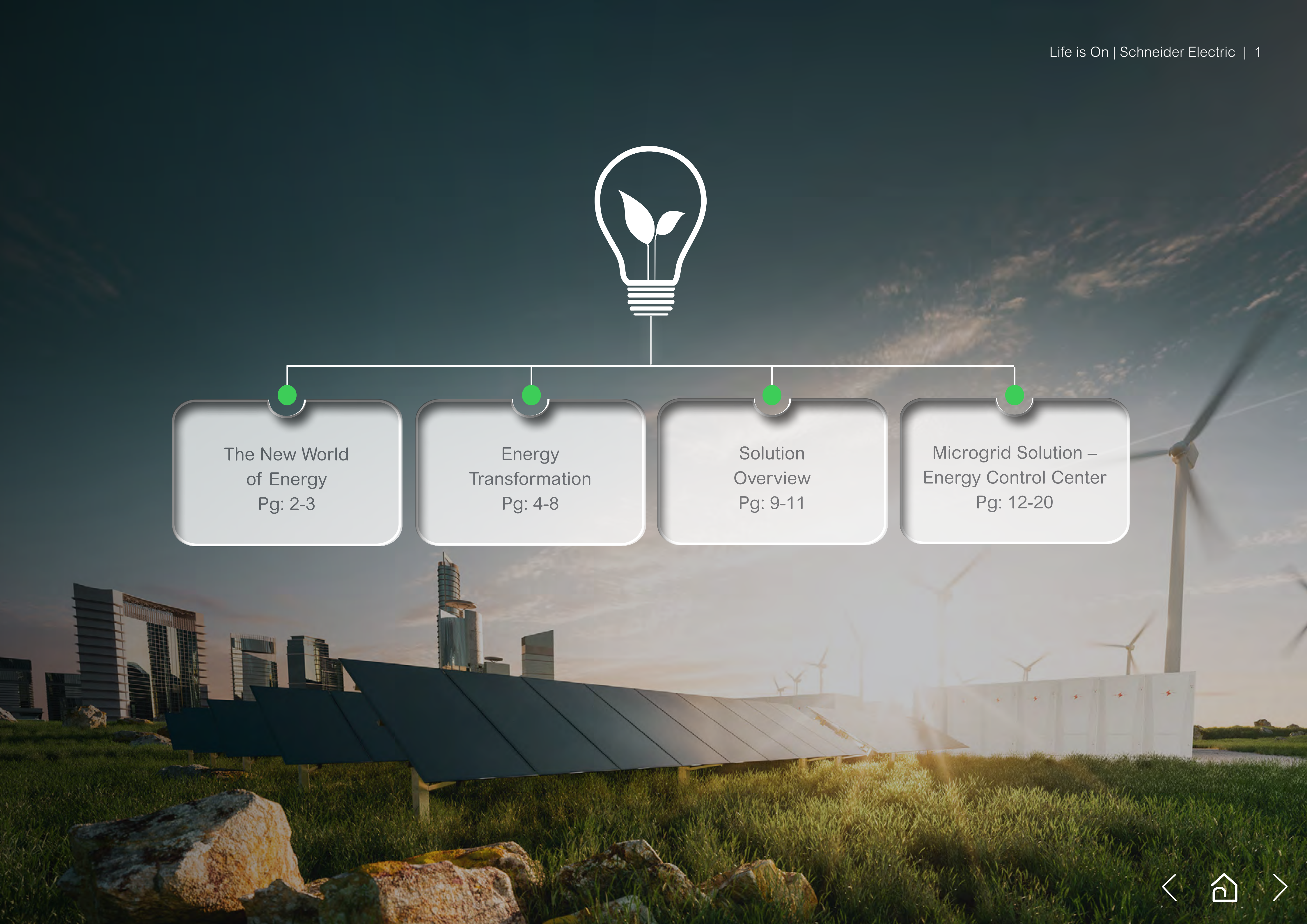
EcoStruxure™ Microgrid Solution

Microgrid in a Box

Future-proof your site with a fully integrated and ready to use microgrid solution, designed specifically for Buildings and Communities.

se.com/ca/microgridsolutions

Life Is On | Schneider Electric



The world of energy is undergoing a massive transformation

Energy has historically been centralized – generated from traditional energy sources, and distributed through one-way electrical grids.

The new world of energy is increasingly decentralized yet connected, intermittent renewable resources like solar and wind are seeing widespread adoption, and the flow of decarbonized energy is bi-directional between smart supply and smart demand.

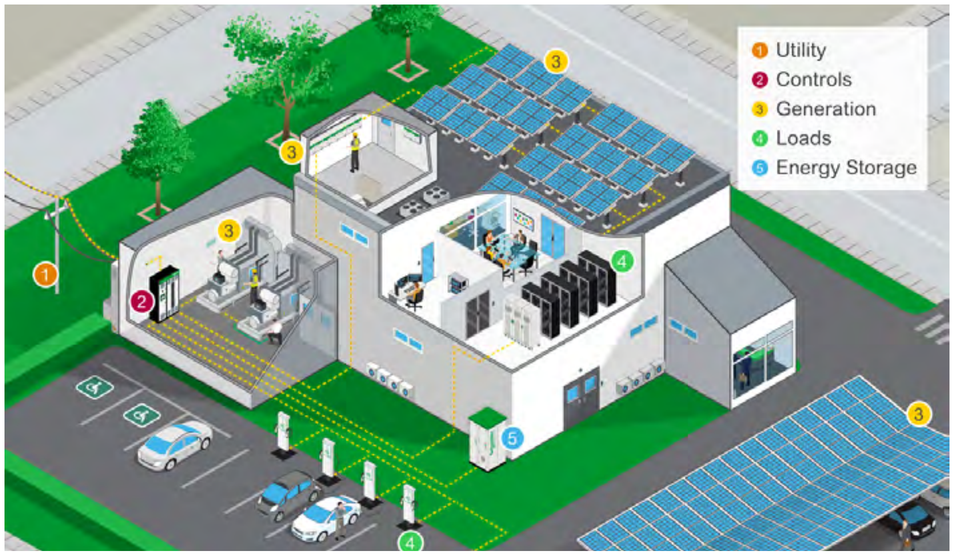
The new grid will be considerably more digitized. It will also be more flexible, dynamic, and connected.

This energy transformation will enable increased engagement from demand-side consumers. Naturally, this will result in increased requirements for energy performance in a world where electricity takes a higher share of the complete 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 (DERs) and energy storage options, exponential adoption of EVs, and innovation in smart flexible loads - greatly increases grid complexity, evolving the industry from a traditional value chain, to an interconnected digital business model. Retail customers require that their energy choices are safe, reliable, sustainable, and digitized, while also requiring a tangible means to monitor and assess the impact of their choices.

In this exciting new shift in the energy landscape, microgrids are becoming a key player that can efficiently integrate distributed energy resources, and all the various aspects of the new world of energy.



The world energy consumption is projected to increase **50%** between 2018 and 2050*

Buildings account for more than **55%** of global electricity consumption**

Global building operations account for about **28%** of emissions annually**

**International Energy Agency

*The U.S. Energy Information Administration (EIA)

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Clean Energy Transformation in Canada

Canada's recent bold climate actions and commitments have the country on track to deliver the largest emissions reduction in its history. We are striving to have 90 percent of Canada's electricity coming from non-emitting sources by 2030, with the country aiming to be completely net-zero by 2050.

These ambitious targets impact and require the support and engagement of all parts of our society from individuals and groups, to provinces and territories, to businesses of all sizes.

Canadian industries and small/medium businesses are also focusing on maximizing their energy independence. The energy transformation happening across Canada can be understood through four key drivers (which we can refer to as the 4 E's).

- Environment
- Energy Generation Mix
- Energy Cost
- Electrification of Transportation

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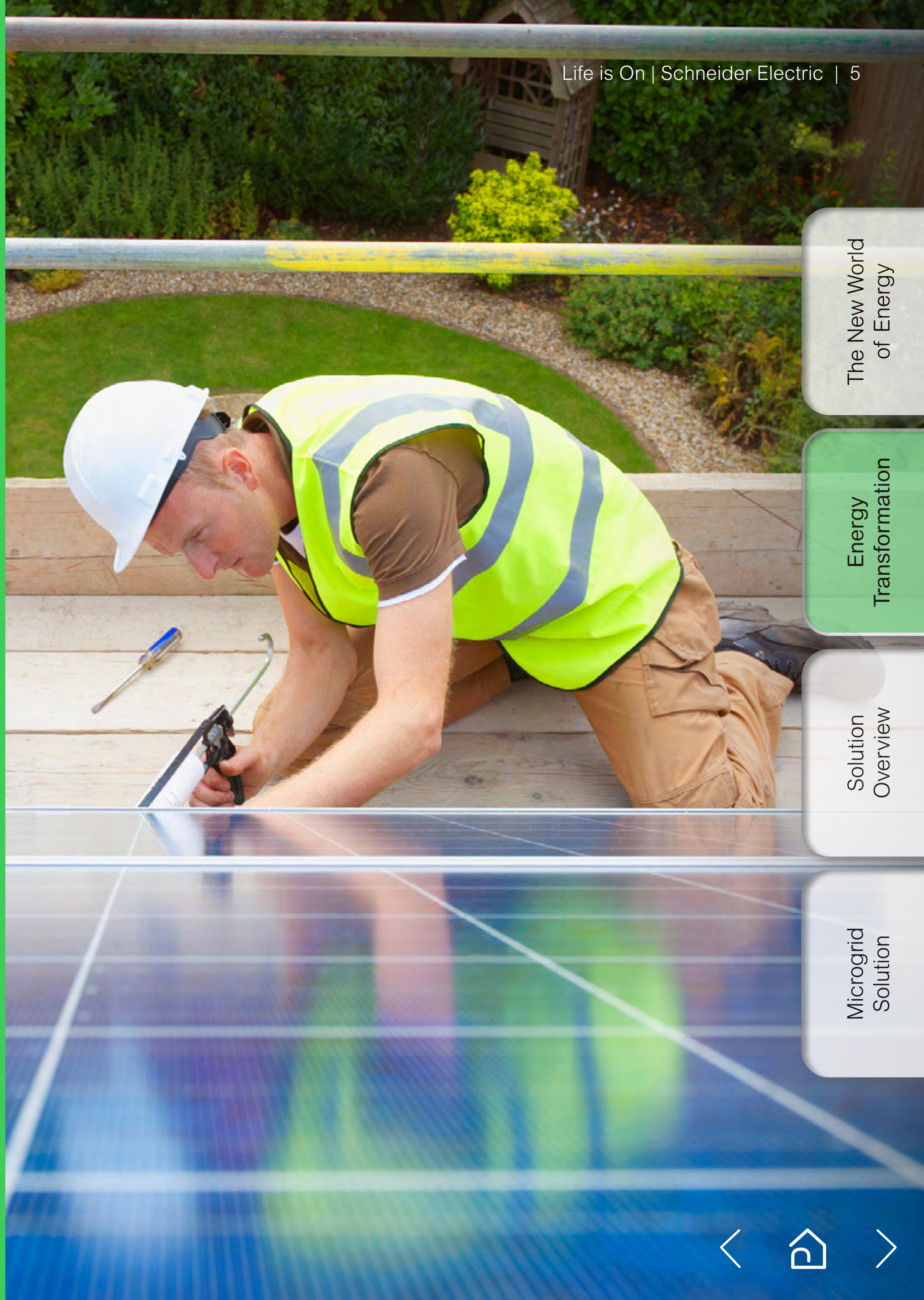
Environment

The Canadian government aims 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.

Approximately 292 remote communities in Canada's North rely on diesel to generate electricity, which amounts to approximately 90 million litres of diesel consumption annually. Microgrids provide a great opportunity for these communities to greatly reduce their GHG emissions from fossil fuels by offsetting diesel with distributed clean energy technologies.



Energy Generation Mix

Integrating environmentally friendly distributed energy resources (DERs) and encouraging the adoption of electric vehicles (EVs) is one way to considerably reduce CO_2 emissions. At the same time, however, they can highly complicate electrical distribution system operations. As 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, for example, by integrating solar photovoltaics and battery energy storage systems. In fact, by 2040, Canada aims to increase its Renewable Energy Capacity by 70% compared to in 2018. It is important to note that since these are variable generation resources which produce intermittent power, it adds complexity for utilities, whose goal is to provide electricity to a large number of customers, with consistently high resiliency.

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Energy Cost

When you think of energy cost, there are two parts that need to be considered — outage costs and energy bills. According to S&C Electric Company's industry analysis*, the true cost of power outages in Canada was approximately CAD $12 billion in 2018. During outages, most facilities rely on diesel generators to keep their operations running. Producing electricity using fossil-fuel based generators exclusively is not only bad for the environment – it is also significantly expensive when all costs are considered. These costs will only continue to rise as stricter carbon tax laws take effect in Canada.

On the other hand, we are witnessing a consistent downward trend in the cost of innovative solar and wind technologies, which makes them more cost-effective in generating electricity, when compared to fossil fuels. This brings us the perfect opportunity to implement these technologies in reducing energy costs for both industrial and residential customers, while ensuring their facilities stay resilient in the face of any outages.

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

*The True Cost of Outages in Canada: $12 Billion

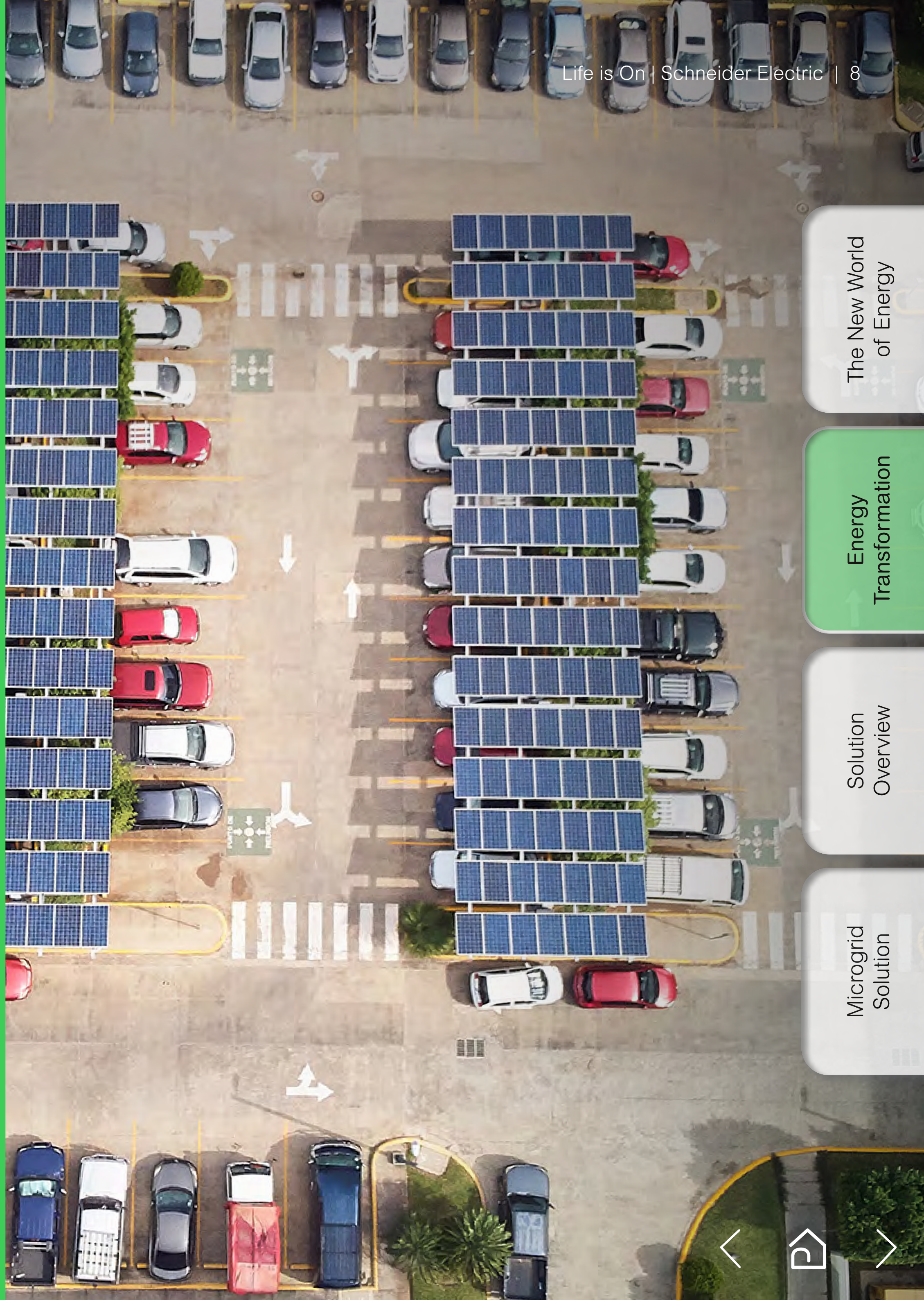
Electrification of Transportation

Today, the transportation sector accounts for around 24% of all greenhouse gas (GHG) emissions in Canada. A focus on this sector will have an influential impact on meeting our 2030 and 2050 GHG emissions targets.

Fortunately, we can reduce the amount of transportation-related GHG emissions by encouraging the adoption of more zero-emission vehicles (ZEVs). Innovative technologies are making ZEVs more affordable, and access to an expanding charging network from coast to coast is making clean vehicles a viable option for more and more Canadians.

Canada is committed to decarbonizing the country's transportation sector and making clean and affordable transportation options available in every community. The Government of Canada is expanding the supply of clean electricity through investments in renewable and next-generation clean energy technologies, and is setting ambitious country-wide targets, encompassing battery electric vehicles, hydrogen fuel cell electric vehicles and plug-in hybrid electric vehicles.

As the adoption of ZEVs continues its upward trend, it is important to start thinking about how these additional loads will be integrated into buildings, the impact they will have on the existing electrical infrastructure, and how this extra load will be managed.



Future-Proofing Buildings with local Microgrids

Medical facilities, universities, offices, shopping complexes, resorts, and even micro-communities worldwide have begun employing various distributed energy resources (DERs) such as gensets, wind turbines, solar photovoltaics, and fuel cells to meet their sustainability goals and become less dependent on the traditional grid. As the utilization of DERs continues to increase, it brings forth various challenges for electrical 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 can be grid-tied, islandable, or completely off-grid. The type of microgrid implemented, and its sequence of operations, is determined based on the end user's application and requirements.

In the new energy landscape, today's buildings can be both producers and consumers of energy. The EcoStruxure™ Microgrid in a Box from Schneider Electric is an intelligent, pre-engineered, and configurable solution that facilitates easy integration of DERs (PVs, EVs, generators and batteries) into a customer's facility, with minimal effort. It allows customers to easily optimize their distributed energy resources and maximize their facility performance, while ensuring their facilities are prepared for the future of energy.

Modular Microgrid Architectures

Traditionally, microgrids have been custom engineered, with every design being unique and tailored entirely for the specific facility, building, or campus. This makes design, installation, and even operation - time consuming and costly.

Due to the maturing of the microgrid market, advancements in knowledge and technology have spawned a new breed of microgrid solutions based on standardized, pre-packaged system components. These building blocks, together with predefined architectures, enable configured-to-order microgrid systems.

Pre-engineered Control Centers

Pre-engineered microgrid control centers allow for selected components to be pre-installed during manufacturing to deliver a ready-to-use solution. The newest designs typically include:

» Controls and power management that oversee distribution and control of electric power flow between the electric utility grid, DER, and all critical and flexible loads.

» Protection and monitoring, such as protective relays, circuit breakers, intelligent energy metering with power quality monitoring capability, and front panel touchscreen interface.

» Scalability and adaptability, to meet requirements of small or large sites, and to allow for future expansion and fast integration of additional DER.

Modularity delivers simplicity and reliability

Advancements in hardware and software modularity are making microgrids for buildings

1. **Easier to design,** due to improved repeatability
2. **Easier to install,** with lower implementation cost
3. **Easier to support,** with standardized vendor services
4. **Lower cost to maintain,** due to simplified servicing and plug-and-play replacement of standardized components
5. **More reliable,** due to tested and validated architectures
6. **Easier to adapt,** adjusting over time to new energy technologies

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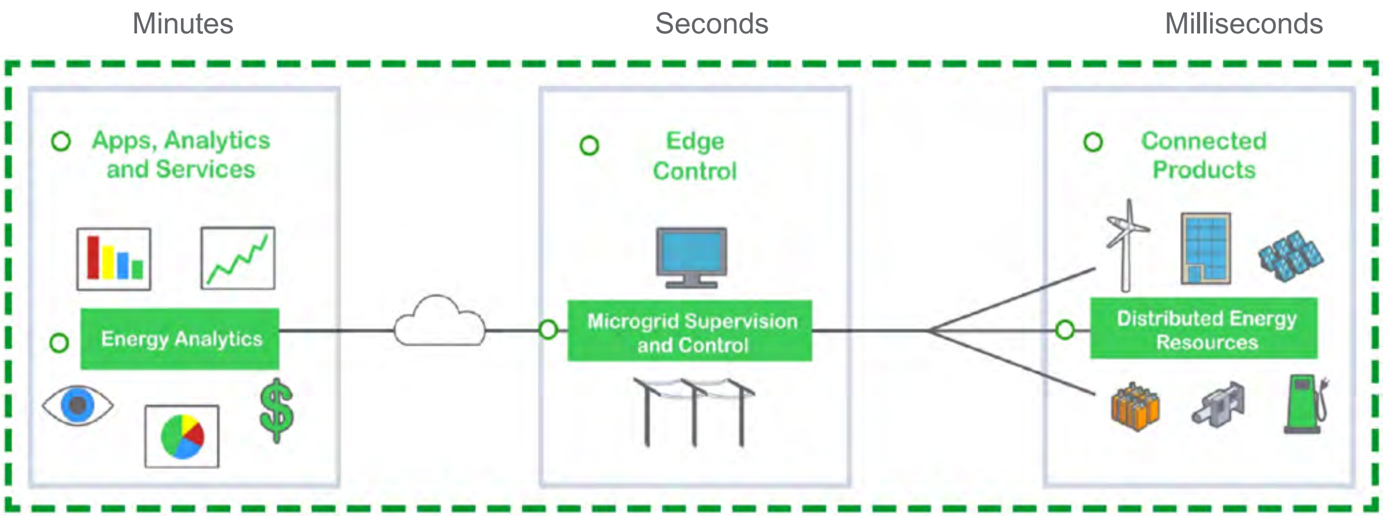
Introducing the Microgrid in a Box from Schneider Electric

The EcoStruxure™ Microgrid Solution for Buildings is a prepackaged solution with advanced microgrid controllers fitted into the Energy Control Center. It simplifies the integration of distributed energy resources into an intelligent, pre-engineered, and configurable power control center to easily optimize resources and maximize facility performance.



At the Apps, Analytics, and Services level, EcoStruxure™ Microgrid Advisor (EMA) provides economic optimization and remote monitoring capabilities when the utility grid is available. EMA is used to create an optimized microgrid through advanced forecast algorithms to maximize revenues from DERs, optimize energy consumption, curtail carbon emissions and ensure power reliability from the onsite generation assets.

At the Edge Level, EcoStruxure™ Microgrid Operation (EMO) is the microgrid power control system that is responsible for the islanding management of the microgrid, and provides electrical resiliency in the event of a utility grid outage. EMO comes with a dedicated SCADA that allows for the local monitoring and control of the DER systems within the microgrid.

Connected products like Schneider Electric's Smart Breakers operate autonomously in the millisecond timeframe to provide essential safety functions, for example, clearing a short circuit before a fire starts. These smart products have valuable information that needs to be shared with controllers in other layers of the architecture. For example, the Micrologic trip units in SE's breakers are like mini power meters, which share key information like power, voltage, and frequency with the edge controller.

Predefined Control Algorithms

In addition to modular switchgear designs, prepackaged microgrid management software includes pre-engineered algorithms to support all important decision making and control applications.

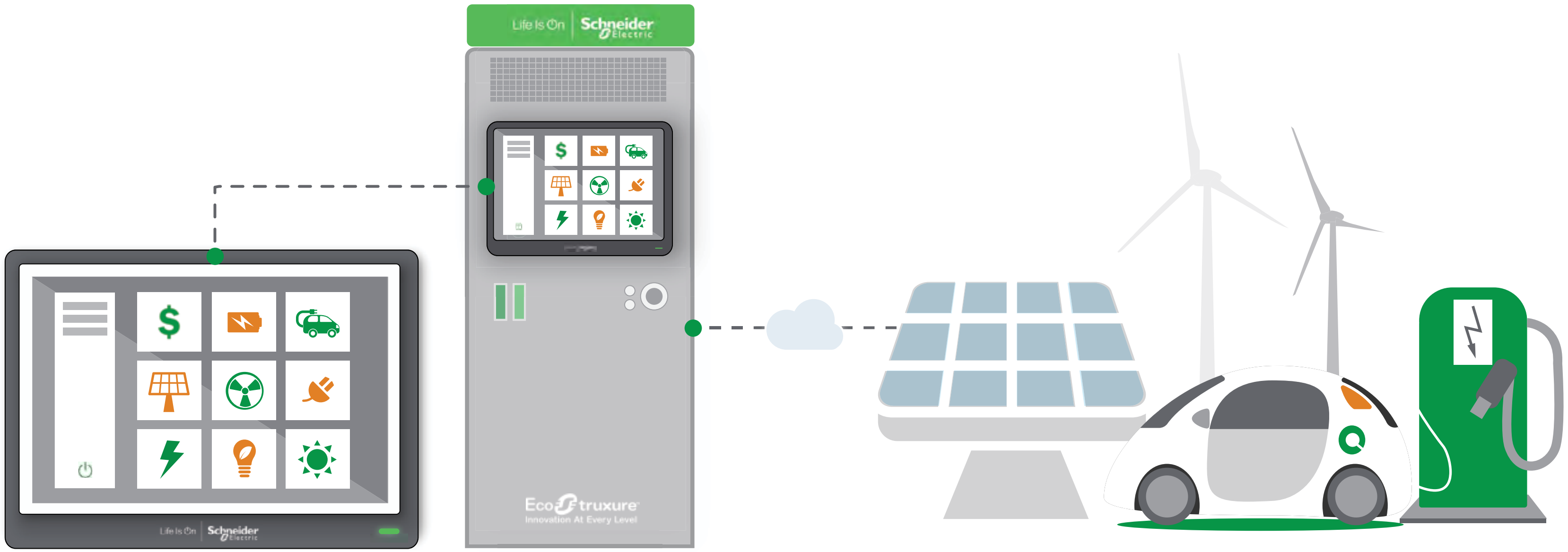
At the local 'edge control' layer, functions that focus on monitoring and control of generation and consumption will include:

- **Management of grid connection.** Disconnect from the grid, support critical loads, and reconnect after an event.
- **Management of DERs in islanded mode.** Ensure energy production is balanced against consumption, maximize the use of renewables when possible, and store excess energy.
- **Assurance of microgrid safety.** Manage facility-wide electrical network protection, in grid-connected mode, island mode, and during transition.
- **Management of DER in grid-connected mode.** Maximize the use of renewables, store excess energy, and manage export to the utility grid.

At the 'energy analytics' layer, a variety of decisions and actions are made to minimize costs and maximize sustainability, including:

- **Avoidance of demand penalties.** Dynamically manage demand by consuming more energy from onsite resources or temporarily turning off non-critical loads.
- **Tariff management.** Respond to pricing signals by determining when to consume onsite energy resources, shift loads to off-peak periods, or store energy.
- **Demand response participation.** Optimize program participation by choosing between the use of local generation, stored energy, or load management to respond to curtailment requests.
- **Optimization of self-consumption of renewables.** Decide when it is most economical to consume energy from local solar and wind generation, and when it makes sense to store, consume, or sell stored energy.

Enable Intelligent Integration of on-site Distributed Energy Resources



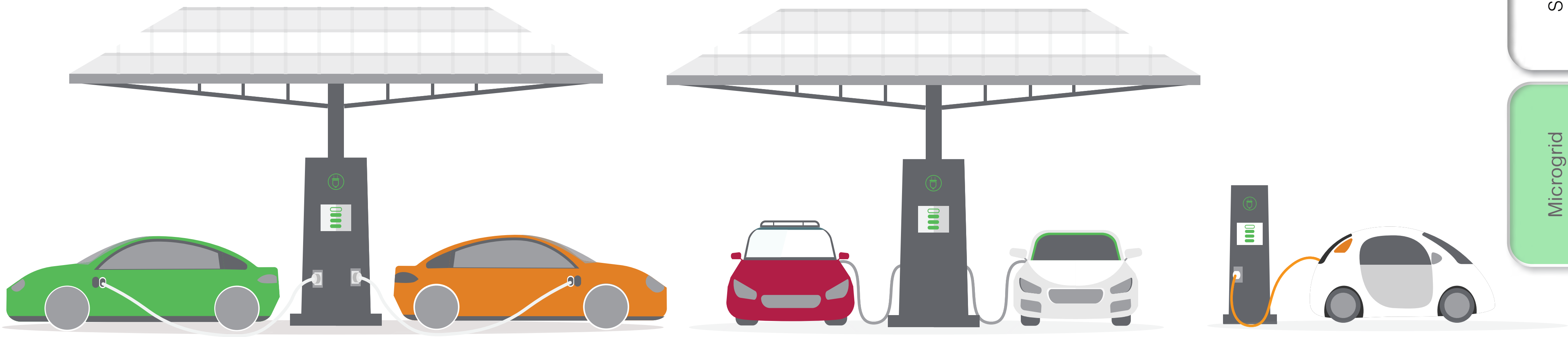
The data-driven analytics from customer DERs & EVs can provide the foundational intelligence for new microgrid control systems. We can maximize the operational performance of assets, optimize loads and meet end users' needs to provide new services as well as new revenue streams. By collecting data (such 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).

Seamlessly Integrate EVs at Your Facility

Our goal is to create more accessible and sustainable buildings by utilizing DERs 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 GHG emissions.

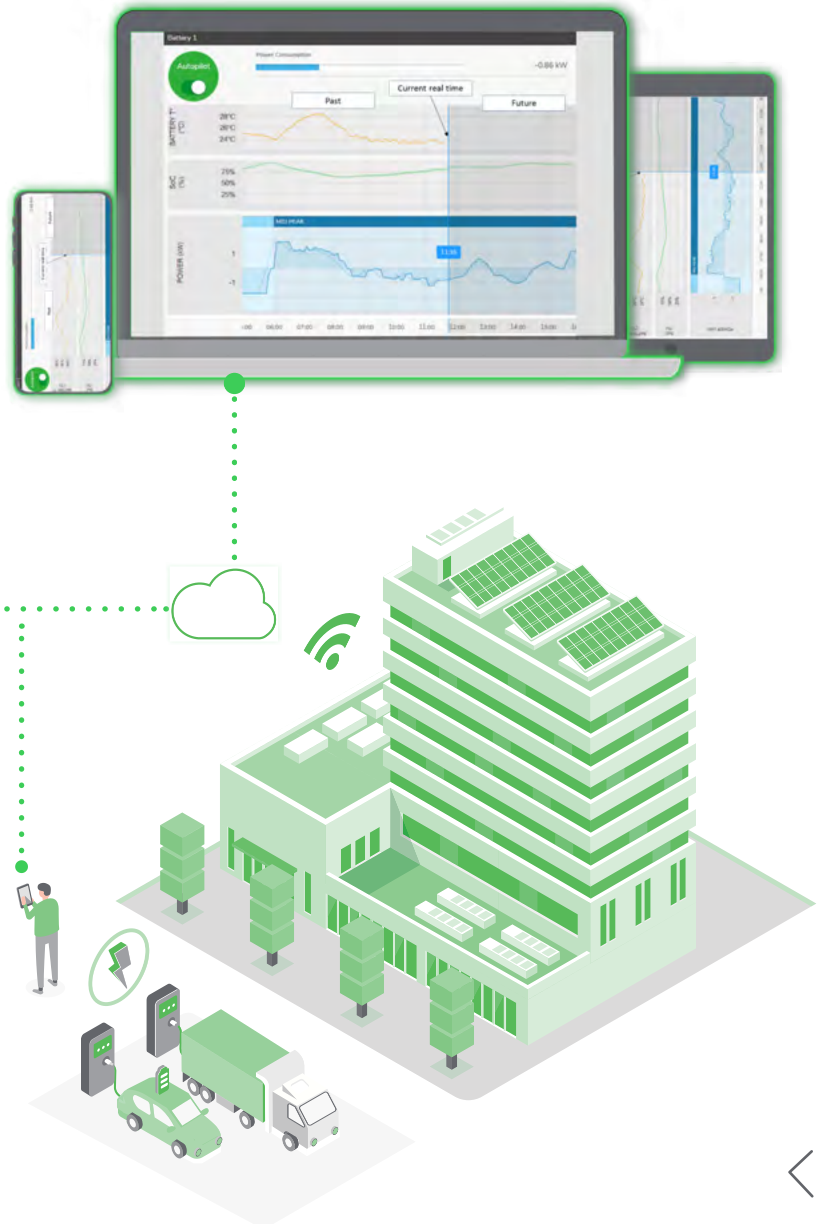
Building owners are seeking simple solutions to integrate the usage of DERs and EV charging systems that manage electricity demand and energy costs. They would like to provide their occupants with the technologies they need to confidently drive their EVs to and from work. As the use of EVs becomes more 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 with EcoStruxure™ Microgrid Advisor

The cloud-based platform EcoStruxure™ Microgrid Advisor platform allows site managers to reach a new level of grid management, by allowing them to visualize their site and DER remotely, from anywhere with an internet connection.

Monitoring and forecasting of all the DERs connected to the platform is done in real time, with a 15-minute refreshment rate.



EMA can monitor:

- The DERs' performance
- The forecast of energy production/consumption,
- The comparison between forecasted and actual values
- The different cost and savings/earnings

Each DER's energy consumption / production can be seen for different time frames:

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

EcoStruxure™ Microgrid Advisor also allows the data to be exported for performing deeper analysis.

Demand Charge Management with EcoStruxure™ Microgrid Advisor

Control for Distributed Energy Resources (DER) reduces 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 the commissioning phase.

When the energy consumption at the site is approaching the power limit (either defined by the customer or automatically set up by the EMA algorithm), EMA decides to:

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

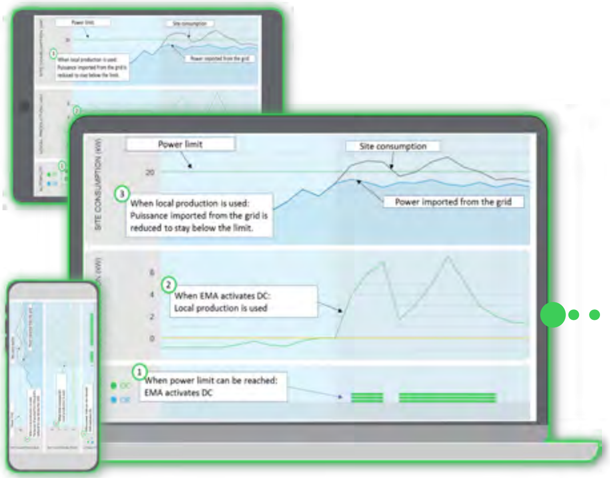
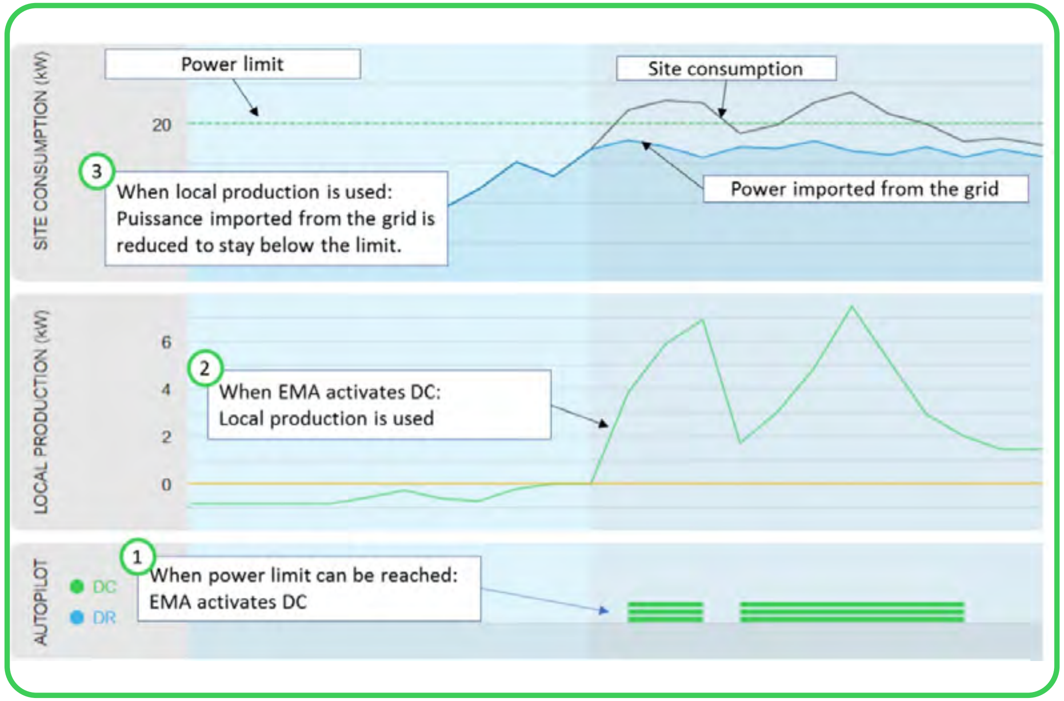


Figure 2
Demand Charge Use Case Example



Demand Response Management with EcoStruxure™ Microgrid Advisor

EcoStruxure™ Microgrid Advisor can be used to respond to Demand Response events. In order to do so, it must be connected to a utility or a commercial aggregator platform which can monetize demand response orders.

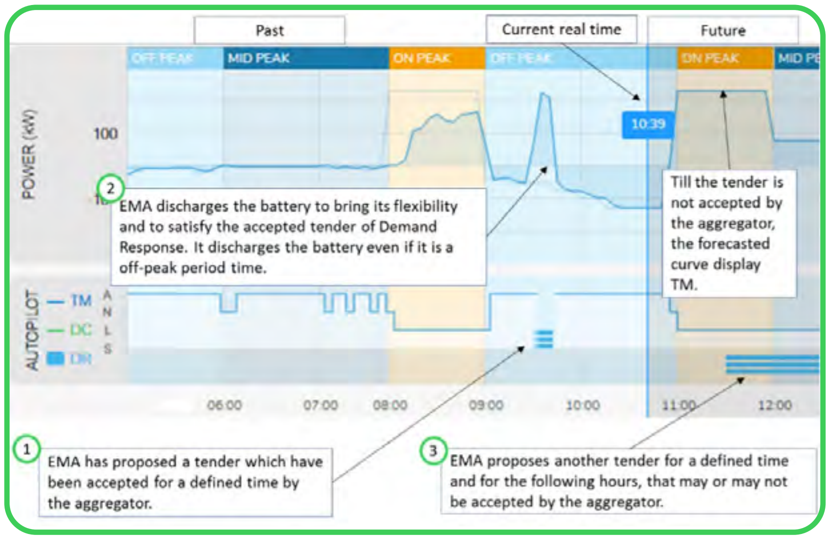
Demand Response can be performed in an innovative way with EMA and its forecasting capabilities. By predicting the future flexibility of the different DERs that are part of the microgrid, EMA can propose to the utility or commercial aggregator, flexibility tenders that can be accepted or rejected. If they are accepted, EMA executes the DR orders to the DER through the Controller Box. The validation of actual execution of Demand Response 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 neighbouring 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 neighbouring hourly buckets (typically the previous hour and the following hour).

Figure 3

Demand Response Example



The EMA algorithm proposes a tender of 100kW for 1 hour to a commercial aggregator. The commercial aggregator accepts theoffer. EMA then sends this order to the onsite EMA Controller. The loads are then curtailed, production sources are turned on, and energy storage systems are discharged, for reaching the 100kW for 1 hour.

Tariff Management with EcoStruxure™ Microgrid Advisor

Tariff Management consists of controlling DERs 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 will then 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.

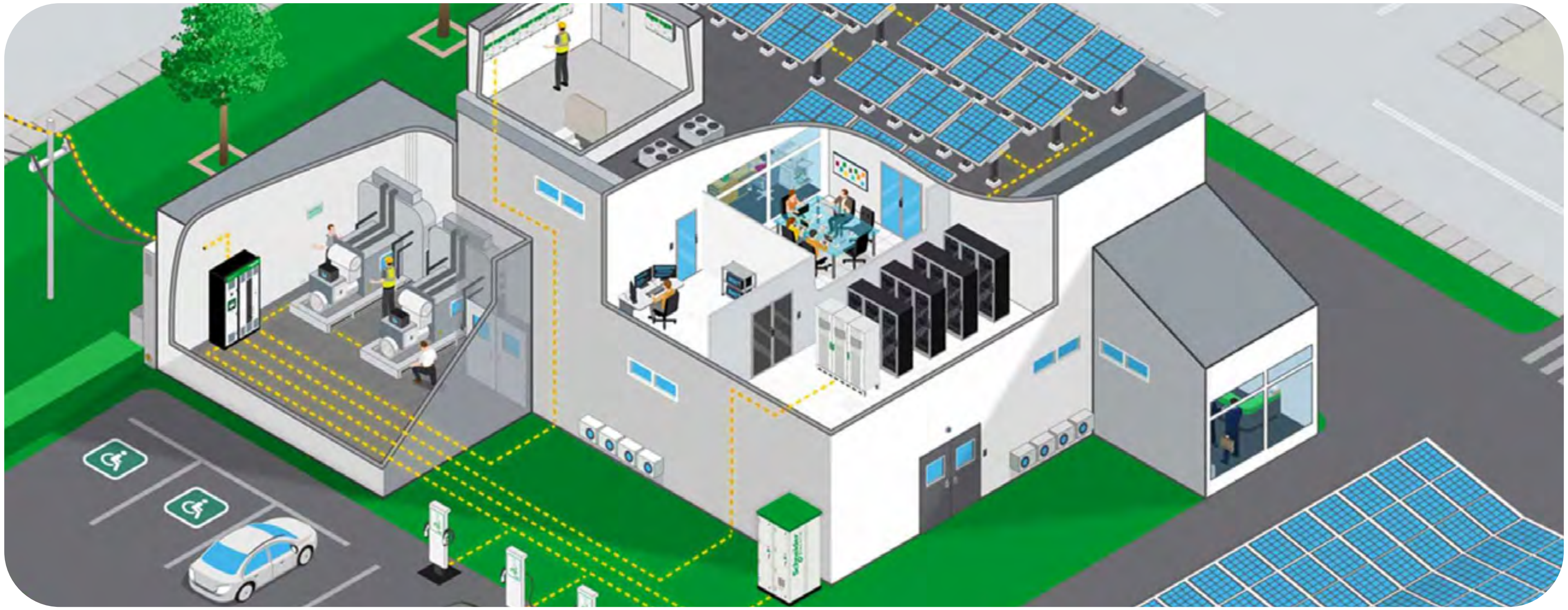
Figure 4

Demand Response Example

In Conclusion

The new world of energy will drastically transform the way in which we produce and consume energy. Instead of centralized power plants and distributed grids, microgrids will be located at, or close to, consumers' sites and loads. These microgrids enable the energy transition by efficiently and intelligently integrating and optimizing various distributed energy resources to increase resilience against grid disruptions and reduce energy-related operational costs. They create the possibility of a truly decentralized, decarbonized, and digitized energy future.

Pre-engineered microgrid architectures make it easier and more affordable to implement, operate, and maintain a microgrid. Financing options, available incentives, and various operational models should all be considered, to make a microgrid affordable while reducing financial risks and maximizing returns. To ensure an optimized solution, it is recommended that the customer seek the expertise of a trusted expert like Schneider Electric, who can offer the newest microgrid planning tools, architectures, financing, and technology, designed to safely and efficiently prepare your site for the decentralized energy future.



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Is a microgrid right for you?

Connect with an expert now!

Let's talk

Schneider Electric
5985 McLaughlin Rd
Mississauga, ON
Tel : 905 366 3999

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