



COMMUNIQUÉ – CANADIAN ROADMAP FOR RESILIENT BUILDINGS

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Canadian Academy of Engineering: www.cae-acq.ca

The Canadian Academy of Engineering (CAE) assembled Thought Leaders from the professional community, construction industry, academia and three levels of government to begin to work on a national “Roadmap to Resilient, Ultra-Low Energy Built Environment with Deep Integration of Renewables in 2050”, with an aim to achieve at least an 80% reduction in greenhouse gas (GHG) emissions in new and existing buildings and associated community infrastructure.

The CAE's [Trottier Energy Futures Pathway project](#) described scenarios for reducing energy supply emissions by up to 70% below 1990 levels across all energy uses, requiring an investment of 20-30% of Canada's non-residential business capital up to 2050. This represents a significant opportunity for diversification and economic growth.

The CAE Roadmap will articulate resilient solutions for community planning, building form and design, existing building renewal, "smart" community energy infrastructure, and on-site renewable energy generation to provide a supplemental perspective on the Trottier project. These solutions could enable achievement of the 80% by 2050 goal, while simultaneously increasing the resilience of communities to acute shocks and chronic stresses that are anticipated this century.

In recent history, we have experienced such shocks as the 1998 central/eastern Canada ice storm that resulted in up to 5-week power cut, 4.7 million people displaced in Québec and Ontario and economic loss of over \$6 billion. This led to significant damages to buildings after their occupants evacuated them due to utility outages, resulting in extensive water damage from frozen water pipes and contributing to the economic loss. Such damage could be greatly reduced through resilient solutions that enable on-site electricity and heat production with building-integrated renewables. We anticipate that climate change will increase prevalence and intensity of chronic stresses as well as acute shocks. We need to increase our resilience to these and other acute shocks, such as a catastrophic earthquake in British Columbia or the Yukon where much of the older building stock could be destroyed in some cities, depending on the location and scale of the event. Solutions that address the three objectives of resilience, deep reductions in GHG emissions, and optimized energy efficiency plus on-site renewables can future-proof buildings and infrastructure and maximize long-term economic benefits for building owners, occupants and society.

At the March 22 Thought Leaders' Workshop, we discussed many technological and systems solutions already demonstrated by leaders across Canada, including the Varennes Library in Québec, Canada's first institutional solar net-zero energy building. Inaugurated in 2016, this building is designed to

produce approximately as much energy as it uses in an average year through a building-integrated photovoltaic system. In fact, the solar energy potential across most of the populated areas of Canada is significantly higher than most of northern Europe. Peak utility demand can be reduced through smart grids, with smart buildings being active participants to provide load flexibility and services to the grid, including short-term curtailment of water heaters, thermal storage on-site, and additional storage from electrical vehicles. Energy utility resource planning, consumption and production rate structures, and the development of building codes and standards will benefit from access to measured data from building operations, requiring information infrastructure aligned with privacy legislation.

The CAE and its partners have launched a major effort to consider many of the questions raised at the workshop, reflecting various constituencies represented, to identify practical technical, policy, standards development and institutional solutions, and to develop the Roadmap document by 2021. The Roadmap could be used by all levels of government, including Indigenous communities, the construction and real-estate industries, energy utilities, the associated professional communities, product manufacturers, academia, and other key influencers. The vision is for a resilient built environment that is economically optimized in design, operation, retrofit/renewal and energy over a long-term horizon equivalent to the lifetime of the building/infrastructure (at least 50 years).

Further research will build upon existing strong evidence that energy efficiency and on-site renewable energy generation are required for broader resilience of the building stock and associated community infrastructure. To accelerate the innovation cycle, we will look to reframe the problem statements, continue to learn from existing building operations, and enable “double-loop” learning. We will aim to integrate “silos” in the professional community (*i.e.*, engineering, planning, architecture, real estate, and the administration and management of construction, buildings, utilities, governments and others). Finally, we will develop win-win approaches and solutions adapted to the different regional contexts for new and existing buildings and community energy infrastructure by identifying the design solutions that optimize the multiple objectives of building code objectives, energy efficiency, GHG reductions, on-site renewable energy generation and durability.

The first order of business is to clarify the scope of the Roadmap. We will then define the range of questions that correspond with technical, market and human behavioural barriers. The Thought Leaders discussed concerns around the durability of modern construction, fuel and material choices, maintenance of existing affordable housing stock, procurement of professional services and “value engineering” (often cutting construction costs by installing lower performing components than envisioned in the design), market acceptance of innovative designs, management of risk and liability, and capacity of the industries to deliver solutions at scale. Consideration of key related barriers and research questions is being addressed through a network of leading Canadian researchers from about 15 universities across all major regions and over forty partners covering major stakeholders, including the built environment designers, energy utilities, municipalities, builders, and manufacturers.

The Roadmap will articulate existing and emerging societal goals, highlight all available government policy levers and market mechanisms, and provide at least three “pathways” to achieve the vision. Pathways are expected to include, but not limited to the following: evolving objectives for the national building code development system; adoption/ implementation of these codes by provinces, territories Indigenous communities and local governments; public/ industry awareness and education; opportunities through incentives/ insurance/ financing/ leadership investments; technical synergies of having buildings be active participants in the energy grids; energy pricing strategies for energy efficiency and models to facilitate integration of on-site renewable energy systems; qualification-based/ financial

outcome-based (best net-present value design) construction procurement; alternative institutional frameworks, and community planning.

In 2019 and 2020 the Thought Leaders' Workshop participants and associated partners will endeavour to develop the "near final" draft Roadmap in time for a symposium in Montreal in the fall of 2020, co-hosted by the CAE and the Concordia Centre for Zero Energy Building Studies. At the Montreal meeting, a broadened audience of all stakeholders and key influencers will be invited to submit papers and discuss the draft Roadmap in progress with a dual emphasis on technological win-win solutions and government policies.

In 2021 a symposium will be held in Victoria BC, focusing on policy solutions for all four levels of government (local/regional, Indigenous, provincial, federal) that are analyzed and vetted by the CAE and partners, along with options for the roles and responsibilities of the key institutions that develop, implement and support building codes and standards, community energy infrastructure, and construction and building management.

The resultant draft Roadmap will be posted by mid-2021 with an opportunity for public input to the Canadian Academy of Engineering. It will be practical and digestible by layperson audiences and decision makers alike. It will provide multiple pathways that will appeal to the diversity of Canadian jurisdictions.

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