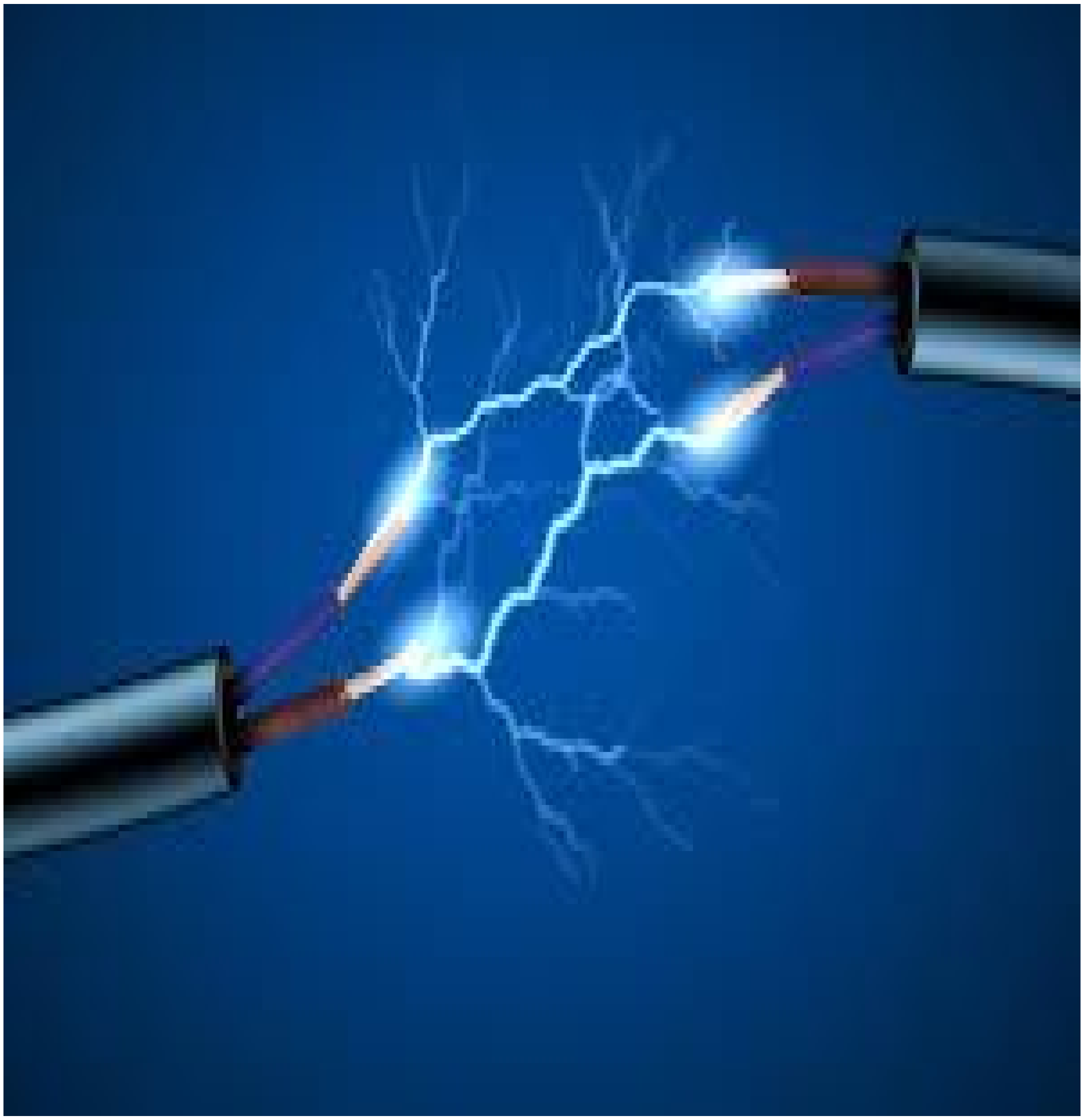
URJA 2015-16

Electrical & Electronics Engineering Department E-Magazine



Research papers
Li-Fi Technology
Solar air conditioning
Virtual reality in India

CONTENTS

Editorial Board

Contents

Principal’s Message

Institute of Engineering and Science, IPS Academy is a leading, premium institution devoted to imparting quality engineering education since 1999. The sustained growth with constant academic brilliance achieved by IES is due to a greater commitment m management, dynamic leadership of the president, academically distinctive and experienced faculty, Disciplined students and service oriented supporting staff. The Institute is playing a key role in creating and ambiance for the creation of novel ideas, knowledge, and graduates who will be the leaders of tomorrow. The Institute is convinced that in order to achieve this objective, we will need to pursue a strategy that fosters creativity, supports interdisciplinary research and education.

I am delighted to note that the engineering graduates of this institute have been able to demonstrate their capable identities in different spheres of life and occupied prestigious position within the country and abroad. The excellence of any institute is a measure of achievements made by the students and faculty.

Dr. Archana Keerti Chowdhary

Principal

HOD’S Message

Our Country is passing through a critical phase of growth. If you take an over view of this growth, we find that we are developing new energy dimension and electrical energy plays the most vital part in total energy context. In fact, electricity is taking the role of indispensible energy form of our daily life. Ours is the sixth largest country in terms of global energy consumption. The last decades of economic growth of our country has brought an unprecedented demand for energy. The installed electrical generating capacity of our country stands at 162366 Megawatts in 2010, and is projected to be 950000 MW by 2030. This large scale use of electrical energy will definitely demand a large team of electrical engineers to manage its use. All the same there is continuous pressure of balancing our ecology especially in context to global warming. This is forcing to ensure efficient use of electrical energy. Electronic power control is offering new tools in management of electrical energy.

Electrical and Electronics engineering together is a dedicated branch of engineering to fulfill all challenges of electrical energy futures.

Prof. B.N. Phadke
HOD

Electrical and Electronics Engineering Department

Vision

The vision of the Electrical and Electronics Engineering is to prepare students to compete globally in their profession, in order to reach the highest level of intellectual attainment and making significant contribution to society.

Mission

- To become an internationally leading Electrical and Electronics Engineering department for higher learning and be self reliant.
- To build upon the culture and values of universal science and contemporary education through understanding of Electrical and Electronics Engineering.
- To be a center of research and education generating knowledge and technologies, this lay groundwork in shaping the future in the fields of Electrical and Electronics Engineering.
- To develop partnership with industrial, R&D and government agencies and actively participate in conferences, technical and community activities

About the Department

Electrical Engineers are the backbone of any country. They provide power for industrial & domestic needs. The department of Electrical & Electronics Engineering was established in the year 2003. B.E. (Electrical & Electronics Engineering) is focus on Electrical Machines, Control System, Power System, Network Analysis. Recently the rapid advance in Semiconductors technology and its application in electrical industry, the branch has introduced adequate number electronics subject like Micro Controller & its Interfacing, Power Semiconductor devices, Power Semiconductor drives, DSP, Advance Communication, Analog and Digital Communication etc. With the emphasis on above areas, the student will acquire analytic and practical skills and hence can serve better in industrial, services and research organizational set ups. The Various laboratories in the department are Basic Electrical Engineering, Electrical Instrumentation, Network Analysis, Electrical Machine, Power System & Protection, Power / Industrial Electronics, Control System, Electronic Devices & Circuits, Microcontroller & Interfacing, Software & Simulation Digital Electronics & Logic Design.

Student Chapter

- Indian society for technical education
- Electrical and Electronics Engineering Association

Student Activities

- Student Council
- Student Placement Cell

Annual Program Organised

National workshop on PLC & SCADA

FDPs and workshops on National Level

National level paper presentation competition

Expert Lecture

Technical Visit

National Quiz

Training Program

Annual Software Training Program Organised

- PLC & SCADA
- NI Instruments lab View
- MATLAB

R & D projects of Department

- Thermo Electric Semiconductor Chip (Peltier Based Devices)
- Anti Collision Devices for Vehicles
- LIDAR Sensor Based 3D RADAR

Achievements of the Faculty

Paper Published in Journals	14
Seminar & Workshop Attended	42
SDP/FDP Attended	12

Student Achievements

- Rahul Karne Won Volleyball Nodal tournament on Nodal Level.
- Mohd. Aaquib Ansari Won Basket-ball tournament on Inter College Level.

Solar Energy:Future Aspects

ANSHUMAN PATWA
anshuman.patwa55@gmail.com
RANJEET SINGH CHOUHAN
ranjeet.singh.chouhan94@gmail.com
BANWARI LAL YADAV
banwariyadav.biaora@gmail.com

ABSTRACT

India, a rapidly growing economy with more than 1 billion people, is facing a huge energy demand. The country stands fifth in the world in the production and consumption of electricity. The electricity production has expanded over the years but we cannot deny the fact that the population of the country is also expanding. The power produced in the country is mostly from coal (53%) and it is predicted that country's coal reserves won't last beyond 2040-50. More than 72% population living in villages and half of the villages remain without electricity. It's high time that our country should concentrate more on energy efficiency, conservation and renewable energy. To meet this surging demand, solar energy is the best form of energy to fulfill the energy needs of India and bridge the energy demand-supply gap.

1 INTRODUCTION

India has tremendous scope of generating solar energy. The geographical location of the country stands to its benefit for generating solar energy. The reason being India is a tropical country and it receives solar radiation almost throughout the year, which amounts to 3,000 hours of sunshine. This is equal to more than 5,000 trillion kWh. Almost all parts of India receive 4-7 kWh of solar radiation per sqmetres. This is equivalent to 2,300–3,200 sunshine hours per year. States like Andhra Pradesh, Bihar, Gujarat, Haryana, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, and West Bengal have great potential for tapping solar energy due to their location. Since majority of the population lives in rural areas, there is much scope for solar energy being promoted in these areas. Use of solar energy can reduce the use of firewood and dung cakes by rural household.

2 GROWTH OF THE SOLAR MARKET IN INDIA

The Rural Electrification Program of 2006 was the first step by the Indian Government in recognizing the importance of solar power. It gave guidelines for the implementation of off-grid solar applications. However, at this early stage, only 33.8MW (as on 14-2-2012) of capacity was installed through this policy. This primarily included solar lanterns, solar pumps, home lighting systems, street lighting systems and solar home systems. In 2007, as a next step, India introduced the Semiconductor Policy to encourage the electronic and IT industries. This included the Silicon and PV manufacturing industry as well. New manufacturers like Titan EnergySystems, Indo Solar Limited and KSK Surya Photovoltaic Venture Private Limited took advantage of the Special Incentive Scheme included in this policy and constructed plants for PV modules. This move helped the manufacturing industry to grow, but a majority of the production was still being exported. There were no PV projects being developed in India at that stage. There was also a need for a policy to incorporate solar power into the grid.

3 PRESENT STATUS OF SOLAR ENERGY IN INDIA

The grid-connected capacity(all PV) in India now stands at 4344.91 MW as of 30August 2015. However, the market is set to grow significantly in the next ten years, driven mainly by rising power demand and prices for fossil fuels, the ambitious National Solar Mission (NSM), various state level initiatives, renewable energy quotas including solar energy quotas for utilities as well as by falling international technology costs.

3.1.GROWTH OF SOLAR ENERGY IN INDIA

India's government has begun to acknowledge the importance of solar energy to the country's economic growth. solar energy will transform rural India, launched a National Solar Mission in 2010. Initial growth has been dramatic. From less than 12 MW in 2009, solar-power generation in the country grew to 190 MW in 2011. Which grew to 4344.91MW on August 2015 but the country has a long way to go to its goal of increasing solar-power generation to 20 gigawatts by 2020. Across India, there are still thousands of villages with plenty of sun but not enough power.

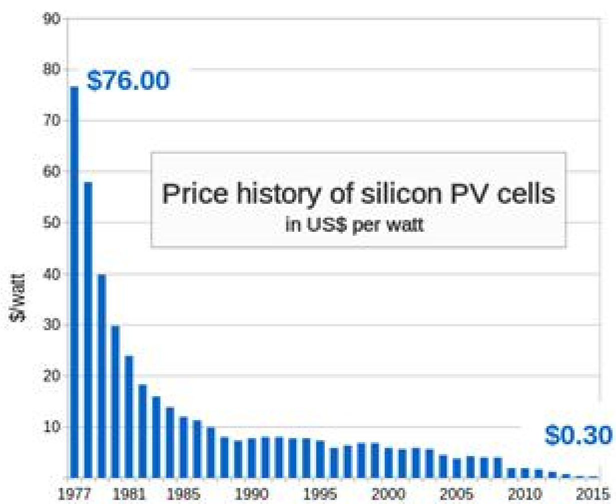


Fig 1: price history of silicon PV cells

4. INDIA'S POTENTIAL OF SOLAR ENERGY

India has a great potential to generate electricity from solar energy and the Country is on course to emerge as a solar energy hub. The techno-commercial potential of photovoltaics in India is enormous. With GDP growing in excess of 8%, the energy 'gap' between supply and demand will only widen. Solar PV is a renewable energy resource capable of bridging this 'gap'.

5. JAWAHARLAL NEHRU NATIONAL SOLAR MISSION

The Jawaharlal Nehru National Solar Mission aims at development and deployment of solar energy technologies in the country to achieve parity with grid power tariff by 2022. The main features of the National Solar Mission are:

1. Make India a global leader in solar energy and the mission envisages an installed solar generation capacity of 20,000 MW by 2022, 1,00,000 MW by 2030 and of 2,00,000 MW by 2050.

2. The total expected investment required for the 30-year period will run is from Rs. 85,000 crore to Rs. 105,000 crore.

3. Between 2017 and 2020, the target is to achieve tariff parity with conventional grid power and achieve an installed capacity of 20 gigawatts (Gw) by 2020.

4. 4-5GW of installed solar manufacturing capacity by 2017.

5. To deploy 20 million solar lighting systems for rural areas by 2022.

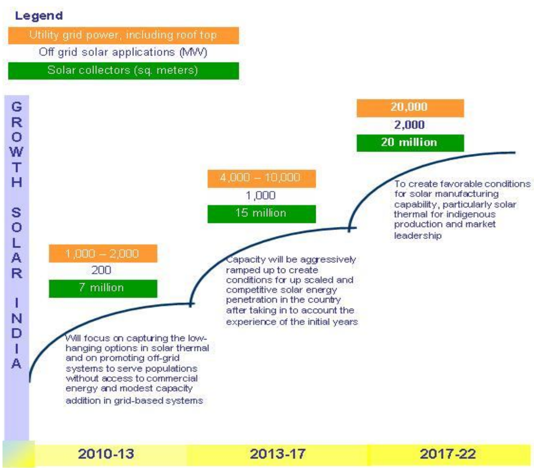


Fig 2: future plans by JNNSM.

6. SOLAR ENERGY DEVELOPMENT IN DIFFERENT STATES

The Gujarat solar policy initiated a process of the states formulating their own policy frameworks independent of the federal guidelines. Other states like Karnataka, Andhra Pradesh and Rajasthan have followed suit in developing solar power development programs. Rajasthan has implemented land banks as well to make land acquisition easier. As more states plan to meet their solar power obligations, new policies are expected to be offered, creating as very vibrant set of markets across the subcontinent.

6.1. GUJARAT SOLAR POWER POLICY -2009

Gujarat is the first state to launch its own solar policy in 2009. The initial target is to achieve 500 MW of installed capacity by the end of this period.

6.1.1. INDIA'S FIRST SOLAR PARK

On December 29th 2010, India's first solar park was inaugurated at Charanaka in Patan district of northern Gujarat. So far, land has been allotted in the solar park for projects worth 176MW to 16 companies from the first and second phases. The total capacity of the solar park is 500MW with 30,000 sq. m per MW land allottedto Solar Thermal and 20,000 sq. m per MW of land allotted to PV projects. The solar park has been financedwith overRs. 12 billion by financial institutions like the International Finance Corporation (IFC), the Asian Development Bank (ADB) and the Infrastructure Development Finance Corporation (IDFC). The park tackles land procurement, water availability and grid connectivity issues and offers a "single-window" clearance process. Sixteen companies, including SunEdison Energy India (25MW), Alex Astral Power (25MW), Roha Energy (25MW), GMR Gujarat Solar (25MW), Kiran Energy (20MW), Emami Cement (10MW) and Azure Power (5MW) have been allotted projects worth a total of 176MW in the park. They have all signed PPAs with the state government.

6.2. KARNATAKA SOLAR POWER POLICY (2011-16)

Karnataka, a south-western state of India, announced its solar policy on July 1, 2011. Under the solar policy 2011-16, the Karnataka Government proposes to promote solar power as part of renewable energy generation policy in the state.

1. It targets 350 MW worth of projects till 2016.

2 .200 MW is to be developed for direct sale to the distribution companies in the state (40 MW to be added each year)

3. 100 MW under REC Mechanism

4. 50 MW for bundling of power with thermal power from outside the state at rates to be determined by the State Government subject to approval of KERC. The minimum capacity of solar PV projects is 3 MW and maximum capacity of 10 MW, while for Solar Thermal the minimum is 5MW with no cap on maximum. The quantum of power to be procured by

ESCOMs from solar resources under purchase obligation is 0.25% of the total consumption and the shortfall in procurement of solar energy by the ESCOMs can be made good by purchase of solar specific RECs. Though the state has come up with its own policy, it will continue to support programs like the NSM. The state has set a combined target of 126 MW of solar power to be developed by 2013-14 through NSM and its own solar policy.

6.3. RAJASTHAN SOLAR POWER POLICY - 2011

On April 19th 2011, Government of Rajasthan issued Rajasthan Solar Energy Policy, 2011 to promote solar energy in the state.The policy aims to help Rajasthan, develop as a global hub of solar power for 10000-12000 MW capacity over the next 10 to 12 years to meet energy requirements of Rajasthan and other states of India.

1. It targets a minimum of 550MW of grid connected solar power in Phase 1 (up to 2013).

2. Projects will be awarded through a process of competitive bidding.

3. PV projects will be worth 300MW, out of which 100MW are reserved for project developers and 200MW forpanel manufacturers.

4. The minimum and maximum sizes for PV projects are 5MW and 10MW.

5.Module manufacturers that set up their manufacturing plant in Rajasthan can bid for either 10MW or 20 MW worth of PV projects based on their manufacturing capacity.

6. A further 50MW will be allocated for rooftop PV (1MW each) and other small solar power plants.

7. The DISCOMS in Rajasthan will provide PPAs for the projects. In addition, projects worth 100MW (50MW PV and 50MW CSP) are targeted for bundled solar power. In such projects, the developer can sell conventional power and solar power in a ratio of 4:1 at the weighted average tariff to the distribution utilities in Rajasthan..

7. SOLAR THERMAL PROCESS

Solar thermal electricity technologies produce electric power by converting the sun’s energy into high temperature heat using various mirror configurations, which is then channeled to an on-site power plant and used to make electricity through traditional heat-conversion technologies. The plant essentially consists of two parts; one that collects Solar energy and converts it to heat, and another that converts the heat energy to electricity.

7.1. SOLAR CELL – A solar cell is a semiconductor device that transforms sunlight into electricity. Semiconductor material is placed between two electrodes. When sunshine reaches the cell, free negatively charged electrons are discharged from the material, enabling conversion to electricity. This is the so-called photovoltaic effect. In theory, a solar cell made from one semiconductor material only can convert about 30 percent of the solar radiation energy it I exposed to into electricity.

7.2. SOLAR PHOTOVOLTAICS–

Photovoltaic has been derived from the combination of two words, Photo means Light and Voltaic means electricity. It is a technology that converts light directly into electricity. Photovoltaic material, most commonly utilizing highly-purified silicon, converts sunlight directly into electricity measures.

8. RURAL ELECTRIFICATION

Lack of electricity infrastructure is one of the main hurdles in the development of rural India. India’s grid system is considerably under-developed, with major sections of its populace still surviving off-grid. As of 2004 there are about 80,000 un electrified villages in the country. Of these villages, 18,000 could not beelectrified through extension of the conventional grid. A target for electrifying 5,000 such villages was fixed balance of systems (BoS) in India, a trend that is likely to continue for the Tenth National Five Year Plan (2002–2007). As on 2004, more than 2,700 villages and hamlets had been electrified mainly using SPV systems

9. FUTURE GROWTH OF SOLAR IN INDIA

The solar industry's structure will rapidly evolve as solar reaches grid parity with conventional power between 2016 and 2018. Solar will be seen more as a viable energy source, not just as an alternative to other renewable sources but also to a significant proportion of conventional grid power. The testing and refinement of off-grid and rooftop solar models in the seed phase will help lead to the explosive growth of this segment in the growth phase. Global prices for photovoltaic (PV) modules are dropping, reducing the overall cost of generating solar power .In India, this led to a steep decline in the winning bids for JNNSM projects. With average prices of 15 to 17cents per kilowatt hour (kWh), solar costs in India are already among the world's lowest. Given overcapacity in the module industry, prices will likely continue falling over the next four years before leveling off. By 2016, the cost of solar power could be as much as 15 percent lower than that of the most expensive grid-connected conventional energy suppliers. The capacity of those suppliers alone, nearly 8 GW in conventional terms ,corresponds to solar equivalent generation capacity potential of 25 to 30 GW. Due to implementation challenges, however, it's unlikely that all of this potential will be realized by 2016. Grid parity will be an inflection point, leading to two major shifts in the solar market. First, thanks to favorable project economics, grid-connected capacity will rise at a much faster rate than before, and second, regulations and policy will be refined to promote off-grid generation.

10. CHALLENGES AND CONSTRAINTS

10.1. LAND SCARCITY

10.2. SLOW PROGRESS

10.3. GOVERNMENT SUPPORT

11. PROBLEM AND SUGGESTIONS

11.1. PROBLEMS

11.1.1. Manufacturing space will still be dominated by imports:-

One area of the solar market won't be dominated by small local companies: manufacturing of modules. Given global overcapacity in this segment, module-manufacturing facilities likely will not be built in India unless mandated by local regulations. If that happens, the lower-cost economics of Indian manufacturers could delay grid parity by two to three years. None the less, global players have already started setting up bases for

11.2. SUGGESTIONS

Global procurement is unlikely to remain a differentiator as more players achieve scale and become adept at it. Creating value in the Indian market, therefore, requires efficient execution, financing, and localization.

11.2.1. FINANCING

Innovative means of financing will create win-win situations for all stakeholders and drive significant up front value for project developers. Differentiated models could include teaming with technology providers from low cost financing countries—Japan, for example—or with consumers seeking sustainability benefits or tax credits. A pool of low-cost project equity developed from retail or other cost sources can add up to a distinct advantage.

11.2.2. LOCALIZATION

Local design and engineering will play a major role in India's solar market. Inverter and balance-of-system designs that incorporate local requirements and eliminate unnecessary elements that are geared more toward global markets can generate significant benefits. Eventually, global players will see the benefits of manufacturing locally and specifically for the Indian market. Competition from local players could further drive down systems costs.

11.2.3. AN OPEN MARKET

Although India's solar market appears well suited for local players, it's currently open to global players as well. In deed, global firms that tailor their broad expertise to serve unique local needs in a frugal way could actually extract significant value. At the same time, local players can bridge capability gaps by striking appropriate alliances, or by recruiting strong teams or individuals. A partnership of foreign technology and local EPC canhelp both parties climb up the steep learning curve fast, but mechanisms will need to be put in place to ensure that the risks and upsides are shared equally. Both parties involved will need a long-term view of the market ,with lessons learned from initial projects built into subsequent ones.

12. CONCLUSIONS

Present Study led us to three major conclusions:

12.1. India's solar market could be worth billions of dollars over the next decade**:-** India's solar potential is real enough, and the support environment is improving fast enough, to forecast a $6 billion to $7 billion capital-equipment market and close to $4 billion in annual revenues for grid-connected solar generators over the next decade.

12.2. Project execution, financing, and localization are crucial.***:***-A frugal cost base will be at the core of successful Indian solar ventures. As the number of projects and players increases, procurement effectiveness will become a requirement. Longer-term value will come from efficiently executed projects, low-cost (and often innovative) financing, and localization.

12.3. Local players will dominate the downstream solar industry:-In contrast to the global nature of the upstream industry (solar modules), we expect local, or at least well-localized players to dominate the downstream side in the initial years; this includes project development, installation, and distribution. Given sufficient time to fine-tune their business models, global players entering India for the first time will be able to prosper. Entering and learning the ropes early will be important for both local and global players. While some players have already begun preparing, most have yet to place a bet on solar, given the uncertainties within the sector. Success in solar energy will require a long-term commitment and a sound understanding of local dynamics.

REFERENCES

1. www.seci.gov.in

2. Jawaharlallal Nehru national solar mission.

3. India.gov.in

4.Delhi International Renewable Energy Conference (DIREC-2010): accessed on 12 Dec, 2010 (http:/www.direc2010.gov.in/)

5.US-India Energy Partnership Summit, Washington DC(2010); Solar Energy Review, New Delhi-India

6. http://www.energymile.com

7. http://www.worldenergyoutlook .org/

8. www.pcra.org

Fuel Cell Technology and it's Applications

Yash Jaiswal (080EX141080)

Second year, B.E ,Department Of Electrical And Electronic Engineering,

I.E.S, IPSA, Indore, Madhya Pradesh, India

yjaiswal27@gmail.com

***Abstract**-*

Energy is an inescapable part of today's society and economy. Accomplishment of every work depends on the sufficient and incessant supply of energy. But the conventional fossil energy sources like oil are ultimately limited. Moreover, the increasing demand and flinching supply of oil has made the sustainable energy supply more vulnerable This paper discusses these crucial energetic, environmental and sustainability issues and the role of hydrogen and fuel cell technologies as one of the potential solutions to these issues This paper provides a survey of fuel cell technology and application. A description of fuel cell's operating principles is followed by a comparative analysis of the current fuel cell technology together with issues concerning various fuels. Appropriate applications for current and perceived potential advances of fuel cell technology are discussed.

I. INTRODUCTION-

In order to move towards a sustainable existence in our critically energy dependent society there is a continuing need to adopt environmentally sustainable methods for energy production, storage, and conversion. The use of fuel cells in both stationary and mobile power applications can offer significant advantages for the sustainable conversion of energy. Benefits arising from the use of fuel cells include efficiency and reliability, as well as economy, unique operating characteristics, and planning flexibility and future development potential. By integrating the application of fuel cells, in series with renewable energy storage and production methods, sustainable energy requirements may be completely realized.[1]. The main objective of this paper is to discuss the role of hydrogen and fuel cell systems for sustainable future, and present a study on the life cycle assessment of fuel cell from energy, environment, and sustainability points of views.

II. FUEL CELL FUNDAMENTALS

A. Description

A fuel cell is conventionally defined as an

"electrochemical cell which can continuously convert the chemical energy of a fuel and an oxidant to electrical energy by a process involving an essentially invariant electrode-electrolyte system",For a hydrogen/oxygen fuel cell the inputs are hydrogen (fuel) and oxygen (oxidant) and the only outputs are dc power, heat, and water. When pure hydrogen is used no pollutants are produced, and the hydrogen itself can be produced from water using renewable energy sources such that the system is environmentally benign. In practice hydrogen is the best fuel for most applications. In addition to hydrogen some fuel cells can also use carbon monoxide and natural gas as a fuel. In these reactions, carbon monoxide reacts with water producing hydrogen and carbon dioxide, and natural gas reacts with water producing hydrogen and carbon monoxide, the hydrogen that is produced is then used as the actual fuel.

B. Electrochemistry

The basic physical structure of all fuel cells consists of an electrolyte layer in contact with an anode and cathode electrode on either side of the electrolyte. The electrolyte provides a physical barrier to prevent the direct mixing of the fuel and the oxidant, allows the conduction of ionic charge between the electrodes, and transports the dissolved reactants to the electrode. The electrode structure is porous, and is used to maximize the three-phase interface between the electrode, electrolyte and the gas/liquid, and also to separate the bulk gas phase and the electrolyte. The gas/liquid ionisation or de-ionisation reactions take place on the surface of the electrode, and the reactant ions are conducted away from or into the three-phase interface [1]. A schematic representation of a fuel cell with the reactant/product gases and the ion conduction flow directions through the cell is shown in Fig.1.

In theory a fuel cell is capable of producing an electric current so long as it supplied with fuel and an oxidant. In practice the operational life of the fuel
cell is finite, and fuel cell performance will gradually deteriorate over a period of time as the electrode and electrolyte age. However, because fuel cells operate with no moving parts, highly reliable systems are achieved.

C. Advantages

The main advantages of fuel cells are:

Efficiency **-** Fuel cells are generally more efficient
than combustion engines as they are not limited by
temperature as is the heat engine.

Simplicity **-** Fuel cells are essentially simple with few or no moving parts. High reliability may be attained with operational lifetimes exceeding 40,000 hours (the operational life is formally over when the rated power of the fuel cell is no longer satisfied)

Anode reaction	Cathode reaction	Overall reaction
$H_2 \rightarrow 2H^+ + 2e^-$	$^1/_2\, O_2 + 2H^+ + 2e^- \rightarrow H_2O$	$H_2 + {^1/_2}\, O_2 \rightarrow H_2O$

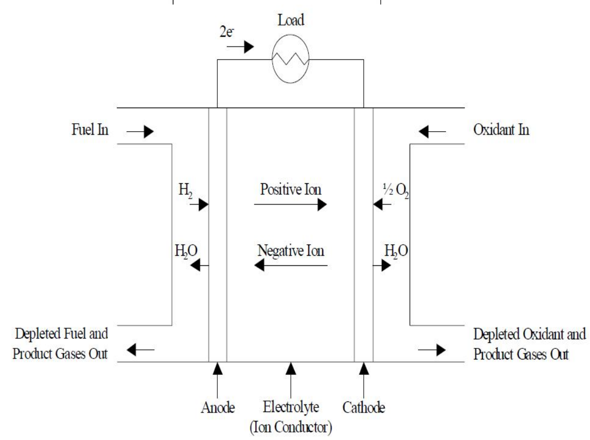


Fig.1 Basic working concepts [2]

Low emissions - Fuel cells running on direct hydrogen and air produce only water as the byproduct.

Silence **-** The operation of fuel cell systems are very
quiet with only a few moving parts if any. This is in
strong contrast with present combustion engines.

Flexibility **-** Modular installations can be used to match the load and increase reliability of the system.

D. Disadvantages

The principal disadvantages of fuel cells, however, are the relatively high cost of the fuel cell, and to a lesser extent the source of fuel. For automotive applications a cost of US$10 to $50 per kW and an operation life of 4000 hours is required in order to compete with current internal combustion engine technology. The current cost for automotive applications has been decreased from US$**115** in 1998 to US$**55** in 2014,which makes usage of fuel cell technology very feasible.[7]

Whereas For stationary combined heat and power systems a cost of US$1000 per kW and an operation life of 40,000 hours is required [7]. The current cost of a fuel cell system is around US$2000 per kW for large systems with additional costs required for the heat exchanger in the combined heat and power systems. The cost of fuel cells will be brought down with advancing Fabrication technology and ongoing researches in Material science and Nanotechnology, also the prices are significantly lowered Using mass manufacturing, and costs of US$100 per kW have been predicted in 2030 as the production of fuel cells expand over the following few years [7].

III. FUEL CELL CLASSES

There are five primary classes of fuel cells, identified by their electrolyte, which have emerged as viable systems [3]. Although the most common classification of fuel cells is by the type of electrolyte used, there are always other important differences as well. Each fuel cell class differs in the materials of construction, the fabrication techniques, and the system requirements. The potential use for different applications is inherent in the main characteristics of each fuel cell class [1].

Solid Oxide (SOFC): The solid oxide fuel cell operates between 500-1000^{0}C. The electrolyte in this fuel cell is a solid, nonporous metal oxide and the charge carriers are oxygen ions. The electrolyte always remains in a solid state adding to the inherent simplicity of the fuel cell. The solid ceramic construction of the cell, can minimize hardware corrosion, allows for flexible design shapes, and is impervious to gas crossover from one electrode to the other. Due to the high temperature operation, high reaction rates are achieved without the need for expensive catalysts and also gases such as natural gas can be internally reformed without the need for fuel reforming. Unfortunately the high operating temperature limits the materials selection and a difficult fabrication processes results. In addition the

ceramic materials used for the electrolyte exhibit a relatively low conductivity, which lowers the performance of the fuel cell.

Polymer Electrolyte Membrane (PEMFC):

The polymer electrolyte membrane fuel cell operates at 50-100^{0}C. The electrolyte in this fuel cell is a solid ion exchange membrane used to conduct protons. Hardware corrosion and gas crossover are minimized as a result of the solid electrolyte and very high current densities as well as fast start times have been realized for this cell. However due to the low temperature operation, catalysts (mostly platinum) are needed to increase the rate of reaction. In addition heat and water management issues are not easily over come in a practical system, and tolerance for CO is low.

Alkaline (AFC): The alkaline fuel cell operates between 50-250^{0}C. The electrolyte in this fuel cell is KOH, and can be either mobile or retained in a matrix material. Many catalysts can be used in this fuel cell, an attribute that provides development flexibility. The ACF has excellent performance on hydrogen and oxygen compared to other candidate fuel cells. The major disadvantage of this fuel cell is that it is very susceptible to CO2 and CO poisoning and hence its use with reformed fuels and air is limited.

Phosphoric Acid (PAFC): The phosphoric acid fuel cell operates at 200^{0}C with phosphoric acid (100%) used for the electrolyte. The matrix universally used to retain the acid is silicon carbide, and the catalyst is Platinum. The use of concentrated acid (100%) minimises the water vapour pressure so water management in the cell is not difficult. The cell is tolerant to CO2 and the higher temperature operation is of benefit for co-generation applications. The main limitation of the PAFC is the lower efficiency realized in comparison with other fuel cells.

Molten Carbonate (MCFC): The molten carbonate fuel cell operates at 600^{0}C. The electrolyte in this fuel cell is usually a combination of alkali carbonates retained in a ceramic matrix. At the high temperature of operation the alkali carbonates form a highly conductive molten salt, with carbonate ions providing ionic conduction. The high reaction rates remove the need for noble metal catalysts and gases such as natural gas can be internally reformed without the need for a separate unit. In addition the cell can be made of commonly available sheet metals for less costly fabrication. One feature of the MCFC is the requirement of CO2 at the cathode for efficient operation. The main disadvantage of the MCFC is the very corrosive electrolyte that is formed, which on the fuel cell life, as does the high temperature operation. In addition to the five primary fuel classes, there are two more classes of fuel cells that are not distinguished by their electrolyte. These are the Direct Methanol Fuel Cell (DMFC), distinguished by the type of fuel used, and the Regenerative Fuel Cell (RGF) distinguished by its method of operation.

IV. FUELS FOR FUEL CELLS

A. *Fuel Requirements*

In theory, any substance that is capable of being chemically oxidised at a sufficient rate at the anode of the fuel cell may be used as a fuel. In the same sense, any substance that is capable of being reduced at the cathode of the fuel cell at a sufficient rate may be used as an oxidant [2]. In practice, hydrogen is the best fuel for most applications. The low-temperature fuel cells such as the AFC, PEMFC, and PAFC, are electrochemically constrained to hydrogen fuel use only, while the high temperature fuel cells such as MCFC and the SOFC, in addition to hydrogen can also use carbon monoxide and natural gas as a fuel. In these reactions, carbon monoxide reacts with water producing hydrogen and carbon dioxide, and natural gas reacts with water producing hydrogen and carbon monoxide, the hydrogen that is produced is then used as the fuel. Similarly, oxygen is the most common oxidant because it is readily and economically available from air.

B. *Advantages of Hydrogen*

The wide spread use of hydrogen as the fuel choice for fuel cells has the following benefits [2]:

- High electrochemical reactivity when suitable catalysts are used, and high energy content (kJ/kg),
- The oxidation of hydrogen is a simple and environmentally benign reaction that makes zero emissions power systems possible,
- The source of energy production is not constrained to any particular fuel type and hence provides the basis for a rapid progress towards asustainable transportation and electricity system,
- An increase in retail price competition as a result of the many fuel sources available.

C. *Sources of Hydrogen*

Unfortunately, hydrogen does not occur naturally as a gaseous fuel and must be produced from another source. Potential sources of hydrogen include, such as fossil fuels (coal, oil, or natural gas), a variety of chemical intermediates (refinery products, ammonia, methanol), and alternative resources such as bio-mass, bio-gas, and waste materials. Hydrogen can also be produced by water electrolysis, which uses electricity to split hydrogen and oxygen elements [6]. The electricity for the water electrolysis can be generated from conventional sources or from renewable sources. In the longer term, hydrogen generation could be based on photo-biological or photochemical methods [2].

D. *Hydrogen storage*

In addition the storage of hydrogen, although not limited to, can be achieved in the simple form of a compressed gas. While the use of compressed hydrogen gas in stationary applications presents a

viable option there is concern that the insufficient density of storing hydrogen as a compressed gas limits its inclusion in mobile applications. This is however not necessarily the case, as is illustrated with the design approach of using compressed hydrogen gas storage in the ultra light fuel cell vehicles termed hypercars [1]. Finally, the safe storing hydrogen as a compressed gas Hydrogen is also non-toxic and requires a four fold higher concentration than petrol to ignite [5]. are in many ways less stringent than the safe storing of alternative fuels such as methanol, petrol, or natural gas. The hydrogen gas would be stored in extremely strong carbon fibre cylinders. Because of the rapid
diffusion of hydrogen any spill will dissipate quickly

V. FUEL CELL APPLICATIONS

As a result of the inherent size flexibility of fuel cells, the technology may be used in applications with a broad range of power needs. This is a unique feature of fuel cells and their potential application ranges from systems of a few watts to megawatts. Fuel cell applications may be classified as being either mobile or stationary applications. The mobile applications primarily include transportation systems and portable electronic equipment while stationary applications primarily include combined heat and power systems for both residential and commercial needs.

APPLICATION IN AUTOMOTIVE INDUSTRY

The current most feasible and promising application of fuel cell is in the automotive sector, by using pre-processed fuel (hydrogen, methanol, hydrocarbons) an independent system

Additional methods of hydrogen storage include [3]:

1. Storage as a cryogenic liquid,
2. Storage as a reversible metal hydride,
3. The use of metal hydride reactions with water, and
4. The use of carbon nano-fibers.

The first three methods of hydrogen storage are currently available and are generally well understood processes. The fourth method, which uses carbon nano-fibres for hydrogen storage is not yet practical although considerable efforts are being invested into making this a feasible technology.V

.

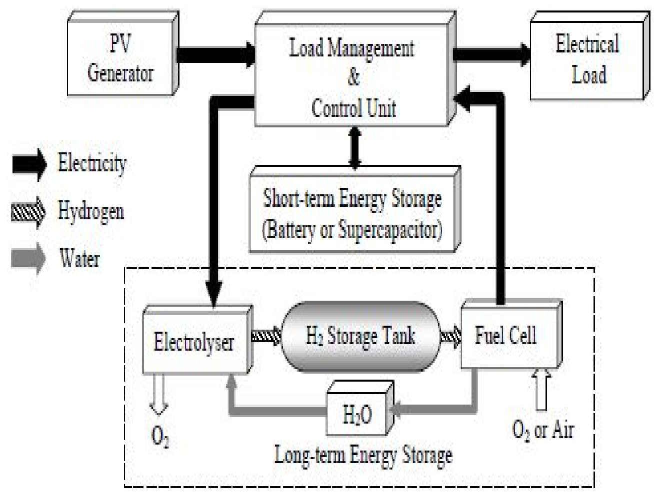
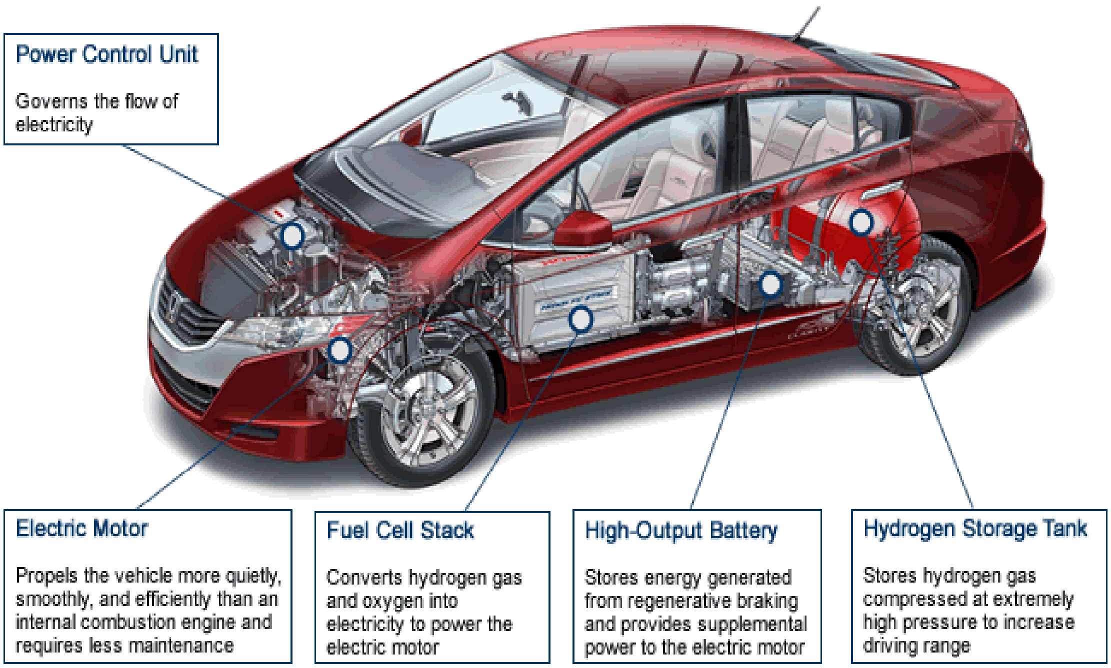


Figure 2. Block Diagram of Fuel Cell and Renewable Hydrogen Energy System

can be assembled using a battery hybrid model to bring this technology into effective practical use.



VI. CONCLUSION

In summary the significant areas identified for further research relate to the storage of hydrogen, the integration of fuel cells with renewable energy sources, and the modelling and methodology for system optimization and design.The primary barrier to the commercialization of fuel cell applications is the associated manufacturing cost. Currently the cost of fuel cell systems is greater than that of similar, already available products, mainly because of small scale production and the lack of economies of scale. The best fuel for fuel cells is hydrogen and another
hyper car concept. As fuel cell application increases and improved fuel storage methods and handling is developed, it is expected that

barrier is fuel flexibility. In stationary applications there is a case for using natural gas or electricity from conventional sources, as an intermediate step to reduce the large infrastructure costs associated with implementing a hydrogen economy. In mobile applications particularly transportation there is a case for deriving hydrogen from the onboard reforming of an alternative fuel. This would however seriously limit the flexibility of the fuel source. For this reason a better approach would be the storage of hydrogen directly onboard as demonstrated with the
the costs associated with fuel cell systems will fall dramatically in the future.

VII. REFERENCES

[1] B.J. Holland, J.G. Zhu, and L. Jamet ,*FUEL CELL TECHNOLOGY AND APPLICATION*, Faculty of Engineering,University of Technology, Sydney(2007)

[2] Ibrahim Dincer ,*Hydrogen and Fuel Cell Technologies for Sustainable Futur Faculty of Engineering & Applied Science, University of Ontario Institute of Technology, North Oshawa,*

Canada

[3] Khizir Mahmud,**Fuel** *Cell and Renewable Hydrogen Energy to Meet Household Energy Demand Department of Electrical Engineering, Northwestern Polytechnical University, Xi'an - 710072, PR. China.*

[4] https://en.wikipedia.org/wiki/Alkaline_anion_exchange_membrane_fuel_cells?oldid=659240090

[5] A.B. Lovins and B.D. Williams, "*A strategy for the Hydrogen Transition*", Rocky Mountain Institute,

[6] www.nfcrc.uci.edu/journal/article/fcarticleE.htm, National Fuel Cell Research Center at the University of California.

[7] Haruki Tsuchiyaa ,"*Mass production cost of PEM fuel cell by learning curve*" aResearch Institute for Systems Technology, 2-1-6, Higashinihonbashi, Cuouku, Tokyo, Japan

OLED (Organic LED)

Vaishnavi Gupta(Vaishnavi.gupta28@gmail.com), Priyanka Kumari(Pf.priyanka15@gmail.com),Saumya Anand(Saumyaanand.165@gmail.com)

Abstract

Thinking about the statement „Everything Is Just A Touch Away‟, becomes real when we talk about the shimmering OLED Technology. OLED is one of the most recent, upcoming and promising next-generation lighting technologies. It has taken over the world of LCDs and LEDs. OLED is an Organic Light Emitting Diode. OLED lighting panels are a thin device that emits uniformly distributed light over their surface. They can be made flexible and transparent. This paper focuses on a general discussion about the history of OLED and its evolution. The working is explained in a simplified manner without going into the deep details. This paper also focuses on the present as well as future aspects of OLEDs. Some advantages and disadvantages of OLEDs are also mentioned. In the end, the advancement ideas and development aspects are discussed in brief.

Keywords— OLED, LED, Display, Electrons, Panel, Diode, Applications

INTRODUCTION

OLED is a new promising technology that is gathering pace in the market because of its brilliant features. OLED‟s full form is Organic Light Emitting Diode. OLED displays have entered the market in the form of electronic equipments such as digital cameras, mobile phones, console games and radio displays. OLED displays have high switching speed that leads to high refresh rate and helps full motion videos to work properly. Due to the simple construction and polymer material, the cost of production reduces in OLED manufacture. Examples of thin displays start from Sony‟s first production XEL-1 with 3 mm thick screen that now has gone to 0.3 mm thick. In theory, these displays can be rolled up like real paper and can be hung on a wall using some adhesive [1]. The self luminescence property of OLED helps to bring bright real colours. OLED displays are being used in the mobile handsets as well. Day by day, the production cost of OLED screens is increasing. In June 2008, Samsung was one of the first companies to announce a $55 million investment for 2 inch OLED screen. OLED is a thin film solid state device [2]. It is basically an LED (Light Emitting Diode), in which the organic compound is used as emissive electroluminescent layer. When electric current passes through this compound, light is generated. There are two types of OLEDs: a) OLED with small molecules b) OLED with polymers

The OLED displays can be either active or passive.

AMOLED

(Active Matrix Organic Light Emitting Diode) is a display technology which is being used in Television and display phones. The AMOLED display contains active matrix of OLED pixels. When electric current is passed, these pixels generate light. The TFT (Thin Film Transistor) works as switches that controls the flow of current to individual pixel. At each pixel level, at least two TFTs control the flow of current. One of the TFTs is used for the process of starting and stopping of the capacitor charger and other to give constant current. Super AMOLED is the term given by the

Samsung that means that touch is integrated in the screen itself. Minimum sunlight is reflected by these screens. The future perspective of AMOLED is the transparent Super AMOLED Plus which will be flexible, 3D and unbreakable. In this, the substrate used is a polymer, so there is no need of glass cover or metal backing.

PMOLED

(Passive-Matrix OLED), controls each row of display turn by turn. It does not contain storage capacitor, so they are not aligned most of the time. So, more voltage is required for brighter look. They are not efficient, have a short lifetime and suffer from less resolution and size [3]. OLED display does not require a backlight. So, it displays crisp images and deep black levels. OLEDs are thinner and lighter as compared to LCDs. Multi pixel colour display OLED have many remarkable applications. Single pixel form is being used by many lighting manufacturers in Europe like OSRAM and Philips.

HISTORY

The electroluminescence in organic compound was first observed by Andre Bernanose and his co-workers in France. In the experiment, they applied AC voltage to acridine orange. This lead to direct excitation of electrons those emitted light. Later in 1960, Martin Pope used DC voltage and vacuumed area on pure single crystal of anthracene for the production of electroluminescence. They described the need for holes and electron injecting electrode contacts. This was taken as a base for charge injection in all modern OLEDs. In 1965, pope proposed that electroluminescence in antracene crystal was due to reunion of electron and hole and the conductivity of antrascene was high in absence of external electric field. In 1965, W Helfrich and WG Schneider generated double injection recombination electroluminescence in anthracene using hole and electron injecting electrode. Polymer was first used for electroluminescence by Roger Partridge. Ching W Tang and Steven Van Slyke discovered the first diode device. The structure of this device consisted of two layers: one layer consisted of hole transporting and the other layer had electron transporting. In this paper, the emission of light and reunion took place in the middle of organic layer. As a consequence, it leads to improved efficiency and less use of voltage [4]. This is the current scenario of OLED working. OSRAM was the first company to introduce the first lighting device in 2008. It was a desk lamp that was created by Ingo Maurer who used 10 OLED panels.

WORKING

OLED is a semiconductor device in a solid state. It is approximately 100-500 nm thick in structure. Two or three layers of organic materials are used to make an OLED. In this structure, third layer is used to carry the electrons from cathode to emissive layer. OLED contains anode and substrate. In an OLED, the organic matter is sandwiched between a cathode and an anode, which are the two electrodes and this arrangement is then put on a substrate. The organic molecules of the organic matter are electrically conductive in nature which is due to the delocalisation of Pi electrons. The conducting nature of organic materials can be as conductive as insulators and can also be as conductive as conductors [5]. This is the reason why they are considered as organic semiconductors. HOMO (Highest Occupied Molecular Orbital) and LUMO (Lowest Unoccupied Molecular Orbital) are the two parts of the semiconductor. In the beginning, the most simple polymer OLED that was made consisted of only one organic layer. But to improve efficiency, multilayer OLEDs were made with the help of two or more layers. The most prevalent OLEDs these days are made up of two layers, out of which one is conductive layer and the second one is an emissive layer. In the working of an OLED, the voltage is given to the OLED such that when compared to cathode, anode stays positive [6]. A good anode should have properties like good optical transparency, electrical conductivity and chemical stability. The current in the OLED flows from cathode to anode as the electrons are injected in the cathode of the LUMO layer and are withdrawn at anode from the HOMO layer. The anode gets rid of the electrons from the conductive layer. Electrons try to find the electron holes, which are present at the edges of conductive and emissive layer. Whenever an electron finds any electron hole, it fits by filling the hole and it leads to the release of energy by the electrons in the form of light (photon). In this way, the light is emitted by OLED. The colour intensity depends on the factors such as amount of electric current applied and the kind of organic matter present in the emissive layer. OLEDs produce full colour display using RGB matrix. It contains three basic colours i.e. green and blue, which have different aging rate. So to maintain the balance, a compensation algorithm is used [7].

ADVANTAGES AND DISADVANTAGES

1. Advantages

a) The display of organic light emitting diode is brighter than LEDs.

b) The backlight is not required in organic light emitting diode. LCD blocks the backlight to form images on the screen, while OLED produces their own light.

c) Power consumption is less in organic light emitting diodes.

d) It’s easy to produce light emitting diodes.

e) Organic light emitting diodes have around 170 degree of field view.

f) As compared to LCD, OLED screen achieves greater contrast ratio in low light conditions.

g) Organic light emitting diode doesn‟t contain harmful material like mercury

h) OLED provides high colour quality and turns on immediately when the current is applied

2. Disadvantages –

a) OLED can be damaged by water.

b) It is an expensive technology.

c) The working of organic light emitting diode is interrupted in sunlight.

d) Organic light emitting diode has relatively shorter life span

USAGE-

1. Present Use:

a) Curved TV- OLED technology is used in LG‟s Curved OLED TV as shown

In this, electric current passes through an organic substance that glows in excited state. It shows crisp colours. It is 4.3mm in thickness and 17 kg in weight. OLED screen has minimum glare on the screen. It is a bit expensive and costs around $17000

b) OLED displays are used in latest mobile phones like Samsung, Nokia, etc.

c) OLED displays are used in display screens of digital cameras like Kodak.

d) Military uses the unbreakable property of OLED displays. Due to ruggedness nature, military people need something really strong. The wide field of view property of OLED is also used. OLED consumes less power, so it is being used in thermal imaging, simulation and training in military. There are two types of applications of OLED in military: - The near eye micro display and flexible OLED which were developed by Universal Display Corporation (UDC). The devices that are used in military include display sleeves, windshield displays and visor mounted displays [11].

e) In 2008, the world’s first flexible OLED was introduced for military operations which can be used for both daytime and night due to its property of emitting visible green emission during daytime and infrared (IR) emission during night.

2. Future Use:

a) Future OLED TV- The future TV would be 80 inch wide and 0.25 inch thick. They could be rolled up when not in use. They will be very light in weight [12].

b) Philips and BASF are making a car with transparent roof. The roof will be solar powered, when these will be switched off the roof will become transparent [16].

c) OLED panels will be used in windows. When they will be switched on, it will make the window opaque and emit lights of desired colours. When they will be switched off it will make the window see through.

d) OLED panels will be used in the washrooms in the place of mirrors. A person can use it as a mirror or a warm reflecting planer. The tiles can be replaced by OLED to make warm surroundings.

e) Large OLED ceilings as shown in Figure 2, will be used as an artificial sky in a building [13].

f)OLED will work in an interactive mode. The roof of bus top will be made of OLED. It will light up only when there will be people underneath it.

g) Audi, Phillips, Merck are working on Audi TT that will be worlds first OLED car with real lighting panel as shown in Figure 3 [19]. Figure 3. OLED Lighting Panel

h) Use in Laptops as shown in Figure 4, OLED panel will be used to make laptop screen i) Used in Keyboards- OLED will be used in keyboards .It will be a large panel that would be touch sensitive. It is called Optimus Tactus [18]. OLED will also be used in individual keys. According to the application, the context will change on the keys like in the case of different

j) Use in mobile phones-OLED will be used in future mobile phones that will be flexible, roll able, and bendable as shown in Figure 6 [17]. Figure 6. OLED Mobile

l) OLED will be used in military operations in the form of shades, camouflage systems and smart light emitting windows.

CONCLUSION

OLED Technology is evolving very fast. It has become the new glitter of all the gadgets. It is taking the electronic aspect to a new dimension. All the electronic companies are trying to implement and use this technology in one way or the other. Till now it is not widespread because of its cost, lack of knowledge among masses and developments. With the help of OLED technology:

a) The battery life of gadgets will be longer.

b) The display of devices will consume relatively less energy.

c) The viewing angles of the displays will be larger.

d) The displays will have sharper colours and deeper blacks.

e) The display panels will be thin as paper.

f) The cars will be able to communicate with each other through displays.

The human race is using OLED technology in advancements and improvements. The resources are being carefully used as OLED is much more efficient as compared to existing ongoing gadgets. OLED technology is not harmful, it is efficient in terms of power consumption and it has thinner displays and is more flexible. Unbreakable devices can be made using this technology as the refreshing rate of OLED is very fast, so in near future we could expect a newspaper made of OLED panel that would refresh with the latest breaking news every second.

REFERENCES:

[1] Simon Forge and Colin Blackman, “OLEDS and E-PAPER:

[2] https://en.wikipedia.org/wiki/OLED

[3] Wikipedia, NOVEMBER 15, 2013.

[4] Wikipedia, NOVEMBER 15, 2013. http://en.wikipedia.org/wiki/OLED

[5] http://electronics.howstuffworks.com/oled1.htm

[6] http://electronics.howstuffworks.com/oled5.html

[7] http://www.about-oled.com/advantages-and-drawbacks.html

[8]http://pioneer.jp/en/info/globalnetwork/japan/tohokupioneer/mainbusinesses/oled/application/

[9] http://news.oled-display.net/oled-lighting/

Comparative Study to Increase the Speed and Storage capacity of Li-Ion Battery

Mukul Prajapati
Department of ELECTRICAL AND ELECTRONICS
IES IPS ACADEMY INDORE(M.P),INDIA
mukul.p15@gmail.com

Abstract—
Lithium ion batteries with significantly higher energy and power density desired for new personal electronic devices, electric vehicles, and large-scale energy storage, require new materials. This review focuses on the replacement of the graphite anode with silicon or germanium. Si and Ge both have significantly higher Li storage capacities than graphite, but also undergo significant volumetric expansion and contraction during lithiation and delithiation. Si and Ge nanomaterials can tolerate these mechanical stresses, but solvent decomposition and loss of electrical contact with the current collector tend to lead to failure. Si and Ge anodes must therefore be formulated with appropriate binder, conductive carbon, and stabilizing additives in the electrolyte solvent to achieve stable cycling and high capacity, as described herein. wheareas Aluminum is cheaper than lithium. It's safe. It is more durable, completing over 7500 charge cycles without losing capacity, compared to the typical Li-ion battery's 1000 cycles. It charges incredibly fast.
Keywords— Li-ion,Si-based anode,Al-ion

Introduction

They're generally much lighter than other types of rechargeable batteries of the same size. The electrodes of a lithium-ion battery are made of lightweight lithium and carbon. Lithium is also a highly reactive element, meaning that a lot of energy can be stored in its atomic bonds. This translates into a very high energy density for lithium-ion batteries. Here is a way to get a perspective on the energy density. A typical lithium-ion battery can store 150 watt-hours of electricity in 1 kilogram of battery. A NiMH (nickel-metal hydride) battery pack can store perhaps 100 watt-hours per kilogram, although 60 to 70 watt-hours might be more typical. A lead-acid battery can store only 25 watt-hours per kilogram. Using lead-acid technology, it takes 6 kilograms to store the same amount of energy that a 1 kilogram lithium-ion battery can handle. That's a huge difference. .

Problems with Li-ion Batteries

- They hold their charge. A lithium-ion battery pack loses only about 5 percent of its charge per month, compared to a 20 percent loss per month for NiMH batteries.
- They have no memory effect, which means that you do not have to completely discharge them before recharging, as with some other battery chemistries.
- Lithium-ion batteries can handle hundreds of charge/discharge cycles. That is not to say that lithium-ion batteries are flawless. They have a few disadvantages as well:
- They start degrading as soon as they leave the factory. They will only last two or three years from the date of manufacture whether you use them or not.
- They are extremely sensitive to high temperatures. Heat causes lithium-ion battery packs to degrade much faster than they normally would.
- If you completely discharge a lithium-ion battery, it is ruined.
- A lithium-ion battery pack must have an on-board computer to manage the battery. This makes them even more expensive than they already are.
- There is a small chance that, if a lithium-ion battery pack fails, it will burst into flame.

Methods TO Solve these Problems

Replacing li-ion battery with

1-Aluminium battery

2-Si-Based Anode Materials for Li-Ion Batteries

A-Aluminum has long been an attractive material for batteries, mainly because of its low cost, low flammability and high-charge storage capacity. For decades, researchers have tried unsuccessfully to develop a commercially viable aluminum-ion battery. A key challenge has been finding materials capable of producing sufficient voltage after repeated cycles of charging and discharging.

Graphite cathode

An aluminum-ion battery consists of two electrodes: a negatively charged anode made of aluminum and a positively charged cathode "People have tried different kinds of materials for the cathode," Dai said."they accidentally discovered that a simple solution is to use graphite, which is basically carbon. In our study, we identified a few types of graphite material that give us very good performance." "The electrolyte is basically a salt that's liquid at room temperature, so it's very safe," said Stanford graduate student Ming Gong, co-lead author of the *Nature* study.

Aluminum batteries are safer than conventional lithium-ion batteries used in millions of laptops and cell phones today, "Lithium-ion batteries can be a fire hazard, we have achieved major breakthroughs in aluminum battery performance." One example is ultra-fast charging. Smartphone owners know that it can take hours to charge a lithium-ion battery. But the Stanford team reported "unprecedented charging times" of down to one minute with the aluminum prototype.

Durability is another important factor. Aluminum batteries developed at other laboratories usually died after just 100 charge-discharge cycles. But the Stanford battery was able to withstand more than 7,500 cycles without any loss of capacity. "This was the first time an ultra-fast aluminum-ion battery was constructed with stability over thousands of cycles," the authors wrote. By comparison, a typical lithium-ion battery lasts about 1,000 cycles. "Another feature of the aluminum battery is flexibility," Gong said. "You can bend it and fold it, so it has the potential for use in flexible electronic devices. Aluminum is also a cheaper metal than lithium."

System	Cell capacity (mAh/g)	Cell voltage (V)	Energy density (Wh/kg)
Li-ion battery (LiC_6 - Mn_2O_4)	106	4.0	424
Al-ion battery (Al - Mn_2O_4)	400	2.65	1,060

*Calculation is based on the weight of anode and cathode materials.

Si-Based Anode Materials for Li-Ion Batteries:A paper describing the research is published by the journal Advanced Energy Materials**.**

"We have found a way to extend a new lithium-ion battery's charge life by 10 times," said Harold H. Kung, lead author of the paper. "Even after 150 charges, which would be one year or more of operation, the battery is still five times more effective than lithium-ion batteries on the market today." Lithium-ion batteries charge through a chemical reaction in which lithium ions are sent between two ends of the battery, the anode and the cathode. As energy in the battery is used, the lithium ions travel from the anode, through the electrolyte, and to the cathode; as the battery is recharged, they travel in the reverse direction.With current technology, the performance of a lithium-ion battery is limited in two ways. Its energy capacity how long a battery can maintain its charge is limited by the charge density, or how many lithium ions can be packed into the anode or cathode. Meanwhile, a battery's charge rate the speed at which it recharges is limited by another factor: the speed at which the lithium ions can make their way from the electrolyte into the anode.

In current rechargeable batteries, the anode -- made of layer upon layer of carbon-based graphene sheets -- can only accommodate one lithium atom for every six carbon atoms. To increase energy capacity, scientists have previously experimented with replacing the carbon with silicon, as silicon can accommodate much more lithium: four lithium atoms for every silicon atom. However, silicon expands and contracts dramatically in the charging process, causing fragmentation and losing its charge capacity rapidly. Currently, the speed of a battery's charge rate is hindered by the shape of the graphene sheets: they are extremely thin -- just one carbon atom thick -- but by comparison, very long. During the charging process, a lithium ion must travel all the way to the outer edges of the graphene sheet before entering and coming to rest between the sheets. And because it takes so long for lithium to travel to the middle of the graphene sheet, a sort of ionic traffic jam occurs around the edges of the material.

Now, Kung's research team has combined two techniques to combat both these problems. First, to stabilize the silicon in order to maintain maximum charge capacity, they sandwiched clusters of silicon between the graphene sheets. This allowed for a greater number of lithium atoms in the electrode while utilizing the flexibility of graphene sheets to accommodate the volume changes of silicon during use.

"Now we almost have the best of both worlds," Kung said. "We have much higher energy density because of the silicon, and the sandwiching reduces the capacity loss caused by the silicon expanding and contracting. Even if the silicon clusters break up, the silicon won't be lost."

Kung's team also used a chemical oxidation process to create miniscule holes (10 to 20 nanometers) in the graphene sheets -- termed "in-plane defects" -- so the lithium ions would have a "shortcut" into the anode and be stored there by reaction with silicon. This reduced the time it takes the battery to recharge by up to 10 times.

This research was all focused on the anode; next, the researchers will begin studying changes in the cathode that could further increase effectiveness of the batteries. They also will look into developing an electrolyte system that will allow the battery to automatically and reversibly

shut off at high temperatures -- a safety mechanism that could prove vital in electric car applications.The Energy Frontier Research Center program of the U.S. Department of Energy, Basic Energy Sciences, supported the research.

Conclusion and Result

Si and Ge both have significantly higher Li charge storage capacity than graphite. The main challenge facing their commercial use relates to the large volume changes that take place during battery cycling. Nanomaterials can tolerate these volume changes without significant loss of structural integrity, but the entire battery cell must withstand the volume changes as well. This means that an appropriate binder is needed and stabilizing electrolyte solvent additives that create thin and robust SEI layers. Binder materials are selected based on their ability to adhere to the nano wires and the current collector. Promising binders include PVdF for Ge, and CMC, NaAlg, and PAA for Si. Graphene and carbon nanotube composites have also been shown to increase capacities with improved structural integrity. Electrolyte additives have been sought to improve the formation and stability of the anode SEI layer with FEC and VC providing relatively stable electrochemical performance. To date, Si and Ge nanomaterial anodes have demonstrated reversible capacities up to 3500 mA h g1 and 1475 mA h g1 , close to their respective maximum theoretical capacities, which are nearly 10-fold and 4-fold improvements over carbonaceous anodes. While their performance benefits are currently limited by the low capacities of current cathodes, prelithiation efforts look to enable the use of Si and Ge anodes with higher capacity, non-lithium containing cathodes. Although there are many research challenges that remain, Si and Ge nanomaterials are one of the most promising new revolutionary approaches to creating next generation Li-ion batteries.

For Al-ion battery -It's safe. Li-ion batteries have a tendency to burst into flames, which has led to a number of recalls since their introduction in early 90s. The video Stanford released shows researchers drilling a hole through their prototype without eliciting so much as a snarl. It's flexible. As Scientific American explains, the battery's aluminium metal anode (negative side) is divided from its graphite foam cathode (positive side) by a liquid electrolyte separator, which, in consumer terms, translates into a pouch as bendable—even foldable—as an underfilled ketchup packet. It charges incredibly fast. Researchers managed to charge a smartphone in a minute using their prototype. Li-ion batteries, as we're all painfully aware, require hours.

It is more durable, completing over 7500 charge cycles without losing capacity, compared to the typical Li-ion battery's 1000 cycles. Previous cracks at developing an Al-ion battery usually only managed about 100 cycles.

Aluminum is cheaper than lithium. Scientific American reports that the Al-ion battery's energy density is a quarter of the typical Li-ion battery's. Additionally, as Stanford chemistry professor Hongjie Dai admits, his team's prototype "produces about half the voltage of a typical lithium battery." He remains optimistic, however: "improving the cathode material could eventually increase the voltage and energy density." Until those improvements materialize, the battery will probably not be making an appearance in electric cars. The Tesla Model S Li-ion battery pack already pushes practical and economic limits, weighing an estimated 1200 lbs and costing around $45,000. An attempt to wire up twice the number of cells in order to achieve similar voltage with Al-ion batteries would probably be impractical.

The same issue would likely make the Al-ion battery a no-go for smartphones and other portable devices, despite the fact that that application has generated much of the media buzz so far

Acknowledgment

This project consumed huge amount of work, research and dedication. Still, implementation would not have been possible if we did not have a support of many individuals and organizations. Therefore we would like to extend our sincere gratitude to all of them.

First of all we are thankful to IES IPS Academy Indore for their financial and logistical support and for providing necessary guidance concerning projects implementation.

We are also grateful to Elecrical and Electronics Department for provision of expertise, and technical support in the implementation. Without their superior knowledge and experience, the Project would like in quality of outcomes, and thus their support has been essential. Nevertheless, we express our gratitude toward our families and colleagues for their kind co-operation and encouragement which help us in completion of this project.

References

[1] http://www.researchgate.net/publication/255970635_High_capacity_lithium_ion_battery_anodes_of_silicon_and_germanium

[2] http://web.ornl.gov/adm/partnerships/events/presentations/spark_aluminum_ion_battery.pdf

[3] http://www.northwestern.edu/newscenter/stories/2011/11/batteries-energy-kung.html

[4] http://news.stanford.edu/news/2015/march/aluminum-ion-battery-033115.html

[5] http://electronics.howstuffworks.com/everyday-tech/lithium-ion-battery.htm

The Study: of Electrical Energy Vehicle

ANKUR NAGDIYA
ankurnagdia@gmail.com
2^{nd} Year (3^{rd} semester)
Department of Electrical & Electronics Engineering,
IES-IPS Academy, INDORE.

ABSTRACT

The world is going towards the major environmental issues such as global warming and energy consumption, so this paper work is to aware all of you about the importance, utility and environment friendly nature of "ELECTRIC CAR". The basic concepts, needs, and assembling of the electric car. Here we'll also see the advantages of electric engine over IC engine (i.e. petrol or diesel engine), as well as the disadvantages. As we know all things has golden time, so we'll also see here the golden time of electric car as before it was not that much popular. Also its popularity was affected because of the IC engine. But the energy crisis of 1970-80 brought about renewed interest in the electric car as the future.

INTRODUCTION

Electric car is an automobile which is propelled by one or more electric motor using electric energy which is stored in rechargeable batteries or other storage devices. Because of using electric motor, as it gives instant torque, it takes smooth and strong acceleration. Efficiency of this car is high as compared to IC (Internal Combustion) Engine. It was first produced in the 1880s and gets popularity in late 19^{th} and early 20^{th} century. Also the energy crisis of 1970s-80s brought interest in electric car. In 21^{th} century, electric car gets a renaissance because of advances in energy management system.

DISCRIPTION

Electric car is an automobile vehicle which uses electric motor to get motion. It consist an Electric motor, an Array of batteries (i.e. LI-ion batteries), motor controller, power converters, charging system, transmission, body (included wheels and other required things), cables etc. As shown below-

It's first invented by "**Thomas Parker**" in 1884. An electric car can never be imagine without rechargeable batteries, Rechargeable batteries that provides a viable mean for storing electricity in-board , a vehicle did not come into being until 1859, with the invention of the lead acid battery by French physicist Gaston Plante. Parker made the Car, using his own specially designed high-capacity rechargeable batteries.

WHY PARKER DID SO?

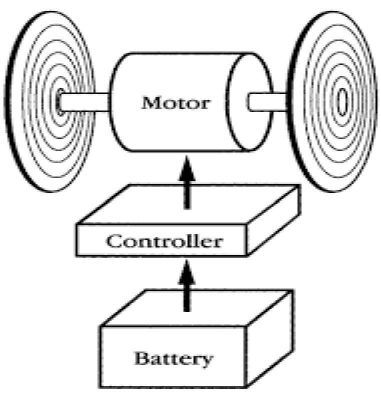
CLASSIFICATION

Classification of Electric car is as follows:-

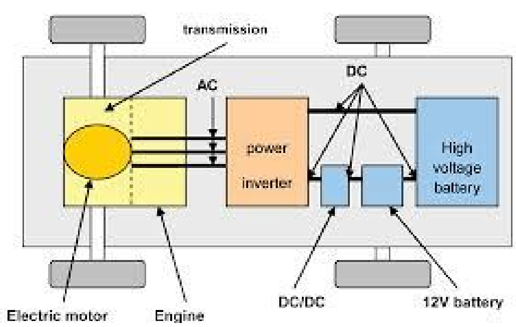
- **Solar Car-**An Electric Car powered by Solar Energy.
- **Hybrid Car-**An Electric Car powered by a Gasoline Generator.
- **Battery Electric Vehicles (BEVs)-**An Electric Car that derives its power from an on-board battery pack.

WORKING

The Electric Car works on AC and DC motors and there are rechargeable batteries, which are the main source of energy for the car. The rechargeable batteries provide the energy to the Ac or DC motor and motion of wheels carried out. In case of AC motor we use inverter or DC to AC converter. The AC or DC controller mechanism feed the power to the car instead of direct feeding. The speed of an Electric car is controlled by the motor controller device which is connected in between the source of power and motor and amount of power to be delivered to the motor is determined by it or controlled by it. The power transfer, from motor to wheel, takes place by the help of single speed transmission (excluding reverse transmission).

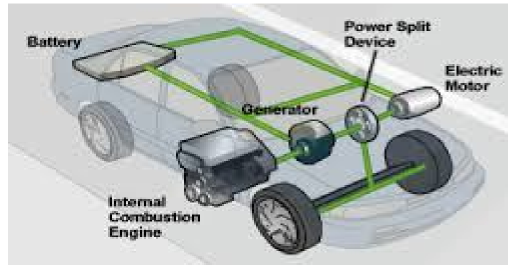


The block diagram shown above is the simple working block diagram of Electric Car which is propelled by DC Motor.

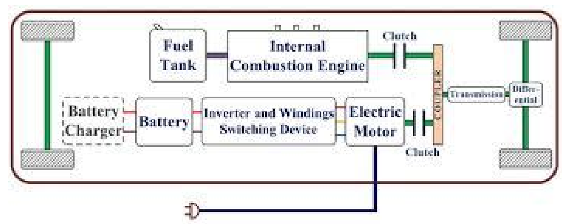


This is the block diagram of Electric Car which is propelled by AC Motor.

In the case of hybrid electric car, the power is generated by Internal Combustion generator either to charge battery for other work or to run wheels by use of Electric motor.

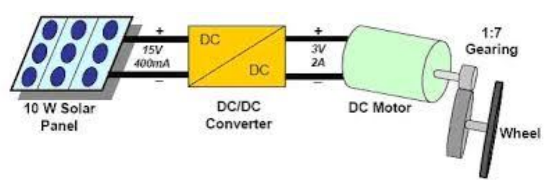


In above diagram Internal Combustion generator is used to charge battery by using Electric Motor and further this power is used to power the wheel as well as other energy requirement areas.



In the above block diagram internal combustion engine is separately used to provide power to the wheels of car along with power provided by electric motor separately.

In case of solar car we can use solar panels to charge the battery. Electric car cannot run directly by solar panel because the energy generated by panels are not constant as well as is not enough to run the wheels.



In the above diagram it's shown that, power generated by solar panel is converted into suitable dc power then used to run small dc motor. In case of heavy motor it's not possible practically.

MOTOR TYPES

AC MOTOR- Alternating-Current motors are better for continuous power (required in hilly areas). Its Starting power is slower, but the motor can run at high RPMs without overheating. They can also move a heavy vehicle. AC motor gives best result for using regenerative breaking system. AC motors runs more smoothly and is easy to control.

AC motors have some disadvantages. They are more expensive than DC motors and also more complicated to control because it requires DC to AC converter.

DC MOTOR- DC motors are more affordable and do not required converter as AC motor require. They also have good starting torque than AC motors and also have high power.

The major disadvantage of DC motor is overheating. And they are very large and heavy according to their output power.

ADVANTAGES OF ELECTRIC CAR

1. It's easy to drive.
2. It provides instant torque and smooth acceleration.
3. They are significantly quieter than conventional internal combustion engine automobiles.
4. They do not emit tailpipe pollutants.
5. It gives a large reduction of local air pollution, greenhouse gases and other emission (depends on the method used for electricity generation).
6. It's independent from foreign oil, oil price volatility and other petroleum fuel (including natural gases).

DISADVANTAGES OF ELECTRIC CAR

1. It has higher purchase cost.
2. It has range anxiety (i.e. the driver's fear that energy stored in the battery will run out before reaching destination).
3. It takes lots of recharging time.
4. It has less number of recharging infrastructure.

WHY WE ARE CHANGING TO ELECTRIC CAR

We are changing form internal combustion automobile to electric car due to following region-

1. Because of continued subsidisation of fossil fuel.
2. Pollution, due to the tailpipe emission of IC automobiles.
3. Due to continuous increment in global warming.

BOUNDATIONS TO CHANGE ICs TO ELECTRIC CAR

1. Price of electric car.
2. Energy stored capacity.
3. Recharging time.
4. Refuelling infrastructure.

GOLDEN AGE

Thomas Parker invent electric car because of its interest in the construction of more fuel efficient vehicles and his concern about environment. But the mass production of internal combustion engine automobile led to lessen the selling of electric car. But later the energy crisis of 1970s-80s and the awareness for environment led to develop the electric vehicles. The mass production of electric car led to decrease the purchasing cost of the vehicle which makes electric car to stand in front of IC engine automobiles.

PROBLEMS REGARDING ELECTRIC CAR

1. Storage problem.
2. Recharging time.
3. Battery backup.
4. Cost of production

SOLUTIONS TILL NOW

1. Latest use technology including: Li-ion batteries, Solid state batteries, Al-ion batteries etc.
2. Technicians have been developed technology to charge 80% of the battery in half an hour.
3. Tesla motors have been developed laptop size cells for the battery packs which are efficient and cheaper as well.
4. Mass production and technological development has been reduced the cost of production of electric vehicle up to some extent.

FUTURE AREAS TO WORK ON

1. Solar panals (to utilise solar energy in more convinient way)
2. Piezoelectric transducer (to utilise pressure energy)
3. Regenerative braking system

CONCLUSION

After studying about "ELECTRIC CAR" I conclude that electric car is cheaper and more environmental friendly than internal combustion engine automobile. As we are moving to clean over surrounding i.e. we want to control pollution around us as well as want to save and utilize energy then it's a best option to go with as well as provides us a better future scope.

REFERENCE

[1.] Electric Cars: Effect on the Environment. (1998) Retrieved January 31, 2010 from http://library.thinkquest.org/20463/environment.html. [2.] Bellis, M. History of Electric Vehicles. Retrieved January 31, 2010 from http://inventors.about.com/library/weekly/aacarselectrica.htm. [3.] Brain, M. (2002). How Electric Cars Work. Retrieved January 29, 2010 from http://auto.howstuffworks.com/electric-car2.htm. [4.] How Hybrids Work. (2009) Retrieved February 20, 2010 from http://www.fueleconomy.gov/feg/hybridtech.shtml. [5.] Electric Vehicles (EVs).(2009) Retrieved January 31, 2010 from http://www.fueleconomy.gov/feg/evtech.shtml. [6.] Dunn, P. (2006). Hybrid Cars – Pros and Cons. Retrieved February 20, 2010 from http://www.physorg.com/news10031.html. [7.] Sparling, B. (2001). Ozone Layer. Retrieved February 1, 2010 from http://www.nas.nasa.gov/About/Education/Ozone/ozonelayer.html. [8.] Future Electric Cars. (2007) Retrieved January 29, 2010 from http://www.future-car.ghnet/future-electric-cars.html.

Li-Fi Technology

Light Fidelity (Li-Fi) is a bidirectional, high speed and fully networked wireless communication technology similar to Wi-Fi. The term was coined by Harald Haas and is a form of visible light communication and a subset of optical wireless communications (OWC) and could be a complement to RF communication (Wi-Fi or Cellular network), or even a replacement in contexts of data broadcasting. It is so far measured to be about 100 times faster than some Wi-Fi implementations, reaching speeds of 224 gigabits per second.

It is wireless and uses visible light communication or infra-red and near ultraviolet (instead of radio frequency waves) spectrum, part of optical wireless communications technology, which carries much more information, and has been proposed as a solution to the RF-bandwidth limitations.Li-Fi has the advantage of being useful in electromagnetic sensitive areas such as in aircraft cabins, hospitals and nuclear power plants without causing electromagnetic interference. Both Wi-Fi and Li-Fi transmit data over the electromagnetic spectrum, but whereas Wi-Fi utilizes radio waves, Li-Fi uses visible light. While the US Federal Communications Commission has warned of a potential spectrum crisis because Wi-Fi is close to full capacity, Li-Fi has almost no limitations on capacity. The visible light spectrum is 10,000 times larger than the entire radio frequency spectrum.Researchers have reached data rates of over 10 Gbit/s, which is much faster than typical fast broadband in 2013. Li-Fi is expected to be ten times cheaper than Wi-Fi.

Nupur Rawat

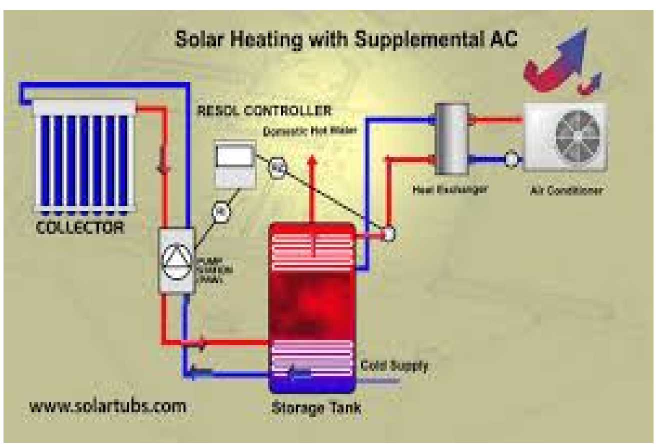
EX 4th Year

WHY HINDI IS NOT AN OFFICIAL LANGUAGE

I don't understand why non Hindi speakers can't embrace Hindi as an official language. There was a time during the British rule that most of the people in India used to boycott things related to British. Today after independence people in India have become dependent on foreign jobs and the usage of English. Why can't we Indians have an identity of ourselves to use Hindi as an official language. I agree that English has become a global language. But that doesn't mean that we need to use it in our daily works in India. There are some other country for n the world who works in their own language where English is not official like (Spain ,Africa, Brazil, France, China, Japan, turkey, Greek) . In fact Hindi is a fifth largest Spoken language in the world. So I don't think there should be any problem in making Hindi is an official language. It is strange that people would love to embrace English which is a foreign language but cannot embrace Hindi which is our own. It would be a matter of pride to show the world that we Indians have our own identity. So India needs to follow Hindi language. I feel every country will have a feeling of oneness and of being a common people only if they speak one language. **Shubham Sharma**

EX 3rd Year

Solar air conditioning



Solar air conditioning refers to any air conditioning (cooling) system that uses solar power. This can be done through passive solar,solar thermal energy conversion and photovoltaic conversion(sun light to electricity).Photovoltaics can provide the power for any type of electrically powered cooling be it conventional compressor-based or adsorption/absorptionbased, though the most common implementation is with compressors. For small residential and small commercial cooling (less than 5 MWh/a) PV-powered cooling has been the most frequently implemented solar cooling technology. The reason for this is debated, but commonly suggested reasons include incentive structuring, lack of residential-sized equipment for other solar-cooling technologies, the advent of more efficient electrical coolers, or ease of installation compared to other solar-cooling technologies (like radiant cooling). Since PV cooling's cost effectiveness depends largely on the cooling equipment and given the poor efficiencies in electrical cooling methods until recently it has not been cost effective without subsidies.

Avani Kumar Shrivastava

EX 2nd Year

Virtual reality in India

The age of virtual reality is upon us (again) with a torrent of devices and content expected to launch in 2016.There has been a buzz around virtual reality (VR) for the past few years. Some of this has come from the lengthy development of devices like Oculus Rift, but also through a growing interest in what we'll be able to get VR to do in the modern era. The idea of VR isn't new. It's been circulating in the tech space for a number of years, but recently, the technology has broken through some of the long-standing barriers. Some of this has been about enabling access, with devices like Google's Cardboard opening the door for anyone with a smart phone, right up to demonstrating what a fully-fledged premium system like HTC Vive will be capable of. We now have the power in home computers for life like virtual environment and this makes it a much more exciting time for VR. So, without further ado, we've listed some of the top VR systems available. Their prices range dramatically, and some haven't actually been officially launched yet, but they're all worth being aware of, as you'll be seeing a lot more of VR in 2016. According to experts, head-mounted devices (HMDs) that create an immersive virtual world for users is the future after the successful touch screen era.

Today, the market is flooded with VR devices: Oculus Rift,HTC Vive,Sony PlayStation VR,Samsung Gear VR(co-developed with Oculus),LG 360 VR,Google Cardboard, Zeiss VR One and One GX and several other players soon going to join the VR fray. But, with a huge smartphone base of 160 million plus users that is likely to surpass the US smartphone user base in a couple of years, what India needs are low-cost VR headsets compatible with low-cost smartphones. Only then will VR use truly explode in India."I feel that VR adoption is currently at a minuscule level in India". Many firms like Sony,Samsung,HTC,One plus have joined Facebook's Oculus platform in the virtual reality space. But we are still far away from its widespread adoption here.

Shubham goswami

EX 3rd year

A hope to survive more for Opium Eater Or "It's better to Change your Lifestyle"

Heart has the most complex structure in any Living Being. Every living individual wants to spend more time with his love ones.The Jarvik 7 total artificial heart is probably the best known of the artificial heart devices provide us this opportunity and allow us to spend 2-3 days more with them. The artificial heart is a replacement of the human heart, in the form of a device, which performs the functions and processes involved with the heart. In particular, by utilizing the fluid mechanic properties of the heart, doctors and researchers have been able to produce systems that are used to either allow for a transition phase for a patient without a donor or for the use as a permanent replacement. Unlike stents or other vascular devices intended on repairing functionality of a human heart. Artificial hearts offer a new system, which is powered by an outside source. The circulation of blood and opening of valves is mechanically controlled and is powered by a battery pack, which keeps all mechanical parts moving. It is also important to note that unlike a human heart, where flow rates can be adjusted by activity or nerve impulses, the artificial heart utilizes special controllers to calibrate itself for the tasks to stimulate blood flow movement Alarming Statistics from India Current projections suggest that India will have the largest cardiovascular disease burden in the world.

One fifth of the deaths in India are from coronary heart disease. By the year 2020, it will account for one third of all deaths. Sadly, many of these Indians will be dying young. Heart disease in India occurs 10 to 15 years earlier than in the west.

There are an estimated 45 million patients of coronary artery disease in India. An increasing number of young Indians are falling prey to coronary artery disease. With millions hooked to a roller-coaster lifestyle, the future looks even grimmer.

There are at least 50.8 million diabetics in India, which is the highest ever reported number from anywhere in the world according to International Diabetes Federation. The prevalence of diabetes varies between 6-8% in urban and 2-3% in rural adults

Indians tend to be diabetic at a relatively young age of 45 years which is about 10 years earlier than in West. There appears to be a steady increase in hypertension prevalence over the last 50 years, more in urban than in rural areas. **Hypertension is 25-30% in urban and 10-15% in rural subjects.**Sedentary lifestyle is a major cause of death, disease and disability. Physical inactivity increases all causes of mortality, doubles the risk of cardiovascular disease, type II diabetes and obesity. It also increases the risk of colon and breast cancer, high blood pressure.

Mukul Prajapati

EX3rd Year

Pillars of Electrical & Electronics Engineering

Mr. Manish sahajwani

Dr. A. G. Kothari

Prof. Bhagwant phadke

Prof. Ramesh kaveeshwar

Ms. Sujata gupta

Ms. Vidhya fulmali

Mr. Manoj gupta

Dr. Yogendra singh dohare

Mr. Kamlesh gupta

Mr. Deepesh Bhati

Md. Firoz Khan

Ms. Ankita singh

Mr. Hemant mehar

Ms. Namrata nebhnani

Ms. Sweety jain

Ms. Priya pal

Ms. Shahanam baig

Mr. Subhash kumar mandal

Lab Assistants

Mr. Bidut Chatterji

Mr. Sonu Verma

Mr. Kamal Patidar

Mr.Nirmal Muradiya

Mr. Anil Songare

Mr. Deepak Raikwar

Class IV

Ms. Asha Deshmukh

Ms. Arti

Mr. Vishal

IPS ACADEMY

INSTITUTE OF ENGINEERING & SCIENCE

Electrical & Electronics Engineering Department

Knowledge Village, Rajendra Nagar, A.B. Road, Indore (M.P.), 452012
Ph.0731-4014601, Telefax 0731-4014602
E-mail:director.ies@ipsacademy.org, Visit us : ies.ipsacademy.org