



Session 2: ICT for design, monitoring and management of energy-efficient buildings and districts

Area 3: Energy performance monitoring and management of energy efficient buildings

EeB PPP Impact workshop

Brussels, 18-19 April 2016

FP7



Integrated control systems and methodologies to monitor and improve building energy performance

EeB.NMP.2013-4

Development of new self-inspection techniques and quality check methodologies for efficient construction processes

EeB-03-2014

New tools and methodologies to reduce the gap between predicted and actual energy performances at the level of buildings and blocks of buildings

EeB-07-2015

3 PHASES



EeB.NMP.2013-4

Integrated control systems and methodologies to monitor and improve building energy performance

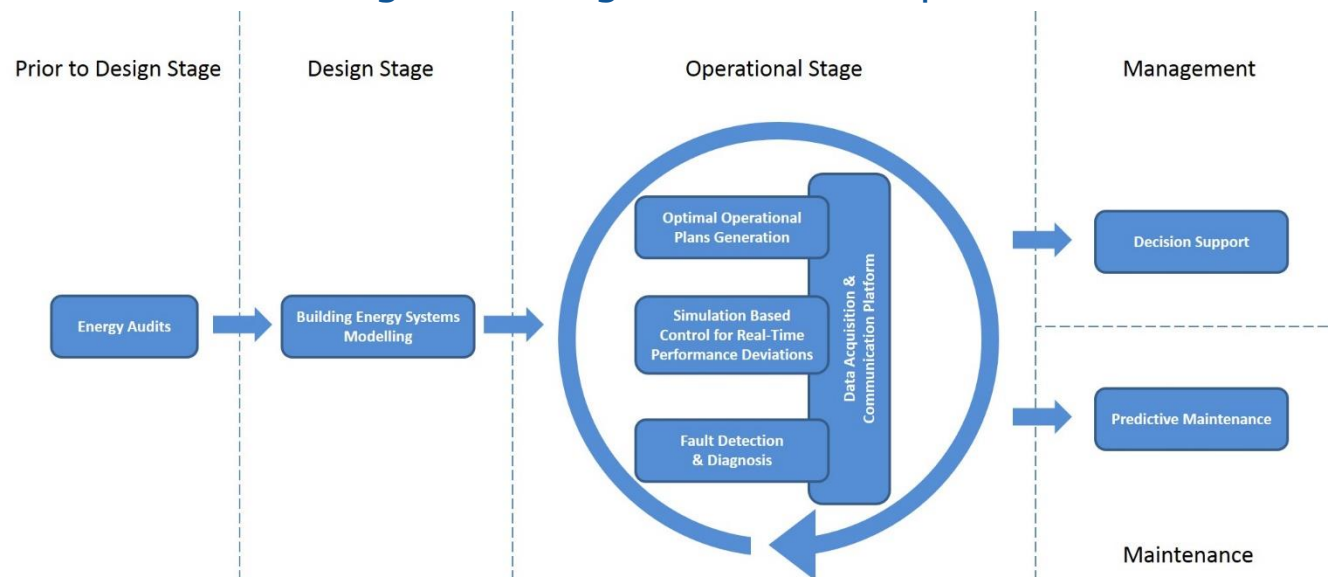
Energy IN TIME	Anna Perehinec anna.perehinec@engie.com
PERFORMER	
TRIBUTE	



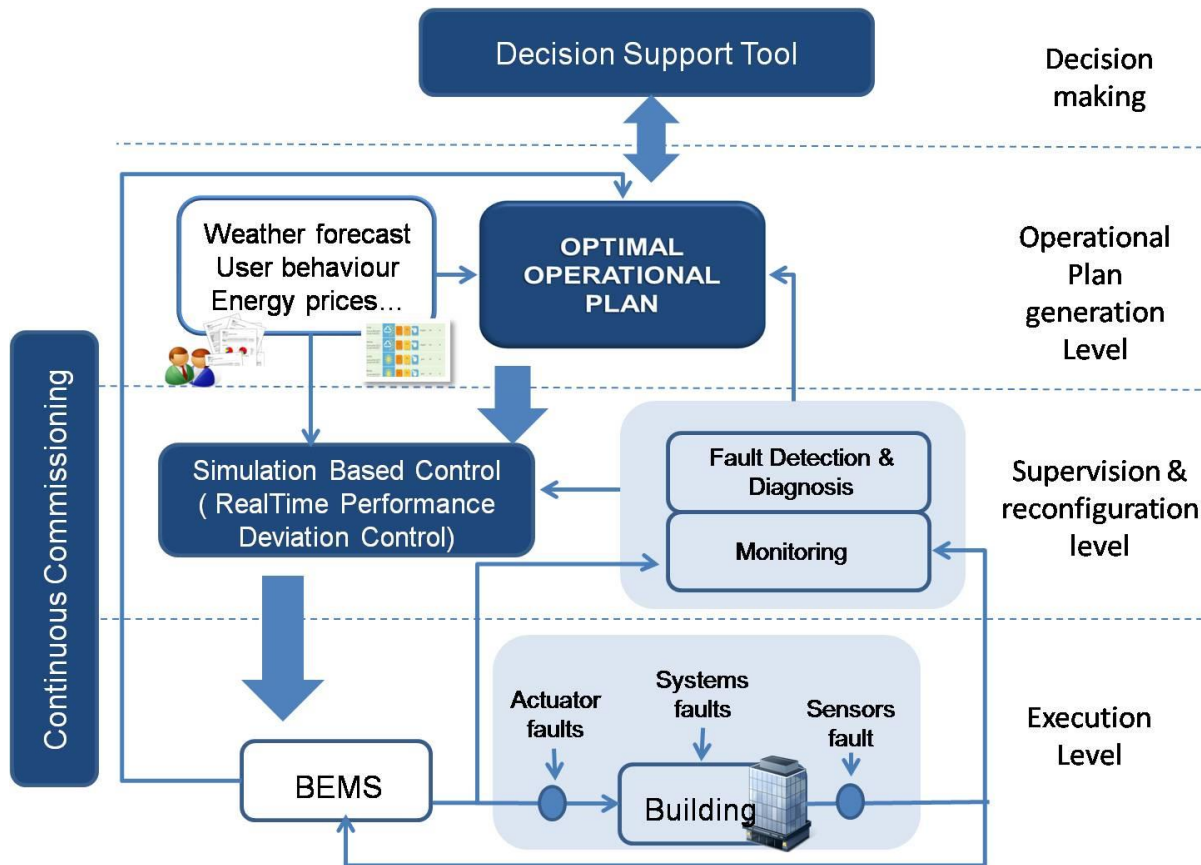
- **ENERGY IN TIME:** Simulation based control for Energy Efficiency operation and maintenance
- **PERFORMER:** Portable, Exhaustive, Reliable, Flexible and Optimized approach to Monitoring and Evaluation of building energy performance
- **TRIBUTE:** Take the energy bill back to the promised building performance

Energy In Time's objectives

EIT will develop a **Smart Energy Simulation Based Control method to reduce the energy consumption in the operational stage** of existing non-residential buildings. New techniques will be developed based on the prediction of indoor comfort conditions and user behaviour performance to improve the Lifetime and Efficiency of Energy Equipment and Installations through **continuous commissioning** and **predictive maintenance**, while centralizing the remote control of different buildings in a single automated process.



EIT's methodology

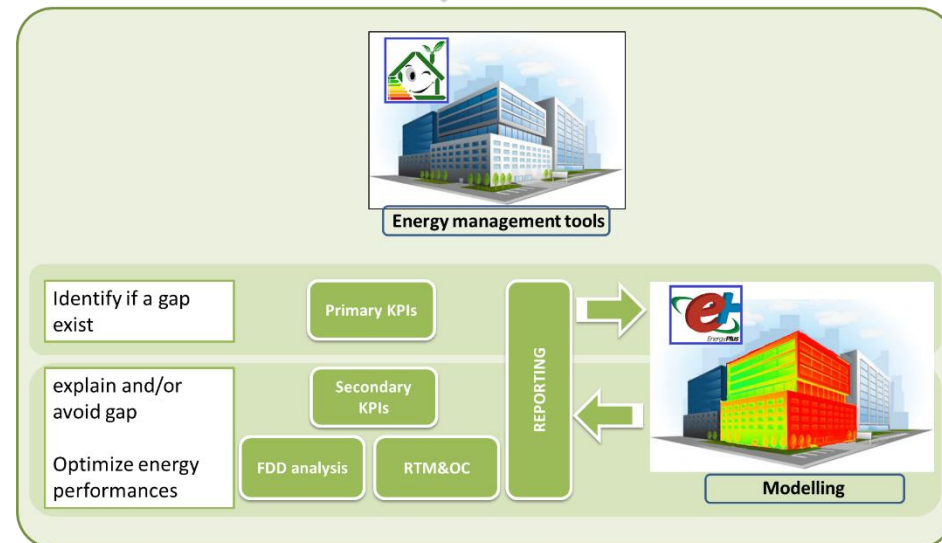
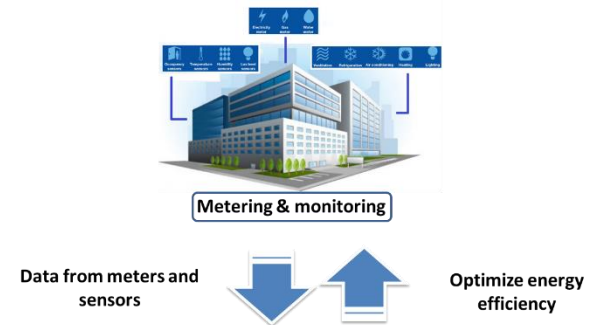
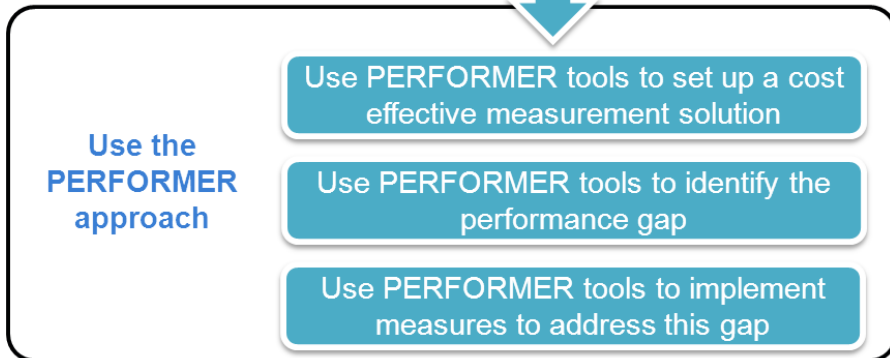
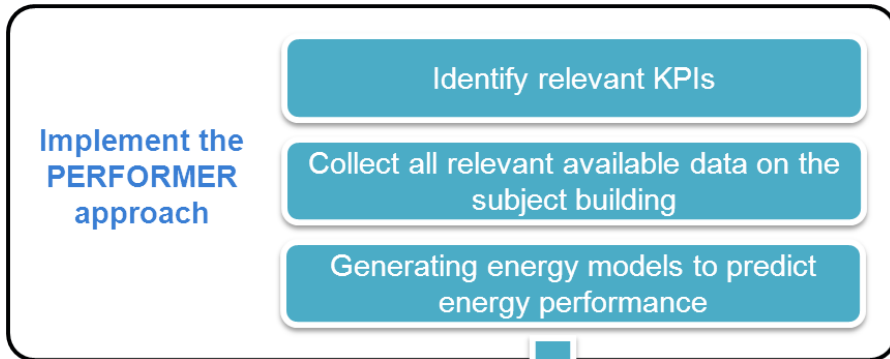


- **Medium-long term decisions support tool:** trend analysis by data mining techniques implemented in a user-friendly tool.
- **Advanced Simulation models:** continuously updated virtual representations of the building behaviour,.
- **Simulation Based Control:** of the building energy performance, selfadaptable to the building-user's actual conditions.
- **Continuous Commissioning:** a new method combining advanced monitoring, fault detection, diagnosis and adaptive tools to detect and implement corrective measures and predictive maintenance strategies.

PERFORMER's objectives

- **PERFORMER is aimed at** : reducing the gap between expected and actual energy performance
- **By** : delivering a comprehensive energy performance assessment framework including a set of assessment methodologies and a suite of ICT tools to monitor energy performance over the whole building's life cycle
- **To eventually** : provide building managers with methods and tools to make more efficient decisions
- **Key expected outcomes include** :
 - ⇒ Energy performance assessment methodology & KPIs
 - ⇒ ICT infrastructure for building energy & occupancy monitoring
 - ⇒ Software tools for energy simulation, performance assessment, energy diagnosis (identifying causes of potential performance gaps / Expert rules + system)
 - ⇒ Secure and high performance solution for data computation and storage

PERFORMER's methodology



TRIBUTE's objectives

- **Building Simulation**

⇒ **Minimization of the gap** between simulated and measured energy performances

- Design simulations don't model real conditions

- Real buildings often don't perform as expected by their designers

⇒ **Utilization of model** to commission , use and aftercare

- **EEMCS (Occupant, HVAC, Building envelope)**

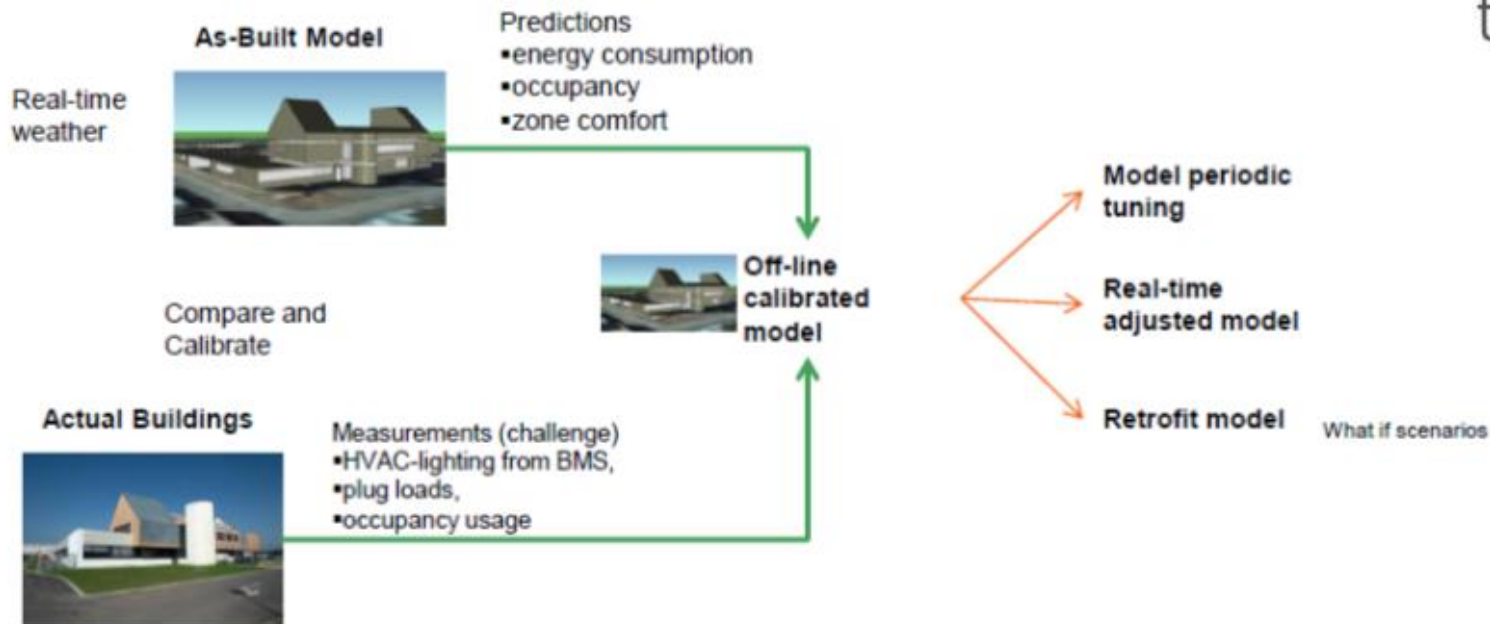
⇒ **Extended Energy Management and Control System** thanks to consideration of occupancy behavior and continuous model-based building monitoring approach

⇒ Development of significantly faster and more precise retrofit decision tool



European
Commission

TRIBUTE's methodology



Need for a **scalable building energy management system** that includes whole building energy diagnostics and visualization

Integrated monitoring and simulation models of building energy use to identify sources of waste and savings potential

Summary of the EeB PPP Impact Workshop 2015 session

- All the participants listed the **scientific & technical objectives** of their projects to identify the potential **impacts** of their work in terms of **technological, environmental, economic and social** activities.
- Technical and non-technical **cross-cutting issues** were therefore defined as well as **synergies** and **benefits of clustering**.
- Among the issues raised during the last Impact Workshop, the participants insisted particularly on :
 - The risk of internal conflicts on **IPR**;
 - The **uniqueness** of the solutions developed within each project;
 - The importance to improve **dissemination activities** and the participation to external workshops, and more particularly to contribute to **existing standards**;
 - The **business model and development**;
 - The necessity to establish a process to bring products **to market** after projects.



How we moved forward

- Most of the projects had their first Review Meeting with the European Commission. It was clearly stated that **dissemination activities had to be improved** and efforts should be made on the clustering aspects.
- The issues raised during the 2015 session and listed beforehand were also flagged out by the Project Officers and Technical Advisors.
- The **second session of the Sustainable Places clustering workshop** was held in Savona in September 2015. Participants attended the workshop on behalf of PERFORMER, TRIBUTE, DIRECTION and EIT projects.
- As a result, **we decided to focus on the main common exploitable results** to develop further synergies and improve the visibility of our activities through communication and dissemination activities.
- Important note : **DIRECTION is no longer part of the clustering group** as it is meant to end before the other projects and has a different strategy focused on demonstration rather than market exploitation.

What we expect to achieve by June 2016

- Following the last SP clustering workshop, participants completed **2 outputs to be reused during the Impact Workshop** :
 - **The full list of their ERs according to 4 areas** :
 1. Data collection and storage
 2. Models and Simulation
 3. Decision Support Tools (including visualization, FDD...)
 4. Consultancy aspects (KPIs for example)
 - **A description of each ER including**
 1. their uniqueness
 2. the marketing and exploitation strategies identified
- Take the opportunity of the Impact Workshop to come up with an **Exploitation Map** to bench our ERs according to 2 main criteria: the **technical maturity** of the solution and its **commercial perspectives**.
- **Create and build up the materials to present the maps at one or two events.**
- Additional : Make a short **commercial video** to present the project and the expected outcome for the market (projects' pitching)

Data Collect & Usage ERs

Project	ER Title
PERFORMER	Critical measurement point identification and sensor gap analysis methodology
PERFORMER	Building data storage system
TRIBUTE	Metering system for buildings
TRIBUTE	Methodology for sensor subsetting
TRIBUTE	Occupancy detection system
EIT	Virtual Auditing App (VAA) / A smart tool to gather data from the building on its systems, the equipment availability and condition, in a very easy and fast way

Models & Simulation ERs

Project	ER Title
PERFORMER	Building information collection standard for energy performance assessment.
PERFORMER	Building intrinsic performances assessment software
PERFORMER	Energy performances monitoring algorithms
PERFORMER	Building system schedule model-based optimisation algorithms
TRIBUTE	Modelling of occupant behaviour
TRIBUTE	Methodology for the collection of existing building information
TRIBUTE	TRIBUTE 3D visualization tool
EIT	Simulation Reference Model / Thermodynamic and energetic building simulation model that accurately reflects the building performance

Decision & Support Tools ERs

Project	ER Title
PERFORMER	Cost optimised sensor selection support tool
PERFORMER	Building energy performance visualisation tool
PERFORMER	Experts rules platform for building energy performance and users' comfort
PERFORMER	HW&SW solution for situation assessment
PERFORMER	Front-end (Dashboard) for visualisation tool
TRIBUTE	Retrofit toolkit
TRIBUTE	TRIBUTE i-BEPS
TRIBUTE	FDD & Monitoring interfaces
TRIBUTE	Methodology for building model calibration
EIT	Predictive Maintenance Application
EIT	Fault Diagnostics HVAC Systems
EIT	Medium and long-term building and equipment decision support system
EIT	Intelligent Operational Plan Generator

Consultancy Services ERs

Project	ER Title
PERFORMER	Building energy KPI library and selection methodology
PERFORMER	Energy Baseline Methodology
PERFORMER	Consultancy services
TRIBUTE	Consultancy services for all phases of the TRIBUTE

Summary / way forward

- Deliver a map for each area that could stack projects' ERs against each other to present their benefits around 3 key criteria : 1) time to market; 2) IPR value; 3) technology maturity
- To be presented at one international event in 2016
- Take the Impact Workshop as a unique opportunity to discuss the content and the format and share knowledge & experience in order to come up with a great and valuable output by June
- Suggest to extend the scope to the other participants & projects

Development of new self-inspection techniques and quality check methodologies for efficient construction processes

EeB-03-2014


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- **Built2SPEC:** Self-Inspection, 3D Modelling, Management and Quality-Check Tools for the 21st Century Construction Worksite
- **INSITER:** Intuitive Self-Inspection Techniques using Augmented Reality for construction, refurbishment and maintenance of energy-efficient buildings made of prefabricated components
- **ACCEPT:** - Assistant for Quality Check during Construction Execution Processes for Energy-efficient buildings



- More portable
- Easier to use
- Cheaper to deploy
- Quicker to assess
- Lighter to carry

 Energy efficiency quality checks

 Building Information Modelling

 Indoor air quality tools

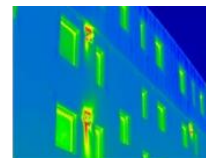
 Acoustic tools

 3D and imagery tools

 Airtightness test tools

 Smart building components

 Thermal imaging tools



- ... and interconnected



Energy efficiency quality checks



Indoor air quality tools



3D and imagery tools



Smart building components



Building Information Modelling



Acoustic tools



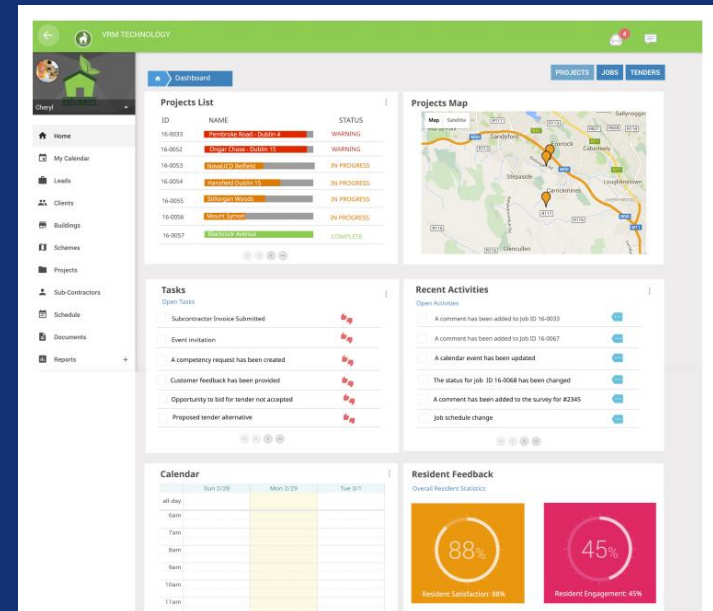
Airtightness test tools



Thermal imaging tools



VCMP - Virtual Construction Management Platform



PROJECT APPROACH and Project Aim

- **On-site** : Real building sites



- **Insight** : Knowledge and skills



- **Insiders** : Direct stakeholders



1. To prevent gaps in building's quality and energy performance by validating the on-site realisation against the 3D BIM design model using VR and AR
2. To develop protocols and guidelines for self-instruction and self-inspection
 - **SELF-INSTRUCTION**: a pro-active approach to provide construction workers with interactive guidance during their working processes,
 - **SELF-INSPECTION**: enabling construction workers to check their own working processes and the results respectively, both individually as well as peer-to-peer with other workers and with their supervisors
3. To provide construction workers with intuitive, robust and cost-effective diagnostic devices and software tools for self-instruction and self-inspection

Targeted MAIN OUTCOMES = KEY EXPLOITABLE RESULTS

1. Methods

Guidelines and use cases of self-instruction and self-inspection

2. Hardware optimization

Protocols for improvements of data inter-operability, user-friendliness and cost-effectiveness



3. Software tool enhancement

3D interfaces with BIM and Augmented Reality, self-monitoring KPI dashboard



4. Training modules

Professional courses for skilled and specialised workers; training modules supported with interactive demonstrations



ACCEPT



European
Commission



Bob, please install
the window on 2nd
floor!



Knowledge Transfer

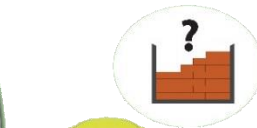
Sharing information between the different stakeholders in real-time

Project Coordination

Orchestrating workflows for the interaction between different entities

Quality Assurance

Collecting sensor data actively and passively as basis for self-inspection



An Assistant for quality Check during Construction Execution Processes for energy-efficient buildings



Exploitable Results

**Advanced
Knowledge
Transfer**

**CoOp App
for
Construction
Operatives**

*Using Epson
Moverio Smart
Glasses*

**Agile
Project
Co-ordination**

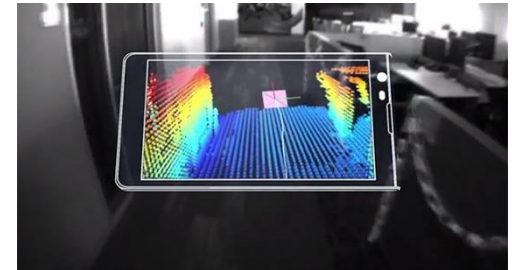
**SiMa App
for
Site Managers**

*Using Google
Project Tango
Tablet*

**Adaptive
Quality
Assurance**

**Dashboard
for
Consultants**

*Using
Laptops/Desktops*



Scientific/Technical goals of the supported area: *EeB-03-2014*

- Reduction by at least 50% the energy performance GAP between design and actual as built
- To develop new self-inspection techniques and quality check measures for efficient construction processes enabled by portable and robust systems that can be easily handled in the construction site
- To guarantee the final thermal, IAQ, acoustic and energy performance of the building while increasing the efficiency, reliability and productivity of the construction processes
- To develop a set of intuitive, robust and cost-effective instruments for self-instruction and self-inspection by workers and other stakeholders
- Advanced Knowledge Transfer for Energy-efficient Construction
- Use of augmented reality, smart glasses and drones
- Self instruction

Current and Expected impact(s) of the supported area: *EeB-03-2014*

- **Technological**

- ICT Platforms that aggregate, streamline, make available and make useful information across the phases of construction to include quality checks
- New sensors, tools, techniques and methodologies for self-inspection and quality assurance checks
- Guarantee the final thermal, acoustic and energy performance of the building
- Innovative techniques to measure the contribution of each critical component to thermal insulation, air-tightness and building services equipment in energy efficient construction (Google Tango, Flir one, air pulse test, smart glass technology)
- Streamlining the application of BIM processes in construction projects
- Improved communication to manage change control/clash detection
- Better alignment between designed and as-built detailing
- Continued involvement of stakeholders throughout design/construction process
- Data availability to support maintenance (softlanding)

Current and Expected impact(s) of the supported area: *EeB-03-2014*

• Economic/Social

- Reduction by at least 50% of the mismatch of energy performance between design stage and commissioning stage due to construction processes.
- Transfer of technical solutions and methods that are used for assembly and inspection in other sectors (e.g. automotive or aerospace industry - FOF) for potential use in the construction sector
- Automated filling of compliance paperwork via ICT platforms (saving time and errors on the worksite)
- Decreased risk of accident, workflow error, construction processes error and administrative error
- Demonstrate the existence of a valuable market to technology provider
- Increased cost efficiency of ICT-guided construction site for stakeholders
- Contribution to standardisation and labour training (BuildUpSkills)
- Health and Safety awareness in Construction (INSITER)
- 10% reduction in construction time (ACCEPT)
- New high skilled job role on site (digital masterbuilder)
- Startup company launched (B2S)

Current and Expected impact(s) of the supported area: EeB-03-2014

Environmental

- Delivery of innovative sustainable design ideas currently deemed unviable
- Less material wastage
- 50% reduction of the current “performance gap” between anticipated and actual energy performance of buildings
- Drastically reduce energy consumption and decrease CO2 emissions, in relation to new and existing buildings
- The use of prefab components reduces the environmental impact on the building site by creating less waste, and reducing environmental hazards
- 3 Pilot projects targeting 15% reduction in ‘Performance Gap’ achieved through construction, saving approximately 275kg/unit/year i.e. 41 Tons/CO2 or 121Megawatt Hours during lifetime
- Wider medium-term impact targeting ACCEPT uptake in 50% of Key Investor portfolio, achieving energy saving of 2460 Megawatts/year or 123GWh during lifetime
- Reduction of embodied energy and waste by 50% through prefabricated building elements, optimisation of on-site logistic processes, and avoidance of repair and rework during on-site assembly.

Technical cross-cutting issues: EeB-03-2014

What technical cross-cutting issues among your projects should be taken into account to increase the overall impact?

- Extended BIM approach for lifecycle performance and asset management (3D model, BIM onsite on mobile devices; accessible by all actors)
- Open source coding (ACCEPT)
- Development in Android to foster wider hardware integration
- Free basic version of the VCOMP (B2S)
- Augmented Reality/ Virtual reality for training modules self-inspection
- Cheaper, portable, quicker, lighter, easier to use and interconnected inspections tools (B2S)
- Field demonstration projects addressing prefab buildings (INSITER)



Non-technical cross-cutting issues: EeB-03-2014

What non-technical cross-cutting issues among your projects should be taken into account to increase the overall impact?

- Contribution to standards: implementation roadmap for a new policy on self-quality assurance (e.g. 'private kwaliteitsborging' in the Netherlands - INSITER)
- Skills development: training for skilled and specialist construction workers in conjunction with H2020 CSA BuildUpSkills and PROF-TRAC (INSITER).
- Licencing and Business Deployment (ACCEPT)
 - Single Investor targeted (from within Consortium) with 5 year scale-up
 - Territorial licencing approach
- Specific dissemination activities (ALL)
 - Established social media and blogging
 - Participation in European Research& Innovation events
 - Developed model for localised participation from external SMEs
 - National Workshops

Non-technical cross-cutting issues: EeB-03-2014

What non-technical cross-cutting issues among your projects should be taken into account to increase the overall impact?

- Business deployment (e.g. spin-off, start-up, new business models, patent, scaling up activities)
- Contribution to existing (national and international) standards in quality engineering, hardware interfacing and BIM open standards
- Increased collective participation (EeB Area) in “Expo” type events as opposed to “Research” related events to facilitate technology transfer activities.
- Similar to Exploitation Strategy Seminar type services – seminars that provide assistance on best practices and the steps/process required to bring products to market after projects would be appreciated (CE marking, pricing, partnering, licensing...)
- Full engagement of pilot building partners

Synergies and benefits of clustering

What cluster activities have you undertaken in the last year?

- EeB PPP Impact WS 2015, 2016 (Brussels)
- 1st Workshops at Sustainable Places 2015 (Savona, Italy)
- 2nd Workshops planned at Sustainable Places 2016 (Anglet, France)



Synergies and benefits of clustering

How have cluster activities added value to your projects?

- Investigation of other approaches for solving of technical issues
- Providing input into future strategy and roadmaps
- Creating a knowledge body
- Providing easy access to researchers and industry stakeholders
- Giving us access to further demonstration sites to deliver a broader basis for benchmarking of own results
- Bigger impact on standardization
- By creating a potential “early adopters” group
- Exploitation could be improved by joint activities of individual projects (joint presentations, journal papers, etc.)
- Increased subject creditability – collaborative impact stronger than that of individual projects
- Sounding board for prototypes and methodologies
- Collaboration in future projects

Synergies and benefits of clustering

How can cluster activities help exploitation of results after the projects end?

- Enhanced visibility of products and cutting edge technologies/developments – market size and
- More industry relevance of products towards market take-up
- Cross-selling (cross project and cross country) especially if compatibility among technologies is considered during development into the projects lifetime

Way forward

- Keep up the cluster projects collaboration
- Consider to pair with all projects in Session 2 (ICT for design, monitoring and management of energy-efficient buildings and districts) and Area 3 (Energy performance monitoring and management of energy efficient buildings)

EeB-07-2015

New tools and methodologies to reduce the gap between predicted and actual energy performances at the level of buildings and blocks of buildings

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EeB-07-2015

New tools and methodologies to reduce the gap between predicted and actual energy performances at the level of buildings and blocks of buildings



hit2gap

QUANTUM

- **MOEEBIUS:** Modelling Optimization of Energy Efficiency in Buildings for Urban Sustainability
- **TOPAs:** Tools for cOntinuous building Performance Auditing
- **Hit2GAP:** Highly Innovative building control Tools Tackling the energy performance GAP
- **QUANTUM:** Quality management for building performance - improving energy performance by life cycle quality management



- **MOEEBIUS:** Modelling Optimization of Energy Efficiency in Buildings for Urban Sustainability

Scientific/Technical goals of the supported area

- Reduction of the gap between real and predicted energy performance of buildings and block of buildings narrowed down to values consistent with EPC
 - Develop **methodologies and tools** to **monitor and assess** actual building energy performance → MOEEBIUS **advances the capabilities of current BEPST** to enable accurate predictions through addressing current modelling and measurement & verification inefficiencies.
 - Include energy performance diagnostics to support decision making during the different stages in the life of the buildings → MOEEEBIUS further complements the improved predictions with **innovative maintenance and retrofitting decision-making tools**.
 - Real time optimisation of energy demand and supply using intelligent energy management systems → **MOEEBIUS mobilizes demand response strategies at district level** integrating the aggregated flexibilities and response capacities of distributed energy resources to achieve real-time peak load reduction.

Scientific/Technical goals of the supported area

- Solutions with high replication potential
 - A holistic “open” approach to building control and monitoring systems → MOEEBIUS **deploys Open and Semantically Enhanced Middleware Systems** to enable standardised multi-directional communication and control interfaces.
 - **Validation** over a period of over **20 Months** in real-life conditions, in **different buildings** (office buildings, residential buildings, hotels, schools, sports complexes), districts characterized by increased **heterogeneity** (incorporating a variety of energy **management systems**) and **interaction features** between buildings (district heating systems, storage facilities and renewable energy sources) and under different environmental, social and cultural contexts in three dispersed geographical areas (UK, Serbia, Portugal).

Current and Expected impact(s) of the supported area

- Technological
 - Current and anticipated TRL of MOEEBIUS Components: TRL 5 → TRL 7 (1); TRL 6 → TRL 7 (5); TRL 7 (2); TRL 9 (2). i.e.: new innovative non-intrusive, low-cost, plug & play and self-configurable sensor/ actuator wireless device with enhanced communication capabilities and energy autonomy.
- Environmental
 - **Deviations between forecasted and measured** consumption below **10%**.
 - **Reduction of peak** demand at levels of **~50%**.
 - Reduced energy consumption through **real-time optimization 35%**.
 - **Reduce CO₂ footprint by 180.000 tonnes annually** in the pilot sites of the project.

Current and Expected impact(s) of the supported area

- Economic/Social
 - **Regulated comfort** and health in built environments **at levels above 80%**.
 - Targeted **payback** period **for ESCO projects** at acceptable values **below 5 years**.
 - **Strong industrial participation** (3 Larges + 7 SMEs).
 - **25 ESCOs and Aggregators involved** in the co-definition of new business models and roles.
 - **Validate Energy Efficiency Services Agreement business models** for ESCOs in the 3 project **pilot sites** (with the participation of 3 ESCOs).
 - **Validate holistic business models addressing demand response** and energy efficiency services in the **UK pilot site**.

Technical cross-cutting issues

What technical cross-cutting issues are addressed in your project that would increase the overall impact?

- Involvement of the cleanweb community → The **open approach adopted in MOEEBIUS will enable the seamless integration with all mainstream BEMS and Sensors available in the market.** MOEEBIUS Core Technological Components and End-Users Applications are mostly based on existing and emerging standards.

Non-technical cross-cutting issues

What non-technical cross-cutting issues are addressed in your project that would increase the overall impact?

- Innovation Capacity and Integration of New Knowledge. MOEEBIUS adopts **User-Driven in an Open Innovation collaborative framework** through a Living Lab approach towards setting the foundation for the efficient **cocreation of market-ready solutions**.
- Technology transfer. MOEEBIUS partners are committed to provide open **access to all scientific publications**.
- A **Start-Up company is expected to take over the commercialization of the Integrated Solution** with joint participation of the main industrial and research partners of the project.
- **Several MOEEBIUS partners have already applied for patents and trademarks and granted licenses on key relevant areas** to provide the consortium the necessary freedom to **penetrate the market without IP protection barriers** from competitive companies.
- **Introducing Novel ESCO Business Models** and New Energy Market Roles enabling the transition to demand-driven Smart Grid Services through Demand Side Aggregators.

Synergies and benefits of clustering

What cluster activities have you undertaken in the last year / are you planning to undertake?

Participation in EEBERS Expert Workshop on ICT for Energy Efficient Buildings / Establish synergies with eeSemantics Wiki, IEA-DSM Task 24, European Building Automation Controls Association and European Association of ESCOs, Open Reference Models Initiative, etc.

How have cluster activities added / would add value to your projects?

Widely disseminate the project towards end-users and various stakeholders so as to generate a broad awareness and engagement/ involvement in the various project results.

How can cluster activities help exploitation of results after the projects end?

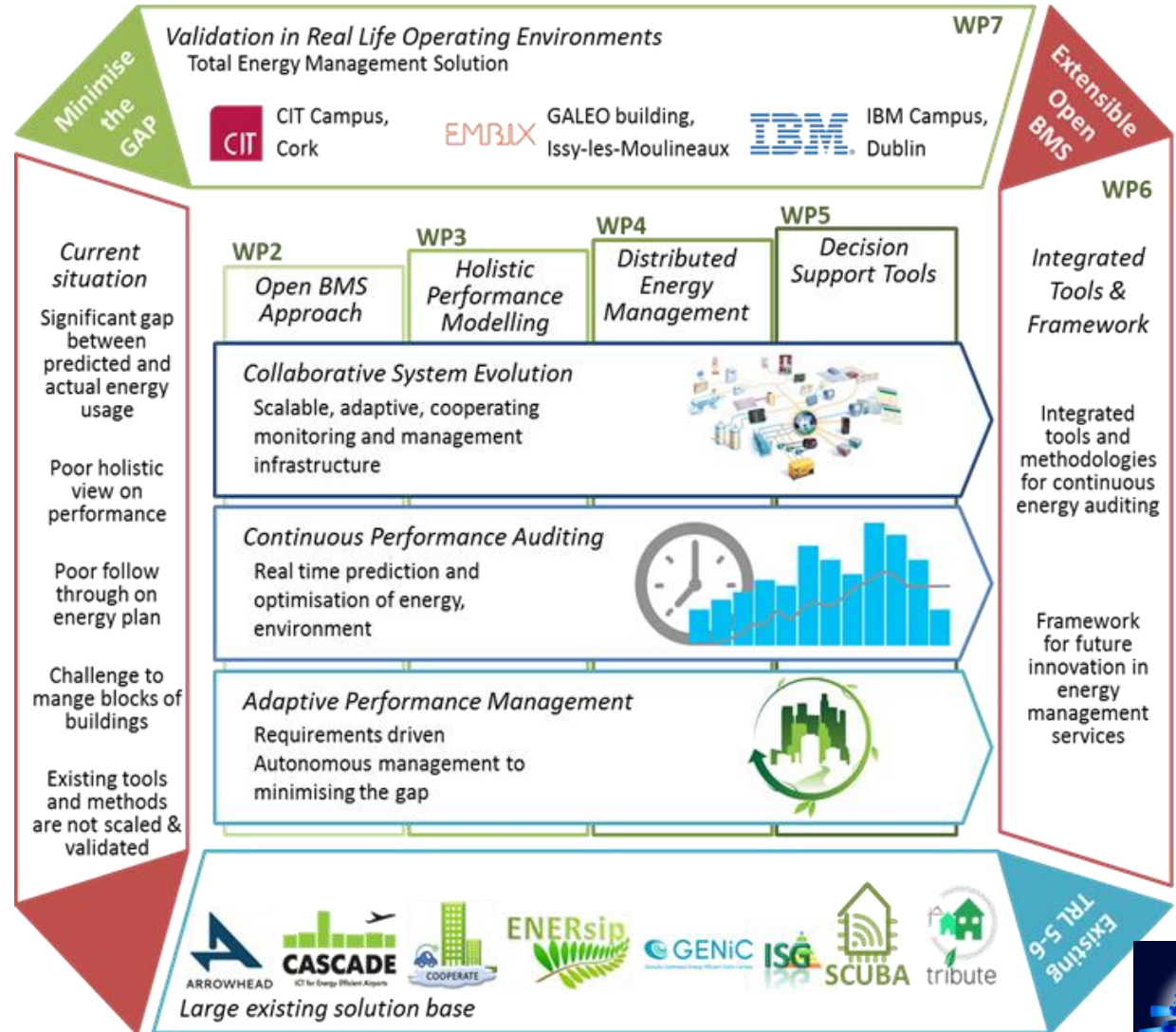
Facilitating quick market entry by creating opportunities for further replication of the project results



- **TOPAS:** Tools for cOntinuous building Performance Auditing

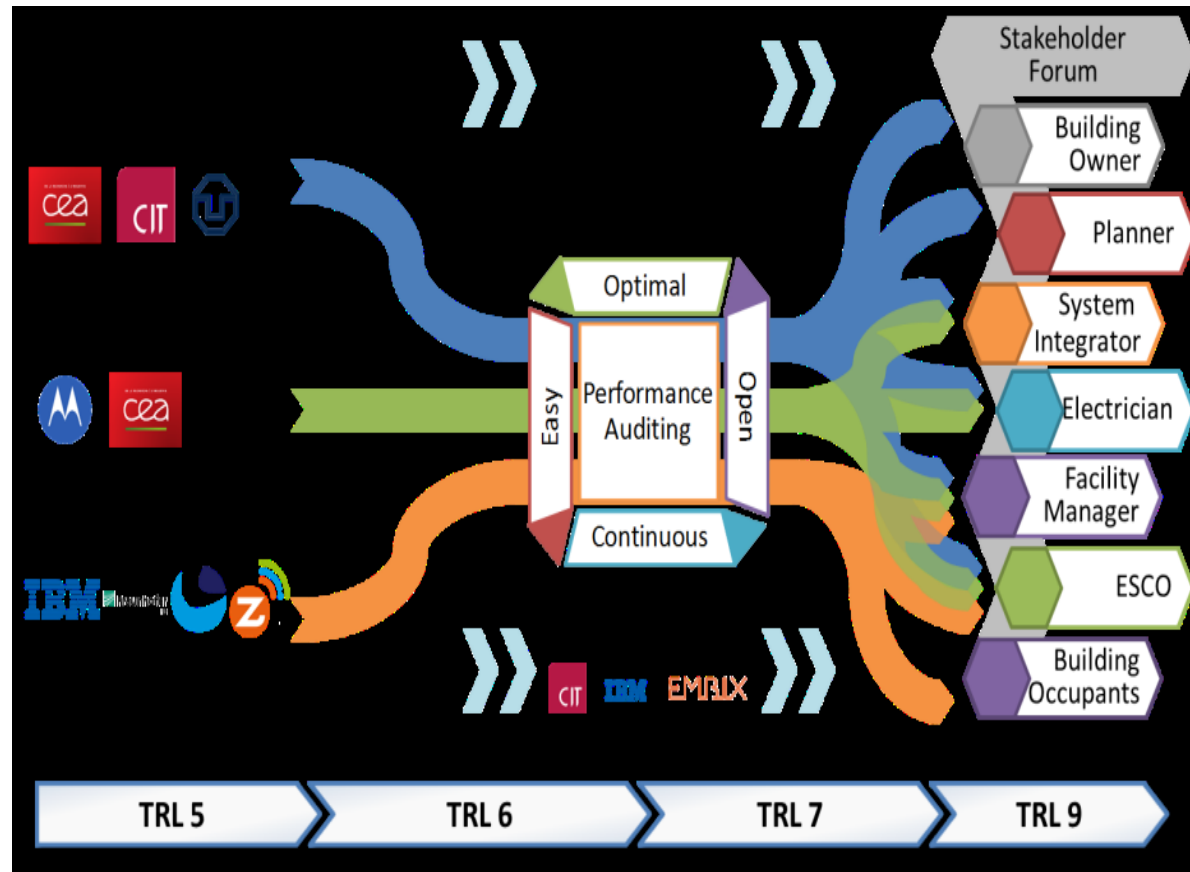


- **TOPAs:** Tools for cOntinuous building Performance Auditing



Exploitable Results

- Open BMS
- Model Predictive Control
- Decision support tools (FDD)
- Analytic solutions (occupancy, air quality)
- Energy models – Gap reduction
- Continuous energy assessment process



Scientific/Technical goals of the supported area

- **Open BMS** - an open **platform to analyse large amounts of data** from building & blocks of buildings, including existing building management and metering systems.
- **Energy Prediction - refinement** of building performance modeling approaches to accurately predict energy usage.
- Gap Reduction: **Target a reduction in the gap to 10%** in existing buildings.
- **Decision support tools** and **predictive control**. Integration of suite of predictive control and **FDD tools**.
- **Continuous energy assessment process and tool**. Quantification of energy savings in existing buildings.

Current and Expected impact(s) of the supported area

- Technological
 - Open BMS platform with analytic, diagnostic and energy management tools. Integration of existing technologies **(TRL~5/6) to TRL ~6/7.**
- Economic/Social
 - **Business model for open BMS** and ICT for energy management to deliver energy efficiency in buildings
 - Business models to foster growth in the **energy services sector**
 - Promotion and **dissemination** of best practice including input into **standard development** where appropriate
- Environmental
 - **Reduction in energy use of 15%-20%**

Technical cross-cutting issues

What technical cross-cutting issues are addressed in your project that would increase the overall impact?

- Open BMS. **Use of Remote Terminal Unit with middleware** to interface with BMS and data acquisition systems.
- **Data analytics** to process and collate data collected
- Predictive control and FDD to optimise energy performance.

Non-technical cross-cutting issues

What non-technical cross-cutting issues are addressed in your project that would increase the overall impact?

- Potential for IPR/Licencing- **patents to be investigated**
- Specific dissemination activities
- **Business planning** with a view to potential business deployment
- **Liaison with relevant standards development** bodies and committees. Potential for contribution to standards to be monitored.



- **Hit2GAP:** Highly Innovative building control Tools Tackling the energy performance GAP

HIT2GAP at a glance



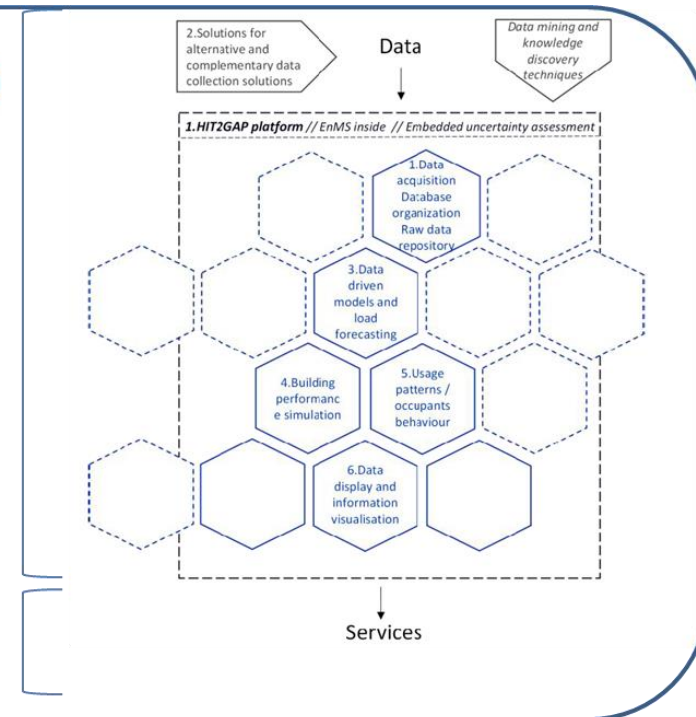
HIT2GAP main goal is the elaboration and development of **new methods and tools for the better assessment of energy use** within a building or a block of buildings in order **to minimize the gap** between the theoretical and measured values



**Modular + Open
Platform**



**Associated
Services**



The innovation is an open **approach for A NEW GENERATION OF BMS SOLUTIONS** with plug and play analytics tools and modular services using a win-win strategy.

Main exploitable results

- **License platform data treatment modules with a TRL >7:** full-fledge platform that can integrate third-party systems and applications.
- Demonstration of the ability to reach important **>30% savings with advanced data treatment approach**
- Integrate a **new level of intelligence into current BMS** product offerings for commercial buildings
- Further development of the **FDD-Framework to be integrated** in BAS/BMS
- **Integrated modules:** Occupant behaviour and state module/Demand Supply Matching/monitoring and report misbehaviours/electric load forecasting.

Scientific/Technical goals of the supported area

- To reduce the energy performance gap between predicted and real building performances, **focusing on the operational phase of buildings.**
- To propose a new paradigm for the development of energy management platforms in buildings, integrating existing expertise and resources: open approach for **A NEW GENERATION OF BMS SOLUTIONS with plug and play analytics tools and modular services** using a win-win strategy.
- Significant reduction of the energy performance gap using enhanced data treatment modules for monitoring real-time building operation and **occupancy data and real-time meteorological and building performance data** that will be used to **continuously calibrate** the models to more accurately represent the real energy behaviour.

Current and Expected impact(s) of the supported area

- Technological
 - **Empowerment of building managers/owners/occupants** by increasing their visibility and knowledge of buildings energy performance
 - Added value for building energy performance management brought by **advanced data treatment** (data mining, forecasting, fault detection & diagnosis...) and display Modules
- Economic/Social
 - **Engagement of end-users** of tertiary buildings through the visualisation modules developed as part of the project
 - Support to **Energy Performance Contracting**
 - **2,737 M€ savings in buildings managed by Veolia (FM)** plus building managed by competitors
- Environmental
 - **20-25% energy savings**
 - Reduction of greenhouse emissions achieved through direct reduction in energy use

Technical cross-cutting issues

What technical cross-cutting issues are addressed in your project that would increase the overall impact?

- **Data treatment and information display modules:** they are until today integrated in packaged black box solutions → HIT2GAP will make them **available through a kind of AppStore**
- Ensure the **link between large system providers and small but highly innovative start-up companies** by providing a full-fledge platform that can integrate third-party systems and applications.
- **Support to EPC:** the HIT2GAP platform establishes a baseline more adjusted to reality (removing uncertainties between design and building, actual building usage profiles, etc.).

Non-technical cross-cutting issues

What non-technical cross-cutting issues are addressed in your project that would increase the overall impact?

- Link between large system **providers (BMS providers) and start-up companies** → this link enables an improvement into current BMS product offerings, gain in competitiveness and generates new market opportunities for both parties
- **Involvement of a BMS provider in the consortium that strengthens the business model envisioned in the project**
- **Demonstration in different kinds of buildings** and full **engagement** of pilot building **partners**

Synergies and benefits of clustering

What cluster activities have you undertaken in the last year / are you planning to undertake?

- **National Stakeholders group** currently being created
- Workshop planned during the **Sustainable Places 2016** conference to be held at the end of June 2016

How have cluster activities added / would add value to your projects?

- Linking HIT2GAP to ongoing research activities for clustering synergies and identifying and leveraging complementarities
- Providing input for future strategy

How can cluster activities help exploitation of results after the projects end?

- **Meaningfully widen the promotion of HIT2GAP key results** and communication messages
- **Stakeholder groups** used as project advocates and **early adopters** allowing the replication beyond project partners.

QUANTUM

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

S/T goals of the supported area

QUANTUM:

1. Reduce gap between feasible (calculated) and real energy performance of buildings based on quality management loops
2. Maintain/improve IEQ
3. Results within less than 3 month
4. ROI < 1a
5. High productivity / Minimum requirements for expert knowledge
6. Development of ICT-tools and business models for fast, cost effective, robust and scalable services

Current and Expected impact(s) of the supported area

QUANTUM

- Business models based on **quality management**
- Software as a service (**SaaS**) solutions for quality management
- Cost effective reduction of energy consumption
- **Energy savings 10%** in existing buildings

Technical cross-cutting issues

What technical cross-cutting issues are addressed in your project that would increase the overall impact?

QUANTUM

- Application of Software as a Service ICT
- Development of **Meta-Modelling tools** to **enable quality management for individual HVAC designs**

Non-technical cross-cutting issues

What non-technical cross-cutting issues are addressed in your project that would increase the overall impact?

QUANTUM

- **Integration of (third party) quality management services** into regular design, construction/Cx and operation phases of buildings
- **Development of corresponding standards**
- Start-up and **new business models** for quality management services

Synergies and benefits of clustering

What cluster activities have you undertaken in the last year / are you planning to undertake?

QUANTUM:

Early stage talks with commercial Cx companies, REHVA and national clusters.

How have cluster activities added / would add value to your projects?

Clusters may provide expert feedback on developments, contact to pilot applications and technology or service partners.

How can cluster activities help exploitation of results after the projects end?

Boost business through dissemination activities.

Summary / way forward

QUANTUM ...

... **implements quality management as a key process** to improve energy performance of buildings

... **developes Software as a Services tools** for quality management

... creates fast, cost effective, robust and scalable **services**

... applies tools an services in 15 projects.



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CASCADE – ICT for Energy Efficient Airports

www.cascade-eu.org

[Twitter: CASCADE ICT](#)

FP7 Collaborative Project (CP) - Small or medium-scale focused research project (STREP)

Total budget 3`884 T€

Total funding 2`599 T€

9 partners (3 Ind. / 3 Ind.-SME / 3 Res)

Project lifetime 3 years from 01/10/2011 until 31.03.2015

Scientific/Technical goals of the supported area

- Development of an open communication hard- and software solution for a distributed measurement concept with focus on wireless technologies
- Development of a Fault Detection and Diagnostics Action Management System by integrating feedback from FDD algorithms in an ISO 50001 based Energy Management Planning and Action module.
- Demonstration and validation at two large European airports. Energy savings potentials $\sim 20\%$ at both airports. Partially achieved.

Current and Expected impact(s) of the supported area

- Technological:
 - Automated Fault Detection and Diagnostic systems linked with ISO 50001 based Energy Action Plan - TRL 6 → TRL 7
 - Airport ontology models – TRL 4 → TRL 5
- Economic/Social
 - 3 SMEs as project partners: PSE (D), SMI (I), ENERIT (EIR), further SMEs involved in the commissioning phase
 - Private investments mobilised: ~ 210 k€
 - Further investments planned at FCO airport (2015/2016): ~ 300 k€
- Environmental
 - Energy and CO₂ savings potentials estimated up to 20% at the project end. Measured energy savings 15-20% after the project end in a demonstration site.

Technical cross-cutting issues

What technical cross-cutting issues are addressed in your project that would increase the overall impact?

- Continuous data based ISO 50001 Energy Action Plan
- Open architecture
- Ontology based data model

Non-technical cross-cutting issues

What non-technical cross-cutting issues are addressed in your project that would increase the overall impact?

- Unique solution providing linking between AFDD and ISO 50001
- Euronews Futuris movie on CASCADE: <https://youtu.be/KRvBwM8h4K8>
- Business model development for use of the technology in energy performance contracting
- Additional development efforts to reach TRL9 are needed. (automatization of intermediary tasks, frontend development, marketing strategy development)

Synergies and benefits of clustering

What cluster activities have you undertaken in the last year / are you planning to undertake?

- Cooperation in the IEA Annex60 under activity 2.3 - Model use during operation - between SEAM4US and CASCADE projects

How have cluster activities added / would add value to your projects?

- Scientific cooperation in the field of advanced modelling of complex environment and systems

How can cluster activities help exploitation of results after the projects end?

- Use of common technologies
- Avoid duplication

Summary / way forward

- AFDD and energy management challenge successfully demonstrated in large facilities (airports)
- Future works for the integration of BIM/Ontology in O&M and FM required
- Technologies/methods required to enhance the data quality from BAS/BMS or to cope with
- SaaS business model and energy contracting for AFDD and ISO 50001
- Licensing / spinoff / startup generation

Open discussion ...

- Which are the main technical and non-technical barriers for demonstration of TRL<9 products/systems on real case study?
- Which are the main technical and non-technical barriers for shared exploitation (involving more than one partner) of project results?
- Did you use EC service for supporting exploitation? Feedbacks?
- How to make more effective the exchange and cooperation among projects with some “overlapping” to optimise the capitalization of background?
- Which kind of common communication, dissemination, and exploitation action could be done and possibly chair by the EC to increase the market penetration of PPP EeB project results?
- How to measure the matching of stakeholders needs with project results (successful of the projects)?
- Have you got shining examples of successful exploitation? Do you think it would be worthy to collect them in a structured repository?



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Thank you!

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