ISSN 2394-3777 (Print)

ISSN 2394-3785 (Online)

Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET) Vol. 6, Issue 1, January 2019

A Case Study of Green EnergyConservation for Electric Vehicles and Centralized Public Transport Using Smart E-Wallet Card

Srinivasan R [1]
[2]*Associative Professor, Department of Electronics and Communication Engineering,*
DhanalakshmiSrinivasan College of Engineering and Technology,
Mamallapuram,Chennai,
Tamilnadu,India.
srinivassan.asstprof@gmail.com

Padmavathy R [2]
[2]*Associative Professor, Department of Electronics and Communication Engineering,*
DhanalakshmiSrinivasan College of Engineering and Technology,
Mamallapuram,Chennai,
Tamilnadu,India.
ramanujampadmavathyf@gmail.com

Abstract:

We are everyday converting yesterday's science fiction dreams into reality in our ubiquitous tech savvy world. We are experiencing the double edged sword of every technical invention we bring about and we are trying to balance the cutting edge technology and its environmental harms. To balance both we need to develop a greener environment. Our concept for smarter city revolves around conserving energies and utilizing greener technology. Electricity and fuel have become mandatory requirements to our lifestyle. Solar energy is the best and sustainable alternative energy resource for both electricity and fuel. Solar power in India is a fast developing industry. Our country's solar installed capacity reached 26 GW as of 30 September 2018. Also we as a nation are targeted to achieve production of 100 GW of solar energy by 2022.We propose Smart cities to best contribute by implementing SOLAR VALLEYS which are large scale solar power station built for urban consumers through governmental agencies. If in the total energy conservation of smart cities, 30% consumption can be contributed as solar energy by creating solar valleys for mass production of solar power to contribute to the consumption of urban population. This solar energy will be given to ELECTRIC VEHICLES as DC supply. AFFORDABLE AND CLEAN ENERGY which is one of the goals of 17 SUSTAINABLE GOALS OF UNO can be easily attained with this conservation method. We also propose the use of the centralized transport management system which could be implemented by the use of smart card with RFID and payment rechargeable facilities. This facility can monitor all the vehicles and their travelling path and store the data in cloud server. This card can also be used in electric vehicle charge stations and toll gates. E-wallet concept will be behind this smart card accessibility.

Keywords: *Electric vehicles, Solar energy, Solar Valley, Smart City, Green card*

ISSN 2394-3777 (Print)

ISSN 2394-3785 (Online)

Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 6, Issue 1, January 2019

I. INTRODUCTION

An electric vehicle (EV) is a vehicle powered by an electric motor, instead of an internal combustion engine (ICE), and the motor is run using the power stored in the batteries. The batteries have to be charged frequently by plugging into any main (120 V or 240 V) supply. EV has a much longer history than most people realize. As EVs have fewer moving parts, maintenance is also minimal. With no engine there are no oil changes, tune-ups, or timing and there is no exhaust. EVs don't have ICEs in them. Instead, electrical energy is stored in a storage battery or ultra-capacitor, converted from chemical energy in a fuel cell, or converted from mechanical energy in a flywheel. This electrical energy is used to power an electric motor, which then turns the wheels and provides propulsion. Since no fuel is burned in an EV, they don't produce the pollution that ICE vehicles do.ICE vehicles can go much farther on a tankfull of gas and could be quickly refueled. Now, urban air quality issues, coupled with a rising awareness of the problems associated with the world's (and particularly America's) appetite for oil, have created interest in EVs. Traditional lead-acid batteries have been improved some over the years, but their energy and power densities remain disappointingly low, particularly when compared with gasoline. The focus will be given to the two most common EV battery technologies: NiMH and Li-ion. It is particularly important for power engineers to understand the basic chemistry of the different batteries, and specific EV battery requirements of energy density, specific energy, power density, cost, durability, etc. The EV battery modeling will be introduced in the way that it is suitable for power engineers to appreciate and use it for power electronic interfacing converter design, battery management, and system level studies.[1]

II. BATTERIES FOR ELECTRIC VEHICLES AND HYBRID ELECTRIC VEHICLES

Batteries have widely been adopted in ground vehicles due to their characteristics in terms of high energy density, compact size, and reliability.

a. Lead–Acid Batteries

The spongy lead works as the negative active material of the battery, lead oxide is the positive active material, and iluted sulfuric acid is the electrolyte. For discharging, both positive and negative materials are transformed into lead sulfate. The lead–acid battery presents several advantages for HEV applications. They are available in production volumes today, yielding a comparatively low-cost power source. In addition, lead–acid battery technology is a mature technique due to its wide use over the past 50 years .However, the lead–acid battery is not suitable for discharges over 20% of its rated capacity. When operated at a deep rate of state of charge (SOC), the battery would have a limited life cycle. The energy and power density of the battery is low due to the weight of lead collectors. Research efforts have found that energy density can be improved by using lighter noncorrosive collectors.

b. Nickel–Metal Hydride (NiMH) Batteries

The NiMH battery uses an alkaline solution as the electrolyte. The NiMH battery is composed of nickel hydroxide on the positive electrode, and the negative ctrode consists of an engineered alloy of vanadium, titanium, nickel, and other metals. The energy density of the NiMH battery is twice that ofthe lead–acid battery. The components of NiMH are harmless to the environment; moreover, the batteries can be recycled. The NiMH battery is safe to operate at high voltage and has distinct advantages, such as storing volumetric energy and power, long cycle life, wide operation temperature ranges, and a resistance to over charge and discharge. On the other hand, if repeatedly discharged at high load currents, the life of NiMH is reduced to about 200–300 cycles. The best operation performance is achieved when discharged
20% to 50% of the rated capacity. The memory effect in NiMH battery systems reduces the usable power for the HEV,which reduces the usable SOC of the battery to a value smaller than 100%.

c. Lithium-Ion Batteries

The lithium-ion battery has been proven to have excellent performance in portable electronics and medical devices. The lithium-ion battery has high energy density, has good high temperature performance, and is recyclable. The positive electrode is made of an oxidized cobalt material, and the negative electrode is made of a carbon material. The lithium salt in an organic solvent is used as the electrolyte. The promising aspects of the Li-ion batteries include low memory effect, high specific power of 300 W/kg, high specific energy of 100 Wh/kg, and long battery life of 1000 cycles. These

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com
International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 6, Issue 1, January 2019

excellent characteristics give the lithium-ion battery a high possibility of replacing NiMH as next-generation batteries for vehicles. NiMH batteries were priced at about $1500/kWh in 2007.Since the price of nickel is increasing, the potential cost reduction of NiMH batteries is not promising. Li-ion batteries have twice energy density of NiMH batteries, which are priced at $750 to $1000/kWh.

d. Nickel–Zinc (Ni–Zn) Batteries

Nickel–zinc batteries have high energy and power density,low-cost materials, and deep cycle capability and are environmentally friendly. The operation temperature of Ni–Zn batteries ranges from −10 ◦C to 50◦C, which means that they can,be used under severe working circumstances. However, they suffer from poor life cycles due to the fast growth of dendrites,which prevents the development of Ni–Zn batteries in vehicular applications.

e. Nickel–Cadmium (Ni–Cd) Batteries

Nickel–cadmium batteries have a long lifetime and can be fully discharged without damage. The specific energy of Ni–Cd batteries is around 55 Wh/kg. These batteries can be recycled, but cadmium is a kind of heavy metal that could cause environmental pollution if not properly disposed of. Another drawback of Ni–Cd batteries is the cost. Usually, it will cost more than $20 000 to install these batteries in vehicles.Currently, all available HEVs, such as the Toyota Prius, use NiMH as the ESS. Ni–Zn and Li-ion batteries show considerable potential but still need much work to make them suitable for HEV use.

III. ULTRACAPACITORS

The UC stores energy by physically separating positive and negative charges. The charges are stored on two parallel plates divided by an insulator. Since there are no chemical variations on the electrodes, therefore, UCs have a long cycle life but low energy density. The applied potential on the positive electrode attracts the negative ions in the electrolyte, whereas the potential on the negative electrode attracts positive ions. The power density of the UC is considerably higher than that of the battery; this is due to the fact that the charges are physically stored on the electrodes. Low internal resistance
gives UC high efficiency but can result in a large burst of output currents if the UC is charged at a very low SOC. Another feature of the UC is that the terminal voltage is directly proportional to the SOC. The development of interface electronics allows the UC to operate throughout its variable voltage range. Researchers are investigating various methods to increase the surface area of the electrodes to further improve the energy-storage capability of UCs .UCs can be used as assistant energy-storage devices for HEVs. In urban driving, there are many stop-and-go driving conditions, and the total power required is relatively low. UCs are very appropriate in capturing electricity from regenerative braking and quickly delivering power for acceleration due to their fast charge and discharge rates. Batteries have high energy density,whereas UCs has higher power densities. Long lifetime and low maintenance lead to cost savings. In HEV applications, both batteries and UCs could be combined to maximize the benefits of both components. It is estimated that over 30 000 UCs are at work in hybrid drives, delivering over 75 000 000F of electric drive and regenerative braking power. There are five UC technologies in development: carbon/metal fiber composites, foamed carbon, a carbon particulate with a binder, doped conducting polymer films on a carbon cloth, and mixed metal oxide coatings on a metal foil. Higher energydensity can be achieved with a carbon composite electrode using an organic electrolyte rather than a carbon/metal fiber composite electrode with an aqueous electrolyte.[2]

IV. FUEL CELLS

The FC generates electricity from the fuel on the anode and the oxidant on the cathode and reacts in the electrolyte. During the generation process, the reactants flow into the cell, whereas the products of reaction flow out. The FC is able to generate electricity as long as the reactant flows are maintained. Advantages of the FC include high conversion efficiency of fuel to electrical energy, quiet operation, zero or very low emission, waste heat recoverability, fuel flexibility, durability, and reliability. Different combinations of fuels and oxidants are possible for FCs. Hydrogen is an ideal nonpolluting fuel for FCs, since it has the highest energy density than any other fuel, and the product of cell reaction is just water. Other fuels include hydrocarbons and alcohols, and other oxidants include chlorine and chlorine dioxide.

Unlike electrochemical batteries, the reactants of FCs must be refilled before they are used up. In vehicular applications, a specific fuel tank should be included on board. Due to the relatively low energy

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com
International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 6, Issue 1, January 2019

density (2.6 kWh/L for liquid hydrogen compared with 6 kWh/L for petrol), large fuel tanks are required.
The efficiency of the FC is dependent on the amount of power drawn from it. Generally, the more power had drawn, the lower the efficiency. Most losses manifest as a voltage drop on internal resistances. The response time of FCs is relatively longer compared with that of batteries and UCs. Another drawback of FCs is that they are expensive. FCs currently cost five times more than ICEs, the major cost components being the membrane, the electro catalyst, and the bipolar plates [3]

V. HYBRID ELECTRIC VEHICLES

There is another alternative to EVs: hybrid electric vehicles (HEVs). There are many different potential HEV configurations, but in general, an HEV has an electric drivetrain like an EV, plus a fuel-burning engine of some type that can recharge the batteries periodically. The advantage of an HEV is that the fuel-burning engine, in general, is most efficient in only a small range of operating conditions (speed and load). Also, at this most efficient operating point, the fuel-burning engine usually produces its lowest levels of emissions. Unfortunately, while driving, the engine in the car has to run under a wide range of speeds and loads, and thus it is far less efficient and produces much greater emissions than it would if it could run at its most efficient point all the time. Hybrid technologies extend the usable range of EVs beyond what an all-electric vehicle can achieve with batteries only. Being a hybrid would allow the vehicle to operate on only batteries within an urban/polluted area, and then switch to its engine outside the urban area. There are two types of hybrids: parallel hybrids and series hybrids [4].

VI. EVs AND RENEWABLE ENERGY

The ability of EVs to assist the integration of renewable energy sources into the existing power grid is potentially the most transformative impact on the electricity system. The literature on this subject is primarily focused on the analysis of wind energy and solar energy, with wind energy receiving much greater attention and more detailed analysis. A few papers have compared the use of biomass energy for electricity in EVs as opposed to biofuels. The models that study the interaction between renewable energy, generally wind, and EVs tend to measure the amount of renewable capacity that EVs can accommodate, or the effect on system performance that results from integrating EVs into an electricity system with a large fraction of renewable generation. Results from a number of studies on the integration of wind energy and EVs will first be discussed, beginning with a look at the large system scale models and then the hourly timeseries models. This is followed by an overview of the work that has been done concerning solar energy and EVs, and a discussion of bioelectricity in comparison to biofuels. It should be noted that a few papers examine the impacts of EVs on electricity systems with a large share of wind, but the results and discussion are focused on costs or carbon emissions and do not directly address renewable energy integration.

VII. SOLAR ENERGY

The literature on solar energy and EVs is much more diverse than the previously reviewed studies that integrate wind energy and vehicles. Electricity from solar PV can be produced anywhere; this provides more interesting methods to directly integrate energy production and use in EVs. However, it should be noted that the depth of analysis in this field is not nearly as strong as with wind and electric vehicles. A PV module efficiency of 14%, and a 15 m^2 parking space, the average summertime production would be 12.6 kWh and the winter average would be 3.78 kWh. This would be enough to meet most driving needs in the summer, but not during the winter. The paper does not assess the economic practicality of such a system, the utility system benefits, or the environmental benefits. However, 78 m^2 of PV panel would be necessary to provide enough electricity in December. The oversized PV panel would produce 67 kWh of excess electricity on the best summer days, which could be sold to the grid to offset the costs of the panel. 14–50% of the city’s passenger transportation energy demand could be provided through solar energy under the proposed system. PV parking lot charging and other business models to charge EVs with solar energy. Lot chargers could be grid-connected or stand-alone units, sized to meet a daily PV demand. The business models are not analyzed in detail in this paper. Solar PV is estimated to be a cheaper fuel per vehicle kilometer than gasoline, especially as PV module prices decrease and gasoline stays around $4/gallon (USD) or higher. This would allow EVs to be charged using electricity generated on-site, avoiding transmission losses from distant power plants or wind farms. Furthermore, converting DC solar electricity to AC

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com
International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 6, Issue 1, January 2019

grid electricity results in energy losses of around 10%; directly charging the batteries from PV panels avoids those losses. These two studies provide a proof of concept for this approach, demonstrating the safety and viability of this charging scheme. One method of taking advantage of direct battery charging from solar PV would be to combine it with parking lot chargers, as described earlier. Alternatively, PV systems could be mounted directly on the vehicle as an auxiliary power source, also called vehicle-integrated PV (VIPV). This has been done by universities in solar car competitions for years, in which solar energy is the primary power source for the vehicle. Solar cars are not intended for commercial purposes; however VIPV could be used with existing hybrid and electric vehicles to improve efficiency. The idea is that vehicle batteries would form a short-term buffer for PV output. The calculations do not consider transportation demand or any system analysis. Peak electricity production from PV panels occurs at midday, a few hours before the daily peak in electricity demand. This means that electricity generated at the solar peak would need to be stored for a few hours before use to meet peak demand. Air source heat pump water heater systems were modeled as a means to meet domestic hot water demand while using excess PV electricity. The study indicates that if 30GW of solar capacity was installed in the area, just over 10 TWh of annual production would be in excess. One million EVs and 1 million HPs could reduce this excess production by approximately 30%, while five million of each could absorb virtually all the excess production. Though HPs were never modeled separately from EVs, the marginal benefit of adding EVs to the system appears to be greater than that of HPs.[5]

VIII. SOLAR VALLEY

Solar valleys are the foremost initiative for this battery storage stations. The backup batteries will be recharged with the solar power panels installed in a huge area that provides DC supply to the stations. The 3.1 kW AC system is a 4.14 kW DC system made up of 12 345-watt **panels**, where each **panel** is about 17.3 ft². So 12 **panels** would be about 207 ft² and if those 207 **square feet** of **panels** generates 6205**kWh per** year, then one **square foot** of **solar panel** generates about 30 **kWh per** year. Most electric vehicles cover between 80 and 100 kilometers with 10 kWh. Their low energy loss makes means that they are not very energy intensive. While petrol or diesel engines convert a maximum of 35 % of this energy into driving force, an electric car reaches 90 % and more. With these huge conservation of solar power to electric vehicles,we can easily preserve renewable energy.

IX. FORMULA

Battery capacity is measured in Amp Hours.
To convert this to Watt Hours by multiplying the AH figure by the battery voltage.

It can be calculated by,

$$X * Y = Z$$

X=*Battery size in AH*
Y= *Battery Voltage*
Z= *Power available in watt hours*

The conversion of DC to AC is given by,

AC=DC/0.636

S.No	Panel length(in sq.ft)	Power(kWh)
1	1	30
2	10	300
3	207	6205

TABLE 1:Solar power given per year by panel

X. GERMANY'S SOLAR VALLEY

Most of Germany's solar technology R&D is carried out in a region called 'Solar Valley'. The area – that encompasses the former communist East German states of Saxony, Thuringia and Saxony-Anhalt – has been coined Solar Valley by energy companies, politicians and scientists wanting to portray themselves as the photovoltaic equivalent of the computer industry's Silicon Valley in San Francisco, US. Some might laugh at the name due to the flatness of the region – no valleys in sight. But there is no denying that Solar Valley's photovoltaic industry has, in little more than a decade, grown from almost nothing to become a top player in this field – housing dozens of young companies in all aspects of solar cell production.[6]

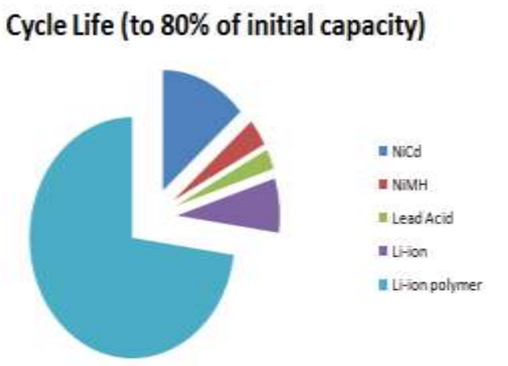
ISSN 2394-3777 (Print)

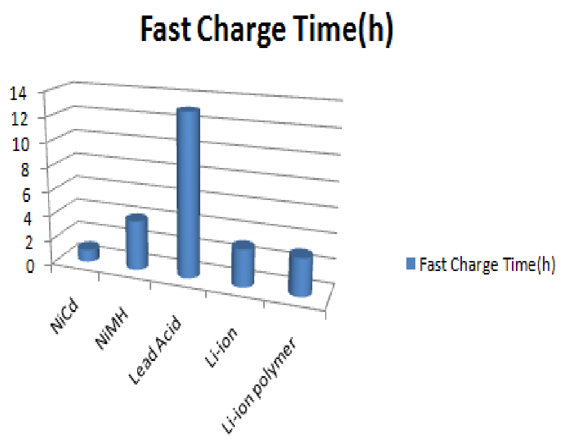
ISSN 2394-3785 (Online)

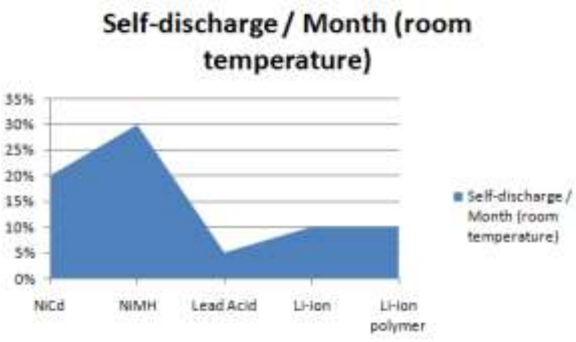
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 6, Issue 1, January 2019

XI. COMPARISON OF BATTERIES







XII. CENTRALIZED PUBLIC TRANSPORT

As public transport system is more familiar and comfortable for 80% of the population of India, it should be secured and easily payable with digital transactions and e-wallet payments. The concept of centralized transport can be briefed as all the public transport vehicles like auto,cab,bus,train are connected through a cloud storage payment system. All the vehicle details are stored along with their owner details in cloud. It will be act as the back end server of the system. Every activities of the vehicle is monitored and stored in separate database. In case of emergency circumstances with the history of database we can easily find out the location and current status of the vehicle. This centralized system can also provide the database about the vehicles that experience higher utilization that is, the percentage of time they are in operation than consumer vehicles are a considerable contributor to climate change and poor air quality.

XIII. SMART E-WALLET CARD

Nol card is the smart card which is used in Dubai for public transport system. As considering this card as an existing idea, we are going to implement E-Wallet card in our centralized transportation system. This should be a credit card sized, contactless, store value smart card. The card consists of RFID that connects the user and back end server. With store value we can make our payments and recharge it after. As it has to be used in centralized transport system, we can construct machine to machine communication. For example, in emergency situation with the help of M2M, the vehicles in the road can be alerted to provide way to emergency vehicle. M2M is going to implement with the interrogator of the RFID. And also it can be used as location finder of the user with back end server of the system.

XIV. CONCLUSION

In this study paper we have discuss about the various type of batteries and their life cycle to choose the best for electric vehicles. Analysis states that Li-ion batteries will provide standby life and cost effective. And also study about the idea of implementing centralized transportation system for public transport in India and benefits of smart E-wallet card. In future we should utilize more electric vehicles to protect our environment and renewable energies.

XV. REFERENCES

[1]Electric Vehicles,Ramesh C. Bansal,Birla Institute of Technology and Science, Pilani, India© 2005 by Taylor & Francis Group, LLC

[2]Electric Vehicle Battery Technologies

ISSN 2394-3777 (Print)

ISSN 2394-3785 (Online)

Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 6, Issue 1, January 2019

Kwo Young, Caisheng Wang, Le Yi Wang, and Kai Strunz,R. Garcia-Valle and J.A. Pec¸as Lopes (eds.), Electric Vehicle Integration
into Modern Power Networks, Power Electronics and Power Systems

[3]Battery, Ultracapacitor, Fuel Cell, and Hybrid EnergyStorage Systems for Electric, Hybrid Electric,Fuel Cell, and Plug-In Hybrid Electric
Vehicles: State of the Art,AlirezaKhaligh, Senior Member, IEEE, and Zhihao Li, Student Member, IEEETRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 59, NO. 6, JULY 2010

[4]Electric vehicles and the electric grid: A review of modeling approaches,
Impacts, and renewable energy integration
David B. Richardson ,Renewable and Sustainable Energy Reviews 19 (2013) 247–254

[5]Solar storms,Chemistry World | June 2010 |

ISSN 2394-3777 (Print)

ISSN 2394-3785 (Online)

Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 6, Issue 1, January 2019