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ECO-BUILDINGS**



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1. Executive Summary

This report presents the Deliverable from the work carried out under Workpackage 5 related to the Stakeholders. The work within the Workpackage comprised, setting up and maintaining a group of Stakeholders, with a variety of expertise and experiences that covered the entire spectrum needed to comprise a wide spectrum of viewpoints from the sustainable construction vision. For this, a list of 238 contacts were created from the Smart-ECO consortium from a wide range of sectors. These included authorities, technical experts, industrialists, developers, materials experts, architects, builders, demolition companies and educationalists. From these contacts, three groups of Stakeholders were created (Total 66) as follows:

- Low level (8): Stakeholder members who wished to be involved only via email and who only want to receive executive summary documents and the Smart-ECO questionnaires
- Medium level (8): Stakeholders who wished to receive more detailed documents in order to make more detailed comments in addition to the questionnaires
- High level (50): Stakeholders who wished to also attend face to face Smart-ECO events and meetings

The report describes the details of the work carried out in setting up the Stakeholder group and formulating the questionnaires to engage the Stakeholders in the work being carried out within the Smart-ECO project. In this respect, three technical Workpackages carried out work to; 1) formulate the vision for sustainable construction, 2) innovations needed to realise the vision, and 3) evaluation metrics for monitoring success. Three questionnaires have been formulated to distribute initial drafts of the work carried out for Workpackages 2, 3, and 4, and responses from the Stakeholder group passed back to the Smart-ECO partnership for prioritising the details of the work in each of the tasks being carried out. The details of these questionnaires, and the results obtained, are presented in this report. Following on from this work a market perspective on eco-buildings is created and presented in this report.

The first Smart-ECO questionnaire (Q1) focused on ensuring the Vision comprised the most important elements and that the ranking of each component was appropriate as assessed by the Stakeholder Group. A total of 58 Q1 questionnaires were completed and the most important issues that should be included in the Smart-ECO vision (in ranked order) have been assessed to be as follows:

1. Lifecycle of building
2. Minimum energy consumption
3. Monitoring of building
4. Building user manuals
5. Building adaptability
6. Local issues
7. Dismantling building phase
8. Setting up building phase

The second Smart-ECO questionnaire (Q2) focussed on identifying the innovations (technical and non-technical) that had the potential to contribute to realizing the Smart-ECO Vision. A total of 51 Q2 questionnaires were completed with the questions aimed at assessing a variety of issues; the most important of these related to the innovations are summarised here. Areas where innovations have the most potential for achieving the Smart-ECO Vision (in ranked order) are:

1. Renewable energy generation
2. Passive design measures
3. Operation of building
4. Finance and incentives
5. New materials
6. Management and processes
7. Education
8. Policies
9. Recycling
10. Communications
11. Water conservation

The energy saving and efficient technologies with high potential to impact Smart-ECO buildings (in ranked order) are:

1. Insulation
2. Passive cooling
3. Passive solar
4. Lighting

5. Orientation
6. Innovative material
7. Water conservation and storage

The renewable energy technologies with high potential to impact Smart-ECO buildings (in ranked order) are:

1. Solar thermal
2. Co-generation
3. Earth energy
4. PVs
5. Biomass
6. Wind related technologies
7. Fuel cells

The most important operational innovations with high potential to impact Smart-ECO buildings (in ranked order) are:

1. Building management systems
2. Automation for energy saving
3. Robustness to user behaviour
4. Post occupancy monitoring
5. Waste management plan
6. Intelligent lighting
7. Air quality control
8. Daylight dependent control systems

The third Smart-ECO questionnaire (Q3) focussed on evaluating the innovations identified in Q2 and their potential for realizing the Vision aims from Q1. A total of 18 Q3 questionnaires were completed with the questions aimed at assessing the various innovations via different evaluation criteria and the results are summarised here. From a holistic viewpoint the most important issues in ranked order are:

1. Technical performance
2. Economic
3. Sustainable
4. Regional pre-conditions
5. Social

Some of these criteria have been further assessed. For example the main issues that should be included in the regional pre-conditions (in ranked order) are: 1) climatic conditions, 2) local building regulations and local policies (equal second), and 4) geographical features; and the main issues to be included in the performing the technical evaluations (in ranked order) are: 1) requirements are met, 2) reliability, 3) robustness, and 4) maintainability. The economic evaluations should include (in ranked order): 1) cost-benefit analysis, 2) the set up costs, 3) the operational costs, and 4) service life time.

The various innovations have been assessed from different viewpoints such as minimising energy consumption, being easy to use, reliant on local issues, being adaptable, easy to set up, easy to dismantle, taking into account life cycle aspects and the increasing awareness of the user.

The market potentials of the various innovations have also been assessed by the Stakeholders. For example the market potential of the energy saving innovations (in ranked order) are:

1. Insulation products (with average score of 4.4 and market take up potential of 84% by 2030)
2. Lighting products (with average score of 4.1 and market take up potential of 69% by 2030)
3. Passive solar products (with average score of 3.2 and market take up potential of 52% by 2030)
4. Passive cooling products (with average score of 2.8 and market take up potential of 38% by 2030)
5. Building orientation (with average score of 2.7 and market take up potential of 32% by 2030).

Also, the market potentials of the renewable energy innovations have been assessed (in ranked order) as:

1. Co-generation products (with average score of 3.6 and market take up potential of 46% by 2030)
2. Solar thermal products (with average score of 3.5 and market take up potential of 54% by 2030)
3. Photovoltaic products (with average score of 3.4 and market take up potential of 42% by 2030)
4. Biomass products (with average score of 2.5 and market take up potential of 36% by 2030)
5. Earth energy products (with average score of 2.5 and market take up potential of 27% by 2030).

2. Creation and co-ordination of Stakeholder group

2.1. Setting up Smart-ECO Stakeholder Group

At the start of the Smart-ECO project, it was necessary to establish a group of Stakeholders, and to develop a plan to involve the Stakeholders in the project in order to achieve the project goal. The primary objective here was that Stakeholders priorities and concerns, from all viewpoints, were to be gathered and then used in carrying out the technical details of the Smart-ECO work programme. The work was started by focussing on the type of Stakeholders that were felt to be needed, and included, within the Stakeholder group. In doing this the following categories of Stakeholders were felt to be needed;

1. Technical experts in all the areas of technology needed in the construction sector, to comprise researchers, engineers, scientists, etc, all with vested interest in developing innovations for a sustainable construction sector.
2. Industrialists involved in manufacturing and commercialising products for construction.
3. Developers involved in real estate development and planning of large construction sites.
4. Material specialists to support the variety of materials needed in construction.
5. Architects involved in design of green and eco-friendly in particular.
6. Builders, ranging from house builders to construction companies involved in building large commercial structures.
7. Occupants of various disciplines, to give feedback from a general viewpoint on the acceptability of various innovations being considered for adoption.
8. Educationalists involved in training and education of different types of Stakeholders in the construction sector.
9. Authorities ranging from government bodies to professional organisations and associations involved in developing policy and having activities related to the construction areas.

All the project partners were invited to contribute their personal contacts in these areas, and a list of over 238 persons was created. This majority of this list is presented in Annex 1. In order to engage and invite the potential Stakeholder members, a one page introduction to the Smart-ECO project was created, and this is presented in Annex 2. This one page flyer was sent to all the potential Stakeholder members with the invitation to join the Stakeholder group in the three following categories:

1. Low level involvement. Here the Stakeholder members only needed to respond to simple questionnaires (via email) on what is being proposed by Smart-ECO, and if they agreed with the ideas being put forward or not.
2. Medium level involvement, for those who wanted to see full draft reports that had been within the project, and make detailed comments on any aspect that they felt strongly about. These could be followed up by more detailed telephone, or e-meeting conversations, to discuss the contributions in more detail.
3. High level involvement, where Stakeholder members also attended face-to-face meetings and Smart-ECO events that were to be planned as part of the project. During these meetings, detailed discussions and involvement could be carried out in performing the Smart-ECO work plan.

From these contacts, and follow on, further suggestions for additional contacts, the three levels of Stakeholder group were set up. The low and medium level groups were quite small, having 8 in the low level involvement category, and 8 in the medium level involvement category, although some of these even attended some project meetings. The high level involvement group comprised the largest number of Stakeholders with 50 Stakeholders wishing to participate at this level.

These 66 Stakeholders were from the following countries: UK(9), Italy(12), Turkey(1), Belgium(1), France(6), Sweden(5), Greece(3), Estonia(10), Netherlands(1), Romania(1), Germany(3), Portugal(1), Finland(1), Spain(2), Hong Kong(1), USA(2), Brazil(1), South Africa(1), Japan(2), Pakistan(1), Canada(1), Australia(1). Total =66

Once the groups had been set up, there was an active exchange of information both ways in supplying feedback to the questionnaires that had been produced. The details of the questionnaires and the comments collected are given next.

3. Smart-ECO questionnaires

In total, 3 questionnaires were formulated and distributed to the Stakeholder group. These were as follows:

- Questionnaire 1 – related to Workpackage 2, focussing on formulating the vision for Smart-ECO.
- Questionnaire 2 – related to Workpackage 3, focussing on the innovations needed to realise the Smart-ECO vision.
- Questionnaire 3 – related to Workpackages 4 and 5, focussing on developing the evaluation methods to realise the sustainable construction vision and the potential market for sustainable construction products.

The questionnaires comprised providing an executive summary of the work carried out within the project and a range of questions formulated to obtain the views of the stakeholders. For most of the questions a statement was made and a 5-point scale was used to assessing agreement /disagreement with the statement made as follows:

- 0: Strongly disagree
- 1: Disagree
- 2: Neutral
- 3: Agree
- 4: Strongly agree

In addition, there were questions for assessing and ranking the most important issues as well as opportunities for comment to be feedback. The details of the questionnaires are presented next.

3.1. Smart-ECO Vision: Questionnaire 1

In order to determine whether the suggestions being made by the Smart-ECO Consortium had a proper grounding, a short executive summary of the draft vision being formulated was produced together with questionnaires to determine the viewpoints of the Stakeholder members on different aspects being considered within the vision. The questions also related to the relative importance of different aspects that were being considered within the vision. The executive summary of the vision and the first Smart-ECO questionnaire produced are presented in Annexes 2 and 3 respectively. For convenience the questions are as follows:

1. It is important to ensure that the SMART-ECO vision is obtained via wide consultation and consensus rather than consulting a few elitist stakeholders
2. Using the back-casting approach is important in formulating a reliable and robust “Vision” document.
3. The general principles of sustainability set out in ISO 15392:2008 are acceptable for basing the Vision.
4. An SS-E building could be a new or a renovated building without any difference of approach.
5. The main use functions of SS-E buildings as expressed by CIB WO52 Procurement systems”: 1995 are acceptable for formulating the SMART-ECO Vision document.
6. From the detailed issues stated in the Initial SMART-ECO Executive summary, please indicate your level of agreement/ disagreement on the importance of each issue:
 - a. SS-Es should result from a collective decision
 - b. SS-Es should be designed from a life cycle perspective
 - c. SS-Es should be erected in acceptable setting up conditions
 - d. SS-Es should sustain their use functions with minimised energy consumptions
 - e. SS-Es provide monitored and traceable technical and environmental performances
 - f. SS-Es should come with user and operation manuals
 - g. SS-Es should allow the insertion into local networks and urban life
 - h. SS-Es should permit and ensure refurbishing, retrofitting and adaptation, etc for different uses.
 - i. SS-Es should facilitate dismantling

3.1.1. Data Analysis from Questionnaire 1 (Q1)

A total of 58 Q1 questionnaires were completed (44 stakeholders and 14 partners) and the top 8 ranked issues of the stakeholders and the project partners agree very closely. The overall result from Q1 indicates that the issues (in ranked order) that should be included in the Smart-ECO Vision are as follows:

1. Lifecycle of building
2. Minimum energy consumption
3. Monitoring of building
4. Building user manuals
5. Building adaptability
6. Local issues

7. Dismantling building phase
8. Setting up building phase

The detailed responses for the questions are presented next.

Question 1: It is important to ensure that the SMART-ECO vision is obtained via wide consultation and consensus rather than consulting a few elitist stakeholders (average of responses: 3.2).

Some comments received:

- It is essential. Smart-ECO will work if the economics are viable for all the stakeholders
- What is important is not just to ensure a correct DIAGNOSTIC or even a RECIPE for correcting measures but also to really begin the THERAPY for real improvement in the field, by convincing those powerful stakeholders (who have the means to bring important changes) to act in the best way!! Therefore the need to focus in priority on the powerful (I would avoid the term “elitist”) stakeholders
- Wide consultation can dilute ideas, particularly between groups that have different aspirations- for example the 2006 iteration of the Building Regs had more teeth before builders and manufacturers reduced its field of influence.
- The stakeholder group can assist in casting the draft, much wider consultation and feedback is necessary to guarantee any future acceptance.
- Balance is required between large numbers (statistical significance) and forward-looking spirit that is not everyone’s.
- Yes, as long as participants ALL share the future vision
- Perhaps using the web site; “interactive consultation”.
- The Stakeholders are the representatives for wider opinion
- Elite for ambition, wide consultation for anchoring
- Pay attention on the common idea that NATURAL=ECO / SYNTETIC=NON ECO
- Both of parties should be involved, firm process rules should be developed
- Due to my understanding it is not important to ask “many” people, but it is important to ask experienced people from many different parts of the value chain (including the users).

Question 2: Using the back-casting approach is important in formulating a reliable and robust “Vision” document (average of responses: 3).

Some comments received:

- Not sure that I entirely understand backcasting
- It is a means to an end
- Again, not all stakeholders may identify themselves completely with a very “visionary” document: this does not mean that the vision should become weaker
- This is the approach I endorse in my book/ papers on TRANSITIONING the built environment(attached FYI, Newton 2008, 2009)
- Useful in mapping the background - not necessarily important while “formulating”
- Do not understand the meaning of the question
- To implement smart-eco buildings we have to avoid the continuation of present methods extrapolated into the future.

Question 3: The general principles of sustainability set out in ISO 15392:2008 are acceptable for basing the Vision (average of responses: 2.7).

Some comments received:

- This ISO standard establishes general principles for sustainability in building construction without providing levels or benchmarks. Therefore we believe that it is not so useful for setting sustainability claims.
- I am not familiar with this document
- Not read the ISO document in detail
- Useful in mapping the background - not necessarily important while “formulating”
- The vision should go further than what is contained in ISO
- Don’t know about ISO xxxxx
- Actually I agree but ISO is not such kind of magic system. There are most important what will happened in our mind.
- Not familiar yet with ISO 15392:2008
- The general principles are “very” general.

Question 4: An SS-E building could be a new or a renovated building without any difference of approach. (average of responses: 1.8).

Some comments received:

- There are features which can only be envisaged economically for new buildings!
- Although the ultimate goal is identical, the approaches should be different since probably in most cases of existing buildings the effective measures to be implemented are limited
- Compromises will need to be made for existing buildings
- I am neutral because their service life are different. This could be considered in Vision approach.
- Approach will probably require to be different with refurb very much more difficult to get performance standards
- Not sure of meaning of approach the items to be addressed should be the same approach but the technical issues, proforma, and assessments should be appropriate to the type of structure, and thus a different approach
- General aims should be the same but approaches and achievable results can be different
- The options will be completely different and the potential for refurbishment should be addressed separately from a new build approach
- No difference of approach means adopting very general principles; but this point of view may change with the development of the research.
- Certainly the performance assessment tools should not differentiate between old/new; see Newton et al 2009 FYI)
- Vision can be same, solutions are different
- Same goals, different approach
- Approach should be as flexible as possible
- There is a need to have a new or a renovated approach is not the issue but validating is necessary
- Vision no different, measures different
- I have a preference for renovation considering the big stock of old buildings in the market
- They need different ways of evaluation but both of them could become SS-E
- Even if design approach could be similar, drivers, strategies and techniques are generally different for renovation and new build.
- There are some differences of building a new building or renovating it (energy consumption, indoor climate, using materials etc)
- Don't know the document
- The approach is differentiated.

Question 5: The main use functions of SS-E buildings as expressed by CIB WO52 Procurement systems”: 1995 are acceptable for formulating the SMART-ECO Vision document (average of responses: 2.4).

Some comments received:

- Not sufficiently familiar with CIB document
- No access to the CIB document to answer
- Unfortunately I could not access the CIB report in a timely fashion, but the summary of it in the CSTB Vision would seem to be somewhat limited from an environmental sustainability perspective
- Not familiar with this classification
- Useful in mapping the background - not necessarily important while “formulating”
- Unaware of the referred document
- I am not familiar with CIB WO52, however the vision should be the result of a comprehensive analysis of existing regulations, and as such should examine all available data.
- Not familiar yet with CIB WO52 “Procurement systems” (not accessible via internet)
- Needs discussion
- For me it is not clear, if a building has to bring “meaning”. Rest is ok.

Question 6: From the detailed issues stated in the Initial SMART-ECO Executive summary, please indicate your level of agreement/ disagreement on the importance of each issue:

Generic comments received:

- Some of your questions I do not understand (see comments above), either because of phrasing or lack of familiarity of documents - might be good to have documents in an appendix or with a web link
- I would prefer that buildings be designed for far longer life spans, but if this is too much then dismantling is necessary. At some point it will be necessary to recommend the parties that bear the responsibility and audit ability. Also, the result of these efforts should be a structure branded (e.g. certified green compliant). In this way stakeholders know what they are purchasing, and this should increase the marketability, and hopefully this will increase the price to offset the costs of design, construction, and operation
- New and better sustainable methods are needed and they need to be widely demonstrated to convince the general public and the policy makers. In view of this a strong competitive market to develop and test the new solutions is needed. Only through such competition will commercially viable solutions be realised.

Grants and other tax incentives may help in the initial stages to make the new sustainable methods compete with traditional (non-sustainable) methods which should be penalised wide adoption of carbon taxes, etc.

- The objectives of the SMART ECO project seem very worthwhile, but I cannot see from the website what the deliverables are to be. I think that there may be a danger that the aims and objectives are diffuse, and the outputs over the 30 months will therefore be difficult to quantify. This is an area where the Stakeholder group should be active in proposing worthwhile activities from the project. The activities may be defined very well elsewhere, but from my reading of the webpage and vision document this is my initial concern
- If I had to compromise on some of the above points in order to achieve a positive result, I would compromise on dismantling and reusing of building components (usually infeasible and expensive)
- It is difficult to disagree!
- I have left questions blank above (c and g) where the topic is not clear to me (Neutral selected)
- I am very comfortable with each of these points except for (i) because ideally a SS-E would be designed for reuse rather than dismantling. Planning for disposal is like treating a building in a similar way to a car
- There should be as little as possible difference between requirements for “standard” buildings and SSE buildings, only the performance should be better for SSE buildings.
- The technology should be user friendly. The visual expression of the used technology could either have its own architectural expression for new buildings or in contrast with existing buildings, or have an expression for a retrofit situation where it does not change the existing architectural expression.

Question 6a: SS-Es should result from a collective decision (average of responses: 3.1).

Some comments received:

- Stakeholder group should reflect consensus in vision, and then seek optimal pathways to attaining that vision in most eco-efficient manner (where divergent views can be welcome)
- A SS-Es building (a) has to be also with low impact to the users (indoor pollution).

Question 6b: SS-Es should be designed from a life cycle perspective (average of responses: 3.6).

Question 6c: SS-Es should be erected in acceptable setting up conditions (average of responses: 2.8).

Some comments received:

- I am neutral in 6c because I could not understand very well what it means.
- Which are the acceptable setting up conditions? Not clear what is meant.

Question 6d: SS-Es should sustain their use functions with minimised energy consumptions (average of responses: 3.5).

Some comments received:

- Preferably “carbon neutral”
- Term “minimised energy consumption” seems too tough (absolute) or uncertain. Some criteria are needed.

Question 6e: SS-Es provide monitored and traceable technical and environmental performances (average of responses:) 3.4.

Question 6f: SS-Es should come with user and operation manuals (average of responses: 3.4).

Some comments received:

- “Manuals” seems to be an outdated concept to me; should be expressed as ‘accessible on-line as-built BIMs as platform for effective FM’
- The Vision may not need to go as far as producing a manual, it depends who will be the stakeholders

Question 6g: SS-Es should allow the insertion into local networks and urban life (average of responses: 3.2).

Some comments received:

- Insertion of SS-Es into urban networks may introduce additional variables that may over complicate the problem. In addition, these decisions may vary from community to community and may be part of a more political and social process.

Question 6h: SS-Es should permit and ensure refurbishing, retrofitting and adaptation, etc, for different uses (average of responses: 3.2).

Some comments received:

- There are many differences when considering the type of building connected to its use and the utilities needed, access to the building or access of building to resources, therefore I consider that this statement is far too general
- Depends on their intended use and service life specific solutions for short usage may also be sustainable
- Ensuring for refurbishing, retrofitting and adaptation may result in a less “sustainable” building, therefore these issues must be weighted against other variables.

Question 6i: SS-Es should facilitate dismantling (average of responses: 3.1).

3.2. Innovations to realise the Smart-ECO Vision: Questionnaire 2

The second Smart-ECO Questionnaire (Q2), related to how the Smart-ECO Vision produced could be realised. The technical team within the Consortium have considered a variety of innovations, both technical and non-technical, and the work for Q2 involved gathering the views of the Stakeholders and making sure the proposals being suggested were properly grounded within the built sector community represented by the experts in the Stakeholder group. As for Questionnaire 1, a summary of the innovations was formulated together with a set of questions that requested the views and priorities of the Stakeholder members. The executive summary of the innovations and the second Smart-EO questionnaire produced are presented in Annex 4. For convenience, the questions are as follows:

1. There is added value of EU level action to promote innovative technologies.
2. Taking into account public and private sector initiatives, the current economic downturn will slow down the deployment of innovations.
3. The most important issues to help improve innovation through international cooperation are (select max 3 from following: Applied research & demonstration actions; Exchange of know how; Technology transfer; Basic research; Stimulate global market; Global codes and standards; Regulatory aspects; Intellectual property rights; and Others (please specify)).
4. The stakeholders that will most contribute to the identification of innovative elements required for WP3 are the following (select max 3 from: Architects; Engineers/ consultants; Product manufacturers; Policy makers; Clients/ developers; Contractors/ builders; Research institutions/ universities/ R&D; Local authorities; and Financers).
5. TECHNOLOGY PUSH or DEMAND PULL is needed to promote innovation. Which is the most able to accelerate the pathway to the market?
6. Smart-ECO buildings could be achieved with technologies currently available in the market.
7. Types of buildings (new and existing) where Smart-ECO building are likely to have the higher impact are the following (select max 2 from Residential; Offices; Retail / Shops; Hospitals; Warehouses; Stations/ Airports; or Others (please specify)).
8. The stages of the building life cycle process where innovations are likely to be most effective are (select max 2):
 - Innovations affecting the way buildings are designed
 - Innovations affecting the way buildings are constructed
 - Innovations affecting the way buildings are refurbished
 - Innovations affecting the way buildings are operated
 - Innovations affecting the way buildings are demolished or dismantled
9. The areas where innovation has the higher potential to impact Smart-ECO buildings are (select max 3 from Education; Policies; Finance and incentives; Communications; Management and processes; Passive design measures; New materials; Renewable energy generation; Water conservation; Operation; Recycling; or Others (please specify)).
10. Innovations adaptable to the refurbishment of existing buildings are more important than innovations for new buildings in the period 2010-2030.
11. Applying integrated design procedures (close cooperation among architects, engineers, consultants, etc.) is important to achieve the Smart-Eco Vision objectives.
12. The energy saving and efficient technologies with high potentials to impact Smart-ECO buildings are (please rank from 1 to 7 on potential impact where 1=high, 7=low) from the list: Insulation; Passive cooling; Lighting; Passive solar; Orientation; Innovative materials; Water conservation and storage; or Others (please specify).
13. The renewable technologies with high potentials to impact Smart-ECO buildings are (max 3 from Wind related technologies; Solar thermal; Photovoltaics; Earth energy; Biomass; Cogeneration (CHP); Fuel cells; or Others (please specify)).
14. Energy generation related innovations should focus on (select max 2):
 - Improving large power plant efficiency
 - Increase energy generated at building level
 - Develop more local / district plants
 - Increase large-scale renewable power generation
15. The most important 'Operation' to help improve innovation are (select max 3 from Building management systems; Air quality control sensors; Waste management plan; Intelligent lighting; Daylight dependent control systems; Robustness to user behaviour; Automation or controls for energy saving; Post occupancy monitoring; or Others (please specify)).

3.2.1. Data Analysis from Questionnaire 2 (Q2)

A total of 51 Q2 questionnaires were completed (37 stakeholders and 14 partners) and again the responses from the stakeholders and the project partners for the various rankings of the key issues agree very closely.

The detailed responses for the questions are presented next.

Question 1: There is added value of EU level action to promote innovative technologies. (average of responses: 3.3).

Some comments received:

- This is true to some extent but the actions need tuning to local regions.
- The ability to trial new technologies quickly; subject to fast fail/succeed tests; share results/costs; gather performance-in-use data and disseminate
- Should be encouraged but not necessarily prescriptive
- Slow but sure process

Question 2: Taking into account public and private sector initiatives, the current economic downturn will slow down the deployment of innovations (average of responses: 2.2).

Some comments received:

- Depends from attitudes of Governments: they may use the crisis to push innovation as a way out of stagnating economy if they realise its added value in the global market.
- Of course we have to build in more effective way to save resources and stay in the budget, but in the situation of economic downturn is lack of financial resources to promote innovations.
- To the contrary people will be looking for more cost effective solutions as money is tighter
- Kondratief theory would suggest that this does not necessarily follow; there has been a build up of innovative built environment technologies waiting to be unleashed; challenge is capturing share of counter-cyclical public investment; the USA will be interesting to watch
- Most of the innovation process was already ongoing before the economic downturn, so the current situation may only slow the pace of innovation. Looking at the immediate future, there are great chances that such innovations will be main players in the economy, especially if we take into account global warming, the dependence on unreliable suppliers for fossil fuels, and the associated increase in the price of oil once the economy recovers. Moreover, on 28 January 2009 the European Commission decided to deploy €3.5 billion for projects on gas and electricity supply interconnections, the next generation of offshore wind technology, and carbon capture and storage
- There may be less resources, but the lack of resources may encourage innovation and creativity
- It makes available to use engineers better to push innovation – but it should be supported from outside of their employers
- According to various economic surveys sustainability and energy efficiency fields will remain at the top of the agenda despite the current economic downturn. This is also due to the introduction of the energy certifications in buildings
- Crisis is often fertile for innovation
- While strengthening the need for innovation
- Depending on the political decisions.

Question 3: The most important issues to help improve innovation through international cooperation are (select max 3 from following: Applied research & demonstration actions; Exchange of know how; Technology transfer; Basic research; Stimulate global market; Global codes and standards; Regulatory aspects; Intellectual property rights; and Others (please specify)).

The ranked responses are as follows:

1. Applied R&D
2. Exchange of know how
3. Technology transfer
4. Global codes and standards
5. Stimulate global market
6. Regulatory aspects
7. Intellectual property rights
8. Basic research

Some comments received:

- Other - Integration aspects
- Official guidance
- Are “Exchange of know-hoe” and “Technology transfer” the same in the options?

Question 4: The stakeholders that will most contribute to the identification of innovative elements required for WP3 are the following (select max 3 from: Architects; Engineers/ consultants; Product manufacturers; Policy makers; Clients/ developers; Contractors/ builders; Research institutions/ universities/ R&D; Local authorities; and Financers).

The ranked responses are as follows:

1. Research institutes
2. Engineers and consultants
3. Architects
4. Product manufacturers
5. Clients, developers
6. Contractors, builders
7. Policy makers
8. Local authorities
9. Financers.

Question 5: TECHNOLOGY PUSH or DEMAND PULL is needed to promote innovation. Which is the most able to accelerate the pathway to the market?

The ratio of "Technology push" to "Demand pull" of the responses is 19:36 with some persons voting for both.

Some comments received:

- Availability of a technology is not enough to have it spread in the market
- Driving force is the competition, which is very strong and motivating for manufacturers while owners/inhabitants are looking for the best price of "technologies" existing on the market
- The demand for cheaper and more reliable forms of energy will be the main drivers for new solutions
- Innovation requires implementation of new tech, processes etc, so DEMAND is critical that is the unfortunate reality of reflecting on 30 years in a R&D organisation
- We must combine these two approaches
- Both
- The demand pull creates a need, a market and awareness, which will provide the necessary confidence to the finance sector to support the development of new technologies
- Innovations must be cost effective, otherwise demand will not develop
- Innovation is not only Technology
- Cheaper and more effective
- Technology may provide anything, but when there will be no need for this we will never now about it as an innovation
- I personally think that both of the above are crucial to promote innovation in the construction industry
- It needs a bit of both.

Question 6: Smart-ECO buildings could be achieved with technologies currently available in the market (average of responses: 2.7).

Some comments received:

- Advanced technology exists, the problem is the cost! Poor inhabitants cannot afford high technologies
- A workbench survey would quickly confirm that
- Many of the available technologies are too expensive and would make buildings not competitive against current solutions
- Depends what is meant by "Smart-ECO"
- However, there needs to be more technologies to deal with air quality, overheating and noise
- We currently have all the technologies required to design and build Carbon Neutral Buildings. The problem is that most of renewable energy technologies are still too expensive and thus carbon neutrality is still not economically viable
- Achievable but costly
- Only if the labour forces are taught how to build Smart-ECO.

Question 7: Types of buildings (new and existing) where Smart-ECO building are likely to have the higher impact are the following (select max 2 from Residential; Offices; Retail / Shops; Hospitals; Warehouses; Stations/ Airports; or Others (please specify)).

The ranked responses are as follows:

1. Residential buildings
2. Offices
3. Retail/shops
4. Hospitals
5. Stations/airports
6. Warehouses

7. Schools

Some comments received:

- Others - Schools
- Residential and office buildings are sectors highly in need of improving their energy efficiency. Other structures such as hospitals, warehouses and stations are less numerous and may already be benefitting from more sustainable designs
- Schools + education bodies.

Question 8: The stages of the building life cycle process where innovations are likely to be most effective are (select max 2):

- Innovations affecting the way buildings are designed
- Innovations affecting the way buildings are constructed
- Innovations affecting the way buildings are refurbished
- Innovations affecting the way buildings are operated
- Innovations affecting the way buildings are demolished or dismantled

The ranked responses are as follows:

1. Design stage
2. Operational stage
3. Refurbishment stage
4. Construction phase
5. Demolition stage

A comment received:

- All are important.

Question 9: The areas where innovation has the higher potential to impact Smart-ECO buildings are (select max 3 from Education; Policies; Finance and incentives; Communications; Management and processes; Passive design measures; New materials; Renewable energy generation; Water conservation; Operation; Recycling; or Others (please specify)).

The ranked responses are as follows:

1. Renewable energy generation
2. Passive design measures
3. Operation of building
4. Finance and incentives
5. New materials
6. Management and processes
7. Education
8. Policies
9. Recycling
10. Communications
11. Water conservation

A comment received:

- Design 1

Question 10: Innovations adaptable to the refurbishment of existing buildings are more important than innovations for new buildings in the period 2010-2030 (average of responses: 2.6).

Some comments received:

- The new build sector is a tiny proportion of the building stock so the biggest impact will be to address the existing building to make them more sustainable
- In Australia it is estimated that even by 2050 approx. half the housing stock will be performing below current best practice
- In Europe, most of the building stock is existing and will only be replaced at a very slow pace. In view of this the importance of refurbishment. Nevertheless, new designs should be developed in parallel, as they will be an important asset in emerging economies
- Both sides are important
- This is especially important for the countries which have a large building stock
- Existing – Less impact on high volume New- High impact on low
- Existing buildings have biggest environmental impact
- Equally important
- Perhaps existing stock is more important than new buildings
- Existing buildings are almost 80% of the construction market
- Need to focus on tonnes CO2 saved / £1,000 spent

- There are many buildings which are currently not refurbishable. Main problems are 1) Planning security/planability (is it possible to detect the problems before the decision to renovate?), and 2) Warranty (what happens if the repaired parts (e.g. humidity protection) fail after e.g. 6 years?). If we do not solve these problems we will have to demolish many buildings and new buildings will become more important.

Question 11: Applying integrated design procedures (close cooperation among architects, engineers, consultants, etc.) is important to achieve the Smart-Eco Vision objectives (average of responses: 3.6).

Some comments received:

- This is the basis of our new book (Newton P et al eds 2009 Technology, Design and Process innovation in the built environment Taylor & Francis)
- I think holistic approach is very important for building integration. This type of integration will allow some changes in building design process to achieve a more sustainable environment
- I would include clients & financiers in the cooperation list (as the first two)
- Multi-disciplinary design and holist design approach are crucial to sustainable buildings
- Holstic approach seems to be vital
- Using appropriate integrated project rails.

Question 12: The energy saving and efficient technologies with high potentials to impact Smart-ECO buildings are (please rank from 1 to 7 on potential impact where 1=high, 7=low) from the list: Insulation; Passive cooling; Lighting; Passive solar; Orientation; Innovative materials; Water conservation and storage; or Others (please specify).

The ranked responses are as follows:

1. Insulation
2. Passive cooling
3. Passive solar
4. Lighting
5. Orientation
6. Innovative material
7. Water conservation and storage

Some comments received:

- Behaviour of occupants, embedded sensors and real time feedback on behaviour
- Design=1
- I assume it is daylight
- Other - Using of latest IT possibilities (BIM): simulations at design stage. Also smart automation of building systems and lighting
- Air tightness
- More important is building as a whole
- Hard to rank the above as all are important impactors on smart eco building?
- The above ranking should be done taking into account heating season and cooling season separately
- Improved building controls and operation
- Active solar (thermal and PV) in order to reach zero energy balance.

Question 13: The renewable technologies with high potentials to impact Smart-ECO buildings are (max 3 from Wind related technologies; Solar thermal; Photovoltaics; Earth energy; Biomass; Cogeneration (CHP); Fuel cells; or Others (please specify)).

The ranked responses are as follows:

1. Solar thermal
2. Co-generation
3. Earth energy
4. PVs
5. Biomass
6. Wind related technologies
7. Fuel cells

Question 14: Energy generation related innovations should focus on (select max 2):

- Improving large power plant efficiency
- Increase energy generated at building level
- Develop more local / district plants
- Increase large-scale renewable power generation

The ranked responses are as follows:

1. Increased energy generated at building level
2. Increased large scale renewable power generation

3. More local power plants
4. Improved power plant efficiency

Some comments received:

- Large scale renewable power generation: This is a highly contested area---where the most eco-efficient points for intervention are; I am leading a Hybrid Building project in this area at present
- Decentralise and reduce transmission losses.

Question 15: The most important ‘Operation’ to help improve innovation are (select max 3 from Building management systems; Air quality control sensors; Waste management plan; Intelligent lighting; Daylight dependent control systems; Robustness to user behaviour; Automation or controls for energy saving; Post occupancy monitoring; or Others (please specify)).

The ranked responses are as follows:

1. Building management systems
2. Automation for energy saving
3. Robustness to user behaviour
4. Post occupancy monitoring
5. Waste management plan
6. Intelligent lighting
7. Air quality control
8. Daylight dependent control systems

Some comments received:

- Question 15 doesn’t make sense – I assume it is asking what kind of building operation/control can reduce energy/waste etc.? Or is it asking which of the options listed can benefit from innovation? They don’t ‘help improve innovation’ on their own except perhaps in identifying areas which can benefit from innovation (ie. using the BMS to monitor systems within a building)
- Innovating the supply chain, life cycle approaches becoming standard practice
- Procurement
- Good user briefing and instructor
- What is the difference between “Automation or controls ...” and “BMS”?

3.3. Evaluating the Smart-ECO Innovations: Questionnaire 3

The third and final Smart-ECO Questionnaire (Q3), is related to how the Smart-ECO innovations identified in Workpackage 3 can be evaluated to assess success. The technical team within the Consortium have considered a variety of metrics and viewpoints, and the work for Q3 involved gathering the views of the Stakeholders and making sure the proposals being suggested were again properly grounded within the built sector community represented by the experts in the Stakeholder group. For Questionnaire 3, a summary of the first two questionnaires was formulated together with a set of questions that requested the views and priorities of the Stakeholder members. The executive summary of this and the third Smart-EO questionnaire produced are presented in Annex 5. For convenience, the questions are as follows:

1. In order to perform holistic evaluations of the innovative technologies, the main viewpoints that need to be considered from WPs 2 and 3 are stated below; please rank in order of priority (1: highest; 2 next highest, etc) from the list: Technical performance; Economic; Sustainable; Social.
2. The main issues to be included in the regional pre-conditions for performing the evaluations, in ranked order, are: (Choose from the list: Climatic conditions; Local building regs; Local policies; Geographical features; and Other (specify)).
3. The main issues to be included in performing technical evaluations of the innovations, in ranked order, are: (Choose from the list: Requirements met?; Robustness; Reliability; Maintainability; and Other (specify)).
4. The main issues to be included in performing economic evaluations of the innovations, in ranked order, are: (Choose from the list: Set up costs; Operational costs; Cost-benefit; Service length; and Other (specify)).

Questions 5 – 8 asked the experts to assess the potential contribution that the innovations identified in Q2 could make to the various issues important to the Vision as determined by Q1 (minimum energy consumption, monitoring, local issues, user manuals, adaptability, lifecycle, setting up and dismantling) by a number between 0 – 5, where 0 indicates no potential contribution, and 5 indicates maximal contribution.

5. Please assess the potential impact of the most important energy saving innovations identified in Q2, namely insulation, passive cooling, passive solar, lighting, orientation, etc.
6. Please assess the innovations which are felt to have the highest potential impact as identified in Q2, namely, renewable energy, passive measures, building operation, financial incentives, new materials, etc.

7. Please assess the potential impact of the most important renewable energy innovations identified in Q2, namely, solar thermal, co-generation, earth energy, photovoltaics, biomass, etc.
8. Please assess the potential impact of the most important operational aspect innovations identified in Q2, namely, building management system, automation, robustness to users, monitoring, waste management, etc.

Questions 9-12 are formulated to assess the potential contribution that the top innovations identified in Q2 could make to the key decision criteria identified in WP4 (ie, “How effective is it?”, “Does it have large potential?”, “Is it sustainable?”, “Is it cost effective?”, and “Is it easy to implement?”). This was done by entering a number between 0 – 5 in each box, where 0 indicates no potential contribution, and 5 indicates maximal contribution.

9. Please assess the most important energy saving innovations identified in Q2 (namely, insulation, passive cooling, passive solar, lighting, orientation, etc.) with respect to the WP4 criteria.
10. Please assess the innovations having the highest potential impact identified in Q2 (namely, renewable energy, passive measures, building operation, financial incentives, new materials, etc.) with respect to the WP4 criteria.
11. Please assess the most important renewable energy innovations identified in Q2 (namely, solar thermal, co-generation, earth energy, photovoltaics, biomass, etc.) with respect to the WP4 criteria.
12. Please assess the most important operational innovations identified in Q2 (namely, building management system, automation, robustness to users, monitoring, waste management, etc.) with respect to the WP4 criteria.

Question 13 requested comments to identify key validation issues in a generic way as follows:

13. What are important issues related to the validation of implementing the innovations within Smart-Eco buildings?

Questions 14-15 are aimed more at WP5 where one of the aims is to estimate the market perspective for the innovations considered and the likely take up rates at the EU level (in percentage) within the built sector over various timescales.

14. From all the best energy saving innovations identified in Q2 (namely, insulation, passive cooling, passive solar, lighting, orientation, etc) estimate the market perspective for the timescales to 2015, 2020, 2025 and 2030.
15. From all the renewable energy innovations from Q2 (namely, solar thermal, co-generation, earth energy, photovoltaics, biomass, etc.) estimate the market perspective for the timescales requested.

3.3.1. Data Analysis from Questionnaire 3 (Q3)

A total of 18 Q3 questionnaires have been completed and the detailed responses for the questions are presented next.

Question 1: From a holistic viewpoint the most important evaluation criteria (in ranked order) are:

1. Technical performance
2. Economic
3. Sustainable
4. Regional pre-conditions
5. Social

Some comments received for Q1 are:

- For me, sustainable covers other view points and regional pre-conditions is not a question of interest, it is a question of context since we do not have choice.
- For me sustainability includes environmental, economical and social parts, and brings the 3 together in a semi-holistic approach
- I tend to robustness, reliability and maintainability as rather equal. They ensure that the “thing” does what it is supposed to in the long run.
- “Sustainable” includes environmental, economic and social, on the basis of a technical and functional performance.

Question 2: The main issues to be included in the regional pre-conditions for determining the evaluations in ranked order are:

1. Climatic conditions
2. Local building regulations
2. Local policies

4. Geographical features

Some comments received for Q2 are:

- National or regional 'State of the Art' construction/materials currently used/ know-how of operators & construction companies, etc, i.e, how distant is the current practice from the Smart-ECO goals?
- Other: Financial is rated 2nd
- It is very difficult to rate the different bullets and one is forced, by the government, and the other bullets, to work hand in hand where one requirement is needed to fulfil the other
- All the issues have the same rank from my point of view
- The climatic conditions and geographical features should have impact on the local policies and building regulations
- I'd say regulations and policies might need to be adapted in order to enable sustainable construction. Applying them as basis for an evaluation would regard these as given and unchangeable
- Other: Economic preconditions

Question 3: The main issues to be included in the performing the technical evaluations of the innovations, in ranked order are:

1. Requirements are met
2. Reliability
3. Robustness
4. Maintainability

Some comments received for Q3 are:

- Maintainability should be intended in a wider sense, including the possibility of upgrading performances in the future should regulations/market require so
- What is the difference between reliability and robustness?
- Ease of use
- I tend to robustness, reliability and maintainability as rather equal. They ensure that the "thing" does what it is supposed to in the long run.

Question 4: The main issues to be included in the performing the economic evaluations of the innovations, in ranked order are:

1. Cost-benefit analysis
2. Set up costs
3. Operational costs
4. Service life time

Some comments received for Q4 are:

- The component must be bought, and these costs are very important
- Other: cost of the acquisitions is the highest issue
- Other: life-cycle cost performance is the most important issue regarding economic evaluation
- Life-cycle costs and economical risk (risky to use new concept, lack of experience, etc)
- Other: the highest priority should be life-cycle costs for doing the economic evaluations
- Cost-benefit – regarded over the full service life and over a reasonable period of analysis would include the others. The items are elements of each other.

Question 5: The potential impact of the most important energy saving innovations identified in Q2 towards achieving the various vision goals, in ranked order are:

(a) Potential of using insulation innovations

1. Minimise energy consumption
2. User manuals (easy to use)
3. Local issues
3. Adaptability
5. Setting up (ease to set up)
6. Dismantling (ease to dismantle)
7. Life cycle (ease of reuseability)
8. Monitoring (increases awareness)

(b) Potential of using passive cooling innovations

1. Minimise energy consumption
2. User manuals (easy to use)
3. Adaptability
4. Local issues

5. Setting up (ease to set up)
6. Dismantling (ease to dismantle)
7. Life cycle (ease of reuseability)
8. Monitoring (increases awareness)

(c) Potential of using passive solar innovations

1. Minimise energy consumption
2. User manuals (easy to use)
3. Local issues
4. Adaptability
5. Setting up (ease to set up)
6. Dismantling (ease to dismantle)
6. Life cycle (ease of reuseability)
8. Monitoring (increases awareness)

(d) Potential of using lighting innovations

1. User manuals (easy to use)
2. Minimise energy consumption
3. Setting up (ease to set up)
4. Adaptability
5. Dismantling (ease to dismantle)
6. Local issues
7. Life cycle (ease of reuseability)
8. Monitoring (increases awareness)

(e) Potential of using building orientation as an innovation

1. Minimise energy consumption
2. Local issues
3. Setting up (ease to set up)
4. Adaptability

A comment received for Q5 is:

- It is difficult to say so many things in a unique way, every one includes its own weighting, how to interpret these heterogeneous data is not so clear for me.

Question 6: The potential impact of the innovations identified in Q2 towards achieving the various vision goals, in ranked order are:

(a) Potential of using renewable energy innovations

1. Minimise energy consumption
2. Local issues
3. User manuals (easy to use)
4. Life cycle (ease of reuseability)
5. Adaptability
5. Setting up (ease to set up)
7. Dismantling (ease to dismantle)
8. Monitoring (increases awareness)

(b) Potential of using passive measures

1. Minimise energy consumption
2. User manuals (easy to use)
3. Local issues
4. Adaptability
4. Setting up (ease to set up)
6. Life cycle (ease of reuseability)
7. Dismantling (ease to dismantle)
8. Monitoring (increases awareness)

(c) Potential of using operational innovations

1. Minimise energy consumption
2. User manuals (easy to use)
3. Monitoring (increases awareness)
4. Adaptability
5. Life cycle (ease of reuseability)
6. Local issues

7. Dismantling (ease to dismantle)
8. Setting up (ease to set up)

(d) Potential of using finance incentive innovations

1. Minimise energy consumption
1. Monitoring (increases awareness)
3. Local issues
4. Setting up (ease to set up)
5. Adaptability
6. Life cycle (ease of reuseability)

(e) Potential of using new materials as innovations

1. Minimise energy consumption
2. Life cycle (ease of reuseability)
3. Setting up (ease to set up)
3. Local issues Adaptability
5. Dismantling (ease to dismantle)

A comment received for Q6 is:

- What are new materials? Which person/group defines what are new materials? And a question which goes along with this is What are old materials? This depends on the country and financial background

Question 7: The potential impact of the most important renewable energy innovations identified in Q2 towards achieving the various vision goals, in ranked order are:

(a) Potential of using solar thermal innovations

1. Minimise energy consumption
2. User manuals (easy to use)
3. Adaptability
3. Local issues
5. Setting up (ease to set up)
6. Dismantling (ease to dismantle)
7. Life cycle (ease of reuseability)
8. Monitoring (increases awareness)

(b) Potential of using co-generation innovations

1. Minimise energy consumption
2. User manuals (easy to use)
3. Local issues
4. Adaptability
5. Setting up (ease to set up)
6. Dismantling (ease to dismantle)
7. Life cycle (ease of reuseability)
8. Monitoring (increases awareness)

(c) Potential of using Earth energy innovations

1. Minimise energy consumption
2. User manuals (easy to use)
3. Local issues
4. Adaptability
5. Setting up (ease to set up)
6. Dismantling (ease to dismantle)
6. Life cycle (ease of reuseability)
8. Monitoring (increases awareness)

(d) Potential of using photovoltaic innovations

1. User manuals (easy to use)
2. Minimise energy consumption
3. Local issues
4. Setting up (ease to set up)
5. Adaptability
6. Life cycle (ease of reuseability)
7. Dismantling (ease to dismantle)
8. Monitoring (increases awareness)

(e) Potential of using biomass innovations

1. Minimise energy consumption
2. Local issues
3. User manuals (easy to use)
4. Adaptability
5. Setting up (ease to set up)
6. Life cycle (ease of reuseability)
7. Dismantling (ease to dismantle)
8. Monitoring (increases awareness)

Some comments received for Q7 are:

- What does co-generation mean exactly? Combination PV & ST? This is my point of view. This is the only way to include into Smart-ECO buildings. District heating is not considered
- Minimise energy: it is not clear if this means fossil fuel or overall energy
- Adaptability: not clear what the question is here, ie, if it is possible to increase production if needed? If Yes it is adaptable to every type of building, roof, occupation etc.
- Life cycle/ easily reusable: not many things are reusable but materials could be recycled
- Ease of set up: this could be easy for professionals but not for others.

Question 8: The potential impact of the most important operational innovations identified in Q2 towards achieving the various vision goals, in ranked order are:

(a) Potential of using building management system innovations

1. Minimise energy consumption
2. User manuals (easy to use)
3. Monitoring (increases awareness)
4. Adaptability
5. Setting up (ease to set up)
6. Local issues
7. Life cycle (ease of reuseability)
8. Dismantling (ease to dismantle)

(b) Potential of using automation innovations

1. Minimise energy consumption
2. User manuals (easy to use)
3. Adaptability
4. Monitoring (increases awareness)
5. Setting up (ease to set up)
6. Life cycle (ease of reuseability)
7. Local issues
8. Dismantling (ease to dismantle)

(c) Potential of using innovations which are robust to users

1. User manuals (easy to use)
2. Monitoring (increases awareness)
3. Minimise energy consumption
4. Adaptability
5. Local issues
6. Life cycle (ease of reuseability)
7. Dismantling (ease to dismantle)
8. Setting up (ease to set up)

(d) Potential of using monitoring innovations

1. Monitoring (increases awareness)
2. Minimise energy consumption
2. User manuals (easy to use)
4. Adaptability
5. Setting up (ease to set up)
6. Life cycle (ease of reuseability)
7. Local issues
8. Dismantling (ease to dismantle)

(e) Potential of using waste management innovations

1. Monitoring (increases awareness)
2. Local issues
3. Minimise energy consumption

4. Setting up (ease to set up)
5. Adaptability
6. Life cycle (ease of reuseability)
7. User manuals (easy to use)
8. Dismantling (ease to dismantle)

Some comments received:

- Robustness to users: very difficult to rate this, does it make sense to rate this with the headlines?
- Monitoring: for a higher rating a combination of monitoring and control is preferable
- Waste Management: in my opinion it makes no sense to include this point in this table.

Question 9: The potential impact assessment of the most important energy saving innovations identified in Q2 towards achieving the WP4 criteria, in ranked order are:

(a) Insulation innovations are likely to have the most potential with respect to following viewpoints:

1. Technical effectiveness
2. Large overall potential
3. Cost effectiveness
4. Ease of implementation
5. Sustainable

(a) Insulation innovations are likely to have the most potential with respect to following viewpoints:

1. Technical effectiveness
2. Large overall potential
3. Cost effectiveness
4. Ease of implementation
5. Sustainable

(b) Passive cooling innovations are likely to have the most potential with respect to following viewpoints:

1. Technical effectiveness
2. Sustainable
3. Large overall potential
3. Cost effectiveness
5. Ease of implementation

(c) Passive solar innovations are likely to have the most potential with respect to following viewpoints:

1. Sustainable
2. Technical effectiveness
3. Large overall potential
4. Ease of implementation
5. Cost effectiveness

(d) Lighting innovations are likely to have the most potential with respect to following viewpoints:

1. Large overall potential
1. Ease of implementation
3. Cost effectiveness
4. Technical effectiveness
5. Sustainable

(e) Building orientation is likely to have the most potential with respect to following viewpoints:

1. Sustainable
2. Technical effectiveness
3. Large overall potential
4. Cost effectiveness
5. Ease of implementation

Question 10: The assessment of the innovations felt to have the highest impact potential as identified in Q2 towards achieving the WP4 criteria, in ranked order are:

(a) Renewable energy innovations are likely to have potential with respect to following viewpoints:

1. Sustainable
2. Large overall potential
3. Technical effectiveness
4. Ease of implementation
5. Cost effectiveness

(b) Innovations using passive measures are likely to have potential with respect to following viewpoints:

1. Sustainable
2. Large overall potential
3. Technical effectiveness
4. Ease of implementation
5. Cost effectiveness

(c) Operational innovations are likely to have potential with respect to following viewpoints:

1. Large overall potential
2. Sustainable
3. Cost effectiveness
4. Ease of implementation
5. Technical effectiveness

(d) Finance incentive innovations are likely to have potential with respect to following viewpoints:

1. Large overall potential
2. Overall effectiveness
3. Ease of implementation
4. Sustainable
5. Cost effectiveness

(e) Innovations using new materials are likely to have potential with respect to following viewpoints:

1. Large overall potential
2. Technical effectiveness
3. Sustainable
4. Ease of implementation
5. Cost effectiveness

Question 11: The assessment of the most important renewable energy innovations felt to have the highest impact potential as identified in Q2 towards achieving the WP4 criteria, in ranked order are:

(a) Solar thermal innovations are likely to have potential with respect to following viewpoints:

1. Sustainable
2. Large overall potential
3. Technical effectiveness
4. Cost effectiveness
5. Ease of implementation

(b) Co-generation based innovations are likely to have potential with respect to following viewpoints:

1. Technical effectiveness
2. Sustainable
3. Large overall potential
4. Cost effectiveness
5. Ease of implementation

(c) Earth energy based innovations are likely to have potential with respect to following viewpoints:

1. Sustainable
2. Technical effectiveness
3. Large overall potential
4. Cost effectiveness
5. Ease of implementation

(d) Photovoltaic based innovations are likely to have potential with respect to following viewpoints:

1. Sustainable
2. Technical effectiveness
2. Large overall potential
4. Ease of implementation
5. Cost effectiveness

(e) Biomass based innovations are likely to have potential with respect to following viewpoints:

1. Sustainable
2. Cost effectiveness
3. Technical effectiveness
4. Large overall potential
4. Ease of implementation

Question 12: The assessment of the most important operational innovations felt to have the highest impact potential as identified in Q2 towards achieving the WP4 criteria, in ranked order are:

(a) Building management system innovations have potential with respect to following viewpoints:

1. Technical effectiveness
2. Large overall potential
3. Cost effectiveness
4. Sustainable
5. Ease of implementation

(b) Automation innovations are likely to have potential with respect to following viewpoints:

1. Large overall potential
2. Technical effectiveness
3. Cost effectiveness
3. Sustainable
5. Ease of implementation

(c) Innovations robust to users are likely to have potential with respect to following viewpoints:

1. Technical effectiveness
2. Large overall potential
3. Cost effectiveness
3. Ease of implementation
5. Sustainable

(d) Monitoring innovations are likely to have potential with respect to following viewpoints:

1. Technical effectiveness
1. Large overall potential
1. Sustainable
4. Ease of implementation
5. Cost effectiveness

(e) Waste management based innovations are likely to have potential with respect to following viewpoints:

1. Sustainable
2. Large overall potential
3. Cost effectiveness
4. Technical effectiveness
5. Ease of implementation

Question 13: Comments received relating to the validation of implementing the innovations within Smart-ECO buildings are:

- Most important issue is to find out the appropriate incentives for the public sector in order to facilitate implementation of energy and renewable innovations in public buildings stock – as a large application area as well as visible.
- Not competent to comment
- Understandable, reliable, cost/benefit
- Local policies, adaptability, economy
- One aspect is to fulfil the governmental laws, and furthermore, it is very difficult to find the right components.
- Works all year and when needed
- Price, education of consumers, government policies.

Question 14: The assessment of the market perspective for the best energy saving innovations considered and their likely take up rates at the EU level (in percentages) within the built sector over various time scales are:

(a) Insulation innovations:

- Likely product average score: 4.4
- Average score for market take up by 2015: 44%
- Average score for market take up by 2020: 60%
- Average score for market take up by 2025: 76%
- Average score for market take up by 2030: 84%

(b) Passive cooling innovations:

- Likely product average score: 2.8
- Average score for market take up by 2015: 12%
- Average score for market take up by 2020: 20%

- Average score for market take up by 2025: 27%
- Average score for market take up by 2030: 38%

(c) Passive solar innovations:

- Likely product average score: 3.2
- Average score for market take up by 2015: 19%
- Average score for market take up by 2020: 28%
- Average score for market take up by 2025: 38%
- Average score for market take up by 2030: 52%

(d) Lighting innovations:

- Likely product average score: 4.1
- Average score for market take up by 2015: 22%
- Average score for market take up by 2020: 44%
- Average score for market take up by 2025: 59%
- Average score for market take up by 2030: 69%

(e) Building orientation innovations:

- Likely product average score: 2.7
- Average score for market take up by 2015: 14%
- Average score for market take up by 2020: 24%
- Average score for market take up by 2025: 26%
- Average score for market take up by 2030: 32%

Some comments received for Q14 are:

- I cannot estimate these %s for the Market perspective
- Insulation products could be for refurbishment
- Passive cooling: integrated application of passive solutions are already existing
- Lighting: innovative shading systems
- Time scales have to compare between each other. Hence only one column is 100% so I give you my feeling of the different components compared to the others. This is based on current status and for Germany
- Likely products are as follows: Insulation = insulating panels, passive cooling = natural ventilation, passive solar = passive solar windows, lighting = light tubes, orientation = orientation for maximum PV irradiation
- Passive Solar: Solar Thermal and Shadowing? This topic has a wide range and PV is active and not included.

Question 15: The assessment of the market perspective for the renewable energy innovations considered and their likely take up rates at the EU level (in percentages) within the built sector over various time scales are:

(a) Solar thermal innovations:

- Likely product average score: 3.5
- Average score for market take up by 2015: 20%
- Average score for market take up by 2020: 30%
- Average score for market take up by 2025: 39%
- Average score for market take up by 2030: 54%

(b) Co-generation innovations:

- Likely product average score: 3.6
- Average score for market take up by 2015: 28%
- Average score for market take up by 2020: 33%
- Average score for market take up by 2025: 40%
- Average score for market take up by 2030: 46%

(c) Earth energy based innovations:

- Likely product average score: 2.5
- Average score for market take up by 2015: 13%
- Average score for market take up by 2020: 17%
- Average score for market take up by 2025: 22%
- Average score for market take up by 2030: 27%

(d) Photovoltaic based innovations:

- Likely product average score: 3.4
- Average score for market take up by 2015: 22%

- Average score for market take up by 2020: 26%
- Average score for market take up by 2025: 34%
- Average score for market take up by 2030: 42%

(e) Biomass based innovations:

- Likely product average score: 2.5
- Average score for market take up by 2015: 17%
- Average score for market take up by 2020: 23%
- Average score for market take up by 2025: 31%
- Average score for market take up by 2030: 36%

Some comments received for Q15 are:

- Time scales: for an adequate perspective, a comparison to a standard value is necessary. It makes no sense to say perspective is 20% the real formulation should be compared to, for example, the situation in 2000 where the market perspective/rate of increase would be/ could be 20 or 30%. Another possibility is to compare the different possibilities amongst each other.
- Photovoltaics: The expected market perspective may in fact reduce over the coming years as the government aid will be reduced.
- Likely products are as follows: solar thermal = solar collectors, co-generation = integrated district heating cogeneration, earth energy = ground source heat pumps, photovoltaics = transparent PV modules, biomass = biomass combined heat and power.

4. Market perspectives on Eco buildings and stakeholders

One of the aims of WP5 is to use the results from the workpackage to produce a report on the market perspective for Eco-buildings and the stakeholders. This will be produced from the responses from Q3 as some specific questions (questions 14 and 15) have been included to gauge the opinions on the market perspectives of the built sector and which products are likely to emerge initially and be widely accepted. The experts have made comments relating to the fact that these are extremely difficult questions to answer and in some cases the responses are pure guesses. Having said this most of the responses have been quite similar and the ranking of the various innovations to produce market products are presented next.

Market potential assessments of the energy saving innovations ranking are:

1. Insulation products (with average score of 4.4 and market take up potential of 84% by 2030)
2. Lighting products (with average score of 4.1 and market take up potential of 69% by 2030)
3. Passive solar products (with average score of 3.2 and market take up potential of 52% by 2030)
4. Passive cooling products (with average score of 2.8 and market take up potential of 38% by 2030)
5. Building orientation (with average score of 2.7 and market take up potential of 32% by 2030).

Market potential assessments of the renewable energy innovations ranking are:

1. Co-generation products (with average score of 3.6 and market take up potential of 46% by 2030)
2. Solar thermal products (with average score of 3.5 and market take up potential of 54% by 2030)
3. Photovoltaic products (with average score of 3.4 and market take up potential of 42% by 2030)
4. Biomass products (with average score of 2.5 and market take up potential of 36% by 2030)
5. Earth energy products (with average score of 2.5 and market take up potential of 27% by 2030).

5. Conclusions

The report has presented the work carried out within the WP5 Workpackage of the Smart-ECO project to set up and engage with the built sector Stakeholders. A large number of experts (238) from a range of areas were contacted and invited to participate with the Smart-ECO project to formulate the Vision, identify the innovations and evaluate the proposed solutions that have been identified within the project. Of these contacts 66 agreed to join the Smart-Eco project and have assisted in the project by providing responses and comments to specially produced questionnaires. In addition, some stakeholders have attended Smart-ECO meetings and events and provided detailed input on various tasks of the project.

This report has presented the details of the responses that have been gathered from the Stakeholder group for the three questionnaires formulated and used to ground the detailed work carried out within the project. These questionnaires have helped the partners to finalise and rank the various aspects in the Smart-ECO Vision (Q1), identify the innovations which have potential to contribute to this vision (Q2) and how the innovations identified should be evaluated for helping achieve the Vision (Q3).

Overall the Stakeholder group has been successful in connecting a wide group of experts to the detailed work programme and provide a valuable mechanism for ranking the various issues important for the different workpackages.

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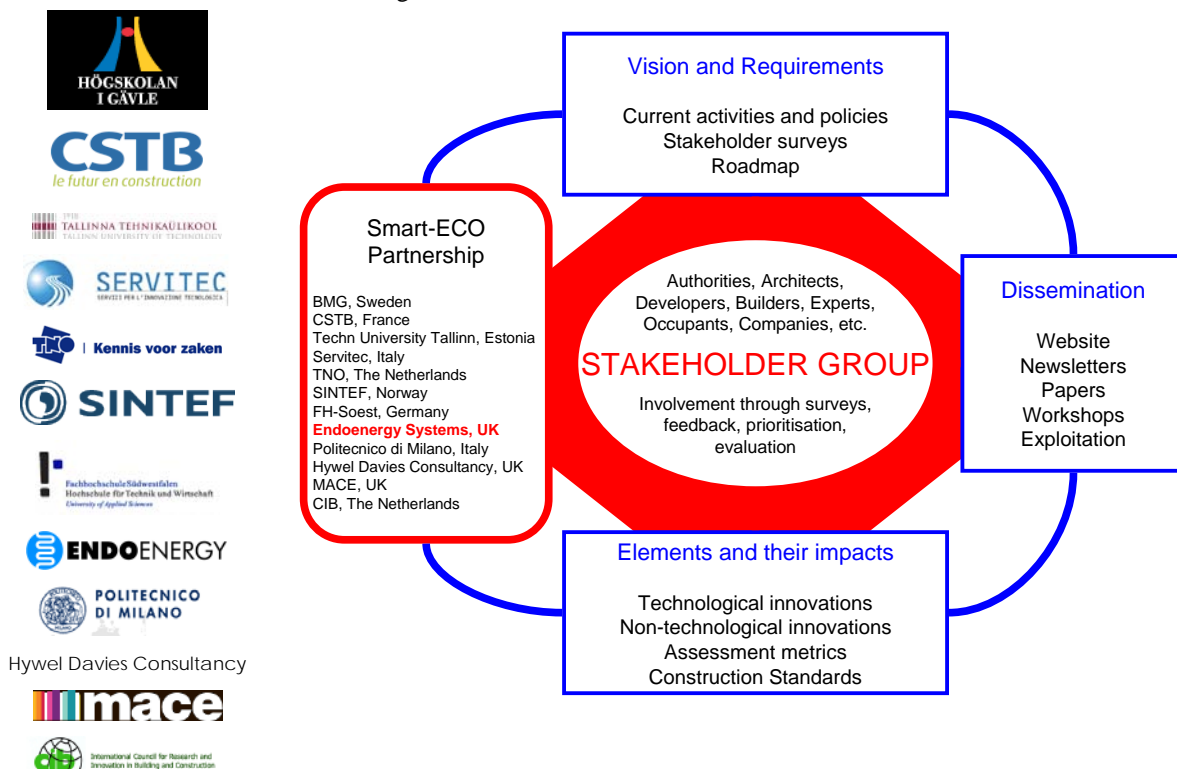
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Annex 2: Introduction of Smart-ECO project for the Stakeholders

Sustainable Smart Eco-buildings in the EU (SMART-ECO): EC Specific Support Action



SMART-ECO is a 30-month specific support action funded by the EC DG TREN (Directorate General on Transport and Energy) to **create an all-inclusive community of stakeholders for eco-buildings** by bringing together experienced organizations that span the full range of views. SMART-ECO will be involving this community to focus on the global issues of sustainable buildings so that the key issues needing adoption can be agreed holistically within an appropriate timeline as well as the main items being prioritised within an overall **Roadmap for this area**. In this way it is intended that recommendations to the EC can be made from the results obtained to ensure that EU level activities and policies can be mapped to **ensure even coverage and gaps identified for focussing future efforts**. Aspects of sustainable development, life performance, ambient intelligence, and relevant stakeholder concerns will be brought into the discussions of innovative technologies and how they may be introduced into the built sector. To achieve these important goals in **agreeing and implementing a strategy for sustainable smart eco-buildings**, the project is setting up a core, but wide-ranging group of stakeholders who can assist in developing the strategies that are needed to create smart eco-buildings in the EU. This stakeholder group will be involved throughout the project, and will serve as a reference group so that the wider community will have **“ownership of the recommendations”** arrived at. SMART-ECO has been structured to allow proposals that could have a role in achieving the “sustainable eco-buildings vision” so that they can be fully assessed from all technical and non-technical views in order to determine their “real” potential in terms of acceptability for adoption by the stakeholder community. To achieve this overall aim, SMART-ECO has been structured as shown in the figure below:



The project focuses on routes and means that enable the uptake of efficient innovative technologies that can allow the building and construction sector to meet the required vision of sustainability. The current situation and the vision of a more sustainable built environment sets the frame for the appreciation of the long term effectiveness of Eco-buildings and innovative technologies, especially renewable energy systems. Together, the vision and relevant EC policies serve as a reference framework for the analysis of life performance aspects of innovative technologies applied to realise more energy efficient and more sustainable buildings. The potential results will be evaluated from a range of viewpoints validated by the Stakeholders Group enabling widespread usage and to create a common approach for benchmarking. The impact an innovation can have with regards to

sustainability clearly depends on a set of factors, including environmental performance, life cycle perspectives, economic aspects, together with technical, managerial performance and applicability need to be applied.

We hope because of your interest and experience in the area, we would like to invite you to participate in the project to formulate the SMART-Eco vision and assess and validate the results. The interaction will be via emails, e-meetings and face-to-face meetings as appropriate. Documents produced by the SMART-ECO will be provided and feedback will be requested in the form of surveys and interviews to ensure the proposals are well accepted by the stakeholder community or if changes are needed in the priorities and how these should be realised.

If you are interested to be involved please contact the individuals listed below. Further details may be found at the URL: <http://www.smart-eco.eu>



Annex 3: Smart-ECO Questionnaire 1

Vision of Sustainable Smart Eco-buildings in 2030

Jean-Luc Chevalier and Alexandra Lebert, CSTB, France

The objective of the vision document is to provide a **consensual vision of what should constitute sustainable SMART-ECO buildings in the period 2010-2030**, considering the actual EU's starting point. A second document will establish the requirements to support the vision, and suggest tools for measuring how the requirements are being fulfilled. Both will be submitted to the stakeholders for comments. The resulting stakeholder-supported vision will serve as the point of reference for the identification and discussion of the innovations. It will provide the basis for further work in the SMART-ECO project.

The SMART-ECO project plans to apply the “back-casting” approach to realise the “Smart-ECO Vision” in Workpackage WP2 which is led by CSTB, France. For this, different aspects of sustainable SMART-ECO (SS-E) buildings are first formulated as the goals to reach. The steps to reach these goals are then derived backwards, successively through identifying the problems and requirements so that the solutions may be realised.

Executive summary of the Initial SMART-ECO “Vision”

Sustainable SMART-ECO buildings result from the practical application of the general principles of sustainability [ISO 15392:2008]: Continual improvement, Equity, Global thinking and local action, Holistic approach, Involvement of all interested parties, Long term considerations, Precaution and risk, Responsibility, Transparency. These general principles need to be applied in all decision making (especially the project planning phases) associated with the buildings' life cycles.

SS-E buildings meet the needs expressed by the owners and/or future users, and fulfil their main use functions [CIB W052 “Procurement systems” – 1995]: Provide space, Provide an indoor climate, Provide safety and security, Allow the use of goods and tools, Control the nearby relationship, Take advantage from the site without damaging it, Bring meaning (semiology).

SS-E buildings contribute to sustainable development, when designed and operated for matching the appropriate fitness for use, with minimum adverse environmental impacts, while encouraging improvements in economic, social and cultural aspects at local, regional and global levels.

More precisely, SS-E buildings:

- a) Result from a collective decision to build (or to renovate) on a chosen spot, taken in accordance with the needs and with the specific conditions of the close natural and built environment.
- b) Are designed from a life cycle perspective, on the environmental, economic, and social points of view, and anticipating at the design phase the consequences of the choices at each phase of the project, especially when technical and/or process innovations are required.
- c) Are erected in acceptable setting up conditions, including limited resource withdrawals (material resources, embodied energy, site energy consumption, waste, etc.), environmental management of the construction site and working conditions.
- d) Sustain the use functions (see above) with minimised energy consumptions (for each purposes including heating and cooling, lighting, hot water production, household appliances operation, etc), minimized waste production, and minimum operation complexity and cost, for the required service life, including the necessary maintenance and repair procedures.
- e) Provide monitored and traceable technical and environmental performances, thanks to the responsible behaviour of owners, operation managers and users.
- f) Come with user and operation manuals.
- g) Allow the insertion into the local networks and urban life: accessibility for all, safety and security, proximity to transportation means, consistent with new information technologies, with nearby services, with a patrimonial value, and with low impacts on the environment.
- h) Permit and ensure refurbishing, retrofitting and adaptation: adaptable for changing performance requirements, for increased or decreased capacity, for different uses, etc.
- i) Facilitate dismantling: ease for demolition, possibility of dismantling, opportunities of demolition materials recycling, and site restoration planning have been foreseen.

All these aspects are part of the overall detailed SMART-ECO Vision document. It is felt that they may be formulated with quantified targets only when established in detail and for individual categories of buildings.

The above is a short executive summary of the initial SMART-ECO Vision document. If you would like to receive and review the whole Draft Vision document, please contact the chair of the Stakeholders Group listed below. You are requested to respond to the short questionnaire that has been prepared to gather your views on this Vision document.

Further details regarding the SMART-ECO project may be found at the URL: <http://www.smart-eco.eu>



Stakeholders' views in initial SMART-ECO Vision

We would like to solicit views on the key issues that have been identified by the Smart-ECO consortium to ensure that the Smart-ECO sustainable building vision has a sound grounding within the community. Part of the project involves creating a Stakeholder Group which you have very kindly agreed to join. Because of your interest, expertise and standing in the area your views are most important. Your involvement can be as much or as little as you like, the key thing is we would very much appreciate your views and opinions on the key decisions that are made.

Various activities are planned where stakeholders will be invited to attend key meetings and workshops and funds have been budgeted for enabling this involvement. We hope you will be able to become as pro-active as possible and help us create a sustainable building community for the EU and beyond. The next SMART-ECO meeting is planned to be held at **SINTEF in Oslo, Norway on 12-13 January 2009**. If you are able to attend this meeting please let me know.

To start the consultation with the Stakeholder Group we would appreciate you looking at the "Vision of sustainable smart eco-buildings in 2030" document that has been prepared by colleagues working in the WP2 Workpackage in the SMART-ECO project.

We very much appreciate your help, and hope this work and its results will be of interest to you. The final report of the Smart-ECO project results will be sent to all active stakeholders.

Very brief anonymous information about you.

I am <input type="checkbox"/> Male <input type="checkbox"/> Female	I live in (give name of country)	I am interested in environmental issues <input type="checkbox"/> No <input type="checkbox"/> Don't know <input type="checkbox"/> Yes
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Please, fill in the parts of the questionnaire that are applicable to you.

My areas of expertise and experience are the following (tick all that apply).

<input type="checkbox"/> Authorities	<input type="checkbox"/> Technical experts	<input type="checkbox"/> Industry	<input type="checkbox"/> Material expert
<input type="checkbox"/> Developer	<input type="checkbox"/> Architect	<input type="checkbox"/> Builder	<input type="checkbox"/> Occupant
<input type="checkbox"/> Demolition expert	<input type="checkbox"/> Education	<input type="checkbox"/> Other (Please specify):.....	

1. It is important to ensure that the SMART-ECO vision is obtained via wide consultation and consensus rather than consulting a few elitist stakeholders.

<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly Agree
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Any comments?

2. Using the back-casting approach is important in formulating a reliable and robust "Vision" document.

<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly Agree
--	-----------------------------------	----------------------------------	--------------------------------	---

Any comments?

3. The general principles of sustainability set out in ISO 15392:2008 are acceptable for basing the Vision.

Strongly disagree | Disagree | Neutral | Agree | Strongly Agree

Any comments?

4. An SS-E building could be a new or a renovated building without any difference of approach.

Strongly disagree | Disagree | Neutral | Agree | Strongly Agree

Any comments?

5. The main use functions of SS-E buildings as expressed by CIB WO52 Procurement systems”: 1995 are acceptable for formulating the SMART-ECO Vision document.

Strongly disagree | Disagree | Neutral | Agree | Strongly Agree

Any comments?

6. From the detailed issues stated in the Initial SMART-ECO Executive summary, please indicate your level of agreement/ disagreement on the importance of each issue:

a. SS-Es should result from a collective decision

Strongly disagree | Disagree | Neutral | Agree | Strongly Agree

b. SS-Es should be designed from a life cycle perspective

Strongly disagree | Disagree | Neutral | Agree | Strongly Agree

c. SS-Es should be erected in acceptable setting up conditions

Strongly disagree | Disagree | Neutral | Agree | Strongly Agree

d. SS-Es should sustain their use functions with minimised energy consumptions

Strongly disagree | Disagree | Neutral | Agree | Strongly Agree

e. SS-Es provide monitored and traceable technical and environmental performances

Strongly disagree | Disagree | Neutral | Agree | Strongly Agree

f. SS-Es should come with user and operation manuals

Strongly disagree | Disagree | Neutral | Agree | Strongly Agree

g. SS-Es should allow the insertion into local networks and urban life

Strongly disagree | Disagree | Neutral | Agree | Strongly Agree

h. SS-Es should permit and ensure refurbishing, retrofitting and adaptation, etc for different uses.

Strongly disagree | Disagree | Neutral | Agree | Strongly Agree

i. SS-Es should facilitate dismantling

Strongly disagree | Disagree | Neutral | Agree | Strongly Agree

Comments:

Further details regarding the SMART-ECO project may be found at the URL: <http://www.smart-eco.eu>

Annex 4: Smart-ECO Questionnaire 2

Innovations to meet the vision of sustainable building 2030



Stefano Saldini, Amber Stevens, Mace Limited UK

Smart-ECO brings together experienced organizations that span the full range of stakeholders to focus on the global issues of sustainable building so that value can be added to the evaluation of current and future RTD activities at the EU level. As part of the project, the requirements for the vision for sustainable building is being formulated and stakeholders have already indicated the following key issues which should be included in the Smart-ECO vision document (in order of priority):

1. Buildings must be designed from a lifecycle point of view
2. Buildings must be constructed with limited resources and minimised energy consumption and waste production
3. Buildings must have minimised operational complexity while allowing easy monitoring of technical and environmental performances
4. Buildings must be adaptable to changes in capacity, type of users and performance requirements
5. Local issues must be included in all aspects of design, construction, use and dismantling
6. Buildings must facilitate ease of dismantling – reuse, recycle, restore.

The project is also looking at how the Vision identified can best be realised via a separate workpackage (WP3-Innovation). Work for WP3 has been carried out and it is now necessary to consult the Smart-ECO Stakeholders for their views and comment.

Executive Summary of WP3 - Identification of Innovations

This work package is tasked with identifying the innovative elements that could provide significant contributions to the vision of sustainable Smart-ECO buildings in the EU. Identification of the key elements is considered to be essential in the process of the realising the construction sector that evolves towards the Smart-ECO vision. Each element shall be independently evaluated in another workpackage of the project (in WP4-Evaluation) with regard to its contribution to this vision and the likely level of impact if the innovation is adopted widely throughout the EU.

The innovation elements are focussed on technical and application specific aspects identified from the following four tasks:

T3.1. Innovative technological solutions, especially renewable energy

Technologies are identified in terms of technical and performance characteristics associated with buildings. These innovations here include wind, solar thermal, photovoltaics, geothermal, biomass, waste, hydro, hydrogen, energy storage, insulation, lighting, water conservation, materials, operation, etc.

T3.2. Holistic building design applying innovative technologies

Elements are identified relating to technology, design tools and tools used to generate information required by designers when striving for a holistic view on design. These include using the best design knowledge available, reducing demand on materials, adopting adaptable and flexible designs, making efficient use of existing buildings, using passive design solutions, etc.

T3.3. Building construction with innovative technologies and building operation

This task elaborates issues that need to be considered when applying innovative technologies to the construction process. It is concerned both with how the innovative elements can be applied as well as innovative construction techniques. Innovations here include taking consideration of the availability of supply locally, optimal use of site, optimising delivery of materials for implementation, using most appropriate form of construction systems, effective operation and use manuals, comprehensive monitoring systems, etc.

T3.4. Meeting future requirements

This task illustrates how design and construction can be influenced now to increase adaptability over the long service life of buildings in order to embrace change. Issues important here include good management and processes, relevant policies at local, national and international levels, good communications to disseminate Best Practice, proper and attractive financial incentives, good education programmes, etc.

The above is a short executive summary of the key issues that are described in the initial SMART-ECO Innovations document. If you would like to receive and review the whole Draft Innovations document, please contact the chair of the Stakeholders Group listed below. You are requested to respond to the short questionnaire that has been prepared to gather your views on identifying the key elements of the Smart-ECO Innovations.

Further details regarding the SMART-ECO project may be found at the URL: <http://www.smart-eco.eu>



Stakeholders' views to identify key innovations

We would like to solicit views on the key issues that have been identified by the Smart-ECO consortium to ensure that the Smart-ECO sustainable building vision has a sound grounding within the community. This is the second questionnaire that focuses on identifying the key innovations needed to realise the Smart-ECO vision.

Various activities are planned where stakeholders will be invited to attend key meetings and funds have been budgeted for enabling this involvement. We would to invite about 20 Stakeholders to each meeting. We hope you will be able to become as pro-active as possible and help us create a sustainable building community for the EU and beyond. The next event planned is a **Stakeholder Workshop to be held in Brussels on 5th March 2009**. If you are able to attend this meeting please let me know. The Workshop is aimed at allowing detailed discussions to be carried out to further develop both the Smart-ECO “**Vision**” and to identify the key Smart-ECO “**Innovations**”.

Even if you cannot attend the planned meetings, we would value your contribution to this short questionnaire. We very much appreciate your help, and hope this work and its results will be of interest to you. The final report of the Smart-ECO project results will be sent to all active stakeholders.

Very brief anonymous information about you.

I am <input type="checkbox"/> Male <input type="checkbox"/> Female	I live in (give name of country)	I am interested in environmental issues <input type="checkbox"/> No <input type="checkbox"/> Don't know <input type="checkbox"/> Yes
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Please, fill in the parts of the questionnaire that are applicable to you.

My areas of expertise and experience are the following (tick all that apply).

<input type="checkbox"/> Authorities	<input type="checkbox"/> Technical experts	<input type="checkbox"/> Industry	<input type="checkbox"/> Material expert
<input type="checkbox"/> Developer	<input type="checkbox"/> Architect	<input type="checkbox"/> Builder	<input type="checkbox"/> Occupant
<input type="checkbox"/> Demolition expert	<input type="checkbox"/> Education	<input type="checkbox"/> Other (Please specify):.....	

7. There is added value of EU level action to promote innovative technologies.

Strongly disagree | Disagree | Neutral | Agree | Strongly agree

Any comments?

8. Taking into account public and private sector initiatives, the current economic downturn will slow down the deployment of innovations.

Strongly disagree | Disagree | Neutral | Agree | Strongly agree

Any comments?

9. The most important issues to help improve innovation through international cooperation are (select max 3):

<input type="checkbox"/> Applied research & demonstration actions	<input type="checkbox"/> Basic research	<input type="checkbox"/> Regulatory aspects
<input type="checkbox"/> Exchange of know how	<input type="checkbox"/> Stimulate global market	<input type="checkbox"/> Intellectual property rights
<input type="checkbox"/> Technology transfer	<input type="checkbox"/> Global codes and standards	<input type="checkbox"/> Others (please specify)

10. The stakeholders that will most contribute to the identification of innovative elements required for WP3 are the following (select max 3):

<input type="checkbox"/> Architects	<input type="checkbox"/> Policy makers	<input type="checkbox"/> Research institutions / universities / R&D
<input type="checkbox"/> Engineers / consultants	<input type="checkbox"/> Clients / developers	<input type="checkbox"/> Local authorities
<input type="checkbox"/> Product manufacturers	<input type="checkbox"/> Contractors / builders	<input type="checkbox"/> Financers

11. TECHNOLOGY PUSH or **DEMAND PULL** is needed to promote innovation. Which is the most able to accelerate the pathway to the market?

Technology push Demand pull

Any comments?

12. Smart-ECO buildings could be achieved with technologies currently available in the market.

Strongly disagree | Disagree | Neutral | Agree | Strongly agree

Any comments?

13. Types of buildings (new and existing) where Smart-ECO building are likely to have the higher impact are the following (select max 2):

Residential | Offices | Retail / Shops | Hospitals | Warehouses | Stations / Airports

Others (please specify).....

14. The stages of the building life cycle process where innovations are likely to be most effective are (select max 2):

Innovations affecting the way buildings are designed

Innovations affecting the way buildings are constructed

Innovations affecting the way buildings are refurbished

Innovations affecting the way buildings are operated

Innovations affecting the way buildings are demolished or dismantled

15. The areas where innovation has the higher potential to impact Smart-ECO buildings are (select max 3):

<input type="checkbox"/> Education	<input type="checkbox"/> Management and processes	<input type="checkbox"/> Water conservation
<input type="checkbox"/> Policies	<input type="checkbox"/> Passive design measures	<input type="checkbox"/> Operation
<input type="checkbox"/> Finance and incentives	<input type="checkbox"/> New materials	<input type="checkbox"/> Recycling
<input type="checkbox"/> Communications	<input type="checkbox"/> Renewable energy generation	<input type="checkbox"/> Others (please specify).....

16. Innovations adaptable to the refurbishment of existing buildings are more important than innovations for new buildings in the period 2010-2030.

Strongly disagree | Disagree | Neutral | Agree | Strongly agree

Any comments?

17. Applying integrated design procedures (close cooperation among architects, engineers, consultants, etc.) is important to achieve the Smart-Eco Vision objectives.

Strongly disagree | Disagree | Neutral | Agree | Strongly agree

Any comments?

18. The energy saving and efficient technologies with high potentials to impact Smart-ECO buildings are (please rank from 1 to 7 on potential impact where 1=high, 7=low):

<input type="checkbox"/> Insulation	<input type="checkbox"/> Lighting	<input type="checkbox"/> Orientation	<input type="checkbox"/> Water conservation and storage
<input type="checkbox"/> Passive cooling	<input type="checkbox"/> Passive solar	<input type="checkbox"/> Innovative materials	
<input type="checkbox"/> Others (please specify).....			

19. The renewable technologies with high potentials to impact Smart-ECO buildings are (max 3):

<input type="checkbox"/> Wind related technologies	<input type="checkbox"/> Earth energy	<input type="checkbox"/> Fuel cells
<input type="checkbox"/> Solar thermal	<input type="checkbox"/> Biomass	<input type="checkbox"/> Others (please specify)
<input type="checkbox"/> PV	<input type="checkbox"/> Cogeneration (CHP)

20. Energy generation related innovations should focus on (select max 2):

<input type="checkbox"/> Improving large power plant efficiency	<input type="checkbox"/> Develop more local / district plants
<input type="checkbox"/> Increase energy generated at building level	<input type="checkbox"/> Increase large-scale renewable power generation

21. The most important ‘Operation’ to help improve innovation are (select max 3):

<input type="checkbox"/> Building management system	<input type="checkbox"/> Intelligent lighting	<input type="checkbox"/> Automation or controls for energy saving
<input type="checkbox"/> Air quality control sensors	<input type="checkbox"/> Daylight dependent control sys	<input type="checkbox"/> Post occupancy monitoring
<input type="checkbox"/> Waste management plan	<input type="checkbox"/> Robustness to user behaviour	<input type="checkbox"/> Others (please specify).....

Any other comments?

Further details regarding the SMART-ECO project may be found at the URL: <http://www.smart-eco.eu>

Annex 5: Smart-ECO Questionnaire 3



WP4: Evaluation metrics

Leo Bakker, TNO, The Netherlands

Smart-ECO is an EC funded SSA being coordinated by the University of Gävle to set up a network of Stakeholders from the built sector able create and a generic vision framework for eco-buildings, determine what innovations could be useful for realising the vision and identify those elements that have the highest impact potentials. The project has been carried out but a number of workpackages (WPs); the three main technical workpackages are WP2 which has developed the Vision for sustainable smart eco-buildings in 2030; WP3 has determined the main innovations which could be used to realise the vision and WP4 aims to evaluate the innovations from WP3 to identify those which will have the highest impact toward realising the vision that has been formulated.

As part of the project a Stakeholder group comprising technical experts, industrialists, property developers, materials experts, architects, builders, demolition companies and educationalists has been set up with a total of 66 experts. These stakeholders have been invited to assist in the project to comment upon the work carried out and provide valuable feedback on the technical work carried out by completing questionnaires. To date two questionnaires have been carried out, the first questionnaire (Q1) focussed on the Vision work and the second questionnaire (Q2) focussed on the innovations and the following results have been obtained:

Q1 (WP2-Vision): 58 completed questionnaires

Most important issues in ranked order as identified by Stakeholders:

- | | |
|-----------------------------------|-----------------------------|
| 1. Lifecycle aspects of buildings | 5. Building adaptability |
| 2. Minimum energy consumption | 6. Local issues |
| 3. Monitoring of buildings | 7. Dismantling of buildings |
| 4. Building user manuals | 8. Setting up of buildings |

Q2 (WP3-Innovations): 51 completed questionnaires: Most important innovations identified, in ranked order:

“Best energy saving”	“Highest potential impact”	“Best renewable energies”	“Operational aspects”
1. Insulation	1. Renewable energy	1. Solar thermal	1. Building management systems
2. Passive cooling	2. Passive measures	2. Co-generation	2. Automation
3. Passive solar	3. Operation	3. Earth energy	3. Robustness to users
4. Lighting	4. Finance incentives	4. Photovoltaics	4. Monitoring
5. Orientation	5. New materials	5. Biomass	5. Waste management
6. Innovative material	6. Management	6. Wind technologies	6. Intelligent lighting
7. Water conservation	7. Education	7. Fuel cells	7. Air quality control
	8. Policies		8. Daylight controls
	9. Recycling		
	10. Communications		
	11. Water conservation		

WP4 continues the work of the Smart-ECO project and focuses on the methodology that should be used to evaluate the various innovations presented in WP3 with regard to assessing the potential contribution they are likely to make towards achieving the vision developed in WP2, as well as their likely level of impact if the innovation is adopted widely throughout the EU. In addition, the evaluation workpackage focuses on assessing the technical and application specific aspects identified from the following four tasks:

T4.1 Regional preconditions: This task has focused on the regional preconditions for the application of innovative technologies.

T4.2 Evaluation of innovation potential and efficiency: The task addresses the potential and the efficiency of innovative technologies with reference to the performance of buildings applying the technologies.

T4.3 Operation of innovative buildings: The task elaborates on the novelties that operators of smart sustainable eco-buildings need to handle. Usability and prevention of mal-operation (“smartness”) are key aspects ensuring the intended efficiency of innovative eco-buildings to be achieved in practice. Operation includes consideration of maintainability and preconditions for long-term efficiency.

T4.4 Mapping issues related to sustainability: This task gives an overview of the issues of sustainable smart eco-buildings in the EU. The issues related to sustainable eco-buildings and innovative technologies on the one hand and topics in policies and directives on the other hand are mapped. The task results in an identification of the focus area as well as the gaps that need to be addressed in order to sustain development towards the vision. The integral approach will be used to manage and interrelate this complex information.

T4.5 Life performance: The task addresses the evaluation of long-term technical performance (“life performance”) of innovative technologies, combining the concepts of performance based building, service life planning, environmental and economic life cycle assessment (LCA and LCC) and life management systems.

Further details regarding the SMART-ECO project may be found at the URL: <http://www.smart-eco.eu>.



Stakeholders’ views to identify the evaluation process

We would like to solicit views on the key issues that have been identified by the Smart-ECO consortium to ensure that the Smart-ECO sustainable building vision has a sound grounding within the community. This is the third questionnaire that focuses on identifying the process needed to be followed in evaluating the innovations which have been identified in WP3 to realise the Smart-ECO vision. We are grateful for your assistance to date with gathering the data for the first two Smart-ECO questionnaires on the “Vision” and the “Innovations” which are used here to formulate this third questionnaire on “Evaluation”. We would value your contribution to this questionnaire as well.

We very much appreciate your help, and hope this work and its results will be of interest to you. The final report of the Smart-ECO project results will be sent to all active stakeholders.

Very brief anonymous information about you.

I am <input type="checkbox"/> Male <input type="checkbox"/> Female	I live in (give name of country)	I am interested in environmental issues <input type="checkbox"/> No <input type="checkbox"/> Don’t know <input type="checkbox"/> Yes
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Please, fill in the parts of the questionnaire that are applicable to you. My areas of expertise and experience are the following (tick all that apply).			
<input type="checkbox"/> Authorities	<input type="checkbox"/> Technical experts	<input type="checkbox"/> Industry	<input type="checkbox"/> Material expert
<input type="checkbox"/> Developer	<input type="checkbox"/> Architect	<input type="checkbox"/> Builder	<input type="checkbox"/> Occupant
<input type="checkbox"/> Demolition expert	<input type="checkbox"/> Education	<input type="checkbox"/> Other (Please specify):.....	

1. In order to perform holistic evaluations of the innovative technologies, the main viewpoints that need to be considered from WPs 2 and 3 are stated below; please rank in order of priority (1: highest; 2 next highest, etc):				
<input type="checkbox"/> Regional pre-conditions	<input type="checkbox"/> Technical performance	<input type="checkbox"/> Economic	<input type="checkbox"/> Sustainable	<input type="checkbox"/> Social
Other and any comments?				

2. The main issues to be included in the regional pre-conditions for performing the evaluations, in ranked order, are:				
<input type="checkbox"/> Climatic conditions	<input type="checkbox"/> Local building regs	<input type="checkbox"/> Local policies	<input type="checkbox"/> Geographical features	<input type="checkbox"/> Other:
Any comments?				

3. The main issues to be included in performing technical evaluations of the innovations, in ranked order, are:				
<input type="checkbox"/> Requirements met?	<input type="checkbox"/> Robustness	<input type="checkbox"/> Reliability	<input type="checkbox"/> Maintainability	<input type="checkbox"/> Other:
Any comments?				

4. The main issues to be included in performing economic evaluations of the innovations, in ranked order, are:				
<input type="checkbox"/> Set up costs	<input type="checkbox"/> Operational costs	<input type="checkbox"/> Cost-benefit	<input type="checkbox"/> Service length	<input type="checkbox"/> Other:
Any comments?				

For questions 5 – 8 please assess the potential contribution that the top innovations identified in Q2 could make to the various issues that are important to the Vision as determined by Q1. To do this please enter a number between 0 – 5 in each box, where 0 indicates no potential contribution, and 5 indicates maximal contribution. The boxes which are shaded are felt to be no applicable for the innovation under question. However if you feel that some contribution could be made with respect to that issue, feel free to enter a number between 0 – 5.

5. Please assess the potential impact of the most important energy saving innovations identified in Q2.

Vision “issue” (Q2)	Min energy	Monitoring	Local issues	User manuals	Adaptability	Life cycle	Setting up	Dismantling
(Assessment criteria)	Reduces energy	Increases awareness	Regional conditions	Easy to use	Adaptable	Easily reuseable	Ease to set up	Ease to dismantle
1. Insulation								
2. Passive Cooling								
3. Passive solar								
4. Lighting								
5. Orientation								
1 st other?.....								
2 nd other?.....								

6: Please assess the innovations which are felt to have the highest potential impact as identified in Q2.

Vision “issue” (Q2)	Min energy	Monitoring	Local issues	User manuals	Adaptability	Life cycle	Setting up	Dismantling
(Assessment criteria)	Reduces energy	Increases awareness	Regional conditions	Easy to use	Adaptable	Easily reuseable	Ease to set up	Ease to dismantle
1. Renewable energy								
2. Passive measures								
3. Operation								
4. Finance incentives								
5. New materials								
1 st other?.....								
2 nd other?.....								

7: Please assess the potential impact of the most important renewable energy innovations identified in Q2.

Vision “issue” (Q2)	Min energy	Monitoring	Local issues	User manuals	Adaptability	Life cycle	Setting up	Dismantling
(Assessment criteria)	Reduces energy	Increases awareness	Regional conditions	Easy to use	Adaptable	Easily reuseable	Ease to set up	Ease to dismantle
1. Solar thermal								
2. Co-generation								
3. Earth energy								
4. Photovoltaics								
5. Biomass								
1 st other?.....								
2 nd other?.....								

8: Please assess the potential impact of the most important operational aspect innovations identified in Q2.

Vision “issue” (Q2)	Min energy	Monitoring	Local issues	User manuals	Adaptability	Life cycle	Setting up	Dismantling
(Assessment criteria)	Reduces energy	Increases awareness	Regional conditions	Easy to use	Adaptable	Easily reuseable	Ease to set up	Ease to dismantle
1. Building management sys								
2. Automation								
3. Robustness to users								
4. Monitoring								
5. Waste management								
1 st other?.....								
2 nd other?.....								

For questions 9-12 please assess the potential contribution that the top innovations identified in Q2 could make to the key decision criteria identified in WP4. To do this please enter a number between 0 – 5 in each box, where 0 indicates no potential contribution, and 5 indicates maximal contribution.

9: Please assess the most important energy saving innovations identified in Q2 with respect to the WP4 criteria.

Assessment criteria	How effective is it?	Does it have large potential?	How sustainable is it?	How cost effective is it?	How easy is it to implement?
1. Insulation					
2. Passive Cooling					
3. Passive solar					
4. Lighting					
5. Orientation					
1 st other?.....					
2 nd other?.....					

10: Please assess the innovations having the highest potential impact identified in Q2 with respect to the WP4 criteria.

Assessment criteria	How effective is it?	Does it have large potential?	How sustainable is it?	How cost effective is it?	How easy is it to implement?
1. Renewable energy					
2. Passive measures					
3. Operation					
4. Finance incentives					
5. New materials					
1 st other?.....					
2 nd other?.....					

11: Please assess the most important renewable energy innovations identified in Q2 with respect to the WP4 criteria.

Assessment criteria	How effective is it?	Does it have large potential?	How sustainable is it?	How cost effective is it?	How easy is it to implement?
1. Solar thermal					
2. Co-generation					
3. Earth energy					
4. Photovoltaics					
5. Biomass					
1 st other?.....					
2 nd other?.....					

12: Please assess the most important operational innovations identified in Q2 with respect to the WP4 criteria.

Assessment criteria	How effective is it?	Does it have large potential?	How sustainable is it?	How cost effective is it?	How easy is it to implement?
1. Building management system					
2. Automation					
3. Robustness to users					
4. Monitoring					
5. Waste management					
1 st other?.....					
2 nd other?.....					

13: What are important issues related to the validation of implementing the innovations within Smart-Eco buildings?

.....

.....

.....

For questions 14-15 estimate the market perspective for the innovations considered and the likely take up rates at the EU level (in percentage) within the built sector over various timescales.

14: From all the best energy innovations identified in Q2 estimate the market perspective for the timescales requested.

	Likely product?	Take up % by 2015	Take up % by 2020	Take up % by 2025	Take up % by 2030
1. Insulation					
2. Passive Cooling					
3. Passive solar					
4. Lighting					
5. Orientation					
1 st other?.....					
2 nd other?.....					

15: From all the renewable energy innovations from Q2 estimate the market perspective for the timescales requested.

	Likely product?	Take up % by 2015	Take up % by 2020	Take up % by 2025	Take up % by 2030
1. Solar thermal					
2. Co-generation					
3. Earth energy					
4. Photovoltaics					
5. Biomass					
1 st other?.....					
2 nd other?.....					