Building for a Smarter Future: An Examination of How to Navigate and Incorporate Strategic Engineering Concepts Towards Effective Community Building

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ONTARIO SOCIETY OF PROFESSIONAL ENGINEERS

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Acknowledgements

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Contributors

Emily Pepper P.Eng., CAHP (Chair)

Mukul Asthana P.Eng., MBA

Carly Connor P.Eng., CAHP

Doug DeRabbie M.A (ACEC)

Laura Lambie, CAE (ACEC)

Shivani Nathoo P.Eng.

Kimberly Paradis

Paul Acchione Meng, P.Eng, FCAE

Carl Bodimeade P.Eng.

Kadra Branker P.Eng.

Tom Markowitz P.Eng.

Chloe Richard P.Eng.

Geoff Sheffrin, P.Eng.

Mo Yousefpour PMP, MASc, Meng, EIT

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The ongoing housing crisis in Ontario has become a critical challenge, exacerbated by rapid population growth, rising housing costs, and increasing environmental concerns. As the demand for affordable and sustainable housing continues to outpace supply, the need for effective, forward-thinking policies that address these issues is more urgent than ever. Ontario's engineering community, with its deep knowledge of infrastructure, sustainability, and innovation, is uniquely positioned to contribute to the creation of policies that can help overcome these challenges. In response, a set of policy recommendations has been put forth by engineers in Ontario to guide the province toward a future where housing is not only more affordable but also environmentally sustainable, resilient, and accessible to all.

These recommendations are underpinned by overarching principles aimed at addressing key needs such as reducing operating costs, minimizing waste, improving resiliency, ensuring safety, enhancing comfort, fostering a sense of community, and lowering environmental impact. By structuring these efforts around these shared goals, these recommendations aim to engage all stakeholders, ensuring that housing solutions are designed to support both the people who live in them and the broader communities they serve.

Energy Efficiency and Renewable Energy Integration

Energy efficiency and renewable energy integration are among key focus areas. The engineering community emphasizes the importance of incorporating advanced energy systems in new and existing housing developments. This includes optimizing building designs to reduce energy consumption, integrating renewable energy sources such as solar and wind, and implementing energy storage solutions. These measures not only help lower utility costs for residents but also contribute to Ontario's ongoing efforts to combat climate change, aligning with the principle of reducing costs and improving environmental outcomes.

Green Building Materials and Techniques

Equally important is the promotion of green building materials and techniques. Ontario engineers advocate for the adoption of materials that reduce the environmental impact of construction, such as low-carbon alternatives, recycled materials, and innovative products that enhance building performance. These materials, when combined with cutting-edge construction techniques, significantly reduce the carbon footprint of new housing developments and contribute to more sustainable urban growth. This approach directly supports waste reduction and environmental sustainability.

Sustainable Transportation and Connectivity

Transportation and connectivity also play a pivotal role in shaping Ontario's housing future. Policy recommendations emphasize the integration of sustainable transportation solutions, such as efficient public transit networks and active transportation infrastructure, into housing developments. By reducing reliance on private vehicles and facilitating easier access to public transportation, these measures aim to make housing more accessible, reduce congestion, and lower greenhouse gas emissions, aligning with the goal of fostering community and improving daily living conditions.

Harnessing Smart, Green Technologies for Sustainable Housing

The incorporation of innovative green technologies is another area of focus. By leveraging advancements in automation, artificial intelligence, and smart technologies, Ontario can create housing that is energy-efficient and more responsive to residents' needs. These technologies can optimize energy usage, enhance building performance, and improve the quality of life for occupants. This contributes to long-term sustainability and cost-efficiency.

Climate-Resilient Design and Construction

As Ontario faces the growing threat of extreme weather events due to climate change, climate-resilient design and construction are critical. Ontario's engineers advocate for building practices that prioritize durability and resilience, ensuring that homes can withstand floods, heatwaves, and other environmental stresses. These designs not only protect residents but also safeguard long-term investments in housing infrastructure. Furthermore, insurance companies will offer lower cost policies, which will save homeowners significantly over the years.

Equitable Access to Sustainable Housing

Finally, the recommendations stress the importance of equitable access to sustainable housing. The goal is to ensure that all Ontarians, especially those in underserved communities, have access to affordable housing that is both environmentally friendly, and built to withstand the challenges posed by a changing climate. This aligns with the overarching principles of inclusivity, resilience, and community support.

By integrating these overarching principles and targeted solutions, these recommendations represent a comprehensive approach to addressing Ontario's housing crisis. The engineering community's insights and expertise are instrumental in shaping policies that reduce costs, minimize waste, and create a housing system that is sustainable, resilient, and inclusive. With these measures, Ontario can prepare for a future that meets the needs of its people while fostering a thriving and sustainable environment for generations to come.

A. Energy Efficiency and Renewable Energy Integration

This section examines the impact that energy efficiency and renewable energy integration can have sustainable housing developments. Engineers in Ontario emphasize the importance of advanced energy systems that enhance efficiency, minimize dependence on conventional energy sources, and elevate overall building performance. Through optimized design, the incorporation of renewable energy solutions like solar and wind, and the integration of energy storage technologies, these strategies not only lower operational costs for residents but also advance Ontario's climate goals. The overarching aim is to harmonize economic and environmental priorities, ensuring that housing developments are both resilient and energy-efficient for the future.

1. Energy-Efficient Technologies and Incentives

1.1. Incentives/Requirements for Energy-Efficient Technologies:

Introduce incentives for the adoption of energy-efficient technologies, such as smart HVAC systems, LED lighting, and advanced insulation. Examples of incentives include accelerated permitting, rebates for developers, tax breaks.[i]

1.2 Green Roof and Green Wall Incentives:

Provide incentives for the installation of green spaces including green roofs and walls, which contribute to energy efficiency by enhancing insulation and reducing the urban heat island effect.[ii]

1.3 Smart Building Technologies:

Promote the adoption of smart building technologies, including energy management systems and IoT (Internet of Things) devices, to optimize energy usage.[iii]

1.4 Collaboration with Utilities:

Partner with utility companies to design and implement programs that encourage energy efficiency measures and the integration of renewable energy systems in building projects.[iv]

2. Renewable Energy Integration

2.1. Renewable Energy Mandates:

Require building designs to support renewable energy integration -such as solar-ready wiring, roof load capacity for solar panels, and grid-compatible systems - up to the optimal penetration limits for on-site generation.[v]

2.2. Community Renewable Energy Programs:

Encourage the development of community-based renewable energy projects as part of new construction, while also incentivizing renewable energy programs and deep energy retrofits for existing buildings. Leverage emerging technologies to engage local communities, optimize energy efficiency, and reduce costs. Foster collaboration with local hydro distribution companies to address the unique challenges of remote areas, enhancing energy security and delivering economic benefits.[vi]

2.3 Optimize Wind and Solar Energy Use:

Optimize wind generation, which operates continuously day and night, alongside solar generation, which functions during daylight hours, to reduce overproduction, minimize reliance on expensive storage solutions, and limit energy curtailment.[vii]

2.4 Leverage Nuclear and Hydroelectric Power for Base-Load Demand:

Use dependable, high-capacity factor nuclear and hydroelectric plants to meet base-load demand, reducing the need for costly backup and storage solutions if renewables were used for this load category.[viii]

2.5 Consider the Role of Inverters in Renewable Integration:

Optimize the use of inverter-based generation like solar and wind systems, which require additional equipment for backup and frequency and voltage stability, that can increase overall system costs as penetration increases.[ix]

3. Power System Reliability and Backup Solutions

3.1 Ensure High Reliability Standards for Electricity Systems:

Adopt mandatory reliability standards, such as those established by NERC, to ensure the high-voltage transmission system is robust and reliable enough to consistently meet consumer demands.[x]

3.2 Ensuring Reliable Power System Performance

Implement sufficient system integration services to ensure all power system performance requirements (load/generation balancing, ramp rates, frequency and voltage) are met, particularly during extreme weather conditions.[xi]

3.3 Increase Backup Generation Capacity:

Ensure adequate backup power generation capacity to manage equipment failures and unexpected demand surges, with a focus on maintaining reliability and resilience during severe weather events.[xii]

3.4 Plan for Backup Energy Generation:

Backup for wind and solar during peak demand periods must be addressed—solar requires up to 95% backup during peak demand hours in the winter, while wind requires 87% backup in the summer in Ontario. (Higher backup is required for summer months, while lower backup is needed for winter months) This is location specific.[xiii]

Prioritize cost-effective backup options, such as natural gas or emerging clean fuels like renewable natural gas, or other biofuels to mitigate costs.[xiv]

3.5 Provide Life-Critical Backup Generation:

Ensure that dependable emergency reserve generation, such as natural gas combustion turbines, are available and distributed throughout the power system to maintain critical services like hospitals and community cooling or warming centers during power system outages such as transmission failures. If net zero is required for emergency services, then renewable natural gas can be used as the fuel

source albeit at a higher cost. Note: Not done physically but contractually through RNG injection into the natural gas distribution system.[xiv]

4. Grid and Infrastructure Development

4.1. Strengthening Transmission and Distribution Infrastructure for Peak Demand and Future Growth

Invest in robust and scalable transmission and distribution infrastructure to reliably support peak power demand, enhance grid resilience, and accommodate future increases in energy consumption. This includes upgrading aging infrastructure, integrating advanced technologies for real-time monitoring and control, and enabling the seamless integration of renewable energy sources to ensure a stable and efficient power supply.[xvi]

4.2 Diversify Energy Storage and Backup Systems:

Integrate variable energy sources such as solar and wind with reliable backup solutions like natural gas, hydroelectric power, or battery storage to ensure a stable and consistent energy supply.[xvii]

4.3 Optimizing Solar Energy with Short-Duration Storage

Utilize shorter-duration energy storage systems, such as four-hour batteries, to effectively extend solar energy production into high-demand evening periods, ensuring a reliable and consistent energy supply during peak usage times.[xviii]

4.4 Address System Costs for Low Operating Capacity Factor Renewables:

Recognize that wind and solar have lower capacity factors (15-35%) compared to hydroelectric and nuclear (60-90%) and align their production with incremental daily peak consumer demand to avoid high retail uplift charges.[xix]

5. Energy Efficiency in Thermal Systems

5.1 District Energy Systems:

Explore and implement district energy systems that utilize waste heat and renewable energy sources to provide heating and cooling for clusters of buildings. Note: waste heat in this sense is from community activities such as wastewater processing, refrigeration plants, data centers, power production and other industrial processes, etc.

Ontario should adopt a holistic approach to achieving net zero emissions by 2050, one that integrates district energy solutions into a broader low-carbon ecosystem. This includes leveraging all energy sources, including synthetic fuels, embracing circular economy principles to reduce per-capita energy use, and fostering a collaborative, stakeholder-driven environment that accelerates technological innovation and sustainable community design.[xx]

5.2 Promote Thermal Energy Efficiency:

In urban high population density areas, consider district heating systems powered by nuclear, biomass and commercial/industrial waste heat to supply thermal energy, which is more cost-effective than making electricity and converting electricity to heat. When using waste heat, you reduce the total energy footprint that the community needs.[xxi]

Support the use of thermal storage at both the building and community level, as it is much cheaper than electrical storage and can reduce the amount of installed thermal generation capacity to meet peak thermal demand on the coldest days. Long term (seasonal) thermal storage is approximately 100x cheaper than battery (seasonal) storage.[xxii]

5.3 Consider Seasonal Thermal Storage:

Explore seasonal thermal storage options, particularly in cities, to allow for more cost-effective energy management of peak demands and use of waste heat sources such as data centers and industrial processes.[xxiii]

B. Green Building Materials and Technologies

This section explores the role of energy efficiency and renewable energy integration in advancing sustainable housing developments. Ontario's engineers advocate for the adoption of cutting-edge energy systems that enhance efficiency, reduce reliance on traditional power sources, and improve overall building performance. By incorporating smart design principles, renewable energy solutions such as solar and wind, and energy storage technologies, these strategies not only reduce long-term costs for residents but also support Ontario's climate objectives. The goal is to balance economic viability with environmental responsibility, ensuring that future housing developments are resilient, energy-efficient, and sustainable.

1. Recommendations for Sustainable Construction Materials

1.1 Lifecycle Assessment Standards:

Establish standards for conducting comprehensive lifecycle assessments of construction materials, considering environmental, social, and economic impacts.[xxiv]

1.2 Embodied Carbon Labels:

Introduce labeling systems indicating the embodied carbon content of construction materials, empowering builders and consumers to make environmentally informed choices.[xxv]

1.3 Green Building Material Certification:

Support and promote certification programs for green building materials, verifying their sustainable attributes and encouraging their widespread use.[xxvi]

1.4 Recycled Content Requirements:

Implement regulations or guidelines mandating a minimum percentage of recycled content in construction materials, reducing reliance on virgin resources.[xxvii]

2. Circular Economy and Low-Impact Materials

2.1 Circular Economy Practices:

Encourage circular economy principles by promoting the reuse, recycling, or repurposing of construction materials, reducing overall waste and cost.[xxviii]

2.2 Low-Impact Alternative Materials:

Invest in research and development of low-impact alternative materials, exploring options such as bamboo, recycled plastic, or sustainable composites.[xxix]

3. Carbon Management and Waste Reduction

3.1 Carbon Offset Programs for Materials Production:
Establish or support carbon offset programs to neutralize the carbon emissions associated with the production of construction materials.

3.2 Waste Reduction in Construction:

Develop and enforce construction waste reduction strategies, encouraging practices such as deconstruction, salvage, and recycling.[xxx]

4. Innovative Materials and Technologies

4.1 Innovative Eco-Friendly Concrete:

Invest in research for eco-friendly concrete alternatives, such as fly ash, slag, or high-performance concrete with reduced environmental impact.[xxxi]

4.2 Energy-Efficient Insulation Materials:

Encourage the use of energy-efficient insulation materials, such as recycled or bio-based insulating materials, to enhance building energy performance.[xxxii]

4.3 Green IT and Cloud Computing:

Promote the adoption of energy-efficient IT practices and cloud computing solutions, reducing the environmental impact of data centers and digital infrastructure.[xxxiii]

5. Smart Energy and Infrastructure Solutions

5.1 Smart Grid Implementation:

Develop and implement smart grid technologies to enhance the efficiency and reliability of energy distribution, facilitating the integration of renewable energy sources.[xxxiv]

5.2 Energy Storage Solutions:

Invest in research and development of advanced energy storage technologies, such as batteries and capacitors, to store excess energy generated by renewable sources for later use.[xxxv]

5.3 Smart Building Systems:

Promote the adoption of smart building systems that optimize energy consumption through automated controls, real-time monitoring, and predictive analytics.[xxxvi]

5.4 Grid-Connected Renewable Energy:

Facilitate the integration of decentralized renewable energy sources, such as solar panels and wind turbines, into the main power grid to augment overall energy supply.[xxxvii]

5.5 Microgrid Development:

Support the creation of microgrids that operate independently or in conjunction with the main power grid, enhancing resilience and providing localized, sustainable energy solutions.[xxxviii]

6. Emerging Green Energy Solutions

6.1 Green Hydrogen Production:

Invest in the development of green hydrogen production technologies using renewable energy sources, promoting hydrogen as a clean and versatile energy carrier.[xxxix]

6.2 Electric Vehicle Charging Infrastructure:

Expand the infrastructure for electric vehicle charging stations, encouraging the adoption of electric vehicles and facilitating their integration into the broader energy system.

Ontario should explore the implementation of electrified roads with embedded charging units, similar to Sweden's model, to enable dynamic charging for electric vehicles, reduce range anxiety, and enhance EV infrastructure accessibility in key locations like bus stops, driveways, and parking lots, supporting the transition to sustainable transportation.[xl]

Explore and implement decentralized energy systems that empower communities and businesses to generate, store, and manage their energy locally.[xli]

7. Building Integrated and Renewable Technologies

7.1 Building-Integrated Photovoltaics (BIPV):

Encourage the incorporation of photovoltaic technology into building materials, such as solar windows, roofing, and facades, to seamlessly integrate renewable energy generation with construction.[xlii]

7.2 Innovative Wind Energy Solutions:

Invest in innovative wind energy solutions, including vertical-axis wind turbines and airborne wind energy systems, to diversify and enhance wind power generation.[xliii]

8. Environmental Systems and Waste Management

8.1 Biogas and Biomass Utilization:

Explore the utilization of biogas and biomass for clean energy production, supporting the development of anaerobic digestion and bioenergy technologies.[xliv]

8.2 Smart Water and Wastewater Systems:

Implement smart technologies in water and wastewater systems as part of initiatives to reduce energy consumption, enhance efficiency, and promote sustainable water management.[xlv]

C. Sustainable Transportation and Connectivity:

This section highlights the essential role of transportation and connectivity in shaping Ontario's future housing developments. Ontario engineers and policymakers emphasize the integration of sustainable mobility solutions, including efficient public transit systems and active transportation infrastructure, to enhance accessibility and reduce dependence on private vehicles. By fostering seamless connections between residential areas and transit options, these strategies aim to alleviate congestion, lower greenhouse gas emissions, and enhance overall livability. This approach aligns with the broader vision of creating dynamic, well-connected communities that prioritize environmental sustainability and urban efficiency.

1. Funding and Financial Strategies

1.1 Prioritize Funding:

Invest in critical transportation projects, including subway expansions, light rail transit (LRT), and high-frequency Bus Rapid Transit (BRT) services.[xlvi]

1.2 Innovative Funding:

Explore new revenue models, such as real estate development near transit hubs and infrastructure-based taxes, to sustain long-term transportation projects.[xlvii]

2. Enhancing Transit Systems

2.1 Public Transit User Experience:

Improve public transit reliability, safety, and user satisfaction by implementing real-time information systems, cleaner stations, and active security measures.[xlviii]

2.2 Climate Friendly Energy for Transit Systems:

Electrify the entire transit system, including the GO Rail network, to reduce emissions and operational costs, improve travel times, increase capacity, and promote climate-friendly, sustainable transportation with closer station spacing for greater efficiency.[xlix]

2.3 Digital Integration:

Leverage big data analytics and real-time demand prediction to optimize routes, schedules, and resource allocation across transit services.[l]

3. Sustainable Urban Mobility

3.1 Sustainable Development:

Promote transit-oriented development (TOD) that integrates urban planning with public transportation to encourage car-free living.[li]

3.2 Active Transportation:

Enhance walking and cycling infrastructure by developing protected bike lanes and expanding bike-sharing programs. Prioritize these improvements in low-density micro-neighborhoods where residents can easily live, work, and play, while also implementing them in other strategic areas where they will

have the greatest impact.[lii]

3.3 First Mile/Last-Mile Solutions:

Introduce on-demand transit, ridesharing, and bike-sharing programs to bridge gaps between public transport stations and homes.[liii]

3.4 Integrating Housing and Transportation for Economic Mobility:

To address the needs of low-income households, urban planning should integrate housing and transportation strategies, ensuring that affordable housing is paired with accessible, reliable transportation options to reduce economic disparities and improve overall mobility and quality of life.[liv]

D. Climate-Resilient Design and Construction

This section explores the transformative impact of innovative green technologies in driving sustainable housing solutions. By incorporating automation, artificial intelligence, and smart technologies, housing developments can become more energy-efficient, adaptable, and responsive to residents' needs. These advancements optimize energy consumption, enhance building performance, and improve occupant comfort, fostering both long-term sustainability and cost-effectiveness. Emphasizing the integration of cutting-edge technology in modern housing aligns with Ontario's commitment to environmentally responsible, future-ready communities.

1. Resilient Construction Techniques

1.1 Flood-Resistant Construction Techniques:

Develop and advocate for construction techniques that enhance buildings' resistance to flooding, flood defense mechanisms, such as elevated structures, waterproofing materials, climate projections, flood mapping and proper drainage systems. (Eg. Not locating electrical panels from the lower levels or flood risk zones).[lv]

1.2 Fire-Resistant Building Materials:

Research and promote the use of fire-resistant materials in construction to mitigate the risk of wildfires and enhance building resilience in fire-prone regions.

Review appropriateness of design and vegetation management adjacent to buildings (existing and new).

Review appropriateness of nature of storage to limit fire propagation to structures.[lvi]

1.3 Climate-Resilient Building Materials:

Encourage the use of climate-resilient building materials that can withstand the impact of extreme weather, reducing damage and improving the overall durability of structures.[lvii]

2. Adapting to Extreme Events

2.1 Extreme Weather Events

Develop policies that mandate design considerations for heatwaves and extreme cold and consider impacts on vulnerable populations.

Encourage the adoption of energy-efficient heating, ventilation, and air conditioning (HVAC) systems that consider climate variations and contribute to overall building resilience.
Encourage the use of passive ventilation and shading.

Making sure that communities have sufficient backup cooling/warming centres in case of extreme events.

Design urban spaces with heat-resilient features, such as green spaces, cool roofs, and shade structures, to mitigate the urban heat island effect during heatwaves.[lviii]

2.2 Seismic Retrofitting:

Implement programs to retrofit existing buildings to withstand seismic events, ensuring structural integrity and occupant safety during earthquakes, accounting for the increased seismic loading in the building codes.[lix]

3. Infrastructure Policy for Resilience

3.1 Flexible Zoning and Land Use Policies:

Review and update zoning and land use policies to allow for flexible and adaptive development in response to changing climate conditions and potential risks.

Restrict development for building location and construction in areas in at-risk flood and other high risk environmental zones based on climate change mapping.[lx]

3.2 Investment in Critical Infrastructure Resilience:

Allocate funds for the retrofitting and reinforcement of critical infrastructure, such as bridges, power grids, and water treatment plants, to enhance resilience against extreme weather events.

Develop policies and allocate funds for developing resilience in the design of new infrastructure as well as accelerating the construction of new infrastructure where current shortfalls are present.[lxi]

4. Systems for Climate Resilience

4.1 Early Warning Systems:

Implement and enhance early warning systems to provide timely alerts about extreme weather events, allowing communities to prepare and respond effectively.[lxii]

4.2 Distributed Energy Resources:

Promote the use of distributed energy resources, such as decentralized renewable energy systems, and passively safe small modular nuclear reactors and micro modular nuclear reactors to ensure energy availability during power outages caused by extreme weather events.[lxiii]

4.3 Climate-Resilient Water Management:

Develop adaptive water management strategies, including improved stormwater management, water storage, and distribution systems that can withstand the impacts of extreme weather.[lxiv]

E. Inclusive and Sustainable Housing Solutions

This section highlights the critical need for climate-resilient design and construction as Ontario faces increasing threats from extreme weather events. Engineers in Ontario advocate for durable, adaptive building practices that strengthen homes against flooding, heatwaves, and other environmental challenges. By embedding resilience into housing infrastructure, these strategies safeguard residents, reduce long-term maintenance costs, and extend the lifespan of developments. This approach reinforces Ontario's commitment to sustainable, future-ready communities that can withstand evolving climate conditions.

1. Inclusive Infrastructure Design

1.1 Equitable Access to Sustainable Housing:

Promote affordable and energy-efficient housing projects to ensure accessibility for diverse socioeconomic groups.

Collaborate with community organizations to address specific housing needs for marginalized communities.[lxv]

1.2 Inclusive Design Standards:

Develop and implement building design standards that prioritize universal accessibility, accommodating individuals with diverse physical abilities.

Incorporate cultural and demographic considerations into architectural designs to create spaces that reflect the community's diversity.[lxvi]

1.3 Accessible Infrastructure:

Implement infrastructure that considers the needs of individuals with disabilities, such as accessible public spaces, ramps, elevators and wayfinding. Enhance these features with smart technologies that improve accessibility and help residents with a wide range of abilities navigate and use community spaces with ease. [lxvii]

1.4 Promoting Green Spaces:

Develop sustainable urban planning policies that prioritize the creation of green spaces accessible to all residents.

Collaborate with local communities to design parks and recreational areas that celebrate diverse cultures and preferences. [lxviii]

2. Workforce and Community Engagement

2.1 Diverse Workforce Engagement:

Establish training and mentorship programs to encourage diverse participation in the construction and engineering industries.

Partner with educational institutions to promote EDIA in STEM education, fostering a pipeline of diverse talent.[lxix]

2.2 Community Engagement and Consultation:

Facilitate inclusive community consultations to ensure diverse voices are heard in the planning and development stages.

Utilize participatory design approaches to incorporate community preferences into building projects. [lxx]

3. Awareness and Cultural Preservation

3.1 Cultural Heritage Preservation:

Integrate preservation strategies for culturally significant buildings within sustainability frameworks.

Develop initiatives to protect and celebrate cultural heritage sites, ensuring they are accessible to the public. [lxxi]

3.2 Public Awareness and Education:

Conduct public awareness campaigns on sustainable building practices with a focus on EDIA principles.

Establish educational programs to inform communities about the benefits of inclusive and sustainable building initiatives. [lxxii]

Supporting Documents for Key Recommendations

This section provides supplementary materials that reinforce and substantiate our recommendations. These documents may include industry reports, policy briefs, case studies, regulatory guidelines, and best practice frameworks that support the discussions on engineering fees, professional recognition, business skills, and advocacy efforts. By compiling these resources, we ensure that stakeholders have access to comprehensive information that strengthens their understanding and implementation of the strategies included in this document.

A. Energy Efficiency and Renewable Energy Integration

1. Energy Efficient Technologies and Incentives

1.1. Incentives/Requirements for Energy-Efficient Technologies:

[i] https://ospe.on.ca/wp-content/uploads/2023/03/NRCan-Submission-MARCH-23-FINAL.pdf

1.2 Green Roof and Wall Incentives

[ii] https://www.toronto.ca/services-payments/water-environment/environmental-grants-incentives/green-your-roof/
https://natural-resources.canada.ca/energy-efficiency/homes/canada-greener-homes-grant/start-your-energy-efficient-retrofits/plan-document-and-complete-your-home-retrofits/eligible-grants-for-my-home-retrofit/23504
https://www.sciencedirect.com/science/article/abs/pii/S0264837719310543
https://greenroofs.org/policy-resources
https://horttrades.com/torontos-green-roof-bylaw-keeps-on-giving
https://heatactionplatform.onebillionresilient.org/heatactionpolicy/green-walls-incentive/
https://climateinstitute.ca/wp-content/uploads/2021/04/GreenRoofs-study_April26_EN_Final.pdf
https://greenroofs.org/about-green-roofs
https://static1.squarespace.com/static/58e3eecf2994ca997dd56381/t/5d84dfc371cf0822bdf7dc29/1568989140101/Green_Roof_and_Wall_Policy_in_North_America.pdf

1.3.1 Smart Building Technologies:

[iii] https://ospe.on.ca/wp-content/uploads/2023/07/06-30-2023-Submission-Electrification-Transition-Panel.pdf

2. Renewable Energy Integration

2.1 Renewable Energy mandates

[v] https://ospe.on.ca/wp-content/uploads/2023/07/06-30-2023-Submission-Electrification-Transition-Panel.pdf

2.2 Community Renewable Energy Programs:

[vi] https://trca.ca/conservation/community-transformation/renewable-energy-program/
https://earth.org/power-to-the-people-an-overview-of-community-energy/
https://natural-resources.canada.ca/reducingdiesel
https://www.pembina.org/reports/community-owned-re-fact-sheet.pdf
https://www.iea.org/commentaries/empowering-people-the-role-of-local-energy-communities-in-clean-energy-transitions
https://news.ontario.ca/en/release/1000890/ontario-supporting-renewable-energy-for-sustainable-communities\
https://www2.gov.bc.ca/gov/content/industry/electricity-alternative-energy/community-energy-solutions/community-energy-project-examples
https://indigenousclimatehub.ca/2021/06/indigenous-engagement-with-renewable-energy-projects/
https://renewableenergy.usask.ca/news-articles/the-benefits-of-community-owned-renewable-energy-projects.php

2.3 Optimize Wind and Solar Energy Use

[vii] https://www.sierraclub.org/sierra/what-do-we-do-too-much-renewable-energy
https://news.harvard.edu/gazette/story/2018/10/large-scale-wind-power-has-its-down-side/
https://www.sciencedirect.com/science/article/abs/pii/S0959652619303944
https://www.sciencedaily.com/releases/2021/10/211012112301.htm

2.4 Leverage Nuclear and Hydroelectric Power for Base-Load Demand:

[viii]https://www.opg.com/power-generation/our-power/hydro/
https://www.energy.gov/ne/articles/nuclear-power-most-reliable-energy-source-and-its-not-even-close
https://world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-power-reactors/advanced-nuclear-power-reactors
https://www.sciencedirect.com/science/article/abs/pii/S2211339822000880

2.5 Consider the Role of Inverters in Renewable Integrations

[ix]https://www.solarctrl.com/blog/common-problems-with-solar-inverters/#:~:text=Common%20issues%20with%20solar%20inverters%20range%20from%20bad%20installation%20and,of%20your%20solar%20energy%20system.
https://www.allegromicro.com/en/insights-and-innovations/blogs/xtremesense-tmr/5-challenges-to-solar-inverters-tmr
https://www.solarreviews.com/blog/pros-and-cons-of-string-inverter-vs-microinverter
https://greensolver.net/the-5-most-common-problems-with-solar-inverter/

3. Power System Reliability and Backup Solutions

3.1 Ensure High Reliability Standards for Electricity Systems

[x]https://www.nerc.com/pa/Stand/Pages/ReliabilityStandards.aspx
https://www.nerc.com/pa/Stand/Pages/ReliabilityStandardsOntario.aspx
https://www.ferc.gov/reliability-explainer

3.2 Ensuring Reliable Power System Performance

[xi]https://greeningthegrid.org/energy-storage-toolkit/topics-resources/grid-services-and-value-stacking
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1.2 Innovative Funding:
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2.2 Climate Friendly Energy for Transit Systems:
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Contact Us

Ontario Society of Professional Engineers
5000 Yonge Street, Suite 701
North York, ON, M2N 7E9
1-866-763-1654
info@ospe.on.ca

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