Smart(er) Grids

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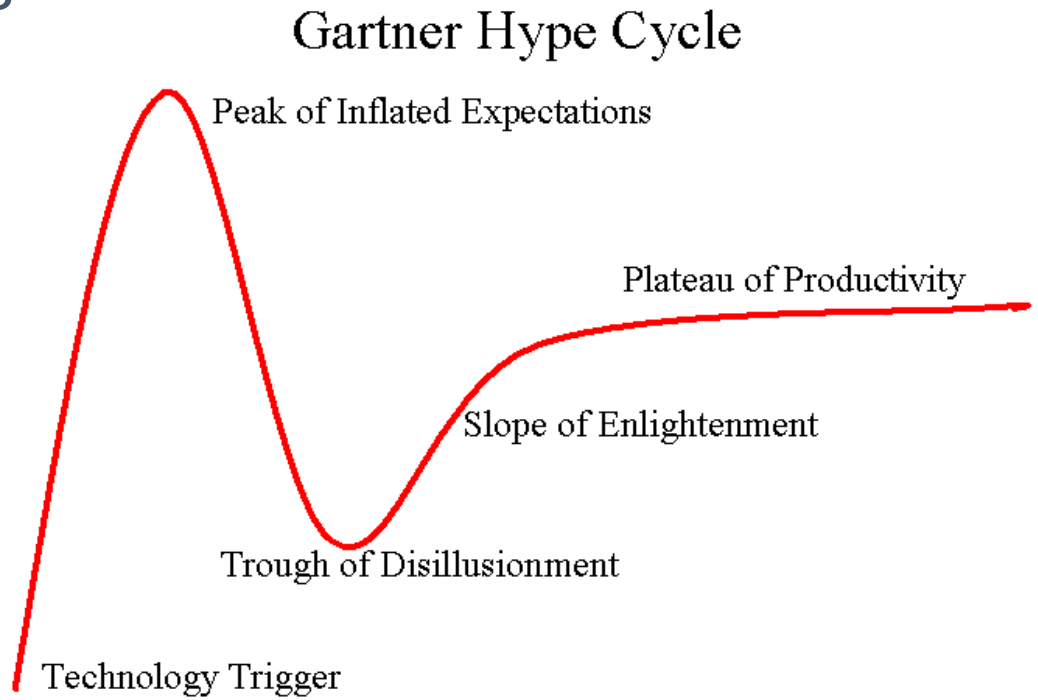
All views are personal

Personal Background

- Scholar, Researcher, and Advisor
  - Interdisciplinary: combine technology, policy, regulation, innovation, etc.
- Fellow, Brookings India
- Adj. Professor at Carnegie Mellon University
  - Faculty member since 1998 – went on leave in 2009 to come to India
  - Was on Tech. Advisory Board at leading US utility Smart Grid project ($1.2B Southern California Edison SmartConnect)
- Have been active in SG in India, e.g.,
  - Min. of Power IT Task Force Report Update (2008)
  - Key advisor to (and helped found) SG Task Force, SG Forum
  - Work *bottom-up* with a number of utilities
    - Roadmaps, IT planning, CBA, etc.

Smart Grids have Arrived in India!

- Outlook Business Aug. 7, 2010



But one has to be cautious where we are…
(else these are just buzzwords)

Smart Grid: Motivation and Agenda

- How do you cut down load-shedding?
- How do you detect theft?
- Physically, can you offer improved quality/service in today's grid?
- Are Smart Meters and Smart Grids viable?

Stylized Definition of Smart Grids

- A Smart Grid is a Transformation of the power system based on harnessing digital communications and control
- Utilities will be able to:
  - Know what power is going where, and when
  - Charge “appropriately” for it
  - Control the use of (if not flow) of power

- Although **Advanced Metering Infrastructure (AMI)** is considered to be the **basic building block** for a **Smart Grid,** the Smart Grid is not just **AMI!**
  - ❖ The **Smart Grid** is a much broader set of technologies and solutions

Smart Grids Big Picture

- SG is an enabling environment
  - What we want of it is up to us
- No single definition of a Smart Grid
  - "A **smart grid** delivers electricity from suppliers to consumers using digital technology to save energy, reduce cost and increase reliability."

    -- Wikipedia

    *(More formal definitions are **far** more complex)*

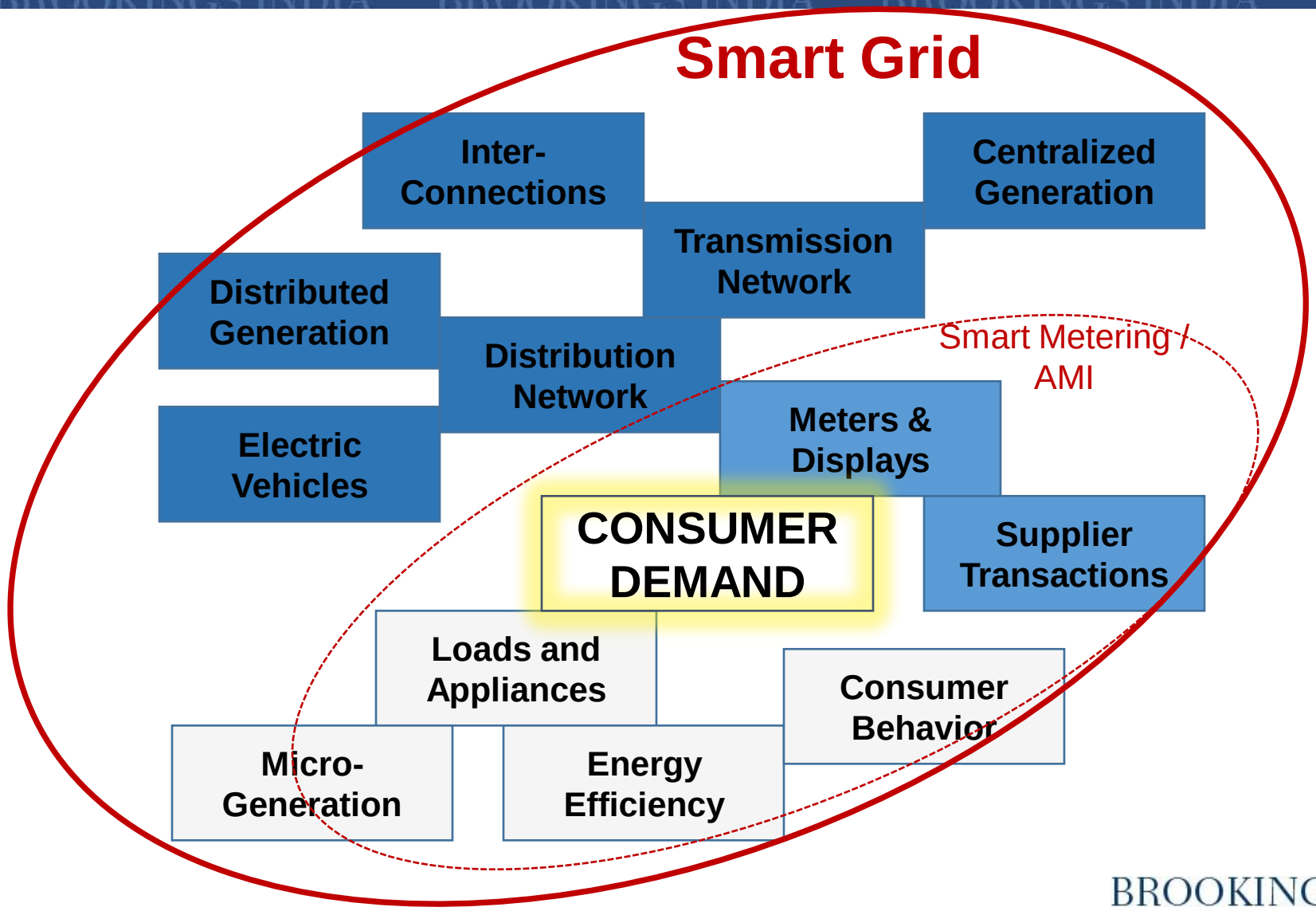
    E.g., US Dept. of Energy talks of 7 Functionalities

What Smart Grids really mean

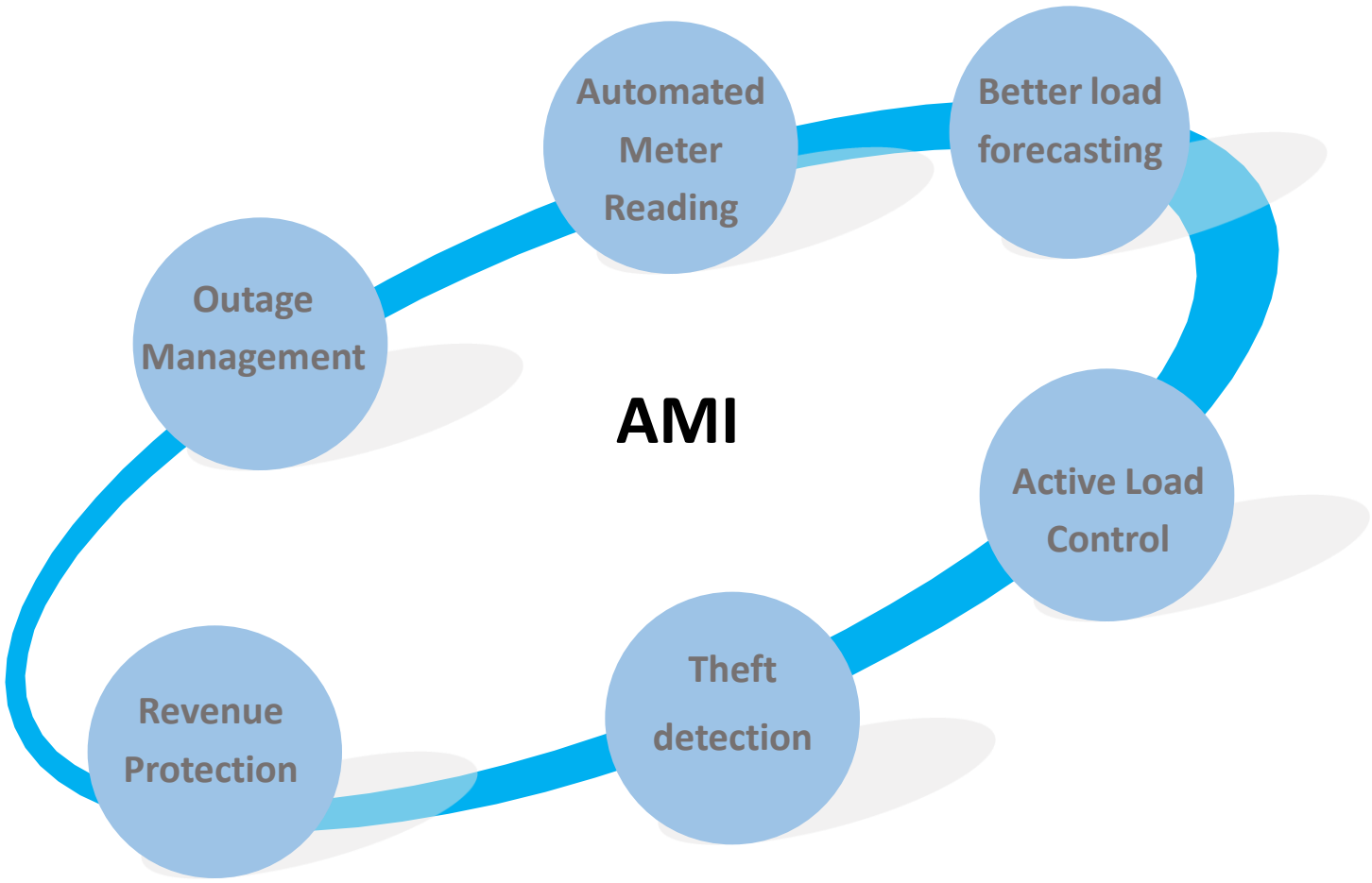
- *Cost Implications**

↑ ?	• 1. More choices • Includes renewables
↑ ↑	• 2. Better quality and service
↑ ↑	• 3. Greater resiliency / robustness
↓ ↓	• 4. Increased efficiency and asset utilization

Smart Grid Components



Advanced Metering Infrastructure (AMI) = Basic building block for a Smart Grid



Smart Grid Vision and Roadmap

SG Roadmap was approved by Ministry of Power in August 2013 and it was released by the Power Minister on 10th Sept 2013 in a conference of all state power ministers in Delhi

Smart Grid Vision for India

Transform the Indian power sector into a secure, adaptive, sustainable and digitally enabled ecosystem that provides reliable and quality energy for all with active participation of stakeholders

Drivers for Smart Grids

Utilities	Customers	Government
• Loss reduction • Peak load management • Asset management • Renewable integration • Self healing grid	• Access to power • Reliability • Quality Power • Prosumer (producer-consumer) enablement • Choices of power purchase	• Satisfied customer • Reduction in emission intensity • Financially sound utilities • Tariff neutral system

Source: India Smart Grid Vision and Roadmap (2013)

Indian Examples of Functionalities

- Loss reduction
  - Requires precise and full metering
  - 15 minute or 30 minute or even hourly readings can help give visibility for operations

  Estimate: loss improvement might be 15% on average *at best*
- Ending load shedding
  - Only two options
    - Buy more (peak) power
    - Reduce Demand
    - (Third “Option” is to load shed!)

  Estimate: Growth in 20 years (lifespan of metering projects) of 150-200%

(Possible) Impacts on Consumers

- Carrots
  - No load shedding
  - Increased accuracy in Billing
  - (possible) Personalized data (e.g. Home Display)
  - Better knowledge and control over energy usage
  - Opportunity to reduce energy bills (Using ToU tariffs)
  - Option for pre-paid connection
  - Less Power outage or less momentary interruptions
  - Quick fault detection
  - Faster restoration of faults
  - Better Power Quality
  - No Regional Blackouts
- Sticks
  - Penalties for violations or non-compliance
  - Possibility of disconnection (remotely)
  - Increased accuracy in billing (bill may go up, *especially MD charges*, and no more chicanery)

Where are we?

- R-APDRP is ongoing…now IPDS
  - Homework or precursor to a Smart Grid
  - Many lessons (not all yet fixed!)
    - This is not a one-time or drop in solution, e.g., updating is a challenge
- A number of pilot projects announced and underway
  - Why a pilot? Need to know the impacts (this isn't about "does the technology work?")
- Utilities need to take a lead
- Need regulatory buy-in
  - Consider "ending load shedding" via smart meters

Costs

"If you think education is expensive, try ignorance"

– Derek Bok
Former President
Harvard University

If you think smart grids are expensive, try BAU

- Increasing procurement costs
- Customer Churn
  - Open Access needs better metering
- Higher than necessary opex, losses
- Missed opportunities for new revenues
- Inefficient socialization of true costs

Will you pay for more reliability?

- Indians are very price sensitive (???)
- Would you pay Rs. ___ for lowering or ending load-shedding?
- Bangalore Domestic Electricity Survey ongoing
  - Major Survey (jointly with IIM-B)
    - Multiple times larger, and stratified, coverage than NSSO
  - Results forthcoming
    - Many people pay for coping with load-shedding

- Personal Belief: SG can succeed BETTER than in the West
  - Enormous volumes (witness EESL's success with LEDs)
  - Consumers there may be indifferent to potential savings of $1/month
  - Our consumers will not be indifferent
    (and are already heavily engaged with the grid, via load-shedding)

Parmenides Fallacy

"Comparing the future with the present, instead of alternative futures"

- Cannot compare a regular meter reading (accounting) with a smart meter (highly evolved functionality)

Is a Smart Meter Worthwhile?

- Cost of a Smart meter
  - Capex at node – incrementally over a regular meter – perhaps Rs. 1,000 – 1,500 (comms, logic, connect/disconnect)
  - Total costs in NPV basis (including communications, back-end, data center, etc.) – adding perhaps Rs. 2,500-3,000 more
- Assume a Smart Meter costs Rs. 50/month total extra costs (hardware, opex, etc.) – IN VOLUME (10 yrs, 10% rate)
- How will we get benefits? (There are many categories)
  - Not all consumers will provide enough savings
    - Average total bill in some areas may be only a few hundred rupees per month
    - BUT others can provide disproportionate benefits (e.g., those on diesel, and clearly willing to pay)

Green, Clean, and Smart

- These can and should be more than buzzwords
  - These feed off each other
- The “old” grid is changing
  - Supply is no longer a given, so now demand may need to be controlled
- Heterogeneity is one challenge, and opportunity
  - One size does NOT fit all
- The solution to India’s power scenario involves a *portfolio* approach
  - Different supply mix
  - Different scales (incl. opportunistic microgrids)
  - Differential pricing (procurement and retail)

"The best way to predict the future is to invent it"

– Alan Kay

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