FUTURE OF MICROGRIDS

COMMUNITY

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.

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OVERVIEW

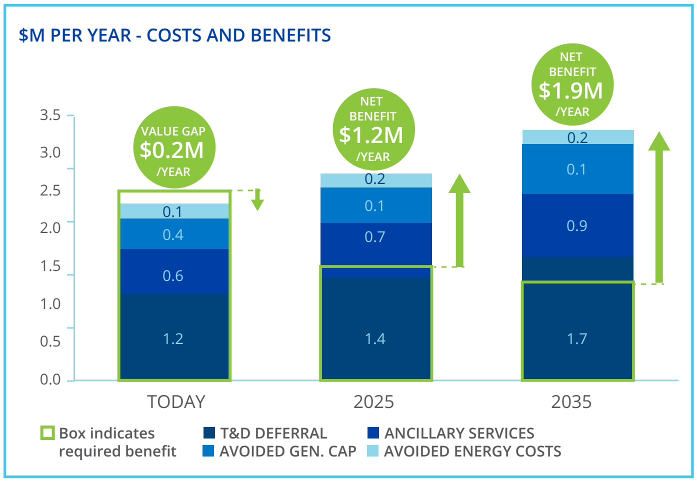
Community microgrids have achieved significant traction in the microgrid market. In response to extreme weather events, states like New York, Massachusetts, and Connecticut have allocated funding to assess the feasibility of community microgrids for emergency resiliency. At the same time, utilities are beginning to look at community microgrids as an alternative to traditional poles-and-wires solutions for heavily loaded distribution feeders and substations. A community microgrid consists of an advanced control system (or "controller") that integrates customer loads and manages distributed resources, and is capable of providing services to the electricity distribution and transmission network operators.

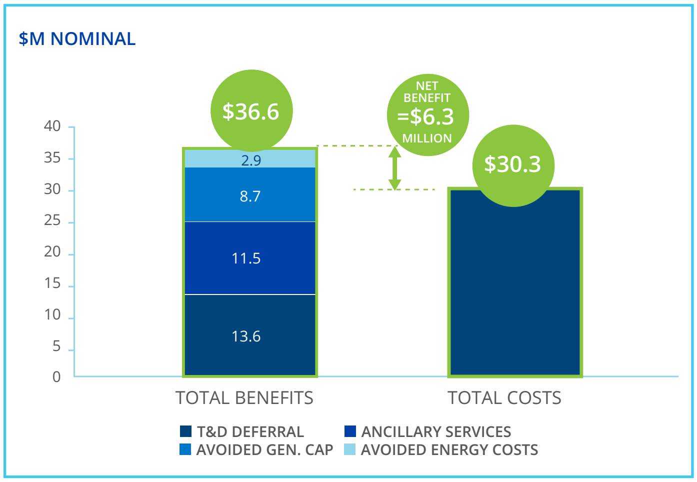
ASSUMPTIONS

This analysis is based on a utility-owned and operated microgrid. The microgrid consists of a distribution feeder serving part of the downtown core of a mid-size Ontario city. This feeder serves a mix of residential apartment buildings and office space with a 12 MW peak. The microgrid consists of a microgrid controller, a 5MW (10MWh) Li-ion battery, a 2MW solar array, and approximately 1MW of remote-controlled demand response (DR) capacity. The battery is primarily used to reduce the local distribution peak and to deliver grid services, and is also used in conjunction with the microgrid controller, and the microgrid's switchgear to sustain power during network outages.

RESULTS

The high costs of solar and storage technologies make the deployment of industrial microgrids at scale more difficult today. However, rapid declines in the cost of solar PV and Li-ion battery storage are expected to result in a strong and positive business case for community microgrids in the near and long term. The value gap required to make community microgrids cost effective today is estimated at $200,000 per year. By 2025, the business case becomes positive creating a net-benefit of $1.2 million per year, increasing to $1.9 million by 2035.





CONTINUED ANALYSIS

This analysis focused on high value opportunities, that is communities and network areas with characteristics that are favorable to the economics of a community microgrid.

The results presented above are based exclusively on the direct economic benefits of a community microgrid, and assessed based on a desired payback period of 10 years.

ASSESSING THE IMPACT OF ECONOMIC FACTORS.

DECLINING TECHNOLOGY COSTS. One of the key drivers of microgrid deployment is the cost of solar and energy storage technologies. Since 2010, the average costs of large-scale solar PV systems have decreased from $4.2/watt down to approximately $2.3/watt today. Solar costs are projected to decrease substantially over the next two decades down to $1.2/watt in 2035. The costs of large-scale Li-ion battery storage systems are also projected to decline rapidly, from $740/kWh today down to $230 in 2035.

VALUE OF DEFERRED T&D INVESTMENTS. The largest source of value for community microgrids is from deferred or avoided T&D infrastructure investments. The marginal costs of T&D infrastructure capacity required to serve load growth in capacity-constrained areas can be substantial. These areas will require infrastructure upgrades in the near term and the development of a microgrid may be a more cost effective alternative to T&D upgrades. Highly-loaded distribution feeders and substations operating close to or at their maximum capacity are high-value opportunities for microgrid deployments. This analysis is based on a constrained 12 MW distribution feeder projected to trigger upstream upgrades at an average cost of $450 per kW of additional peak demand. Upgrade costs of this magnitude are not uncommon. Costs in severely constrained areas may be in excess of $600 per kW of demand.

NON-WIRES ALTERNATIVES (NWA) TO TRADITIONAL SOLUTIONS. Non-wires alternatives are an innovative approach to deal with capacity constraints. Instead of traditional, and at times costly, T&D investments, load growth can be met through more innovative solutions such as targeted energy efficiency and demand management, and distributed energy resources (DER). The analysis of this community microgrid is based on the use of a 5MW battery, a 2MW solar array, and 1MW of remote-controlled DR capacity, including direct load control of space cooling and water heating equipment, and smart thermostats. The microgrid controller optimizes the dispatch of these resources enabling a combined peak demand reduction of approximately 4MW. This decrease in peak demand enables the community microgrid to defer planned distribution upgrades by five years and planned transmission upgrades by one year.

One of the most well-known and publicized utility-owned community microgrid projects is San Diego Gas & Electric's Borrego Springs project. Borrego Springs boasts the integration of utility-owned and customer-owned DERs, price-responsive and remote-controlled DR, distributed storage devices, and plug-in hybrid vehicles.

ELECTRICITY SECTOR EVOLUTION. The evolution of the Ontario electricity market and regulatory framework has the potential to create a more favorable market for the development of community microgrids. A community microgrid can deliver significant value to a utility. Community microgrids can be transformed into flexible and fast-acting resource, capable of decreasing local T&D and system peaks and capable of providing ancillary services to network operators.

THE VALUE OF IMPROVED RELIABILITY. One of the key driving factors for the development of community microgrids is the prospect of increased grid resiliency and reliability during severe storms. During natural disasters or extreme weather, community microgrids can island from the macrogrid and provide emergency power to mission-critical facilities. For example, in the wake of Superstorm Sandy, New Jersey established a microgrid fund to assess the feasibility of community resiliency microgrids and hubs across the state. Several other states have since followed suit.

THE VALUE OF INTEGRATING DIVERSE RESOURCES AND TECHNOLOGIES. Community microgrids are characterized by the ability to integrate various DERs, and enabling technologies including utility- and customer-owned solar PV, smart DR loads, energy efficiency, electric vehicles, battery storage, and home energy management systems. The ability to seamlessly integrate various technologies has emerged as a key factor to enhance the economics of community 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 community microgrids.

QUALITATIVE IMPACT OF DER AND OTHER FACTORS

↑ High Value T&D Infrastructure	↑ Declining Technology Costs
↑ Smart DR & Load Control	↑ Market Transformation
↑ Smart EV & DG Integration	
↓ 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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