FUTURE OF MICROGRIDS

COMMERCIAL & INDUSTRIAL

ADVANCED ENERGY CENTRE
MaRS Cleantech | Ontario, Canada

FUTURE OF MICROGRIDS SERIES OVERVIEW

Electricity distribution networks globally are undergoing a transformation, driven by the emergence of new distributed energy resources, including microgrids. However, with the majority of microgrids at the pilot and demonstration phase, this series will examine and forecast the commercial viability of microgrids right here in Ontario, and indicate factors that could result in deployment of these systems on fully commercial terms. The analysis, prepared with Navigant Consulting, also takes into account the non-financial factors affecting the overall business case for each microgrid use case, examined within the residential, institutional, utility, and commercial & industrial customer segments.

THE FUTURE OF MICROGRIDS SERIES WAS DEVELOPED WITH SUPPORT FROM OUR SPONSORS:

SIEMENS NRSTOR INC PowerStream TORONTO HYDRO ONTARIO POWER GENERATION

OVERVIEW

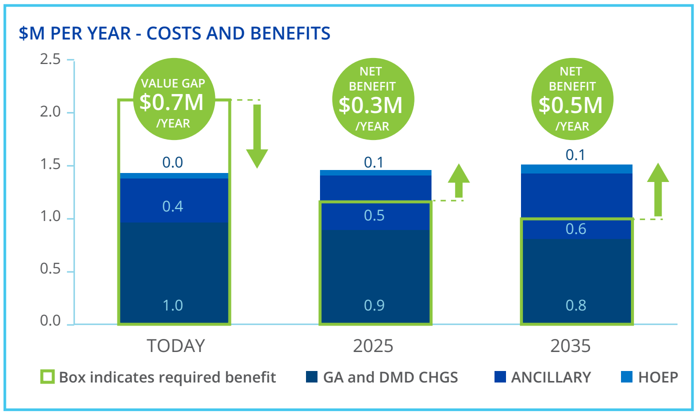
Commercial and industrial (C&I) customers are rethinking their role as traditional electricity consumers. A microgrid enables a C&I customer to become a fast-acting network resource, capable of responding to market signals and providing services to the electricity distribution and transmission network operators. A C&I microgrid consists of an advanced control system (or "controller") that integrates the customer's electrical loads, manages distributed resources such energy storage, and coordinates with the transmission and distribution networks. A C&I microgrid also provides emergency power to critical circuits during power outages, and reduces a customer's dependence on centralized electricity supply.

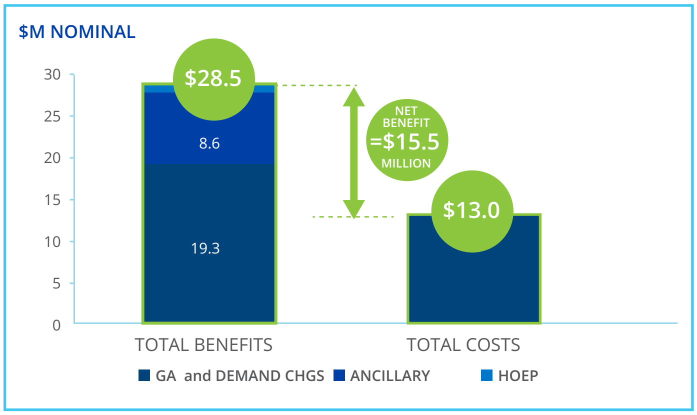
ASSUMPTIONS

This analysis is based on a Class A industrial customer operating a large manufacturing facility. The facility operates on a 24/7 schedule with a relatively flat load that averages 5MW throughout the year, and peaks at 6MW. The microgrid consists of a microgrid controller and a 5MW (10MWh) Li-ion battery. The microgrid controller, the battery, and the microgrid's switchgear enable the industrial facility to sustain power for critical systems during network outages. The battery is also used to reduce demand during Ontario system peaks in order to reduce GA charges, to participate in the operating reserve (OR) market administered by the transmission operator, and to provide demand response (DR) capacity.

RESULTS

The high costs of storage technologies make the deployment of industrial microgrids at scale more difficult today. However, the rapid decline in the cost of Li-ion battery storage is expected to result in a strong and positive business case for industrial microgrids in the near and long term. The value gap (the difference between the direct costs and the direct economic benefits) required to make industrial microgrids cost effective today is estimated to be $700,000 per year. By 2025, the business case becomes positive creating a net-benefit of $300,000 per year, increasing to $500,000 by 2035.





CONTINUED ANALYSIS

This analysis focused on high value opportunities, that is customers with characteristics that are favourable to the economics of an industrial microgrid.

The results presented above are based exclusively on the direct economic benefits of a C&I microgrid, and assuming the desired simple-payback period is seven years.

ASSESSING THE IMPACT OF ECONOMIC FACTORS.

DECLINING TECHNOLOGY COSTS. One of the key drivers of microgrid deployment will be the declining costs of storage technologies. Since 2010, the average cost of a large-scale energy storage system has decreased from $1,300/kWh down to approximately $740/kWh today – a 50% reduction. Storage costs are projected to continue to decrease substantially over the next two decades down to $230/kWh by 2035.

MAGNITUDE OF GA CHARGES. The largest economic benefit stream for a C&I microgrid in Ontario is avoided Global Adjustment (GA) charges. GA costs are the largest component of the electricity bill of most C&I customers. Class A C&I customers pay GA charges in proportion to their contribution to Ontario's top five system peaks. A customer able to decrease demand during those system peak hours can reduce their GA charges. A key implication of the way GA charges are calculated for Class A customers is that charges are determined based on a very small number of hours of the year. As a result, the financial incentive to reduce demand during each of the system peaks is substantial. In 2011, the financial incentive averaged approximately $220,000 per MW of demand reduction. Since then, the financial incentive has increased to close to $500,000 per MW.

GA RESPONSIVE BEHAVIOR. Forecasting the occurrence of system peaks is complex, given the inherent uncertainty of electricity consumption hour to hour and the added intricacy of a number of large customers reducing their consumption on expected peak days in an effort to reduce their GA charges. Most industrial customers hedge the risk of missing the peak by responding on more than five days and for several hours ahead of a potential system peak, and several hours after. Certain industrial customers may respond to +/- three hours around a potential system peak, and others –willing to take on more risk– may limit their response to +/- one or +/- two hours. The duration of a customer's response has direct implications on the amount of battery capacity discharged in each hour. A short response duration will achieve a higher load reduction, while a longer response will achieve a lower reduction. This analysis is based on a battery size of 10 MWh and an average response of +/- two hours –for a total response duration of five hours. In effect, this industrial customer is able to achieve a 2 MW demand reduction during each hour.

ELECTRICITY SECTOR EVOLUTION. The evolution of the Ontario electricity market and regulatory framework has the potential to create a more favourable market for microgrid deployment. A C&I microgrid, has sufficient scale to deliver value to utilities. A C&I microgrid can be transformed into a flexible and fast-acting resource, capable of decreasing local system constraints and providing ancillary services such as voltage or power quality support to network operators.

THE VALUE OF IMPROVED RELIABILITY. One of the key drivers of microgrid adoption by C&I customers is the prospect of improved reliability. C&I customers can incur significant financial losses – from lost production and sales – as a result of power interruptions, and increasingly due to power quality issues, as a result of the increased use of sensitive power electronic equipment. Interruption costs can vary widely for different C&I customers. Some C&I customers, such as a semiconductor or plastics manufacturer, may be particularly sensitive to power interruptions and may incur interruption costs in excess of $1.0 million per year. These customers will evaluate the adoption of a microgrid not only based on the direct economic benefits but also on the value of improved grid reliability and power quality. Industrial customers incurring annual interruption and power quality costs higher than the current gap in economic benefits – estimated at $700,000 per year– will be able to justify the investment and are likely to lead the adoption of C&I microgrids in Ontario.

THE VALUE OF INTEGRATING DIVERSE RESOURCES AND TECHNOLOGIES. One of the key characteristics of a microgrid is the ability to integrate multiple distributed energy resources and enabling technologies, including demand response, energy management systems, and distributed generation. This functionality has emerged as a major factor that can enhance the economics of C&I microgrids. This diagram shows a qualitative assessment of the impact of several key factors -including distributed resources, technology costs, and market transformation- on the business case of industrial microgrids.

QUALITATIVE IMPACT OF DER AND OTHER FACTORS

⬆ Smart DR & Load Control	⬆ Energy Management Systems
⬆ Smart EV Charging	⬆ Declining Technology Costs
⬆ DG Integration	⬆ Market Transformation
⬇ Anti-Islanding Provisions	⬇ Lack of Market Transformation

The Advanced Energy Centre is a independent non-profit catalyst for adoption of innovative energy technologies, hosted at the MaRS Discovery District in Toronto, Canada. We facilitate solutions-based approaches to addressing today's energy challenges, by collaboratively identifying systemic barriers with industry, and providing a linkage to Canadian energy technology entrepreneurs.

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