Global Trends in the Political Economy of Smart Grids

23rth of September 2016
Responding to Crises – UN Wider

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Some terminology:
What are smart grids?

"Electricity networks that enable **two-way communication and power exchange between** consumers and producers utilizing **IT** to **respond and manage demand**, and ensure safe and secure electricity distribution"

(DOE, 2006; Hall & Foxon, 2014).

From policy perspective:

- A necessity to integrate a significant share of renewable sources
- Efficient use of network/supply resources (affordability)
- Reliability

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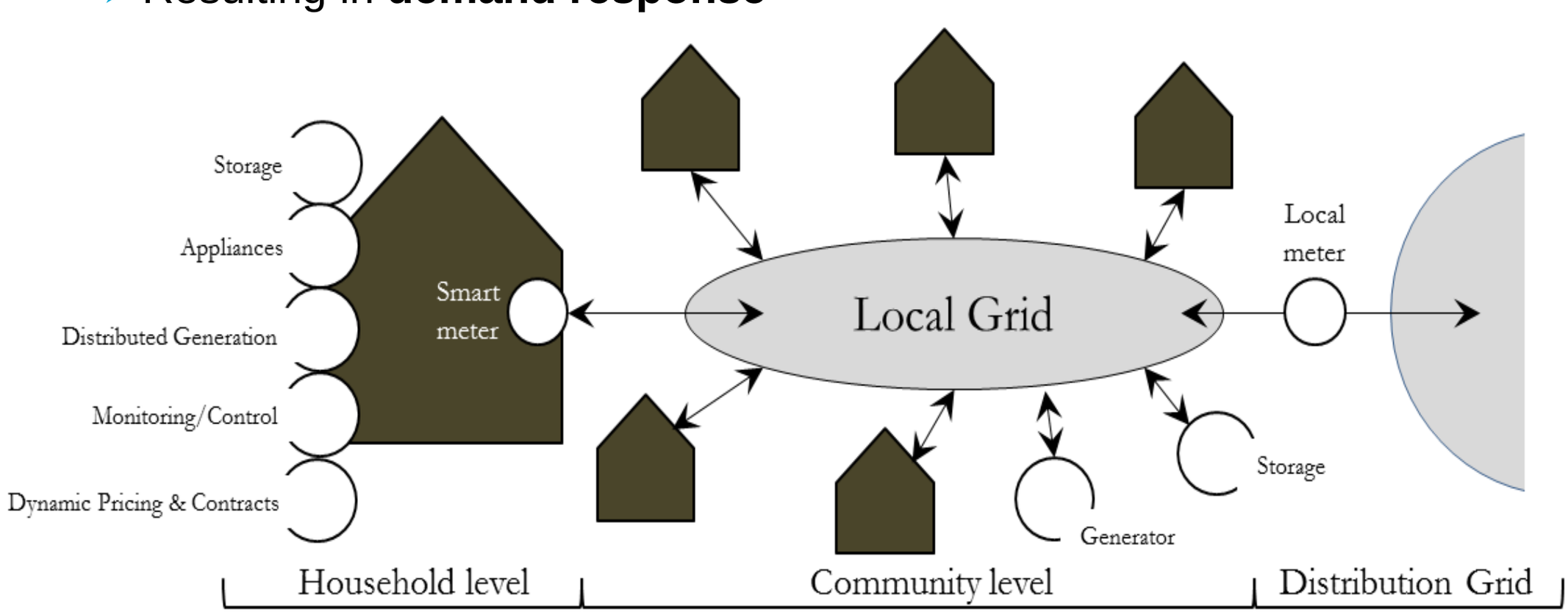
Some terminology:
Important elements of Smart Grids

- Smart Meters
- Distributed Energy resources: Electric Vehicles, Solar Panels, Storage, consumer appliances, monitoring and control.
- Real-time management of devices:
  - Resulting in **demand response**



Geelen et al. (2013)

Some terminology:
Demand Response

- Demand response by ACER(2012):

“Changes in electric usage by end-use consumers from their normal load patterns in response to changes in electricity prices and/or incentive payments designed to adjust electricity usage, or in response to the acceptance of the consumer’s bid, including through aggregation.”

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Smart Grid!

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Presentation Structure

1. Smart Grid History

2. Factors influencing Smart Grids in US, EU, China
   - Industry Structure
   - Regulation
   - Energy policy

3. Smart Grids in the developing world

4. Recommendations

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Smart Grid History

- Functionality of Smart Grid already described in 1981:
  - Homeostatic control: The utility/customer marketplace for electric power (Schweppe et al., 1981)

- **USA**: Toward a smart grid: power delivery for the 21st century (Amin, 2005) in IEEE, Electricity grid compared to F15 Aircraft.
  - Energy Independence and Security Act of 2007: Smart Grid a main pillar for reformation

- **EU**: Report 2006 European smart Grid technology Platform
  - The Energy Efficiency directive 2012: 80% smart meter installation in 2020.

- **China** in 12th Five-Year Plan for National Economic and Social Development: Objective of accelerating smart grid developments (2011)

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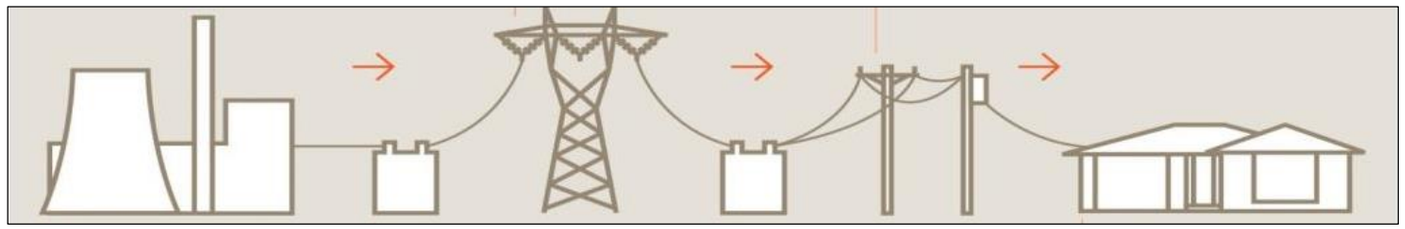
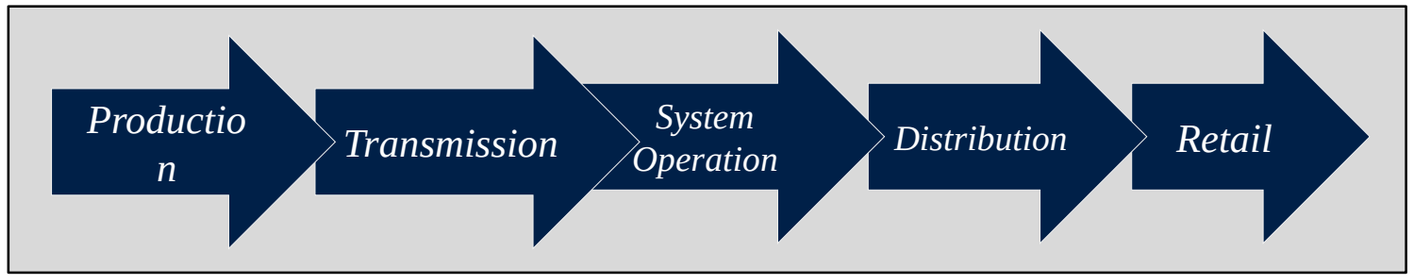
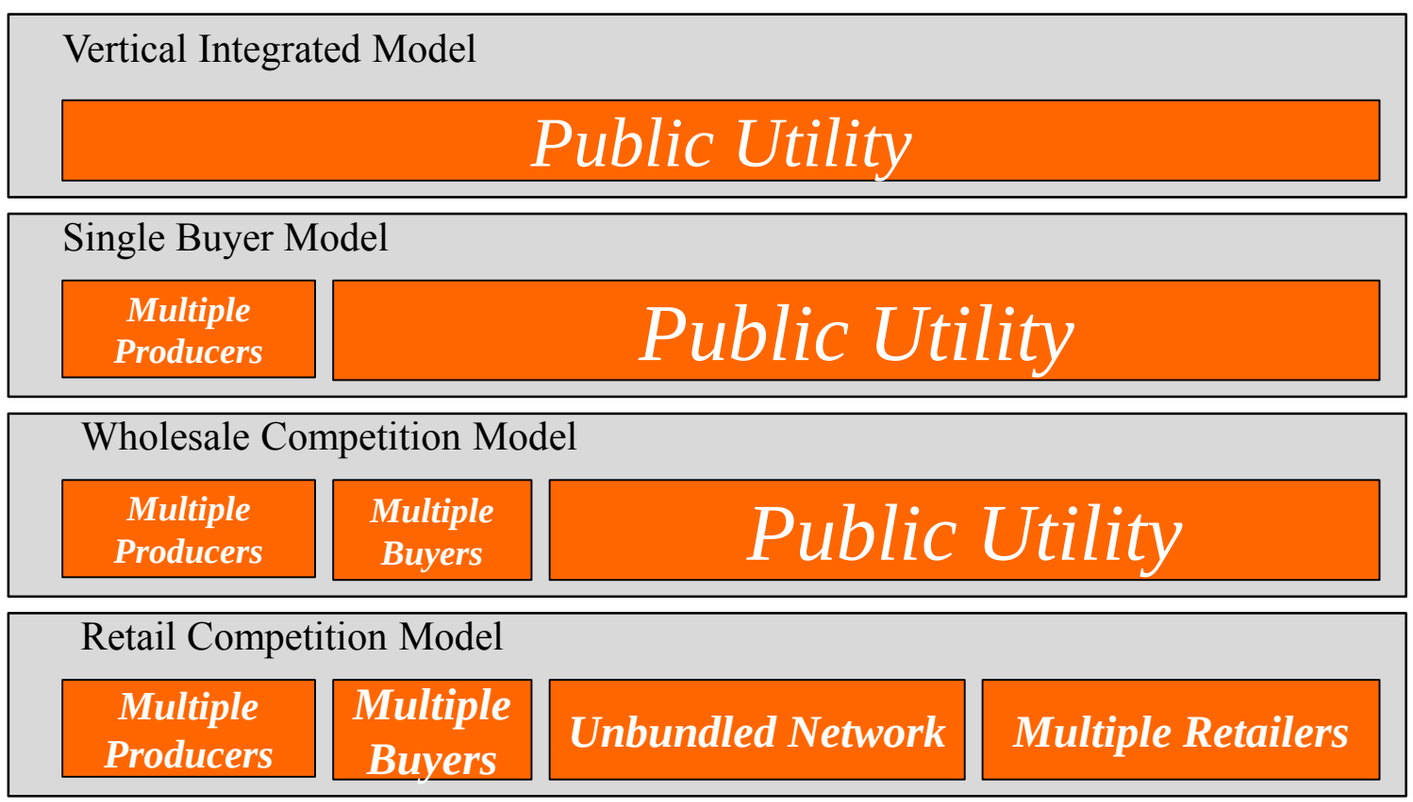
Electricity supply chain and industry structure







China

United States

Europe

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Actors perspectives on Smart Grid development

- **Integrated Utility**
  - Most present in US and China
  - Demand response for supply/network needs
- **Distribution Service Operator (DSO)**
  - In retail competition model can be legally/administrative or ownership unbundled
  - Reduction of network investments
  - Reduction of metering costs
- **Electricity retailers**
  - Use SG for risk reduction in energy markets
- **Aggregators**
  - Trading of demand response in balancing, frequency regulation, intraday market.
- **Consumers**
  - Increased engagement with electricity supply
  - Price transparency
  - Reduced electricity costs

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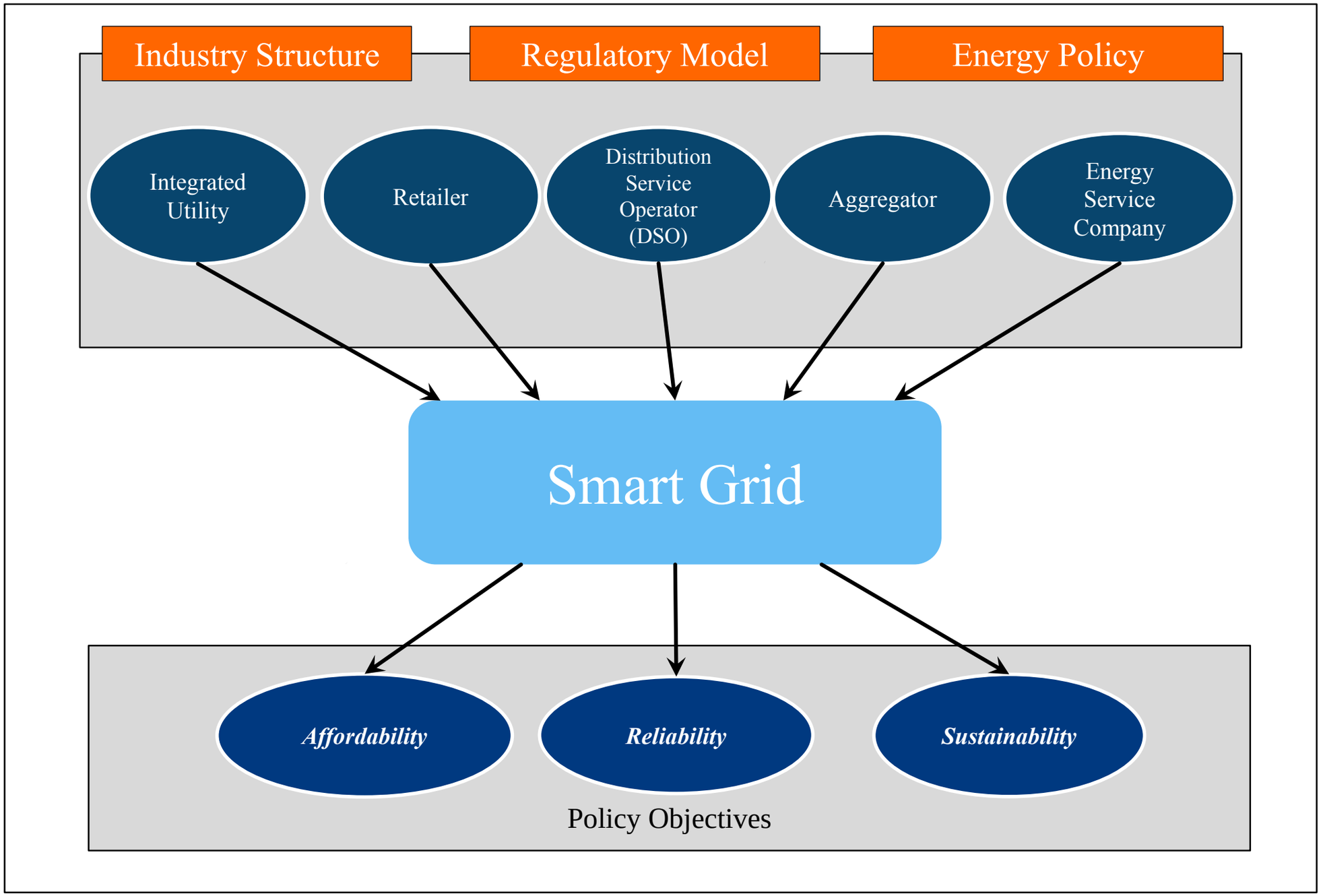
Political-Economy Factors influencing SG developments



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Drivers and regulatory models

- USA
  - Reason: Grid reliability problems between 1984-2006 in north
  - Regulatory model: cost of service/rate of return
  - American Recovery and Reinvestment Act of 2009 (ARRA), US$4.5 billion available for SG investments (but mostly metering infrastructure)
  - Problem: deal with penetration of distributed energy resources?
- EU
  - Reason: improved sustainability and affordability aims (European Commission, 2006)
  - Regulatory model: Incentive based regulation
  - Questions remaining regarding the role of the DSO in retail competition model
- China
  - Large demand growth and pollution issues
  - Regulatory model: Rate of return
  - Large EV car fleets Shenzhen, UHV transmission grids to support international position of UHV technologies
  - No smart metering developments

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Overview

	The United States	Europe	China
Industry structure	Mostly vertically integrated	Retail competition	Vertically Integrated
Regulatory model	Cost of service / Rate of return regulation	Incentive regulation for DSO	Rate of Return regulation
Energy Policy	Bottom-Up	Hybrid	Top-Down
Initial Smart Grid interests	Reliability & recovery of investments for utilities	Affordability and sustainability	Supply surge of electricity demand in reliable and sustainable manner
SG development	Smart metering applied in many places, but no greater smart grid vision. End-user left passive in many cases.	Smart metering roll out only fully done in Sweden and Italy. Remaining problems are the role of the DSO in the retail competition model.	Projects like micro grids and EV pilot projects are deployed at larger scale, where direct control is applied by state grid company. Smart metering and end-user engagement is not main focus.

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Smart Grids in the developing world: India

- 10,000 villages still un-electrified
  - Micro-grids present but not with clean technologies

- **National Smart Grid Mission (2013 approved):**
  - Experimentation phase: 10 smart grid pilot projects of the national grid.

- Organizations involved with smart grids/microgrids
    - NGOs involvement with micro grid/smart grid developments
    - For-Profit companies local solutions like Solar Panel applications with subscriptions. Example: Rural Spark.

- Problem: need for sustainable long-term business models. Also required viable in interconnected mode to central grid.

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Conclusions & Recommendations

- Smart Grid development is depending on industry structure, regulatory model and energy policy at stake

- Smart Meter investments should be incentivized, otherwise will not be invested in by regulated utilities

- Strict CAPEX cost of service regulation merely supports smart meter investments, but leaves out incentives for demand response
  - ➢ Provide not only incentives for CAPEX, but also for OPEX expenses

- Utilities which are regulated with incentive regulation
  - Leave smart grid investments outside of the regulatory benchmark
  - Not only for CAPEX, but also for OPEX

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Conclusions & Recommendations

- New measures needed for regulatory supervision of utilities procuring flexibility with Smart Grids
  - If price for demand response is not competitively set, extra regulation/transparency rules required
  - Otherwise excessive benefits from demand response

- In developing, rural areas, SGs provide benefits due to:
  - Absence of stranded cost
    - However, need long-term focus for business models that lasts
    - Need to remain viable when interconnected to central grid

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Thank you for your attention!

Questions/Remarks:

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Latest developments

- USA:
  - Smart Grid: new terminology “Grid Edge”
  - New York drive for integration of distributed energy resources
    - Reforming the Energy Vision (REV) proceedings (2015): innovative regulatory vision towards local markets for integration distributed energy resources
- PJM and California:
  - Demand response programs for large participation of aggregated demand response. (Demand Response Auction Mechanism (DRAM) in California)

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