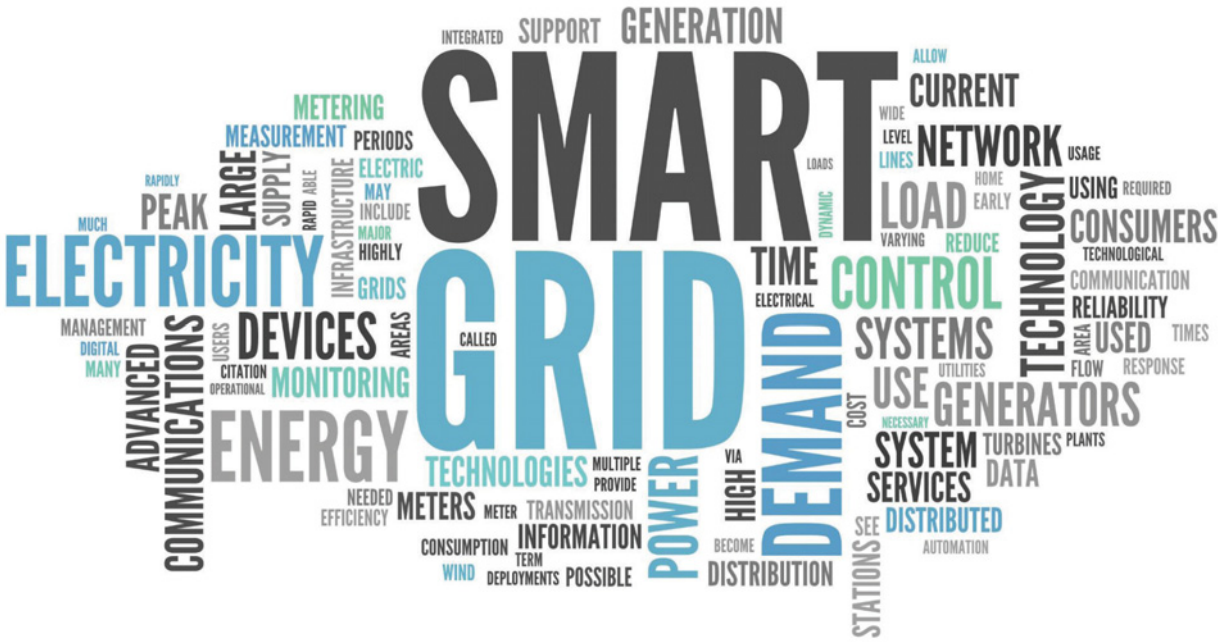
Require A Smart Grid Rollout

The world's sixth largest economy needs to buck up on the implementation of smart grid solutions, if it wants to ensure quality, 24 x 7 power to service the aspirations of both an expanding population and industry.

The Indian electricity grid or the National Grid consists of 335 GW of connected load spread over an area of 3 million square kilometres, according to data from the New Delhi-based public–private initiative, Indian Smart Grid Forum (ISGF). With 250 million customers and varied sources of power generation, it is also one of the largest and most complex grids globally. With the federal government targeting to add another 175 GW of renewable energy to the grid by 2022, the best way to ensure that the benefits of this network are made widely available to the country's over 1.3 billion citizens is through a rapid, yet systematic rollout of the smart grid, also termed as the energy internet of the future.

With the country emerging as the world's fastest-growing major economy, the arguments favouring a rapid rollout of smart grid technologies across the country have become increasingly vociferous. Opines **Peter Herweck, Executive Vice President, Industrial Business, Schneider Electric**, "Increasing productivity means generating or producing more with lesser inputs. Obviously, systems then become more complex. For example, if you take the energy chain, in the past, electricity was generated, transmitted, distributed, and used. But now, the whole process is being turned



180-degree in the other direction." For one, this enables users with their own solar panels to also become prosumers (producers and consumers) of electricity.

Opines **Shantanu Jaiswal, Head of India Research, Bloomberg New Energy Finance (BNEF)**, "To maintain such a complex grid, we need smart and fast response systems that help manage the grid operations and also take automatic corrective actions when needed." In fact, BNEF's New Energy Outlook (NEO) 2018 report co-authored by Jaiswal, predicts that by 2050 renewables will supply 75 per cent of electricity in India compared to 62 per cent in China.

FAST-TRACK IMPLEMENTATION

As part of its aggressive renewable energy targets, the Ministry of New & Renewable Energy (MNRE) unveiled the draft of wind–solar hybrid policy document in May 2018. "Over the past few years, the country has been moving towards an increased share of renewables in its power mix. However, this has resulted in transmission bottlenecks, as these capacities are usually concentrated in limited areas where wind density is high or solar radiation is high," says **Shravan Sampath, CEO Oakridge Energy**. He sees the new policy as a welcome initiative to improve transmission efficiencies by adding solar and wind capacities together.

Moreover, the growing use of renewable energy will result in electricity grids becoming highly interactive. They will intervene to seek a reduction in demand from consumers during peak hours. Traditionally, Indian electric utilities have relied on load shedding to avoid an all-out crash in the distribution system to meet shortage during peak hours. However, rather than resorting to drastic power cuts, a smart grid can reduce supply so that consumers can operate at least basic electrical appliances such as lights and fan.

In India, the per capita consumption of electricity remains around 1,100 kWh per person, per year, which is one-third of the global average. **Reji Kumar Pillai, President, India Smart Grid Forum (ISGF)** feels that with the demand projected to rise significantly, the country needs to move aggressively towards enhancing generation capabilities. "At the same time, there is a narrative that we are a power surplus country because some power stations are lying idle owing to contractual issues. This, together with huge non-performing assets with banks, prevents new generation capacities from coming online and also keeping the investors away," he affirms. Pillai says that with nearly 50 per cent of the 150,000 MW generated daily by up to three-decade-old power plants, there is an urgent need to ensure their renovation and modernisation (R&M) as well as creation of new generation capacities of coal, nuclear, hydro, solar, and wind. "However, if we continue to believe that we are a power surplus country, we will return to the dark ages of the 1970s and 1980s when frequent power cuts used to be the norm," he warns emphatically.

Smart technologies will, therefore, play a major role in integrating electricity from diffused sources of generation. But they come at a cost, which is often much higher than that for conventional

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solutions. "The precarious financial health of distribution companies and the additional cost of deploying smart equipment will definitely slow down the adoption of smart grid technologies. But, as smartness in the grid becomes more standardised, we will see costs starting to decline and distribution companies being able to adopt new technologies one at a time," predicts BNEF's Jaiswal. He points out that already most of the new equipment being used at the transmission level is smart to some extent and new investments will mostly be needed at the distribution level to have a truly smart grid.

ENSURING OPERATIONAL SUSTAINABILITY

The conventional grid is largely based on a system of cross-subsidisation where certain categories of consumers such as commercial establishments pay extra to sustain electric utilities. In the emerging scenario, it would be no surprise to see them migrate to renewable energy.

Summarising the scenario, a 2014 post by the US-based not-for-profit organisation Clean Energy Group noted, "Solar + storage systems will soon reach cost parity with grid-purchased electricity, thus presenting the first serious challenge to the centralised utility model. Customers, the theory goes, will soon be able to cut the cord that has bound them to traditional utilities, opting instead to self-generate using cheap photovoltaics (PV) with batteries to regulate intermittent output and carry them through cloudy spells. Factors such as the plummeting cost of solar panels, the imminent increased production and decreased cost of electric vehicle batteries that can be used in stationary applications have combined to create a perfect storm in terms of technology."

This forecast has raised the spectre of 'utility death spiral', where an increasing number of consumers would either substantially reduce or completely stop depending on the conventional grid. With more people self-generating electricity, utilities will be forced to seek higher tariffs from a shrinking consumer base.

"I have had some experience in telecommunications 20 years ago and see something similar happening in the utility industry. With new players and new business models coming in, distribution companies and municipalities will have to discover new business models going forward," proclaims **Thomas Zimmerman, CEO, Digital Grid, Energy Management Division, Siemens AG**.

Experts feel that in a price-sensitive market like India, this can best be addressed through the time of day (ToD) mechanism of dynamic pricing. Effective ToD mechanism will not only provide a fillip to demand response, but also serve to buttress the renewable energy revolution.

Further, the needs of the hour is "firm" power, as both wind and solar are infirm sources of power that can ramp up or down based on the requirements. It is equally important to also include storage to reduce and balance out the variabilities of both these forms of renewable energy. "That would add enormous value to the utilities as they are presently grappling with the problems of uncertain power availability due to large new solar and wind capacities," says Oakridge Energy's Sampath.

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However, Jaiswal views the policy interventions undertaken so far as being more reactive than proactive. "The government is very careful in not indulging in technologies that are either very expensive or ahead of their time. Therefore, policies and incentives will continue to play catch-up especially for capital-intensive projects that do not offer immediate economic benefits," he avers.

Other than the increase in disposable income, the demand from the manufacturing sector on the back of government programmes like Make in India, expansion of data centres, increased use of blockchain technology and growth in electric mobility are all going to whet the appetite for electricity. In anticipation of this explosion in demand, a fast reorientation of mindset is required on both policy and execution fronts to cope up with an increasingly disruptive environment.

- MANISH PANT

"Smart grid technologies to address new dynamics"

India needs smart grid systems on account of the changes in the entire dynamics of the electric power system and the need to maintain its very complex and prodigious grid, says **Reji Kumar Pillai, President, India Smart Grid Forum (ISGF)**. There is also a need to go beyond the present narrative of being a power surplus nation and undertake renovation and modernisation of thermal plants as also add the new generation capacities of coal, nuclear, hydro and renewables. The failure to do that would result in a return of power cuts, he warns in this comprehensive interaction with INFRASTRUCTURE TODAY.

Why do the Indian grids need to imbibe smart technologies?

We operate one of the biggest and the most complex grids in the world, covering 3 millionsquare kilometres with 345 GW of connected load and over 250 million customers. This grid is growing at 8 to 10 per cent per annum, both in terms of connected capacity as well as customers. The government is targeting to add 175 GW of renewable energy to the grid by 2022. I am convinced that by 2022, we will achieve about 150 GW, if not more. A grid of around 500 GW with 30 percent plus renewables and 300 million plus customers will be very complex to manage. We need smart technologies and smarter systems to operate such a complex grid. Take the present example of Karnataka, which in the last three years has added 5,000 MW of solar power to the grid. During the monsoon season this year, the total load in Karnataka was less than 10,000 MW, while their total renewable capacity is over 12,000 MW. On a good day, with wind and solar, the state produces almost 100 per cent electricity from renewables which keeps going up and down all the time; and maintaining grid stability is a nightmare in that scenario. The states in Karnataka's neighbourhood like Tamil Nadu, Andhra Pradesh and Telangana will also be reaching that stage very soon. The entire dynamics of the electric power system has changed and we need smarter technologies to manage the grid.

How can such technologies aid in the decentralisation of the country's energy requirements?

The biggest challenge today is to provide 24X7 quality power to all the citizens in India. The generation capacity is idling, primarily because of the financial viability of distribution companies. But on the other side, customers who don't get quality power from the grid are resorting to alternate arrangements like diesel generating (DG) sets and inverters, which are several times more expensive than power from the grid. For example, in Gurugram, most of the big buildings are on DG sets and are paying Rs15-18 per unit of electricity. They will be more than happy to pay Rs8-10 per unit to Dakshin Haryana Bhijli Vitran Nigam (DHBVN) but the distribution company is unable to supply power though there are over 40,000 MW of thermal power stations lying idle in the country that could supply power at around Rs5 per unit. Something seems to have gone terribly wrong

with the Indian power sector. Therefore, technologies need to be leveraged and policies need to be tweaked to resolve this problem. The per capita consumption of electricity in the country is still one-third of the world average, with a little over 1,000 kWh per person per year. At the same time, there is a narrative that we are a power surplus country because some power stations are lying idle owing to contractual issues. This, together with huge non-performing assets with banks, is preventing the new generation capacities from coming online and is also keeping the investors away. Today, out of the daily average generation of 150,000 MW, at least half is coming from power plants that are 25 to 30 years old and require renovation and modernisation (R&M). Since, no multilateral lending agencies are willing to lend money for R&M of coal fired plants, we have to find resources internally and also build the new generation capacities of coal, nuclear, hydro, solar and wind. However, if we continue to believe that we are a power surplus country, we will return to the dark ages of the 1970s and 1980s when frequent power cuts used to be the norm.

However, the high cost of replacing existing equipment may prove to be a deterrent at least as far as brownfield projects are concerned. What are your own views on this challenge?

There is no other way out but to find the means to R&M of the existing coal plants that will help to reduce pollution levels, increase output and provide a pre-existing transmission infrastructure for power evacuation. Although several licenses were awarded to set up hydroelectric plants in the last 15 years, most of them could not be developed owing to a variety of reasons like the right of way, long transmission, hydrological issues, financial closure and environmental clearances. Moreover, we are at least a decade away from the completely digitalised grids that shall possess the ability to self-balance themselves to adjust to the intermittency of renewable generation resources. The new policies on the anvil related to emission reduction from thermal plants could significantly add to the cost of generation and pose technical and commercial challenges to generation companies. We need consistency in policies with a long-term vision which is lacking. With every change of the government, the minister, secretary, joint secretary and chief executive officer of a utility, the policies and programmes also change. In the present system of the governance in India, institutions do not learn even from their own mistakes as there is no mechanism to capture the learnings. Individuals who learn, move on frequently from one ministry to another. This is the bane of India.

Similarly, the existing regulatory guidelines framed for grids and utilities have become antiquated in view of the ongoing technological disruptions. Therefore, how proactive are the policy interventions at the federal and the state level in this regard?

India is far ahead of many countries in terms of the regulatory environment for electricity grid modernisation. What we lack is in the implementation, which is the primary responsibility of the states. The Ancillary Services Regulations issued in 2015 is yet to be operationalised. For smart grids, we have issued so many policies and regulations. Take net metering for instance. Every consumer in India toady can theoretically be a prosumer, i.e., both a producer and a consumer of electricity. From 2013 to 2016, all the 28 state regulatory commissions had issued net metering policies. ISGF is working with the Forum of Regulators and state electricity commissions for making it more prosumer friendly. We are now doing some modelling studies which indicate that most states have a cap of 25 per cent on the distribution transformer capacity for rooftop solar in their net metering policies. Our studies indicate that it can go up to 60-70 per cent in most parts of India, since our distribution system is overloaded and rooftop generation, which gets consumed in the low voltage grid will actually give a load relief to the distribution transformers. Our recommendation will be to change the net metering policies with at least 50 per cent of the distribution transformer capacity, which will actually start a revolution of rooftop solar in the country. ISGF has also been advocating for the Right to Electricity Act. Suppose you are a customer in Gurugram who is willing to pay Rs10 per unit of electricity to the distribution company. But owing to the frequent power cuts, depend on electricity from the DG set at Rs18 per unit. The smart grid technologies today can offer differential pricing to customers on a feeder and those who do not wish to buy at the Time of Use (ToU) tariff can either turn-off or reduce their consumption based on real time alters and price signals.

For the complete interview log on to www.infrastructuretoday.co.in

- MANISH PANT

"Smart grid deployment will happen automatically"

In this interaction with INFRASTRUCTURE TODAY, **Peter Herweck, Executive Vice President, Industrial Business, Schneider Electric** affirms that electricity continues to remain a very dynamic invention. In the fast-emerging complex environment, where the generation, transmission and distribution of electricity are undergoing a complete transformation, it is the smart grids that will power the future.

How can smart grids help in enhancing systemic efficiencies, especially in India where we are trying to meet our growing demand for electricity from a highly diverse and complex grid of conventional and renewable energy?

Increasing productivity means generating or producing more with lesser inputs. Obviously, systems then become more complex. For example, if you take the energy chain, in the past, electricity would be generated, transmitted, distributed and used. But now the whole process is being turned 180-degrees into the other direction. We are using and producing at the same time. And what appears to be a very stable system, suddenly transforms into a very complex environment, in terms of exercising control over a factory or electrical grid. Although we have been engaged in automation and digitisation for several years with the availability of technologies like the Internet of Things (IoT), we can gather more data and interconnect better to enhance our customers' experience in terms of decision making. This is particularly important in terms of artificial intelligence or machine learning that is deployed in Schneider's EcoStruxure architecture. That's why I am very excited whenever I visit India because all of that is being promoted by the current government on the manufacturing side with Make in India and is totally compatible with what we have to offer.

Over the years, the developments in India have been astounding. If you look at the growth in GDP and rise in the income levels, they have gone hand-in-hand. When you have more people entering the job market, you have to make sure that they are gainfully employed. But how do you bring more people into the workforce even while staying competitive with respect to manufacturing and utilisation of resources? Those objectives can be met through automation and digitisation. That's why these days, we at Schneider Electric are very excited wherever we go, for that's our business.

Although India has been aggressively pushing for generation of more renewable energy, there is the problem of intermittency in the grid. How can technology help in the creation of smart grids of wind-solar and conventional energy?

If you are able to inject intelligence in the system, you also get to understand who is utilising how much and with that knowledge, you can start balancing the system. In the past, we called this Balance of Plant (BOP) and would undertake it in very small power plants to ensure stability in power frequency that was injected into the network. But now, it has increasingly become far more complex. Therefore, your balance of plant becomes the balance of grid or balance of island. To put it in simple terms, think about the electric grid as an isolated island with

different types of generators and users. You need to make sure that everything is in balance. And that's what we are trying to incorporate in the smart grid, to stabilise utilisation and production as also to ensure stable distribution in the network.

In conversation with our sister publication, IPF, you had reiterated a very interesting observation: "Digitisation is the present, electrification is the future." But aren't the two already happening simultaneously?

Let me contextualise my statement. Everything is connected and there is a forward and backward exchange of data. There are a lot of people who don't give a second thought to what might be driving the digitisation process. To give you a couple of examples, the biggest user of energy today is blockchain because it is a highly distributed yet intelligent network that runs on multiple servers in multiple time zones. Therefore, a lot of energy gets consumed in that area.

Similarly, I heard that some of the video streaming services have arrived in India to produce entertainment content because that's really picking up traction. Therefore, you will need a lot of data centres and once you have them in place, you will need a lot of electricity to drive those data centres. However, electricity is totally underestimated as people think that it is something that belongs to the past. What we would like to say is that electricity will be very important in the future to enable us to do things like data centres and digitisation. Similarly, if you look at electric cars – though their base is presently very small globally – we see that many automakers will come out with a series of Electric Vehicle (EV) models over the next few years.

Therefore, the choice that the customer will have in terms of the number of Evs, will increase dramatically. And with that, we believe there will be an acceleration in the use of electric or hybrid cars. Again for that, you will need a lot of electricity. Some of the prosumers will charge the car battery during the day, use it in the evening for dissipating energy into their homes. Owing to all those developments, electricity and its storage have become far more important than we can imagine. Also, the increased use of renewables will make grids smarter and there will be a need to digitise and automate them further. The same is obviously happening in India as well. For instance, if you look at Reliance Industries' Jio division, it's growing exponentially and that's an indicator of what's happening in the telecommunications industry.

Is that why rapidly growing economies like India need to progressively move to smart grid technologies?

That's going to come about automatically with the deployment of renewables as well as with more demand for electricity. At the same time, we need to make sure that these resources are available at a lower cost. On August 1, when we utilised all the natural resources that the planet had for one year, the remaining four months we were living off the future. We are now utilising resources that were available for the next year. It means that every year we are utilising more resources of the future. Unless absolutely necessary, we, at Schneider Electric, are trying to better utilise resources; that we better electrify, that we better digitise and that we better automate in order to push that stage further backward. We call this initiative #MoveTheDate and fully support it.

One of your favourite themes that you touch upon in your various presentations globally is that it is not only important to build efficiencies in the electric grid but also to reduce costs. So, how can disruptive technologies help in realising that objective?

In the past, Schneider was known for power distribution or industrial automation products. On top of that, we had control systems that would drive and control a grid or production site. We added this to our EcoStruxure architecture by adding a third layer to build more intelligent systems. Therefore, one of the things that have been facilitated in a power plant is the monitoring of the distribution network. By gathering data on a continuous basis, you know when the system starts failing. That helps you reduce maintenance costs through measures such as curtailment of downtime and an increase in the plant output. There are simple cause and effects that go through the complete value chain and many a times begin with the energy, of course. We are not only experts in the energy field but all the way to the finishing processes in factories. Therefore, we want to advise our customers on how they can maximise their investment or better utilise their assets to control costs.

It's not necessarily always about the cost of energy, since we are not a generation company. But we help out by reducing costs through lesser maintenance and maximising electricity utilisation so that the energy intensity for finished products gets lowered.

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