Framework Guidelines for Energy Efficiency Standards in Buildings

Global transformation of buildings in the built environment: Framing the design, delivery and operation of buildings as integrated, thermodynamic and environmental systems

I. Introduction

1. Buildings are central to meeting the sustainability challenge. In the developed world, buildings consume over 70% of the electrical power generated and 40% of primary energy, and are responsible for 40% of CO_2 emissions from combustion. While developing countries will need to accommodate 2.4 billion new urban residents by 2050, in Europe 75-90% of buildings standing today are expected to remain in use in 2050. Renewable energy technology alone cannot meet those requirements, despite recent improvements. The energy performance of buildings must be managed, but the capability to meet this challenge is in place.

2. Standards are an effective instrument for addressing energy efficiency in buildings. Development and deployment of standards support the achievements of the targets set by several international initiatives such as the 2030 Agenda for Sustainable Development, the Sustainable Energy for All Initiative, the Geneva United Nations Charter on Sustainable Housing. The concepts set forth herein go well beyond the incremental, components approach of existing building standards. Rather, they represent a principles-based performance guidance for building energy standards that is outcome-based, anchored in energy actually consumed, and that is designed to project a vision of holistically designed and operated, ultra-high performance buildings as part of an integrated sustainable energy system.

II. Goal

3. Economic growth and the quality of indoor environments have depended on increased primary energy use. Shifting that reliance to renewables requires a holistic, systems approach to building design, delivery and operation and a paradigm that envisions buildings as energy producers and not solely or primarily as energy sinks. At costs equal or close to those of traditional buildings, it is possible with today's technology to transform buildings to align with the highest standards of health, comfort, well-being and sustainability, including improving energy productivity and reducing CO_2 emissions.

4. The energy required by buildings can be reduced to a level that can be supplied largely, perhaps exclusively, by non-carbon-based energy. While further improvement in renewable energy technology and electrical and thermal storage is to be expected, the results will be more immediate and robust if buildings are transformed fundamentally in terms of their energy performance. Limiting building

heating and cooling requirements to 25 kWh/m^2-a (final energy in conditioned space) each reduces energy needs sufficiently to permit renewable energy or zero carbon sources to meet most or all of the remaining space conditioning energy requirements. Total primary energy use in buildings' conditioned spaces, including heating, ventilation, cooling and hot water, can be limited to 45 kWh/ m^2-a or, including plug-in loads (appliances), to 90 kWh/ m^2-a. Over time with improvements in technology and materials and with enhanced connections to the built environment, these targets could be improved further. In parallel, there will be need for effective controls for generation, distribution, and emission at full and partial demand loads to match energy use with building and occupant needs.

III. The Principles

5. The principles required for an era of truly sustainable buildings emerge from building science, materials science, digital science, information and communication technology and more. They reflect accumulated lessons learned and best practices of building owners, designers, engineers, builders, managers, policy makers, and more. The principles shift the building industry paradigm from fragmented and serial to holistic and integrated.

6. The principles cannot be prescriptive because of the vast diversity of circumstances and conditions experienced around the world. Rather, the principles provide guidance for planners, builders, and the entire building delivery and management chain as elements of innovative sustainability strategy.

A. Strategic – Buildings must be:

- **Science-based**: design, construction, and management.
- **Financed** through policies recognizing the value of better buildings.
- **Service-oriented**: meet the sustainability demands of the populations served.
- **Integrated** with their built environment life-cycle to connect buildings as energy generators and consumers.
- **Cost effective** to mobilize private investment and entrepreneurs.
- **Performance-monitored** with feedback loops to operations and design tools.
- **Performance-based**: evaluated by system outcomes, not component prescriptions.

B. Design and Construction – Conception/delivery of buildings must be:

- **Holistic and integrated**: recognize buildings and their environment are part of a system.
- **Affordable**: high performance buildings costing the same as or less than in 2016.

- **Validated**: based on energy models that reliably predict actual building performance.
- **Sustainable**: made using sustainable materials, equipment, construction, management and retirement practices.
- **Code-driven**: with local adaptation of global building standards.
- **Skills based**: develop work-forces to provide technology/skills needed for design, construction and operation.

C. Management – Building must be maintained over their life-cycle:

- **Commissioning:** With commissioning and re-commissioning of active systems.
- **Performance-based:** With on-going benchmarking, monitoring & reporting of performance data.
- **Certification:** Maintain certification or labelling to ensure energy performance is incorporated in to asset value.
- **Managed:** professionally managed large or complex buildings with ethos of sustainability & social responsibility.
- **Data-linked:** with advanced building information management capacity, where public infrastructure permits.
- **Evaluated:** Ongoing performance evaluation and improvement.
- **City-scaled:** information analysis and outcomes.
- **Life cycle-based:** with long term analysis.

IV. Implementation

7. Transformative change in buildings is possible, and the capabilities to create a new world of buildings and energy is in hand or within reach. Already today we have the techniques to achieve climate neutrality in the building sector until 2050/2060. Progress will require follow-on action in five areas to support the Framework and make its vision a reality:

(a) **Dissemination**: national, regional and municipal leaders in the public, private, research and education sectors must be made aware of the framework – its vision, logic, practicality, and advantages.

(b) **Education**: information, guidance, instruction, and avenues to ongoing dialogue and knowledge resources must be provided to policy, market, and knowledge stakeholders to foster local development of building standards, codes and practices aligned with the Framework.

(c) **Research**: through collaborations among leaders in science and technology, focused on the frontier challenges in such areas as: (1) building components and materials; (2) building design, construction and monitoring; (3) energy generation and distribution; (4) integrated

urban systems and life cycle management; and (5) strategies for each country and climate zone to be carbon-free in 2050/2060.

(d) **Consultation**: formal and informal channels with local policy, market, and knowledge stakeholders for evaluation of impact, dialogue on in impact strategy, addressing discovered or unanticipated challenges, and cultivating global consensus in support of the Framework.

(e) **Participation**: networks of support and engagement among leading corporations, foundations, universities, professions, civil society and others with the array of resources – intellectual, experiential, financial, and relational – that will be required to make transformation a grass roots or deep market movement.