

The future of distributed generation

What are the regulatory, commercial
and technological barriers to
implementing DG?



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The roundtable

Senior executives and experts from 16 countries and four continents gathered for a PwC roundtable on market design in Madrid. The event brought together leading players with substantial experience from the regulatory and corporate spheres to discuss the regulatory, commercial and technological barriers to implementing distributed generation and integrating renewables into the grid.

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Introduction

Distributed generation is a fast-growing feature of modern electricity systems. It is transforming the traditional centralised grid model and, in parts of the world without developed grid systems, it offers leapfrog opportunities to increase access to electricity.

But the complexities – technological, regulatory, commercial and financial – of integrating renewables and distributed generation into the grid are immense. They carry wide sector impact and require fresh thinking about company business models and the role of grids. “It’s a ‘burning platform’ issue for utilities globally,” observed Norbert Schwieters, PwC’s Global Power & Utilities Leader as he welcomed participants to the roundtable event.

The roundtable brought together leading figures from the utilities sector to discuss these challenges, the lessons learnt so far and to look at what the future might bring, not just the technological and sector impact that lies ahead but the possible financial mechanisms of the future as well. The roundtable event is part of PwC’s industry programme for power & utilities companies worldwide. This report focuses its summary of the roundtable discussion on:

- Growth – meeting the challenges of distributed energy resources
- Financing – developments in PPA- (power purchase agreement) based distributed generation
- Technological transformation and the growth of storage in energy

The growth and challenges of distributed energy resources

Distributed generation (DG) is electricity-generating plant that is connected to a distribution network rather than the transmission network. DG is a key element in a growing number of distributed energy resources (DERs) that are being deployed across the distribution grid. They range from larger generation plants to small-scale resources. They are typically close to load, giving value to individual customers as well as exporting to the grid, and many are behind the meter.

Global DER capacity is expected to grow from 132.4 GW in 2017 to 528.4 GW in 2026.¹ It is adding considerable complexity to energy systems and constitutes a major shift from centralised grid systems designed for one-way flows to a grid network that has to manage multi-directional flows and a proliferation of energy sources, many with a high degree of intermittency. Parallel technology advances, such as rapid digitalisation, advances in energy storage and the development of electric vehicles, are adding to the opportunities and challenges. Together these developments are reshaping the relationship between utilities and customers.

The implications for utility companies are considerable. David Etheridge, Global Leader, Power & Utilities, Advisory, PwC US, observed: “We know the cat is out of the bag. Our industry is evolving fast, some would say it’s a revolution not an evolution and many have different ideas for where this industry will go. One thing’s for sure – it is going to look very different in ten to fifteen years’ time.” The point about the pace of technology change was picked

up by Jean Rappe, CEO of Engie Solar: “What we’re seeing now puts the first half of my career into perspective. Then it was a slow evolution. Each time a gas turbine was improving its efficiency by a quarter of a percentage; that was a great achievement. Today the pace of change is a technology revolution. On the renewables side it is so quick that it’s a game changer for everyone.”

Mark McCullough, EVP Generation with American Electric Power, highlighted the need for mindset and business model change: “We’ve been operating one-way, single-direction electricity for over 100 years and the advent of new technology across this value stream is changing the way we think about the business.” It is taking AEP towards different value streams, including virtual power plants and micro-grids close to the customer, adding to supply resilience particularly in locations vulnerable to severe weather events. “We need to be with our customers when they’re considering these types of solutions,” stressed McCullough. “We can help them design better solutions and choices, taking advantage of scale at a local level.”

¹ Navigant Research, Global DER Deployment Forecast Database, 2017.

Q&A

Technology investment risk

Q: We're in an exciting phase of very rapid technological change. It's very promising but it raises the risk that today's investments may have a much shorter working life than one actually expects. How do you respond to that risk?

Jean Rappe, CEO, Engie Solar:

That's why PPAs are important. Without PPAs, investors would need to assume much faster amortisation cost because the pace of technological progress is such that investments are rapidly becoming obsolete. The PPAs provide for long-term stable revenue, making it possible to reduce the cost of capital and make renewables more competitive. One good thing about renewables that investors like is that variable costs are very low. Once you have invested, there is very little cost to run, so the likelihood of you not being able to sell your production is zero.

Ken Zagzebski, President, AES US Strategic Business Unit:

My concern is what looks good today is not going to look good ten years from now. So the critical criterion that I'm asking my team to use is that it has to add customer value. If you're not looking specifically at customer value, whether it's a transmission line or distribution assets, I think you have got a real risk of stranded investments.

Mark McCullough, EVP Generation, American Electric Power:

We see evidence in the media quite often today where large investment has been the cause of write-offs and so forth. This points us more towards smaller solutions like distributed generation and I couldn't agree more with the statement about customer value; it has to be the highest customer value solution for it to work.

Rodolfo Martinez Campillo, Head of Infrastructure Regulation at Iberdrola, talked about the challenge of integrating distributed generation into the grid: "First there is a technical integration issue that needs to be solved. There is also a commercial issue in the economic compensation to exported production. And it is an operational issue due to the need to balance the whole system."

Martinez Campillo went on to observe how volumetric tariffs and net metering have fostered inefficient DG growth, particularly roof-top solar: "Large DG penetration has confirmed the existence of hidden subsidies, increasing prices to other customers." The National Association of Regulatory Utility Commissioners in the US and the Council of European Regulators in Europe have both produced policy papers on the topic which are now beginning to be reflected in regulatory modifications. These are taking different forms in different jurisdictions. Among the boldest are reforms in Hawaii and Maine where regulators are ending net metering and moving towards buy-all, sell-all payment frameworks.

The growth of DG is pretty much universal but the nature and pace of change is heavily influenced by regulation. Ken Zagzebski, President, AES Southland Energy and Executive Chairman of the Board, Indianapolis Power & Light Company and Dayton Power and Light Company, emphasised: "Each market is very different. In the US, if you do something in Hawaii it doesn't mean you can do it in Indiana and I'm sure you experience the same thing here in Europe." He cautioned: "States that are pushing renewables aggressively are going to have issues to contend with such as stranded costs, affordability and grid reliability. In states where generation is more traditional, there will be the issue of cannibalisation of the current load through the growth of 'market-driven' distributed generation and renewables. It may not be a death spiral, but there's clearly a spiral that can take you downward if you don't participate in it. In those markets that are not as aggressive, you still need to be participating now so that you're in a good position before distributed energy or renewables are more integrated."

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Financing – developments in PPA-based distributed generation

Distributed generation and renewables is a growth area that is increasingly standing on its own two feet without the need for subsidies. Power purchase agreements (PPAs) with utilities have been a staple of financing in many markets for some time. Now corporate buyers are joining the market as they weigh up the attractiveness of distributed generation. As well as delivering on clean energy ambitions, a corporate PPA with the right pricing structure can also provide a hedge against electricity price volatility.

“We need to wean the renewables industry off subsidies,” observed Steve Hunter, Senior VP Global Markets Development, GE. “It’s happening in some markets but investors need to mitigate merchant power price exposure. PPAs are the biggest tool we have in the box today to help investors manage that exposure. Then on the other side we have consumers who want to do their part in going renewable and demonstrate that to their customers. The structures that we put in place with PPAs are very important to help them do that. We’re seeing a huge variety of different structures. The development of these contracts is still at an early stage and I think we will see some standardisation developing.”

Mark Coughlin, Global Leader, Market Design, PwC Australia, explained how renewable infrastructure players and corporate customers in Australia have started to turn to PPAs in response to turbulence and disruption in the energy market: “It has gathered some real momentum in the last 12 months. We expect to see announcements coming through, with some of the biggest energy users signing up major corporate PPAs with distributed generation at the end of it. That is a significant shift from a few years ago. It’s been driven by a lack of trust in the system as a result of wholesale price volatility and the system shocks we’ve been experiencing.”

“We’re moving to networks as enablers, as platforms that allow different participants in the market to converse and transact with each other to develop and utilise new technologies. PPAs form a part of that development, a very strong part at the moment”

Weero Koster, Partner Energy, Sustainability & Climate Change, Aeolian

Looking ahead, Weero Koster, Partner Energy, Sustainability & Climate Change at Aeolian, sees PPAs as an important stepping stone towards a future where networks act as market platforms: “We’re moving to networks as enablers, as platforms that allow different participants in the market to converse and transact with each other to develop and utilise new technologies. PPAs form a part of that development, a very strong part at the moment with about 70 countries in the world that have market structures that allow for PPAs. Eventually, we will move to enabling networks of DERs that may take some of the load from the PPA market in due course.”

One of the key issues for PPAs is which party to the agreement takes the balancing risk. Should balancing sit with the generator or does the off-taker take the balancing responsibility? It is clear that this varies considerably in different markets. Aeolian’s Weero Koster said: “I’ve seen very few instances where the project itself offers portfolio management services or balancing

services. In the Netherlands, we’ve seen the market change completely with corporates needing to take on those responsibilities. In the past, projects would just go to the utility but now there is such a large demand from corporates that the competition for projects means the balancing and portfolio management responsibility is lying with the off-taker for 15 years. Depending on their business model and capabilities, they may either hold or outsource it.”

Steve Hunter from GE observed: “I think the Netherlands is quite a special case. If we look at Spain, the power is all with the consumer. There are literally gigawatts of projects that are trying to financially close. We see the same thing in the UK and in Ireland, where you have markets where the subsidies have ended, in some cases quite abruptly, or they’re in a transition from one subsidy regime to another. But developers don’t stop developing. Once they’ve spent their money, they want their revenue; they don’t want to sit on it. They are incentivised to go out and close the project and, if that means signing up

to a PPA with terms which are more friendly to the consumer, my experience is they will do that if they don’t have an alternative.”

Koster picked up on the diversity theme: “This market is very diverse around the world for a number of reasons - different regulatory regimes, different incentive regimes and very different corporate cultures. The contracts that I see are very bespoke, which is good but also has its own difficulties: mainly illiquidity. So we do need some standardisation.” Hunter singled out the Nordic market: “Nordpool is the most liquid power trading market we have and consumers have a long history of hedging their long-term power price exposure. It’s a market design which is very facilitating towards corporate PPAs. The economics are challenging for new wind projects because electricity prices are low but we are still seeing projects close. While the US is the biggest market, the biggest deals we have seen done are in the Nordics.”

Q&A

Longevity of PPAs

Q: Do you see the length of PPAs coming down over time?

Weero Koster, Partner Energy, Sustainability & Climate Change, Aeolian: Yes, depending on different markets. In the Nordics we see PPAs that are much shorter. Speaking about my home market in the Netherlands, the PPA market is still very much driven by subsidies. Subsidy schemes are 15 years so the PPAs are based on the length of the subsidy. Fifteen years is very difficult for most of the corporate clients. What I’m going for is trying to make the product more liquid, so that at least you can get out of the PPA by transferring it to somebody else. You need to go into an investment with the exit in mind.

Mark Coughlin, Global Market Design Leader, PwC Australia: We’re seeing more like ten years. Developers would love to see 20, but they’re just not being written at the moment, so ten years is about the maximum in Australia.

Steve Hunter, Senior VP Global Markets Development, GE: Around ten years is about the minimum if you want to finance a new-build project. We’re trying to work on opportunities where we could perhaps bundle some ten-year volume and some shorter volume and see if we can still get the project past financial close on that basis. But that increases the complexity so goes against the simplification that we’re trying to achieve.

Technological transformation and the growth of storage in energy

Innovations in power-sector technology, such as battery storage, grid automation and smartphone-linked energy saving and control devices, are advancing at a pace that has surprised developers and adopters alike. Technological innovation will be key to the transformation of grids into platforms that are able to successfully host, manage and integrate a plethora of distributed energy resources.

Companies are responding to the pace of technological change with the launch of new business units, new partnerships and a stronger emphasis on collaborative working across and beyond the traditional boundaries of the sector. One such example is the coalition of power industry and other partners that are backing Energy Impact Partners (EIP), a US-based investment platform that seeks to invest in emerging trends, new technologies and innovative business models to build a better energy future.

EIP's Chief Utility Officer Kevin Fitzgerald told the roundtable: "The network that we have behind us makes it the largest clean energy network on the planet." He explained that one of the themes driving their investment strategy is that the renewable energy transition and DER proliferation will go hand in hand. He outlined EIP's investment in two companies, AutoGrid and Opus One, as examples of creating the software pillars that will be needed for a DER-rich grid.

Electric vehicles will be a key element in a future DER world. EIP is an investor in EV-charging software company

Greenlots, whose SKY platform aims to provide real-time charger health status, utilisation data, dynamic pricing capabilities and a seamless charging experience for EV customers. "The Greenlots business model is to whiteboard this for the utility company or the automaker based on open standards," said Fitzgerald.

Fitzgerald outlined another key investment theme: "There's so much inefficiency in the system that we believe there is a ton of opportunity in the digitisation of the grid. We lose between 60 to 70% of the product before it is finally consumed. Utilities can create substantial customer value in core grid infrastructure through optimisation of the platform. And that may be done with all the new tools in the tool kit, like distributed generation, battery storage, EV charging etc."

Electricity storage, long viewed as the holy grail for the power industry, is coming of age with utility-scale storage solutions being deployed at an increasing rate. One of the companies leading the storage charge is Fluence, a joint venture collaboration between AES and Siemens. Jan Teichmann, VP, Global

Markets, Fluence, explained: "We are focusing on projects greater than 1MW, so what you would generally define as utility grid scale. Nobody buys storage just because it looks good. It is only if there is an economic case." To date, over 500MW of Fluence storage has been deployed or been awarded in 16 different countries around the world.

The advantages of storage are widely recognised in relation to integrating renewables into the grid, but Teichmann explained how storage also makes economic sense in a wide variety of situations. Storage for reliability, frequency, resilience and critical power security are among the reasons for deploying storage, as well as the obvious one of adding an on-demand capability to renewables. Energy cost control is another motivation for customers of battery storage. In Finland, Fluence has installed 1.6MW of storage in a Helsinki shopping centre, enabling the customer to cut grid consumption at times of peak prices.

In other situations, storage is integral to energy security. For example, storage can be used for black start recovery of gas-fired generation, getting it

Q&A

Implications of distribution networks as platforms

Q: We've talked a lot about distribution networks becoming platforms. Do we need to consider splitting up roles and start thinking about a distribution owner and a system operator at the distribution level?

Leonardo Benítez, Head of Utilities, Indra: I do believe that will be the future. The DSO will become a platform operator, generating a playing field where there will be other companies, new companies coming in and offering new services.

Jan Teichmann, VP, Global Markets, Fluence: I'm not sure that something like this should be forced. I think some regulatory topics are too complicated for change to be forced. It needs to evolve.

Eliano Russo, Head of e-Industries, Enel X: When we think about networks, we need to think as network orchestrators and as platform businesses. Look at other sectors, what happened in tourism, mobility, real estate. There are network orchestrators that are eating margins of traditional capex-intensive players and it's clear that when it comes to energy we have to go in the same direction. I think today the energy business, also the energy solution business, is still a pipeline business. We generate leads, we develop solutions and then we sell, implement and operate those solutions. I think we need to move to the next level because we want to be less capital-intensive, we want to move to a softer intelligent solution. So the direction is clear but the jury is still out on how we are going to get there.

“Utilities can create substantial value in core grid infrastructure through optimisation of the platform”

Kevin Fitzgerald, Chief Utility Officer, Energy Impact Partners

online without reliance on external transmission lines. For this very reason, a steel plant in Eisenhüttenstadt, Germany has added 2.8MW of battery storage to its gas-fired generation plant. As Teichmann explained: “Our storage is an insurance. The facility has never had a power cut but, if it did, the facility would suffer irreparable damage. With storage, the steel plant has complete insurance.”

Italian global energy group Enel has brought its digitisation, sustainability, innovation and technological solutions together under a new Enel X brand which delivers four key areas of activity – e-City, e-Home, e-Industries and e-Mobility. Eliano Russo heads up the e-Industries division, providing a range of energy efficiency and distributed generation technology services and the creation of off-grid and demand response solutions.

Enel's acquisition of Enernoc has helped to secure its position as a demand response aggregator: “We are managing more than 6GW of demand response capacity” said Russo. “It's changing the customer relationship substantially.

Instead of selling services and asking money for them, we are going to them to identify and monetise their flexibility.”

Leonardo Benítez, Head of Utilities at global technology company Indra, highlighted the technology challenges facing the grid: “Distributed generation poses a variety of technical issues for existing networks. They were designed for traditional one-way power flow from the big centralised generation to the consumer and are not ready to absorb a big amount of energy resources without investing in technology.”

“The grid is becoming more complex and growing faster than existing control methods and tools can handle,” observed Benitez. “We need fundamental changes in how we monitor and control a far more complex system. Utilities need real-time monitoring and control infrastructure to achieve situational awareness. The Industrial IoT is a key technology which will enable utilities to have visibility on what's happening in the medium to low voltage, to be able to control, react, and be able to do things like self-healing.”

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