KITCHENER-WATERLOO-CAMBRIDGE-GUELPH REGION INTEGRATED REGIONAL RESOURCE PLAN

April 28, 2015

ieso
Independent Electricity System Operator

Integrated Regional Resource Plan

Kitchener-Waterloo-Cambridge-Guelph

This Integrated Regional Resource Plan ("IRRP") was prepared by the IESO pursuant to the terms of its Ontario Energy Board licence, EI-2013-0066.

This IRRP was prepared on behalf of the KWCG Region Working Group, which included the following members:

- Independent Electricity System Operator
- Kitchener-Wilmot Hydro Inc.
- Waterloo North Hydro Inc.
- Cambridge & North Dumfries Hydro Inc.
- Guelph Hydro Electric Systems Inc.
- Hydro One Networks Inc. (Distribution) and
- Hydro One Networks Inc. (Transmission)

The KWCG Region Working Group assessed the adequacy of electricity supply to customers in the KWCG Region over a 20-year period; developed a flexible, comprehensive, integrated plan that considers opportunities for coordination in anticipation of potential demand growth scenarios and varying supply conditions in the KWCG Region; and developed an implementation plan for the recommended options, while maintaining flexibility in order to accommodate changes in key assumptions over time.

KWCG Region Working Group members agree with the IRRP's recommendations and support implementation of the plan through the recommended actions. KWCG Region Working Group members do not commit to any capital expenditures and must still obtain all necessary regulatory and other approvals to implement recommended actions.

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List of Abbreviations

Abbreviation	Description
BCP	Brant County Power
C&S	Codes and Standards
CDM	Conservation Demand Management
CEP	Community Energy Plan
CHP	Combined Heat and Power
CHPSOP	Combined Heat and Power Standard Offer Program
DG	Distributed Generation
DR	Demand Response
ECO	(Region of Waterloo's) Energy Conservation Office
EV	Electric Vehicle
EE	Energy Efficiency
FIT	Feed-in Tariff
GATR	Guelph Area Transmission Refurbishment
GS	Generating Station
GHG	Greenhouse Gases
GDP	Gross Domestic Product
IESO	Independent Electricity System Operator
IPSP	(2007) Integrated Power System Plan
IRRP	Integrated Regional Resource Plan
KWCG Region or Region	Kitchener, Waterloo, Cambridge and Guelph
kV	Kilovolt
LAC	Local Advisory Committee
LRT	Light Rail Transit
LMC	Load Meeting Capability
LDC	Local Distribution Company
LED	Light Emitting Diode
LTEP	(2013) Long-Term Energy Plan
MW	Megawatt
MEP/CEP	Municipal or Community Energy Plan
MTS	Municipal Transformer Station
NERC	North American Electric Reliability Corporation
NPCC	Northeast Power Coordinating Council
OEB or Board	Ontario Energy Board
OPA	Ontario Power Authority
ORTAC	Ontario Resource and Transmission Assessment Criteria
PPWG	Planning Process Working Group

Abbreviation	Description
PV	Photovoltaic
RIP	Regional Infrastructure Plan
SCADA	Supervisory Control and Data Acquisition
SS	Switching Station
TWh	Terawatt Hour(s)
TOR	Terms of Reference
TOU	Time-of-Use
TS	Transformer Station
Working Group	Technical Working Group of the KWCG Region

1. Introduction

This report outlines the Integrated Regional Resource Plan ("IRRP") for the Kitchener, Waterloo, Cambridge and Guelph ("KWCG") Region (together "KWCG Region" or "Region") over the next 20 years. This report was prepared by the IESO on behalf of a technical Working Group composed of Kitchener-Wilmot Hydro, Waterloo North Hydro, Guelph Hydro Electric Systems Inc., Hydro One Distribution, Cambridge and North Dumfries Hydro, and Hydro One Transmission (the "Working Group").

The KWCG Region is located in southwestern Ontario and includes the Region of Waterloo, the City of Guelph, Wellington County and a portion of Oxford County. The population of the region is forecast to significantly grow during the 20-year period (2011-2031) – by roughly 40% – according to the province's "Places to Grow" initiative.[1] This growth will be accompanied by population intensification, the development of regional transit infrastructure, redevelopment of the downtown areas, and the development of commercial and industrial parks. A reliable supply of electricity is essential to supporting community growth. There is therefore a strong need for integrated regional electricity planning to ensure that the electricity system can support the pace of development over the long term.

In Ontario, planning to meet the electrical supply and reliability needs of a large area or region is done through regional electricity planning, a process that was formalized by the Ontario Energy Board ("OEB" or "Board") in 2013. In accordance with the OEB regional planning process, transmitters, distributers and the IESO are required to carry out regional planning activities for the 21 electricity planning regions at least once every five years.

The KWCG Region is one of the 21 electricity planning regions in Ontario as identified through the regional planning process. This IRRP fulfills the requirements for the Region as required by the IESO's OEB licence.

This IRRP for KWCG identifies electricity supply and reliability needs in the near term (0-5 years), medium term (5-10 years) and long term (10-20 years), and sets out specific priorities and investments to meet near- and medium-term needs, respecting the lead time for development. This IRRP also identifies actions to develop long-term options and to facilitate discussions about how the communities may plan their future electricity supply. Since

[1] http://www.placestogrow.ca/

economic, demographic, and technological conditions will inevitably change, IRRPs will be reviewed on a five-year cycle so that plans can be updated to reflect the changing electricity outlook. The KWCG IRRP will be revisited in 2020 or sooner, if significant changes occur relative to the current forecast.

This report is organized as follows:

- A summary of the recommended plan for the Region is provided in Section 2;
- The process and methodology used to develop the plan are discussed in Section 3;
- The context for electricity planning in the Region and the study scope are discussed in Section 4;
- Demand forecast scenarios, and conservation and DG assumptions, are described in Section 5;
- The near- and medium-term plan is presented in Section 6;
- The long-term plan is presented in Section 7;
- A summary of community, aboriginal and stakeholder engagement to date and moving forward in developing this IRRP is provided in Section 8;
- A conclusion is provided in Section 9.

2. The Integrated Regional Resource Plan

The KWCG IRRP addresses the Region's electricity needs over the next 20 years, based on application of the IESO's Ontario Resource and Transmission Assessment Criteria ("ORTAC"). This IRRP identifies the needs that are forecast to arise in the near- and medium-term (0-10 years) and in the long-term (10-20 years). These two planning horizons are distinguished in the IRRP to reflect the level of commitment required to address needs over these time periods. The plans for both timeframes are coordinated to ensure consistency. The IRRP was developed based on consideration of planning criteria, including reliability, cost and feasibility; and, in the near term, it seeks to maximize the use of the existing electricity system, where it is economic to do so.

For the near- and medium-term, the IRRP identifies specific actions and investments for immediate implementation. This ensures that necessary resources are in service in time to address the KWCG Region's more urgent needs.

For the long term, the IRRP identifies potential approaches to meet needs that may arise in 10-20 years. It is not necessary to recommend specific projects at this time (nor would it be prudent given forecast uncertainty and the potential for technological change). Instead, the long-term plan focuses on developing and maintaining the viability of long-term options, engaging with the communities, and gathering information to lay the groundwork for making decisions on future options. These actions are intended to be completed before the next IRRP cycle in 2020 so that their results can inform a decision, should one be needed at that time.

The needs and recommended actions are summarized below.

2.1 Near- and Medium-Term Plan (2014-2023)

Today, the electricity system supplying the KWCG Region is approaching its maximum capacity and has limited ability to minimize potential supply interruptions to customers. The plan to meet the needs of electricity customers in the KWCG Region over the near and medium term was developed based on consideration of planning criteria, including reliability, cost, feasibility, and maximizing the use of the existing electricity system, where it is economic to do so. The near- and medium-term plan was also developed to be consistent with the long-term development of the Region's electricity system.

Recommendations

1. Implement conservation and distributed generation (LDCs/IESO)

The implementation of provincial energy conservation targets established in the 2013 Long-Term Energy Plan ("LTEP") is a key component of the near- and medium-term plan for the KWCG Region. As part of the near- and medium-term plan, peak demand savings from provincial energy conservation targets are estimated to account for 40% of the forecast peak demand growth in the KWCG Region between 2014-2023.

To ensure that these savings materialize, it is recommended that the LDCs' conservation efforts be focused not only on achieving their energy savings targets, but also maximizing peak demand reductions. Monitoring conservation achievements, and measuring peak demand savings, will be important elements of the near- and medium-term plan, and will also lay the foundation for the long-term plan by reviewing performance of specific conservation measures in the KWCG Region, and assessing potential in the KWCG Region for further conservation efforts.

Provincial programs that encourage the development of DG, such as the Feed-in Tariff ("FIT"), and Combined Heat and Power Standard Offer ("CHPSOP") programs, and local interests and opportunities for distributed generation ("DG") development can also contribute to reducing peak demand in the KWCG Region. The LDCs and the IESO will continue their activities to support these initiatives and monitor their impacts.

2. Implement the Guelph Area Transmission Refurbishment (GATR) project (Hydro One)

In 2012, the Working Group recommended proceeding with the implementation of the Guelph Area Transmission Refurbishment ("GATR") project to address imminent supply needs in South-Central Guelph and the Kitchener area and to minimize the impact of potential supply interruptions to customers in Waterloo, Guelph and surrounding areas. This project includes the installation of two 115 kV/230 kV auto-transformers, switching facilities, and the upgrade of an existing transmission line in Guelph. The GATR project was approved by the OEB on September 26, 2013 and is expected to be in service by spring 2016. The project will substantially contribute to meeting near- and medium-term needs in the KWCG Region.

3. Install two circuit switchers at Galt Junction and explore opportunities to further improve restoration capability in the Cambridge area (Hydro One)

To substantially improve load restoration in the Cambridge and Kitchener area following a major transmission outage, the Working Group recommends proceeding with the installation of two 230 kilovolt ("kV") circuit switchers at Galt Junction, near Highway 5. Hydro One has begun early development work on these switching facilities, which are expected to be in-service by spring 2017. Hydro One will continue to examine other potential measures to further improve the restoration capability in the Cambridge area. Please refer to Appendix C for further information regarding load restoration improvements for the Cambridge-Kitchener 230 kV sub-system.

2.2 Long-Term Plan (2024-2033)

There are no major regional supply and reliability needs identified in the KWCG Region beyond 2023, therefore early development work for major infrastructure projects in the KWCG Region is not required at this time. Localized needs, such as transformer station ("TS") capacity needs in the KWCG Region, may arise over the long term under certain growth scenarios, but these potential needs do not require any immediate action. There may be opportunity for communities and local utilities to manage their future electricity demand through the development of community-based solutions. Communities and local utilities in the KWCG Region have become increasingly involved in the development of DG and conservation initiatives. The results of early community-based pilot projects, energy conservation initiatives, and achievable potential studies of the IESO will provide useful information to consider the potential for conservation to address identified needs in the KWCG Region in the next iteration of the plan and the ongoing regional planning process.[2]

Recommendations

1. Undertake community engagement (IESO/LDCs)

In between the 5-year regional planning cycle, the IESO and LDCs will continue to engage with First Nations communities and other stakeholders through community planning, environmental and sustainability initiatives, and broader community outreach such as, informational public open houses.

[2] The IESO's is currently developing an achievable potential study scheduled to be completed by June 1, 2016. This study will provide an updated forecast for conservation potential in Ontario.

2. Monitor demand growth, conservation and demand management (CDM) achievement and distributed generation (IESO)

On an annual basis, the IESO will coordinate a review of conservation and demand management ("CDM" or "conservation") achievement, provincial DG projects, and demand growth in the KWCG Region. This information will be used to track the expected timing of long-term needs to determine when a decision on the long-term plan is required. Information on CDM and DG performance will also provide useful input into the ongoing development of these options as potential long-term solutions.

3. Explore opportunities to coordinate use and development of transformation station facilities in the KWCG Region (LDCs)

Depending on the location, timing and magnitude of electricity demand growth, TS capacity needs may arise in the KWCG Region beyond 2023. LDCs will monitor the load closely to determine the timing of potential transformation needs. Where possible, these LDCs will coordinate use and development of transformation station facilities in the KWCG Region. The need, timing and location of transformer(s) will be confirmed in the next planning cycle.

3. Development of the IRRP

3.1 The Regional Planning Process

In Ontario, planning to meet the electricity needs of customers at a regional level is done through regional planning. Regional planning assesses the interrelated needs of a region - defined by common electricity supply infrastructure over the near, medium and long term, and develops a plan to ensure cost-effective, reliable, electricity supply. Regional plans consider the existing electricity infrastructure in an area, forecast growth and customer reliability, evaluate options for addressing needs, and recommend actions.

Regional planning has been conducted on an as needed basis in Ontario for many years. Most recently, the Ontario Power Authority ("OPA") carried out regional planning activities to address regional electricity supply needs. The OPA conducted joint regional planning studies with distributors, transmitters, the IESO and other stakeholders in regions where a need for coordinated regional planning had been identified.

In 2012, the Ontario Energy Board convened the Planning Process Working Group ("PPWG") to develop a more structured, transparent, and systematic regional planning process. This group was composed of industry stakeholders including electricity agencies, utilities, and stakeholders. In May 2013, the PPWG released its Working Group Report to the Board, setting out the new regional planning process. Twenty-one electricity planning regions in the province were identified in the Working Group Report and a phased schedule for completion was outlined. The Board endorsed the Working Group Report and formalized the process timelines through changes to the Transmission System Code and Distribution System Code in August 2013, as well as through changes to the OPA's licence in October 2013. The OPA licence changes required it to lead a number of aspects of regional planning, including the completion of comprehensive IRRPs. Following the merger of the IESO and the OPA on January 1, 2015, the regional planning responsibilities identified in the OPA's licence were transferred to the IESO.

The regional planning process begins with a Needs Screening process performed by the transmitter, which determines whether there are needs requiring regional coordination. If regional planning is required, the IESO then conducts a Scoping Assessment to determine whether a comprehensive IRRP is required, which considers conservation, generation, transmission, and distribution solutions, or whether a straightforward "wires" solution is the

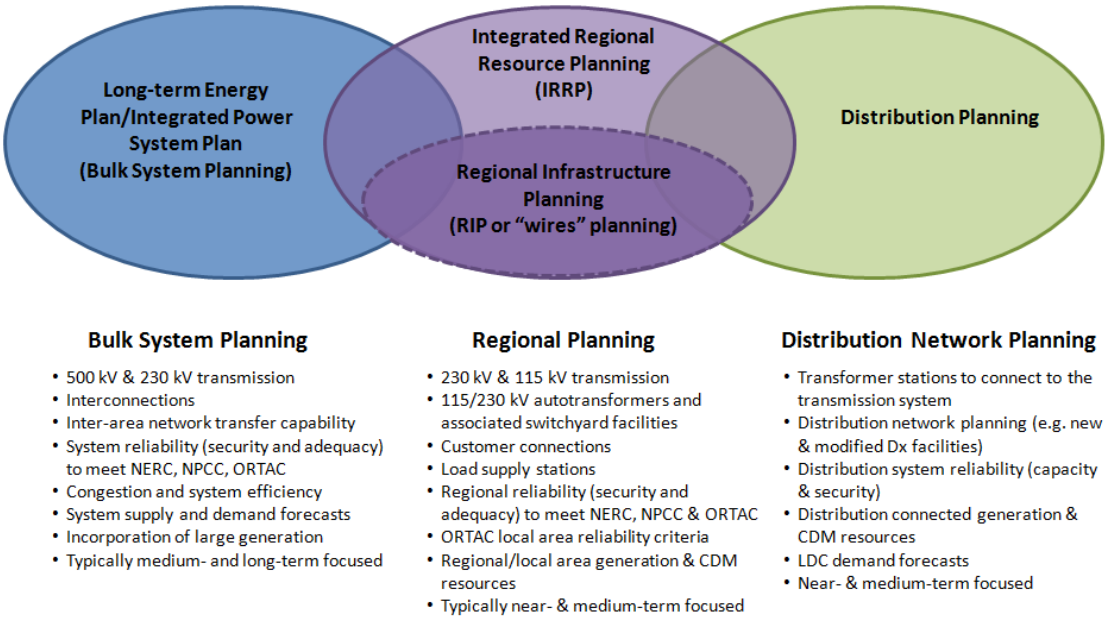
only option. If the latter applies, then a transmission and distribution focused Regional Infrastructure Plan ("RIP") is required. The Scoping Assessment process also identifies any sub-regions that require assessment. There may also be regions where infrastructure investments do not require regional coordination and can be planned directly by the distributor and transmitter, outside of the regional planning process. At the conclusion of the Scoping Assessment, the IESO produces a report that includes the results of the Needs Screening process – identifying whether an IRRP, RIP or no regional coordination is required - and a preliminary Terms of Reference. If an IRRP is the identified outcome, then the IESO is required to complete the IRRP within 18 months. If a RIP is required, the transmitter takes the lead and has six months to complete it. Both RIPs and IRRPs are to be updated at least every five years.

The final IRRPs and RIPs are to be posted on the IESO and relevant transmitter websites, and can be used as supporting evidence in a rate hearing or Leave to Construct application for specific infrastructure investments. These documents may also be used by municipalities for planning purposes and by other parties to better understand local electricity growth and infrastructure requirements.

Regional planning, as shown in Figure 3-1, is just one form of electricity planning that is undertaken in Ontario. There are three types of electricity planning in Ontario:

- Bulk system planning
- Regional system planning
- Distribution system planning

Figure 3-1: Levels of Electricity System Planning



Planning at the bulk system level typically considers the 230 kV and 500 kV network. Bulk system planning considers the major transmission facilities and assesses the resources needed to adequately supply the province. Bulk system planning is carried out by the IESO in accordance with government policy. Distribution planning, which is carried out by local distribution companies, looks at specific investments on the low voltage, distribution system.

Regional planning can overlap with bulk system planning. For example, overlap can occur at interface points where regional resource options may also address a bulk system issue. Similarly, regional planning can overlap with the distribution planning of LDCs. An example of this is when a distribution solution addresses the needs of the broader local area or region. Therefore, to ensure efficiency and cost-effectiveness, it is important for regional planning to be coordinated with both bulk and distribution system planning.

By recognizing the linkages with bulk and distribution system planning, and coordinating multiple needs identified within a given region over the long term, the regional planning process provides an integrated assessment of needs. Regional planning aligns near- and long-term solutions and allows specific investments recommended in the plan to be understood as part of a larger context. Furthermore, regional planning optimizes ratepayer interests by avoiding piecemeal planning and asset duplication, and allows Ontario ratepayers' interests to be represented along with the interests of LDC ratepayers. Where IRRPs are undertaken, they

allow an evaluation of the multiple options available to meet needs, including conservation, generation, and "wires" solutions. Regional plans also provide greater transparency through engagement in the planning process, and by making plans available to the public.

3.2 The IESO's Approach to Regional Planning

IRRPs assess electricity system needs for a region over a 20-year period. The 20-year outlook anticipates long-term trends so that near-term actions are developed within the context of a longer-term view. This enables coordination and consistency with the long-term plan, rather than simply reacting to immediate needs.

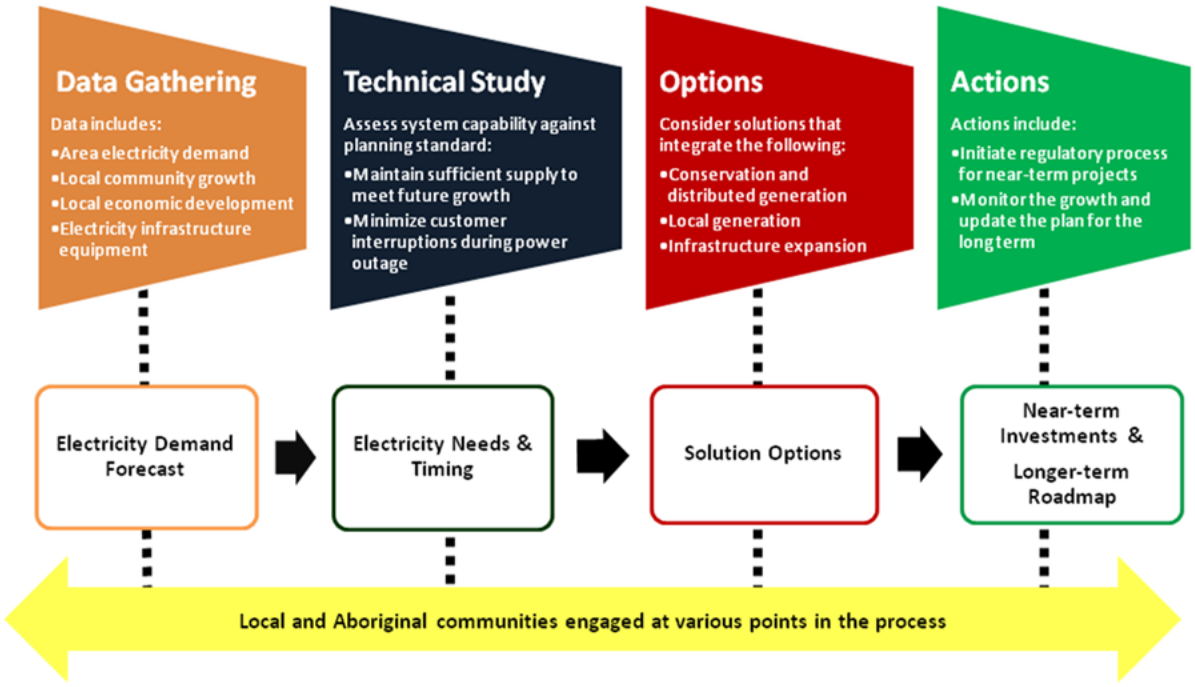
In developing an IRRP, a different approach is taken to developing the plan for the first 10 years of the plan—the near- and medium-term—than for the longer-term period of 10-20 years. The plan for the first 10 years is developed based on best available information on demand, conservation, and other local developments. Given the long lead time to develop electricity infrastructure, near-term electricity needs require prompt action to enable the specified solutions in a timely manner. By contrast, the long-term plan is characterized by greater forecast uncertainty and longer development lead time; as such solutions do not need to be committed to immediately. Given the potential for changing conditions and technological development, the IRRP for the long term is more directional, focusing on developing and maintaining the viability of options for the future, and continuing to monitor demand forecast scenarios.

In developing an IRRP, the IESO and regional working groups (see Figure 3-2 below) carry out a number of steps. These steps include electricity demand forecasts; technical studies to determine electricity needs and the timing of these needs; the development of potential options; and, a recommended plan including actions for the near and long-term. Throughout this process, engagement is carried out with communities, including local First Nations and Métis communities and stakeholders who may have an interest in the planning area. The steps of an IRRP are illustrated in Figure 3-2 below.

The IRRP report documents the inputs, findings and recommendations developed through the process described above, and provides recommended actions for the various entities responsible for plan implementation. Where "wires"" solutions are included in the plan recommendations, the completion of the IRRP report is the trigger for the transmitter to initiate an RIP process to develop those options. Other actions may involve development of

conservation, local generation, or other solutions, community engagement, or information gathering to support future iterations of the regional planning process in the region.

Figure 3-2: Steps in the IRRP Process



3.3 KWCG Working Group and IRRP Development

Prior to the formation of the OEB's Regional Planning Process in 2013, regional planning activities were undertaken by the IESO, the OPA, Hydro One and local LDCs in order to maintain a reliable supply of electricity to the KWCG Region. In the absence of a formalized process, regional planning activities in the area were triggered on an as needed basis, and solutions were examined, implemented, or deferred depending on the timing of electricity system requirements.

In 2003, as the result of a regional transmission study conducted by Hydro One and the local LDCs, a 115 kV/230 kV auto-transformer and associated remedial measures were installed at the Preston Transformer Station ("TS") to improve the Region's reliability. In 2007, in order to meet forecast electricity demand growth in the South-Central Guelph and Kitchener area, the Integrated Power System Plan ("IPSP")[3] recommended proceeding with the development of the GATR project. However, as a result of the global economic recession in 2008/2009, electricity

[3] Integrated Power System Plan 2007 - EB-2007-0707 – Exhibit E Tab 5 Schedule 2

consumption declined across the KWCG Region and the development work for the GATR project was put on hold.

In 2010, the KWCG planning electricity supply study was initiated to re-assess electricity supply and reliability over the next 20 years. The OPA agreed that a coordinated, integrated approach was appropriate and formed the Working Group. The Working Group developed the Terms of Reference for the study[4] and gathered data, identified near and long-term needs in the Region, and assessed a range of integrated options. In 2012/2013, the Working Group recommended proceeding with the implementation of GATR and initiating early development work on the second 115 kV/230 kV auto-transformer at Preston TS to address imminent supply and reliability needs in the KWCG Region.[5] In March 2013, Hydro One submitted the Leave to Construct application for the GATR project and in September 2013, the application was approved by the OEB.[6]

In October 2013, the KWCG planning electricity supply study was transitioned to align with the OEB's new regional planning process. The Working Group revised the Terms of Reference to reflect the new process, and updated the study information, including demand forecasts and conservation and DG data.[7] With this updated information, the Working Group re-confirmed the reliability and supply needs in the KWCG Region, re-examined the need for the second 115 kV/230 kV auto-transformer at Preston in the near term, and continued to revise the near-term plan and to develop recommendations for the long-term plan. This IRRP reflects this revised and updated information.

[4] Original Terms of Reference:
http://www.ieso.ca/Documents/Regional-Planning/KWCG/KWCG-Terms-of-References.pdf
[5] OPA Letter to Hydro One - March 8, 2012:
http://www.ieso.ca/Documents/Regional-Planning/KWCG/Exhibit%20B-1-4,%20Attachments%201%20and%202.pdf
OPA Letter to Hydro One - May 29, 2013:
http://www.ieso.ca/Documents/Regional-Planning/KWCG/OPA-Letter-Hydro-One-KWCG.pdf
[6] (EB-2013-0056) Ontario Energy Board Decision and Order dated September 26, 2013
[7] Revised July 2014 Terms of Reference (Addendum):
http://www.ieso.ca/Documents/Regional-Planning/KWCG/Addendum-TOR-KWCG.pdf

4. Background and Scope of the KWCG IRRP

The KWCG IRRP assesses the regional electricity supply and reliability needs for the KWCG Region, and identifies integrated solutions for the 20-year period from 2014 to 2033. Specifically, this IRRP includes the following components:

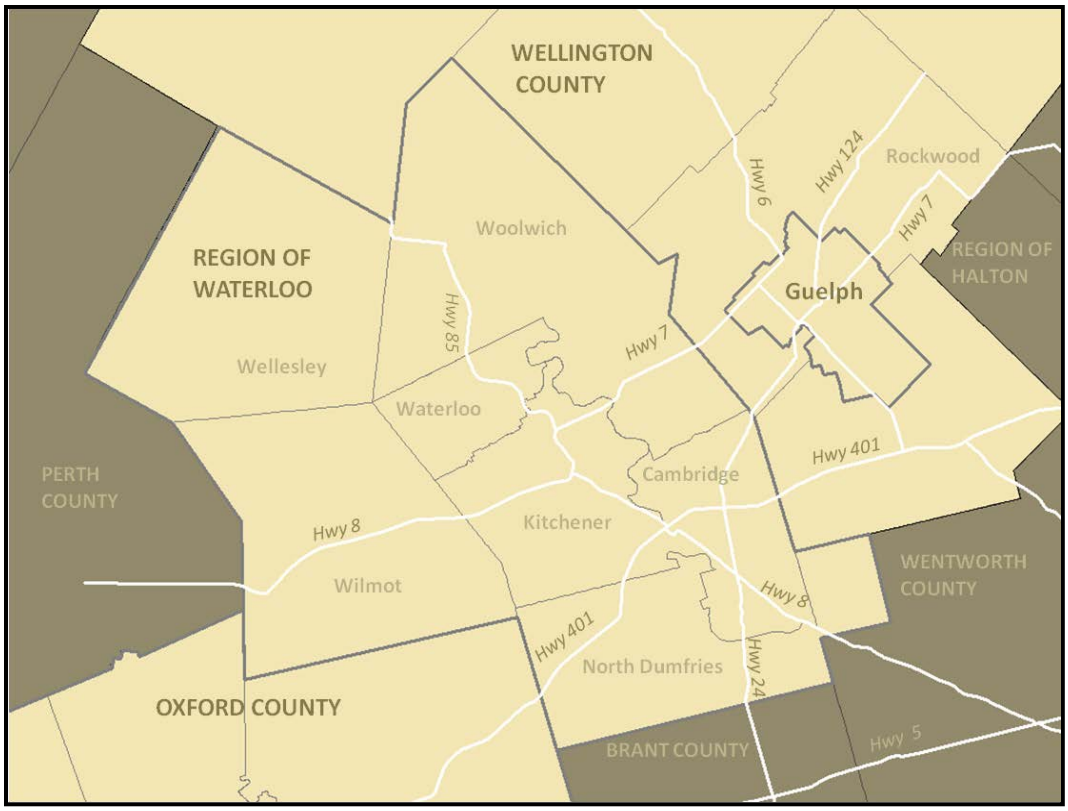
- Examination of electricity demand requirements in the near- and medium-term (2014-2023) and under alternate long-term demand growth scenarios (2024-2033);
- Reliability and adequacy assessment of the electricity system in the KWCG Region;
- Development and evaluation of integrated alternatives including a mix of CDM, generation, transmission and distribution facilities, and other electricity system initiatives to address near- and medium-term electricity supply needs in this region (2014-2023);
- Assessment of alternate demand scenarios and development of potential approaches for the local community to address future long-term electricity supply needs (2024-2033); and
- Development of an implementation plan to address near- and medium-term electricity requirements and to ensure that options remain available to address long-term needs.

To set the context for this IRRP, the scope of this IRRP and a description of the Region are set out in Section 4.1. Section 4.2 details the existing transmission system in the KWCG Region.

4.1 Scope of the KWCG IRRP

The KWCG Region is located in southwestern Ontario and includes the Region of Waterloo, the City of Guelph, Wellington County and the Township of Blandford-Blenheim (Oxford County), as shown in Figure 4-1.

Figure 4-1: Kitchener, Waterloo, Cambridge and Guelph Area



The KWCG Region has an estimated population of 735,000.[8] Based on growth plans, as detailed in the provincial Places to Grow Initiative,[9] the population is forecast to increase by approximately 40% over a 20-year period (2011-2031). This is equivalent to adding 14,500 new residents and 6,500 new jobs each year. This growth will be accompanied by population intensification, the development of regional transit infrastructure, redevelopment of the downtown areas, and the development of commercial and industrial parks.

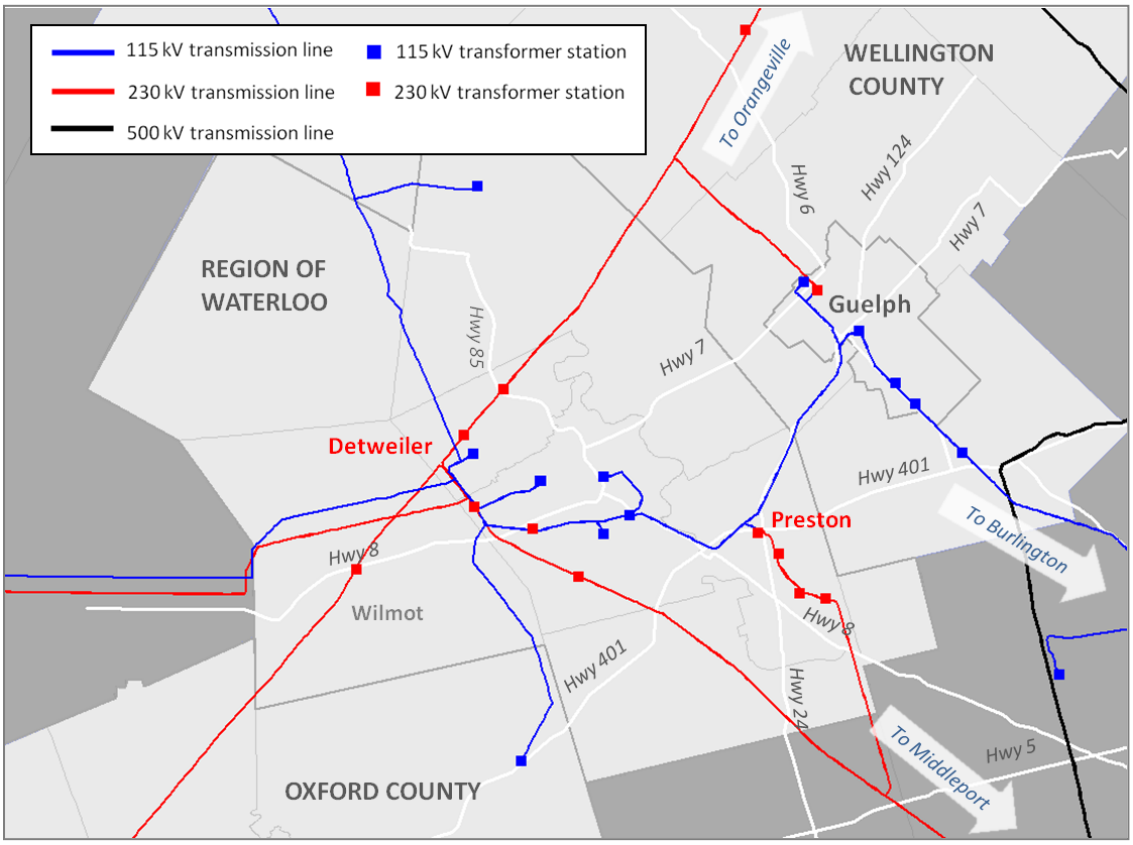
Given the mix of rural and urban development, the nature of growth and local developments may vary across the Region of Waterloo, City of Guelph, Wellington County and the Township of Blandford-Blenheim. The economic activities in the Region of Waterloo and the City of Guelph include a mix of educational institutions, manufacturing, and high-tech industries. For Wellington County and the Township of Blandford-Blenheim, the agriculture and manufacturing sectors play a key role in its economic development.

[8] 2011 Census Data
[9] http://www.placestogrow.ca/

4.2 Existing Electricity System in the KWCG Region

The KWCG Region relies primarily on the regional transmission and distribution infrastructure to deliver electricity into the local area, as there is no large, centralized generation resource in the region. The transmission system within the KWCG Region consists of an integrated 230 kV and 115 kV network. As shown in Figure 4-2, the main sources of electricity into the KWCG Region are Middleport Transformer Station, Detweiler TS, Orangeville TS, and Burlington TS.

Figure 4-2: KWCG Electricity System

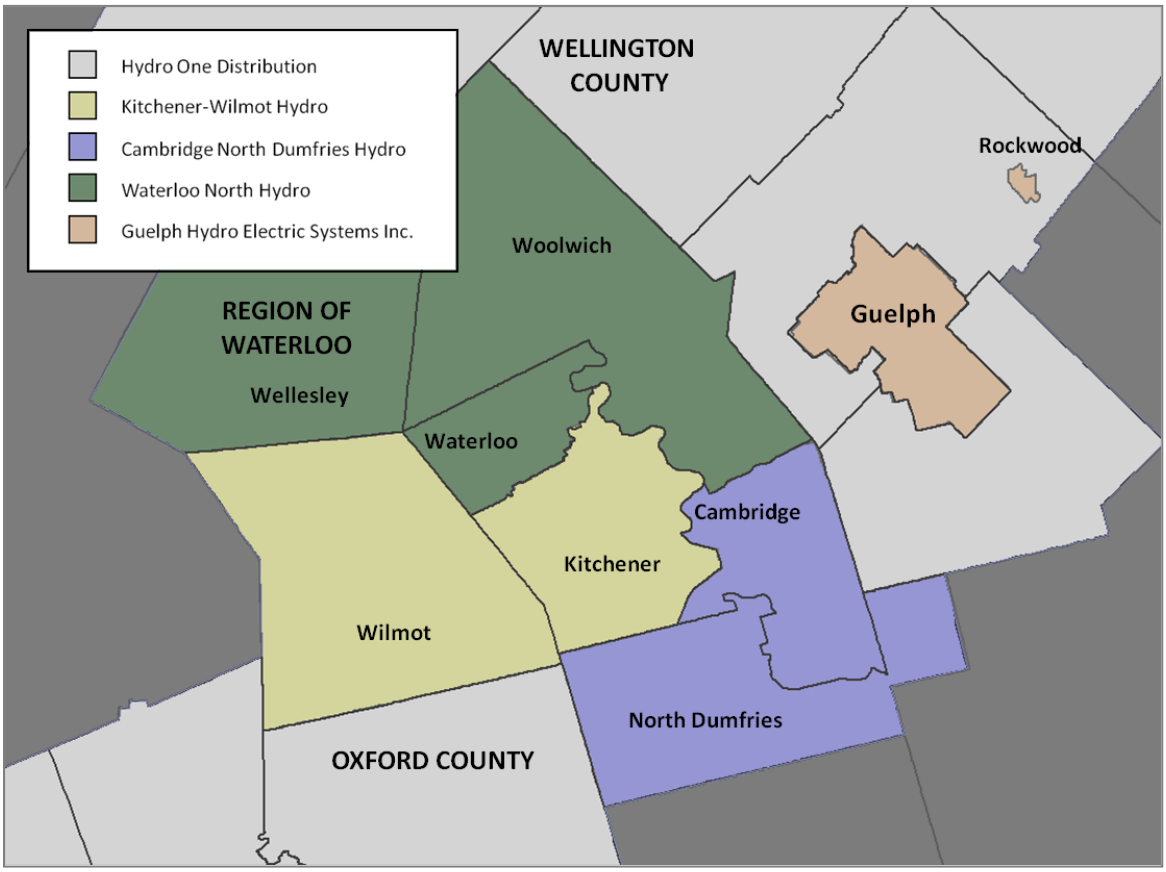


Along these local 230 kV and 115 kV networks, there are three transmission-connected customers and 25 step-down transformers that enable electricity to be delivered from the high-voltage transmission system (115 kV or 230 kV) to the low-voltage distribution systems that serve the communities.

The local distribution system in the KWCG Region is operated and managed by five LDCs: Guelph Hydro Electric Systems Inc. ("Guelph Hydro"), Waterloo North Hydro Inc. ("Waterloo North Hydro"), Kitchener-Wilmot Hydro Inc. ("Kitchener-Wilmot Hydro") Hydro One

Networks Inc. ("Hydro One Distribution"), and Cambridge North Dumfries Hydro Inc. ("Cambridge North Dumfries Hydro"), as shown in Figure 4-3 below.

Figure 4-3: LDC Service Area



5. Demand Forecast

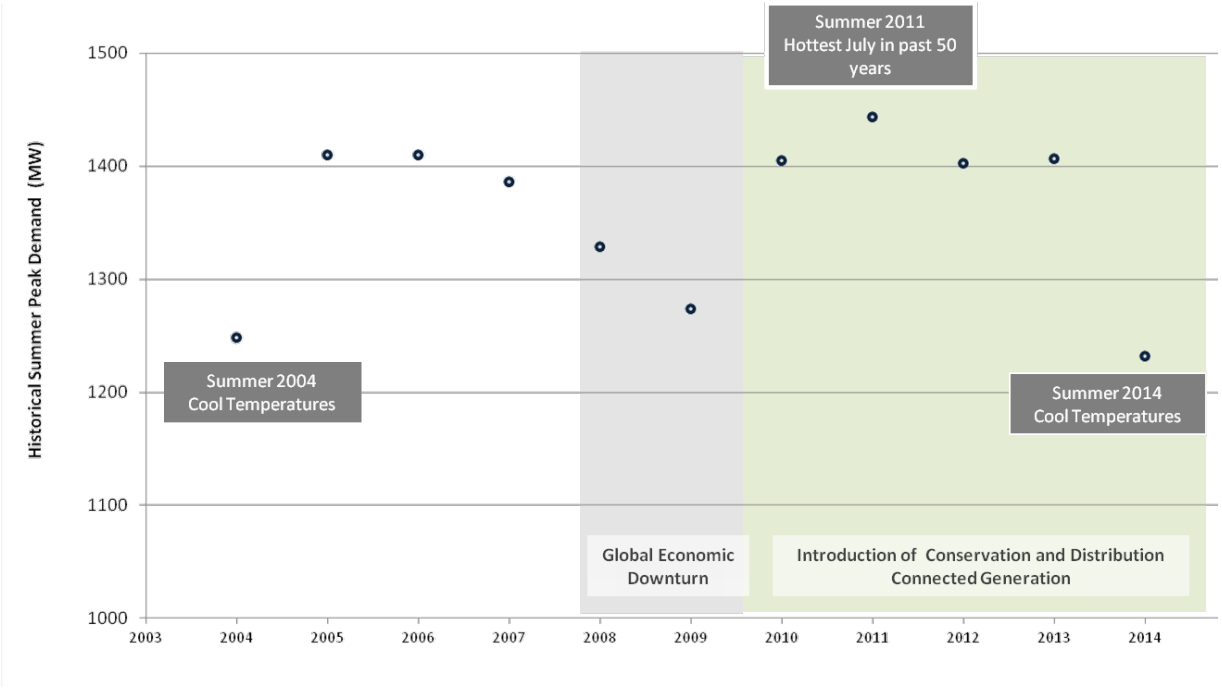
This section describes the specific details of the development of the regional demand forecast: Section 5.1 describes electricity demand trends in the region from 2004 to 2014; Section 5.2 describes the demand forecast methodology used in this study; Section 5.3 provides the near- and medium-term planning forecast; and Section 5.4 explains the long-term planning demand forecast.

5.1 Historical Electricity Demand

The KWCG Region electricity demand is a mix of residential, commercial and industrial loads, encompassing diverse economic activities ranging from educational institutions to automobile manufacturing. While the industrial and commercial sector is the largest consumer of electricity, high-energy-consuming end uses such as air conditioning also play a significant role in contributing to peak electricity demand. During the summer months, peak demand can also be influenced by extreme weather conditions, with peaks in demand typically occurring after several days of high temperatures.

As shown in Figure 5-1, the 2004-2014 historical summer peak demand has fluctuated between 1,250 MW to 1,450 MW, due to a combination of extreme summer temperatures and factors affecting commercial and industrial energy demand, such as the impact of the economic downturn, improvements in energy efficiency ("EE"), and the development of on-site generation. Specifically, the combination of the global recession and low summer temperatures resulted in a decrease in peak demand consumption during 2008 and 2009.

Figure 5-1: Historical Summer Peak Demand in the KWCG Region



In recent years, provincial policies and incentives encouraging conservation, demand response ("DR") and on-site generation have provided opportunities for businesses and residents to better manage their electricity use. These initiatives have resulted in an increase in on-site generation, district energy systems and EE improvements for industrial, commercial, and municipal customers. This in turn has resulted in a reduced reliance on the provincial electricity grid. Local utilities in the KWCG Region have also observed more modest growth in electricity consumption in their service areas due to increased DG and conservation.

5.2 Demand Forecast Methodology

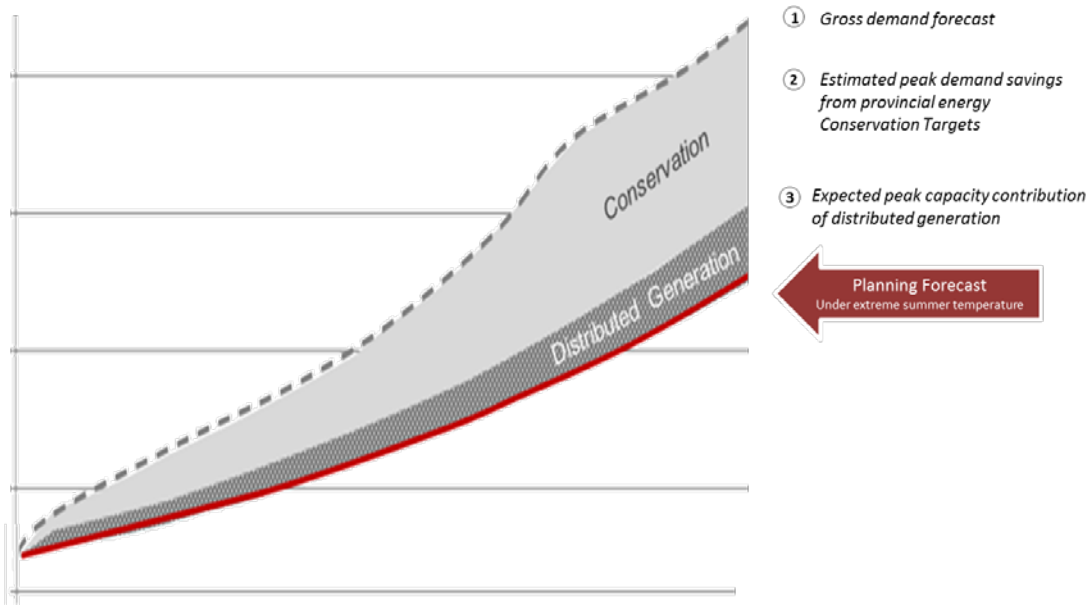
The regional electricity systems in southern Ontario are designed to meet regional coincident peak demand under extreme summer temperature conditions. Regional coincident peak demand is the 1-hour period each year when total regional demand for electricity is the highest.

For the purpose of the IRRP, a 20-year planning forecast is developed to assess supply and reliability needs at the regional level.

The 20-year planning forecast takes into consideration the gross demand forecast, estimated peak demand savings from provincial energy conservation targets, and expected peak capacity contribution of contracted DG, and adjusted to reflect extreme summer temperature conditions,

as shown in Figure 5-2. The methodology and assumptions used for the development of planning forecasts are described in detail in Appendix A.

Figure 5-2: Development of a 20-Year Planning Forecast



The 20-year planning forecast is divided into two timeframes. The first 10 years is developed under normal-year temperature conditions and is based on expected peak demand consumption growth projections from LDCs and from transmission-connected customers' in the LDC's service territory. These growth projections are modified to reflect the estimated peak demand savings from provincial energy conservation targets and contracted DG, and are also adjusted to reflect extreme temperature conditions. This modified forecast represents the near- and medium-term planning forecast, which is required to inform more immediate planning decisions.

For the 10-20-year timeframe, there is greater uncertainty with electricity demand growth, peak demand impact of conservation, DG, and emerging technologies. Longer-term demand scenarios, which consider policy drivers and emerging trends, are developed. These scenarios help communities anticipate potential future electricity demand requirements and electricity supply and reliability needs.

5.3 Near- and Medium-Term Planning Forecast

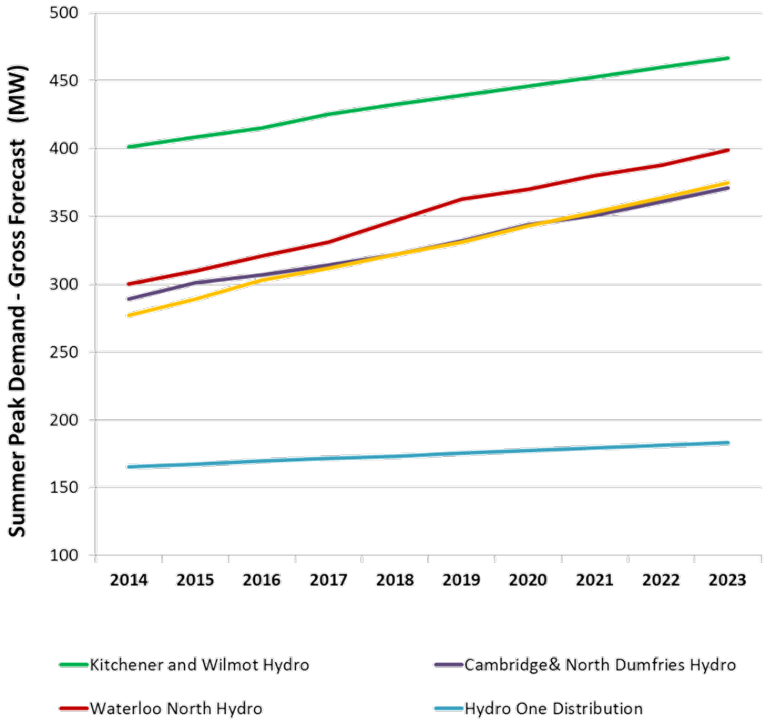
As described above, the near- and medium-term planning forecast (2014-2023) begins with the LDCs' gross demand forecast. Peak demand savings from provincial energy conservation targets and contracted DG are then deducted, and the forecast adjusted for extreme weather to produce the planning forecast. The details of this near- and medium-term forecast are described in the following sections.

5.3.1 Gross Demand Forecast

The gross demand forecast was initially developed in 2010 by the LDCs based on customer connection requests, local economic development and growth assumptions outlined in Ontario's *Places to Grow Act, 2005*, which are reflected in municipal and regional plans. LDCs periodically reviewed and updated the gross demand forecast for their service area to reflect the latest information and electricity demand trends.

Based on the most up-to-date information, LDCs indicate that the gross demand in the KWCG Region is expected to grow at an annual rate of 2.5% in the near and medium term. Consistent with the 2010 projection, Kitchener-Wilmot Hydro, Waterloo North Hydro, and Hydro One Distribution's service areas are forecast to grow at annual rates of 1.7%, 3.2%, and 1.1% respectively. Although Guelph Hydro has made a downward adjustment to the 2014 electricity peak demand level to align with current electricity consumption patterns, it expects electricity peak demand in its service area to grow at an annual rate of 3.4% over the next 10 years. In contrast, Cambridge and North Dumfries Hydro anticipate slower growth in the near term than initially forecast in 2010. A slower than expected economic recovery and a decline in energy usage from industrial customers are the primary reasons for the reduced peak demand growth in the near and medium term. Figure 5-3 shows the gross demand forecast for the LDCs in the KWCG Region.

Figure 5-3: Gross Demand Forecast by LDCs



LDCs	Gross Demand Forecast 2014-2023 Annual Growth Rate
Cambridge & North Dumfries Hydro	2.8%
Guelph Hydro	3.4%
Kitchener-Wilmot Hydro	1.7%
Waterloo North Hydro	3.2%
Hydro One Distribution	1.1%

In addition, three transmission-connected customers also contribute to the overall peak demand in the KWCG Region. For planning purposes, the IESO estimates the peak demand of these transmission-connected customers based on historical metering data and expected peak demand consumption. Prior to 2014, the peak demand of the three transmission-connected customers accounted for approximately 47 MW of the peak demand in the KWCG Region. In 2014, the total peak demand contributed by the transmission-customers was reduced to 12 MW to reflect a reduction in energy usage by a transmission-connected customer in the Cambridge area.

The specific forecasting methodology and assumptions for the gross demand forecast can be found in Appendix A.

5.3.2 Estimated Peak Demand Savings from Provincial Energy Conservation Targets

Conservation plays a key role in maximizing the useful life of existing infrastructure, and maintaining reliable supply. The 2013 LTEP committed to establishing a new 6-year

Conservation First Framework beginning in January 2015 to enable the achievement of all cost-effective conservation. In the near term, Ontario's LDCs have an aggregate energy reduction target of 7 TWh, as well as individual LDC specific targets. These targets are to be achieved between 2015 and the end of 2020 through LDC conservation programs enabled by the Conservation First Framework. Each LDC is required to prepare a CDM Plan describing how their target will be achieved and submit their CDM Plan by May 1, 2015.[10] The LDC CDM Plans will link closely with regional plans, providing more detail about how a portion of the conservation targets that have been incorporated into regional planning will be realized.

As part of the Conservation First policy, the provincial government has adopted a broad definition of conservation that includes various types of customer action and behind-the-meter generation. This means that conservation includes any efforts to reduce the amount of energy consumed from the provincial electricity grid. Conservation initiatives, including behind the meter generation projects and on-site generation,[11] are expected to reduce customers' reliance on the provincial electricity grid and contribute to peak demand savings in the KWCG Region over the next 10 years. For the purpose of this IRRP, the allocation of the provincial energy savings target for the KWCG Region is estimated to offset approximately 144 MW or 40% of the forecast peak demand growth in the KWCG Region between 2014-2023. It is assumed that existing DR already in the base year will continue but savings from potential future DR resources are not included in the forecast. Instead, future savings are considered as possible solution to identified future needs.

Using a planning forecast that is net of provincial energy conservation targets provides consistency with the province's Conservation First policy by reducing demand requirements before assessing any growth-related needs. The planning forecast assumes that the targets will be met, and will produce the expected local peak demand impacts. Therefore, an important aspect of plan implementation will be monitoring the actual peak demand impacts of conservation programs delivered by the local LDCs.

The estimated annual peak demand savings from the provincial energy conservation targets in the KWCG Region are summarized in Appendix A.

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[10] At the time of this report, the CDM plans have not been submitted by the LDCs. The CDM plans will be available on the IESO and LDCs' websites once they have been submitted and reviewed.

[11] The government has directed the former OPA to "consider CDM to be inclusive of activities aimed at reducing electricity consumption and reducing the draw from the electricity grid, such as geothermal heating and cooling, solar heating and small scale (i.e., < 10 MW) behind-the-meter customer generation."

5.3.3 Expected Peak Demand Contribution of Contracted Distributed Generation

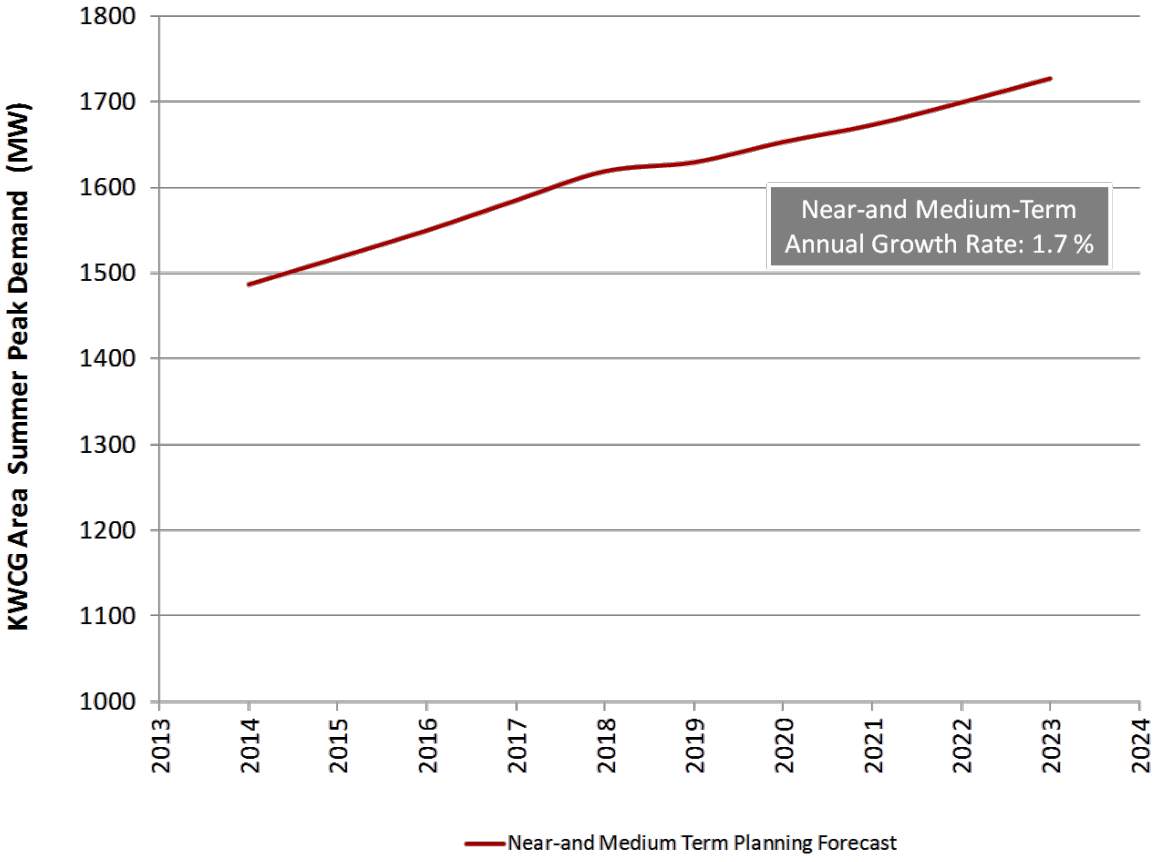
In recent years, a number of DG projects including, wind, solar, hydro and combined heat and power ("CHP") projects, have been developed in the KWCG Region as a result of provincial procurement programs such as FIT and CHPSOP. Since 2010, an additional 98 MW of DG was contracted in the KWCG Region. These contracted DG resources are expected to reduce the regional peak demand by 35 MW or about 10% of forecast demand growth in the Region during the 2014-2023 timeframe. Future DG uptake was, as noted, not included in the planning forecast and is instead considered as an option for meeting identified needs.

The expected annual peak demand contribution of contracted DG in the KWCG Region can be found in Appendix A.

5.3.4 Planning Forecast

Figure 5-4 shows the near- and medium-term planning forecast for the KWCG Region (2014-2023), which takes into consideration the gross demand forecast, estimated peak demand savings from provincial energy conservation targets, and contracted DG adjusted to reflect extreme summer temperature conditions.

Figure 5-4: KWCG Near-and Medium-Term Planning Forecast 2014-2023



According to the planning forecast, the summer peak electricity demand in the KWCG Region is expected to increase at a rate of approximately 1.7% each year, with an incremental peak demand growth of approximately 250 MW between 2014-2023. Over the next 10 years, a large portion of the demand growth will be concentrated in Guelph and Waterloo. The near- and medium-term growth is driven by several concentrated areas of local developments, such as the Region of Waterloo East-Side Lands, the Rapid Transit Initiatives in Waterloo, and the Hanlon Creek Business Park in Guelph.

5.4 Long-Term Planning Forecast

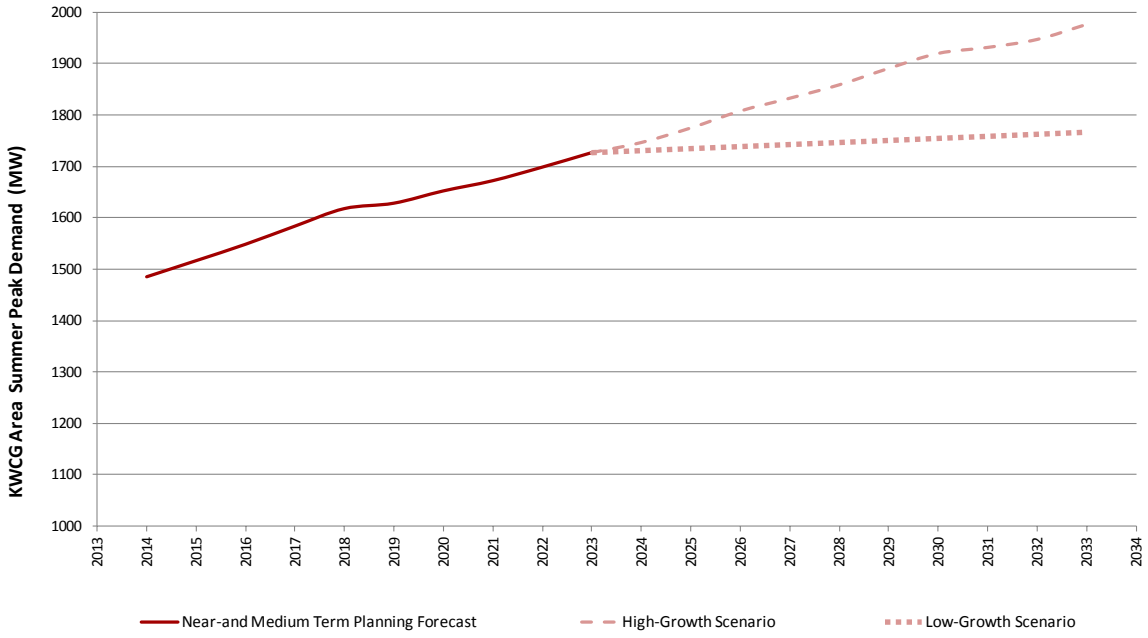
As described in Section 5.2 above, for the 10-20 year timeframe, due to greater uncertainty with electricity demand growth, two longer-term demand scenarios were developed.

Two alternate policy drivers were considered in the development of long-term demand scenarios for the KWCG Region:

- Ontario's *Places to Grow Act, 2005*; and
- Ontario's 2013 LTEP.

The two long-term demand scenarios are shown in Figure 5-5 below and are described in the following sections. Additional details related to the development of these longer-term scenarios are provided in Appendix A.

Figure 5-5: Long-Term Planning Forecast Scenarios 2024-2033



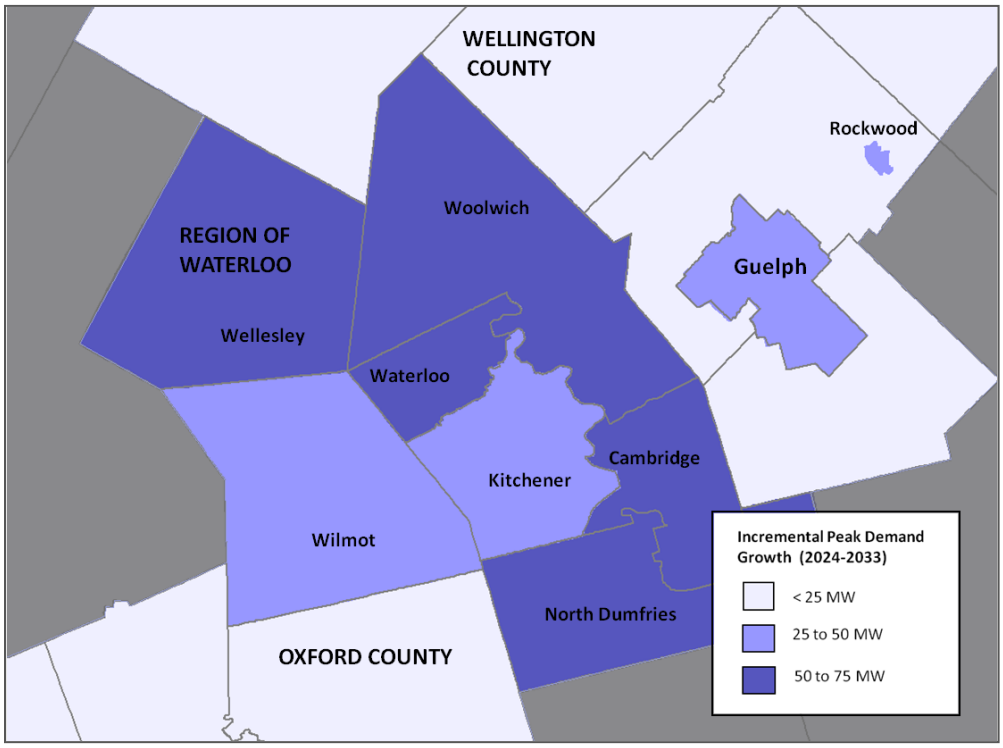
5.4.1 High-Growth Scenario

This scenario reflects the Region's forecast peak electricity demand requirements associated with growth assumptions as detailed in Ontario's Places to Grow plan. It represents a future with sustained electricity demand growth across the region driven by local developments and intensification initiatives outlined in the Places to Grow plan and as reflected in municipal official plans.

Under the high-growth scenario, the summer peak electricity demand requirement in the KWCG Region is forecast to increase at a rate of 1.4% each year over the long term, with an

incremental growth of 150 MW between 2024-2033. Figure 5-6 shows the forecast incremental peak demand growth for the municipalities in the KWCG Region over the longer term.

Figure 5-6: High-Growth Scenario – Incremental Peak Demand Growth 2024-2033 by Municipality



5.4.2 Low-Growth Scenario

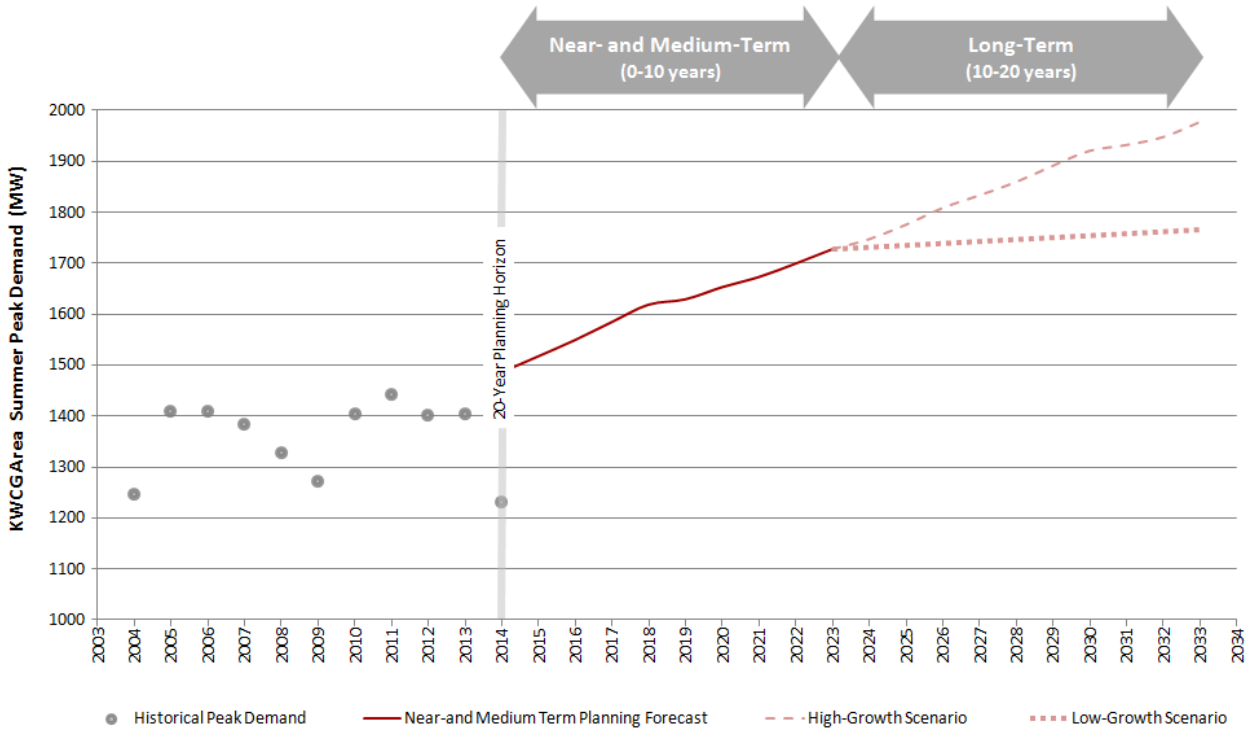
This scenario reflects the region's forecast peak electricity demand requirements associated with the more modest growth assumptions in the 2013 LTEP. The low-growth scenario represents a future with lower electricity demand growth due to higher electricity prices, increased electricity conservation and lower energy intensity within the broader economy. Despite an expected increase in population, energy consumption per household is assumed to decrease over time. Similarly, lower energy intensity is assumed for the commercial and industrial sectors.

Consistent with the 2013 LTEP forecast for southwest Ontario, the peak demand in the KWCG Region beyond 2023 is assumed to grow at a rate of 0.2%, far less than the high-growth scenario. This scenario assumes that electricity demand growth is managed through increased conservation and DG efforts, resulting in less incremental consumption on the provincial electricity grid in the long term.

5.5 Summary of Demand Forecast

The historical peak demand, near- and medium-term planning forecast, and long-term scenarios are shown in Figure 5-7. The annual historical demand data is influenced by variable weather and energy consumption patterns. The planning forecast was developed using assumptions based on extreme weather conditions and typical energy consumption patterns so that demand can be met under a range of conditions. Historical peak demand data was not adjusted to align with the extreme temperature and typical consumption pattern assumptions used in the planning forecast, and as such, may be lower than future projections.

Figure 5-7: Historical Peak Demand, Planning Forecast and Long-Term Scenarios



6. Near- and Medium-Term Plan

The regional planning process considers when system needs may arise by comparing the capability of the existing system with the forecast electricity demand. This section identifies the needs in the near and medium term, considers available options, and recommends actions in the near and medium term.

6.1 Needs Assessment Methodology

The IESO's Ontario Resource and Transmission Assessment Criteria ("ORTAC"),[12] the provincial standard for assessing the reliability of the transmission system, was applied to assess supply capacity and reliability needs. ORTAC includes criteria related to the assessment of the bulk transmission system, as well as the assessment of local or regional reliability requirements (see Appendix B for more details).

Through the application of these criteria, three broad categories of needs can be identified:

- **Transformer Station Capacity** describes the electricity system's ability to deliver power to the local distribution network through the regional transformer stations. This is limited by the 10-day Limited Time Rating ("LTR") of the step-down transformer stations in the local area. Transformer station capacity need is identified when the peak demand at step-down transformer stations in the local area exceeds the combined LTR ratings.
- **Supply Capacity** describes the electricity system's ability to provide continuous supply to a local area. This is limited by the load meeting capability ("LMC") of the transmission line or sub-system which is the maximum demand that can be supplied on a transmission line or sub-system under applicable transmission and generation outage scenarios as prescribed by ORTAC, and is determined through power system simulations analysis (See Appendix B for more details). Supply capacity needs are identified when peak demand on a transmission line or sub-system exceeds its LMC.
- **Load Security and Restoration** describes the electricity system's ability to minimize the impacts of potential supply interruptions to customers in the event of a major transmission outage, such as an outage on a double-circuit tower line resulting in the loss of both circuits. Load security describes the amount of load susceptible to supply interruptions in the event of a major transmission outage. Load restoration describes the

[12] http://www.ieso.ca/imoweb/pubs/marketadmin/imo_req_0041_transmissionassessmentcriteria.pdf

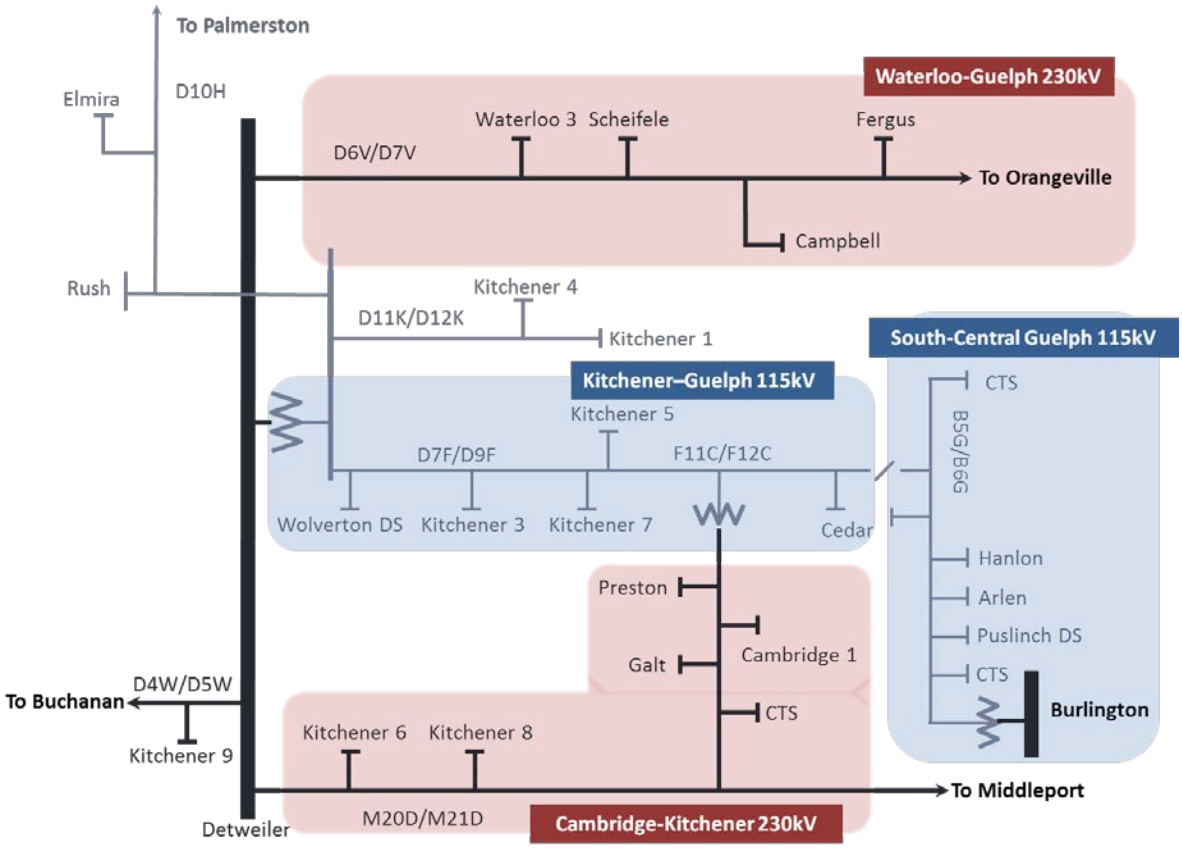
electricity system's ability to restore power to those affected by a major transmission outage within reasonable timeframes. The specific load security and restoration requirements prescribed by ORTAC are described in Appendix B.

In addition, the needs assessment may also identify needs related to transmission reliability performance, equipment end-of-life and planned sustainment activities. Reliability performance describes the frequency and probability of major outages on an electricity system, which can be affected by various factors such as exposure to elements, age and maintenance of equipment, and length and configuration of the transmission or distribution network. Equipment reaching the end of its life and planned sustainment activities may have an impact on the needs assessment and option development.

6.2 Summary of Near- and Medium-Term Needs

As noted earlier, the transmission system within the KWCG Region consists of an integrated 230 kV and 115 kV network. Figure 6-1, The KWCG transmission system can be further subdivided into four regional sub-systems.

Figure 6-1: Regional Sub-systems in the KWCG Region



Today, the 115 kV sub-systems supplying the KWCG Region are at or approaching maximum capacity, and the 230 kV sub-systems have limited ability to restore electricity supply to customers in the event of a major transmission outage. Table 6-1 provides a summary of the near- and medium-term needs in the KWCG Region.

Table 6-1: Near- and Medium-Term Needs in the KWCG Region

Needs	Regional Sub-systems	Need Date
Supply Capacity	South-Central Guelph 115 kV	Today
	Kitchener-Guelph 115 kV	
Load Restoration	Waterloo-Guelph 230 kV	
	Cambridge-Kitchener 230 kV	

6.2.1 Supply Capacity Needs on the South-Central Guelph and Kitchener-Guelph 115 kV Systems

South-Central Guelph 115 kV Sub-system

The South-Central Guelph 115 kV sub-system can provide up to 100 MW of continuous supply to the Kitchener and Guelph area under specific transmission and outage scenarios as defined by ORTAC (South-Central Guelph 115 kV System LMC = 100 MW). Based on the historical peak demand, the summer peak demand in the South-Central Guelph area has already exceeded the 100 MW LMC limit of the South-Central Guelph 115 kV sub-system over the last two years. The existing South-Central Guelph 115 kV sub-system therefore does not meet the ORTAC supply capacity criteria.

Kitchener-Guelph 115 kV sub-system

The Kitchener-Guelph 115 kV sub-system can provide up to 260 MW of continuous supply to the Kitchener and Guelph area under specific transmission and outage scenarios as defined by ORTAC (Kitchener-Guelph 115 kV sub-system LMC = 260 MW). Based on the planning forecast, the peak demand in the Kitchener and Guelph area exceeded the 260 MW LMC limit of Kitchener-Guelph 115 kV system in the summer of 2014. Given the forecast near- and medium-term summer peak demand growth, the existing Kitchener-Guelph 115 kV sub-system does not meet the ORTAC supply capacity criteria.

6.2.2 Load Restoration Needs on the Waterloo-Guelph, and Cambridge-Kitchener 230 kV Sub-system

Waterloo-Guelph 230 kV Sub-system

The Waterloo-Guelph 230 kV sub-system is a 77 km double-circuit 230 kV transmission line (D6V/D7V) between Detweiler TS and Orangeville TS. This system currently supplies about 465 MW of peak demand load in the Waterloo and Guelph area. Based on the planning forecast, the summer peak demand on this system is expected to increase to about 550 MW by 2023. As prescribed by ORTAC, no more than 250 MW of load can be without electricity supply within 30 minutes of a major outage involving the loss of two transmission elements.

In the event of a major outage involving the loss of both transmission circuits on the Waterloo-Guelph 230 kV system (D6/7V), all load supplied by this transmission line would be interrupted. The existing system cannot restore any load within 30 minutes, and can only

restore electricity supply in 3-4 hours using manual restoration procedures. As a result, the Waterloo-Guelph 230 kV system does not meet the ORTAC 30 minute restoration criteria.

A major outage of this type occurred on February 29, 2012, when a forced outage on one of the D6V/D7V circuits, coupled with scheduled maintenance on the companion circuit, resulted in the interruption of electricity supply for three hours to approximately 350 MW of load in Waterloo, Guelph and the surrounding area.

Cambridge-Kitchener 230 kV Sub-system

The Cambridge-Kitchener 230 kV sub-system consists of an 82 km double-circuit 230 kV transmission line (M20D/M21D) between Detweiler TS and Middleport TS. This system currently supplies about 420 MW of peak electricity demand in the Cambridge and Kitchener area. Based on the planning forecast, the summer peak demand on this system is expected to increase to about 480 MW by 2023. As prescribed by ORTAC, no more than 250 MW of load can be without electricity supply within 30 minutes of a major transmission outage.

Should a major outage involving the loss of both transmission circuits on the Cambridge-Kitchener 230 kV system (M20/21D) occur, all load supplied by M20D/M21D would be interrupted. The existing system has the ability to restore up to 65 MW of electricity supply in Cambridge within 30 minutes via the existing 115 kV/230 kV auto-transformer and the circuit switchers at Preston TS. This existing system does not meet the ORTAC criteria because more than 250 MW of load on the Cambridge-Kitchener 230 kV system would still be without service within 30 minutes of a major outage. In fact, a large portion of the customers on the Cambridge-Kitchener 230 kV sub-system would be without power for at least 3-4 hours.

Prior to the installation of the existing 115 kV/230 kV auto-transformer and disconnect switches at Preston TS, power could not be restored to any customers in the area in a timely manner. Such was the case in 2003, when supply to parts of the City of Cambridge, the Township of North Dumfries and the City of Kitchener, totaling over 250 MW, was interrupted for nearly four hours.

6.3 Options to Address the Near- and Medium-Term Needs

In developing the near- and medium-term plan, the Working Group considered a range of integrated alternatives for addressing the needs, including a mix of conservation, generation, transmission and distribution facilities, and other electricity system initiatives. Technical

feasibility, cost, and consistency with long-term needs and options were considered when evaluating alternatives. Solutions that maximized the use of existing infrastructure were given priority.

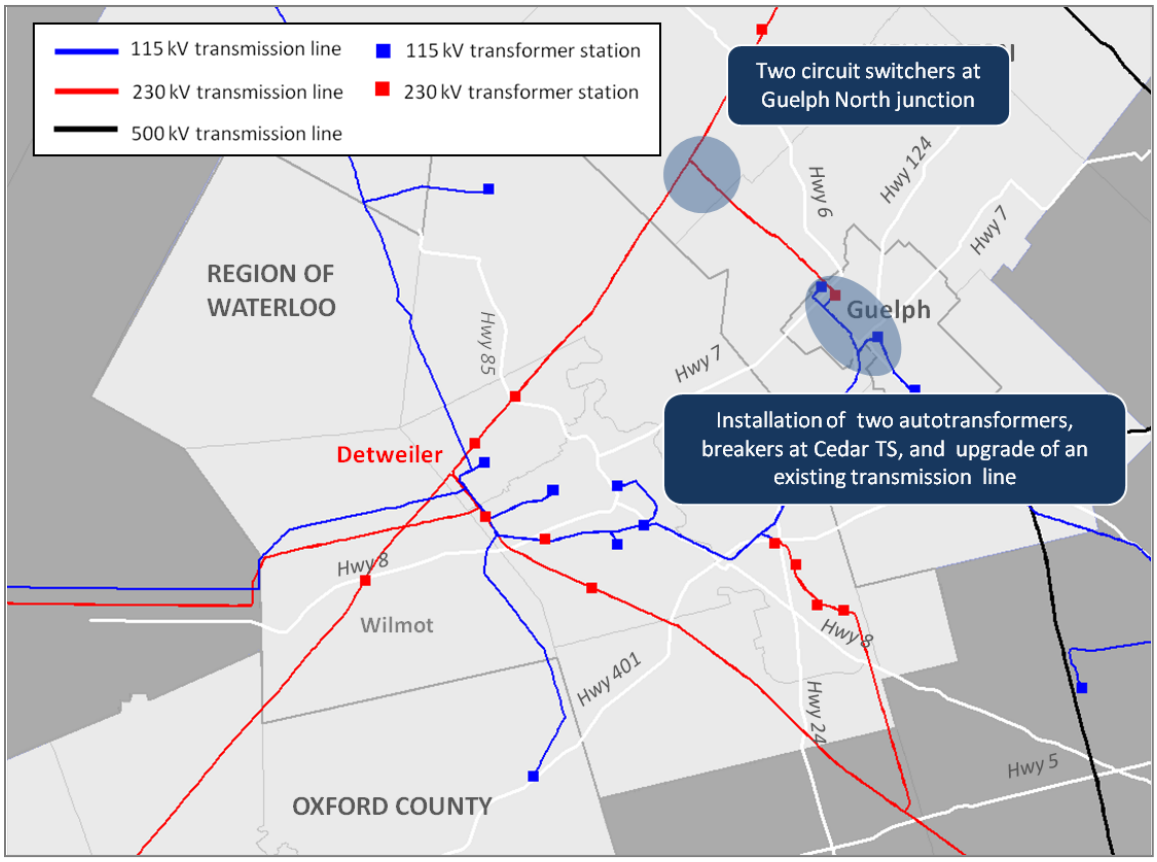
For needs arising in the near term, specific projects are recommended. Given the lead time required to develop electricity infrastructure and CDM programs, these projects must be commenced as soon as possible to ensure customer reliability. Typically, conservation solutions can be implemented within six months, or up to two years for larger projects, whereas transmission and distribution facilities can take 5-7 years. The lead time for generation development is typically 2-3 years, but it could be longer depending on the size and technology type. Recommended actions are therefore identified to initiate investments.

6.3.1 Guelph Area Transmission Refurbishment (GATR) Project

As discussed in Section 3.3, the Working Group recommended proceeding with the implementation of the GATR project, in combination with increased conservation and DG, to address imminent supply capacity and restoration needs in the KWCG Region. This project includes the installation of two 115 kV/230 kV auto-transformers, two 230 kV circuit switchers at Guelph North Junction, two 115 kV breakers at Cedar TS, and the upgrade of an existing transmission line in Guelph (as shown in Figure 6-2). The cost of the GATR project is approximately $95 million. The project was approved by the OEB and is expected to be in-service by spring 2016.[13]

[13] EB-2013-0056 Ontario Energy Board Decision and Order dated September 26, 2013

Figure 6-2: Guelph Area Transmission Refurbishment (GATR) Project



By interconnecting the Waterloo-Guelph 230 kV system with the South Central Guelph 115 kV system and the Kitchener-Guelph 115 kV system, the GATR project maximizes the use of the existing infrastructure and brings a strong source of supply capacity into both 115 kV systems. Following the installation of GATR, there will be sufficient supply capacity on both 115 kV systems to supply electricity demand growth in Guelph and Kitchener and to accommodate up to 100 MW of electricity demand growth in the Cambridge area over the longer term.

The GATR project also improves the ability to restore power to customers on the Waterloo-Guelph 230 kV system. By installing two 230 kV circuit switchers at Guelph North Junction,[14] the sections of the Waterloo-Guelph 230 kV system affected by a possible outage can be isolated

[14] The installation of two 230 kV circuit breakers at Guelph North Junction was originally identified in the GATR Section 92 filing as the preferred option to reduce the impact of supply interruptions to customers on the Waterloo-Guelph 230 kV sub-system. However, after reviewing detailed engineering studies and considering other options, the Working Group determined that it would be cost-effective to install circuit switchers at Guelph North Junction in the near-term and to defer the installation of breakers if and when they are required.

quickly. As a result, about 50% of the electricity supply to customers on the Waterloo-Guelph 230 kV system could be restored within 30 minutes.

The detailed discussion on rationale for GATR and alternatives considered can be found in the Hydro One Inc. Leave to Construct filing for GATR.[15]

6.3.2 Options to Improve Load Restoration on the Cambridge-Kitchener 230 kV Sub-system

As shown in Table 6-2, the GATR project provides sufficient supply capacity on the 115 kV regional sub-systems to meet the electricity demand growth in Guelph, Kitchener and Cambridge over the near and medium term, and improve the ability to restore supply to customers in Waterloo and Guelph. However, the restoration needs on the Cambridge-Kitchener 230 kV sub-system remain.

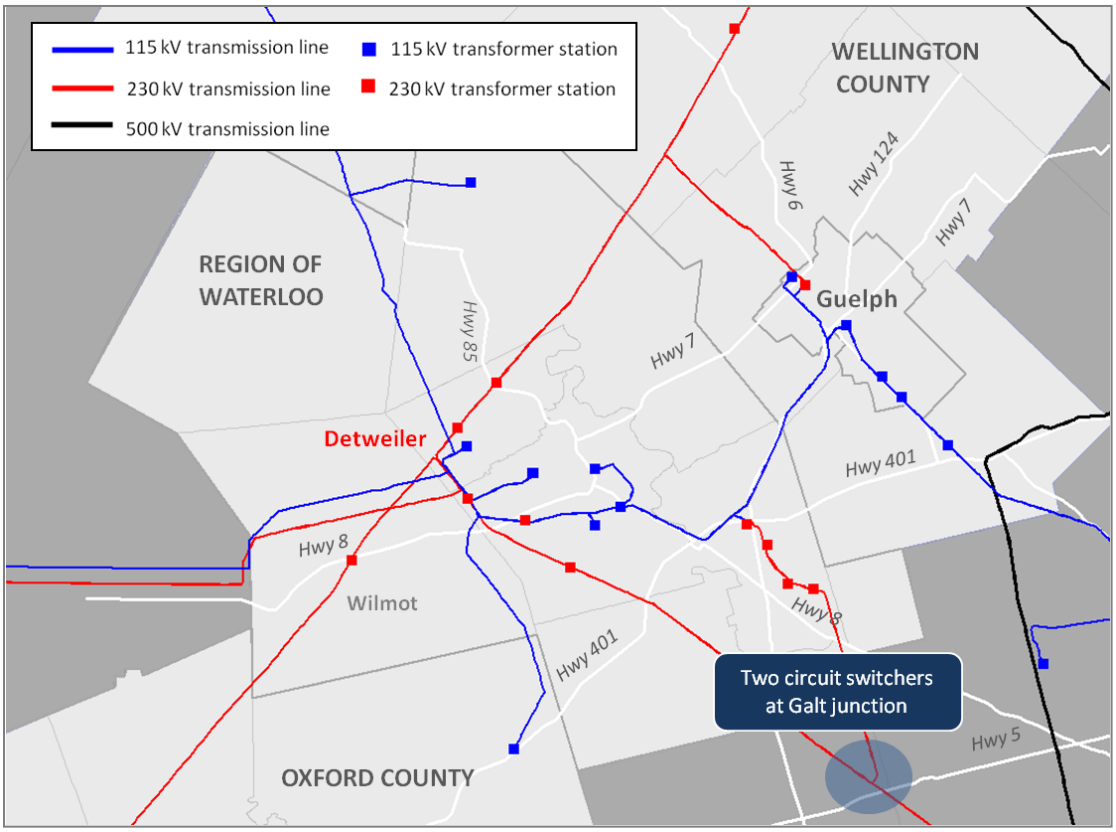
Table 6-2: Summary of Needs Addressed by the GATR Project

Needs	Regional Sub-systems	Needs addressed by the GATR project
Supply Capacity	South Central Guelph 115 kV	✓
	Kitchener-Guelph 115 kV	✓
Load Restoration	Waterloo-Guelph 230 kV	✓
	Cambridge-Kitchener 230 kV	

To substantially improve load restoration in Cambridge and Kitchener in the event of major transmission outages, the Working Group recommended proceeding with the installation of two 230 kV circuit switchers at Galt Junction, near Highway 5, as shown in Figure 6-3. The following section describes the alternatives considered and the rationale for the recommendation.

[15] EB-2013-0056
http://www.rds.ontarioenergyboard.ca/webdrawer/webdrawer.dll/webdrawer/search/rec&sm_udf10=eb-2013-0053&sortd1=rs_dateregistered&rows=200

Figure 6-3: Two Circuit Switchers at Galt Junction



6.3.2.1 Conservation Options

The allocation of the provincial energy savings target is estimated to account for about 40 MW or 40% of the forecast peak demand growth on the Cambridge-Kitchener 230 kV sub-system between 2014-2023. After taking into consideration the estimated peak demand savings from the provincial energy savings conservation targets in the development of the planning forecast, more than 400 MW will still be interrupted on the Cambridge-Kitchener 230 kV sub-system in the event of major transmission outage and power will need to be restored to these customers.

While conservation can be an effective means for communities to manage electricity demand growth and reduce their reliance on the provincial electricity grid, conservation cannot aid in the restoration of power to customers in the event of a major transmission outage. As such, conservation was not considered a feasible solution to address the restoration needs on the Cambridge-Kitchener 230 kV system.

6.3.2.2 Local Generation Options

The extent to which DG can restore electricity supply following a major transmission outage depends on a number of factors, such as the size of the facility, the facility's start-up time, the ramp rate, the availability of black-start capability, storage options, safety protocols and other operating procedures. Given the uncertainties and variability associated with DG, the Working Group agreed that it cannot rely on DG to address restoration needs on the Cambridge-Kitchener 230 kV sub-system.

A large, centralized, transmission-connected generation source (100-200 MW) could improve the restoration on the 230 kV system if properly sited and integrated (e.g., Preston TS and associated switching devices). However, given the high cost associated with large, centralized generation, this option is only cost-effective when it can contribute to both regional and provincial capacity and energy needs. It is not cost-effective to implement a large, centralized generation only for improving load restoration in a local area. This option was therefore ruled out by the Working Group.

6.3.2.3 Distribution Options

One method to restore electricity supply to customers following a major outage on the transmission system is to execute temporary load transfers through the distribution network to unaffected neighboring transformer stations. The amount of load that can be transferred temporarily through the distribution network, as well as the time required to transfer, are highly variable and can depend on various factors such as load level at neighboring stations, distance between stations, voltage of the neighboring distribution system, time of day and operating procedures in place on the distribution system. As such, the Working Group determined that it is difficult to rely on distribution load transfer to restore large amounts of load on the Cambridge-Kitchener 230 kV sub-system in the event of a major transmission outage.

6.3.2.4 Transmission Options

As discussed in Section 3.3, in 2013, the installation of a second 115 kV/230 kV auto-transformer at Preston TS and associated switching and reactive facilities was previously identified by the Working Group as a potential option to address the restoration needs on the Cambridge-Kitchener 230 kV sub-system. In response to the hand-off letter to undertake a detailed study

on the development of the second 115 kV/230 kV auto-transformer at Preston TS option,[16] Hydro One also identified and examined a number of alternatives to reduce the impact of supply interruptions to customers in Cambridge and Kitchener in the event of a major transmission outage on the 230 kV system. Based on Hydro One's analysis,[17] the installation of two 230 kV circuit switchers at Galt junction meets the ORTAC 30-minute restoration criteria on the Cambridge-Kitchener 230 kV sub-system, provides regional benefits, and strikes a reasonable balance between cost, reliability improvement, and feasibility. As such, the Working Group recommended proceeding with the installation of two 230 kV circuit switchers at Galt junction. Hydro One has begun early development work on these switching facilities, which are expected to be in service by spring 2017. Hydro One will continue to examine other potential measures to further improve the restoration capability in the Cambridge area. Please refer to Appendix C for further information regarding load restoration improvements for the Cambridge-Kitchener 230 kV sub-system.

6.4 Recommendations for the Near and Medium Term

Based on the evaluation of alternatives discussed above, the Working Group recommends the actions described below to meet the near-term electricity needs of the KWCG Region. Successful implementation of this plan will substantially address the regional electricity supply needs in the KWCG Region over the next 20 years.

To ensure that the near-term electricity needs of the KWCG Region are addressed, it is important that the near-term plan recommendations are implemented in a timely manner. The specific actions and deliverables associated with the near-term plan are outlined in Table 6-3, along with the proposed timing and the parties that will lead the implementation.

The KWCG Working Group will continue to meet at regular intervals during the implementation phase of this IRRP to monitor developments in the KWCG Region and to track progress toward these deliverables.

[16] OPA Letter to Hydro One - May 29, 2013 for the 2nd Preston Autotransformer: http://www.ieso.ca/Documents/Regional-Planning/KWCG/OPA-Letter-Hydro-One-KWCG.pdf

[17] Hydro One's Kitchener-Waterloo-Cambridge-Guelph area Adequacy of Transmission Facilities Report 2013/2014 report

Table 6-3: Implementation of the Near-Term Plan for the KWCG Region

Recommendations		Action(s)/Deliverable(s)	Lead Responsibility	Timeframe
1	Implement conservation and DG	Develop CDM plans	LDCs	May 2015
		LDC CDM programs implemented	LDCs	2015-2020
		Conduct Evaluation, Measurement and Verification (EM&V) of programs, including peak-demand impacts, and provide results to Working Group	IESO	annually
		Continue to support provincial DG programs	LDCs/ IESO	ongoing
2	Implement the GATR project	Design, develop and construct Seek project approval from the OEB (Leave to Construct application)	Hydro One	Submitted Leave to Construct application on March 8, 2013 Approved by the OEB on Sept 29 2013 In-service spring 2016
3	Install two 230 kV circuit switchers at Galt Junction and explore opportunities to further improve restoration capability in the Cambridge area	Design, develop and construct two 230 kV circuit switchers near Galt junction, near Highway 5 Examine cost and feasibility of potential measures to further improve restoration capability in the Cambridge area	Hydro One	In-service spring 2017

7. Long-Term Plan (2024-2033)

Given the uncertainty in forecasting demand beyond 2023, the purpose of the long-term plan is to consider alternate potential demand scenarios in order to facilitate discussions about how the KWCG Region may plan its future electricity supply, and to lay the groundwork for the next regional planning cycle. This section describes potential long-term needs, approaches to addressing these needs, and recommended actions.

7.1 Summary of Long-Term Needs

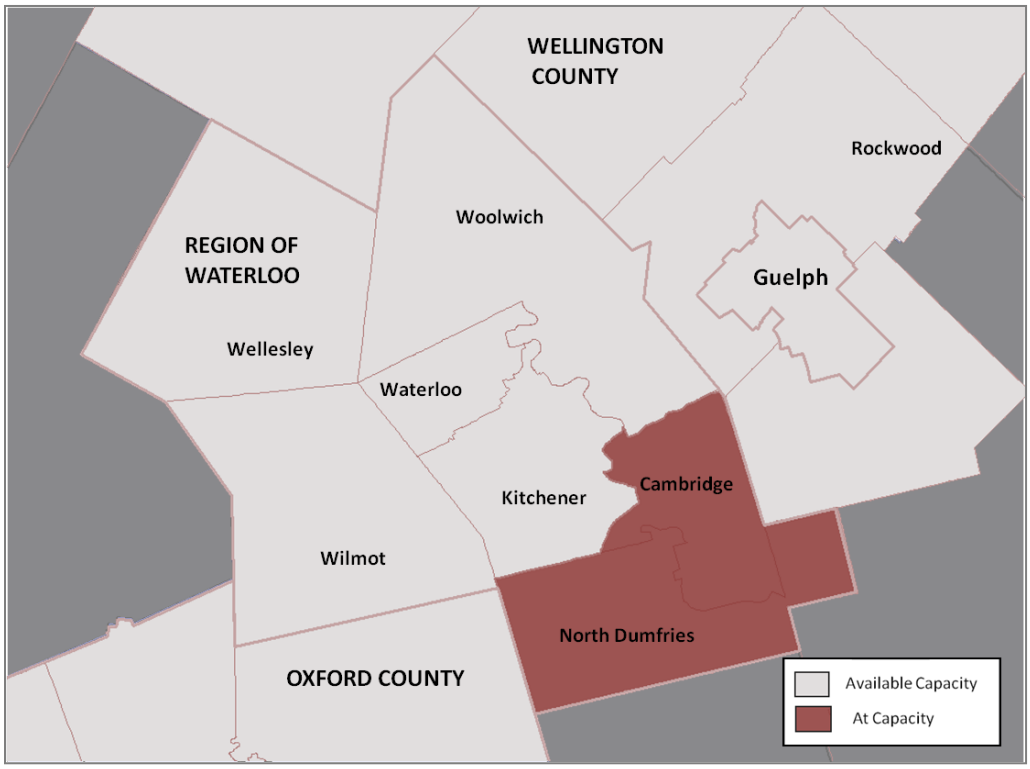
Using the needs assessment methodology outlined in Section 6.1, the KWCG Region was assessed under both of the long-term scenarios: the high-growth scenario and the low-growth scenario.

7.1.1 High-Growth Scenario – Long-Term Needs

Following the implementation of the near-term plan (Section 6.4), there will be sufficient supply capacity on the 115 kV and 230 kV systems over the long term to support the electricity demand growth projected under the high-growth scenario.

Although the 230 kV transmission system supplying customers in the Cambridge area is expected to approach its maximum capacity in the long term, as shown in Figure 7-1, future electricity demand growth in the Cambridge area can utilize the Kitchener-Guelph 115 kV sub-system as an alternative source of supply.

Figure 7-1: Remaining Transmission Supply Capacity 2024-2033



As discussed in Section 6.3.1, once the GATR project comes into service around 2016, there will be sufficient capacity on the Kitchener-Guelph 115 kV sub-system to supply up to 100 MW of peak demand growth in Cambridge over the longer-term. Therefore, no major regional supply and reliability needs are identified in the KWCG Region beyond 2023.

However, localized reliability and supply needs, such as TS capacity needs, may arise in the long term. LDCs are monitoring the load closely to determine the timing of potential transformation needs. Where possible, these LDCs are exploring opportunities to coordinate use and development of TS facilities in the KWCG Region over the long term.

7.1.2 Low-Growth Scenario – Long-Term Needs

Under the low-growth scenario, there is little incremental demand growth in the long term, and no additional needs are identified beyond 2023. Following the implementation of the near- and medium-term plan (see Section 6.4), the electricity system would have sufficient capacity to maintain reliability and manage the demand requirements under the low-growth scenario.

7.2 Approaches to Address Long-Term Needs

For localized needs developing over the long term, there is an opportunity to develop and explore a broader set of options, as specific projects do not need to be committed to immediately. Instead, the focus is on identifying possible approaches to meeting long-term needs, including alternatives that are not currently in widespread use but which show promise for the future. To facilitate these long-term options, preliminary actions should be taken to develop the identified alternatives, monitor growth, and engage with stakeholders and communities in the KWCG Region.

This approach is designed to maintain flexibility, avoid committing ratepayers to investments before they are needed, provide adequate time to gauge the success and future potential of conservation measures, test out emerging technologies, engage with communities and stakeholders, coordinate with any municipal or community energy planning ("MEP/CEP") activities, and to lay the foundation for informed decisions in the future. While it is not necessary to commit to specific projects given forecast uncertainty and technological change, the long-term plan identifies near-term actions to develop alternatives, engage with the communities, gather information and lay the groundwork for future options.

To facilitate discussions about how the KWCG Region may plan its future electricity supply and lay the groundwork for the next planning cycle, the Working Group examined three conceptual approaches to address potential long-term electricity needs in the KWCG Region: community self-sufficiency; delivering provincial resources ("wires" planning); and, large localized generation. In practice, certain elements of electricity plans will be common to all three approaches, and some overlap between them may be necessary. It is likely that all plans will contain some combination of conservation, local generation, transmission and distribution elements. The following section describes the attributes, benefits, risks and implementation requirements associated with each of the three long-term approaches.

7.2.1 Community Self-Sufficiency

The purpose of the community self-sufficiency approach is to reduce a community's reliance on the provincial electricity system by meeting their electricity needs with local, distributed resources and community-based solutions. This approach can include: aggressive DR and conservation programs, DG and advanced storage technologies, micro-grid and smart-grid technologies, and more efficient and integrated process systems combining heat and power and electric vehicles ("EV").

Community self-sufficiency can supplement and/or defer transmission or generation infrastructure development and improve energy security for communities by reducing their reliance on the provincial electricity system through conservation efforts and DG. This approach can be an effective means for addressing localized supply and reliability needs and managing a community's electricity demand growth over the long term.

This approach acknowledges community interest and the desire for grassroots involvement in local electricity planning and infrastructure siting. In recent years, a number of municipalities across the province began undertaking Municipal Energy Plans[18] to better understand their local energy needs, identify opportunities for EE and renewable energy, and to begin aligning their land use planning with energy infrastructure planning. With the self-sufficiency approach, commercial and industrial businesses, educational institutions, municipalities and community energy cooperatives have the ability to take greater ownership of their electricity needs and related infrastructure requirements.

Addressing the long-term needs of the KWCG Region through community self-sufficiency requires leadership from the community to identify local opportunities, to align community energy planning initiatives with the regional electricity planning process, and to develop appropriate local and provincial policy and incentives to guide the development of community-based energy solutions. This can be achieved through the development of municipal and community energy plans and increased coordination between the provincial, regional and municipal governments and local utilities.

As this approach relies on emerging technologies, recently, some communities and/or local utilities are taking action to examine the feasibility, scalability and cost-effectiveness of such technologies through the implementation of pilot projects. Going forward, regulatory guidance would be required to clarify cost recovery mechanisms for emerging technologies and to address the potential risk of stranding assets.

Communities and local utilities in the KWCG Region have become increasingly involved in the development of DG and conservation initiatives as a result of provincial procurement programs and conservation policy. The following sections provide an overview of the ongoing

[18] A Municipal Energy Plan is a comprehensive long-term plan to improve energy efficiency, reduce energy consumption and greenhouse gas (GHG) emissions.

community energy initiatives, policies and solutions being developed in the City of Guelph, Region of Waterloo, Wellington County and Oxford County.

City of Guelph

The City of Guelph places an emphasis on community-based energy management and solutions. According to the Guelph Community Energy Initiative, the City of Guelph has established ambitious goals to reduce energy use per capita, to encourage and facilitate community-based renewable energy systems and to reduce greenhouse gases ("GHG") over the next 20 years.

To facilitate the implementation of these goals under the Guelph Community Energy Initiative, the City of Guelph formed Envida Community Energy Inc. to develop and implement community-based electricity generation, thermal energy and energy management solutions. In recent years, Envida has successfully developed and implemented various district energy, combined heat and power, solar energy and bio-energy projects. Such projects include the Hanlon Creek Business Park District Energy System and Combined Heat and Power Project, the Eastview Landfill Gas Facility, and the Galt District Energy System in downtown Guelph. To facilitate the integration and optimization of these distributed resources, Guelph Hydro has been upgrading its smart grid.

In addition, Guelph Hydro and Envida have taken steps to better understand the potential and feasibility of community-based solutions and emerging technologies. Guelph Hydro conducted an Electric Vehicle Market Research Study in 2011 and was involved with an EV charging station pilot. As part of Guelph's District Energy Strategic Plan, Envida identified 10 potential areas for district energy development and set out a 20-year roadmap for district energy development in Guelph.

To facilitate EE improvements, the City of Guelph has established building codes and efficiency requirements on building renovations and implemented voluntary energy performance labeling in buildings.

Region of Waterloo

The Region of Waterloo released a Corporate Energy Plan for 2014-2024 to effectively manage the region's corporate energy use. Over the next 10 years, the region plans to pursue EE retrofits for buildings and renewable energy generation. The region's Energy Conservation Office ("ECO"), established in 2007, will play a leading role in implementing the goals as

detailed in the Corporate Energy Plan. To date, the ECO has implemented more than 130 conservation and DG projects across the region, including demand shifting, energy audits, building retrofits, and geothermal, biogas, landfill gas, solar heating and solar photovoltaic ("PV") installations. The ECO will provide information on new and emerging generation technologies to the region, by initiating new partnerships with cities and local organizations, attending relevant conferences, and reviewing research publications.

A Climate Action Plan was also developed for the region, as a collective direction for municipal and community leaders to investigate several strategies to reduce energy needs and increase local renewable energy generation. According to the plan, local building codes and standards are to be updated and improved in terms of energy efficiency, targeting building retrofits and new development. In order to help cover capital costs of building retrofits and renewable generation for homeowners, the region will consider using Local Improvement Charges as a funding mechanism. A district energy feasibility study will be conducted for the Region of Waterloo, to identify opportunities within the region for both homes and businesses. By installing public EV charging stations and raising awareness among the local residents, the region intends to have 1,000 EVs in the community. The application of geothermal energy, solar hot water systems and PV net metering solutions will be explored and developed through increased collaboration with LDCs.

The Community Environmental Fund in the Region of Waterloo has supported community-based environmental initiatives, such as supporting a solar thermal project and associated education workshops, and funding a green housing demonstration project combining passive and active solar design as well as integrated energy production.

To facilitate the integration and optimization of distributed resources, LDCs in the Region of Waterloo have invested in advanced smart grid technologies, such as automated switching, Supervisory Control and Data Acquisition ("SCADA"), and outage management systems.

Wellington and Oxford Counties

Both Wellington and Oxford Counties have recently published their Energy Management Plans that outline their goals and initiatives to monitor energy usage, reduce energy consumption and minimize carbon emission and environmental footprints in their communities. These initiatives include installing light emitting diode ("LED") streetlights, conducting energy audits in municipal-owned and high-energy consumption buildings and exploring opportunities for the development of DG in their communities. Today, Wellington County has 15 solar PV units

operating with revenues directed to the Green Energy Reserve, a fund for future green initiatives.

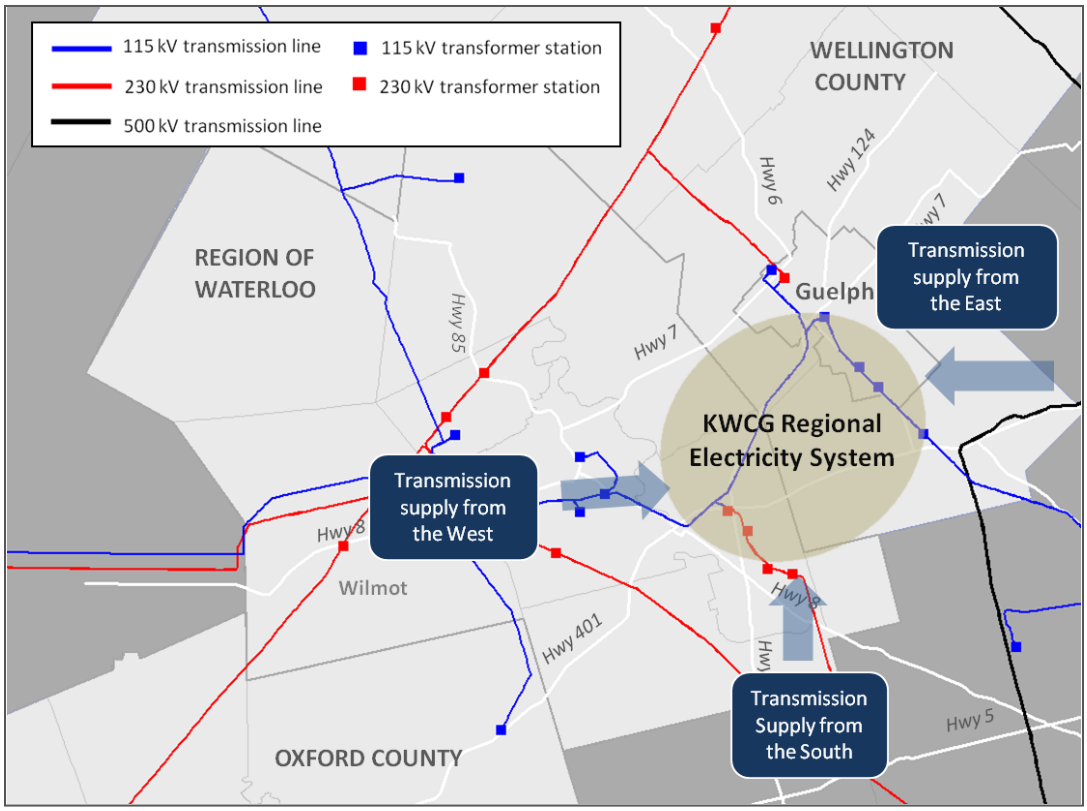
7.2.2 Delivering Provincial Resources ("Wires" Planning)

Delivering provincial resources, or "wires" planning, reflects the traditional regional electricity planning approach associated with the development of centralized electric power systems. This approach involves using transmission and distribution infrastructure to supply a region's electricity needs, taking power from the provincial electricity system. This model takes advantage of generation that is planned at the provincial level, with generation sources typically located remotely from the region. Utilities, both transmitters and distributors, play a lead role in the development of this approach.

Transmission and distribution enhancements, such as the installation of a TS, reactive support and switching facilities, can be an effective means for addressing localized supply and reliability needs in the KWCG Region in the long term.

Although it is not required at this time, a transmission line bringing supply from the west, south or east into the KWCG regional electricity system can be a potential option to address major regional supply needs (as shown in Figure 7-2), if such needs are identified in future planning cycles.

Figure 7-2: Potential Transmission Supply into the KWCG Region



Standard planning practices give preference to solutions that make use of existing corridors and brownfield sites, or that involve development of new joint-use corridors for linear infrastructure. Planning, coordination and engagement with local communities and key stakeholders are required to align land use planning and the siting of transmission and distribution infrastructure. Depending on the requirements and size of the transmission and distribution facilities, the lead time for transmission or distribution facilities is typically 5-7 years. These enhancements may be subject to regulatory approvals, such as a Class Environmental Assessment and a Leave to Construct application. The costs of "wires" solutions would depend not only on the specific infrastructure involved, but also on the cost of providing energy at the provincial system level. Cost responsibility for the transmission and distribution infrastructure would be determined as part of the regulatory application review process.

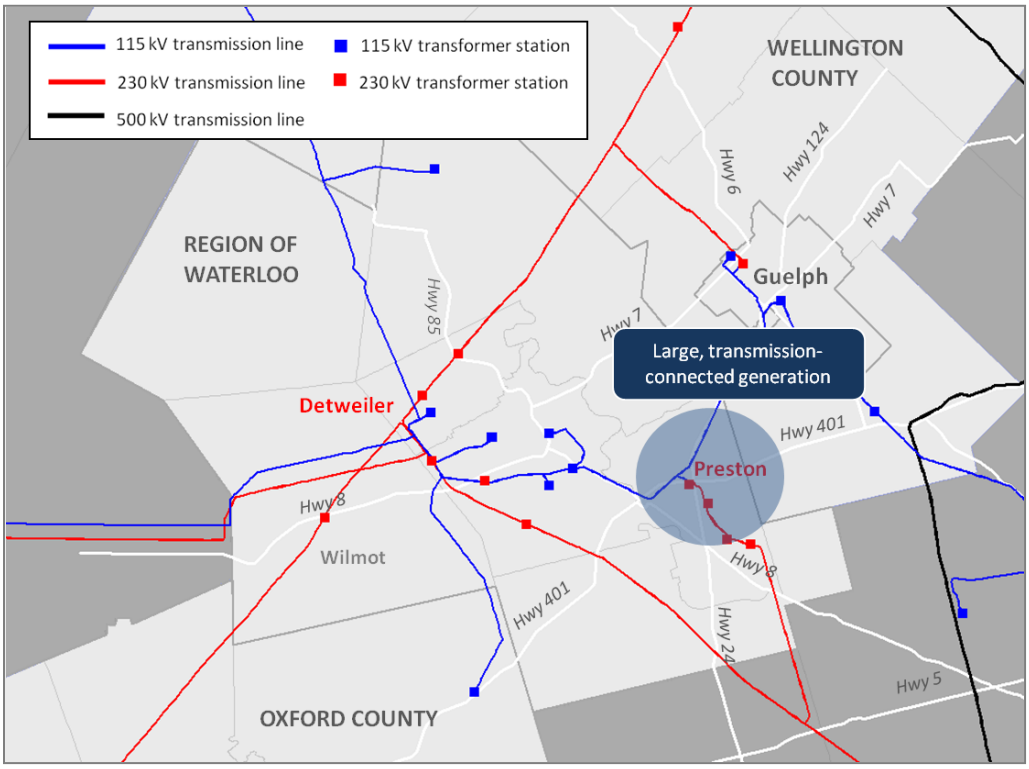
7.2.3 Large, Localized Generation Resources

Siting localized generation based on the size and location of the electricity requirements can be an effective means for addressing major regional supply and reliability needs over the long

term. While this approach is similar to community self-sufficiency in that it shares the goal of providing supply locally, the emphasis is on large, transmission-connected generation facilities rather than smaller, distributed resources.

In the context of the KWCG Region, a large, transmission-connected generation source can be sited near Cambridge (as shown in Figure 7-3) to address major regional supply needs, if such needs are identified in future planning cycles.

Figure 7-3: Large, Transmission-Connected Generation Option



There are a number of factors that need to be considered when siting localized generation, and any decisions about siting this generation would need to align with appropriate recommendations found in the August 2013 report entitled "Engaging Local Communities in Ontario's Electricity Planning Continuum"[19] that was prepared for the Minister of Energy by the OPA and the IESO.

[19] http://www.powerauthority.on.ca/stakeholder-engagement/stakeholder-consultation/ontario-regional-energy-planning-review

As the requirements in the KWCG Region are for additional capacity during times of peak demand, a large, transmission-connected generation solution would need to be capable of being dispatched when needed, and to operate at an appropriate capacity factor. In some cases, additional transmission reinforcements may be required to accompany the generation. In addition, siting may be a challenge if the generation is to be sited in densely populated and/or urban areas.

The cost of the centralized generation option depends on the size and technology of the units chosen, as well as the degree to which they can contribute to the local and provincial capacity or energy need. The lead time for generation development is typically 2-3 years, but it could be longer depending on the size and technology type.

7.3 Recommendations for the Long Term

While specific solutions do not need to be committed to today, it is appropriate to begin work now to gather information, monitor developments, engage the community and develop alternatives to support decision-making for the next iteration of the IRRP. The long-term plan sets out the near-term actions required to ensure that options remain available to address future needs, if and when they arise.

Localized reliability and supply needs may still arise in the long term under certain growth scenarios, but these potential needs do not require any immediate action. There may be opportunity for communities and local utilities to manage their future electricity demand through the development of community-based solutions. Communities and local utilities in the KWCG Region have become increasing involved in the development of DG and conservation initiatives. The results of early community-based pilot projects, energy conservation initiatives, and achievable potential studies will be an important input to the long-term plan for the KWCG Region and will be considered in the next iteration of the KWCG IRRP.

The recommended actions and deliverables for the long-term plan are outlined in Table 7-1, along with the proposed timing, and the parties assigned with lead responsibility for implementation. The KWCG Working Group will continue to meet regularly during the implementation phase of this IRRP to monitor developments in the KWCG Region and to track progress of these deliverables.

Table 7-1: Implementation of Near-Term Actions in Support of the Long-Term Plan for KWCG Region

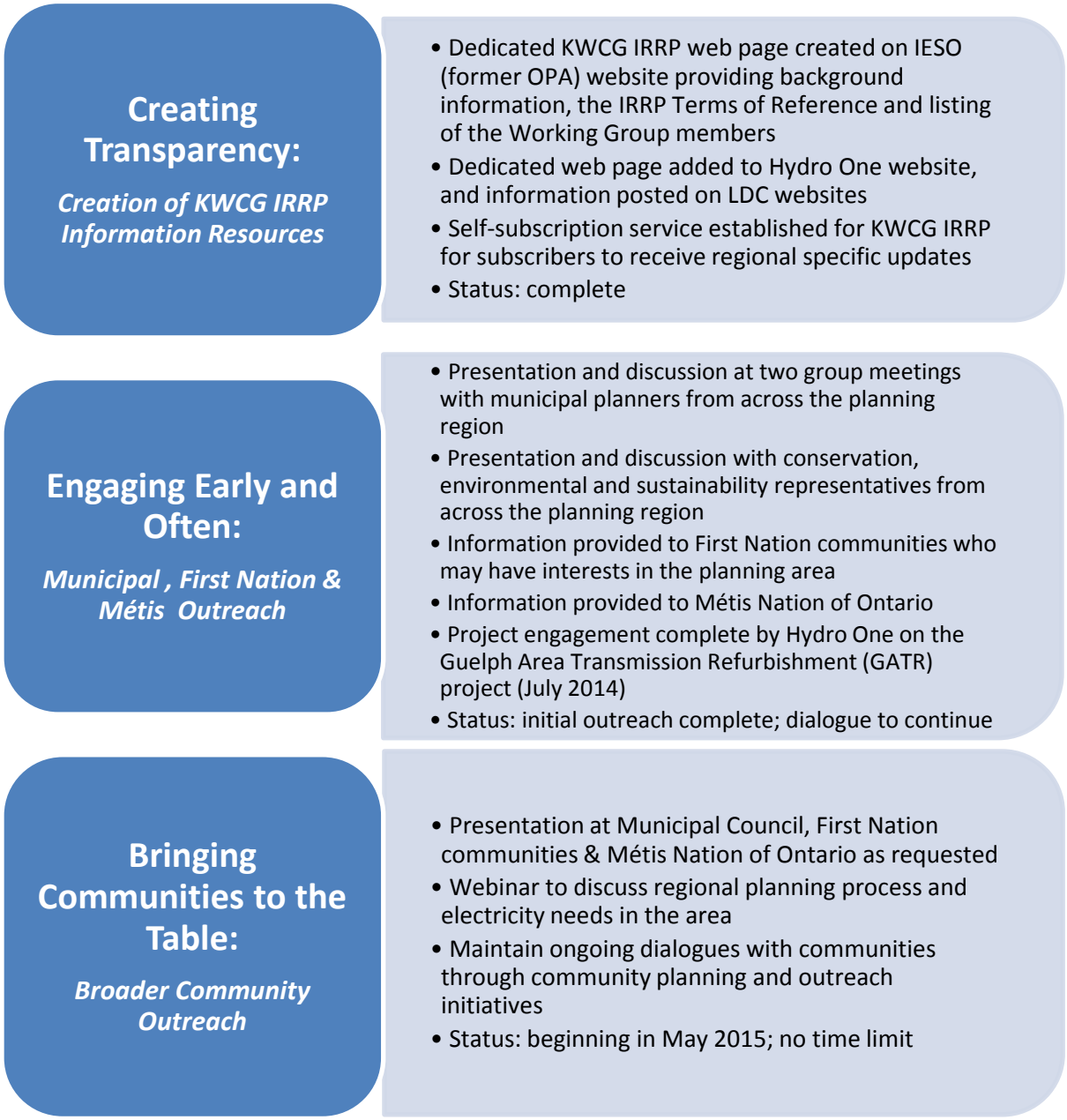
Recommendations		Action(s)/Deliverable(s)	Lead Responsibility	Timeframe
1	Maintain ongoing dialogues with communities about their future electricity supply	Engage with municipalities through community planning and outreach initiatives Engage with First Nations communities through community planning and outreach initiatives	IESO/LDC	2015-2020
2	Monitor load growth, CDM achievement, and DG uptake	Prepare annual update to the Working Group on demand, conservation and DG trends in the area, based on information provided by Working Group	IESO	Annually
3	Coordinate use and development of TS facilities	Monitor growth in respective service area Explore opportunity to coordinate use and development of TS facilities among the LDCs in the KWCG Region	LDCs	2015-2020

8. Community, Aboriginal and Stakeholder Engagement

Community engagement is an important aspect of the regional planning process. Providing opportunities for input in the regional planning process enables the views and preferences of the community to be considered in the development of the plan, and helps lay the foundation for successful implementation. This section outlines the engagement principles as well as the activities undertaken to date for the KWCG Region IRRP and those that will take place to discuss the long-term needs identified in the plan and obtain input in the development of options.

A phased community engagement approach has been developed for the KWCG IRRP based on the core principles of creating transparency, engaging early and often, and bringing communities to the table. These principles were established as a result of the IESO's outreach with Ontarians to determine how to improve the regional planning process, and they are now guiding the IRRP outreach with communities and will ensure this dialogue continues and expands as the plan moves forward.

Figure 8-1: Summary of the KWCG IRRP Community Engagement Process



Creating Transparency

To start the dialogue on the KWCG IRRP and build transparency in the planning process, a number of information resources were created for the plan. A dedicated web page was created on the IESO (former OPA) website to provide a map of the regional planning area, information on why the plan was being developed, the Terms of Reference for the IRRP and a listing of the organizations involved was posted on the websites of the Working Group members. A dedicated email subscription service was also established for the KWCG IRRP where communities and stakeholders could subscribe to receive email updates about the IRRP.

Engaging Early and Often

The first step in the engagement of the KWCG IRRP was meeting with representatives from the municipalities and the First Nations communities in the Region. For the municipal meetings, presentations were made to the KWCG Region municipal planners at two group meetings held in Kitchener and Guelph. The IESO held a separate meeting with representatives of the Six Nations Elected Council. During these meetings, key topics of discussion included Hydro One's Guelph Area Transmission Refurbishment Project (GATR), confirmation of the growth projections, discussion of the near- and long-term needs identified in the KWCG Region, a review of the identified near-term projects including those that have already begun due to timing requirements, and a discussion of the possible approaches to address long-term needs. The discussion also focused on ways to achieve greater community self-sufficiency in the long term, a topic which was also discussed at a separate meeting with conservation, environmental and sustainability representatives from across the planning Region. Invitations to meet to discuss the KWCG IRRP were also extended to the Mississaugas of the New Credit First Nation and to the Haudenosaunee Confederacy Chiefs Council, and the IESO remains committed to responding to any questions or concerns from these communities.

Over the last couple of years, Hydro One has undertaken engagement activities for the GATR project. Going forward, additional engagement activities may be undertaken for other near-term projects. Information on these project-level engagements will be provided on Hydro One's website and will also be listed on the IESO's KWCG IRRP main webpage.

Bringing Communities to the Table

This engagement will begin with a webinar hosted by the Working Group to discuss the plan and potential approaches of possible long-term options. Presentations on the KWCG IRRP will also be made to Municipal Councils on request. To maintain ongoing dialogues with

communities, the IESO and LDCs will continue to engage with First Nations, the Métis Nation of Ontario and municipalities through community planning, environmental and sustainability initiatives and broader community outreach such as, informational public open houses, in between the 5-year regional planning cycle.

Strengthening processes for early and sustained engagement with communities and the public were introduced following an engagement held in 2013 with 1,250 Ontarians on how to enhance regional electricity planning in 2013. This feedback resulted in the development of a series of recommendations that were presented to, and subsequently adopted by the Minister of Energy. Further information can be found in the report entitled "Engaging Local Communities in Ontario's Electricity Planning Continuum"[20] available on the IESO website.

Information on outreach activities for the KWCG Region IRRP can be found on the IESO website and updates will be sent to all subscribers who have requested updates on the KWCG IRRP.

[20] http://www.powerauthority.on.ca/stakeholder-engagement/stakeholder-consultation/ontario-regional-energy-planning-review

9. Conclusion

This report documents the IRRP that has been carried out for the KWCG Region and fulfills the OEB's regional planning requirement for the KWCG Region. The IRRP identifies electricity needs in the KWCG Region over the 20-year period from 2014 to 2033, and recommends a plan to address near-term needs and actions to facilitate discussions about how the KWCG Region may plan its future electricity supply over the longer-term.

Implementation of the near-term plan is already underway. Consistent with the Conservation First policy, LDCs are currently preparing CDM plans, which will be submitted to the IESO by May 2015. Concurrently, the GATR project has been approved and is expected to come into service in 2016. The early development work for the two circuit switchers on the Cambridge-Kitchener 230 kV sub-system is underway. The implementation of these near-term actions would substantially address electricity supply and reliability needs in the KWCG Region and there are no major regional needs identified beyond 2023. Early development work for major electricity infrastructure projects in the KWCG Region is not required at this time. Localized reliability and supply needs may still arise in the long term under certain growth scenarios, but these potential needs do not require any immediate action. There may be opportunity for communities and local utilities to manage their future electricity demand through the development of community-based solutions.

The KWCG Working Group will continue to meet regularly throughout the implementation of the plan to monitor progress and developments in the area, and will produce annual update reports that will be posted on the IESO website. To support development of the long-term plan, a number of actions have been identified to develop alternatives, engage with the community, and monitor growth in the area, and responsibility has been assigned to appropriate members of the Working Group for these actions. Information gathered and lessons learned from these activities will inform development of the next iteration of the IRRP for the KWCG Region. The plan will be revisited according to the OEB-mandated 5-year schedule.