Amp Feedback on the IESO Non-Emitting Resources RFI

Amp is pleased to provide its feedback with respect to the Non Emitting Resource RFI and seeks to emphasize that every effort should be made that the overall Market Renewal Project should consider not only the full range of market design and resource types that will drive the energy industry over the course of the near, medium and long term but also the related and interdependent advancements in grid infrastructure and the evolution of transactive energy.

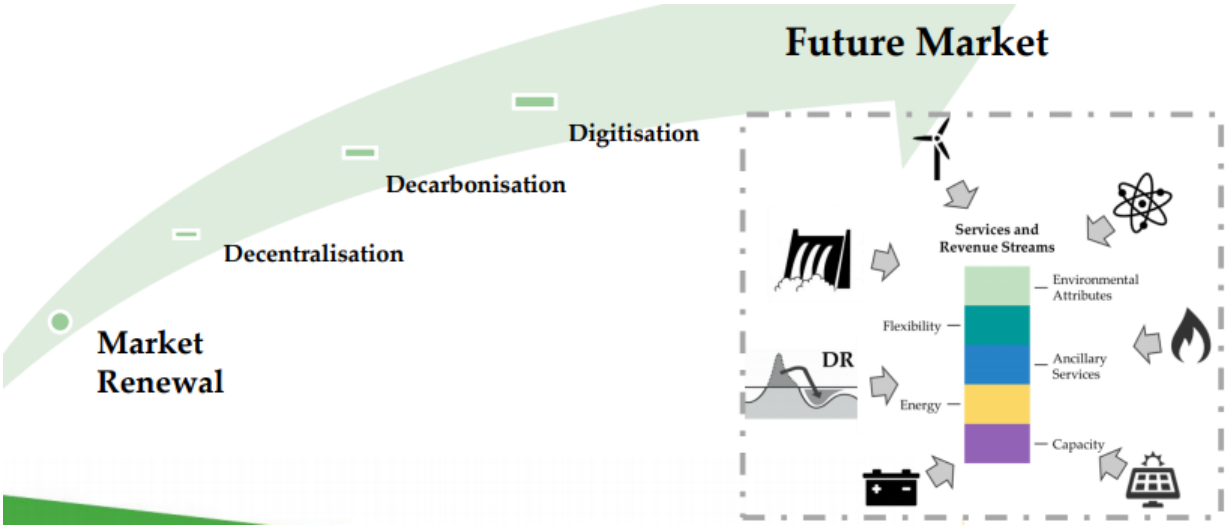
Our system is transitioning to one that fundamentally flows two ways. There is a potential range of disruptive technologies that present vast possibilities for the deployment and monetization of renewable distributed generation.

To this end there is no shortage of primary considerations that must be viewed in the context of market renewal contributing to the future electricity market, in conjunction with information pertaining to non-emitting resources that will be obtained by the pending IESO RFI.

Below is feedback for consideration to the overall scope of the RFI and additional considerations pertaining to the scope of the overall Market Renewal Initiative. The considerations outlined below should be considered as part of the overall approach to the engagement.

Amp has some initial concerns around the scope of the RFI and wishes to emphasize that the context and the evolution of electrical infrastructure, the nature of energy transactions and the integration of planning processes will significantly determine the range of potential energy futures which are contemplated and served by the new IESO electricity market design. The context and the technology trends that surround the new market design will be just as critical to the sector as the structure of the market itself.

The materials presented at the December 21, NER-SC meeting emphasize the following:
***Market Renewal will put in place a foundation to manage a range of potential energy futures driven by <u>decentralisation, digitisation and decarbonisation</u>* (From the NERSC DEC 21 Deck).**



The market renewal process must adequately prepare this foundation for a range of possibilities and, in so far as the market design drivers accept evolution towards, Distributed Energy Resources, advancements in digital technologies, and the impacts of climate change mitigation policies; advancements in electricity infrastructure and the nature of economic transactions should be considered foundational; and further that they may create fundamentally new possibilities for the

monetization of energy and the meaning of grid modernization. This foundation must prepare and determine additional baseline assumptions that align with key objectives from the LTEP.

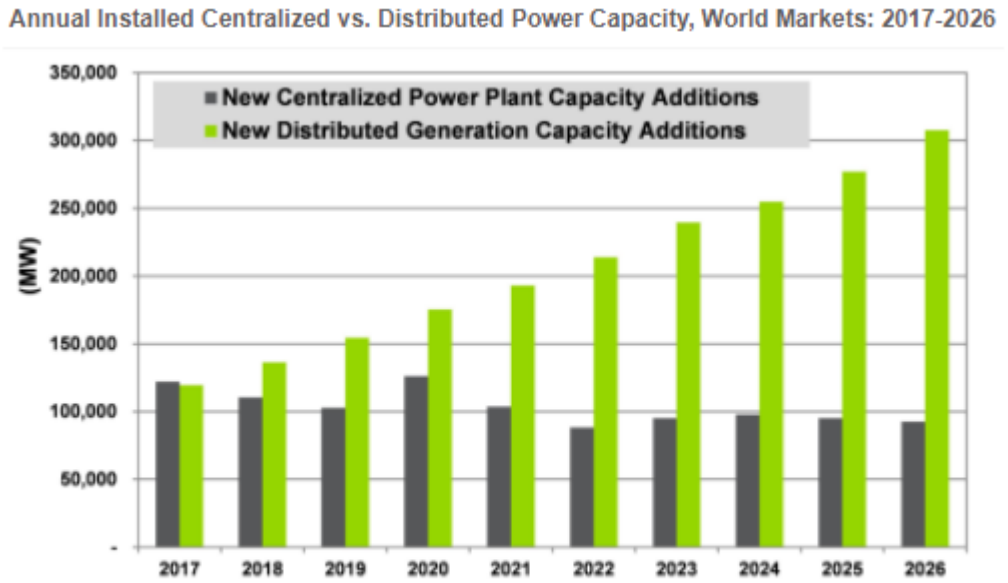
1) Encouraging an Innovative Sector
2) Integration of Bulk System Planning
3) Regional Planning and Non-Wires Solutions
4) Assessment of the barriers to the fair competition of energy storage

Additional considerations and assumptions include:

A) Will the IESO take a conservative or aggressive approach to system limits and the management and integration of the intermittency of renewable generation?

B) Does Market Design adequately consider the anticipated proportional share of new types of generation facilities?

Within the range of potential energy futures, adequate consideration should be given to the types of generation most likely to be deployed and not the historic bias of a market design driven by centralized large scale generation.



(Source: Navigant Research) [1]

The following references provide substantial guidance around the opportunity to enhance system planning and the integration and utilization of renewables.

- IEA PVPS Power System Operation and Augmentation Planning with PV Integration
- IEA PVPS Transition from uni-directional to bi-directional Distribution Grids
- Utility Dive Article – California Solar Pilot provides Grid Services

[1] https://www.navigantresearch.com/tag/distributed-generation

C) Has the IESO considered potential market constraints on Renewables and overall price depression?

Full decarbonization of a power sector that relies on renewable technologies alone, given the current design of these markets, is not possible as conventional technologies provide important price signals. If all power had zero marginal cost, this would lead to the collapse of a liberalized electricity market. Accommodating a small quantity of renewables in the electricity system can be achieved without distorting prices, profits or incentives for investments. However, to streamline a transition to low carbon sources, current power markets require restructuring – potentially even a reversal of liberalization. This is necessary to address the 'renewables blend wall', the point when sufficient renewables penetration materially reduces the market clearing price, or marginal cost of the most expensive facility required to meet demand, below the full cycle cost of new baseload generation. The low initial costs and price impacts of renewables penetration should not blind policymakers to the costs associated with renewable energy transitions, including those affecting the viability of currently liberalized electricity markets[2]

D) What will be the market and energy impacts associated with the emergence of the energy cloud?

The energy cloud and the underlying trends and technologies that are enabling its operation provide an early peek into a broader paradigm shift in the electric utility industry. Not unlike disruptive challenges that led to dynamic change in the telecom industry, for example, the energy cloud requires incumbent players to be considerably more flexible than today's business models allow in order to both accommodate the degree of technological change transforming the grid and thrive in an increasingly competitive marketplace. Ultimately, the emerging energy cloud will be far more dynamic, responsive, and democratized than what current infrastructure can support.[3]

E) What are the impacts and technical operating (network) assumptions of the power system as they pertain to new technologies ie. Faraday Grid?
   a. Faraday Exchangers
   b. Faraday Grid

The Faraday Exchanger product, due to be tested in Australia next year, would reduce grid losses by up to 15 percent by automatically correcting fluctuations in frequency and voltage caused by intermittent generation. According to a company investor briefing document, a single Faraday Exchanger would be able to control voltage by plus or minus 25 percent and power factors by plus or minus 0.7 percent, maintaining grid stability to well above current levels.

It "dynamically and autonomously controls power flow with an efficiency, reliability and speed not previously achievable," the document states.

"The Faraday Exchanger operates slightly below the peak operating point of a typical transformer; however, its band of operation is wider and hence performs more efficiently for longer periods."[4]

For further details see Appendix B.

[2] Renewable Energy Policy Paradox KAPSARC – Rolando Fuentes
[3] Navigant Energy Cloud White Paper`

[4] GTM Article Faraday

F) What will the market impacts be relating to Transactive Energy?

The GridWise vision rests on the premise that information technology will revolutionize planning and operation of the electric power grid just as it has transformed business, education, and entertainment. Information technology will form the "nervous system" that integrates new distributed technologies— demand response, distributed generation and storage—with traditional grid generation, transmission, and distribution assets. Responsibility for managing the grid will be shared by a "society" of devices and system entities. The mission of the GridWise Architecture Council is to enable all elements of the electric system to interact. We are an independent body that believes tomorrow's electric infrastructure can be more efficient and secure by integrating information technology and e-commerce with distributed intelligent networks and devices. To achieve this vision of a transformed electric system, the Council is defining the principles for interaction among the information systems that will effectively and dynamically operate the grid. The Council, which is supported by the U.S. Department of Energy, includes 13 representatives from electric energy generation and delivery, industrial systems control, building automation, information technology and telecommunications, and economic and regulatory policy.[5]

For additional information on blockchain technology and other aspects of transactive energy, see Appendix A.

Summary

These emerging influences cannot be viewed in isolation but represent prime determinants and base assumptions affecting the range of potential energy futures that will impact the effectiveness of Ontario's electricity market design. Ontario's market design could face immense challenges down the road if it does not give adequate consideration to the full range of potential energy futures that will be impacted by

I. potential changes to the nature of energy transactions (blockchain – transactive energy)
II. The Renewable Energy Policy Paradox and the depression of WS prices (Rolando Fuentes)
III. Improvements to technical limits and Grid Modernization including high penetration PV and innovative grid management tools including
    a. Faraday Exchangers
    b. Faraday Grid
IV. The Impacts and monetization opportunities afforded by evolution of the Energy Cloud

How has/will the IESO consider the potential impacts of these influences in the proposed streams and Market Renewal Objectives?

Where are these factors considered in the market renewal & power system planning processes?

Amp is very grateful for the opportunity to provide this feedback and welcomes the opportunity to discuss these recommendations further.

[5] https://www.gridwiseac.org/pdfs/te_framework_report_pnnl-22946.pdf

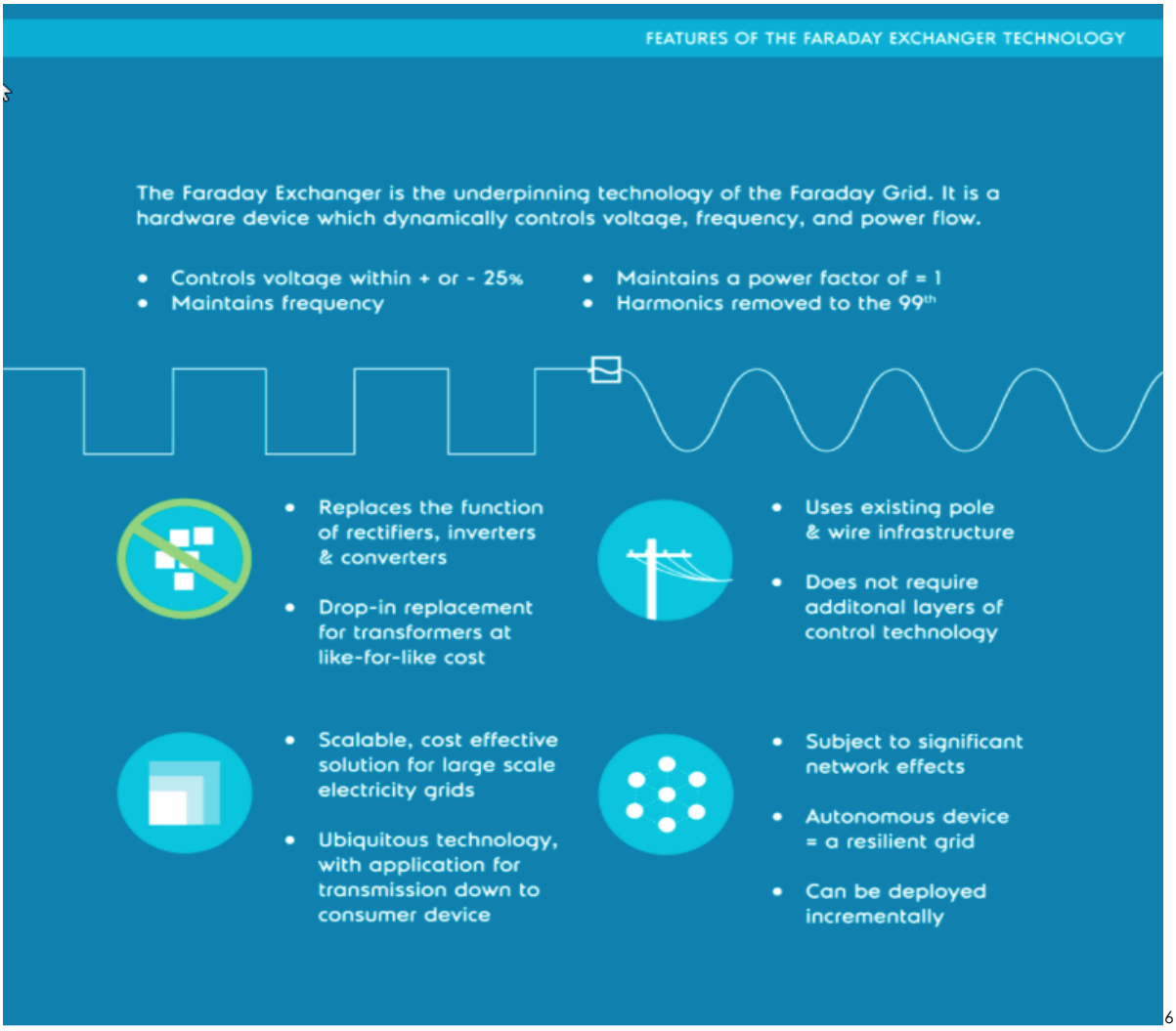
Appendix A - Additional References pertaining to Transactive Energy

a) Leveraging Bitcoin & Blockchain For 'Solar Power' Sun Exchange Scores $1.6M From U.S. Investors - Forbes

b) How Blockchain Could Give Us a Smarter Energy Grid – MIT Technology Review

c) MIT Technology Review – Blockchain is helping to build a new kind of energy grid

Appendix B – Features of the Faraday Exchanger Technology



[6] http://www.faradaygrid.com/the-faraday-exchanger/