ONTARIO'S ENERGY POLICY: LOOKING BEYOND ONTARIO

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THE UPSHOT OF A SERIES of current developments–from Canada's withdrawal from the Kyoto Protocol to interprovincial disagreements over energy resources, the politics and paralysis of the process for pipeline and power plant approvals through to the reality of growing global energy demand–will be a litmus test of Canada's low-carbon and sustainable energy development agenda. The energy future of Ontario as a critical player in the Canadian energy market must be guided by a credible long-term vision that is rooted in influencing the pathway of development consistent with North American and global trends.

More specifically, an effective long-term vision of energy planning for Ontario should address the following key areas:

- recognize the urgent need for low-carbon energy development, where energy transition serves a multitude of purposes, from driving economic recovery to delivering quality energy services, through to mitigating anthropogenic climate change; and
- focus on innovation as the driver of change to embolden our national and provincial scientific, technological and industrial capacity to transform our aging energy infrastructure into smarter energy networks.

DEVELOPMENT GOALS AND THE ENVIRONMENT

The challenges of the global energy system are well known but the task of implementing effective change seems nearly herculean. The near doubling or tripling of global energy demand by 2050 is largely driven by demographics and income shifts in emerging economies, continued use of fossil fuels and build-out of fossil-based energy infrastructure, and the resultant environmental stress exerted by global deterioration of the climate system.

The confluence of these factors will not only exact a consequential toll on the global climate system, it has the potential to set in motion tensions around issues of energy security, energy affordability and our capabilities to make measureable impacts on the quality of lives of billions trapped by energy poverty.

The Canadian and Ontario outlook needs to be positioned within the frame of making a contribution to the global energy challenge. This has the potential to yield powerful economic benefits at home, but requires a move away from provincial self-sufficiency in the planning and development of energy infrastructure. The guiding vision should be advancement and development of our own infrastructure replacement with an intelligent system that not only satisfies our requirements, but is also synchronized with the requirements of the global energy marketplace and consistent with the need to cut emissions.

Ontario and Canada have time and time again demonstrated a capacity to adapt, innovate and lead. With a vast network of established public universities and the requisite engineering prowess, world-class financial centres and business environments, and strong economic ties with the US and increasingly with emerging economies, Ontario's strengths and assets should be focused on making a significant impact on global energy transitions to shape the directions for change, taking into full account the need for climate change mitigation.

POLICY PERSPECTIVE

If we are serious about Ontario's energy future and committed to reducing our carbon footprint, a long-term strategy focused on investment in technological innovation is necessary. From a policy perspective, the strategy should embrace good governance, regardless of which policy instruments (taxation, cap-and-trade, sovereign funds, etc.) are

employed. Through several rounds of climate change negotiations over the last two decades, it has become increasingly clear that because of treaties, targets and timelines, with the attendant politics around which country has obligations to cut emissions, by how much, and who is more deserving of subsidies, the United Nations Framework Convention on Climate Change (UNFCCC) process has exhausted its relevance.

IF WE ARE SERIOUS ABOUT ONTARIO'S ENERGY FUTURE AND COMMITTED TO REDUCING OUR CARBON FOOTPRINT, A LONG-TERM STRATEGY FOCUSED ON INVESTMENT IN TECHNOLOGICAL INNOVATION IS NECESSARY.

TECHNOLOGICAL OPTIONS

Focus on technological innovation is a critical ingredient in engineering a long-term strategy for energy transition. An ability to navigate through the energy technology landscape and identify wise applications of science and technology would provide vital insights into the direction of innovation policy.

Here in Ontario, we have developed an initiative to advance the global dialogue around the interface between policy and transformative technologies. The Equinox Summit: Energy 2030, hosted by the Waterloo Global Science Initiative (WGSI), a Waterloo-based partnership between the Perimeter Institute for Theoretical Physics and the University of Waterloo, and subsequent launch of the Equinox Energy 2030 blueprint at the American Association for the Advancement of Science (AAAS) annual meeting in Vancouver in February 2012, mark but one step forward in the journey.

The summit brought together 40 leading innovators from science, policy, civil society and business along with young, emerging leaders from around the world to rethink the challenges and complexity facing the global energy system. The immediate outcome of the summit was a living blueprint for action, called *Equinox Blueprint: Energy 2030*, which touched upon credible technological options, practical implementation steps and, above all else, a proposed guiding vision of a low-carbon electricity ecosystem that assists thinking through the reality of our existing high-energy civilization and how its transition can be achieved with select transformative technologies.

The low-carbon electricity ecosystem view goes beyond scenario design and gets at the big question of what kind of future we want, and then works backwards to identify and illustrate technologies that have the potential to bring about transformative change. An innovation roadmap for Ontario's energy future could benefit from similar thinking.

As shown in the figure below, the low-carbon electricity ecosystem comprises the four core elements of baseload power, smart urbanization, electrified transport and off-grid electrification, each combining some forms of energy technologies in generation, distribution and storage to tackle a specific domain in the energy system. Within each element, illustrative technologies are described. They include advanced nuclear, enhanced geothermal system and large-scale storage for renewables for baseload generation, smart grid and superconductors for smart urbanization and electrified transport, and smart micro-grid for off-grid energy access.

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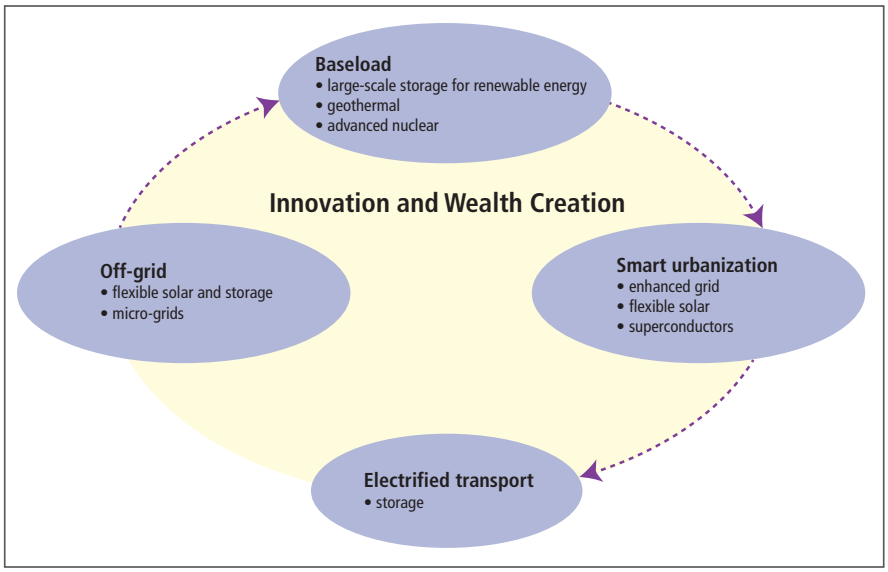

The low-carbon electricity ecosystem

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Each technology is an integral part of an ecosystem linked closely to its constituent parts, and its future evolution is subject to outside forces and stresses. For example, the advanced nuclear technologies are generation IV concepts with enormous potential. They are a logical technological evolution from the current nuclear generation technologies, using novel design concepts to close the nuclear fuel cycle by eliminating high-level nuclear waste, reducing the threat of proliferation and providing an inexhaustible source of energy. In thinking about a long-term energy transition, the integral fast reactor design is an excellent example of a technology that can be scaled up to displace greenhouse emissions with positive impacts on the climate.

Similarly, enhanced geothermal systems are situated in a wider technological landscape of geothermal energy developments that have great potential. Enhanced geothermal systems stand out within the spectrum of geothermal energy resources because they can provide baseload power that is renewable and produces no CO_2 emissions. Canada's oil and gas and mining industries have already developed great expertise in drilling. Their experience could be borrowed, through co-option of policy mechanisms, to begin a meaningful conversation on geothermal development.

Large-scale deployment of renewable energy technologies, such as wind and solar, is critically dependent on storage. There are a number of storage technologies available (for example, compressed air energy systems, pumped hydro, flywheels, electrochemical batteries, superconducting magnetic energy storage, etc.), but their ability to be deployed on a large scale and at a capacity to meet the requirements of an operational power grid are a barrier to implementation. A suite of large-scale storage systems could enhance and amplify the value of intermittent and variable generation resources.

All of the above baseload schemes could not be made possible without being intelligently integrated into the electricity grid. A smart energy network, founded upon smart grids, natural gas networks and communication technologies, has the potential to incorporate and accommodate those generation infrastructures.

Superconducting technologies as a choice for transmission in dense urban environments, such as Toronto, seeks to enhance the point that transmission requirements, such as the physical footprint of wires, are non-negligible issues if we are really going to make cities "smart." Superconducting technologies fill this niche, but are less suited to long-distance transmission, in which high-voltage direct current (HVDC) is a more economical alternative.

Communities disconnected from the electricity grid exist in Ontario. Their energy and development needs may be better served through the deployment of plug-and-play micro-grid systems that use local renewable resources, such as wind, solar and small hydro, as well as distributed generation schemes, such as the spectrum of technologies that extend from silicon-based photovoltaics and thin-film solar technologies to the emerging next-generation nanotechnologies. Solar technologies can subsequently become part of a larger energy ecosystem that draws on additional energy resources to complement and enhance the level of energy service to those who have very little.

CONCLUSION

Ontario has the intellectual and financial capacity to be a potential leader in global energy transition. We should not allow ourselves to be stymied by the prospect of economic downturn across the province and end up denying opportunities for the betterment of society. We need to look ahead, beyond Ontario and over the horizon to shape a brighter and cleaner future.

Visit www.wgsi.org for more information regarding the initiative and the Equinox Summit and to download the *Equinox Blueprint: Energy 2030*. Σ

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