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The Changing Energy Value Chain

Good morning!

First, let me express my thanks and appreciation to the Manitoba Chambers of Commerce for the opportunity to be before you today, and to all of you for coming out this early…thank you! I'd also like to acknowledge our Board Chair Marina R James, as well as board members Michael Moore, Wade Linden and Vince Warden who are in attendance this morning. Thank you.

I'd like to start today by asking you to imagine what Manitoba might look like in the not too distant future. In many ways, visually, it might look similar to today. But if you look past the surface, it could be very different.

You drive home from work in your electric car, which you bought three years earlier to combat high gasoline prices. With the newest models having a range of over 400 km, and public rapid charging stations almost everywhere, the "range anxiety" of the 2010s is no longer a factor. You pull into your garage and plug it in.

The solar panels on your roof have charged the energy storage batteries in your basement, and now, as the light of the day fades, the smart energy controller you installed when you bought the

panels sends a message to your phone telling you that you are no longer generating electricity, but rather using the storage batteries. It asks when you will need your car again so that it can optimize when to charge it.

You are still connected to the Manitoba Hydro grid, and the energy controller will automatically switch to grid power in response to dynamic pricing signals to minimize your energy costs. The phone app tells you your current consumption, and provides an estimated cost for your Hydro use, as well as tips for lowering your costs.

The app also prompts you to confirm the conservation choices you've made to balance energy convenience versus cost. Subject to your choices, the controller may turn off your hot water tank and freezer at times or adjust your thermostat for optimum efficiency and cost-effectiveness.

In this vision of the future, energy consumers are also energy producers – "prosumers" as it were. The prosumer generates with solar panels and stores electricity locally in their car and house batteries. They buy and sell energy transactionally from the grid, using their batteries to bridge between when the energy is generated and when it is consumed. Batteries allow the prosumer

to effectively trade electricity - buying low and selling high - according to price signals from the grid. Having charged their car from the solar panel during the day and knowing that they only need their car for a short trip in the morning, the prosumer may elect to sell some of the energy stored in their car battery onto the grid at night when prices climb in response to a lack of solar generation and demand for electric heating.

As you may have already guessed, the grid of tomorrow is not the grid of today – it is a SmartGrid backed with sensors and analytics to optimize supply and demand. Electricity pricing is set dynamically in real time, providing incentives to prosumers to manage their consumption.

In the future, all the credits for these services are tallied and instantly available from Manitoba Hydro on your smart phone. In fact, most of your interactions with Hydro — questions about services and your bill, making payments, getting line locates — are all handled on line. You're saving money, getting great service, and taking full advantage not only your solar panel system but also the reliable, renewable electrical energy provided by Manitoba Hydro. And you have reduced your carbon footprint.

You even have a similar system installed in your business to perform the same functions at work, helping to keep your production and operating costs down, and improving efficiency and profits.

Interesting? Far fetched? This future may be closer than you think.

Disruption to the energy value chain is occurring worldwide, as we enter what I think could be the biggest period of change for the utility business since post-war mass electrification.

Consider how much has changed since Y2K when we didn't email, we faxed…data was stored on discs - not the cloud…the world wide web was in its' infancy and your cell phone, if you had one, made phone calls — that's it. Who could have dreamt of today in those early days? That's the thing about exponential growth: it's mild in the early going but then explodes, taking many by surprise.

For decades there has been only one utility model: large central plants generating electricity, distributed via networks of powerlines to customers who value stability and reliability. Economies of scale made this the most efficient model to supply energy to

customers. Utilities were monopolies selling a commodity product, and customers had few choices.

But all that is changing.

So what's driving these changes to the energy value chain? What disruptors are we going to have to deal with as we plan for the future?

In my opinion there are five key drivers — all are inter-related:

1) **New technologies**, such as vastly improved energy storage systems and information networks;
2) **The electrification of transportation**;
3) The **growth in distributed self- generation**;
4) The **de-carbonization** of our economy in response to climate change;
5) And finally — and possibly most importantly — the **changing expectations of our customers**.

Advances in information technology, creating the Internet of Things, is a key driver. Our increasingly wired world — or wireless probably more correctly — makes it possible for devices to talk to

one another in ways we never imagined even five years ago. That also means new ways to interface with even more new technology — providing more automation, but at the same time, more individual control. More control means more opportunity to balance and optimize. Whether its Nest in your thermostat, Tesla in your car, or Google in your home, competition to manage your energy through internet connected devices will be fierce. It also means that cyber-security, something we already spend a lot of resources on today, will become even more important in the future.

Technology advancements are also driving down the cost of solar panels and batteries. Inexpensive solar panels may mean cheap energy when the sun is shining, but we will need inexpensive batteries to use that energy at night.

Batteries are so key to unlocking this potential that the whole world is desperately hunting for new storage technologies.

Steadily advancing battery technology also plays a role in a couple of the other drivers — namely the electrification of transportation and the rise of distributed generation.

Better battery technology is already driving a paradigm shift in what will power our cars, buses and trucks in the coming years. The electrification of transportation represents a major opportunity to reduce Greenhouse Gas emissions, as is the objective of the federal government in targeting that all new cars sold in Canada by 2040 be zero-emission.

Manitoba Hydro is proud to have already been involved with New Flyer in the development of battery-powered buses and rapid charging facilities — with great success thanks to the hard work of New Flyer!

The electrification of transportation is only going to speed up as batteries improve and vehicle production costs continue to decline. Increasing carbon taxes, environmental concerns, and government incentives are going to help drive the change faster than I think any of us anticipate.

The shift from fossil-fuelled to electric powered transportation will have wide-ranging impacts to commerce and industry in Manitoba, and will need careful consideration well beyond Manitoba Hydro.

And will other, non-utility companies enter the vehicle charging field, such as Tesla? I think that's a given, and so the challenge is how do we respond to that, in a way that is in the best interests of our customers and Manitoba's energy future?

New and improving technologies are also driving the rise of renewable distributed generation, such as photovoltaic rooftop solar panels. As we saw with our own solar energy pilot project a couple of years ago, there is a tremendous demand for localized, self-generation when the economics make sense.

Improved solar cells are offering levels of efficiency unimaginable even 10 years ago. Smart energy controllers can send excess power produced by customers back to the grid, offering the potential to help balance local demand peaks and provide customers' with savings on their bills.

Many suppliers are certain to enter this market, offering distributed generation and home energy storage solutions directly to the customer, or "behind the meter", as we like to say. In fact, on August 19, Tesla announced their intention to begin renting rooftop solar installations to customers in select U.S. markets for as little as $50 a month. Distributed self-generation, while providing

customers with additional control over their energy sources and consumption, poses multiple challenges for utilities across North America in terms of managing a two-way flow of energy over the grid, while maintaining the stability and reliability that is our hallmark.

It is my belief that decarbonizing the economy will be a major factor in the changing energy landscape going forward. As governments worldwide look to reduce carbon emissions, renewable electricity is going to play an increasingly important role. This includes in the transportation sector, as I mentioned, but also in other areas, such as heating and industrial processes.

The drive to de-carbonize is not confined to any one region or market. Here in Manitoba our electricity supply is already 99 per cent renewable — meaning we are vastly ahead of the curve in this regard. However, many states in our wholesale markets — who were previously heavily reliant on coal for electricity production — are developing, or have already adopted, legislation mandating that electricity come from 80 or 100 per cent renewable sources by the years 2050, 2040 and even earlier. Even here in Canada, the federal carbon charge and recent changes to

environmental legislation are helping drive the shift towards renewable energy sources such as hydro, wind and solar.

The last major disruptor — I believe — is changing customer expectations. Customers today have been "Amazon'd" and "Google'd"…they are used to having whatever information they need instantly available at their fingertips, via this (HOLD UP PHONE). And they expect to be able to get the same level of service — that is, almost instantaneous service and information — from their utility.

At Manitoba Hydro, we have been seeing this trend develop over the past five years…for example, customers today expect almost immediate responses to questions they send via social media about power outages…24 hours a day, seven days a week. They also tell us they want to be able to monitor their home and business energy use, and perform more of their interactions with us on-line, from their smartphones. The generation that has grown up with the internet is upon us. They have grown up with the seamless integration of technology. How it works, how complex our business is, and the challenges we face getting legacy I.T. systems to work with new technology…that isn't their concern. They are comparing their end-user experiences with e-commerce,

financial services and other online companies to their experiences with their utility. In many ways, it is re-defining the commercial relationship, driving massive change in the way our customers expect us to interact with them.

As I said, this change is already upon us, and Manitoba Hydro has been responding by enhancing its social media presence, adding new technologies and processes to speed the flow of information from our field staff to our customers, adding more self-serve options to our web presence, and a host of other behind-the-scenes activities. Again, with every new opportunity — and make no mistake this is a massive opportunity — comes challenges. What technology do we invest in? How do we ensure reliability while managing a two-way flow of energy? Do we have the right skill sets and organizational structure to be as responsive as we need to be? What are the costs of even more changes?

So those are the big disruptors changing the energy value chain. And I need to be clear — this isn't an issue for Manitoba Hydro alone. Every electricity and natural gas provider in North America, indeed around the world, is struggling with how to deal with these disruptors. Even everyone in this room, I would think, has been

touched by at least one…if not more…of these disrupting influences in your own business.

So, how do we respond, as your utility? What steps can we take at Manitoba Hydro to ensure we are continuing to meet your needs while investing wisely. How can we ensure that you and your businesses are getting the best value for your energy dollar? And how do we prove to you that Manitoba Hydro is in the best position to address these challenges and opportunities in the future?

About three months ago, to begin to address at least some of these future challenges, we began the development of a 20-year, Long-Term Strategic Plan. Manitoba Hydro has been in a building phase for the last number of years — working on critical major energy projects like Keeyask, Bipole III and now the Manitoba-Minnesota Transmission Project. But as these projects wind down and are completed, we need to be ready to shift gears. Our Long Term Strategic Plan will lay the ground work for that shift.

One of the first steps we took in that process was to talk to you…our customers, along with our regulators, owners, Indigenous communities, NGOs and other stakeholders, about what you want — and need — from Manitoba Hydro in the next

five, 10 and 20 years. Over the course of the summer, we held meetings with stakeholder groups across the province, gathering this critical input, which will help form the basis for our strategy going forward.

We are also talking to our employees, to find out what they think we should be doing tomorrow, and what we could be doing better today.

And I can tell you, our senior management team has been meeting regularly…looking at each one of the major disruptors I described earlier. How will they affect us here in Manitoba? What could the potential impacts be of each of those to our business? Will they affect revenue, or costs? What are the risks of various scenarios? What will the regulatory environment look like in five or 10 years?

The energy value chain of the future is going to be substantially different than the one we have today. And while any change brings risk, it can also bring tremendous opportunity for utilities like Manitoba Hydro who are willing to plan for these changes.

We are doing our utmost to ensure that whatever our strategy looks like in the end, the needs of you — our customers, our

indigenous partners, regulators and other stakeholders — are our North Star. Whenever we consider any action or future plan, the one question we must always ask ourselves is: “does this promote a sustainable energy future for Manitoba?”

If we keep that in mind throughout the process, I am confident we will chart a path forward that ensures Manitoba Hydro will continue to be the trusted, low cost energy provider it has always been.

As they say, Rome wasn’t built in a day. We have a lot more work to do. This is an incredibly complex business, operating in a very complex world — a world that is constantly evolving. Building a strategy this forward-looking takes time. We are targeting to have something ready to reveal mid- to late-winter. But even then, the work won’t be over.

No single plan can provide all the answers to the questions we may face about the future. As variables change, we must also adjust and adapt. Uncertainty — and opportunity — abound in the future. It’s how we plan for that uncertainty, to take advantage of the opportunities that arise, that will determine our success.

So while we may not be ready to power all of our cars with renewable hydroelectricity in three years, or have the latest behind the meter technology ready to deploy in 12 months, you can rest assured that we are thinking about those issues, and charting a path forward to ensure that as the energy value chain evolves, Manitoba Hydro will evolve with it — to meet the needs of all Manitobans well into the future.

Thank you.