

GREEN ENERGY TECHNOLOGY (GET)

FOR

TELECOM APPLICATIONS

Ram Krishna

Dy. Director General (FLA)
TEC New Delhi, DoT, Govt. of India.
E-mail: ddgfla.tec@gov.in

R. K. Siddhartha

Director (FLA)
TEC New Delhi, DoT, Govt. of India.
E-mail: dirfla.tec@gmail.com

Naveen Kumar

Asstt. Director General (FLA)
TEC New Delhi, DoT, Govt. of India.
E-mail: nk@live.in

Abstract

There is a strong need to develop a viable independent power industry that serves the public interest by providing cost-effective electricity through the environmentally responsible and efficient development of the available energy resources. The other objective of this paper is to highlight the Green Energy technology (GET) in term of need, types of GETs, features, deployment barriers, applications, drawbacks, challenges, etc. GETs are not only simple power sources for telecom or other applications rather helpful in keeping environment as clean and green. Similarly, we can use the word Green Telecom (GT) while using GETs in telecom applications. The energy industry must be involved by switching generation sources to more sustainable sources and working with customers to help them use energy more efficiently. Green Telecom theme is to promote carbon accountability in the telecoms industry. The demand of renewable energy for environmental concerns has been increasing rapidly. Though the Green Energy Technologies are readily available in the market, but there are some issues and challenges along with barriers in implementation.

Keywords: Green Energy Technology (GET), Clean Energy Technology (CET), Renewable Energy Technology (RET), Green Energy Options (GEOs), Green Telecom

(GT), Green Power, Green House effect, Green House Gases CHG), Carbon Dioxide (CO2), Fossil Fuels, Non - conventional Energy.

1.0 Introduction

- 1.1 The energy industry must be involved in a big way in any sustainable initiatives, since it is also a major source of CO₂ emissions today. Electric energy supplies a large percentage of our energy needs. We use energy to facilitate modern society with critical items like: lights, water pumps, life support equipment, elevators, furnaces, and mass transit etc. A lot of attention has been given to energy in recent period for several reasons including:
 - Gasoline prices are volatile and higher than we like,
 - Prices for electricity and natural gas have increased, and
 - Global warming has become a major issue.
- 1.2 Run-of-river hydropower, wind, geothermal, biomass and other renewables such as solar, wave and tidal energy are the most plentiful and environmentally sound renewable energy sources. Greater availability of non-polluting renewable will help mitigate environmental impacts of energy use, now and for years to come.
- 1.3 Clean Energy Technology is essential to limiting global warming and protecting ecosystems by reducing CO₂ emissions through energy efficiency and use of renewable energy. Clean Energy Technology reduces CO₂ emissions by increasing energy efficiency and enabling alternative sources like solar, wind and biomass etc.
- 1.4 The sustainability of our planet is an important goal as we have ever had. In the 1950's we feared it was not sustainable because of the destructive power of the nuclear weapons arsenal that prevailed the situation of cold war. The governments around the world have resolved that concern, at least for now. The current threat to sustainability requires the involvement of all stakeholders. This will happen more readily if compelling business-value acts as a driver of sustainable activity. The greenhouse gas emissions are mainly from utility sector industrial energy generation.

- 1.5 The mere availability of a renewable energy resource does not mean that resource can readily be used as an energy source. To utilise a resource several factors need to be considered: the conversion system, quality of the fuel, conversion cost, transport cost as well as the size and location of the demand.
- 1.6 It is a fact that the information and communications technology (ICT) industry alone accounts for about 2% or 860 million tonnes of the world's greenhouse gas emissions.

2.0 The need of Clean or Green Energy

- 2.1 Clean Energy Technology is essential to limiting global warming and protecting ecosystems by reducing CO₂ emissions through energy efficiency and renewable Energy. Climate change comes at a cost to both our economy and our environment. As temperatures rise, agricultural output will fall, damage from floods and storms will increase, (tropical) diseases will become more prevalent and access to water will become more of a problem for more and more people. The cost to our environment is greater and loss is irreversible. The Earth's flora and fauna will suffer both directly from higher temperatures and indirectly through the damage to their habitats. Ecosystems will disappear. Even small temperature increases will cause coral bleaching and threaten some amphibians. Temperature rises of 3° or 4°C and more will lead to major extinctions around the globe.

3.0 Telecom Industry and Green Energy

- 3.1 Growing telecommunications infrastructure requires increasing amount of electricity to power it. Part of the electricity comes from the power grid and remaining through burning of fossil fuel like diesel. Both of these sources contribute to emission of green house gases (GHG) with the attendant negative environmental effects. Reduction of the GHG produced or caused to be produced by the telecom sector is referred to as greening of telecom. Green telecom has many facets. It can be classified broadly in terms of greening of telecom networks, green telecom equipment manufacture, environment friendly design of telecom buildings and safe telecom waste disposal. These aspects are briefly described below:

- (i) **Green Telecom Networks:** In telecom networks greening would refer to minimizing consumption of energy through use of energy efficient technology, using renewable energy sources and ecofriendly consumables.
- (ii) **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.
- (iii) **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.
- (iv) **Design of green central office buildings:** Although new technologies are constantly being developed to complement current practices in creating greener structures.

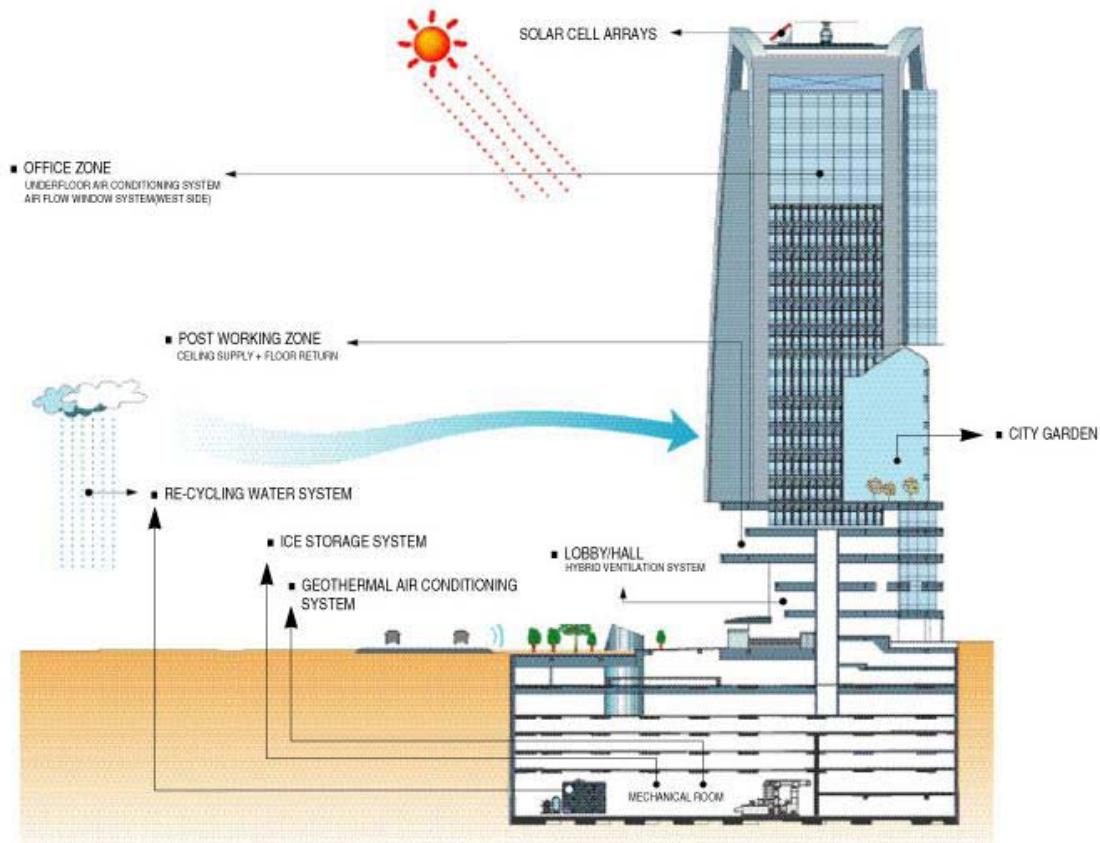


Fig 1: Green Building

3.2 The common objective is that green buildings are designed to reduce the overall impact of the built environment on human health and the natural environment by:

- Efficiently using energy, water, and other resources.
- Protecting occupant health and improving employee productivity.
- Reducing waste, pollution and environmental degradation.

4.0 Various Green Energy Technologies and Innovations

4.1 Given today's technology, there are only a few options available to supply our electric energy demands. Coal, natural gas, nuclear, and renewables such as wind, solar, biomass, hydro, and geothermal are energy options for new generation. The final goal is energy efficiency, which includes conservation, reduced demand, and improved codes, standards, and related technology. All of us have our favorite option and are perhaps biased against a few of the others, but if we really believe that global warming is happening, that humans are causing it, and that we are quickly approaching a tipping point beyond which recovery is either impossible or impractical, then we must consider all the options. Under that scenario we cannot afford to let any option go without careful consideration.

4.2 The various Green Energy Technologies and Innovations available are:

Energy source	RETs	
	Energy for domestic use	Electricity
<i>Elemental renewables</i>		
Solar	Solar pump, solar cooker	Solar PV
Water (including wave/tidal)		Micro- and pico-hydroelectric generating plant
Wind	Wind-powered pump	Wind turbine generator
Geothermal		Geothermal generating plant
<i>Biological renewables</i>		
Energy crops		Biomass generating plant
Standard crops (and by-products)		Biomass generating plant
Forestry and forestry by-products	Improved cookstoves	Biomass generating plant
Animal by-products	Biogas digester, improved cookstoves	Biogas digester

Source: Renewable Energy Association 2009.

Table 1: Renewable Sources and corresponding RETs.

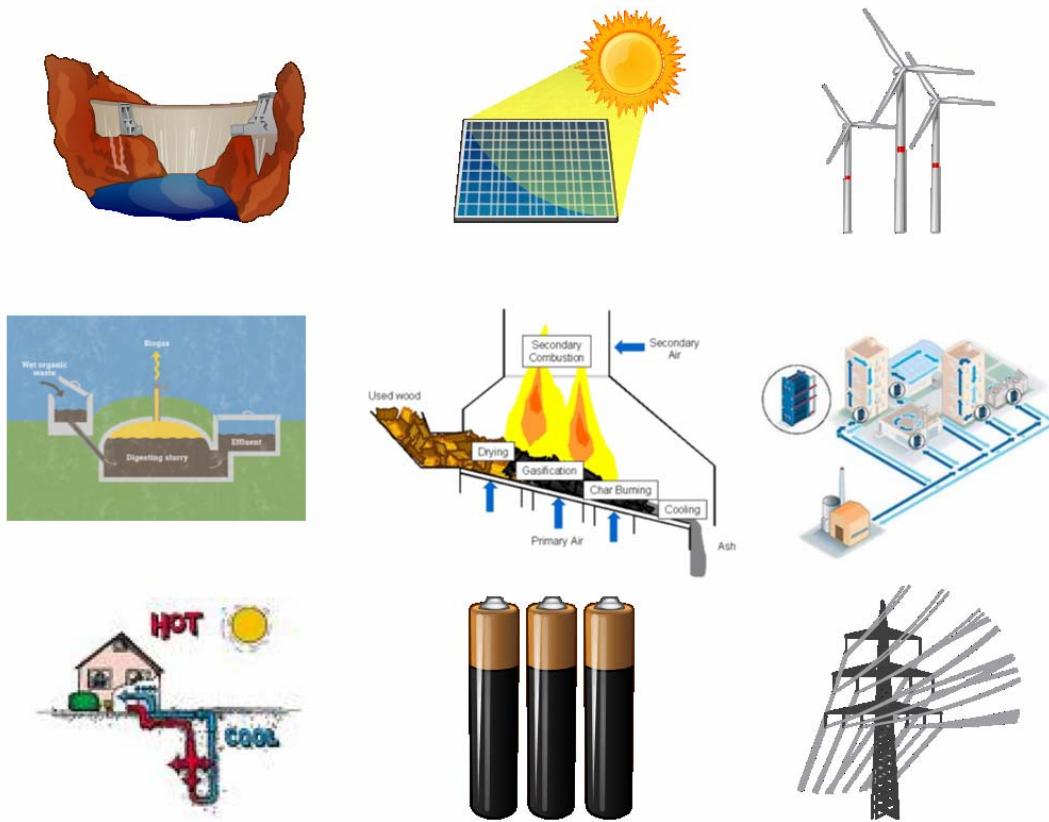


Fig 2: Various Green Energy Technologies

4.2.1 Solar Power

The use of solar power is growing but equipment still requires subsidies. Technology continues to make this option more attractive. Solar Power Energy is one of the fastest growing sectors of the Renewable Energy Sector in India. The estimated potential of Solar Energy in India is 5000 trillion units per year. Most of the expansion in India is to primarily cater to global demand for solar energy infrastructure. The demand in India for solar energy generation infrastructure is growing at 25% per annum. The solar energy industry requires additional incentives by the government to encourage solar power adoption to give an added boost to the sector in India. Some of the major technology trends in Solar Energy Generation in India are: -

1. Solar tracking mechanisms – collectors or parabolic dishes that track the movement of the sun and move accordingly,
2. High efficiency photovoltaic cells – With an efficiency of 13% with single crystal silicon, no moving parts and easy maintenance,

- Cells with concentrators to become effective and deliver same results with lower intensity of sunlight or fewer cells.



Fig 3: SPV Panel

The major constraint to Solar Energy Generation in India is the high initial costs setting up. The solar energy industry requires additional incentives by the government to encourage solar power adoption to give an added boost to the sector in India. Compared to diesel, solar electricity offers a sustainable, cost-effective and environment-friendly electricity supply for growing telecommunication industry.

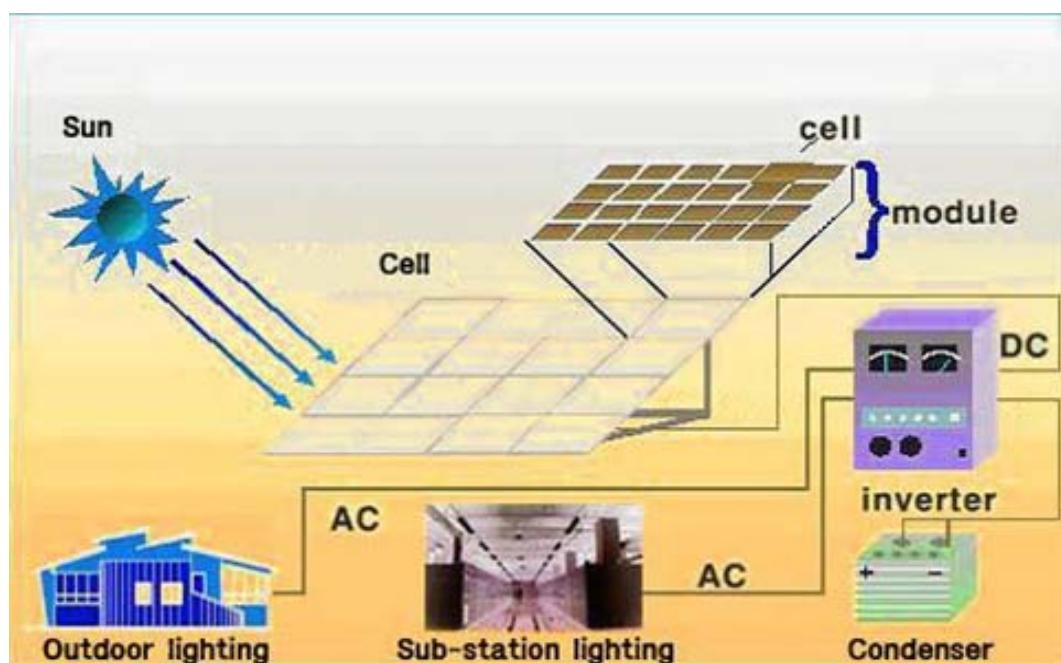


Fig 4: Solar Power System

4.2.2 Run-of-River Hydro

Hydro power is well developed technology. There are few opportunities to create additional sources and there are supporters of taking out existing dams. Run-of-river hydro uses the natural flow and elevation drop of a river to generate electricity without the need for dams or water storage. A portion of the water from a fast-moving river is diverted into a penstock or pipe that channels it to a turbine, then back to the river, leaving enough of the waterway's existing flow so environmental values are protected. New sources of energy from hydro facilities cannot be counted as renewables if those facilities are 60 MW or greater.

4.2.3 Wind Power

Alternative energy will play a larger role in supplying our energy needs. Wind generation is the most popular now and we will see many more wind turbines installed. The issues with wind are price, impact of a variable resource on the grid, and siting. The technology has advanced rapidly in recent years. Wind power is a clean, reliable, renewable, cost competitive source of renewable energy that has been used for decades. A single modern wind turbine can generate up to three megawatts of electricity and is 200 times more efficient than just two decades ago.

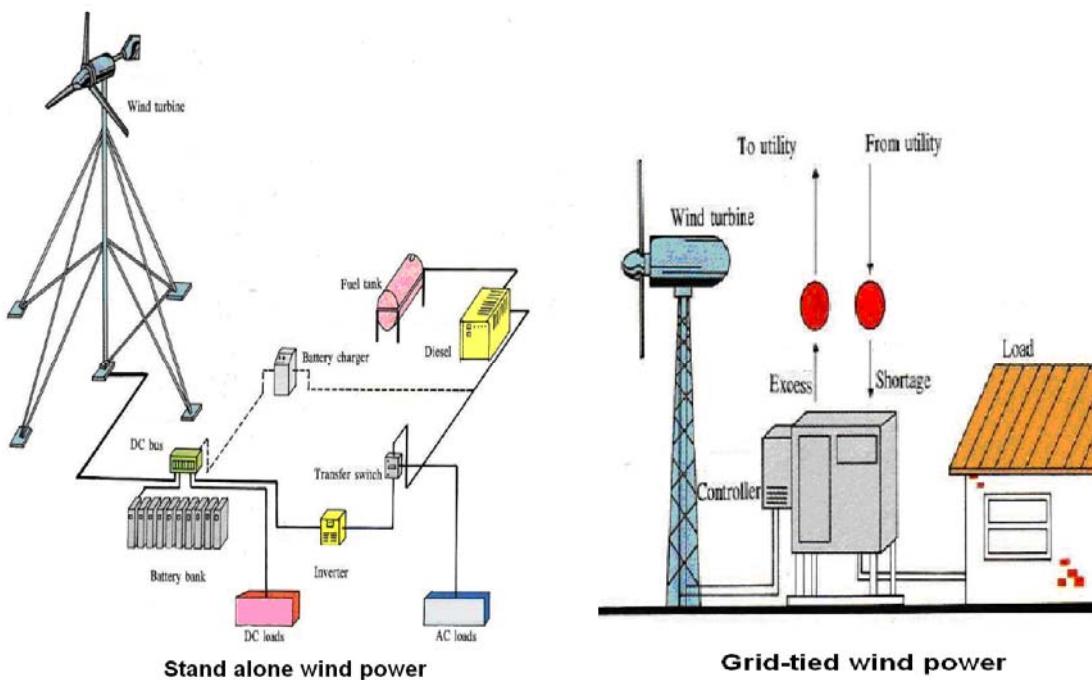


Fig 5: Various Wind Power Generation Techniques

4.2.4 Geothermal Power

Geothermal power is renewable form of energy utilizing underground hot water or steam created by the natural heat beneath the earth's surface. Low temperature geothermal sources can be utilized to heat and cool residential and commercial buildings by installing heat pump systems. Hot water or steam from high temperature geothermal sources can be used to power turbines to produce, clean, renewable electrical energy. The 'hydrothermal' is hot water rather than steam. Geothermal will be used extensively where possible. If one expands the definition to include temperature differences at various levels in the earth, it will get broader use.

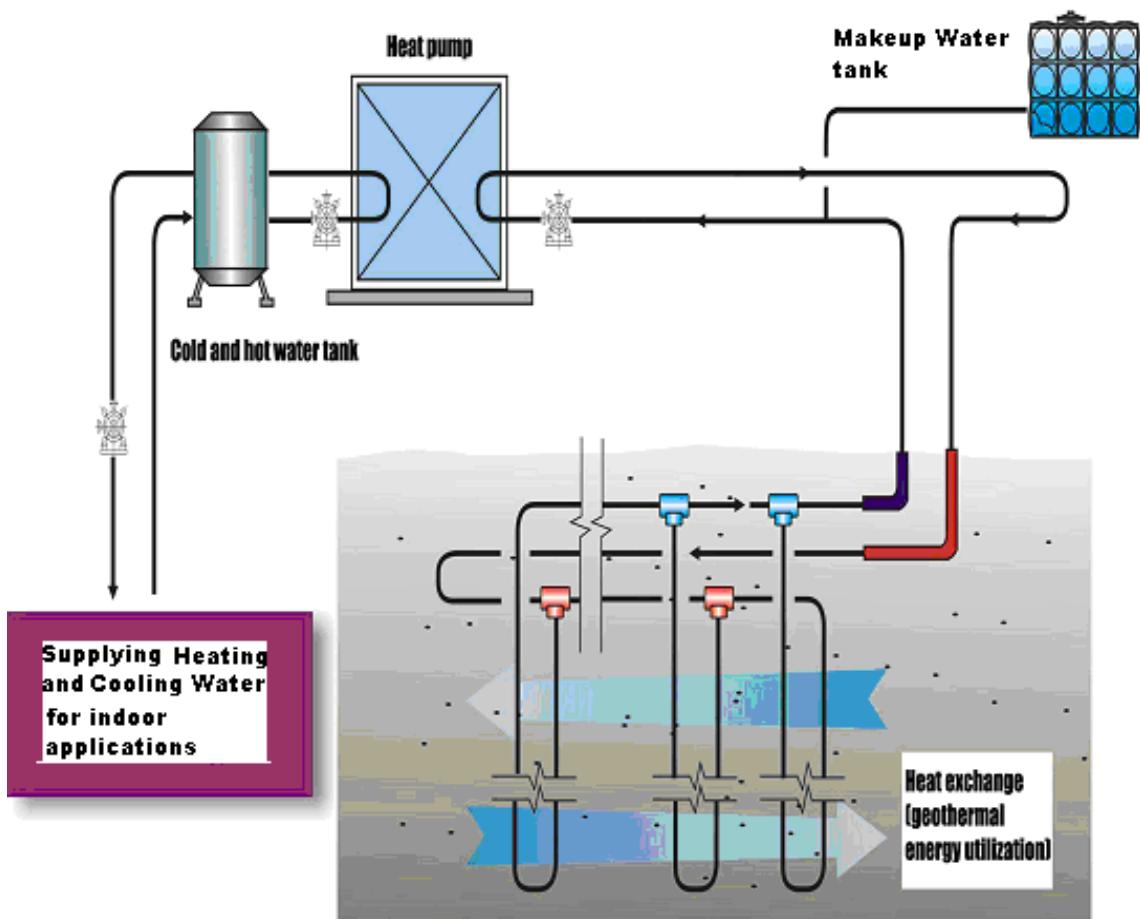


Fig 6: The geothermal power plant

4.2.5 Biomass Power

Biomass generation is the creation of bioenergy (heat and/or power) from wood or wood

residues, agricultural food and feed crop residues, aquatic plants, animal wastes, dedicated agricultural energy crops and tree farms. The biomass used to fuel the plant is uncontaminated wood residue from local forest product companies. The technologies utilized to create bioenergy include combustion, gasification, pyrolysis, digestion and gas collection. These technologies are considered to be carbon neutral due to the short processing cycle involved, combined with the regeneration of carbon through replanting. Biomass technology on dairy farms is developing rapidly. Other forms of biomass generation using switchgrass and other crops will play a role, although small because they require combustion which emits gases and they impact other parts of our food chain.

The Biogas is converting Waste into Gas, Electricity and Organic Fertilizer. It is Smoke-free, clean and healthy cooking environment, time and cost-effective cooking resulting in economic savings, short payback period, more clients attracted because of smoke free environment and creates green jobs for local youth.

4.2.6 Fuel cell

The volatility of natural gas prices has impacted the development of fuel cells. Fuel cells are a promising technology for use, as a source of heat and electricity for buildings, and as an electrical power source for electric motors propelling vehicles. Fuel cells operate best on pure hydrogen. But fuels like natural gas, methanol, or even gasoline can be reformed to produce the hydrogen required for fuel cells. Some fuel cells even can be fueled directly with methanol, without using a reformer. A fuel cell combines hydrogen and oxygen to produce electricity, heat, and water. Fuel cells are often compared to batteries. Both convert the energy produced by a chemical reaction into usable electric power. However, the fuel cell will produce electricity as long as fuel (hydrogen) is supplied, never losing its charge.

Based on the electrical energy generated and the types of chemicals used as the fuel and the oxidant, fuel cells can be categorized into the following basic types:

- Alkali fuel cells
- Direct methanol fuel cell

- Reformed methanol fuel cell
- Direct ethanol fuel cell
- Molten carbonate fuel cells (MCFC)
- Phosphoric acid fuel cells (PAFC)
- Proton exchange membrane fuel cells (PEM)
- Solid oxide fuel cells (SOFC)

A fuel cell can be used in electric vehicles, power plants and smart phones as well as for various portable charging applications. Worldwide, scientists are exploring ways to make fuel cell vehicles economically viable by 2020.

4.2.7 Bio-Fuels

Bio-fuels in liquid form can be produced from the conversion of biomass and used, for example, for transportation. The two most common bio-fuels are ethanol and bio-diesel. Fermenting any biomass that is rich in carbohydrate, such as maize, makes ethanol. Biodiesel is made using vegetable oils, animal fats and algae.

4.2.8 Other innovative solutions:

4.2.8.1 Firewood may also be a renewable energy resource like wind, solar and hydroelectric power. To meet the challenge of global warming, we'll need to use more renewables and less oil, gas and coal in the future. Heating with wood can be a part of the solution, provided the wood is burned efficiently. Because new trees grow to replace those that die or are harvested, the burning of wood does not contribute to global warming and climate change, the way the “fossil” fuels do. When oil, gas and coal are burned, the carbon they contain (which was buried millions of years ago) is oxidized to carbon dioxide (CO_2 - which is the main greenhouse gas). The use of fossil fuels releases ancient carbon, increasing the atmospheric concentration of CO_2 . Wood also releases carbon when burned but its use is almost carbon neutral because trees absorb CO_2 as they grow. When trees fall in the forest and decompose they release the same amount of CO_2 as if they were burned. In other words, rotting is slow oxidation, whereas combustion in a wood stove is fast oxidation, with heat as the main by-product. When considered over the normal tree life cycle of about fifty years, heating with wood can be considered almost

CO₂ neutral, except for the energy used to harvest, process and transport the firewood.

4.2.8.2 Wave power, tidal power and ocean currents can be used to drive turbines to generate electricity. Technologies to harness these forms of power are presently being developed to the stage of commercialization.

4.2.8.3 Manure that's gone through a digester becomes a higher quality organic fertilizer that's more available and less harmful to crops. This means farmers can purchase less commercial fertilizer, which uses valuable natural gas to produce it. The digestion process also eliminates almost all of the manure's odor, helping improve air quality. It also destroys very small seeds in the manure, allowing farmers to use fewer herbicides. And the digested solids can be dried and used for livestock bedding and potting soil. This is a great example of business value offering a compelling driver for sustainable activity.

5.0 Barriers in Renewable Energy Implementation

There are significant barriers to the further implementation of renewable energy that need to be addressed. The key issues include the following:

- 5.1 Many renewable energy technologies remain expensive, on account of higher capital costs, compared to conventional energy supplies for bulk energy supply to urban areas or major industries.
- 5.2 Implementation of renewable energy technologies needs significant initial investment and may need support for relatively long periods before reaching profitability.
- 5.3 There is a lack of consumer awareness on benefits and opportunities of renewable energy.
- 5.4 The economic and social system of energy services is based on centralised development around conventional sources of energy, specifically electricity generation, gas supplies and, to some extent, liquid fuel provision.

- 5.5 Financial, legal, regulatory and organisational barriers need to be overcome in order to implement renewable energy technologies and develop markets.
- 5.6 There is a lack of non-discriminatory open access to key energy infrastructure such as the national electricity grid, certain liquid fuels and gas infrastructure.

6.0 Requirements for implementation

Countries aiming to emulate their success and build strong domestic Clean Energy Technology sectors of their own. These countries should:

- 6.1 Launch Technology Action Programs that develop a single technology from research to demonstration. This will make government support more consistent and bridge the gap between academia and industry.
- 6.2 Central banks should encourage the integration of CO2 risk into financial models to facilitate a shift towards “clean” investments. More capital must also be raised for seed investment in Clean Energy Technology ventures.
- 6.3 Develop a strong home market for Clean Energy Technology applications by influencing the purchasing decisions of government, business and consumers through government procurement, greater stability in (policies on) sustainable energy subsidies and tax differentiation.
- 6.4 There is need of Mandatory conservation and energy efficiency practices Act in India. The major constraint to Solar Energy Generation in India is the high initial costs for setting up. The solar energy industry requires additional incentives by the government to encourage solar power adoption to give an added boost to the sector in India.

7.0 Issues and Challenges

- 7.1 Limitations on carbon dioxide emissions will be more difficult for most of the countries where electric generation comes primarily from coal. The cost of energy will increase dramatically.

- 7.2 In vehicular transport, the policies that will be adopted are not yet clear but it is clear that consumers will have an incentive to decrease the size and weight of vehicles we drive and change the power sources for those vehicles.
- 7.3 Innovative dairy farmers are taking the renewable resource that their cows produce every day – manure – and are using anaerobic digesters to produce and capture methane, which is burned to generate green electricity. Methane, by the way, is a greenhouse gas. It is 12 times more effective in trapping heat in the atmosphere than carbon dioxide.
- 7.4 In Wind Energy the wind Direction Problem arises. Large Wind Turbine (LWT) is using anemometer to assure wind direction has been change and drive servo motor to rotate wind turbine toward the correct wind direction. LWT is not sensitive to the random wind direction change. Small Wind Turbine (SWT) designed with tail which expected to trace wind direction directly; but it results that SWT has been too much sensitive to the random wind direction change. Further, wind turbines causes noise problem at higher rotating speed.
- 7.5 Energy use is a large and increasing cost. Customers have no idea what the overall energy efficiency of their load centers are. There is currently no simple approach for customers to evaluate and compare their overall energy efficiency. Customers cannot identify or prioritize opportunity for energy efficient investments based on a financial return.

8.0 Conclusions

- 8.1 Create energy solutions for a sustainable tomorrow. What will it take for us to be successful in reaching sustainability? It will take a broad-based effort involving entire communities, businesses, and industries in initiatives such as those already identified and in new initiatives we can't even envision yet. We must all become involved.
- 8.2 The industrial sector will have to reduce its use of energy per unit of output. Industries may have to revise their product line to consider only products that are energy efficient, environmentally sustainable, and economically sustainable for them.

- 8.3 The good news is that attaining sustainability is still possible. We have not reached the tipping point. The required changes may seem great. That is where ingenuity, innovation, and education come in. It is the right thing to do. Now we just need to combine our genius and common sense for a sustainable green future.
- 8.4 In telecom industry, with the pressure from carbon credits, all the resource companies are required at ways to help reduce their carbon footprint. The use of Green Energy technology is about the only way. Globally a number of manufacturers of telecom equipment have to commit for R&D in green telecom equipment.

References

1. Larry L. Weyers, Speech on '*Green Energy*', Green Innovations 2009, Environmental Management & Business Institute University of Wisconsin – Green Bay, Speech, April 22, 2009.
2. Roland Berger, Report on '*Clean Economy, Living Planet - Building strong clean energy technology industries*', Wereld Natuur Fonds, November 2009.
3. Department of Minerals and Energy, Republic of South Africa, '*White Paper on Renewable Energy*' November 2003
4. Telecom Regulatory Authority of India, '*Consultation paper on Green Telecommunications*' Consultation paper No. 3/2011.