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RESEARCH BRIEF

Emerging Microgrid Business Models

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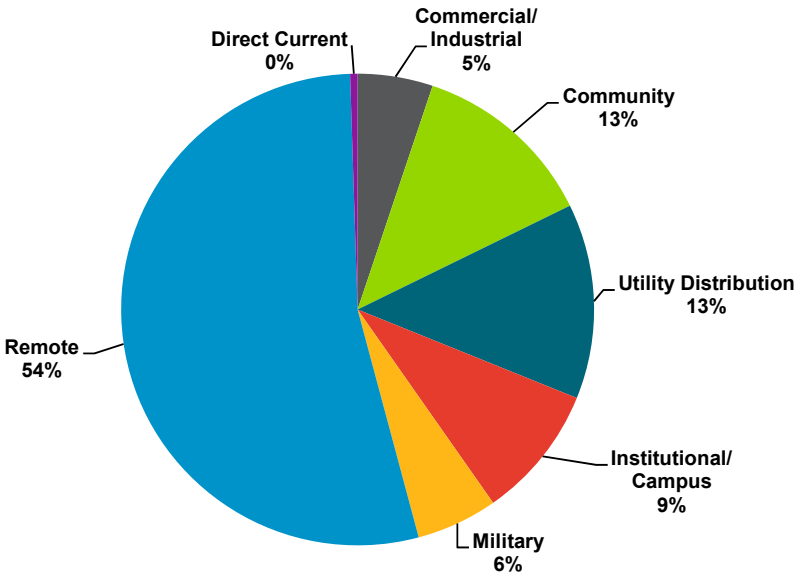
1. Executive Summary

The majority of the microgrids operating today are pilot projects or R&D experiments. However, the industry is now moving into the next phase of project development. It appears that the main technology components of microgrids are reaching maturity, with energy storage technologies making the most dramatic leaps within the past 2 years. The key to future growth rests with greater flexibility in regulation and public policy that, in turn, are spawning business model innovation from market players both large and small. This is not anticipated to ever be a one-size-fits-all market, but progress is being made in standardizing the process of design, creating viable third-party contract structures for development, and identifying key value stream components common to most microgrids.

Due to the diversity of microgrid segments (see Chart 1), the business cases for microgrids continue to evolve. The modularity and highly variable configurations of microgrids make calculating an overall return on investment for all microgrids virtually impossible. Through their ability to enable networking and sharing of resources to match loads, microgrids can play a role in realizing greater utilization of existing generation and load resources. Thus, microgrids are expected to ultimately lower the cost per kilowatt-hour. Yet, resiliency services enabled by technology are not free, and each microgrid segment leans toward a different business model. This report reveals the latest thinking among utilities, technology vendors, and regulators about emerging business models that can take this market to the next level.

Chart 1 Total Microgrid Power Capacity Market Share by Segment, World Markets: 4Q 2015



(Source: Navigant Research)

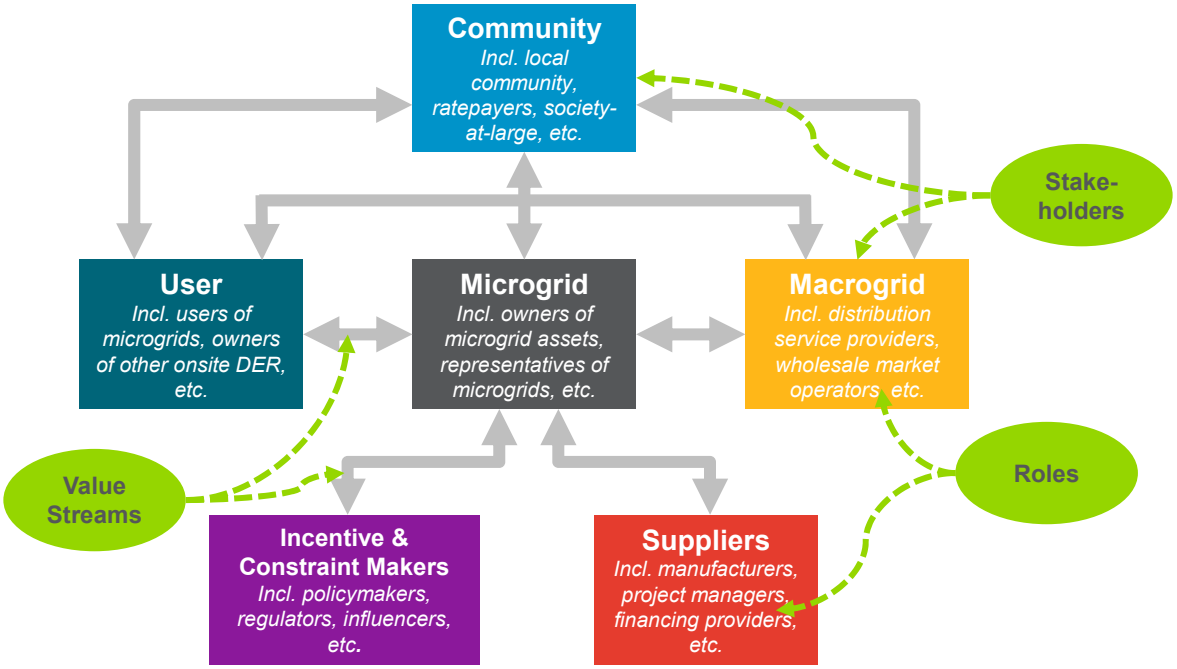
2. Business Model Taxonomy

2.1 What Is a Microgrid Business Model?

With respect to microgrids, a business model defines the way in which a microgrid project or business is planned, implemented, and executed to meet strategic objectives. Strategic objectives can range from community resiliency to renewable energy integration to greater profit for a new economy enterprise such as a data center. For a microgrid to be commercially and financially viable, it must address both the technical (e.g., plan, operations, components, and functions) and commercial (e.g., revenue, expense, and profit) components of the business model definition.

While there is a logic to this way of summing up a project's technical and commercial viability, what does the term business model really mean when it comes to microgrids? As simple as that question may seem, the answer is not easy. If one dons the perspective of a utility, for example, the answer depends upon how the utility is regulated. Is it vertically integrated, does it operate in a competitive retail market, or is it exploring options with an unregulated business in service territories other than its own? Another complicating factor in defining a microgrid business model is that a microgrid is a collection of technologies organized into a system which then is either supported or challenged by a wide diversity of market actors playing in the energy service ecosystem (see Figure 1).

Figure 1 Microgrid Commercial Ecosystem Mapping: Business Model Considerations



(Source: Navigant Consulting, Inc.)

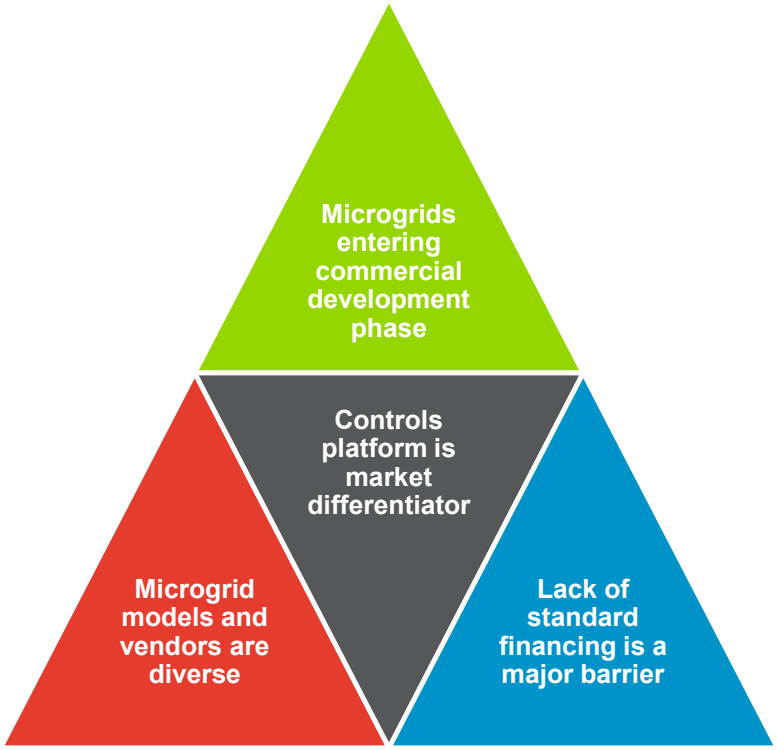
Rather than mapping out what a vertically integrated microgrid business model might look like, this report focuses instead on the methods by which microgrids are being developed today under current market conditions. The examples presented show how different market segments gravitate toward different development strategies that reflect preferred resource mixes, existing contracting vehicles, and lessons

learned from adjacent markets such as solar PV and energy storage. Navigant Research deems these pathways to deployment as business models.

Whether exploring opportunities for the U.S. military in off-grid environments for forward operating bases or large complex systems exceeding 100 MW for a utility in the eastern United States, the controls platform (software plus integration with control devices such as smart inverters) is the gateway technology for successful business model deployment. Regardless of architecture—top-down, bottom-up, centralized or distributed, proprietary or open source—it is the controls platform that determines whether any business model for microgrids will work and deliver value. As the pyramid in Figure 2 illustrates, from an end-user/customer perspective, the two largest barriers today are the lack of standard financing packages for microgrids and the sheer number of vendors vying for shares of the microgrid market.

The second barrier can actually be viewed as a sign of an emerging healthy market. Yet, too much choice can also deter customers from moving forward. Given the large numbers of players involved in different components of the microgrid value streams, customers may lack confidence—and often do not have enough information—to make good decisions about whether to proceed with a microgrid project.

Figure 2 Microgrid Commercial Development Pyramid



(Source: Navigant Research)

Below is a brief description of the most common business models being deployed by microgrid owners, developers, integrators, and utilities today.

2.2 An Inventory of 10 Microgrid Development Paths

What follows is a summary table of 10 microgrid business models that Navigant Research has identified as preferred vehicles to capture a portion or all of the development and ongoing revenue generated by a microgrid project. Then a short summary of each of these business models is presented, peppered with examples of vendors deploying such strategies in the market today. Finally, this section maps each of these 10 business models to the primary market segments identified in Table 1.

Table 1 Microgrid Business Model Matrix: Global 2016 Snapshot

Business Model	Prevalence	Maturity	Large Technology Vendors	Small Technology Vendors	Geography	Revenue Potential
Owner Financing & Maintenance	High	High	No	No	Broad	Medium
Utility Rate Base	Low	Low	No	No	Broad	Medium
Pure Component Sales	High	High	Yes	Yes	Broad	High
Software as a Service	Low	Medium	No	Yes	Limited	Low
Government Energy Service Contracts	Low	High	Yes	No	Limited	Medium
Power Purchase Agreements (PPAs)	Medium	Low	Yes	No	Limited	High
Direct Current	Low	Low	Yes	Yes	Limited	High
O&M	Low	Low	No	No	Limited	Low
Pay-As-You-Go (PAYG)	High	Medium	No	Yes	Broad	Low
Design, Build, Operate, Own, and Maintain (DBOOM)	Low	Medium	Yes	No	Limited	High

(Source: Navigant Research)

2.2.1 Facility Owner Financing and Maintenance

The most straightforward way to build a microgrid is for the facility owner to finance the project and then maintain the assets. A majority of grid-tied microgrids running today use this business model, especially projects deployed in the leading market segment of campus/ institutional microgrids. Often, some level of facility owner financing is also involved with R&D/pilot projects. The most common scenario is that significant legacy assets already exist, such as diesel generators, combined heat and power (CHP), and distribution infrastructure. The owners are seeking either to green their supply portfolio with customer-owned assets or to gain efficiency through new technology.

Once the new technologies are introduced to the resource mix, a more sophisticated integration is required and the incremental upgrades are paid for by the facility owner. The economic benefits of increased efficiency and reliability then flow back directly to the facility owner through reduced operations costs. As microgrids become more complex and focus on integrating distributed renewables and/or

advanced energy storage, these projects are being shifted to private developers. They often rely upon a power purchase agreement (PPA), as discussed in Section 2.2.6.

2.2.2 Utility Rate Base

In an ideal world, a utility would be able to place the costs of designing, building, and maintaining a microgrid into its rate base. Today, the deployment of microgrids by utilities within a grid-tied context is not a mature market. As just noted, facility owner financing is most appropriate for customer-owned microgrids, which account for the vast majority of microgrids that have already been deployed.

Less common (though expected to grow in scale over the next 10 years) are microgrids deployed by utilities themselves. To date, most utility systems using this rate-base approach are public power entities in rural, off-grid markets, such as Alaska, Australia, or South Africa. Investor-owned utilities (IOUs) such as Commonwealth Edison in Illinois have been supporting state legislation that would set an important precedent for rate-basing community resilience microgrids owned and operated by the utility (on the utility side of the meter). In 2014, Central Hudson Gas & Electric was the first U.S. utility to propose rate-basing microgrids under a narrow category: those that serve communities such as a summer camp at the end of long feeder lines and which therefore represent the most economic means to bolster reliability. (It also proposed a fee-based microgrid service for commercial customers. The rationale for this pricing structure was that such microgrids could not be supported under a rate-base business model, since the majority of benefits would flow to a single customer.)

Many substation and distribution automation projects being developed by utilities could easily morph into microgrids in the near future. Instead of islanding being the primary focus, which is often the case with third-party microgrids seeking higher levels of reliability, the capability to island would be lower in priority. The main goal of the microgrid would be integration of distributed energy resources (DER) to help support the reliability and resilience of the utility distribution system.

2.2.3 Pure Hardware Component Sales

Like any other form of infrastructure, the least risky business model is to be a straightforward supplier, especially of hardware products such as distributed generation (DG), smart meters, or switchgear. Many technology vendors view microgrids as just another destination for their product. This is particularly the case for firms selling energy storage, smart meters, and (especially) different forms of DG. That said, companies active in the microgrid space are creating partnerships to better integrate these types of components with the networking, optimizing, and economic leveraging aspects of microgrids. As such efforts increase, this pure component sales business model may begin to fall out of favor. For example, Cummins, a manufacturer of clean diesel systems, has created partnerships with SunEdison (solar PV), Northern Power Systems (wind), and Tangent (controls) as it looks to provide a more complete microgrid solution for customers.

There are some companies, such as General Electric (GE), that sell both hardware (DG, energy storage, and distribution grid components) and the software controls for microgrids. In 2015, GE created a new DER-related services company called Current. The company is shifting from selling GE hardware products (such as solar and batteries, which are now viewed as wrong bets) to an explicit focus on digital innovation—such as software coupled with balance sheet financing. The largest revenue source for microgrid market participants is the sale of DG hardware, often representing between 60% and 75% of

the upfront investment. Navigant Research expects vendors active in this space to view microgrids as a submarket that will grow over time. Ultimately, strategic partnerships may emerge that could offer bundled microgrid packages of components, as underscored by the Cummins example.

2.2.4 Software as a Service

On the opposite side of the spectrum from microgrid business models consisting of pure component sales are models which offer controls that create a network for a microgrid as a service. While sales of DG hardware will likely always be the largest portion of microgrid revenue, the most challenging technological task is the networking function. Because there are so many approaches to controlling and optimizing microgrids, this is the space where Navigant Research expects the most creativity. Customers just want their microgrid to work, so an attractive value proposition for vendors would be a software service agreement whereby the vendors take on the risk of performance.

A few vendors are already moving into this business model, among them Power Analytics and Green Energy Corp. However, few microgrids have been deployed on this basis, so it is difficult to project whether this may become the leading platform of the future. One can surmise that companies that are more focused on open architectures, plug-and-play functionality, and the ability to seamlessly network diverse renewables and energy storage devices would have an advantage in developing and implementing such business models.

2.2.5 Government Energy Service Contracts

During this industry's nascent stage, many microgrids deployed in the United States for government entities have prescribed contract vehicles that dictate the terms for any viable business model. This is the contracting approach most frequently deployed in the U.S. Department of Defense (DOD) microgrids market. Because of how firms are prequalified to do business with the U.S. DOD, this contracting approach is the one most frequently used in the U.S. military market. There are two primary versions of this approach.

The first is energy savings performance contracts (ESPCs), a common vehicle for energy efficiency upgrades. There are no upfront costs, and facility upgrades are paid for by the savings accrued through efficiency. These ESPCs can be extended to 25 years for federal government agencies. Microgrids can be bundled into these vehicles as long as energy savings can be clearly identified and quantified.

The more generic utility energy services contract (UESC) can be a sole-source contract and may involve the local utility. The idea is a holistic approach to energy management to capture economies of scale. Like ESPCs, these can feature terms as long as 25 years.

Another twist to these contracting vehicles is enhanced use leases (EULs), which allow private developers to lease underused U.S. federal property for a project of direct benefit to the United States. EULs are the most expensive financial instrument due to typical project fees. Such an approach requires a deep private sector pocket, but the lease may last as long as 75 years. The EUL structure also has the advantage of allowing the microgrid to sell energy services and excess capacity derived from assets inside the fence back to the utility grid.

2.2.6 PPAs

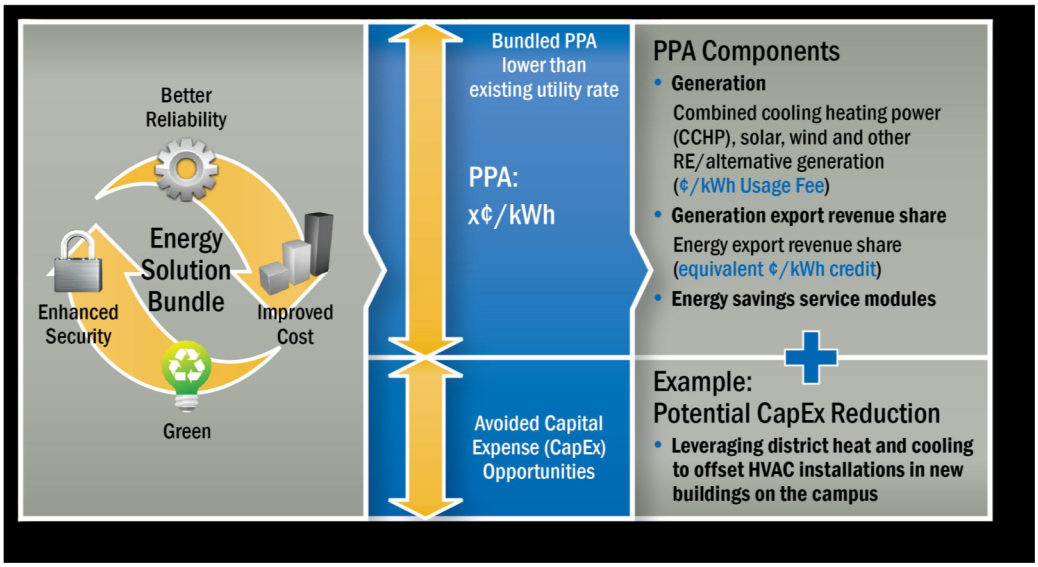
The PPA is a common approach to developing an independent power project, whether it be a large-scale wind farm or a rooftop solar PV installation. It is, in practice, often pegged to the utility cost of providing an identical energy services, priced at or just below this cost, and then increases by 1%-5% annually over a 20-year term. It is designed for a third party that acts as a virtual utility in terms of delivery of energy services to take advantage of various tax credits and other subsidies. This is the business model that now leads the U.S. residential and commercial solar PV markets.

Moving forward, PPAs are expected to become the primary vehicle for non-utility, grid-tied microgrid projects for private sector clients. Similar to the ESPC described above, there are no upfront costs for the customer. In the case of solar PV, deep private sector pockets own the hardware and lease out the systems until all tax credits and accelerated depreciation benefits are maximized.

Some vendors in the commercial space are now moving forward with PPAs for microgrids, taking on the risk of performance in exchange for capturing of revenue streams from ancillary service sales. In order for this business model to work, the network controls architecture needs to be streamlined and—ideally—open. This limits customized engineering costs for new hardware that is added to the microgrid over time. Performance also needs to be monitored closely.

PPA solar projects outperform those installed by smaller contractors, since the financial success of those projects hinges on good design, installation, and maintenance. Since microgrids are much more complex than a simple solar PV system, companies willing to enter into long-term PPAs must be conscious about risk and choose suppliers wisely. Companies should favor simple, elegant controls that do not require customization each time a new resource is integrated into the microgrid. Among the leading innovators in this space is Leidos Engineering, which wraps the value of thermal energy into its PPA structure via combined cooling, heat, and power (CCHP), as shown in Figure 3.

Figure 3 Energy Solution Bundle Blended PPA Model



(Source: Leidos)

2.2.7 Non-Synchronous Direct Current

In terms of technology, the most novel of all microgrid business models is developing a non-synchronous direct current (DC) microgrid. This approach represents a completely different take on the microgrid business model, based on the disruptive technology of grid-tied, DC-based, non-synchronous microgrid architectures. Interestingly enough, this approach dates back to Thomas Edison in the late 19th century. Edison's initial foray into the provision of electricity involved DC microgrids. The primary advantages of the DC approach is its modularity in adding new components (such as a battery) without the need for substantial re-engineering, as can be the case with an alternating current (AC) microgrid due to the need for additional inverters and other supporting hardware.

This unique business model is currently being offered by Bosch, Emerson Network Power, and—with a few novel twists—Pareto Energy. It involves developing DC microgrids that are non-synchronous with the larger AC utility grid and so do not violate the utility AC monopoly franchise. This approach can speed up the permitting process because it avoids the time-consuming and expensive interconnection studies required for many DG projects that must synchronize frequency with the AC grid.

Unlike most AC microgrids, which have a single point of common coupling with the larger utility grid, DC architecture can interconnect with the larger grid at several points. This results in greater flexibility in power flows, grid segmentation, and other energy service exchanges. Another advantage is that the stiffness of a DC backbone can often ride through power quality issues created by variable frequency and voltage spikes and sags. Finally, the elegance and modularity of a DC microgrid fits in with other DC technologies such as solar PV, energy storage, and LED lighting, all of which play a greater role in large commercial buildings.

Among the biggest barriers to this approach is both vendor and end-use customer ineligibility for government incentives to reduce capital costs. Many such incentives are tied to the size of the inverter. In a DC system, these inverters are greatly reduced or eliminated altogether, thereby making these hardware components more expensive. This may be only a temporary issue.

2.2.8 Operations and Maintenance Contracts

Operations and maintenance (O&M) contracts are a common way to ensure microgrid performance. These contracts are often rolled into utility-developed microgrid projects. For microgrids not developed by a utility or under the owner financing and maintenance model, O&M contracts represent opportunities for both utilities and other vendors to capture relatively small revenue streams from microgrid deployments. O&M contracts are designed to maintain optimum performance and are likely to become increasingly popular as microgrids move into the mainstream.

The greatest need for such business models is for systems in remote locations serving low-income communities where skilled labor and engineering expertise are rare. The weak link in these off-grid markets has been thought to be the failure of lead-acid batteries, followed by degraded performance of solar and wind generators. In Nepal, for example, over 250,000 dead lead-acid batteries have been found scattered across the countryside. In the Kathmandu region, over half of the solar PV systems installed are not delivering power as promised due to poor designs and no O&M.

Diesel generators are also critical to overall microgrid performance, since they are present in virtually all remote microgrids. They, too, can fail without ongoing maintenance. In fact, one study by Echidna Energy of 111 diesel sites in Southeast Asia representing 192 MW found that only 70 MW of power was actually available. This represents a capacity factor of approximately 36%, a ratio normally associated with variable renewable energy resources. Furthermore, 74% of the diesel systems operating provided electricity for less than 12 hours daily.

Most grid-tied microgrids have been deployed within a campus environment, where O&M is handled in-house. As PPAs become more common throughout the growing population of microgrids, O&M functions are expected to increasingly become part of the overall project bundle since economic viability will hinge on actual microgrid performance. This is also a portion of the microgrid value stream in which utilities are expected to play, as they seek a larger role in managing the microgrids proliferating within their own service territories, whether they own them or not.

2.2.9 Pay-As-You-Go

Perhaps the most unique business model in terms of financial innovation is the pay-as-you-go (PAYG) model, aimed at accelerating the progress on the energy access front being championed by organizations such as the United Nations (UN), World Bank, and various philanthropic foundations. In this model, the microgrid may be financed by several mechanisms but customers pay for energy as they use it.

The primary challenge for the smallest forms of microgrid aggregation in the developing world is this: How does one capture revenue streams to support a sustainable business venture from the so-called bottom of the pyramid? It is estimated that over one-fifth of humankind lacks modern energy services. According to the UN, more than 95% of these potential customers live in Sub-Saharan Africa and Southeast Asia, with 78% residing in rural areas. While the cost of providing universal access to the electricity grid and decentralized electrification systems would be in the tens of billions of dollars annually, these costs also represent potential revenue to vendors of microgrid products and services.

A PAYG strategy for critical infrastructure, such as power supplies, is growing in popularity. This is especially the case when applied to small, remote microgrids (and nanogrids) in the developing world, where all that is needed is enough electricity for lights, computers, and cell phones. The key to this business model is to keep service costs flat and ensure the ability to turn off service when customers do not pay. Among the leading innovators with this approach is Simpa Networks in India. Billed as a progressive purchase, the firm relies upon smart meters to measure consumption. Customers purchase power similarly to cell phone users who rely upon prepaid cards. The difference is that Simpa customers are slowly investing in their own solar PV systems, which are typically paid off within 3-5 years.

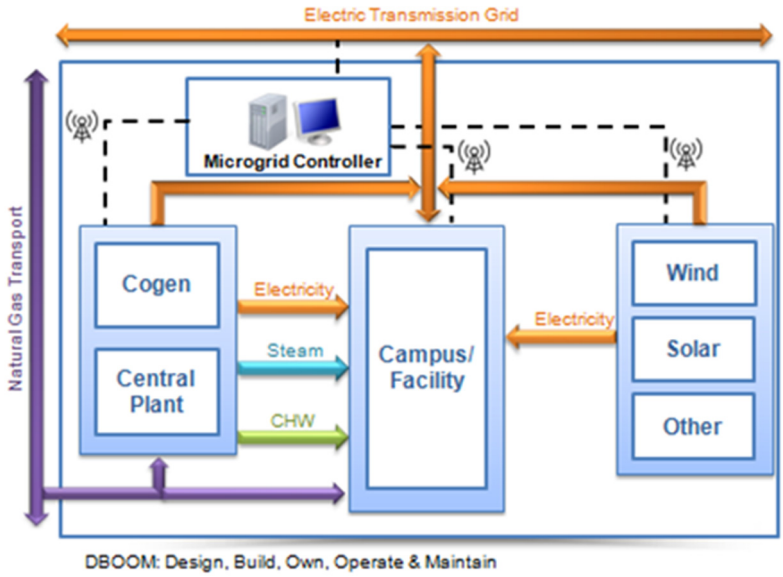
While not a mandatory enabling technology for microgrids, smart meters play a key role in remote systems by accounting for energy usage on an individual customer basis in small village power systems. For example, energy theft is a huge issue in developing country markets where existing utility grid service is often weak, and embedded subsidies have created a cultural rationalization that power should be low-cost or free. Without a reliable, granular way to track actual energy usage, the business model for these emerging microgrid markets is currently not sustainable on the back end. One could therefore argue that smart meters are more vital to remote microgrids developed under a PAYG business model than any other form of grid-tied microgrid application.

2.2.10 DBOOM

The final example of a microgrid business model is reliance upon one entity to handle everything associated with upfront microgrid design and planning, construction, and ongoing operations. Siemens is the first private sector company to offer such an approach. The company's microgrid value proposition lies in offering a comprehensive solution. Siemens' turnkey capabilities pull together financing, consulting, advanced grid technology, generation assets, O&M, and an adapted supervisory control and data acquisition system sized for microgrid management,—all within a comprehensive systems integration package. The company offers a broad microgrid business model approach based on the concept of design, build, operate, own, and maintain (DBOOM). This approach is also being used by PowerStream, a municipal utility based in the Canadian province of Ontario. (The utility added the letter E to the end to represent energize.) This DBOOME model is also set to be applied to smaller nanogrids within PowerStream's service territory.

The advantage of this approach for the customer is that it represents one-stop shopping. For the vendor—whether a private company or public utility—it theoretically captures all potential revenue derived from a microgrid project, from upfront engineering and permitting to full-scale development, and then ongoing O&M. However, this is the case only if the company—such as Siemens—offers the full range of hardware, software, and integration products and services. The downside is that most microgrids presently being developed include a variety of hardware and software vendors and perhaps legacy service contracts and commitments since these projects are usually retrofits. Projects that are eligible for such a complete turnkey offering are in the clear minority. This model is better suited to greenfield microgrids.

Figure 4 Siemens DBOOM Microgrid Offering



(Source: Siemens)

2.3 Mapping Business Models to Markets

The prior section provides a snapshot of development activities today. The identified business models are development pathways forward for microgrids. Some business models are preferred in some market segments as opposed to others, and new business models may emerge. For example, there is growing interest in the PPA model, especially in the United States, as technologies such as energy storage become more mature and control systems are validated in the marketplace. The rate-basing of microgrids by utilities is likely to grow in popularity, but hinges on state regulators in the United States being able to justify the system-wide benefits of microgrids with adequate data. While owner financed and maintained microgrids are perhaps the most mature business model, these are likely to decline in importance as third-party vendors develop more innovative technology and new financial strategies, piggybacking on advances pioneered by the solar PV industry. For remote microgrids, PAYG is projected to continue to innovate for smaller systems. Cash-poor utilities are likely to turn to the private sector for technology, controls, and financing, and rely upon a variation of the PPA for such large-scale microgrids.

The primary issue for the maturation of microgrid business models is on the financial side of the development process. While government regulations and market structures can set the stage for microgrids, the missing pieces are prequalified sources of capital that can underwrite an entire microgrid project. Today, many developers need to cobble together a variety of funding sources for different components, which increases transaction costs and lengthens the development cycle. Microgrids are not likely to ever be a cookie-cutter business. Yet, standard design processes for certain segments, along with a pool of investment vehicles attuned to the specific needs of this mixed asset aggregation and optimization platform, will likely emerge within the next 3 years.

Table 2 offers a general guide as to which of the 10 identified business models is most commonly deployed within each of the primary seven segments tracked in the Navigant Research global database. There are certainly exceptions. This table is primarily being presented to illustrate the diversity of approaches one can use to develop a microgrid today.

Table 2 Mapping 10 Microgrid Business Models to Market Segments

Market Segment	Owner	Rate Base	Direct Sales	Service	ESPC/ UESC	PPA	DC	O&M	PAYG	DBOOM
Campus	✓		✓		✓	✓		✓		✓
Commercial & Industrial						✓	✓			✓
Military			✓	✓	✓	✓			✓	
Utility		✓		✓				✓		✓
Community Resilience		✓				✓		✓		
Remote	✓	✓		✓		✓	✓		✓	✓
DC			✓			✓			✓	

(Source: Navigant Research)

3. Conclusions and Recommendations

Bankability and replicability remain among the biggest current challenges for microgrid projects, businesses, and markets. These challenges stem from a lack of consensus on clear, identifiable business models that would be profitable across all microgrid market segments. Because the market is in an early stage of development, technical and legal execution of demonstration projects can eclipse profitability concerns. Nevertheless, there are companies, some of them quite small, that boast online microgrid project portfolios in excess of 1 GW on a single continent.

Creative enterprises are moving forward with microgrid projects today. Successful microgrid projects will likely be implemented in open markets with advanced wholesale energy trading, high retail electricity prices, and market structures that foster third-party development early on to accelerate financial innovation. Over time, there may be a shift to markets that also open the door to utility ownership and/or operation of microgrids. When this latter step is accomplished, microgrids may be considered to be mainstreamed.

Utilities also have multiple business models to choose from (see Table 3), depending upon the type of market in which they operate and whether they seek opportunity on the regulated or unregulated side of their businesses. One could create a similar table for other types of players, such as developers or systems integrators. However, given the unique regulatory burdens placed upon utilities, it is the category of market player for which the path forward is most complex and least defined.

One business model not included in the above list of 10 major development pathways is public-private partnerships leveraging a municipal utility's existing customer billing relationship with the development expertise of a private developer, which then assembles the key supplier team. In this case, the revenue flow to multiple parties. To the end-use customers—which would include residents—the transaction is simple. This is an established way to develop infrastructure in selected markets, such as Canada, and is now being pioneered with large-scale utility distribution microgrids.

Table 3 Utility Business Model Options for Microgrids: Pros and Cons

Utility Business Models	Pros	Cons
DBOOM	Capture entire revenue stream	Take on performance risk
Public-Private Partnership	Leverage expertise of vendors	Upside may be limited
Unregulated Financing	Fill market niche in new PPA market	How can such structures anticipate future revenue streams from wholesale markets?
Unregulated O&M	Build markets outside of customer base	Is controls expertise available in-house?
Regulated O&M	Fits well within current regulatory environment	Market limited to single service territory

(Source: Navigant Research)

What is different about the new microgrid paradigm compared to the utility status quo is that if the right business model is deployed, these new networks offer both distribution utilities and their customers a host of new ways to bolster reliability and manage variable, bidirectional resources that are mutually beneficial.

The key determining factor today is no longer proof-of-concept projects or even technology breakthroughs. It is more a matter of which business models will take this platform to the next level in terms of commercial deployments. This applies to both grid-tied systems—where interactions with host distribution utilities remain an important factor—and off-grid opportunities, where the challenges revolve around addressing issues of historic subsidies, energy theft, and logistical and ongoing maintenance and customer billing concerns.

If one wants to be a bit provocative, one could argue that since the microgrid controls platform is the gateway technology for success, the business models deployed for this single aspect of microgrid operations are the most important of all. This is probably true; it is the most competitive and diverse piece of the microgrid value chain. Internal data reveals that the cost swing for this portion of the microgrid business is also the widest, reflecting the rich diversity of hardware and software options available to provide varying degrees of functionality.

There is a stunning variety of business models. Here are three key takeaways:

- Since third-party microgrids lead on innovation, including in regard to financing, they are expected to lead the way in structuring PPAs that account for the changing nature of organized markets for ancillary services. These PPA structures are expected to help monetize the value streams microgrids provide, especially as the microgrids they help pay for seek to capture the benefits of transactive energy as these distribution level networks bring value up to the wholesale system.
- The primary business model for a publicly owned utility is to work with a private sector partner to develop microgrids within the utility's service territory For IOUs, the best opportunity today is to invest via unregulated businesses; IOUs should investigate O&M options for third-party microgrids within service territories, especially community resilience microgrids. As regulatory institutions are provided data and metrics validating the system benefits microgrids create, both public and private utilities are anticipated to move more quickly into the market, especially if they seek to rate-base such projects.
- This market is so vast—for such a wide variety of applications and in so many regions of the world—that it is likely the industry will never coalesce around one business model. Some applications may lean strongly upon one model, but even that could vary by geography depending upon the available resource mix, regulatory structures, financial options, and key vendors involved.

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