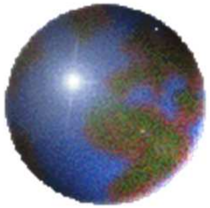
Seminário Matriz e Segurança Energética Brasileira



Technology, Utility Driven Energy Efficiency and Climate Change

FGV/IBRE/CERI/Conjuntura Econômica

Luiz Maurer, IFC

Rio de Janeiro
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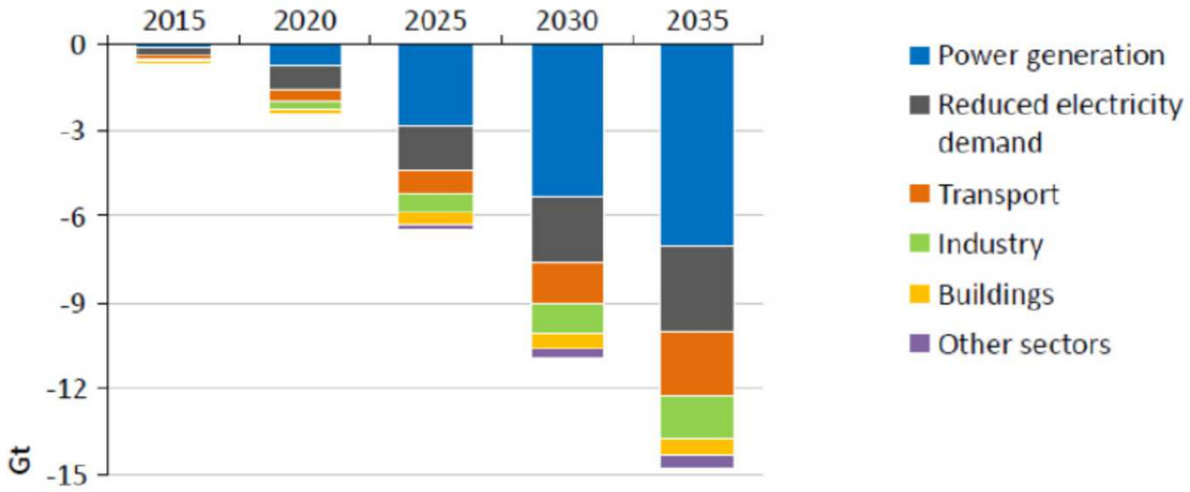
Agenda

- IEA and utility driven EE to stabilize GHG emissions
- Utility Driven Energy Efficiency (UDEE)
- The importance of technology – e.g. Smart Grids
- Transformative aspects of technology – anectodal evidence "beyond the meter"
- Potentializing the role of technology
- IFC value proposition
- In a nutshell

IEA – Two thirds of GHG reduction requirements should come from the power sector

Energy providers will play a pivotal role over the coming decades in managing energy demand growth and reducing greenhouse gas (GHG) emissions. The IEA projects that the power sector will deliver up to two-thirds of cumulative emissions reductions under the climate-stabilizing 450 ppm scenario, by switching to less carbon-intensive generation, improving operational efficiency, and reducing demand (IEA 2011a). Reducing electricity end-use demand by itself is expected to account for 1/3 of the GHG emissions reductions through 2025 (See Figure 1).

Figure 1 • World energy-related CO2 abatement by sector in the 450 Scenario (IEA 2011a)



A sound utility driven EE platform will be essential

IFC UTILITY DRIVEN ENERGY EFFICIENCY (UDEE) FRAMEWORK					
Utility Business					Separate Companies
GENERATION	TRANSMISSION	DISTRIBUTION	METERING	BEYOND THE METER	
* Retrofits of existing thermal plants	* New SCADA Generation Control Systems	* Streamlining Commercial Processes	* Meter with multiple features, including smart ones	* EE at customer premises, district cooling	UTILITY ESCOS
*Repowering of existing hydro plants	* Synchrophasor Wide Area Monitoring	* Technical and Commercial Losses Control	* In Home Display	* Load Control & Load Management	
* District Heating Retrofits and Expansion	* Special controls and smart systems to manage intermittency	* Distribution Automation	* AMI	* DG Beyond the Meter - On Bill Financed PV Rooftop	VALUE ADDED SERVICES
* Fuel switching	* Transmission enhancements to relieve congestion				

Smart Grids – a key role to play

Existing smart grid technologies may support the entire supply chain …

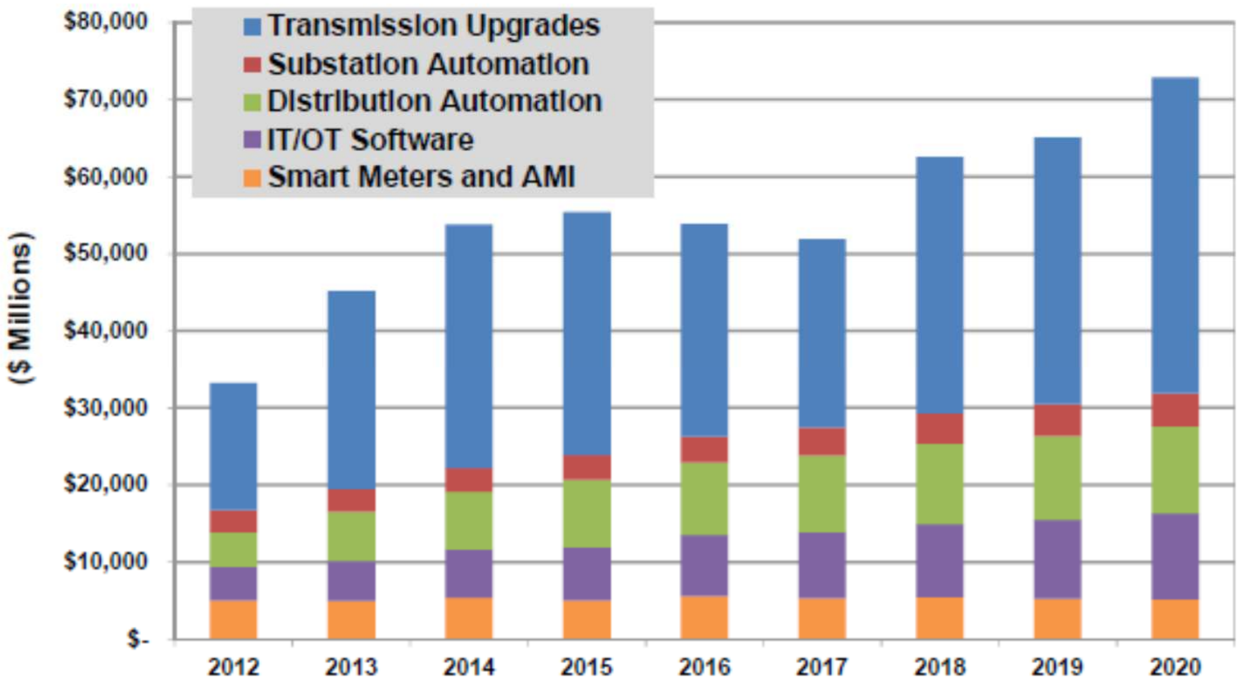
- Transmission upgrades
- Substation automation
- Distribution automation
- Smart Grid information and operations
- Smart metering
- Beyond the meter

… With multiple benefits

- Reduce energy losses
- Increase capacity of existing network – key in congested areas
- Integration of renewables
- Demand side management and reliability
- Better asset utilization

Transmission upgrades and distribution automation should lead smart grid investments on the supply side

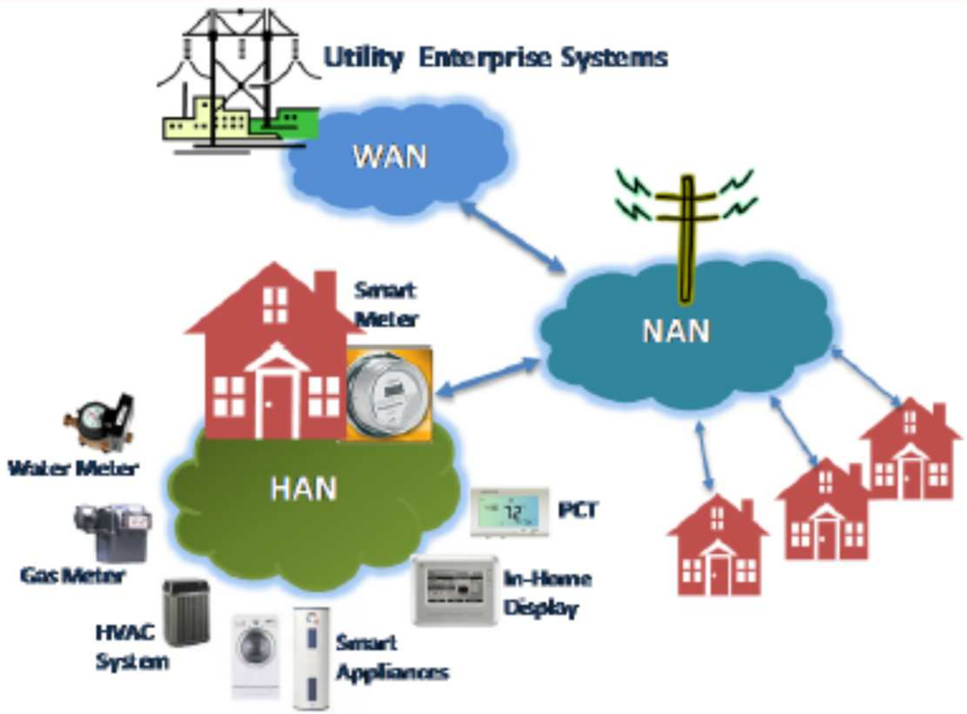
Chart 5.1 Smart Grid Technology Revenue by Application, World Markets: 2012-2020



(Source: Pike Research)

A typical smart meter architecture should engage the customer

Typical Smart Meter Network Architecture



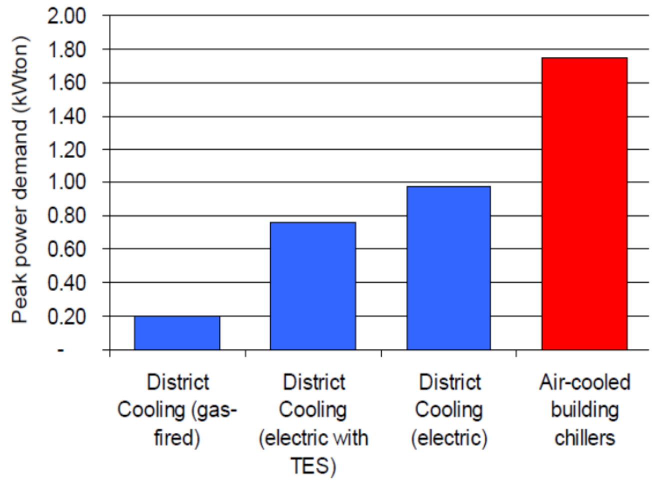
(Source: Pike Research)

Technology will evolve dramatically to support customer response - the Internet of Things (IoT) (*)

Internet of Computers	Internet of People	Internet of Things
• 1990 – 2000 • Use case: Network computers, render information in browsers • First phase of the commercial Internet • # nodes: from millions to hundreds of millions	• 2000 – 2010 • Use case: Online mobility (laptops, cell phones, tablets), de-couple the Internet from the desktop computer • # nodes: from hundreds of millions to billions	• 2010 – 2020 • Use case: Devices interact directly, automation of many processes • # nodes: From billions to tens of billions

(*) Mockel, Peter. Smart Meters. IFC, May 2013.

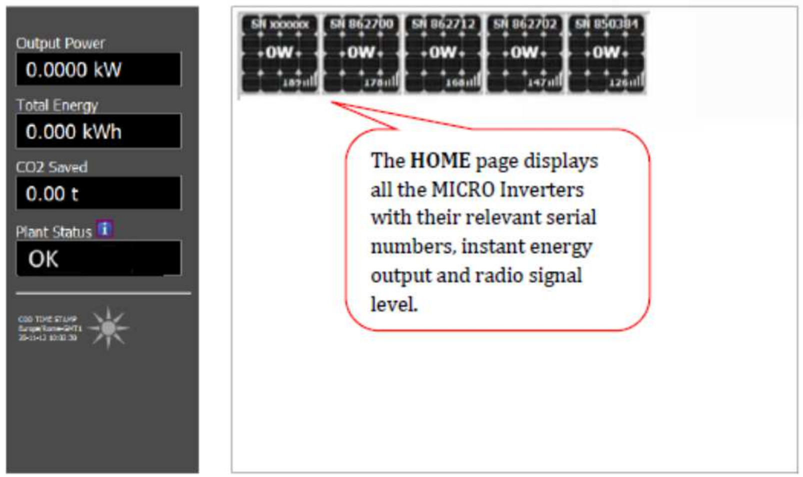
Technologies are available to promote EE – for example, at residential and commercial levels



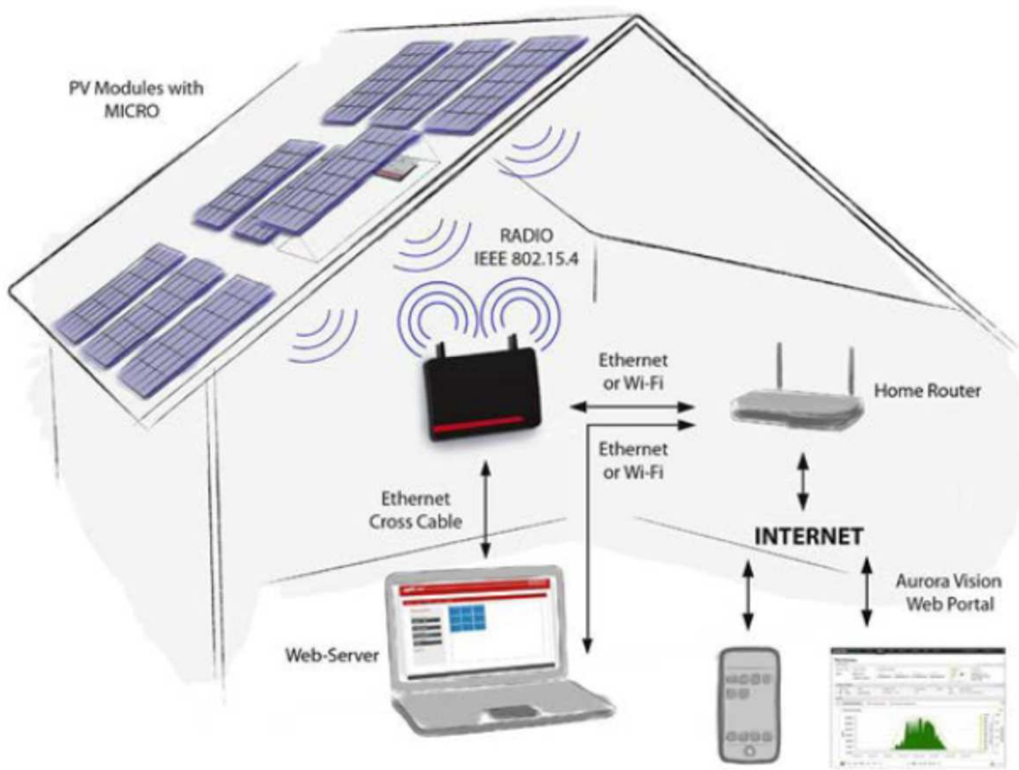
Technology provides information, which changes behavior – the "Prius" Effect

Even small, PV household systems have full information capability (data concentrator)

Each Micro-Inverter has an IP address and is monitored individually in a PC



Multiple communication technologies now exist to make this happen



In the power sector, meters, even "smart" ones, have not been very helpful in this regard

Then

Now

But

Analog electricity meters

- Invented by Galileo Ferraris (1847-1897)
- Basic design unchanged for over a century
- Works by counting the revolutions of a non-magnetic, but electrically conductive metal disc which is made to rotate at speed proportional to power through meter
- Records kWh only
- The meter is read visually, requires inspection

Smart electricity meters

- Solid state design, no mechanical parts
- Three principal components: Metering engine with DSP, microprocessor, transceiver
- Advantages
  - More accurate
  - Network interface for remote reading
  - More parameters (e.g. reactive power)
  - Cheaper to produce at scale

Smarter meters required

- Most of today's smart meters are a product of the previous decade.
- They don't fulfill the potential
- New features of the coming generation
  - Higher sampling rate (>2Hz)
  - Wireless, always on network connection for real time data
  - Home area network interface (HAN)
  - In home display

(*) Mockel, Peter. Smart Meters. IFC, May 2013.

Future is brighter – disaggregated information in your PC or a specific app in your tablet – potential to change behavior – 5% to 15% of savings, average 7%

Disaggregation

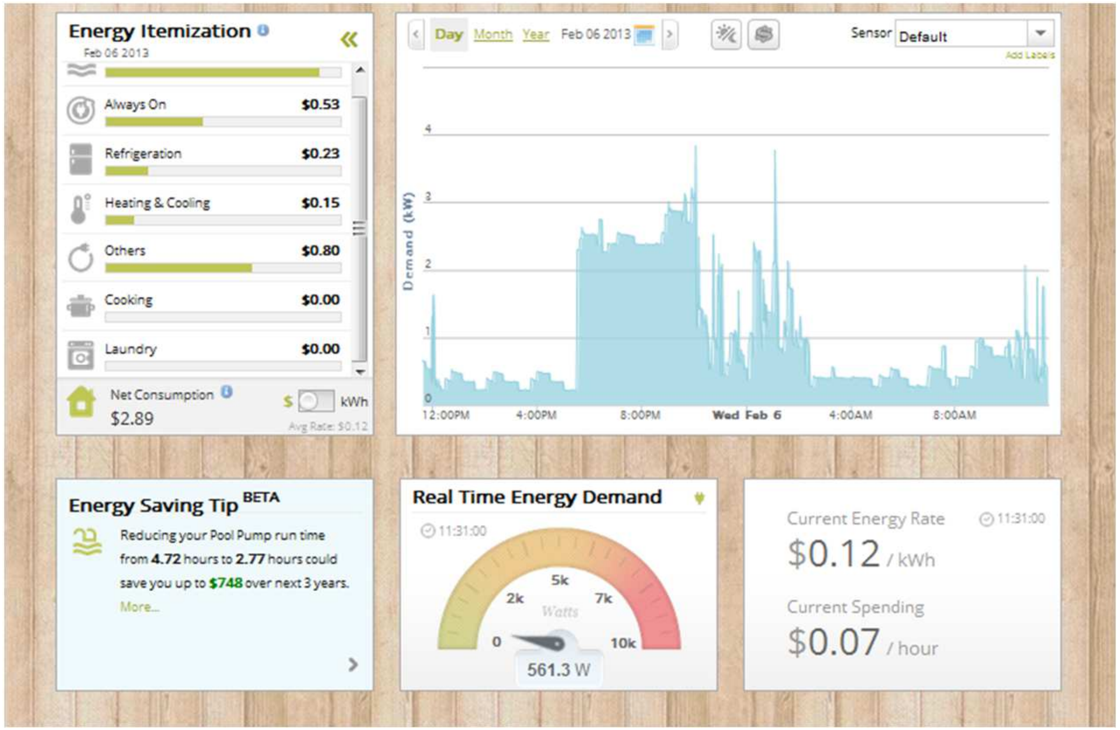
The challenge: Meter readings contain aggregate signals of all appliances in a household/an SME

Difficult for the user to understand how their behavior changes overall power demand

The solution: Use modern AI techniques to heuristically disaggregate the signal

The result: An itemized energy bill

Product example: Bidgely



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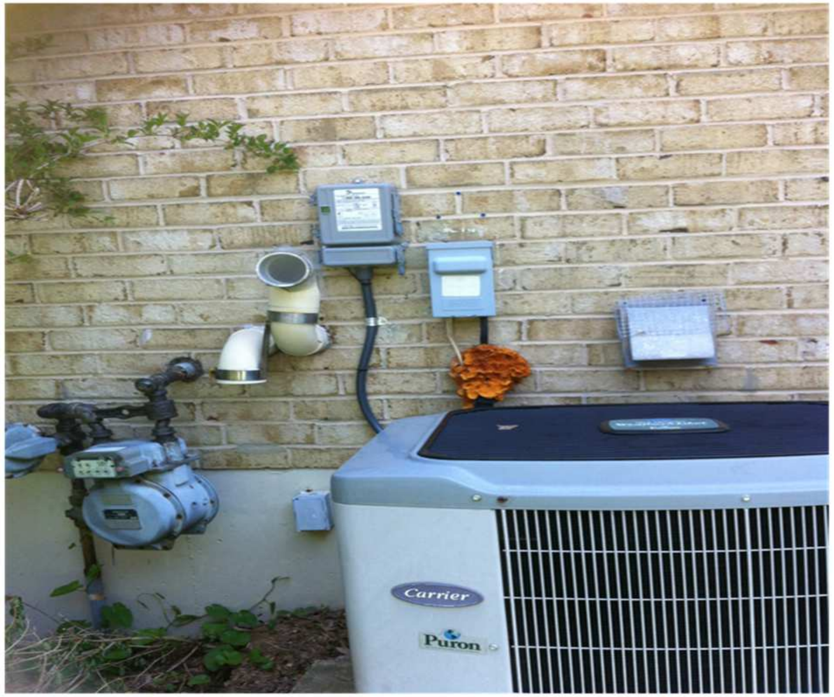
Making demand response easier, more automated and effective – today via smart switches

HVAC is cycled by the utility (not fan), managing aggregate demand

Smart Switch – precursor of a smart meter to enable remote control



Technology empowers the customer

US$ 90 - 300 Watt Grid Tie Inverter

PV as an "appliance"

- PV Panel connected to this Grid-tie inverter
- All built in protection (unintentional islanding)
- A simple 250 Watt system would cost about US$ 350 (or US$ 1.4 per Wp)
- Plug to an outlet and start saving energy
- In many cases, meter "spins backwards" – or at least PV will offset real time consumption
- How can utility know? Or prevent it?
- Technology will push regulations
- A poster child example of end-user empowerment
- Challenging the last bastion of utility monopoly – distribution
- The utility would'd better engage

Is the customer fully empowered today to be a "Do-it-yourself" Independent Power Producer?

"Do it yourself scheme"

But diseconomies of scale and cost barriers – not technology

- Micro versus one inverter, multiple roofs
- Lumpiness in a few cases
- Transportation costs (from CA)
- Lack of local expertise to meet electric codes for connection to grid
- Structural design on a case by case basis
- Fixed costs not amortized over multiple installations
- Complexity of licensing, varying by jurisdiction
- In spite of all this, US$2.4/Wp
- Utility offers net-metering – and more recently, a 5-year, long term PPA @ US 15 cents, for entire production
- Payback = 6 years

Renewables will help push the energy efficiency agenda

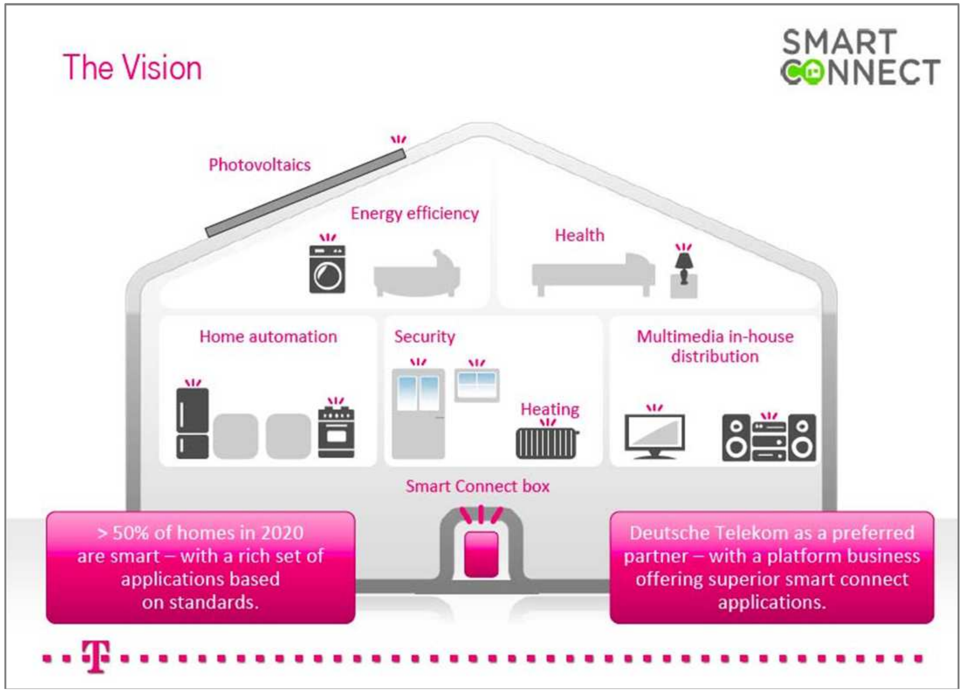
How it should work – and how it works

- It should be the other way around – EE opportunities are NPV positive, in the McKinsey curve, therefore should be captured first
- But transaction costs and behavioral aspects not included in this analysis
- "Consumer psyche" - people do no see energy efficiency, their neighbors do not see it, no easy way to measure - so, why bother?
- Information awareness from renewable data will create appetite for more energy surplus – EE comes next in end-user radar screen

Net-Meter – the "cash register"

Moving beyond the meter is an opportunity (or risk) for utilities (*)

- Smart meters offer the opportunity of upselling customers to HANs & HEMS (Home Energy Management Systems) to residential customers and SMEs
- However, this is an unfamiliar business model for utilities
  - It requires up-front financing of h/w - similar to cell phones and broadband routers
  - It requires flexible billing of value added services
  - It requires customers support
- Incidentally, telcos are experienced in h/w + services business models. They are also running out of growth in their core markets.
- If utilities hesitate, they will be relegated to being the dumb electron pipe by other service providers. E.g. initiative by Deutsche Telekom AG:



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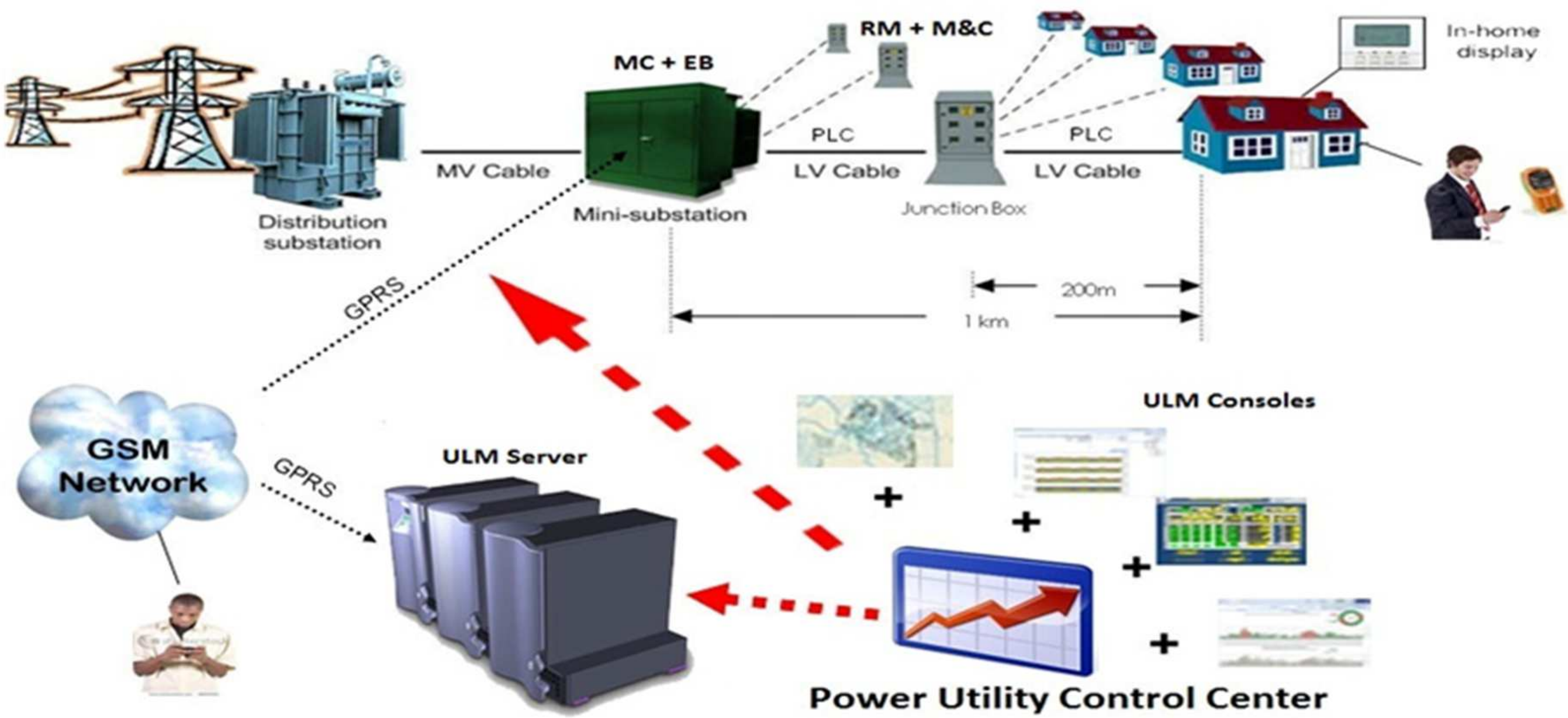
The private sector is willing to engage, being an aggregator to provide demand response – real case solution proposed in a developing country to entertain demand response



To be really transformative, technology can not operate in a vacuum

- Four basic pillars for market transformation
  - Technology
  - Economics
  - Regulation
  - Behavior
- The power of technology is pervasive, positively influencing all dimensions – e.g. continuous reduction in PV panels and electronics, empowering the customer, pushing regulations to move faster
- A market transformation is more effective if all those elements are dealt with, synergistically
- For example, if Brazil wants to develop EE and PV technologies, issues to be addressed include
  - Compensation for utilities engaging in EE – e.g. decoupling, shared incentives
  - Why is PV so expensive? R$15/Wp residential, while Do-it-yourself results in US2.4/Wp
  - Can "Cost Brazil" explain? If so, why is wind generation from reverse auctions one of the cheapest in the world? Or is Brazil lagging behind in technology?
  - Certainly, the economics, regulatory and behavioral aspects need further thinking

Technology development also requires a sound policy

U.S. Department of Energy

Advanced Research Projects Agency-Energy *Energy Efficiency and Renewable Energy*

$1/W Photovoltaic Systems

White Paper to Explore

A Grand Challenge for Electricity from Solar

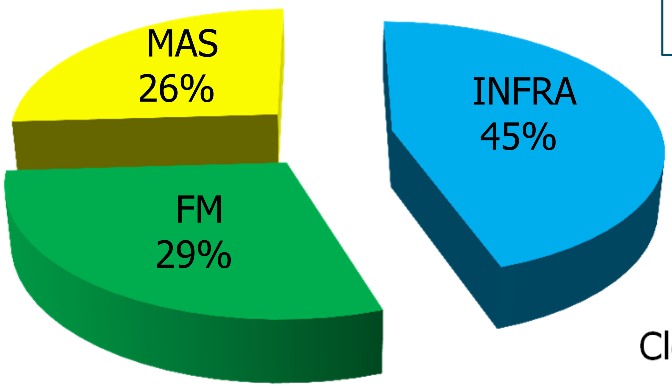
DISCLAIMER: The purpose of this paper is to facilitate discussion among participants in the "$1/W Systems: A Grand Challenge for Electricity from Solar" Workshop, to be held on August 10-11, 2010 in Washington, DC. This paper does not represent, reflect, or endorse an existing, planned, or proposed policy of the U.S. Government, including but not limited to the U.S. Department of Energy. The U.S. Department of Energy does not guarantee the accuracy, relevance, timeliness, or completeness of information herein, and does not endorse any sources used to obtain this information. As such, this paper is not subject to the Information Quality Act and implementing regulations and guidelines.

IFC: Our Reputation and Value

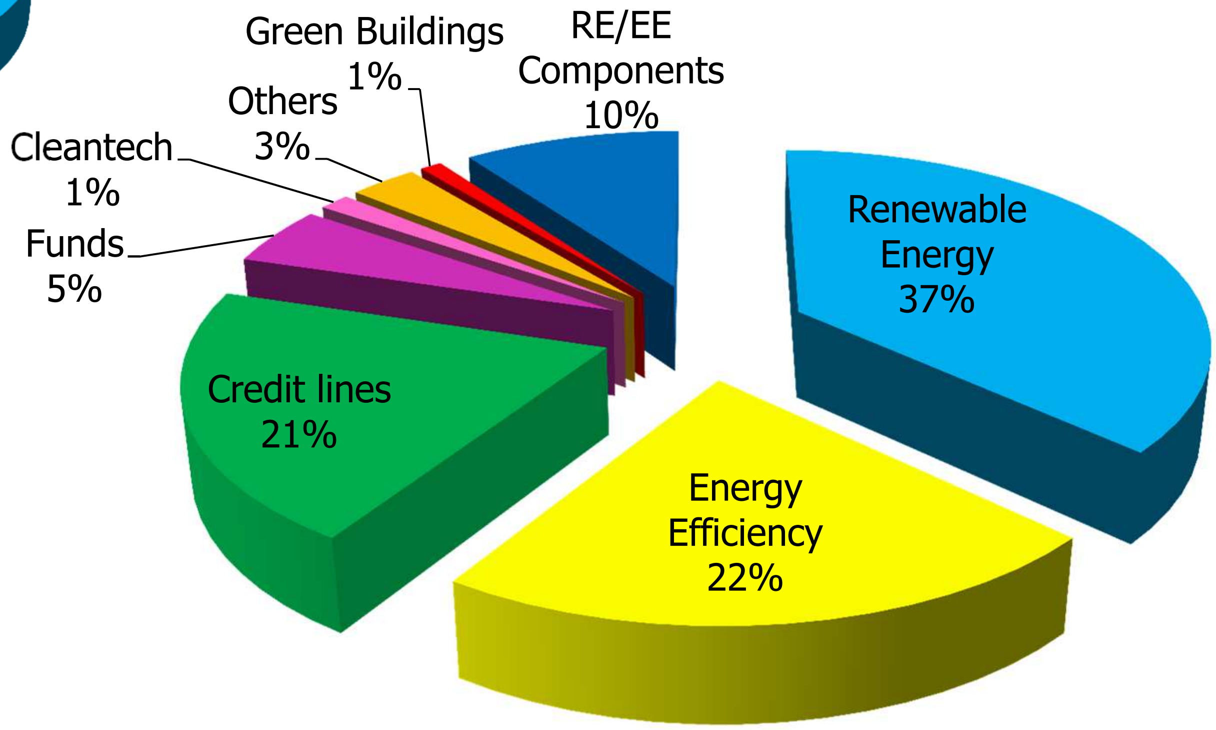
- IFC is the world's largest multilateral private sector investor in the emerging markets. -- AAA rating
- Total Committed Investments: US$85 Billion
- Past year commitments of US$20.4 Billion, including US$4.9 B syndication and US$231.2 million of advisory project expenditures
- 3,600 employees in over 80 countries worldwide (55% in the field)
- In-house syndications department working with over 200 banks
- Strong advocate and brand on environmental and social issues
- In the last two years – commitment to have a transformational impact on climate change – 20% of IFC commitments by 2015
- A greater supporter of technology – recently new products created to support nascent companies in the climate space – private equity

IFC has invested US$6.5 billion in climate business in 2005-11 (Over US$2 billion in FY2012)

By industry



By sector

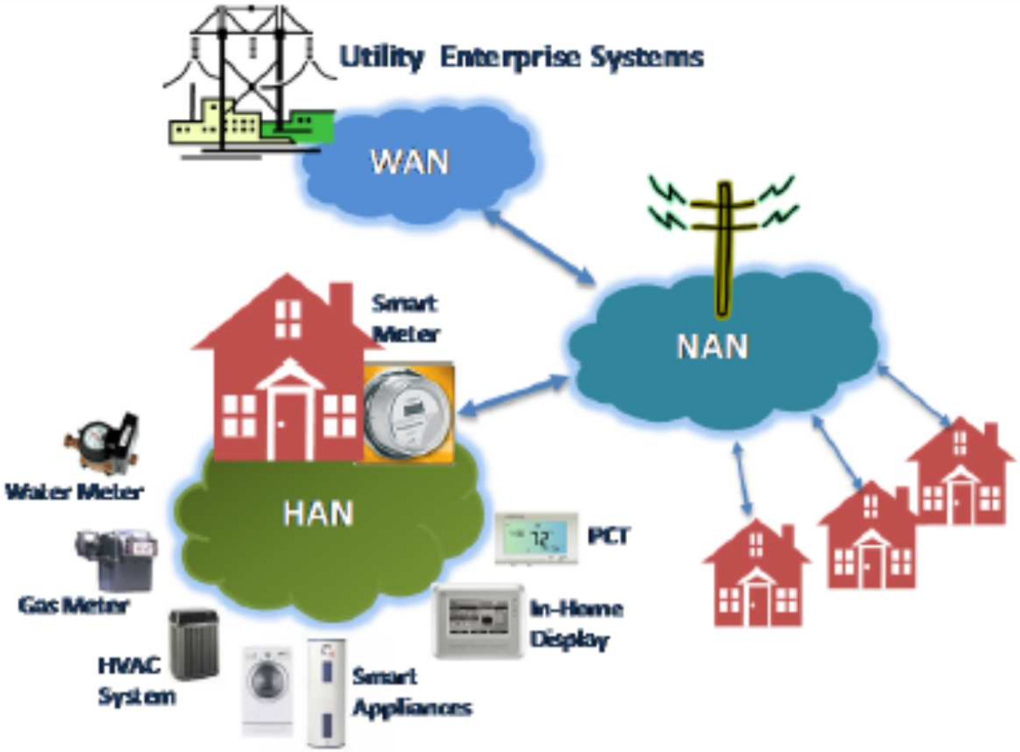


MAS – Manufacturing
INFRA – Infrastructure
FM- Financial Market

In a nutshell

- Utility Driven Energy Efficiency has a major role to play in helping reduce GHG emissions to tolerable levels
- Existing technologies can play a major role – for example, smart grids, but with a holistic view – as opposed to distribution automation only
- Technology is moving very fast in many areas – e.g. IoT, communications, PV, EE
- And it has a potential to drive costs down, change behavior, and even force regulators and utilities to move faster
- However, full market transformation happens with a proper combination of regulations, economics, technology and behavior
- Clearly articulated in a government policy directive

Typical Smart Meter Network Architecture



(Source: Pike Research)