ENERGY EFFICIENT BUILDINGS
AN ECTP COMMITTEE FOR INNOVATIVE BUILT ENVIRONMENT

EeB PPP Project review 2018

May 2018

Foreword

The Energy Efficient Buildings (E2B) Committee of the ECTP is pleased to introduce the seventh edition of the EeB PPP Project Review. This yearly publication presents the progress of a portfolio of 168 projects in total. 110 are co-funded within the EeB PPP under the 7th Framework Programme (FP7) from 2010 to 2013 and 58 co-funded projects under the Horizon 2020 programme between 2014 and 2017.

The Energy Efficient Buildings (EeB) Public Private Partnership (PPP) is a joint initiative of the European Commission (EC) and the construction industry, represented by the Energy Efficient Buildings (E2B) Committee of the European Construction, built environment and energy efficient building Technology Platform (ECTP). This initiative aims at promoting research on new methods and technologies to accelerate the process of reduction of energy use in new and retrofitted buildings and to improve the European industrial competitiveness. One of the contractual PPP commitments consists in monitoring the impact and exploitable outcomes generated by the projects.

The 2018 edition of the Project Review highlights current results and achieved or expected benefits of the EeB PPP projects. The overall target is to develop breakthrough affordable technical and business driven solutions at building and district scale. The projects demonstrate scientific and technological excellence, across the whole value chain, from early stage conception to demonstration of almost ready-to-market innovations. Categorised into 7 technology-clusters defined according to the construction-related research & innovation value chain from the EeB PPP Roadmap (Design, Technology Building Blocks, Advanced materials and nanotechnology, Construction process, Energy performance monitoring & management, ICT and BIM), the 168 research projects presented in this brochure illustrate the diverse innovation approaches and the importance of embracing all aspects of the building and construction sectors.

We hope you will enjoy learning about the progress of the EeB PPP projects featured in this new edition and potentially develop fruitful cooperation with some of them.

Javier Bonilla
Chair of the Energy Efficient Buildings Committee of the ECTP

Antoine Aslanides
Co-Chair of the EeB PPP

Emmanuel Forest
ECTP President

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The information on each project has been kindly provided by the project participants. Neither the ECTP nor the European Commission can assume responsibility for any errors.

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*
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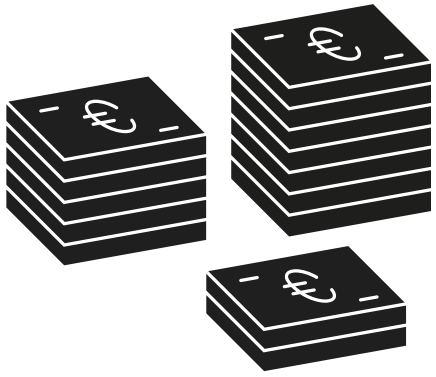
Average values were calculated from relevant figures provided by the FP7 EeB PPP projects in the questionnaire and therefore do not represent the whole set of 168 projects featured in this document.



Average budget (M€)

7.5

Number of spin-offs & start ups resulting from cPPP projects

16

Highest budget (M€) (CityFiED)

46

Highest additional private investment mobilised in the project (M€)(READY)

174

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Technology Readiness Level for all clusters

- 9 — Actual system proven in operational environment — The highest for all clusters
- 8 — System complete and qualified
- 7 — System prototype demo in operational environment
- 6.4 — Average for all clusters
- 6 — Technology demonstrated in relevant environment
- 5 — Technology validated in relevant environment
- 4 — Technology validated in lab
- 3 — Experimental proof of concept
- 3.5 — The lowest for all clusters
- 2 — Technology concept formulated
- 1 — Basic principles observed

Average reduction of energy use due to the innovation

31.6%

Most represented cluster

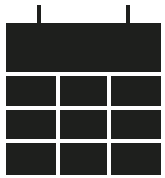
Energy performance monitoring and management

Number of systems & technologies developed by the cPPP projects

300+

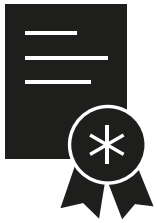
Average reduction of waste due to the innovation

7.9%



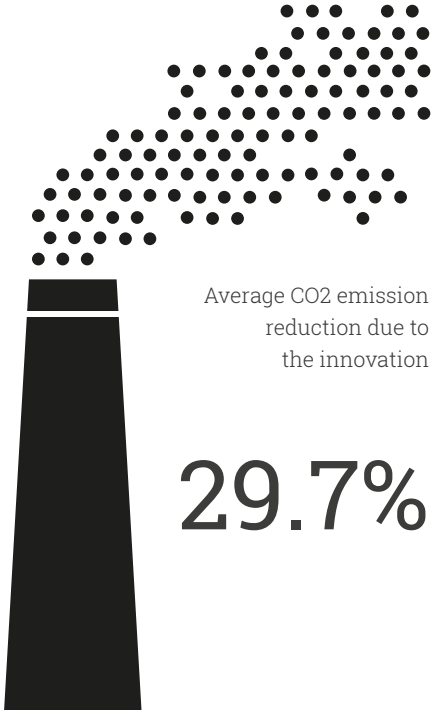
Duration (month) (average per project)

43.5



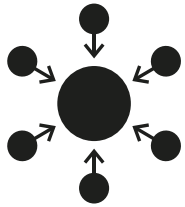
Number of patents application (average/project)

1



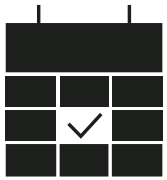
Average CO2 emission reduction due to the innovation

29.7%



Share of participation of SMEs

28%



Training & events (average/project)

19.7

Full scale demonstrators (average/project)

2.8

Number of people trained (average/project)

899

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H2020 EeB PPP Impact Key Performance Indicators

*
Figures are based on the EeB PPP monitoring questionnaire circulated in March 2018.
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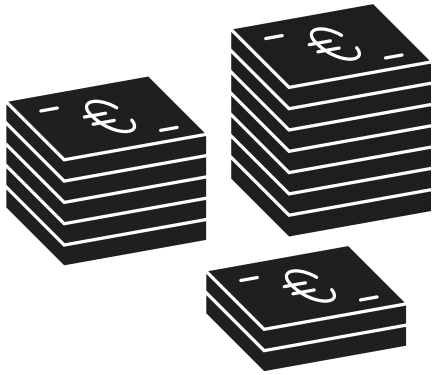

Average budget (M€)

5.4

Number of spin-offs & start ups resulting from cPPP projects

7

Highest budget (M€) (BuildHEAT)

9.1

Highest additional private investment mobilised in the project (M€)(DREEAM)

11.2

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Technology Readiness Level for all clusters

- 9 — Actual system proven in operational environment — The highest for all clusters
- 8 — System complete and qualified
- 7 — System prototype demo in operational environment
- 6 — Technology demonstrated in relevant environment
- 5.3 — Average for all clusters
- 5 — Technology validated in relevant environment
- 4 — Technology validated in lab
- 3.8 — The lowest for all clusters
- 3 — Experimental proof of concept
- 2 — Technology concept formulated
- 1 — Basic principles observed

Average reduction of energy use due to the innovation

18.7%

Most represented cluster

Technology building blocks

Number of systems & technologies developed by the cPPP projects

223

Average reduction of waste due to the innovation

10.8%

Duration (month) (average per project)

52.5

Number of patents application (average/project)

0.2

Share of participation of SMEs

35%

Training & events (average/project)

10.7

Average CO2 emission reduction due to the innovation

13.1%

Full scale demonstrators (average/project)

3.6

Number of people trained (average/project)

450

Design

There are 23 'design' projects, covering a vast range of relevant and related subjects essential to help Europe reduce its carbon emissions. Although this section is defined as 'design', many of the projects inevitably cross over into other areas such as materials; construction process; monitoring; systems management; BIM and life-cycle. Likewise, other projects fringe upon the 'design' category even though they are not defined as such in this report. Conversely all other funded categories will ultimately be involved in the design process as the products and services come to market.

The topics covered by the design projects range from individual buildings to neighbourhoods; from new building design to retrofit solutions; and from products and processes to advanced decision support tools. All projects are involved in creating or applying new technology to help achieve a more sustainable built environment. The importance of getting the design right is emphasised throughout all projects.

In terms of scale the projects fall predominantly into four categories: building materials and components [11, 69, 70]; buildings [26, 79 and 94, 116, 144, 154]; building projects which subsequently target neighborhood applications [36, 41, 43 and 103, 141]; and neighborhoods [17, 22, 32, 40, 49, 60, 66, 86 and 90]

Primarily all projects are targeting reducing energy consumption and/or making buildings more sustainable. Projects have energy targets ranging from 20% energy savings [26]; to net zero-energy buildings [70, 79]; to projects with aspirations of achieving up to 50% energy reduction for neighbourhoods [90, 103]. Collectively the various neighbourhood projects are attempting to address 'economies of scale' for three principal reasons: it will take too long to improve Europe's 160m buildings one building at a time; we need to reduce cost of renovation (154) in order to improve the financial return; and the decision-making process becomes more complex as the scale grows.

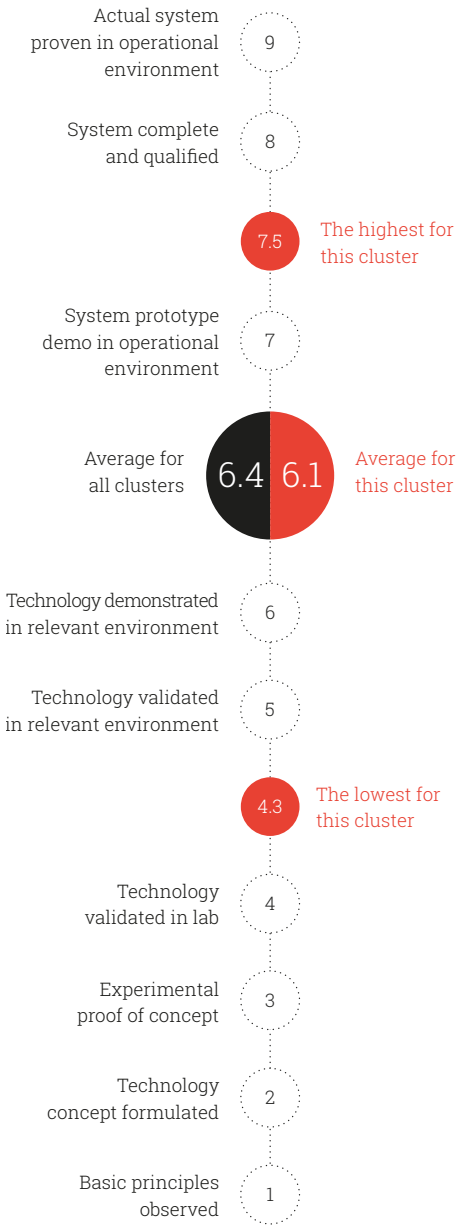
Fragmentation within the construction value chain becomes more acute as the project becomes larger. The neighbourhood projects are trying to overcome this problem by providing information to encourage collaboration and holistic decision making throughout the neighbourhood lifecycle. Typically, the projects are taking slightly different approaches to solve this problem and provide the tools necessary for different target markets. For example, a project is addressing energy system optimisation for different life-cycle phases [17] whilst another takes account of the whole building lifecycle and the influence of the neighbourhood [60].

One of the key trends in the neighbourhood projects is to engage with multiple stakeholders and decision makers throughout the whole lifecycle process. Such a coordinated approach enables interdisciplinarity in design and construction processes as well as monitoring of results [17, 32, 36, 49, 60, 66, 86 and 103].

Providing information or decision support tools is prominent in numerous projects. This includes defining a roadmap [66] to help inform future policy and provide recommendations, to create awareness among stakeholders, and develop tools to guide decision makers in creating more energy-efficient neighbourhoods. Other decision support tools take a more direct approach [32] aimed at providing tools to assess the life-cycle costs and benefits, as well as the environmental and social impacts at a neighbourhood level.

Several projects aim to develop cloud-based, modular open source and/or BIM-based collaborative design platforms to integrate energy management systems and decision support services with other services such as security and transport [22, 32, 36, 60, 103]. One project has a BIM-based system central to providing an integrated multi-model information management system [36], aiming to design more energy-efficient buildings and integrate them well with other buildings in the neighbourhood. Another project [49] aims to provide an Integrated Decision Support Tool to help decision makers select the best energy retrofitting strategy in order to increase the sustainability of the whole neighbourhood.

Technology Readiness Level for this cluster



Several projects are aimed at specific building applications: residential areas [86], public buildings [90], hospitals [103] and schools [94].

Renovation of residential buildings to achieve near zero-energy neighbourhoods is a massive challenge and hence one project is investigating design, construction and management of large scale residential neighbourhood renovations projects [86]. For example, a project aims to leverage public and private investment by aggregating multifamily houses residents [116].

Renovation of public buildings is used to demonstrate the viability of energy efficient retrofitting and the performance of innovative retrofit technologies [90]. These projects are ensuring that design and decision-making tools are operating together to provide the necessary information for stakeholders and decision-makers [146].

The hospital project [103] addresses the wider 'campus' issue looking at applications where there are a number of buildings on a hospital site. The projects aim is to reduce energy consumption on hospital campuses by 50% within the next ten years, by replacing current inadequate methodologies with a holistic energy efficient approach for new and retrofitted buildings.

The school project [94] aims to improve energy performance and indoor comfort of schools by investigating holistic building envelopes, renewables and management systems. The project demonstrates significant energy savings at relatively low additional costs.

In a socio-oriented perspective, [150] creates a distinctive integration between energy deep renovation techniques and seismic retrofitting actions.

Several projects working at the building level are providing innovative products and processes to improve energy efficiency and sustainability.

The first project involves high performance insulation. Whilst appropriate for new and existing buildings this technology is being targeted at pre-1975 buildings [11]. The second project relates to a quadruple glazed window system aimed at residential and commercial markets [70] to help achieve zero-energy buildings. Both projects emphasise the need to cooperate with architects and the building design team to successfully adopt the material into real cases. Another project is addressing predicting the future performance of a building by considering such factors as material deterioration; technology evolution; and climate [26]. This solution is targeted at both the building and neighbourhood level, with decision support particularly targeting early design phases. A fourth project investigates a new and innovative façade system to increase the energy efficiency of residential buildings in Europe [69].

Two projects are geared towards energy storage systems to align energy availability with demand. Both projects address the issue of long-term energy storage. The first project stores excess heat via Thermo-Chemical Materials for prolonged periods with minimal heat loss or in distributed storage vessels or boreholes for prolonged periods with minimal heat loss, using intelligent controls [40]. The second project is investigating the use of a low energy heating system based on Seasonal Thermal Energy Storage in combination with heat pumps for space heating and domestic hot water [41].

User-centred design with environmental, social and economic benefits is the emphasis of a range of projects. One project involves a phone app which allows the user to search through products in different product groups [43]. Other projects use scenarios [17], a 3D graphic user interface [49] or user interviews [40] to analyse user consumption behaviour, increase acceptance by users and achieve more holistic solutions.

In summary, the overall result will be projects with significant environmental, social and economic benefits for end users and society as a whole.

Techology building blocks

Nanotechnology-based materials are used to improve envelope thermal features and cost-effectiveness. Thermal insulation is implemented with aerogel, working on its mechanical reinforcement [4] and the integration into building products for its extensive use in new buildings and retrofits [59]. Nano-porous foam as a VIP-core allows adding value to the envelope with improved gas and water vapour barrier properties [75]. Lightweight and highly insulating nano-cellular foams were coupled with embedded sensors [51]. The dispersion of microcapsules containing PCM into insulation was investigated to improve thermal capacity [76]. A cost-effective range of nanotech improved NIR coatings can be used to substantially reduce energy demand for cooling [21].

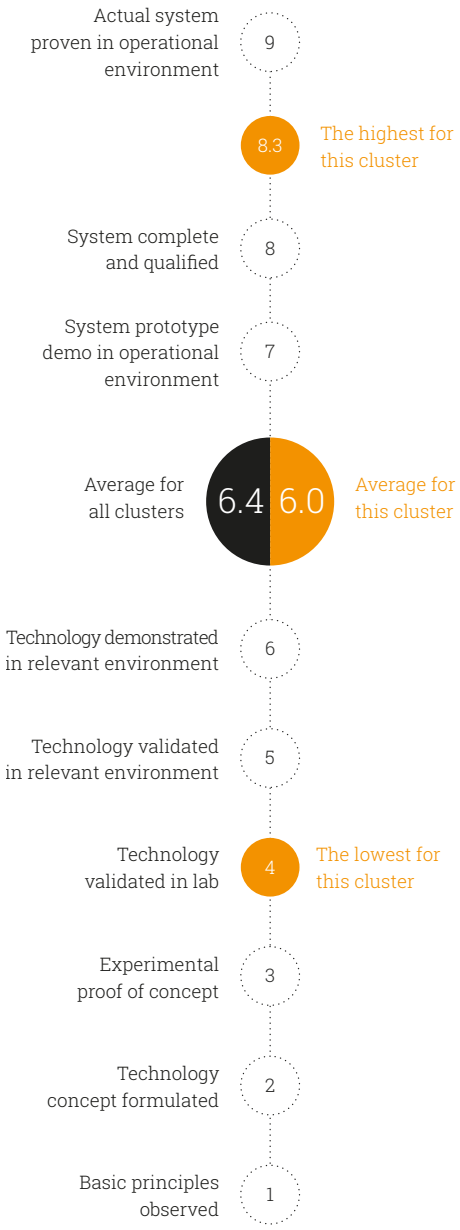
Advanced insulation materials improve the envelope's thermal and energy features [124] by use of inert, "zero-embodied energy" mineral wastes, and industrial by-products [68]. Finishing, such as silica advanced aerogel-based composites, are aimed at a healthier indoor environment [134]. Composites consisting out of bio-derived aggregates reduce embodied energy and take advantage of the natural moisture release feature to improve indoor air quality [141]. Forest based-bio composite for façades and interior partitions improve indoor air quality while increasing thermal insulation [83]. Eco-innovative, concrete-based, pre-cast envelope components, addressing thermal insulation, low-embodied energy, aesthetic aspects and costs are under demonstration [121]. Advanced mineral-based plaster to improve insulating performances were developed [167].

Windows weight is reduced in combination with PCMs and dynamic glass-polymer composites [54]. To control light, glass systems become fluid thanks to high micro-structured rolled glasses, embossed with microfluidic channels [142]. Windows get smarter through active shading, applying a hybrid film constituted of ink-jet printed electrochromic and PV materials [100] resulting in enhanced U-value, lightweight and combination of vacuum insulation glazing with suitable optical transmission control schemes [109].

Historic buildings with renovation affected by architectural value were maintained as functional living and working spaces [1]. Internal insulation topic was investigated with resolutions offering hygrothermal performance and not harming existing constructions [158].

Facade systems and wall panels for new buildings innovations include prefabricated modular elements with nano-enhanced solutions offer excellent thermal protection [42] or cooling glass surfaces made of fluid flow glazing [137]. Building envelope and internal wall components based on cementitious materials, earthen plasters and bio-composites protect against moisture, heat loss or, over-heating, pollutants, and noise [58]. Facade elements with integrated insulation and reactive powder concrete enable lightweight components whereas the concrete-aerogel composite foam improves fire safety and insulation [98]. Pre-fabricated façade models are developed with the support of a BIM based integrated design process [136]. **Regarding renovation**, the combination of insulation and heat exchanger component for adaptive energy harvesting with a lightweight concrete buffer for temporary energy storage, results in increased energy savings whilst maintaining structural functionalities [3]. An active building envelope enables the adaptation to a dynamic environment and to building occupants' needs [115] with modular façades [116]. Layered panels incorporating nano-materials, with functional improvements are developed for a cost-effective retrofitting [72]. Prefab ventilated façade modules are proposed with integrated optimized anchorages, and a heat thermal storage based on PCM for peak savings [120]. Prefabricated lightweight customizable panels for exterior retrofitting allow to avoid scaffolding during installation, minimizing impact on building's occupants [30] as well as prefab and conventional panels from demolition waste materials [138] [129], also able to reduce up to few days the renovation time, thanks to plug & play connections [145,148,149) or click&go substructures (125). Tailor-made renovation concepts, using industrialized manufacturing

Technology Readiness Level for this cluster



process, produce structural composite panels allowing flexible integration of technologies [69]. A methodology based on digital data flow in BIM will enable the production of timber prefabricated modules again reducing as well renovation while and lowering financial risk for investors [114].

Renovation solution packages & deep energy renovation strategies were developed to grow the renovation rate of EU building stock. Affordable and adaptable technologies for public buildings [2] integrating leading-edge envelope retrofitting solutions with zero-emission energy production technologies into a unique concept [10]; four-dimensional solutions, consisting of passive, active, social and financial measures [7]; fast low-intrusive renovation kits [64]; multi-functional, modular, prefab technologies and a retrofit toolbox [91], 130). **Indoor environmental quality** is improved with systems using VOC sensors, and low-cost infrared vision system to monitor comfort and health related parameters [15]. Products couple natural and technological solutions [19] use low carbon structural elements with moisture buffering plasters, bio-based insulation, durable materials, and vapour permeable photocatalytic coatings [33].

A next generation of high performance energy buildings using constructive and nature-based solutions are demonstrated [12, 79]. **Energy management systems for new buildings** were developed such as a management system for leisure buildings [102], a decision support system to manage energy flows in public buildings [46], the intelligent use of sounds to improve buildings' energy control [93] and a network of self-powered multi magnitude wireless sensors to measure the local air temperature and detect occupancy [105].

Replicable strategies at district level enable reducing buildings' energy demand and increasing use of RES [16], defining integrated climate planning for balanced solutions [87], develop dynamic heat exchange between buildings exploiting μ-CHP units and wireless communication network for energy autonomous and sustainable districts [50].

With regards to **HVAC research & monitoring**, nanotechnologies are used to improve heat transfer, exchange and transport [44] and for ducts insulation while introducing new cleaning and maintenance technologies [74]. Concepts were developed for a Gas Absorption Heat Pump solution to be used in existing residential buildings [55], for air conditioning systems with temperature and humidity independent controls [73], for thermal storage system based on Thermo-Chemical Materials (TCMs) [118].

High performance buildings use **renewables energies** in an innovative way, converting high-rise building facades into multi-functional, energy harvesting components [24] or have a compact hybrid energy storage system [135]. Stored energy can be directly use for heating or converts into power via fuel cells in case of renewable energy shortage [53]. RES potential can be fully exploited only with efficient control strategies, and **energy storage systems** [71], and such exploitation much be supported by advanced calculation tools [119].

Building **owners and tenants** can be assisted with an online real-time building energy simulation performance model [106] enabling effective quality management [151]. Deep renovation technology packages are supported by methodologies to manage every step of the process [111] such as web collaborative platform (160). A smartphones app enables users to evaluate energy efficient product options [43]. Augmented reality for self-inspection connecting virtual and physical buildings [140] ensures reaching energy-performance targets. A system for innovative solutions for the envelope and energy generation and management at building and settlement level was set up [168]. Finally, [113] created a coordination and clustering action platform among all projects.

100 SMARTBLIND
102 SPORTE2
105 TIBUCON
106 TRIBUTE
109 WINSMART
111 4RinEU
113 AMANAC
114 BERTIM
115 BRESAER
116 BuildHEAT
118 CREATE
119 DREEAM
120 E2VENT
121 ECO-Binder
124 EENSULATE
125 EnergyMatching
129 GreenInstruct
130 HEART
134 HOMESKIN
135 Hybuild
136 IMPRESS
137 IndeWag
138 InnoWEE
140 Insiter
141 ISOBIO
142 LaWin
145 MORE-CONNECT
148 P2Endure
149 Plug-N-Harvest
151 QUANTUM
158 RIBuild
160 Stunning
167 WALL-ACE
168 ZERO-PLUS

Advanced materials and nanotechnology

Advanced materials and nanotechnologies were the focus of a dedicated CSA [113].

1: Nanotechnology-based high performance insulation and HVAC systems

Aerogels and Vacuum Insulation Panels (VIPs) are promising Super-Insulation Materials (SIM). [4] develops SIM by overcoming poor mechanical properties and high costs associated with its production. [134] [128] develops a new aerogel-based composite material, whilst [59] creates a sustainable and cost-effective technology to produce a nanostructured aerogel for incorporation into paint, plaster and panel applications. [75] [139] focused on VIPs with new nanotechnology-based core materials, achieving low thermal conductivities down to 0.004-0.009 W/mK and lower costs. Other important insulation products are also considered, useful for different applications. [76] worked on low cost insulation materials able to store heat through the use of Phase Change Material (PCM) and nanotechnology, reaching after the project completion a PCM inclusion up to 30% of the overall panel weight. In [21], new building envelope multifunctional materials (ceramic tiles, acrylic paints and bituminous membranes) with improved Near-Infrared (NIR) reflectance (+30%) were developed, allowing reduction in cooling energy demand and energy peaks.

[4], [21], [75] and [76] shared the same testing and demonstration facility, the Algete demo park, where a detailed quantitative evaluation of achieved performances was performed.

Nano-materials are also applied to improve performance of HVAC systems and heat-pumps [131] [74] developed an approach for duct insulation while introducing cleaning and maintenance technologies, all enabled by nanotechnologies. [44] focused on improving efficiency of heat exchangers using functional sol-gels coatings and surfaces structuring.

2: Materials with reduced embodied energy

Concrete is a material where a large impact can be achieved. [121] works to demonstrate the possibility of replacing Ordinary Portland Cement (OPC) based concrete products with new ones based on the Belite-Ye'elimite-Ferrite (BYF) class of low-CO2 binders. [104] and [166] integrate different kinds of waste materials in the production cycle of concrete, for both ready-mixed and pre-cast applications.

Insulation materials have usually high embodied energy; as a consequence [68] develops novel, inorganic insulation materials and building insulation masonry components based on mineral tailings, recycled materials and industrial by-products, expecting to achieve 50% reduction in embodied energy and 15% in costs.

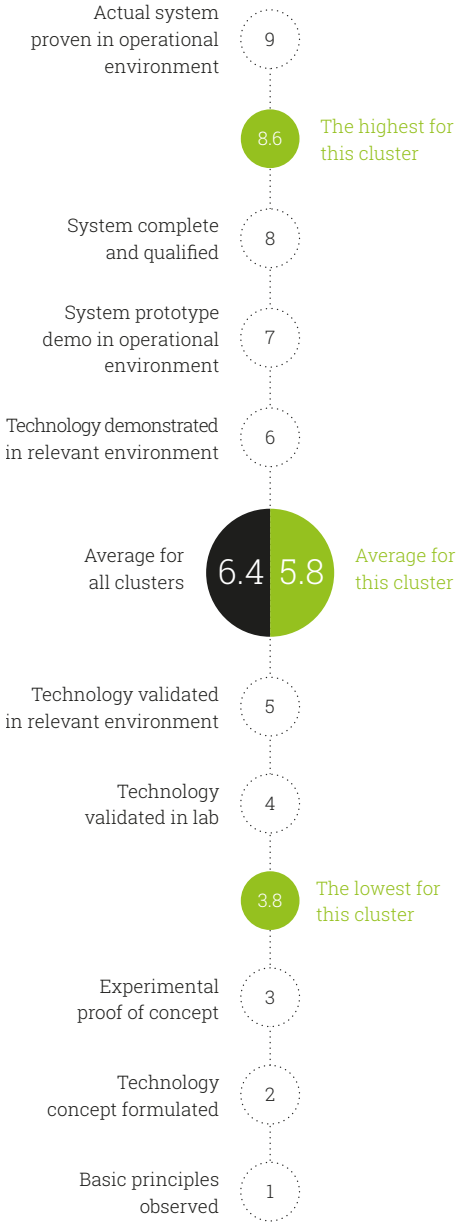
[141] focuses on the development and demonstration of highly insulating, composite construction materials from bio-derived aggregates with innovative binders. [9] uses biocomposites to reduce embodied energy in building-façade, supporting structures and internal-partition systems. [163] develops an advanced energy storage system that uses integrated phase change materials. (159) develops compact hybrid storage technologies.

[167] develops new mineral based indoor and outdoor plaster and a brick filling material for to improve the existing performances of mineral insulating materials.

3: Novel materials for smart windows

[109] addresses a new Vacuum Insulation Glazing (VIG) combined with robust switchable glazing systems mounted in durable sash and frame. VIG offers the potential of 2-5 times higher insulation performance with a doubly glazed pane, at the same time providing an extremely slim and lightweight solution. In addition, the smart windows will have switchable optical properties and exterior surface protection (anti-fogging, easy to clean, scratch resistant etc.). [70] introduces an Integrated Glazing Unit (IG-Unit) for quadruple glazing containing ultra-thin glass membranes dedicated as frameless openable windows for direct application in facades. [70] implements ink-jet printed organic photovoltaics (OPVs) and fully integrated solar thermal collectors for energy harvesting and micro mirrors for energy control and advances day lighting. [54] uses glass particle reinforcement of laminated

Technology Readiness Level for this cluster



glazing and glass fiber reinforcement of light weight polymer-glass-composite frames with the aim to reduce the weight while further improving their U-value. The core of the technology in [142] is a structured glass which contains microfluidic channels through which a functional fluid circulates. As an example, this liquid will make it possible to automatically adjust the incidence of light or to harvest exterior heat which will then be transported to a heat pump.

4: Nanotechnologies for multifunctional lightweight construction materials and components

[3] will provide a climate-adaptive panel. [138] will develop a prefabricated geopolymeric panel for eco-insulating facades. [98] works on nano-based lightweight and fire safe façades, developing sandwich panels using reactive powder concrete as structural material. Non-flammable insulation layer (foam concrete-aerogel composite) and a new type of sealing tape and intumescent coating are developed to enhance fire safety.

In the same context, [51] develops a next generation external thermal insulation composite system (ETICS) including a nano-cellular thermoplastic particle foam to achieve high thermal insulation behavior. [124] develops highly insulating foams and lightweight, thin, double pane vacuum glasses. Light-weight load bearing steel skeleton/ dry wall modules with optimal thermal, vibration/seismic and fire performance are developed in [42], incorporating VIPs, intumescent paints, aerogel blankets and Active Damping Devices (ADD) to ensure optimal performance, maximum energy efficiency, fire resistance and seismic resilience.

5: Technologies and materials for a healthier indoor environment

Nowadays, it is necessary to address emerging health problems associated with very airtight buildings, as potentially harmful chemicals in the air may cause negative impacts on occupants. In [11] and [33] this will be achieved with new eco-innovative and bio-renewable indoor materials with an overall objective to reduce operational energy, in combination with the capability not to emit harmful substances and to act as an absorber for indoor pollutants. [58] proposes innovative sustainable façades based on optimized cementitious materials with modified surfaces and partition walls based on low emitting earthen materials, wood, straw and flax fiber composites. An innovative modification of the materials will include energy-saving and air purifying aerogel granulates to create optimal indoor conditions. Within [83] a holistic solution for facades and interior partitions will be developed by means of forest based bio composites with different functionalities able to improve indoor air quality by VOC and microorganism's elimination, increase thermal and acoustic insulation and control breathability of the construction systems. In [30] activities carried out with respect to interior insulation allowed the development of advanced perlite boards with a hydrophobic barrier; laminated insulating panels based on aerogel-impregnated mats glued on expanded glass granulate boards; and a permeable insulating wallpaper based on aerogel-impregnated mats and a finishing fabric tensioned with an innovative anchoring system. New nano-materials can also be coupled with dedicated sensors and control algorithms to improve indoor air quality, thermal comfort and lighting, as in [19].

Construction process, end of life, cross-cutting information

The **Construction process** is critical in achieving energy efficient performance. When standards are high, the complexity of buildings and technical equipment increase significantly and quality control is crucial to avoid errors, potentially jeopardizing the durability of the building. There is a need to increase effectiveness and quality, improving the prospect for a highly performant building. This requires exploration of the potential for prefabrication, new procedures for detailed performance control, continuous improvement processes and ICT. **Self-inspection techniques** are used by each player in the construction value chain, facilitating the final thermal, acoustic and energy performance of the building. The next step is to develop interoperable, cost effective solutions for quality driven management supported by cost effective innovative ICT-based technologies. This delivers data in real time to the workers, thereby enhancing productivity, reducing deviations and improving safety. Innovative onsite tools for energy efficiency enhancing quality checks such as 3D imagery and thermal imaging, air-pulse airtightness test, acoustic & IAQ tools are developed [117]. Software running on smart glasses guide construction workers and enable site-managers to access on-site sensors and project data and dashboards, enabling real-time collaboration among all actors [112]. Intuitive and cost-effective Augmented Reality for self-inspection that connects virtual and physical buildings in real-time is a key innovation [140].

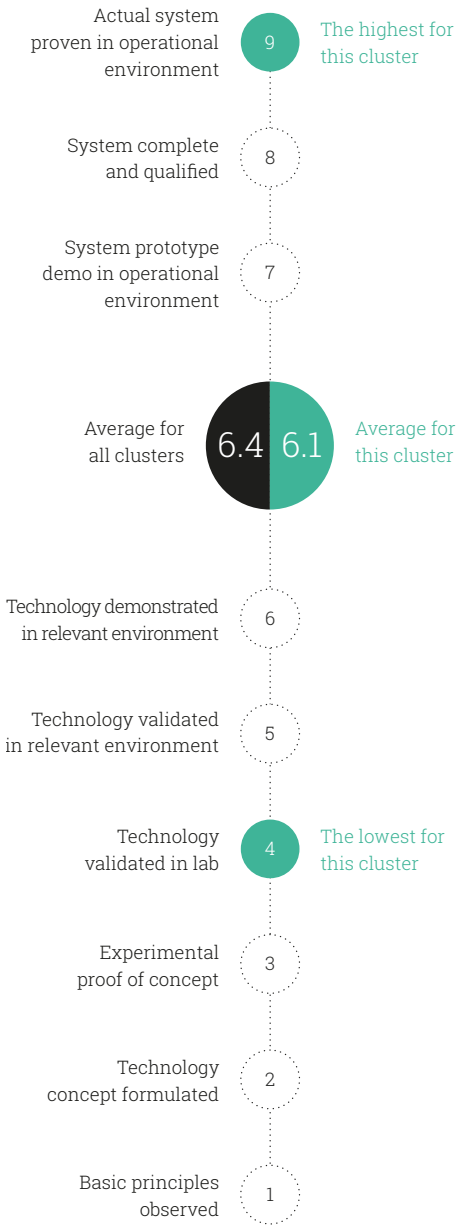
Advanced and automated processes for new build and energy efficient refurbishing using **prefabricated modular systems** are in development. Prefabrication aims to reduce on-site construction time, whilst improving health of workers and reducing the embodied energy of the building. For refurbishment, a new envelope can be pre-assembled off-site, borrowing mass customization techniques from window manufacturing. With the support of 3D scanning and BIM, elements can be customised to the existing façade (design and location). Innovative new-build and retrofitting systems for prefabricated elements have been successfully deployed [29, 114, 120, 136, 72 and 152]. Robust solutions for older buildings, respecting architectural and cultural aspects are developed in [158].

Training schemes for continuous improvement of worker skills are set up to meet the demand for a SME workforce specialized in energy-efficient buildings. The aim is to promote collaborative work, to increase understanding in air-tightness, thermal bridges, self-inspection techniques, reuse and recycling. Examples include a knowledge transfer framework tool promoting knowledge sharing amongst agents of the building retrofitting sector [38], guidelines and training material for teachers and pupils [94]. Design tools, processes and business models for efficient refurbishment on building and district level will also be developed [143].

Further to the challenges identified in each step of the value chain, some critical issues relate to the **integration of steps** e.g. allowing transfer and sharing of good practices and tools and the integration of innovative technology components and systems. In addition, new integration processes are needed to implement large scale demonstration and also to minimize costs of validated solutions. An important target is a **supply chain of adaptable refurbishment solutions** adaptable to local building conditions and users but also with the potential for standardization to reduce manufacturing and construction costs. A framework for demonstration and dissemination has been set up [28] using innovative measures, from construction elements for energy optimization to highly energy efficient equipment and advanced energy management systems to check CO2 emissions and energy savings. A collective self- organised housing platform was set up [85] by matching offers from SME's with the end user's demand for sustainable dwellings. It offers practical information, an e-marketplace where stakeholders can meet and interact, as well as a number of tools. Technologies and methods for shopping mall retrofits based on an optimal combination of solutions and related control strategies were developed and an integrated modelling environment was defined [20].

Systemic integration of components and subsystems is a key target area. Research and innovation areas are an optimal integration process dynamic multi criteria

Technology Readiness Level for this cluster



design tools and probabilistic models to predict the ageing performance and properties of construction materials and components. An innovative, web-based decision-support application was developed, analyzing the building energy performance against the user's needs, to give recommended energy efficient solutions and optimized business models [107]. A decision support tool and guidelines for designing energy-efficient buildings integrated in the neighbourhood energy systems was also developed [26]. Further, 4 demo sites have been built [77], with each building integrating a combination of cost-effective solutions and technologies, selected during the design phase by applying BIM, IPD, LCA/LCC and energy simulation tools.

To **speed up the innovation take-up** at member state level, a methodology and toolset for smart, sustainable and future proof cities is being developed [18]. This is being done by co-creating solutions during roadshows, serious games and decision-making workshops and involves implementation and demonstration of 22 specific innovations. Nearly 226 000m² of living space will be renovated in 6 smart districts to achieve primary energy savings of up to 80 % while increasing the share of renewable energy by 25% (by 2018) while implementing a balanced mix of technical, socio-economic and financial solutions adapted to local needs [48]. A refurbished city district model is built, demonstrating the potential for scalability and replication by middle-sized European cities [99]. At a neighbourhood scale, the implementation and study of five demonstrations of near zero energy renovations is carried out [110] and a whole city approach towards affordable retrofitting of buildings is also demonstrated [87].

Key to the success of the Smart cities initiative is the **integration of systems from building to neighbourhood level.** To facilitate this, an ICT roadmap encompassing data interoperability for energy systems in smart cities has been developed [88], and it is shown how savings on design, coordination and energy can be achieved via an open integrated ICT platform [57]. Demand side management of energy use is demonstrated on community-level using new technology for weather forecasting and renewable energy generation [82]. Computer models for optimization of components for each retrofitting technology and solution are also developed [56]. At the stakeholder level, there are examples of knowledge sharing platforms. One demonstrates how more than 100 experts can share a common taxonomy, thereby enabling the coordination of their multidisciplinary activities [92]. Another platform supports a forum which facilitates exploring the opportunities for further research and integration of ICT systems for energy efficiency in buildings [61].
End of life must be considered in tandem with deeper refurbishment, at a design and demolition level. Selective deconstruction to reuse single components and LCA approaches will be pursued. The building industry is already involved in significant waste recovery. Innovation is expected in lowering both embodied energy and also resource usage, allowing increased utilisation of components and materials from construction and demolition waste [129]. Lightweight and recycled construction materials and structures made from secondary raw materials such as slag, ash, mixed plastic, tyre rubbers, concrete and PU foams are considered [104, 166]. Products with lower embodied energy and increased insulation properties are developed, signposting the future direction of the construction industry.

Energy performance monitoring and management

DSS for all kind of buildings

Decision Support System (DSS) have been proposed to select suitable energy efficiency interventions for historical districts [39] or for public buildings [46] to enable operators to manage energy flows with short-term operational decisions and long-term strategic decision. In addition, ICT has been applied for monitoring, control and optimization of the energy flows in recreation buildings [102] as well as in metro stations [95] and tertiary buildings [28], for energy metering and sensor-actuator networking to update and enable a set of adaptive energy consumption and environmental models to be used for proactively and optimally controlling. For airport energy management [14], a Fault Detection Diagnosis (FDD) method has been proposed for a facility-specific measurement-based energy action plan.

Holistic approaches to building management

Other applications refer to a holistic approach [5, 133] with reference to the optimization and modelization taking into account buildings, RES, energy storage/production and implementing energy management strategies [144] as well as specific objectives assigned (eg. cost, environmental impact…) or considering users, business, law, standard and social aspects associated with the energy efficiency [31]. Some of the solutions proposed have considered an internet-based or cloud-based service infrastructure to manage real-time information flows [62, 63, 165] or to provide dynamic assessment of the interactions between buildings, the electricity grid, (ICT). The proposed concept of Energy Hub Model [47,40] aims at optimising on-site RES within local community operating at the microgrid level with the reference to the micro-combined heat and power network technologies [50] and exploiting the concept of Virtual Power Plant (VPP) [89,18].

ICT Applications for energy management

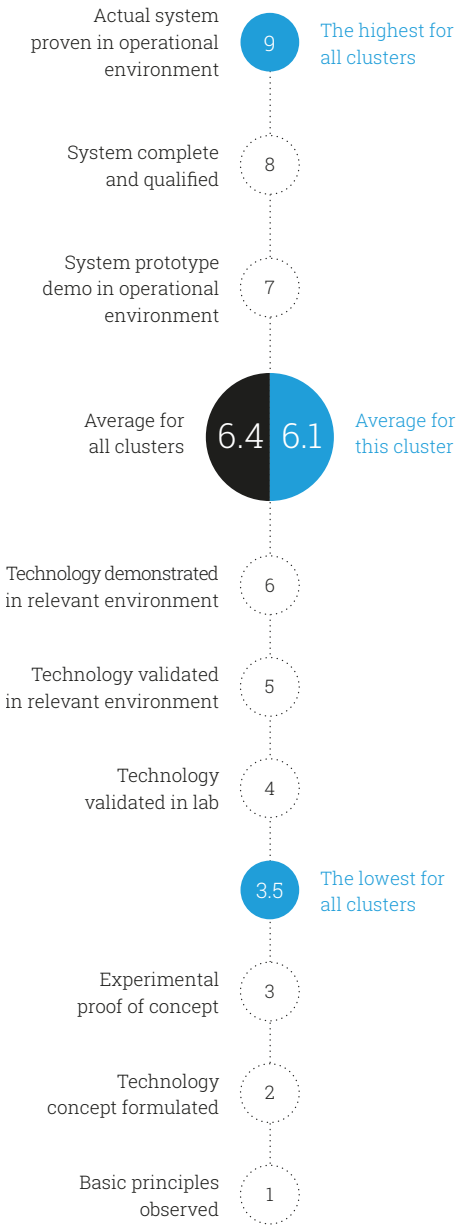
Open interoperability platforms have been developed to interact with ICT solutions [6] as "gateway" opened to ESCOs and grid operators as well as to share data and services to external third party providing information on building subsystems, occupancy monitoring and external context for the development of new business models [143] and procurement schemes [8,13]. It also helps energy companies to define and validate their business strategies and pricing schemes [25].

ICT platforms offer new approaches for supporting building owners in selecting optimal technologies and financing model for energy-efficient buildings retrofitting [78]. Also, a Self-Correcting Intelligent Building Energy Management System optimizes operational strategy [131]. Some applications addressed innovative ICT based systems using interaction devices such as smartphones and touchpads [23], 3D visualization [67], virtual and augmented reality as well as business and monitoring/ controloriented cockpit [97]; these applications are mostly based on different data sources such as qualitative database [127], BIM, System Information Model, Geographic Information System [27] or Building Energy Management System [37, 162].

Monitoring methodologies and measuring

Tools for planning optimised energy systems have been proposed for predicting behaviour of local energy networks gathering data from a range of sources in the cloud platform [80] and addressing the dynamics of energy supply and demand in neighbourhoods to optimise the use of energy [81], or with extent to districts [17] or city authorities and utilities to support the district in becoming more energy efficient and cost effective [108]. Potential fields of application can be recognised in the communities with sophisticated intelligent ICT system for management of energy [82] and in the district heating and cooling with real time monitoring and forecasting of peak loads and energy demand [99]. Holistic building energy monitoring methodology and protocols were developed for replicable, strategies to transform cities into smart cities [84, 16]. Special care was taken in monitoring of built environment - from the energy performance optimization of the renovated buildings [119] to the financing schemes chosen by the municipalities [48]. To evaluate building energy performance during different

Technology Readiness Level for this cluster



stages of building operation the energy instrumentation kit for data storage and simulations was developed [84]. wireless monitoring systems were developed to detect different building parameters important for energy efficiency and for the occupant's comfort [15, 105, 96]. Integrated electronic systems and software applications running on platforms built for mobile devices are providing the energy performance monitoring [152] and control of lighting and HVAC systems [97, 45] and can provide decision support [132]

New trend for large public buildings is the development of the Building energy management optimiser (BEMO), based on measurements of the occupancy level by the acoustic system [93], to proactively control HVAC and lighting systems. Full integration of air pollutant sources and sinks in building simulation models are innovative solutions for better monitoring and regulation of the indoor environment [15]. Water flow glass façade systems has been developed towards a system that will be able to satisfy the cooling requirements and the hot water needs for a whole building [137]. Real time building energy performance simulation (BEPS) models were extended to the commissioning and operation phases with the goal to minimize the gap between computed and measured energy performance [106, 28]. Research was conducted in innovative building energy management system to measure both envelope and energy use of retrofitted buildings, with focus on the facades [2, 115, 10]. A kit-concept was applied in the development of new integrated energy management solutions in case of retrofitting buildings [91]. Facade related ICT parts and electronic control devices for different visual control strategy were included [100]. Advanced energy management system is ensuring interaction of the system components [53, 56] as well as the optimized integration between them [41]. Special attention is given to the management of heat storage [118] and waste-heat from the system components [73].

All types of profiles in value chain can be connected through a knowledge transfer platform capable of compiling information of energy efficient building retrofitting [38]. New diagnosis methodology for an integrated renovation are addressed [90, 86]. Building management energy systems were expanded into district management energy systems enabling the visualization of energy consumption [16, 126] and real time districts and building thermal energy management and storage system [164, 163]. Better management of the loads and resources can help reducing operational costs on a district scale rather than on the scale of a single building [168]

Energy management for retrofitting

Solutions for integrated system for matching production with consumption are leading to the concept of building self-sustainability and integration with smart cities [71]. An energy integrated approach for retrofitting which includes intelligent building energy management system and energy grid interaction scenarios was established [20]. The connections to surrounding infrastructures for optimizing energy use and reducing peak loads and the waste management systems are addressed [12].

The transformation of the retrofitting construction sector into an innovative energy-efficient sector is supported by a web-based tool for an evaluation of retrofit options of apartment buildings [29]. Energy efficiency in the new construction projects is supported with replicable methodology for designing, constructing, operating new low energy buildings [77, 151] and deep renovated buildings [111]. Interactive, web-based tools, plug & play systems (155) and operational guidance were developed to facilitate the life cycle assessments of buildings [35] and the implementation of effective energy efficiency solutions in built environment and better market uptake [52].

80 NRG4CAST
81 ODYSSEUS
82 ORIGIN
84 PERFORMER
86 R2CITIES
89 RESILIENT
90 RESSEEPE
91 RETROKIT
93 S4ECoB
95 SEAM4US
96 SEEDS
97 SEEMPUBS
99 SINFONIA
100 SMARTBLIND
101 SMARTKYE
102 SPORTE2
105 TIBUCON
106 TRIBUTE
108 URB-Grade
111 4RinEU
115 BRESAER
118 CREATE
119 DREEAM
126 ENVISION
127 EXCEED
131 HEAT4COOL
132 HIT2GAP
133 HOLISDER
137 InDeWag
143 MODER
144 MOEEBIUS
151 QUANTUM
152 Rennovates
155 RenoZEB
162 TABEDE
163 TESSe2B
164 THERMOSS
165 TOPAS
168 ZERO-PLUS

ICT

ICT play pivotal role in Energy Efficient Buildings and as such several R&D projects utilize it in effort to tackle key challenges. Key identified clusters [123] include: tools for EE design & production management, intelligent and integrated control at building level, user-awareness & decision support, energy management & trading at district or city level and Integration technologies.

Tools for supporting design towards energy efficiency are developed for planning and retrofitting of buildings. Such tools largely integrate multiple stakeholder requirements; provide dimensioning, configuration and visualisation alongside with best design practices. They enable their users to take informed decisions, on retrofitting and renewal of existing districts and its composing buildings [32,108,78].

Production management aspects related to planning, scheduling, contracts, procurement, logistics etc. are also tackled. Examples include developments towards autonomic multi-agent systems that coordinate energy usage and storage at neighbourhood level [23], monitoring of the network for anomaly detection, root cause analysis, trend detection, planning and optimisation [80], as well as marketplaces that bring together building owners and SMEs [80].

BIM including ontologies, semantics and district-wide energy information models often complement offerings targeting energy simulations, holistic energy monitoring, evaluation and prediction of building energy performance [84, 144], or quality checking and 3D modelling [117]. The application of open data technologies, like Linked (Open) Data, ensures interoperability and accessibility of data for building energy management processes [161].

Performance estimation aspects such as indicators and methods for assessing life-cycles, design solutions & processes, as well as simulation, are significantly in focus. Augmented reality is utilized e.g. for quality checking [112] or profiling in real-time by visualising of energy-related information [27]. Optimisation aspects e.g. of business models [107], as well as creation of tools that optimise energy usage at district level by managing energy flows [5], as well as simulation techniques that will ensure the minimum energy consumption while maintaining the comfort conditions [45].

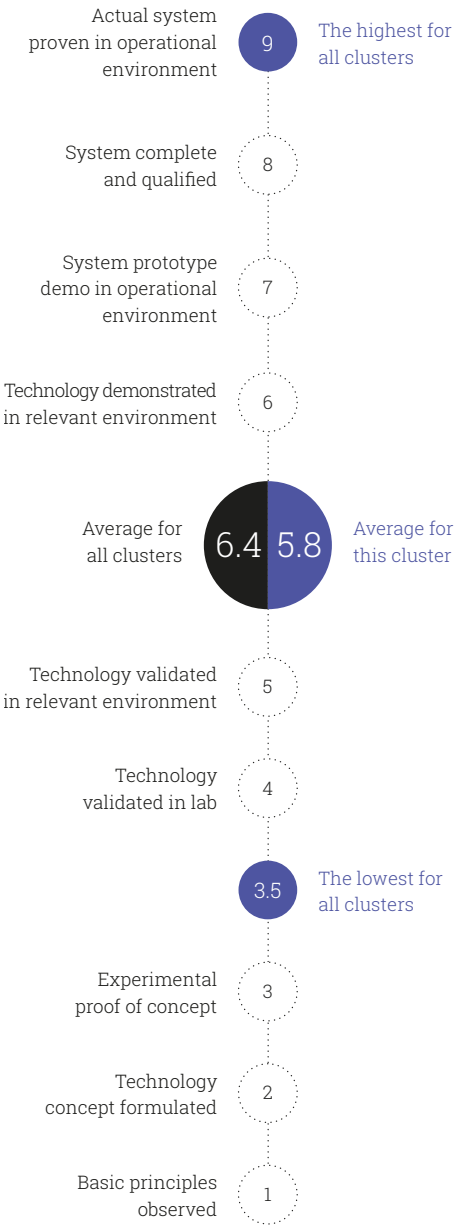
Intelligent and Integrated Control
Monitoring of energy e.g. via instrumentation, smart metering, sensor networks as well as efforts towards data protection, and availability of them, as open data, is tackled in several projects [6,8,25,27,31,37,65,96,101]. Monitoring aspects are tackled from a holistic perspective at large infrastructures e.g. at neighbourhood or whole city level [101,6,8,25,31] offering also decision support [37], self-adjustment [96], simulation 27] and in cases also management of the infrastructure. Energy reduction efforts go also beyond the electricity grid and include thermal [27] and air-quality [65], as well as social aspects [31].

Data analysis and diagnostics are used to analyse the acquired data and derive new insights e.g. via data mining. This is done at smart city level [101, 6, 8], where it is often combined with business data [101], and also at specialized domains e.g. construction [112, 117].

Significantly increasing approaches are also related to management of the infrastructure, especially with focus on automation and control. The later comprises intelligent HVAC, smart lighting and predictive management [6, 8, 65].

Energy Management and Trading
Plug and play modular solutions for generation, storage and consumption systems is gaining interest. This includes ICT-controlled solutions that balance demand and supply [31,89], data frameworks for interoperability among the different systems [88], as well as end-user devices e.g. smartphones and tablets [23]. Energy system integration focuses on methods [117], service-oriented architectures and resulting platforms, gateways, middleware and, cloud solutions [117, 108]. This enables interoperable integration of disparate systems and therefore engagement of communities [62]. Energy

Technology Readiness Level for this cluster



system operations i.e. the coordination and optimisation of distributed generation, storage and consumption in order to enable load shifting/balancing and accommodate demand-response scenarios is of interest. These goals are realised via ICT service platforms [25,32,37,108] and qualitative database(s) [127] doing monitoring, simulation and analysis [19], often on near real-time data [67,80]. Concrete results are not limited only to buildings or traditional grid systems but include also e.g. underground transportation systems [95].

User awareness & decision support

Performance management i.e. modelling and understanding ICT impacts on energy efficiency, tools for analysing and assessing these impacts, compliance validation etc. are some of the focus areas. Tools developed go beyond technical monitoring and provide assessment of acquired data e.g. at smart city [101,6,8], for urban planning [8], for energy production [37] and for retrofitting design [147] in order to enable informed decision making. User empowerment is also targeted via visualisation of energy use, real-time pricing, social media and gamification, training, labelling etc. all of which aim towards having the user to take an informed decision and adjust its behavioural pattern [6,8,25,27,37].

ICT Integration technologies are in the heart of the technology efforts for energy efficiency and new organisational and business models allow construction SMEs to create an alliance with stakeholders [78]. On System integration, methods, plug & play solutions, platforms (108,95) and tools are developed [132]. These range from integration of existing solutions with new ones [117,31,78], collaborative and cloud-based platform [146, 165], building to grid energy interactions [89] etc. The goal is to offer sophisticated decision support tools for energy management and balance demand, supply [47,81] or integration and real-time universal access to self-inspection and quality check results to reduce the energy performance gap [117].

Interoperability, especially with respect to BIM standardisation, open data, energy trading protocols as well as tools to test service interoperability are in focus. Solutions are developed for interconnecting DER, grids, energy service companies, utilities etc. at district level [6,89] as well as trustworthy platforms for data and service sharing [8]. Tools are also under development that use BIM and standardised W3C semantics to simulate the construction and operation of a facility [84].

Knowledge sharing aspects such as access to- and maintenance of- repositories, solutions and best practices is investigated. This is supported via actions such as common data frameworks for the key stakeholders [88], dashboards and tools for designers in order to collaborate in real-time in a common system [112], user interfaces to engage communities and individuals [62] as well as modelling, simulation and visualisation tools for knowledge-based energy management [67]. Efforts are made also on virtualisation of physical assets and workplace practices, interaction via virtual organizations and factories as well as multi-purpose buildings. Such actions are supported by augmented reality [112], predictive behavioural models of buildings and districts [5,96], visualisation of energy performance [37,67]. Also, multi-purpose buildings can be realised as business models can be optimised, and the relating implications for interventions to the specified building can be applied any stage of its design or use [107].

Roadmaps for Research Policies

The community of ICT for EeB experts regularly participates in research policy making and on the development of roadmaps. These allow to exchange knowledge with the domain stakeholders and to build consensus on future technologies and research priorities for energy efficiency as well as key paths for the deployment of Smart Cities solutions [61, 66, 88, 92].

BIM/ Data/ Interoperability

The energy used on construction sites generates large amounts of data. Thus, methods to improve the accessibility and interoperability of information are required across the design, implementation and operation of buildings and districts.

Building Information Modelling (BIM) appears in this context as an instrument to help the structuring, managing and integration of building projects' information, facilitating the design, simulation, analysis and operation of energy efficient solutions. BIM technology supports the building of accurate 3D virtual and parametric models of a building containing precise geometry and relevant information needed to support all the building life cycle activities which effectively contributes to increase collaboration, efficiency (materials, costs, time) and project quality. By making virtual reality simulations possible, BIM emphasizes integrated and coordinated decision-making in supply chains, providing the construction industry with an instrument to support consistent decisions throughout the building's life cycle.

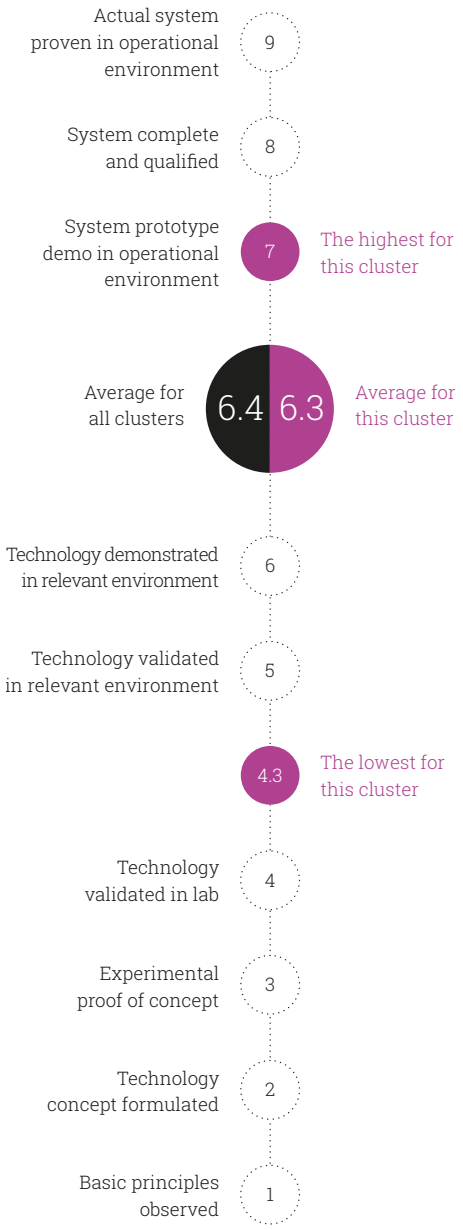
True benefits of BIM are obtained when the technology is applied throughout the project lifecycle, from design to demolition [161; 123; 36; 57]. The data contained in the BIM-based design model can be shared throughout the project life cycle, which can reduce the heavy human workload and manual errors in traditional work. Having data centralised in a specific model may also increase process efficiency and accurateness, as all specialties will be working on the same model. The capacity of BIM to integrate building information and create a collaborative environment makes it a powerful tool for developing simulations of a wide range of specialties, such as energy analysis.

However, this leads to a major challenge: the data exchange between all the involved parties requires seamless interoperability. To address this problem, standard formats have been developed. Some software developers, e.g. Autodesk, Nemetschek, Bentley, have developed their proprietary BIM. But in order to provide interoperability among tool of different software developers, an open standard BIM, IFC (Industry Foundation Classes) has been defined by BuildingSMART. IFC is an object-oriented interoperable format to enable the creation of holistic building models, and support lifecycle integration. While IFC offers a lot of flexibility to share information, extending its scope and aligning it with other standards outside of the core BIM business is an ongoing challenge [161].

Between BIM and energy performance there are several synergies that can be established. The ability of BIM models to capture multiple types of building data (location, geometry, use, construction type, installations, comfort settings…) supports the generation of more reliable results, avoiding errors and incoherencies, saving time and effort, and minimizing uncertainties in building energy modelling processes. There have been several studies in the field of BIM and energy performance of buildings, e.g. the assessment of photovoltaics contribution, the exploration of how renewable energies can be integrated in a BIM model, and the study of the impact of adapting people's behaviour to improve energy efficiency. There are also undergoing projects that are addressing the energy efficiency of buildings and infrastructures through the use of ICT and novel BIM approaches [14; 123; 57; 60; 145; 103; 157].

It must also be emphasized that BIM is not only about the data (model), but also about the process (modelling) considering the use of the data. This is reflected in current trends which show a shift from local, file-exchange based interoperability solutions to cloud based collaborative environments which help to better address and support business processes. For example, the W3C Data Activity provides new and exciting opportunities to not only make BIM data more accessible by publishing it to the web, but also provide tools for interlinking data with the wider web of data through the use of Linked (Open) Data [161], thus enabling new and novel energy management processes to be developed. These approaches can also support each stakeholder in the

Technology Readiness Level for this cluster



process of accessing the right information at the right time while also ensuring that other relevant stakeholders are updated and notified by information changes performed by other users. Some of these solutions also offer model visualization, annotation capabilities and advanced functionalities like tracking of changes, timeline, etc. [36; 39; 49; 60; 103]

Furthermore, by considering not just the optimisation of single buildings, but the cooperation and collaborative work in managing the entire urban environment, it is possible to achieve positive energy neighbourhoods [22; 36; 39; 49] or smart cities [63]. In this case, data models as CityGML are especially relevant. CityGML is an open standard data model, defined by the OGC, based on XML format for storage and exchange virtual 3D models of cities, including semantic modelling and geometric/ topological properties. It can also represent graphic information at various levels of detail (LoD), reusing semantic information. This is another example where BIM data needs to embedded into a broader context and aligned with other standards [161].

Although many of the projects emphasizes the adoption of BIM as a collaboration framework among stakeholders in design, construction and maintenance process, some also address the integration of BIM in on-line building and district energy management systems [14; 22; 36; 57; 156].

The existing built environment is, today, the biggest challenge in Europe for achieving a more energy efficient society, as the buildings built 20 years ago and beyond were built with considerably more permissive legislation. As such, it becomes crucial to address the renovation of those buildings, with several projects already taking these issues into consideration [14; 39; 49; 63; 103]. For example, a platform offers optimal scenarios for renovation [147]. Also, [150] integrates seismic retrofitting actions.

The progressive implementation of BIM and other information technologies is, in fact, changing the built environment industry paradigm. Gradually, energy performance-based project delivery methods focused on environmental methodologies are being implemented and advanced, instruments are being used to achieve more efficient and well performing buildings, infrastructures and cities. BIM can also be combined with plug-and-play systems and on-site robotic 3D-printing [148].

Several challenges remain and may deserve particular attention. For instance, although electronic platforms certainly promote the adoption of performance-based contracts, as demonstrated by under development projects [85], there is a relevant challenge that must be carefully addressed: semantic interoperability, which can be particularly problematic. Semantic interoperability has much to do with dissemination of standardized processes and standardized taxonomies, i.e. standardized collections of terms organized into hierarchical structures that support information management and communication. However, there are currently projects that tackle this issue [161; 85].

To achieve higher levels of sustainability and efficiency, we now must look upon new technologies and methodologies that will make our jobs and life easier, such as BIM, Linked (Open) Data and Big Data. Big Data can play an important role in the design of Smart and Sustainable Cities, as its analytical methods can improve not only the collection of data but also its management. If we take a step in the direction of digital construction and harvest its potential in a wide range of field (e.g. energy performance of buildings and districts), certainly we will be creating a new world where the resources for future generations will not be jeopardised.

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FP7

2010

3ENCULT
A2PBEER
ADAPTIWALL
AEROCOINS
AMBASSADOR
BEAMS
BEEM-UP
BESOS
BIOBUILD
BRICKER
BRIMEE

2011

BUILDSMART
CAMPUS21
CASCADE
CETIEB
CITYFIED
CITYOPT
CITY-ZEN
ENBUS
ENE-HVAC
ENERGY IN TIME
ENRIMA
EPIC-HUB
EU-GUGLE
FASUDIR
FC-DISTRICT
FOAM-BUILD
GE2O
H2SusBuild
HARWIN
HEAT4U
HERB
HESMOS
H-HOUSE
HIPIN
HOLISTEEC
PROFICIENT
R2CITIES
READY
READY4SmartCities
RESILIENT
RESSEEPE
RETROKIT
REVISITE
S4ECoB
SCHOOL OF THE FUTURE
SEAM4US
SEEDS
SEEMPUBS
SESBE
SINFONIA
SMARTBLIND
SMARTKYE
SPORTE2

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2012

Clear-Up
COMMONENERGY
COOL-COVERINGS
COOPERATE
CoSSMic
COST-EFFECTIVE
DAREED
DESIGN4ENERGY
DIMMER
DIRECTION
E2REBUILD
EASEE
e-balance
ECODISTR-ICT
ECO-SEE
ECOSHOPPING
EEBGUIDE
EEEMBEDDED
EEPOS
EE-WISE
EFFESUS
E-HUB
EINSTEIN
ELISSA
ICT4E2B FORUM
IDEAS
INDICATE
INSPIRE
INTASENSE
IREEN
KNOHOLEM
LEEMA
MEEFS RETROFITTING
MEM4WIN
MESSIB
MF-RETROFIT
NANOCOOL
NANO-HVAC
NANOINSULATE
NANOPCM
NEED4B
NEWBEE
NEXT-BUILDINGS
NRG4CAST
ODYSSEUS
ORIGIN
OSIRYS
PERFORMER
STREAMER
SUS-CON
TIBUCON
TRIBUTE
UMBRELLA
URB-Grade
WINSMART
ZENN

2013

*
Projects funded under the
2010, 2011, 2012, 2013 calls for proposals

Technology Building Blocks
Construction process, end of life, cross-cutting information

3ENCULT [1]
Efficient energy for EU cultural heritage

3ENCULT demonstrated that energy retrofit is achievable in historic buildings while respecting their heritage value. The multidisciplinary project resulted in a handbook with design guidelines, technical solutions for planners, new and enhanced products, guides for local governments, position papers and a number of tested products, e.g. a low-impact ventilation system.

Start date	October 2010
Duration	42 months
Status	Finished
Total budget	6.6 M€
Website	**www.3encult.eu**
Coordinator	EURAC research, Italy
Partners	**Austria:** Bartenbach Lichtlabor, University of Innsbruck. **Belgium:** REHVA, youris.com. **Czech Republic:** ATREA. **Denmark**: Royal Danish Academy of Fine Arts. **France**: Menuiserie André. **Germany**: ICLEI, IDK, Passivhaus Institut, Remmers, Technical University of Dresden, University of Stuttgart. **Italy**: Artemis, Municipality of Bologna, University of Bologna. **The Netherlands**: TNO. **Spain**: CARTIF, Grupo Unisolar. **UK**: Arup.

Technology Building Blocks
Energy performance monitoring and management

A2PBEER [2]
Affordable and adaptable public buildings through energy efficient retrofitting

A2PBEER is developing, demonstrating & evaluating energy efficient retrofitting solution packages and a systemic approach in order to reduce public buildings' energy consumption by more than 50% in 3 demo buildings/districts in Spain, Turkey and Sweden. Innovative, affordable and adaptable technologies and a methodology are exploited using a support guide toolkit and training across Europe.

Start date	September 2013
Duration	54 months
Status	In progress
Total budget	10.4 M€
Website	**www.a2pbeer.eu**
Coordinator	Tecnalia, Spain
Partners	**Belgium**: CAE Services GEIE. **Croatia**: HEP-ESCO. **France**: OPAC38. **Hungary**: ABUD. **Ireland**: LIT. **Italy**: D'Appolonia, TOSHIBA. **Norway**: Oslo Kommune. **Poland**: BERGAMO. **Spain**: Acciona, EVE, ISOLEIKA, UPV-EHU. **Sweden**: Climatewell, CWS, IVL, PARANS, Malmo. **Turkey**: AFLIVA-D EM, EKODENGE, MoNE-Cankaya.

Technology Building Blocks
Advanced materials and nanotechnology

ADAPTIWALL [3]
Development of a multi-functional light-weight wall panel based on adaptive insulation and nanomaterials for energy efficient buildings

ADAPTIWALL developed a climate-adaptive façade panel reducing heating and cooling demands wit over 50% compared to current retrofitting practice. The panel consists of:
- a lightweight concrete buffer with more than 3 times the thermal storage capacity compared to normal concrete, - a total heat exchanger with an efficiency of 75% for sensible as well as latent heat recovery,
- an adaptive insulation component for energy exchange between indoor and outdoor environment.

Start date	September 2013
Duration	48 months
Status	Finished
Total budget	5 M€
Website	**www.adaptiwall.eu**
Coordinator	TNO, The Netherlands
Partners	**Belgium**: Isodal. **France**: CEA, Prochimir. **The Netherlands**: Adviesbureau Snijders. **Poland**: Prefasada. **Spain**: Acciona.

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Technology Building Blocks
Advanced materials and nanotechnology

AEROCOINs [4]

Aerogel-based composite/hybrid nanomaterials for cost-effective building superinsulation systems

AEROCOINs has successfully developed new strategies for the preparation of mechanically reinforced silica based aerogel materials. The project has also developed a prototype of a novel building component that incorporates these novel aerogel materials. This new component is compatible with conventional construction installations; its thermal, structural and mechanical performance has been successfully demonstrated under real conditions.

Start date	June 2011
Duration	48 months
Status	Finished
Total budget	4.3 M€
Website	**www.aerocoins.eu**
Coordinator	TECNALIA, Spain
Partners	**France**: ARMINES, PCAS, SEPAREX. **Finland**: VTT. **Germany**: ZAE Bayern. **Poland**: Politechnika Łódzka. **Spain**: ACCIONA. **Switzerland**: Empa.

Energy performance monitoring and management
ICT

AMBASSADOR [5]

Autonomous management System Developed for Building and District Levels

AMBASSADOR's developed and demonstrated systems and tools that optimise the energy usage in the perimeter of a district by managing the energy flows, predicting and mastering energy consumption and production. The key element is the District Energy Management and Information System which is the global management component of the system running the optimisation algorithms.

	November 2012
	48 months
	In progress
	9.8 M€
	www.ambassador-fp7.eu
	Schneider Electric Industries SAS, France
	Belgium: European Consulting Brussels. **Czech Republic**: AMIRES. **Finland**: VTT. **France**: CEA-INES. **Germany**: Leclanché. **Greece**: National Technical University of Athens. **Italy**: D'Appolonia. **Spain**: Tekniker, Zigor R&D. **Switzerland**: CSEM, Neurobat, Planair. **UK**: ZEDfactory.

Energy performance monitoring and management
ICT

BEAMS [6]

Building energy advanced management system

BEAMS developed an advanced, integrated Building Energy Management system which considers energy efficiency in buildings and infrastructure from a holistic perspective. Via an open interoperability gateway, heterogeneous subsystems acting as sources and loads in the facility can be managed optimally e.g. by the building manager or energy service company. It was trialled at Barcelona football club.

	October 2011
	30 months
	Finished
	2.7 M€
	www.ict-beams.eu
	ETRA I+D, Spain
	Germany: Fraunhofer Iwes Advancing Energy Systems. **Greece**: Institute of Communication and Computer Systems of the National Technical University of Athens. **Italy**: Thales Italia Spa, Università del Salento. **Spain**: Barcelona Digital, Sodexo España.

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Technology Building Blocks

BEEM-UP [7]

Building energy efficiency for massive market uptake

In BEEM-UP, a total of 21 Partners from a variety of sectors collaborated over 4 years to demonstrate successful approaches for deep retrofitting with the potential for largescale replication. The project identified and implemented cost-effective ´solution packages´ and delivered approximately 75% heating demand reduction in over 340 dwellings located different buildings in Sweden, France and the Netherlands.

Start date	January 2010
Duration	48 months
Status	Finished
Total budget	7.7 M€
Website	**www.beem-up.eu**
Coordinator	ACCIONA Infraestructuras, Spain
Partners	**France**: ICF Novedis, NOBATEK. **Germany**: BASF, LUWOCO. **The Netherlands**: Dura Vermeer, ENECO, Maastricht University, OTB, Woonbron. **Portugal**: ISA. **Spain**: Bax and Willems, ITA, Macpuarsa, Solintel. **Sweden**: AHEM, SKANSKA, SP, Chalmers University. **Switzerland**: ETH Zurich, Siemens.

Energy performance monitoring and management
ICT

BESOS [8]

Innovative open and trustworthy platform for smart cities

BESOS provides an advanced and integrated management system which enables energy efficiency in smart cities from a holistic perspective. This enables the design and development of higher level applications that are able to process real-time data and generate valuable analysis to help effect the business strategies that operate a smart city or a subset of the energy services deployed.

	October 2013
	36 months
	Finished
	4.6 M€
	www.besos-project.eu
	ETRA I+D, Spain
	Spain: Barcelona municipality, COBRA, SODEXO. **Germany**: Enercast, University of Duisburg. **Portugal**: FICOSA, Lisboa E-Nova, Portugal Telecom. **Greece**: Hypertech.

Advanced materials and nanotechnology

BIOBUILD [9]

High-performance, economical and sustainable bio composite building materials

BioBuild produced biocomposite building components. Using flax fibres, bio-polyester and polyfurfuryl alcohol resin, BioBuild made a cladding panel; 100% biocomposite with half the embodied energy of current industry standards. BioBuild also made a flax fibre-biopolyester façade panel which won the JEC Award for construction. The parts met the requirements for fire, mechanical strength, wind resistance, etc.

	December 2011
	42 months
	Finished
	7.7 M€
	www.biobuildproject.eu
	NetComposites, UK
	Belgium: KU Leuven, TransFurans Chemicals. **Denmark**: 3XN. **Germany**: Arup, IVW, Fiber-Tech. **The Netherlands**: SHR, TNO. **Portugal**: Amorim Cork Composites, LNEC. **UK**: Exel Composites.

Technology Building Blocks
Energy performance monitoring and management

BRICKER [10]

Total renovation strategies for energy reduction in public building stock

BRICKER demonstrates targeted and cost effective retrofitting strategies. Tools, techniques and resources have been developed to help navigate the latest in building know-how and businesses models, as well as understand continuous operation strategies and their costs. The results of four and half years research and demonstration testing are now being made available to help local authorities and professionals work faster and with more confidence to meet national and European energy goals.

Start date	October 2013
Duration	48 months
Status	Finished
Total budget	12.7 M€
Website	**www.bricker-project.com**
Coordinator	Acciona Infraestrcuturas, Spain.
Partners	**Belgium**: Greencom SCRL, Province de Liège, Université de Liège, youris.com GEIE. **Germany**: Steinbeis-Europa-Zentrum of the Steinbeis Innovation gGmbH. **Italy**: EURAC, Fondazione Bruno Kessler, Laterizi Gambettola SRL. **Poland**: Purinova Sp. z o.o. **Spain**: Fundación CARTIF, CEMOSA, Expander Tech SL, Fundación Tecnalia, Gobierno de Extremadura. **Turkey**: Adnan Menderes University, Onur Enerji, Ozyegin University.

Design
Advanced materials and nanotechnology

BRIMEE [11]

Cost-effective and sustainable bio-renewable indoor materials with high potential for customisation and creative design in energy efficient buildings

BRIMEE combines the development of natural-based insulation, to improve energy performance, absorb indoor pollutants and to avoid harmful substances emission. Innovation is based on Nano-Cellulose (NCC) foam, embedded in thermal and noise insulation panels. Market approach is ensured through partners in the Material and Building fields, and architects fostering the adoption into real cases.

	July 2013
	48 months
	Finished
	5.7 M€
	www.brimee-project.eu
	D'Appolonia SpA, Italy
	Czech Republic: FENIX TNT s.r.o. **Germany**: Bundesanstalt Für Materialforschung und pruefung, Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung eV. **Greece**: AMSolutions. **Israel**: The Hebrew University of Jerusalem, Melodea Ltd. **Italy**: Silcart S.p.A. **Poland**: Bergamo Tecnologie Sp z o.o, Brzozowski Grabowiecki Architekci Sp z o.o, Stowarzyszenie Architektów Polskich. **Romania**: Institutul De Cercet ri Electrotehnice ICPE. **Slovenia**: Zavod za gradbeništvo Slovenije. **Spain**: Dragados SA. **UK**: Building Research Establishment Ltd.

Energy performance monitoring and management
Technology Building Blocks

BUILDSMART [12]

Energy efficient solutions ready for market

Buildsmart constructs demonstration buildings using innovative techniques: air tight building envelopes reducing energy loss, energy efficient installations, good windows and shading equipment. Technologies displaying Live Energy Use Data influence the behaviour of homeowners, employees and the public.
The feasibility of mainstreaming the techniques has been analysed for the entire energy system.

	December 2011
	60 months
	Finished
	6.7M€
	www.buildsmart-energy.eu
	City of Malmö, Sweden
	Ireland: CODEMA. **Spain**: Basque Government, FCC Construcción, Tecnalia. **Sweden**: IVL - Svenska Miljöinstitutet, Roth Fastigheter, Skanska.

BRICKER
ENERGY REDUCTION IN PUBLIC BUILDING STOCK

BRIMEE

BUILDSMART
Energy efficient solutions ready for market

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Construction process, end of life, cross-cutting information
Energy performance monitoring and management

CAMPUS 21 [13]

Control and automation management of buildings and public spaces for the 21st century

Campus 21 focuses on the energy efficient operation of public buildings, developing a hardware-software platform for load-balancing, advanced control, and building performance analysis. It spans the entire innovation chain. The holistic evaluation framework includes performance Indicators for indoor comfort, systems operation, the intensity at which facilities are used, and energy usage.

Start date	September 2011
Duration	45 months
Status	Finished
Total budget	3.9 M€
Website	**www.campus21-project.eu**
Coordinator	University College Cork, IRUSE Group, Ireland
Partners	**Austria**: Technical University Vienna. **Germany**: Bilfinger HSG FM International, NEC Research Centre. **Ireland**: Electricity Supply Board, Sirus Ltd, United Technologies Research Centre. **Netherlands**: BAM. **Spain**: Cartif, Valladolid City Council.

Energy performance monitoring and management
BIM/ Data/ Interoperability

CASCADE [14]

ICT for energy efficient airports

CASCADE developed an ISO 50001 based energy action plan, supported by fault detection and diagnosis that detects inefficiencies in the operation of building services and generates an energy action plan. The solution has been tested in two European airports and could reveal energy consumption and costs saving potentials in the operation of the heating, ventilation and air conditioning systems.

	October 2011
	36 months
	Finished
	3.9 M€
	www.cascade-eu.org
	Fraunhofer ISE, Germany
	Germany: PSE AG. **Ireland**: Enerit Limited, National University of Ireland, Galway. **Italy**: Aeroporti di Roma SpA, D'Appolonia SpA, SEA, Sensus Mi Italia SrL. **Serbia**: Institut Mihajlo Pupin.

Technology Building Blocks
Energy performance monitoring and management

CETIEB [15]

Cost-effective tools for better indoor environment in retrofitted energy-efficient buildings

CETIEB developed solutions for monitoring indoor environment quality and detecting insufficient comfort and health factors. Achieved results are a new single VOC sensor (MEMS based spectrometer on a chip) as OEM, a lowcost infrared vision system to monitor comfort parameters (MRT, PMV), an air biofilter to remove VOC, and a fully mineral thermal insulation render TRI-O-THREM M by Quick-Mix (former Schwenk) which received the BAKA Award 2017 and had his market launch at the BAU 2017 in Munich.

	October 2011
	36 months
	Finished
	3.5 M€
	www.cetieb.eu
	University of Stuttgart, Germany
	France: CEA-INES. **Germany**: Fraunhofer IPM, InfraTec GmbH, Schwenk Putztechnik GmbH & Co. KG, TTI GmbH – TGU Smartmote. **Greece**: S&B Industrial Minerals SA. **Ireland**: DW EcoCo. **Italy**: Consorzio TRE, Research Engineering Design SRL, Stam SRL, Università Politecnica delle Marche. **Spain**: FCC Construccion SA, Solintel. **Taiwan**: National Taiwan University of Science and Technology.

Technology Building Blocks
Energy performance monitoring and management

CITyFiED [16]

RepliCable and InnovaTive Future Efficient Districts and cities

CITyFiED is based on a mix of demonstration, innovative technologies and business models towards the sustainable development of EU cities. The extensive demonstration action in the cities of Laguna de Duero-Valladolid (Spain), Soma (Turkey) and Lund (Sweden) involves the retrofitting of 221,158 m2 of living space and 2,213 dwellings and focuses on reducing the energy demand and GHG emissions and increasing the use of renewable energy sources.

Start date: April 2014
Duration: 60 months
Status: In progress

Total budget: 46.04 M€
Website: **www.cityfied.eu**
Coordinator: Fundación CARTIF, Spain.
Partners:
Belgium: Youris.com.
Germany: Steinbeis Innovation gGmbH.
Spain: Acciona Infraestructuras SA, Ayuntamiento de Laguna de Duero, Veolia Servicios LECAM SA, Fundación Tecnalia Research & Innovation, Mondragon Corporación Cooperativa Scoop, 3IA Ingeniería Acústica S.L.
Sweden: IVL Svenska Miljoeinstitutet AB, Kraftringen Energy AB (Publ), Lunds Kommun, Lunds Kommuns Fastighets AB*LKF.
Turkey: Instambul Teknik Universitesi, MIR Arastirma VE Gelistirme AS, Soma Belediyesi, Soma Elektirik Uretim Ve Ticaret AS, Turkiye Bilimsel Ve Teknolojik Arastirma Kurumu, De Surdurulebilir Enerji Ve Insaat Sanayi Ticaret Limited Sirketi; Reengen Enerji Arastirma Gelistirmeinsaat Egitim Danismanlik San Ve Dis Tic Ltd Sti; Manisa Buyuksehir Belediyesi.

Design
Energy performance monitoring and management

CITYOPT [17]

Holistic simulation and optimisation of energy systems in smart cities

CITYOPT supports planning, detailed design and operation of energy systems in urban districts. CITYOPT developed a planning tool to optimise energy systems in Vienna and Helsinki, and an operational tool to send demand-response notifications to households in Nice during energy peaks. CITYOPT achieved up to 25% energy demand reduction through optimised urban planning and increased energy awareness.

February 2014
36 months
Finished

3.96 M€
www.cityopt.eu
VTT technical research Centre of Finland Ltd, Finland
Austria: AIT Austrian Institute of Technology GmbH.
Finland: VTT, City of Helsinki and Helen Oy
France: Centre Scientifique et Technique de Batiment, Electricite de France SA, Metropole Nice Cote d'Azur.
Italy: Experientia Srl.

Construction process, end of life, cross-cutting information
Energy performance monitoring and management

City-zen [18]

In Grenoble and Amsterdam a consortium of 25 partners is learning by doing in 20 innovative projects how to get cities on clean energy

In Grenoble and Amsterdam 2 roadmaps and 22 urban energy transition innovations are demonstrated, such as retrofit of buildings, smart grids with local storage in home batteries and via VehicletoGrid, use of water supply infrastructure and rivers to cool buildings, smart tools and dashboards, and renewable energy and phase change materials integrated into district heating networks. City-zen shares its solutions via roadshows, serious games and events.

March 2014
69 months
In progress

42.8 M€
www.cityzen-smartcity.eu
VITO, Belgium
Belgium: Th!nk.
France: HESPUL Association, Ville de Grenoble, Commissariat a l'Energie Atomique et aux Energies Alternatives, Compagnie de Chauffage Intercommunale de l'Agglomeration Grenobloise, Gaz Electricite de Grenoble, SAS ATOS Worldgrid, La Metro, ALEC.
Italy: Universita'degli Studi di Siena.
The Netherlands: Stichting Amsterdam Economic Board, Universiteit van Amsterdam, Westpoort Warmte B.V., Alliander, DNGVL, Technische Universiteit Delft, Stichting Waternet, Greenspread Projects BV, Sanquin, AEB Exploitatie BV, Daikin Airconditioning Netherlands B.V., Siemens Nederland NV.
UK: The Queens University of Belfast, Clicks and Links Ltd&L.

Technology Building Blocks

Clear-Up [19]

Clean and resource-efficient buildings for real life

The clear-up consortium has brought nanomaterials from the lab into real applications and developed sensors and control strategies for an optimal integration and interaction. Substantial savings in operational energy use were achieved (14% overall energy savings in the monitoring period and 34% cooling energy saving) whilst maintaining a high quality environment for building occupants.

Start date	November 2008
Duration	48 months
Status	Finished
Total budget	12 M€
Website	**www.clear-up.eu**
Coordinator	University of Tübingen, Germany
Partners	**Belgium**: Belgian Building Research Institute. **Czech Republic**: Czech Technical University in Prague, Saint-Gobain Weber Terranova a.s. **Denmark**: Technical University of Denmark, International Centre for Indoor Environment and Energy, Velux AS. **France**: Bouygues Construction, Centre Scientifique et Technique du Bâtiment. **Germany**: Fraunhofer Institute for Surface Engineering and Thin Films, Eberhard Karls University of Tübingen, Fraunhofer Institute for Solar Energy Systems, AppliedSensor GmbH, Saint-Gobain Weber GmbH, Porextherm Dämmstoffe GmbH, Siemens Corporate Technology, Steinbeis Transfer Centre AO Action. **Greece**: FORTH Foundation of Research and Technology Hellas. **Hungary**: Budapest University of Technology and Economics. **Italy**: C.T.G. SPA, European Commission, DG Joint Research Centre, Institute for Health and Consumer Protection. **Spain**: ACCIONA Real Estate. **Sweden**: Uppsala University, Ångström Laboratory, Chromogenics AB. **Switzerland**: Siemens Building Technology.

Construction process, end of life, cross-cutting information
Energy performance monitoring and management

CommONEnergy [20]

Re-conceptualise shopping malls from consumerism to energy conservation

CommONEnergy developed a number of solutions-sets for deep systemic retrofitting of shopping centres, as well as support tools and methods for energy-economic evaluation, comfort analysis lean management, continuous commissioning, environmental and socio-cultural impact assessment, Balance among energy efficiency, enhancing of customers' experience, and investment, ensures the widest replication of the investigated and demonstrated cases.

	October 2013
	48 months
	Finished
	13 M€
	www.commonenergyproject.eu
	EURAC, Italy
	Austria: Bartenbach LichtLabor Gmbh, SOLID, Sunplugged, Technische Universität Wien. **Belgium**: BPIE. **Germany**: DS Consulting, Durlum, Fraunhofer IBP. **Greece**: AMS. **Italy**: D'APPOLONIA, EPTA, INRES, Schneider Electric SpA, Università degli Studi di Udine. **Norway**: SINTEF, Storebrand Kjopesenter City Syd. **Poland**: CIM-mes. **Spain**: Acciona Infraestructuras SA, Ayuntamiento de Valladolid, CARTIF. **Sweden**: NILAR. **UK**: ITM Power.

Technology Building Blocks
Advanced materials and nanotechnology

COOL-Coverings [21]

Development of a novel and cost-effective range of nanotech improved coatings

COOL-Coverings project developed a novel cost-effective range of insulation materials to improve the energy efficiency of the building envelope for retrofits and new constructions, based on nanotechnologies ('Cool ' materials) that significantly improve the Near Infrared (NIR) reflection capabilities of existing covering products for roofs and façades while maintaining the traditional colours.

	June 2010
	36 months
	Finished
	4.3 M€
	www.coolcoverings.org
	Keraben Grupo SA, Spain
	Finland: Finnish Institute of Occupational Health. **Germany**: Borner, Active Space Technologies. **Greece**: NANOPHOS, National Technical University of Athens. **Italy**: D'Appolonia, Università Politecnica delle Marche, MBN Nanomaterialia, CSGI. **The Netherlands**: TNO. Poland: Mostostal. Spain: Instituto de Tecnología Cerámica. **Switzerland**: IRIS SW.

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Design
BIM/ Data/ Interoperability

COOPERaTE [22]
Control and optimisation for energy positive neighbourhoods

COOPERaTE has defined a path towards energy positive neighbourhoods. The key element is a System of Systems view: thanks to a web-based service called Neighbourhood Information Model, COOPERaTE offers a unique way to integrate data from different cloud solutions to deploy innovative services. The concept has been implemented and validated in two test sites.

Start date	October 2012
Duration	36 months
Status	Finished
Total budget	3.6 M€
Website	**www.cooperate-fp7.eu**
Coordinator	RWTH Aachen University, Germany
Partners	**France**: Bouygues Energies & Services, EMBIX. **Ireland**: CIT, Intel Ireland, UTRC Ireland. **UK**: University of Manchester.

Energy performance monitoring and management
ICT

CoSSMic [23]
Collaborating smart solar powered microgrids

CoSSMic has developed and demonstrated an innovative, autonomic ICT system coordinating energy usage in neighbourhoods with local PV panels. The system leverages loadshifting and two-way exchange of energy with public power grids to reduce peak loads and increase self consumption. It is governed by inhabitants' constraints, and weather forecasts.

	October 2013
	39 months
	Finished
	4.27 M€
	www.cossmic.eu
	SINTEF, Norway **Germany**: City of Konstanz, International Solar Energy Research Center Konstanz, Sunny Solartechnik. **Italy**: Province of Caserta, Seconda Universita Degli Studi di Napoli. **The Netherlands**: Boukje.com Consulting. **Norway**: Norges Teknisk-Naturvitenskapelige Universitet, Universitet I Oslo.

Technology Building Blocks

Cost-Effective [24]
Resource- and cost-effective integration of renewables in existing high-rise buildings

With a focus on high-rise buildings, the CostEffective project has developed new façade components in addition to business models and technical concepts and has demonstrated these concepts in two pilot buildings. It aims to help achieve ambitious energy reduction targets.

	October 2008
	48 months
	Finished
	10.7 M€
	www.cost-effective-renewables.eu
	Fraunhofer ISE, Germany **France**: CSTB, EDF. **Germany**: Interpane, Kollektorfabrik, PSE, STO, University of Stuttgart. **Greece**: NKUA. Italy: D'Appolonia, Permasteelisa. **The Netherlands**: Alusta, ECN, KOW, TNO. **Poland**: ASM. **Slovenia**: Hidria, ZAG. **Spain**: ACCIONA, Labein.

Energy performance monitoring and management
ICT

DAREED [25]

Decision support Advisor for innovative business models and user engagement for smart energy efficient districts

DAREED created a 'smart city' technology platform to manage a neighbourhood or districts energy in order to increase the energy efficiency rating ("C" to "A") and reduce energy consumption by up to 10%. It gives citizens, public authorities and utilities a decision making tool to increase efficiency, reduce emissions and reduce a building, installation or districts energy consumption.

Start date	August 2013
Duration	36 months
Status	In progress
Total budget	4.08 M€
Website	**www.dareed.eu**
Coordinator	ISOTROL, Spain
Partners	**Germany**: Cleopa GmbH, Karlsruher Institut für Technologie, Open Experience. **Italy**: CETMA, Comune di Lizzanello, Enel Università di Bologna. **Spain**: Empresas Municipales - Ayuntamiento de Sevilla, IAT. **UK**: Brunel University London, Cambridge County Council.

Design
Construction process, end of life, cross-cutting information

Design4Energy [26]

Building life-cycle evolutionary design methodology able to create energy-efficient buildings flexibly connected with the neighbourhood energy system

Design4Energy develops tools and methodologies for designing energy-efficient buildings integrated in the neighbourhood energy systems. Using the platform at early design phase, it could help to reduce cost and improve by at least 20% the energy efficiency compared with traditional methods. A Design4Energy portal coupled with an energy enhanced database, online gaming and guidelines are available.

	October 2013
	48 months
	Finished
	6.5 M€
	www.design4energy.eu
	Solintel M&P, Spain
	Finland: Teknologian Tutkimuskeskus VTT. **Germany**: Fraunhofer-Gesellschaft Zur Förderung der Angewandten Forschung EV, Lenze-Luig 3-L-Plan GBR, Technische Universität Dresden. **Hungary**: Metropolitan Research Institute LTD. **The Netherlands**: Corio NV. **Poland**: Iznab Sp z o.o, TPF Sp z o.o. **Portugal**: Uninova-Instituto de Desenvolvimento de Novas Tecnologias. **Spain**: Ancodarq SL, Assignia Infraestructuras SA, Gaspar Sánchez Moro Arquitectos SL, Sistemas y Montajes Eléctricos SL. **Switzerland**: Cadcamation KMR SA. **UK**: Loughborough University, The University of Salford.

Energy performance monitoring and management
ICT

DIMMER [27]

District information modelling and management for energy reduction

DIMMER focuses on the interoperability of district energy production/consumption, environmental and user data including:
- the exploitation of visual and web-based interfaces to provide real-time feedback about energy impact of user behaviours,
- the integration of BIM with realtime data and its extension to district level,
- energy profiling business models for energy traders and prosumers.

	October 2013
	36 months
	Finished
	11 M€
	www.dimmer.polito.it
	Politecnico di Torino, Italy
	Germany: Fraunhofer-Gesellschaft Zur Förderung der Angewandten Forschung EV. **Italy**: Consorzio per il Sistema Informativo, D'Appolonia SPA, IREN Energia SPA, Istituto Superiore Mario Boella, ST-Polito Società consortile arl, Università degli Studi di Torino. **Sweden**: CNet Svenska AB. **UK**: Arup, Clicks and LinksI LTD, Oldham Metropolitan Borough Council, The University of Manchester.

Construction process, end of life, cross-cutting information
Energy performance monitoring and management

DIRECTION [28]

Demonstration at European level of innovative and replicable effective solutions for very low energy new buildings

DIRECTION project has set a framework of demonstration and dissemination of very low energy new buildings through two new buildings located in Spain and Germany, deploying highly monitored innovative measures from constructive elements for energy optimization to highly efficient energy equipment & advanced EMS to check CO2 emissions and energy consumption savings (up to 60% and 50% expected respectively).

Start date	January 2012
Duration	48 months
Status	Finished
Total budget	6.95 M€
Website	**www.direction-fp7.eu**
Coordinator	Fundación CARTIF. Spain.
Partners	**Belgium**: youris.com GEIE. **Germany**: Domagk Gewerbepark, FACIT GmbH & Co KG, Fraunhofer Institute for Building Physics. **Italy**: Claudio Lucchin & architetti associati, EnginSoft SpA, EURAC, Province of Bolzano. **Spain**: 1A Ingenieros, DRAGADOS.

Construction process, end of life, cross-cutting information
Energy performance monitoring and management

E2ReBuild [29]

Industrial energy efficient retrofitting of resident buildings in cold climates

Through E2ReBuild, 7 demonstration projects in 6 countries were realised - a total of 25,000m2 of energy renovated buildings. Due to the introduction of industrial manufacturing methods, such as prefabricated elements and standardised retrofit measures, reductions of up to 75% in heat use were achieved. An innovative design and decision tool for sustainable renovation strategies was developed.

	January 2011
	42 months
	Finished
	8 M€
	www.e2rebuild.eu
	NCC AB, Sweden **Finland**: Aalto University, NCC Rakennus Oy, PSOAS. **France**: Opac38. **Germany**: Gumpp & Maier, GWG München, Lichtblau Architekten, SchwörerHaus, WBG Augsburg, TUM - Technische Universität München. **The Netherlands**: AlleeWonen, Trecodome. **Poland**: Mostostal. **Sweden**: Akelius Bostad Väst, SP Technical Research Institute of Sweden, White arkitekter. **Switzerland**: Empa, HSLU Hochschule Luzern Technik & Architektur. **UK**: Gallions Housing Association.

Technology Building Blocks
Advanced materials and nanotechnolog

EASEE [30]

Envelope approach to improve sustainability and energy e fficiency in multi-storey multi-owner residential buildings

EASEE developed a new approach for building retrofitting, based on advanced tools and solutions. Residential buildings were retrofitted in order to validate the approach, achieving a decrease in U-value up to 60% by installing prefabricated panels, from 25% to 45% by retrofitting the interior through aerogel and perlite based kits and up to 80% by injecting hydrophobized perlite in the cavity.

	March 2012
	48 months
	Finished
	7.6 M€
	www.easee-project.eu
	D'Appolonia SpA, Italy **Belgium**: Building Performance Institute of Europe. **Germany**: Schwenk GmbH. **Greece**: National Technical University of Athens, S&B Industrial Minerals. **Italy**: Consortium of European Small and Middle-Sized Anchors Producers, Halfen SRL, Magnetti Building Solutions, Politecnico di Milano, STAM SRL. **Poland**: CIM-MES Project Sp z o.o, Pre-Fasada, Ridan Sp z o.o. **Spain**: Ancodarq SL. **Switzerland**: Swiss Federal Laboratories for material science and technology. **UK**: IES.

Energy performance monitoring and management
ICT

e-balance [31]

Balancing energy production and consumption in energy efficient neighbourhoods

The e-balance project develops an ICT platform for smart grids to improve the efficiency in using renewable energy. Aspects addressed by the project are the balancing of energy consumption to match the available energy and the controlling of energy production to provide a resilient grid. They are accompanied by research on social issues related to enabling flexibility and to security and privacy.

Start date	October 2013
Duration	46 months
Status	In progress
Total budget	5.18 M€
Website	**www.e-balance-project.eu**
Coordinator	IHP GmbH, Germany
Partners	**Germany**: IHP GmbH, Lesswire AG. **The Netherlands**: Alliander NV, University of Twente. **Poland**: National Information Processing Institute, University of Łód. **Portugal**: EDP Distribuição - Energia, Efacec Engenharia e Sistemas SA, INESC INOVAÇÃO. **Spain**: CEMOSA, University of Malaga.

Design
ICT

ECODISTR-ICT [32]

Integrated decision support tool for retrofit and renewal towards sustainable districts

ECODISTR-ICT developed an integrated decision support system geared towards the sustainable renewal of districts. It connects the main stakeholders in the district transformation processes to reach a coordinated approach, which is supported by data and simulation models. The modular set-up and open source nature of the ECODISTR-ICT IDSS result in a truly interdisciplinary and versatile platform.

Start date	December 2013
Duration	36 months
Status	Finished
Total budget	4.1 M€
Website	**www.ecodistr-ict.eu**
Coordinator	VITO, Belgium
Partners	**Belgium**: Omgeving CVBA. **France**: CSTB, Sigma Orionis SA. **The Netherlands**: Arup bv, TNO, VABI. **Spain**: Bipolaire Arquitectos SLP. **Sweden**: SP, StruSoft, White Arkitekter Aktiebolag.

Technology building blocks
Advanced materials and nanotechnology

ECO-SEE [33]

Eco-innovative, safe and energy efficient wall panels and materials for a healthier indoor environment

The ECO-SEE project developed new eco-materials and components for the purpose of creating both healthier and more energy efficient buildings. It successfully created and symbiotically used natural eco-materials for healthier indoor environments through hygrothermal (heat and moisture) regulation and the removal of airborne contaminants through both chemical capture and photocatalysis.

Start date	September 2013
Duration	48 months
Status	Finished
Total budget	9.3 M€
Website	**www.eco-see.eu**
Coordinator	University of Bath, UK
Partners	**Belgium**: Greenovate! Europe. **France**: BCB SAS. **Germany**: Claytec EK, Fraunhofer- Gesellschaft zur Foerderung der Angewandten Forschung EV. **India**: Indian Institute of Technology, Dehli. **Italy**: Parco Scientifico e Tecnologico per L'Ambiente - Environment Park SPA, Nesocell SRL. **Poland**: Instytut Technologii Drewna. **Portugal**: Universidade de Aveiro. **Spain**: Acciona Infraestructuras SA, Fundacion Technalia Research & Innovation. **UK**: Bangor University, Black Mountain Insulation Ltd, Building Research Establishment Ltd, Kronospan Ltd, Modcell Ltd, Skanska UK Plc.

Construction process, end of life, cross-cutting information

EcoShopping [34]

Energy efficient & Cost competitive retrofitting solutions for Shopping buildings

EcoShopping developed a comprehensive retrofitting solution for shopping buildings. The integration of novel and market available technologies of HVAC systems, energy generation, lighting and building automation complete with environmental and acoustic sensor networks resulted in significant energy savings. The results are completed with a guide and business plan for shopping buildings.

Start date	September 2013
Duration	48 months
Status	In progress
Total budget	5.9 M€
Website	**www.ecoshopping-project.eu**
Coordinator	EnergoSyS, Hungary
Partners	**Austria**: AIT. **Croatia**: NOVAMINA. **Germany**: Fraunhofer, GeoClimaDesign. **Hungary**: Lagross. **Italy**: CNR, RED. **Poland**: IZNAB. **Portugal**: ISA. **Spain**: Ancodarq, Solintel, Symelec. **Taiwan**: NTUST. **Turkey**: Yasar University. **UK**: BRE.

Construction process, end of life, cross-cutting information
Energy performance monitoring and management

EEBGUIDE [35]

Operational guidance for life cycle assessment studies of the energy efficient buildings initiative

Within EeBGuide LCA guidance documents were provided to support practitioner´s conducting LCA studies for the E2B EI. The developed guidelines serve as input for further regulations regarding EPDs or PEF. Associations like the ECO platform or green building certification schemes could use the results (e.g. developed benchmarks) to advance their guidance regarding their certification systems.

	November 2011
	12 months
	Finished
	0.8 M€
	www.eebguide.eu
	Fraunhofer IBP, Germany
	France: Centre Scientifique et Technique du Bâtiment. **Germany**: Fraunhofer Institute for Building Physics IBP, PE International. **Spain**: Escola Superior de Comerç Internacional. **Sweden**: Prof Ch Sjöström Consultancy. **UK**: BRE Global Limited.

Design
BIM/ Data/ Interoperability

eeEmbedded [36]

Collaborative holistic design laboratory and methodology for energy-efficient embedded buildings

eeEmbedded develops an open BIM-based collaborative design and simulation platform, a related design methodology based on hierarchical verifiable check points (Key Design Parameters & Key Performance Indicators), an energy system information model and an integrated information management platform for designing energy efficient buildings and their optimal energetic embedding in the neighbourhood.

	October 2013
	48 months
	In progress
	11.1 M€
	www.eeembedded.eu
	Technische Universität Dresden - Institute of Construction Informatics, Germany
	Austria: STRABAG AG. **Germany**: Technische Universität Dresden - Institute of Construction Informatics, Institute of Power Engineering, RIB Information Technologies AG, Fraunhofer Gesellschaft eV - Institute IIS/EAS, Obermeyer Planen + Beraten GmbH, Institut für angewandte Bauinformatik (iabi). **Finland**: Granlund Oy. **Greece**: SOFiSTiK Hellas AE. **The Netherlands**: Royal BAM Group NV. **Norway**: Data Design System ASA, Jotne EPM Technology AS. **Slovakia**: NEMETSCHEK ALLPLAN SLOVENSKO SRO. **Spain**: CEMOSA. **Switzerland**: Fr. Sauter AG.

Energy performance monitoring and management
ICT

EEPOS [37]

Energy management and decision support systems for energy positive neighbourhoods

The project increased energy efficiency through neighbourhood management. It developed concepts for energy management business models in energy positive neighbourhoods. The business models were based on data from the two pilots plus a virtual prototype (real buildings) and a laboratory prototype. Evaluation of the project showed business potential in all cases. Also CO2 was calculated. The use of the solutions used in EEPOS monitoring have been used and further developed in other projects.

Start date	October 2012
Duration	36 months
Status	Finished
Total budget	4.1 M€
Website	**www.eepos-project.eu**
Coordinator	VTT Technical Research Centre of Finland, Finland
Partners	**Austria**: AIT Austrian Institute of Technology GmbH. **Finland**: Caverion Suomi Oy, Fatman Oy. **Germany**: Ennovatis GmbH, European Distributed Energy Resources Laboratories eV. **Spain**: Ayuntamiento De Asparrena, Solintel M&p SL.

Construction process, end of life, cross-cutting information
Energy performance monitoring and management

ee-WiSE [38]

Knowledge transfer framework for energy efficient building retrofitting in the Mediterranean area

The ee-WiSE tool was designed to promote Energy Efficiency (EE) knowledge sharing amongst agents of the building retrofitting sector. It works as a social database where users can exchange EE material over different topics. The platform developed provides specific suggestions for 20 different agent profiles to share & search for content. The tool was validated in 7 Mediterranean countries and accommodated more than 300 users from the region.

	October 2012
	24 months
	Finished
	1.2 M€
	www.ee-wise.eu
	INTROMAC, Spain
	Bulgaria: Bulgarian Construction Chamber. **Cyprus**: IMA Architecture, X-Panel. **Greece**: AVACA Technologies, Harbour of Rafina, Positive Energy. **Italy**: ANCE, ISTEDIL. **Malta**: Projects in Motion. **Spain**: AIDICO, ENERCYA, EOLAS. **Turkey**: EGE University.

Energy performance monitoring and management
BIM/ Data/ Interoperability

EFFESUS [39]

Energy efficiency for EU historic districts' sustainability

EFFESUS developed a decision support system to make informed decisions about improvement measures for historic urban districts. It also applied, to seven case studies, cost-effective innovative products for the historic context, including insulating mortars, radiant reflective coatings, blow-in aerogel insulation, secondary window solutions and intelligent energy management systems.

	September 2012
	48 months
	Finished
	6.8 M€
	www.effesus.eu
	Tecnalia, Spain
	France: GOUAS. Germany: Fraunhofer, University of Stuttgart. **Greece**: AMS, I2S. **Hungary**: HOR-BER. **Ireland**: DWE. **Italy**: CNR- ISAC, D'Appolonia, Eurac research, RED. **The Netherlands**: Bofimex. **Norway**: NTNU, Snekkeriet. **Portugal**: Active Aerogels. **Spain**: Acciona, Consorcio Santiago. **Sweden**: Uppsala University. **Turkey**: SAMPAS. **UK**: APG, Dennis Rodwell, Historic Scotland.

Design
Energy performance monitoring and management

E-hub [40]

Energy-hub for residential and commercial districts and transport

To accommodate large amounts of renewable energy from wind, biomass and solar energy into the existing energy infrastructure, E-hub developed an intelligent energy management system to simultaneously match demand and supply of heat and electricity (hybrid matcher). Matching is further facilitated by the development of novel short term and long term heat storage, such as thermochemical storage.

Start date	December 2010
Duration	48 months
Status	Finished
Total budget	11.7 M€
Website	**www.e-hub.org**
Coordinator	TNO, The Netherlands
Partners	**Belgium**: Ertzberg, ISPE, VITO. **Finland**: VTT. **France**: EDF. **Germany**: Fraunhofer-ISE, HSW. **Italy**: Finlombarda, D'Appolonia, University of Genoa. **The Netherlands**: ECN. **Poland**: Mostostal. **Spain**: Acciona, Solintel. **UK**: ICAX.

Design
Energy performance monitoring and management

EINSTEIN [41]

Effective integration of seasonal thermal energy storage systems in existing buildings

Two Seasonal Thermal Energy Storage (STES) demo plants have been designed, built and monitored. Solar thermal heat collected in summer is stored as hot water in tanks to be used in winter in combination with a heat pump for space heating. A new high T heat pump has been designed and tested. STES guidelines, training courses and two Decision Support Tools have been developed for future stakeholders. Currently STES would be economically feasible in southern Europe.

	January 2012
	48 months
	Finished
	9 M€
	www.einstein-project.eu
	Tecnalia, Spain
	Bulgaria: Archspies. **Germany**: Solites, Usttut. **Ireland**: Scanhome. **Italy**: D´Appolonia, Icop. **The Netherlands**: TNO. **Poland**: CIM-mes, MAE, Mostostal. **Spain**: Acciona, Airlan, Arteaga, Fomento San Sebastián, Girotze. **UK**: Ulster.

Technology Building Blocks
Advanced materials and nanotechnolog

ELISSA [42]

Energy efficient lightweight sustainable safe steel construction

ELISSA has developed modular prefabricated lightweight cold formed steel skeleton / drywall elements and modules that can be flexibly interconnected. Innovations include: a) High earthquake resilience b) Vacuum Insulation Panels with very high insulation values yielding small element thicknesses and excellent energy performance c) Active damping devices to mitigate the structural response under seismic action d) intumescent paint coatings to protect steel in case of fire.

	September 2013
	36 months
	Finished
	3.6 M€
	www.elissaproject.eu
	National Technical University of Athens, Greece
	Germany: Wölfel Beratende Ingenieure GmbH + Co KG, ZAE Bayern eV, KNAUF Gips KG, va-Q- tec. **Italy**: STRESS S.c.a.r.l, Farbe SpA, Università degli Studi di Napoli Federico II, Knauf di Lothar Knauf Sas. **Switzerland**: Häring Nepple AG. **UK**: University of Ulster.

Design
Technology building blocks

ENBUS [43]
Energising the building sector

An app for smartphones has been developed with EU support, which will make it easy for the end user (add space bet end and user) to evaluate energy efficient product options, when renovating or building a new house. The app enables comparison of potential energy savings for four different product groups: windows, insulation, ventilation and heating. It is an easy-to-use tool.

Start date	September 2012
Duration	30 months
Status	Finished
Total budget	1.3 M€
Website	**www.enbus.eu**
Coordinator	Swerea IVF, Sweden
Partners	**Denmark**: Teknologisk Institut. **Germany**: Fraunhofer IAO. **The Netherlands**: Kamer van Koophandel. **Poland**: Dolnoslaski Park Innowacji I Nauki SA. **Sweden**: SP Technical Research Institute of Sweden.

Technology building blocks
Advanced materials and nanotechnology

EnE-HVAC [44]
Energy efficient heat exchangers for HVAC applications

The EnE-HVAC achieved energy savings in Heating, Ventilation, and Air Conditioning systems via new and innovative technologies; including anti-icing nanotechnological coatings, structured surfaces for improved heat transfer; new nano- and micro-materials for improved efficiency of the refrigerants, and improved efficiency and heat transfer capabilities of coolants via nanotechnological additives.

	October 2012
	36 months
	Finished
	4.1 M€
	www.ene-hvac.eu
	Danish Technological Institute, Denmark.
	Denmark: Danish Heatpump Industry, EXHAUSTO A/S.
	Finland: Carbodeon Oy, Vahterus Oy.
	Germany: ESI Group.
	Italy: LuVe S.p.a. Spain: IK4 Tekniker.

Energy performance monitoring and management
ICT

EiT [45]
Energy in time

EiT has developed a monitoring system for energy efficiency in the operation and maintenance of buildings, reducing the energy bill in operational phases. The project was based on simulation and technical control, based on models capable of representing the construction complexity of buildings. EiT wase validated in 4 buildings of different typology located in different European climates (Finland, Romania and Portugal).

	October 2013
	48 months
	Finished
	7.7 M€
	www.energyintime.eu
	ACCIONA Infraestructuras SA, Spain
	Finland: Caverion Suomi Oy.
	France: Centre Scientifique et Technique de Batiment, Université de Lorraine. **Ireland**: Cork Institute for Technology, United Technologies Research Centre Ireland. **Italy**: Stam SRL.
	Portugal: ANA Aeroportos de Portugal SA.
	Romania: Institutul de Cercetari Electrotehnice.
	Spain: Centro de Investigación de Recursos y Consumos Energéticos, Fundación Universitaria Iberoamericana, Universidad de Granada.
	UK: IES.

Technology Building Blocks
Energy performance monitoring and management

EnRiMa [46]

Energy efficiency and risk management in public buildings

EnRiMa developed a decision support system to enable operators to manage energy flows in public buildings, which delivers a holistic solution for meeting their energy needs in a less costly, and less CO2-intensive manner subject to comfort tolerances and long-term risk preferences. Audited energy savings of 8% for short-term optimisation and 15% for long-term optimisation have been delivered.

Start date	October 2010
Duration	42 months
Status	Finished
Total budget	3.5 M€
Website	**www.enrima-project.eu**
Coordinator	Stockholm University, Sweden
Partners	**Austria**: Center for Energy and Innovative Technologies, International Institute for Applied Systems Analysis. **Belgium**: Minerva Consulting and Communication. **Norway**: Stiftelsen SINTEF. **Spain**: Fundación Tecnalia Research and Innovation, Hidrocantábrico Energia SA, Universidad Rey Juan Carlos. **UK**: University College London.

Energy performance monitoring and management
ICT

EPIC-HUB [47]

Energy positive neighbourhoods' infrastructure middleware based on the energy-hub concept

EPIC-HUB impacts on energy efficiency (+15%) and emissions reduction (-20%) through ICT solutions exploiting energy excess in the neighbourhoods. The energy hub model and demand side management strategies are combined in a hybrid way to optimise energy flows. EPIC-HUB provides services for the integration of energy resources featuring energy planning, data analytics, and integrated management cockpit.

	October 2012
	43 months
	Finished
	6.7 M€
	www.epichub.eu
	D'Appolonia SpA, Italy
	Czech Republic: Honeywell, spol. s.r.o. **Israel**: Panoramic Power Ltd. **Italy**: D'Appolonia SpA., Energrid SpA, Terminal San Giorgio Srl, Thales Italia SpA. **Serbia**: Institut Mihajlo Pupin. **Spain**: Acciona Infraestructuras SA, Bilbao Exhibition Centre SA, Fundacion Tekniker. **Switzerland**: Eidgenössische Technische Hochschule Zurich.

Technology Building Blocks
Energy performance monitoring and management

EU-GUGLE [48]

European cities serving as green urban gates towards leadership in sustainable energy

As part of EU-GUGLE, nearly 190,000m² of living space will be renovated in six smart districts with the objective of achieving 40% to 80% primary energy savings per pilot district, while increasing their share of renewable energy by 25% by 2019. EU-GUGLE districts and three associated cities will implement a balanced mix of technical, socio-economic and financial solutions adapted to local needs.

	April 2013
	72 months
	In progress
	26.4 M€
	www.eu-gugle.eu
	National Renewable Energy Centre of Spain CENER , Spain
	Austria: City of Vienna, IC Group, University for Natural Resources and Life Sciences (BOKU), Magistrat der Stadt Wien. **Belgium**: Greennovate! Europe. **Bulgaria**: Municipality of Plovdiv. **Finland**: City of Tampere, Technical research centre of Finland (VTT), **Germany**: City of Aachen, Gewoge Aachen, Stadtwerke Aachen, Synergiekomm. **Italy**: City of Milan, Politecnico di Milano. **Slovakia**: Building Testing and Research Institute (TSUS), City of Bratislava, Green Building Council Slovakia (SKGBC). **Spain**: Ente Vasco de la Energía (EVE), Sestaoberri 2010. **Sweden**: City of Gothenburg. **Turkey**: Gaziantep Metropolitan Municipality.

Design
BIM/ Data/ Interoperability

FASUDIR [49]

Friendly and affordable sustainable urban districts retrofitting

FASUDIR developed an Integrated Decision Support Tool (IDST) that helps select the best energy retrofitting strategy to increase the sustainability of a district. The IDST features a 3D GUI and models the district using a number of sustainable retrofitting strategies and technical solutions. It facilitates the interaction of the multiple stakeholders involved in the decision making process.

Start date	September 2013
Duration	36 months
Status	Finished
Total budget	4 M€
Website	**www.fasudir.eu**
Coordinator	Tecnalia, Spain
Partners	**Germany**: CalCon, Munich University of Applied Science. **Hungary**: Abud, Geonardo. **Italy**: D'Appolonia, iiSBE R&D. **Spain**: Acciona, Acciona Inf., Consorcio de Santiago. **UK**: IES, London Business School.

Technology building blocks
Energy performance monitoring and management

FC-DISTRICT [50]

New µ-CHP network technologies for energy efficient and sustainable districts

FC-DISTRICT optimised and demonstrated an innovative energy production and distribution system, based on dynamic heat exchange between buildings, achieving heat and electricity balance at district level. The system comprises m-CHP units (SOFCs), district heating pipes with VIPs, new ETICS with VIPs, food waste collection tanks for biogas production and a wireless communication and control network.

Start date	September 2010
Duration	48 months
Status	Finished
Total budget	11.8 M€
Website	**www.fc-district.eu**
Coordinator	Mostostal Warszawa SA, Poland
Partners	**Belgium**: IntesaSanpaolo. **Germany**: EBZ, Knauf KG, Sunfire GmbH, Technische Universität Bergakademie Freiberg. **Greece**: Knauf ABEE, National Technical University of Athens. **Italy**: D'Appolonia, Ecofast. **The Netherlands**: ECN, Vito. **Poland**: Institute of Power Engineering. **Portugal**: Istituto Superior Tecnico. **Romania**: OVM ICCPET. **Spain**: Acciona, Fagor, Ikerlan, Solintel M&P SL. **Sweden**: Chalmers Tekniska Hoegskola, Powerpipe Systems, SP. **UK**: Rinicom.

Technology building blocks
Advanced materials and nanotechnology

FoAM-BUILD [51]

Functional adaptive nano-materials and technologies for energy efficient buildings

The growth of microorganisms has been investigated under static and dynamic conditions. The already constructed moisture control system has been tested on real facades. Innovations include the creation of a low thermal conductivity insulation material. Different halogen-free flame retardants have been tested successfully in polymer foams. A new fast-curing mortar system was developed and established.

Start date	September 2013
Duration	48 months
Status	Finished
Total budget	5.1 M€
Website	**www.foambuild.eu**
Coordinator	Fraunhofer Gesellschaft zur Foerderung der angewandten Forschung e.V., Germany
Partners	**Austria**: Sunpor Kunststoff GmbH. **France**: TBC générateurs d'innovation. **Germany**: Deutsche Amphibolin-Werke von Robert von Murjahn Stiftung & Co KG. **Greece**: National Center for Scientific Research "Demokritos". **The Netherlands**: Stichting Nederlands Normalisatie - Instituut. **Norway**: Norner Research AS. **Spain**: Ateknea Solutions Catalonia S.A. **UK**: Smithers Rapra and Smithers Pira Limited.

Construction process, end of life, cross-cutting information
Energy performance monitoring and management

GE2O [52]

Geo-clustering to deploy the potential of energy efficient buildings across EU

GE2O developed a geo-cluster mapping tool consisting of a multi-dimensional and dynamic GIS to identify similarities across the EU. It enables the combination of single or multiple parameters addressing both technological and non-technological aspects. Virtual transnational areas are identified with strong similarities in terms of climate, construction typologies, energy prices and regulations.

Start date	January 2012
Duration	48 months
Status	Finished
Total budget	1 M€
Website	**www.geoclusters.eu**
Coordinator	CSTB, France
Partners	**Belgium**: BBRI, E2BA. **Czech Republic**: TZUS. **Italy**: D'appolonia, POLIMI. **Luxembourg**: Arcelor Mittal. **The Netherlands**: TNO. **Poland**: ASM. **Slovenia**: ZAG. **Spain**: ACCIONA. **UK**: IFS.

Technology Building Blocks
Energy performance monitoring and management

H2SusBuild [53]

Development of a clean and energy self-sustained building in the vision of integrating H2 economy with renewable energy sources

H2SusBuild developed a hybrid energy system for buildings that uses renewable energy to produce hydrogen from water, stores the hydrogen as a back-up energy source, and converts it into power and heat via fuel cells in case of renewable energy shortage. An installation satisfying energy needs of a 600m2 office building was realized. Safety and energy management were two fundamental aspects.

	October 2008
	48 months
	Finished
	6.6 M€
	www.h2susbuild.ntua.gr
	D'Appolonia, Italy.
	Germany: CirComp, Institut für Verbundwerkstoffe.
	Greece: Centre for Renewable Energy Sources, National Technical University of Athens, Schneider Electric.
	Italy: CAVE, ICI Caldaie, Idrogen2, SCAME Sistemi.
	Norway: Det Norske Veritas.
	Poland: Decsoft.
	Spain: Acciona Infraestructuras, Ikerlan.
	Sweden: Catator, SKANSKA.
	The Netherlands: Van Berkel & Bos UN Studio.
	UK: The University Court of the University of St Andrews.

Technology Building Blocks
Advanced materials and nanotechnolog

HarWin [54]

Harvesting solar energy with multifunctional glass-polymer windows

In HarWin new materials were developed for next generation windows significantly improving energy efficiency beyond the current state of the art. The improvements focussed on reduced weight, reduced thermal conductivity and energy consumption, reduced material usage and life cycle environmental performance. New functionality included intelligent phase changing materials and glass-polymer composites.

	September 2012
	36 months
	Finished
	4.9 M€
	www.harwin-fp7.eu
	University of Bayreuth, Germany
	Belgium: Isomatex SA, Joint Research Centre - European Commission.
	Finland: Eckart Pigments KY.
	Germany: BayFOR, Centrosolar Glas GmbH & Co. KG, Fraunhofer ISC, InGlas Produktions GmbH.
	Poland: Zachodniopomorski Uniwersytet Technologiczny Szczecinie.
	Switzerland: GlassX AG.
	UK: IES.

Technology building blocks

HEAT4U [55]

Gas absorption heat pump solution for existing residential buildings

HEAT4U is an industry-led project which developed a totally new heating and DHW product: a Gas Absorption Heat Pump (GAHP) solution with a primary energy efficiency of 165% (EN12309) to allow a cost-effective use of renewable energy in existing residential buildings. The project overcame a number of technological and non-technological barriers to enable a GAHP application in residential buildings.

Start date	November 2011
Duration	36 months
Status	Finished
Total budget	9.5 M€
Website	**www.heat4u.eu**
Coordinator	Robur SpA, Italy
Partners	**France**: GDF Suez, GrDF. **Germany**: Bosch Thermotechnik GmbH, E.ON, Fraunhofer. **Italy**: CF Consulting, D'Appolonia, ENEA, Pininfarina, Politecnico di Milano. **Poland**: Flowair. **Slovenia**: Zavod Za Gradbenistvo Slovenije. **UK**: British Gas

Construction process, end of life, cross-cutting information
Energy performance monitoring and management

Herb [56]

Holistic energy retrofit of buildings

Herb developed and demonstrated new energy efficient and innovative technologies and solutions for retrofitting a number of typical residential buildings in the EU: various types of insulation materials e.g. Aerobel/aerogel, starch micro-porous insulation, vacuum insulated panels, smart windows, surface coatings, materials integrated with phase change material and integrated heat recovery panels.

	October 2012
	42 months
	Finished
	8.6 M€
	www.euroretrofit.com
	University of Nottingham, United Kingdom
	Germany: Stuttgart University of Applied Sciences. **Greece**: Green Evolution Ltd, The University of Athens. **Italy**: The Municipality of Bologna, The University of Bologna. **The Netherlands**: Netherlands Organisation for Applied Scientific Research (TNO). **Poland**: Complex Ltd. **Portugal**: The Municipality of Almada, Lasting Values Ltd. **Spain**: Onyx Solar Energy Ltd. **Switzerland**: University of Applied Sciences Western Switzerland. **UK**: Kingspan Insulation Ltd, Leicester Housing Association, The Mark Group, Phase Change Products Ltd.

Construction process, end of life, cross-cutting information
BIM/ Data/ Interoperability

HESMOS [57]

ICT platform for holistic energy efficiency simulation and life cycle management of public use facilities

HESMOS developed an open integrated virtual energy lab with standardized BIM-based interfaces for exchangeable energy calculation, CAD, monitoring and FM tools, and a life cycle information repository for energy and cost estimation. Validation on real projects showed that through HESMOS up to 30% of design coordination & energy analysis time and 20 to 25% energy and CO2 reduction can be achieved.

	September 2010
	40 months
	Finished
	5.1 M€
	www.foambuild.eu
	Fraunhofer Gesellschaft zur Foerderung der angewandten Forschung e.V., Germany
	Austria: Sunpor Kunststoff GmbH. **France**: TBC générateurs d'innovation. **Germany**: Deutsche Amphibolin-Werke von Robert von Murjahn Stiftung & Co KG. **Greece**: National Center for Scientific Research "Demokritos". **The Netherlands**: Stichting Nederlands Normalisatie - Instituut. **Norway**: ELKEM AS, Norner Research AS. **Spain**: Ateknea Solutions Catalonia S.A. **UK**: Smithers Rapra and Smithers Pira Limited.

Technology Building Blocks
Advanced materials and nanotechnolog

H-HOUSE [58]

Healthier life with eco-innovative components for housing constructions

H-HOUSE was focused on multifunctional and flexible components for the building envelope and internal walls based on cementitious materials, earthen plasters and bio-composites. The aim was to design affordable building components with lower carbon footprint and embodied energy, that are durable, energy efficient, prevent the accumulation of indoor pollutants and reduce noise.

Start date	September 2013
Duration	48 months
Status	Finished
Total budget	6.5 M€
Website	**www.h-house-project.eu**
Coordinator	CBI Swedish Cement and Concrete Research Institute, Sweden
Partners	**France**: Cycleco SAS. **Germany**: BAM Federal Institute for Materials Research and Testing, Dyckerhoff GmbH, Roswag Architekten, Xella Technology and Research Centre. **Poland**: ITB Building Research Institute, Mostostal Warszawa SA, PRE Fasada sp. z o.o. **Sweden**: Aercrete Technology AB, Strängbetong AB, Svenska Aerogel AB.

Technology Building Blocks
Advanced materials and nanotechnolog

HIPIN [59]

High performance insulation based on nanostructure encapsulation of air

A novel aerogel with very low thermal conductivity and based on a high-silica content precursor was developed during the project and incorporated into three building products : paint, plaster, and panels. All three products demonstrated improved thermal performance compared to benchmark products and provide an opportunity to utilize the usually fragile aerogel in both new buildings and retrofits.

	November 2011
	41 months
	Finished
	2.9 M€
	www.hipin.eu
	TWI, UK
	France: Separex.
	Italy: Envipark, Methodo, Vimark.
	Turkey: Orient Research.
	UK: ICI, Thomas Swan.

Design
BIM/ Data/ Interoperability

HOLISTEEC [60]

Holistic and optimized life-cycle integrated support for energy-efficient building design and construction

HOLISTEEC aims to provide the European AEC industry with a comprehensive design approach taking into account the whole building lifecycle, the influence of neighbourhoods and energy efficiency.The main objective is to design, develop, and demonstrate a BIM-based, on-the-cloud, collaborative building design software platform, featuring advanced design support for multi-criteria building optimization.

	October 2013
	48 months
	Finished
	6.5 M€
	www.holisteecproject.eu
	D'Appolonia, Italy
	Finland: Senaatti-Kiinteistöt, Teknologian Tutkimuskeskus VTT.
	France: Centre Scientifique et Technique Du Batiment, Commissariat A L'energie Atomique Et Aux Energies Alternatives, Geomod, GDF Suez.
	Germany: IABI-Institut für angewandte Bauinformatik, GEM Team Solutions, Technische Universität Dresden.
	Italy: STI Engineering.
	The Netherlands: Koninklijke Bam Groep.
	Poland: Bergamo Tecnologie.
	Spain: Acciona Infraestructuras, Cype Soft, Fundacion Tecnalia Research and Innovation, Pich-Aguilera Arquitectos.
	Slovakia: NEMETSCHEK Slovensko.
	Taiwan: National Taiwan University of Science and Technology.

Construction process, end of life, cross-cutting information
ICT

ICT4E2B Forum [61]

European stakeholders' forum to explore further research and integration of ICT systems for energy efficiency in buildings

The ICT4E2B Forum project brought together all relevant stakeholders involved in ICT systems and solutions for energy efficiency in buildings to achieve EU climate and energy objectives. The project community reviewed the needs of ICT and construction in terms of research and system integration and developed the ICT4E2B's Forum Technology roadmap, facilitating EeB through ICT solutions.

Start date	September 2010
Duration	26 months
Status	Finished
Total budget	1.4 M€
Website	**www.ict4e2b.eu**
Coordinator	D'Appolonia SpA, Italy
Partners	**Finland**: Teknologian tutkimuskeskus VTT. **Germany**: SAP. **Poland**: Mostostal Warszawa. **Spain**: Atos Research. **Sweden**: Schneider Electric.

Energy performance monitoring and management
ICT

IDEAS [62]

Intelligent neighbourhood energy allocation and supervision

IDEAS developed an Energy Management System (EMS). The optimisation & prediction algorithms embedded in the EMS enable up to a 30% increase of the revenue generation from distributed renewable electricity & heat production and a 10% increase in the efficiency of distributed renewable energy plant. Innovative user interfaces and a decision support urban planning tool are integrated with the EMS.

	November 2012
	36 months
	Finished
	4 M€
	www.ideasproject.eu
	Teesside University, UK
	France: CSTB, IBM, NOBATEK. **Finland**: Porvoon Energia Oy, Porvoon Kaupunki, VTT. **Israel**: IBM.

Energy performance monitoring and management
BIM/ Data/ Interoperability

INDICATE [63]

Indicator-based interactive decision support and information exchange platform for smart cities

INDICATE resulted in: 1. Modelling of a city to provide performance benchmarks, 2. Integration of energy simulation capabilities, 3. A dashboard to display performance, 4. Integration of algorithms for energy use optimisation. It facilitates master planning for urban development, economic and environmental impact assessment of technologies for the urban environment and tools to reduce energy consumption.

	October 2013
	36 months
	Finished
	4.4 M€
	www.indicate-smartcities.eu
	IES, UK
	Ireland: Dundalk Institute of Technology, Future Analytics Consulting, Louth County Council, Trinity College Dublin. **Italy**: D'Appolonia, Ente Ospedaliero Ospedali Galliera. **Switzerland**: ESRI R&D Center Zurich AG.

Technology building blocks
Energy performance monitoring and management

iNSPiRe [64]

Development of systemic packages for deep energy renovation of residential and tertiary buildings including envelope and systems

iNSPiRe produced a database of renovation solutions. This required extensive desk research and running a numerical simulation campaign on a range of reference buildings representing the majority of the EU building stock. In addition, the project created a number of easilyadopted renovation kits facilitating the fast implementation of the renovation measures.

Start date	October 2012
Duration	48 months
Status	Finished
Total budget	10.8 M€
Website	**www.inspirefp7.eu**
Coordinator	EURAC, Italy
Partners	**Austria**: Bartnebach, Siko solar, Tripan, University Innsbruck. **Belgium**: ACE, UIPI. **France**: Cycleco. **Germany**: Fraunhofer ISE, Gump & Maier, Hochschule für Technik Stuttgart, ICLEI, Vaillant, Wohnungsbau Ludwigsburg. **Italy**: Gruppo Industriale Tosoni, Manens-Tifs, University Venice. **Spain**: Acciona, Cartif, EMVS. **Sweden**: Climatewell, SERC. **UK**: BSRIA, Insight Publisher.

Construction process, end of life, cross-cutting information
ICT

INTASENSE [65]

Integrated air quality sensor for energy-efficient environmental control

INTASENSE developed an integrated low cost system to provide a low cost comprehensive monitoring of key airborne pollutants using novel sensors for volatile organic compounds, particulates and combustion gasses. The smart air quality sensing system interfaces intelligently with existing ventilation and air treatment systems to optimise energy efficiency while maintaining an acceptable air quality.

Start date	October 2011
Duration	36 months
Status	Finished
Total budget	3.39 M€
Website	**www.intasense.eu**
Coordinator	C-Tech Innovation Ltd, UK
Partners	**Germany**: Technische Universität Ilmenau Institut fur Mikro- and Nanotechnologien (TUIL). **The Netherlands**: UC Technologies BV. **Spain**: Advantic Sistemas y Servicios, Centro de Estudios e Investigaciones Tecnicas. **Switzerland**: Centre Suisse d'Electronique et de Microtechnique SA. **UK**: Gooch & Housego Ltd, Lancaster University.

Design
ICT

IREEN [66]

ICT Roadmap for Energy Efficient Neighbourhoods

The IREEN roadmap demonstrates the ways in which technology can support energy efficiency decisions at a neighbourhood level and contribute to the sustainability agenda. It considers areas such as data analytics and "big data"; energy brokering; neighbourhood management systems; models for performance metrics and economic analysis to estimate and validate the impacts of ICT on energy efficiency.

Start date	September 2011
Duration	27 months
Status	Finished
Total budget	1 M€
Website	**www.ireenproject.eu**
Coordinator	Manchester City Council, UK
Partners	**Austria**: Austrian Institute of Technology. **Finland**: Technical Research Centre of Finland. **France**: Centre Scientifique et Technique du Bâtiment. **Italy**: D'Appolonia SpA. **The Netherlands**: Green IT Amsterdam. **Spain**: Acciona, Atos Spain.

Energy performance monitoring and management
ICT

KnoholEM [67]

Knowledge-based energy management for public buildings through holistic information modeling and 3D visualisation

KnoholEM improves energy efficiency of public buildings (by up to 30%) in Europe by offering a system that monitors energy consumption based on the usage of the building's occupants. Savings are achieved by a holistic knowledge based approach that maps different models into a single open ontology format.

Start date	September 2011
Duration	36 months
Status	Finished
Total budget	4.46 M€
Website	**www.knoholem.eu**
Coordinator	Building Research Establishment Ltd, UK
Partners	**Germany**: Karlsruher Institut für Technologie, Steinbeis Innovation gGmbH. **Ireland**: Trinity College Dublin. **Italy**: CETMA, Matrix Spa, Tera SRL. **Spain**: Isotrol, BDigital. **The Netherlands**: Stichting Smart Homes, Woningstichting de Zaligheden, Haagse Hogeschool. **UK**: Cardiff University.

Technology building blocks
Advanced materials and nanotechnology

LEEMA [68]

Low embodied energy, advanced materials and insulating masonry components for energy efficient buildings

The development of the LEEMA products is based on intelligent use of inert, "zero-embodied energy" mineral wastes and industrial byproducts. Chemical formulations and low energy innovative processes have been developed and up-scaled to produce pilot scale prototypes. The results indicate a reduction of up to 40% in density, and 60% in embodied energy compared to commercial products.

Start date	January 2012
Duration	48 months
Status	Finished
Total budget	8.1 M€
Website	
Coordinator	S&B Industrial Minerals SA, Greece
Partners	**Belgium**: CAE Services GEIE, Centre Scientifique et Technique de la Construction, REDCO NV. **Czech Republic**: FENIX TNT SRO. **France**: Thermal Ceramics de France SAS. **Germany**: Bauhaus-Universität Weimar, KG, Schlagmann Baustoffwerke GmbH & Co, Universität Stuttgart. **Greece**: FIBRAN, National Technical University of Athens, Proigmenes Erevnitikes & Diaheiristikes Efarmoges. **Italy**: D'Appolonia SpA, Morando SrI.

Design
Technology building blocks

MEEFS Retrofitting [69]

Multifunctional façade system, modular, allowing a flexible integration of technologies, contributing to the energy efficiency in residential sector

MEEFS developed standardised structural composite panels and its components, finally manufactured and implemented for retrofitting in Mérida (2016, Spain). Six façade system prototype units have been certified for fire, water, wind, impact, acoustic and permeability performance: insulation unit, green unit, ventilated unit, sun-protection unit, and two passive solar units (energy absorption automobile and ventilation modules).

Start date	December 2011
Duration	60 months
Status	Finished
Total budget	9.9 M€
Website	**www.meefs-retrofitting.eu**
Coordinator	ACCIONA Infraestructuras, Spain
Partners	**Belgium**: Greenovate! Europe. **Finland**: Teknologian Tutkimuskeskus VTT. **France**: CQFD Composites SARL, TBC Générateurs D'innovation. **Germany**: Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung EV. **Greece**: GK Rizakos - ABETE, National Technical University of Athens. **Israel**: Technion - Israel Institute of Technology. **Italy**: AntWorks SRL, Vipiemme Solar SRL. **Poland**: SKA Polska Sp z o.o, TPF Spólka z ograniczona odpowiedzialnoscia - E&L Architects. **Spain**: Consejería de Fomento - Junta de Extremadura, Fundación Tecnalia Research & Innovation, Advanced Simulation Technologies.

Design
Advanced materials and nanotechnolog

MEM4WIN [70]

Ultra-thin glass membranes for advanced, adjustable and affordable quadruple glazing windows for zero-energy buildings

MEM4WIN introduced a novel unit for quadruple glazing containing ultra thin glass membranes and frameless openable windows for direct application in façades. It achieved a reduction in weight of 50% and costs of 20% and Ug-values of 0.3 W/m²K. It implemented direct ink-jet printed OPVs, fully integrated solar thermal collectors and micro mirror arrays for energy control and advances day lighting.

Start date	October 2012
Duration	42 months
Status	Finished
Total budget	6.6 M€
Website	**www.mem4win.com**
Coordinator	LiSEC Austria GmbH, Austria
Partners	**Austria**: Profactor, Tiger Coatings, University Linz. **Germany**: Aixtron SE, Belectric OPV, Energy Glas, University Kassel. **Italy**: CNR, Durst Phototechnik. **South Korea**: Korea University. **UK**: Aixtron Ltd, University of Cambridge.

Technology Building Blocks
Energy performance monitoring and management

MESSIB [71]

Multi energy storage systems integrated in buildings

MESSIB developed 4 different storage technologies (2 thermal, 2 electric) for their application into buildings, reducing the primary energy used and increasing the operational efficiency of current HVAC systems. The integration model, coupled with a tailored control system and increased storage capacity, increases the penetration of renewables and reduces the emissions of fossil fuels.

	March 2009
	48 months
	Finished
	8.5 M€
	www.messib.eu
	ACCIONA, Spain **Finland**: Uponor, VTT. **France**: CSTB. **Germany**: BASF, Fraunhofer, KnaufKG, Ustutt. **Greece**: Knauf Abee, NTUA.HMCS. **Italy**: CNRISAC, D'Appolonia, Gesta. **Poland**: Mostostal. **The Netherlands**: ECN, Wansdronk. **Slovenia**: CCS, Robotina. **Spain**: Aidico, Tecnalia, Tekniker, Zigor.

Technology Building Blocks
Construction process, end of life, cross-cutting information

MF-Retrofit [72]

Multifunctional façades of reduced thickness for fast and cost-effective retrofitting

The MF-RETROFIT project developed multifunctional facades by employing technologies that can improve all aspects of an exterior facade panel, from significantly reducing weight, thickness and installation time to increasing shelf life. With a 40 % reduction in weight and volume, the innovative facades enhance thermal insulation, protect from fire, offer self-cleaning properties through photocatalytic layers, control humidity and moisture, and provide a structurally stable exterior walling.

	September 2013
	42 months
	Finished
	5 M€
	www.mf-retrofit.eu
	National Technical University of Athens, Greece **Germany**: Fraunhofer-Gesellschaft zur Förderung der Angewandten Forschung EV. **Greece**: Center for Research and Technology of Hellas. **Italy**: MBN Nanomaterialia SpA. **Poland**: IZNAB Spolka Z Organiczona Odpowiedzialnoscia. **Portugal**: CoolHaven, University of Aveiro. **Spain**: Advanced Composite Fibers, Advanced Material Simulation SL. **UK**: Tremco Illbruck Coatings Limited.

Technology building blocks
Energy performance monitoring and management

nanoCOOL [73]

An energy efficient air conditioning system based on the combination of a liquid desiccant cycle with an adapted conventional air cooling system

nanoCOOL presents an innovative solution based on a liquid desiccant system, in which the absorber and regenerator are internally cooled/heated, combined with conventional HVAC systems that is especially suitable for air conditioning in tropical and sub-tropical countries. A prototype of the nanoCOOL system was built, tested and refined, and finally run in real conditions in Taiwan.

Start date	September 2012
Duration	42 months
Status	Finished
Total budget	5 M€
Website	**www.nanocoolproject.eu**
Coordinator	Tecnalia, Spain
Partners	**Czech Republic**: Fenix TNT. **Germany**: SGL Carbon. **Israel**: Technion. **Italy**: D'Appolonia, DECSA, Politecnico di Torino, STAM. **Poland**: Ridan. **Spain**: Airlan, Universitat Rovira i Virgili. **Taiwan**: National Taiwan University of Science and Technology.

Technology building blocks
Advanced materials and nanotechnology

NANO-HVAC [74]

Novel Nano-enabled Energy Efficient and Safe HVAC ducts and systems contributing to an healthier indoor environment

The NANO-HVAC system has been shown to significantly improve air quality in buildings. The solution proved particularly useful in harsh environments and HVAC systems in buildings. Testing demonstrated an excellent antimicrobial reduction performance: the joint impact of the coated filter and the UV LED system led to a 93.3% reduction of the microbial load.

	September 2012
	36 months
	Finished
	2.8 M€
	www.nanohvac.eu
	Vento NV, Belgium **Belgium**: Sirris. **Greece**: Nanophos, NTUA. **Italy**: D'Appolonia SpA, Farbe SpA, Politecnico di Milano. **Portugal**: INL. **Romania**: ICAA. **Spain**: Acciona, Aidico.

Technology building blocks
Advanced materials and nanotechnology

NanoInsulate [75]

Development of nanotechnology-based insulation systems

NanoInsulate developed nano-porous foam as a VIP-core and envelopes with improved gas and water vapor barrier properties. NanoInsulate demonstrated that VIPs are effective in Spanish and Polish demo-buildings. Transparent VIPs were investigated for use by using a modified aerogel. Life cycle assessments show that VIPs at an insulation thickness of 25mm perform better than polyurethane foam boards.

	July 2010
	48 months
	Finished
	6 M€
	www.nanoinsulate.eu
	KINGSPAN, Ireland. **Germany**: BASF, Fraunhofer, va-Q-tec. **Israel**: Hanita. **Spain**: Acciona, Gaiker. **Sweden**: Airglass. **Turkey**: Koç University. **UK**: Pera.

Technology Building Blocks
Advanced materials and nanotechnolog

NANOPCM [76]

New advanced insulation phase change materials

The NANOPCM project developed, produced and implemented a low cost insulation material able to store heat through the use of Phase Change Material (PCM) embedded in wall panels. Results from testing show reduced room temperature variations due to the PCM. Follow-on work focuses on further increasing the proportion of PCM in the panel whilst reducing the thermal conductivity of the new panels.

Start date	June 2010
Duration	36 months
Status	Finished
Total budget	3.5 M€
Website	
Coordinator	ACCIONA, Spain
Partners	**Germany**: Active Space Technology. **Italy**: DIAD Group. **Poland**: Purinova. **Spain**: ACCIONA, Tekniker, Universidad de Castilla-La Mancha. **UK**: PCM Products.

Construction process, end of life, cross-cutting information
Energy performance monitoring and management

NEED4B [77]

New Energy Efficient Demonstration for Buildings

NEED4B designed and constructed 5 demonstration buildings with a very low energy consumption deploying cost-effective and energy-efficient solutions and technologies. Results after 2 years of monitoring reveal an average primary energy consumption of 50 kWh/m2.year in the buildings, located in Belgium, Italy, Sweden, and Turkey (23.000 m2). In addition, NEED4B developed the NEED4B methodology, which puts together the main findings on how to develop very low energy buildings in practice.

	February 2012
	72 months
	Finished
	9.4 M€
	www.need4b.eu
	CIRCE Foundation, Spain.
	Belgium: Format D2, Intesa SanPaolo Eurodesk, M5, Université de Mons, Vue Sur Mons.
	Italy: D'Appolonia, Dirco Srl.
	Spain: Acciona Infraestructuras, Ingeniería y Control Electrónico, Universidad de Zaragoza.
	Sweden: Derome, SP Technical Research Institute of Sweden.
	Turkey: BG Mimarlik, Fiba Holding, Özye in University.

Energy performance monitoring and management
ICT

NewBEE [78]

Novel business model generator for energy efficiency in construction and retrofitting

NewBEE developed an innovative methodology and a web-based ICT platform to support energy efficient retrofitting projects by Small and Medium Enterprises (SMEs):
- Knowledge repository.
- Pre-assessment and financial tools.
- Marketplace tool.
- Energy performance assessment tool.
- Business model assessment tool.

	October 2012
	36 months
	Finished
	4.5 M€
	www.newbee.eu
	FUNDACIÓN TECNALIA , Spain
	Finland: Eriksson, FINNERGIA, KVA, VTT.
	Germany: ATB, Conclude, FHG, ifA-Bau Consult, Rahm.
	Italy: UniPD.
	Malta: AcrossLimits.
	Slovenia: SGG, ZRMK.
	Spain: Acciona, Eslaban, TEUSA.

Design
Technology building blocks

NEXT-Buildings [79]

Next zero energy buildings at lowest cost by using competitive sustainable technology

The NEXT-Buildings project focuses on the demonstration of low-energy, affordable buildings with the aim of achieving net zerocarbon/energy or better. All demonstrations have been completed (total about 50,000 m2) The project is now finished. In the field of technological developments, transmission controllable glazing and dual function photovoltaics have been produced.

Start date	January 2012
Duration	72 months
Status	Finished
Total budget	8.4 M€
Website	**www.next-buildings.com**
Coordinator	KEMA Nederland BV, The Netherlands
Partners	**Denmark**: COWI A/S. **France**: Bouygues Immobilier, HESPUL, SPLA Lyon Confluence. **Germany**: University of Kassel. **The Netherlands**: Gemeente Amsterdam Stadsdeel West, Liander NV, Vrije Universiteit Amsterdam (VU-VUmc). **Sweden**: BKAB Boende Komfort, Helsingborgshem. **Switzerland**: Ecole Polytechnique Federale De Lausanne.

Energy performance monitoring and management
ICT

NRG4Cast [80]

Energy forecasting

NRG4Cast developed an intelligent decision support platform with integrated services for monitoring & forecasting for energy distribution networks and advanced analytical modules to support analysis of multimodal data, network devices data, energy demand and consumption, environmental data and energy prices data. NRG4Cast is further exploited by a company NRG4CAST Ltd.

Start date	December 2013
Duration	36 months
Status	In progress
Total budget	3.7 M€
Website	**www.nrg4cast.org**
Coordinator	Institut Jozef Stefan (JSI), Slovenia
Partners	**Germany**: Forschungsinstitut fuer Rationalisierung. **Greece**: Kentro Ananeosimon Pigon Ke Exikonomisis Energeias (Centre for Renewable Energy Sources and Saving) Kape, National Technical University of Athens, SingularLogic Anonymi Etairia Pliroforiakon Sistimaton Kai Efarmogon Pliroforikis. **Italy**: Consorzio per il Sistema Informativo, IREN Rinnovabili SRL. **Slovenia**: Envigence, Okoljska Inteligenca, d.o.o.

Energy performance monitoring and management
ICT

ODYSSEUS [81]

Open dynamic system for saving energy in urban spaces

ODYSSEUS enables the 'holistic energy management' of the dynamics of energy supply, demand and storage in urban areas. ODYSSEUS also offers an open integration platform supporting the integration scenarios for designated urban areas. It is demonstrated in the cities of Rome and Manchester.

Start date	November 2012
Duration	36 months
Status	Finished
Total budget	3.7 M€
Website	**www.odysseus-project.eu**
Coordinator	Telvent, Spain
Partners	**France**: CSTB. **Italy**: Comune di Roma, EsoCeNet. **The Netherlands**: Priva BV, TNO. **Spain**: Advantic Sistemas y Servicios. **UK**: Manchester City Council.

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Construction process, end of life, cross-cutting information
Energy performance monitoring and management

ORIGIN [82]

Orchestration of renewable integrated generation in neighbourhoods

The ORIGIN project demonstrated demand side management of energy use in 3 European communities. It utilised new technology for accurate localised weather forecasting (and renewable generation forecasting) and for achieving demand-response from community (add space) level energy actions. Potential for increased uptake of community generated electricity (ranging from 3% to 33%) was shown in the 3 communities. The demand and forecasting technology developed in ORIGIN continues to be developed.

Start date	November 2012
Duration	36 months
Status	Finished
Total budget	4 M€
Website	**www.origin-concept.eu**
Coordinator	Heriot-Watt University, UK
Partners	**Germany**: Fraunhofer-Gesellschaft zur Förderung der Angewandten Forschung EV. **Italy**: Solera SCRL. **Portugal**: ILOS - Peace Research Centre LDA, Portugal, ISA. **Spain**: Instituto Tecnologico De Informatica. **UK**: Findhorn Foundation College LBG, University of Strathclyde.

Technology Building Blocks
Advanced materials and nanotechnolog

OSIRYS [83]

Forest based composites for façades and interior partitions to improve indoor air quality in new builds and restoration

Within OSIRYS proposal, a holistic solution for facades and interior partitions has been developed ready to be applied in building retroffiting and new construction by means of the development of forest based biocomposites with different functionalities able to meet the strictest requisites of the European Building Codes. Moreover to improve indoor air quality by VOC and microorganisms elimination and increase thermal and acoustic insulation.

	June 2013
	48 months
	Finished
	9.1 M€
	www.osirysproject.eu
	Fundación Tecnalia Research & Innovation, Spain
	Finland: Conenor, VTT. **Germany**: Fraunhofer IGB, SICC, Tecnaro. **Hungary**: Omikron-Dokk. **Italy**: Collanti Concorde. **The Netherlands**: UNStudio. **Poland**: Bergamo. **Portugal**: Amorim Cork Composites. **Spain**: Acciona Infraestructuras, AIMPLAS, ENAR, VISESA. **Sweden**: IVL. **UK**: NetComposites.

Energy performance monitoring and management
ICT

PERFORMER [84]

Portable, exhaustive, reliable, flexible and optimised approach to monitoring and evaluation of building energy performance

PERFORMER is a set of methodologies and tools aimed at reducing the gap between expected and actual energy consumption of a building, achieved by more accurately characterising and assessing the building and its energy performance. This results in better forecasting, targeted advice and decision support for building managers supported by expert rules and fault detection and diagnosis modules.

	September 2013
	48 months
	In progress
	8.7 M€
	www.performerproject.eu
	SMS, UK
	France: CEA, CSTB, ENGIE, Saint Gobain Recherche **Poland**: ASM, Sea Developments. **Spain**: Iberostar, Dragados, Euroconsult. **UK**: BRE, Cardiff University, City of Cardiff Council.

BIM/ Data/ Interoperability
ICT

PROFICIENT [85]

SME network business model for collective self-organised processes in construction and retrofit of energy-efficient residential districts

PROFICIENT promoted collective self-organised housing by matching end users' demands for sustainable dwellings and offers by SMEs. It is developing a web-based 'CSO housing platform', offering practical information, an e-marketplace where stakeholders can meet and interact, and a number of tools. One of these allows end users to import a design of their dwelling into the urban environment.

Start date	September 2012
Duration	48 months
Status	Finished
Total budget	7.2 M€
Website	**www.proficient-project.eu**
Coordinator	TNO, The Netherlands
Partners	**Bulgaria**: RDF. **Czech Republic**: IRS Servis, STU-k. **Germany**: 3L. **Hungary**: Energosys, Metropolitan Research Institute. **Italy**: Becquerel Electric, Ipostudio. **The Netherlands**: DEMO Consultants, Municipality of The Hague, SBR. **Norway**: Husbanken, SINTEF. **Spain**: SOLINTEL. **UK**: Lancaster Cohousing Ltd, Lancaster University.

Design
Energy performance monitoring and management

R2CITIES [86]

Renovation of residential urban spaces: towards nearly zero energy cities

The three demosites of the R2CITIES project have implemented successfully the methodology developed based on IPD, BIM and a set of district sustainability indicators. A total of 49,560 m2 in Valladolid (Spain), Genoa (Italy) and Kartal-Istambul (Turkey) have been energy retrofitted and the evaluation stage is being finished to confirm the expected savings around 50%.

Start date	July 2013
Duration	60 months
Status	In progress
Total budget	14.8 M€
Website	**www.r2cities.eu**
Coordinator	Fundación CARTIF, Spain.
Partners	**Belgium**: youris.com. **Germany**: Steinbeis. **Italy**: ABB, D'Appolonia, Genova Municipality, Officinae Verdi, Università di Genova. **Spain**: Acciona, Onyx Solar Energy, Sociedad Municipal VIVA. **Turkey**: Energy Institute Istanbul, Kartal Municipality, Ekodenge, MIR solutions, REENGEN, Solitem.

Technology building blocks
Energy performance monitoring and management

READY [87]

Resource efficient cities implementing advanced smart city solutions

Based on integrated climate planning the READY project demonstrates a whole city approach towards affordable retrofitting of buildings in Aarhus and Växjö. With available and innovative technology measures READY demonstrates how the demand for energy, the need for fossil fuels and release of CO2 can be considerably reduced to nearly zero, and shows a sustainable way to go for other European cities.

Start date	December 2014
Duration	60 months
Status	In progress
Total budget	33.34 M€
Website	**www.smartcity-ready.eu**
Coordinator	COWI, Denmark
Partners	**Austria**: AIT - Austrian Institute of Technology. **Denmark**: COWI, Aarhus Municipality, Aarhus University, Boligforeningen Ringgården, Danfoss, Dansk Fjernvarme, DONG Energy, E.ON Denmark, Kamstrup, Lithium Balance, Racell Saphire. **France**: LGI consulting. **Lithuania**: Kauno Energija, Lietuvos Energetikos Institutas. **Sweden**: CA Araby Fastigheter, Energy Agency for Southwest Sweden, Linneaus University, VEAB, Växjö Energy, Växjöbostäder, Växjö Municipality, Växjö Fastighetsforvaltning, Wexnet.

BIM/ Data/ Interoperability
ICT

READY4SmartCities [88]

ICT roadmap and data interoperability for energy systems in smart cities

READY4SmartCities defined a set of tools (online catalogues and alignment server). In addition, reference guidelines for generating, publishing and exploiting linked energy data were released and made available for free. This supports interoperability and usage of open linked data for efficient energy systems in smart cities, and provides a consistent vision on how ICT can support those systems.

Start date	October 2013
Duration	24 months
Status	Finished
Total budget	1.36 M€
Website	**www.ready4smartcities.eu**
Coordinator	D'Appolonia SpA, Italy
Partners	**Austria**: AIT. **Finland**: VTT. **France**: CSTB, INRIA. **Germany**: EMPIRICA. **Greece**: CERTH/ITI. **Italy**: Politecnico di Torino. **Spain**: Universidad Politécnica de Madrid. **UK**: AEC3.

Energy performance monitoring and management
ICT

RESILIENT [89]

Coupling renewable, storage and ICTs, for low carbon intelligent energy management at district level

The RESILIENT project, which started in September 2012 and finished in August 2016, has designed and developed a new integrated concept that addresses the increased level of complexity and diversity of energy management. We used a combination of different innovative technologies, including optimised energy generation and storage technologies, as well as smart ICT components.

	September 2012
	48 months
	Finished
	8.03 M€
	www.resilient-project.eu
	D'Appolonia SpA, Italy
	Belgium: Cordium CVBA, Infrax, Terra Energy NV, VITO. **France**: Centre Scientifique et Technique du Batiment, Commissariat a'l energie atomique et aux énergies alternatives, Sigma Orionis. **Italy**: Università degli Studi di Genova, Vipiemme SpA. **Spain**: Acciona Infraestructuras SA. **UK**: Cardiff University, Building Research Establishment Ltd, Blaenau Gwent County Borough Council.

Energy performance monitoring and management
Technology Building Blocks

RESSEEPE [90]

Retrofitting solutions and services for the enhancement of energy efficiency in public edification

The RESSEEPE project brought together design and decision-making tools, innovative building fabric manufacturers and a strong demonstration programme to improve the building performance of public buildings through retrofitting. RESSEEPE developed a retrofitting toolbox of 13 results, including software solutions, monitoring technology, passive and active building level interventions. The demonstration programme showed the potential for energy savings and GHG emission reduction can reach 70%.

	July 2013
	48 months
	Finished
	13.62 M€
	www.resseepe-project.eu
	IES, UK.
	Austria: TUW. **France**: Nobatek, Separex, Vertech, Logirep. **Germany**: Va-q-tec. **Greece**: Apintech. **Italy**: INSTM. **Slovenia**: Institute for the Protection of Cultural Heritage of Slovenia. **Spain**: Consorci Sanitari de Terrassa, Corporacio Sanitaria Parc Taulí, Eurecat, Fundacio Privada Centre CIM, Grupo Puma, Incurvo, Leitat, OHL, Tecnalia, Universitat Politecica de Cataluna. **Sweden**: City of Skellefteå. **Switzerland**: EMPA. **UK**: Coventry University, Exergy, PCM Products

Technology building blocks
Construction process, end of life, cross-cutting information

RetroKit [91]

RetroKit - Toolboxes for systemic retrofitting

RetroKit developed and integrated prefabricated technologies for systemic retrofitting of multi-family residential buildings, to reduce energy consumption. Proof of concept of the achievement is demonstrated in Frankfurt, in Madrid and in a small scale demo in Pitea (SW). A toolbox, based on these solutions, integrates paper catalogue and a retrofitting integrated ICT decision support tool.

Start date	September 2012
Duration	48 months
Status	Finished
Total budget	10 M€
Website	**www.retrokitproject.eu**
Coordinator	D'Appolonia, Italy
Partners	**Germany**: ABGNova, Fraunhofer, STO. **Greece**: Kokotas Klimatismos, Proigmenes Erevnitikes & Diahiristikes Efarmoges. **Ireland**: Delap & Waller Ecoco Limited. **Italy**: IDP. **The Netherlands**: TNO. **Norway**: Segel, Stiftelsen Sintef. **Poland**: Bergamo Tecnologie. **Romania**: Institutul de Cercetari Electrothnice. **Spain**: Empresa Municipal de la vivienda y suelo de Madrid, Dragados, Fundacion Tecnalia Research & Innovation. **Sweden**: SP Sveriges Tekniska Forsknings Institut, Blatraden.

Construction process, end of life, cross-cutting information
ICT

REViSITE [92]

Roadmap enabling vision and strategy in ICT-enabled energy efficiency

REViSITE has achieved a cross sectoral community with over 100 experts in the four sectors; the SMARTT Taxonomy comprising six high-level categories and 23 sub-categories covering the scope of the ICT4EE domain; six 'roadmap' tables aligned to the SMARTT (sub) categories; IAP which is focused on identifying potential call themes/text and stakeholder specific actions; recommendations for Standards.

	February 2010
	29 months
	Finished
	1.8 M€
	www.revisite.eu
	Loughborough University, UK
	Finland: VTT Technical Research Centre. **France**: Centre Scientifique & Technique du Bâtiment. **Germany**: The Fraunhofer Institute for Production Systems and Design Technology IPK. **Ireland**: Intel Labs Europe. **Italy**: Innova SpA. **The Netherlands**: KEMA consulting.

Technology building blocks
Energy performance monitoring and management

S4ECoB [93]

Making intelligent use of sounds in order to improve the energy control of buildings

S4ECoB developed an innovative ICT solution to optimise the existent Building Energy Management Systems (BEMS) by means of acquiring, identifying and adding the parameters of occupancy level in buildings and surroundings through the integration of a low-cost novel network of audio sensors to enhance operations and eliminate unnecessary energy consumption of HVACL systems, maintaining user comfort.

	October 2011
	42 months
	Finished
	3.9 M€
	www.s4ecob.eu
	D'Appolonia SpA, Italy
	Austria: Austrian Institute of Technology. **Germany**: Fraunhofer Institute for Digital Media Technology, Institute for Microelectronic and Mechatronic Systems. **Italy**: Società per Azioni Esercizi Aeroportuali. **The Netherlands**: Corio NV. **Spain**: Solintel M&P SL.

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Design
Construction process, end of life, cross-cutting information

School of the Future [94]

School of the Future - Towards zero emissions with high performance indoor environment

The project has demonstrated highly energy-efficient renovations of 4 school buildings with improved indoor comfort. Additional outcomes include: a technology screening report; school retrofit guidelines; an energy assessment tool; a tool with case studies, retrofit measures, performance rating; training material for pupils/ teachers/technical personnel; a community on the EU portal BUILD UP.

Start date	February 2011
Duration	60 months
Status	Finished
Total budget	4.9 M€
Website	**www.school-of-the-future.eu**
Coordinator	Fraunhofer Institute for Building Physics, Germany
Partners	**Denmark**: Cenergia Energy Consultants, Aalborg Universitet - SBi, Ballerup Kommune, Saint-Gobain Isover, Schneider Electric Building Denmark AS. **Germany**: Fraunhofer Institute for Building Physics, Landeshauptstadt Stuttgart. **Italy**: ENEA, Comune di Cesena, Aldes. **Norway**: Stiftelsen SINTEF, Drammen Eiendom, Glass og Fasadeforeningen.

Energy performance monitoring and management
ICT

SEAM4US [95]

Sustainable energy management for underground stations

Lighting and passenger transfer systems in the Passeig De Gracia metro station in Barcelona. The main SEAM4US energy saving rates are:
- Lighting system 24.1% ± 1.9%;
- Forced ventilation system 35.3% ± 3.1%;
- Passenger transfer system 8.5% ± 1.9%.

The metro network manager is designing the exploitation in the metro network.

	October 2011
	36 months
	Finished
	4.15 M€
	www.seam4us.eu
	Cofely Italia SpA, Italy
	Finland: Teknologian Tutkimuskeskus VTT. **Germany**: Fraunhofer-Gesellschaft FIT, University of Kassel. **Italy**: Università Politecnica delle Marche. **The Netherlands**: Almende BV. **Spain**: Universitat Politecnica de Catalunya, Ferrocarril Metropolita de Barcelona TMB. **Sweden**: Cnet Svenska AB.

Energy performance monitoring and management
BIM/ Data/ Interoperability

SEEDS [96]

Self-learning energy efficient buildings and open spaces

SEEDS developed a Building Energy Management System (BEMS) for the optimal performance of buildings and open spaces in terms of energy consumption, cost and comfort conditions. It is based on an innovative model predictive control strategy based on measurements and selfleaning techniques. The modelling methodology is based on BIM. Wireless techniques are used for monitoring and control.

	September 2011
	42 months
	Finished
	4 M€
	CEMOSA, Spain
	Germany: FASA AG, Fraunhofer IIS/EAS, NSC GmbH. **Norway**: University of Stavanger. **Spain**: Ferrovial Agroman SA, Fundación Cidaut, Software for Critical Systems. **UK**: University of Salford.

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Energy performance monitoring and management
ICT

SEEMPubS [97]

Smart energy efficient middleware for public spaces

The SEEMPubS project reduced the carbon footprint and energy usage of existing public buildings and spaces through intelligent ICT-based service monitoring and energy consumption management, an approach particularly suited to historical buildings where damage caused by extensive retrofitting is avoided. Leading-edge technology was exploited including augmented reality associated with QR codes.

Start date	September 2010
Duration	36 months
Status	Finished
Total budget	2.9 M€
Website	**www.seempubs.polito.it**
Coordinator	Politecnico di Torino, Italy
Partners	**Belgium**: Katholieke Universiteit Leuven. **France**: Sinovia SA, Université Claude Bernard Lyon 1. **Germany**: Fraunhofer-FIT. **Italy**: Centro Ricerche Fiat, Istituto Superiore Mario Boella, STMicroelectronics. **Sweden**: CNet Svenska AB.

Advanced materials and nanotechnology
Technology building blocks

SESBE [98]

Smart elements for sustainable building envelopes

SESBE developed new types of façade elements with integrated insulation. Reactive powder concrete enables much thinner, lightweight and durable components whereas the nonflammable foam concrete-aerogel composite insulation improves the fire safety and thermal performance. Dismantling elements will have a low environmental impact due to the mineral based nature of the material components.

Start date	August 2013
Duration	42 months
Status	Finished
Total budget	4.9 M€
Website	**www.sesbe.eu**
Coordinator	CBI Betonginstitutet AB, Sweden
Partners	**Germany**: Tremco illbruck Production GmbH. **Poland**: Instytut Techniki Budowlanej, Instytut Technologii Elektronowej, Mostostal Warszawa SA. **Spain**: ACCIONA Infraestructuras SA. **Sweden**: Svenska Aerogel AB, AERCRETE TECHNOLOGY AB, Projetengagemang Byggprocesstyrning AB, SP Svergies Tekniska Forskningsinstitut AB, Uppsala Universitet. **UK**: Tremoc illbruck Coatings Ltd.

SESBE
Smart Elements for Sustainable Building Envelopes

Energy performance monitoring and management
Technology building blocks

Sinfonia [99]

Smart initiative of cities fully committed to invest in advanced large-scaled energy solutions

Sinfonia demonstrates reduction of energy use and CO2 emissions in Innsbruck and Bolzano. Three years into the Project the demonstrations are well under way. Refurbishments are being finalised in both cities.Demonstration schemes on sustainable production of heat and Power is also implemented in oth cities. A simulation tool has been developed to analyse replicability of demo Projects, stakeholder participation and Communication actions is carried out.

Start date	June 2014
Duration	60 months
Status	In progress
Total budget	43.23 M€
Website	**www.sinfonia-smartcities.eu**
Coordinator	RISE Technical Research Institute of Sweden, Sweden
Partners	**Austria**: City of Innsbruck, Innsbruck Immobilien GmbH, Innsbruck Kommunalbetriebe, Liebherr, Neue Heimat Tirol, Strandort Agentur Tirol, TIGAS-Erdgas Tirol GmbH, University of Innsbruck. **Belgium**: Greenovate!Europe. **Cyprus**: City of Pafos. **France**: City of La Rochelle, CSTB, Technofi. **Germany**: City of Rosenheim, Passive House Institute. **Italy**: Agenzia per l'energia Alto Adige - Casa Clima, City of Bolzano, EURAC, IPES, SEL SpA. **Spain**: CEMS, Zabala Innovation Consulting. **Sweden**: Alfa Laval, City of Borås.

Sinfonia
Low Carbon cities for better living

Technology Building Blocks
Energy performance monitoring and management

SMARTBLIND [100]

Development of an active film for smart windows with inkjet method. Application to a building component: autonomous smart device

SMARTBLIND produced a hybrid flexible device, including printed Electrochromic (EC) and Photovoltaic (PV) films, and an energy saving window for light and solar control aimed at the construction and renovation markets. Large EC panes with a fast response time (0.1 second), supplied with PV were integrated into a low weight frame (-20%). Smart active shading was achieved in 2015.

Start date	September 2012
Duration	36 months
Status	Finished
Total budget	5.2 M€
Website	**www.smartblind-project.eu**
Coordinator	Polymage, France
Partners	**Belgium**: VUB. **France**: Ardeje, CEA-INES, Kurt Salmon, Polymage. **Germany**: DITF. **Poland**: Politechnika Lodzka. **Portugal**: A Catedral, FFCT. **Romania**: Termoglass. **Spain**: FCC Construccion, LEITAT, IASO.

Energy performance monitoring and management
ICT

SMARTKYE [101]

An innovative energy efficiency service platform for smart districts

The final version of the SmartKYE energy efficiency service platform for smart districts has been deployed in Barcelona and Crete in order to evaluate their performance and impact. The results of the evaluation have been 4-8% for energy cost reduction while 6% energy has been saved due to the RES penetration. The platform is planned to be replicated in new scenarios.

	November 2012
	30 months
	Finished
	3.1 M€
	www.smartkye.eu
	ETRA I+D, Spain
	Germany: University of Duisburg, SAP.
	Greece: HEDNO, ICCS.
	Spain: Bdigital, Technoflex.

Technology Building Blocks
Energy performance monitoring and management

SportE2 [102]

Intelligent management system to integrate and control energy generation, and consumption for european sport and recreation buildings

SportE2 is a Building Energy Management System (BEMS) designed specifically for sports centres. It considers outdoor conditions in order to maintain a high level of indoor comfort for athletes. Results from the case study in Italy, Spain and Portugal demonstrated that SportE2 generated overall energy savings of about 30% (from electrical and thermal systems) and related carbon emission reductions.

	September 2010
	42 months
	Finished
	4.7 M€
	www.sporte2.eu
	D'Appolonia SpA, Italy
	Italy: Fidia Sport, Schneider Electric, STARING, Università Politecnica della Marche.
	Portugal: Intelligent Sensing Anywhere ISA, Self Energy.
	Spain: EmteSport, Tecnalia.
	UK: Cardiff University.

Design
BIM/ Data/ Interoperability

STREAMER [103]

Semantics-driven design through geo and building information modelling for energy-efficient buildings integrated in mixed-use healthcare districts

The STREAMER project addresses the design of energy efficient hospital buildings. The objective of the project is to reduce the energy use and carbon emission of healthcare districts in the EU by 50% in the next 10 years. This is achieved by using semantics-driven design methods and interoperable tools. The project creates dashboards that support decision making in the early design stages.

Start date	September 2013
Duration	48 months
Status	In progress
Total budget	11 M€
Website	**www.streamer-project.eu**
Coordinator	TNO, The Netherlands
Partners	**France**: Bouygues Construction, Assistance Publique - Hopitaux de Paris, Commissariat a l'Energie Atomique et aux Énergies Alternatives, Centre Scientifique et Technique du Batiment. **Germany**: Karlsruher Institut für Technologie. **Italy**: Ipostudio Architetti Srl, Becquerel Electric Srl, Azienda Ospedaliero-Universitaria Careggi. **The Netherlands**: De Jong Gortemaker Algra, DWA BV, DEMO Consultants BV, Stichting Rijnstate Ziekenhuis. **Poland**: Mostostal Warszawa SA, Mazowiecka Agencja Energetyczna. **Sweden**: NCC AB, Locum AB. **UK**: Arup, AEC3 Ltd, The Rotherham NHS Foundation Trust.

Advanced materials and nanotechnology
Construction process, end of life, cross-cutting information

SUS-CON [104]

Sustainable, innovative and energy-efficient concrete, based on the integration of all-waste materials

SUS-CON developed lightweight construction materials and structures made from secondary raw materials (slag, ash, mixed plastic from MPW, end-of-life tyre rubbers and PU foams. SUS-CON products, with lower embodied energy and increased insulation properties than traditional concrete products, are suitable for both ready-mixed products (screed) and precasted applications (blocks and panels.

	January 2012
	48 months
	Finished
	7.16 M€
	www.sus-con.eu
	CETMA, Italy
	Germany: BASF. **Greece**: National Technical University of Athens, S&B Minerals. **Italy**: Centro Riciclo Vedelago, Consorzio TRE, Magnetti Building, TUV Italia. **The Netherlands**: TNO. **Portugal**: CeNTI. **Romania**: Iridex Group - Plastic. **Spain**: Acciona. **Taiwan**: National Taiwan University of Science and Technology. **Turkey**: Iston. **UK**: Queen's University Belfast.

Technology building blocks
Energy performance monitoring and management

TIBUCON [105]

Self Powered Wireless Sensor Network for HVAC System Energy Improvement TOwards Integral BUilding CONnectivity

The TIBUCON project developed a system which enables building owners to improve comfort levels in offices while reducing energy cost and optimising the heating, ventilating and air conditioning systems. This was achieved by designing self-powered, wireless sensors to measure the local air temperature and detect occupancy. The system was validated in Spain and Poland.

	September 2010
	38 months
	Finished
	2.4 M€
	www.tibucon.eu
	Mostostal Warszawa SA, Poland
	Belgium: Katholieke Hogeschool Kempen. **Poland**: E&L Architects. **Spain**: Giroa-Dalkia, Tekniker-IK4. **UK**: University of Southampton.

Technology Building Blocks
Energy performance monitoring and management

TRIBUTE [106]

Take the energy bill back to the promised building performance

TRIBUTE is developing a system able to assist building owners in evaluating and anticipating the impact of the evolution (age, retrofit, occupancy, etc.) of a building through the automatic adaptation of the online, real-time building energy simulation performance model of the building. This is done by accessing both the key building parameters as well as the realtime data actually measured.

Start date	October 2013
Duration	48 months
Status	In progress
Total budget	9.9 M€
Website	**www.tribute-fp7.eu**
Coordinator	Centre Suisse d'Electronique et de Microtechnique SA, Switzerland
Partners	**Czech Republic**: AMIRES. **France**: Communauté d'agglomération de La Rochelle, Schneider Electric Industries SAS, TBC Générateurs d´innovation, Université de La Rochelle. **Germany**: Technische Universität Dresden. **Ireland**: Cork Institute of Technology, IBM Ireland Ltd. **Italy**: Città di Torino, Politecnico di Torino. **The Netherlands**: NXP semiconductors Netherlands BV. **Portugal**: TEKEVERTecnologias de Informação, SA. **Spain**: Institut de Recerca de l'Energia de Catalunya. **Sweden**: EQUA simulation AB. **UK**: ZEDfactory Europe Limited.

Construction process, end of life, cross-cutting information
ICT

UMBRELLA [107]

Business model innovation for high performance buildings supported by whole life optimisation

UMBRELLA developed an innovative, web-based decision-support application (Re:Form), which supports and connects stakeholders involved in energy efficiency design and retrofitting of buildings. The tools analyse building energy performance against the user's needs, to give recommended energy efficient solutions and optimised business models for implementation across the whole life of the building.

Start date	September 2012
Duration	36 months
Status	Finished
Total budget	3.9 M€
Website	**www.umbrella-project.eu**
Coordinator	IES, UK
Partners	**France**: LGI Consulting. **Ireland**: University College Cork, Trinity College Dublin. **Italy**: D'Appolonia, E++, Stam. **Poland**: National Energy Conservation Agency. **Spain**: Solintel. **UK**: University of Bath.

Energy performance monitoring and management
ICT

URB-Grade [108]

URB-grade decision support tool: towards the district as a service

URB-Grade developed a platform for decision support to allow city authorities to choose correct retrofitting actions for a sustainable city. The project developed a platform for the acquisition of heterogeneous data from heterogeneous use cases (type, format and intensity), presentation of the data in a homogeneous way, mechanisms to reduce the traffic data, and processing to ensure data quality.

Start date	October 2012
Duration	39 months
Status	Finished
Total budget	2.66 M€
Website	**www.urb-grade.eu**
Coordinator	Alexandra Instituttet AS, Denmark
Partners	**Denmark**: Kalundborg Kommune, Seas-Nve Holding AS, Kalundborg Forsyning. **Finland**: THT Control OY, TTY-Saatio. **Spain**: Ayuntamiento de Eibar, Fenie Energia SA, Fundación Tekniker, Telvent Global Services SA, Global Rosetta.

Technology building blocks
Advanced materials and nanotechnology

WINSMART [109]

Smart, lightweight, cost-effective and energy efficient windows based on novel material combinations

WINSMART developed a new production technology for vacuum insulation glazing (VIG) using anodic bonding and laser welding in vaccum. A superinsulation frame was developed for the VIG. WINSMART significantly advanced developments within photochromic and electrochromic optical transmission control technologies. Widespread adoption of the new technology will have a large impact on the energy efficiency of buildings.

Start date	October 2012
Duration	48 months
Status	Finished
Total budget	5.15 M€
Website	**www.winsmart.eu**
Coordinator	Danish Technological Institute, Denmark
Partners	**Belgium**: AGC Glass Europe. **Denmark**: IdealCombi, M€icroshade. **Germany**: Econtrol-glas, Fraunhofer. **Slovenia**: University of Ljubljana. **Switzerland**: EMPA.

Construction process, end of life, cross-cutting information
Energy performance monitoring and management

ZenN [110]

Nearly zero energy neighborhoods

ZenN focuses on the benefits of integrated, urban scale energy retrofitting of the EU residential stock. Through district-scale demonstrators in four EU cities, the impact of new energy-saving technologies, combined with increased awareness and involvement of all stakeholders, results in highly visible best-practice examples for authorities, public and private building owners, as well as citizens.

	March 2013
	48 months
	Finished
	15.6 M€
	www.zenn-fp7.eu
	Tecnalia Research & Innovation, Spain
	France: CEA, Ville de Grenoble. **Norway**: NTNU, City of Oslo, SINTEF. **Poland**: ASM. **Spain**: Ayuntamiento de Eibar, DEBEGESA, Gobierno Vasco. **Sweden**: City of M€almö, IVL.

H2020

2014

4RinEU
Accept
AMANAC
BERTIM
BRESAER
BuildHEAT
Built2SPEC

2015

CREATE
DREEAM
E2VENT
ECO-Binder
EeB-CA2
EEBERS
EENSULATE
EnergyMatching

2016

ENVISION
EXCEED
GELCLAD
RE4
ReCO2ST
RenoZEB
RESPOND
REZBUILD
RIBuild
SCORES
Stunning
SWIMing
TABEDE
TESSe2b
THERMOSS
TOPAS
VEEP
WALL-ACE
ZERO-Plus

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2017

Greeninstruct
HEART
HEAT4COOL
HIT2GAP
HOLISDER
HomeSkin
Hybuild
IMPRESS
InDeWag
InnoWEE
INNOVIP
Insiter
ISOBIO
LaWin
MODER
MOEEBIUS
Moreconnect
New TREND
OptEEmAL
P2Endure
Plug-N-Harvest
Pro-GET-OnE
QUANTUM
Rennovates

*
Projects funded under the 2014, 2015, 2016 and 2017 calls for proposals

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Technology building blocks
Energy performance monitoring and management

4RinEU [111]

Robust and Reliable technology concepts and business models for triggering deep Renovation of Residential buildings in EU

4RinEU has the goal to define robust, cost-effective, tailorable deep renovation technology packages supported by usable methodologies, feeding into reliable business models. It aims to minimize failures managing different stages of the deep renovation process, from the preliminary audit up to the end-of life, and provide information on energy, comfort, users' impact, and investment performance.

Start date	October 2016
Duration	48 Months
Status	In progress
Total budget	4.6 M€
Website	**www.4rineu.eu**
Coordinator	Accademia Europea Di Bolzano, Italy
Partners	**Germany:** Gumpp & Maier GmbH **Italy:** Aderma, Thermics Energie, R2M Solution **Netherlands:** Trecodome, Stichting Woonzorg Nederland **Norway:** SINTEF, Oslo Kommune **Spain:** Aiguasol, ACCIONA Construccion, Agencia De L'habitatge De Catalunya **United Kingdom:** IES

Construction process, end of life, cross-cutting information
ICT

ACCEPT [112]

Assistant for quality check during construction execution processes for energy-efficient buildings

ACCEPT consists of 3 software apps to support the construction industry in knowledge transfer and quality assurance to improve energy efficiency of buildings. CoOp App runs on smart glasses guiding construction workers with Augmented Reality; site managers access a tablet app linked to on-site sensors and project data; a dashboard links designers to ACCEPT so all users can collaborate in real-time.

	January 2015
	36 Months
	Finished
	4.46 M€
	www.accept-project.com
	Ascora GmbH, Germany **Belgium**: Entreprises Jacques Delens s.a., University of Liege - LUCID. **Cyprus**: EPITESSERA Architects. **Germany**: Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V. **Italy**: Fraunhofer Italia Research Konsortialgesellschaft mbH. **The Netherlands**: TIE Nederland B.V. **Spain**: AnswareTech s.l., CYPE SOFT, S.L., Ferrovial Agroman. **UK**: Ingleton Wood LLP.

Advanced materials and nanotechnology
Technology building blocks

AMANAC [113]

Advanced material and nanotechnology cluster

AMANAC developed an effective collaboration platform between the FP7 & H2020 Advanced Materials and Nanotechnology projects in EeB PPP, to maximise impact via targeted common dissemination, exploitation and communication activities. The wiki, materials photo gallery and database development supported by the joint action plan, thematic workshops and specific workshops are the most innovative aspects.

	January 2015
	24 months
	Finished
	0.48 M€
	www.amanac.eu
	NTUA, Greece **Germany**: Fraunhofer, Universität Bayreuth. **Italy**: CETMA. **Poland**: FASADA. **Spain**: TECNALIA. **Sweden**: CBI Betonginstitutet AB. **UK**: UBAH, TWI Limited.

Technology Building Blocks
Construction process, end of life, cross-cutting information

BERTIM [114]

Building energy renovation through timber prefabricated modules

BERTIM develops high energy performance timber prefabricated modules for buildings' deep renovation; integrating windows, insulation materials, collective HVAC systems, renewable energy systems and energy supply systems. An innovative holistic renovation process methodology based on a data digital workflow to improve the timber manufacturing processes is developed and implemented in RenoBIM tool.

Start date	June 2015
Duration	48 months
Status	In progress
Total budget	4.9 M€
Website	**www.bertim.eu**
Coordinator	Tecnalia, Spain
Partners	**Denmark**: BBBO. **France**: FCBA, POBI, Dietrichs'. **Germany**: Technische Universitaet Muenchen (TUM). **Poland**: ASM. **Spain**: Empresa Municipal de la Vivienda y Suelo de Madrid SA, EGOIN. **Sweden**: SP, Martinssons, Collage.

Technology Building Blocks
Energy performance monitoring and management

BRESAER [115]

Breakthrough solutions for adaptable envelopes for building refurbishment

BRESAER is putting forward new solutions to be adopted by the European existing building stock with the aim to get near zero energy buildings by the transformation of the envelope into an active element rather than passive, enabling it to adapt to a dynamic environment and to occupants' requirements during its lifetime. It has been validated under European Standards and will be demonstrated in a real building in 2019.

	February 2015
	54 months
	In progress
	5.8 M€
	www.bresaer.eu
	Acciona, Spain
	Belgium: Youris. **France**: Technofi. **Greece**: NanoPhos. **Hungary**: EMI. **Israel**: Technion. **Italy**: Stam. **The Netherlands**: TNO. **Spain**: AENOR, Ascamm, Cartif, Mondragon, Solarwall, Tecnalia. **Turkey**: Ekodenge, Ministry of Education.

Technology Building Blocks
Design

BuildHEAT [116]

Standardized approaches and products for the systemic retrofit of residential Buildings, focusing on heating and cooling consumptions attenuation

BuildHeat aims to elaborate a set of reliable, energy efficient and affordable retrofit solutions for multifamily houses, which execution is facilitated by industrialised, modular and flexible HVAC, façade and ICT systems made available on the market. BuildHeat aims to leverage private and public investments by aggregating customers into energy efficient communities that are attractive to large investors.

	September 2015
	48 months
	In progress
	3.4 M€
	www.buildheat.eu
	EURAC , Italy
	Austria: Pink Energie- Und Speichertechnik **Belgium**: Youris.Com, Airria **Germany**: Allplan, HALFEN, EWE-Forschungszentrum , MIG **Italy**: SiTI, Clivet, Schneider Electric, Rete RI.GE.N.E.R.A **Spain**: Acciona Construccion, Fundacion Circe, Sociedad Municipal Zaragoza Vivienda **United Kingdom**: Ove Arup & Partners International, The University Of Salford, Salix Homes

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Construction process, end of life, cross-cutting information
ICT

BUILT2SPEC [117]

Built to specifications: Self-inspection, 3D modelling, management and quality-check tools for the 21st century construction worksite

BUILT2SPEC will ensure the quality of construction activities on site by developing new, innovative on-site tools including: EE quality checks, 3D imagery & thermal imaging, BIM and smart building components, air pulse airtightness test, acoustic & IAQ tools. All these technologies are to be connected to a virtual construction management platform supporting the collection and sharing of all project data, from initial design to delivery.

Start date	January 2015
Duration	54 months
Status	In progress
Total budget	6 M€
Website	**www.built2spec-project.eu**
Coordinator	Nobatek, France
Partners	**France**: Blue Industry & Science, ENSA Nantes, LogiRep, Université de Bordeaux. **Germany**: Passive House Institute **Italy**: De Cinque, R2M Solution **Ireland**: ECOFIX, National University of Ireland Galway, Oran Precast **Spain**: EURECAT, FUNITEC, OHL **Switzerland**: ETH Zurich **The Netherlands**: TNO **UK**: BRSIA, LakeHouse, The University of Nottingham, VRM Technology

Technology Building Blocks
Energy performance monitoring and management

CREATE [118]

Compact retrofit Advanced Thermal Energy storage

The main aim of CREATE is to develop and demonstrate a heat battery, i.e. an advanced thermal storage system based on Thermo-Chemical Materials (TCMs), that enables economically affordable, compact and loss-free storage of heat in existing buildings.

	October 2015
	48 months
	In progress
	5.9 M€
	www.createproject.eu
	TNO, Netherlands
	Austria: AEE Institut Fur Nachhaltige Technologien **Belgium**: Tessenderlo Chemie **Czech Republic**: Fenix TNT **France**: EDF **Germany**: Vaillant, Dow Wolff Cellulosics **Italy**: D'appolonia **Netherlands**: TNO, Technische Universiteit Eindhoven, Caldic Nederland **Poland**: Mostostal **United Kingdom**: Luvata

Technology Building Blocks
Energy performance monitoring and management

DREEAM [119]

Demonstrating an integrated Renovation approach for Energy Efficiency At the Multi-building scale

DREEAM is a pan-European project focusing on nZEB renovation of residential buildings. The uniqueness of DREEAM's approach is its multi-building focus. The project investigates the benefits of large-scale renovations on potential energy efficiency gains, inclusion of renewables and access to funding. DREEAM supports housing companies through an integrated set of services: investment planning, renovation design, quality assurance, energy consumption analysis, and tenant engagement.

	February 2015
	48 months
	In progress
	7.9 M€
	www.dreeam.eu
	Chalmers University Of Technology, Sweden
	Belgium: EURHONET **Germany**: 3C PRECON, Wuppertal Institut Fur Klima, Umwelt, Energie **Italy**: ATER TREVISO **Poland**: NAPE **Spain**: Bax & Compagny, OpenDomo Services, Sinceo 2 Ingenieria Energetica, Exeleria **Sweden**: Aktiebolaget Landskronahem, Sveriges Tekniska Forskningsinstitut **United Kingdom**: Savills, Places For People Group, ENERGYPRO

Technology Building Blocks
Construction process, end of life, cross-cutting information

E2VENT [120]

Energy efficient ventilated facades with integrated heat exchangers for optimal adaptability for the refurbishment of existing buildings

The E2VENT team is developing a module for the refurbishment of residential buildings. Adding to the classical insulation layer, the module embeds an air renewal system with a heat exchanger to ensure air quality while limiting the energy losses and a PCM based thermal storage for cooling. The Building Management System allows optimal piloting and adaptability. Pilots buildings in Burgos (Spain) and Gdansk (Poland) are now renovated and being monitored.

Start date	January 2015
Duration	42 months
Status	In progress
Total budget	3.4 M€
Website	**www.e2vent.eu**
Coordinator	Nobatek, France
Partners	**Belgium**: European Aluminium Association. **Czech Republic**: Fenix TNT SRO. **Greece**: AUTH, Greece. **Italy**: D'Appolonia, Elval. **Poland**: Fasada. **Spain**: Tecnalia, Acciona, Cartif, UBU, Pich-Aguilera architects. **UK**: University of Hull.

Advanced materials and nanotechnolog
Technology Building Blocks

ECO-Binder [121]

Development of ICFs based on novel low CO^2 binders for a new family of eco-innovative, durable and standardised energy efficient envelope components

Ecobinder aims to develop a new generation of prefabricated building envelope components with a new class of low-CO2 binders based on Belite-Ye'elimite-Ferrite, able to fully replace OPC while less environmentally impacting. The Eco-Binder solutions also provide multi-functional surface properties such as thermal reflection, anti-stain, anti-bacterial and self-cleaning, through the finishing technologies applied.

	January 2015
	48 months
	In progress
	7.6 M€
	www.ecobinder-project.eu
	D'Appolonia, Italy
	Czech Republic: Fenix TNT. **Denmark**: Danish Technological Institute. **France**: LafargeHolcim Centre de Recherche, VICAT. **Germany**: Heidelberg Cement. **Greece**: National Technical University of Athens. **Hungary**: Geonardo. **Italy**: Nuova Tesi System. **Romania**: Drobeta Turnu Severin City Hall, Novel Technologies Center. **Spain**: Acciona, Tecnalia. **UK**: Building Research Establishment.

Construction process, end of life, cross-cutting information

EEB-CA2 [122]

Energy efficient buildings cluster activities coordination action

EeB-CA2 developed a set of technology and geo-clustering instruments as well as services for integrated dissemination and technology transfer. EeB-CA2 has contributed to increase public presence and awareness of EeB PPP activities, to stimulate networks and alliances for further RTD and industrial innovation in the addressed technology and application areas, and to speed up industrial exploitation of EeB PPP projects

	February 2015
	24 months
	Finished
	0.5 M€
	www.e2b-clusters.eu
	CSTB, France
	Italy: D'appolonia SPA. **Belgium**: ECTP. **Germany**: Steinbeis Innovation GGMBH.

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ICT
BIM/ Data/ Interoperability

EEBERS [123]

Energy efficient buildings ICT clusters

EEBERS aims to identify opportunities for synergies in ICT related RTD in the EeB (energy efficient buildings) domain and to engage stakeholders in networking for future RTD and exploitation of results. EEBERS booklets and finally the main public reports have been used in discussions in current projects and project preparations. The EEBERS taxonomy and the pictures and descriptions of the technological solutions are a good starting point to further development.

Start date	February 2015
Duration	24 months
Status	Finished
Total budget	0.5 M€
Website	**www. eebers.eu**
Coordinator	Teknologian tutkimuskeskus VTT Oy, Finland
Partners	**Germany**: Fraunhofer Gesellschaft Zur Forderung Der Angewandten Forschung Ev. **Spain**: Solintel M&P Sl. **UK**: Loughborough University.

Technology building blocks
Advanced materials and nanotechnology

EENSULATE [124]

Development of lightweight and highly insulating energy efficient components and associated enabling materials for cost-effective retrofitting and new construction of curtain wall facades

Development of an affordable and lightweight solution for envelope insulation to bring existing curtain wall buildings to “nearly zero energy” standards while complying with structural limits and national building codes. Commercial insulating products developed: environmentally friendly highly insulating foams and lightweight, thin double pane vacuum glasses with multi-functional thermo-tunable coatings.

Start date	August 2015
Duration	42 months
Status	In progress
Total budget	6.7 M€
Website	**www.eensulate.eu**
Coordinator	D’Appolonia, Italy
Partners	**Belgium**: AGC Glass Europe **Czech Republic**: Fenix TNT **Germany**: Evonik Nutrition & Care **Italy**: SAES Getters, Focchi, Universita Politecnica Delle Marche **Netherlands**: Van Berkel & Bos U.N. Studio **Poland**: Selena Labs Spolka Z Ograniczona Odpowiedzialnoscia, Bergamo Tecnologie Spzoo, Gmina Miejska Dzierzoniow **Spain**: TVITEC **United Kingdom**: University College London, University Of Ulster

Technology building blocks
Energy performance monitoring and management

ENERGY MATCHING [125]

Adaptable and adaptive RES envelope solutions to maximise energy harvesting and optimize EU building and district load matching

EnergyMatching aims at developing adaptive and adaptable envelope and building solutions for maximizing RES (Renewable Energy Sources) harvesting: versatile click&go substructure for different cladding systems, solar window package, modular appealing BIPV envelope solutions, RES harvesting package to heat and ventilate. Such solutions are integrated into energy efficient building concepts for self-consumers connected in a local area energy network.

Start date	October 2017
Duration	54 month
Status	In progress
Total budget	7.0 M€
Website	**www.energymatching.eu**
Coordinator	EURAC, Italy
Partners	**France**: Bouygues Construction, Solarwall Europe **Germany**: Wirtschaft und Infrastruktur GMBH & co Planungs KG **Italy**: Casa S.P.A, Eurofinestra SAS di Ecosistema SRL, Pellini SPA, R2M Solution SRL **Netherlands**: Plastica Plaat BV, Tulipps BV **Spain**: Fundacion Tecnalia Research and Innovation, Onyx Solar Energy S.L **Sweden**: Ferroamp Elektronik AB, Hogskolan Dalarna, Ludvikahem Aktiebolag, Nibe Aktiebolag

Energy performance monitoring and management
Advanced materials and nanotechnolog

ENVISION [126]

Energy harvesting by Invisible Solar IntegratiON in building skins

ENVISION aims at developing and demonstrating an integrated renovation concept using all the available building surfaces (vertical/horizontal, transparent/opaque) for thermal and electrical energy harvesting. The ENVISION façade solutions focus on absorbing the invisible part of the solar radiation, the near-infrared (NIR), roughly 50% of the solar spectrum, allowing visible and aesthetical aspects to be retained.

Start date	October 2017
Duration	54 months
Status	In progress
Total budget	6.0 M€
Website	**www.energy-envision.eu**
Coordinator	TNO, Netherlands
Partners	**France**: Electricité de France **Germany**: Pilkington Deutschland BV **Italy**: Rina Consulting SPA **Netherlands**: Akzo Nobel Decorative Coatings BV, BAM Techniek BV, BAM Woningbouw BV, Emergo Hout & Bouw BV, Pilkington Nederland BV, Stichting Vestia **United Kingdom**: Imperial Chemical Industries Limited

Energy performance monitoring and management
ICT

EXCEED [127]

European Energy Efficient building & district Database: from data to information to knowledge

ExcEED has the overall objective of creating a European self-sustainable and dynamic database for measured and qualitative data on beyond the state of the art buildings. The advanced tools and KPIs associated to the database (also available here http://kpidb.eurac.edu/) will allow the analysis of real energy performance and environmental quality at the level of single building, geo-cluster of buildings, and European new or renovated building.

	December-2014
	33 month
	In progress
	0.7 M€
	www.exceedproject.eu
	Accademia Europea Di Bolzano, Italy
	Belgium: 3E NV, BPIE
	Italy: Hoval
	Ireland: Wattics

Advanced materials and nanotechnolog
Technology Building Blocks

GELCLAD [128]

Highly efficient cladding eco-panels with improved nano-insulation properties

Gelclad is developing the manufacturing technologies to provide the building market with a superior façade insulation modular system that comprises a nano-insulation aerogel core and an eco-composite skin layer. Gelclad will be an all-in-one single, durable, affordable and easy to install panel solution, capable of delivering strict energy efficiency requirements and outstanding traditional multi-product systems.

	September 2016
	36 months
	In progress
	5.5 M€
	www.gelclad.eu
	Instituto Pedro Nunes, Portugal
	Germany: TECNARO GmbH, Fraunhofer Institute for Chemical Technology
	Portugal: LNEC, Active Aerogels
	Slovenia: Navodnik Kemijski Inzeniring, Slovenski Gradbeni Grozd-GIZ, JUB d.o.o
	Spain: Construcciones Garcia Rama
	United Kingdom: Brunel University London, Vannplastic, BRE

Technology building blocks
Construction process, end of life, cross-cutting information

Green INSTRUCT [129]

Green Integrated Structural Elements for Retrofitting and New Construction of Buildings

The underlining theme of the project is to achieve sustainability and cost savings through CDW sourced materials, while maintaining recyclability of the components in a C2C approach. The construction block will be BIM-optimised and include: photocatalytic and self-cleaning coating; continuous extrusion fabrication technology for low carbon cementitious materials; integration of a green wall technology for CO2 capture, greywater cleaning and a healthy micro-climate for living.

Start date	October 2016
Duration	42 months
Status	In progress
Total budget	7.6 M€
Website	**www.greeninstruct.eu**
Coordinator	Brunel University London, United Kingdom
Partners	**Austria**: Alchemia-Nova **Cyprus**: CETRI **Greece**: NTUA, Artia Nano - Engineering & Consulting Ike **Italy**: STRESS, Collanti Concorde **Poland**: Nr-Gia **Portugal**: Universidade De Aveiro, Cool Haven - Habitacoes Modulares E Eco Sustentaveis **Spain**: Fundacion Cidetec, Acondicionamiento Tarrasense Associacion, Acciona Construccion **United Kingdom**: EXERGY

Technology building blocks
Energy performance monitoring and management

HEART [130]

Holistic Energy and Architectural Retofit Toolkit

HEART aims at developing a multifunctional retrofit toolkit where different subcomponents - ICT, BEMS, HV AC, BIPV and Envelope Technologies - cooperate synergistically to transform an existing building into a Smart Building. Based on a whole-building performance approach, the toolkit is conceived to achieve extremely high levels of energy efficiency in the existing residential building stock, with particular reference to Central and Southern Europe.

	October 2017
	48 months
	In progress
	6.6 M€
	www.heartproject.eu
	Politecnico di Milano, Italy
	Austria: Heliotherm **Belgium**: Housing Europe, Revolve Water **Croatia**: STILLE **France**: ENTPE Lyon, Est Métropole Habitat **Italy**: Accademia Europea di Bolzano, ACER RE, Politecnico di Milano, ZH **Luxembourg**: VuzVoice **Slovenia**: University of Ljubljana **Spain**: CTIC Technology Center, GarciaRama **Swiss**: Quantis **United Kingdom**: Turbo Power Systems

Advanced materials and nanotechnolog
Energy performance monitoring and management

HEAT4COOL [131]

Smart building retrofitting complemented by solar assisted heat pumps integrated within a self-correcting intelligent building energy management system

Heat4Cool aims to demonstrate the efficient and cost-effective integration of gas and solar thermally driven adsorption heat pumps, solar PV assisted DC powered heat pump connected to an advanced modular PCM heat storage system, and energy recovery from sewage water. A Self-Correcting Intelligent Building Energy Management System will optimize operational strategy. Implementation of four retrofitting projects.

	October 2016
	48 months
	In progress
	7.5 M€
	www.heat4cool.eu
	Belgium: EHPA **Bulgaria**: Balkanika Energy **Germany**: SorTech AG **Greece**: Hypertech AE **Hungary**: Thermowatt Ltd. **Poland**: IZNAB **Spain**: SOLINTEL, SYMELEC RENOVABLES, TECNALIA **Switzerland**: HOCHSCHULE LUZERN **United Kingdom**: AES Ltd, Sunamp Ltd

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Energy performance monitoring and management
ICT

HIT2GAP [132]

Highly Innovative building control Tools Tackling the energy performance GAP

The HIT2GAP project aims to elaborate and develop new methods and tools for the better assessment of energy use within a building or a block of buildings in order to minimise the gap between predicted and measured energy consumption. In its essence, HIT2GAP aims to deliver an open approach for A NEW GENERATION OF BMS SOLUTIONS with plug and play analytics tools and modular services using a win-win strategy (between service providers, BMS manufacturers and cutting-edge SMEs).

Start date	September 2015
Duration	48 months
Status	In progress
Total budget	7.9 M€
Website	**www.hit2gap.eu**
Coordinator	NOBATEK , France
Partners	**Cyprus**: CY.R.I.C **France**: Bouygues Energies & Services, Evolution, Universite De Pau Et Des Pays De L'adour **Germany**: Fraunhofer-Gesellschaft **Greece**: Applied Industrial Technologies **Ireland**: Zutec Inc., Enerit, National University Of Ireland, Cylon Controls **Italy**: R2M Solution, ABO DATA, **Poland**: Mostostal, Miasto Stoleczne, Warszawa **Spain**: Fundacio Eurecat, Fundacion Tekniker, Giroa S.A, Universitat De Girona **Turkey**: Ege Universitesi **United Kingdom**: BRE, University Of Strathclyde

Energy performance monitoring and management
BIM/ Data/ Interoperability

HOLISDER [133]

Integrating Real-Intelligence in Energy Management Systems enabling Holistic Demand Response Optimization in Buildings and Districts

HOLISDER introduces a Holistic Demand Response Optimization Framework that enables significant energy costs reduction at the consumer side, while introducing buildings as a major contributor to energy networks' stability. HOLISDER brings together a wide range of mature technologies and integrates them, comprising of a fully-fledged suite of tools, addressing the needs of the whole DR value chain. It will be validated in 4 large-scale pilot sites, located in Greece, UK, Finland and Serbia.

	October 2017
	36 months
	In progress
	5.1 M€
	www.holisder.eu
	Tecnalia, Spain
	Croatia: KONKAR **Czech Republic**: HONEYWELL **Finland**: CAVERION **Greece**: HYPERTECH, MYTILINEOS **Netherlands**: TNO **Poland**: ASM **Serbia**: BEOELEK, BELIT **Spain**: ETRA, Solintel **United Kingdom**: KIWI

Advanced materials and nanotechnolog
Technology Building Blocks

HOMESKIN [134]

Homes key insulating material

The HOMESKIN project has developed a new super-insulation panel possessing the lowest thermal conductivity of all insulation materials. The proposed solution brings to the market an insulation technology that do not only have high thermal insulation performance but also is thinner, lighter, non-flammable and with no VOC emissions.
This new material is suitable to new buildings as well as to old buildings retrofits.

	February 2015
	36 months
	In progress
	6.3 M€
	www.homeskin.net
	Enersens, France
	Germany: University of Stuttgart. **France**: ARMINES, CEA, Parex. **Italy**: FLAG, Trocellen. **Luxembourg**: Kurt Salmon. **Spain**: ITeC. **Switzerland**: SORANE.

Technology building blocks

HYBUILD [135]

Innovative compact HYbrid electrical/thermal storage systems for low energy BUILDings

HYBUILD develops two innovative compact hybrid electrical/thermal storage systems for buildings: one for the Mediterranean climate primarily meant for cooling energy provision, and one for the Continental climate primarily meant for heating and DHW production. The impact is focused on enhancing energy savings, leading to reduced greenhouse gas (GHG) emissions and fossil fuel utilization, and thus contributing to EU energy security and supply, and reach reliable and cost-effective solutions.

Start date	October 2017
Duration	48 months
Status	In progress
Total budget	6 M€
Website	**www.hybuild.eu**
Coordinator	Comsa Corporacion de Infraestructuras SL, Spain
Partners	**Austria**: Alustrian Institute of Technology GMBH, FRESNEX GMBH, Ochsner Warmepumpen GMBH, PINK GMBH – Energie und Speichertechnik **Cyprus**: Municipality of Aglantzia, University of Cyprus **Czech** Republic: Mikrometal Sro **France**: R2M Solution, Nobatek **Germany**: AKG Verwaltungsgesellschaft, Sortech AG **Greece**: Daikin Air-conditioning Hellas SA, NTUA **Italy**: EURAC, CNR, Engineering – Ingegneria Informatica Spa, STRESS **Spain**: Ajuntament almatret, Universidad de Lleida (UdL) **Switzerland**: CSEM – Centre Suisse d'Electronique et de Microtechnique SA

Technology building blocks
Construction process, end of life, cross-cutting information

IMPRESS [136]

New easy to install and manufacture pre-fabricated modules supported by a BIM based integrated design process

IMPRESS will develop innovative prefabricated panels to reduce energy demand while preserving or improving the building aesthetics. An iterative design methodology has been developed, incorporating all stages of the Design-Construct-Install-Operate process, integrated with a cloud based BIM database. A decision support software tool has also been developed to help the end user choose the most suitable renovation option.

	June 2015
	48 months
	In progress
	4.6 M€
	www.project-impress.eu
	IES, UK
	Hungary: Geonardo Environmental Technologies. **Ireland**: Temperature, Techrete. **Italy**: STRESS, Hypucem, CSP, Biesse Tape Solutions. **Poland**: BG Technologies. **Romania**: Novel Technologies, Municipiul Drobeta Turnu Severin. **Spain**: Alonso Hernandez & Asociados Arquitectos. **UK**: Coventry City Council, Queen's University Belfast, TEKLA.

Technology building blocks
Energy performance monitoring and management

InDeWaG [137]

Industrial Development of Water Flow Glazing

The main objective of InDeWaG is the fabrication industrialization of a disruptive glass façade and glass interior wall system based on cost affordable Fluid Flow Glazing elements (FFG), which give maximum daylight utilization and maximum interior comfort by means of variable radiant heating and cooling with appealing glass surfaces at energy consumption level of nZEB and significant cost reduction of construction and installation.

	September 2015
	42 months
	In progress
	5 M€
	indewag.eu
	Universitaet Bayreuth, Germany
	Bulgaria: Architectonika Studio, Central Laboratory Of Solar Energy& New Energy Sources Of The Bulgarian Academy Of Sciences, ETEM Bulgaria **Germany**: Bollinger + Grohmann Consulting , HTCO , Fraunhofer ISE **Spain**: Savior Venture Capital, Universidad Politecnica De Madrid, Cerviglas

Technology building blocks
Advanced materials and nanotechnology

InnoWEE [138]

Innovative pre-fabricated components including different waste construction materials reducing building energy and minimising environmental impacts

Development of an optimized reuse of Construction and Demolition Waste materials producing high added-value prefabricated geopolymeric panels to be used in Energy-Efficient Buildings for eco-insulating facades (ETIC panels, ventilated façade panels) and eco-friendly indoor radiating system (monolithic and assembled panel) with low environmental impact, low embodied energy, low CO2 emissions, high thermal performance.

Start date	October 2016
Duration	48 months
Status	In progress
Total budget	3.3 M€
Website	**www.innowee.eu**
Coordinator	Consiglio Nazionale delle Ricerche, Italy
Partners	**Greece**: Proigmenes Erevnitikes & Diahiristikes Efarmoges Dimos Varis - Voulas - Vouliagmenis **Italy**: R.E.D. SRL, Guidolin Giuseppe - Eco. G. **Poland**: IZNAB Sp.z.o.o **Romania**: Pietre Edil , Magnetti Building **Slovenia**: Zavod Za Gradbenistvo Slovenije **Spain**: Tecnalia

Advanced materials and nanotechnology
Technology building blocks

INNOVIP [139]

Innovative multi-functional Vacuum-Insulation-Panels (VIPs) for use in the building sector

INNOVIP Consortium reinvents the top-of-the-line insulating material vacuum-insulationpanels (VIP) by improving their thermal performance over the entire lifetime by at least 25 % and making VIPs adjustable, mountable and machineable. By reducing the density and/or using an alternative core material together with less expensive VIP-envelopes as gas barrier, the costs will decrease by 25 %.

Start date	October 2016
Duration	36 months
Status	In progress
Total budget	5.8 M€
Website	**innovip-h2020.eu**
Coordinator	Forschungsinstitut für Wärmeschutz e. V. München, Germany
Partners	**Denmark**: Nordisk Perlite **France**: SOPREMA, LNE **Germany**: va-Q-tec, Fraunhofer-Gesellschaft IVV **Israël**: Hanita Coatings Rca **Poland**: Mostostal **Portugal**: ITeCons **Spain**: Tecnologia Navarra De Nanoproductos , L'urederra **United Kingdom**: Oxford Brookes University

Construction process, end of life, cross-cutting information
Technology building blocks

INSITER [140]

Intuitive self-inspection techniques using augmented reality for energy-efficient buildings made of prefabricated components

The key innovation of INSITER is intuitive and cost-effective Augmented Reality for self-inspection that connects virtual and physical buildings in real-time. It will ensure that the targeted performance in the design model is realised; by eliminating the gaps in quality and energy-performance between the design and realisation of energy-efficient buildings made of prefabricated components.

Start date	December 2014
Duration	48 months
Status	In progress
Total budget	6 M€
Website	**www.insiter-project.eu**
Coordinator	DEMO Consultants, Netherlands
Partners	**Belgium**: Siemens Industry Software. **Bulgaria**: RDF. **Germany**: 3-L, Fraunhofer, Hochtief ViCon. **Italy**: AICE Consulting, Ipostudio, Università Politecnica Delle Marche. **The Netherlands**: DWA, Stichting ISSO, SBRCURnet. **Spain**: CARTIF, Dragados.

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Advanced materials and nanotechnology
Technology building blocks

ISOBIO [141]

Development and demonstration of highly insulating, construction materials from bio-derived aggregates

The ISOBIO project is developing a new approach to insulation materials by combining existing low embodied energy bio-derived aggregates with innovative binders and surface treatments. These novel composites will have lower embodied energy than traditional insulation and will take advantage of the natural moisture release characteristics of the aggregates, resulting in improved indoor air quality.

Start date	February 2015
Duration	48 months
Status	In progress
Total budget	6.3 M€
Website	**www.isobioproject.com**
Coordinator	TWI, United Kingdom.
Partners	**Belgium**: Greenovate! Europe. **France**: Universite de Rennes I, CAVAC Biomateriaux, BCB. **Germany**: CLAYTEC. **Norway**: Norsk Institutt for Skog og Landskap. **Spain**: Acciona Infraestructuras, ProGETIC. **UK**: University of Bath, ModCell, STRAMIT International.

Advanced materials and nanotechnology
Technology building blocks

LAWIN [142]

Large area fluidic windows

LaWin targets the development of glass-based façade and window elements which make use of microfluidic functionality comprising: low-cost thin and strong cover glasses, microstructured rolled glasses of architectural quality, a glass-glass laminate of the two filled with a heat storage liquid which is designed for transparency. Additional functions such as polychromism will be added.

	January 2015
	36 months
	Finished
	8.1 M€
	www.lawin.uni-jena.de
	University of Jena, Germany
	Austria: Lisec. **Belgium**: Ducatt. **Czech Republic**: Glass Service. **Germany**: Schott TGS, Ungricht, Fickert & Winterling, Folienwerk Wolfen, Clariant, Eura Innovation, Bauhaus University, Beuth Hochschule, Eilenburger Fenstertechnik, Flachglas Sachsen.

Energy performance monitoring and management
Construction process, end of life, cross-cutting information

MODER [143]

Mobilization of innovative design tools for refurbishing of buildings at district level

MODER develops processes and practices that enable building owners to activate refurbishment at district level with the help integrated project delivery models needed in refurbishment at district level. The project has also produced visalisation tools for better unerstanding of a large scale district level project and its targets.

	September 2015
	36 months
	In progress
	4 M€
	www.moderproject.eu
	Sweco, Finland
	Austria: Ertex Solartechnik GMBH **Finland**: Teknologian tutkimuskeskus VTT Oy, FinnEnergia Oy **Germany**: Fraunhofer Institute for Building Physics, Siemens Aktiengesellschaft **Latvia**: Rem Pro SIA **Netherlands**: W/E Consultants for Sustainable Building **Slovenia**: Gradbeni Institut ZRMK Doo, Leag Lokalna Energetska Agencija Gorenske Javni Zavod

Energy performance monitoring and management
ICT

MOEEBIUS [144]

Modelling Optimization of Energy Efficiency in Buildings for Urban Sustainability

MOEEBIUS introduces a Holistic Energy Performance Optimization Framework that enhances current building modelling approaches and delivers innovative simulation tools to reduce the gap between predicted and actual energy performances at the level of buildings and blocks of buildings. Once the simulation models and technical components of the framework have been developed, the MOEEBIUS solution is being roll-out in 3 pilot sites (UK, Serbia, Portugal) for its validation.

Start date	November 2015
Duration	42 months
Status	In progress
Total budget	7.2 M€
Website	**www.moeebius.eu**
Coordinator	Tecnalia, Spain
Partners	**Czech Republic**: Honeywell **Germany**: Fraunhofer – Gesellschaft, Technische Hochschule Nurnberg **Greece**: Hypertech **Ireland**: University College Cork, National University Of Ireland, CIT **Netherland**: Almende **Poland**: ASM **Portugal**: ISQ, Municipio De Mafra **Serbia**: Beogradske Elektrane, Preduzece Za Informacione Tehnologije I Elektronsko Trgovanje Belit **Spain**: SOLINTEL **United Kingdom**: Grindrop, Kiwi Power

MOEEBIUS

Technology Building Blocks
BIM/ Data/ Interoperability

MORE-CONNECT [145]

Development and advanced prefabrication of innovative, multifunctional building envelope elements for modular retrofitting and smart connections

MORE-CONNECT will develop and demonstrate Plug & Play solutions for prefabricated modular renovation elements, including integration of components for climate control, energy saving, building physics and aesthetics. It will develop tailor-made renovation concepts, in a standardised manufacturing process with NZE performance, a maximum ROI of 8 years and a renovation time of less than 5 days.

	December-2014
	48 month
	In progress
	5.5 M€
	www.more-connect.eu
	Huygen Installatie Adviseurs, Netherlands
	Czech Republic: Czech Technical University in Prague, RD Rýmařov.
	Denmark: Cenergia, Innogie ApS, Invela ApS.
	Estonia: Tallinn University of Technology, AS Matek, REF Ehitustööd.
	Latvia: Riga Technical University, Latvia Wood Construction Cluster, Technological Centre of Zemgale.
	The Netherlands: Zuyd University, BJW, WEBO.
	Portugal: University of Minho, Darkglobe.
	Switzerland: Econcept.

MORE—CONNECT

Design
ICT

New TREND [146]

New integrated methodology and Tools for Retrofit design towards a next generation of energy efficient and sustainable buildings and Districts

NewTREND is developing a new participatory integrated design methodology targeted to the energy retrofit of buildings and neighbourhoods, establishing energy performance as a key component of refurbishments. Its implementation is supported by a set of tools enabling structured and standardized data collection and evaluation of retrofitting needs guiding decision makers to select the best energy retrofitting strategy.

	September 2014
	36 months
	In progress
	4.7 M€
	newtrend-project.eu
	IES, United Kingdom
	Finland: Granlund
	Germany: dr. jakob energy research, University of Applied Science Munich
	Hungary: Advanced Building & Urban Design
	Ireland: University College Cork, University College Dublin
	Italy: IISBE, STAM, Universita Politecnica Delle Marche
	Spain: REGENERA, Ajuntament de SantCugat
	United Kingdom: IES, London Business School

NewTREND
NEW Integrated Methodology and **T**ools for **R**etrofit Design Towards a Next Generation of **EN**ergy Efficient and Sustainable Buildings and **D**istricts

BIM/ Data/ Interoperability
ICT

OptEEmAL [147]

Optimised Energy Efficient Design Platform for Refurbishment at District Level

The project is developing an Optimised Energy Efficient Design Platform able to provide a set of scenarios that are based on different energy conservation measures to improve the energy behaviour of a district. The platform will deliver an integrated and systemic design based on an Integrated Project Delivery approach for buildings and district retrofitting projects, and bring together BIM and IFC, District Performance Indicators, Energy Conservation Measures, and Implementation of ontologies.

Start date: September 2015
Duration: 42 months
Status: In progress

Total budget: 4.7 M€
Website: **www.opteemal-project.eu/**
Coordinator: Fundacion Cartif, Spain
Partners:
France: Nobatek
Germany: Steinbeis-Europa-Zentrum
Greece: Technical University of Crete
Ireland: United Technologies Research Centre Ireland
Italy: Expert System, Distretto Tecnologico Trentino
Spain: Fundación Tecnalia, Fundació Privada Universitat I Tecnologia, Acciona Construccion, Fomento San Sebastian
Sweden: Lunds Kommun
Turkey: Argedor Information Technologies Ltd.

Technology building blocks
BIM/ Data/ Interoperability

P2Endure [148]

Plug-and-Play product and process innovation for Energy-efficient building deep renovation

P2ENDURE provides scalable, adaptable and ready-to-implement innovative Plug-and-Play prefab solutions for deep renovation of building envelopes and technical systems. Within P2ENDURE the innovative solutions are complemented with a proof-of-performance, which is based on pilot implementation and monitoring in 10 live demonstration projects representing deep renovation characteristics in all main EU geo-clusters.

Start date: September 2016
Duration: 48 months
Status: In progress

Total budget: 5.3 M€
Website: **www.P2Endure-project.eu**
Coordinator: DEMO Consultants, Netherlands
Partners:
Denmark: Invela
Germany: Lenze-Luig 3-L-Plan, Fermacell, Technische Universitaet Berlin
Italy: Becquerel Electric, SGR Servizi, D'appolonia, Universita Politecnica Delle Marche
Netherlands: Huygen Installatie Adviseurs, Panplus Architektuur, Camelot Vastgoed
Poland: Bergamo Tecnologie, Fasada. Sp. Z.o.o, Mostostal, Miasto Stoleczne

Technology building blocks
Energy performance monitoring and management

Plug-N-Harvest [149]

PLUG-N-play passive and active multi-modal energy HARVESTing systems, circular economy by design, with high replicability for Self-sufficient Districts Near-Zero Buildings

The main strategic goal of Plug-n-Harvest is to design, develop, demonstrate & exploit a new modular, plug-n-play concept/product for Adaptable/Dynamic Building Envelopes, considering circular economy principles, deployable to both residential & non-residential buildings, able to provide high energy use reductions & energy harvesting from Renewable Energy Sources both at the single-building and the district scale while requiring medium-to-low installation costs & almost-zero operational costs.

Start date: September 2017
Duration: 51 months
Status: In progress

Total budget: 6.9 M€
Website: **www.plug-n-harvest.eu**
Coordinator: Centre for Research and Technology Hellas – CERTH, Greece
Partners:
Germany: RWTH - Aachen University
Greece: Alumil Aluminium Industry S.A. – ALUMIL, Region of Western Macedonia – RWM
Spain: Agencia de l'Habitatge de Catalunya, Eco Intelligent Growth, S.L, ETRA, Odin Solutions S.L, Sistemes Avancats De Energia Solar Termica SCCL-AIGUASOL
Romania: Siemens SRL - SIE
United Kingdom: Cardiff University, County Council of the City and County of Cardiff, Energy Transition Limited

Design
BIM/ Data/ Interoperability

Pro-GET-OnE [150]

Proactive synergy of integrated Efficient Technologies on buildings' Envelopes

The innovative aspect in Pro-GET-OnE consists in the integration of pre-assembled component with the highest performances in terms of:
- Energy requirements – by adding new plug-and-play high energy performing envelopes;
- Safety – by using appropriate steel structures to reduce horizontal loads and implementing the structural safety while supporting the new envelopes; - Social sustainability – increasing the desirability of retrofit options.

Start date: May 2017
Duration: 48 months
Status: In progress

Total budget: 3.7 M€
Website:
Coordinator: UNIBO, Italy
Partners:
Belgium: ABT
Denmark: TECHNISCHE UNIVERSITAET MUENCHEN
Greece: National and Kapodistrian University of Athens, Municipality of Peristeri, Athens
Italy: ACERRE, SAVIO, Bloomfield, ALIVA, CLIVET
Netherlands: HUYGEN Installatie Adviseurs, BJW
Romania: Municipality of Brasov
Spain: LIMA
Switzerland: ANERDGY

Technology Building Blocks
Advanced materials and nanotechnology

QUANTUM [151]

Quality management for building performance - improving energy performance by life cycle quality management

The goal of this project is to develop and demonstrate pragmatic services and appropriate tools with high replication potential supporting quality management (QM) for building performance in the design, construction, commissioning and operation phase as a means to close the gap between predicted and actual energy performance in European buildings. The project focusses on ICT tools to allow for fast and robust scalability of QM services.

January 2016
48 months
In progress

6.8 M€
www.quantum-project.eu
Institute for Building Services and Energy Design (IGS), TU Braunschweig, Germany
Austria: e7 Energie Market Analyse
Belgium: Factor 4 BVBA
Czech Republic: Ceske Vysoke Uceni Technicke v Praze, ENESA a.s.
Denmark: COWI A/S
Germany: Synavision
Greece: National and Kapodistrian University of Athens
Italy: Energy Team, Politecnico di Milano
Latvia: EKODOMA
Netherlands: REHVA
Norway: Norges Teknisknaturvitenskapelige Universitet
United Kingdom: Building Research Establishment

Construction process, end of life, cross-cutting information
Energy performance monitoring and management

Rennovates [152]

REnnovates - Flexibility activated zero energy districts

Rennovates is a holistic systemic deep renovation concept using smart services and developing smart energy-based communities resulting in energy-neutral housing up to and beyond Zero Net Energy by reducing energy consumption and maximizing the use of renewable energy. Old or outdated buildings will be aligned with up-to-date comfort levels : this will increase its value and longevity up to 50ys. REnnovates aims to get smart neighbourhoods into the realm of feasible business.

September 2015
36 month
In progress

7 M€
www.rennovates.eu
Koninklijke Bam Groep, Netherlands
Belgium: Enervalis, VITO, Belfius Banque
Finland: Massivecell Technologies
Germany: KEO
Netherlands: Stedin Netbeheer
Poland: Mostostal
Spain: MONDRAGON

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Advanced materials and nanotechnology
Construction process, end of life, cross-cutting information

RE⁴ [153]

Reuse and recycling of CDW materials and structures in energy efficient prefabricated elements for building refurbishment and construction

The RE⁴ project aims to radically modify the construction process and off-site production by promoting new technological solutions for the design and development of structural and non-structural pre-fabricated elements with a high degree of recycled materials from construction and demolition waste (CDW) and, reused structures from the partial or total demolition of buildings.

Start date: September 2016
Duration: 42 months
Status: In progress

Total budget: 4.8 M€
Website: **www.re4.eu**
Coordinator: CETMA, Italy
Partners:
Belgium: ACR+
Czech Republic: Fenix TNT
Germany: Roswag Architekten Gesellschaft Von Architekten
Italy: STRESS, Vortex Hydra, STAM
Spain: Acciona Construccion
Sweden: CBI Betonginstitutet
Taiwan: National Taiwan University Of Science And Technology
United Kingdom: CDE Global, Creagh Concrete Products, The Queen's University Of Belfast

Technology building blocks
Construction process, end of life, cross-cutting information

ReCO2ST [154]

Residential Retrofit assessment platform and demonstrations for near zero energy and CO2 emissions with optimum cost, health, comfort and environmental quality

The near-ZEB market share in refurbishment needs to significantly increase. However, the state of fragmentation in the building industry makes offering holistic solutions for deep renovation difficult, especially at acceptable cost and quality level. The RECO2ST project addresses these issues, through coverage of the entire supply chain and encompassing all stages, from planning and decision making to installation and operation. The project enables customized and efficient renovation action plans.

January 2018
42 months
In progress

8.4 M€
www.reco2st.eu
Aalborg University, Denmark
Austria: Alchemia-Nova GMBH
Belgium: European Cool Roofs Council
Denmark: Frederikshavn Boligforening, Horn Irene
Germany: VA-Q-TECH AG
Greece: Core Innovation and Technology OE
Ireland: United Technologies Research Centre Ireland, University College of Cork
Spain: Acciona Construccion SA, Ayutamiento de Cadiz, Universidad de Cadiz
Switzerland: Estia SA, Groupe E Greenwatt SA, Quantis, Retraites Populaires
United Kingdom: Brunel University London

Energy performance monitoring and management
BIM/ Data/ Interoperability

RenoZEB [155]

Accelerating Energy renovation solutions for Zero Energy buildings and Neighbourhoods

The project aims to unlock the nZEB renovation market leveraging the gain on property value through a new systemic approach to retrofitting that will include innovative components, processes and decision making methodologies to guide all value-chain actors in the nZEB building renovation process. A multifunctional modular "plug and play" system, a renovation methodology for better decision making, cloud collaborative environment will be demonstrated into 2 real / 3 virtual demos.

February 2017
42 months
In progress

8.7 M€
www.renozeb.eu
Solintel M&P, Spain
Belgium: Conseil des Architectes d'Europe, UIPI
Bulgaria: Balkanika Energy AD
Cyprus: HIT Hypertech Innovation
Estonia: Korteriuhistu Rennaliiva, Mittetulundusuhing Tartu Regiooni Energiaagentuur
France: CSTB
Germany: Beck + Heun GMBH, Fraunhofer
Italy: Focchi SPA, Rina Consulting, Universita Polytecnica della Marche
Spain: Cype Soft, Durango Eraikitzen, Tecnalia, Symelec Renovables
United Kingdom: Energypro Limited, University of Salford

BIM/ Data/ Interoperability
Energy performance monitoring and management

RESPOND [156]

Integrated demand REsponse Solution towards POsitive NeighbourhooDs

RESPOND will deploy and demonstrate an interoperable, cost effective and user-centered demand response solution. The solution will use energy automation, control and monitoring tools to integrate a cooperative demand response program into legacy energy management systems. To this end, RESPOND will use an integrated approach to optimize energy dispatching in real time, taking account both energy demand and supply while exploiting all available energy assets at each site.

Start date	October 2017
Duration	36 months
Status	In progress
Total budget	3.7 M€
Website	**project-respond.eu**
Coordinator	Fenie Energia SA, Spain
Partners	**Czech Republic**: Energomonitor **Denmark**: ALBOA, Aura Radgivning AS, Aalborg Universitet, Develco Products **Ireland**: National University of Ireland Galway, Comharchumann Fauinnimh Oileain Arann Teoranta **Serbia**: Institut Mihajlo Pupin **Spain**: Fundacion Tekniker, Dexma Sensor SL

BIM/ Data/ Interoperability
Energy performance monitoring and management

REZBUILD [157]

Refurbishement decision making platform through advanced technologies for near zero energy building renovation

The REZBUILD project is aimed at defining a collaborative refurbishment ecosystem focused on the existing residential building stock. H2020 Framework Programme is taking action for the support and promotion of business research and innovation in Key Enabling Technologies (KETs) through energy-efficient buildings. Thus, REZBUILD will address these challenges by opening the construction sector through the integration of innovation technologies in order to pave the way towards an annual renovation.

January 2017
48 months
In progress

9 M€
www.rezbuildproject.eu
Officinae Verdi Group SpA, Italy
France: ESTIA
Italy: Rimond Engineering Procurement and Construction Management Srl
Norway: Obos Prosjekt AS, Stiftelsen Sintef
Spain: Comunidad de Madrid, Exploded View SL, Fundacion Cartif, Onyx Solar Energy S.L, Saint-Gobain Placo Iberica SA, Vias y Construcciones SA, Zabala Innovation Consulting SA
United Kingdom: The University of Nottingham

Technology Building Blocks
Construction process, end of life, cross-cutting information

RIBuild [158]

Robust internal thermal insulation of historic buildings

RIBuild studies internal insulation energy saving measures of buildings more than 70 years old, thus respecting architectural and cultural aspects. It focuses on solutions with a good hygrothermal performance, not harming the existing constructions. Guidelines will help the building owner decide whether his building is suitable for internal insulation. They will be based on pre-calculated examples of typical external walls of brick or natural stone and different types of internal insulation.

January 2015
60 months
In progress

5 M€
www.ribuild.eu
Aalborg University, Denmark
Belgium: Katholieke Universiteit Leuven.
Denmark: Technical University of Denmark, Intro Flex A/S, Erik Møller Architects.
Germany: Technische Universität Dresden.
Italy: Università Politecnica delle Marche.
Latvia: Riga Technical University.
Sweden: SP Technical Research Institute of Sweden.
Switzerland: Haute Ecole Spécialisee de Suisse Occidentale.

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Advanced Materials & Nanotechnology

SCORES [159]
Self Consumption Of Renewable Energy by hybrid Storage systems

The main aim of the SCORES project is to develop and demonstrate a building energy system including new compact hybrid storage technologies, that optimizes supply, storage and demand of electricity and heat in residential buildings, increasing self-consumption of local renewable energy in residential buildings at the lowest cost and deferring investments in the energy grid.

Start date	November 2017
Duration	48 months
Status	In progress
Total budget	6 M€
Website	**www.scores-project.eu**
Coordinator	TNO, The Netherlands
Partners	**Austria**: AEE INTEC, Saltzburg AG für Energie, Verkehr und Telekommunikation **Czech Republic**: Fenix TNT SRO **Denmark**: König Metall GmbH &Co. KG **France**: Campa, Electricité de France SA, Forsee Power, Heliopac **Italy**: Rina Consulting **Netherlands**: Siemens Nederland NV **Portugal**: Instituto Politécnico de Setúbal

Technology building blocks
Construction process, end of life, cross-cutting information

Stunning [160]
Sustainable business models for the deep renovation of buildings

STUNNING's goal is to identify and promote innovative refurbishment packages to accelerate their acceptance. Data on adaptable solutions, combined with innovative business models which allow consumers and the market to invest with confidence, are synthesized so as to select, fine-tune and validate the most promising ones. The generated information is then presented on a web-based collaborative knowledge sharing platform (the Renovation Hub), providing key facts on these packages.

	October 2017
	24 months
	In progress
	1 M€
	www.stunning-project.eu
	TECHNOFI, France
	France: CSTB
	Germany: Steinbeis 2I GMBH
	Italy: RINA Consulting SPA
	Spain: SOLINTEL

BIM/ Data/ Interoperability
ICT

SWIMing [161]
Semantic web for information modelling in energy efficient buildings

SWIMing has worked with EeB projects to identify shared data requirements, promote data harmonization for improved interoperability, and identify where linked open data technologies can be utilized to make data more accessible and hence easier to exploit. SWIMing approached over 100 EeB projects, analyzing 53 in detail, resulting in 49 use cases from 33 projects of particular relevance to BIM and interoperability.

	February 2015
	24 months
	Finished
	0.5 M€
	www.swiming-project.eu
	Trinity College Dublin, Ireland
	Germany: KIT, AEC3.
	Greece: CERTH.
	Ireland: Tyndall.

Energy performance monitoring and management
ICT

TABEDE [162]

TowArds Building rEady for Demand rEsponse

TABEDE will pave the way to a new generation of Building Management Systems (BMS) to maximise the adoption of demand-response schemes. TABEDE extender will allow the building manager to lower energy cost without affecting occupant comfort. On the other hand, the energy provider will be able to take advantage of the building flexibility to maximize the usage of renewable energy and ensure power quality.

Start date	November 2017
Duration	36 months
Status	In progress
Total budget	3.8 M€
Website	**www.tabede.eu**
Coordinator	Tractebel Engineering, Belgium
Partners	**France**: Schneider Electric Industries, CEA **Italy**: R2M Solution, Schneider Electric **Switzerland**: CSEM (Centre Suisse d'Electronique et de Microtechnique) **United Kingdom**: Cardiff University

Advanced materials and nanotechnolog
Energy performance monitoring and management

TESSe2b [163]

Thermal Energy Storage Systems for Energy Efficient Buildings. An integrated solution for residential building energy storage by solar and geothermal resources

TESSe2b is developing an innovative thermal energy solution which combines two renewable energy technologies (solar and geothermal) with an advanced thermal energy storage system that uses integrated enhanced phase change materials.

	October 2015
	48 months
	In progress
	4.3 M€
	www.tesse2b.eu
	Instituto Politecnico De Setubal, Portugal
	Austria: Geoteam Technisches Buro Fur Hydrogeologie, Geothermie Und Umwelt
	Cyprus: Z & X Mechanical Installations
	Germany: Ruhr-Universitaet Bochum
	Greece: CRES, Technologiko Ekpedeftiko Idrima Stereas Elladas, University of Ioannina
	Poland: WARSAW Univeristy of Life Sciences WULS-SGGW
	Spain: Asociacion Ecoserveis
	United Kingdom: Phase Change Material Products

TESSE2B
the smart energy storage

Energy performance monitoring and management
Technology Building Blocks

THERMOSS [164]

Building and district thermal Retrofit and Management solutions

The main goal of THERMOSS is to study, develop and demonstrate innovative technologies and tools to optimise the economic and energetic performance of standalone buildings and districts. Key outcomes are a technology sizing toolbox, a two-way substation and a real-time district thermal energy management system, which will lead to a smart grid of thermal energy.

	September 2016
	42 months
	In progress
	8.7 M€
	http://thermoss.eu
	EXERGY LTD, United Kingdom
	Czech Republic: Fenix TNT
	France: CSTB, CEA
	Germany: Bosch Thermotechnik
	Italy: Schneider Electric, Stamtech, D'appolonia
	Spain: GIROA S.A
	Switzerland:Planair, CSEM
	United Kingdom: Cardiff University, University Of Southampton

THERMOSS

Energy performance monitoring and management
ICT

TOPAs [165]

Tools for Continuous Building Performance Auditing

The TOPAs continuous performance auditing framework enables a better understanding of the actual energy performance and facilitates continuous performance improvement during the building operation. TOPAs provides decision support tools, visibility on how energy related decisions impact cost, occupant comfort and general management processes. TOPAs targets a reduction in the existing gap (between predicted and actual) to 10% and additional energy savings in the pilot sites of up to 20%.

Start date	November 2015
Duration	36 month
Status	In progress
Total budget	6.1 M€
Website	**www.topas-eeb.eu**
Coordinator	Motorola Solutions Israel, Israel
Partners	**France**: CEA, Azimut Monitoring, EMBIX **Germany**: Technische Universitaet Dresden, Fraunhofer-Gesellschaft **Ireland**: CIT, Arden Energy, IBM Ireland

Construction process, end of life, cross-cutting information
Advanced materials and nanotechnolog

VEEP [166]

Cost-effective recycling of CDW in high added value energy efficient prefabricated concrete components for massive retrofitting of our buit environmen

Growing interest in green buildings and circular economy is encouraging the consumption of high-grade secondary raw materials in the building sector. In this context the main objective of VEEP is to develop and demonstrate a series of technological solutions for massive retrofitting of our built environment, aiming at cost efficient reduction of building energy consumption.

	October 2016
	48 months
	In progress
	4.9 M€
	www.veep-project.eu
	D'appolonia, Italy
	Belgium: BIBM
	Czech Republic: Fenix TNT
	Finland: Tiihonen Ismo
	France: NOBATEK, Keey Aerogel
	Italy: Nuova Tesi System, Stamtech
	Netherlands: Technische Universiteit Delft, Universiteit Leiden, Strukton Civiel , ADR Technology
	Spain: Tecnalia, Acciona Construccion, Asociacion Espanola De Normalizacion

Technology building blocks
Advanced materials and nanotechnolog

WALL-ACE [167]

Wall insulation novel nanomaterials efficient systems

The goal of this project is to develop novel mineral based indoor/outdoor plasters and a brick filling material in order to improve the existing performances of mineral insulating materials. The complete system will be tested in practical application on pilot and thereafter on real buildings. The project is currently in the middle phase and many set goals have already been achieved in the lab. The second phase of the project will be about transferring these achievements to the industrial level.

	October 2016
	36 months
	In progress
	6.25 M€
	www.wall-ace.eu
	Quick-Mix, Germany
	France: Enersens, Toupret , Wavestone Advisors, CEA
	Germany: Leipfinger-Bader Kg, Universitaet Stuttgart
	Italy: Vimark, Politecnico Di Torino, Agenzia Territoriale Per La Casa Del Piemonte Centrale
	Switzerland: EFFINART, AGITEC
	United Kingdom: BRE

Technology Building Blocks
Energy performance monitoring and management

ZERO-Plus [168]

Achieving near Zero and Positive Energy Settlements in Europe using Advanced Energy Technology

A comprehensive, cost-effective system for Net Zero Energy (NZE) settlements is developed and implemented in four EU case studies. The system is composed of innovative solutions for the building envelope and for energy generation and management at building and settlement level. The implementation results will be monitored, analyzed and disseminated. A business plan for commercial exploitation will be developed.

Start date	October 2015
Duration	48 months
Status	In progress

Total budget	4.17 M€
Website	**www.zeroplus.org**
Coordinator	National and Kapodistrian University of Athens, Greece
Partners	**Cyprus**: The Cyprus Institute, George Vassiliou Ltd. **France**: OPAC38 **Germany**: Technische Universitaet Muenchen **Greece**:Technical University of Crete, FIBRAN Insulating Materials **Israël**: Ben-Gurion University Of The Negev **Italy**: Università Degli Studi Di Perugia, ABB SPA, Consorzio ARCA, CONTEDIL DI RICCO MARIA & C SAS **Switzerland**: ANERDGY **United Kingdom**: Oxford Brookes University, E Co., Joseph Rowntree Housing Trust

Credits

The European Construction Technology Platform (ECTP), founded in 2004, is a leading membership organization promoting and influencing the future of the Built Environment in Europe. 150 member organizations have the opportunity to influence European innovation and Strategic Research Agendas and be connected to a wide network of organizations promoting and realizing innovation in the Built Environment.

The ECTP Energy Efficient Buildings (E2B) Committee's vision is to drive the creation of a knowledge-based building industry which turns energy efficiency into sustainable business, within the public-private partnership on Energy efficient Buildings (EeB PPP) under Horizon 2020.

The general objectives of E2B Committee are to:

- Develop technologies and solutions enabling to speed up the reduction in energy use and GHG emission in line with the 2020 goals, e.g. through a higher renovation rate of the building stock at lower cost and to meet regulatory needs;
- Develop energy efficiency solutions in order to turn the building industry into a knowledge-driven sustainable business, with higher productivity and higher skilled employees;
- Develop innovative and smart systemic approaches for green buildings and districts, helping to improve the competitiveness of EU building industry by providing cost-effective, user-friendly, healthy and safe products for smart cities.

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ECTP
INNOVATIVE BUILT ENVIRONMENT

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ECTP - Energy Efficient Buildings Committee

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