Ontario Energy Board

Staff Discussion Paper

In regard to the Establishment, Implementation and Promotion of a Smart Grid in Ontario

EB-2011-0004

November 8, 2011

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1 Introduction

The purpose of this staff Discussion Paper ("Discussion Paper") is to seek comments from stakeholders on the issues to be considered by the Board in providing guidance on the establishment, implementation and promotion of a smart grid in Ontario, as required by the Minister's Directive of November 23, 2010 ("Directive"). The Board is required by the Directive to provide guidance to licensed distributors, transmitters and other regulated entities whose fees and expenditures are reviewed by the Board, and that propose to undertake smart grid activities. In setting out the issues for discussion Board staff has been assisted by the technical consultations with the Smart Grid Working Group (SGWG) which are described in more detail in chapter 3. In part, this paper documents the advice from the consultations with the SGWG.

November 23, 2010
Minister's Directive

The Directive sets out a number of parameters under three major categories of objectives – customer control, power system flexibility and adaptive infrastructure – and provides a list of ten overarching policy objectives. Under the terms of the Directive, the Board is required to take these objectives into account in providing its regulatory policy guidance to affected licensees. The Board's smart grid policy must provide for the industry with the Board's expectations for smart grid development and the criteria the Board will use to evaluate the plans of SG licensees. The Directive is attached as Appendix 5.

Organization of this Paper

Staff has organized the discussion into eight key issue areas - including a main question and then some more detailed related

questions - on which staff is soliciting stakeholder input. Board staff believes that the questions proposed allow for a focused discussion of the regulatory options facing the Board. With minor changes in wording, the above questions are basically the same questions posed to the members of the SGWG in a short Background Paper that accompanied the invitation to take part in the consultation. The feedback received from the SGWG broadly endorsed these questions as a useful way to frame the discussion. However, persons responding to this Discussion Paper should feel free to raise issues which seem to be outside the scope of the questions posed.

The Discussion Paper is organized as follows. The context is described in the Background chapter. The next chapter is a summary of the consultations with the SGWG followed by a chapter that discusses the regulatory options for responding to the Minister's Directive. The latter chapter sets out the eight key issues and a number of questions that staff has identified for stakeholder comment in relation to the regulatory options. In the Discussion Paper staff suggests that the response to the Directive can be considered to be a matrix of the policy objectives and specific functional objectives of the Directive, Appendix 2 indicates key questions associated with each intersection in the matrix and Appendix 3 provides the regulatory options in a tabular format.

2 Background

New Board objective for smart grid created by statute

2.1 Context

On May 14, 2009 the *Green Energy and Green Economy Act* ("GEA") was given Royal Assent. One of the GEA's provisions is the addition of an objective to the *Ontario Energy Board Act*, ("OEBA") section1.1, namely the "facilitation of the implementation of a smart grid in Ontario". The legislation also included a definition of smart grid to be reflected in *The Electricity Act* as follows:

> (1.3) For the purposes of this Act, the smart grid means the advanced information exchange systems and equipment that when utilized together improve the flexibility, security, reliability, efficiency and safety of the integrated power system and distribution systems, particularly for the purposes of,
>
> (a) enabling the increased use of renewable energy sources and technology, including generation facilities connected to the distribution system;
>
> (b) expanding opportunities to provide demand response, price information and load control to electricity customers;
>
> (c) accommodating the use of emerging, innovative and energy-saving technologies and system control applications; or
>
> (d) supporting other objectives that may be prescribed by regulation. 2009, c. 12, Sched. B, s. 1 (5).

In addition, the GEA created a new deemed licence condition that obliged distributors and transmitters to file plans when required by the Board for: i) the expansion or reinforcement of the licensees transmission or distribution system to accommodate the connection of renewable generation; and, ii) the development and implementation of the smart grid in relation to the licensees' transmission or distribution system. The deemed licence condition also requires a licensee to make the investments set out in the plan once it has been approved by the Board. In addition, the GEA authorized the Minister to issue Directives respecting the smart grid

that the Board would be required to consider in reviewing the plans of licensees.

Board's response to GEA

In March 2010 in response to the new deemed licence conditions, the Board issued filing requirements for distributors, *Filing Requirements: Distribution System Plans – Filing under Deemed Conditions of Licence* ("*DS Filing Requirements*"). Although the Board has not mandated that all distributors file distribution system plans pertaining to the development and implementation of a smart grid, these *DS Filing Requirements* provide direction to those distributors who wish to include smart grid development activities and expenditures in their distribution system plans. The focus of the *DS Filing Requirements* was on smart grid demonstration projects, smart grid studies or planning exercises and smart grid education and training. The *DS Filing Requirements* also established deferral accounts for demonstration expenditures on smart grid technology by distributors as well as for education, training and studies.

Minister's DIrective

On January 13, 2011, the Board issued a letter which described the Board's approach to developing the guidance required by the Directive. The Board's approach is comprised of a two-phase consultation process.

The first phase consisted of a working group, the SGWG, which was composed of technical experts drawn from stakeholders. Chapter 3 summarizes the discussions and advice from the SGWG, all of which informed the preparation of this Discussion Paper.

In the second phase stakeholder comment is being sought on the key issues and questions raised in this Discussion Paper.

Smart meter initiative

In many jurisdictions smart grid has become synonymous with the implementation of smart metering. In Ontario the Smart Meter Initiative began in 2004 prior to the GEA coming into force. While the meters and the associated Advanced Metering Infrastructure (AMI) are already in place in Ontario they will be an important part of the continuing development of the Ontario smart grid. To date approximately 4.7 million smart meters have been installed by distributors in residential and small business locations. The costs associated with these installations are being recovered through rates. The Government also designated the Independent Electricity System Operator (IESO) as the Smart Metering Entity (SME) to coordinate its Smart Metering System Implementation Program. The SME is responsible for establishing a meter data management and repository (MDM/R) facility that is responsible for receiving meter data from distributors and then providing metered quantities back to distributors for the purpose of billing consumers. The SME has a meter enrolment process that requires extensive testing of meter communications protocols prior to the MDM/R data collection. Participation in the MDM/R process is intended to be mandatory for all distributors as the SME has been given the exclusive role of providing billing data from smart meters, once the meter has been enrolled with the MDMR.

The Board's role in the Smart Meter Initiative was initially to set up a rate adder which was designed to provide distributors with a cashflow to facilitate the installation of the new meters. The Board also set out rules regarding smart meter funding (e.g., rate adders), cost recovery, and code changes to facilitate the smart meter program (e.g., customer notification). The Board has also established a Time-of-Use (TOU) pricing structure as part of the Regulated Price Plan. Distributors are in the process of completing

the transition to TOU pricing for all residential and small commercial consumers. Currently approximately 3.1 million consumers are paying TOU prices.

Renewed Regulatory Framework Initiative

The development of a smart grid in Ontario relates to the investment plans of electricity distributors and transmitters. This consultation on the Board's response to the Directive therefore has links to the Board's expectations regarding planning by these entities. In related initiatives the Board is considering the issues of regional planning and the requirements for plans for the purpose of assessment and approval by the Board. In particular, it is expected that the outcome of this smart grid consultation will be integrated into the outcome of the planning assessment and review initiative *Distribution Network Investment Planning (EB-2010-0377)*.

3 Summary of Smart Grid Working Group Discussions

3.1 Introduction

This chapter of the Discussion Paper provides an overview of the topics discussed and opinions provided during the Smart Grid Working Group meetings that took place from March through to mid-May 2011. The SGWG was composed of 26 members from a variety of key stakeholders including distributors, transmitters, consumer groups and technology vendors. In order to assist the SGWG members staff issued a short background paper. Six meetings were held from March 1, 2011 to May 10, 2011. A full record of the meetings, the list of SGWG members, and the background discussion paper are available at: http://www.ontarioenergyboard.ca/OEB/Industry/Regulatory+Proceedings/Policy+Initiatives+and+Consultations/Energy+Issues+Relating+to+Smart+Grid/Smart+Grid+Working+Group

The discussions that follow are separated into each of the four main objectives outlined in the Directive for developing guidance on the Smart Grid: (i) Policy Objectives, (ii) Customer Control Objectives, (iii) Power System Flexibility Objectives and (iv) Adaptive Infrastructure Objectives. A summary of the member's key observations and their advice to staff has been provided for each objective.

3.2 SGWG Discussion of Policy Objectives

Summary of SGWG discussion of Directive's policy objectives

The Directive states that, in developing the guidance referred to in paragraph 1 of the Directive and in evaluating the smart grid

activities of the SG licensees referred to in that paragraph, the Board shall be guided by certain policy objectives which are discussed below. Each objective has been reproduced at the start of the applicable section.

3.2.1 Efficiency

Objective: Improve efficiency of grid operation, taking into account the cost-effectiveness of the electricity system.

In the discussions at the SGWG members identified that there are different 'types' of efficiencies: physical (energy lost), operational (staff processes and resources), and market level (economic efficiency). Additionally they suggested that there are also different 'levels' of efficiency (e.g. total grid improvements versus efficiencies at the individual distributor level.). The majority of working group members agreed that efficiencies related to the smart grid are related to more and better information, leading to better decision making and better processes. Many so-called smart grid technologies also facilitate operational efficiencies not directly related to the provision of raw data (e.g. more efficient meter reading and the provision of tampering alerts.) Several SGWG participants felt that efficiency is also a customer benefit and that customers can and should be part of making the grid more efficient.

3.2.2 Customer Value

Objective: Provide benefits to electricity customers.

SGWG members advised that although different types of customers will derive different benefits from the smart grid, the primary benefit for all customer classes will be better information which can and should result in better service, reduced costs and the facilitation of localized decision-making by consumers. These benefits could be

realized by shifting loads to periods of cheaper supply, participation in energy efficiency and/or demand response programs and activities and tariff selection to match lifestyles better. The SGWG participants pointed out that cost would be a significant determinant of customer engagement, depending on the customer and their energy consumption. The current level of customer engagement in energy is typically low, especially at the residential level and is primarily related to bill complaints, power interruptions and service turn-on or turn-off. To the extent that that today's customers may become more engaged energy consumers in the future – and will therefore be driven by different benefits in the future – this consultation should also consider the smart grid benefits to future customers.

3.2.3 Co-ordination

Objective: The smart grid implementation efforts should be coordinated by, among other means, establishing regionally coordinated Smart Grid Plans ("Regional Smart Grid Plans"), including coordinating smart grid activities amongst appropriate groupings of distributors, requiring distributors to share information and results of pilot projects, and engaging in common procurements to achieve economies of scale and scope.

There was consensus among the SGWG members that coordination between and among distributors and transmitters will be key to achieving the full benefits of the smart grid. Utilities noted that many distributors are already in contact with one another regarding their smart grid plans (e.g. several distributors are cooperating on cyber-security audits) and that the challenge lies in formalizing these activities. SGWG members suggested that the establishment of a central body for coordination could facilitate

coordination not only on the hardware level, but also in coordinated integration and deployment of investments. Working group members advised that key considerations when considering regional plans include the different maturity curves, capabilities and interests of each utility.

3.2.4 Interoperability

Objective: Adopt recognized industry standards that support the exchange of meaningful and actionable information between and among smart grid systems and enable common protocols for operation. Where no standards exist, support the development of new recognized standards through coordinated means.

SGWG members suggested that it would be advantageous to take a larger scale view of interoperability moving forward, where the term refers not only to the ability of devices to communicate with one another but also to the organizational interoperability among market participants the smart grid technologies will enable and/or require. From a technological standpoint, the three main issues related to interoperability are: (i) how to ensure interoperability with existing systems, (ii) how to ensure interoperability at the distribution system level and (iii) how to facilitate interoperability of devices within Home Area Networks (HANs) with utility control and information management systems and home energy management systems. SGWG members generally agreed that a key challenge for ensuring interoperability is communication latency and the existence of multiple standards. Different data frequency needs can complicate interoperability and constrain function, if care is not taken.

Generally, the working group was of the view that the Board should monitor standards development in other jurisdictions, particularly

the US, but should exercise caution when considering codifying standards.

3.2.5 Security and Privacy – Dual Objectives

Security Objective: Cyber security and physical security should be provided to protect data, access points, and the overall electricity grid from unauthorized access and malicious attacks.
Privacy Objective: Respect and protect the privacy of customers. Integrate privacy requirements into smart grid planning and design from an early stage, including the completion of privacy impact assessments.

Generally speaking, SGWG members believed that there is a significant body of work on security and privacy that can be used to develop the Board's guidance. In particular the Privacy by Design ("PbD") concept of the Office of the Information and Privacy Commissioner of Ontario, which stresses "building in" privacy protections to the smart grid, provides a privacy benchmark. It was suggested that the experiences from other sectors, such as telecommunications and banking, could be drawn upon provided that the significant differences between the sectors, such as time constraints and latency, are addressed. Discussion at the Working Group sessions identified that an end-to-end view of the grid (i.e. from the consumer interface to "back office" utility data management systems) is necessary for assessing privacy and security concerns.

3.2.6 Safety

Objective: Maintain, and in no way compromise, health and safety protections and improve electrical safety wherever practical.

Working group members were of the view that safety is already considered good utility practice and that it need not be addressed any differently as part of the smart grid guidance. It was noted that the Electrical Safety Authority (ESA) will address many safety issues, directly, through the development of their regulations and codes. Many working group members believed that safety improvements will result, naturally, from the additional information and automation afforded by smart grid technologies.

3.2.7 Economic Development

Objective: Encourage economic growth and job creation within the province of Ontario. Actively encourage the development and adoption of smart grid products, services, and innovative solutions from Ontario-based sources.

A number of SGWG members provided examples of products that they have developed as a result of the introduction of smart meters and TOU prices. The development and implementation of the smart grid is expected to lead to similar economic development opportunities. While SGWG members provided some suggestions for facilitating economic development through the Board's regulatory policy, there was no consensus as to how the Board's policy might directly address the objective.

3.2.8 Environmental Benefits

Objective: Promote the integration of clean technologies, conservation, and more efficient use of existing technologies.

There was overall agreement among SGWG members that smart grid technology inherently provides environmental benefits. As an example, voltage monitoring technology can reduce the need to engage carbon-emitting generation assets during peak load

periods. Many members suggested that an economic test for the environmental benefits would be required for evaluating projects/technologies but differed in opinion with respect to the exact form of that test.

3.2.8 Reliability

Objective: Maintain reliability of the electricity grid and improve it wherever practical, including reducing the impact, frequency and duration of outages.

Staff was advised by SGWG members that performance information made available through smart grid technologies will, in general, improve the reliability of power systems. Several working group members noted that some smart grid technologies, such as Electric Vehicles (EVs) or distributed renewable generators, could reduce reliability in the short term if not planned in an effective and integrated way and that the Board should consider these impacts when evaluating smart grid investments.

3.3 SGWG Discussion of Customer Control Summary of SGWG discussion of Directive's customer control objectives

The Directive introduces customer control objectives "(f)or the purpose of providing the customer with increased information and tools to promote conservation of electricity, which will "expand opportunities to provide demand response, price information and load control to electricity customers", in accordance with subsection 2(1.3)(b) of the Electricity Act" and sets out the objectives discussed below.

3.3.1. Access

Objective: Enable access to data by customer authorized parties who can provide customer value and enhance a customer's ability to manage consumption and home energy systems.

SGWG members were generally in agreement that the level of detail, frequency, and latency of information (i.e. within the time period that actions can be taken based on the information) that customers will want varies by customer class (residential, commercial/institutional and industrial) and is likely to be related to the cost of electricity. They suggested that care should be taken when making assumptions about what customers want based on current behavior in order to avoid limiting options in the future.

SGWG members largely agreed that access to real-time or near real-time data should be provided to facilitate future needs of customers, even if real-time access is not required now. The working group differed in opinion regarding the most cost effective and efficient solution for providing real time data to customers. Many SGWG members believed that Ontario has both a foundation of AMI on which to build as well as challenges as a result of the particular way that AMI systems have been deployed. They suggested that data access should take these realities into account.

There was general agreement among working group members that third parties should have access to data, with customer permission.

3.3.2 Visibility

Objective: Improve visibility of information to and by customers, which can benefit the customer and the electricity system, such as electricity consumption, generation characteristics and commodity price.

SGWG members were of the view that visibility requirements will vary greatly depending on the use of the data. Additionally, the working group members believed that the Board cannot forecast what services consumers will want in the future and therefore the Board's guidance should be careful not to limit options regarding data or information and, instead, facilitate consumer choice regarding visibility. Similarly, the Board should not specify the protocols or methods by which data and information is made visible to consumers.

SGWG members felt that comparative consumption data is an important element of visibility. They felt customers would want to compare their usage to their own historical usage, their peers and to that of the average consumer.

3.3.3 Control

Objective: Enable consumers to better control their consumption of electricity in order to facilitate active, simple, and consumer-friendly participation in conservation and load management.

SGWG members believed that customers will have different needs for control, and that those needs may change in the future, particularly as prices for electricity change. They suggested that it may be necessary to ensure high levels of control for all customers should they desire it. They believed that the foundation of customer control is information. The SGWG believed that to ensure customer control, one must determine the most cost effective way to provide customers with the information that they genuinely need.

Many SGWG members suggested that any guidance should be sensitive to the need for a balance between providing information for current and future uses and between current and future data capabilities of the AMI systems.

3.3.4 Participation in Renewable Generation

Objective: Provide consumers with opportunities to provide services back to the electricity grid such as small-scale renewable generation and storage.

Staff was advised that technical constraints on the electricity system may result in customers in Ontario having different levels of access to be able to participate in distributed renewable generation. Some SGWG members believed that investments in smart grid integration should be prioritized to maximize opportunities for participation, while others believed that distributed generation (DG) should be promoted in high growth areas where future capital expenditures will be the highest (as capacity is high and equipment is in most need of replacement).

The SGWG members identified several customer value drivers for participating in renewable generation, such as: financial (selling power back to the grid or reducing power purchased from grid), marketing (building brand, public relations issues), self-sufficiency and environmental drivers.

3.3.5 Customer Choice

Objective: Enable improved channels through which customers can interact with electricity service providers, and enable more customer choice.

The smart grid, particularly AMI with interval data measurement capability, facilitates the opportunity to provide customers with a wider range of options and choices with respect to dynamic pricing, consumption displays and energy analysis. SGWG members suggested that as distributors currently have varying capabilities, customer choice available from smart grid will vary by distributor.

3.3.6 Education

Objective: Actively educate consumers about opportunities for their involvement in generation and conservation associated with a smarter grid, and present customers with easily understood material that explains how to increase their participation in the smart grid and the benefits thereof.

SGWG members generally agreed that distributors may be well-suited to educate customers about many issues - such as billing, for example - since they are the primary point of contact for most customers. However, as it is important that a consistent message is promoted, customer education related to provincial energy policy and other cross-cutting issues may be best handled by a central body such as the Ontario Power Authority (OPA). This highlights the importance of balancing the need for provincial consistency with the need to address variation among distributors in education and messaging.

The SGWG believed that past experience (within and external to Ontario) has shown that it is important that the benefits of any new project are accurately portrayed to the public, particularly to avoid unrealistic expectations of the benefits of smart grid. Equally important is the requirement to educate consumers about how electricity is supplied, how periodic energy bills are calculated and how delivery and commodity charges are allocated.

3.4 SGWG Discussion of Power System Flexibility

The Directive sets out power system flexibility objectives for the purpose of "enabling the increased use of renewable energy sources and technology, including generation facilities connected to the distribution system, in accordance with subsection 2(1.3) (a) of the *Electricity Act,1998*, and recognizing the need for flexibility on

the integrated power system" and sets out the objectives discussed below.

3.4.1 Distributed Renewable Generation

Objective: Enable a flexible distribution system infrastructure that promotes increased levels of distributed renewable generation.

There was consensus among the SGWG that without prescribing technologies or applying burdensome procurement requirements, the Board should investigate cost recovery guidelines for DG on topics including connection, modeling and forecasting, monitoring, ancillary services and control (including dispatch capabilities).

Storage is a key component of optimizing DG and the Board should provide guidance in this area.

Coordination among utilities is an important tool for optimizing DG on the system as a whole.

3.4.2 Visibility

Objective: Improve network visibility of grid conditions for grid operations where a demonstrated need exists or will exist, including the siting and operating of distributed renewable generation.

In the course of the SGWG sessions, staff was advised of the importance of visibility in promoting grid efficiency and optimizing DG. Guidance on visibility should address requirements for coordination among utilities including but not be limited to information sharing. However, in providing guidance the Board should also take into account that distributors have varying levels of visibility capabilities due to their size and existing technology and infrastructure.

3.4.3 Control and Automation

Objective: Enable improved control and automation on the electricity grid where needed to promote distributed renewable generation. To the extent practical, move toward distribution automation such as a self-healing and self-correcting grid infrastructure to automatically anticipate and respond to system disturbances for faster restoration.

Some SGWG members believe that the Board should adopt interoperability standards while others believe that the Board should avoid any procurement requirements including specific standards. The SGWG noted the 'right' balance of control and automation will vary among distributors. This is another area that lends itself to coordination among distributors.

3.4.5 Quality

Objective: Maintain the quality of power delivered by the grid, and improve it wherever practical.

The working group generally agreed that the Board should focus on maintaining current, rather than increased, reliability levels as smart grid devices and applications are integrated. Several group members believe power quality metrics should be established.

Views among the group were divided as to whether distributors should be allowed to charge increased rates for premium power quality services or if this market should be limited to unregulated entities including distributor affiliates.

3.5 SGWG Discussion of Adaptive Infrastructure

The Directive sets out the adaptive infrastructure objectives "(f)or the purpose of "accommodating the use of emerging, innovative and energy saving technologies and system control applications," in accordance with subsection 2(1.3)(c) of the Electricity Act" which are discussed further below.

A common theme in SGWG discussions was the limitations and challenges posed by the varied AMI technologies employed throughout the province of Ontario. As such, the SGWG discussed the lessons learned from the smart meter roll out with respect to flexibility and forward compatibility in order to ensure that the Board's smart grid policy reflects these lessons. When discussing forward compatibility, the topic of electric vehicles (EVs) was often cited as an example of a future technology that must be enabled by the smart grid. Summaries of the discussions of those two case studies can be found below followed by discussions of the adaptive infrastructure objectives themselves.

3.5.1 Case Study #1: Lessons Learned from Smart Meter Deployment

Staff received feedback from SGWG members regarding some of the effects of setting deadlines on the deployment of certain smart grid technologies, e.g. the risk of stranding assets. An assessment of such impacts should be considered when the deadlines for smart grid technology deployment are being established and such deployment should utilize and build on existing grid assets, such as smart meters, AMI, the MDM/R etc., where appropriate.

Many SGWG members felt that the Board should take the time to establish a clear and comprehensive roadmap for the development

of certain smart grid technologies to provide clarity for market participants and to ensure that consistent functionality is available across the province.

Most SGWG members felt that inaccurate messaging regarding the benefits and purpose of the smart meter initiative may have reduced consumer acceptance. The SGWG suggested that the Board should focus on clear messaging for future smart grid technology rollouts to reduce customer uncertainty and increase customer adoption.

3.5.2 Case Study #2: Electric Vehicles (EVs)

The SGWG discussed the many challenges facing LDCs with respect to the deployment of EVs, including:

- Location of EVs on the grid (e.g., distributed or concentrated loading);
- Managing charging of EVs (e.g. when does charging occur: off-peak or on-peak? Do the low power requirements of EVs warrant metering in public locations?)
- Upgrading infrastructure to accommodate EVs (e.g., who bears the cost, where in grid to upgrade based on demand, landlord issues)
- Multi-jurisdictional dynamics (e.g., owner of EV living in one jurisdiction but requiring a charge in another)
- Use of EVs as energy storage devices

The consensus from the SGWG, including additional staff discussions with several automotive manufacturers, is that it is likely that the take up of EVs will occur at a fairly slow rate – if hybrid vehicles are any indication. Given this view, the working group members believed that distributors and regulators will likely

have a substantial amount of time to address issues regarding grid infrastructure, which will assist with the addressing the above challenges.

3.5.3 Flexibility and Forward Compatibility

Flexibility Objective: Provide flexibility within smart grid implementation to support future innovative applications, such as electric vehicles and energy storage.
Forward Compatibility Objective: Protect against technology lock-in to minimize stranded assets and investments and incorporate principles of modularity, scalability and extensibility into smart grid planning.

SGWG members generally believed that the Board should promote open standards especially in relation to software application development. The SGWG also suggested that ruling out devices and functionality that could enable future functionality simply on the basis of cost should be avoided. Rather, technology installed should facilitate future potential applications or requirements. Additionally, some SGWG members suggested that some new technologies will need to be replaced at faster rates than traditional technologies and that shorter depreciation periods should be allowed.

Some SGWG members suggested that a vision or roadmap document would help guide investments without prescribing them.

3.5.4 Encourage Innovation and Maintain a Pulse on Innovation

Encourage Innovation Objective: Nest within smart grid infrastructure planning and development the ability to adapt to and actively encourage innovation in technologies, energy services and

investment / business models.
*Maintain Pulse on Innovation Objective***:** Encourage information sharing, relating to innovation and the smart grid, and ensure Ontario is aware of best practices and innovations in Canada and around the world.

Generally speaking, the working group agreed that collaboration among electricity stakeholders will help achieve innovation, and could be achieved by establishing a forum for the sharing and discussion of ideas related to smart grid. The SGWG could meet on a regular basis during the deployment of smart grid technologies, with the involvement of multiple stakeholders (regulators, distributors, technology vendors, consumer groups, agencies, etc.), and the consideration of smart grid activities in a global context.

4 Discussion of Board's Regulatory Options for Responding to the Minister's Directive

4.1 Introduction

Staff's view of broad options available to the Board

The purpose of this chapter is to develop questions to facilitate stakeholder response.

The Board's objective is to ensure that the delivery of electricity is efficient, serves customer values and provides for safety, reliability, security, privacy and interoperability. Utilities smart grid activities are to be evaluated against these outcomes. The challenge for the Board is to provide guidance as to these outcomes at the appropriate level of detail by finding the balance between broad principles – as set out in the Directive - and detailed prescriptions.

The Board has two broad forms of regulation at its disposal: regulation of rates and regulation of conduct. The current rate regulation regime for distributors is known as Incentive Regulation Mechanism ("IRM"). With this mechanism, a distributor has its rates rebased through examining its costs and revenues in a Cost of Service ("COS") application every four years. During the intervening three years, through an IRM formula, a distributor has its rates adjusted for inflation, and a productivity stretch factor.

Transmitters and the other regulated entities (Ontario Power Authority -OPA, IESO, and Ontario Power Generation-OPG) are subject to varying forms of fees review or cost of service regulation.

The conduct of licensees is regulated through conditions of licence and codes, such as the Distribution System Code.

The *GEA* amended the *OEBA* to include a deemed licence condition in every distributor's and transmitter's licence regarding plan approvals and plan implementation. That deemed condition provided a new form of Board oversight for distributors and transmitters in the form of a requirement for the review of distribution and transmission system plans.

These reviews involve a mixture of rate and conduct regulation. To recover costs, distributors and transmitters must file plans which have to meet the review criteria set out in the *DS Filing Requirements*. As described in Chapter 2 above, these filing requirements are currently limited to demonstration projects, planning studies, training and education in relation to the smart grid. Once the Board has established its smart grid development policy in response to the directive, it is expected that the *DS Filing Requirements* will be revised. The plan review criteria may be forms of conduct regulation, e.g. requirements to document processes that ensure safety, privacy and security. Alternatively, these matters could be addressed through code requirements with plan review criteria limited to ensuring prudent investment through rate approvals.

Two general types of criteria

Staff suggests that the 24 objectives of the Minister's Directive may be distinguished between those objectives that have always been implicitly part of the Board's regulatory processes ("traditional objectives") and new objectives. Table 1 provides one possible classification of those two types of objectives combined with a classification into threshold and evaluative criteria. Appendix 2 provides an overview of the Directive's objectives and the kinds of questions Board staff has developed to facilitate, but not limit, the

consultation. Appendix 3 provides a summary of the options for responding to each objective in terms of the broad categories of rate or conduct regulation. With the assistance of the SGWG, staff has identified the key questions shown in Appendix 2 and the options in Appendix 3. In turn these questions and options have been distilled into the questions discussed below.

Table 1: Types of Criteria

	Threshold	Evaluative
Traditional Objectives		
Efficiency		✔
Customer Value		✔
Safety	✔	
Privacy	✔	
Security	✔	
Reliability	✔	
Education	✔	
Access	✔	
Customer Choice	✔	
Quality	✔	
Control and automation		✔
Forward compatibility	✔	
New Objectives		
Co-ordination	✔	
Interoperability	✔	
Economic Development	✔	
Environmental Benefits		✔
Visibility to consumer	✔	
Consumer control	✔	
Participation in renewable generation	✔	

Distributed renewable generation	✔	
Distribution system visibility	✔	
Flexibility	✔	
Encourage innovation	✔	
Maintain pulse on innovation	✔	

Table 1 indicates that the only new objective which is not of a threshold type is that of environmental benefits. This means that the remaining objectives can largely be achieved by requirements that either regulate conduct or through the assessment of information submitted as part of planning filings indicating that certain procedures have been followed or any required standards met. For example, distributors may need to provide proof of having co-ordinated planning, including, where applicable, regional smart grid plans. Another example may be a requirement that licensees provide certification that privacy standards have been met.

With regard to environmental benefits, these are unambiguously associated in the Directive with the promotion of electricity conservation and demand management (CDM) and of the use and generation of electricity from renewable energy sources. There may be a case that any activities that reduce losses also contribute to environmental benefits. These points are discussed further in 4.2.2.

In the “traditional” objectives category the evaluative criteria identified by staff are those of efficiency, customer value and “control and automation”. While the first two criteria require no explanation, the latter is proposed as requiring an evaluative approach because there are a variety of ways of meeting the objective of improved control and automation each with a different future stream of benefits and costs that are easily quantifiable. In

other words, there would appear to be no clear threshold values for this objective.

Another objective that may be regarded as evaluative is that of "economic development". However, staff classifies this objective as a threshold criterion because the Directive instructs the Board to provide guidance that will "encourage" economic growth, job creation and "the development and adoption of smart grid products, services, and innovative solutions from Ontario-based sources."

This is an essentially qualitative objective that would not lend itself easily to evaluative criteria. Using a threshold approach the Board could seek evidence from licensees that adequate consideration has been given to the factors enumerated in this objective and determine whether a licensee has given them adequate consideration. The Board might assess, for example, the extent to which a licensee's smart grid activities provide an incentive for development of new products in the marketplace, in a manner similar to the way in which the rollout of smart meters and the implementation of TOU pricing encouraged the development of new "behind-the-meter" (BTM) products which are discussed in more detail in 4.2.3 below.

Directive gives rise to explicit benefits

However, as discussed further in 4.2.2. below, the Directive also gives rise to an explicit set of benefits in relation to operational savings and new consumer services. While the former cannot accurately be depicted as representing new considerations for the Board, the Directive appears to place a requirement on the Board to evaluate the benefits explicitly. Similarly, while customer value has always been a core principle, the smart grid as envisaged in the *OEBA,* as amended by the *GEA,* and in the Directive

contemplates new types of consumer services. These are BTM products and services which are mentioned above and examined in greater detail in section 4.2.3. Broadly speaking, BTM products and services provide consumers with a greatly expanded ability to monitor and control electricity costs. It is not clear whether any or some of these new services may be provided by unregulated third parties in a competitive environment.

4.2 Key Issues

Board's response to Directive organized by staff into eight issues

Staff has considered how the Board might formulate guiding principles in response to the objectives of the Minister's Directive. This consideration of the regulatory options available to the Board has given rise to eight questions which were also addressed by the SGWG.

4.2.1 Key Issue No. 1: How should smart grid investment be treated?

What is the scope of "smart grid"?

The first issue to be addressed concerns the meaning or definition of what constitutes the "smart grid". There are two broad approaches to this question:

(A) going forward, to assume that smart grid is integral to all distribution and transmission investment with the result that there would be **no** activities that are not considered part of the "smart grid" or, conversely, that such enhancements constitute the utility's normal undertaking to revise periodically and update its plant, and that none of it would be considered to be smart grid; or,

(B) to identify specific aspects, such as EVs or HAN-enablement, etc. as constituting the "smart grid" with all other activities excluded.

The key difference in the two approaches is that the latter would, in one way or another, involve drawing up a list of eligible and non-eligible technologies and/or activities to which the objectives do or do not apply whereas the former would focus on specifying the objectives as applying to all activities and noting any exceptions. For example, if a distributor had no HAN projects in its service area within the term of the application then its COS application would have to meet all of the objectives except those that focus on HAN (i.e. the Customer Control objectives except for "participation in renewable generation" and "education" as it pertains to consumer activities not related to renewable generation).

A. Smart Grid as the Evolving Modernization of the Grid

Smart grid as the modernized "grid of the future"

The first approach, which was suggested by several SGWG members and enjoyed broad support at the SGWG, acknowledges that the smart grid is the "grid of the future" and considers all of the Board's regulation of distributors, transmitters and other regulated entities whose budgets are reviewed by the Board as coming within the scope of facilitating implementation of a smart grid. This option has the benefit that it is the most straightforward approach to cost recovery. A single process for rate applications would cover all of the activities of distributors and transmitters, as well as the other regulated entities. Distributors and transmitters would still be required to file system plans as they are now in accordance with the *DS Filing Requirements* The line items in the COS applications would be reviewed for their contributions to serving load and generation customers within their service area, and to fulfilling the Directive's objectives.

It needs to be emphasized that serving load and contributing to smart grid objectives should be complementary, not mutually exclusive. At the line item level, such as a project to upgrade equipment on a particular feeder, it is likely that the proposed expenditures serve load growth or the maintenance of reliability and power quality for existing load as well as one or more objectives of the Directive. The addition of smart grid objectives to traditional tests of reasonable expenditures is needed to ensure that the benefits of the smart grid are not overlooked. The specific nature of these benefits is discussed in 4.2.2. One of the strongest messages from the SGWG was the importance of understanding the "foundational" nature of the smart grid in the sense that it provides the foundation for future benefits.

In order for the Board to assess whether a distributor's activities contribute to smart grid objectives the Board's *DS Filing Requirements* for distributors' smart grid plans would require amendments. Currently they cover demonstration projects, studies, training and education and allow distributors to accrue costs to two deferral accounts for later review and approval by the Board. A transition period would be needed during which some activities of these kinds will co-exist with activities under the comprehensive smart grid development framework.

If the Board were to consider enhancements to the plant of the utility to be part of its usual undertaking, and not necessarily characterized as "smart grid" activity, the changes to the *DS Filing Guidelines* would be restricted to a much narrower category of technologies, genuinely representing significant paradigm changes.

B. Smart Grid Investments as Discrete and Different from "Normal" Utility Practice

Smart grid as separate from "normal" grid

The broad alternative to the approach discussed in section A above is to identity specific elements within grid operations and investment as "smart grid" that require "facilitation". To give this operational meaning the Board would have to consider applying different treatments for rate-setting purposes and/or for approval of capital plans than would be the case for activities and investment that do not fall within the rubric of "smart grid".

This approach envisages distinguishing "smart grid" elements from "non-smart grid" or "normal" grid elements on the basis of technological categories, e.g. investments and activities in support of the integration of EVs or renewable generation, etc. To use the same example as approach A, a feeder upgrade that did not include the use of defined smart grid technologies would be scrutinized for its prudence in the context of meeting load within acceptable service standards. If smart grid technologies were involved the project would be subject to the expanded set of tests in relation to the Directive's objectives.

4.2.1.1 Implications for Rate Regulation

Broad implications for rate regulation

With respect to rate regulation the Board's traditional approach to the review and approval of all expenditures may need to be modified. Under either approach A or B the requirement for the Board to consider the objectives of smart grid development and implementation set out in the Directive will need to be addressed.

Consistent with widely accepted principles of economic regulation[1] the Board has focused on the criterion of "just and reasonable"

rates. Since these rates have been set in order to cover the costs of service – i.e. meeting load requirements within acceptable reliability and, more recently, required service quality standards – this test may be viewed as equivalent to a benefit-cost (B/C) ratio of unity. That is to say, the benefits are the value of meeting load and the allowed costs (including a fair return to capital) are set to be equal to the projected benefits.[2]

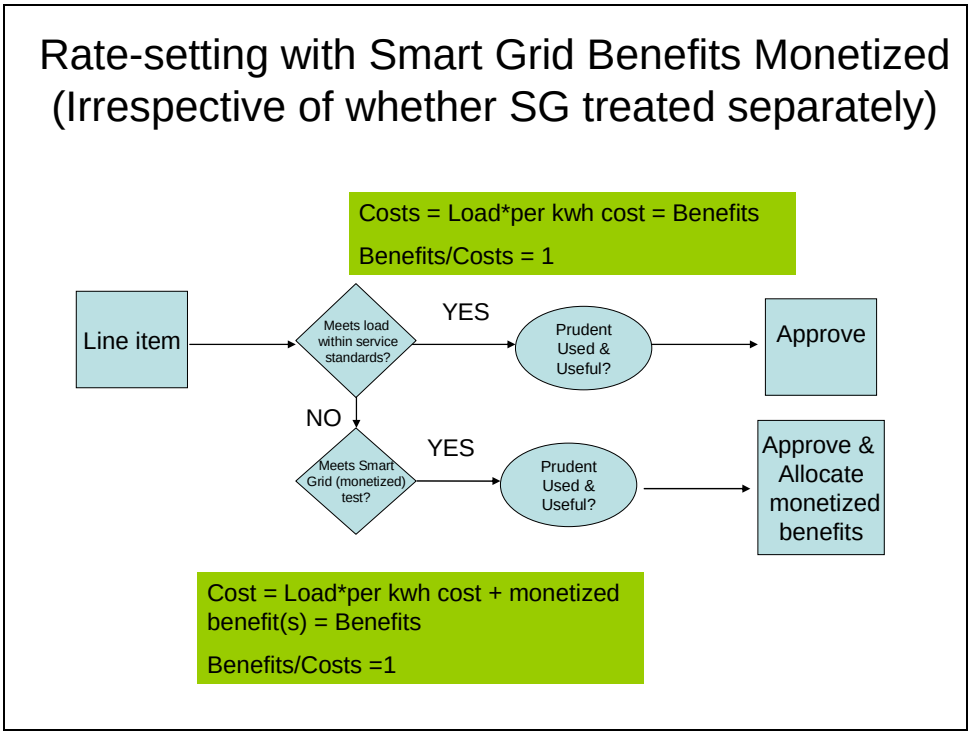

Figure 1: Rate-setting with Smart Grid Benefits Monetized (Irrespective of whether SG treated separately)

Figure 1 illustrates conceptually how rate setting might proceed under the approaches discussed in sections A and B above if the benefits associated with the objectives of the Directive were to be monetized. For example, if a proposed feeder upgrade were to include equipment and/or software that would contribute to a decrease of distribution losses this would represent an additional flow of benefits which, if excluded from the project analysis, could result in different choices of equipment and/or software. For rate–

setting purposes smart grid investments and activities would be subject to an expanded benefit-cost test at a level of materiality consistent with established Board practice as under option (ii), with monetized environmental benefits above that level of materiality. The separate treatment would also need to take into account the "extra" revenues collected for the environmental benefits.

Figures 2 and 3 show how rate setting might proceed with evaluative standards instead of monetization for options A and B, respectively. The specific B/C tests are outlined in 4.2.2, below. For CDM the Total Resource Cost (TRC) test could continue to be applied to specific expenditures while meeting the specified targets. An example of an evaluative standard for renewable generation might be derived from traditional rate-setting principles, e.g. the extent of annual costs of renewable generation connection and integration may be limited by the need to maintain rate impacts within certain bounds. A distributor with a large number of FIT or microFIT generators awaiting connection may limit the connection and integration expenses in any one year to a level that would not increase the average distribution cost to its customers beyond a certain percentage increase. Otherwise the applicable evaluative standard is a B/C ratio greater than one.

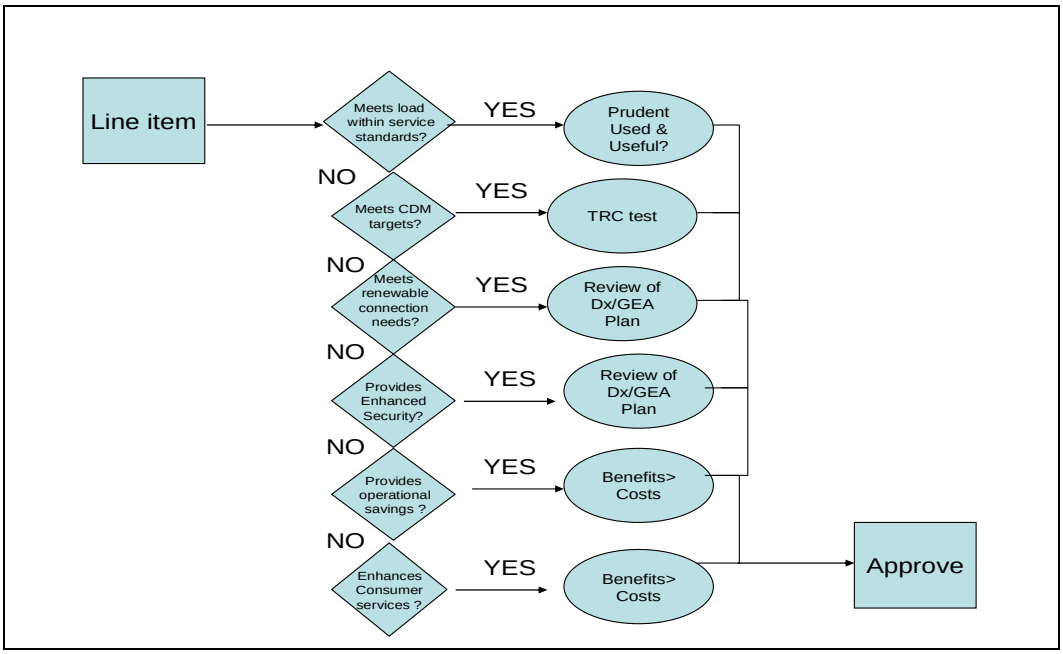

Figure 2 Tests for Integrated Rate-setting (Approach A)

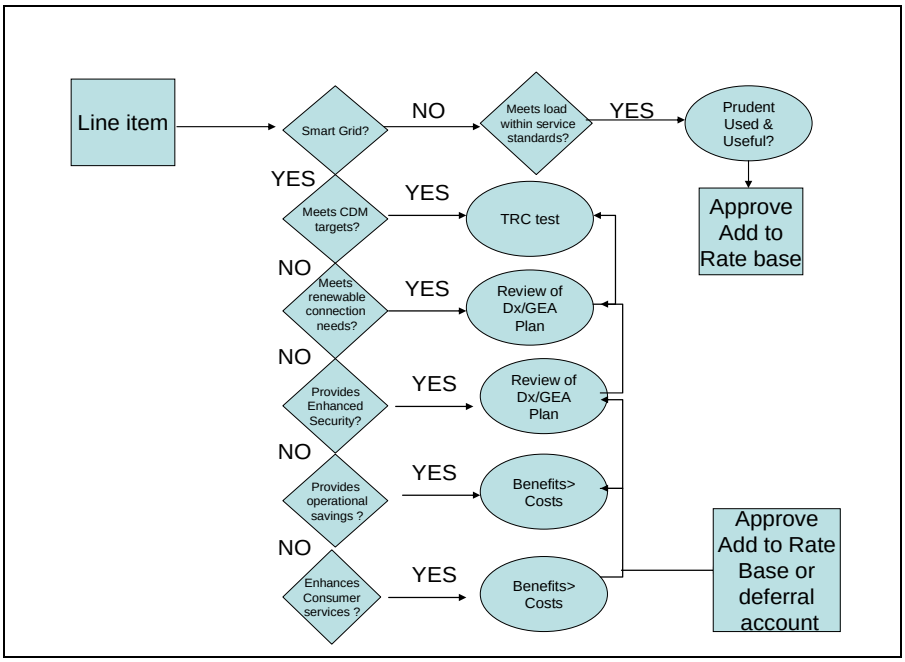

Figure 3 Rate-setting with Smart Grid treated separately (Approach B)

1. Staff invites comments from stakeholders on which model is preferred: (A) the smart grid is an evolution of the modernization of the grid or, (B) it is a collection of distinct technologies that are separate from the "traditional" grid?

4.2.2 Key Issue No. 2: In developing principles for the evaluation criteria for the regulated entities, what benefits should the Board recognize?

What benefits should the Board evaluate?

As discussed in 4.2.1 above, there are two models for treating the investments related to smart grid development for rate-setting purposes: an evolutionary model in which the smart grid is treated as the "grid of the future"; and, a model in which smart grid technologies are treated separately. In either case the Board may want to consider benefits in addition to meeting projected load within acceptable service standards. Staff received advice from the SGWG that the smart grid should be seen as a "foundation" for the realization of new benefits not traditionally associated with electricity systems. These benefits are such that they may not accrue, at least in full, to the utilities that undertake the relevant investments. For instance, a smart grid automation system may allow a distributor to increase the amount of renewable generation on its system or reduce peak usage. Such a benefit would not accrue only to the distributor or its customers, and would be recovered over a period of time.

Societal benefits in the context of government policy

For benefits that accrue to others, analysis is required to identify to whom these benefits accrue, such as vendors of BTM services or "upstream" system benefits. The former would need to be estimated as some portion of the benefits of enhanced consumer services which are discussed below. The SGWG advised that

consideration should also be given to broader system or societal benefits, the upstream benefits, such as the deferment of large investment in new transmission or generation capacity. These benefits include environmental benefits such as reduced carbon dioxide emissions. Besides CDM and renewable generation these benefits may be created by other types of distributed generation, gains in energy efficiency not attributable to CDM programs and distributed storage. CDM targets for distributors are prescribed by condition of licence. The requirement to promote renewable energy generation is an object of the *OEBA* and conditions of licence and code requirements. Similarly, long-term benefits need to be acknowledged. The regulatory treatment of all of these benefits is discussed below in 4.2.2.4**.**

The additional benefits for which distributors and transmitters may make application for cost recovery, in order to achieve the objectives set out in the Minister's Directive, are discussed under the following headings: increased efficiency of power delivery; reduced operations and maintenance costs; improved system reliability; integration of renewable energy and distributed resources, including CDM; and, enhanced consumer services. As noted in section 4.1, staff is of the view that the "economic development" policy objective should be classified as a threshold criterion. Were it to be treated as evaluative the Board would need to consider economic development benefits, and develop criteria for estimating such benefits.

Staff emphasize that the consideration of these additional benefits should not detract in any way from the Board's longstanding focus on customer value and the appropriate control of costs as indicated

by the Board's development of a renewed regulatory framework for the electricity sector.

4.2.2.1 Increased efficiency of power delivery

In the smart grid context, "efficiency" means technical efficiency, i.e. the efficiency of the delivery of electrical energy. SGWG members pointed to the example that up to a threshold of 5% energy losses distributors currently have no incentive to reduce losses. As part of their regular rate adjustment application, distributors apply to the Board to update their loss factors. If a distributor's losses exceed 5%, it is required to provide an explanation and action plan as to how it intends to reduce its losses. Smart grid investments may reduce losses below this level but the reductions may take some time to appear. Associated costs could be recoverable over a longer period than is normally the case. The business cases provided as part of the rate applications could provide an estimate of the reduced losses and demonstrate that these benefits exceed the net present value (NPV) of any incremental capital and operating costs. As noted in the introduction to this section, reduced losses also result in environmental benefits similar to those that result from CDM and greater use of renewable sources.

4.2.2.2 Reduced operations and maintenance costs

Smart grid investments can lead to the realization of operational and maintenance savings by the better use of assets. For example, better control systems that detect consumer outages more accurately can reduce the costs by dispatching service technicians ("truck rolls") more efficiently. This may also help achieve safety objectives by reducing vehicle accidents which, in turn, may reduce total employee compensation costs. Another category of similar benefits are the cost reductions that can be achieved over time by

"right sizing" equipment, such as transformers for example. As more and better data is made available by smart meters, improved sensors and Surveillance, Control and Data Acquisition (SCADA) systems distributors will be better able invest in equipment that is sized in a more suitable way rather than erring on the side of greater capacity in order to ensure reliability. Similar savings and efficiencies can be expected on transmission systems or within generation operations as greater and more accurate operating data is available.

To capture these operational and maintenance benefits SG licensees would be expected to submit business cases for the relevant investments which show that NPV of benefits, appropriately evaluated, exceed the projected costs.

4.2.2.3 Improved system reliability

Investments in physical assets that reduce the incidence of outages beyond current and historically acceptable levels could be eligible for cost recovery, subject to a B/C test, under either of the models discussed in 4.2.1 above. Until the Board concludes its initiative to set system reliability standards the benefits could be estimated by, for example, projecting the average energy delivered to customers by avoiding outages valued at average value of total electricity services to each customer class for which projections of reduced outages are developed. Alternatively, benefits from improved system reliability may be estimated by SG licensees through valuation of the impact of lost productivity due to loss of supply. This could be developed by SG licensees through a variety of mechanisms, including consumer surveys and detailed economic studies.

In this regard it is also important to consider just what levels of reliability may be optimal. Even using current technology reliability can be improved at a cost but this raises the issue of how much reliability do different customers require and how much they are prepared to pay for enhanced reliability.

4.2.2.4 Integration of renewable energy and distributed resources including CDM

The *GEA* amended the OEBA to include an objective to "promote the use and generation of electricity from renewable energy sources in a manner consistent with the policies of the Government of Ontario". The Board has taken a number of initiatives in order to further this object, including amendments to the DSC to facilitate connections to distribution systems and establishing a framework for determining the direct benefits accruing to customers of a distributor under Ontario Regulation 330/09. The definition of the smart grid in section 1.3 of the *Electricity Act, 1998,* as amended by the GEA, that also applies to the *OEBA* also notes the need to accommodate "emerging, innovative and energy-saving technologies".

The role of the smart grid in relation to this objective is as an enabler of, or foundation for renewable energy generation. There is a significant task for distributors and transmitters, as well as the IESO, in integrating the reverse flow of energy from distributed generation within the radial load-oriented design of Ontario's distribution systems. While there are substantial benefits for Ontario that result from this enabling role a quantification of the benefits may not be necessary for the purpose of meeting the Board's review of *GEA* plans and rate applications. This is because the Board's statutory objectives now include the promotion of renewable energy and to enable its connection to the grid. The

demand for generator connections to distribution systems is almost entirely driven by the Feed-in-Tariff (FIT) program and its precursor, the Renewable Energy Standard Offer Program (RESOP). The prices paid to FIT and RESOP contract holders are intended to capture the “upstream” benefits such as deferred capacity and environmental benefits. However, issues remain regarding the prioritization and timing of investments to integrate renewable generation and B/C tests could play a role in determining the optimal location of generation connections and the timing. Another possible approach which was introduced as an example in 4.2.1.1, above, would be to apply rate impact criteria to annual investments in the integration of renewable generation, e.g. bringing in renewable generation gradually to reduce the rate impact on ratepayers. (The connection costs themselves have been addressed by the Board in proceeding EB-2009-0077 which led to amendments to the DSC.)

To support investments that facilitate the integration of renewable distributed generation, distributors need to develop projections of energy to be made available from generators using renewable energy sources, subject to capacity limits on the transmission system determined by load-flow studies. Determining the locations of the projected energy injections on each feeder helps to plan for related expenditures. The distributor should also be able to identify expenditures necessary to remove any capacity constraints (such as “transfer trip” schemes) not only on each feeder but also in SCADA systems, distribution station automation and control center expenditures. In addition, investments may be needed to maintain acceptable levels of power quality (flicker, harmonics, voltage spikes) due to the effects of renewable generators equipped with inverters.

The benefits of CDM investments may also be viewed as implicit. In this case, timing and prioritization are not issues since the Board has set targets and has prescribed a TRC methodology. However, the Board did not include environmental benefits as part of the TRC methodology and also did not include environmental benefits for natural gas Demand and Supply Management (DSM) (EB-2008-0346). Similarly, the Board declined to include monetization of environmental benefits in its Guidelines for Integrated Power System Plan. (*Report of the Board on the Review of, and Filing Guidelines Applicable to, the Ontario Power Authority's Integrated Power System Plan and Procurement Processes*). The inclusion of environmental benefits as a policy objective in the Directive may lead the Board to consider environmental benefits associated with CDM for the purpose of fulfilling its role in the facilitation of a smart grid. One way to accomplish this could be to revise the TRC methodology and the Lost Revenue Adjustment Mechanism (LRAM) which, in turn, may involve the monetization of environmental benefits. Alternatively, the Board could establish a requirement to evaluate such benefits within the context of distributors' applications for approval of distribution system plans.

In addition, each distributor needs similar projections and details to those outlined above for renewable generation regarding other distributed resources, such as fossil-fired CHP and EVs and any energy efficiency benefits not included in CDM programs. However, it is not clear that the Board is obliged to accept the need for expenditures in support of these types of distributed resources in the same way as for renewables since they are not specifically identified in the Board's objectives under the *OEBA* or the Directive. CHP, EVs and non-CDM energy efficiency technologies should be

the subject of a review to determine whether they are reasonably judged to be “emerging technologies”. If they are not, then the Board may require estimates of benefits, such as, deferred or avoided capacity and/or environmental benefits. In each case, methods would need to be developed appropriate to the estimations required.

EVs may or may not provide distributed resources depending on the future evolution of business models for EVs. Where it is expected that EVs will provide distributed resources it seems reasonable that distributors should provide information on any expenditures that are planned in order to support greater use of EVs. In the immediate future, based on the advice of the SGWG, it is likely that most, if not all, EV projects will be of a demonstration nature and, as such, will fall under the existing *DS Filing Requirements*.

Relationship to Board’s Distribution Network Investment Planning initiative

Costs may be recoverable for all such integration investments subject to the requirements for distribution system planning review and approvals which will be established by the Board’s Distribution Network Investment Planning (DNIP) initiative (EB-2010-0377), e.g. a rolling five year plan. The DNIP framework may also provide guidance on the time-profile of expenditures to enable renewable energy.

The Directive highlights the need for regional co-ordination by distributors in developing smart grid through regional smart grid plans. The Board has begun a consultation aimed at promoting the cost-effective development of electricity infrastructure through coordinated planning on a regional basis between licensed distributors and transmitters (EB 2011-0043). It is expected that

these initiatives will help to create the conditions for the realization of benefits from greater coordination and rational planning.

4.2.2.5 Enhanced consumer services

There are two broad approaches to estimating the benefits of BTM services: (a) by projecting the value of sales of BTM services, which is the orthodox economic benefit-cost approach; and (b) the benefits could be estimated as for CDM, CHP, EVs etc. (i.e. using estimates of various avoided costs and environmental benefits). In the latter case particular care will be needed not to "double count" benefits already assumed by CDM programs. Complicating this question is the concept that these services, and others created or facilitated by smart grid enhancements, may be provided by third party competitive entities or unregulated affiliates of the utility.

2. Does Board staff's classification of benefits appropriately capture all of the benefits of the smart grid?

4.2.3 Key Issue No. 3: What are the best ways to increase customer control?

The Directive sets out that the objectives with regard to customer control are "...for the purpose of providing the customer with increased information and tools to promote conservation of electricity, which will 'expand opportunities to provide demand response, price information and load control to electricity customers'".

Customer control needs vary with customer type

The SGWG suggested that the need for customer control varies by customer class. However, for each customer class the new factor introduced by the smart grid is the possibility of enhanced

capabilities for BTM customer control. In Ontario there is a well-established regime whereby distributors own and control meters and customers own their own data. Enhanced customer control potentially provides system benefits in the form of load-shifting and reduced load, and value to the customer in the forms of such benefits as reduced costs, greater visibility and understanding of electricity usage, as well as convenience.

Business models for BTM services

From the SGWG discussions, staff understands that there are three business models for providing increased customer control: 1) the meter acts as a "gateway" to devices behind the meter; 2) specific "gateways" are purchased by the customer; or 3) the use of computer-based local area networks (LANs) that function as "gateways". A "gateway" has two essential elements: communications with a source of usage data and the ability to act on the information in that data. In the simplest case, this would be the display of relevant information, such as kWh or dollar cost. More advanced products would enable the control of load devices. Besides the usage data, a gateway may also communicate with sources of additional data via the internet, such as prices, weather, past usages and benchmark usages (e.g. average usage of similar homes). One of the points of emphasis that emerged from the SGWG consultations is that such examples only touch on the future potential for BTM products, many of which will only be known as the smart grid develops.

In all three business models the issue arises of access to meter data. In assessing the best role for rate-regulated utilities it is important to understand clearly the new services that may be made available to the consumer. Figure 4 below provides illustrative "use case" summary scenarios for behind-the-meter applications. The

figure depicts three ways in which metering data could be communicated to the customer (related to but distinct from the three "gateway" business models): via the distributor-owned meter; by means of additional metering devices; and by using devices that either re-retransmit the distributor AMI data or transmit "pulse outputs" from the distributor-owned meter. In all cases, there are two essential elements in the services provided: display of information gathered from the metering data and, in many instances, other sources (e.g weather, prices, past usages); and control of load based on this information.

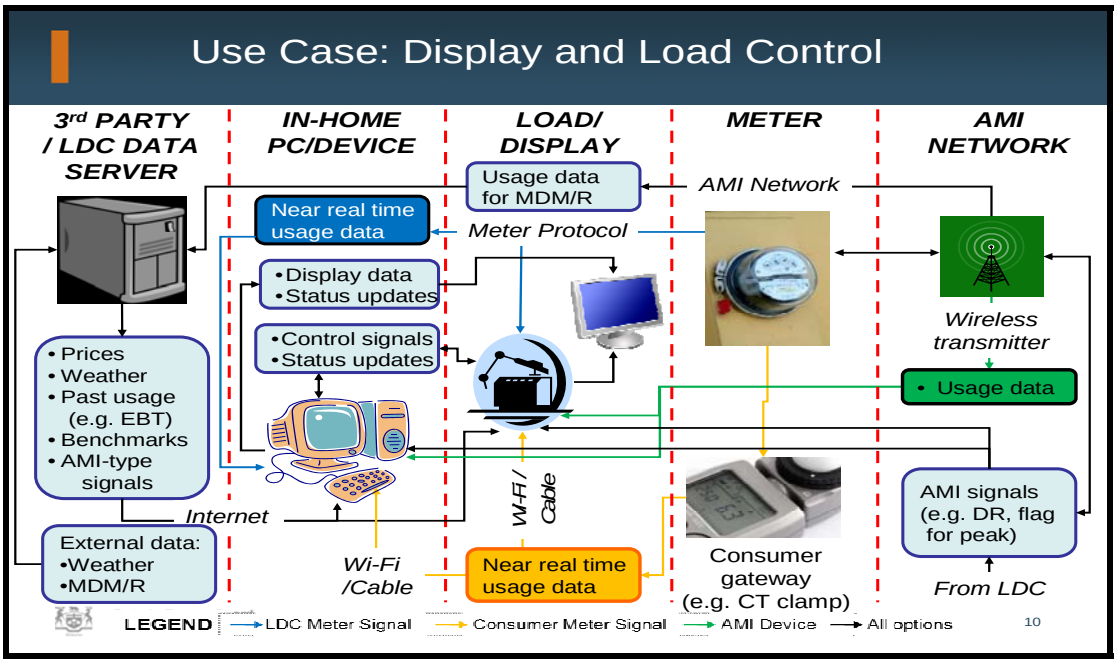

Figure 4

These services could be offered by distributors, retailers (or other third parties). Some vendors wish to provide services using "near real-time" data. This view found wide support amongst the SGWG members. The general rationale for "near" real-time data is that consumers want this data for control actions in response to the consumer's increased awareness of this data, for example, in the forms of displays or by the means of pre-programmed algorithms. Such services can be provided now by the competitive market

which re-emphasizes the importance of clear lines of demarcation between rate supported activities and activities that are beyond the scope of the regulated utility.

4.2.3.1 The Current Framework

The Retail Settlement Code (RSC) provides consumers and their agents (e.g. retailers) with access to all data from the meter provided that the customer gives consent in the case of retailer access. Interval data (i.e. billing quality data) processed by distributors can be provided to retailers by means of the Electronic Business Transactions (EBT) system , however the provision of smart meter data is currently not permitted under the RSC. This prohibition was included in the RSC to allow for the transition to smart meters and the MDM/R. Any consumer has the right to access the "raw data" produced by the meter attached to their location and to assign this right to third parties as long as the customer compensates the LDC for any costs incurred to enable such access, specifically any additional communication or meter costs. Such "raw data" is as near to real-time as it is possible to provide. The DSC allows consumers to request that LDCs install meters with advanced capabilities at the consumer's expense (i.e. four-quadrant interval meters).

The involvement of distributors in BTM is currently a "grey area" with regard to the role of distributors. While distributors are *de facto* involved in CDM programs that are of a BTM nature the broader consideration of which BTM activities should be treated as competitive and which part of the regulated monopoly service has not yet been considered by the Board. This is addressed further in section 4.2.4.

4.2.3.2 Current Constraints

A constraint of the current smart meter situation in Ontario is that most smart meters do not have the built-in capabilities (e.g. wireless communication with appliances) for most BTM services and where they do have the capabilities they vary across meter type. Under Measurement Canada (MC) rules upgrades to meters require the meter to be removed, recalibrated and replaced. This constraint, along with the existence of multiple types of Advanced Metering Infrastructure (AMI) in Ontario, creates potential additional costs for BTM service vendors since gateways and/or devices have to be designed to accommodate multiple sets of communications protocols. This raises the inter-related issues of the Board's roles in relation to interoperability standards and the appropriate demarcation point for the scope of the Board's regulation of BTM services. These issues are discussed in 4.2.4. and 4.2.8, respectively, below.

For services that provide displays of cost estimates it is important to realize that in Ontario at present it is not possible to reconcile continuous displays of cost with billing data. The main reason for this is that the Global Adjustment (GA) portion of the cost cannot be derived on a real time basis as it is a function of monthly costs. For most residential and low-volume consumers these costs are captured in the Regulated Price Plan (RPP) rates which are either determined on the distributors billing cycle or by three TOU price periods. For consumers served by retailers or paying the spot price for electricity, the exact value of the GA applicable to "real-time" consumption cannot be known until the end of the billing month.

In addition, there is always some portion of bills that requires administrative adjustments. The following considerations also apply.

Most of the line items on the bills of Ontario consumers, representing more than 50% of total costs, are time invariant, i.e. distribution and transmission charges. While algorithms may be created to multiply the unit charges by continuous meter data, as already noted, these costs can never be fully reconciled with the billed quantity. The charges for which the bill determinant is the measured monthly peak demand (kW) or reactive power (kVa) can only be determined at the end of each billing period.

4.2.3.3 Options

Broad options for BTM services

Notwithstanding the current constraints discussed above, SGWG members expressed the view that Board needs to take a longer term perspective in setting guiding principles for smart grid development. The main issue raised by the discussion of options below is the importance of billing-quality data in meeting customer expectations with respect to innovative BTM services.

A. Maintain the current framework

Under the current framework the main limitations on the development of BTM services are created by the existing deployment of smart meters. As discussed above and further below in section 4.2.8, this constraint imposes costs on vendors of BTM products which could be lowered by the Board's intervention in the area of interoperability standards. The restrictions currently in place concern access to interval billing data. Currently only licensed retailers may access customers' billing data with the consent of the customer and this data is restricted to existing billing cycles. Retailers authorized by customers that are now billed on interval data may receive hourly usage data. All other customers do not receive hourly data, until such time as the Board amends the RSC to make smart meter data available. Where billing-quality data is

not required the only regulatory restriction on providers of BTM services is that of customer consent to the provision of data. Another option within the current framework is to allow access to the MDM/R data. This data, of course, is not “near real-time” (it is provided the next day) but is of billing quality. However one issue that would have to be addressed is the lack of consumer identifiers with meter data held by the MDM/R. Prior to this approach being adopted system changes would be required to attach a consumer identification to the meter data.

B. Modify the current framework

Two potential modifications to the current framework suggest themselves: the extension of the RSC provisions on billing data to all interval data; and, the extension of the RSC provisions on billing data to other third parties.

The Board has indicated that it intends to initiate a proceeding on the first issue once TOU prices are fully implemented. (EB-2008-0297)

As a practical matter, the extension of the RSC provisions on billing quality data to third parties other than retailers would entail such third parties using the EBT system. Since the costs of meeting EBT Standards are undoubtedly greater than the licensing costs of becoming a retailer, the requirement to become a retailer does not represent a significant financial barrier for organizations that may want to offer BTM services. However, there may be economies from the “leverage” of an existing system for the exchange of data. While billing quality data is clearly not needed for third parties with whom no settlement for electricity costs is required there may be an

advantage to the use of this data for other purposes (e.g. customer display and control of loads).

3. What is the level, if any, of BTM services should the consumer expect from distributors? Should third parties other than retailers be allowed to provide BTM services? What minimum level of functionality should distributors provide for BTM applications that use distributor meter data?

4.2.4 Key Issue No. 4: What is the appropriate demarcation point for the development of smart grid by distributors and transmitters? Should the Board's guidance deal with "behind the meter" smart grid solutions?

As discussed in 4.2.3, above, the demarcation point between activities that fall within the regulated monopoly rate base and competitive activities has not been addressed by the Board. Advice from the SGWG on this matter varied considerably. One view is that the meter is the appropriate demarcation point with regard to cost recovery, access and data. Other views suggest that no demarcation point is needed and a flexible approach with different points for different purposes (e.g. regulatory, such as cost recovery versus data access or functional, e.g. reliability or power quality versus BTM services) would be appropriate.

While there are OPA-approved CDM programs that involve distributor activities "behind the meter" such as PeakSaver and demand response (DR) the question remains whether distributors should become involved in other BTM services.

Tradeoff between greater interoperability and cost

There is a current perceived need to provide for a greater degree of interoperability between existing meters and a variety of BTM products. This need has to be balanced against the costs that may be incurred in order to facilitate the development of the BTM market. For example, if the Board were to require a specific communications protocol for BTM (such as Zigbee) or even a broader standards-based functionality this would require the replacement or modification of over four million meters. By setting a demarcation point at the meter the Board would preclude any need for replacement but it could also preclude the potential benefits of a more widespread public uptake of BTM services.

4. What are the most appropriate considerations in setting a demarcation point or points? Should the Board set one demarcation point for all purposes or different points for different purposes? What should the point(s) be?

4.2.5 Key Issue No.5: How should the Board address cyber-security and privacy in the context of the smart grid

From the SGWG consultations staff learned that while cyber-security and privacy considerations have always been treated as critical aspects of distribution and transmission services the smart grid adds a new level of criticality to the need to provide cyber-security and privacy protection. Threats to privacy and to the security of distribution and transmission grids are unfortunately very real. Nevertheless there are methods for providing protection and for the recovery of breaches when they do occur. As a generalization, the opportunities for security and /or privacy breaches increase as the means of access to data increase. Since many of the anticipated benefits of a smart grid flow from greatly increased data access, vigilance in matters of security and privacy

should be viewed as an intrinsic part of the "utility business" in much the same way that environmental considerations have become an intrinsic aspect of utility operations over the past 30 years.

There are three ways to ensure that cyber-security and privacy standards are met: (a) make such requirements part of the approval of smart grid plans; (b) make privacy and security conditions of licence either by licence amendments or code requirements; or, (c) a combination of both, applicable to different circumstances. Distributor and transmitter licences have always included privacy conditions so the issue, going forward, is whether and how to supplement these conditions. For example the DSC could be amended to supplement the existing privacy provisions and to add security provisions for AMI. In addition, there could be a requirement for smart grid plans to ensure adequate security and privacy for HANs.

These are areas in which benefits may be derived from the co-ordination of efforts among licensed entities, much in the same way that some LDCs already co-ordinate cyber-security audits.

As to the form of certification, licensees could, for example, self-certify to the standards of the Ontario Privacy Commissioner's Privacy by Design (PbD) framework and to the NISTIR 7628 Guidelines for Smart Grid Cyber Security. Complicating this is the issue that international security standards may play. It is clear that the connection of Ontario's grid to the United States may bring with it demanding security standards which may differ from or go beyond those adopted within Ontario.

5. Which model is preferred: (a) privacy and cyber-security requirements as part of the approval of smart grid plans; (b) privacy and security as conditions of licence either by licence amendments or code requirements; or, (c) a combination of both?
6. What guidance should the Board provide regarding evidence of co-ordination?

4.2.6 Key Issue No.6: What type of smart grid investments ensure that systems are flexible in order to be able to respond to future developments

Future flexibility will be best preserved by investments in technologies that serve clearly-defined consumer needs and/or generate net benefits in terms of operational efficiencies. This may be tested by the Board in the course of plan review and/or hearing of rate applications without the explicit requirement for future flexibility in the Board's legislative framework. In addition, technologies that are easily scalable should be encouraged. While this is relatively easy to achieve for Information Technology (IT) (because the main determinant of scalability is software) this may be more difficult for engineered power systems (which require investments in physical hardware). The SGWG members generally endorsed the idea that "future proofing" is best achieved by a judicious combination of sound business plans and sensitivity to the need to preserve flexibility to allow innovative solutions to emerge.

In order to make these judgments licensees will need to have the capability to stay abreast of technological developments. This may be an opportunity for co-ordination among licencees. The Minister's Directive emphasizes the importance of regional co-ordination and planning in the development of plans.

7. What evidence should the Board require in COS and/or GEA plans that future flexibility has been addressed ?
8. What guidance, if any, should the Board provide regarding cost recovery of technology monitoring and forecasting?
9. Are the existing *DS Filing Requirements* clear enough with respect to these kinds of activities?

4.2.7 Key Issue No.7: What level of detail should distributors be required to provide in support of an economic case for their proposals

While the ultimate level of detail that will be needed to support applications to the Board is more appropriately determined when the choice of options regarding the definition of smart grid, discussed in section 4.2.1, is made, some general observations may be helpful to evaluate the options discussed in this paper. The current requirements are set out in the *Accounting Procedures Handbook*, the *Filing Requirements for Transmission and Distribution Applications* and in the *DS Filing Requirements*. An issue to be determined is whether the same level of materiality should be applied to applications involving smart grid investments as has been traditionally the case in other applications before the Board. The SGWG emphasized a need to strike a balance between providing the Board providing enough guidance to give licensees the certainty needed to develop their business plans while avoiding being too prescriptive. While the diversity of Ontario's distributors is a factor that touches upon all smart grid issues, it is especially pertinent in relation to this issue. SGWG members noted that many smart grid considerations vary a great deal from small to large distributors. When the Board ultimately issues its Report providing guidance with respect to the development and implementation of

smart grid the relevant level of detail that is suitable for all applicants will be an important question. It can also be the case that monetary materiality may not be the only materiality to be considered. In some cases relatively modest expenditures can have far-reaching implications.

10. What level of materiality should be applied to applications involving smart grid investments? Should materiality be measured in financial terms alone or are other considerations relevant?

4.2.8 Key Issue No. 8: What roles should Ontario utilities and the Board play, respectively, in relation to international efforts to establish smart grid standards?

Staff is aware of major international projects to set the relevant smart grid standards. Appendix 4 provides an overview of smart grid standards development. Should these processes be allowed to run their course and the resulting standards be incorporated into good utility practice? In general, getting ahead of international standards-setting processes entails considerable risks. Ontario is a small market relative to the international electrical equipment and services industries. Equipment manufactured to small-market specifications is always likely to be more costly than equipment designed for larger markets.

As discussed in 4.2.3.2 and 4.2.4 above, in the area of BTM services there is evidence that the main constraint that vendors of BTM services face in Ontario is the nature of the existing meter stock. Were the Board to accept a role beyond the meter with regard to interoperability standards (see above) and to prescribe specific protocols or a standard this could facilitate the development

of this market. Since such an action would incur new costs how should the Board determine the appropriate course of action?

A consensus of SGWG members indicated strongly that the Board should avoid overly-prescriptive requirements in relation to smart grid technology especially IT technology. The Board should strive to specify the “what” not the “how”. In approving any expenditures however, the Board would need to be confident that the subject technology is robust and not subject to early obsolescence.

12. How should the Board take cognizance of international standards processes?

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Appendix 1: Summary of Issues for Comment

Issue	For Comment
Key Issue No. 1	1. Staff invites comments from stakeholders on which model is preferred: (A) the smart grid is an evolution of the modernization of the grid or, (B) it is a collection of distinct technologies that are separate from the "traditional" grid?
Key Issue No. 2	Does Board staff's classification of benefits appropriately capture all of the benefits of the smart grid?
Key Issue No. 3	What is the level, if any, of BTM services should the consumer expect from distributors? Should third parties other than retailers be allowed to provide BTM services? What minimum level of functionality should distributors provide for BTM applications that use distributor meter data?
Key Issue No. 4	4. What are the most appropriate considerations in setting a demarcation point or points? Should the Board set one demarcation point for all purposes or different points for different purposes? What should the point(s) be?
Key Issue No.5	5. Which model is preferred: (a) privacy and cyber-security requirements as part of the approval of smart grid plans; (b) privacy and security as conditions of licence either by licence amendments or code requirements; or, (c) a combination of both? 6. What guidance should the Board provide regarding evidence of co-ordination?
Key Issue No.6	7. What evidence should the Board require in COS and/or GEA plans that future flexibility has been addressed ? 8. What guidance, if any, should the Board provide regarding cost recovery of technology monitoring and forecasting? 9. Are the existing *DS Filing Requirements* clear enough with respect to these kinds of activities?
Key Issue No.7	10. What level of materiality should be applied to applications involving smart grid investments?
Key Issue No. 8	12. How should the Board take cognizance of international standards processes?

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Appendix 2: Summary of Questions on Minister's Directive's Objectives

Policy Objectives	Smart Grid Objectives: Customer control – Access	Customer control – Visibility	Customer control – Control	Customer control – Participation in Ren. Gen	Customer control – Customer Choice	Customer control – Education	System Flexibility – Renewable DG	System Flexibility – Visibility	System Flexibility – Control & Automation	System Flexibility – Quality	Adaptive Infrastructure – Flexibility	Adaptive Infrastructure – Forward compatibility	Adaptive Infrastructure – Encourage Innovation	Adaptive Infrastructure – Pulse on innovation
Efficiency	What type of access best serves customer control and efficiency?	How may visibility contribute to control and efficiency?	How may control contribute to efficiency?	How may renewable generation contribute to control and efficiency?	How may customer choice contribute to control and efficiency?	How may education contribute to control and efficiency?	How may renewable DG assist flexibility and efficiency?	How may system visibility assist flexibility and efficiency?	How may increased control and automation assist flexibility and efficiency?	How may maintained or enhanced power quality be balanced with	How may increased flexibility be balanced with efficiency?	How can forward compatibility also serve efficiency?	How can innovation serve efficiency?	How can utilities monitor innovation while serving efficiency?
Customer Value	What type of access best serves customer control and value?	How may visibility contribute to customer control and value?	How may customer control create value?	How may participation in renewable generation create value?	How may customer choice contribute to customer control and value?	How may education contribute to customer control and value?	How may renewable DG contribute to customer control and value?	How may system visibility create customer value?	How may control and automation create customer value?	How may power quality and customer value be optimised?	How may increased flexibility be balanced with customer value?	How can forward compatibility also serve customer value?	How can innovation serve customer value?	How can utilities monitor innovation while serving customer value?
Co-ordination	What type of co-ordination best serves customer access and control?	What type of co-ordination best serves customer visibility and control?	How may co-ordination help control?	What type of co-ordination best serves participation in renewable generation?	What type of co-ordination best serves customer control and choice?	How may co-ordination help education about control?	How may co-ordination help integrate renewable DG?	How may co-ordination help system visibility?	How may co-ordination help control and automation?	How may co-ordination help power quality?	How may co-ordination help flexibility?	How may co-ordination help forward compatibility?	How may co-ordination help forward to encourage innovation?	How may co-ordination help to keep the pulse on innovation?
Interoperability	How best to ensure inter-operability for customer access?	How best to ensure inter-operability for customer visibility?	How best to ensure inter-operability for customer control?	How best to ensure inter-operability for participation in renewable generation?	How best to ensure inter-operability for customer choice?	How to ensure education for interoperability and control?	How best to ensure inter-operability for renewable DG?	How best to ensure inter-operability for system visibility?	How best to ensure inter-operability for control and automation?	How best to ensure that inter-operability aids power quality?	How may interoperability help flexibility?	How may interoperability help forward compatibility?	How may interoperability encourage innovation?	How best to keep the pulse on innovation and interoperability?
Security	How best to ensure security with greater customer access?	How best to ensure security with greater customer visibility?	How best to ensure security with greater customer control?	How best to ensure security with greater participation in renewables?	How best to ensure security with greater customer choice?	How to ensure education for security?	How best to ensure security and flexible renewable DG?	How best to ensure security with increased system visibility?	How best to ensure security with increased control and automation?	How best to ensure security and power quality are maintained?	How best to ensure security with flexibility?	How best to ensure security with forward compatibility?	How best to encourage innovation and maintain security?	How to monitor innovation and maintain security?
Privacy	How best to ensure privacy with greater customer access?	How best to ensure privacy with greater customer visibility?	How best to ensure privacy with greater customer control?	How best to ensure privacy with greater participation in renewables?	How best to ensure privacy with greater customer choice?	How to ensure education for privacy?	How best to ensure privacy and flexible renewable DG?	How best to ensure privacy with increased system visibility?	How best to ensure privacy with increased control and automation?	How best to ensure privacy and power quality are maintained?	How best to ensure privacy and flexibility?	How best to ensure privacy with forward compatibility?	How best to encourage innovation and maintain privacy?	How to monitor innovation and maintain privacy?
Safety	How best to ensure safety with greater customer access?	How best to ensure safety with greater customer visibility?	How best to ensure safety with greater customer control?	How best to ensure safety with greater participation in renewables?	How best to ensure safety with greater customer choice?	How to ensure education for safety?	How best to ensure safety and flexible renewable DG?	How best to ensure safety with increased system visibility?	How best to ensure safety with increased control and automation?	How best to ensure safety and power quality are maintained?	How best to ensure safety and flexibility?	How best to ensure safety with forward compatibility?	How best to encourage innovation and maintain safety?	How to monitor innovation and maintain safety?
Economic Development	How best to create economic development from greater customer access?	How best to create economic development from greater customer visibility?	How best to create economic development from greater customer	How best to create economic development from participation in renewable generation?	How best to create economic development from greater customer choice?	How to best use education to aid economic development?	How best to create economic development from renewable DG?	How best to create economic development from system visibility?	How best to create economic development from control and automation?	How to create economic development and maintain power quality?	How to create economic development and flexibility?	How to create economic development and forward compatbility?	How to create economic development through innovation?	How to maintain economic development through innovation?
Environmental Benefits	How best to create environmental benefits from greater customer access?	How best to create environmental benefits from greater customer visibility?	How best to create environmental benefits from greater customer control?	How best to create environmental benefits from participation in renewable generation?	How best to create environmental benefits from more customer choice?	How to best use education to realise environmental benefits?	How best to create environmental benefits from renewable DG?	How best to create environmental benefits from system visibility?	How best to create environmental benefits from control and automation?	How best to create environmental benefits and power quality?	How best to create environmental benefits and flexibility?	How to create environmental benefits and forward compatibility?	How to create environmental benefits from innovation?	How to maintain environmental benefits from innovation?
Reliability	How to assure reliability and greater customer access?	How to assure reliability and greater customer visibility?	How to assure reliability and greater customer control?	How to assure reliability and greater participation in renewable generation?	How to assure reliability and greater customer choice?	How to ensure education for reliability?	How to assure reliability and more renewable DG?	How may visibility and reliability best complement each other?	How may control and automation and reliability best complement each other?	How may power quality and reliability best complement each other?	How may flexibility and reliability best complement each other?	How may forward compatibility and reliability best complement each other?	How may innovation and reliability best complement each other?	How may innovation and reliability best complement each other?

Appendix 3 Summary of Options to meet Objectives

	Conduct Regulation		***COS Regulation***		
	Code amendment	***Licence amendment***	***Separate Rates***	***Plan Review***	***Integrated Rates***
Policy					
Efficiency			✔		✔
Customer Value			✔		✔
Co-ordination	✔			✔	
Safety	✔	✔		✔	
Privacy	✔	✔		✔	
Security	✔	✔		✔	
Interoperability	✔	✔		✔	
Economic Development				✔	
Environmental Benefits			✔	✔	✔
Reliability				✔	
Customer Control					
Access	✔	✔		✔	
Visibility	✔	✔		✔	
Control	✔	✔		✔	
Participation in renewable generation	✔			✔	
Customer Choice	✔	✔		✔	
Education		✔		✔	
Visibility to consumer	✔			✔	
Power System Flexibility					
Distributed renewable generation	✔		✔	✔	✔
Distribution system visibility			✔	✔	✔
Control and automation			✔	✔	✔
Quality	✔		✔	✔	✔
Adaptive Infrastructure					
Forward compatibility				✔	
Flexibility				✔	
Encourage innovation				✔	
Maintain pulse on innovation				✔	

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Appendix 4 Overview of Smart Grid Standards Development

International

In 2009 by the International Electrotechnical Commission (IEC) Standardisation Management Board established SG 3, a working group tasked with providing advice on potential new international standards and assisting in the coordination of updating existing standards related to smart grid. In June 2010 the group released a Smart Grid Roadmap which covers standards for interoperability, transmission, distribution, metering, connecting consumers and cyber security. The IEC through SG 3 is working in close collaboration with smart grid initiatives around the globe, including NIST's standards development efforts in the US.

Canada

In collaboration with the Standards Council of Canada and other partners, the Standards Council of Canada established a national Smart Grid Technology and Standards Task Force. The task force aims to identify smart grid standards needs for Canada and to ensure that those needs are reflected in the IEC's initiatives. The task force has been charged with producing a road map to provide recommendations regarding gaps or conflict between various global standards initiatives including NIST's standards development, which the task force has been monitoring closely.

United States

Under the Energy Independence and Security Act 2007 (EISA) NIST was mandated to adopt interoperability standards through consensus among various stakeholders. EISA directs FERC to then approve and implement these standards. When FERC implements them the standards will apply to inter-state transmission and Regional Transmission Organizations (RTO's) which fall under FERC's jurisdiction.[i] However, it is likely that many states will adopt these standards as well.

FERC is currently reviewing the first five 'families' of standards posted by NIST to determine if they should be made subject to a FERC rulemaking proceeding. During the review process two main issues have emerged. First, stakeholders are concerned with the implications of FERC 'adopting' a standard. Would compliance with standards adopted by FERC be voluntary or mandatory? If voluntary, there is a risk that standards will not be applied uniformly across the industry at the expense of system security and reliability. If mandatory, there is a risk that standards 'frozen' in time in regulations will hinder technological evolution or that market participants will become more concerned with compliance than true interoperability or security. The second issue relates to whether there was true consensus around these standards.

NIST released Version 1.0 of the Framework and Roadmap for Smart Grid Interoperability Standards in January 2010. The Roadmap includes a high level conceptual architecture for smart grid; 26 'adopted' standards and an additional 51 existing standards for consideration; as well as plans for addressing 'priority standards gaps'. In August 2010 NIST released version 1.0 of NISTIR 7628 Guidelines for Smart Grid Cyber Security. Volume one of the report assists users in identifying high-level security requirements; volume two focuses on privacy issues within personal dwellings; and volume three is a compilation of supporting analysis and references used to develop the high-level security requirements presented in the first two volumes. Both documents are meant to guide users (such as utilities) in deploying a secure, interoperable grid. As such, one of tasks going forward will be to educate users on how to navigate and utilize these large, dense reports.

The Smart Grid Interoperability Panel (SGIP) is responsible both for facilitating the development of further standards as needed and developing a standards testing and certification plan. The Panel is composed of 370 organizations covering 22 stakeholder categories. An SGIP Governing Board was established with one representative for each stakeholder category.

Europe

Since March 2009 the European Commission has issued multiple mandates to the European standardisation organisations CEN, CENELEC and ETSI (ESOs) regarding

smart grid. The first is to establish standards for the interoperability of smart utility meters (electricity, gas, water and heat). The second mandate is to review existing standards and develop new standards so that a European harmonised approach could be adopted for the interoperability of chargers for electric vehicles with all types of electric vehicles and with electricity supply points. Lastly, in March 2011, the Commission issued a mandate to develop standards facilitating the implementation of high-level smart grid services and functionalities by the end of 2012. The Commission is monitoring standards development closely and will intervene to ensure that the deadline is met and the necessary standards are set if necessary.

CEN, CENELEC, and ETSI are charged with developing a framework to enable European standardisation Organisations to perform continuous standard enhancement and development in the field of smart grid. The expected framework will consist of the following deliverables:

A technical reference architecture, which will represent the functional information data flows between the main domains and integrate many systems and subsystems architectures.

A set of consistent standards, which will support the information exchange (communication protocols and data models) and the integration of all users into the electric system operation.

Sustainable standardization processes and collaborative tools to enable stakeholder interactions, to improve the two above and adapt them to new requirements based on gap analysis, while ensuring the fit to high level system constraints such as interoperability, security, and privacy, etc.[ii]

Australia

Standards Australia formed an Australian Reference Group on Smart Grid to assist in providing Australian input to the IEC's SG 3. In conjunction with the nominated Australian representative, Standards Australia's Reference Group on Smart Grid is responsible for providing input and strategic direction to SG3 on behalf of Australian

stakeholders. This is to ensure new areas of activities relating to standards will take into consideration Australian requirements where possible. The Reference Group is also expected to collaborate closely with the Commonwealth Government's Smart Grid Initiative and Standards Working Group.

Appendix 5: Minister's Directive

Ontario
Executive Council
Conseil des ministres

Order in Council
Décret

On the recommendation of the undersigned, the Lieutenant Governor, by and with the advice and concurrence of the Executive Council, orders that:

Sur la recommandation du soussigné, le lieutenant-gouverneur, sur l'avis et avec le consentement du Conseil des ministres, décrète ce qui suit:

WHEREAS it is desirable that the Province and the Ontario Energy Board move forward together with a plan to implement the advanced information exchange systems and equipment that together comprise the Smart Grid ("Smart Grid"), as defined in the amendments to the *Electricity Act, 1998* made by the *Green Energy and Green Economy Act, 2009*;

AND WHEREAS in furtherance of this goal, it is desirable that the Province provide guidance and direction to the Board as to the principles and objectives which must be met in order to fully achieve the Province's objectives related to the Smart Grid in a cost-efficient manner;

AND WHEREAS the Minister of Energy has the authority, with the approval of the Lieutenant Governor in Council, to issue Directives pursuant to section 28.5 of the *Ontario Energy Board Act, 1998*, as amended by the *Green Energy and Green Economy Act, 2009,* in relation to the establishment, implementation or promotion of a Smart Grid for Ontario;

NOW THEREFORE the Directive attached hereto, is approved.

Recommended: _____
Minister of Energy

Concurred: _____
Chair of Cabinet

Approved and Ordered: NOV 2 3 2010
Date

_____
Administrator of the Government

O.C./Décret 1515/2010

MINISTER'S DIRECTIVE

TO: THE ONTARIO ENERGY BOARD

I, Brad Duguid, Minister of Energy, hereby direct the Ontario Energy Board pursuant to section 28.5 of the *Ontario Energy Board Act, 1998* (the "Act"), as described below.

The Board shall take the following steps in relation to the establishment, implementation and promotion of a smart grid:

1. The Board shall provide guidance to licensed electricity distributors and transmitters, and other regulated entities whose fees and expenditures are reviewed by the Board, that propose to undertake smart grid activities, regarding the Board's expectations in relation to such activities in support of the establishment and implementation of a smart grid.

2. For licensed distributors and transmitters, the guidance referred to in paragraph 1 shall be provided in particular to: (a) guide these regulated entities in the preparation of plans for the development and implementation of the smart grid, as contemplated in subparagraph 70(2.1)2(ii) of the Act ("Smart Grid Plans"); and (b) identify the criteria that the Board will use to evaluate Smart Grid Plans.

3. In developing the guidance referred to in paragraph 1, and in evaluating the Smart Grid Plans and activities undertaken by the regulated entities referred to in that paragraph, the Board shall be guided by, and adopt where appropriate, the parameters for the three objectives of a smart grid referred to in subsection 2(1.3) of the definition for "smart grid" as provided for under the *Electricity Act, 1998*, where such elements of said objectives are set out in Appendices A through C.

4. Further, in developing the guidance referred to in paragraph 1 and in evaluating the smart grid activities of the regulated entities referred to in that paragraph, the Board shall be guided by the following policy objectives of the government:

    (i) *Efficiency***:** Improve efficiency of grid operation, taking into account the cost-effectiveness of the electricity system.

    (ii) *Customer value:* The smart grid should provide benefits to electricity customers.

    (iii) *Co-ordination*: The smart grid implementation efforts should be coordinated by, among other means, establishing regionally

coordinated Smart Grid Plans ("Regional Smart Grid Plans"), including coordinating smart grid activities amongst appropriate groupings of distributors, requiring distributors to share information and results of pilot projects, and engaging in common procurements to achieve economies of scale and scope.

(iv) *Interoperability:* Adopt recognized industry standards that support the exchange of meaningful and actionable information between and among smart grid systems and enable common protocols for operation. Where no standards exist, support the development of new recognized standards through coordinated means.

(v) *Security:* Cybersecurity and physical security should be provided to protect data, access points, and the overall electricity grid from unauthorized access and malicious attacks.

(vi) *Privacy:* Respect and protect the privacy of customers. Integrate privacy requirements into smart grid planning and design from an early stage, including the completion of privacy impact assessments.

(vii) *Safety:* Maintain, and in no way compromise, health and safety protections and improve electrical safety wherever practical.

(viii) *Economic Development:* Encourage economic growth and job creation within the province of Ontario. Actively encourage the development and adoption of smart grid products, services, and innovative solutions from Ontario-based sources.

(ix) *Environmental Benefits:* Promote the integration of clean technologies, conservation, and more efficient use of existing technologies.

(x) *Reliability***:** Maintain reliability of the electricity grid and improve it wherever practical, including reducing the impact, frequency and duration of outages.

The Board may consider such other factors as are relevant in the circumstances.

5. In furtherance of the government's policy objective as described in item (iii) of paragraph 4 above, the Board shall undertake a consultation process with licensed electricity distributors and other relevant stakeholders for the purpose of developing a regional or otherwise coordinated approach to the planning and implementation of smart grid activities by licensed electricity distributors that promotes coordination

amongst them having regard to, among other things, cost-effective outcomes.

6. Nothing in paragraph 5 shall be construed as limiting the ability of licensed electricity distributors to engage in smart grid activities or the authority or discretion of the Board in exercising its responsibilities in relation to the smart grid activities of licensed electricity distributors pending the development of the regional or coordinated approach referred to in that paragraph.

APPENDIX “A”

CUSTOMER CONTROL OBJECTIVES

For the purpose of providing the customer with increased information and tools to promote conservation of electricity, which will “expand opportunities to provide demand response, price information and load control to electricity customers”, in accordance with subsection 2(1.3)(b) of the Electricity Act, the following objectives apply:

- **ACCESS:** Enable access to data by customer authorized parties who can provide customer value and enhance a customer’s ability to manage consumption and home energy systems.

- **VISIBILITY:** Improve visibility of information, to and by customers, which can benefit the customer and the electricity system, such as electricity consumption, generation characteristics, and commodity price.

- **CONTROL:** Enable consumers to better control their consumption of electricity in order to facilitate active, simple, and consumer-friendly participation in conservation and load management.

- **PARTICIPATION IN RENEWABLE GENERATION:** Provide consumers with opportunities to provide services back to the electricity grid such as small-scale renewable generation and storage.

- **CUSTOMER CHOICE:** Enable improved channels through which customers can interact with electricity service providers, and enable more customer choice.

- **EDUCATION:** Actively educate consumers about opportunities for their involvement in generation and conservation associated with a smarter grid, and present customers with easily understood material that explains how to increase their participation in the smart grid and the benefits thereof.

APPENDIX “B”

POWER SYSTEM FLEXIBILITY OBJECTIVES

For the purpose of “enabling the increased use of renewable energy sources and technology, including generation facilities connected to the distribution system,” , in accordance with subsection 2(1.3)(a) of the Electricity Act, and recognizing the need for flexibility on the integrated power system, the following objectives apply:

- **DISTRIBUTED RENEWABLE GENERATION:** Enable a flexible distribution system infrastructure that promotes increased levels of distributed renewable generation.

- **VISIBILITY:** Improve network visibility of grid conditions for grid operations where a demonstrated need exists or will exist, including the siting and operating of distributed renewable generation.

- **CONTROL AND AUTOMATION:** Enable improved control and automation on the electricity grid where needed to promote distributed renewable generation. To the extent practical, move toward distribution automation such as a self-healing and self-correcting grid infrastructure to automatically anticipate and respond to system disturbances for faster restoration.

- **QUALITY:** Maintain the quality of power delivered by the grid, and improve it wherever practical.

APPENDIX "C"

ADAPTIVE INFRASTRUCTURE OBJECTIVES

For the purpose of "accommodating the use of emerging, innovative and energy-saving technologies and system control applications," in accordance with subsection 2(1.3)(c) of the Electricity Act, the following objectives apply:

- **FLEXIBILITY:** Provide flexibility within smart grid implementation to support future innovative applications, such as electric vehicles and energy storage.

- **FORWARD COMPATIBILITY:** Protect against technology lock-in to minimize stranded assets and investments and incorporate principles of modularity, scalability and extensibility into smart grid planning.

- **ENCOURAGE INNOVATION:** Nest within smart grid infrastructure planning and development the ability to adapt to and actively encourage innovation in technologies, energy services and investment / business models.

- **MAINTAIN PULSE ON INNOVATION:** Encourage information sharing, relating to innovation and the smart grid, and ensure Ontario is aware of best practices and innovations in Canada and around the world.

Endnotes

[1] For example, Bonbright, James C., *Principles of Public Utility Rates*, Columbia University Press, 1966 which, *inter alia*, identifies the central role of an economic regulator, like the OEB, as attempting to create as close to a market result as possible in sectors in which competitive markets do not exist usually because of the existence of a "natural" monopoly. In competitive markets, **prices** provide the signals to buyers and sellers to equate benefits (the value of the goods received) and (production) costs.

[2] This applies to the **approved** rates which set the revenue requirement to equal exactly costs. The actual revenues are almost always different, just as the allowed Return on Equity is almost always different from the allowed return.