European Council of Civil Engineers

ECCE Position Paper:

Sustainable Building and Civil Engineering

Implementation into Praxis in EU

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1.1 Strategic Goals of EU

1.1.1 Mainstreaming Sustainable Development into EU Policies

Sustainable Development

Sustainable development is set out in the Treaty as the overarching long-term goal of the European Union.

The **Sustainable Development Strategy of the European Union (EU SDS)**, as revised in 2006, is a framework for a **long-term vision of sustainability**.

In recent years, the European Union has **mainstreamed the objective of sustainable development (SD)** into a broad range of policies. It has, in particular, taken **the lead internationally** in the fight against climate change and is committed to promoting a lowcarbon, knowledge-based, resource-efficient economy.

The demand on **natural resources, especially in energy consumption,** has been growing fast and exceeds what the Earth can sustain in the long term**. Biodiversity** is in decline globally and major ecosystems are placed under increasing pressure.

Sustainable Economy

The current economic and financial crisis has shown that sustainability is also a key factor for our financial systems and the economy as a whole. The crisis is affecting all sectors of the economy, households, businesses and jobs. The latest data show that EU labour markets continue to deteriorate in reaction to the economic crisis.

It is crucial that measures to support the real economy and reduce the social impact of the current crisis are compatible with long-term sustainability goals. The EU should turn the crisis into an opportunity to address financial and ecological sustainability and develop a dynamic low-carbon and resource-efficient, knowledge-based, socially inclusive society, and promote this approach globally. The Employment guidelines are part of the European Employment Strategy and provide a framework for the development and implementation of measures that are in line with sustainable strategy goals. For instance, the EU deploys the Structural Funds to support the Member States in their efforts to foster a low-carbon and resource-efficient economy. Further development of the low-carbon economy will also be key to driving the EU back to recovery.

[1] 2009 Review of the European Union Strategy for Sustainable Development

Climate Change

In recent years, the EU has been at the forefront of the fight against climate change. In December 2008, the EU legislator agreed on a Climate and Energy Package6 that sets ambitious targets for the EU. The EU committed itself unilaterally to reducing its overall emissions by 20% below 1990 levels by 2020, and to upgrading this effort to a 30% emissions reduction in the event of a comprehensive international climate agreement in Copenhagen in December 2009. As part of the package, the directive on the EU Emission Trading System Commission staff working document accompanying Communication "Towards a comprehensive climate change agreement in Copenhagen", SEC(2009) 101 (http://ec.europa.eu/environment/climat/climate_action.htm)

Energy Efficiency

The Energy Efficiency Package reinforces the key energy efficiency legislation on buildings and energy-using products. It also set itself the target of increasing the share of renewables in energy use to 20% by 2020.Additional energy savings will be provided by the extension of the Ecodesign Directive12 to energy-related products. The European Strategic Energy Technology Plan15 (SET-Plan) accelerates the development and deployment of cost-effective low-carbon technologies.

Raw Materials

EU initiatives include the EU Raw Materials Initiative45, which proposed an integrated strategy to deal with the various challenges related to access to raw materials, including secondary raw materials that can be obtained in the EU through more and better recycling.

The revised Waste Framework Directive48 is an important stepping stone to help the EU move towards better management of material resources and improved resource efficiency. It clarifies the basic concepts such as the waste hierarchy, the prevention of waste, and the incorporation of life-cycle thinking. The Directive lays down important targets for the recycling of waste for the year 2020: 50% for household waste recycling and 70% for construction and demolition waste.

Education and Training

Education and training build the critical foundation for sustainable development. The Commission encourages Member States in their efforts to develop more strategic approaches to sharing knowledge and good practice in a bid to stimulate Education for Sustainable Development (ESD). A Commission Inventory of innovative practices in Member States and EEA countries highlights the importance of ESD73. The Commission's "Updated strategic framework for European cooperation in education and training‟ will guide European level cooperation in this field to 2020. The "Lifelong Learning Programme 2007-2013" is a prime tool for developing the role of education and training Education and training build the critical foundation for sustainable development. The

Commission encourages Member States in their efforts to develop more strategic approaches to sharing knowledge and good practice in a bid to stimulate Education for Sustainable Development (ESD). A Commission Inventory of innovative practices in Member States and EEA countries highlights the importance of ESD73.

Research and Development

According to Eurostat data, the share of gross domestic expenditure on R&D in GDP decreased between 2000 and 2007 from 1.85% to 1.83%. This indicator thus shows a move away from the EU target of 3% by 2010. One of the key objectives of the Seventh Framework Programme for Research and Technological Development for the period of 2007-2013 (FP7) is to contribute to sustainable development. In 2007 and 2008, around 44% of the total budget devoted to cooperative research was allocated to sustainable development-related projects.

Moreover, in the European economic recovery plan, the Commission proposed three major public-private partnerships (PPPs) around three key issues for sustainability:

- "green cars",
- "energy-efficient buildings", and
- "factories of the future".

The Commission is striving to ensure that the whole European Research Area is responsive to sustainable development objectives. The challenge ahead is to build on the promising first steps and to enhance the contribution of research to sustainable development.

Taking Sustainable Development into the Future

At EU level, the **EU SDS (Sustainable Development Strategy**) itself plays a central role in promoting the overall objective of sustainable development. The EU SDS has also been instrumental in developing sustainable development strategies at national and regional levels. Today, almost all EU Member States have their own **national sustainable development strategies (NSDS)** in place. In particular, the strategy could focus on the EU's long-term goals in crucial areas, contributing to:

- a rapid shift to a **low-carbon and low-input economy**, based on energy and resource-efficient technologies
- sustainable transport and
- shifts towards sustainable consumption behaviour.

In the EU document *Communication from the Commission of 19 October 2006 entitled* ***"Action Plan for Energy Efficiency: Realising the Potential"*** (http://europa.eu/legislation_summaries/energy/energy_efficiency/l27064_en.htm), the following conclusions on the saving potential of energy on building sector by the year 2020 have been presented:

The Commission considers **the biggest energy savings** are to be made in the following sectors:

- residential and commercial **buildings** (tertiary), with **savings potentials estimated at 27% and 30%** respectively, the manufacturing industry, with the potential for a 25% reduction, and transport, with the potential for a 26% reduction in energy consumption.
- These sectoral reductions of energy consumption correspond to overall savings estimated at 390 million tonnes of oil equivalent (Mtoe) each year or 100 billion per year up to 2020. They would also help reduce CO2 emissions by 780 million tonnes per year.
- These potential savings come in addition to an estimated 1.8% (or 470 Mtoe) reduction in annual consumption which would partly stem from other measures already adopted and normal replacements of material.

Achieving the 20% reduction objective will help reduce the EU's impact on climate change and dependence on fossil fuel imports. The Action Plan will also **boost industrial competitiveness, increase exports of new technologies and will have positive benefits in terms of**

employment. The savings made will, moreover, offset the **investments put into innovative technologies**."

1.1.2 EU Directives

In the "DIRECTIVE 2002/91/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2002 on the energy performance of buildings" the following has been stated:

- (6) The residential and tertiary sector, the major part of which is buildings, accounts for **more than 40 % of final energy consumption** in the Community and **is expanding**, a trend which is bound to increase its energy consumption and hence also its carbon dioxide emissions.
- (12) Buildings will have an impact on long-term energy consumption and **new buildings should therefore meet minimum energy performance requirements tailored to the local climate**. Best practice should in this respect be geared to the optimum use of factors relevant to enhancing energy performance. As the application of **alternative energy supply systems** is generally not explored to its full potential, the technical, environmental and economic feasibility of alternative energy supply systems should be considered; this can be carried out once, by the Member State, through a study which produces a list of energy conservation measures, for average local market conditions, **meeting cost-effectiveness criteria**. Before construction starts, specific studies may be requested if the measure, or measures, are deemed feasible.
- (13) **Major renovations of existing buildings** above a certain size should be regarded **as an opportunity** to take cost effective measures to enhance energy performance. Major renovations are cases such as those where the total cost of the renovation related to the building shell and/or energy installations such as heating, hot water supply, air-conditioning, ventilation and lighting is higher than 25 % of the value of the building, excluding the value of the land upon which the building is situated, or those where more than 25 % of the building shell undergoes renovation.

1.2 Markets

Sustainable construction can be defined as a new and sustainable paradigm of developers with new solutions. Investors, the construction industry, professional services, industry suppliers and other relevant parties are facing the challenge towards achieving sustainable development, taking into consideration environmental, socio-economic and cultural issues.

This **new paradigm** embraces a design and management of buildings and constructed assets, **drastic improved energy efficiency of buildings, choice of materials, improved building performance as well as interaction with urban and economic development and management**.

Different approaches may be followed according to the local socio-economic context; in some regions and cases, priority is given to resource use (energy, materials, water, and land use), while in others social inclusion and economic cohesion are the more determining factors. In the context of the Lead Market initiative, the Commission intends to look at the interaction and combined effects of **two market drivers** on innovation:
(a) the rational use of natural resources (energy, water and materials),
(b) the user's convenience and welfare (accessibility, safety & security, indoor air quality, etc.).

The choice of these 2 set of drivers is guided by a number of general considerations on the future anticipated market requirements and trends.

1.2.1 Trends on the Market Segments [2]

Trends on the Residential Market:

- The users' **requirements will change** more frequently than before. This behaviour should be anticipated in design and construction processes, for instance by separating the technical utilities from the main structure.
- **Renovation will integrate new components and prefabricated products** which can be installed and used rapidly.
- **Accessibility and flexibility** will be significantly improved in dwellings throughout their life cycle for all types of users and ages
- There will be an increased emphasis on **energy efficiency, environmental, water, health and safety** issues in the selection of materials and structural components.
  - The **passive house concept** will be more and more widespread even in warm climate conditions, as well as the **integration of renewable energies**.
- **Building management systems** would enable occupants to control a greater variety of **functions for** a **better comfort** (ventilation, air filtration, temperature, lighting, etc.).
- ICT will facilitate remote **supervision, monitoring and control** of appliances, equipment and security systems.
  - There would be a growing demand for improving the access to affordable and decent homes and for a more harmonious urban and social mix.

Trends on the Non-Residential Market:

- The requirements **for improved energy efficiency and the integration of renewable energies** would influence both the building structure and its utilities.
- **Indoor air quality** would be considered as a factor affecting **comfort and work efficiency**. This will require meeting different needs in terms of heating, cooling, ventilation, lighting and acoustic levels.
- Business premises will more often be occupied **by fast growing and changing organisations** which will require **business-related facility services**.
- Requirements for **adaptability and divisibility** of the premises will stimulate the development of **new structural and system technological solutions**, which will be facilitated by the expansion of the wireless data transmission.

Trends on the Infrastructure Market

- Investment will be assessed on a **more strategic approach towards the long term functional characteristics** of the infrastructure and the associated **life-cycle costs**.
- There might be specific considerations depending on the market segment considered and the **specific regional context**.
- Overall, it appears that innovation will have to respond to an increasingly differentiated ownership and usage of premises and facility services, as well as to sustainability issues and **life-cycle considerations** which will become important **decision-making** criteria.

[2] Accelerating the Development of the Sustainable Construction Market in Europe REPORT OF THE TASKFORCE ON SUSTAINABLE CONSTRUCTION Composed in preparation of the Communication "A Lead Market Initiative for Europe" {COM(2007) 860 final}

- A growing importance of **retrofitting of buildings and infrastructure**: land-use and resources constraint will lead to opt **more often for retrofitting instead of (demolishing and) building new** products.
- The public and the private sectors are becoming more and more **aware of** the significant impact of the built environment on **climate change, the use of natural resources, air quality, health, the economic activity as a whole and the social cohesion and inclusion**, and of the importance of **integrating various elements** in certain ways in order to meet the economic and societal needs.

1.2.2 Innovation Issues

Innovation manifests in many forms, especially:

- at the level of the construction product industries to improve the **properties and performances of materials and components**, or
- at the level of **the construction asset and of the services provided to the customer/occupants** by the supply chain.

Within the scope of the Lead Market Initiative, a special attention would be given to the initiatives which could **change the attitudes** in the construction supply chain from the 'physical delivery of a construction asset' into a 'culture of services' and develop a **full Life Cycle-oriented approach**. This should be seen in parallel to a desirable **change in the demand side from a cost-driven market to a value-driven market**.

1.2.3 Transformation of the market and products and services

There are many ways to initiate this transformation, although some appears to have a potential significant impact.

The Construction Industrialisation

In some market segments and regional contexts, the **improvement of quality and productivity will contribute to** a greater utilisation of **prefabricated products and** to a higher **industrialisation of the work processes**. **Without compromising architectural requirements**, the transfer of part of the on-site construction activity to off-site production, independent from weather conditions, will ensure a more continuous activity, a better quality of the finished products and an improved control of their environmental characteristics. The partial industrialisation of the on-site activity will be facilitated by **product model-based construction design, the management of product information and e-business, on-site information technology** and the use of standardised elements on site. This will **reduce the volume of construction wastes and the number of accidents** at work. However, the **logistic constraints** associated with the transport of heavy prefabricated and modular elements and the impact on the European road infrastructure should be considered carefully.

Collaborative Working in Project Implementation

Effective communication and collaboration in the supply chain based on mutual trust could improve construction productivity and provide economically viable **life-cycle services**.

Collaborative working brings together architects, contractors, specialist contractors and suppliers with the client **at the decision-making process** of the project. It provides for a transparent

process, a more efficient supply chain and an opportunity to discuss the use of innovative methods and products. It would likely stimulate relationships that go beyond single projects, bringing benefits in terms of retention and re-use of knowledge and experience. Construction works involve large investments and penalties which can be severe when projects run late. This could hamper the development of **new forms of collaborative working** in the supply chain. However, **insurance arrangements** could spread the risk and liability between customer, contractors and specialist contractors and suppliers should a project face difficulties when implementing novel products or process. Such arrangements might require an independent assessment of the inherent risks associated with the innovative products or processes and of the expected performances.

Life-Cycle Expertise

The construction sector needs to further develop skills and services **to meet the customer and occupants requirements over its life-cycle**. These would cover **knowledge in energy consumption, environmental impacts, indoor environment, safety, the adaptability of structures and premises, service life planning and facility management, as well as in life-cycle economics**. On the customer side, this expertise will build on a closer **cooperation between the bodies taking the investment decision and the services** responsible **for the operation and maintenance** of the construction assets.

New Services Models

The variety of specific customer needs will be addressed by new service models that combine and/or specialise in design, construction and maintenance, and financial services together with a guarantee on environmental and economic performances and indoor air conditions. It is crucial that the industry acquires experience in tackling issues related to the variable nature of the context and of the conditions in which buildings are used. This might require further standardisation work to what is actually done. **Public Private Partnership** (PPP) could help to promote such new services but other initiatives would also stimulate the emergence of such new service models and the empowerment of the end user.

1.3 Analysis of the Market Potential

1.3.1 Present Situation

In 2004, the **EU-27 construction industry generated a total production of 1305 billion € and employed 13.2 million persons**. This represents **10% of GDP and 7.3% of the total employment**. These figures relate to the new construction and renovation of buildings and civil engineering on-site, e.g. they do not cover the manufacturing industry and the downstream services related to construction. About one third of the GDP is attributable to construction materials and building products. According to FIEC, **26 million workers** in the EU depend**, directly or indirectly**, on the construction sector. Direct employment in the construction materials and building product industry is about 2.5 million jobs. The residential sector represents 46% of the total EU production, the non-residential sector 31% and civil engineering 23%. The building sector is characterised by a **long service life** of several decades or even more, a **slow replacement rate** of the building stock (**about 1% per year**) and a much lower rate for building demolition

(about 20 times less than new construction). This means that **interventions on the existing buildings** such as insulation works, double glazing, acoustic developments, etc. will **have immediate effects** on climate change, indoor air quality, re-use/recycling and other sustainability issues like safety and accessibility. **New construction** already incorporates more recent technical solutions and therefore will **affect** sustainability issues **on the long term**.

Numerous demonstration programmes in Europe and elsewhere show the **significant potential for sustainable construction**. In particular, there are many examples of innovative technologies which could substantially **improve the energy performance of buildings by more than 30-70 %** at reasonable cost conditions on short term (payback time: 5-12 years) or which could offer opportunities for **decentralised energy supply with renewable energies**. Yet, the **market for sustainable construction** needs to be more and better developed.

More than 50% of all materials extracted from earth are transformed into construction materials and products. **Construction and Demolition Wastes** (C&DW) amount to more than 450 million tonnes per year in the EU. However, these figures should be placed in their proper perspective. The construction activity intrinsically requires a lot of raw material per unit of production and C&DW are proportionally significant in quantitative terms. However, this leaves room for rationalisation and large improvement in the sector. Most of C&DW are today recycled or re-used principally in the form of embankment. A significant proportion could potentially be used as a substitute for newly quarried aggregates in certain lower grade applications.

Heating and lighting of buildings accounts for the largest share of energy use (42%) and produces about 35% of all greenhouse emissions. Energy standards for houses and the introduction of more efficient electrical appliances and heating installations have not lead to a decrease in total energy and electricity consumption by households. The energy use per household has remained about constant since 1985 and the final energy consumption has risen due to the increase in number of households as well as surface and comfort demand. The European passive house market is in rapid growth with approximately 1000 new dwellings per year but this represents only 0,1% of the total new construction today. The current number of existing passive houses in Europe is more than 8000. Still, many existing houses have not yet a roof insulation and double-glazing. There is a number of energy services companies remunerated based on a pre-determined energy performance plan but this market is only developed to some extent in few countries.

The World Health Organisation has outlined the effects of indoor air pollution on health; in particular the increased premature mortality caused by lung cancer and other respiratory and cardiovascular diseases, and subsequently, the increased medication use, sick leaves and lowered performances in learning and working. This situation is mostly affecting vulnerable people such as elderly and children. Incorrect air ventilation due to increased thermal insulation and air infiltration tightness as well as thermal bridges in the building structures are the origin of condensation of water and microbial growth, and a faster deterioration of building material. The European Construction Technology Platform has estimated the savings for EU-15 which could result from a more comfortable and healthy indoor environment:

Buildings Savings [Source: European Construction Technology Platform]

- Reduced Allergies and asthma (based on a reduction of 8 to 25% of medical costs): Savings 3-6 (b€/year)
- Reduced Sick building Syndrome symptoms (based on 20-50% reduction and 2% productivity improvement): Savings15-45 (b€/year)

- Increased productivity by comfort related improvements (based on 0.5-5% increase in worker performance) : Savings 30-240 (b€/year)

Various studies undertaken by the Association for Higher Education Access and Disability (AHEAD) show that a high proportion of public buildings and homes are not accessible to people with physical disabilities. Other sources estimate that the actual building stock is not adapted to the ageing of the European population.

1.3.2 Factors Affecting the Development of the Market

The development of the market would be influenced by a number of interrelated factors:

• ***The concept of sustainable construction:*** this relatively new concept aims at integrating the objectives of sustainable development into the construction activities. It is generally understood in relation with the environmental performances of construction products and assets (environmental sustainability), and should more largely refer to a balanced economical, ecological and social approach (Table 1.). Its influence on market developments is indirect, through the decisions of market actors integrating the objectives of sustainable development in their decision process. This can be done through evaluation models and methods, despite some dimensions of sustainability (for example the impact on biodiversity or local value creation or comfort) are not easily quantifiable.

Table 1. Generic classified requirements of structures and buildings[3].

1. Human requirements • functionality in use • safety • health • comfort	2. Economic requirements • investment economy • construction economy • lifetime economy in: ○ operation ○ maintenance ○ repair ○ rehabilitation ○ renewal ○ demolition ○ recovery and reuse ○ recycling of materials ○ disposal
3. Cultural requirements • building traditions • life style • business culture • aesthetics • architectural styles and trends • imago	4. Ecological requirements • raw materials economy • energy economy • environmental burdens economy • waste economy • biodiversity and geodiversity

[3]

- Sarja, Asko (ed). Open and industrialised building. London. E & FN Spon, 1998. 228 p.
- Sarja, Asko 2002, Integrated Life Cycle Design of Structures. 142 pp. Spon Press, London 2002. ISBN 0- 415-25235-0.
- Asko Sarja (Editor) 2006, Predictive and Optimising Life Cycle Management of Buildings and Infrastructures. 667 pp. Taylor & Francise, London, 2006. ISBN 10: 0-415-35393-9 (hbk) ISBN 10: 0-203-34898-2 (ebk)

• ***Life cycle costs***: many key decisions are currently taken on the basis of the lowest costs instead of quality, safety and environmental criteria and life-cycle costs. This applies indistinctly to customer and construction firms. With the actual tendering practices and separation of the budgeting functions within the public sector, there is little incentive to propose solutions with a higher quality which match the customer's requirements. There is a need to identify incentives to offer solutions at the advantage of both the clients and the industry. Best practices that allow acceptance of the "Economical Most Advantageous Tender" (EMAT) and Life-Cycle Costing, and encourage the proposal of technological variants, would be a step forward.

• ***Public Procurement***: Opportunities exist for public clients to encourage innovative proposals without the risk of compromising best value or accountability. Green Public Procurement provides a framework for action with respect to environmental criteria.

However, public clients rarely take these opportunities, especially for construction works falling outside the scope of the EU public procurement directives. This might be due to legal uncertainties linked to the specific context of construction , to a lack of knowledge in environmental matters, to insufficient political and managerial support and to budgetary constraints. This could discourage innovation in this direction. Whenever appropriate, training and practical guidance to the public sector and to the private operators might remedy this situation consistently.

• ***Standardisation*****:** The actual standardisation process is very much fragmented and adapting very slowly to technological progress and market development. There is a need to see how it could evolve more rapidly towards a set of standards integrating the various aspects of sustainable development taking benefit of new scientific and technical knowledge. When the standardisation process cannot deal correctly with innovative technologies, alternative paths should be explored to back-up their performance and support their market development without compromising on safety and responsibility issues.

• ***Design and training:*** The high proportion of small contractors working in a traditional way: This group of market actors consists of a few large players and many micros to small businesses. The owners of these businesses look for job opportunities in their local areas and are often not inclined to invest time in innovation. Their main concern is to ensure order books for the next 6 to 12 months. This economic reality has an impact on the effectiveness of planning and design activities, and on training requirements.

• ***The fragmentation of the supply chain*****:** the supply chain is composed of many actors: (a) material suppliers, (b) producers of construction materials, (c) architects, engineers and designers, (d) contractors, (d) product distributors (e) service providers. There is a concern about the difficulty to integrate chosen specialists contractors and suppliers into an efficient project teams and supply chain. The knowledge generated in the process design and construction is often lost after the handling over of the project. Long term relationships may partly overcome this difficulty but there might be a concern to achieve a correct balance between competition and cooperation.

• ***The lack of adequate education and skills for innovation*** uptake: Many construction trades are well known for their low educational background compared to other sectors of the economy. It appears that the experience gained from solving problems is not organised enough in a learning

building process which allow solving problems associated with the performance of construction assets and constituent elements in a more systematic way.

This could be the case for addressing life-cycle issues, the re-use and recycling of materials. The need for training multi-skilled operatives should be also considered with respect to new organisational forms and construction processes.

• ***Liability issues and risks*** linked to the long-term consequences of failures: some liability regimes discourage different parties of a project to work as a team and to share risk in the event of a problem. This works against innovation. Most of the insurance regimes also do not stimulate customers to take an active role in this cooperation since they see the indemnity insurance as their safeguard against failure. However, the insurance might play a larger role in innovation by linking insurance premiums to the adoption of appropriate management procedures and to the performance of the construction assets, in particular in terms of environmental impacts. Remedial costs might be incurred if breaches of good practice occurred.

1.3.3 Market Perspectives

There are a number of initiatives at European and national levels which could stimulate a rapid development of the market for sustainable construction. It is important to establish customer confidence and to avoid problems which occurred in the past with the implementation of innovative construction technologies. It is also important to consolidate the productivity and sustainability of the supply chain. This means that innovation and the markets will need time to develop and to match. However, if the construction sector has to bring a significant contribution to the debate on Climate Change, the Sustainable Use of Natural Resources, Waste Management, Life-Cycle thinking and other sustainability issues, the construction sector and all other private and public stakeholders should become more proactive with respect to the sustainable development agenda within the next 15-20 years.

Along this line, it could be worth considering some global indicative voluntary targets - quantitative and qualitative - to achieve sustainability and the policy instruments which would allow achieving these targets. The baseline is the actual state-of-the-art of the construction industry delivering sustainable solutions with a focus on climate change, the use of natural and water resources, the associated life cycle costs, the qualifications needs, etc. The targets would indicate the expected improvements to be achieved by the supply chains and customers acting more responsibly at 3 timeframes: short term (2010-2012), medium term (2012-2020) and long term (20020-2050). Defining such targets and monitoring progress in a realistic way is not a straightforward exercise and would require socio-economic research and consensus building on a number of socio-economic and environmental indicators. This would consider the interaction of both supply-side and demand-side policies at EU and national levels and the level of progress already achieved.

1.4 Commission-Industry Partnership

Practical implementation of the European Directive and the Communication conceived in order to save energy in the building sector is the duty of the Construction professionals, industries at the first rank.

Then, Commission-Industry partnership is of major importance, especially for decisions dealing with necessary research (programmes, funding) aiming at new design, materials, processes and maintenance for energy efficiency buildings.

Several partnerships are to be noted : the *European Council for Construction Research Development and Innovation (ECCREDI)* since 1995, the *European Construction Technology Platform (ECTP)* since 2003, answer of the Construction sector to the Commission request for constitution of European Technology Platforms, and the very recent "*Energy Efficient Buildings European Initiative (E2B EI)"* for the support of Public-Private-Partnerships (E2B A is the related supportive Association).

Initial ECTP activities produced a *2030 Vision* and a *Strategic Research Action plan*, base for preparation of many research topics opened in FP7 Calls for proposals.

The *European Recovery Plan* (November 2008) was an opportunity to focus actions on 3 formal Public-Private-Partnerships, one being specifically devoted to energy saving in Buildings: *EeB (Energy efficient Buildings).* This PPP will involve 1M€ between 2010 and 2013 for energy saving and CO2 reduction in new and existing buildings, but also at the level of buildings districts.

The base for this PPP action is a 2009 document, *"Research priorities for the definition of a Multi annual Roadmap and longer term Strategy"* written by an Ad-hoc Advisory Group in which the private sector is represented by the European "Energy Efficient Buildings Association", in connection with Commission Directorates: DGRTD, DGTREN, DGINFSO This document presents the strategic objectives, the long term research objectives , the economic, social and policy challenges, finally a list of priorities.

The first clear result of this EeB PPP is a 65 M€ FP7 Cross Thematic Call for proposal (30 July 2009) involving NMP, ICT, Energy and Environment Themes of the Cooperation Programme.

2. CURRENT STATE OF DIRECTIVES, CODES AND STANDARDS IN EU

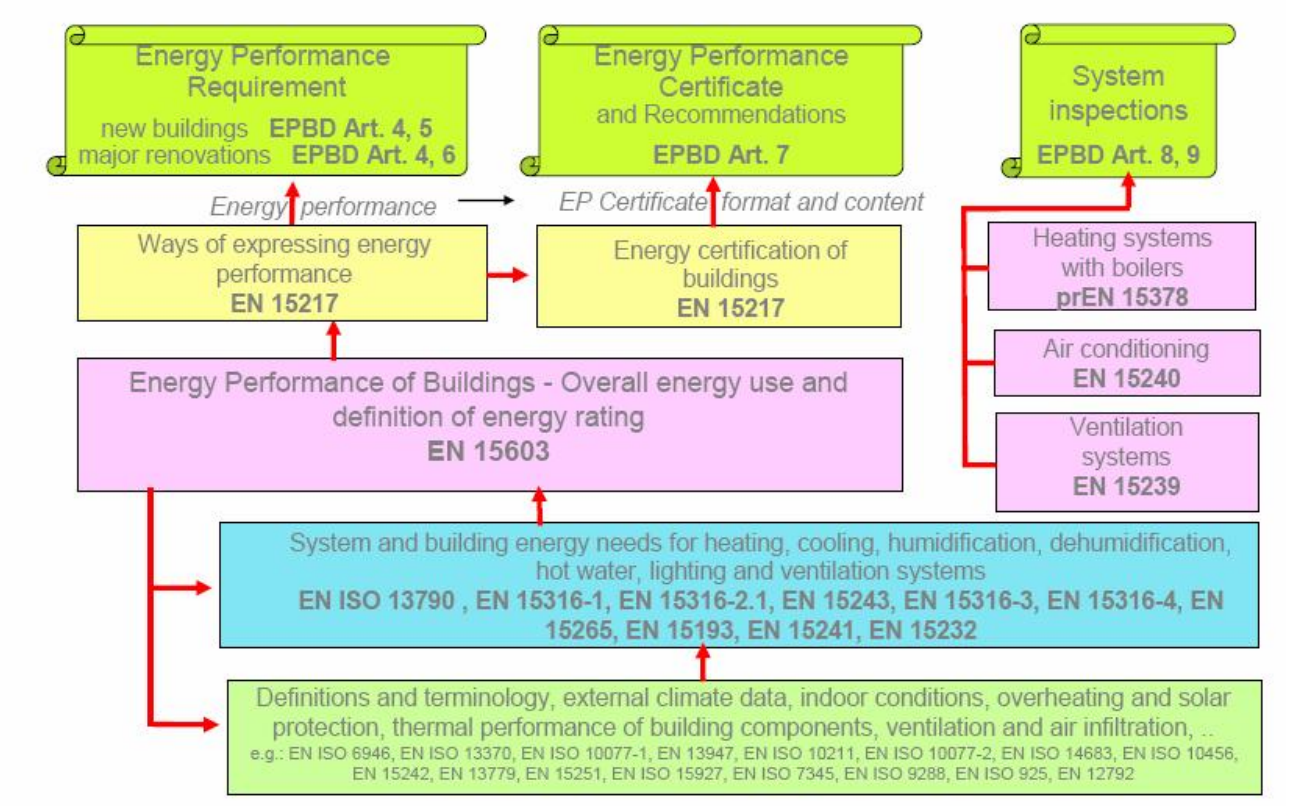
A number of EU Directives and member States legislations concern directly and indirectly sustainability issues related to construction assets, the construction activity itself or the construction product industry, in particular the Building Energy Performance (Figure 1.).

Other central directives are for example:

- Directive (2002/91), the Energy Services Directive (2006/36), the Waste Framework
- Directive (98/83/EC), the Construction Product
- Directive (89/106/EC), the Equal Treatment in Employment and Occupation Directive (78/2000/EC), etc.

In addition to the specific policy objectives served by individual legislation and to the specific conditions of implementation under the responsibility of member States, it is important to consider the overall effect of legislation on the industry competitiveness and on innovation. New or revised legislation can be supportive to the development of a lead market if it contributes to raise the performance standards in the industry, to enlarge the market for innovative products, without imposing unnecessary additional burden on top of current legislative requirements.

Figure 1. Methods for calculating energy performance (EPBD Article 3 and Annex).



The framework Directive for the EUP provides a basis for establishing minimum eco-design requirements for energy using products. The aim of the Directive is to reduce the environmental impact of these products, contributing to sustainable development and ensuring the free movement of products in the EU.

The Directive demands that:

- marking and declaration of conformity; a CE conformity marking should be fixed to the product
- consumer information; consumers of EUP should be provided with information on the sustainable use of the product
- implementing measures are placed on certain products which have a significant environmental impact.

In the follow up study [4]on the implementation of the Energy Performance of Buildings Directiven(EPBD) that makes certificates for the energy performance of buildings mandatory and requires minimum energy performance requirements for new buildings and existing buildings that undergo major renovation.

EPBD has significantly raised awareness of the issue of energy performance of buildings amongst stakeholders, and that it has indirectly led to the introduction of some new national legislation that goes beyond the requirements of the Directive. Implementation is also thought to have raised the numbers and skills of inspectors and to have led to development or wider usage of appropriate

[4] European Parlament, Policy Department, Economic and Scientific Policy
STUDY ON ENERGY PERFORMANCE OF BUILDINGS, IP/A/ITRE/FWC/2006-087/lot 4/C1/SC4, February, 2009.

software tools. Further work is needed in providing a unified approach to the delivery of the EPBD throughout the Member States, and in line with other Directives and legislative requirements. For example, harmonisation and facilitation of building assessment tools/methodologies is needed if the Commission are to provide clarity of the application of the setting of minimum energy performance requirements that are also 'cost-optimal'. The tools must be transparent and easy to use.

3. KEY MESSAGES OF EUROPEAN COUNCIL OF CIVIL ENGINEERS

3.1 Statements and Claims of ECCE

European Council of Civil Engineers (ECCE) expresses the following **statements and claims** for the European construction sector:

- **The construction sector has to bring a significant contribution** to the debate on Climate Change, the Energy saving and the change towards the use of renewable and CO_2- free energy, Sustainable Use of other Natural Resources, Waste Management, Life-Cycle thinking and other sustainability issues.
- There is a significant and **increasing gap** between the targets for civil engineering in the policy of EU and the civil engineering praxis.
- **The construction sector and all other private and public stakeholders should become more proactive** with respect to the sustainable development agenda.
- **There are a number of strategies and initiatives** at European and national levels which could stimulate a rapid development of the market for sustainable construction, **but these have to be implemented into business and everyday praxis**.
- **ECCE regards the sustainable buildings and civil infrastructures as an opportunity and as a crucial means** of tackling climate change and maintaining the competitiveness of the EU economy and security.
- **ECCE supports** the idea of the **Paradigm Change** of the entire civil engineering in EU **into Sustainable Civil Engineering**.
- The **Sustainable Civil Engineering is totally based on** cost-optimal **lifetime (life cycle) principle, integrating** the objectives of **sustainable developmen**t in the decision process at all phases of the life cycles.
- **ECCE and its member organisations in each country are strongly committed** to activate and support developing and rolling out the knowledge and technology of sustainable building and civil engineering. Roles of ECCE will especially be:
  - **Dissemination of knowledge and examples of best** practice of sustainable construction, maintenance and renovation
  - **Increasing the level of knowledge, as well as** activating and helping national organisations of civil engineers in creating and distributing information material and in organising training courses for civil engineers in praxis.

3.2 Buildings

There is significant potential in Europe for radical change **on building production and renovation towards sustainability**.

For **new buildings**, there are many examples of **innovative low energy and passive building concepts** which could substantially **improve the energy performance by 50 - 85 %** at reasonable cost conditions in construction and in relation to **lifetime costs.** These concepts offer high opportunities for **decentralised energy supply with renewable energies.**

Innovative **low energy and passive building concepts** are especially highly needed in **energy renovation of existing building stock**. **Innovative building materials, components and modules** for these concepts can be penetrated into national, European and, even, global markets.

When the standardisation process cannot deal rapidly enough with innovative technologies, **alternative voluntary paths should be explored** to support the market development without compromising on safety and responsibility issues.

3.3 Civil Infrastructures

Land-use and resources constraint will lead to opt more often for **retrofitting instead of (demolishing and) infrastructural assets**.

Public and private sectors are becoming more and more aware of the significant **impact of the built environment on climate change**, **the use of natural resources, air quality, health, economic activity** as a whole and on the **social cohesion and inclusion**, and aware of the importance of integrating various elements in certain ways in order to meet the economic and societal needs.

Investment will be assessed on a more strategic approach towards the long term functional characteristics of the infrastructure and the **associated life-cycle costs**.

There might be specific considerations depending on the **market segment considered and the specific regional context.**

4. CONCLUSIONS

Public and Private sectors of our society are becoming more and more **aware of the significant impact of the built environment** on climate change, the use of natural resources, air quality, health, economic activity as a whole and on the social cohesion and inclusion, and aware of the importance of **integrating various elements in lifetime engineering** in order to meet the economic and societal needs.

It appears that **innovation will have to respond** to an increasingly differentiated ownership and the usage of premises and facility services, as well as to **sustainability issues and life-cycle considerations** which will become important **decision-making criteria**. This includes a growing importance of **retrofitting of buildings and infrastructure**: land-use and resources constraint will lead to opt more often for retrofitting instead of (demolishing and) building new products.

In the **lifetime building process,** the **(PPP) - contract models:** Public Private Partnership and Private Private Partnership may play an important role.

For the **change of the paradigm of building and civil engineering into sustainability knowledge and tools already exist**: excellent strategies, concepts, methodologies, directives, codes, standards and literature. The **challenge for civil engineers is to implement this knowledge into praxis**. For this objective especially, **effective actions are needed** for disseminating the knowledge among civil engineers through **training and guidance**.

European Council of Civil Engineers and its national member organisations may play an important activating role, acting effectively in implementation of the sustainable civil engineering into praxis, both nationally and in the European dimension. For this objective, ECCE has to prepare a specific long term **Action Plan in sustainable civil engineering practice**.

The revised **Paradigm of Sustainable Civil Engineering** is a high opportunity towards an advanced civil engineering practice.

Vassilis P. Economopoulos — ECCE President

Prof Asko Sarja — Chairman of ECCE SC on "Knowledge & Technology"