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A Review Based on Energy Management System for Hybrid Energy System

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Abstract- *With the advancement of civilization and evolution of technology, energy demand has become a basic issue for the development of a society today. The usual ways to address this demand today are based mostly on resources such as fossil or nuclear fuels, which have a negative impact on the environment, either contributing with greenhouse gases, or by production of radioactive or inert solid waste. For this reason, every day the need to migrate to more environmentally responsible energy production models becomes more evident. In this paper discuss the energy demand of the worldwide. Due need of new energy sources here n this paper discuss the hybrid energy system, a brief review of all the researches in the field of hybrid energy renewable sources is discussed in this paper.*

***Keywords*:-** PV, FC, Wind Energy, RES, HES EMS.

Introduction

The high cost of electricity being charged by the utility grid to consumers, in addition to the energy crisis and dependence on imported fossil fuels, have forced a transition from fossil fuel-based electricity to electricity from renewable and alternative sources. Around the world each year, power outages of the utility grid network have resulted in huge revenue losses. Gas price fluctuations are yet another current problem. The grid utility networks deliver their power across millions of miles resulting in huge losses and expenses on the shoulders of those who remain tied to the power lines.

There are other problems with this system, such as power quality, efficiency and reliability. Researchers have focused on reducing electricity costs through innovating and upgrading the optimal micro-grid configuration. Micro-grids could become a portion of a power distribution network that is located at the downstream.

Since the beginning of the last century, fossil fuel has been and still is the main energy source to meet the world'sincreased energy demand. The improved quality of life is pushing the world's energy consumption year after year. As a result of extensive fossil fuel consumption, millions of tonnes of pollutant gases have been released into the atmosphere, which is believed to be the main cause of global warming [1]. There is growing high pressure on governments around the world to meet future energy demand and to reduce CO_2 emissions at the same time. During the years 2007 and 2008, oil prices hit their highest ever since the Second World War. The world realized that oil is no longer a cheap energy source. Besides the sudden increase in oil prices, more scientific evidence has pointed out that burning fossil fuel is the main reason behind global warming and climate changes. The reasons above and the expected growth of the world's energy demands have put world leaders under heavy pressure to invest and investigate new sustainable sources of energy, to reduce CO_2 emissions and to close the gap of the predicated increases in future energy demand.

In this paper firstly discuss the how energy crises occurs in the future. The demand and generation imbalanced system get dominate day by

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day in the world. Then discuss the how hybrid system is operated to reduce the imbalance of demand and generation of the energy crisis.

II. Energy Demand Requirement

Despite the recession the world economy went through during 2008, it is estimated that the world's energy consumption will grow up by about 49% from 2007 until the year 2035, with an average increase of 1.4 % per year as shown in figure 1 [2].

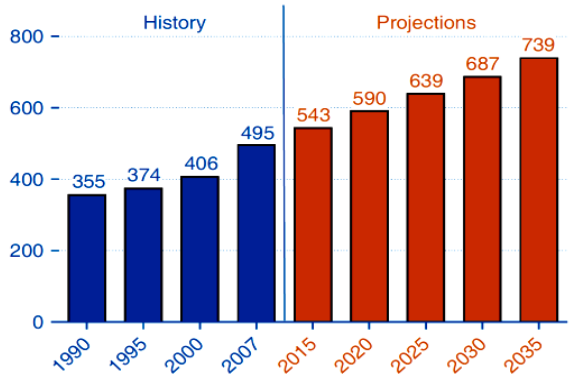

Fig. 1: World's Energy Consumption in quadrillion BTU [2].

However, energy demand in fast growing economy countries like China and India is expected to grow dramatically in the next two decades as shown in figure 2. Both countries were consuming about 10% of the world's energy consumptionin 1990, but their consumption had jumped to 20% by the year 2007. By 2035 it is predicted that about 30% of the overall world energy consumption will be shared between China and India [2]. For example, car ownership increased in 2007 in China and India by 37% and 17% respectively [3]. On the other hand, the US share in world energy consumption will drop from 21% in 2007 to 16% by the year 2035. This is due to high improvement in building and equipment efficiency [2].

Fossil fuel will continue to play a big role as the main source of current and future expected energy growth. The non-even distribution of oil around the world will risk energy supply stability, especially during natural disasters or political conflicts.

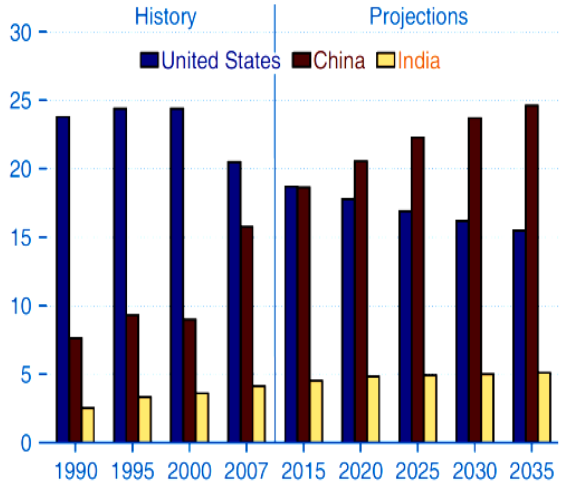

Fig. 2: Shares of World's Energy Consumption % of total in USA, China and India [2].

The other problem with oil supply is the increasing gap between oil predicted future demand and expected new discovery. Figure 3 shows the actual oil discoveries in grey bars and oil consumption in dotted black lines for the period from 1930 to 2008. As a result of the first oil crisis, consumption hit a peak in 1979. For the following five years the world's consumption decreased owing to the world economy slow down and the introduction of more efficient transport vehicles. As per the grey bars shown in Figure 3, most of the major oil fields were discovered early last century. This includes the world's largest oil field, Ghawar, discovered in Saudi Arabia in 1948 and Burgan Kuwait's big oil field discovered the late 30s. It is important to note that oil discovery was far greater than oil consumption until 1984; since then, oil consumption has been exceeding discoveries. In the future the already existing large gap between new oil discoveries and predicted production demand will continue to increase. The future projected growth demand is shown in red. The yellow bars are the estimated future oil discoveries [3].

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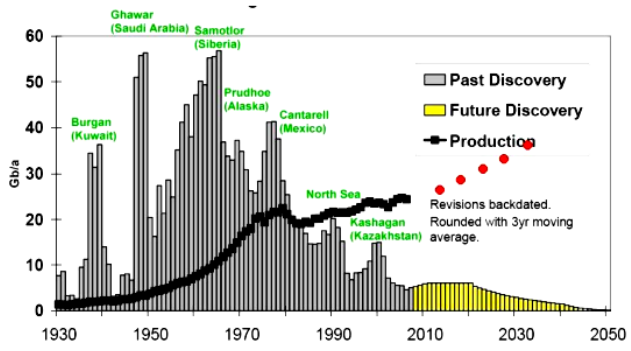

Fig 3: The Growing Gap between the Oil past and future [3].

III. Review Based on Hybrid Energy System

THE WORLD IS WORKING HARD TO FIND RELIABLE ALTERNATIVES TO THE OIL THAT HAS DOMINATED ENERGY SUPPLY SINCE EARLY LAST CENTURY. THE PROBLEM IS NOT BECAUSE WE ARE GOING TO RUN OUT OF OIL, BUT DUE TO THE FOLLOWING MAIN REASONS [4]:

- Expected oil consumption to rise far above the production rate.
- To reduce CO2 emission and improve cities' air quality, and reduce the effect of global warming.
- Ensure sustainable security of energy supply.
- Reduce the dependence on imported oil.

A hybrid energy system, or hybrid power, usually consists of two or more renewable energy sources used together to provide increased system efficiency as well as greater balance in energy supply[1].

Completely Renewable Hybrid Power Plant (solar, wind, biomass, hydrogen) is a hybrid power plant consisting of all four renewable energy sources which can be made into operation by proper utilization of these resources in a completely controlled manner. In Europe introduce hybridizing HVDC transmission with Marine hydro pumped Energy Storage via ellipse. A hybrid energy system, or hybrid power, usually consists of two or more renewable energy sources used together to provide increased system efficiency as well as greater balance in energy supply.

In this section discuss the review of the literature based on the work of hybrid energy sources of different authors.

In [5] review the research on the unit sizing, optimization, energy management and modelling of the hybrid renewable energy system components. Developments in research on modelling of hybrid energy resources (PV systems), backup energy systems (Fuel Cell, Battery, Ultra-capacitor, and Diesel Generator), power conditioning units (MPPT converters, Buck/Boost converters, Battery chargers) and techniques for energy flow management have been discussed in detail. In [6] reviewed the different software tools in the field of hybrid energy system. The research work related to hybrid systems carried out using this software at different locations worldwide is also reviewed. The main objective of the paper is to provide the current status of this software to provide basic insight for a researcher to identify and utilize suitable tool for research and development studies of hybrid systems. The capabilities of different software are also highlighted. The limitations, availability and areas of further research have also been identified. Investigation based on the feasibility of different power generation configurations comprising solar array, wind turbine and diesel generator in different locations within the geo-political zones of Nigeria is discussed in [7]. Six rural communities were randomly chosen from each of the six geo-political zones in Nigeria with the intention that the results of the study could be replicated in other remote locations of the selected zones with similar terrains.

A hybrid energy storage system (HESS), which combines battery for long-term energy management and super capacitor for fast dynamic power regulation, is proposed for remote area renewable energy power supply systems in [8]. The operation of a passive connected HESS was examined via both theoretical analysis and numerical simulation using MATLAB/Simulink. In [9] compare PSO (Particle Swarm

Optimisation) to HOMER for the simultaneous optimization of size and PMS (Power Management Strategy) in stand-alone hybrid energy systems. These systems incorporate significant relative water load met by reverse osmosis. Multi-objective functions in PSO minimize Total NPC (Net Present Cost) (includes capital, maintenance and replacement costs over a 25 year system lifetime) and lifetime CO2 emissions whilst meeting these two loads.

Rajanna Siddaiah et al [10] studied a comprehensive review of the research work carried out in planning, configurations, and modelling and optimization techniques of hybrid renewable energy systems for off grid applications. Hybrid renewable system utilities today are more dependent on an optimal design to minimize the cost function. This paper presents a review of various mathematical models proposed by different researchers. Amir Ostadi et al [11] provides a detailed comparative analysis of optimal sizing of battery-only, ultra capacitor-only and battery-ultra capacitor hybrid energy storage systems (ESSs) for a plug-in electric city bus (PECB). It is shown how the configuration affects the optimal size of the ESS.

Three decision variables related to the system renewable energy components: number of storage tanks, total swept area by the rotating turbine blades and total area occupied by the set of photovoltaic panels is discussed in [12]. The former is an integer decision variable, while the latter two are continuous decision variables. All the components are modelled and an objective function is defined based on minimizing the life cycle cost and satisfying the maximum allowable loss of power supply probability.

IV. Review Based on Energy Management System

Energy management is the main issue in the hybridisation of the energy sources. Because the output of the renewable sources is varied due to variation of the surrounding climate, area where installed etc. in this section discuss the different energy management work associated in the hybrid energy system.

Rodrigo Palma-Behnke et al [13] proposed a novel energy management system (EMS) based on a rolling horizon (RH) strategy for a renewable-based Microgrid. For each decision step, a mixed integer optimization problem based on forecasting models is solved. The EMS provides online set points for each generation unit and signals for consumers based on a demand-side management (DSM) mechanism. An operational architecture for Real Time Operation (RTO) of an islanded MG is presented in [14]. This architecture considers two different parts including Central Control Unit (CCU) and MG Test bed. CCU implements an EMS based on Local Energy Market (LEM) to control a MG. In order to reach this objective, this unit executes Day Ahead Scheduling (DAS) and Real Time Scheduling (RTS). Regarding DAS, a Modified Conventional EMS (MCEMS) based on LEM (MCEMS−LEM) algorithm has been proposed to find out hourly power set-points of Distributed Energy Resources (DERs) and customers. The mathematical formulation of the microgrid's energy management problem and its implementation in a centralized Energy Management System (EMS) for isolated microgrids is presented in [15]. Using the model predictive control technique, the optimal operation of the microgrid is determined using an extended horizon of evaluation and recourse, which allows a proper dispatch of the energy storage units. Design and investigation of a decentralized energy management system for the autonomous poly-generation microgrid topology is presented in [16]. The decentralized energy management system gives the possibility to control each unit of the microgrid independently. The most important advantage of using a decentralized architecture is that the managed microgrid has much higher chances of partial operation in cases when malfunctions occur at different parts of it, instead of a complete system breakdown.

In [17] proposes a novel control strategy for coordinated operation of networked microgrids

(MGs) in a distribution system. The distribution network operator (DNO) and each MG are considered as distinct entities with individual objectives to minimize the operation costs. It is assumed that both the dispatchable and non-dispatchable distributed generators (DGs) exist in the networked MGs. In order to achieve the equilibrium among all entities and take into account the uncertainties of DG outputs, we formulate the problem as a stochastic bi-level problem with the DNO in the upper level and MGs in the lower level. Each level consists of two stages. A decentralized energy management system for the coordinated operation of networked microgrids (MGs) in a distribution system is proposed in [18]. In the grid-connected mode, the distribution network operator and each MG are considered as distinct entities with individual objectives to minimize their own operation costs. It is assumed that both dispatchable and renewable energy source-based distributed generators (DGs) exist in the distribution network and the networked MGs.

The development of an intelligent dynamic energy management system (I-DEMS) for a smart microgrid is discussed in [19]. An evolutionary adaptive dynamic programming and reinforcement learning framework is introduced for evolving the I-DEMS online. The I-DEMS is an optimal or near-optimal DEMS capable of performing grid-connected and islanded microgrid operations. The primary sources of energy are sustainable, green, and environmentally friendly renewable energy systems (RESs), e.g., wind and solar; however, these forms of energy are uncertain and non-dispatchable. Backup battery energy storage and thermal generation were used to overcome these challenges. In [20] proposes an energy management and control system for laboratory scale microgrid based on hybrid energy resources such as wind, solar, and battery. Power converters and control algorithms have been used along with dedicated energy resources for the efficient operation of the microgrid. The control algorithms are developed to provide power compatibility and energy management between different resources in the microgrid. It provides stable operation of the control in all microgrid subsystems under various power generation and load conditions.

V. Problem Formulation

In the last few years, energy consumption and prices have hit their highest record since the last energy crisis in the late 1970s. Besides energy prices, strong environmental campaigns to reduce global warming have enhanced the interest in renewable green energy power generation. Solar, wind power and hydrogen as a power carrier are the most attractive green sources of renewable energy. The European Photovoltaic Industry Association (EPIA) estimated that electricity produced by PV will cover about 12% of electricity demand generated in Europe by 2020 [21]. Due to the fact that solar and wind generated power is affected by weather changes,using hydrogen as power storage and then generating electrical power via fuel cells also showed great potential as a green power source for the future. FC have many advantages, such as lowor even zero CO_2 emission, high efficiency and low maintenance cost.Also, in the last few years, fuel cell technology has dramatically improved and, as a result of that, the cost has dropped rapidly.

VI. Conclusion

By advancing civilization and technological evolution, energy demand has become a fundamental challenge in the development of today's society. Current approaches to this requirement are mainly based on resources like fossil and nuclear fuels that adversely affect the environment, either by contributing with greenhouse gasses or by producing radioactive or inert solid waste. For this reason, the need to migrate to energy production models that are more environmentally responsible is becoming increasingly obvious. In this paper discuss the new sources for fulfilling the requirement of energy. Also in this paper discuss the review based on energy management system for the hybrid energy sources.

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