Civil engineering in EU Horizon 2020

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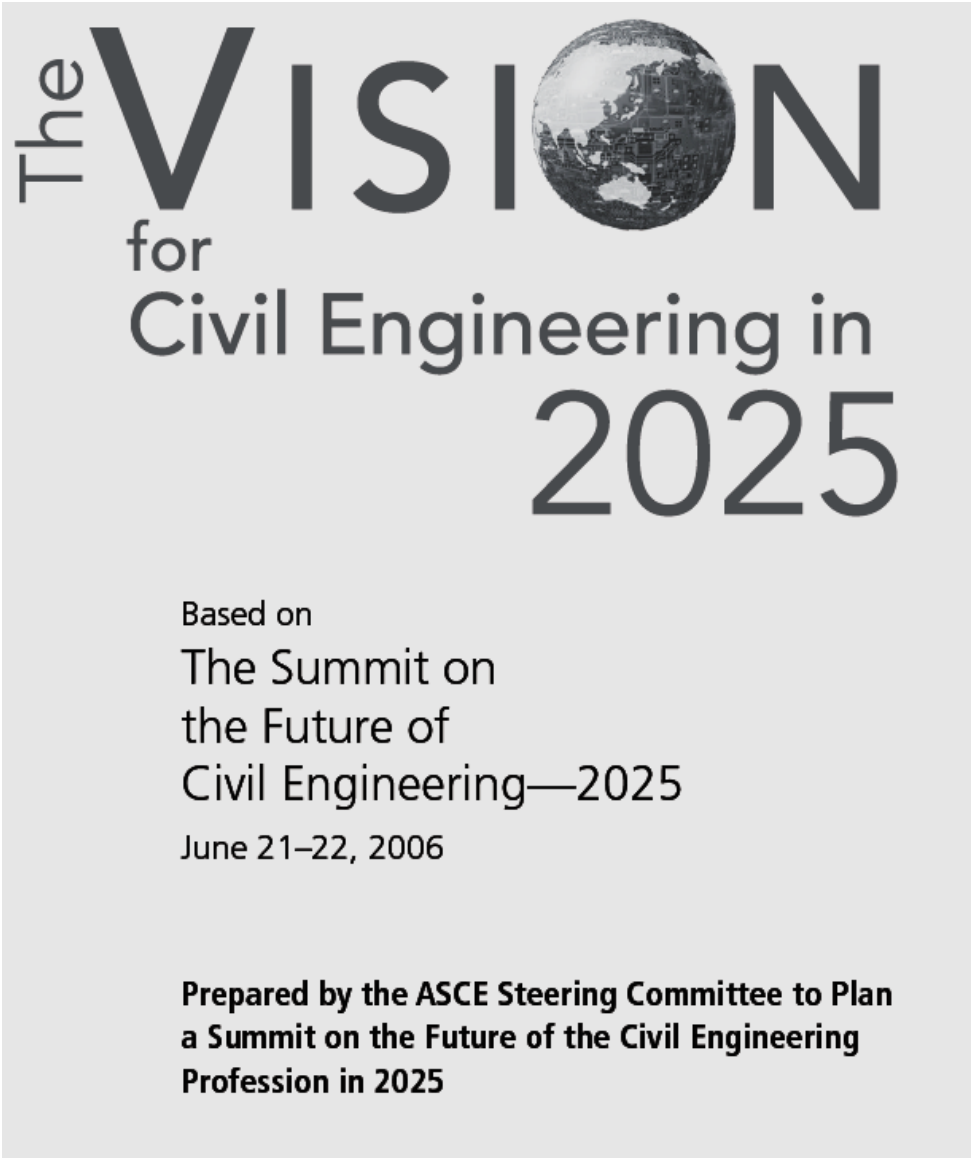

The VISION for Civil Engineering in 2025
Based on
The Summit on the Future of Civil Engineering—2025
June 21–22, 2006
Prepared by the ASCE Steering Committee to Plan a Summit on the Future of the Civil Engineering Profession in 2025
www. asce.org

Global Vision 2025

In 2025, civil engineers will serve as master builders, environmental stewards, innovators and integrators, managers of risk and uncertainty, and leaders in shaping public policy.

Global Vision 2025 (continued)

Entrusted by society
to create a sustainable world and
enhance the global quality of life,
civil engineers
serve competently, collaboratively, and ethically as master:

- planners, designers, constructors, and operators of society's economic and social engine—the built environment;
- stewards of the natural environment and its resources;
- innovators and integrators of ideas and technology across the public, private, and academic sectors;
- managers of risk and uncertainty caused by natural events, accidents, and other threats; and
- leaders in discussions and decisions shaping public environmental and infrastructure policy.

Profile of the 2025 Civil Engineer

The civil engineer is knowledgeable about technical and professional, as well as socio-economic, topics.

The civil engineer embraces a range of attitudes that supplement knowledge and skills and facilitate effective professional practice within industry, education, and government.

Profile of the 2025 Civil Engineer (continued)

The civil engineer is **knowledgeable.** He or she understands the theories, principles, and/or fundamentals of:

- **Mathematics, physics, chemistry, biology, mechanics, and materials,** which are the foundation of engineering
- **Design** of structures, facilities, and systems
- **Risk/uncertainty,** such as risk identification, data-based and knowledge-based types, and probability and statistics
- **Sustainability,** including social, economic, and physical dimensions
- **Public policy and administration,** including elements such as the political process, laws and regulations, and funding mechanisms
- **Business basics,** such as legal forms of ownership, profit, income statements and balance sheets, decision or engineering economics, and marketing
- **Social sciences,** including economics, history, and sociology
- **Ethical behavior,** including client confidentiality, codes of ethics within and outside of engineering societies, anti-corruption and the differences between legal requirements and ethical expectations, and the profession's responsibility to hold paramount public health, safety, and welfare

Profile of the 2025 Civil Engineer (continued)

The civil engineer is **skillful.** He or she knows how to:

- **Apply basic engineering tools,** such as statistical analysis, computer models, design codes and standards, and project monitoring methods
- **Learn about, assess, and master new technology** to enhance individual and organizational effectiveness and efficiency
- **Communicate** with technical and non-technical audiences, convincingly and with passion, through listening, speaking, writing, mathematics, and visuals
- **Collaborate** on intra-disciplinary, cross-disciplinary, and multi-disciplinary traditional and virtual teams[8]
- **Manage** tasks, projects, and programs to provide expected deliverables while satisfying budget, schedule, and other constraints
- **Lead** by formulating and articulating environmental, infrastructure, and other improvements and build **consensus** by practicing inclusiveness, empathy, compassion, persuasiveness, patience, and critical thinking

Profile of the 2025 Civil Engineer (continued)

The civil engineer embraces **attitudes** conducive to effective professional practice. He or she exhibits:

- **Creativity** and **entrepreneurship** that leads to proactive identification of possibilities and opportunities and taking action to develop them
- **Commitment** to ethics, personal and organizational goals, and worthy teams and organizations
- **Curiosity,** which is a basis for continued learning, fresh approaches, development of new technology or innovative applications of existing technology, and new endeavors
- **Honesty** and **integrity**—telling the truth and keeping one's word.
- **Optimism** in the face of challenges and setbacks, recognizing the power inherent in vision, commitment, planning, persistence, flexibility, and teamwork
- **Respect** for and **tolerance** of the rights, values, views, property, possessions, and sensitivities of others
- **Thoroughness** and **self-discipline** in keeping with the public health, safety, and welfare implications for most engineering projects and the high-degree of interdependence within project teams and between teams and their stakeholders

The Civil Engineer`s World 2025

Civil engineers can determine the roles they will play in the world of 2025.

The Civil Engineer`s World 2025 (continued)

Civil engineers have helped raise global expectations for sustainability and for environmental stewardship.

The shift of people from rural to urban areas increasingly strained the overburdened infrastructure.

The Civil Engineer`s World 2025 (continued)

Demands for sustainable energy, fresh water, clean air, and safe waste disposal drive global infrastructure development.

The Civil Engineer`s World 2025 (continued)

Civil engineers lead in adapting and integrating new technologies into design and construction.

Life cycle design philosophies have been widely adopted.

The Civil Engineer`s World 2025 (continued)

As a result of leadership and collaboration, the gaps between advanced, developing, and underdeveloped nations have been reduced.

Master Innovation and Integration (continued)

Civil engineers provide critical guidance for determining public policy and defining the research agenda.

Civil engineers lead in adapting and integrating new technologies into design and construction.

Master Innovation and Integration (continued)

Many improvements in project management, especially involving virtual teams, are attributed to civil engineers.

Research and Development

Civil engineering has helped define the nanoscience, nanotechnology, and biotechnology research agenda.

Research and Development (continued)

The profession's advancements in information technology and data management have improved the design, construction, and maintenance of facilities.

Managing Risk

The effort to manage and mitigate risk is led by civil engineers.

Civil engineers have been in the forefront in developing and applying global, performance-based codes and standards.

Multi-national corporations are now major drivers of global environmental standards.

Reforms in the preparation of engineers

The widely-accepted body of knowledge is now the basis for the formal education and pre-licensure experience of civil engineers.

Civil engineers are widely recognized as opportunity identifiers and problem solvers.

Levels of expertice of civil engineers

- The global civil engineering profession has taken up the challenge.
- Such a broad collection of activities cannot be centrally controlled, but overall monitoring will be necessary.
- Certain types of organizations stand out as key for involvement in achieving the Vision.
- Civil engineers have to raise their visibility and become more proactive and sought after within public policy forums.

Civil Engineers 2025

- Civil engineers have recognized the reality of shrinking resources and embraced sustainable practices and designs.
- Civil engineers facilitate and lead multi-disciplinary, collaborative programs using a systems approach to achieve successful project outcomes.
- In 2025, more civil engineers will hold elected and appointed positions within all levels of government.

How can the civil engineers manage such a very broad mission?

- Civil engineers have always used to work on a broad bases
- The leadership of the future anyway rise needs for renewal of the university education
- Civil engineers will be educated and will work in organoisations on several levels of expertice:
  - Strategic level
  - Tactic level and
  - Detailed level

Central roles of civil engineers in 2025

Civil engineers serve as master:

1. Planners, designers, constructors, and operators of society's economic and social engine—the built environment;

2. Stewards of the natural environment and its resources;

3. Innovators and integrators of ideas and technology across the public, private, and academic sectors;

4. Managers of risk and uncertainty caused by natural events, accidents, and other threats; and

5. Leaders in discussions and decisions shaping public environmental and infrastructure policy.

EU HORIZON 2020

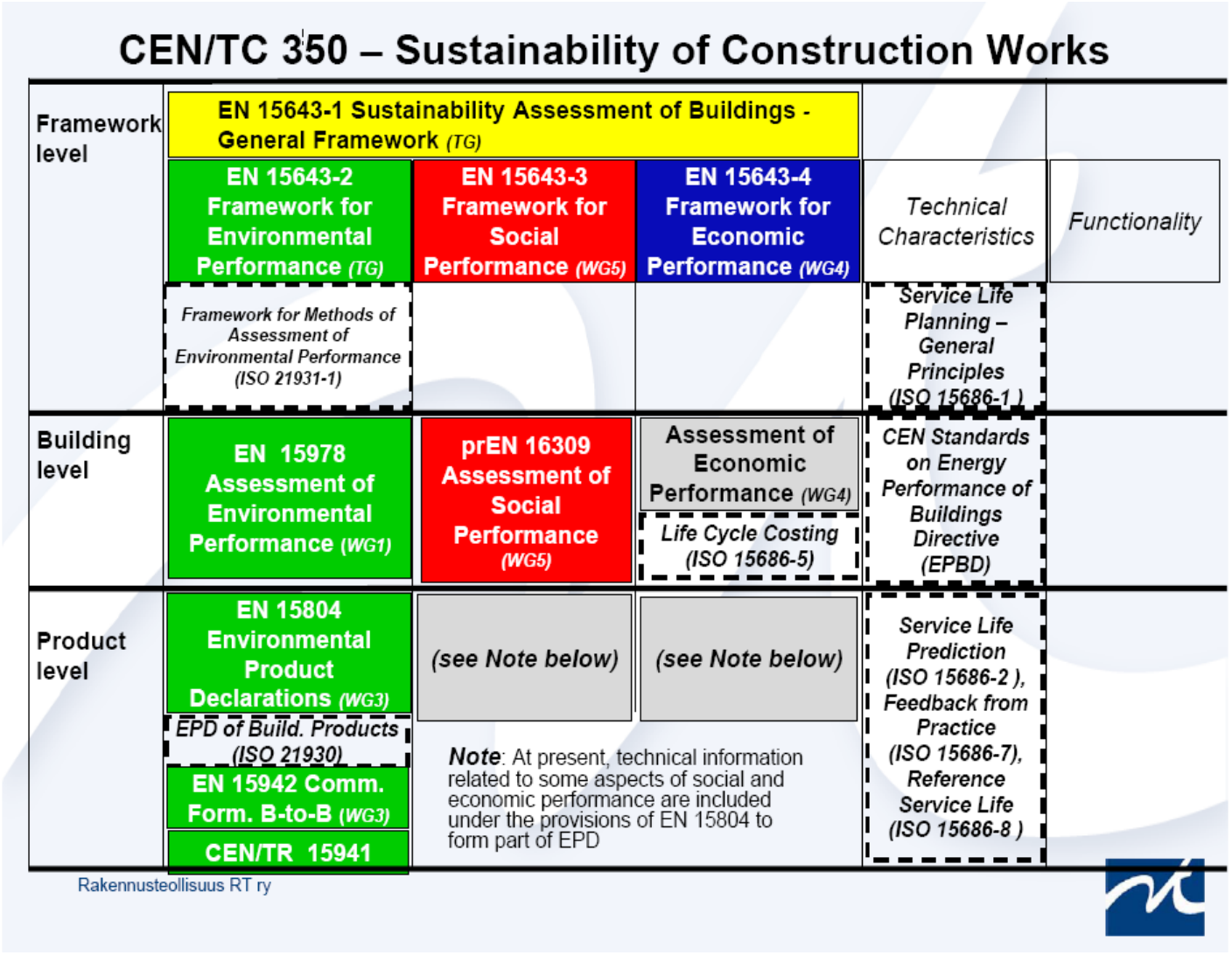
Strategic Goals of EU

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

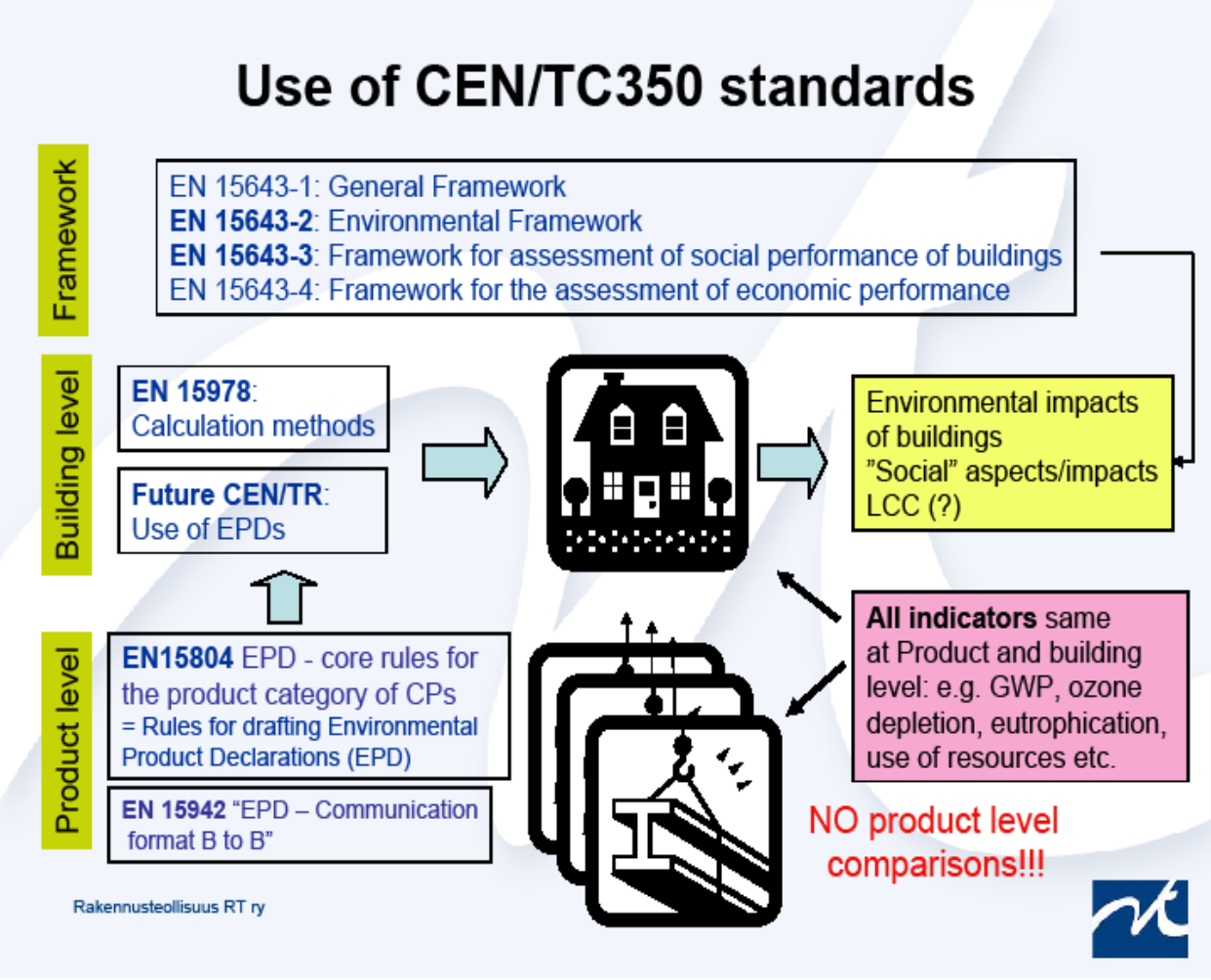
Targets for materials economy and waste reduction

- 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

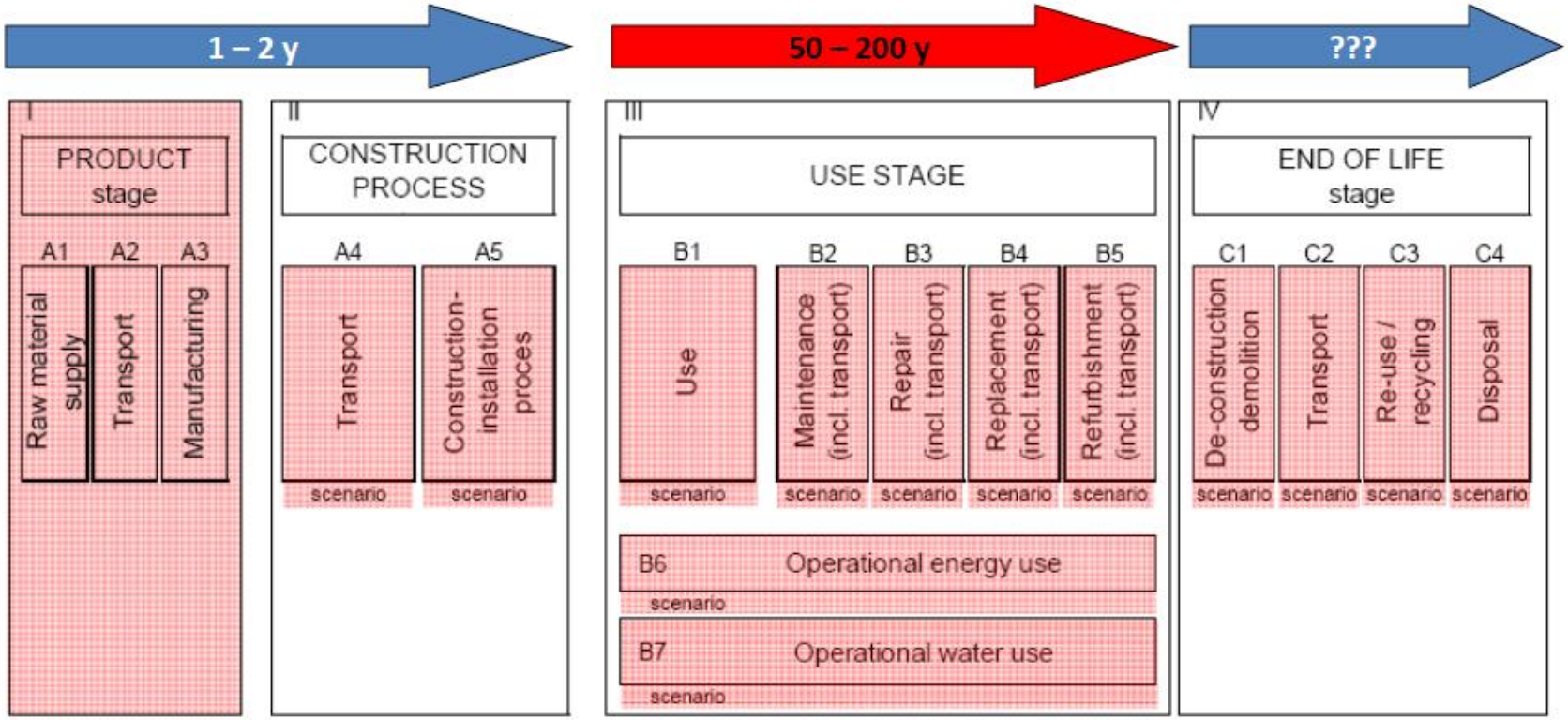
Standards for sustainable buildings to be in common use in 2020



Use of CEN Standards for buildings in 2020



Life cycle construction process



nearly Zero Energy Buildings nZEB 2020

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Three principles of the nZEB

First nZEB Principle: Energy demand	Second nZEB Principle: Renewable energy share	Third nZEB Principle: Primary energy and CO_2 emissions
There should be a clearly defined boundary in the energy flow related to the operation of the building that defines the energy quality of the energy demand with clear guidance on how to assess corresponding values.	There should be a clearly defined boundary in the energy flow related to the operation of the building where the share of renewable energy is calculated or measured with clear guidance on how to assess this share.	There should be a clearly defined boundary in the energy flow related to the operation of the building where the overarching primary energy demand and CO_2 emissions are calculated with clear guidance on how to assess these values.
Implementation approach: This boundary should be the energy need of the building, i.e. the sum of useful heat, cold and electricity needed for space cooling, space heating, domestic hot water and lighting (the latter only for non-residential buildings). It should also include the distribution and storage losses within the building. **Addendum:** The electricity (energy) consumption of appliances (plug load) and of the other building technical systems (i.e. lifts, fire security lighting etc.) may also be included in the nZEB definition as an additional indicative fixed value (similar to the approach on domestic hot water demand in most of the MSs building regulations).	**Implementation approach:** This could be the sum of energy needs and system losses, i.e. the total energy delivered into the building from active supply systems incl. auxiliary energy for pumps, fans etc. The eligible share of renewable energy is all energy produced from renewable sources on site (including the renewable share of heat pumps), nearby and offsite being delivered to the building. Double counting must be avoided.	**Implementation approach:** This is the primary energy demand and CO_2 emissions related to the total energy delivered into the building from active supply systems. If more renewable energy should be produced than energy used during a balance period, clear national rules should be available on how to account for the net export.

12 | Principles for nearly Zero-Energy Buildings

Asko Sarja - ECCE Meeting, May 25th, 2012, Vilnius, Lithuania

Renewable and CO2-free energy

- Most common types of local renewable energy sources are:
  - Geothermal energy: Earth heat pumps
  - Air heat energy: air heat pumps and exhaust air heat pumps
  - Solar energy: Solar panels and electric solar cells
  - Wind energy
- The selection in each case is depending on the geografic location (North, Central, South) and on the lifetime economy of the heating system

Markets

- **Sustainable construction can be defined as a new and sustainable paradigm** of developers with new solutions.
- 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**.
- **Two market drivers** on innovation are:
  - (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 targets have to be achieved under a very **slow economic growth** during this decade

Trends on the Residential Market

- The users' **requirements will change** more frequently than before.
- **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.
- Harmonous urban and social mix.

Trends on the Infrastructure Market

- Investment on a **more strategic approach towards the long term functional characteristics** of the infrastructure and the associated **life-cycle costs**.
- Considerations depending on the market segment considered and the **specific regional context**.
- Innovation 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.
- A growing importance of **retrofitting of buildings and infrastructure**
- 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.

SOME VIEWPOINTS from ECCE HORIZON

Some viewpoints for ECCE

- ECCE could work as a central European discussion body for implementing the global Vision 2025 into visionary development of the European civil engineering profession
  - As a co-operation between national civil engineering associations
- As a concrete result, ECCE will develop and publish the European Vision of Civil Engineering in 2020-2025

Central issues of discussions in ECCE

- Promote a universally accepted body of knowledge that prepares civil engineers for professional practice.
- Encourage wide acceptance of a multi-tiered system to deliver civil engineering services based on a well defined hierarchy of professional and paraprofessional competencies.
- Encourage collaboration between civil engineering researchers and builders to identify and evaluate promising construction techniques.
- Improve documentation and sharing of innovations.

The objectives of EU and ECCE

The Executive Board of ECCE has published in October, 2009 a Position Paper:

"Sustainable Building and Civil Engineering Implementation into Praxis in EU".

- In this paper has been presented the following conclusion:
  - The revised **Paradigm of Sustainable Civil Engineering** is a **high opportunity** towards an **advanced civil engineering practice**.

Current state of knowledge and development in ECCE countries

Knowledge and tools already exist for the **new paradigm** :

- excellent **strategies, concepts, methodologies, directives, codes, standards and literature**.

- The **challenge** for civil engineers is **to learn and implement this knowledge into praxis:**
  - **Effective actions are needed** for **disseminating the knowledge among civil engineer**s through **information, training, guidance and education**.
  - Modern social media as an interactive collaboration tool

Detailed challences and responsive actions of ECCE

Challence 1:

Construction sector and all its private and public stakeholders should become more **proactive** with the sustainable development agenda

Action 1:

Inform the European Society of Civil Engineers on the need to build a close cooperation between the actors

- in decision making, planning design and construction

and

- in the services responsible for the operation and maintenance of the assets

Challences and responsive actions of ECCE (continued)

Challence 2:

There are a number of strategies and initiatives at European and national levels but not a unified plan to transform them to real-life practices

Action 2:

Implement new paradigm into business and **practice**

- **Applying** the principles, processes, methodologies and methods of **Life Cycle Engineering (LCE**) of the **IT**
- Using the modern **Internet Society** for **information exchange and knowledge distribution** between partners of construction sector

Challences and responsive actions of ECCE (continued)

Challenge 3:

- **Standardisation** process cannot alone deal rapidly enough with new technologies

Action 3:

- Create **voluntary paths** to support the market development. Combine this into the Actions 1. and 2.

Challences and responsive actions of ECCE (continued)

Challence 4:

Objective of EU: Improve the **energy effectiveness** of the building stock by **25 % until 2020**, and by **85 % until 2050:**

- at reasonable cost conditions in construction and in relation to lifetime costs and
- energy supply with **renewable and low carbon** primary energy

Action 4:

Inform and deliver with knowledge the ECCE Members for implementing energy efficient, **low energy and passive buildings** in practice, combined with renewable energy supplies.

Challences and responsive actions of ECCE

(continued)

Challence 5:

The construction sector needs to further **develop skills and services** to **meet** the customers and occupants the **quality requirements and the lifetime economy** of the assets over the life-cycle.

Action 5:

Develop national and European **education and training** program for improving the skills of building and cIvil engineers in all phases of the sustainable life cycle engineering process.

A basic Question for ECCE

- How can ECCE contribute in solving these very high Challenges?
  - Integrating all knowledge of the Member Organisations and
  - Working interactively with all National Organisations of Civil Engineers
  - For the benefit of all Members of ECCE
- STRATEGIC PLAN 2020 of ECCE has to show a concrete road map for Solving these Challenges