Literature study on smart grids

1 Projects in the US and the rest of the world

http://www.oe.energy.gov/smartgrid.htm
http://www.gridwise.org/
http://intelligrid.epri.com/
http://www.nist.gov/smartgrid/

Almost all scientific publications on Smart Grids appear in IEEE journals

1.1 IEEE top 11 cited publications on Smart Grids

Grid of the future
Journal Paper, Article # 4787536, Power and Energy, 2009
This [Smart grid] transformation will be necessary to meet environmental targets, to accommodate a greater emphasis on demand response (DR), and to support plug-in hybrid electric vehicles (PHEVs) as well as distributed generation and storage capabilities. On one hand, the transition to a smart grid has to be evolutionary to keep the lights on; on the other hand, the issues surrounding the smart grid are significant enough to demand major changes in power systems operating philosophy.

Power electronics and its applications to renewable energy in Japan
Journal Paper, Article # 4609963, Circuits and Systems, 2008
Regarding practical use of renewal energy in Japan, a new set of requirements advents. The first is the development of a set of policies for promoting power generated from renewable energy.

Impact of Smart Grid on distribution system design
Conference Paper, Article # 4596843, Power and Energy, 2008
Functionally, a smart grid should be able to provide new abilities such as self-healing, high reliability, energy management, and real-time pricing. From a design perspective, smart grids will likely incorporate new technologies such as advanced metering, automation, communication, distributed generation, and distributed storage.

The evolution of distribution
Journal Paper, Article # 4787537, Power and Energy, 2009
In this paper discussed the advanced distribution management system for smart grid. The smart-grid initiative uses these building blocks to work toward a more integrated and long-term infrastructure.

Smart grid millionaire
Journal Paper, Article # 4412936, Power and Energy, 2008
Technology overview.

Toward a smart grid: power delivery for the 21st century
Journal Paper, Article # 1507024, Power and Energy, 2005
In this article, we present the security, agility, and robustness/survivability of a large-scale power delivery infrastructure that faces new threats and unanticipated conditions.

Smart Integration

Journal Paper, Article # 4626381, Power and Energy, 2008

- Smart grid, which generally includes improvements upward of the meters all the way to the transmission network and beyond
- Smart metering, sometimes called advanced metering infrastructure (AMI), which usually includes control and monitoring of devices and appliances inside customer premises
- Smart pricing including real-time pricing (RTP) or, more broadly, time-variable pricing, sometimes including differentiated pricing
- Smart devices and in-home energy management systems such as programmable controllable thermostats (PCTs) capable of making intelligent decisions based on smart prices
- Peak load curtailment, demand-side management (DSM), and demand response (DR)
- Distributed generation, which allows customers to be net buyers or sellers of electricity at different times and with different tariffs, for example, plug-in hybrid electric vehicles (PHEVs), which can be charged under differentiated prices during off-peak hours. The main drivers of change include:
    - Insufficient central generation capacity planned to meet the growing demand coupled with the increasing costs of traditional supply-side options
    - Rising price of primary fuels including oil, natural gas, and coal
    - Increased concerns about global climate change associated with conventional means of power generation
    - Demand for higher power quality in the digital age.

Getting Smart

Journal Paper, Article # 4457958, Power and Energy, 2008

The smart grid entails a transformation to an information-enabled and a highly interconnected network between electricity consumers and electric suppliers embracing transmission, distribution, and generation.

A framework for operation and control of smart grids with distributed generation, Conference Paper, Article # 4596344, Power and Energy, 2008

The current status of distributed generation technologies and Flexible AC Transmissions (FACTS) Technologies is reviewed. Then this paper discusses a framework for operation and control of smart grids with distributed generation and FACTS in which two controls such as voltage control and stability control are included.

From smart grids to an energy-internet: Assumptions, architectures and requirements, Conference Paper, Article # 4523385, 2008

An implementation of smart grids is an energy Internet where energy flows from suppliers to customers like data packets do in the Internet. Apparent benefits from an energy Internet are its openness, robustness and reliability. This paper uses electricity as an example to present some key assumptions and requirements for building the energy Internet. An example is presented.

2 Topics of interest (for a non-Technical University)

Based on a quick scan of number of articles and number of citations

- Electricity Without Price Control - Architecture Framework (EWPC – AF)
- Information and Decision systems for Smart Grid management
- Scalability (from different angles: Technology, Organization and Engagement, Policies, Legislation, Manageability, Security and Privacy)
    - Plug-in Hybrid Electric Vehicles (PHEVs)
    - Demand Side Management (DSM) and Demand Response (DR)
    - Integrate Distributed Generation and Storage
    - Advanced Metering Infrastructure (AMI) – Smart Metering

Note that academia do not seam to be (heavily) involved in standardization. Main participants in the standardization discussions are big industrial partners and government bodies.

3 References

Mason Willrich, MIT, Industrial Performance Center, "Electricity Transmission Policy for America: Enabling a Smart Grid, End-to-End", 2009

The Smart Grid Interoperability Panel – Cyber Security Working Group, NIST, "Smart Grid Cyber Security Strategy and Requirements (Draft)", 2010

John Scott et al., KEMA, Economic Affairs, "Reflections on Smart Grids for the Future", 2008

Michael Chertkov, arXiv:0904.0477v3, "Message Passing for Optimization and Control of Power Grid: Model of Distribution System with Redundancy", 2009

Michael Chertkov, research grand proposal, "Optimization and Control Theory for Smart Grids", 2010

4 Acronyms

T&D = Transport and Delivery