

Use of Nonconventional Resources for Electrical Energy Generation - An Approach towards Management of scarcity of Conventional Resources

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Abstract: *Use of energy, particularly electrical energy is on trend of exponential growth since almost last decade of previous century. Requirement of Electrical energy per anum in India is almost 15×10^{10} mwh and most of this amount of Electrical energy is generated by using conventional means with use of fossil foil.*

However, fossil foil with its existing available stock in India is expected to last a limited span. Coal with existing reserve stock is observed to be available for another 150 years at the most taking into consideration the existing rate of consumption and crude petroleum resources are expected to be available for much more shorter period – popular estimation is not beyond 50 years. The possibilities of gaseous fuel have not been explored very specifically and relevantly till now in India.

Consequently it requires extensive research work over possibilities and means of management of these energy disasters and the favourable outcome thereof by use of possible alternative resources which are nonconventional and sustainable in nature.

Key word: *Electrical energy, exponential growth, fossil fuel, alternative resources.*

1.0 Introduction: The total globe on the whole is on a trend of exponential rise over utilization of energy and to be very specific electrical energy. Also at the same time in almost all over the globe there is rush at equal rate towards the scarcity of conventional natural resources, mostly fossil fuel except few locations where there is availability of water based electricity called hydroelectricity in country like Rhodesia or in place like Holland where potentiality of wind power is in abundance or few more alike where the resources are sustainable.

Hence it requires a compromise in between these two extremes to avoid the extreme consequence of disaster jeopardising even the basic privilege of living in these days. It requires proper energy management to come over the disastrous situation.

India is victim of this poor energy situation since only 36% of total installed capacity of Electrical power generation is available from source other than fossil fuel presently. It needs to find out how best this may be managed to migrate dependency of energy requirement from sources of fossil fuel which is

expected to last for another 125 years only with its present rate of consumption to some other sources which are sustainable in nature.

1.1 Scope and Criticality of Conventional and nonconventional Energy Resources: Conventional energy resource is the resource that is conventionally or traditionally used for generation of energy – electrical energy in the present context of discussion. At present the annual primary energy consumption of the world is 138.8×10^{12} kwh or average power of 1.5×10^7 MW. Fossil fuel roughly provides about 90% of this energy. Approximately 25% of this energy is consumed in transportation sector and remaining 75% by industries, domestic, agriculture, and social consumers.

A. Conventional Resources:

i) Fossil Fuels – Fossil fuels have been a major source of energy since 1850, the start of industrial era. As an estimate, if the world continues to consume fossil fuels at year 2006 rates, the reserve of coal, oil and gas will last 200,40 and 70 years respectively.

ii) Hydro Resources – Among all renewable, hydro power is the most advanced and flexible source of power. It is a well developed and established source of electric power. The global installed generating capacity of hydro power is about 7,78, 038 MW which accounts for about 20% of total world's installed electric power generating capacity.

iii) Nuclear Resources – U^{235} and U^{233} (isotopes of uranium) and Pu^{239} (plutonium) are used as nuclear fuels in nuclear reactors. Nuclear power is a low cost, low emission technology. As up to end of last decade in around 440 nuclear power plants in world 3, 71,980 MW electricity is generated.

Nuclear fusion reaction has a lot more potential and vast resources are available. It is predicted that by year 2500 some breakthrough will take place in fusion technology and nuclear fusion will be main source of energy in world.

B. Nonconventional Resources;

Non conventional technologies are presently under developing stages. Taken under scope and privileges of suitable energy management program there is abundant potentialities of harnessing the benefit out of these.

i) Solar Energy – The earth continuously intercepts solar power of 178 billion MW, which is about 10,000 times the world's demand. But so far, it could not be developed on a large scale.

ii) Wind Energy – The power available in the winds flowing over the earth surface is estimated to be 1.6×10^7 MW which is more than the present energy requirement of the world. Wind power has emerged as the most economical of all renewable energy resources.

iii) Biomass Energy – Energy resources available from animal and vegetation are called biomass energy resources. This is an important resource for developing countries, and especially in rural areas. At present, there are millions of biomass plants in the world.

iv) Geothermal Energy – Geothermal energy is derived from huge amount of stored thermal energy in the interior of the earth. Globally, use of geothermal power is growing annually at the rate of 10.5%.

v) Ocean Tidal Energy – Tidal energy is a form of hydro power that converts energy of ocean tides into electricity. It is in the developing stage and although not yet widely used, tidal power has potential for large quantity of electricity generation.

vi) Ocean Thermal Energy Conversion (OTEC) – OTEC is still in its nascent stage. Conceptual design of OTEC commercial power plants has been finalized. The potential is likely to be more than that of tidal or wave energy.

1.2 Trend of growth in electric energy requirement: At present annual energy consumption of the world is almost equivalent to 138.8×10^{12} kWh. In India total annual energy consumption is 23.8×10^{12} kWh. The growth is forecast to continue at an annual average rate of 2.2% during 2004 – 30.

1.3 Global situation of availability fossil fuel resources:

Fossil fuel reserves of few countries are shown in table as below:

Country	Fossil fuel reserve (in thousand million tonnes oil equivalent)			
	Oil	Coal	Gas	Total
North America	8	170	7	185
South America	15	13	6	34
Europe	2	40	5	47
Russia	18	152	52	222
Middle East	101	0	66	167
India	1	62	1	64
China	2	60	10	72

Though at present consumption rate (calculated in 2006), the above stock of coal, oil and gas in world is like to continue for another 200, 40 and 70 years and in India for another 120, 30 and 60 years, there is like to be acute crisis of fossil fuel after this

Consequence of scarcity of fossil fuel resources because of depletion

Though at present consumption rate (calculated in 2006), the above stock of coal, oil and gas in world is like to continue for another 200, 40 and 70 years and in India for another 120, 30 and 60 years, there is like to be acute crisis of fossil fuel after this period.

1.4 Prospects of generation of electricity from resources other than fossil fuel: Under these constraints unless some measure is identified to manage the disaster of energy crisis, there will not be any answer to the question - how the future will satisfy the need of electrical energy requirement to meet the bare necessities of survival or existence of human beings. Something alternative is required to be done in the form of the process of energy disaster management.

The main purpose of this research work is to identify the solution of the unimaginable crisis by sorting out the alternative energy disaster management techniques and finding out not the most economic or technology friendly outcome but the most optimum outcome in the multivariate regression problem having the contribution of several independent variables like availability and abundance of fuel, feasibility of technology, economy, hazards associated with power generation problem like pollution

etc., sustainability of resources under use, depletion of resources, period of maturity in the product – life-cycle of the process and technology and also feasibility etc. upon the dependent variable - required quantity of electrical power on long run basis to meet the energy demand of country.

1.5 Scope of meeting the shortage by replacing fossil fuel generated power with other resources: Globally there is tremendous effort, especially in Western countries, Latin American countries, Australia, China and some other countries of Asia to try for switching off to nonconventional energy resources for generation of electrical energy. In many countries, including Canada, Russia, Brazil, Mexico, America and also some European countries, introduction of non conventional energy resource like solar system, wind power and also hydra and nuclear resources are on use.

of fossil fuel. India is also presently on beginning to consider the gravity of the situation and effort just has been initiated to explore possibility of using nonconventional sources like solar , wind power and biogas. Also using hydra and nuclear sources are already on move. But there needs to be a total move to ban use of conventional fuel because fossil fuel which is absolutely subjected to depletion is the most used conventionally resource for power generation. In India, in national level it requires use of non conventional resources for power generation so that gap of electrical power shortage is bridged because scarcity

1.6 Managing the electrical energy disaster: It needs to find out the suitable process of power generation which should not follow a common process along the whole country, in each region actual process to be followed should be in accordance with resources available and other associated facilities in that region. India has got abundance over the necessary resources; these are to be, as mentioned above, used with optimum utility value.

2.0 Literature Survey: Different authors, research scholars, technical experts etc. have undertaken exhaustive work to identify the problem as discussed above and also to find out the solution some of these works has briefly been taken for consideration as below.

1. G. Furlan, N.A. Mancini and A.M.Sayigh (1983), A View of Non conventional Energy Sources, World Scientific Pub. Co. Pvt. Ltd, Singapore

This book contains an elaborate discussion over non convention sources of power available on global basis and prospects and feasibility of each towards commercial generation.

2. S. Rao and B.B. Parulekar (1999), Energy Technology: Non Conventional, Renewable and Conventional, Khanna Publishers

In this work the authors mostly stressed upon the available technology used for power generation in the three areas as mentioned and also highlighted the scope and prospects of these resources.

3. G.D. Rai (2000), Non Conventional Energy Sources, Khanna Publishers

The author has mostly worked upon the scope and prospects of use of non conventional power generation resources and also tried to identify quantitative availability of these resources.

4. R. Messenger and J. Ventre (2000), Photovoltaic System Engineering, CRC Press

Author has undergone a research based work upon the potentiality of solar energy in area of photovoltaic system of power generation. Also in this work the author has analysed the extent of technology available for use for the purpose of commercial power generation.

5. D.S.Chauhan and S.K.Srivastava(2004), Non conventional Energy Resources, New Age International Publication.

In this work categorical availability of non conventional energy resources with respect to location in India has been discussed and also at present contribution of each has been studied.

6. John W. Twidell and Anthony D Weir (2006), Renewable Energy Resources, Taylor and Francis

Elaborately discussed the possible renewable resources of energy used for power generation and extent of present use. Also in this work the feasibility of technology being used has been taken for discussion.

Also several others like Anthony D. Weir, Samuel Glasstone, M. R. Patel, S. Dasappa, I.L.Fresis, R.Messenger etc. have worked significantly in these areas stating the seriousness of conventional resource crisis and its consequence etc. But still now not much significant work is available designed to ménage the impending energy crisis.

3.0 Objectives: Objective of this research work is to manage the energy crisis so that in absence or in situation of total exhaustion of fossil fuel because of depletion which is unavoidable under present situation, the situation is developed such that the disaster of non-availability of electrical power is eliminated. It requires looking for energy disaster management situation.

The different critical variables which may be termed to be predictors in process of power generation should be identified and a model relation among the variables including the dependent variable and independent variables should be formed and it should be optimized by using statistical method in order to find out the most optimal solution of the problem. From the model relationship formulated among the variables, the scope and opportunities of power generation from each resource or each type of power generation as discussed above, the most optimum one for a particular region may be established. This will help to identify the most suitable and usable alternative resource base energy generation. The objective of this research work is:

- i) To find out the potential of non conventional energy resources in India
- ii) To identify the availability of technology and other opportunities of generation of electricity available from these resources.
- iii) Economy of electrical energy generation from these resources
- iv) To identify the most feasible non conventional and renewable energy resources.

Hypotheses:

Also it is desired formulation of following hypotheses:

H₁: Long term reliability upon fossil oil based electrical power is not desirable.

H₂: Growth rate of consumption of fossil fuel will be regularly increasing order

H₃: Cumulative use of all types of available fossil fuel is enough for required electrical power generation in India.

H₄: Growth of renewable resource is essential to replenish conventional resources which are not renewable

4.0 Scope, Limitations and Delimitations:

Scope of this research work is to guide the overall power generation system- identifying the requirement of electrical energy and corresponding requirement and availability of conventional fuel that is presently used. Since the availability is limited, the research work will find out the scope of use of non conventional renewable forces.

However, there are some shortcomings those need to be studied. The electrical power generation in a country is linked with quantity of power requirement. The quantity of power requirement is dependent upon growth of country including industrial growth, social growth etc. which in several case are difficult to find out. In presence of shortcoming over finding out quantity of requirement of power, it becomes difficult to establish requirement of resources necessary for power generation.

However, existing research work is done on the basis of some assumptions which are established on the basis of study based on data both presently collected and established and also old data which has been collected and generated in process of previous research work and also is outcomes of previous research work.

5.0 Research Methodology/ Requirements of the Research Work : The research work will be undertaken on the basis of contribution of different parameters of power generation – the parameters may be identified as efficiency of process, economy and cost involvement, availability of technology, expertiseness, availability of machineries (whether indigenous or imported), Maturity life of the project in project –life-cycle, other than prime resource other necessary resource or raw material required and their availability etc. The parameters are actually independent variables because power generated from a particular resource or called otherwise, a particular type of power e.g. hydra power or nuclear power which is the dependent variable is dependent upon these independent variables.

These parameters are suitably identified and upon each of these few questions are made, thus making a total set of questionnaire containing few selected questions upon each dimension. This questionnaire is given to several experts in the area of power generation and their feedback is taken. This feedback may be taken as expert opinion contributing towards the suitability and details information over the parameters. From statistical analysis of the data obtained from expert feedback a relational equation is modeled among the dependent variable and independent variables. The variables are suitably grouped by doing factor analysis and after this the coefficient of the dependent variables is found out by regression analysis.

This relational model is once statistically established, this may be used to find out which power generating process or which natural resource generated power is optimum for a particular region or location of a country.

6.0 Data Collection: Data to be used in this research work will be primary data. Once the questionnaire is made, as discussed above, is given to experts for their feedback. Each respondent gives his unbiased expert opinion and thus a large number of primary data (depending upon the number of questions in the questionnaire and number of respondents) is available.

7.0 Data Analysis: Data thus collected are taken for analysis by using different statistical measures for testing the validity of questionnaire, inter-rater agreement among the predictors, inter-item (predictor)-correlation, successive position of predictors in accordance with contribution over the decision outcome of proposed power generation system as rated by respondents who are experts etc. Also the grouping of predictors as done in factor analysis and regression analysis to find out the coefficients of independent is done in process of analysis of collected data.

8.0 Observation: The outcome of analysis of data are taken for analysis and observation with respect to scope and facility of utilizing the available natural resources for power generation with nonconventional natural resources used for power generation.

9.0 Conclusion: Finally this part of research work will help to come to decision over the outcome of the research work – what is to be done at the use of which natural resource in order to come over the disaster over power generation and availability under existing situation.

10.0 References:

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