American Journal of Engineering Research (AJER)
e-ISSN : 2320-0847 p-ISSN : 2320-0936
Volume-03, Issue-05, pp-48-56
www.ajer.org

Research Paper Open Access

Green cooperative communication network using solar energy sources

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Abstract : - Solar energy has experienced phenomenal growth in recent years due to both technological improvements resulting in cost reductions and government policies supportive of renewable energy development and utilization. This study analyzes the technical, economic and policy aspects of solar energy development and deployment. While the cost of solar energy has declined rapidly in the recent past, it still remains much higher than the cost of conventional energy technologies. Like other renewable energy technologies, solar energy benefits from fiscal and regulatory incentives and mandates, including tax credits and exemptions, feed-in-tariff, preferential interest rates, renewable portfolio standards and voluntary green power programs in many countries. Potential expansion of carbon credit markets also would provide additional incentives to solar energy deployment; however, the scale of incentives provided by the existing carbon market instruments, such as the Clean Development Mechanism of the Kyoto Protocol, is limited. Despite the huge technical potential, development and large-scale, market-driven deployment of solar energy technologies world-wide still has to overcome a number of technical and financial barriers. Unless these barriers are overcome, maintaining and increasing electricity supplies from solar energy will require continuation of potentially costly policy support.
Indexing terms/

Keywords: - *solar energy; renewable energy economics and policies; climate change EARTH, gion, energy efficiency,green communications,femtocells, interference,radio resource management.*

I. INTRODUCTION

Solar energy has experienced an impressive technological shift. While early solar technologies consisted of small-scale photovoltaic (PV) cells, recent technologies are represented by solar concentrated power (CSP) and also by large-scale PV systems that feed into electricity grids. The costs of solar energy technologies have dropped substantially over the last 30 years. For example, the cost of high power band solar modules has decreased from about $27,000/kW in 1982 to about $4,000/kW in 2006; the installed cost of a PV system declined from $16,000/kW in 1992 to around $6,000/kW in 2008 (IEA-PVPS, 2007; Solarbuzz, 2006, Lazard 2009). The rapid expansion of the solar energy market can be attributed to a number of supportive policy instruments, the increased volatility of fossil fuel prices and the environmental externalities of fossil fuels, particularly greenhouse gas (GHG) emissions.

Theoretically, solar energy has resource potential that far exceeds the entire global energy demand (Kurokawa et al. 2007; EPIA, 2007). Despite this technical potential and the recent growth of the market, the contribution of solar energy to the global energy supply mix is still negligible (IEA, 2009). This study attempts to address why the role of solar energy in meeting the global energy supply mix continues to be so a small. What are the key barriers that prevented large-scale deployment of solar energy in the national energy systems? What types of policy instruments have been introduced to boost the solar energy markets? Have these policies produced desired results? If not, what type of new policy instruments would be needed?

A number of studies, including Arvizu et al. (2011), have addressed various issues related to solar energy. This study presents a synthesis review of existing literature as well as presents economic analysis to examine competitiveness solar energy with fossil energy counterparts. Our study shows that despite a large drop in capital costs and an increase in fossil fuel prices, solar energy technologies are not yet competitive with conventional technologies for electricity production. The economic competitiveness of these technologies does not improve much even when the environmental externalities of fossil fuels are taken into consideration. Besides the economic disadvantage, solar energy technologies face a number of technological, financial and institutional barriers that further constrain their large-scale deployment. Policy instruments introduced to address these barriers include feed in tariffs (FIT), tax credits, capital subsidies and grants, renewable energy portfolio standards (RPS) with specified standards for solar energy, public investments and other financial incentives. While FIT played an instrumental role in 3

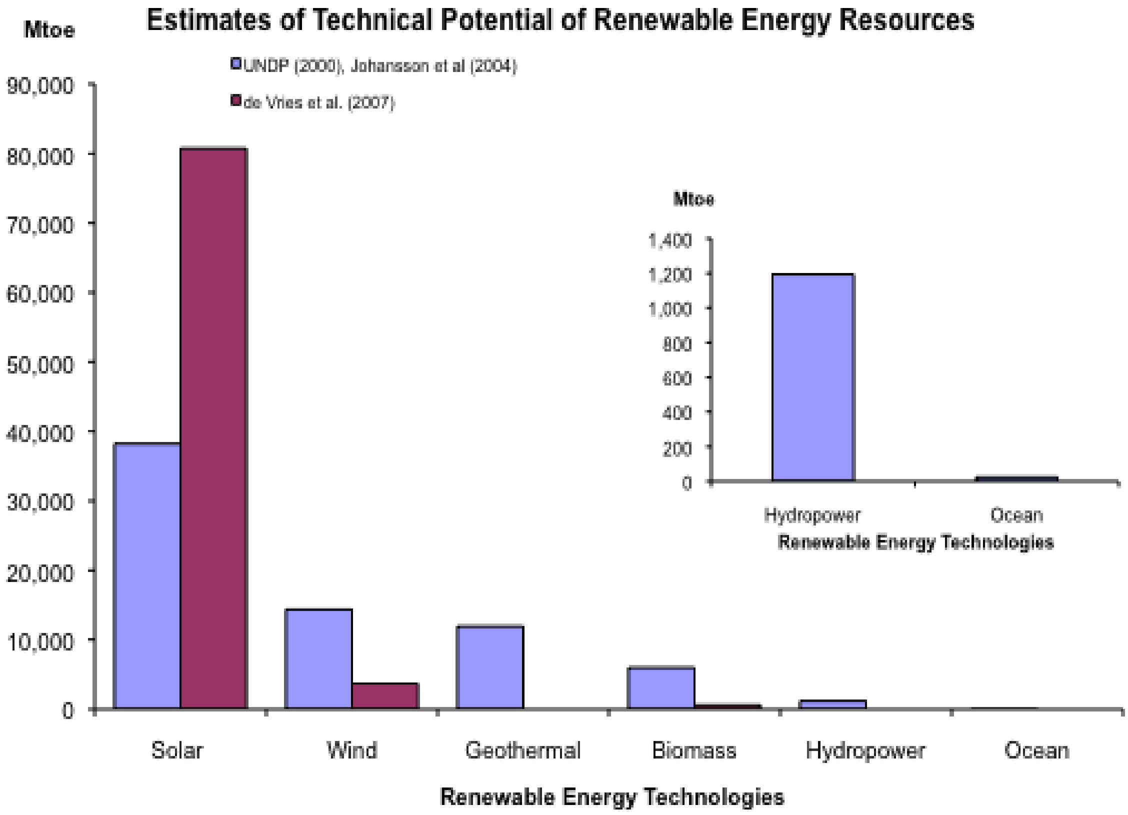
Current status of solar energy technologies and markets

Technologies and resources

Solar energy refers to sources of energy that can be directly attributed to the light of the sun or the heat that sunlight generates (Bradford, 2006). Solar energy technologies can be classified along the following *continuum*: 1) passive and active; 2) thermal and photovoltaic; and 3) concentrating and non-concentrating. Passive solar energy technology merely collects the energy without converting the heat or light into other forms. It includes, for example, maximizing the use of day light or heat through building design (Bradford, 2006; Chiras, 2002).

In contrast, active solar energy technology refers to the harnessing of solar energy to store it or convert it for other applications and can be broadly classified into two groups: (i) 4

Solar energy represents our largest source of renewable energy supply. Effective solar irradiance reaching the earth"s surface ranges from about 0.06kW/m2 at the highest latitudes to 0.25kW/m2 at low latitudes. Figure 1 compares the technically feasible potential of different renewable energy options using the present conversion efficiencies of available technologies. Even when evaluated on a regional basis, the technical potential of solar energy in most regions of the world is many times greater than current total primary energy consumption in those regions (de Vries et al. 2007).



photovoltaic (PV) and (ii) solar thermal. The PV technology converts radiant energy contained in light quanta into electrical energy when light falls upon a semiconductor material, causing electron excitation and strongly enhancing conductivity (Sorensen, 2000). Two types of PV technology are currently available in the market: (a) crystalline silicon-based PV cells and (b) thin film technologies made out of a range of different semi-conductor materials, including amorphous silicon, cadmium-telluride and copper indium gallium diselenide1. Solar thermal technology uses solar heat, which can be used directly for either thermal or heating application or electricity generation. Accordingly, it can be divided into two categories: (i) solar thermal non-electric and (ii) solar thermal electric. The former includes applications as agricultural drying, solar water heaters, solar air heaters, solar cooling systems and solar cookers2 (e.g. Weiss et al., 2007); the latter refers to use of solar heat to produce steam for electricity generation, also known as concentrated solar power (CSP). Four types of CSP technologies are currently available in the market: Parabolic Trough, Fresnel Mirror, Power Tower and Solar Dish Collector (Muller-Steinhagen and Trieb, 2004; Taggart 2008a and b; Wolff et al., 2008).
Solar energy technologies have a long history. Between 1860 and the First World War, a range of technologies were developed to generate steam, by capturing the sun"s heat, to run engines and irrigation pumps (Smith, 1995). Solar PV cells were invented at Bell Labs in the United States in 1954, and they have been used in space satellites for electricity generation since the late 1950s (Hoogwijk, 2004). The years immediately following the oil-shock in the seventies saw much interest in the development and commercialization of solar energy technologies. However, this incipient solar energy industry of the 1970s and early 80s collapsed due to the sharp decline in oil prices and a lack of sustained policy support (Bradford, 2006). Solar energy markets have regained momentum since early 2000, exhibiting phenomenal growth recently. The total installed capacity of solar based electricity generation capacity has increased to more than 40 GW by the end of 2010 from almost negligible capacity in the early nineties (REN21, 2011).Germany and Spain, a mix of policy portfolios that includes federal tax credits, subsidies and rebates, RPS, net metering and renewable energy certificates (REC) facilitated solar energy market growth in the United States. Although the clean development mechanism (CDM) of the Kyoto Protocol has helped the implementation of some solar energy projects, its role in promoting solar energy is very small as compared to that for other renewable energy technologies because of cost competitiveness. Existing studies we reviewed indicate that the share of solar energy in global energy supply mix could exceed 10% by 2050. This would still be a small share of total energy supply and a small share of renewable supply if the carbon intensity of the global energy system were reduced by something on the order of 75%, as many have argued is necessary to stem the threat of global warming.

The paper is organized as follows. Section 2 presents the current status of solar energy technologies, resource potential and market development. This is followed by economic analysis of solar energy technologies, including sensitivities on capital cost reductions and environmental benefits in Section 3. Section 4 identifies the technical, economic, and institutional barriers to the development and utilization of solar energy technologies, followed by a review of existing fiscal and regulatory policy approaches to increase solar energy development in Sections 5 and 6, including potential impacts of greenhouse gas mitigation policies on the deployment of solar energy technologies.

In green radio communications, a main network design objective is to reduce the amount of energy consumption while maintaining satisfactory quality of service (QoS). Two motivations are behind this design criterion. One is the service provider’s financial considerations. Almost half of a mobile service provider’s annual operating expenses are energy costs [1]. Each base station(BS) in a cellular network consumes roughly upto 2.7 kWh of electrical power [2]. With densely deployed BSs to achieve wide area coverage, high energy is consumed per annum. Such high energy consumption of green radio communications network design:environmental considerations. Currently, the telecommunication industry is responsible for about 2 percent of CO_2 emissions, and given the industry’s growth it could increase to 4 percent by 2020 [3]. As a result, political initiatives start to put requirements on ope CO_2 emissions of communication networks [4].In Europe, companies such as Orange (France),Ericson (Sweden), and Vodafone (United Kingdom)aim to reduce their CO_2 emissions by 50–80 percent by 2020 [5]. Hence, the reduction of energy consumption in the telecommunication

industry sector will result in a positive impact on both the environment and operators’ profits [1].In the literature, there have been several proposals for designing an energy-aware infrastructure in wireless communications networks.In the following, energy saving techniques at the network level are discussed. The limitations of the existing techniques are pointed out. We investigate network cooperation as a means of energy saving in green radio communications.
The objective is to develop a framework that enables networks with overlapped coverage in a given geographical region to cooperate with each other to achieve energy saving.

II. RENEWABLE ENERGY SOURCES

From an environmental perspective, the objective of green radio communications is to reduce CO2 emissions [6]. This can be achieved by using renewable energy sources at the BSs, such as locally generated wind and solar power. This can reduce the amount of electrical power consumption taken from the grid. Also, it can complement the fossil fuel power generators in off-grid sites. Moreover,air cooling and cold climates can be used to cool the electronic devices in the BSs [6]. However, the renewable energy sources cannot replace the traditional energy sources in the BSs due to their
required high reliability, since any power shortage will disturb the wireless network's service provision.

Green Wireless Communication

The term Green Wireless Communication can be defined as the technology which uses convergence of energy efficient methodologies at different stages to minimize the adverse effects of technology on environment. Growing telecommunication infrastructure requires increasing amount of electricity to power it. India currently has more than 310000 cell phone towers, which consume about 2 billion liters of diesel per year. The move from diesel to solar and other alternate sources of energy will result in a reduction of 5 million tons of CO2 emissions as well as a savings of $1.4 billion in operating expenses for telecommunication tower companies. Move to renewable energy sources can generate millions of carbon credits that could offset the opex on their towers. In addition saving in the energy bill would further reduce the operating expense. Green wireless communication has many facets. It can be classified broadly in terms of greening of telecommunication networks, green telecommunication equipment manufacture [2], and safe telecommunication waste disposal. These aspects are briefly described below:

Green Telecommunication Networks

In telecommunication networks, greening would refer to minimizing utilization of energy through use of energy efficient technology, using renewable energy resources and environmental friendly consumables

Green Manufacturing

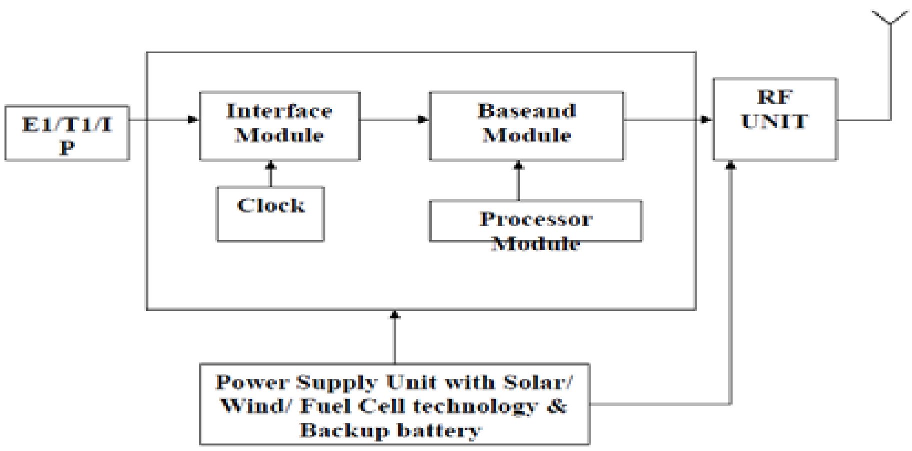
The greening process would involve using eco-friendly components, energy efficient manufacturing equipment, electronic and mechanical waste recycling and disposal, reduction in use of hazardous substances like chromium, lead and mercury and reduction of harmful radio emission.

Waste Disposal

Disposal of mobile phones, network equipment etc., in an environment-friendly manner so that any toxic material used during production does not get channelized into the atmosphere or underground water

Methods of Reducing Carbon Footprint

International experience shows that there can be considerable diminution in the telecommunication carbon footprint through a number of activities of the telecommunication value chain. From the manufacture of electronic components through telecommunication network equipment and handsets to their operational life span and eventual disposal there are activities that produce green house gases directly or indirectly. Following steps could be taken to reduce carbon footprint.



1. Proper radio planning to reduce number of Base transceiver stations
2. Sharing of backhaul network
3. Sharing of passive and active infrastructure
4. Replacing air-conditioners with forced air cooling
5. HFC free cooling systems
6. Installing outdoor base-stations
7. Using energy efficient technology and renewable energy resources

III. GREEN TECHNOLOGIES

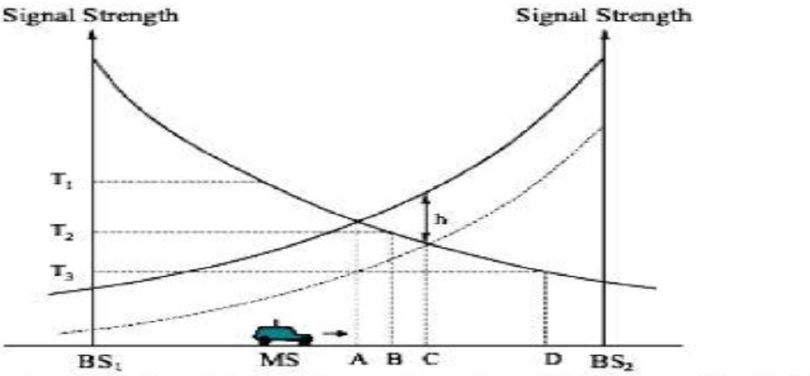
Green base transceiver stations-

In times of gradually rising energy expenses and with the vanishing resources of the conventional and non- regenerative energy sources, we see the challenge of finding new solutions for the uninterruptible power supply of Base transceiver stations. The Green Base Station [3] which is introduced is operational with the regenerative energy sources wind power and photo voltaic energy to reduce the power utilization taken out of the public grid to a minimum, whenever sunlight or wind is present. Besides highly efficient system mechanism, alternative and renewable energy sources are significant in the Green BTS concept. The utilization of solar energy [4], wind energy and hydrogen make the green BTS a real hybrid system and even allow one to think about off-grid solutions. Solar energy, wind energy, Fuel cells or Pico Hydro technologies can be used to feed base transceiver stations. Recycling of the used materials is another part in the Green BTS concept. Figure 3 shows the concept of green BTS

Green handovers

Green handover mechanism for cellular networks aims at reduced emission from mobile phones figure 4. The criterion for handover in common cellular systems is based on the quality of received downlink signal. This criterion makes sense when the uplink and downlink are symmetric. However, the advent of MIMO technology changes this criterion as MIMO transmission and reception techniques may significantly alter the uplink and downlink characteristics. For example, the number of transmit antennas may differ from the number of receive antennas. Alternatively, the techniques may significantly differ, such as when the transmitter broadcasts the downlink signal whereas the receiver performs beamforming. Consequently a mobile phone may receive Cell A with best quality, whereas Cell B may receive the mobile at better quality than Cell A, and hence Cell B requires minimal emission from the mobile phone.

The new handover mechanism uses this concept and chooses, among neighboring cells with sufficient downlink, the cell for which the emission from the mobile phone is minimized [5]. This mechanism requires methods to estimate the expected uplink emission. These include procedures where cells broadcast their uplink reception capabilities or request mobiles to perform test transmissions. The INTERPHONE study is the largest and most thorough study trying to assess whether cellular phone usage is associated with cancer. The analysis has not been completed yet, but intermediate results link cellular phone usage to certain types of cancer. This and other results have led several institutions and authorities to take precautionary steps. The evolution of wireless technology and specifically the advent of multiple input multiple output (MIMO) system provides an opportunity in this aspect. Localized and distributed MIMO systems may be leveraged to significantly reduce radiation from mobile phones. For example, when connected to a mobile phone, a base station equipped with multiple antennas may employ receive beam forming in order to suppress interference and significantly enhance the uplink quality. The increase in uplink quality in turn allows for a similar decrease in the uplink transmission power and respective exposure to radiation. However, in common systems, even when such a BS is nearby, in many cases the mobile phone would prefer another BS requiring higher uplink power and radiation over it. This is because the criterion for handover in common cellular systems is based on the received downlink signal strength or signal quality. This handover criterion is simple and makes sense when the uplink and downlink are balanced. This is not the case in MIMO systems. For example, many base stations employing MIMO techniques receive with all antennas, but transmit from only one or two. Things become even more significant when receive only devices, such as Green Antennas are deployed in the proximity of the mobile. This means that the measured DL quality may be a poor indicator for the expected UL quality and required transmit power. In orthogonal frequency division multiplexing (OFDM) MIMO based communications systems (such as LTE and WiMAX), soft handover is not employed and each mobile phone is served by a single BS. In such systems, the main criterion for choosing a BS for establishing a connection and handover is the received DL signal strength or signal quality. Signal to noise ratio (SNR) or signal to interference and noise ratio (SINR) are common measures for the downlink signal quality. Obviously, the DL signal quality is not the only criterion in the handover process. For example, when the UL transmit power is high (e.g., above 20dBm), and/or when the uplink packet error rate is not sufficient, the BS may initiate a handover process. However, once initiated, the criterion for choosing the target BS is DL signal quality. Therefore, in current handover mechanism, when the mobile recognizes multiple target base stations, it chooses the BS it receives best. This does not necessarily mean the chosen BS is the one which receives the mobile at best quality. In other words, it is not necessarily the one which requires minimal UL transmission power and respective exposure to radiation. This is especially true in case the base stations employ multiple antennas. With multiple antennas, a large variety of transmission and reception schemes is available. Each scheme exploits the MIMO channel differently which often results in significantly different link quality.



Signal strength and hysteresis between two adjacent BSs for potential handoff.

Figure 3: Handover.

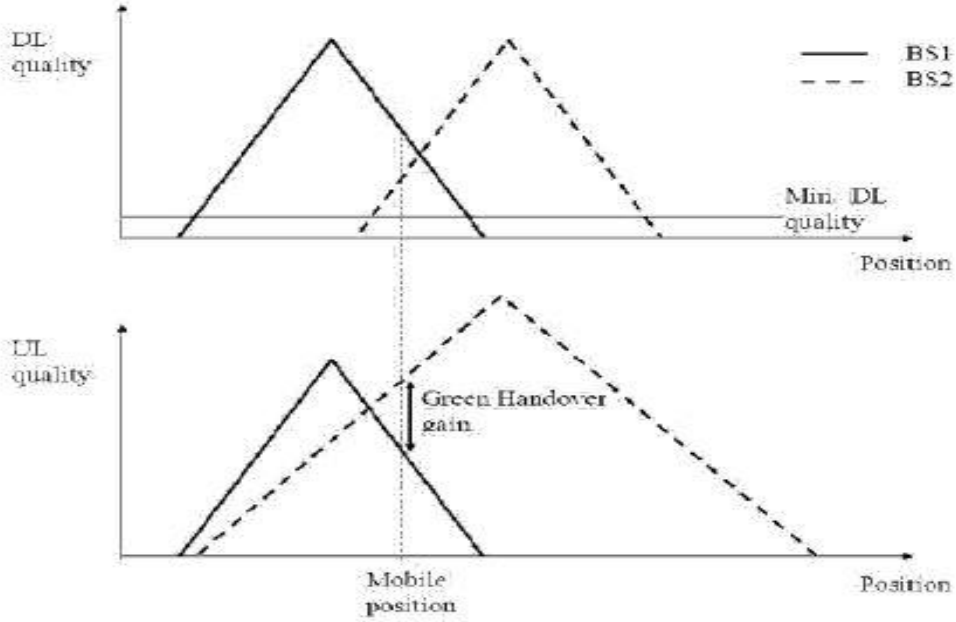


Figure 4: Green Handover Green Charger.

Green charger

Figure 5 shows a green charger using solar cells. Each set of three solar cells develops about 2.0 volts across itself when in full sunlight. The string of 6 solar cells puts out around 4V with no load. When the solar cells are connected to the battery (a 3.7V), a current will flow which will charge the battery.

The 6 solar cell panel with diode is the recommended circuit. The diode prevents the battery from discharging through the cells at night and the 6th cell boosts the voltage up enough to compensate for the voltage drop across the diode. For a 6 solar cell panel, connect jumper J2 and disconnect J1.

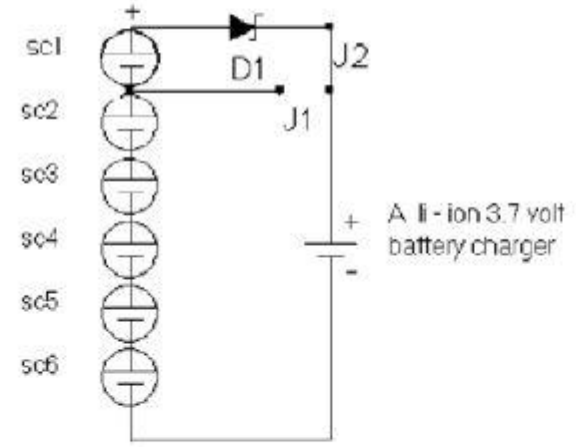


Figure 5: A lithium-ion 3.7 volt battery charger.

Smart grid technology

The term "Smart Grid" refers to a transformation of the electricity delivery system so it monitors, protects and automatically optimizes the operation of its interconnected elements–from the central and distributed generator through the high-voltage transmission network and the distribution system, to industrial users and building automation systems, to energy storage installations and to end-use consumers and their thermostats, electric vehicles, appliances and other household devices. Two-way seamless communication is the key aspect of realizing the vision of smart grid. There are numerous standardized wired and wireless communication technologies available for various smart grid applications. With the recent growth in wireless communication, it can offer standardized technologies for wide area, metropolitan area, local area, and personal area networks. Moreover, wireless technologies not only offer significant benefits over wired, such as including low installation cost, quick deployment, mobility, etc., but also more suitable for remote end applications. Numerous activities

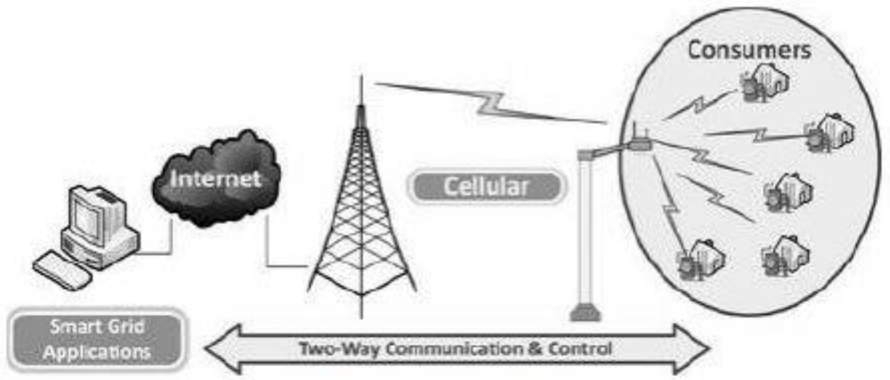


Figure 6: Smart Grid Technology for Wireless Communication.

are going on to explore specific applications of these technologies in smart grid environment. Figure 6 shows the Smart Grid Technology for wireless communication.

Various smart grid applications can be achieved through standardized wireless communication technologies, e.g. IEEE 802.11 based wireless LAN, IEEE 802.16 based WiMAX, 3G/4G cellular, ZigBee based on IEEE 802.15, IEEE 802.20 based MobileFi, etc.

Smart grid will be characterized by two-way flow of power in electrical network, and information in communication network. In the recent report on National Institute of Standard and Technology framework and roadmap for smart grid interoperability standards, several wired and wireless communication technologies are identified for smart grid. Advanced wireless systems offer the benefits of inexpensive products, fast deployment, low cost installations, widespread access, and mobile communications which wired and even the older wireless technologies often cannot provide. However, in the past, wireless technologies had comparatively slow acceptance in power industries due to low data rates, interference related issues, security concerns, limited product availability, etc. Several activities have already been initiated to address the wireless technical issues, and identify suitable wireless technologies particularly for smart grid. In the latest Electric Power Research Institute report to NIST on the smart grid interoperability standards roadmap, one of the suggested prioritized actions is to address the "Communications Interference in Unlicensed Radio Spectrum". The success of this action would alleviate many issues related to wireless communication in unlicensed radio spectrum by providing a dedicated communication channels for the mission-critical inter-operations of the smart grid. With these motivations from recent developments and ongoing activities, the efforts have been carried out in this work to present the various smart applications using standardized wireless communication technologies, e.g. IEEE 802.11 based wireless LAN, IEEE 802.16 based WiMAX, 3G/4G cellular, ZigBee based on IEEE 802.15, IEEE 802.20 based MobileFi, etc. Different applications of these wireless technologies have been identified considering the latest available data rates, distance coverage, and other important technology features in smart grid environment

Green antennas and green electronics

Solar power is the primary source for renewable energy. Over the past decade, some works have been reported on integrating the antenna with solar cells [6] light reflecting green antenna for the solar cell should be designed. Green Antenna and its ground plane simultaneously act as light-reflecting surfaces for the solar-cell system. These antennas can be used for advanced wireless technologies for energy efficient green communication. Lead free electronics should be developed to promote the idea of green wireless communication.

IV. CONCLUSION

The need to develop green wireless communication systems turns out to be more and more vital as wireless networks are becoming ubiquitous. Green Wireless Communication will provide energy efficient communication. It will result into less radiation from devices as well as more economic solutions for service providers and subscriber. Green wireless communication is the part of Corporate Social Responsibility which strives to reduce carbon footprint and Green house gases to provide Green ICT services to customers. Governmentshould also form rules and regulations to certify a service provider as Green service provider. The integration of different energy efficient technologies like Green BTS, Green manufacturing, Green Handover, Green antennas, Green electronics and Smart Grid solution will create accord between human being and nature

V. REFERENCES

[1]. Vikram Chandrasekhar and Jeffrey G. Andrews, Alan Gatherer, Texas Instruments "Femtocell Networks: A Survey"communication magazine,IEEE,vol.46,pp.59-67,sept 2012

[2]. Shuguang Cui, Andrea J. Goldsmith, and Ahmad Bahai, "Energy-constrained Modulation Optimization"IEEE Trans.wireless commun.,vol.4,no.5,pp.2349-2360,sept.,2011

[3]. Qing Chen and Mustafa Cenk Gursoy "Energy Efficiency Analysis in Amplify-and-Forward and Decode-and-Forward Cooperative Networks"information sceinse and systems.53rd annual conference on ,vol.no.pp.811-816

[4]. Qing Chen and Mustafa Cenk Gurso"Energy-Efficient Modulation Design for Reliable Communication in Wireless Networks"WCNC,2011 IEEE.,vol.no.,pp.1-6,18-21 april 2011

[5]. Albrecht J. Fehske, Fred Richter, and Gerhard P. Fettweis "Energy Efficiency Improvements through Micro Sites in Cellular Mobile Radio Networks"PIMPRC 2011 IEEE 46TH INTERNATIONAL SYNOPSYM on,vol.,no.pp1-6,april 2010

[6]. Muhammad Ismail and Weihua Zhuang "Network Cooperation for Energy Saving in Green Radio Communications"wireless communication,IEEE vol no.48.,no.11,pp.no.66-72,nov.2011

[7]. Aria nosratinia, dallas, todd E. Hunter "Green technology in cooperative communication network using coded cooperative method" IEEE communication magazine vol.no.4,october 2013

[8] India: Greenhouse Gas Emissions 2007. (2010) Ministry of Environment and Forests, Govt. of India

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