New Energy Opportunities

INNOVATIONS THAT SHAPE HOW COMPANIES MANAGE ENERGY

renewable choice ENERGY is now Schneider Electric™

Aggressive innovation among energy solutions providers—in response to pressures such as corporate demand and policy changes including the Paris Climate Accord—has accelerated development of new clean technologies. Corporate adopters across a wide variety of industries are championing these new energy opportunities, including wind and solar power, distributed generation, energy storage, and other disruptive technologies.

Companies have grown increasingly willing to test out new cleantech in order to create operational efficiencies, reduce environmental impacts, and potentially to reduce costs or even generate ROI. In this paper, we will explore several of these cutting-edge technologies, uncover the benefits and challenges of each, and learn by example from organizations that are already embracing the promising future that these new energy technologies offer.

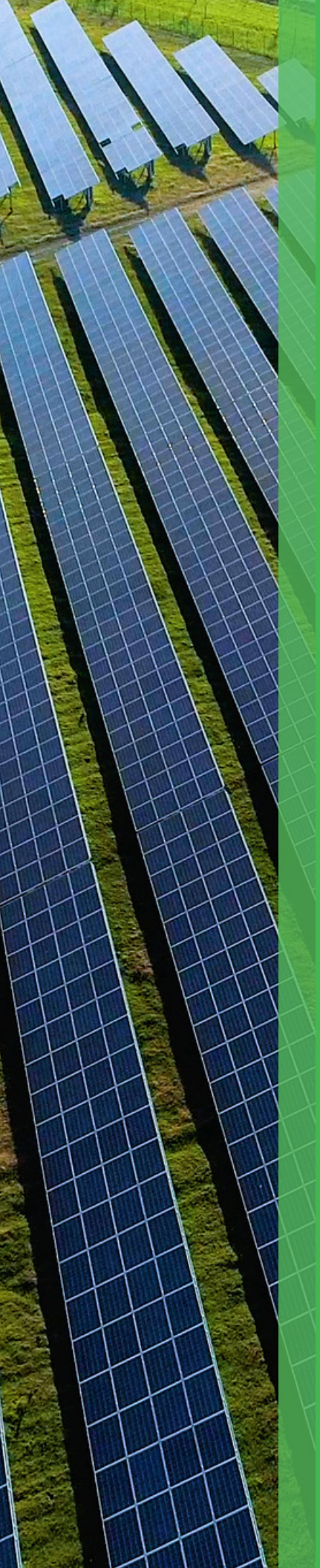
Table of Contents

Renewable Energy

Foundational technologies of the new energy landscape

One disruptive technology is already shaping the way companies buy and sell energy today. Commercial, industrial, and institutional (C&I) buyers are utilizing clean power more than ever before. Often referred to in the past as an "alternative," renewable energy is becoming a centerpiece of many corporate energy management programs. More than 100 global companies have signed on to the RE100[1], committing to source 100% of their electricity from renewable sources. In the U.S., C&I purchasers were responsible for 52% of the contracted capacity of new wind power in 2015, and, in total, have helped add more than 8,000 megawatts (MW) of wind and solar to the U.S. grid since 2010.

1 Learn more at www.there100.org.



There are four top ways C&I buyers are using renewable energy:

Offsite Power Purchase Agreements (PPAs)

Large-scale renewable energy projects that are not physically collocated with the purchaser's facilities are referred to as *offsite*. The predominant way that buyers purchase renewable electricity from these projects is via a long-term power purchase agreement (PPA)[2], which locks-in a fixed price for power with the project owner over a specified duration.

Renewable energy PPAs have received considerable attention over the past several years from C&I buyers, as they allow these large users of electricity to purchase renewables at considerable scale, and, in some cases, for less than the price of conventional fossil fuel generation[3]. Typically, offsite PPAs require buyers to have a large load size or to post credit as the offtaker of the power from a project.

For buyers that meet the load and credit thresholds, a PPA is a significant way that companies can put new renewable energy onto the grid at scale while also addressing a sizable portion of their energy demand.

Onsite PPAs/Distributed Generation

Another common form of renewable electricity purchasing is via onsite installation, generally rooftop or ground-mounted solar photovoltaics (PV). This mechanism is particularly attractive to buyers with many decentralized centers of operation (such as retailers, banks, or franchisees) or a large real estate footprint.

Onsite projects are not for every C&I buyer. There can be siting concerns, capital expenditure constraints, or operational risk that buyers may choose to bypass. In addition, most C&I purchasers won't be able to use onsite generation to achieve more than a fraction of their overall electricity demand due to the smaller scale of these projects. As part of a portfolio approach to renewable energy, though, onsite solutions have several unique advantages[4] that any company should take into serious consideration.

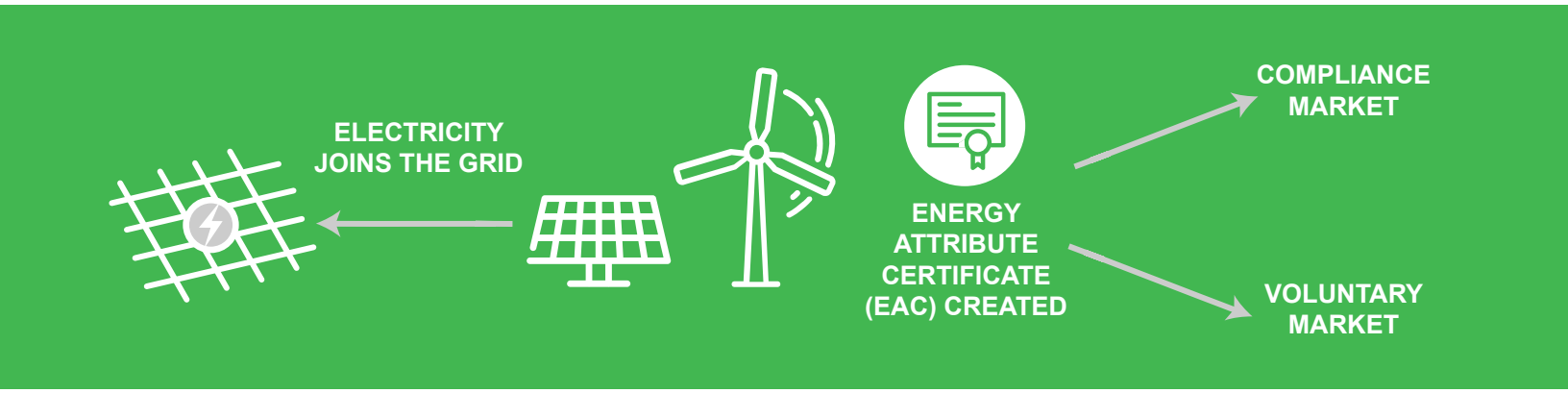
2 For more information on how your company can use renewable energy at scale, download our white paper: Accelerate Your Energy Strategy With Power Purchase Agreements. http://www.renewablechoice.com/accelerate-your-energy-strategy-ppa-wp/.

3 Read our Digital Realty case study to learn how one C&I buyer is using PPAs as part of a comprehensive energy strategy. http://hub.resourceadvisor.com/renewable-energy/how-digital-realty-is-leading-on-renewables.

4 Read more in this blog about the unique political advantages of onsite solar. http://www.renewablechoice.com/blog-onsite-renewables-advantages/.

Energy Attribute Certificates (EACs)

EACs are used in both compliance markets and by voluntary purchasers to achieve their goals. They can be bundled with retail electricity via green utility purchasing programs or "unbundled" and sold as a separate commodity. EACs are generally issued at the same time that renewable electricity is generated. They are the way that renewable electricity is tracked and traded globally. EACs represent the environmental attributes of clean generation, typically in a 1:1 ratio, and are the "proof" that renewable electricity was created and added to the grid.



Over time, with the development of new global markets, a variety of certificates have been created. The term Energy Attribute Certificate refers to this class of established and emerging green power commodities—including Renewable Energy Certificates (RECs), Guarantees of Origin (GOs), I-RECs, TIGRs, and more—regardless of the country of origin.

EACs have a relatively low barrier of entry for most C&I purchasers[5]. They can be easy to obtain, represent zero carbon electricity generation, and—when sourced from a reputable provider and third-party certified—are highly reliable.

Utility Green Power Programs

Largely viewed as a response to the growing C&I demand for greater energy choice and clean energy options, centralized utilities have begun to offer green power options in the form of green tariff and subscriber programs. Concerned by the trend of environmentally conscious consumers replacing traditional utility generation supply with directly-sourced renewable options, many utilities have begun to pivot away from providing only large-scale, conventional energy generation by offering green power solutions. Though limited by geographic location of the utility, this attempt to capture the growing audience of corporate energy buyers asking for renewable options signals a meaningful shift in the way electric power is bought and sold.

5 For an in depth look into global EACs, download our Definitive Guide to Energy Attribute Certificates. http://www.renewablechoice.com/landing-page-definitive-guide-to-eacs/.

Emerging Energy Opportunities

Technologies on the horizon of the new energy landscape

Early adopters of renewable energy are now beginning to explore and implement new, forward-thinking energy technologies. Renewables have opened the door for the next wave of cleantech solutions to once again elevate the corporate energy management landscape. The next horizon of smart energy strategies represents a new playing field where companies will continue to increase the resiliency and efficiency of their energy management programs. As corporate sustainability and energy strategies advance, the following opportunities will emerge as options worth seriously considering.

Microgrids

Decentralization of new energy opportunities

Today's market forces are leading to a departure from a highly centralized power system and a return to smaller scale, localized systems that optimize power demand, consumption, and management. Increased access to locally generated and managed clean energy is allowing companies greater choice in how and when they use energy and produces a significant amount of cost savings for pioneering organizations. If present trends continue, decentralization of generation will become a key component of the energy future. Microgrids are emerging as one of these decentralizing technologies.

Microgrids Defined

A microgrid is a local energy grid that has the ability to operate autonomously from the traditional grid. A microgrid can be powered using a combination of technologies including distributed generators, batteries, and renewable resources such as onsite solar panels[6].

Companies use microgrids to bridge the gap between large, inflexible centralized systems of energy generation and delivery of localized, renewable power. They assist in the efficient transition of power systems while also helping to address intermittency and other energy management costs and concerns. In times of crisis, such as storms or power outages, microgrids can also provide an extra level of security to companies reliant on consistent power access to deliver critical services.

Why Microgrids, and How Companies Benefit

Changes currently affecting the primary cost-driver for electric power make microgrids a particularly attractive option. Record low prices for power generation (charged by the number of kilowatt-hours [kWh] a buyer consumes) are causing power plant operators to struggle to maintain operation of enormous, expensive utility-scale assets. Put simply, if the market prices per kWh are not sufficient, the generating sector has decreasing incentive to continue supplying a stable, plentiful power supply to the grid. To combat this challenge, some markets are beginning to incorporate higher capacity charges (charged by the kilowatt [kW], or rate of consumption) in addition to generation charges.

This change in pricing for electricity is analogous to driving a car in an era when gasoline is getting cheaper, but drivers are also being charged not only on how much gas they use but also on how fast they drive. Generation (kWh) charges are measured by the odometer; capacity (kW) charges by the speedometer. Capacity charge regimes set up a series of "speed traps" for companies that have high energy demand—especially during times of peak overall system demand. The "speeding tickets" are getting really expensive, but, fortunately, the "speed traps" are increasingly avoidable.

6 For a deeper dive into microgrid technology, refer to this blog by the Department of Energy. https://energy.gov/articles/how-microgrids-work.

This change in pricing for electricity is analogous to driving a car in an era when gasoline is getting cheaper, but drivers are also being charged not only on how much gas they use but also on how fast they drive. ***Microgrids help companies use less gasoline and drive slower without compromising productivity.***

The Internet of Things (IoT) and improving energy management analytics are awakening corporate energy buyers to the possibility of playing a more active role in the energy value chain. Companies are looking at microgrids as one way to take back control of their energy strategy to avoid changes in energy expenditure and risk. To return to the analogy, microgrids help companies use less gasoline and drive slower without compromising productivity.

One of the first steps to taking an active role in energy management is knowing how, when, and where energy is used or created. By combining new energy technologies (including onsite solar, software-enabled and data-driven equipment, and battery storage), microgrids help companies better visualize their energy use patterns and quickly react to optimize total energy spend. The many connected components that make up a microgrid allow companies to avoid energy "speed traps" by closely monitoring real-time energy consumption, generating electricity via renewable and other onsite sources when available, and otherwise deploying resources at the optimal time.

Regulation and policy tailwinds, access to advanced analytics, and corporate uptick in energy investment are creating a perfect storm for C&I energy consumers to take an active role in the energy value chain to solve their own unique ambitions through microgrids[7]. C&I energy buyers can realize substantial near-term cost savings by implementing technologies embedded within a microgrid that insulate their facilities from the risk and changing cost components of an ever-evolving energy market.

7 Did you know Schneider Electric has a Microgrid Solutions team and a functioning microgrid at its Boston campus? http://www.prnewswire.com/news-releases/schneider-electric-unveils-advanced-microgrid-at-boston-one-campus-hq-300436051.html.

CASE STUDY

Microgrids in the Market Today

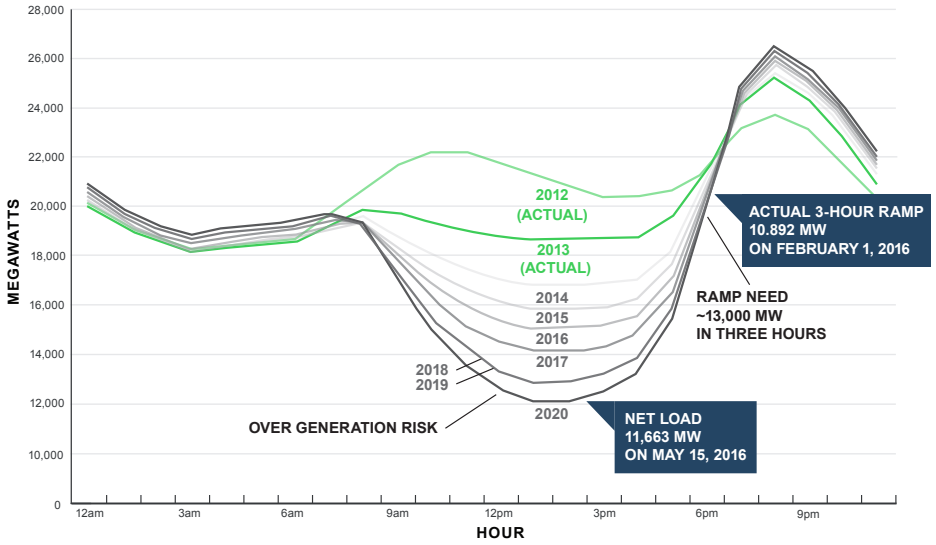
In a recent report, Navigant Research notes[8] that global capacity (C&I) microgrids could be as high as 5,400 MW by 2026, compared to today's 448 MW. Though the application of C&I microgrids has been limited thus far, there are several examples that demonstrate their potential to shape the way energy is bought and sold in the future.

Apple

In California, the world's 6th largest economy, microgrids are helping to manage grid reliability concerns sparked by a rapidly increasing percentage of added solar power capacity. Due to the maturity of California's clean energy market, in addition to the retirement of aging centralized generation assets, such as the San Onofre Nuclear Generating Station, the state is confronting this challenge (commonly referred to as the "duck curve[9]") sooner than much of the rest of the United States.

California's Duck Curve

Source: GreenBiz[10]



The situation in California provides powerful insight into the grid of the future—other regions can expect to face similar challenges as renewable power continues to join the grid and large-scale baseload generation from fossil fuels becomes more difficult to build. Proposed solutions to this problem largely involve greater grid flexibility achieved through onsite storage, shifting energy demand to more optimal periods, cogeneration, and integration of distributed generation—each potential elements of a microgrid.

For example, Apple has designed its new Apple Park headquarters in California as a self-contained microgrid, using battery storage, solar PV, fuel cells, and backup generators. In the event that a grid outage should occur, Apple's microgrid will be able to operate autonomously, protecting the company from the effects of a compromised grid system.

8 https://www.navigantresearch.com/blog/ci-customers-are-the-new-rage-in-todays-evolving-microgrid-landscape.

9 https://www.greentechmedia.com/articles/read/the-california-duck-curve-is-real-and-bigger-than-expected.

10 https://www.greenbiz.com/article/californias-grid-geeks-flattening-duck-curve.

Energy Storage

Empowering organizations to decarbonize at scale

Of the technology trends contributing to the current state of the energy market, energy storage is one that has especially interesting implications for corporate energy strategies. Batteries and other types of storage play a key role in enabling companies to embrace clean, low-cost, renewable energy at a higher level. By mitigating the intermittency issues that renewable power sources like wind and solar face, storage helps remove a significant barrier that has prevented more widespread adoption of wind and solar resources.

Paired with energy storage, technologies such as onsite solar and wind come to have an entirely new value proposition. Cost efficiency and increased reliance on renewable sources are among the most compelling benefits that companies testing this partnership between renewables and storage enjoy.

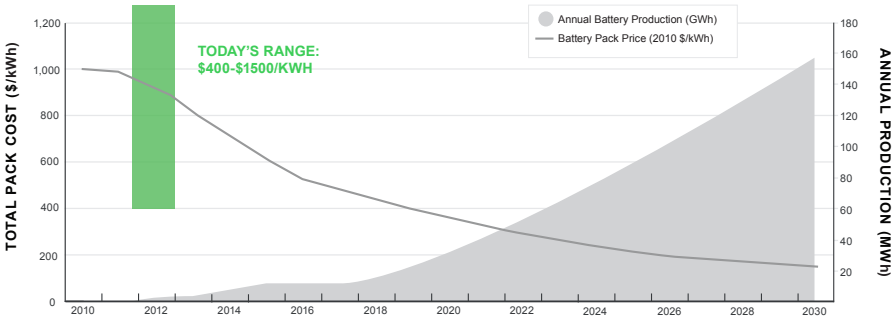
Energy Storage Defined

Energy storage is the capture of energy produced at one time for use at a later time. Energy storage solutions are technologies that discharge potential energies—stored through chemical, mechanical, or thermal systems—to provide power to a company's facilities. Energy storage as a technology can be broadly categorized in four ways: conventional and advanced batteries, mechanical energy storage, thermal energy storage, and software for discharge operation.

Why Energy Storage, and How Companies Benefit

Advances in technology, battery duration, and increased distribution of renewable generation sources have renewed the interests of C&I buyers in energy storage. These trends, alongside rapidly declining prices for energy storage, and constraints on the development of new power transmission infrastructure, make energy storage an exciting prospect.

LI-ION BATTERY PACK COST AND PRODUCTION, 2010–30



Source: Bloomberg New Energy Finance[11]

11 https://about.bnef.com/new-energy-outlook/.

Energy Security & Power Reliability

Storage is viewed as a fail-safe power source. It is one of few technologies that can replace or supplement baseload generation, and it is able to act as a back-up power supply during catastrophic system failures either at the facility level or on the grid. For many companies, this resilience is absolutely crucial, especially as the effects of climate change—including flooding, extreme weather events, and rising global temperatures—pose an increasing threat to energy security.

Many companies in the Information and Communications Technology (ITC) sector, for example, depend on the functionality of critical facilities such as data centers and colocation centers. This infrastructure, which backs the use of digital devices, networks, and the internet, relies on grid security to deliver vital services. As a result, ITC companies are particularly exposed to grid disruption. Energy storage that is rapidly dispatchable (discharges within milliseconds) can help to avoid outages. Having a fail-safe power backup in the case of an energy emergency can be a make-or-break for these companies, which are among the largest employers and economic powers in the world.

Equipment Maintenance Deferral

Companies testing the value of energy storage may also consider maintenance deferral. Using energy storage solutions promotes increased use of existing equipment, thereby deferring or eliminating costly upgrades. For energy managers with tight budgets and aggressive goals to hit, the ability to stretch the life of existing assets and instead use investments towards other efficiency and sustainability activities is significant.

Peak Load Management

Software-enabled solutions in the behind-the-meter energy storage market, which includes any systems installed on the customer's side of the utility meter, open up the potential for demand charge reductions and peak load management. Proprietary software from companies including SolarCity, STEM, Tesla, and others add intelligence to battery solutions to manage demand spikes in a facility's load. The reduction of a facility's peak demand helps consumers to either avoid setting a new consumption maximum for the facility—and potentially a higher per kW or capacity cost—or to lower their demand during coincident peak measurements.

CASE STUDY

Growing Support For Energy Storage in the C&I Sector to Meet Energy Demand and Reduce Costs

Whole Foods Market

Whole Foods Market recently deployed[12] a thermal energy storage solution at a store in California. The company has been testing the potential for energy storage to reduce its electricity expenditures by shifting electricity load off of peak demand hours.

This refrigeration battery provides daily electricity load-shifting by moving electricity used by refrigeration, which amounts to over half of the supermarket's energy use on average, to off-peak times. This means that instead of pulling energy from the grid during the day, when it's most expensive, Whole Foods can instead use its stored energy and take advantage of lower-priced nighttime rates. The system also provides real-time information about its performance through monitoring and analytics, helping the company actively manage its energy portfolios.

Walmart

WalMart is another innovative company exploring the frontier of onsite renewables combined with energy storage. At several stores in California[13], where state incentives produce the greatest savings, the company is experimenting with energy storage applications. These energy storage projects are predicted to increase cost efficiency while helping the company reach its science-based targets for greenhouse gas reduction by enabling greater integration of renewables into its energy strategy.

---

12 http://www.prnewswire.com/news-releases/axiom-exergy-energy-storage-assists-whole-foods-market-los-altos-store-in-shifting-up-to-1040-kwh-of-electricity-to-lower-costs-300444849.html.

13 https://www.smartenergydecisions.com/news/2017/04/12/wal-mart-to-turn-stores-into-hybrid-electric-buildings?contact_id=57592&inf_contact_key=3f8b4fcc40e7d268a90060173acb1687ef7219bf9cd8ea0efead903c6b1e7b12.

The Future of Energy Storage

Navigant reports[14] that in 2014 and 2015, 520 MW of new energy storage capacity was deployed globally. More than 80% of these storage deployments were made in the utility sector, while some 9,000 MW of new utility-owned storage capacity is to be deployed by 2020. This means that non-hydropower energy storage will equal approximately 2,276 MW by the end of 2017. Overall, the global market is expected to grow 47% this year over 2016's record-breaking performance.

The true potential for energy storage is in the heretofore untapped C&I market[15]. More than ever before, companies are actively seeking ways to gain control over their energy spend by utilizing cleantech and other innovative solutions. As the price for batteries and other storage solutions drops, corporate buyers will be well poised to maximize energy investments, while contributing to the clean energy transition. Additionally, with microgrid opportunities on the rise, energy storage in conjunction with other new energy opportunities very well may become commonplace for companies in the not-so-distant future.

Fuel Cells

An emerging energy investment worth serious consideration for innovative orgs

The earliest use of fuel cells dates back to the early 1800's, but it wasn't until the lunar program of the 1960's (when NASA's spacecraft first used them) that the technology began to commercialize. Although the performance viability of the base technology and its related benefits have long been proven, modern day fuel cells are still in the early phases of the adoption curve for C&I buyers.

Today, and into the foreseeable future, fuel cells are gaining popularity due to their very low emissions and high efficiency factors. If this technology follows a similar trajectory as battery storage, as is expected[16], R&D investments and further exploration of the business case for fuel cells will likely position this futuristic power source as a front-runner for environmentally and fiscally-conscious companies to consider within the next 10 years.

Fuel Cells Defined

Fuel cells electrochemically combine a fuel (ranging from pure hydrogen to natural gas or biogas) with oxygen, and convert the resulting chemical energy into electricity without any form of combustion. Fuel cells have minimal moving parts, which contributes to their efficiency and reliability. Because they require a constant, steady source of fuel to produce electricity, fuel cells are able to provide a continuous, baseload source of electric power.

14 http://www.renewableenergyworld.com/articles/print/volume-20/issue-1/features/storage/energy-storage-market-outlook-2017-state-of-play.html.

15 Did you know Schneider Electric offers solutions for grid-scale and large end-user energy storage applications? https://solar.schneider-electric.com/solution/energy-storage-system/.

16 http://www.eesi.org/files/2017-Sustainable-Energy-in-America-Factbook.pdf.

Why Fuel Cells, and How Companies Benefit

The most compelling benefit of fuel cells is the potential to generate clean power at a scale that meets the needs of C&I buyers. The type and amount of emissions vary depending on fuel cell. However, across the board, the most common emissions include water and heat with trace amounts of carbon dioxide. All fuel cells virtually eliminate emissions of harmful pollutants, including sulfur oxides and nitrogen oxides.

An additional benefit comes as a result of a fuel cell system's small footprint and modularity. Fuel cells can be scaled up or down to match demand of the individual customer, customized to fit a particular facility size and load. Fuel cells can be tied to the grid or grid-independent, making them an ideal component for companies exploring holistic energy management solutions such as microgrids.

As a baseload resource, fuel cell technology helps bridge the gap where other renewable energy sources face challenges.

As a baseload resource, fuel cell technology helps bridge the gap where other renewable energy sources face challenges. The intermittency issues that wind and solar must overcome are not a concern for fuel cells. So long as they are supplied with constant fuel inputs, fuel cell systems continuously generate stable amounts of power. Partnered with other renewable technologies, fuel cells can balance the difference between demand and generation of intermittent resources.

Fuel Cells Are Not Without Challenges

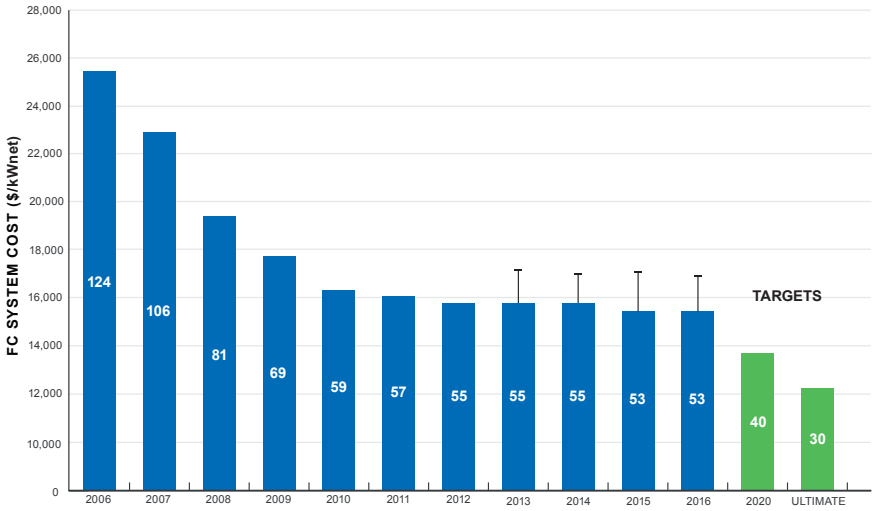
Fuel cell technology is poised to emerge as an advanced generation source capable of providing significant baseload generation, high efficiency, and drastically lower emissions.

However, the challenges that have prevented widespread adoption of fuel cells are not unlike the challenges that other new energy opportunities have overcome. The high capital cost, for instance, makes it difficult for fuel cells to compete with other more mature clean energy sources, as well as conventional generation (assuming no price on carbon).

Though today's economic environment tends to favor the absolute cheapest energy source—which in most markets will still be conventional fuels—this will not always be the case. Energy is the most volatile commodity in the world, and it is expected to become more expensive in the future. The unpredictable price of power and potential for regulatory scenarios like carbon pricing and cap-and-trade programs will tip the scale in favor of low-carbon and carbon-free energy sources. Forward-thinking installation of fuel cells is a great way for C&I buyers to protect their companies against this volatility.

MODELLED FUEL CELL SYSTEM COST (80 kW_{net}) AT 500,000 UNITS/YEAR

U.S. Department of Energy Hydrogen and Fuel Cells Program Record 16020, September 30, 2016



Source: United States Department of Energy[17]

Investments committed to maximizing fuel cell technologies will help drive down costs and increase demand, as wind power, solar power, and now battery storage have all experienced. California has been one of the leading incubators for cleantech ventures, including commercial fuel cells, thanks in part to the state's renewable incentives. The Self-Generation Incentive Program (SGIP) provides rebates for qualifying distributed energy resources, which includes an additional biogas incentive that some fuel cells systems can take advantage of.

Other challenges fuel cells must overcome to enter the mainstream market include an improved infrastructure for supplying fuels (such as hydrogen) at scale, and the demonstration of the longevity and reliability of these supply systems. But, with the combination of falling costs and incentive programs, fuel cells are expected to become more competitive with other proven renewable technologies, as well as conventional baseload power. While companies that install fuel cells today must accept some level of financial risk, an investment in this highly efficient, innovative fuel source is truly an investment in a company's future.

Fuel cell technology carries tremendous potential benefits as a source of reliable, efficient, and clean baseload power. However, it's also important to understand the headwinds this technology faces at present, including generally low grid prices in key markets, high capital costs, and the relative absence of assigned costs for carbon emissions to fossil fuel generating sources. Companies that embrace a clean energy transition must rely on a diverse portfolio of cleantech solutions, and as fuel cells overcome their challenges, they should become a vital measure to carefully consider within the active energy management[18] landscape.

17 https://www.hydrogen.energy.gov/pdfs/15015_fuel_cell_system_cost_2015.pdf.

18 To learn more about active energy management, download our eBook: Activate an Efficient & Sustainable Future. http://hub.resourceadvisor.com/active-energy-management/active-energy-management-ebook.

CASE STUDY

Fuel Cell Applications in the Private Sector

Equinix

In pursuit of its 100% global renewable energy goal, Equinix is deploying fuel cells worldwide to supplement other clean energy strategies - including renewable PPAs and EACs. Sparked by an interest in driving down alternative energy costs globally, while making a positive impact on employees, the communities in which it operates, and the environment, Equinix has begun using onsite fuel cells to power data centers.

Provided by top fuel cell generator Bloom Energy, Equinix's fuel cell system for its San Jose facilities is already returning a 15% reduction in carbon emissions annually compared to locally supplied energy from the grid. The fuel cell project operates at best-in-class efficiency, and provides always-on, reliable power to the data center. As a result of the proven value of their existing installations, Equinix is exploring future fuel cell investment as a key milestone of the company's sustainability program.

> "As Equinix data centers, and the interconnection they facilitate, become increasingly critical to the infrastructure of our digital world, this fuel cell expansion is one step in lessening the overall impact of the digital economy on the planet. It enables us to serve our customers with the highest levels of performance while assisting their efforts to make their supply chain clean and efficient."
>
> ~ Karl Strohmeyer, President, Americas, Equinix[19]

19 http://www.equinix.co.uk/newsroom/press-releases/pr/123571/equinix-to-install-largestdeployment-of-fuel-cells-for-the-colocation-data-center-industry/.

Blockchain

Digitization of new energy opportunities for more efficient transactions

With blockchain, EACs can be created instantaneously as renewable energy is put onto the grid—no matter the size or physical location of the producer.

Blockchain Defined

Blockchain technology is a distributed, digital ledger used to record and track transactions. It uses sophisticated algorithms to validate, encrypt, and instantaneously record transactions for virtually anything of value in a secure and decentralized manner. While most well known as the technology underpinning Bitcoin virtual currency, blockchain has the potential to be used in many different industries and contexts due to the high degree of transactional efficiency it provides.

Why Blockchain, and How Companies Benefit

Energy is one area of interest for blockchain applications. Energy markets are experiencing a confluence of trends, where electricity production from renewable sources such as wind or solar power is increasing, while barriers to direct market participation are decreasing, allowing smaller consumers to become market participants. This growth is driven by the expansion of distributed energy resources (DERs). As previously discussed, the advent of these smaller, innovative energy projects—like microgrids—pose challenges to the historic centralization of the grid.

Today's new energy opportunities focus more on DERs, such as rooftop solar, where producing-consumers—or *prosumers*—occupy a newfound position in the grid value chain. Distributed technologies collectively shift the industry towards greater decentralization. However, these new energy opportunities often struggle to gain a foothold in a system that was not designed with them in mind. For the industry to realize the full potential of renewables and other emerging clean technologies, the grid must be re-envisioned as a transformative tool that enables these prosumers of distributed energy.

Currently, the only means to track renewable energy generation is through EACs, and information sharing among market participants is a manual process. To date, this process has worked due to the closed, controlled nature of energy markets. However, as new technologies come online and the grid becomes more decentralized, markets become more complex and tracking the generation and ownership of EACs becomes much more difficult.

With blockchain, EACs can be created instantaneously as renewable energy is put onto the grid—no matter the size or physical location of the producer. This immediate production of the certificate creates a verifiable chain of custody for renewable energy's environmental attributes and helps ensure clean energy producers receive credit for the energy they generate, while prohibiting the double-counting of these attributes, a key function of EACs.

The Brooklyn Microgrid[20] project is a good example of blockchain's potential to create efficiencies in electricity trading.

This microgrid uses blockchain to cut out third parties (such as a local utility) and empowers rooftop solar customers to sell excess power to their neighbors directly. This groundbreaking peer-to-peer network provides increased control to consumers. By decentralizing power supply, it also insulates customers from price volatility and supply disruptions in the broader energy market.

Companies exploring clean technologies to meet sustainability and financial goals often find that traditional energy markets restrict their efforts. With the increased autonomy that blockchain introduces, corporate energy buyers may find it easier to accomplish these goals—and at a lower cost and time commitment. While the diversity of blockchain applications and timing of deployment is unknown at this time, this disruptive technology is sure to make waves in the energy industry for years to come.

Conclusion

A digitized, decentralized, decarbonized grid demands active energy management—and to actively manage an energy portfolio means to think critically about not only where a company is in its energy journey today, but where it is heading in the future. Managing a global footprint by implementing clean technologies is a key part of maintaining a cost-effective, efficient, and sustainable energy management program.

For many corporate energy buyers, staying in front of viable new energy opportunities can be a daunting task. The NEO Network[21] is home to the largest database of cleantech intelligence and puts actionable opportunities, like the ones we have discussed in this paper, at your fingertips as they become available. For more information on how becoming a member of the NEO Network helps get your company on the road to active energy management, get in touch with our team today.

20 http://fortune.com/2017/03/14/brooklyn-microgrid-solar-energy-blockchain-startup/.

21 Learn more about Schneider's innovative NEO Network at www.neonetworkexchange.com.

neo network | renewable choice ENERGY is now Schneider Electric

Renewable Choice Energy is a pioneering global supplier of renewable energy and clean technology products and services for the commercial, industrial, and institutional (C&I) sectors. The company is a proud part of the Schneider Electric Energy & Sustainability Services division, serving customers in more than 100 countries. Together, the Renewable Choice - Schneider Electric team provides unparalleled experience and expertise in strategic renewable energy execution to more organizations than any other consultancy, and has collectively advised on 2.3 GW of new wind and solar capacity worldwide. To learn more, visit renewablechoice.com and schneider-electric.com/ess.

4775 WALNUT STREET, STE. 230 • BOULDER, CO 80301
877.810.8670 • WWW.RENEWABLECHOICE.COM

Contributors

Dominic Barbato DIRECTOR OF STRATEGY

Dominic leads global strategy for Schneider Electric's Energy and Sustainability Services division where he is responsible for evolving its vision, strategy, innovation, and growth opportunities. Dominic is a certified Project Management Professional and holds a B.S. in Economics from Centre College as well as an M.B.A. from Indiana University's Kelley School of Business .

Josh Heeman CLEANTECH SERVICES SPECIALIST

Schneider's Cleantech clients depend on Josh to conduct and maintain best-in-class renewable energy research used to develop and implement tailored strategies across the full spectrum of business segments and market geographies at Schneider Electric. Josh received his Bachelor of Science in Finance as well as Masters of Business Administration degrees from the University of Louisville.

Tom Muddell MANAGER, CLEANTECH AND SMARTGRID SERVICES

Tom is a 17-year energy industry veteran. He leads global teams responsible for delivering consulting services related to renewable energy procurement strategy, implementation, and ongoing management in the North America and Asia Pacific regions. Tom earned a B.A. from Colgate University and a J.D. from the University of Louisville.

Sarah Wolf PROGRAM AND PROCESS MANAGER

Sarah is a part of Schneider Electric's Strategic Renewables and Cleantech team where she coordinates client PPA activities and RFP processes. Sarah holds an M.A. in International Environmental Policy from The Middlebury Institute of International Studies at Monterey and a B.A. in International Affairs from Northern Arizona University.

Jenna Bieller MARKET INSIGHT & COMMUNICATIONS SPECIALIST

Jenna is responsible for developing thought-leading content and monitoring market trends that inform business strategy. Jenna received a Bachelor of Science in Business Administration and a Bachelor of Arts in Environmental Studies from the University of Colorado at Boulder.