tr>
<th>ALDREN IEQ Parameters</th>
<th>Evaluation method</th>
<th>Compliance with standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>% time outside thermal comfort</td>
<td>Simulation</td>
<td>Level(s)</td>
</tr>
<tr>
<td>Ventilation rate</td>
<td>Simulation</td>
<td>EN16798-1</td>
</tr>
<tr>
<td></td>
<td>Measurement</td>
<td>All certification schemes</td>
</tr>
<tr>
<td>CO₂ concentration</td>
<td>Simulation</td>
<td>EN16798-1</td>
</tr>
<tr>
<td></td>
<td>Measurement</td>
<td>All certification schemes</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>Simulation</td>
<td>EN16798-1</td>
</tr>
<tr>
<td></td>
<td>Measurement</td>
<td>All certification schemes</td>
</tr>
<tr>
<td>Thermal bridges</td>
<td>Simulation</td>
<td>-</td>
</tr>
<tr>
<td>Mould</td>
<td>Measurement</td>
<td>Finish classification system</td>
</tr>
<tr>
<td>Health relevant pollutants: formaldehyde, benzene, PM2.5, NO₂, Radon</td>
<td>Measurement</td>
<td>WHO Air Quality Guidelines</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Some certification schemes</td>
</tr>
<tr>
<td>Low emission materials (new materials introduced during renovation)</td>
<td>Product characteristics</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>EN16798-1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Some certification schemes</td>
</tr>
<tr>
<td>Noise level</td>
<td>Measurement</td>
<td>EN16798-1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Some certification schemes</td>
</tr>
<tr>
<td>Glare</td>
<td>Measurement</td>
<td>EN16798-1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Some certification schemes</td>
</tr>
<tr>
<td>Light color</td>
<td>Measurement</td>
<td>EN16798-1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Some certification schemes</td>
</tr>
<tr>
<td>Illuminance</td>
<td>Measurement</td>
<td>EN16798-1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Some certification schemes</td>
</tr>
<tr>
<td>Possibility to control IEQ: thermostats, blinds, operable windows, task light, quiet rooms</td>
<td>Observation</td>
<td>-</td>
</tr>
</tbody>
</table>
Procedures for quantification/measurement of IEQ parameters (proposal)

- Simulation – comparison of IEQ conditions prior to and after renovation that are the output parameters from energy simulation tools (basic)
- Simulation and verification - comparison of IEQ conditions prior to and after renovation that are the output parameters from energy simulation tools verified by measurements, and supplemented by measurements at locations indicated during simulation as critical (optimal)
- Measurements of IEQ parameters that cannot be simulated prior to and after renovation using the standardized methods (supplementary)
- Observation checklist (optional)
Classification - framework draft

• Parameters to be classified (mandatory, suggested)
  – IEQ before and after renovation to meet EPBD): unchanged, improved
  – COMFORT: according to EN16798-1 (building class I, II, III or IV)
  – HEALTH: compliance with WHO Air Quality Guidelines (Full, Partial, No)
  – ERGONOMY: ability to control (Full, Partial, None)
  – Level(s): compliance with procedures of Levels (L1, L2, L3)

• Parameters to be classified (optional)
  – Any local (or used) sustainability certification scheme
  – WELL certification
Building Renovation Passport & Renovation Strategies

Mathieu RIVALLAIN
mathieu.rivallain@cstb.fr

Rapporteur for POLIMI
Building data & information collection structured in 4 levels

**DATA LAKE = COLLECTED DOCUMENTS, DATA (Plans, factsheets, etc.)**

**PREPROCESS OF LEVEL 0**

**BUILDING LOGBOOK**

**COVER OF ALDREN BRP**

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No. 764159
ALDREN Renovation Roadmaps

REMINDERS

• ALDREN offers **methodologies / protocols**
  
  *No generic building energy retrofit packages*

• **Property owners remain the decision makers**
  
  *ALDREN is to provide inputs so that property owners can further develop their own strategies*

• **Different property owners may have different strategies**
  
  – Public or private real estate
  – 1 building or stock management
  – Multiple locations (local/National/International)
ALDREN Renovation Roadmap[S]?

Potential approaches

Limited interest for a step-by-step approach to building renovation (including energy retrofit)

“We go for deep renovation. We do renovate hotels & offices “once and for all” according to high quality standards”

Financial resources more constrained, smaller property owners

“We need a pragmatic renovation roadmap, consistent with the maintenance needs and possibly offering energy savings”
ALDREN Approach

Actual performance / cost-optimum / deep renovation / NZEB
ALDREN Renovation Roadmaps

- Positioning of maintenance needs overtime
- List of individual options & “Packages”:
  (a) Individual Elementary Renovation Actions
  (b) Towards deep renovation,
  (c) NZEB level
- Template describing the renovation actions
ALDREN Renovation timeline

- **Scope:** Building components and systems related to energy performance improvement
- **Expected renovation periods and remaining (economic) lifespan characterization**
- **Granularity defined by building experts**
List of Elementary Renovation Actions (ERA)

- **Description**, **physical properties**
- **Energy consumptions**
  - [kWhFE/m².an]
  - [kWhPE/m².an]
- **Energy saving** [%]
- **Investment cost** [k€]
- **Investment efficiency**
  - [saved kWh/€]
- **Global cost 20 Y.** [k€]

2 levels: Regulatory & NZEB

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ENVELOPE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal insulation of external walls</td>
<td>U.w = W/m².K</td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal insulation of roof surfaces</td>
<td>U.g = W/m².K</td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal insulation of bottom floor surfaces</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal bridges treatment : Facades to roof</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Windows replacement (1st floor - lobby)</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Windows replacement (2nd - 5th floor - bedrooms)</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doors replacement</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Integration of a double-door entrance</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sliding and solar protections</td>
<td>(envelope air tightness)</td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VENTILATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ventilation : Ventilation system replacement</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENSULATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heating : Heat generation system replacement</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heating : Thermal insulation of distribution network</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heating : Emission systems replacement</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heating : Controls</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DOMESTIC HOT WATER</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DHW : Heat generation system replacement</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DHW : Thermal insulation of the storage</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DHW : Thermal insulation of distribution network</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DHW : Emission systems replacement</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DHW : Controls</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COOLING</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooling : Heat generation system replacement - Group 1</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooling : Heat generation system replacement - Group 2</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooling : Thermal insulation of distribution network (Fluids)</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooling : Emission systems replacement</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooling : Controls</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LIGHTING</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lighting : Lighting system replacement - lobby</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lighting : Controls - lobby</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lighting : Lighting system replacement - corridors</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lighting : Lighting system replacement - bedrooms</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lighting : Controls - bedrooms</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RENEWABLES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Renewable energies : Photovoltaics</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ERA Description template

ILLUSTRATE

Set the performance levels to “Avoid the locker effect”

- “Regulatory” (cost optimum compliant)
- “NZEB”

Introduce the holistic approach “No regression on health, comfort, IEQ, risks”
Ex. NZEB Renovation roadmap

- Methodology
- Rearrangement of the time sequence
- Gathering
- Introduction of required additional renovation actions
- ERAs = NZEB level
Live poll & open discussion
Conclusions & next steps

• ALDREN offers a European harmonized quality benchmark, based on EU CEN standards, and a holistic approach to assess deep renovation benefits and impacts on building valuation, guaranteeing comparability, transparency and quality.

• Upcoming activities:
  – Consolidation of the proposed protocols
  – Implementation in offices and hotels
  – ALDREN Alliance: Create together an effective vehicle for future cooperation and communication of stakeholders, to overcome the barriers for deep renovation.

• We need your opinion and feedback!
This project has received funding from the under the European Union’s Horizon 2020 research and innovation programme under grant agreement No. 754159

JOIN ALDREN!

ALDREN ALliance for Deep RENovation in buildings

Implementing the European Common Voluntary Certification Scheme, as backbone along the whole deep renovation process.
This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 754159.

The information in this publication does not necessarily represent the view of the European Commission.

© ALDREN
All rights reserved. Any duplication or use of objects such as diagrams in other electronic or printed publications is not permitted without the author’s agreement.