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Smart Grid Applications in Iran

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Abstract

During the last decade an increasing interest has been shown in research and development of wide range of subjects related to power systems. The climate change and energy crisis can be considered as the main drivers towards this trend. One of the areas that have attracted many scholars and researchers is 'Smart Grid'. This paper initially reflects on general concepts of Smart Grids; it will then outline the carbon footprints and other challenges linked to electricity grids and power systems in Iran. One solution to manage these problems would be adopting the vision of 'Smart Grid'. The essence of this vision is a fully automated power delivery network that can ensure a two- way flow of electricity and information between power grids and appliances and all points in between. Moreover personal energy management and relative effects of smart grid will be explained.

Key words: Smartening, Automation, Energy Management, Information & Communication Technology

1. Introduction

As Hubert predicted the oil peak, we are facing a challenging era. Energy crisis and climate change are the main contests that human is facing. As a result of both, there has been a constant increase in energy prices (Hubert, 1956). The significant increase in the retail prices of electricity has also been experienced in Iran. This has led to an interest for smart grids as a resolution. . The idea is that smart grid would be a more resilient, reliable, self-balancing, and interactive network i.e. more intelligent. Its application will result a reliable trend towards an environmental and socio-economic sustainable development. This paper provides a consensus view on the current status of smart grid technologies and benefits of applying it in Iran.

2. Data and Material

A smart grid is an electricity network that uses digital and other advanced technologies to monitor and manage the transport of electricity from all generation sources to meet the varying electricity demands of end-users. Smart grid co-ordinate the needs and capabilities of all generators, grid operators, end-users and electricity market stakeholders to operate all parts of the system as efficiently of possible (US Department of Energy, 2011).

Smart grid includes electricity networks (transmission and distribution systems) and interfaces with generation, storage and end users. While many regions have already begun to "smarten" their electricity systems, all regions will require significant additional investment and planning to achieve a smarter grid. Smart grids are an evolving set of technologies that will be deployed at different rates in a variety of settings around the world, depending on local commercial attractiveness, compatibility with existing technologies, regulatory developments and investment frame work.

This new power ecosystem (an intelligent information network that will stretch from power plants to millions of smart nodes and devices in homes and businesses) will revolutionize electric power distribution. No parts of our global society will remain untouched by the smart grid, and already it is creating huge opportunities for business and consumers.

3. Rationale for Smart Grids

The world's electricity systems face a number of challenges such as aging of infrastructure, and continuous growth in demand. These have resulted in the necessity for more research studies and practices in various related areas. Implementation and integration of increasing number of adjustable renewable energy sources, electric vehicles, the need to improve the security of supply and the requisite to lower carbon emissions have been the center of attentions in recent years (Hledik, Apr 2009).

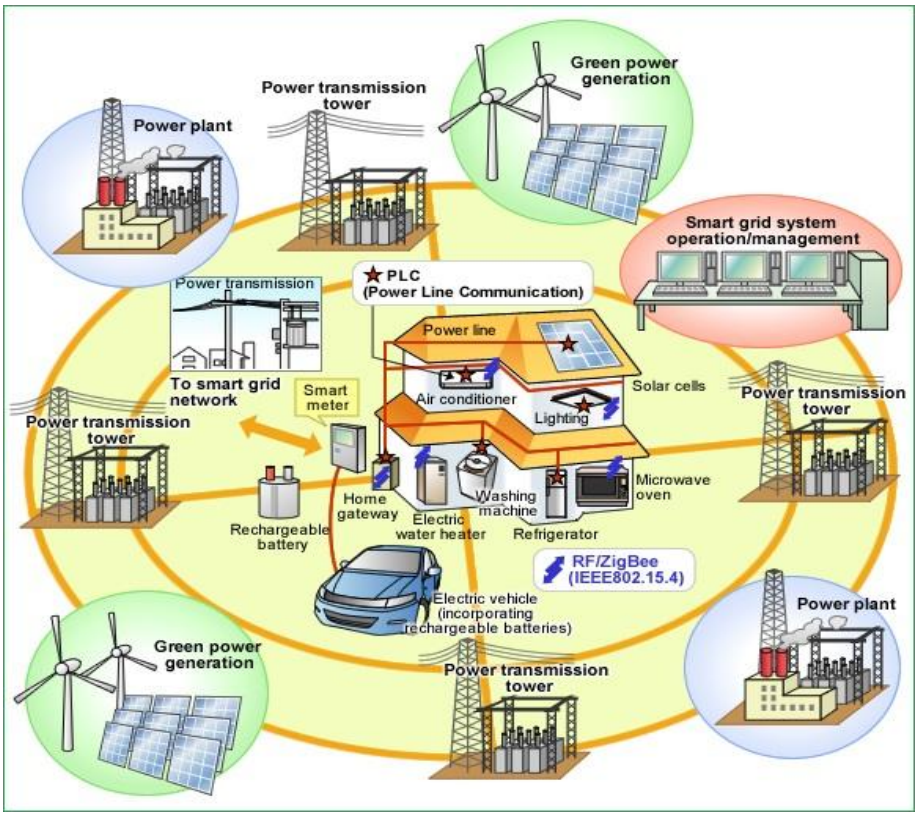

Figure 1: Smart Grid Concept (Renesas, No Date)

Smart Grid technologies offer solutions not only to tackle these challenges but also to develop a cleaner energy supply that is more energy efficient, more affordable and more sustainable. At the time of the design of the smart grids, regional unique technical, financial

and commercial regulatory environment should be addressed. Given the highly regulated nature of the electricity system, proponents of smart grids must ensure that they engage with all stakeholders, including system operators, consumer advocates and consumers to develop tailored, technical, financial and regulatory solutions that enable the implementation of smart grids (Hledik, Apr 2009).

4. Review on Iran Energy

Any results and evaluations coming out of the research can be presented here Iran possesses third largest oil and second largest natural gas reserves in the world. Iran is in constant battle to use its energy resources more effectively in the face of subsidization and the need for technical advances in energy exploration and production.

Iran recycles 28 percent of its used oil and gas whereas figures for certain countries stand at 60 percent. Iran is one of the most energy inefficient countries in the world, with the energy consumption three times higher than global average and 2.5 times than Middle East average (IEA, 2011).

Energy consumption in Iran is 6.5 times than the global average. It is estimated that 18.5 percent of electricity generated in Iran wasted before it reaches consumers due to technical problems. Iran's domestic consumption and production have steadily grown together since 1984 and it is still heavily reliant on traditional thermal energy sources of electricity, with small fraction being produced by hydroelectric plants. Consumption has steadily risen and it is expected to rise about 6 percent per year for the coming decade (Taghizadeh, 2012).

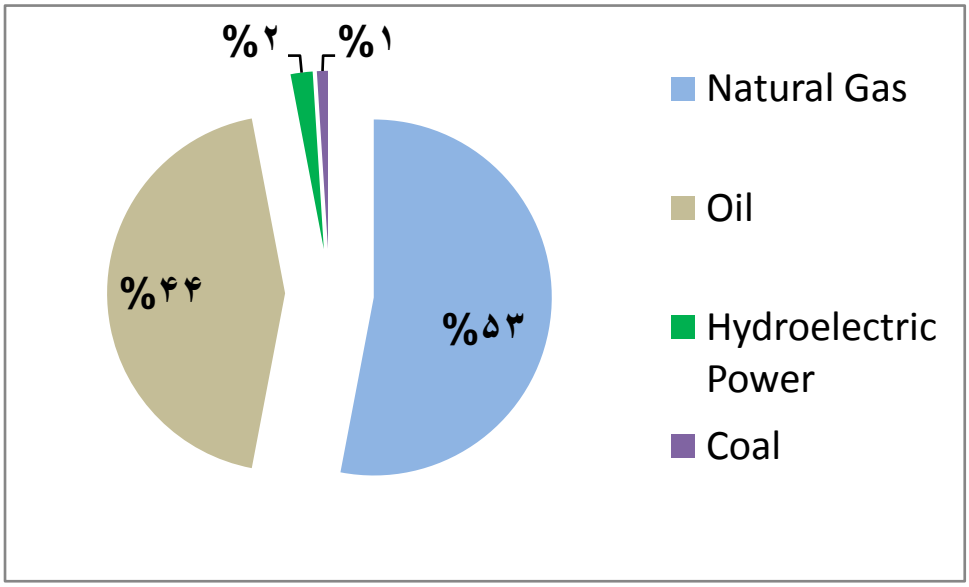

Figure 2: Iran Energy Consumption by Fuel Type (Taghizadeh, 2012)

Totally more than 98 percent of primary energy is derived from oil and gas and only less than 2 percent in form of hydro, coal and non-commercial energies (IEA, 2011).

We cannot reduce consumption of energy but maybe we can change our sources from fossil sources by application of smart grid with incorporated renewable energies.

5. Potential Role of Smart Grid in Iran's Electricity Industry

As of the year 2000, Iran had the biggest electricity network in the Middle East and the 19th biggest in the world (Taghizadeh, 2012). In 2005, it was the17th according to IEA reports Electricity sector was the biggest public utility sector in the country with more than 17 million subscribers (Aflaki-Khorashani Et al. 2009).

According to the IEA reports in 2006, 73.5% of the total production is produced from gas, oil which accounts for as much as about 17.5% of total production; about 9 percent, is produced from hydro-generators, one of the only viable renewable energy source in Iran (IEA, 2011).

The electricity power plants in Iran can be categorized as;

1. Hydraulic power plants; construction of water dam,
2. Water accumulation dates back to Sassanid's era (Lamba, 2011)
3. Solar thermal power plants.

Figure 3: Iran Energy Consumption Trend (IEA, 2011)

Major part of the electric energy supply in Iran is produced by steam, diesel and gas combined cycle plants. In addition thesis increased seven times from 1979 to 1999 and was estimated to double between 2000 and 2010 as a developing country; Iran is likely to face larger electricity demand for industries in the not too distant future.

6. Smart Grid Application in Iran Proposal

If we want to apply smart grid in Iran, we should pay attention to some note: at first the benefits of smart grid transformation related to economy and environment and second the reliability and security. We should apply some devices to have network for smart grid application:

1. Smart metering: smart metering is a tool through which regulators and network operators will be able to shape electricity demands patterns in the future since they

will be educate and financially incentivize consumers to be more aware of energy usage.(smart meters which enable two-way communication between power companies and consumers are an essential component of the smart grid.)

2. Inter-side rapid response
3. SCADA : smart grid Supervisory Control And Data Acquisition
4. Operation data
5. Distribution automation
6. Distributed energy management and control
7. Video surveillance
8. Mobile work force
9. Corporate data
10. Corporate voice (Simi´c Et al. 2011)

The list above was the some of the most smart grid applications as well as other utility applications.

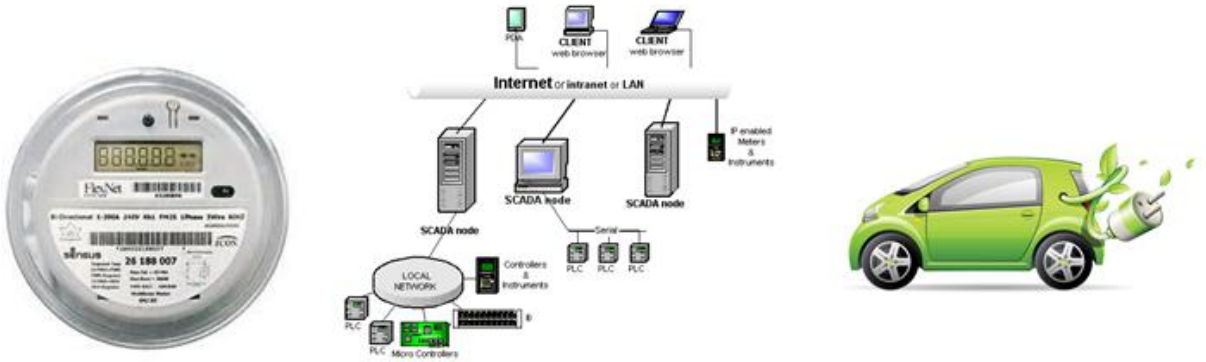

Figure 4: Smart Grid Application Contexts

It is important to consider distance when application requirement change due to the operational context. The quality of service, reliability, security, and unified network management tools needs to ensure delivery of critical smart grid application.

As we should know smart grid is one system for advanced metering infrastructure, distributed automation and personal energy management. In smart grid system, consumer information is received by the electric power company in order to provide the most efficient electric network operations. Distribution automation system provides tools for the distribution power networks security, economical operation. It guarantees power quality, perfecting facility management as well as increasing working efficiency and providing a series of solution for the distribution automation system (Baziliana Et al. 2009). The system supplies the function of power grid monitoring, control failure management and power balance and charge management (Lucent, 2010). Smart grid electricity network can intelligently integrate the action of users connected to it, generators consumers those that do both in order the efficiency deliver sustainable, economic electricity supplies (Willrich, 2009).

If we want to apply the smart grid we need the electric vehicles instead of using the once that work with fossil fuels. It is a sector of smart grid network that helps environment.

7. Conclusion

Iran is characterized by significant electricity related challenges in terms of resources, infrastructure, cost and sustainability. We described the smart grid to aim these challenges.

Technologies such as wind, solar PV, run of river hydro tidal where production of electricity is based on climatic conditions and therefore cannot be dispatched based on a need for additional power alone by applying the smart grid we can use all forms of these energy sources together. Demand response can be performed manually by the end-user or automatically based on predefined setting. As a whole smart grid have lots of benefits.

1. The smart grid will help consumers moderate the energy usage to reduce waste, lower their monthly bill and use power in a more sustainable way.
2. The smart grid will help prevent outages, shorter the response time to problems, reduce cost and increase efficiency, and allow operators to resolve issues remotely.
3. It will integrate renewable energy and reduce carbon emissions.

At the end "the smart grid" will be a safer, more secure, more reliable grid, and will reduce dependency on foreign energy supplies .it also will reduce carbon emissions and combat global warming.

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