# History, Hope and the Culture of Conservation in Ontario's Electricity System

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Twenty years ago, Amory Lovins published an article in Foreign Affairs magazine entitled "Energy Strategy: The Road Not Taken" that signaled the beginning of a paradigm shift in the way we think about energy, including the way we think about the energy business. In the old paradigm, the demand for energy commodities (fuels and electricity) was seen as being fundamentally tied to economic growth. Energy policy and commodity supply investment strategies were built on the premise that commodity consumption must grow for economic output to grow. However, never-ending growth in the production and consumption of fuels and electricity is neither environmentally nor economically sustainable. In a sense, it was this lack of sustainability in the prevailing paradigm that led the government of Ontario to recognize, as far back as 1975, that Ontario Hydro was on a collision course with sustainability. The utility had put forward a capital expansion plan that called for exponential growth in generation capacity in Ontario that was clearly problematic from an environmental perspective. More importantly to the Conservative Government of the day, the plan implied levels of capital investment (all to be underwritten by the government) that were quite literally incredible.

The inconsistency between the environmental and financial realities of the day, as contrasted with the growth strategies that prevailed in both industry and government energy departments, led to a rethinking of the energy policy and business frameworks. In the new paradigm, which is still in its nascent stage of development some thirty years later, it is recognized that the fundamental demand that drives the energy economy is not for fuels and electricity. In the new paradigm, it is the demand for energy services (e.g., space heat, hot water, light, access/mobility, communication, etc.) that is identified as the driver of the energy market. The demand for energy commodities, including electricity, is derived from this underlying service demand. In this framework, the connection between economic output and commodity production is broken to the extent that the service demand can often be met with less rather than more consumption of fuels and electricity (e.g., passive solar gain through design and insulation as opposed to more fuel and electricity to heat a leaky structure).

In the case of electricity, another important reality underscored by this new framework is the relatively small portion of our total consumption of fuels and electricity that goes to the provision of energy services for which electricity has a captive market. These so-called "electricity specific" or "necessary electric" end uses (e.g., lighting, electronics, small motors, most appliances, etc.) comprise only about 12-14% of our total energy commodity consumption. In some parts of Canada, for example in Alberta, electricity is used for very

few other applications than those that are "electricity specific", and for that reason electricity comprises only about 13% of total energy commodity consumption in Alberta. In Ontario, electricity is also used to provide a portion of our space and water heating needs, and so electricity's share of total secondary energy consumption is higher – about 22% instead of 13% -- than it would be if it were only used for the electricity-specific applications.

A review of the history of electricity consumption in Ontario illuminates a series of transitions that evidently came as surprises to those who were counting on electricity consumption to continue to grow with economic output, (e.g., Ontario Hydro, and most utilities and government energy policy agencies in the 1970's and 1980's) which were understandable and even predictable in the context of the emerging paradigm.

The first transition occurred in the early 1970's. For most of the post-war period, until about 1974, electricity consumption galloped ahead of economic growth in Ontario. From 1958 to 1974, the output of the Ontario economy grew at an average rate of 5% per year while electricity consumption grew at 6.8% per year. In addition to the post-war population boom, during this period a number of electricity-using end uses were in a phase of incomplete but rapidly growing saturation (e.g., home appliances). Electricity was actively marketed for space and water heating applications ("Live Better Electrically"), and the post-war economy had a much higher proportion of energy-intensive industries than is the case today. The price of electricity was low and there was virtually no consideration given to efficiency and conservation.

A remarkably rapid transition occurred around 1974, at which point the electricity growth rate slowed down to about the same rate as the growth in output of the Ontario economy, or to about 2.4% per year. Throughout the rest of the 1970's and 1980's, the growth rates of electricity consumption that had formed the basis for capital expansion plans in the mid-1970's failed to materialize as the relationship between electricity consumption and economic growth seemed to reach a new equilibrium. Integrated resource planning attempted to incorporate the new reality by considering both supply and demand options in a single planning framework, and Ontario Hydro launched significant efforts to capture energy efficiency gains, primarily as a way of hedging against the risk of repeating the investment overshoot of the late 1970's. Forecasts of electricity demand were modified somewhat to take into account the new reality on the demand side, but as history would show, Ontario Hydro and most other utilities continued to overestimate the future commodity demand throughout this period and the 1980's ended with the Demand/Supply Plan, a major initiative by Ontario Hydro to expand the province's generation capacity to meet forecast growth rates that would turn out to be erroneous.

A second major transition took place in the early 1990's, in which the electricity productivity of the Ontario economy (measured as dollars of GPP per kilowatt-hour consumed) began to grow dramatically. The economy that emerged from the recession of the early 1990's had a very different dynamic with respect to electricity consumption growth than the economies of previous decades. Ontario Hydro withdrew its application for all of the power plants in the Demand/Supply Plan, and also withdrew from the demand side business. In spite of this, between 1993 and 2003, improvements in electricity productivity emerged as by far the

largest source of electricity supply security in Ontario, larger than the increased output of the coal and gas plants combined, and three times larger than the decline in the output of the nuclear plants. If electricity productivity had not improved during this period; if the ratio of electricity consumption to had stayed at its 1993 level, the demand for electricity in 2003 would have been about 50,000 GW hours greater than it actually was. This is greater than the output of all the hydro dams in the province, or all the coal stations in the province. It is not an exaggeration to state that electricity productivity improvement – an expected and welcome phenomenon in the new energy paradigm – has been almost singly responsible for keeping the lights on in Ontario for the past 15 years.

At the same time, fundamental changes in the structure and ownership patterns in the electricity supply industry swept through all the western economies starting in the 1990's, changes which have yet to run their course. Climate change and air quality emerged as major public concerns, pressure mounted to close down the coal plants, and the traditional scale economies of power plant construction came under serious reconsideration as a new generation of "distributed", smaller scale generation offered advantages in terms of reliability, flexibility, resilience, risk management and even unit costs.

Now we have arrived at another crossroads in the continuing and dynamic story of electricity in Ontario. If history has taught us anything, it is that changes on the "demand side" of the electricity equation are paramount, that we need to pay very close attention to what might happen and what could happen and what we could make happen with regard to continued improvements in Ontario's electricity productivity. We know from first hand experience the economic consequences of errant planning, poor strategy and misguided investment in our electricity industry, and we are just beginning to appreciate the environmental consequences.

Seen through the lens of the old paradigm, the changes on the demand side in Ontario's electricity economy look like adjustments as the system moves from one equilibrium to another, but in which the underlying framework continues to focus on growth in commodity supply as a cornerstone of growth in our well being. Seen through the lens of the emerging paradigm, the improved and improving electricity productivity of the Ontario economy is the central story, not an adjustment. In this frame, a deliberate and aggressive effort by government and business to scientifically and systematically exploit the demand side resource is the foundation of both economic and environmental sustainability. Unlike the supply side resources, the demand side resource grows every time someone thinks up a new way to deliver services with less, rather than more, electricity. An economy that delivers its energy services with less, rather than more, production and consumption of fuels and electricity is generally a more efficient and competitive economy, not the other way around. Improvements in energy efficiency and more generally in energy productivity generate environmental benefits that cannot be matched by any of the supply side alternatives. In the specific case of achieving a low carbon society, it is the conclusion of virtually all the research that has been done on what a low emission future might look like that a doubling and a redoubling of energy efficiency is a cornerstone feature of such futures, not only for its direct emission reduction impact but for the enabling role that improved efficiency plays in making it possible for the new and renewable supply sources to fulfill their potentials.

To the extent that potential for continued improvement in the electricity productivity of the Ontario economy will be realized by improving the efficiency of the techniques and the technologies with which we use electricity, we have also learned that neither technological nor economic feasibility are holding us back. The barriers that face accelerated deployment of the demand side resource have to do with organization, financing and human resource mobilization, (interestingly not unlike the barriers that faced the petroleum industry in the 1880's or for that matter the Ontario electricity industry around the turn of the twentieth century).

That is why it is so appropriate that we are meeting to discuss the challenge of the low carbon energy future at a business school rather than an engineering school. The transition to the low carbon energy future is being held back, more than anything else, by failures in the market to generate environmentally sustainable practices and by an innovation gap in the business community when it comes to the deployment of those techniques and technologies that are already here. These technologies and techniques can be shown to be economic, even in the context of a market that undervalues natural capital, that has as a fundamental principle the discounting of the value of the future, and that relies for its internal consistency on the demonstrably absurd concept of the "environmental externality". Overcoming these barriers to sustainability is not only the central public policy challenge of the 21st century, it is also the central business challenge of the 21st century.

Finally, in our discussions about how we might achieve a low carbon future, or more generally what the energy piece of a sustainable society might look like, the role of education looms large. We are in the middle of a paradigm shift in the way we think and behave with regard to the natural environment and with regard to the way we use fuels and electricity, and the low carbon future lies on the other side of that transition. It entails a rethinking of what constitutes "successful" and sustainable technological design. While there is a demonstrable advantage to having a population that is educated with respect to sustainable energy (e.g., consumer choice, vehicle operation, household operation, etc.), the larger and more profound impact will come from the re-education of those who are involved in the design, construction, marketing and deployment of anything and everything that delivers energy services. In the society there is a relatively small group of people and firms who have a disproportionate influence on the level and pattern of energy commodity use (and carbon emissions). At the top of this list are the businesses and entrepreneurs that devise and deliver the deployment strategies for the new techniques and technologies, but it also includes urban planners, investment bankers, architects, lawyers, engineers of all kinds, building developers, industrial process designers, the building trades, and everyone engaged in investment and purchasing decisions for equipment, vehicles and other energy using technologies. Of course, it also includes teachers everywhere.

The new paradigm has opened a door for Ontario, through which lies the possibility of a new and "softer" path toward a more productive, healthier and sustainable electricity system. How soon or even whether we choose to go through that door wouldn't matter so much if not for the advancing environmental damage being done by the production and consumption of the energy commodities, including fossil fuels. Yesterday's discounted future and environmental externalities are today's economic and public health threats. The climate

change threat in particular has the potential to fundamentally disrupt human society for generations to come if we do not successfully bring our greenhouse gas emissions down to well below half their current levels, and relatively soon. While there is and always will be enormous scope for the research and development of advanced and more efficient ways of providing end use services, it is not a shortage of technological solutions that is holding us back at this point. It is a shortage of imagination and innovation and creative risk taking in the deployment of these solutions. It is challenge to governments and it is a challenge to educators. But most important in the context of this meeting at the Ivey School, it is a challenge to business.