Toward Near-Zero Energy and Carbon Emissions for Buildings and Communities: Overview on R&D and Innovation Projects

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Current trends on energy use and environmental impacts have led many countries and organizations to develop measures and strategies in attempt to drastically reduce energy consumption and environmental impacts from the built environment. Among the key measures and strategy, Innovation and research, is necessary to meet the challenging targets for energy efficiency and environmental impacts in the built environment.

The built environment - i.e., construction sector - represents more than 10% of GDP, and consumes between 30-40% of total energy consumption and 50% of total primary resources. It is also responsible for 25-40% of the total solid waste. Today, a review of energy use (and also environmental impacts) in the built environment shows the emergence of energy efficiency (and environmental) targets in many countries, such as zero- and positive- energy by 2030 or 2050. These are usually supported by newly developed measures and strategies, to drastically reduce energy consumption and environmental impacts from the built environment. Among others, these measures have included development of building energy codes, more focused research agenda and initiatives, and horizontal partnerships resulting in field demonstrations. Many jurisdictions and countries are pursuing R&D activities toward zero-energy buildings, or even positive energy buildings.

On other hand, the sector is recognized as uniquely fragmented especially in the decision-making process or production and manufacturing. More importantly, it is widely accepted the rate of integration of innovation in buildings is relatively very "slow". Further, the sector is expected superior performance and regulatory demands, in other aspects including safety, security and health. This coincides with the shrinking of R&D resources and investments, especially in the area of the built environment, and more demands from people for leadership and effective actions to tackle depletion of natural resources, mitigation of climate change, and increasing construction and occupancy costs.

The presentation will focus on the status of research and innovation in meeting aggressive building energy efficiency and environmental requirements, with supporting evidence from international research projects and initiatives. The author will present projects and initiatives from his chairmanship of the International Energy Agency's Implementing Agreement on Energy Conservation in Buildings and Communities systems (ECBCS) and as Director General of the Institute for Research in Construction at the National Research Council Canada (NRC-IRC). NRC-IRC is responsible for more than 30% of the total R&D in construction in Canada, and is custodial of Model National Building Codes, including the Model national Building Energy Codes. The presentation will focus on the effectiveness of multi-disciplinary R&D projects related to energy efficiency and reduction of carbon emissions from building services – HVAC, lighting; building envelope and material science; integration of renewable –solar and hydrogen.