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Microgrid Solution In-A-Box

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The world of energy is undergoing a massive transformation. Energy has historically been centralized coming from traditional energy sources and being distributed through one-way electrical grids. The new world of energy will have decentralized generation, the addition of intermittent renewable sources (i.e. solar, wind) and a two-way flow of decarbonized energy. These new energy sources will come with an increasing engagement from demand-side consumers.

The new grid will be considerably more digitized. It will be more flexible, dynamic, and connected. There will be increased requirements for energy performance in a world where electricity takes a higher share of the full energy mix. At Schneider Electric, we consider access to energy as a basic human right. We work towards achieving universal energy access by ensuring access to affordable, reliable, sustainable and modern energy for all.

The rise of distributed energy resources (DER) is increasing the grid complexity, evolving the industry from a traditional value chain to an interconnected digital business model. Retail customers are requiring that their energy choices are safe, reliable and green and include efficiency information with digital technology.

The grid is transforming with variable generation and unpredictable EV load. With this new energy transformation and renewable integration, microgrid operation is becoming a key player in the "new distributed generation". According to one industry source, world energy consumption will rise by nearly 50% between 2018 and 2050. Buildings account for about 30% of final energy use and more than 55% of global electricity consumption. While we are trying to supply the increasing energy demand, we recognize that buildings, with a share of 28%, are a major contributor to global energy-related CO2 levels.

Electrical Energy transformation:

Canadian industries and small/medium businesses want to maximize their energy independence and minimize their carbon footprint. Canada is focused on clean energy and striving to have 90% of their electricity come from non-emitting sources by 2030. In Canada an energy transformation is happening. We can observe this change through four drivers (we can say 4 E's).

Environment:
In recent news, the Canadian government will be bringing forward a plan to exceed Canada's 2030 climate goal. The government will also like to legislate Canada's goal of net-zero emissions by 2050. As part of its plan, the government will:

- Create thousands of jobs retrofitting homes and buildings, cutting energy costs for Canadian families and businesses
- Invest in reducing the impact of climate-related disasters, like floods and wildfires, to make

communities safer and more resilient
- Help deliver more transit and active transit options
- Make zero-emission vehicles more affordable while investing in more charging stations across the country.

Remote Communities in Canada located primarily in the North do not have Microgrid systems. Approximately 292 Remote Communities use diesel to generate electricity. That would amount to approximately 90 Million Lit diesel consumption in those communities. These communities provide a great opportunity for emission reduction.

Energy Generation Mix:
Environmentally friendly DER is one way to considerably reduce CO2 emissions. But, at the same time, they highly complicate electrical distribution system operations. Renewable DERs are variable by nature and the periods of usage of EVs are difficult to predict, these new resources can negatively impact reliability and power quality.

There has been substantial progress in decentralizing energy resources, such as solar energy and battery storage systems. However, these lead to variable generation which makes it difficult for the utilities to provide electricity to a larger number of people, with high resiliency. Canada is adding more renewable energy with a goal of getting to 32 GW. This will bring the Canadian Renewable Energy Capacity by 2040, to a ~70% increase from 2018.

Energy Cost:
When you think of energy cost, there are two parts that need to be considered. The first part is the Outage Cost and the second part is Energy Bills. According to one industry analysis, the true cost of power outages in Canada is around CAD$12 billion in 2018. Producing electricity using exclusively diesel generators comes at a significant cost. We have an opportunity reduce the energy bills for both Industry and Residential customers. We are witnessing a downward trend in the cost of solar and wind power. This makes them more competitive in generating electricity compared to fossil fuels.

All of the factors above are contributing towards migration from the old hierarchical method of energy generation and consumption towards a more prosumer driven hybrid approach.

Electrification of Transportation:
Transportation accounts for around 24% of greenhouse gas (GHG) emissions in Canada. We can reduce the amount of transportation-related GHG emissions by having more zero-emission vehicles (ZEVs) on the road. As we see this shift, focus on transportation will have greater impact on meeting 2030 GHGE targets. Canada is committed to decarbonizing the country's transportation sector and becoming a global leader in zero-emission vehicles. Canada is setting ambitious country-wide targets, encompassing battery electric vehicles, hydrogen fuel cell electric vehicles and plug-in hybrid electric vehicles.

Solution Overview:

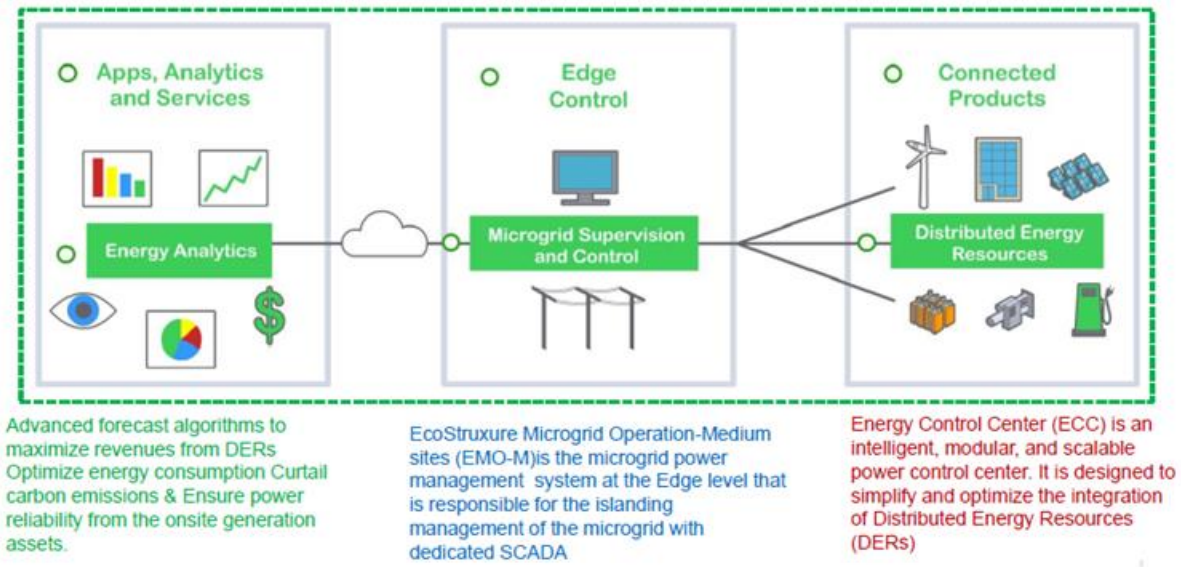
Medical facilities, universities, offices, shopping complexes, resorts, and even micro-communities are making significant investments to become less dependent on the traditional power grid. They have begun employing various distributed energy resources (DERs) such as gensets, windmills, solar panels, and fuel cells to meet their sustainability goals. In many electric systems worldwide, the utilization of DERs are increasing. This increase brings different challenges for electricity system management; however, with Microgrids, the flexibility of those DERs can be well managed.

A Microgrid is a local, interconnected energy system with loads and distributed energy resources within clearly defined electrical boundaries. It is connected to a traditional grid, and operates in islanadable mode, or completely off-grid. The operation modes are to be chosen based on the values of the end-user.

EcoStruxure™ Microgrid Solution is a pre-packaged solution for Small & Medium Buildings with advanced controllers (EMA and EMO-M) fitted in the Energy Control Center. EcoStruxure Microgrid Advisor (EMA) is responsible for the economic dispatch, while EcoStruxure Microgrid Operation – Medium Sites (EMO-M) maintains the stability of the site. It facilitates easy integration of DERs (PVs, EVs, generators, and batteries) at the customer site through the intuitive web-based configuration tool EcoStruxure Microgrid Build that helps to configure the customer's system with minimal effort.

Microgrid Solution in the Energy Control Center

EcoStruxure Microgrid Solution for Buildings is a pre-packaged solution with advanced controllers (EMA and EMO-M) fitted in the Energy Control Center—resilience to renewable integration



The data-driven analytics from customer DER's & EVs can provide the foundational intelligence for new microgrid control systems. We can maximize the operational performance of assets, optimize load and meet end users' needs to provide new services as well as new revenue streams. By collecting data (such as electricity price, facility demand and vehicle battery state of charge), and calculating optimal plans considering specific objectives and operational constraints, the microgrid control system makes the 'best' near real-time decisions based on complex analytics. For this reason, the microgrid controller should be able to interact with a cloud- based solution for predictive control, as well as the connection with the utility. This will increase the reliability and accuracy of decisions taken and optimize the DER usage. The cloud-based platform also integrates weather forecasts and can respond to utility's requests (such as demand response).

We want to create more accessible buildings by utilizing DER and EV charging stations. This will help reduce battery range anxiety for EV drivers and support Canada's 2030 Climate Goal of increasing EV adoption to reduce GHGE Emissions.

Building Owners are seeking simple solutions to implement DER's use and EV charging systems that manage electricity demand and energy costs. They would like to provide their occupants with the technologies they need to confidently drive their EVs to and from work. As the use of EVs becomes more common in Canada, increased load from vehicle charging will need to be managed to reduce

costs to building owners and utilities. Electric vehicle (EV) smart charging systems balance the electricity needed to serve the building, mitigate potential cost increases and provide an easy and accessible charging solution for occupants that encourages the adoption of EV technology.

Monitoring and Forecasting

The cloud-based platform EMA allows the site manager to visualize his site and his DER remotely, from anywhere with an internet connection using a computer, tablet, or smartphone.
Monitoring and Forecasting of all the DER connected to the platform are done within a 15 minutes refreshment rate.

It can monitor:

- How the DERs are performing
- The forecasted energy production / consumption
- The comparison between forecasted and actual values
- The different costs and savings/earnings

Each DER energy consumption / production can be seen at different time frame:

- In the past
- In real time (update every 15 minutes)
- In the future, with a forecast of energy production / consumption for the next 24h

It can export data in an excel file to perform deeper analysis

Example

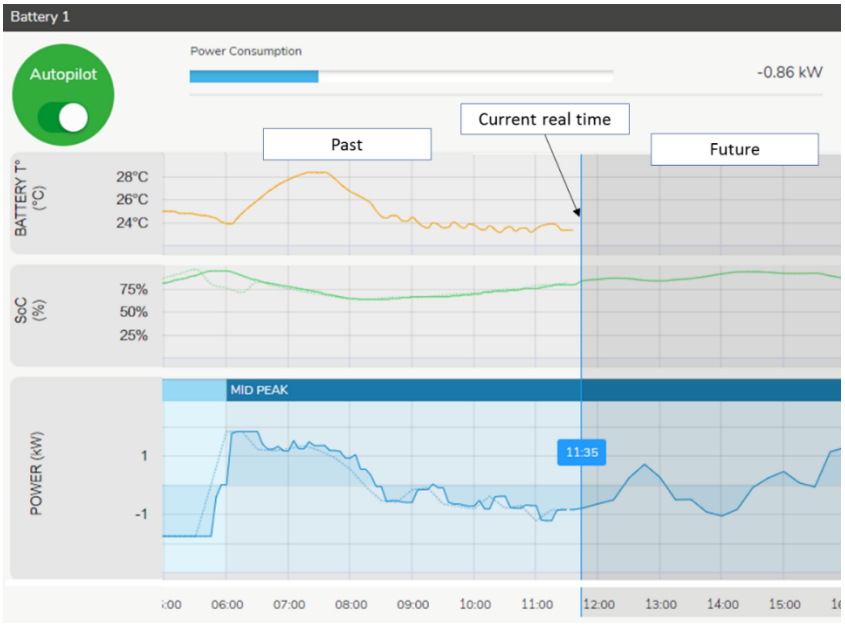


Figure 1 - Monitoring and Forecasting Use Case Example

Demand Charge

Control Distributed Energy Resources (DER) for reduce site power consumption during peak periods. To reduce the demand charge part of the bill, EcoStruxure™ Microgrid Advisor can leverage the DER flexibility to reduce the consumption peak of the facility (peak shaving) and therefore reduce the demand charge for the customer. The EMA Controller Box will curtail available DERs depending on their DC flexibility rank; DERs with a smaller DC Flexibility rank are curtailed at first. DC Flexibility rank parameter is defined in the EMA cloud application for each site at commissioning phase.

Example

When the site energy consumption is going to reach a power limit (defined by the customer or automatically set up by EMA) then EMA decides to:

- Curtail loads
- Discharge an energy storage system
- Start a local production source

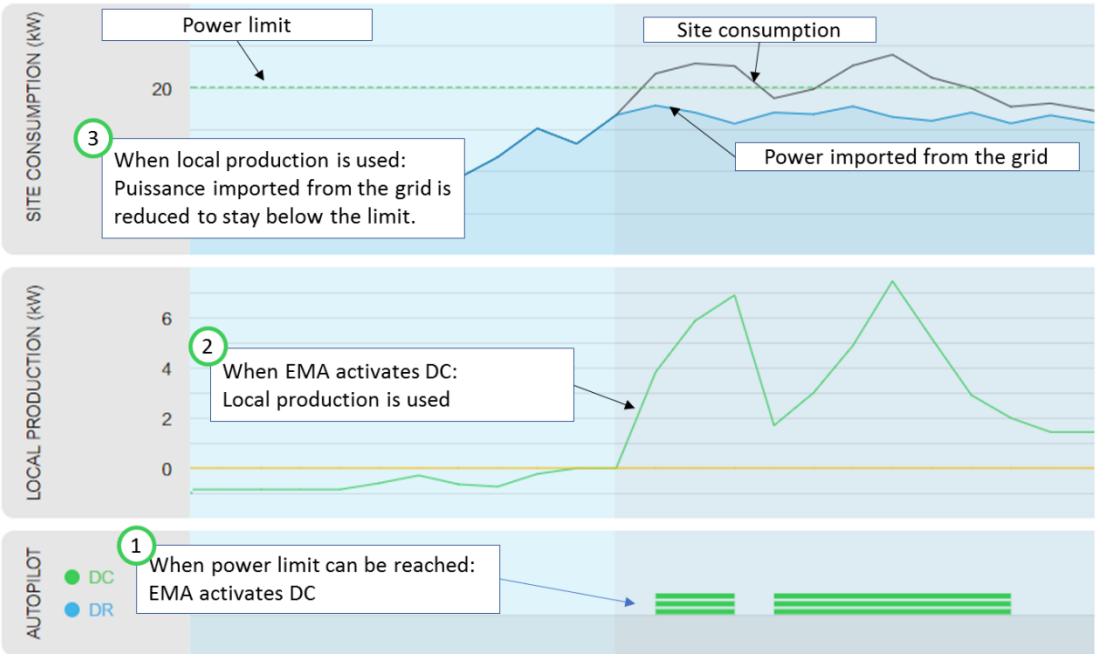


Figure 2 - Demand Charge Use Case Example

Demand Response

EMA can be used to perform Demand Response events. To do so, it must be connected to a utility or a commercial aggregator platform which can monetize demand response orders.

Demand Response can be performed in an innovative way with EMA due to its forecasting capabilities. EMA predicts the future flexibility of different DERs, the software can propose to the utility or commercial aggregator flexibility tenders that can be accepted or rejected. If they are accepted, then EMA will execute the DR orders to the DER through the Controller Box. The validation of actual execution of DR is made by the DERMS using its baseline calculation.

Considering the historical data, EMA will forecast the available volumes of Demand Response for the next 24 hours. These available volumes are aggregated by EMA as 24 blocks of 1 hour each. These blocks must be activated at least 30 minutes before activation time.

The volumes of load curtailments will be calculated by EMA for the next 24-hourly buckets. Each 1-hour bucket will be determined independently from the neighboring hourly buckets. This is a theoretical flexibility availability, because if a load reduction is activated on one hourly bucket, it affects the availability of load reduction of the neighboring hourly buckets (typically the previous hour and the following hour).

Example

EMA proposes a tender of 100kW for 1 hour to a commercial aggregator. The commercial aggregator accepts the offer. Then EMA sends this order to EMA Controller. The loads will then be curtailed, production sources will be turned on and energy storage system will be discharged after reaching the 100kW for 1 hour.

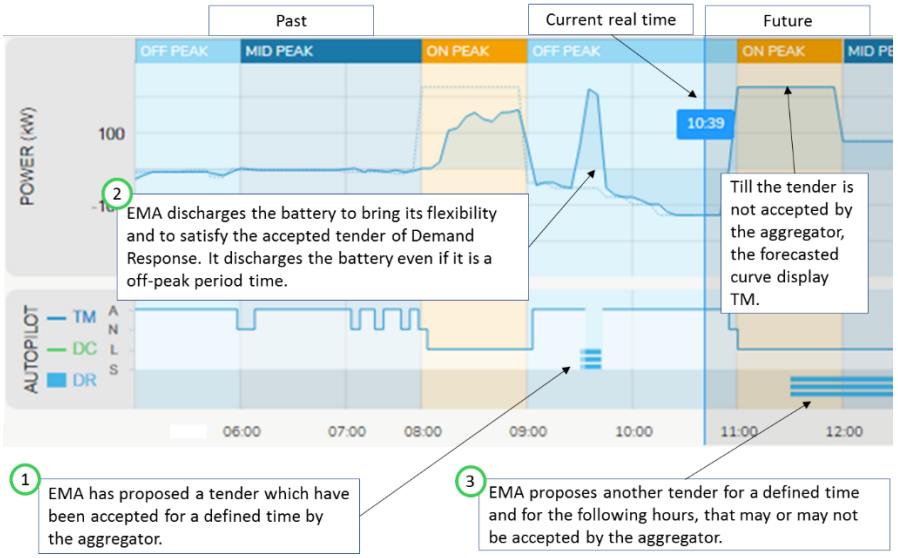


Figure 3 - Demand Response Example

Tariff Management

Tariff Management consists of controlling DER according to the variable electricity tariff rate. In this case, EMA will reduce the energy consumption of the site and increase the site's energy production during the expensive tariff period. Then it will increase the site's energy consumption and decrease the site's energy production during the off-peak
period. These actions would be made while considering the comfort of the site occupants.

Example

EMA consumes energy from the grid when it is cheaper and then will use a local source during peak hours.
Another way is to charge an energy storage system during off peak hours and discharge it during peak hours.
It is possible to also use the thermal inertia of the building to shift the HVAC energy consumption.

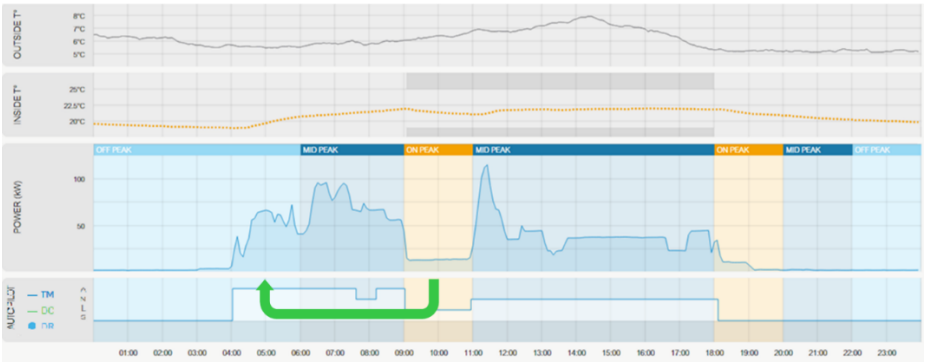


Figure 4 - Tariff Management Use Case Example

Microgrids transform the way we use energy. Instead of centralized power plants and distributed grids, microgrids

will be located close to consumers load. They create the possibility of a truly decentralized, decarbonized, and digitized energy future.

Contact our Microgrid Specialist at any time to ask questions, get a quote, or just to learn about available microgrid solutions

Pratap Revuru
Director of Micro-Grid Solutions and Strategic Partnerships
Schneider Electric
pratap.revuru@se.com