Microgrids on the cusp

Credit: CRONIMET Mining Power Solutions

Microgrids | The technology and financing of the remote microgrid market are maturing. Now improved sales and marketing methods are needed to commercialise the huge potential on offer in this burgeoning market segment, writes Thomas Hillig

Microgrids are one of the hottest topics in the renewable energy world. Solar and wind energy are changing the paradigms of electricity generation toward more decentralised solutions. The utility microgrid segment is mainly driven by autarky and security of supply. The biggest market is in the United States, where an ageing grid infrastructure requires large investments into the grid. Here microgrids are sometimes a more economical alternative. Investments in local generation assets mean in conjunction with microgrids that the improved reliability will have benefits that are felt locally. In case of larger blackouts, the microgrid can "island" certain consumers and continue to provide them with electricity. This could be attractive for communities, utilities and commercial and industrial end-users.

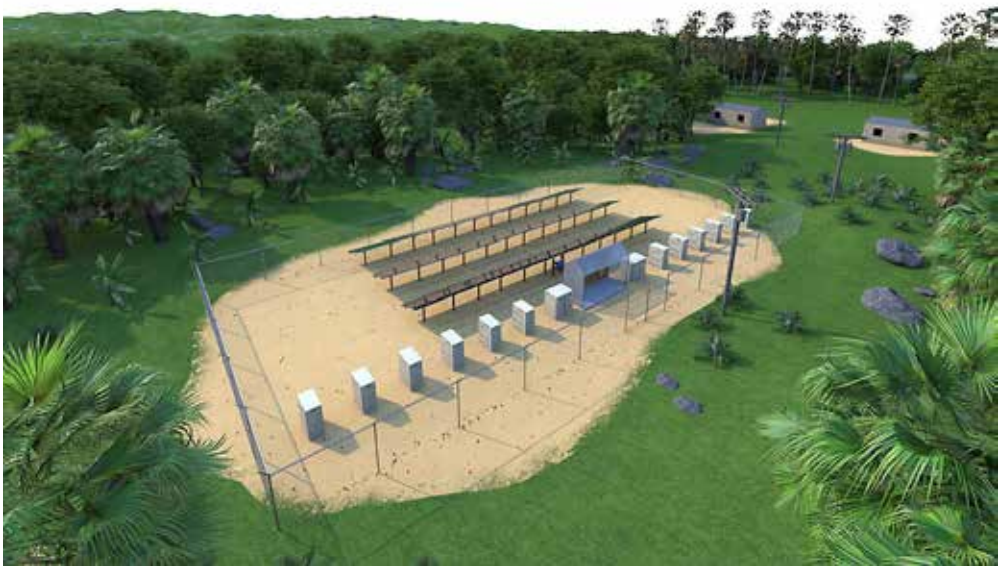
In an international context, microgrids are even more successful in the off-grid or extreme-weak-grid environment. Due to steadily falling prices, solar and wind energy have become very competitive for applications in areas that are not or insufficiently connected to the grid. In these areas, heavy fuel oil and particularly diesel are the main sources for power generation. The business case in this segment is mainly driven by cost reductions and involves replacing expensive diesel or heavy fuel oil by relatively inexpensive solar or wind energy. In remote locations, diesel is an extremely expensive source for electricity generation. The fuel must be transported in trucks to remote sites, taxes apply and losses or theft are a common issue. Renewable energy is typically competitive without additional incentives.

Remote mines are just one of the many applications for renewables-powered microgrids

Microgrid concepts

Solar or wind power plants are built in the proximity of existing diesel gensets. The easiest concept consists of a light microgrid without energy storage. When there is enough solar irradiation or wind speed, the power is mainly generated by renewable energy resources. However, the diesel gensets are the grid-forming element and must run constantly to quickly provide spinning reserve for periods of sudden power drops from shaded solar arrays or unsteady wind speeds. Sometimes wind and solar are combined for diesel reduction. Regarding the intermittency question there are some advantages as solar and wind power often correlate inversely in many conditions of weather changes. Light microgrids are the most widely spread plant type in remote power generation.

This is still due to the relatively high prices for energy storage systems. In more advanced concepts, energy storage is added. This allows for partly switching off the diesel gensets when the weather conditions are favourable. In this scenario, the batteries can also be grid-forming. One of their main functions is to bridge shorter time periods that are needed for starting gensets when unpredicted adverse weather changes occur. Energy storage increases the share of renewable energy sources in the system. The size of the batteries needed for this bridge-to-back-up is relatively small. As energy storage prices have fallen significantly in the past



Credit Caterpillar

Caterpillar has marked its intentions in the microgrid market with a partnership with First Solar and a suite of microgrid products

years, we also see more and more applications in this area. Many off-takers are however reluctant to invest large sums in their power generation infrastructure. For many communities and commercial and industrial consumers, power generation is not a core competence. They are used to paying for their electricity by the kilowatt-hour or by litres of diesel.

The most advanced concept for off-grid power generation involves the addition of long-term storage devices that allow for shifting solar and wind energy consumption to times without solar irradiation or wind speed. For example, solar power that is generated during daytime can be shifted with the help of energy storage systems to the night. For energy shifting, the batteries must be much larger than for bridge-to-back-up applications. At the same time, different battery technologies might be taken into consideration. For example, flow-batteries are hardly adequate for short-term applications, but have advantages in long-term applications because of their scalability regarding capacity.

Market innovation

The market for remote microgrids is maturing rapidly. Many new solutions are being introduced in this quickly growing market segment that has been identified by many experts as highly attractive in the mid-term and long-term future. Traditionally, diesel gensets are optimised for operating in the high load range. For balancing intermittent renewable energy generators, the requirements change. Low-load diesel gensets that can be run at lower loads, which enables them to provide more spinning reserve, are one of these developments. Improved local irradiation, wind velocity and power generation forecasting are also helping with the case for microgrids by making the intermittencies of solar and wind power more manageable, if not eliminating them altogether.

Finally, there are several innovations regarding the transportability of microgrid components. As the generator is linked to a limited number of off-takers, a certain degree of mobility ensures that in case the off-taker does not exist anymore or stops paying, that the solar or wind plant can be moved to another site. In this group of innovations, we see containerised solar power plants, batteries or mounting systems that are easier to relocate.

Innovation is not restricted to technology. We also observe business model innovation. External investors are feeling more and more comfortable with financing off-grid installations. The risk is higher, because of an increased counterparty risk. In case the off-taker does not pay, typically there are no other off-takers close by in remote locations. In addition, many areas with no or weak grids are in developing countries. That means that the country risk is an additional factor to be considered. We see a large number of independent power producers (IPPs) entering the off-grid markets and offering PPAs to remote off-takers. There is also a limited number of companies that offer leasing solutions. These financing options mainly address the issue that many off-takers do not consider power generation as one of their core competencies and are hence not willing to make large investments in their own microgrid systems.

Many IPPs and leasing companies prefer to finance large-scale off-grid renewable energy assets. Most of them have a background in financing grid-connected solar and wind parks and they are used to large-scale investments. For funds, the project due diligence and transaction costs are often too high for small-scale projects.

A high potential for large-scale projects can be found in the mining industry. Electricity consumption is much greater than for most other applications and diesel prices are especially expensive as mines are often remote and do not always have a good transportation infrastructure.

Smaller hybrid projects can be found in the tourism industry with remote island resorts as a flagship. Storage is more common in the hospitality sector, because switching off diesel gensets has advantages beyond cost reductions. Hotel guests see additional value when solar avoids hazardous diesel emission or noise. A third interesting sector is telecommunication. Remote telecommunication towers present an interesting business case, though the power consumption is rather small. Intelligent bundling of projects also allows third-party financing as typically there is a huge number of towers in a country that belong to one telecommunications operator or tower company. Other examples of sectors are agriculture, where powering irrigation systems plays an important role, food processing, commercial real estate such as shopping centres and finally rural electrification.

Microgrid projects in rural electrification are mainly driven by aid or international development organisations. Development cycles are normally much longer than for private sector projects. This is one reason investors tend to focus more on private sector projects. Another reason is that the governments or public utilities involved typically do not have a very high credit rating.

Commercialising microgrids

Many companies from the renewable energy and finance sectors have entered the remote microgrid sector lately. The supply side of the market is relatively mature as far as technology and financing are concerned. The number of remote microgrid projects however is still rather limited. One reason is the crash of world market oil and diesel price in recent years. Another reason is also that many renewable energy companies

are focusing on the engineering rather than commercial aspects of projects. Technology seems to be the focus of their entrepreneurial efforts. European renewable energy companies, in particular, have gained much of their experience in feed-in tariff-driven projects, where the core competencies were securing land, organising the feed-in tariff, legal organisation and financing. There was no industry or commercial end-customer to address. This has changed completely for microgrid projects. Commercialising the renewable energy solutions toward the off-takers becomes a key success factor. At the same time, marketing and sales gain importance.

For many engineering-driven companies the necessary organisational modifications become an insurmountable challenge. With that in mind it is no surprise that more and more component suppliers actively market their products. They do end-customer marketing and put end customers in the focus of their sales activities. A good example is storage providers. They see that microgrids are often the most attractive business case for storage applications. After having identified and pre-developed promising projects they involve project developers under the condition that they can deliver their storage solutions into the projects. The project developers continue the development process.

As the market is maturing, but competitive at the same time, it often is a good idea not to act alone, but to join forces. Many players have formed or are in the process of forming partnerships. There are two main targets for partnerships: market access and technology enhancement by pooling complementary solutions. Table 1 shows some of the recent partnerships that have been forged to focus on the emerging microgrid market.

On the technology side, ABB has teamed up with Samsung and Ideal Power with LG Chem and Aquion Energy to provide tailor-made microgrid solutions featuring energy storage systems. The inverter manufacturers Fronius and Victron have also joined forces in a strategic partnership for smaller microgrids. For larger plants, Schneider Electric has developed a control solution in cooperation with DEIF.

Sometimes the objectives of the partnership are twofold. For microgrids, Caterpillar has lined up with First Solar. From a technology perspective, Caterpillar covers diesel genset expertise, while from a market perspective, Caterpillar is a leading supplier in the mining industry – a key target sector of many microgrid players. First Solar contributes photovoltaics expertise.

Partner	Partner	Year	Partnership focus
Schneider	Green Energy Corp	2014	Technology
Caterpillar	First Solar	2015	Market access + technology
ABB	Samsung	2015	Technology
Northern Power Systems	ELVI	2015	Market access + technology
LG Chem	Ideal Power Inc.	2015	Technology
WindStax	Aquion Energy	2015	Market access + technology
Enerdeal	Henri Fraise	2015	Market access + technology
KACO New Energy	Nixon Power Services	2016	Market access + technology
Fronius	Victron	2016	Technology
ViZn Energy	Jabil Inala	2016	Market access + technology
Renova	CleanSpark	2016	Market access + finance
Aquion	Ideal Power Inc.	2016	Technology
JuWi	KPS (Pacific Energy)	2016	Market access + technology
Schneider Electric	DEIF	2016	Technology
GE	LSIS	2016	Technology
Wärtsilä	Greensmith Energy	2016	Market access + technology
IBC Solar	DHYBRID	2016	Market access + technology

Table 1. A selection of recent major microgrid partnership announcements.

In other instances, the collaboration goes beyond pure strategic partnerships. The French utility ENGIE has invested US$6 million in the California-based company Advanced Microgrid Solutions (AMS) targeting utility microgrids. The French oil and gas major Total SA has acquired majority and minority stakes in several renewable energy and storage companies that cover key aspects of the microgrid value chain. Among the investments are SunPower, Saft, Aquion Energy, STEM, LightSail Energy, EnerVault, Ambri, Offgrid Electric, Powerhive, and DP Energy. It will be interesting to see if Total SA intends to integrate these investments in the future.

THEnergy has been working with several companies in screening the microgrid market landscape for potential partners and assisted them in setting up partnerships. Especially for smaller players, strategic partnerships are an important vehicle for entering new markets. THEnergy is constantly looking at growing our network of microgrid players in emerging markets. At this stage, many European and American companies intend to access new markets through strategic partnerships. THEnergy also helps them to design and implement these new partnerships. Often the beginning of a partnership paves the way for how successful the collaboration will be long term.

It can be expected that microgrids will be play an increasingly important role in the future. Mature, tailor-made solutions for microgrid optimisation are being developed, new business models are evolving and more and more renewable energy players are entering this market segment. The only remaining gap is sophisticated sales and marketing concepts. When this burden is overcome or if oil and diesel world market prices increase slightly, it can be expected that the market for remote microgrids will boom and that decentralised, off-grid energy generation will be a serious competition for grid extensions in many developing countries or sparsely populated regions such as Western and Northern Australia or Northern Canada. ■

Author

Thomas Hillig founded THEnergy in 2013 as a specialised consultancy focusing on energy generation for industrial and commercial consumers. Main areas covered are renewable energy microgrids and remote hybrid power plants for sectors such as mining, tourism, telecommunication, or agriculture. THEnergy combines Hillig's previous experiences working at Alstom Power in conventional energy generation and at Innotech Solar. At the beginning of his career, Hillig consulted leading companies from the transport, telecommunication and construction sectors.