How Prosumers Leverage 4 Technologies for Greener, Reliable, Economical Energy

by François Borghese

Executive summary

As the global energy landscape continues to evolve, the proactive energy consumer, or ‘prosumer’, is emerging. Campuses, institutions, businesses, and homeowners are beginning to use new technologies to take direct control of energy sustainability, reliability, and cost. Local microgrids are being formed by dynamically managing a variety of distributed energy resources, including loads, onsite renewable energy production, and energy storage. And by connecting the prosumer to the smart grid, new information and control platforms are enabling participation in programs that fully monetize the flexibility of these assets.

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Introduction

Imagine a world where green, renewable sources are supplying most or all of the energy needed for every purpose: lighting, heating, processes, and transportation. Imagine that energy customers are able to proactively choose which energy source they want to consume. Imagine an electricity supply that is completely reliable. Imagine a typical business or home spends much less on their energy consumption, or actually generates revenue.

This scenario is becoming possible today with the marriage of new technologies and operational strategies on both sides of the electricity meter.

Over the past many decades, growing energy consumption, the addition of intermittent renewable energy generation, and severe weather events have all contributed to electrical grid instability and energy price volatility. Electricity grid operators and utilities are taking steps to address these challenges in a variety of ways, including looking to the demand side for help.

As part of smart grid modernizations, remunerative programs are being launched or expanded that encourage energy customers to adjust their consumption in response to pricing signals, penalties, or curtailment requests. Due to this potential flexibility, a customer's energy-consuming loads and any onsite energy generation capabilities are now considered important distributed energy resources (DER), critical to helping balance the grid.

At the same time, many customers have begun taking more direct control of the cost, reliability, and green mix of their energy supply. City districts, educational campuses, military bases, hospitals, commercial buildings, factories, and residential homes are becoming proactive energy consumers, or 'prosumers'. They are enabled on this journey by a convergence of four widely available technologies that can automate and fully monetize their energy resources:

1. Energy management systems
2. Onsite renewable energy production
3. Electrical energy storage systems
4. Intelligent, interactive connections to the smart grid

This paper explains how these technologies are contributing to the smart, new energy prosumer paradigm. Armed with these tools, organizations and families are managing energy resources in a more dependable, economic, and environmentally sustainable way.

The evolving energy landscape

The way energy is generated, distributed, and consumed around the globe is evolving quickly. A number of operational, financial, and social factors are influencing these changes.

Growing populations need more energy

A majority of the world's population now lives in cities, consuming 75 percent of our resources and emitting most of the greenhouse gases. The United Nations estimates that by 2050, an additional three billion people will move into these dense, resource-intense urban environments.

As a result of these trends, the increase in worldwide energy demand is estimated to grow by 37 percent by the year 2040, based on planned policies.[1] A percentage of this demand will be due to new kinds of loads, such as electric vehicles.

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[1] IEA World Energy Outlook 2014.

The pros and cons of green energy

Utilities in many regions are being driven by new environmental regulations to gradually close their central fossil-fired generating plants. Some are also phasing out nuclear plants in response to public anti-nuclear sentiment.

Those plants will be partly replaced by renewable energy production means, such as large-scale wind and solar farms, which have both continued to growth at a rapid pace in recent years. For example, in Germany more than 35 percent of energy consumption is targeted to come from renewables by 2020, and 80 percent by 2050.[2]

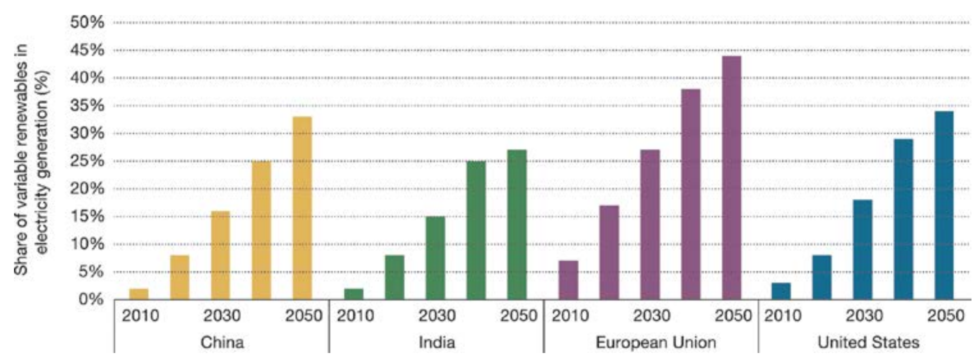

Figure 1

Share of electricity generated from variable renewables (per cent) by region, within the IEA Energy Technology Perspectives 2 Degree Scenario.

Source: IEA Technology Roadmap - Energy Storage

But there are challenges to integrating large amounts of renewable energy production with the grid, due to the inherent intermittency of wind and solar power. One of the options for keeping the grid properly balanced is for grid operators is to implement demand-side management programs.

Open energy markets add complexity

Deregulation of energy markets is a trend already occurring in many regions of the world. Prior to this, network operators were often integrated with the power production companies. This meant they had full control over the majority of the power generation, matching production to the demand.

When the opening of power markets began in the 1990s, the grid operator's activities were unbundled from generation activities. Energy trading produced a far more complex paradigm for grid operators to manage. This has heightened the need for solutions that will help ensure the balance between energy supply and consumption.

An aging grid infrastructure can't keep up with demand

Some of the world's electrical infrastructure dates back to the late 1800s. In the U.S., 70 percent of the grid's transmission lines and power transformers are now over 25 years old and the average age of power plants is over 30 years[3]. Globally, the majority of nuclear power

[2] "Germany's Energiewende: From Wunderkind to Troubled Adolescent?", EnergyTransition.de, November 2013

[3] "Weather-Related Power Outages and Electric System Resiliency", Campbell, Richard J., Congressional Research Service. August 28, 2012

"Even with this additional capacity built in, most grids were not designed for today's loads."

plants have been operating an average of 27 years, with the oldest operating about 43 years.[4] Most will need to be rebuilt or replaced. In fact, one recent report warns that by 2050 nuclear power could disappear altogether.[5]

Most power grids have been designed for answering peak demand, with 25 percent of distribution and 10 percent of generation and transmission assets used less than 400 hours per year.[6] Even with this additional capacity built in, most grids were not designed for today's loads.

In terms of performance, older transmission lines dissipate more energy than new ones, constraining supply during periods of high energy demand.[7] Further, the current model of large, centralized generation plants means that about 70 percent of electricity is lost in generation, transmission and distribution. This equates to a global annual cost of energy loss estimated at about $4.1 trillion.[8]

To address its aging grid, EDF, the largest European utility, plans to invest up to 120 billion euros over 10 years.[9] However, most companies do not have the capital to invest large amounts in upgrading. This limits increases in generation capacity and the expansion of transmission and distribution networks. Demand-side management strategies, including the integration of distributed energy resources, can help lower this required investment by reducing the peak demand across the grid.

Energy prices are becoming more volatile

Electricity is becoming more and more expensive in most parts of the world. In Germany, average electricity prices for companies have jumped 60 percent over the past five years because of costs passed along as part of government subsidies of renewable energy producers. Prices are now more than double those in the U.S.[10]

In the U.S. retail residential electricity prices for the first half of 2014 are on average 3.2 percent above the same period last year, the highest year-over-year growth since 2009. One state saw an increase of 11.8 percent.[11]

$119 billion / year

On average, there are at least 500 000 people affected daily by power outages in the U.S., costing $119 billion annually.
Source: Lexington Institute, Ensuring Resilience of US Electrical Grid

Severe weather increases the risk of blackouts

Power outages due to severe weather events are on the increase in some regions. In August 2003, a widespread blackout caused an estimated 55 million people to lose power across the U.S. northeast and eastern Canada, while later that year a major power outage across most of Italy and part of Switzerland affected 56 million people. Many more were affected by the world's biggest power failure in India in July 2012 that left half of the country without electricity. Soon after, Superstorm Sandy lashed the eastern U.S., cutting power to eight million customers.

[4] "Parc nucléaire mondial (production d'électricité)", Connaissance des Energies, May 2012

[5] "World Nuclear Industry Status Report 2014", Mycle Schneider and Antony Froggatt, July 2014

[6] U.S. Department of Energy

[7] "Economic Benefits to Increasing Electric Grid Resilience to Weather Outages", Executive Office of the President August 2013

[8] " 'We don't need no stinkin' grid' will be the mantra of the developing world, professor says", Smart Grid News, Sep 11, 2014, quoting Dr. Rajendra Singh, Clemson University

[9] "EDF prévoit d'investir entre 100 et 120 milliards d'euros en France sur dix ans", La Tribune, 04/2013

[10] "Germany's Expensive Gamble on Renewable Energy", Wall Street Journal, August 2014

[11] "Residential electricity prices are rising", US Energy Information Administration, September 2014

Severe weather is the leading cause of power outages in the United States. Between 2003 and 2012, an estimated 679 widespread power outages occurred due to severe weather. Thunderstorms, hurricanes and blizzards account for 58 percent of outages observed since 2002, with 87 percent of outages affecting 50,000 or more customers[12]. A recent Congressional Research Service study estimates the inflation-adjusted cost of weather-related outages at $25 to $70 billion annually.[13] Demand-side management can help limit the propagation of a 'cascading' outage by significantly reducing the demand on the grid outside the immediately affected areas. On the delivery-side, many critical-power energy customers are gaining partial autonomy from the grid to help ride through such events.

The smart grid: improving efficiency and reliability

In response to these continuing challenges, grid operators and power utilities in most regions have joined forces to more efficiently balance demand and supply over an increasingly complex network, while also improving response to critical events. Collectively known as the *smart grid*, new strategies combine electricity and IT infrastructure to integrate and interconnect all users: generators, operators, marketers, and consumers.

Smart grid encompasses several different domains, from smarter energy generation methods to smarter homes and enterprises. Whereas many of the first smart grid programs focused on the supply side of energy, programs and technologies are now being introduced to allow all parties to work together to balance product and consumption, improve grid reliability, stabilize pricing, and reduce emissions.

Some smart grid initiatives have been in place for many years in some regions, such as variable energy pricing. Some initiatives are more recent, such as smart meters and automated meter reading (AMR), advanced network automation, and the installation of distributed energy generation.

In the past, smaller generation assets, including renewable energy sources, have typically been used for remote communities far from central plants. But more recently, these assets are being added throughout the grid, for purposes such as helping to reduce peak power demand on extremely hot or cold days. Such distributed generators have the added benefit of being closer to where the energy consumed, which reduces line losses.

Grid operators are also starting to invest in large-scale energy storage systems, located on the main grid. These can be used to level loads, help reduce the amount of generating capacity needed to supply customers at times of high demand, or to provide frequency regulation. Energy storage also supports a smoother integration of intermittent energy from large-scale solar or wind farms.

Accessing energy flexibility through more supplier-consumer partnerships

Grid operators are increasingly looking to energy consuming districts, institutions, businesses, and homes as a potential source of energy flexibility. If an energy customer has the ability to selectively increase or decrease some portion of their energy use when required, that variability can be used to offset stresses and balance the grid. In this way, energy-consuming loads are considered distributed energy resources on the smart grid.

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[12] "Economic Benefits of Increasing Electric Grid Resilience to Weather Outages", Executive Office of the President, August 2013

[13] "Weather-Related Power Outages and Electric System Resiliency", Campbell, Richard J., Congressional Research Service. August 28, 2012

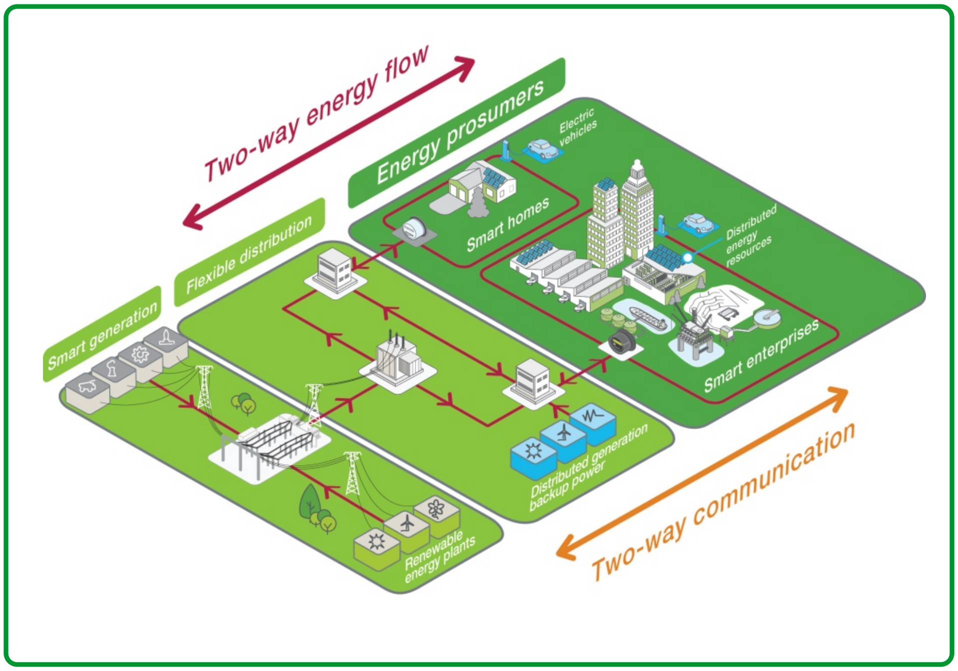

Figure 2
A smart grid connects energy suppliers and consumers together over communication networks, enabling them to work together to improve reliability by dynamically balancing energy demands.

"These are remunerative programs that can financially benefit energy users, as well as helping improve the reliability of the grid."

To access this energy flexibility, grid operators are joining with other entities, such as commercial aggregators, to develop a variety of demand-side management (DSM) programs. These are remunerative programs that can financially benefit energy users, as well as helping improve the reliability of the grid.

Depending on the region, different types of programs may be offered. In some regions, such programs have been offered for many years, dating back as early as the 1970s. But in most regions, these are more recent initiatives.

Variable tariff programs
Energy price-based incentive programs encourage consumers to adjust their electricity usage, typically by increasing the price during peak periods of high demand on the grid. The energy manager or homeowner can then respond by shedding (turning off) one or more loads, shifting (rescheduling) loads to another time of day, consume energy from an energy storage system, or start producing energy onsite.

As an example, an industrial factory might shift a non-critical process to run during the night instead of mid-day. Other demand management options are discussed later in this paper.

The most common types of variable tariff programs are:

1. **Critical peak pricing (CPP) or peak demand surcharge.** A higher energy price or penalty is charged for using excessive amounts of energy at a peak time of day.
2. **Time-of-use (TOU) pricing.** Different blocks of time in a 24-hour day are given different pricing levels based on the cost of producing energy.
3. **Real-time pricing (RTP).** The rate for electricity follows dynamic wholesale market prices.

Demand response programs
Sometimes referred to as interruptible rates, demand response (DR) programs have been offered to commercial and industrial (C&I) customers for many years in some regions, primarily

in the U.S. However, many other regions are starting pilot phases, intending to eventually build out full-scale markets or programs. In fact, the global amount of flexible capacity in the commercial and industrial energy user segments addressed by DR programs is expected to grow from 26.8 GW in 2014 to 132.3 GW in 2023.[14]

By aggregating the available load flexibility of many energy-consuming customers, a *virtual power plant* is created, helping the utility avoid buying comparable levels of generation.

DR programs come in two main variations:

1. **Committing to reduce load when demand is high.** In this scenario, the customer agrees to reduce a portion of their energy consumption when the supply of electricity on the grid is threatened. Load reduction typically needs to be exercised within two or less hours of notice from the grid operator. Participants receive upfront payments for the amount of load capacity they can reduce.
2. **Allowing direct control of loads.** Usually applicable only for residential or small commercial businesses, this program allows the system operator to remotely shut down a specific customer load, such as an air conditioner or water heater, in exchange for an incentive payment or bill credit.

The new energy prosumer: taking direct control of electricity supply

Faced with continued price volatility and grid instability in some regions, as well as increasing competitive and financial pressures, many businesses, institutions, and homeowners want to have more control over their electricity supply.

Enterprises are always seeking to minimize operating budgets and ensure no interruptions to service or processes. Many are now looking at their energy supply for ways to cut costs and boost reliability. Energy also represents a major expense for residential households, while any extended power outages are considered a threat to a family's security.

There is also a growing movement in environmental awareness that is encouraging consumers to seek out greener energy alternatives. Most businesses are starting to consider their 'carbon footprint' as an important key performance indicator.

All of these factors have contributed to the emergence of the new energy prosumer. And with this shift, four important categories of technology are converging to enable their goals: energy management, microgrid, energy storage, and connectivity with the smart grid. These technologies are giving prosumers direct control over a sustainable and reliable energy supply. They are also creating a larger, more dynamic set of distributed energy resources to help strengthen the main grid. And all of these technologies can augment existing facilities, or be integrated as part of new 'greenfield' projects.

1. Energy management for energy efficiency

Energy management systems have existed for many years, in a number of different forms. Most of these have been developed for use by large enterprises such as industrial plants and commercial buildings. However, in more recent years, such solutions are becoming available for smaller buildings of all kinds.

Typically comprising a network of digital energy meters connected to central analysis and control software, these systems are designed to accurately detail the consumption profiles of various loads and processes to help identify inefficiencies, and to provide early warning of potential risks to power quality or reliability.

[14] "Demand Response for Commercial & Industrial Markets", Navigant Research, 2014

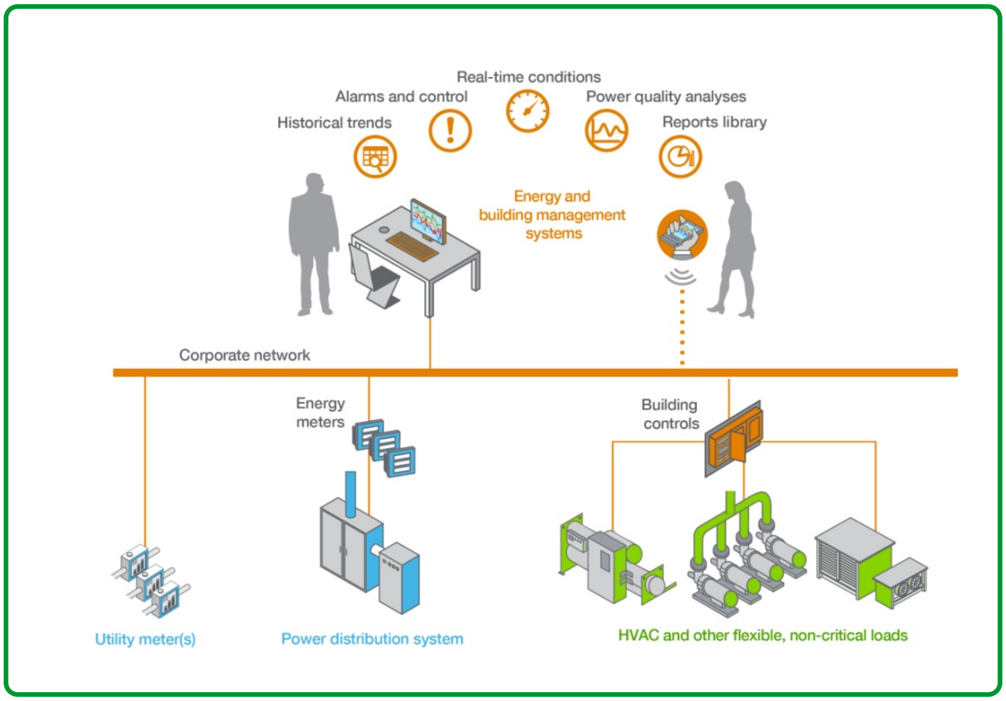

Figure 3
A typical energy management system for a commercial building.

Through integration with building or process management systems, or other types of control devices, intelligent schemes can be used to perform automated load management. Controllable loads would typically include heating, cooling and ventilation (HVAC) systems, as well as any non-critical process systems.

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If a prosumer has access to energy pricing data from their local utility, a system can also be configured to respond directly to variable pricing signals. For example, cooling could be reduced and building temperature allowed to rise by a degree during a period of high energy pricing.

With an energy management system in place, a wider range of strategies can be planned and executed, such as predicting energy needs, revealing unused power distribution system capacity, and isolating sources of problems.

2. Onsite generation creates a green, reliable microgrid

Microgrids are essentially miniature versions of the traditional electric grid. They consist of local energy generation resources, as well as a microgrid controller, the power distribution system, and connected loads. Many types of energy resources can be used, including renewable energy generation (solar, wind, water, biomass, etc.), fuel cells, natural gas or diesel-powered engines, or combined-heat-and-power (CHP) systems. Such systems can operate independently, in parallel with the main grid, or connected to it.

There are now more than 388 remote microgrid projects in operation, under development, or proposed worldwide, in remote locations such as islands and isolated communities that are not connected to a grid. However, as natural gas prices and the cost of solar panels have fallen dramatically in recent years, grid-connected microgrids in urban areas are becoming more common.

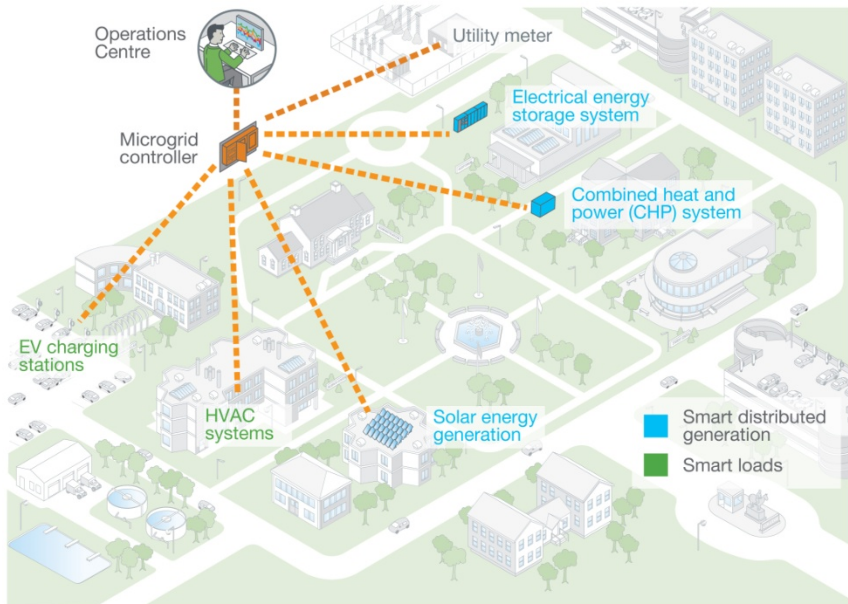

Figure 4

A typical microgrid for a large university campus, showing microgrid controller and distributed energy assets.

More on microgrids

For more detailed information on microgrid benefits and a view of recent policy issues, download the report:
Think Microgrid - A Discussion Guide for Policymakers, Regulators and End Users.

Benefits of microgrids for the prosumer include:

1. **Using onsite generation as a flexible distributed energy asset.** This can optimize participation in a demand response program by providing a choice of using local generation or load management to comply with a curtailment request. In some regions, feed-in tariffs enable customers to be paid for feeding renewable energy back to grid, typically without the option for self-consumption.
2. **Enabling self-consumption of green energy.** Local renewable sources can be used to displace part or all of the energy consumed from the main grid, helping reduce energy-related greenhouse gas emissions. Adding local energy storage can help further maximize the use of this resource. This is discussed in the next section.
3. **Mitigating the economic impacts of power disruptions.** A microgrid can operate in grid-connected mode, or island-mode in the event of blackouts. Going beyond the short-term capabilities of a typical emergency back-up system, microgrids have the potential to run indefinitely off locally generated power or battery energy reserves.

Prime candidates for microgrids include eco-parks and large commercial or industrial facilities. They are also ideal for enterprises where power continuity is critical to success, such as hospitals, military bases, police and fire services, and university campuses. Many colleges and universities have already gained experience using microgrids to supply mission-critical users such as laboratories, research centres, surgeries, and data centres.

Microgrid solutions are also becoming available for individual, smaller buildings. These are often solar-based generation, and may often be packaged with energy storage systems. In some regions, adoption is being strongly encouraged by governments through attractive financial incentives.

"We're getting closer to the inflection point where microgrids will become a legitimate option for almost any campus or industrial park."

—Jesse Berst, Chief Analyst, Smart Grid News

Though some power utilities may view microgrids as a threat[15], they can help improve grid resilience and power reliability, reduce line losses, and enhance integration of renewables. In recognition of these benefits, the U.S. DOE Office of Electricity Delivery and Energy Reliability has allocated funding for microgrid R&D[16] and the U.S. microgrid market is expected to reach $40 billion annually by 2020, with capacity growing to 4.1 GW.[17]

Case study: Microgrid keeps power flowing at remote ski resort

After a major expansion, including new ski runs and snow-making equipment, Bear Creek Mountain Resort & Conference Center in Berks County, Pennsylvania, USA, discovered their electrical demand began to exceed the capacity of the utility line feeding the resort. Rather than invest in a costly upgrade to the line and associated infrastructure, Bear Creek found a less expensive alternative: configuring the resort's six existing backup generators into a grid-connected microgrid. An intelligent monitoring and control system automatically transfers loads to the generators when required to avoid exceeding the 'cap' level. It also allows the resort to participate in the utility's demand response program, with financial payments ranging from $40,000 to over $100,000 annually.

3. Energy storage super-charges the microgrid

According to Navigant Research, advanced energy storage will represent the single largest investment category among 'microgrid enabling technology' options by 2023.[18] For example, in the U.S., California is targeting 1,325 megawatts of energy storage capacity by 2020, requiring around $3 billions of investment with subsidies program. In Germany, encouragements to adopt onsite energy include subsidies for energy storage.

"Energy storage effectively extends the value of renewable energy sources by enabling self-consumption to be increased by up to 100 percent."

Advanced microgrid systems will often include thermal or electric energy storage. Energy storage effectively extends the value of renewable energy sources by enabling self-consumption to be increased by up to 100 percent. It allows locally produced energy to be consumed when it's needed, produced when it's relevant, and to be sold back to the grid when it's most economically advantageous to do so.

Storing energy onsite also helps to increase energy flexibility. For example, if a prosumer is taking advantage of a variable tariff program, stored energy can be consumed during peak hours when grid energy prices are highest. Storage batteries can then be recharged during gap hours, either from onsite energy sources or from grid power at lower pricing.

To optimize participation in demand response programs, stored energy can be consumed to respond to load curtailment requests, to effectively consume less energy from the grid. If the grid operator asks for increased consumption, batteries can be charged from the grid. Stored energy can also be used to provide ancillary services to the grid, such as frequency or voltage support.

[15] "Microgrid Matchup: The Military and The Utilities", Navigant Research, June 2012

[16] "The Advanced Microgrid - Integration and Interoperability", Sandia National Laboratories, March 2014

[17] "Market Data: Microgrids", Navigant Research, 1Q 2013

[18] "Microgrid Enabling Technologies", Navigant Research, Q3 2014

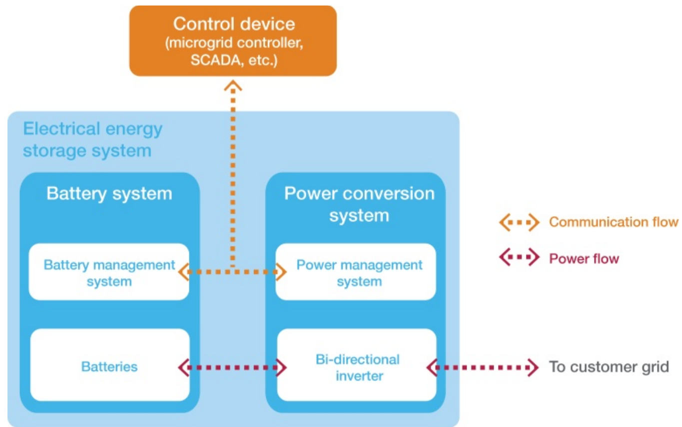

Figure 5
Energy storage system components

Finally, a microgrid designed to provide critical power during and after disruptive events such as storms will often use energy storage as a 'green' backup supply. This can replace the need to maintain a spinning reserve of energy, typically from fossil fuel based generators.

Case study: France's first smart grid-ready office building

In the Brittany region of northern France, the new headquarters of the region's energy union, SDEM, has been equipped with an energy storage system linked to onsite renewable electricity generation. The system will automatically arbitrate between selling stored energy to the grid or auto-consuming it to supply the building. Storing renewable energy onsite enables self-consumption to be maximized and participation in demand response programs to be optimized. The award-winning project also integrates a building management system with intelligent load shedding.

4. A smart connection to the smart grid

"For the new prosumer to fully monetize the value of their energy flexibility, it's crucial to optimize how their distributed energy resources are managed."

For the new prosumer to fully monetize the value of their energy flexibility, it's crucial to optimize how their distributed energy resources are managed. It requires tight coordination of loads, generation, and storage. It also requires knowing the best times to offer 'negawatts' (curtail load) or 'posiwatts' (provide energy) to the grid, all while ensuring comfort and maintaining productivity.

Advanced information, communication, and control platforms are now becoming available to enable these goals. Prosumers are given an intelligent, transparent way to manage their distributed energy resources, as well as a simple, automated way to participate in smart grid programs. These are typically cloud-hosted SaaS platforms, with a modem and smart gateway installed at the prosumer's location that provides access over a secure Internet connection to a remote server.

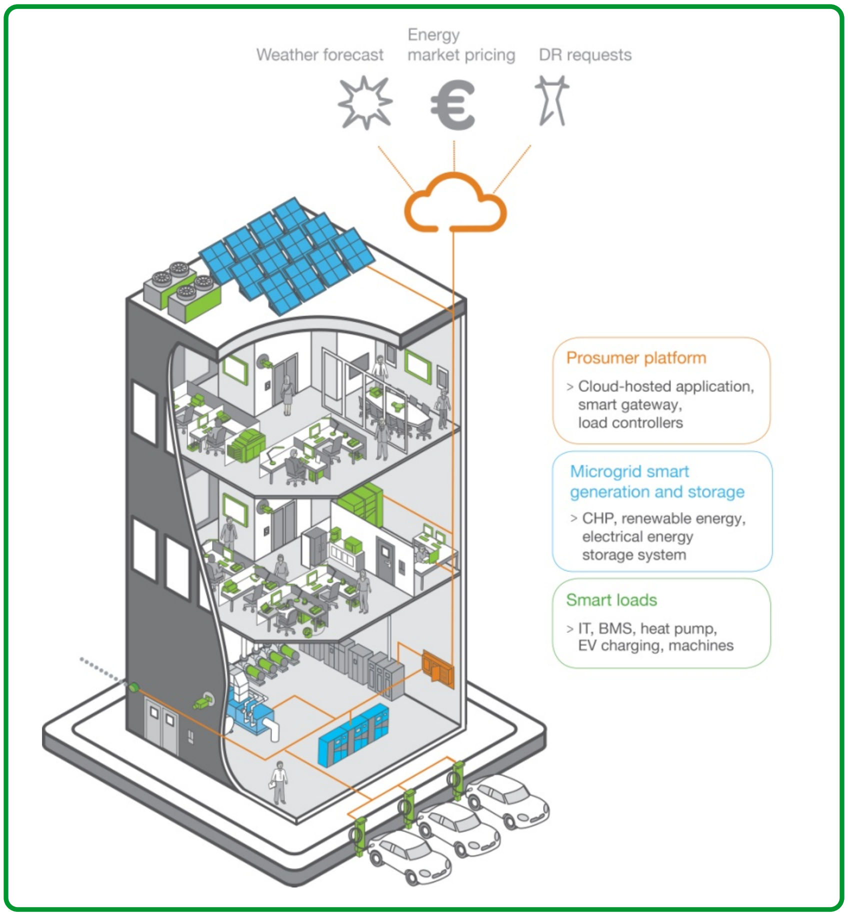

Figure 6
Commercial building running a microgrid and interacting with the smart grid through a typical cloud-hosted prosumer platform.

The platform takes into account the energy, environmental, and economic needs of the enterprise or homeowner. It then automatically proposes the optimal arbitrage between the different opportunities: demand response, variable tariffs, peak demand management, maximizing self-consumption, selling energy back to the grid based, or supporting ancillary services.

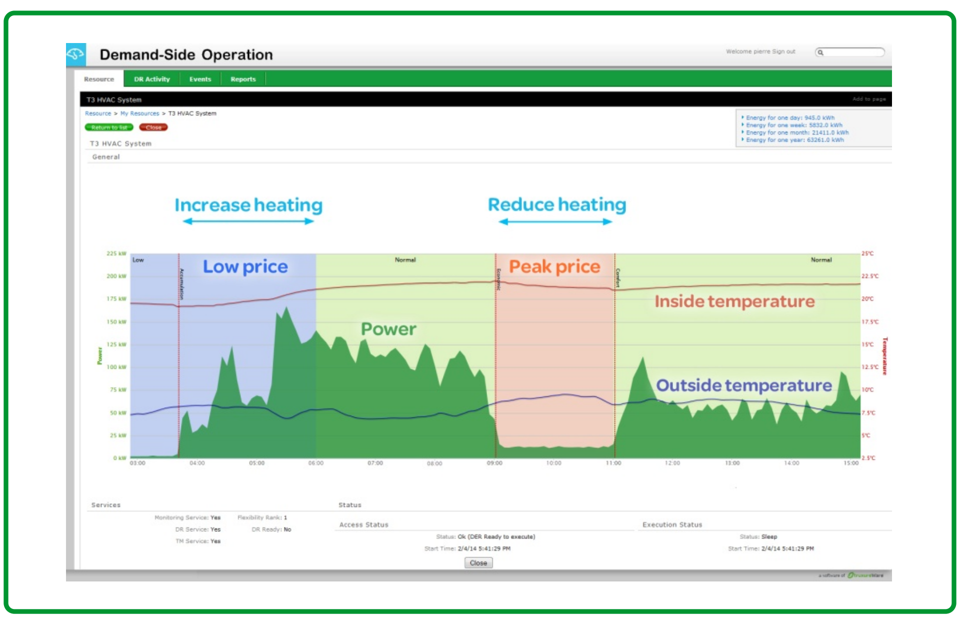

Figure 7
Typical web-based portal for a prosumer software platform, demonstrating automated load shifting in response to energy market pricing signals.

The most comprehensive of these platforms will integrate all energy-relevant drivers. This will include weather forecast data, energy market pricing, load profiles and forecasts of the prosumer's energy needs, and any constraints on their operations. This is crucial in order to predict the most advantageous opportunities to consume, store, or produce energy.

The platform also manages all two-way communication between the grid actors and the prosumer. For example, a utility or aggregator will request curtailment tenders from many energy users, analyzing and monetizing those responses.

"Prosumers are given an intelligent, transparent way to manage their distributed energy resources, as well as a simple, automated way to participate in smart grid programs."

The prosumer will then use the platform to access the status of the curtailment orders, and view the synthesis of past curtailments. They will also be able to monitor the status of their generation, storage, and load assets that are being offered as flexibility to the grid. Curtailment actions can be simplified using automation; however, the prosumer's participation is always voluntary. At any time conditions are not ideal for a business or homeowner, they can decline an opportunity or override a pre-programmed control sequence.

To enable the exchange of data between the platform and the prosumer, the smart gateway enables:

1. **Acquisition of relevant status and performance data** from all distributed energy resources
2. **Sending of curtailment commands to distributed energy assets,** including load controllers, microgrid controllers, building management systems, or process automation systems
3. **Daily backup of all time-stamped load curves and curtailment actions**

The level of intelligence and automation provided by such platforms offers a comfortable means to manage all energy resources and program participation.

Case study: France's first full-scale smart grid demonstration project

In the cities of Lyon and Grenoble, up to 1,000 residential homes and 40 commercial buildings are taking part in the GreenLys project, with the goal to showcase a functional smart grid by 2015. As part of the first stage, a commercial building successfully executed hundreds of curtailment actions, achieving 16 percent cost savings by temporarily shifting heating load from high-cost peak hours to off-peak hours. The project is being expanded to include multi-site load aggregation, electric vehicle charging, and home automation systems.

Conclusion

The emergence of the energy prosumer heralds a significant shift in how energy will be generated, distributed, and consumed in the future. Energy management systems, microgrid technologies, energy storage, and intelligent information and communications platforms are converging. This is enabling a green, locally controlled, reliable energy supply, while maximizing the financial benefits of participating in the smart grid.

Intelligent algorithms that accurately track and project energy needs will ensure that comfort and productivity are maintained. And by providing an automated approach to controlling onsite

"An evolution from energy consumer to energy prosumer promises financial, operational, environmental, and societal benefits."

generation, storage, and consumption, local energy needs can be met while enabling a two-way energy exchange that supports the resiliency of the larger grid.

In summary, an evolution from energy consumer to energy prosumer promises financial, operational, environmental, and societal benefits.

Next steps

To begin building a prosumer strategy, it is important to plan carefully to ensure return on investment is maximized and risks are reduced.

1. **Consult with an expert** to help determine the local regulatory situation, electricity tariff structure, smart grid programs availability, and all available government incentives.
2. **Calculate the potential financial, environmental, and reliability benefits** of installing one or more of the primary components of a prosumer solution: load management, onsite generation, energy storage, and a platform for interaction with smart grid programs.
3. **Find a solution provider that can offer a complete range of services,** including: site audit to determine the most optimal solution for the prosumer's business, design, project management, installation, commissioning, and lifecycle support. See below for special considerations for implementing a microgrid.
4. **Consider complementary services,** such as utility contract optimization and energy efficiency upgrades.

Microgrid special considerations

The characteristics of a microgrid's electrical distribution system will be different when it operates in island mode versus when its distributed energy resources are providing varied amounts of energy to supplement the main grid. A microgrid must be properly designed and implemented to ensure it is safe under all operating modes and to avoid problems with system stability, short-circuit fault current, over-current coordination, grounding, and harmonics. The microgrid provider should have deep expertise in power systems and power quality as well as experience in designing, building, and commissioning microgrids.

About the author

François Borghese is the global marketing lead for the commercial and industrial energy flexibility management offers of Schneider Electric. He is an expert in the building controls market and has managed numerous projects, acquisitions, and market strategies. He led the definition and launch of the company's StruxureWare™ Demand Side Operation software platform, including the deployment of successful pilot projects in France and Germany.