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TABLE OF CONTENTS

LOOKING BACK: 5 YEARS UNDER ONTARIO'S GREEN ENERGY ACT

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On December 16, 2013, Ontario's Minister of Energy, Bob Chiarelli, directed the Ontario Power Authority (OPA) to develop a competitive procurement process for new large-scale renewable projects focusing on bid price, proponent experience, financial capability and site due diligence. The direction followed on directions earlier in 2013 not to procure any new large-scale renewable generation projects under Ontario's Feed-in Tariff (FIT) Program.

These recent changes make it clear that the Ontario Government is changing its approach to large scale renewable generation procurement through the FIT Program, a core feature of the *Green Energy* and *Green Economy Act*, 2009 (the "GEA").

This provides an opportunity to review and consider Ontario's experience with the GEA, including the FIT Program, and to draw some timely insights and lessons learned concerning the policy objectives inherent in this legislation.

The primary focus of the GEA was the promotion of new renewable energy generation from on and off-shore wind, solar, water, biomass, biogas, biofuel, geothermal, and tidal sources; encouraging conservation and the smart grid; increasing ministerial directive powers; and accommodating First Nation and Métis interests. The GEA can be seen as one implementation mechanism associated with Ontario's broader policy to close all coal-fired generation facilities in the province.

The GEA was and remains, in part, an industrial policy aimed at securing new investment and creating new jobs in Ontario's green economy while establishing Ontario as the North American leader in renewable energy. The GEA represented a bold initiative made at a time of considerable economic uncertainty in Ontario and, more broadly, throughout North America. Consistent with the intent to use the electricity sector as an instrument of industrial policy, over the past five years the ministry used its increased directive powers to issue numerous directives to the OPA and the Ontario Energy Board. With an average of over five directives a year, the implementation of the GEA has been, in a word, turbulent. This was largely due, in our view, to the rapid pace of change in permitting, pricing and sourcing of equipment under the GEA. The practical insight would be to: slow down, consult broadly, have a clear understanding of the technical and system operation requirements associated with adding a large amount of renewable generation to the existing transmission and distribution networks in Ontario, and implementing significant new policies in a way that maintains stability in the sector.

The Government's approach to promoting the implementation of the smart grid in Ontario has taken a more consultative, measured and pragmatic approach. The Ontario Smart Grid Forum produced a visioning report in 2009, an implementation report in 2011, and a report on access to consumer data in 2012. Electricity distributors (LDCs) are now required to file

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plans focused on smart grid development and implementation as part of their rate applications, and the province's $50 million Smart Grid Fund focuses on supporting high-value demonstration projects that are partnered with LDCs to advance energy innovation in Ontario. Major investments are not supported unless and until their value is demonstrably justified.

The prime objective of the GEA was to be achieved through a much more intensive approach with the new FIT Program launched October 1, 2009, the establishment of a new renewable energy facilitation office in the Ministry of Energy, the removal of local *Planning Act* control over renewable facilities, the streamlining of environmental approvals for all renewable fuels except waterpower into a single Renewable Energy Approval, and the creation of a mandatory obligation on utilities to connect new renewables, as well as the signing of a major green energy investment agreement by the Ontario government with a Korean consortium including Samsung C&T.

Looking back after five years, while the GEA succeeded in the rapid promotion of new renewable energy generation (although not without some hiccups, most notably the February 2011 suspension of offshore wind projects, stranding at least one FIT Contract holder in limbo), it has done so at significant cost – both financial and political. The OPA reports in its last available quarterly update dated March 31, 2013 that since 2009 it has entered into 1,706 FIT Contracts for large renewables constituting 4.54 TW of new renewable generation in Ontario. New wind accounts for the lion's share (68.5 per cent) of total contracted capacity and new solar accounts for most of what remains (26 per cent).

These results have alternately been argued to be a success or a burden depending on your point of view. Generators received a guaranteed price, buyer, and long-term revenue stream without incurring the costs involved with participating in a standard RFP process. Environmentalists and other advocates of renewable energy argue that Ontario has made progress towards a cleaner and greener electricity system with lower carbon output (in fact some suggest that the GEA constitutes a de facto carbon tax). Electricity system planners and operators had the challenging task to manage and incorporate a large wave of new non-dispatchable generation capacity (at least until the SE-91 market rule amendments become effective) arriving online when Ontario is recovering from a large drop in demand due to the economic downturn. Consumers may perceive a greener and cleaner electricity grid but at a significant cost at least in part due to the generous subsidies paid to wind and solar developers.

First Nation and Métis communities have been strongly encouraged to participate in new renewable projects, through the Aboriginal Energy Partnerships Program, the Aboriginal Loan Guarantee Program, and through the design of the FIT program which provided a contract price adder, reduced security obligations, and later priority points and capacity set-asides. The increased participation of First Nation and Métis communities in new projects has largely been viewed as a win-win and a necessary prerequisite to obtain the social licence to build new generation (and transmission) which impact upon Aboriginal lands and their traditional territories.

The core challenge faced by the FIT program was that it required the OPA to estimate in advance the right price for each renewable technology, not an easy job with ever changing market conditions, technology developments and costs. As a standard-offer program, the OPA could not, through the FIT program, match the timing of new generation procurement with ever changing demand needs. Moreover, the loss of local planning control over new projects added to the considerable local resistance to new projects, particularly wind power projects, driven by loosely organized grass roots individuals and organizations, particularly across rural Ontario. The anti-wind generation concerns that have arisen across Ontario continue to represent a serious political risk which no party can ignore.

In this context, the Government's plan to replace the large FIT program with planned, competitive procurements for large scale renewable generation projects with a focus on price, proponent experience, financial capability, site due diligence, and local considerations and interests, is a common sense approach aimed directly at addressing these concerns.

Conservation remains a core provincial objective under the GEA. The primary focus for conservation and demand management programs remains on province-wide OPA programs implemented by LDCs, which are now required as a term of their distribution licences to meet an allocated portion of the Province's 6,000 GWh consumption and 1,330 MW peak demand conservation and demand management targets between 2011-2014. On December 5, 2013 the OPA reported 2012 results, with the OPA reporting that LDCs have succeeded in achieving a cumulative 65 per cent of the GWh savings and 20 per cent of the MW savings in the second of the four year program. It remains to be seen if all LDCs will successfully achieve their mandated CDM targets, and what will happen if an LDC or multiple LDC(s) fail to meet that target.

From an electricity system perspective, the impact of the GEA is measureable and quantifiable. To a large extent it has been successful at promoting new renewable generation, advancing the smart grid, promoting conservation and First Nation and Métis interests. However, whether the benefits of the FIT program outweigh the costs over the long term remains to be seen.

From an industrial policy perspective of securing new jobs and new investments, some new jobs and investments have been made to advance these FIT projects with built-in domestic content requirements. However, with Canada's recent loss of its appeal of the WTO rulings finding the domestic content obligations not in compliance with GATT and the shift of the large scale FIT program to a competitive procurement, the question remains whether those jobs will remain for the long term.

As Ontario moves onward to its next chapter of electricity sector reform, policy makers can reflect on some important lessons emerging from the GEA's implementation over the past five years:

- The difficulties and risks associated with setting a standard offer price given the rapidly changing nature of underlying global markets. The shift to a competitive procurement for large renewables which factors in bid price will address many of these difficulties and risks, although new questions will no doubt arise.

- The challenges associated with implementing sweeping electricity-related policy initiatives with broad scope and application. The electricity sector is simply too important for all Ontarians not to have policy stability and certainty. The shift to address local considerations and interests represents a positive development to ensure continued stability and certainty.

- The technical, physical connection and electricity system operator issues associated with incorporating significant quantities of new renewable generation into distribution and transmission networks cannot be ignored.

- In addition to typical consultations, the increasing importance and influence of online and social media communications as a means of facilitating both opponents of and proponents for renewable generation should not be ignored. ■

ENERGY STORAGE: THE GREEN ENERGY SILVER BULLET?

*Elisabeth DeMarco and Lauren Heuser**

Introduction

As countries around the world struggle to reduce their greenhouse gas emissions (GHG) and diversify their power supply, many governments have invested significant capital and resources into wind, solar and related renewable electricity generation sources. The International Energy Agency (IEA) reports that renewable energy generation is anticipated to grow three-fold between 2009 and 2035.[1] Much of this growth is occurring through feed-in-tariff and related renewable energy government procurement programs, which have resulted in a greater than 50 per cent growth in wind and solar electricity generation over the last decade alone.[2] However, the dramatic increase in grid connected wind and solar has resulted in a number of unanticipated consequences, including: decreased dispatch control, reliability and power quality challenges, localized grid stability concerns, surplus base load energy, and ultimately electricity pricing and customer cost issues. The intrinsic characteristics of variable wind and solar resources have also changed and complicated the manner in which grid operators must use traditional base load thermal and/or nuclear generation supply resources, thereby altering traditional power market operations and related economics. Now enter energy storage…

The new class of rapidly evolving energy storage technologies may enhance and optimize existing energy infrastructure assets and has the potential to mitigate, if not alleviate, many of the challenges associated with the recent growth in renewable power and the requisite adaptation of related power systems. This paper examines rapidly emerging, commercial energy storage technologies in the context of traditional electricity systems that are attempting to adapt to an influx of renewable power.

I. Common Challenges in Integrating Significant Renewable Energy Supply.

The influx of renewable generation sources into the energy supply mix of many North American jurisdictions has fundamentally changed the nature, regulation and traditional economics of energy markets throughout the continent. The European Union (EU) has faced similar challenges as a result of a number of EU member states' renewable electricity incentives over the last decade. Electricity system operators are now required to operate their

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[1] International Renewable Agency, *FAQs: Renewable energy* (17 February 2014), online: IEA <http://www.iea.org/aboutus/faqs/renewableenergy/>.

[2] *Ibid*.

systems to adapt to huge power and reliability swings associated with variable wind and solar generation, which is largely driven by resource availability, and not dispatch signals from the system operator. The need for adaptation and related challenges are particularly pressing in electricity systems that are characterized by base load assets that are comprised mainly of lower emission, but slower responding nuclear and large hydro generation sources such as those in the province of Ontario. However, similar challenges may exist in power systems with base load assets made up of local or imported, faster responding gas-fired generation sources, as they are being required to ramp, operate, run, and adapt to new intermittent renewable supply in ways that were never previously imagined by facility engineers and system operators.

First, traditional dispatch models were altered to facilitate renewable generation policy objectives and investment in renewable power by affording renewable generation sources grid connection and dispatch priority over other power generation sources.[3] The intrinsic variability of renewables resulted in oversupply and undersupply scenarios that, in certain instances, had jurisdictions like Ontario selling power at a negative price (paying other jurisdictions to take its surplus power) in lieu of incurring the greater costs of ramping down large nuclear assets. Costs of such negative priced sales were socialized among ratepayers, who called for a prompt remedy. In response, jurisdictions including Ontario were required to further modify related dispatch market rules and applicable generation procurement contracts in an attempt to make variable renewable generation facilities dispatchable, and more responsive to market signals.[4] The costs of doing so are also socialized among ratepayers.

Market standard renewable generation procurement contracts, which were entered into at a time when strong pricing terms were necessary to obtain financing, generally provide that even where excess supplies cause wholesale power prices to plummet, retail power prices in renewable energy jurisdictions remain high. Ratepayers are required to pay the fixed prices that governments provided in order to incent transformative renewable investments. These costs may be significant and may not be reflected in the market price, instead being rolled into broader uplift costs that are otherwise incorporated into customer bills. Ontario, California and Germany are all jurisdictions that have invested heavily in renewable power and all currently have considerably higher "all-in" electricity retail rates,[5] significant local renewable energy industries, and among the lowest emission electricity grids in the world.[6]

The timing of renewable electricity production may also pose additional challenges even with less variable solar resources. California's solar energy programs were born out of power supply dynamics that would have had the state facing considerable under-supply of electricity and precariously relying on power imports in order to meet the state's power demand. California's resulting solar power programs have had tremendous success, particularly in the residential sector, with 15.4 per cent of the state's supply now coming from renewable generation resources.[7] However, the successful uptake of solar power initiatives has resulted in a mismatch of California's peak energy supply (which occurs mid to late afternoon) with the state's peak demand (which occurs early evening).

Each and all of the over-supply, under-supply or timing mismatch scenarios that result from integration of a significant amount of renewable

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[3] Although in reality renewables do not yet account for a sufficient share of energy markets to completely displace conventional base load providers, it is in certain jurisdictions the long-term goal to have renewables account for the majority of the energy supply. Germany, for example, has set a target of having 80% of its electricity supply generated from renewables by 2050.

[4] See for example IESO, SE 91, Market Rule Amendment.

[5] "Sunny, windy, costly and dirty", *The Economist* (18 January 2014) at 53.

[6] Ontario, *Ontario's Long Term Energy Plan* (2 December 2013), online: <http://www.energy.gov.on.ca/docs/LTEP_2013_English_WEB.pdf>.

[7] Energy Almanac, "Total Electricity System Power" *Total System Power for 2012: Changes from 2011*, (17 February 2014), online: The California Energy Commission <http://energyalmanac.ca.gov/electricity/total_system_power.html>.

generation resources into an electricity system, still, therefore, beg for a solution to quickly adapt to variable renewable supply. To date, much of that adaptation has been provided by faster ramping, higher emission coal-fired and other thermal generation resources, in a manner that is antithetical to the original zero emission goals of renewable incentives.[8] Further, existing thermal resources may not be sufficient to provide the amount and nature of the flexibility that is required to efficiently integrate existing and increasing renewable energy supply. Moreover, there is considerable public resistance to the siting and cost of the development of any large coal or gas-fired power facility, let alone a thermal generation facility to serve the sole function of grid and system support for renewables. As a result, the need for an alternate low cost, low emission, scalable solution to address the above-mentioned renewable energy challenges is evident and pressing.

Green energy needs a silver bullet.

Innovators around the world have reached the same conclusion. Over the course of the last three years, the global market place has seen exponential growth in the development, implementation and commercialization of a wide variety of energy storage technologies to provide rapidly evolving electricity systems with the flexibility they require to optimize existing energy assets. A number of the leading technologies are outlined in Part II, below.

II. Overview of Currently Available Commercial Energy Storage Technologies.

"Energy Storage" means a system that is developed and operates for the purpose of absorbing, supplying and redelivering electrical energy to electricity systems through low or no emission technologies.[9] The term "energy storage" may encompass a broad variety of technologies that differ greatly in design and function, but have several common characteristics. Energy storage systems are: (i) very flexible and responsive to market signals or conditions (ii) immediately dispatchable with among the shortest ramp times (iii) characterized by low or no emissions that are otherwise associated with thermal generation and (iii) widely scalable, ranging from several kW to over 1000 MW. As such, energy storage technologies are uniquely suited to provide the services needed to adapt to the ever-changing needs of the generation, distribution, transmission and conservation components of rapidly evolving electricity systems.

Energy storage systems have evolved well beyond the research and development phase over the last several years, but the full costs and benefits of grid scale deployment are still being studied in a number of jurisdictions. However, if market-based investment is a proxy for efficiency the jury has come down solidly in favour of this class of assets. New investment in energy storage technologies is significant and entities including Navigant and LUX Research project rapid growth over the next five years. A recent study by LUX Research projects that the grid storage market will reach a value of $10.4 billion by 2017, up from a modest $200 million in 2012.[10]

The current slate of commercialized energy storage technologies that are already capable of providing reliable grid support and renewable energy integration services includes, but is not limited to:[11]

- **Flywheel Energy Storage:** mechanical devices that harness rotational energy to deliver instantaneous electricity;
- **Hydro-Power Energy Storage:** creating large-scale pumped hydro reservoirs of energy with water or smaller scale under-water storage facilities;
- **Solid State Battery Storage:** a range of electrochemical storage solutions,

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[8] "How to lose half a trillion euros", *The Economist* (12 October 2013) at 27.
[9] As adapted from the Ontario Energy Storage Alliance (17 February 2014), online: <http://energystorageontario.com/>
[10] Clean Technica, *Global grid Storage Market to reach $10.4 Billion in 2017* (12 February 2014), online: Clean Technica <http://cleantechnica.com/2013/05/29/global-grid-storage-market-to-reach-10-4-billion-in-2017/>.
[11] Energy Storage Association, *Energy Storage Technologies*, online: ESA <http://energystorage.org/energy-storage/

- including advanced chemistry batteries and capacitors;
- **Flow Battery Storage:** batteries where the energy is stored directly in the electrolyte solution for longer cycle life, and quick response times;
- **Compressed Air Energy Storage:** utilizing compressed air to create a potential energy reserve; and
- **Gas to Power Energy Storage:** using natural gas and hydrogen to store and create energy on demand.

Initial construction, development and operation of a number of energy storage facilities is underway in key renewable jurisdictions, including Germany, California, Japan, and Ontario. However, to date, the deployment of energy storage technologies and full integration into electricity grids is at a nascent stage. The California Public Utilities Commission has just ordered its utilities to procure 1,325 MW of energy storage by 2020, which represents a renewables optimization and efficiency target of 1.5 MW of energy storage for every 10 MW of renewables incorporated into a transmission grid.[12] Similarly, Ontario has recently announced a program to procure 50 MW of energy storage in 2014.[13] Each is considered in further detail in Part III, below. Given the state of commercial energy storage technologies and ongoing procurement activities, we anticipate a significant increase in the number and nature of commercially deployed energy storage technologies over the next five years.

III. Key Regulatory and Policy Developments in North America that Foster Energy Storage.

There are a number of important energy regulatory and policy developments that have occurred over the last two years, which have facilitated and will continue to support the growth of energy storage for energy asset optimization and flexibility in rapidly evolving electricity systems. They may be broadly grouped into two categories: (i) energy regulatory decisions, and (ii) energy storage procurement initiatives.

(i) Energy Regulatory Decisions

The U.S. Federal Energy Regulatory Commission (FERC) has been active in facilitating the implementation of energy storage solutions through rulings relating to frequency regulation and fast response regulation services (FRRS). The use of FRRS helps system operators to correct for short-term changes in electricity use that would otherwise affect the stability of a power system by helping to match generation and load, and adjusting generation output to maintain the desired frequency. FRRS have a speed and precision of response (in the range of seconds) that is unattainable by traditional generators due to their ramp limitations. Two relatively recent FERC Orders (784 and 755) facilitate the market competitiveness and efficiency of transmission systems through this form of energy storage.

- FERC Order 755 - Frequency Regulation Compensation in the Organized Wholesale Power Market requires regional transmission organizations and independent system operators to adopt a two-part, market-based compensation method for frequency regulation services that includes: (i) a capacity payment that compensates for opportunity costs, and (ii) a market-based performance payment which rewards faster-ramping resources, such as batteries, electric vehicles, and flywheels.
- FERC Order 784 expands on the pay-for-performance requirements established by FERC Order 755 and requires public utility transmission providers to consider two additional

energy-storage-technologies>.

[12] M Kintner-Meyer et al, *National Assessment of Energy Storage for Grid Balancing and Arbitrage: Phase 1*, WECC (17 February 2014), online: <http://energyenvironment.pnnl.gov/pdf/PNNL-21388_National_Assessment_Storage_Phase_1_final.pdf>.

[13] *LTEP, supra* note 6.

parameters—speed and accuracy—when evaluating regulation resources including energy storage and traditional generation sources. Energy storage technologies are generally inherently faster responding resources that excel in speed, accuracy, and the ability to ramp quickly. FERC Order 784 also revised accounting and reporting requirements for transactions that are pertinent to the use of energy storage devices in public utility operations. These changes have created potential opportunities for energy storage projects to be used in the ancillary services market.

- The Electric Reliability Council of Texas (ERCOT) also recently took steps to facilitate the classification of energy storage resources as Wholesale Storage Load (WSL) in order to ensure that storage assets are not effectively penalized by being required to pay retail type, demand-related charges and all uplift and related charges on energy being stored, while receiving only wholesale payments when energy is returned to the electricity system.[14] Similarly, the Ontario Energy Board is also looking at related solutions to existing regulatory barriers to energy storage as part of its Smart Grid Advisory Committee.

(ii) Energy Storage Procurement Initiatives

In the last quarter of 2013, California and Ontario launched precedent setting energy storage procurement initiatives that are intended to optimize and address their related renewable energy investments and associated system challenges, respectively.

California. On October 17, 2013 the California Public Utilities Commission (CPUC) released its energy storage decision following several months of related hearings. CPUC mandated that energy storage grow to 1,325 MW by 2020,[15] identified specific targets and milestones for the state's big three investor-owned utilities, and also mandated that the utilities procure energy storage through a "reverse auction" market mechanism. Under CPUC's approach, the utilities are expected to hold their first auction to procure a collective 200 MW of storage in June 2014. Energy storage projects of various types and technologies will be eligible to be counted towards CPUC's targets, and the winning projects will be given a reasonable amount of time to be constructed and interconnected.[16] The program follows California's earlier passage of Assembly Bill 2514, which is directed at increasing energy storage in the state. Specific targets from the CPUC decision are outlined below:

Proposed Energy Storage Procurement Targets (in MW)

Srorage Grid Domain Point of Interconnected	2014	2016	2018	2020	Total
Southern California Edison					
Transmission	50	65	85	110	310
Distribution	30	40	50	65	185
Customer	10	15	25	35	85
Subtotal SCE	90	120	160	210	580
Pacific Gas and Electric					
Transmission	50	65	85	110	310
Distribution	30	40	50	65	185
Customer	10	15	25	35	85
Subtotal PG&E	90	120	160	210	580
San Diego Gas & Electric					
Transmission	10	15	22	33	80
Distribution	7	10	15	23	55
Customer	3	5	8	14	30
Subtotal SDG&E	20	30	45	70	165
Total - all 3 utilities	200	270	365	490	1,325

Ontario. On December 2, 2013 Ontario released its Long-Term Energy Plan (LTEP) noting that:

> *Energy storage technologies have the*

[14] PUC Order, dated March 29, 2012, in Project No. 39917, *Rulemaking on Energy Storage Issues,* and of Nodal Protocol Revision Request (NPRR) 461, *Energy Storage Settlements Consistent with PUCT Project No. 39917,* approved by ERCOT Board on December 11, 2012, and ERCOT Pilot projects for new market services available from existing or emerging technologies (#40150).

[15] AB 2514.

[16] California Public Utilities Commission, *Decision Adopting Energy Storage Procurement Framework and Design Program (proposed Decision)* (17 October 2013), online: CPUC <http://docs.cpuc.ca.gov/PublishedDocs/Published/

> *potential to revolutionize the electricity system, increasing its efficiency, lowering costs and increasing reliability for the consumer. With storage, electricity could be stockpiled during periods of low cost generation, and then used when demand and prices are highest. Storage technology offers the potential to increase the useable energy from renewable energy sources.*[17]

The LTEP also provide for the following concrete steps to procure and integrate energy storage into its system, including:

- conducting an independent study to consider the value of existing and proposed energy storage facilities and their many applications throughout the system;
- examining the opportunities for net metering and conservation policies to support energy storage;
- providing opportunities for storage to be included in the forthcoming large renewable energy procurement;
- initiating work, on a priority basis, to address regulatory barriers that may limit the ability of stored energy resources to compete in Ontario's electricity market, and;
- launching a 50 MW energy storage procurement program to be completed in 2014.

We anticipate that Ontario's prudent and measured energy storage procurement initiative will be under way on or before the second quarter of 2014.

In summary, there are a number of regulatory and policy initiatives that are intended to drive and realize the many efficiencies that energy storage may provide along the energy value chain, as considered in Part IV below.

IV. Implications of Energy Storage for Stakeholders Along the Energy Value Chain.

Energy storage solutions are unique in their potential value and services as they have the ability to optimize assets and address interests all along the energy value chain. Unlike traditional energy infrastructure investments, energy storage investments may be small or large, with services and benefits that transcend the traditional generation, wires, and customer boundaries that so often characterize electricity systems. CPUC was the first to document the more than 20 services and benefits that flow from energy storage to stakeholders all through the energy production and consumption continuum.[18] In the event that benefits for each and all of governments, electricity system operators, generators, transmitters and distributors, ratepayers, and the environment outlined below can be realized in an efficient manner, it is our view that energy storage may very well be green energy's silver bullet.

Governments

Energy storage has the potential to assist governments in realizing financial efficiencies and political returns on sunk (and often sizable) investments in renewable generation. In the event that energy storage allows for renewable electricity sources to firm up their supply or dispatch commitments, governments may be able to defer or avoid the development and siting of high emission fossil fuelled power generation and thereby reduce greenhouse gas (GHG) emissions.

Governments may also enhance provincial coffers by using energy storage to support the cost effective export of clean energy surpluses to neighbouring jurisdictions for a profit, by holding power surpluses in reserve until the energy was in demand and attractively priced. Efficient and effective

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G000/M078/K929/78929853.pdf>.

[17] *Supra* note 6 at 83.

[18] The California Public Utilities Commission has identified numerous benefits from energy storage along all major stages of the energy production/consumption continuum: R.10-12-007, *Energy Storage Framework Staff Proposal* (Final) (3 April 2012), online: CPUC <http://www.cpuc.ca.gov/PUC/energy/electric/storage.htm> R.10-12-007 CAP/sbf/oma.

energy pricing resulting from the flexibility that energy storage will provide, may also assist governments in attracting and keeping energy-intensive businesses and their related jobs in the jurisdiction.

Electricity System and Market Operators

Electricity system and market operators that are responsible for the day-to-day operations and reliability of the bulk electricity system are likely to benefit most directly from energy storage. System operator functions are likely to improve significantly through energy storage technologies that enhance the reliability of energy supplies, stabilize the grid and facilitate related ancillary and power quality services. Storage may provide system operators with reliability, reserve and dispatchability resources that allow immediate responsiveness to support grid systems and an efficient alternative to maintain reliability reserves.

Generators

Energy storage may prompt greater efficiency and effectiveness in the generation mix, as energy storage technologies will allow energy to be stored and released in a manner that better matches electricity supply with demand. Energy storage also enhances the overall efficiency and diversity of the supply mix by allowing for generation and dispatch decisions to better reflect and adapt to market circumstances. Storage may also allow generators to better manage and optimize regular shut down and maintenance conditions and provide for better use of clean energy resources.

Transmission and Distribution Service Providers

Energy storage will give transmission and distribution service providers greater control over electricity availability. Congested grids and those with high line losses are often challenged in peak capacity and high operational periods. Energy storage technologies have the potential to eliminate or significantly mitigate many of these grid operational challenges and may defer and/or delay major investments in generation, transmission and distribution infrastructure by conserving peak demand (MW) and customer specific energy use (MWh). Storage is also likely to limit the wasting of electricity through line losses and effect conservation throughout the power production/consumption continuum. This will allow distributors and transmitters to operate with greater responsiveness and efficiency and rate payers to avoid the contentious costs associated with accounting for such inefficiencies that are passed through to them in regulated electricity rates.

Ratepayers

Industrial and residential ratepayers are anticipated to benefit from the efficiencies and existing generation and grid optimization that is likely to result from energy storage. Power quality sensitive ratepayers such as data centres and large industrials may benefit from enhanced power quality, fewer grid outages, and energy storage back-up solutions. Large industrial ratepayers that are significant energy consumers may also benefit directly from energy storage solutions that allow them to take and store power at lost cost periods and draw from storage at peak periods. This will allow major industrial customers to optimize their processes and production. In the broader context, energy storage will, with appropriate technology, scale and aggregation of storage resources, mitigate low-price power exports and/or nuclear curtailments that result in the inefficient management of low-carbon energy supplies and resulting avoidable costs for ratepayers.

Environment

The environmental benefits of renewable energy sources are limited by the current need for enhanced thermal power support. Energy storage solutions facilitate the enhanced reliability of, and therefore greater reliance on, low or no emission electricity generation sources in accordance with the original spirit and intent of renewable energy policies.

Conclusion

Electricity systems, by their very nature, are complex and multi-faceted entities that affect the daily lives of most people. Changing electricity infrastructure, related investment and environmental impacts have also become major touchstones of most westernized economies. Recent investments in renewable power generation in many jurisdictions have resulted in the above-mentioned costs and unforeseen challenges that beg for a solution. Energy storage has the potential to be a major part of that solution. In a sector where there are no magic fixes that benefit all stakeholders, energy storage has the potential to become a small, but significant "silver bullet for green energy" challenges. ■