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A New Energetic Scenario with Renewable Energy

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1. Introduction

The new energetic scenario with renewable energy faces up the challenge of how to achieve a better integration of flexible demand (demand response and demand side management) with distributed generation, energy storages and smart grids, in order to reduce significantly the costs of integrating renewable sources into the networks.

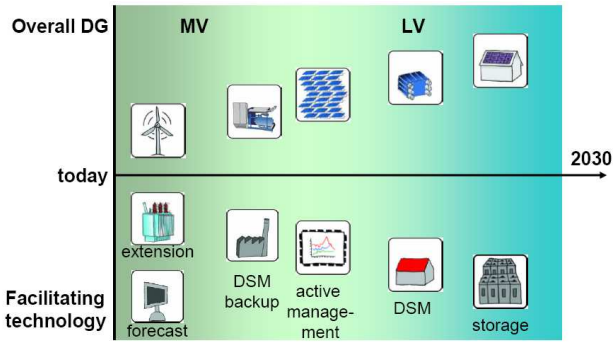

Figure 1. Timeline of DG and its technical impact

In this model, Distributed Energy Resources (DER) provide a significant proportion of power generation. Power can even flow from DER into the distribution network and from distribution to transmission networks. The intelligent FACTS at the nodes between producers and consumers would 'route' power between the nodes in the same way as e-mail is routed from node to node in the Internet.

Key words

Renewable energy, Distributed Energy Resources, Energy Storage Systems, Smart grid

2. New axes of development for the greater penetration of DER

In order to reduce the problems that began to emerge due to the massive integration of distributed generation in the electrical system, it is necessary to develop and implement the following areas of knowledge.
- Demand response (DR): To use flexibility in electricity consumption.
- Information and communication technologies (ICT).
- Add energy storages into the systems (centralised or distributed energy storages DS)
- Power Electronics controllers

A. Demand response (DR)

Demand response (DR) or Demand Side Response (DSR) is programs and activities designed to encourage consumers to change their electricity usage patterns, including timing and level of electricity demand, covering all load shape and customer objectives. DR includes time-off use and dynamic rates or pricing, reliability programs such as direct load control of devices and instantaneous interruptible load, and other market options for demand changes (like demand side bidding).

B. Information and communication technologies (ICT)

In today's electricity networks, information and communication technologies (ICT, including communication, monitoring, metering, automation and intelligence questions related to the DER integration) is, and will be to an even greater extent, a key tool for the operation of the electricity networks, for both technical and administrative purposes.

C. Energy Storages Systems

Energy storage technologies are valuable for reducing pricing volatility, protecting against power quality problems, and supporting intermittent RES on the grid. The storage systems are capable of smoothing out load fluctuations as well as to react to fast transient power quality.

D. Power Electronics controllers

Within the envisaged networks of the future, power electronic converters will be needed to perform many different conversion functions (AC-AC conversion, AC-DC conversion, unidirectional power flow, bi-directional power flow, reactive power injection, FACTS, etc) connected at various points in the network. Such converters will provide, for example: interface for connection of renewables, integration of energy storage, optimised utilisation of transmission/distribution infrastructure, enhanced network stability, power quality (active filtering), power flow control, voltage support and unbalance compensation.

3. New Energetic Scenario

The energy conversion systems using thermal processes, to convert primary energy into mechanical, electrical, electrochemical, or heat energy, etc. are very inefficient. The overall efficiency is about 20%, and in the case of transport is 10%.

The choices that lie ahead to meet the new requirements of the system is the distributed renewable alternative, which electrical energy can be obtained from inexhaustible renewable resources by "cold" systems, with efficiencies that can reach 90%. It would be required 25% of the primary energy that we are currently using for our development.

4. Smart Electrical Energy Network (SEEN)

The new model is based on the integration into electricity networks of large number of small and medium size generators based on new and renewable energy technologies. It may create a new era, where thousands or millions of users will own their generators, becoming both producers and consumers of electricity. All these generators will be interconnected through a fully interactive intelligent electricity network.

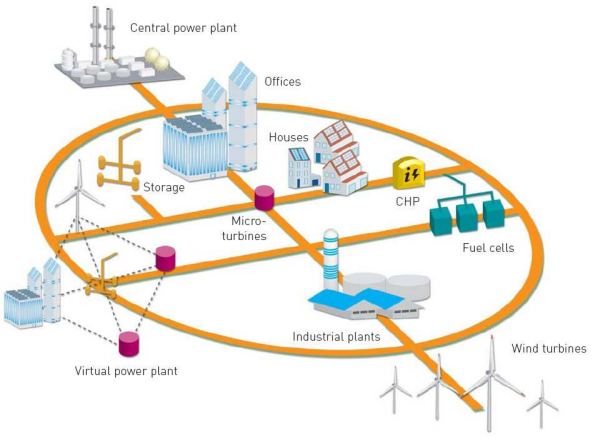

Figure 2. Future Operation of system

The flow of information around the World Wide Web uses the concept of distributed control where each node, web host computer, e-mail server or router, acts autonomously under a global protocol. In the analogous electricity system every supply point, consumer and switching facility corresponds to a node.

With increased distribution of power input nodes due to DER, bi-directional energy flow is possible and new technologies are emerging, which can enable the direct routing of electricity. New power electronics systems offer ways of controlling the routing of electricity and also provide flexible interfaces to the network. FACTS and Custom Power Devices at lower voltages offer the potential to manage routing of power supply in an active manner.

The new grids are being transformed into millions of interconnected bilateral nodes at all levels of transmission and distribution integrated grid. Bulk transmission and distributed generation will coexist on interconnected grids where the distinct difference between traditional transmission and distribution becomes increasingly blurred.

5. Conclusion

The infeasibility of the current system based on the conversion of energy by inefficient and polluting thermal methods speeds up the process of implementing an energy system based on electricity as an energy vector, from its generation from renewable energy by cold methods, through transport, storage and distribution, to its final consumption.

Plug-in Hybrid Electric Vehicles (PHEV) may constitute the engine of development of intelligent networks by allowing full bidirectional control between the automobile batteries and the grid, for load levelling or regulation and for spinning reserve (cashback hybrid, vehicle-to-grid -V2G- power).

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