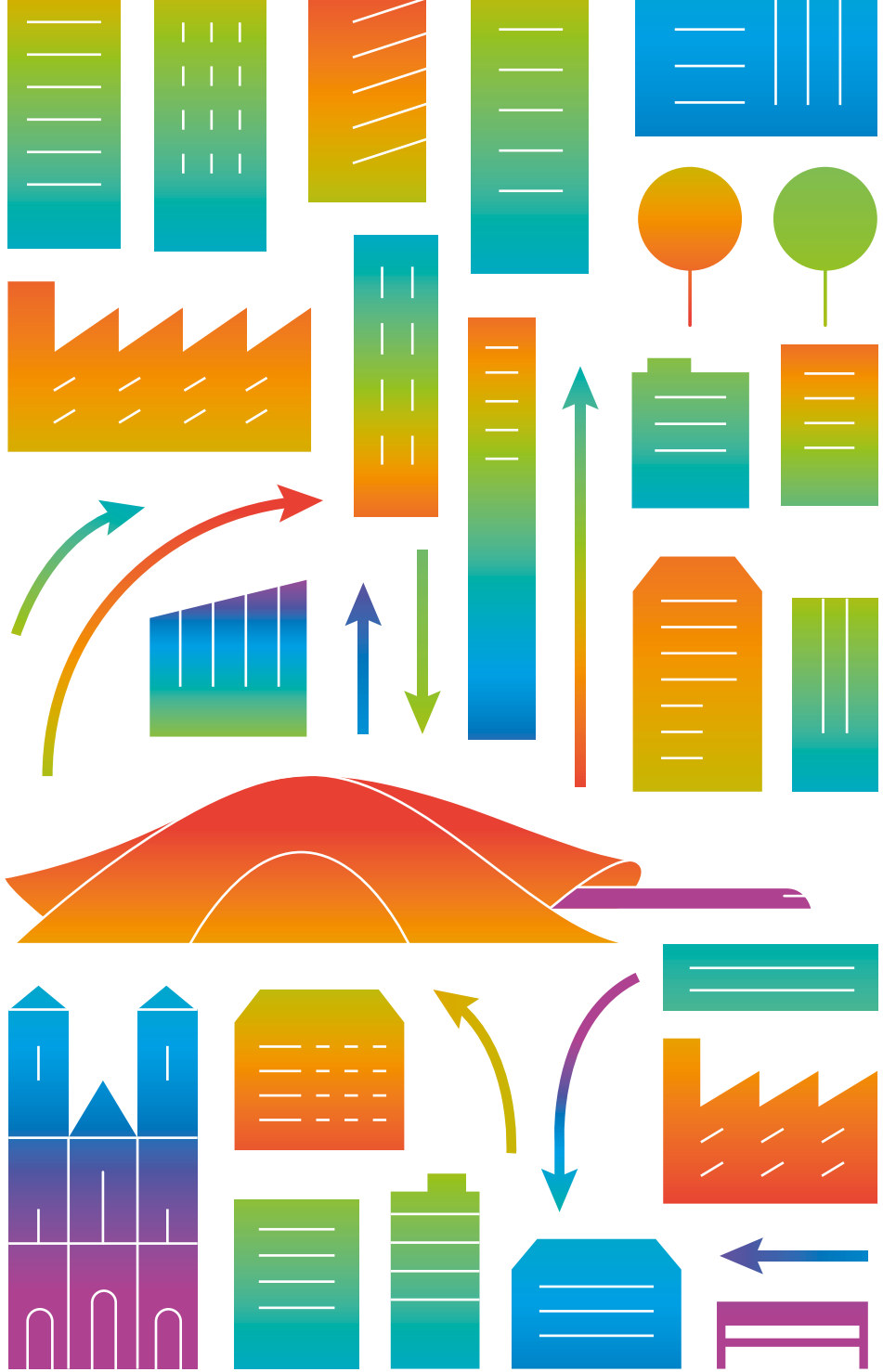

March 2016

EeB PPP Project Review 2016

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ENERGY EFFICIENT BUILDINGS
AN ECTP COMMITTEE FOR INNOVATIVE BUILT ENVIRONMENT

Foreword

We are pleased to introduce the fifth edition of the EeB PPP Project Review. This yearly publication presents the progress of **110 co-funded projects within the EeB PPP under the 7th Framework Programme (FP7) for 2010, 2011, 2012 and 2013 and 17 new co-funded projects under the Horizon 2020 programme for 2014.**

The Energy-efficient Buildings (EeB) Public Private Partnership (PPP) is a joint initiative of the European Commission (EC) and the Energy Efficient Buildings (E2B) Committee of the European Construction Technology Platform (ECTP). This initiative aims at promoting research on new methods and technologies to reduce the energy footprint and CO2 emissions related to new and retrofitted buildings across Europe. In the framework of Horizon 2020, a contractual PPP has been agreed between the E2B Committee of the ECTP and the EC, in order to continue investing in research and innovation. One of the commitments in the arrangement consists in monitoring the impacts and exploitable outcomes generated by the projects. To support this objective, the EC launched in 2015 four Coordination and Support Actions (CSAs) that conduct the monitoring of project results and aim at enhancing and rationalising coordinated and broader dissemination, technology transfer and future exploitation activities of clustered projects.

The four CSAs are :

- EeB-CA2, which considers the whole set of projects;
- EEBERS, which focuses on ICT-related projects;
- SWIMing, which focuses on BIM, Interoperability and Data Models;
- AMANAC, which focuses on material-related projects.

This new edition of the Project Review highlights current results and achieved or potential impact of the EeB PPP projects. The projects demonstrate scientific and technological excellence, across all levels, from early stage conception to demonstration of almost ready-to-market innovations. Distributed into **7 technology-clusters defined according to the construction-related research and 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), they 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 them.

Ignacio Calvo
Chair of the Energy Efficient Buildings Committee of the ECTP

Emmanuel Forest
President of the ECTP

*
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 error.

Contents

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FP7

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H2020

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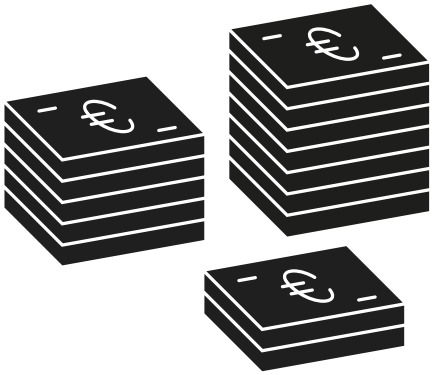
EeB PPP Impact Key Performance Indicators

*
Figures are based on the EeB PPP monitoring questionnaire circulated in April 2015.
Average values were calculated from relevant figures provided by the EeB PPP projects in the questionnaire and therefore do not necessarily always represent the whole set of 127 projects featured in this document.



Average budget (M€)

7.7

The highest budget (M€) (CityFiED)

48.6

Average funding mobilised by partners (M€)

2.8

The highest funding mobilised by partners (M€)

31.2

Average additional private investment in parallel or after the project (M€)

3.9

The highest additional private investment in parallel or after the project (M€)

120

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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

6.5 — 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 — The lowest for all clusters

2 — Technology concept formulated

1 — Basic principles observed

Average reduction of the energy use due to the innovations

34.8%

Most represented cluster

Energy performance monitoring and management

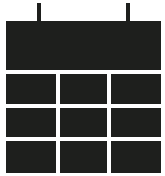
Number of innovations (Average per project)

4.3

Average reduction of waste due to the innovations

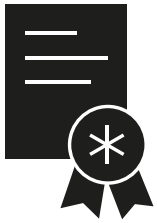
13.2%

Duration (month) (Average per project)



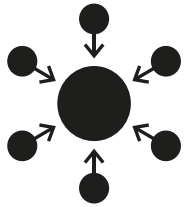
43

Number of patent applications (Average per project)



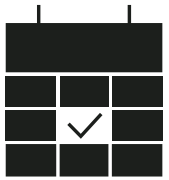
0.9

Share of participation of SMEs

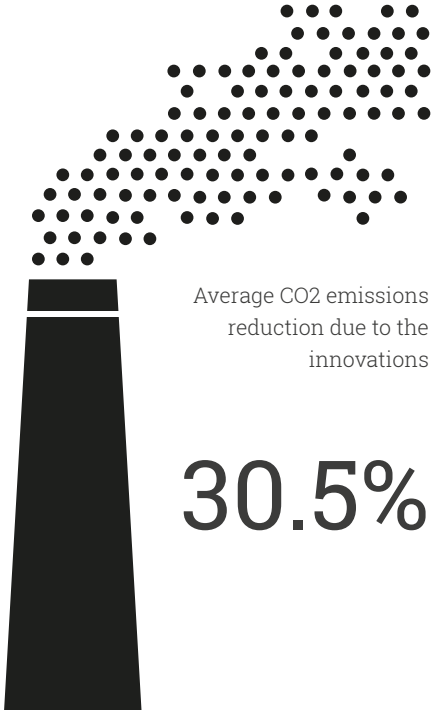


31%

Training and events (Average per project)



8.7



Average CO2 emissions reduction due to the innovations

30.5%

Full-scale demonstrators (Average per project)

2.5

Number of people trained (Average per project)

305

Design

There are 19 'design' projects, covering a vast range of relevant and related subjects essential to helping 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, 94]; building projects which subsequently target neighbourhood applications [36, 41, 43, 103]; and neighbourhoods [17, 22, 32, 40, 49, 60, 66, 86, 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 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 life cycle. Typically, the projects are taking slightly different approaches to solve this problem and provide the tools necessary for different target markets. For example one project is addressing energy system optimisation for different life-cycle phases [17] whilst another takes account of the whole building life cycle and the influence of the neighbourhood [60].

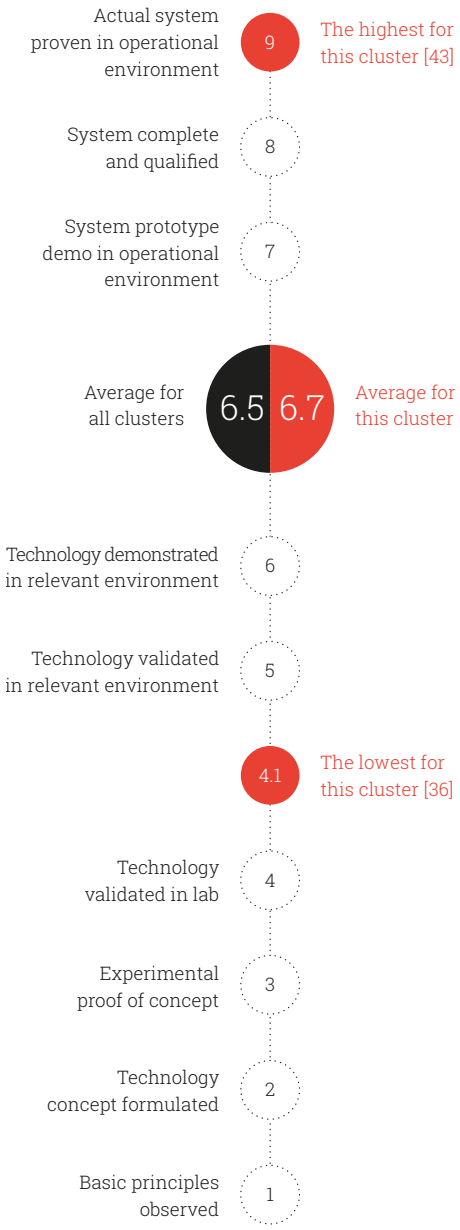
One of the key trends in the neighbourhood projects is to engage with multiple stakeholders and decision makers throughout the whole life cycle process. Such a coordinated approach enables interdisciplinarity in design and construction processes as well as monitoring of results [17, 32, 36, 49, 60, 66,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

[11] BRIMEE
[17] CITYOPT
[22] COOPERATE
[26] DESIGN4ENERGY
[32] ECODISTR-ICT
[36] EEEMBEDDED
[40] E-HUB
[41] EINSTEIN
[43] ENBUS
[49] FASUDIR
[60] HOLISTEEC
[66] IREEN
[69] MEEFS RETROFITTING
[70] MEM4WIN
[79] NEXT-BUILDINGS
[86] R2CITIES
[90] RESSEEPE
[94] SCHOOL OF THE FUTURE
[103] STREAMER

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].

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

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.

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 design projects address many of the issues Europe faces to become more energy efficient and sustainable. They will facilitate better decision making and implement new business models. 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 super-insulation is implemented with aerogel, working on its mechanical reinforcement [4] and the integration into building products for an extensive use of this usually fragile material 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 for fast detecting changes on the surface of external thermal insulation composite systems [51]. The dispersion of microcapsules containing PCM into insulation was investigated to improve thermal capacity [76]. A novel and cost-effective range of nanotech improved NIR coatings can be used to substantially reduce energy demand for cooling [21].

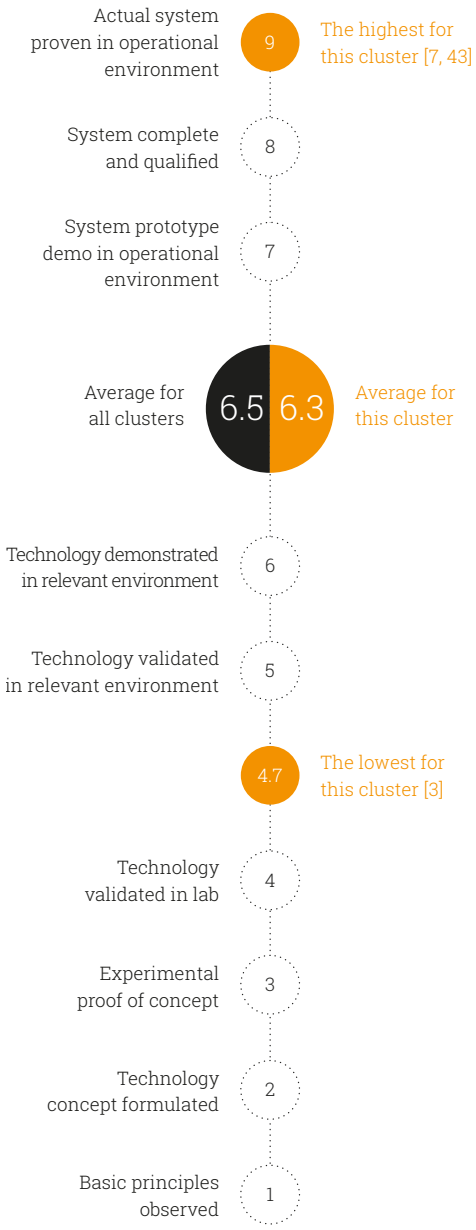
Advanced insulation materials improve the envelope's thermal feature by smart use of inert, "zero-embodied energy" mineral wastes, and industrial by-products [68]. Novel finishing, such as silica advanced aerogel-based composites, are aimed at a healthier indoor environment [120]. Composites consisting of bio-derived aggregates with novel binders and surface treatments reduce embodied energy and take advantage of the natural moisture release feature, resulting in improved indoor air quality [123]. Solutions for façades and interior partitions improve indoor air quality by VOC, and microorganism elimination, while increasing thermal insulation [83]. A family of eco-innovative, durable concrete-based, pre-cast envelope components are under development [117], addressing thermal insulation, low-embodied energy, aesthetic aspects and costs. Window weight is reduced in combination with intelligent PCMs and novel dynamic glass-polymer composites [54]. To better control light, glass systems become fluid thanks to micro-structured rolled glasses of architectural quality, embossed with microfluidic channels [124]. Windows get smarter through active shading, applying a hybrid film constituted of ink-jet printed electrochromic and PV materials [100] resulting in improved U-value, lightweight and combination of vacuum insulation glazing with suitable optical transmission control schemes [109].

Historic buildings whose renovation is affected by architectural value were maintained as functional living and working spaces [1]. Internal insulation issue is investigated with robust solutions offering good hygrothermal performance and not harming existing constructions [126].

Innovations in façade systems and wall panels for buildings include prefabricated modular elements with nano-enhanced lightweight steel skeleton, Dry Wall systems, VIPs, intumescent paints and Active Damping Device are capable of resisting earthquakes and fire and offer excellent thermal protection [42]. 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 thinner, lightweight and durable components whereas the concrete-aerogel composite foam improves fire safety and insulation [98]. New pre-fabricated façade models are developed with the support of a BIM based integrated design process [121]. Development of **Façade systems and wall panels for renovation** is driven by the challenge for adaptive solutions to increase energy savings. The combination of an 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 [114]. Layered panels incorporating nano-materials, with functional improvements are developed for cost-effective retrofitting [72]. Prefab ventilated façade modules are proposed with integrated optimized anchorages, an adaptable air renewal system with a heat exchanger, and a heat thermal storage based on PCM for peak shavings [116]. Prefabricated lightweight customizable panels for

[1] 3ENCULT
[2] A2PBEER
[3] ADAPTIWALL
[4] AEROCOINS
[112] AMANAC
[7] BEEM-UP
[113] BERTIM
[114] BRESAER
[10] BRICKER
[12] BUILDSMART
[15] CETIEB
[16] CITYFIED
[19] Clear-Up
[21] COOL-COVERINGS
[24] COST-EFFECTIVE
[116] E2VENT
[30] EASEE
[117] ECO-Binder
[33] ECO-SEE
[42] ELISSA
[43] ENBUS
[44] ENE-HVAC
[46] ENRIMA
[50] FC-DISTRICT
[51] FOAM-BUILD
[53] H2SusBuild
[54] HARWIN
[55] HEAT4U
[58] H-HOUSE
[59] HIPIN
[120] HOMESKIN
[121] IMPRESS
[122] Insiter
[64] INSPIRE
[123] ISOBIO
[124] LaWin
[68] LEEMA
[69] MEEFS
[71] MESSIB
[72] MF-RETROFIT

Technology Readiness Level for this cluster



exterior retrofitting avoid scaffolding during installation, minimising annoyances for building occupants [30] as well as prefab panels, which also reduce the renovation time to a few days, thanks to plug & play connections [125]. Tailor-made renovation concepts, using industrialised manufacturing processes, 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 renovation time and lowering financial risk for investors [113].

Renovation solution packages & deep energy renovation strategies are 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]. **Indoor environmental quality** is improved with systems using novel VOC sensors, and low-cost infrared vision system to monitor comfort and health related parameters [15]. Novel products couple natural and technological solutions [19] use low carbon structural elements with novel moisture buffering plasters, bio-based insulation, durable materials, and vapour permeable photocatalytic coatings [33].

A next generation of high performance energy buildings using innovative constructive and nature-based solutions are demonstrated [12, 79]. **Energy management systems for new buildings** were developed such as a management system for sport and recreation buildings [102], a decision support system to manage energy flows in public buildings [46], the intelligent use of sounds in order 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 stimulate the growth of smarter Cities with reduced building energy demand and increased use of RES [16], defining integrated climate planning for balanced solutions [87], and developing 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]. Novel concepts were developed for a gas absorption heat pump solution to be used in existing residential buildings [55], and for air conditioning systems with temperature and humidity independent controls [73].

High performance buildings use **renewables energies** in an innovative way, converting high-rise building façades into multi-functional, energy gaining components [24] or with a hybrid energy system that uses RES to produce hydrogen as a back-up, and converts it into power and heat via fuel cells in case of renewable energy shortage [53]. Because of their intrinsic discontinuity, RES can be fully utilized, only with efficient control strategies and **energy storage systems** [71].

Building **owners and tenants** can be assisted with an on-line real-time building energy simulation performance model [106]. A smartphone app enables users to evaluate energy efficient product options [43]. Augmented reality for self-inspection connecting virtual and physical buildings [122] ensures that quality and energy-performance targets are reached.

[125] MORE-CONNECT
[73] NANOCOOL
[74] NANO-HVAC
[75] NANOINSULATE
[76] NANOPCM
[79] NEXT-BUILDINGS
[83] OSIRYS
[87] READY
[91] RETROKIT
[126] RIBuild
[93] S4ECoB
[98] SESBE
[100] SMARTBLIND
[102] SPORTE2
[105] TIBUCON
[106] TRIBUTE
[109] WINSMART

Advanced materials and nanotechnology

Advanced materials and nanotechnologies reside in the core of Energy Efficient Buildings. 5 main technological areas are identified, where 28 projects are contributing with relevant results. In this context, the coordination and clustering action performed within [112] is important; it has established a collaboration platform between the Advanced Materials and Nanotechnology projects in EeB PPP.

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. [120] develops a new silica 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] focused on VIPs with new nanotechnology-based core materials, such as nanofoams and aerogel composites and high-barrier films, achieving low thermal conductivities down to 0.004-0.009 W/ mK.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, aiming to achieve a PCM inclusion up to 30% of the overall panel weight at the project completion. 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, 76] shared the same testing and demonstration facility, the Algete demo park, where a detailed quantitative evaluation of achieved performances was conducted.

Nano-materials are also applied to improve performance of HVAC systems. [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. [117] 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. The aim is to reach 30% lower embodied energy, 20% improved insulation properties and 15% lower cost than the actual solutions based on Portland cement. [104] integrated different kinds of waste materials (ranging from tires to electrical equipment) 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.

[123] 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.

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

[3] ADAPTIWALL
[4] AEROCOINS
[112] AMANAC
[9] BIOBUILD
[11] BRIMEE
[19] Clear-Up
[21] COOL-COVERINGS
[30] EASEE
[117] ECO-Binder
[33] ECO-SEE
[42] ELISSA
[44] ENE-HVAC
[51] FOAM-BUILD
[54] HARWIN
[58] H-HOUSE
[59] HIPIN
[120] HOMESKIN
[123] ISOBIO
[124] LaWin
[68] LEEMA
[70] MEM4WIN
[74] NANO-HVAC
[75] NANOINSULATE
[76] NANOPCM
[83] OSIRYS
[98] SESBE
[104] SUS-CON
[109] WINSMART

Technology Readiness Level for this cluster

openable windows for direct application in façades. [70] implements ink-jet printed organic photovoltaics (OPVs) and fully integrated solar thermal collectors for energy harvesting and micro mirrors for advanced control of energy and day lighting.
[54] uses glass particle reinforcement of laminated glazing and glass fibre 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 [124] 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. This novel panel consists of 3 elements: 1) lightweight concrete with nano-additives for efficient thermal storage; 2) adaptable insulation for switchable thermal resistance; and 3) total heat exchanger with nanostructured membrane for temperature, moisture and anti-bacterial control.
[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 behaviour and a new halogen-free flame retardant to eliminate persistent, bio-accumulative and toxic materials. An environmentally friendly bio-protection system will prevent the growth of microorganisms on the façade surface.

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 optimised cementitious materials with modified surfaces and partition walls based on low emitting earthen materials, wood, straw and flax fibre 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 façades and interior partitions will be developed by means of forest-based biocomposites with different functionalities able to improve indoor air quality by VOC and microorganisms 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 increases significantly and quality control is crucial to avoid errors potentially jeopardising the durability of the building. There is a need to increase effectiveness and quality, to improve the prospect for highly performant buildings. 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. (65) The next step is to develop interoperable, cost effective solutions for quality driven management supported by innovative ICT-based technologies. This delivers data in real time to the workers, thereby enhancing productivity, reducing deviations and improving safety for the workers. Innovative onsite tools for energy efficiency enhancing quality checks, such as 3D imagery and thermal imaging, air-pulse airtightness tests, acoustic & IAQ tools are being developed [115]. Software running on smart glasses guides construction workers and enables site-managers to access on-site sensors as well as project data and dashboards, enabling real-time collaboration among all actors [111]. Intuitive and cost-effective Augmented Reality for self-inspection, which connects virtual and physical buildings in real-time, is a key innovation [122].

Advanced and automated processes for new buildings and refurbishing using **prefabricated modular** systems are in development. Prefabrication aims to reduce on-site construction time, whilst improving the health and safety of workers and reducing the embodied energy of the building. For refurbishment, a new envelope can be pre-assembled off-site, borrowing mass customisation techniques from window manufacturing. With the support of 3D scanning and BIM, elements can be customised to the existing façade in terms of design and location. Innovative new-build and retrofitting systems for prefabricated elements have been successfully deployed [29, 113, 116, 121, 72]. Robust solutions for older buildings are being developed [1, 126].

Training schemes for continuous improvement of worker skills are set up to meet the demand for a SME workforce specialised 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 energy efficiency knowledge sharing amongst agents of the building retrofitting sector [38], and guidelines and training material for teachers and pupils [94].

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 best practices and tools as well as the integration of innovative technology components and systems. In addition, new integration processes are needed to implement large scale demonstrations and also to minimise 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 standardisation 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 optimisation 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 SMEs 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, 34].

Systemic integration of components and subsystems is a key target area. The research and innovation areas

[1] 3ENCULT
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[28] DIRECTION
[29] E2REBUILD
[116] E2VENT
[34] ECOSHOPPING
[118] EeB-CA2
[35] EEBGUIDE
[38] EE-WISE
[48] EU-GUGLE
[52] GE2O
[56] HERB
[57] HESMOS
[61] ICT4E2B FORUM
[121] IMPRESS
[122] Insiter
[65] INTASENSE
[72] MF-RETROFIT
[77] NEED4B
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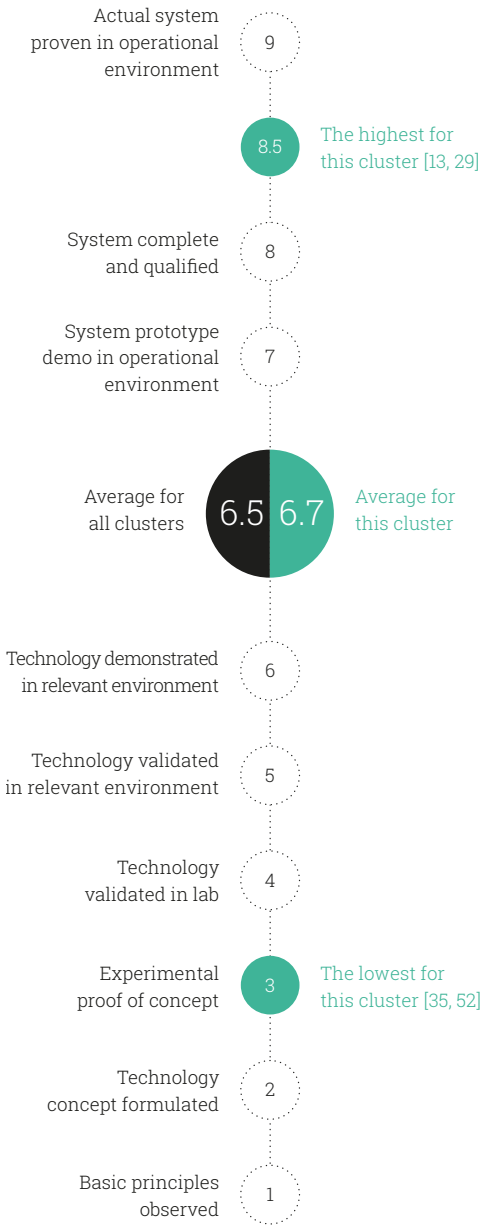
[85] PROFICIENT
[87] READY
[88] READY4SmartCities
[92] REVISITE
[126] RIBuild
[94] SCHOOL OF THE FUTURE
[99] SINFONIA
[104] SUS-CON
[107] UMBRELLA
[110] ZENN

Technology Readiness Level for this cluster



are an optimal integration process, dynamic multi criteria 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, analysing the building's energy performance against the user's needs, to provide recommended energy efficient solutions and optimised business models [107]. A decision support tool and guidelines for designing energy-efficient buildings integrated in the neighbourhood energy systems was also developed [26]. Furthermore, 4 demo sites were 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 implementing the share of renewable energy by 25% (by 2018), and implementing a balanced mix of technical, socio-economic and financial solutions adapted to local needs [48]. A refurbished city district model has been built and validated, demonstrating the potential for scalability and replication by middle-sized European cities [99]. On a neighbourhood scale (and based on integrated climate planning), the implementation and study of five demonstrations of near zero energy renovations is being carried out [110] and a whole city approach towards affordable retrofitting of buildings will also be demonstrated [87].

The key to success of the Smart cities initiative is **the integration of systems from building to neighbourhood level.** To facilitate this, a geo-cluster mapping tool [52] and an ICT roadmap encompassing data interoperability for energy systems in smart cities have been developed (88): they show how savings on design, coordination and energy can be achieved via an open integrated ICT platform [13, 57]. Demand side management of energy use is demonstrated on a community-level using new technology for weather forecasting and renewable energy generation [82]. Computer models for optimisation of components for each energy efficient retrofitting technology and solution are also being 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 and guides developed (35). 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. Lightweight construction materials and structures made from secondary raw materials such as slag, ash, mixed plastic, tyre rubbers and PU foams are being considered [104]. Products with lower embodied energy and increased insulation properties are being developed, signposting the future direction of the construction industry.

Energy performance monitoring and management

The main R&I trends range from application in individual buildings up to their extension into districts with innovative ICT solutions, based on a holistic approach, and modern interaction devices to take into account social factors and citizens.

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 decisions. In addition ICT has been applied for monitoring, control and optimisation of the energy flows (generation, grid exchange, and consumption) in sport facilities and 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 proactive and optimal control. For airport energy management [14], a Fault Detection Diagnosis (FDD) method has been proposed for a facility-specific measurement-based energy action plan.

Other applications refer to a holistic approach [5] with reference to the optimisation and modellisation tool, taking into account energy flows, buildings, RES, electrical vehicles, energy storage/production and implementing energy management strategies as well as specific objectives assigned (e.g. cost, environmental impact, etc.) or considering users, business, law, standard and social aspects associated with energy efficiency [31]. Some of the solutions proposed have considered an internet-based infrastructure to manage real-time information flows [62] or a cloud-based service enabling real-time analytics of consumption data [63] or to provide dynamic assessment of the interactions between buildings, the electricity grid, Renewable Technologies and Information Communication Technologies (ICT); the proposed concept of Energy Hub Model [47, 40] aims at integrating and optimising on-site RES within local communities acting as an "intranet of energy" or 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].

Open interoperability platforms have been developed to interact with ICT solutions [6] as "gateways" opened to ESCOs and grid operators as well as to share data and services to external third parties providing information on building subsystems, occupancy monitoring and external context systems (e.g. weather information, power grid congestion) for the development of new business models and procurement schemes [8, 13] as well as to help energy companies to define and validate their business strategies and pricing schemes [25]. ICT platforms also offer new approaches for supporting building owners in selecting optimal technologies and financing models for energy-efficient buildings retrofitting [78].

Some applications addressed innovative ICT based systems using modern interaction devices such as smartphones and touchpads [23], 3D visualisation [67], virtual and augmented reality as well as business and monitoring/control oriented cockpit [101]; these applications are mostly based on different data sources such as the Building Information Model, System Information Model, Geographic Information System [27] or Building Energy Management System [37].

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 promote and select the correct actions to upgrade a district to become 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].

[2] A2PBEER
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[40] E-HUB
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[56] HERB
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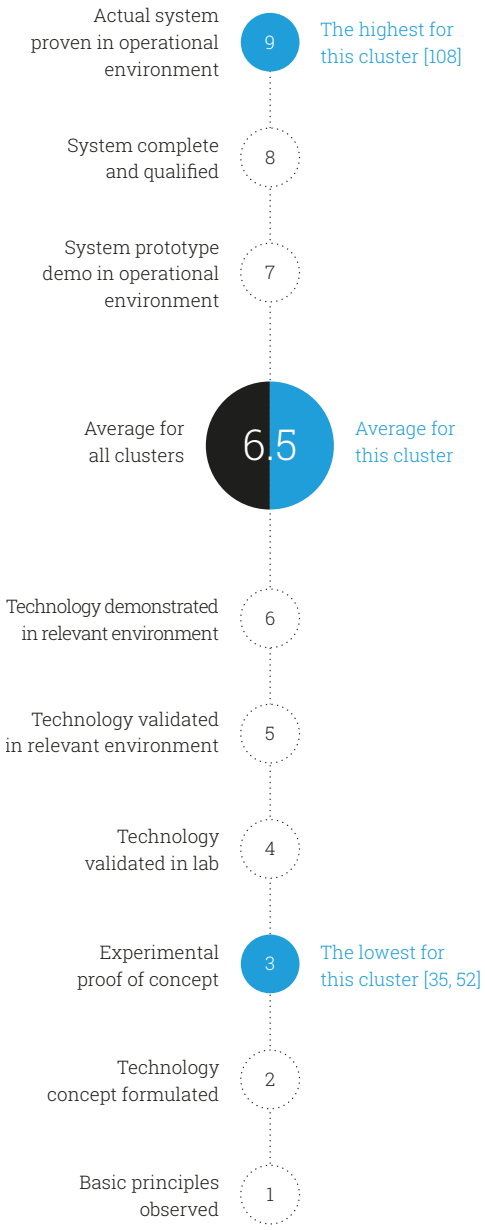
Technology Readiness Level for this cluster



Holistic building energy monitoring methodology and protocols were developed for replicable, systemic and integrated strategies to transform cities into smart cities [84, 16]. Special care was taken in monitoring and evaluation of built environment - from the energy performance of the renovated buildings to the financing schemes chosen by the municipalities [48]. To monitor and evaluate building energy performance during different stages of building operation the energy instrumentation kit for data storage and simulations was developed [84]. An innovation is wireless monitoring systems to detect different building parameters important for energy efficiency and for the occupant's comfort and health [15, 105, 96]. Integrated electronic systems and software applications running on different platforms built for mobile devices are providing the real-time energy performance monitoring and control of lighting and HVAC systems [97, 96, 45].

A 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]. Real time Building Energy Performance Simulation (BEPS) models were extended to the commissioning and operation phases with the goal to minimise the gap between computed and measured energy performance [106, 28]. Research was conducted in innovative building energy management systems to measure and control both the envelope and the energy use of the retrofitted buildings, with the focus on the façades [2, 114, 10]. A kit-concept was applied in the development of new integrated energy management solutions in case of retrofitting the buildings [2, 91]. The façade related ICT parts and electronic control devices for different visual control strategies were included [100]. An advanced energy management and control system ensures the coordination and interaction of the system components [53, 56] as well as the optimised integration between them [41]. Special attention is given to the management of waste-heat from the system components [73].

All types of profiles in the value chain can be connected through a knowledge transfer platform capable of compiling information of energy efficient building retrofitting [38]. New diagnosis methodology and approach for an integrated renovation are addressed [90, 86]. Building management energy systems were expanded into district management energy systems enabling also the visualisation of energy consumption [16]. 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 optimising 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 a simple but detailed evaluation of retrofit options for apartment buildings [29]. Energy efficiency in the new construction projects is supported with open and easily replicable methodology for designing, constructing, and operating new low energy buildings [77]. Interactive, web-based tools and operational guidance were developed to facilitate the life cycle assessments of buildings [35] and the implementation of effective energy efficiency solutions in the built environment and better market uptake [52].

[78] NEWBEE
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[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

ICT

Information and Communication Technologies (ICT) are seen as playing pivotal role in energy efficient buildings, and as such several R&D projects utilise it in the effort to tackle key challenges. Key identified clusters [119] 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 EE design and production management: 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 and holistic energy monitoring and evaluation of building energy performance [84], or quality checking and 3D modelling [115]. The application of open data technologies, like Linked (Open) Data, ensures interoperability and accessibility of data for building energy management processes [127].

Performance estimation aspects such as indicators and methods for assessing life cycles, design solutions & processes, as well as simulation, are significantly in focus. Often augmented reality is utilised e.g. for quality checking [111], 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 holistic 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].

Integrated 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 specialised domains e.g. construction [111, 115].

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

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. in smart cities [101, 6, 8], for urban planning [8], for energy production [37], etc., in order to enable informed decision making.

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[31] e-balance
[32] ECODISTR-ICT
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[61] ICT4E2B FORUM
[62] IDEAS
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[88] READY4SmartCities
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[95] SEAM4US
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[97] SEEMPUBS
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[127] SWIMing
[107] UMBRELLA
[108] URB-Grade

Technology Readiness Level for this cluster

User empowerment is also targeted via visualisation of energy use, real-time pricing, social media and gamification, training, labelling, etc., all of which aim to have users take an informed decision and adjust their behavioural patterns [6, 8, 25, 27, 37].

Energy Management and Trading: Plug and play modular solutions for generation, storage and consumption systems are garnering interest. These include 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 [115], service-oriented architectures and resulting platforms, gateways, middlewares and cloud solutions [115, 108]. This enables interoperable integration of disparate systems and therefore engagement of communities [62].

Energy 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] doing monitoring, simulation and analysis [67], often on near real-time data [67, 80]. Concrete results are not limited only to buildings or traditional grid systems but include also underground transportation systems [95].

Integration technologies: ICT integration technologies are at 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 and tools are developed. These range from integration of existing solutions with new ones [115, 31, 78], new platforms [108, 95], 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 [115].

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 [111], 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 organisations and factories as well as multi-purpose buildings. Such actions are supported by augmented reality [111], 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 stakeholders 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 city solutions [61, 66, 88, 92].

BIM/ Data/ Interoperability

The energy used for the extraction, processing, transport and disposal of building materials, on construction sites and for deconstruction and the energy consumed during the building's operation represent 40% of the European energy consumption and generate 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. This effectively contributes to increased collaboration, efficiency (materials, costs, time) and project quality. By making virtual reality simulations possible, BIM emphasises 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.

The true benefits of BIM are obtained when the technology is applied throughout the project life cycle, from design to demolition [127, 119, 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 tools 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 life cycle 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 [127].

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 etc.) supports the generation of more reliable results, avoiding errors and incoherencies, saving time and effort, and minimising 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 projects underway that are addressing the energy efficiency of buildings and infrastructures through the use of ICT and novel BIM approaches [14, 119, 57, 60, 125, 103].

It must also be emphasised 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 provides tools for interlinking

[14] CASCADE
[22] COOPERATE
[119] EEbers
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[57] HESMOS
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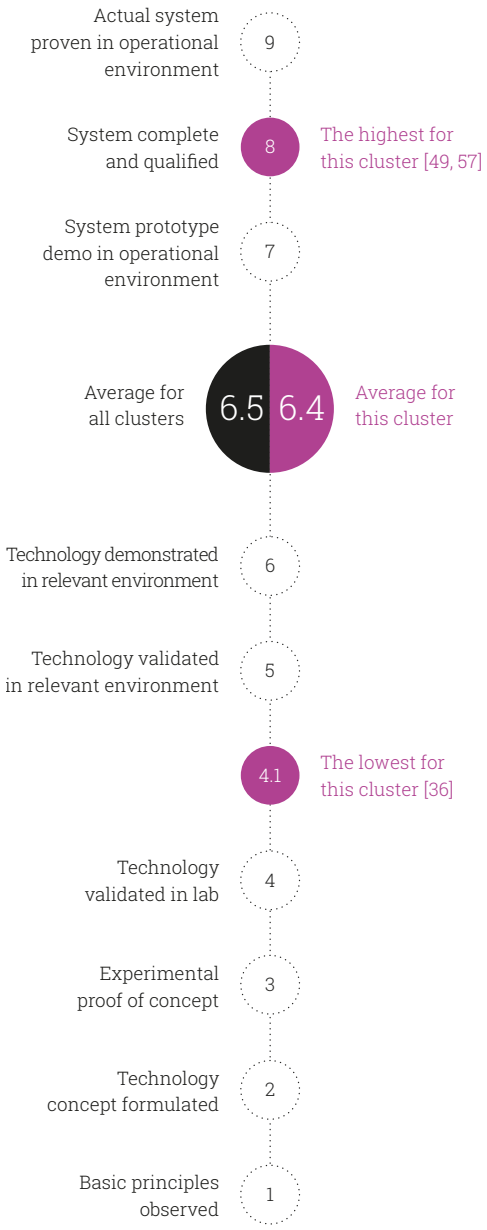
[63] INDICATE
[125] MORE-CONNECT
[85] PROFICIENT
[103] STREAMER
[127] SWIMing

Technology Readiness Level for this cluster



data with the wider web of data through the use of Linked (Open) Data [127], thus enabling new and novel energy management processes to be developed. These approaches can also support each stakeholder in the 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 visualisation, 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 such 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 be embedded into a broader context and aligned with other standards [127].

Although many of the projects emphasise the adoption of BIM as a collaboration framework among stakeholders in design, construction and maintenance processes, some also address the integration of BIM in online building and district energy management systems [14, 22, 36, 57].

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].

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.

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 standardised processes and standardised taxonomies, i.e. standardised collections of terms organised into hierarchical structures that support information management and communication. However, there are currently projects that tackle this issue [127, 85].

To achieve higher levels of sustainability and efficiency, we now must look upon new technologies and methodologies that will make our jobs and lives 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 fields (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
BUILDSMART
CAMPUS21
CASCADE
CETIEB
CITYFIED
ENBUS
ENE-HVAC
ENERGY IN TIME
ENRIMA
EPIC-HUB
EU-GUGLE
FASUDIR
FC-DISTRICT
FOAM-BUILD
GE2O
H2SusBuild
HARWIN
HEAT4U
HERB
HESMOS
H-HOUSE
PROFICIENT
R2CITIES
READY
READY4SmartCities
RESILIENT
RESSEEPE
RETROKIT
REVISITE
S4ECoB
SCHOOL OF THE FUTURE
SEAM4US
SEEDS
SEEMPUBS
SESBE
SINFONIA
SMARTBLIND

2011

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2012

CITYOPT
CITY-ZEN
Clear-Up
COMMONENERGY
COOL-COVERINGS
COOPERATE
CoSSMic
COST-EFFECTIVE
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DESIGN4ENERGY
DIMMER
DIRECTION
E2REBUILD
EASEE

2013

e-balance
ECODISTR-ICT
ECO-SEE
ECOSHOPPING
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EEEMBEDDED
EEPOS
EE-WISE
EFFESUS
E-HUB
EINSTEIN
ELISSA
HIPIN
HOLISTEEC
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
SMARTKYE
SPORTE2
STREAMER
SUS-CON
TIBUCON
TRIBUTE
UMBRELLA
URB-Grade
WINSMART
ZENN

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

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3ENCULT [1]

Efficient energy for EU cultural heritage

3ENCULT demonstrated that energy retrofit is achievable in historic buildings whilst 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, and 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.

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 is exploited using a support guide toolkit and training across Europe.

	September 2013
	48 months
	In progress
	10.4 M€
	www.a2pbeer.eu
	Tecnalia, Spain
	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, EKO DENGE, MoNE-Cankaya.

ADAPTIWALL [3]

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

ADAPTIWALL develops a climate-adaptive façade panel aiming at over 50% energy reduction with respect 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%,
- an adaptive insulation component.

	September 2013
	48 months
	In progress
	5 M€
	www.adaptiwall.eu
	TNO, The Netherlands
	Belgium: Isodal, Sioen. **France**: CEA, Prochimir. **The Netherlands**: Adviesbureau Snijders. **Poland**: Prefasada. **Spain**: Acciona.

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AEROCOINs [4]

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

AEROCOINs has successfully created a new strategy for the preparation of mechanically reinforced aerogel based thermally super-insulating materials and also a prototype for a novel building component. The 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.

AMBASSADOR [5]

Autonomous management System Developed for Building and District Levels

AMBASSADOR's goal is to study, develop and demonstrate systems and tools that will 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.

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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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 large-scale replication. The project identified and implemented cost-effective ´solution packages´ and delivered approximately 75% heating demand reduction in over 340 dwellings located 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.

BESOS [8]
aInnovative open and trustworthy platform for smart cities

BESOS provides an advanced, 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
	In progress
	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.

BIOBUILD [9]
High-performance, economical and sustainable bio composite building materials

BioBuild produced biocomposite building components. Using flax fibres 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.

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BRICKER [10]

Total renovation strategies for energy reduction in public building stock

BRICKER delivers and demonstrates highly replicable innovative retrofitting solutions in public buildings in Belgium, Spain and Turkey. It integrates envelope retrofitting solutions with 0-emission energy production technologies, enabling optimal retrofitting implementation while considering financial constraints, building know-how, innovative business models and continuous operation strategies.

Start date	October 2013
Duration	48 months
Status	In progress
Total budget	12.8 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.

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 materials and building fields, and architects fostering the adoption into real cases.

	July 2013
	48 months
	In progress
	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.

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 will be analysed for the entire energy system.

	December 2011
	45 months
	Finished
	8.6 M€
	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

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.

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 corrective action.
The solution has been tested in two European airports and can reduce energy consumption and costs of the heating, ventilation and air conditioning systems operation.

	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.

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 low-cost infrared vision system to monitor comfort parameters (MRT, PMV), an air biofilter to remove VOC, and a fully mineral thermal insulation plaster which is market ready in 2016.

	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.

CITyFiED [16]

Replicable and innovative future efficient districts and cities

CITyFiED aims to deliver a replicable and integrated strategy to transform European cities into smart cities, focusing on reducing the building energy demand and increasing the use of renewable energy sources. An extensive demonstration action is being carried out in Spain, Turkey and Sweden, involving the retrofitting of 221,158 m^2 of living space and 2,213 dwellings in a variety of locations.

Start date	April 2014
Duration	60 months
Status	In progress
Total budget	48.6 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, Dalkia Energía y Servicios 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.

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. A planning tool is developed to optimise energy systems in Vienna and Helsinki, and an operational tool sends demand-response notifications to households in Nice during energy peaks. CITYOPT targets up to 25% energy demand reduction through optimised urban planning and increased energy awareness.

	February 2014
	36 months
	In progress
	3.9 M€
	www.cityopt.eu
	VTT Technical Research Centre, Finland
	Austria: AIT Austrian Institute of Technology GmbH. **Finland**: Helen. **France**: Centre Scientifique et Technique de Batiment, Electricite de France SA, Metropole Nice Cote d'Azur. **Italy**: Experientia Srl.

City-zen [18]

City-zen builds a methodology and tools for smart, sustainable and future proof cities, saving 59,000 tonnes of CO2/year in Amsterdam and Grenoble

City-zen aims to share urban energy transition solutions via roadshows, serious games and decision-making workshops. 22 innovations are demonstrated, such as retrofit of buildings, smart grids with local storage in homes and cars, use of water supply infrastructure and rivers to cool buildings, smart tools and dashboards, and renewable energy integrated into district heating networks.

	March 2014
	60 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.

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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.

CommONEnergy [20]

Re-conceptualise shopping malls from consumerism to energy conservation

CommONEnergy aims at defining technologies and methods for shopping mall retrofits. Optimal combination of solutions and relative control strategies were developed thanks to an integrated modelling environment. The actual performances are ensured through an intelligent building management system. Identified solution-sets allow energy savings, high comfort, sustainability, and short pay-back times.

Start date	October 2013
Duration	48 months
Status	In progress
Total budget	13.9 M€
Website	**www.commonenergyproject.eu**
Coordinator	EURAC, Italy
Partners	**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.

COOL-Coverings [21]

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

COOL-Coverings aims to develop a novel cost-effective range of insulation materials to improve the energy efficiency of the building envelope for retrofits and new constructions. It will develop 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.

Start date	June 2010
Duration	36 months
Status	Finished
Total budget	4.3 M€
Website	**www.coolcoverings.org**
Coordinator	Keraben Grupo SA, Spain
Partners	**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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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.

CoSSMic [23]

Collaborating smart solar powered microgrids

CoSSMic develops and demonstrates an innovative, autonomic ICT system coordinating energy usage and storage 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, weather forecasts, and price signals from the public grid.

	October 2013
	36 months
	In progress
	4.2 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.

Cost-Effective [24]

Resource- and cost-effective integration of renewables in existing high-rise buildings

With a focus on high-rise buildings, the Cost-Effective 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 demanding 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.

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DAREED [25]

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

DAREED will create 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.

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's expected to reduce cost and improve by at least 20% the energy efficiency compared with traditional methods. A Design4Energy portal together with an energy enhanced database, DST and guidelines will be available.

	October 2013
	48 months
	In progress
	6.49 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.

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
	In progress
	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.

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DIRECTION [28]

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

DIRECTION 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.

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 25,000m^2 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.

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.

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	42 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.

ECODISTR-ICT [32]

Integrated decision support tool for retrofit and renewal towards sustainable districts

ECODISTR-ICT develops 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.

	December 2013
	36 months
	In progress
	4.1 M€
	www.ecodistr-ict.eu
	VITO, Belgium
	Belgium: Omgeving CVBA.
	France: CSTB, Sigma Orionis SA.
	The Netherlands: Arup bv, TNO, VABI.
	Spain: Bipolaire Arquitectos SLP.
	Sweden: SP, StruSoft, White Arkitekter Aktiebolag.

ECO-SEE [33]

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

The ECO-SEE project aims to develop new eco-materials and components for the purpose of creating both healthier and more energy efficient buildings. It will create and symbiotically use 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.

	September 2013
	48 months
	In progress
	9.3 M€
	www.eco-see.eu
	University of Bath, UK
	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.

EcoShopping [34]

Achieving high efficiency by deep retrofitting in case of commercial buildings

EcoShopping is developing 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 will result in significant energy savings. The results are completed with a guide and business plan for shopping buildings.

Start date	September 2013
Duration	24 months
Status	Finished
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.

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.

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.

EEPOS [37]

Energy management and decision support systems for energy positive neighbourhoods

The project increased energy efficiency through neighbourhood management.
The project 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.

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.

ee-WiSE [38]

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

ee-WiSE developed a Knowledge Transfer Framework (KTF) tool that promotes Energy Efficiency (EE) knowledge sharing amongst agents of the building retrofitting sector. The platform provides specific suggestions for 20 different agent profiles that share & search EE material classified in topics. The KTF 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.

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
	In progress
	6.7 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.

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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.

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. STES guidelines, training courses and two DST 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.

ELISSA [42]

Energy efficient lightweight sustainable safe steel construction

ELISSA has developed a modular prefabricated lightweight cold formed steel skeleton / drywall system which can be flexibly interconnected. Innovations include: a) Vacuum Insulation Panels with very high insulation values and small panel thicknesses. b) Active damping devices to mitigate the structural response under seismic action. c) intumescent paint coatings to protect steel in case of fire.

	September 2013
	36 months
	In progress
	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.

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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 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.

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.

EiT [45]
Energy in time

EiT is developing a monitoring system for energy efficiency in the operation and maintenance of buildings, reducing the energy bill in operational phases. The project is based on simulation and control techniques, based on models capable of representing the construction complexity of buildings. EiT will be validated in 4 buildings of different typology located in different European climates.

	October 2013
	48 months
	In progress
	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.

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	3.49 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.

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
	In progress
	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.

EU-GUGLE [48]

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

As part of EU-GUGLE, nearly 226,000m² 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 2018. With support 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
	30.1 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). **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.

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FASUDIR [49]

Friendly and affordable sustainable urban districts retrofitting

FASUDIR develops an Integrated Decision Support Tool (IDST) that will help 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	In progress
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.

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.

	September 2010
	48 months
	Finished
	11.8 M€
	www.fc-district.eu
	Mostostal Warszawa SA, Poland
	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.

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 in climate chambers. Innovations include the creation of a wide range of cell sizes in the particle foams and it was possible to lower the cell size of PS foams with low density. Different halogen-free flame retardants have been tested successfully.

	September 2013
	48 months
	In progress
	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.

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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 trans-national 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.

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 600m^2 office building was accomplished.
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.

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.

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

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
	In progress
	8.6 M€
	www.euroretrofit.com
	University of Nottingham, United Kingdom
Partners	**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.

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
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**: ELKEM AS, Norner Research AS. **Spain**: Ateknea Solutions Catalonia S.A. **UK**: Smithers Rapra and Smithers Pira Limited.

H-HOUSE [58]

Healthier life with eco-innovative components for housing constructions

H-HOUSE develops multifunctional and flexible components for the building envelope and internal walls based on cementitious materials, earthen plasters and bio-composites. The aim is 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	In progress
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.

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.

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 life-cycle, the influence of neighbourhoods and energy efficiency. Main results will be to design, develop, and demonstrate a BIM-based, cloud-based, collaborative building design software platform, with advanced design support for multi-criteria optimization.

	October 2013
	48 months
	In progress
	6.5 M€
	www.holisteecproject.eu
	D'Appolonia, Italy
	Finland: Senaatti-Kiinteistöt, Teknologian Tutkimuskeskus VTT. **France**: Centre Scientifique et Technique Du Batiment, Commisariat 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.

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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.

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.

INDICATE [63]

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

INDICATE provides: 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
	In progress
	2.9 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.

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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 easily-adopted renovation kits facilitating the fast implementation of the renovation measures.

Start date	October 2012
Duration	48 months
Status	In progress
Total budget	7.49 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.

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.

	October 2011
	36 months
	Finished
	3.3 M€
	www.intasense.eu
	C-Tech Innovation Ltd, UK
	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.

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.

	September 2011
	27 months
	Finished
	1 M€
	www.ireenproject.eu
	Manchester City Council, UK
	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.

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 disparate 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.

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 by-products. 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, 20% in λ and 60% in embodied energy compared to commercial products.

	January 2012
	48 months
	Finished
	8.1 M€
	S&B Industrial Minerals SA, Greece **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.

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 which are being manufactured for retrofitting in Mérida (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).

	January 2012
	48 months
	Finished
	9.9 M€
	www.meefs-retrofitting.eu
	ACCIONA Infraestructuras, Spain **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.

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	In progress
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.

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.

MF-Retrofit [72]

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

By incorporating innovative nanotechnologies and nanomaterials, a panel with functional improvements is sought, regarding weight, thickness, installation time, thermal insulation, fire protection, photocatalytic activity, etc.
The panel layers are nearing completion and in 2016, a prototype assembled panel will be manufactured and field trials will be conducted to certify its multi-functionality.

	September 2013
	42 months
	In progress
	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.

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 combined with conventional HVAC systems, in which the absorber and regenerator are internally cooled and heated, especially important for air conditioning in tropical and sub-tropical countries. A prototype of the nanoCOOL system will be built, tested and refined, and then run in real conditions in Taiwan.

Start date	September 2012
Duration	42 months
Status	In progress
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.

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.

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 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.

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.

NEED4B [77]

New energy efficient demonstration for buildings

NEED4B constructed 4 demo sites in Belgium, Italy, Sweden, and Turkey. Each building integrates a combination of cost-effective solutions and technologies, selected during the design phase by applying BIM, IPD, LCA/LCC and energy simulation tools.
Monitoring results after a 1.5 year period reveal an average energy consumption below 50 kWh/m^2 year (primary energy) in 2 pilots.

	February 2012
	72 months
	In progress
	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.

NewBEE [78]

Novel business model generator for energy efficiency in construction and retrofitting

NewBEE has 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.

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 zero-carbon/energy or better. All demonstrators are almost complete (total about 50,000 m^2) and monitoring activities are starting up. In the field of technological developments, transmission controllable glazing and dual function photovoltaics have been produced.

Start date	January 2012
Duration	72 months
Status	In progress
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.

NRG4Cast [80]

Energy forecasting

NRG4Cast has 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 will be further exploited by a company NRG4CAST Ltd.

	December 2013
	36 months
	In progress
	3.7 M€
	www.nrg4cast.org
	Institut Jozef Stefan (JSI), Slovenia
	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.

ODYSSEUS [81]

Open dynamic system for saving energy in urban spaces

(ODYS) enabling 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.

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

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-level energy actions. Potential for increased uptake of community generated electricity (ranging from 3% to 33%) was shown in the 3 communities.

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.

OSIRYS [83]

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

OSIRYS develops a holistic solution for façades and interior partitions for retrofitting and new buildings to improve indoor air quality by VOC and microorganism elimination, and increase thermal insulation. Research activities encompass new low-embodied energy materials, aesthetic aspects, LCA and cost evaluation, compliance with the Building Code and consideration of different climates.

Start date	June 2013
Duration	48 months
Status	In progress
Total budget	9.1 M€
Website	**www.osirysproject.eu**
Coordinator	Fundación Tecnalia Research & Innovation, Spain
Partners	**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.

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.

Start date	September 2013
Duration	48 months
Status	In progress
Total budget	5.7 M€
Website	**www.performer-project.eu**
Coordinator	UPL, UK
Partners	**France**: CEA, CSTB, GDF Suez, Saint Gobain Recherche, Sigma Orionis. **Poland**: ASM, Sea Developments. **Spain**: Animua, Dragados Euroconsult. **UK**: BRE, Cardiff University, City of Cardiff Council.

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	In progress
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.

Proficient

R2CITIES [86]

Renovation of residential urban spaces: towards nearly zero energy cities

R2CITIES methodology, based on IPD, BIM and a set of the so-called district sustainability indicators aims to develop an open and easily replicable strategy for designing, constructing, and managing large scale residential district renovation projects. Valladolid, Genova and Kartal-Istanbul are renovating 57,000m^2 using this framework towards the nearly zero energy district approach.

	July 2013
	48 months
	In progress
	14.8 M€
	www.r2cities.eu
	Fundación CARTIF, Spain.
	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.

R2CITIES
Residential Renovation towards nearly zero energy CITIES

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.

	December 2014
	60 months
	In progress
	1.7 M€
	www.smartcity-ready.eu
	COWI, Denmark
	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, IKEA of Sweden, Linneaus University, VEAB, Växjö Energy, Växjöbostäder, Växjö Municipality, Växjö Fastighetsforvaltning, Wexnet.

READY

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	1.3 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.

RESILIENT [89]

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

RESILIENT developed an open energetic ecosystem, based on the innovative integrated combination of the microgrid and energy hub concepts applied at district level.
Decision making in the operation of distributed energy, resources operation, power levelling, as well as energy storage and priority of different loads are the main achievements of the project, demonstrated in three real full size demos.

Start date	September 2012
Duration	48 months
Status	In progress
Total budget	8.1 M€
Website	**www.resilient-project.eu**
Coordinator	D'Appolonia SpA, Italy
Partners	**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.

RESSEEPE [90]

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

RESSEEPE developed a retrofit planner tool to support decision makers in identifying the best energy efficiency retrofitting solutions at building level and extrapolate the results to similar buildings in the same district.
Monitoring systems have been installed to record pre-retrofit energy consumption, which will be used to validate the retrofitting actions currently underway in the demo sites.

Start date	July 2013
Duration	48 months
Status	In progress
Total budget	8.8 M€
Website	**www.resseepe-project.eu**
Coordinator	Exergy, UK and IES, UK.
Partners	**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**: Ascamm, Consorci Sanitaride Terrassa, Corporacio Sanitaria Parc Taulí, Fundacio Privada Centre CIM, Incurvo, Leitat, OHL, Onexit, Tecnalia, Universitat Politecicade Cataluna. **Sweden**: City of Skellefteå. **Switzerland**: EMPA. **UK**: Coventry University, PCM Products.

RetroKit [91]

RetroKit - Toolboxes for systemic retrofitting

RetroKit develops and integrates prefabricated technologies for systemic retrofitting of multi-family residential buildings, to reduce energy consumption. Proof of concept of the achievement is demonstrated in Frankfurt and Madrid. A third demo in Pitea (SW) is under development. 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	In progress
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.

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.

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.

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	In progress
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.

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.

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 self-leaning techniques. The modelling methodology is based on BIM. Wireless techniques are used for monitoring and control.

	September 2011
	42 months
	Finished
	4 M€
	www.seeds-fp7.eu
	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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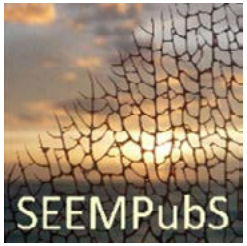
SEEMPubS [97]
Smart energy efficient middleware for public spaces

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.



SESBE [98]
Smart elements for sustainable building envelopes

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

	August 2013
	42 months
	In progress
	4.9 M€
	www.sesbe.eu
	CBI Betonginstitutet AB, Sweden **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

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. Moreover, the project aims to validate a refurbished city district model where the potential for scalability and replication by middle-sized European cities is built and validated during demonstration. This model will be reviewed and reinforced by 5 early adopting cities throughout Europe.

	June 2014
	60 months
	In progress
	43 M€
	www.sinfonia-smartcities.eu
	SP Technical Research Institute of Sweden, Sweden **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, CNEES, 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

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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.

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.

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.

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.

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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.

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 pre-casted applications (blocks and panels).

	January 2012
	48 months
	Finished
	7.16 M€
	www.sus-con.eu
	Consorzio 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.

TIBUCON [105]

Self powered wireless sensor network for hvac system energy improvement

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.

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 real-time 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.

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.

URB-Grade [108]

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

URB-Grade develops 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	4.2 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.

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WINSMART [109]

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

The smart technology has made good progress and shows potential for reducing cost. The first working VIG prototype has been developed with further optimisation scheduled. The first window prototype will be ready for testing in the second quarter of 2016. Widespread adoption of the new technology will have a tremendous impact on the energy efficiency of buildings and on climate change.

Start date	October 2012
Duration	48 months
Status	In progress
Total budget	5.36 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.

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
	In progress
	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.

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H2020

2014

ACCEPT
AMANAC
BERTIM
BRESAER
Built2SPEC
E2VENT
ECO-Binder
EeB-CA2
EEBERS
HOMESKIN
IMPRESS
Insiter
ISOBIO
LaWin
MORE-CONNECT
RIBuild
SWIMing

*
Projects funded under the 2014 calls for proposals

ACCEPT [111]

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.

Start date	January 2015
Duration	36 Months
Status	In progress
Total budget	4.46 M€
Website	**www.accept-project.com**
Coordinator	Ascora GmbH, Germany
Partners	**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.

AMANAC [112]

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
	In progress
	0.4 M€
	www.amanac.eu
	NTUA, Greece
	Germany: Fraunhofer, Universität Bayreuth. **Italy**: CETMA. **Poland**: FASADA. **Spain**: TECNALIA. **Sweden**: CBI Betonginstitutet AB. **UK**: UBAH, TWI Limited.

BERTIM [113]

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.

	June 2015
	48 months
	In progress
	4.9 M€
	www.bertim.eu
	Tecnalia, Spain
	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.

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BRESAER [114]

Breakthrough solutions for adaptable envelopes for building refurbishment

BRESAER is putting forward ground-breaking solutions to be adopted by the existing building stock throughout Europe and beyond with the aim to get near zero energy buildings by the transformation of the building envelope into an active element rather than passive, enabling it to adapt to a dynamic environment and to building occupants' requirements during its lifetime.

Start date	February 2015
Duration	54 months
Status	In progress
Total budget	5.8 M€
Website	**www.bresaer.eu**
Coordinator	Acciona, Spain
Partners	**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.

BUILT2SPEC [115]

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

BUILT2SPEC will help reduce the "energy performance gap" 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 connected to a virtual construction management platform supporting the collection and sharing of all project data, from initial design to delivery.

	January 2015
	48 months
	In progress
	5.9 M€
	www.built2spec-project.eu
	Nobatek, France
	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.

E2VENT [116]

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

The E2VENT team is developing a prefabricated module for the refurbishment of residential buildings. Adding to the classical insulation layer, the module integrates optimised anchorages, an air renewal system with a heat exchanger to ensure air quality while limiting the energy losses, and a PCM based thermal storage for peak shavings. The BMS allows optimal piloting and adaptability.

	January 2015
	42 months
	In progress
	3.4 M€
	www.e2vent.eu
	Nobatek, France
	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.

ECO-Binder [117]

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

ECO-binder is demonstrating that Ordinary Portland Cement can be replaced with new Belite-Ye'elimite-Ferrite (BYF) class of low-CO^2 binders, without compromising on quality or cost. The project develops a new generation of concrete-based pre-cast building envelope components with more than 30% lower embodied energy, 20% improved insulation properties and 15% lower cost than the current solutions.

Start date	January 2015
Duration	48 months
Status	In progress
Total budget	7.6 M€
Website	**www.ecobinder-project.eu**
Coordinator	D'Appolonia, Italy
Partners	**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.

EEB-CA2 [118]

Energy efficient buildings cluster activities coordination action

EeB-CA2 is a coordination and support action which aims at increasing awareness of EeB PPP projects activities. It provides a set of technology and geo-clustering instruments as well as services for integrated dissemination and technology transfer in order to speed up industrial exploitation and take up of the results of EeB PPP projects.

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

EEBERS [119]

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. Connecting innovation stakeholders with R&D results within the construction, energy and ICT sectors is the main project task for speeding up wide-scale deployment of solutions and services for EeB.

	February 2015
	24 months
	In progress
	0.5 M€
	www. eebers.eu
	Teknologian tutkimuskeskus VTT Oy, Finland
	Germany: Fraunhofer Gesellschaft Zur Forderung Der Angewandten Forschung Ev.
	Spain: Solintel M&P Sl.
	UK: Loughborough University.

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HOMESKIN [120]

Homes key insulating material

The HOMESKIN project aims to commercialise new advanced aerogel-based-composite insulation solutions. The 4 industrial partners involved in the project will scale up the production of this new highly efficient insulation system. Used internally, externally and for roof application, systems are 50% more insulant, enabling a 30% reduction in the building's energy consumption and CO2 emissions.

Start date	February 2015
Duration	36 months
Status	In progress
Total budget	6.3 M€
Website	**www.homeskin.net**
Coordinator	Enersens, France
Partners	**Germany**: University of Stuttgart. **France**: ARMINES, CEA, Parex. **Italy**: FLAG, Trocellen. Luxembourg: Kurt Salmon. **Spain**: ITeC. **Switzerland**: SORANE.

IMPRESS [121]

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 will be developed, incorporating all stages of the Design-Construct-Install-Operate process, integrated with a cloud based BIM database.
A decision support software tool will help the end user choose the most suitable renovation option.

	June 2015
	42 months
	In progress
	4.6 M€
	www.project-impress.eu
	Integrated Environmental Solutions, 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.

INSITER [122]

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; eliminating the gaps in quality and energy-performance between the design and realisation of energy-efficient buildings made of prefabricated components.

	December 2014
	48 months
	In progress
	6 M€
	www.insiter-project.eu
	DEMO Consultants, Netherlands
	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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ISOBIO [123]

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.

LAWIN [124]

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
	In progress
	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.

MORE-CONNECT [125]

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.

RIBuild [126]

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. RIBuild focuses on robust solutions, i.e. 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.

Start date	January 2015
Duration	60 months
Status	In progress
Total budget	5 M€
Website	**www.ribuild.eu**
Coordinator	Aalborg University, Denmark
Partners	**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.

SWIMing [127]

Semantic web for information modelling in energy efficient buildings

SWIMing is working with EeB projects to identify shared data requirements, promote data harmonisation for improved interoperability, and identify where linked open data technologies can be utilised to make data more accessible and hence easier to exploit. SWIMing has identified over 46 use cases across 33 projects which can benefit from this harmonisation process of their varying data domains.

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

Credits

EeB-CA2 is a Coordination and Support Action which aims at increasing awareness of EeB PPP projects activities. It provides a set of technology- and geo-clustering instruments as well as services for integrated dissemination and technology transfer in order to spped up industrial exploitation of the results of EeB PPP projects.

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AMANAC is a collaboration and coordination platform across all the Advanced Materials and Nanotechnology projects, approved in the frame of the EeB-PPP, whose activities address development of (nano)materials, components and systems for the improvement of the energy efficiency in the built environment.

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The EE ICT clusters (EEbers) mission is to identify opportunities for synergies in ICT related RTD in the EeB domain. The aim is to effectively engage stakeholders in networking for future RTD and exploitation of results. The cluster activities will involve EeB projects, or projects' activities, that address ICT solutions for EE buildings as one of their key priorities. The ICT clusters will connect relevant innovation stakeholders through R&D results and with the EU, national and regional initiatives within the construction, energy and ICT sectors. The target is to impact on speeding up technology readniess and wide-scale deployment of solutions and services for building energy-efficiency.

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The SWIMing project will support EeB projects to enhance the impact of their results by making their data models open and accessible. It will develop a data modelling cluster where projects can share their use cases, data modelling requirements and get access to expertise in the area of open data models. The cluster will be structured by stages of the building life cycle (BLC), the projects results are applied, its particular domain and the differing data requirements. By making project outcomes open and accessible to multiple stakeholders across the BLC, SWIMing will impact on the ease and efficiency with which these outcomes will be exploited across BLC energy management processes.

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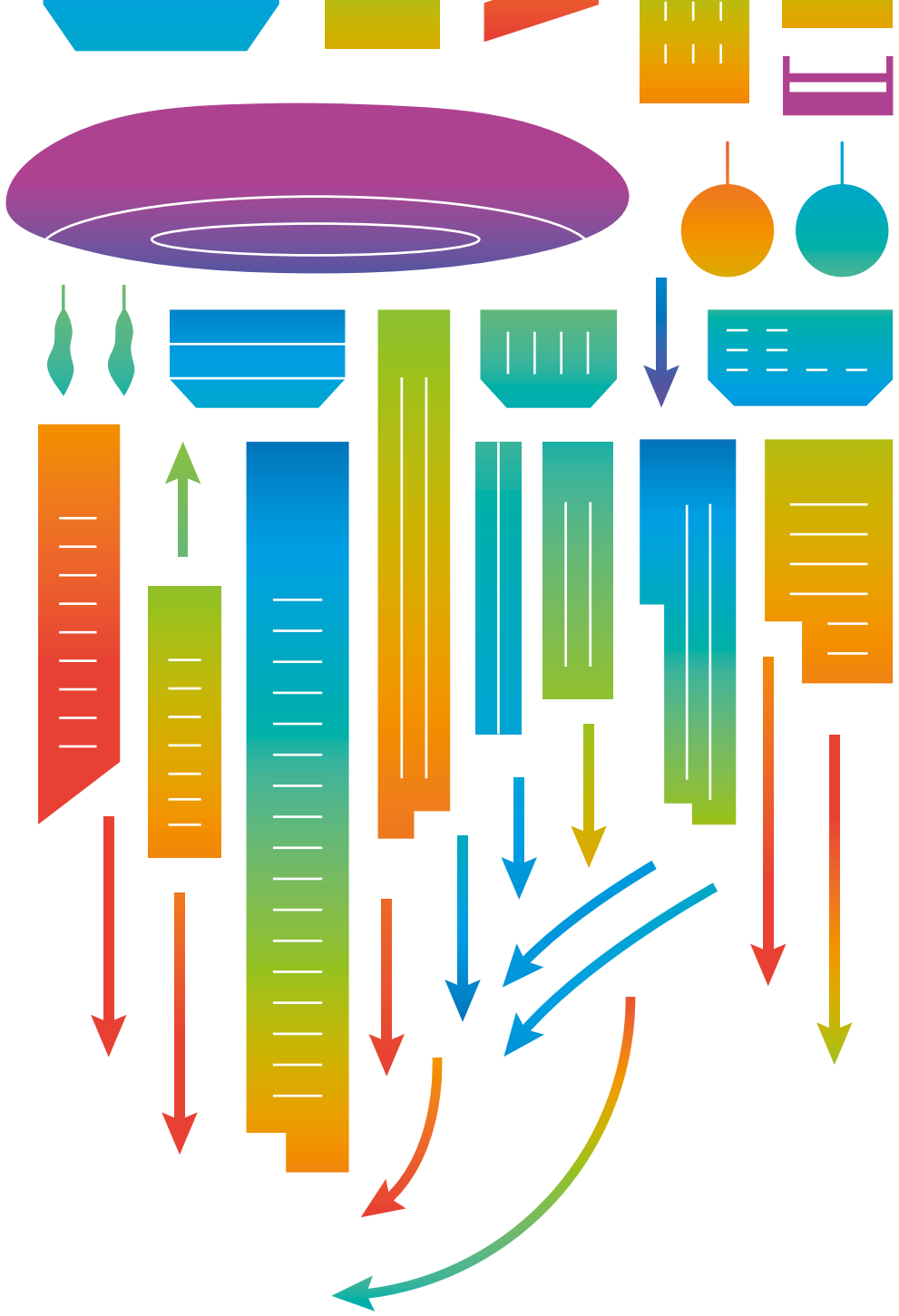

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