LOW EMISSION POWER GENERATION IN INDIA BY 2030

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Abstract

With increasing industrial and agricultural activities in the country, the demand for energy is rising. Development of this Energy Model will help in the proper allocation of these renewable in meeting the future demand of energy in India. Present work deals with effective utilization of all energy sources in India for power generation as well as renewable importance can cater remote places.

The linear programming model is solved using TORA Package. The objective function of model is to minimize the emission during power generation. Formulation of this Optimization Model for energy resources subjected to various constraints like potential, demand, efficiency, running cost and H/C ratio, isolated load and minimum capacity existing . Several scenarios are developed by controlling the individual constraints.

This model shows that 12% of total requirement can be met by renewable itself excluding Hydro power plant. Necessary capacity addition in each technology is required in steady manner. This can be made possible before two decades.

Keywords: Power Supply, Demand -Supply, Indian Power Scenario, Optimization.

I. INTRODUCTION

The sub optimal consumption of the commercial energy adversely affects the productive sectors, which in turn hampers economic growth. Poor hydrocarbon resource base have forced an increased reliance on energy imports. The rising oil import bill has been the focus of serious concerns.

Renewable energy sources such as solar, wind and biomass are receiving increased attention in developed as well as developing countries. The depleting nature and the accelerated demand of conventional energy had forced planners and policy makers to look for alternate sources.

It is now generally accepted that renewable energy sources will have to play a major role in future. Power supply from Renewable Energy will vary from 10 to 20% depends on intensity of work followed by Government and Private Sectors.

II. DEVELOPMENT OF THE MODEL

The electricity demand for the year 2030 would be approximately 13, 95,754 GWh [Iniyan 2006], which is predicted by the ANN forecasting model. This energy requirement should be met with special consideration to renewable sources.

This Model shows the appropriate energy options for power generations and optimized values are selected based on factors such as cost, efficiency, potential and demand, minimal value and renewable constraint with objective as minimizing the emission.

Model targets: Minimizing cost.
Shifting to gaseous fuels from solid fuels.
Electrify all regions.
Increase Efficiency

Possible twenty energy options have been considered in the model to meet the electricity demand in first stage and after three hundred trials finally the following eleven options considered in the Optimization Model. Coal, Oil, Gas, Nuclear, Hydro, Wind, Bio-diesel, Biomass-gasifier, Biogas, Solar PV and Mini hydel sources are considered for power generation.

III. BASE LINE MODEL

As expected Gas and Nuclear are the major contributors with 35 and 20% power supply respectively. Followed by Coal (16%) and Hydro (7%) will meet the country's requirements. Coal contribution from topmost level suppressed by low emission objective .Other suppliers are Diesel 3%, Bio Diesel 3%, Biomass Gasifier 3 % and wind 2%. Biogas and Small Hydro combined can supply only 2%. By this given objective coal's supply can be reduced from current top most priority.

Still now coal is the major player; but this model show the way for reduction of coal power by some other source (Gas) which is reaching the ability to replace coal as major player.

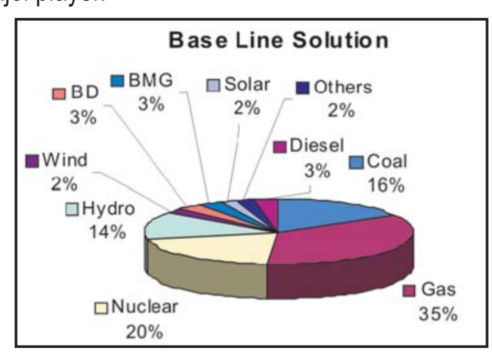

Fig. 1.

IV. DISCUSSIONS AND SCENARIOS

Different scenarios are developed by changing the values of particular constraint while other constraints are maintained as same in base line model.

V. COST CONSTRAINT

Running cost is varied from Rs 3.15 to Rs 3.85 with base line value as 3.5 Rs/KWh. Coal, Gas, Diesel and Solar energy shows the major variation for changing cost. Gas maximum supply is found to be changed from 25% to 40% by allowing more average running cost in overall. Solar value show huge variation of 0.5% to 5.5 % for this cost relaxation. Diesel value reduced to lower boundary value from its base line solution for reduction of even 0.35 Rs / KWh.

Importantly Coal shows positive improvement for cost restriction while other sources fail to maintain its base line value. For 10% cost restriction coal supply sharply rose to 30%. Coal share reduced to 10% for cost relaxation as all the relaxation given is captured by solar. .For huge power requirement in future coal is first preference than gas if selection is based on cost.

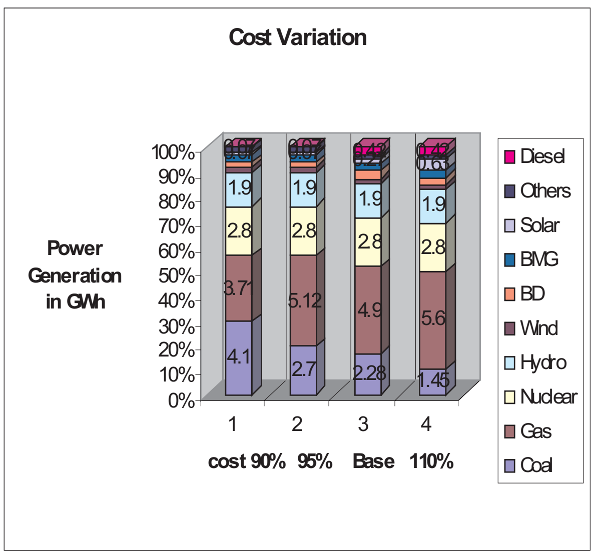

Fig. 2. VI. H/C CONSTRAINT

This is newly introduced constraint ever to show the reality of hydrocarbon sources. When compared to olden days most of applications are shifted to gaseous mode. This constraint will help to realize that aspect in the model. In the absence of this constraint, Gas has comparatively poor show as it has comparatively high cost and emission than non hydro carbon sources.

VII. DEMAND VARIATION

Coal, Gas and Solar sources are showing variation for change in requirement of power. Demand values are changed in a range of -20 to 20% base line model. Coal showing big variation of 10% to 30% as it's an only source which can adapt maximum demand or low cost option. This shows how model objective restrict coal even though it's more reliable in terms of cost, efficiency and rise in demand.

Gas can supply from 24 to 40% for this demand variation. Solar keeps on rising with demand increasing from 1% to 4% also it will increase for further rise in demand. But the problem is with cost and efficiency

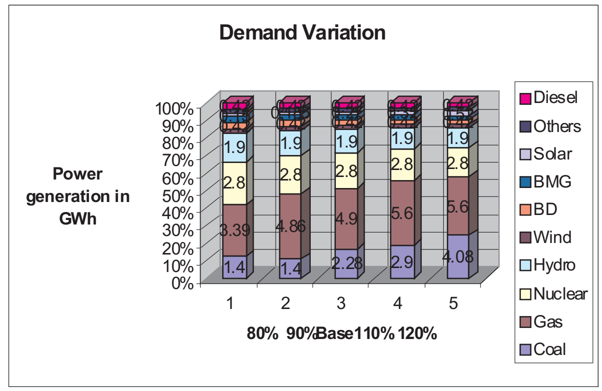

Fig. 3. VIII. EFFICIENCY CONSTRAINT

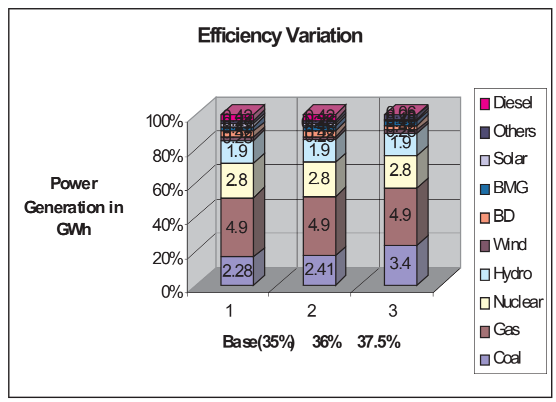

Fig. 4.

Model is designed to meet minimum efficiency in overall. This makes reduction of fuel usage and also helpful in pollution impact by fewer inputs, which is major drawback in most of developing countries. The rise in efficiency requirement makes the coal sources to take up shares of solar as solar efficiency is very low. But base line solution has comparatively high efficiency sources such as coal, Gas, Hydro and Nuclear takes up 80% of total requirement Because of low efficiency of most of renewable sources, maximum overall average efficiency is only 38%.

IX. CONCLUSIONS

The Model was developed for energy allocation in India for the year 2030. Future economic growth depends on long term availability of energy from sources that are affordable, accessible and environmentally friendly. In the coming decade's coal usage cannot be spared for next thirty years. It's better to find the technology with higher efficiency or more gasification method should be used to meet the demand. As the constraint to nuclear fuel is more, the capacity should be increased continuously in uniform rate. Hydrogen carbon ratio constraint makes the difference from the other models developed so far.

This model makes low contribution of coal though it's more reliable fuel in respect of cost, efficiency and meeting demand. To meet energy requirements policy decisions to speedily develop and utilize all types of energy resources at our command need to be taken and implemented. Full potential of RE should be exploited at earliest. If we targets low pollution then it's necessary to consider sources other than coal to deliver the power requirement.

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Umeshkannan .P, is a BEE certified Energy Auditor and Manager. His fields of specialization are Energy Modeling and Energy conservation. He has more than six years of teaching experience in AICTE affiliated engineering colleges and Deemed Universities. His papers were published in international symposium and journals.