MICROGRID KNOWLEDGE

The Financial Decision-Makers Guide to Energy-as-a-Service Microgrids

brought to you by

Life Is On | Schneider Electric

AlphaStruxure

Contents

Overview: Putting Microgrids Within Reach

If you're an executive who makes energy decisions for your company or organization, chances are you're hearing about microgrids with increasing frequency—and for good reason.

Microgrids have been available for years, performing safely and effectively. But new technology and business models present energy customers with a reinvented microgrid, one easier to access and afford.

And this reinvention comes at an important time. Society is becoming increasingly—and painfully—aware of the costs of power outages, the very thing a microgrid averts.

Puerto Rico presents the most pronounced example. Hurricane Maria collapsed the island's grid in 2017, leaving 3.3 million people in the dark, many for months.

The outage illustrated how crucial electricity is to survival in a modern society. Maria led to an estimated 2,975 deaths, many not from the immediate wind and water, but from the lack of electricity. Medical facilities could not operate equipment and refrigerate medications, leaving them unable to adequately treat the ill, injured and aged.

Extended power outages also make it difficult to maintain the economic health of a society. Doing business becomes challenging, if not impossible without lights, computers, or automation.

The Perryman Group estimates that Hurricane Maria, along with two other 2017 storms, Irma and Harvey, accounted for $198.4 billion in lost real personal income and 2.1 million job years of employment. In 2018, damage from Florence added at least another $17-$22 billion to the United States hurricane bill, according to Moody's Analytics.

But even on the mainland—and even when there are no storms—North American businesses have experienced severe economic trauma from relatively short power outages. Delta Airlines, for example, lost $40 million when power failed for 11 hours on December 17, 2017 at the Hartsfield-Jackson Atlanta International Airport, forcing cancelation of 1,400 flights.

Identified Threats and Hazards against and Vulnerabilities of Electric Infrastructure

Natural Hazards	Direct Intentional Threats	Other Threats, Hazards and Vulnerabilities
Ice, snow, and extreme cold weather	Physical attacks	Geomagnetic and eletromagnetic pulses
Thunderstorms, tornadoes, and hurricane-force winds	Cyber attacks	Aging infrastructure
Storm surge, flooding, and increased precipitation	---	Capacity constraints
Increasing temperature and extreme hot weather	---	Workforce turnover and loss of institutional knowledge
Earthquakes	---	Human error
---	---	Dependencies and supply chain interruptions

Source: Argonne National Laboratory, 2016

In all, power outages cost the US economy an average $59 billion per year, according to a preliminary finding by The Institute of Electrical and Electronics Engineers. Commercial and industrial businesses take the largest hit. Although they account for only 13 percent of US electricity use, they are burdened with 97 percent of the outage costs.

Quick look: power outages

- US annual average cost is $59 billion
- Businesses pay 97 percent of outage costs
- US power outages doubled in 2017
- Atlanta airport outage: $40 million
- Puerto Rico/Hurricane Maria: $198.4 billion in lost real personal income

As a result, a wide range of organizational decision-makers are exploring microgrids—from corporate and non-profit board executives, to university and hospital administrators, to government and military officials. Energy savvy, these leaders see on-site microgrids as a way to:

- Increase electric reliability, resilience and security
- Reduce risk by locking in predictable energy use and costs
- Improve sustainability
- Create new revenue streams and employment opportunities

Among these organizations, pent up demand exists for microgrids. But lack of capital or ability to pencil projects stop them from moving forward.

“Energy is a contributor to their business objectives, but that doesn’t mean all of these organizations have the tools, technical competence, access to flexible capital, and regulatory insight on-staff to handle all facets required in the new energy landscape,” said Mark Feasel, vice president of Schneider Electric’s electric utility segment and smart grid business.

Fortunately, a new energy-as-a-service (EaaS) model has emerged that simplifies microgrid development and ownership for organizations. EaaS relieves the microgrid host from operational and financial risk—but guarantees them the benefits.

Microgrid Knowledge, Schneider Electric and AlphaStruxure produced this report, “The Financial Decision-Makers Guide to Energy-as-a-Service Microgrids,” to explain the EaaS model. If you already know you want a microgrid, and just need to learn about this model, skip to Chapter 4.

Chapter 1 focuses on megatrends driving microgrid adoption and the rise of EaaS. Chapter 2 looks at what motivates energy customers to install microgrids — and why it is sometimes difficult. Chapter 3 looks at risks and ways to minimize them. Chapter 4 explores the EaaS model, and Chapter 5 offers real examples.

We hope this report will provide a vision of a path forward for those eager to secure microgrid benefits for their operations.

Microgrids are crucial infrastructure in a world that depends on electrification and digitalization. We believe everyone benefits when energy supply becomes cleaner, more efficient and resilient. So we offer this report for download at no charge and encourage you to distribute the link widely.

What is a microgrid?

Microgrids are advanced electric grids with features that make them especially adept at managing energy and ensuring its reliable delivery. A self-sufficient, local energy plant, a microgrid serves a discrete geographic footprint, such as a manufacturing facility, college campus, hospital complex, business center, public office, or neighborhood.

Within a microgrid is one or more distributed energy resources (solar panels, wind turbines, combined heat & power, generators). In addition, many newer microgrids contain energy storage, typically from batteries as well as electric vehicle charging stations.

Interconnected to nearby buildings, the microgrid provides electricity and possibly heating and cooling for its customers, delivered via sophisticated software and control systems. Most advanced microgrids also are connected to the central grid, from which they buy and sell electricity, creating price efficiencies and sometimes revenue for their hosts.

Chapter 1: Four Megatrends Changing Energy Decision-making

Until recently, the electric power industry saw little in the way of major innovation. For more than a century, the industry produced and delivered power in much the same way—generating electricity at central plants and sending it through miles of wires to homes and businesses. Customers became accustomed to the system and thought little about who created their power—or how it was produced. Alternatives were scarce, if they existed at all, so they just paid the bill each month, acting as passive recipients.

But now the energy landscape is transforming. Customers have choices as electric supply diversifies. New opportunities allow them to secure energy from cleaner sources in a way that better suits their needs—and saves them money. By bringing power production on site, businesses access economic, environmental and reliability benefits unavailable to them under the old electricity business model. They are the new prosumers in charge of their energy destiny.

So how did we get here? What's driving the change? It can be summed up in the phrase, "More E and three D," an encapsulation of four transformative energy trends:

- Growing demand for electricity
- Digitize
- Decarbonize
- Decentralize

It's important to understand these trends because they underscore why businesses need to think about their energy use more closely. Good energy management is no longer a nice-to-do but is a need-to-do. Change is happening rapidly in energy and those who ignore it may find they've left money on the table.

The four main trends

1. Growing demand for electricity

We are becoming an increasingly electrified society. Telecommunications, refrigeration, industrial motors, computers, advanced medical care and other staples of modern life all require power. As a result, worldwide demand for electricity is growing faster than for any other form of energy.

Various factors drive the growth, among them the need to bring power to one billion people in Africa, Asia and India that still lack electricity and the transition from gas-combustion to electric vehicles.

2. Digitize

Meanwhile, society also is becoming more digitized, relying on the Internet and computer-related services to function on almost all levels—households, business operations, food and water management, transportation and communication, and government and military.

To get a sense of the pace of digitization, consider the massive flow of information across the Internet as we add more and more devices, creating an Internet of Things (IoT). Cisco finds that mobile data traffic alone will grow at a compound annual growth rate of 47 percent from 2016 to 2021. This increase comes as the number of cell phone owners grows—more people are expected to own cell phones than have access to running water or even electricity by 2020.

Energy IoT opens the door for better understanding of our energy use.

Sensors can discern energy use down to individual pieces of equipment. Digital energy displays make clear how much energy is being used, and when and where within a building. Smart thermostats and controls ensure that lights, heating and cooling match room use.

"Data demystifies energy," said Feasel. "Digitizing energy infrastructure can unlock better resilience and sustainability, and more predictable costs. Through our project development process, we quantify the value of these improvements to the consumer and then design a solution to achieve agreed upon outcomes."

More ELECTRIC	DIGITIZATION	DECARBONIZATION	DECENTRALIZATION
2X faster growth of electricity demand compared to energy demand by 2040	**10X** more incremental connected devices than connected people by 2020	**82%** of the economic potential of energy efficiency in buildings and more than half in industry, remains untapped	**70%** of new capacity additions will be in Renewables by 2040
Source: IEA WEO	Source: Cisco, Internet World Statistics	Source: World Energy Outlook, Internal Analysis	Source: BNEF

Source: Schneider Electric

Fortunately, the next two trends we will discuss—decarbonization and decentralization—help shape an electric supply that can meet the demands of an increasingly electrified and digitized society.

3. Decarbonize

The conventional electric grid produces high levels of carbon dioxide. Electricity is responsible for over one-third of the carbon produced by the US energy sector. Government and industry are trying to decarbonize; doing so requires finding more efficient ways to produce and use energy.

> *"Data demystifies energy. Digitizing energy infrastructure can unlock better resilience and sustainability, and more predictable costs."*
> *– Mark Feasel, Schneider Electric*

Here's where we see the flip side of digitization. While it demands more use of electricity, digitization also creates new streamlined ways to manage energy. Today's building automation systems and microgrid controllers are products of advanced digitization.

- Building automation systems avoid energy waste by controlling a building's lighting, heating, ventilation and air conditioning in a centralized way.
- A microgrid controller acts as a microgrid's brain, allowing it to island seamlessly away from the central grid during a power outage and then back again when the central grid re-energizes. Controllers also assist in managing on-site and off-site supply. This improves operational efficiency.

These technologies will play an important role in helping industry decarbonize, a worldwide effort now embraced by more than 420 major corporations. The companies have committed to science-based goals to cut greenhouse gas emissions. More than three quarters say their environmental efforts enhance brand reputation and a third cite cost-savings, according to a survey by the Science Based Targets initiative. Those surveyed listed the environment as a chief influence on business growth, even higher than economic policy.

The fourth trend—decentralization—brings even greater sophistication to energy management and adds the benefits of reliability and resiliency.

4. Decentralize

The conventional power model – what Pittsburgh's mayor William Peduto describes as making your toast from electricity produced at a power plant 100 miles away—is giving way to a new decentralized approach. This is made possible by the proliferation of onsite power—smaller, often renewable, generation systems that can be placed on, or near, the buildings they serve.

> *"We no longer necessarily install one big microgrid; instead we may build a federation of microgrids for a facility, tied together at the Cloud level. That drastically reduces the cost of building a microgrid."*
> *– Philip Barton, Schneider Electric*

Distributed energy is efficient because it averts what is known in the power industry as line loss. When power travels over transmission and distribution lines a significant portion dissipates as heat along the journey, as much as 15 percent. That's power produced, and emissions created, for no good purpose. It's money evaporated. So it's ability to avert line loss, alone, makes distributed energy a preferable alternative.

In addition, digitization allows for increasingly pinpointed decentralization, tailored to the unique needs of an operation. Using data, energy analysts can characterize exactly what part of a business most needs reliable energy and tailor the installation accordingly.

"Ten years ago, a microgrid tended to be designed for the whole building. Today we are more prescriptive. We build microgrids to serve specific loads within the facility that are sensitive to outages," said Philip Barton. "So, we no longer necessarily install one big microgrid; instead we may build a federation of microgrids for a facility, tied together at the Cloud level. That drastically reduces the cost of building a microgrid."

Bottomline

For energy decision-makers these four trends—energy demand, digitization, decarbonization and decentralization have opened the way for less expensive, cleaner, more reliable energy supply tailored to a facility's unique needs. So why don't more businesses, institutions and communities have microgrids? We'll get into that in the next chapter.

Chapter 2: Microgrid Drivers and Obstructions

Several compelling arguments exist to install a microgrid. Besides offering environmental and energy efficiency benefits, microgrids can keep a facility's energy spend in check. Advanced microgrids do this several ways, including:

- Managing energy use to reduce demand charges
- Arbitraging against grid resources for best pricing
- Leveraging fuel supply for lowest cost
- Selling capacity and services to the grid (where rules allow)

These capabilities are leading to continued growth of microgrid deployments. Microgrids totaling about 3,000 MW are being added this year, a figure expected to reach 16,000 MW annually by 2027, according to a forecast by Navigant Research. This growth comes, in part, because of improving technology costs. Microgrids are 25-30 percent less expensive than in 2014, according to Navigant's Peter Asmus, author of the study.

Microgrid costs vary dramatically based on the needs of their hosts. A simple microgrid for a small business may cost as little as $250,000, while a microgrid for a diverse campus with multiple forms of generation may run into the tens of millions of dollars.

Yet, given its many benefits, the microgrid industry is still small. Navigant had identified just 2,134 microgrid projects worldwide as of second quarter 2018.

This worries bellwether thinkers who see microgrids as a key security and energy management technology. So in the US, lead states are working to boost microgrid adoption through grant programs and favorable rules. California, for example, is distributing $50 million this year alone to jump-start microgrid commercialization. The state also enacted a law in September 2018 requiring that utilities find ways to support microgrid development. Connecticut, Illinois, Massachusetts, New Jersey, New York and other states also have programs and funding underway to boost microgrids. The military is building demonstration microgrids, while academia is showcasing its working microgrids.

While these efforts are helping to drive the industry forward, a key market obstruction still inhibits many businesses from installing microgrids: Fear of risk.

Businesses worry, perhaps rightly, that since energy is not their core competency, they are entering an unknown arena by installing on-site supply. They know little about developing an energy project, much less maintaining and operating one.

What rules and regulations govern such projects on the local, state and federal level? How do businesses with facilities in several states create a corporate microgrid plan when each state has its own set of energy rules? Is there a way to capture economies of scale?

What if a company's energy needs change over time and it needs to expand the microgrid? Is this possible and how?

What financial exposure does the project create? How much capital must the company risk upfront and how can it justify the expenditure? And how can the company guarantee that the microgrid will remain cost competitive over its 20-year, or more, lifespan?

Legitimate concerns, they can be summed up in one word: complexity.

The next two chapters discuss a solution that makes microgrid development and ownership less complex.

Even bigger obstacles to traditional infrastructure

One might ask, why doesn't the local utility take care of the some of the energy problems that microgrids solve? Can't they increase their investments in energy infrastructure?

Utilities are doing so, to some extent. But new large, energy infrastructure projects face formidable obstacles.

First, utilities must justify the capital expenditures to state regulators in an era when they are experiencing a flattening of electricity sales. Second, they face increasing opposition from local communities concerned that long transmission lines and large power plants will mar scenic views, drive down property values and increase greenhouse gas emissions.

This is another reason why microgrids and distributed energy make sense for today's businesses. Relatively small and unobtrusive, they fulfill their hosts energy needs in a community-friendly way.

Recognizing the value of niche, targeted energy projects, some states are beginning to require that utilities gauge if "non-wires alternatives"—distributed energy resources—are a less expensive alternative when they are considering infrastructure development. This is opening the door to even more microgrids.

Chapter 3: Securing Microgrid Benefits without the Risk

It's clear that microgrids need an 'easy button,' an approach that is as convenient—and risk-free—as buying electricity from a utility.

The two common mechanisms for microgrid development place risk on the host.

- **Self-financed construction, ownership, and operation.** The microgrid owner/operator benefits directly from any costs savings from the power produced, as well as any income from selling excess generation to the utility. But the owner also takes on all financial, development and ownership risk.
- **Third-party construction, ownership, and operation of microgrid assets, which are leased to the host.** The host controls power generation and accrues benefits but also must manage complex energy programs, such as utility demand response or sale of ancillary services to the grid.

Both models put strain on the business, institution or community hosting the microgrid. To reduce this burden, the industry has created a third model—an opportunity to secure microgrid benefits by contracting for services rather than 'buying' an energy plant. This model is called energy-as-a-service (EaaS).

EaaS removes the development and operational burden from the host. Instead, a team of industry specialists engineer, finance, build, operate, and maintain the microgrid for the host under short- or long-term contracts.

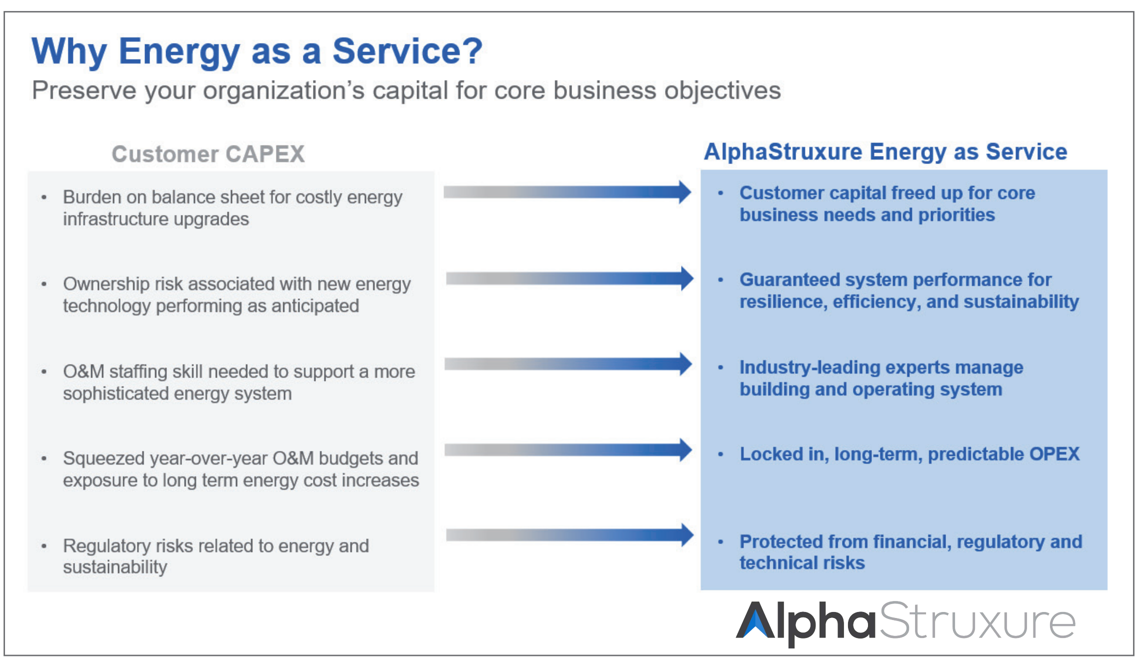
Each party benefits. The host gains reliable and resilient electricity at an agreed upon price. Should the electric grid fail, the host continues to receive power from the microgrid. The energy team, meanwhile, uses its expertise to leverage the microgrid's output in wholesale markets, secure tax benefits, and capture other values from the project.

Financial advantages of EaaS

As-a-service models are used across a range of industries from software to transportation. The approach holds appeal because it spares customers the budget strain of a large upfront capital expenditure and the intricacies of asset development and ownership.

The model works particularly well for capital-intensive energy projects. Consider a company weighing investment in a microgrid:

Budget constraints may make it hard for the business to justify the capital expense of the microgrid, particularly if cost recovery occurs over several years. EaaS converts what would have been a long-term capital expenditure into a short-term operational expense. So the project does not affect the company's borrowing capability as would a large capital expense on its books.



Source: AlphaStruxure, a Carlyle Group and Schneider Electric joint venture

Operational advantages of EaaS

The approach also removes strain on the company's operations with an outside expert providing portfolio advisory services. Energy management is not a core competency of most companies. Nor is it one easily brought in-house, given that regulatory and technological complexity that surrounds energy projects.

Moreover, the company is likely accustomed to outsourcing its energy needs to utilities; an approach baked into business operations for over a century. EaaS gives the company an opportunity to reap these benefits without venturing beyond its area of expertise.

Microgrids are more complex to install and operate, especially those within a campus that incorporates multiple forms of generation acting in coordination with each other and the central electric grid. This complexity requires a team of experts for their development and operation.

Of course, a business can take on the risk of acting as a microgrid developer and owner. Some are emboldened to do so because they have installed back-up generators, solar panels or other relatively straight-forward energy equipment. They assume microgrid development is similar.

However, microgrids are more complex to install and operate, especially those within a campus that incorporates multiple forms of generation acting in coordination with each other and the central electric grid. It is because of this complexity that microgrids can supply so many financial, environmental and efficiency benefits; but it is also this complexity that requires a team of experts for their development and operation.

EaaS allows the host to secure microgrid benefits without the hassle or risk. The microgrid:

- Can serve as the primary source of electrical power and energy for the business
- Serves as the emergency backup source of power in the event of a grid outage
- Captures potential reductions in energy consumption and utility bills
- Manages power for maximum efficiency by engaging in peak shaving and other approaches to reduce power use when electricity is expensive
- Manages dispatch of electricity from on-site solar or other variable power sources to maintain a smooth flow of electricity
- Sells surplus electricity to the local grid operator where it is allowed and is to the host's advantage
- Helps the host earn revenues by providing ancillary grid services such as voltage or frequency regulation, or spinning reserve

How exactly does EaaS work? The next chapter explain the key elements of the agreement and the roles of participants.

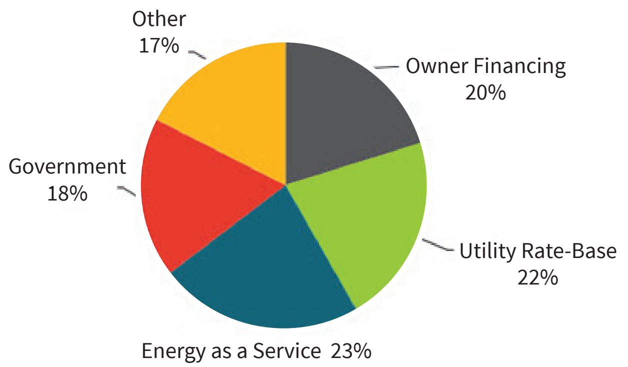
EaaS solutions offerings

- Portfolio Advisory Services: Comprehensive strategic guidance to navigate the unique procurement, energy management, sustainability, financing, business model, and technology opportunities.
- On-site Supply: On-site distributed generation solutions like solar PV, CHP, diesel and natural gas gensets, microturbines, and fuel cells.
- Off-site Supply: Electricity procurement options from offsite sources in retail choice electricity and gas markets and from new emerging large-scale, off-site renewable energy procurement business models.
- Energy Efficiency and Building Optimization: Comprehensive energy efficiency assessment, business case analysis, financing, implementation, monitoring and verification, and building commissioning services.
- Load Management & Optimization: Comprehensive management solutions to optimize energy supply, demand, and load at an enterprise-wide level, including demand response, distributed energy storage, microgrids controls, EV charging equipment, building energy management and automation systems and software controls.

Chapter 4: Understanding the Energy-as-a-Service Model for Microgrids

Although introduced only a few years ago, the EaaS model for microgrids is growing quickly. Already nearly one-quarter of microgrids use EaaS agreements.

Global Snapshot: Microgrid Business Models



Source: Navigant Research

EaaS agreements operate under the premise that risk should not be placed upon the microgrid host. Beyond that, they can be highly customized to the host's energy need, goals, local regulation, and available energy resources. In fact, a key to successfully implementing the EaaS model is understanding clients' needs, desires, goals, and energy objectives.

An EaaS agreement can be applied to a microgrid that is large or small, simple or complex. The host may require only electricity or both electricity and thermal energy.

*Who's included in a microgrid energy industry team?

- Site owner or host
- Project developer
- Microgrid design, engineering, procurement, and construction (EPC) specialist
- Strategic capital
- Supply chain partners for technology, energy, and electrical equipment
- DER manufacturers
- Systems integration specialist
- Operation and maintenance provider

In addition, some of the existing electrical equipment may need to be replaced or may no longer meet code. These can all be addressed within the EaaS.

The host might already have energy infrastructure—such as solar panels or back-up generators—on site and may want to incorporate them into the microgrid. Or microgrid design may start fresh.

Either way the *energy industry team will consider the host's energy demand, operational needs and long and short-term goals in designing the microgrid. A university with a zero-carbon commitment, for example, may want to include renewable energy in the microgrid. A manufacturer that uses thermal energy in production may benefit from combined heat and power.

Almost all facilities achieve cost and environmental benefits from energy efficiency and building optimization. So that's often a starting point for microgrid development. By reducing a facility's energy use, the energy team immediately lowers the host's costs and designs a microgrid that is the right size for the facility.

Microgrid construction is flexible—no need exists to build the project all at once; it may be staged over time. If the host expands its operation at a later date—perhaps a business park adds more buildings—new microgrid capacity can be added. This flexibility also allows the microgrid to incorporate new technologies. As improved components come into play, the microgrid can be updated.

Contracts for EaaS

An EaaS operates like a power purchase agreement. The host makes payments as recurring, short-term operating expenses, not long-term capital expenditures. Host payments to the owner continue as long as electrical services are rendered, with the length of services specified in the contract.

This is similar to the way the host would contract with the utility for electricity. But in this case, the host instead contracts with a third-party microgrid services provider for a specified set of energy services. The services are typically paid monthly but can be arranged under different terms. The payments also have flexible structuring arrangements. Depending on the needs of the customers, EaaS payments can be in a traditional delivery model (kWh) or a flat-rate subscription model, much like a phone plan. The agreement can span in duration from a one-year recurring term, with or without specific options to renew, to longer terms of 20 years or more. Guarantees are written into the contract ensuring that the host will continue to receive power if the central grid fails.

Most microgrids in North America are connected to the central utility grid. This allows the host to receive power from the microgrid or from the utility—whichever is most advantageous at any given time.

For example, the host will take electricity from the microgrid when the central grid experiences a power outage. Or it may rely on microgrid output if the grid is under strain, such as during summer afternoons when power prices rise. At other times, if allowed, the microgrid owner sells the microgrid's idle capacity to the local utility or wholesale market.

Financial incentives and benefits

EaaS agreements can designate that the monthly service fees be performance-based, another attractive benefit to the host. As such, the payments are influenced by pre-established performance indicators agreed upon with the EaaS provider. Hence, EaaS contracts can be highly customized to include the host's needs and concerns for reliability and other issues.

Further, EaaS agreements can be structured so that the host participates in any additional revenue opportunities that result from the microgrid.

EaaS agreement

The EaaS agreement incorporates a range of financing and contracting concepts and innovations, including:

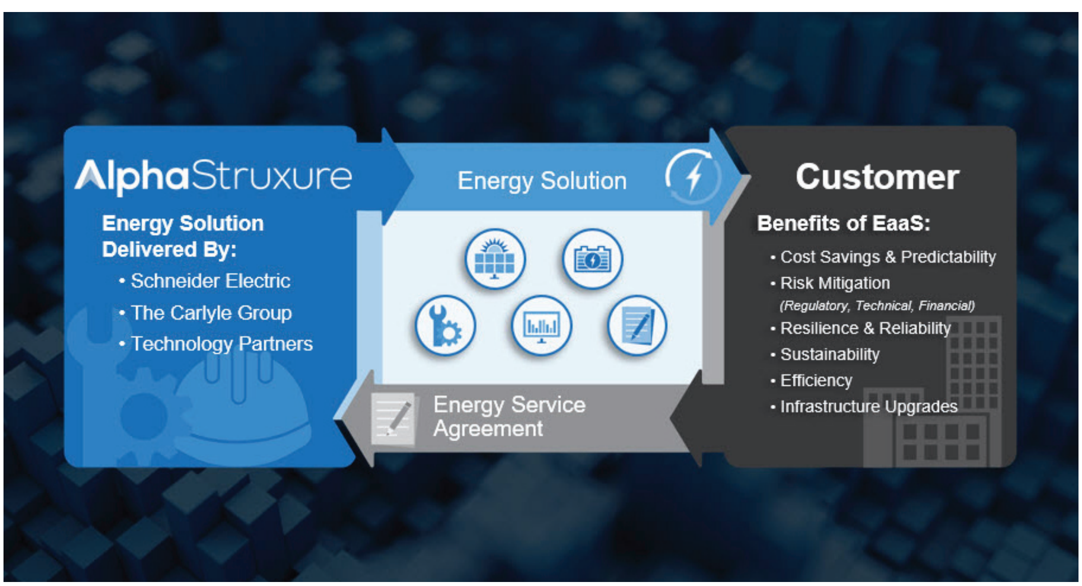
- Equipment Leases/Loans
- Power Purchase Agreements
- Efficiency Savings Agreement
- Energy Savings Performance Contracts
- Shared Savings Agreements
- Energy Asset Concession Agreements

Microgrids enhance the reliability and cost-effectiveness of electric power for communities, organizations and businesses. As microgrid financing tools become more sophisticated, the number and style of opportunities for microgrid development increase.

Microgrids are no longer just seen as a tool to provide reliable power to critical facilities during blackouts. They are increasingly seen as valuable partners—from the utility to the home—in the drive to produce dependable, affordable and flexible electricity customized to suit diverse demands. Now, by incorporating EaaS, these microgrid benefits have become available to a broader range of businesses and institutions.

To see how all this comes together in practice, we will look at real world microgrid project development and operations in the sixth, and final, chapter of this report.

Energy-as-a-Service



Source: AlphaStruxure, a Carlyle Group and Schneider Electric joint venture

Chapter 5: Energy-as-a-Service Microgrids in the Real World

Two significant players, Schneider Electric, a global leader in energy management and automation and The Carlyle Group, one of the largest global investment firms with over $220 billion of assets under management across more than 360 investment vehicles, have created a joint venture, AlphaStruxure, to deliver microgrids and distributed energy resources under the EaaS model.

Top ranked microgrid provider, Schneider backstops the project's technical risk through engineering, prescription and lifecycle services.

AlphaStruxure's EaaS solution transfers the burden of financing, owning, installing and managing a microgrid from the host to AlphaStruxure via a long-term agreement.

"We offer the global reach and domain expertise to deliver energy-as-a-service anywhere in the world, and the staying power to deliver the outcomes to which we commit."
– Juan Macias, CEO, AlphaStruxure

AlphaStruxure designs, builds, owns and operates energy systems that deliver improved productivity and guaranteed reliability, resilience, sustainability and cost outcomes with no capital outlay by the microgrid host.

"Together, we aim to transform the market by offering a platform to own and operate microgrids for organizations and institutions that demand more out of energy than they are getting today," said Juan Macias, CEO of AlphaStruxure. "We offer the global reach and domain expertise to deliver energy-as-a-service anywhere in the world, and the staying power to deliver the outcomes to which we commit."

Illustrations of EaaS for microgrids

The AlphaStruxure joint venture helps organizations tackle large challenges around energy infrastructure upgrades while preserving flexibility to include new technology as the market evolves.

Below are two illustrations of EaaS for microgrids in action.

1. Mid-Atlantic municipal complex

A Maryland county began exploring microgrid technology after experiencing extended outages from severe

The AlphaStruxure joint venture helps organizations tackle large challenges around energy infrastructure upgrades while preserving flexibility to include new technology as the market evolves.

weather. Known for its advanced approach to energy planning, the county saw microgrids as a way to further its sustainability goals.

However, like many local governments, the county was trying to manage a capital budget constrained by competing needs.

After seeking bids for a microgrid—and receiving numerous proposals—the county found the answer to its energy problems in an EaaS offering.

Making no capital outlay, the county secured not only a microgrid, but also badly needed upgrades to its low and medium voltage gear, all packaged into the monthly EaaS payments.

The project includes a 2-MW solar array, two combined heat and power plants (CHP), advanced microgrid controls and monitoring and advanced cybersecurity. The microgrid can supply power for public safety and correctional facilities should a power outage occur. The 25-year contract also provides for operation and maintenance of the microgrid. As a bonus, the microgrid will reduce the county's greenhouse gas emissions.

2. Corporate campus near Boston

Schneider decided it was important to test the EaaS concept firsthand. So the company commissioned a microgrid for its corporate headquarters in Andover, Mass. A company team acted as the customer to fully understand that perspective.

The building was a good candidate for a microgrid because it faced rising and uncertain utility rates and an unreliable utility connection that jeopardized its research and development activities.

Management discovered that installing a microgrid would not only resolve these problems but also help it fulfill its public commitment to be carbon neutral by 2020.

Because of the operational efficiencies and other benefits created by the microgrid project, the new infrastructure had little impact on the bills, raising them marginally—less than 5 percent.

The microgrid generates more than 520,000 kWh of electricity per year and includes a 465-kW solar array. The microgrid also incorporates a natural gas generator as an anchor resource.

The building features an Energy Control Center, which connects its distributed energy resources to the microgrid and provides advanced control. The microgrid also incorporates Schneider's EcoStruxure Microgrid Advisor, which leverages connected hardware, software and cloud-based analytics to help the campus procure energy and manage its consumption more efficiently.

The combination of advanced controls and demand-side software allows the microgrid to leverage weather forecast data and other operational site data to optimize energy performance across its solar, energy storage, electric vehicle charging, building HVAC and natural gas generation assets.

Under a 13-year fixed cost contract, the facility will use solar energy for 50 percent of its energy needs. The microgrid keeps power flowing to crucial areas when the grid fails, improving productivity that is key to the R&D's facility bottom line.

The company made no capital investment—the cost of the microgrid, solar and other infrastructure was incorporated into the facility's monthly energy bill. But because of the operational efficiencies and other benefits created by the microgrid project, the new infrastructure had little impact on the bills, raising them marginally—less than 5 percent while providing resiliency and sustainability benefits.

These projects are just two examples of the facilities that can benefit from EaaS. The approach lends itself to an array of operations: manufacturers, corporate campuses, colleges, hospitals, military facilities, government buildings and others.

The way forward

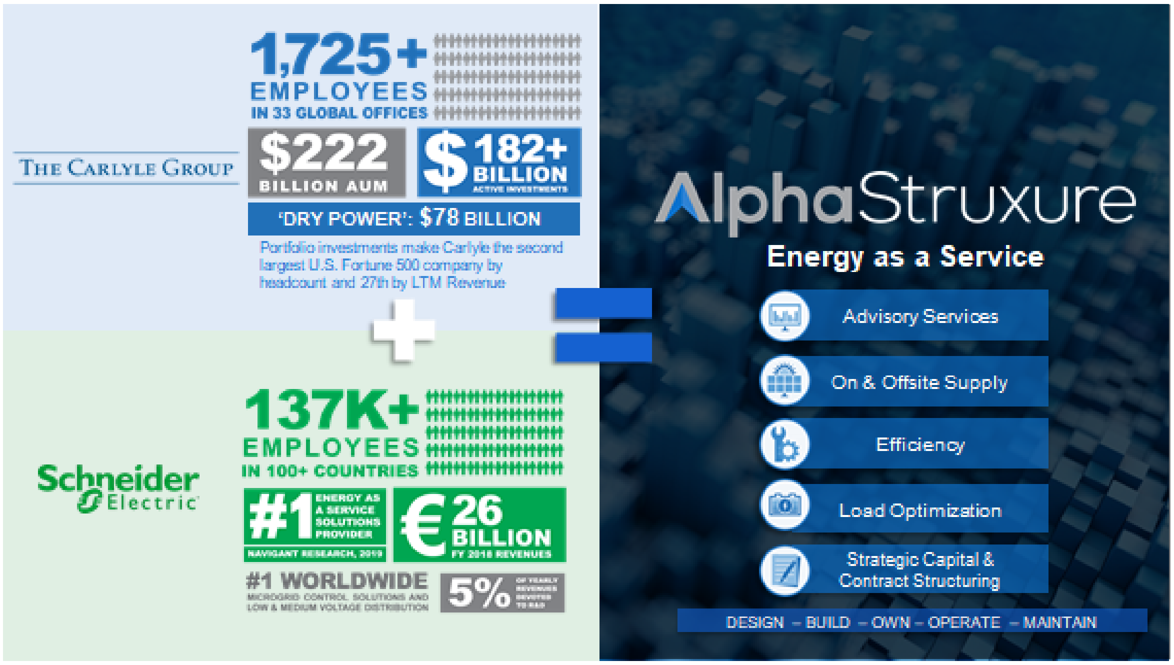
"AlphaStruxure delivers an energy-as-a-service business model that empowers organizations to choose exactly how they will deploy their capital and staff to integrate energy management with their business objectives," Juan Macias said.

He added: "Using a balanced scorecard approach, we can deliver a wide array of outcomes, including: no capital outlay, elimination of costs associated with the maintenance and operation of energy assets, tax incentive optimization, access to wholesale market programs, lower energy costs, more predictable energy costs, increased sustainability and better resilience."

In short, today's energy megatrends point toward microgrids as the path to smart energy management for businesses, institutions and communities.

This is new territory for many decision-makers. But EaaS offers a way for them to bring the many benefits of microgrids to their organizations while using a familiar, low-risk approach to managing their energy spend. The approach promises to increase microgrid adoption, offering secure, reliable, cost-effective and clean electricity to a world that demands energy transformation.

For more details about EaaS—and to determine if it is right for your facility, visit www.schneider-electric.us/microgrid *or* www.AlphaStruxure.com



About AlphaStruxure

AlphaStruxure is a joint venture of the Carlyle Group and Schneider Electric, formed to pursue what is seen as $1 trillion underinvestment in US infrastructure, particularly in the energy sector.

The Carlyle Group is a global investment firm with over $220 billion of assets under management across more than 360 investment vehicles, and Schneider Electric is a $30 billion global company leading the digital transformation of energy management and automation in homes, buildings, data centers, infrastructure, and industries.

AlphaStruxure creates new energy infrastructure investment and Energy as a Service (EaaS) opportunities applying Schneider Electric's capabilities in advanced connectivity and real-time insights to current and future Carlyle Group infrastructure and microgrid investments. This new joint venture offers innovation and efficient solutions meeting the needs of a rapidly changing energy landscape.

www.AlphaStruxure.com

About Schneider Electric

Schneider Electric is leading the Digital Transformation of Energy Management and Automation in Homes, Buildings, Data Centers, Infrastructure and Industries. With global presence in over 100 countries, Schneider is the undisputable leader in Power Management – Medium Voltage, Low Voltage and Secure Power, and in Automation Systems. We provide integrated efficiency solutions, combining energy, automation and software. In our global Ecosystem, we collaborate with the largest Partner, Integrator and Developer Community on our Open Platform to deliver real-time control and operational efficiency. We believe that great people and partners make Schneider a great company and that our commitment to Innovation, Diversity and Sustainability ensures that Life Is On everywhere, for everyone and at every moment.

www.schneider-electric.us