Annals of the Academy of Romanian Scientists
Series on **Engineering Sciences**
ISSN 2066-8570 Volume **3**, Number **1**/**2011**

INTELLIGENT NETWORKS, SMART GRIDS CONCEPT, CRUCIAL TECHNOLOGIES FOR SUSTAINABLE DEVELOPMENT

Constantin RADU[1]

Rezumat. *În acest articol este prezentat conceptul de smart grids, tehnologie deosebit de importantă pentru o dezvoltare durabilă. In contextul globalizarii, lumea intreaga traieste intr-un mediu de securitate tot mai complex, cu schimbari rapide, unele evidente, altele mai putin evidente, cu implicatii pe termen scurt, mediu sau lung, la nivel international, national, local si pana la fiecare cetatean. Toate tarile, in cadrul unei economii mondiale globalizata se confrunta cu probleme energetice in conditiile schimbarilor climatice care s-au acutizat in secolul al XX-lea.*

Abstract. *In this article is presented the concept of smart grids, a very important technology for sustainable development. In the context of globalization of the world lives in an increasingly complex security environment, with rapid changes, some obvious, others less obvious implications in the short, medium or long term, international, national, local and up to every citizen. All countries in the globalized world economy is facing energy problems in terms of climate change have intensified in the twentieth century.*

Keywords: intelligent networks, EU Directive, smart grids, concept, technology

1. Introduction

In terms of primary energy consumption structure in the world, according to forecasts made by the International Energy Agency (IEA) in 2030, up about 29% is covered by coal, gas and oil 6%, 9% of energy produced in power plants 66% nuclear and renewable energy sources (RES) including: wind, solar, biomass, geothermal, fuel cells, hydro and cogeneration plant. In the European Union (EU) promotes the achievement of Strategic Technology Plan (PTS), an energy policy that will lead to increased energy efficiency, accelerate renewable energy production, development of Smart Grid technologies in order to achieve energy security, competitiveness and sustainable development. Considering climate change European Commission (EC) proposed:

- emissions of greenhouse gases by 20% by 2020 compared to 1990 years;
- increasing share of renewable energy from about 11% in 2010 to 20% in 2020;
- reduce global primary energy consumption by 20% in 2020-the introduction of new technologies and increase energy efficiency.

In order to achieve the EU Directive, a very important role will be implementing the intelligent networks.

[1]Engineer, Technical Director NOVA INDUSTRIAL.

2. Definitions

Since there is a single coordinator in the world, there is no single definition appropriated by professionals worldwide. Most accept that the world scientific world "Networks / Network Intelligence" comes from the English words Smart Grids / Grid. The term began to be widely used from 2003 to 2005 in the U.S. and Europe.

Whatever the definition used, an intelligent network includes an interactive system for monitoring and controlling real-time production chain - final energy consumption, using a computer network and bidirectional communications and introduces the latest technologies (superconductivity, RES integration, use automation expert systems, diagnosis and management of energy facilities, the use of intelligent electronic devices for the load curve flattening and tariff choice).

Currently, Network Intelligence is defined as a set of management control systems and electrical networks, sensors and means of communication and information, which incorporates elements of both traditional and next generation. It combines elements of software and hardware designed to dramatically improve the way it is run / operated system including the electric current at low voltage to the highest and allow real time interaction between entities interested in the final production-consumption chain.

3. Expectations of the intelligent network

In accordance with the laws and regulations issued since 2003 in the U.S. intelligence network must meet mainly the following:

- the self and to be able to prevent damage;
- to motivate consumers to participate interactively in the network (two-way communication between consumers and energy entities);
- to withstand the physical and cyber attacks;
- reduce the number of interruptions to supply electricity and observing all quality parameters imposed by standards and regulations;
- to allow their gradual integration into existing networks / classical
- to bring such advantages as the electricity market and to develop medium and long term electricity price to decline;
- to allow connection to all types of RES (including virtual manufacturing plants);
- to ensure an efficient operation by:

a) integration of next generation communications to enable real-time control network;

b) connecting the synchronicity of all types of generators using various types of sensors and synchronic phase / angle;

c) introducing performance components to reduce losses in electric networks (superconductivity introduction, the use of composite conductors, to

promote flexibility of wireless networks and the AC to DC energy storage technology development, diversification of supply solutions to electric cars);

d) control and reduced maintenance costs (in case of disruption solutions for automated, accurate and rapid diagnosis, monitoring on-line extension of the main elements of the network components);

e) measuring electricity smart meters with two-way communication possibilities;

f) better decisions (operation and management);

g) the standardization of automation, protection and communication networks, including communications protocols.

With Network Intelligence view that can be compared to an "Internet of power" may have some vulnerabilities. To ensure security and prevent information from intelligent networks has designated the Department of Commerce National Institute of Standards and Technology (NIST) to develop security guidelines for Smart Grid.

It addresses security requirements at all levels, the risk assessment, evaluating privacy issues and makes recommendations to protect the network (total system) against all threats, especially those covering the informational. The NIST design ensuring network security intelligence will certainly contribute to national security and sustainable development.

I note that in 2009 the U.S. has spent about $ 3.4 billion for Intelligent Networks.

In the EU strategy document was developed to implement intelligent networks called "European Technology Platform (ETP), which was completed in 2006. In the intelligent network concept PTE will consider solving the following objectives:

- facilitating the connection of all types regardless of their size generators (wind, solar, biomass, geothermal, micro hydro, fuel cells);
- allowing consumers of all categories play an active role in the energy system optimization local / regional / national and European;
- providing information to consumers to choose energy provider with the lowest price;
- reducing environmental impact;
- improve current levels of reliability, quality and reliability in electricity supply;
- maintaining and improving existing services (reducing maintenance costs, prevent downtime, reduce repair time, including the prevention of theft and cyber attacks);
- promoting energy penetration in all EU member states of the EU energy market taking into account competitiveness.

Intelligent Network concept is considered as an evolution of existing electric advanced networks will be modernized to meet not only current needs but future electricity using smart technology to control production-consumption chain in real time and interactive.

By implementing the concept of "Smart Grid" The EU believes that sustainable development will be achieved and will achieve climate change objectives summarized in the EU Directive.

In the EU-up effort in 2050 should be financially 1500 euro / European citizen to achieve the Intelligent Network.

In our country up there, in September 2010 at the Government developed a strategy document to deal with intelligent networks.

However Romania as EU member country must meet the objectives established by EU Directive 28/2009 which stipulates that by 2020 RES - I have a 24% share of total consumption in Romania.

The main measures for achieving the 24% are as follows:

- continuation of funding to support projects that lead to increased production of energy from RES both through structural funds and public funds;
- development of certification systems for manufacturers of small boilers and stoves, biomass, solar photovoltaic, solar thermal systems and geothermal heat pumps and shallow;
- environment fund to continue funding the program to replace or supplement conventional heating systems and electricity production projects SER (including cogeneration);
- identification of two in two years of possible congestion in transmission and distribution networks due to the emergence of such networks and financing RES;
- increasing the capacity of the distribution networks of medium and low voltage by applying the Smart Grid technologies;
- promoting the use of local renewable sources for electricity and heat to final consumers by providing incentives.

According to the "Energy Strategy of Romania for the period 2007-2020" the most important objectives to be achieved are:

- security of energy supply;
- sustainable development;
- competitiveness.

Total estimated value of the investments necessary to achieve the objectives of the Strategy 2007-2020 is about EUR 35 billion.

4. Example of conceptual model / framework for smart grid

Next it will present the conceptual model / framework developed by NIST to promote the Smart Grid (figure 1).

Fig. 1. Conceptual Model SMART GRID.

Looking at figure 1 you can see that shows the flow of energy and communications linking each of the seven domains and how the interrelationships between them. In each area will detail the elements of various entities connected by communication networks that allow two-way communication in real time.

In figure 2 highlight electricity producers and their interdependence with other fields.

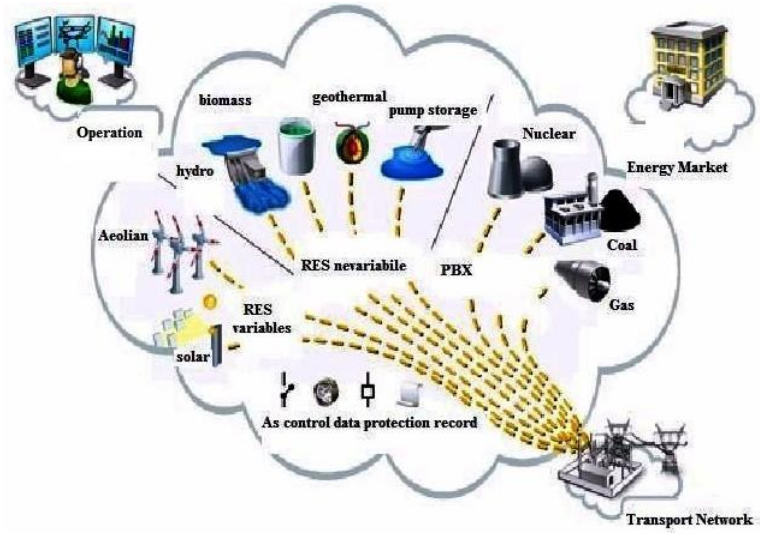

Fig. 2. Energy Producers.

Figure 3 shows the transport network with interdependent areas: dispatch centers, power producers, energy distributors, energy market and infrastructure elements of high and medium voltage networks (power stations equipped with automation and

online monitoring, control equipment, measurement, static and dynamic stability of the system, intelligent electronic devices, sensors and communication networks with specific protocols and can open real-time bidirectional communication).

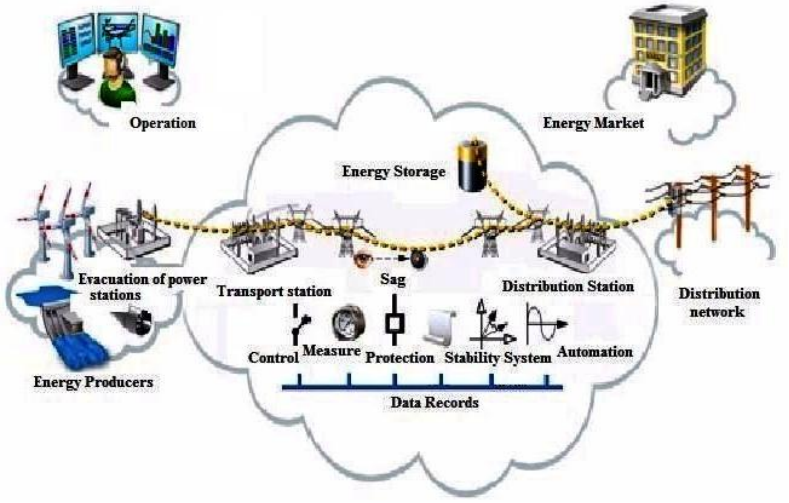

Fig. 3. Transport Network.

In figure 4 is presented the distribution that includes devices and smart meters through which it manages and controls the flow of energy using two-way communication (wireless or the actual power lines or fiber optic networks). SER distribution networks allow distributed connection locally.

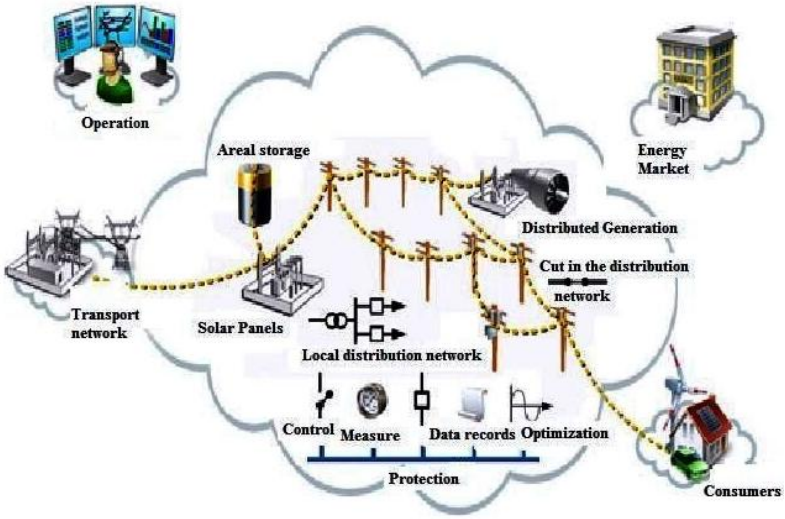

Fig. 4. Distribution Network.

In figure 5 are presented consumers and interdependence with other fields, highlighting the existence of bidirectional communication between the customer and the electricity entity and the active role of consumers in the flattening of consumption.

As a feature of the Intelligent Network is the fact that some consumers may become suppliers of electricity in the system (buildings equipped with solar cells).

Fig. 5. Types of consumers.

Figure 6 details the center network management and interaction with other areas were seen in the bidirectional nature of communication through which it manages and controls the flow of electricity for intelligent electronic devices: monitoring, control, reporting and supervision in order to take more correct operational decisions at all levels and types of electrical networks processed in Intelligent Networks.

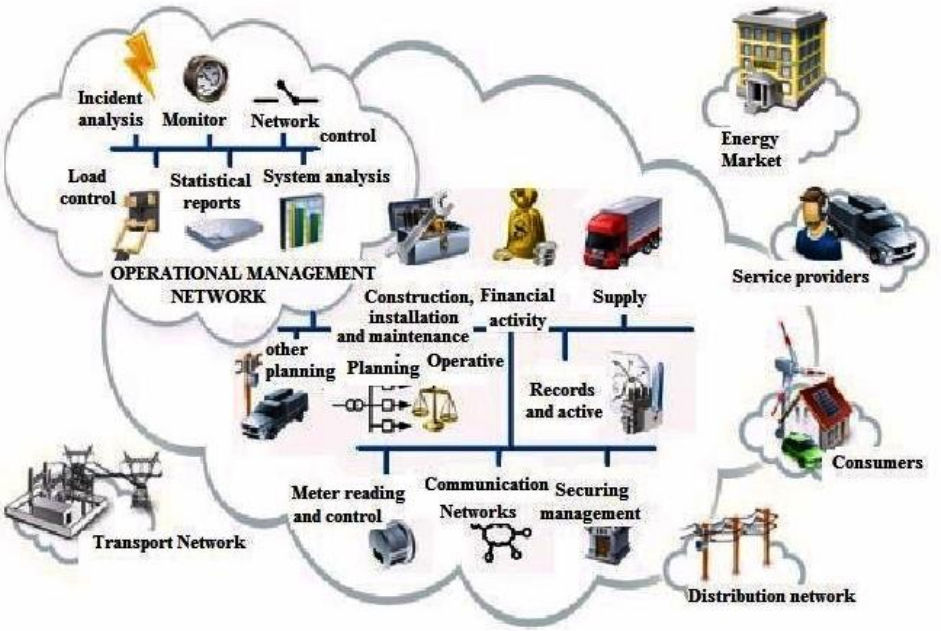

Fig. 6. Centre Dispatcher.

Figure 7 details the power market is presenting the interrelationships with other areas in open and competitive market conditions not only for energy but also for services. Note the bidirectional communication between the players in the energy market and services and other entities.

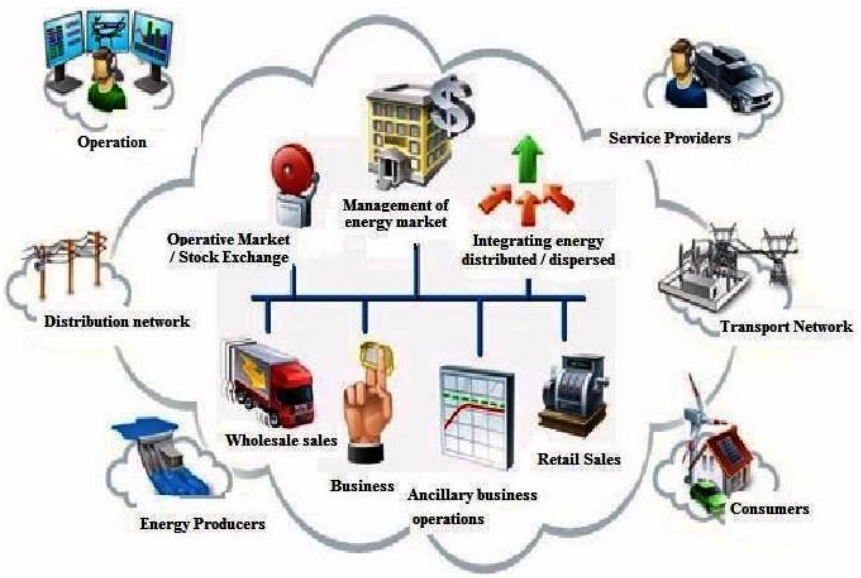

Fig. 7. Energy Market.

In Figure 8 are presented service providers: energy management, construction, installation, maintenance, intervention in case of power outages, scheduling and energy demands of the valuation system.

Fig. 8. Service Providers.

Network Intelligence interoperable and interactive character will allow electricity companies to supply electricity to the system as economically and efficiently and will enable all categories of consumers to purchase electricity at lower prices in 2010 compared to the medium and long term.

Achieving this type of network will help reduce greenhouse gas emissions and sustainable development provided the primary energy reserves of fossil fuels are declining.

5. Recommendations on intelligent networks for Romania

Although we are placing economic crisis, given the advantages of implementing a smart grid, would be made following:

- develop a Government Decision to establish the strategy of intelligent networks given the great number of entities that must work together;
- promoting the Directive 2005/89/EC on RES priority by having the facilities to investors in this area so that the SER to represent 38% of domestic consumption in 2020;
- funding research and development of smart technologies in electricity grids, telecommunications networks and information technology;
- awareness of domestic and industrial consumers to actively intervene in flattening the load curve;
- assimilation and application priority and IEC Standards Network sites that deal with intelligence;
- simultaneously with the modernization of power plants chain: production, transport, distribution and end user to introduce intelligent devices, sensors, automation, on-line monitoring and intelligent application that allows real-time communication between units and all types of electrical networks consumers;
- creating conditions for connection to electric power production of local or regional distributed;
- develop technologies that improve energy efficiency financing by attracting European structural funds, through restructuring and privatization, the Romanian legislation following Directive 2006/32/EC;
- installation of smart meters in households and household appliances in smart devices providing bidirectional communication between consumer and supplier of electricity;
- facilitating access to energy market in Romania and the EU through mutual recognition of the participants in the electricity market;
- stimulate the manufacture of smart devices, software, hardware and open and secure communication protocols for Intelligent Network;
- Recovery of installed optical fiber networks up to the present as one of the ways of communication that will be used to achieve intelligent networks.

6. Embodiment in Romania on the concept of smart grid

By analyzing the U.S. and European Network model, on achieving Intelligent Networks is found that an important implementation of Smart Grid infrastructure as part of electrical installations, the power station. To contribute to this concept in Romania NOVA INDUSTRIAL has developed a comprehensive system for online monitoring an electric voltage and regardless of its complexity. In this pilot project are monitored all primary equipment: switches, disconnectors, measuring transformers and surge arresters. Further details on pilot plants to achieve this will be the subject of another Report.

For a successful transition to the implementation of specific technologies, intelligent networks today and in future all stakeholders must get involved: governments, regulators, universities, manufacturing entities in the chain-end consumer, electrical equipment manufacturers, intelligent electronic device manufacturers, technology providers and computer telecommunications. Local coordination, for regional, national and European level is essential for realizing objectives stipulated in the European Technology Platform for Intelligent Network implementation.

By implementing successful Smart Grid concept, this will provide electricity not only cheaper, but also cleaner, and sustainable development.

R E F E R E N C E S

[1] Romania's Energy Strategy for 2007-2020;

[2] National Institute of Standards and Technology for the U.S. - Conceptual Model of Smart Grid;

[3] National Electric Manufacturers Association-USA-standardization of classification levels of intelligence and performance in the electricity supply chain;

[4] International Electrotechnical Committee - Standards for Smart Grid graph;

[5] European Commission - European Technology Platform for Smart Grid;

[6] U.S. Department of Energy-Smart Grid Research and Development, 2010-2014.