H2020 MORE-CONNECT

Development and advanced prefabrication of innovative, multifunctional building envelope elements for MOdular REtrofitting and smart CONNECTions

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MORE-CONNECT: solving barriers to come to deep (NZEB) retrofitting

- European building sector is fragmented and not able to offer holistic, integral solutions for nZEB deep renovation for reasonable costs and good quality
- European building process is based on a ‘layered’ structure:
  - many labour actions on the buildings site
  - many sub disciplines involved
  - leading to extra costs and failure risks
- European building market is top down and supply driven:
  - mismatch between the offered products and the end-user's needs and the affordability
- Due to long-lasting renovation process and failures risks customers hesitate to renovate their property
- High operation costs are still more acceptable for owners-residences than deep renovation with low exploitation/ energy costs
MORE-CONNECT: challenge and solution

• Deep retrofitting by using *prefabricated multifunctional* renovation elements which have the potential to:
  – reduce costs
  – reduce the renovation time and disturbance for occupants
  – enhance *quality and performances*
    • energy efficiency
    • indoor climate

• The *challenge* of MORE-CONNECT is to make a major step forwards by a combination of:
  – product innovation,
  – process innovation
  – innovative market approach
  – in a process of cost and quality optimization
  – driven by motivated and innovation-driven SME’s.

• Why SME’s?
  – Large building companies are very traditional and have no specific economic interest in this transition
  – Transformation in building practice will be initiated by motivated innovative SME’s, combined with production-line-design specific experience
The four qualitative MORE-CONNECT objectives

1. **The development of cost optimal deep renovation solutions towards nZEB concepts with the possibility of extra customize (cost-effective) features**
   - Development of optimal configurations of energy efficiency and renewable energy systems, as one of the quantitative objectives is the offering of nZEB renovation concepts.
   - Concepts will be preselected in balance between demand reduction and renewable production,
   - Most optimal mix within the range of term ‘nearly’ in Nearly Zero Energy.

2. **The development and demonstration of prefabricated multifunctional modular renovation elements in series of 1 concepts, in a mass production process**
   - Development and demonstration of a platform for prefabricated, multifunctional renovation elements for the total building envelope (facade and roof) and installation/building services.
   - These elements can be combined, selected and configured by the end-user, based on his specific needs.
   - The configuration can be made on the basis of a pre-selection of elements, based on the specific properties and measures of his home inventoried by advanced geomatics with various aesthetic and architectonic appearances.
   - As input into advanced Building Information Modelling systems it can control and steer the further production process of these elements.

3. **The development and demonstration of new fully automated production lines for multifunctional modular renovation elements**
   - Development of new designed automated production lines supporting a line production that is effective on series-1 as well as large series
   - Demonstrated that a model for one common platform for a fully automated production line can be used in different geo-clusters

4. **The offering of a one-stop-shop to the end-user to renovate their homes**
   - End-user will deal with only one party, responsible for the total renovation, starting from an inventory of the existing situation, inventory of specific end-user demands, translation into modular renovation kits, mounting and installing, financing and aftercare
   - Limiting the actual renovation time on site to a maximum of 5 days with a goal for an average of two days, including the complete or partial removal of the existing facades and roofs or other elements
The MORE-CONNECT pillars

• **Product innovation**
  – Modular façade elements
  – Modular roof elements
  – Modular ‘engines’

• **Process innovation**
  – Advanced geomatics to make inventories and gauging of buildings and buildings stock.
  – Web-based and/or digital decision tools will link building characteristics, building (energy) potentials, end-users demands to program requirements, technical solutions, component combinations in concepts, production automation.
  – This will be processed in BIM systems for the steering of industrial processes and for enhanced quality assurance.

• **Optimization** between costs, environmental aspects and quality
  – Integration of components and systems
  – Re-design
  – Smart connectors

• Based on NZE concepts <> perception of end-user
Perception of end-user

End user has three basic questions:

– *What do I get?*
– *What does it cost?*
– *And what does it gain to me?*

How does MORE-CONNECT respond to this?

– Development of a **one stop shop concept**
  • Offered as an ‘advanced energy service’
  • User can make his own renovation configuration
  • User can add extra qualities / options
  • End-user deals with only one party, responsible for total renovation, inventory, mounting, installing, financing, after care and performance guarantee

– Development of a system of performance guarantee
  • In production process
  • In practice (‘remote diagnostics’)

– Development of energy cost guarantee proposition to end-users
Customers are able to make their own choices and configurations!
MORE-CONNECT approach: one philosophy – different solutions for several geoclusters

- **Geo-cluster 1: Northern.**
  - NZE renovation concepts for post-war multifamily dwellings in Denmark.

- **Geo-cluster 2: Continental Northern East.**
  - Focusing on a collaboration between Estonia and Latvia. Focus on application of prefabricated products for typical post-war Soviet multifamily buildings.

- **Geo-cluster 3: Continental Centre.**
  - Focusing on Czech Republic on solutions for continental climates.

- **Geo-cluster 5: Mediterranean.**
  - Focusing on solutions for mild and warmer climates, with a pilot for the Portuguese market.

- **Geo-cluster 6: Western Central.**
  - Focuses on modular prefab concepts for mass built single houses (50’s – 70’s) for the Dutch/Belgium markets.

- Reflected in the consortium: one ‘research partner’ (university or SME with research capacities) with one or two (SME) industrial partners.
MORE-CONNECT pilots

< Denmark
(3D printed facades)

Estonia >
(adding prefab façades)

Latvia >
(adding prefab façades)

< The Netherlands
(total removal and Replacement)

Czech Republic> (mock up façade)

< Portugal
(adding prefab façades)
MORE-CONNECT technical developments

• Modular façade elements
  – Solutions depending from building typology/morphology
    • total removal and replacement of façade
    • partial removal and replacement of façade
    • adding façade elements
    • 3D printing

• Modular roof elements
  – Integrated with PV panels (optional)

• Modular platforms for building services ‘engines’

• Smart connectors (mechanical, hydraulic, air, electric, ICT)
Modular façade elements

• Total removal/replacement (the Netherlands)

• Adding prefab elements (Estonia)
Development basic modular elements for facades - Estonia

- Design and construction of panels
Modular platforms for building services ‘engines’

...which one is more expensive?

~ € 900

~ € 25.000

Steenland
MORE-CONNECT solution: prefab modular ‘engine’ for retrofitting

- Combining heating, ventilation, DHW, storage, PV inverters etc. in one compact platform
- Version 1.0: combination of existing components
- Version 2.0: miniaturizing redesigning components, 35% more compact and lighter
- Modularity:
  - Place in the building:
    - Central unit
    - Decentral (split) units
  - Medium for heat transfer:
    - Water
    - Air
    - All-electric
    - Hybrid
  - Phased in time:
    - Upscaling/downscaling (changing families, use, etc.)
    - Starting with (low budget) basic option, later to be extended or adding new technologies (‘no-regret options’).
....making the engine 1.0
(still ‘hand-made’)

[Images of a machine being assembled and parts being laid out]
...placing the engine on/in the (integrated PV) roof

MORE-CONNECT dwelling
Heerlen, The Netherlands
New development and redesign engine (2.0)

- CO2 controlled MVHR
- Storage
- Heat pump
- PV

Optional:
- Solar thermal
- PCM storage
- E-storage (DC?)

Plug & Play
Maintenance and repair off site
Scalable up/down
Ventilation: two options for prefab retrofitting

• In the engine: Central MVHR, CO2 controlled

• In the façade elements: Decentral combined with radiator or convector
  – MVHR, CO2 controlled (standard in living room)
  – Mechanical supply (optional for bed rooms)
MORE-CONNECT Smart connectors
air, mechanical

- Air (ventilation ducts)

- Mechanical connectors
  - rectification in 3D
  - anchoring only to the ceiling structures
MORE-CONNECT Smart connectors
Electric, ICT

- Distribution of power 230VAC to the flats (Mennekesh)
- Distribution of Photovoltaic DC bus to string the integrated PV panels
- Distribution of ethernet and communication bus for sensors and controller
MORE-CONNECT Smart connectors

- Example smart connection box:
  - Heating by heat emitters below the window
  - Connections in connection box – heating, regulation, electricity)
  - Heating system connected from façade panels
  - Use of special facade elements for hydraulic piping systems
Conclusions

• Series of 1 in mass production possible if production process is fully automated and BIM controlled

• Further improvements to be made by the development of
  – compact installation platforms (‘engines’)
  – Smart connections (mechanical, hydraulic, air, electric, ICT)

• By extreme prefabrication deep renovation of single family dwellings to a nZEB level is possible:
  – For € 45.000 – 50.000 (now € 65.000)
  – Within less then 5 days (now 8 days)
Discussion: barriers versus benefits

Barriers
- Technical
- Social
- Costs

Benefits