What the Smart Grid Means-and Doesn't Mean-for India

Written by Rahul Tongia

The urgent power system needs in India are not necessarily the same as those in advanced industrialized countries. The same goes for the most important power system constraints. Generally, not all smart grid technologies are equally relevant worldwide. In India, the really useful technologies will be those that help constrain peak demand and peak load growth at reasonable cost while cutting losses.

If Singapore now has electricity downtimes of under a minute per year, perhaps the other extreme might be represented by places in India or parts of Africa where large numbers of citizens have no access to electricity at all and outages are measured in hours per day. With such a wide variance in grid conditions, does a smart grid make sense in all these diverse locations?

Of course, as it is generally recognized, the smart grid does not consist of a single technology or solution; exactly what different countries and different utilities focus on will differ. Having worked on smart grids for a number of years, I have arrived at some realizations. Taking into account that I serve as adviser to the Smart Grid Task Force and Smart Grid Forum of India, let me emphasize that these are my personal views only.

First, many solutions adopted in highly industrialized countries will not work on a large scale in places like India. Yes, there are things that can be done that appear to be worthwhile but, too often, the metric applied is simply positive return on investment. Other uses of scarce investment funds—or even non-technical solutions—need to be considered; instead of merely comparing one future to the present, alternative futures must be weighed against each other.

Second, India's most urgent problems and needs are not the same as those the smart grid addresses in wealthy countries. India and other countries at a similar developmental stage are not worried about meter reading labor costs as much as accuracy of billing. Electric vehicles are a more distant prospect than in Europe or Japan. Renewables, though important, are more a national strategic mandate than anything being asked for, bottom-up, from the utilities.

"Resiliency" means something different when a country's utilities do not even have automatic reclosers in measurable degree. Even the peak is different, with two peaks at the grid level, not just one. (The morning peak is entirely residential-driven, while the evening peak is commercial plus residential.) Another major load, agriculture, is throttled at a feeder level and supplied power only during "off-peak" periods. Taking all considerations into account, what this means is that any peak management system design for a country like India must account for many small or medium users, instead of a small number of large users.

India's two biggest challenges are high losses—both electrical (or "technical") and financial (or "commercial," due to both non-payment and theft)—and shortage of electricity supply. It is said that a smart grid can help cut down on the widespread (but not precisely known) theft in the system. Perhaps, but reducing theft does not inherently require a grid with advanced sensing, computing and communications. There are a select number of utilities or areas in India with losses of a half to a third of other areas, without the presence of smart grid technology.

Smart grid technology could, on the other hand, help with shortages—by enabling peak load management and demand response. (One can jokingly say that India has the most effective demand response program in the world: unfortunately it is mandatory and consists of feeder level load shedding!) The Indian peak load shortage is *officially* 12.9 percent and is almost certainly far higher. What is more, data indicate that the peak load is growing faster than average usage, making this problem more acute. To frame the problem sharply, in the next two decades, while the gains from eliminated losses will be measured in tens of percent, India's power needs will grow by *hundreds* of percent.

Can smart grid technology help address India's challenges, including peak load management and peak load growth? Of course. But the elephant in the room is cost. Indian utilities are bleeding money, losing, on average, over one cent for every kilowatt-hour sold. In addition to high losses, the tariffs for many consumers are highly subsidized and almost free for most agricultural users, who are generally unmetered, though they ostensibly consume roughly a quarter of the supply. Accordingly, the average consumer bill is quite low, producing very little revenue to funnel into the infrastructure. In 2008-09, the median household bill in one moderately large city with over 1 million consumers was only about US $7/month.

Partly because money is so tight, the so-called "L1, L2, ..." process is sacrosanct in utility procurement: the point is to identify the lowest-cost provider that appears to be capable of crossing a technical bar. This mechanism works well for a commodity but less well for something that is more a process than a product. Applied to the smart grid, it may lead to false economies on a life-cycle basis.

Given that state utilities are cash-strapped, there is a major central government program, ongoing, to upgrade the IT infrastructure of utilities. Called **R-APDRP** for short, it has funding of over US$ 2 billion to develop deliver "standard" IT-like billing systems, consumer databases, asset codification, geographic information systems, data centers, advanced meter reading on all distribution transformers (other than consumer meters) across all urban and semi-urban areas, and so on.

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Yet in Bangalore's state, Karnataka—to take one example—over a five-year contract period, the monthly cost per urban consumer that R-APDRP covers is only about 10 Rupees, or less than 25 American cents. Thus it is a major challenge to deliver a good solution, not just in terms of meeting cost targets but also in managing issues of scalability, modularity, usability (taking human capabilities into account), security and trust.

So what kind of design philosophy should be adopted under the circumstances?

- The concept of frugal innovation, also called frugal engineering, is important. To take an example from communications, Indian mobile phones represent the fastest growing market and are the cheapest in the world, with average revenue per user of about $7/month, and falling; the cheapest plans come to about $2/month (with free incoming!).
- Modularize solutions so that the barrier to entry is low. For example, roll out a smart meter with minimum functionality that can be deployed universally but designed so that advanced functionality can be added based on consumer and regulatory requirements, utility needs and market growth. The catch is that such solutions have to be seamless, transparent and open (to avoid lock-in).
- Related to modularization is the need to pare down functionality on the basis of commercial viability. If we consider the functionality of outage detection, some parts of the world are specifying a meter with a battery that can communicate in a push model. In India, instead of instant notifications, 15-minute notifications at a consumer level may be sufficient, given that intelligence might be built in at the distribution transformer level but not the consumer level. (In India—and Europe, but not the United States—distribution transformers typically serve hundreds of consumers.)
- Learning curve cost reductions are a public good; therefore, public support for pilot projects and demonstrations are critical. In India, the central government has announced plans for such projects, with matching or partial funding. A high-powered Smart Grid Task Force and the public-private Smart Grid Forum will likely help move power system innovation forward in India.

India has many dozens of distribution utilities, the majority under government control. This heterogeneity will likely be exploited with different utilities moving faster than others, and we will likely see differently designed pilots as well. My hope is that the stakeholders can come together to clearly articulate the need, before describing the solutions. Perhaps then, India can leapfrog its power grid into a 21st-century smart grid.

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