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"Energy-efficient Buildings (EeB)" Public-Private Partnership

Preliminary ideas of areas to be covered by NMP in 2014

EeB.NMP.2014-1 Innovative design tools for refurbishment at building and district level– RTD, TRL 4-6, large

Scope:

The development of sustainable solutions for refurbishment of buildings and their proper integration at district level requires major innovations in the design tools, construction methods and management practices.

To improve the reliability of design tools for the refurbishment of buildings, the main challenge is to ensure the interoperability between tools from various domains and at different scales. Knowledge in the fields of modelling and computation should be applied in order to propose solutions adapted to collaborative multi-disciplinary refurbishing work.

Research activities should be focused on design at buildings and district level, taking into account the adjacent systems such as district heating/cooling and decentralised thermal energy generation and other interactions with the neighbourhood. Projects should promote and set up an integrated approach in support of innovation, by providing actors with holistic methods and tools. The design phases linked to retrofitting of existing buildings taking into account subsequent operation and maintenance will be considered as priority. Knowledge based design can also be used to provide input into management systems. Projects should also cover validation actions on a technical level, which apply the tools on refurbishment projects; and on a societal level, i.e. validation with the occupants of the building. For the latter, involvement of organisations within an Integrated Project Delivery Approach, supporting a participatory design approach, could be an asset.

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In order to ensure the industrial relevance and impact of the research effort, the active participation of industrial partners, including SMEs, represents an added value to the activities.

Funding Scheme: RTD projects

Expected impact:

More effective refurbishment at building and district level. Optimised design of integrated energy-efficient buildings, considering the different physical dimensions in a coupled and holistic way (energy, comfort, air quality, acoustics etc.), enabling actors to take validated and quantified choices for the refurbishment at building and district level on the basis of quantified performance objectives with compliance with regulation and user-oriented comfort expectations and constraints.

EeB.NMP.2014-2 Mass manufacturing of prefabricated modules for refurbishment – RTD, TRL 4-6, large

Scope:

Prefabricated components are more and more commonly used in the construction sector (e.g. precast or prefabricated structural components, preassembled parts of the envelope). Compared to traditional construction processes, prefabrication aims at reducing costs at constant quality, as well as facilitating installation/dismantling/re-use of components. In addition, the shift towards mass customization and standardization allows a better achievement of the building performance targets: factory-made modules, produced in a controlled industrial environment, and easily and quickly assembled, are generally more reliable in their operational response than non-prefabricated solutions.

Therefore, building components could, when relevant, be prefabricated in factories to gain on construction time and to improve health and safety at work sites. This is particularly suitable for refurbishments carried out to reduce the building energy demand in the use-phase, where parts of the new envelope can be pre-assembled off-site.

Further research is needed to improve understanding of material and component behaviour in the whole life cycle and, consequently, to be able to produce better performing products. New materials combining structural properties and/or thermal resistance/inertia and/or light weight, as well as low content of embodied energy and other characteristics that make them suitable for use in prefabricated solutions for energy efficiency need to be developed.

Innovative technologies for energy efficiency can also be integrated in the prefabricated modules and components. The elements are to be developed, prototyped, optimised and transferred from individual manufacturing to mass production.

Innovative mass manufacturing processes must be investigated to lower pre-fabrication costs and ease building integration processes, also taking into account aesthetics. This requires the development of new controlled processes and cost-effective automated/robotised tools. The new tools/machines will assist workers in the deployment phase reducing time and increasing connection quality standards. Dedicated handling tools require new processes to be developed, tested and implemented using enhanced scanning technology collecting spectral and geometric information in combination with a Building Information Model. Guidelines for integration and installation of the elements should be made readily available to all the parties involved. The handling system should also support self-inspection. These new processes will require additional training and the definition of possible emerging risks. Durability of proposed solutions will have to be evaluated in real installation conditions, as this is a crucial factor that influences final product performances.

During the development of technology and components for prefabricated façade elements, structural engineering aspects must be taken into account.

In order to ensure the industrial relevance and impact of the research effort, the active participation of industrial partners, including SMEs, represents an added value to the activities. The proposals should cover both research and demonstration activities. Prototypes and pilot implementations in real industrial settings represent a clear added-value.

Funding Scheme: RTD projects

Expected impact:

- Reduction in energy consumption by at least XX% with respect to the values before renovation.

- Significant Increase in construction and refurbishment productivity, as well as in effectiveness of construction site management.
- Reduction in installation time by at least XX%.
- Better quality standard and performance guarantee for the installed prefabricated modules.
- Demonstration of the replicability potential.
- A maximum return on investment of around XX years.
- Generation of new high-tech SMEs specialised in refurbishment with prefabricated modules.
- High-skill jobs for workers that could master innovative construction tools.

EeB.NMP.2014-3 Development of new self-inspection techniques and quality check measures for efficient construction processes – RTD, TRL 4-6, large

Scope:

Today's availability of better energy-efficient building components (envelopes, windows, etc…) calls for ensuring that these benefits will not be lost by lack of knowledge or bad implementation during the construction processes which may affect the final performance of the building. In addition, the construction sector is characterised by a segmented approach involving a variety of skills and expertise with different role and responsibility. This means that quality control is of utmost importance to guarantee that the energy performance at commissioning stage will meet the one expected at design stage.

The research focus is on new self-inspection techniques and quality check measures for efficient construction processes. In particular methods for energy related self-inspection, for example to avoid the presence of thermal bridges or to ensure and control good air-tightness in low energy or passive buildings.

The solutions proposed should preferably be cost-effective and easy to use, considering that they will be implemented on-site by workers which are not necessarily highly skilled.

The solutions should be validated and demonstrated in a near to operational construction environment.

In order to ensure the industrial relevance and impact of the research effort, the active participation of industrial partners, including SMEs, represents an added value to the activities.

Funding Scheme: RTD Projects

Expected impact:

To guarantee the final thermal, acoustic and energy performance of the building while increasing the efficiency, reliability and productivity of the construction processes. To provide guidelines, methodologies for workers and contribute to standardisation activities. Reduction by at least 50% of the mismatch of energy performance between design stage and commissioning stage.

FoF.NMP.2014-4: Support for cluster activities of EeB PPP projects – Coordination action

Scope:

Clustering of project activities, according to objectives and addressed themes, is an effective way to stimulate the achievement of project results and to exploit synergies. This clustering approach could bring about additional benefits through cross-fertilisation (e.g. reporting of technological progress; exchange or licensing of IPR; joint standardisation efforts) and identification of value chain elements required for industrial success. The final target is to tackle the bottleneck for the deployment in Europe of new and promising technologies, in order to foster innovation in products and their manufacturing and the sustainability of the European industrial economy.

The coordination actions shall aim in particular to the active clustering of existing activities under the EeB PPP.

Funding scheme: CSA

Expected impact:

- Speeding up the industrial exploitation and take up of the results of EeB PPP projects.
- The stimulation of networks and alliances for further RTD and industrial innovation in the addressed technology and application areas.
- Additional added value beyond the original scope of the EeB PPP projects by exploiting synergies and sharing best practice
- Increased public presence and awareness of EeB PPP activities.
- More effective execution of activities of common interest, such as IPR management and standardisation.

Preliminary ideas of areas to be covered by NMP in 2015

EeB.NMP.2015-1 New tools and methodologies to reduce the gap between predicted and actual energy performances at the level of buildings and blocks of buildings – RTD, TRL 4-6, large

Scope:

The monitoring of real energy use in energy-efficient buildings frequently shows major differences with respect to the predicted performance. This is even worse if a set of interacting buildings is considered. It is therefore important to capture the real complexities of the actual buildings energy performance. In addition, effective methodologies for the correct understanding of user behaviour needs to be addressed.

At building level, the research focus is on developing methodologies and tools to monitor and assess real building energy performance, including user behaviour, energy systems performance and to be able to predict accurately buildings short-term load forecast and energy consumption taking into consideration weather forecast. The new methods and tools could include energy performance diagnostics for predictive maintenance (related to different construction typologies and their thermal behaviour), and should be accurate enough to support decision making during the different stages in the life of the buildings. The effective monitoring and management of energy flows to help reduce energy consumption should also be addressed. Common indicators, measuring technologies and data analysis methods should be developed to monitor building performance during operation.

A holistic approach to building control and monitoring systems is required. High quality and reliable data acquisition methodologies are also needed.

At the level of a block of buildings, the focus will be on real time optimisation of energy demand and supply using intelligent energy management systems with the objective of reducing the difference between peak power demand and minimum night time demand.

Cost-effective solutions should be demonstrated for a block of buildings consisting of at least 3 different buildings in near real life operating conditions.

In order to ensure the industrial relevance and impact of the research effort, the active participation of industrial partners, including SMEs, represents an added value to the activities.

Funding scheme: RTD projects

Expected impact:

Significant reduction in the difference between real and predicted energy behaviour in a building or a block of buildings, after the demonstration of the viability of the new tools and methods for measuring and analysing real building energy performance. The gap is narrowed down to a value consistent with energy performance contracts – to be quantified.

EeB.NMP.2015-2 Adaptable envelopes integrated in building refurbishment projects– RTD, TRL 4-6, large

Scope:

The refurbishment of the existing building stock requires ground-breaking strategies in order to meet targets for reduced energy use and greenhouse gas emissions. One of the most important components to be addressed with an innovative approach is the building envelope, which has to develop into an active rather than a passive element, meeting more functions than just the separation of the outer space from the interior with an insulation.

The concept of adaptable envelope is twofold. On the one hand, it is designed to accommodate further modifications (such as future renovation or technology upgrades). On the other hand, the envelope is able to adapt to a dynamic and intricate environment by measuring and processing multi-source information (e.g. outdoor and indoor environment conditions, occupancy, behaviour of users and envelope performance) in order to respond to the building occupant's instructions and to evolving environmental conditions in an appropriate timing and extent.

Breakthrough solutions are therefore needed to improve roof and façade functional characteristics to enable the building envelope to adapt to a dynamic, mutable and complex environment during its lifetime. Research are expected to cover for example, advanced materials or technologies for energy generation and storage; smart insulation materials; strategies for improved air quality, moisture control, ventilation control; automated blinds or movable sun barriers with interrelated issues of summer overheating, air-tightness and natural light use; as well as integration of innovative sensing systems to control and optimise the real time performance of the envelope.

In addition, proposers should also seek to include in the adaptable envelopes features that could facilitate the future renovation or conversion of the whole or part of the building (fostering creativity and an active role of architects and engineers at design stage), such as:

- Adaptability to different shapes, façade conditions, building orientations and general conditions of the building along its lifetime;
- Conversion of rooms, or buildings, to new usage;
- Possibility to integrate new solutions (upcoming technologies) and systems;
- Self-adaptation, which is important in relation to current weather and building load situation, and changing use patterns (including new users, or family instead of single users).

Clear evidence of technical and economic viability should be provided by validating and demonstrating the proposed adaptable envelope in real case retrofitting projects.

Funding scheme: RTD projects

Expected impact:

Energy consumption reduced by at least XX% with respect to the values before installation of the adaptable envelope. Improved indoor environment. Replicability potential must be demonstrated in a real case-study and the return on investment should be around XX years.

EeB.NMP.2015-3 Innovative techniques to measure the contribution of critical components to energy efficiency– RTD, TRL 4-6, SME-targeted

Scope:

The measure of the contribution of critical components to energy-efficient buildings frequently highlights the potential to improve performance. Critical components to energy efficiency have proven to have significant impact for buildings. With today's high energy prices, a proper understanding of critical components to energy efficiency is crucial in terms of savings and comfort.

Each actor of the construction value chain must ensure that its contribution fits into a quality framework defined collectively at the design level. Self-inspection and quality checks are implemented to guarantee the final thermal, acoustic and energy performance of the building which will be quantified during commissioning. For instance, undamaged thermal insulation layers and the air tightness of buildings as well as fully functional building services equipment must be ensured at the commissioning stage.

Funding scheme: RTD projects

Expected impact:

Innovative techniques to measure the contribution of each critical component to thermal insulation, air-tightness and building services equipment in energy efficient construction

EeB.NMP.2015-4 Validation of an integrated approach to retrofitting of residential buildings – DEMO, TRL 6-7

Scope:

Europe is facing the challenge of deep rehabilitation of residential buildings (including buildings of historic value) while lowering the costs of refurbishment. Such a large building stock needs innovative, efficient and cost-effective retrofitting solutions to meet the planned net-zero energy standards. Moreover, due to the current economic crisis investment capability in building retrofitting is limited and public incentives tend to decrease. Breakthrough solutions are, therefore, needed which combine affordability along the whole life cycle with reduced energy use.

Systemic approaches need to be developed which integrate the most promising cost-effective technologies and materials, including for example: energy production and storage through a combination of renewable energy sources and zero-CO2-emission micro-cogeneration at building level; energy use through innovative HVAC systems; solid state lighting; innovative fire-resistant insulation; light-weight components and made-to-measure solutions, as well as components enabling an adaptive behaviour.

The district scale, as well as the interactions between buildings and the grid (i.e. impact on the energy demand) and with an eventual heating network available in the neighbourhood should be taken into account.

Energy efficiency should be addressed by proper system integration and installation, e.g. through synergy between technologies which have already been proven at a small scale and need a larger scale demonstration.

A high replication potential is necessary. At least two demonstration sites should be considered in two different climatic conditions in order to ensure that the technologies are as widely applicable as possible. The corresponding district dimension should be taken into account when defining the overall approach and should be reflected in the selection of the demonstrators.

In order to ensure the industrial relevance and impact of the research effort, the active participation of industrial partners represents an added value to the activities and this will be reflected in the evaluation, under the criteria Implementation and Impact. In addition, to ensure appropriateness of business models, the participation of building owners (private or public organisations) is recommended. User involvement in renovation processes will require special attention, in particular when a deep retrofitting is required. Social and behavioural aspects are critical factors for project success. In parallel, new low intrusive techniques and the utilization of tools and technologies that speed up construction processes with high quality standards are welcome.

Funding scheme: Demonstration projects

Expected impact:

The innovative retrofitting solutions should be proven in the demonstration buildings as real cases approaching net zero energy standards. They should result in a reduction of at least 60% in energy consumption compared to the values before renovation while ensuring affordability. The replicability potential should be demonstrated and the return on investment should be around 7 years (in the case of deep retrofitting). Advent of a new generation of skilled workers and SME contractors in the construction sector aware of the need of a systemic approach towards energy efficiency should be promoted.