NGI101x - 4.1 - Introduction: Smart Grid as socio-technical system

Hello, my name is Zofia Lukszo; I have been working at the Delft University of Technology in the area of smart grids.

In this web lecture I will talk about these smart grids.

What are smart grids actually?

What are the characteristics?

What are the challenges?

What is its socio-technical complexity.

Smart Grids will play an important role in future energy systems.

Many government institutions around the world have been encouraging the use of smart grids for their potential to control and deal with global warming and energy independence scenarios. Renewables, requiring smart grids, are envisaged to become the prevailing energy source to contribute achieving energy policy goals as:

- Sustainable Development including decarbonization
- Security of Supply including Import independency and fuel diversity
- And Affordability.

Moreover, in the old conventional situation the power generation was scheduled to follow demand, and in the new situation the demand should be scheduled to follow generation which has variable and uncertain character.

Smart Grid is an intended option world wide to give an answer to the expected electricity consumption growth.

Smart Grid is a hot topic for scientists, business, government and media…It is a much discussed subject since smart grids are viewed as enablers of integrating in a sustainable and efficient way many unconventional distributed energy resources.

The questions remains: How to design, manage and operate qualitatively new complex socio-technical system of smart grids?

In a majority of countries demonstration pilot smart grids projects are being deployed to formulate lessons learnt and to perform cost-benefit analysis.

Yes, smart grid is a hot topic.

If you look with Google image search at “Smart Grids” in a few milliseconds you will get millions of different images.

What is actually meant by a smart grid?

It is a term without a unique single meaning

- "A smart grid is neither a clearly defined single concept nor a single technology.

Rather it is like a basket containing various combinations of balls, depending upon the user."

EC defined a smart grid as an electricity network that can cost efficiently integrate the behavior and actions of all users connected to it – generators, consumers and those that do both – in order to ensure economically efficient, sustainable power system with low losses and high levels of quality and security of supply and safety.

In other words: smart grid is an electricity network based on digital technology that is used to supply electricity to consumers via two-way digital communication. This system allows for monitoring, analysis, control and communication within the supply chain to help improve efficiency, reduce energy consumption and cost, and maximize the transparency and reliability of the energy supply chain.

The smart grid aims at integrating the behaviour and actions of all users connected to it.

Smart grid actors are categorised as follows:

1) Network operators: transmission and distribution system/network operators (DSOs/DNOs).

2) Grid users: generators, consumers (including mobile consumers), storage owners.

3) and other actors: suppliers, metering operators, ESCOs (Energy Service Companies), aggregators, applications and services providers, power exchange platform operators.

Again, you can see that a power sector, including smart grids, is not only represented by technical components including production, transport, distribution and consumption, but also the market level and different actors owning and using technology as well as defining regulatory context.

To sum up, Smart Grids are seen as an important and effective way to transform the traditional energy grids for the purpose of the future energy systems with a large number of small scale decentralized producers.

Smart grids – with decentralized storage and supply- will also be the most likely paradigm for future energy sytems. It will have a Significant penetration of IT.

The use of ICT hardware/software and communication-infrastructure will allow for (near) real-time monitoring and steering opportunities of network components such that the

transportation and distribution capacity of the grid can be increased in a more flexible manner and against lower costs, compared to investments in more distribution and transmission capacity only.

Smart grids will also require an additional IT layer for demand side management, balancing and billing.

A modern smart grid system has the following capabilities:

- It can repair itself.
- It encourages consumer participation in grid operations.
- It ensures a consistent and premium-quality power supply that resists power leakages.
- It allows the electricity markets to grow and make business.
- It can be operated more efficiently and secure.

The key challenges for smart grids are:

- Integration of intermittent generation
- Decentralized architecture to enable small-scale distributed power generation
- Enhanced intelligence of supply, demand, storage and the transmission and distribution networks
- Information and Communication infrastructure for many new parties to operate and trade on the market
- Implementation of Smart Metering Systems
- Active demand side
- Preparing for electric mobility

Thank you for your attention.

In the next weblecture we will talk more about demand side management