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- All works cited in the text (including sources for tables and figures) should be listed alphabetically.
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- The title of books and journals should be in italics. Double quotation marks are used for titles of journal articles, book chapters, dissertations, reports, working papers, unpublished material, etc.
- For titles in a language other than English, provide an English translation in parentheses.
- The location of endnotes within the text should be indicated by superscript numbers.

PLEASE USE THE FOLLOWING FOR STYLE AND PUNCTUATION IN REFERENCES:

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- Bowersox, Donald J., Closs, David J., (1996), "Logistical Management." Tata McGraw, Hill, New Delhi.
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- Schemenner, R.W., Huber, J.C. and Cook, R.L. (1987), "Geographic Differences and the Location of New Manufacturing Facilities," Journal of Urban Economics, Vol. 21, No. 1, pp. 83-104.

CONFERENCE PAPERS

- Garg Sambhav (2011): "Business Ethics" Paper presented at the Annual International Conference for the All India Management Association, New Delhi, India, 19–22 June.

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ONLINE RESOURCES

- Always indicate the date that the source was accessed, as online resources are frequently updated or removed.

WEBSITE

- Garg, Bhavet (2011): Towards a New Natural Gas Policy, Economic and Political Weekly, Viewed on July 05, 2011 http://epw.in/user/viewabstract.jsp

INDIA'S FUTURE CONSUMPTION OF COAL RESOURCES & INDONESIA AS A POTENTIAL PROCUREMENT DESTINATION

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ABSTRACT

The global energy requirement has grown at a phenomenon rate and the consumption of primary energy sources has been a very high positive growth. This paper focuses on the consumption of different primary energy sources and it identifies that coal will continue to remain as the prime energy source in foreseeable future. It examines the energy requirement perspective for India and demand of coal as the prime energy source. Economic development and poverty alleviation depend on securing affordable energy sources and Indian coal mining industry offers a bright future for the country's energy security, provided the industry is allowed to develop by supportive government policies and adopts latest technologies for mining. It is an irony that in-spite of having a plentiful reserve, India is not able to jack up coal production to meet its current and future demand. It discusses the strategies to be adopted for growth and meeting the coal demand.

KEYWORDS

Coal consumption, Energy, Economic Development, Growth, Procurement.

INTRODUCTION

Energy has been universally recognized as one of the most important inputs for economic growth and human development. There is a strong two-way relationship between economic development and energy consumption. On one hand, growth of an economy, with its global competitiveness, hinges on the availability of cost-effective and environmentally benign energy sources, and on the other hand, the level of economic development has been observed to be reliant on the energy demand.

Energy intensity is an indicator to show how efficiently energy is used in the economy. The energy intensity of India is over twice that of the matured economies, which are represented by the OECD (Organization of Economic Co-operation and Development) member countries. India's energy intensity is also much higher than the emerging economies the Asian countries, which include the ASEAN member countries as well as China. However, since 1999 India's energy intensity has been decreasing and is expected to continue to decrease. The indicator of energy GDP (gross domestic product) elasticity that is the ratio of growth rate of energy to the growth rate GDP captures both the structure of the economy as well as the efficiency. The energy GDP elasticity during 1953–2001 has been above unity.

The elasticity for primary commercial energy consumption for 1991–2000 was less than unity (Planning Commission 2002). This could be attributed to several factors, some of them being demographic shifts from rural to urban areas, structural economic changes towards lesser energy industry, impressive growth of services, improvement in efficiency of energy use, and inter-fuel substitution. The energy sector in India has been receiving high priority in the planning process. The total outlay on energy in the Tenth Five-year Plan has been projected to be 4.03 trillion rupees at 2001/02 prices, which is 26.7% of the total outlay. An increase of 84.2% is projected over the Ninth Five-year Plan in terms of the total plan outlay on energy sector. The Government of India in the mid-term review of the Tenth Plan recognized the fact that under-performance of the energy sector can be a major constraint in delivering a growth rate of 8% GDP during the plan period. It has therefore called for acceleration of the reforms process and adoption of an integrated energy policy. In the recent years, the government has rightly recognized the energy security concerns of the nation and more importance is being placed on energy independence. On the eve of the 59th Independence Day (on 15 August 2005), the President of India emphasized that energy independence has to be the nation's first and highest priority, and India must be determined to achieve this within the next 25 years.

LITERARY REVIEW

Masih and Masih (1996, 1997) in a multivariate framework examined the relationship between total energy consumption and real income of Asian economies such as India; Pakistan; Malaysia; Singapore; Indonesia; Philippines; Korea; and Taiwan. Energy consumption was found to be neutral with respect to income for Malaysia, Singapore and Philippines, unidirectional causality existed from energy consumption to GNP for India, exactly the reverse for Indonesia and mutual causality was present for Pakistan.

Ghosh (2005) using co integration and error correction modeling approach found the existence of a long-run equilibrium relationship between total petroleum products consumption and economic growth in India for the period of 1970-71 to 2001-02.

Ebohon (1996) examined the casual linkage between energy consumption and economic growth for Nigeria and Tanzania. The results showed a simultaneous causal relationship between energy and economic growth for both the countries.

OBJECTIVES OF THE STUDY

1. To analyze the future consumption of Coal Energy by India.
2. Which is the feasible Geographic location to obtain Coal energy till 2025 to India.

METHODOLGY OF THE STUDY

SOURCES OF DATA

The study considers the annual data from 1970-71 to 2004-05. The data relating to different forms of energy consumption and GDP at constant prices have been collected from www.indiastat.com and verified with Indian Petroleum and Natural Gas Statistics, Ministry of Petroleum Natural Gas Economics and Statistics division, Government of India, and Energy Statistics, Ministry of Statistics and program Implementation, Central Statistical Organization (CSO). Examining the link

between Energy Consumption & Economic growth in India, Centre for Development Studies, India 2009. World Energy Demand and Economic Outlook 2010 projections, total world consumption of marketed energy. The largest projected increase in energy demand is for non-OECD economies including India.

TOOLS USED

TIME SERIES

TREND PROJECTION

To emphasis the fact that, in forecasting the independent variable is time ,we will use 't' in equation instead of 'x', in addition we use T in place of 'yˆ'.Thus for a linear trend the estimated sales value expressed as function of time can be written as follows.

Equation for Linear Trend:

$$T_t = b_o + b_{1t}$$

Where:

T_t=Trend value of the time series in period t

b_o = Intercept of the trend line.

b_1 = Slope of the trend line.

t=Time

Computing the slope (b1) and intercept (b_0)

$$b_1 = \{\sum_t y_t - (\sum_t \sum y_t)/n\} / \{\sum_t^2 - (\sum_t)^2/n\}$$

Where:

y_t = Value of the time series in period t.

n = Number of period.

$\bar{y}$ = Average value of the time series; that is $\bar{y} = \sum y_t / n$

$\bar{t}$ = Average value of t; that is $\bar{t} = \sum t/n$

GROWTH MODEL

The following model has been used for finding the growth rates of the variables.

$$Y_t = a\, e^{b*t} e^{u}\, t$$

This can be written as

$$\text{Log } Y_t = \log a + b*t + u_t$$

Exponential Function:

In order to estimate the growth rates, the following function is used

$$Y_1 = f(t, u_t) \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$Y_t = a\, e^{b*t}\, e^{u}\, t \ldots\ldots\ldots\ldots\ldots (2)$$

Where

Y = time period and

U = the stochastic disturbance term

The above relationship can be rewritten as

$$\text{Log } Y\, t = \text{Log } a + b*t + ut \ldots\ldots\ldots\ldots (3)$$

This can be estimated by the method of Ordinary Least Square (OLS).

Here

$$B = (dY/y)/(dt) \ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Which indicates the exponential growth rate.It gives the proportionate change in "y" for a unit change in time.

T-test

Together with the value of r^2 it is necessary to compute the standard errors of the regression coefficient . Some econometricians report the t-ratios of the estimated coefficient in place of standard errors because this way of presentation makes the testing of hypothesis easier and direct .The t-ratio for 'b' is

$$T_b = b/S.E\,(b)$$

Where

$$S.E.\,(b) = \sqrt{Var\,(b)}$$

$$Var\,(b) = \sigma_u^2 / \sum (x_i - \bar{x})^2$$

$$\text{Est. Var}\,(b) = \hat{\sigma}_u^2 / \sum (x_i - \bar{x})^2$$

Where $\hat{\sigma}_u^2 / \sum e_i^2\,(n-2)$

Here $\hat{\sigma}_u^2$ = an unbiased estimator of variance of distributions and n = number of observations.

$$T_a = a/S.E.('\hat{a}')$$

Where

$$S.E.(b) = \sqrt{Var\,(b)}$$

$$Var\,(b) = \hat{\sigma}_u^2 / \sum (x_i - \bar{x})^2$$

$$\text{Est.Var}\,(b) = \hat{\sigma}_u^2 / \sum (x_i - \bar{x})^2$$

Where $\hat{\sigma}_u^2 = \sum e_i^2\,(n-2)$

If t* < t (the tabulated value of t at (n-2) degree of freedom), we accept the null hypothesis*, that is, we accept that 'bˆ is not significant and the regression time does not appear to contribute to the explanation of the variations in Y.

If t* < t (the tabulated value of t at (n-2) degree of freedom),we reject the null hypothesis and we accept the alternative one ,that is ' bˆ' is statistically significant .Thus greater the value of t* the stronger the evidence that ' bˆ' is statistically significant .

COEFFICIENT OF DETERMINATION

To test whether our fit is best or not it is necessary to estimate r^2 , the coefficient of determination.r^2 measures the proportion of variations in the dependent variable that is explained by the independent variables. This definition is valid only when the particular regression model contains term. If our fit is perfect $\sum e_i^2 = 0$ and $r^2 = 1$, indicating the best fit. At the other extreme $r^2 = 0$, indicating that the estimated regression line is horizontal. Thus the limit of r^2 are ZERO and unity.

$$r^2 = 1 - (\sum e_i^2) / (\sum y_i^2)$$

Where

$\sum e_i^2$ = Unexplained sum of squares,

$(\sum y_i^2)$ = Total sum of square (Explained sum of squares)

$(b\hat{}\sum x_i^2)$ + Unexplained sum of squares.

Distance Calculations by the use of GPS Method (Global Positioning System)

Latitude & Longitude of a destination A and a Latitude & Longitude of a destination B = Distance between A & B, Distance / Speed = Time Required.

COAL IN INDIA: CURRENT STATUS AND OUTLOOK

The world cannot do without coal. This energy source covers more than one-quarter (28.4% in 2006) of all primary energy consumption and is used to generate nearly 40% of all electricity consumed worldwide. All scenarios and forecasts agree that coal consumption will be growing substantially, driven mostly by China

and India. According to the IEA reference scenario (World Energy Outlook 2007), these two countries are expected to account for 82% of the increase in global coal demand by 2030. The outlook for India gives cause for concern: despite a strong domestic coal industry, it could eventually become a major importer. If so, what will the economic, industrial and environmental consequences to be.

India ranks Number Six in the world for the consumption of primary energy (432 Mtoe in 2006). Its appetite for energy is growing extremely rapidly: it averaged 6.7% a year between 2003 and 20061. Given the demographics, consumption per capita is one of the lowest in the world (512 kg per capita in 2003), but this figure is steadily increasing.

CONSUMPTION RISING FAST

Coal continues to dominate India's energy portfolio reporting a figure of 238 Mt for 2006, India was the Number Three coal consuming country in the world. It represented 7.7% of the coal consumed worldwide (versus 2.4% in 1966). Coal covers more than half (56.2% in 2006) of domestic demand for commercial primary energy. Moreover, since 2002, it has become steadily more dominant: its share of the national market now stands at about the same level as in the early 1990s.

Demand for coal in India is growing at a particularly fast rate. For decades, it has been running much higher than the world average. Between 1976 and 2006, domestic coal consumption rose by 5.3% a year, versus 2% for the world. In recent years, average annual growth has accelerated sharply, exceeding 8% a year since 2003.

THE CHALLENGES FACING THE ELECTRICITY SECTOR

The power sector alone represents more than 75% of domestic consumption of coal, used to generate more than 69% of India's electricity. In recent years, coal has strengthened its position in this sector: in 1990, it only accounted for 65% of total output.

With installed capacity totaling 137,552 MW in 2005 (about 4% of world output), India has seen its electricity sector expand substantially. Electricity consumption rose 64% during the previous decade, placing India in the sixth position worldwide.

The rate of electrification has not reached 45% of the population: over 580 million Indians still do not have access to electricity. The Indian government aims to connect all villages to the power network by 2010. Reaching this especially ambitious goal will require the mobilization of the entire industry as well as large-scale investments.

As a result, most forecasts estimate that the power sector will grow by 8 to 10% a year between now and 2020, one of the highest growth rates in the world. For base production alone, about 68,500 MW in extra capacity will have to be added. In light of existing domestic economic conditions and resources, it is expected that coal-fired thermal power plants will cover most of this increase in capacity. The five-year XI Plan calls for the construction of several "ultra mega power projects", i.e. giant units designed to exploit economies of scale and series. Each will represent 4,000 MW (5 × 800 MW) in capacity. It is thought that five of these plants will be located near the coast to help cope with increased demand for imports (70 Mt a year).

A SURGE IN INDUSTRIAL GROWTH

Close to 20.5% of domestic coal is consumed by industry, especially two sectors: Steel and related industries (coking) use nearly 12% of domestic coal. Ranked seventh in the world, the Indian steel industry is growing fast: since 2004, production has increased at a rate of almost 10% a year. Coal is also used by the cement industry, which, according to the X Plan for 2002-2006, is growing at a rate of 6-8% a year. Sustained by a dynamic construction sector, cement production accounts for 3% of Indian consumption.

THE IMPACT ON SUPPLY

India possesses abundant coal resources (nearly 253 Gt). With nearly 96 Gt in proved resources (more than 10% of the world total), India ranks fourth in the world behind the United States, Russia and China. At the current rate of extraction, these reserves represent more than 200 years of production. The domestic reserves are composed almost entirely of bituminous coal, with 27 large accumulations in the east and the central part of the country. The lignite formations in the south only represent 2.6% of reserves. Although bituminous coal accounts for more than 97% of domestic reserves (versus 53% for the world), one should keep in mind that Indian coal is of mediocre quality. It is low-sulfur but contains a very high percentage of ash (between 30 and 55%), which gives rise to major logistics problems. Coking coal only represents 17.3% of proved reserves and less than 13% of total estimated resources.

INDIAN COAL DEMAND AND SUPPLY SCENARIO

In the recent years, India’s energy consumption has been increasing at one of the fastest rates in the world due to population growth and economic development. Primary commercial energy demand grew at the rate of six per cent between 1981 and 2001 (Planning Commission 2002).accounting for about 3.5% of the world commercial energy demand in the year 2003. Despite the overall increase in energy demand, in India is still very low compared to other developing countries. India is well endowed with both exhaustible and renewable energy resources. Coal, oil, and natural gas are the three primary commercial energy sources. India’s energy policy, till the end of the 1980s, was mainly based on availability of indigenous resources. Coal was by far the largest source of energy. However, India’s primary energy mix has been changing over a period of time. Despite increasing dependency on commercial fuels, a sizeable quantum of energy requirements (40% of total energy requirement), especially in the rural household sector, is met by non-commercial energy sources, which include fuel wood, crop residue, and animal waste, including human and draught animal power. However, other forms of commercial energy of a much higher quality and efficiency are steadily replacing the traditional energy resources being consumed in the rural sector.Resource augmentation and growth in energy supply has not kept pace with increasing demand and, therefore, India continues to face serious energy shortages. This has led to increased reliance on imports to meet the energy demand.

OVER AMBITIOUS PRODUCTION TARGETS

India is the world's third largest producing country, with output standing roughly at 210 Mtoe. Since the coal industry was nationalized in the 1970s, large-scale investment and modernization programs have been carried out to boost production. In 30 years, average annual output has increased from about 70 Mt to nearly 432 Mt a year for FY2006-2007. There are 565 known mines in India. Most are open-pit mines and some are very large (> 10 Mt/year). Closed mining only represents 19% of national production.

THE END OF SELF-SUFFICIENCY

For many years, domestic production satisfied the bulk of domestic demand. In the last few years, however, production has had difficulty keeping up with the big increase in demand. In five years, coal imports have doubled, rising from 20 Mt to 41 Mt for FY2005-2006. Recent statistics show an even steeper uptrend, with imports reaching 61 Mt for FY2006-2007.

A STRUCTURAL COKING COAL DEFICIT

India is looking at a structural coking coal deficit. Its reserves are limited in size, therefore the country cannot increase production fast enough to keep up with the high growth of its steel industry. Inevitably, India must rely on imports, purchasing substantial quantities of coke and coking coal, particularly from Australia. These imports totaled close to 25.8 Mt for FY2006-2007. But steel-grade coals are not the only thing that India needs to import. Its huge demand for thermal energy has driven steam coal imports up (to 36 Mt for FY2006- 2007) and the pace is expected to accelerate. India needs to install 130 GW in electrical capacity in the next ten years, which is equivalent to 1 GW per month. And coal will continue to dominate the electricity mix in India and China as well.

MAJOR LOGISTICS PROBLEMS

Although great effort has gone into the modernization of the logistics chains in India, its entire electricity/coal supply system is coming under increasing pressure.

- In 2004-2005, a major supply shortage forced the largest domestic power generation company, National Thermal Power Corporation, owned by the government of India, to import close to 4 Mt.
- In 2005, the level of stocks at the 25 largest Indian power plants (about 35% of installed thermal capacity) did not exceed seven production days. Indian coal is mostly extracted in the east of the country and consumed in the north and southwest. Regularly, rail transport problems occur and customers must turn to imports. This situation has prompted key players in the electricity market to secure their supply of imported coal by building up their import

activities and announcing the acquisition of holdings in mines located in other countries. Since 2005, the Ministry of Coal has even recommended certain coal imports to prevent probable shortages at power plants located at a great distance from the mines. To handle this increase in imports, India needs to more than double port import capacity within five years. This may well be the next bottleneck.

WORRISOME FORECASTS ALREADY EXCEEDED

Coal imports for thermal power plants were conjectural but are now becoming structural. The outlook is for a massive increase in imports. By 2025, India may be importing nearly 181 Mt, a figure equivalent to that of Japan, currently the top importer in the world.

Obviously, the fact that India is depending more heavily on the world market will have repercussions on prices. Several signs indicate that India is impacting the international coal business to a greater extent. In this respect, the year 2007 has been instructive: facing a domestic coal shortage aggravated by logistics problems, cement manufacturers and electric power producers have increasingly turned to the international market. Today, India buys from the suppliers (South Africa in particular) that have always furnished the Atlantic Basin. This has led to sharp increases in the price of South African coal and helped push the CIF price in Europe higher.

COAL AND THE ENVIRONMENT IN INDIA

ENERGY EFFICIENCY AND THE KYOTO PROTOCOL

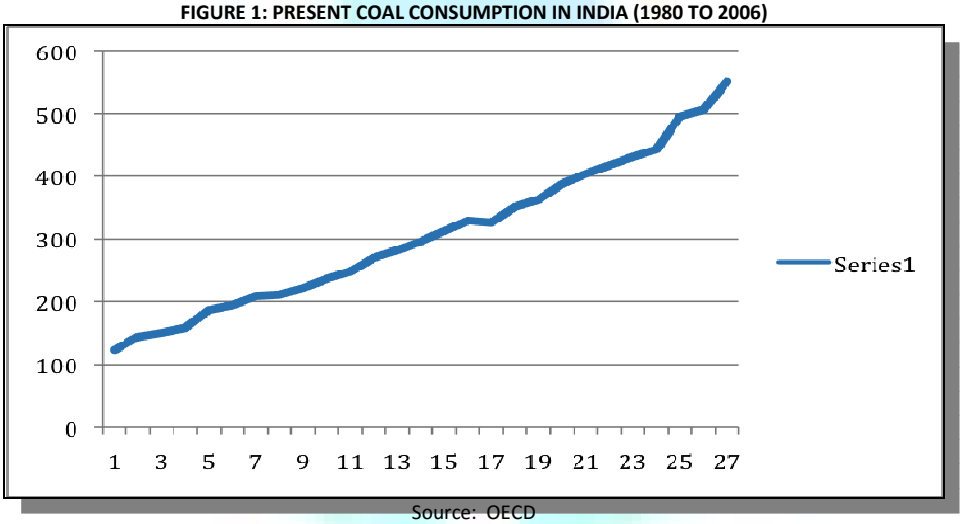
Facing tremendous energy demand, India introduced a policy to promote energy efficiency. In 2001, the Energy Conservation Act was passed. A federal agency, the Bureau of Energy Efficiency, was set up to coordinate actions in this area. Implemented in a booming economy, this policy is now showing the first encouraging signs of improving the energy intensity of the Indian economy (26 kBtu per dollar of GDP), which is comparable to that of the Czech Republic. India's CO_2 emissions totaled 1 Gt in 2003. According to the World Bank, they climbed 57% between 1992 and 2002. India ratified the Kyoto Protocol in August 2002. Since then, it has established the National Clean Development Mechanism Authority (NCDMA), which started operating in December 2003.

THE IMPORTANCE OF THERMAL POWER PLANTS

At present, power plants in India report low energy efficiencies — about 31% on average (versus 36.7% for OECD plants) — because they use "subcritical" technology. In the medium term, only one supercritical power plant, Seepat (3 × 660 MW), scheduled to start up in 2009, will be able to reach an efficiency exceeding 40%. This being said, it will not long remain isolated because, under the XI Plan (2007-2011) and XII Plan (2012-2016), all new plants will be supercritical. This may help moderate the sharp increase in coal consumption that is expected in the electricity sector.

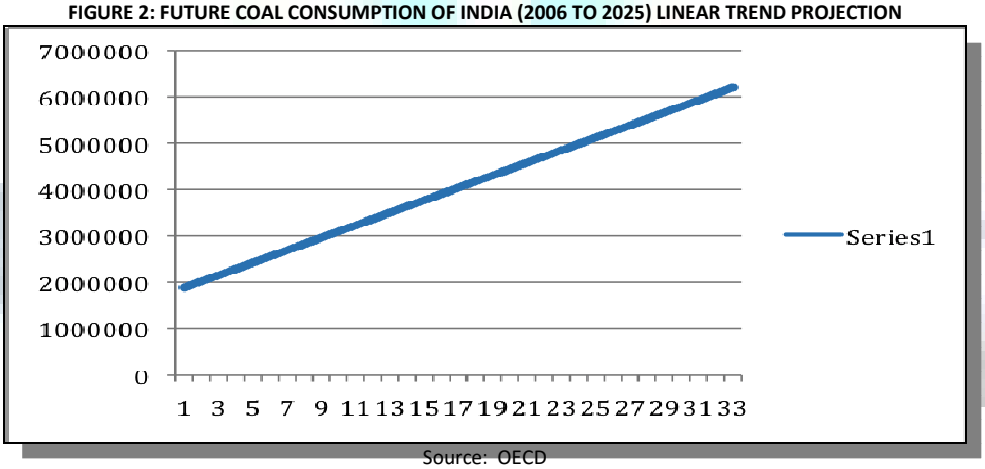
Experiments with IGCC technology are also underway in India. An initial pilot plant (6.2 MW) is to be followed by a demo-plant (100-125 MW) in the state of Uttar Pradesh. India also sees CO_2 capture/storage as a priority. It is a member of the Carbon Sequestration Leadership Forum (CSLF) and involved in Future Gen, a US government project to build and operate a near zero-emissions coal- fueled power plant.

FIGURE 1: PRESENT COAL CONSUMPTION IN INDIA (1980 TO 2006)



Source: OECD

FIGURE 2: FUTURE COAL CONSUMPTION OF INDIA (2006 TO 2025) LINEAR TREND PROJECTION



Source: OECD

FUTURE SCENARIO

Increasing pressure of population and increasing use of energy in different sectors of the economy is an area of concern for India. With a targeted GDP growth rate of 8% during the Tenth Five-year Plan, the energy demand is expected to grow at 5.2%. Driven by the rising population, expanding economy, and a quest for improved quality of life, the total primary energy consumption is expected to about 412 MTOE (million tonnes oil equivalent) and 554 MTOE in the terminal years of the Tenth and Eleventh Plans, respectively (Planning Commission 1999). The International Energy Outlook 2005 (EIA 2005b) projects India's gas consumption to grow at an average annual rate of 5.1%, thereby reaching 2.8 trillion cubic feet by 2025 with the share of electric power sector being of 71% by that time. Coal consumption is expected to increase to 315 MT over the forecast period. In India, slightly less than 60% of the projected growth in coal consumption is attributed to the increased demand of coal in the electricity sector while the industrial sector accounts for most of the remaining increase. The

use of coal for electricity generation in India is expected to increase by 2.2% per annum during 2002–25, thus requiring an additional 59 000 MW of coal-fired capacity. Oil demand in India is expected to increase by 3.5% per annum during the same time.It is quite apparent that coal will continue to be the predominant form of energy in future. However, imports of petroleum and gas would continue to increase substantially in absolute terms, involving a large energy import bill. There is, therefore, an urgent need to conserve energy and reduce energy requirements by demand-side management and by adopting more efficient technologies in all sectors.

INDIA'S POWER CONSUMPTION TO ZOOM NEXT DECADE

Electricity consumption in India, currently at some 600TWh annually, is set to double by next decade, by then it would have surpassed Russian levels in the process. KPMG's Global Advisory Practice released a power industry research published under the title 'Think BRICS' reveals that in order to supply this extra electricity, total generating capacity should jump by 90 GW, to 241GW, with an increased emphasis on nuclear, clean coal and renewable, including solar and small-hydro.

The survey finds that while the state and federal governments have initiated reforms, legislation designed to supply electricity to all consumer groups, conservative elements, social programs; systemic weaknesses and contradictions within frequently combine to stifle progress. Additionally factors like increasing economic activity, wealth and population, an improved standard of living and infrastructure developments are all expected to underline a continuous increase in demand for power in the next decade.

With the per capita GDP rising by about 8 percent per year in 2000-2008, the growth in energy demand is enormous; in particular regarding electricity. While private sector investment in generation is increasing, India could face challenges until 2020 to comfortably meet its demand."

According to the study, the country's peak power capacity deficit is expected to widen in 2010 to 12.6 percent of total capacity, up from 11.9 percent last year. In addition to the generation deficit, this deficit is also contributed by the inefficiencies in the transmission and distribution systems and electricity theft. To combat this, some respondents expressed confidence in government assurances on formation of an independent regulatory system which will support growth in private investment, in public-private partnerships. They also point to the private investors, who have already made a start in building independent power plants, with the share of privately generated electricity currently at around 13 percent of the total and rising.

Coal, which already provides almost 70 percent of India's power, will remain the dominant primary fuel, holding out commercial opportunities to those producers who are global leaders in high efficiency, clean-burn plant. But with India needing to diversify production, openings will exist for nuclear, gas and small hydro schemes. Also the need to extend basic electricity to vast rural population means that there are massive opportunities in terms of wind, biomass and, if we can get the prices right, especially solar energy. The OECD survey also reveals that as compared to the other BRICS countries, India had the second highest growth rate between 2000 and 2008 with an electricity consumption of 5.7 percent. Despite this the country has the lowest electricity consumption per capita out of the BRIC countries. India's electricity consumption per capita is expected to be roughly 841 kWh in 2020, representing only about one quarter of the global average. "While government finances will find it impossible to manage alone, private finance and skills are largely available if investors feel the regulatory and legal framework is made to work for a fair return." India's coal demand may more than triple in the next two decades as Asia's second-fastest growing major economy seeks the fuel to generate electricity and run steel.

INDONESIA AS A COAL ENERGY PROCUREMENT POTENTIAL FOR INDIAN FUTURE COAL ENERGY CONSUMPTION

According to the 2010 BP Statistical Energy Survey, Indonesia had end 2009 coal reserves of 4328 million tonnes, 0.52% of the world total. Indonesia had 2009 coal production of 252.47 million tonnes, 4.55% of the world total. The world's major producers are China, the USA, India, Australia, Russia, Indonesia and South Africa. Indonesia had 2009 coal consumption of 30.47 million tonnes oil equivalent, 0.92% of the world total. Indonesian coal production has increased in recent years, and Indonesia is currently the world's third largest exporter of steaming coal (after Australia and China). According to the 2008 BP Statistical Energy Survey, Indonesia had end 2007 coal reserves of 4328 million tonnes. Indonesia is one of the leading exporters of sub-bituminous coal which represents the bulk of Indonesian coal production. According to the 2008 BP Statistical Energy Survey, Indonesia had 2007 coal production of 174.83 million tonnes, and consumption of 27.8 million tonnes oil equivalent. Most of Indonesia's coal reserves are situated in Sumatra in the south, with the balance located in Kalimantan, West Java, and Sulawesi. Coal quality varies, with lower grade lignite (59%), sub bituminous (27%) and high grade bituminous and anthracite (14%).

Indonesia adopted a National Coal Policy in January 2004, which seeks to promote the development of the country's coal resources to meet domestic requirements and to increase coal exports. The state-owned PT Tambang Bukit Asam is one of the five largest coal producers in Indonesia. Almost a quarter (22%) of its production is exported to international markets, including Japan, Taiwan, Malaysia, Pakistan, Spain, France and Germany. The company has mineable reserves of approximately 7.3 billion tons or 17% of the total coal reserves in Indonesia.

Kaltim Prima Coal, located in northeast Kalimantan, has one of the world's largest open pit mining operations. Kaltim Prima Coal is 100 per cent owned by PT Bumi Resources Tbk.

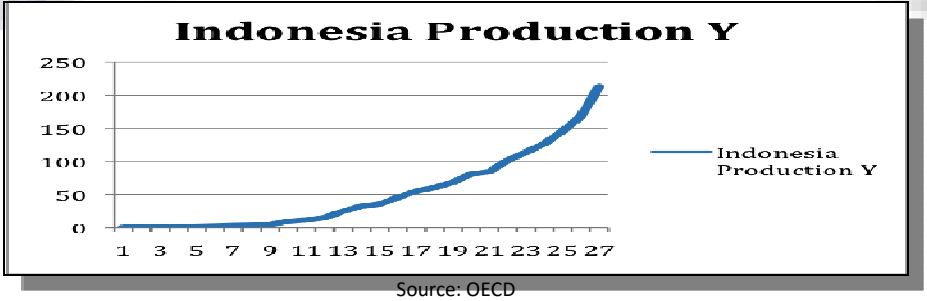
TABLE 1: TOP COAL EXPORTERS (2009)

	Total of which	Steam	Coking
Australia	259Mt	134Mt	125Mt
Indonesia	**230Mt**	200Mt	30Mt
Russia	116Mt	105Mt	11Mt
Colombia	69Mt	69Mt	-
South Africa	67Mt	66Mt	1Mt
USA	53Mt	20Mt	33Mt
Canada	28Mt	7Mt	21Mt

TABLE 2: TOP TEN HARD COAL PRODUCERS (2009)

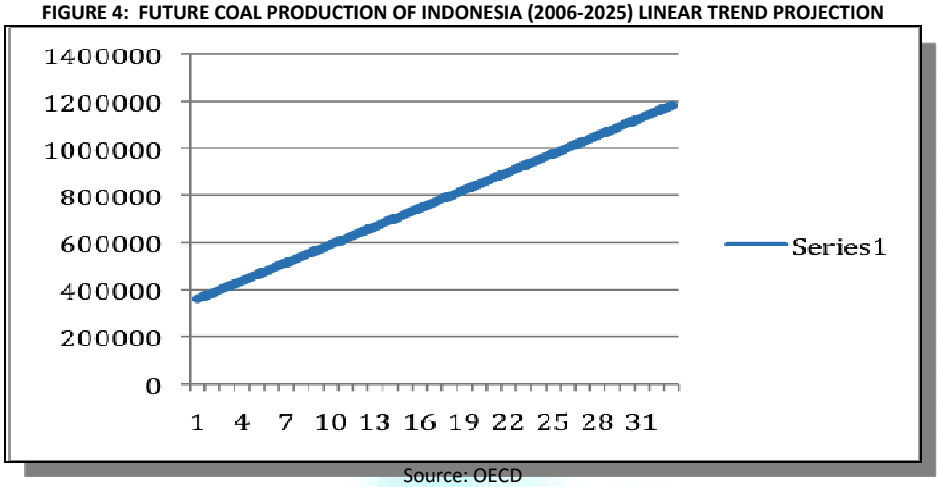
PR China	2971Mt	South Africa	247Mt
USA	919Mt	Russia	229Mt
India	526Mt	Kazakhstan	96Mt
Australia	335Mt	Poland	78Mt
Indonesia	**263Mt**	Colombia	73Mt

FIGURE 3: PRESENT COAL PRODUCTION OF INDONESIA (1980-2006)



Source: OECD

FIGURE 4: FUTURE COAL PRODUCTION OF INDONESIA (2006-2025) LINEAR TREND PROJECTION



Source: OECD

TABLE 3: COAL FACTORS BY PERCENTAGE AND GRADING

Coal Factors by %	Domestic India	Australia	South Africa	Indonesia
Total Moisture	5	8	7	15
Ash Content	40	12	15	5
Volatile Matter	25	30	26	35
Sulphur Content	0.5	0.5	0.6	0.5

From table 3, it is observed that 5% of Ash factor of Indonesian Coal makes the logistical movement economical & efficient to Import Coal to India. The coal logistical movement of India will be more expensive than procuring coal resources from Indonesia because of the less ash content.

TABLE 4: TESTS: ACCURACY OF COAL PRODUCTION BY USING GROWTH MODEL

Coal Production	Growth	Correlation	R^2	T-Ratio	F
India	4.887338672	0.996902271	0.993814139	35.73963189	1277.321288
Indonesia	13.52102604	0.990872371	0.981828055	20.60059306	424.3844346
Australia	3.708973381	0.979173546	0.958780833	13.35717849	178.4142171

From the table 4, Growth rate of Indonesia coal production is higher comparative to India and Australia. It can be stated that the Coal consumption of Indonesia is less comparative to India and Australia.

TABLE 5: TESTS: ACCURACY OF COAL CONSUMPTION BY USING GROWTH MODEL

Coal Consumption	Growth	Correlation	R^2	T-Ratio	F
India	4.90483517	0.980100478	0.960596948	13.68740956	187.3451803
Indonesia	1.417159121	0.237450117	0.056382558	0.164169241	0.02695154
Australia	1.677104887	0.872563236	0.761366601	4.408320901	19.43329316

Coal consumption rate of Indonesia is lesser comparative to India and Australia. It can be stated that Indonesia can export its coal resources to the countries which are in demand in meeting their requirements.

TRANSPORTATION BETWEEN INDIA & INDONESIA

The distance between Chennai, India to Jakartah, Indonesia is about Km 3654 .Where Cargo Ships can be used to transport coal from Indonesia to India. Indonesia is strategically significant in Coal Procurement to India because the next suitable destination would be Australia, which is more than twice the distance between India & Indonesia.

Chennai to Jakartah =7days of Transit Time (10 to 12 knots)

Chennai to Melbourne =16days of transit Time (10 to 12 Knots)

(Source: www.daftlogic.com/projects-google-maps-distance-calculator.htm)

RESULTS

By analyzing the future consumption & requirement of energy to India & rest of the world clearly states Indonesia, Australia & Central Asian Countries are the feasible strategic location to obtain Coal energy till 2030.

Indonesia with available Coal deposit & strategic location, ash factors makes feasible Coal Procurement destination for India in procuring future Coal energy. And sustained renewable energy production will substitute the existing fossil energy consumption by 2030.

LIMITATIONS

To keep the economic growth of India, Coal energy procurement is significant for India's national strategic energy policy. Till the existing thermal power plants are replaced with nuclear or other alternative renewable power plants. There should be a continuous supply of coal to meet the energy requirement of India. This will be affected due to bilateral agreements, Longer Logistical lead-time, quality of the raw materials and environmental Policies.

RECOMMENDATIONS

1. Need to improve the existing technology used in Coal Mining & Production in India.
2. Upgrading the existing Logistics facilities used in Coal Mines in India.
3. Setting up the new renewable energy like Nuclear Plant, Solar & Wind Energy to counter non-renewable energies like Thermal Power Plants.
4. Stricter environmental regulations need to be implemented to ensure lower carbon & harmful hazardous emissions.

CONCLUSION

Indian coal is some of the dirtiest in the world. Its high-ash quality, and the lack of infrastructure to clean it early in the process, creates a huge environmental risk for India, already one of the countries poised to be hit hardest by climate change. Coal is the most polluting fuel in terms of greenhouse gases and already accounts for 65 percent of India's CO2 emissions.

India's coal reserves are not as large as previously thought. At the current usage rate, India's reserves would be depleted in 80 years. At the projected rate of growth in production, that number becomes 40years. Transporting coal is cumbersome and inefficient. Most of the domestic reserves are concentrated in India's eastern and central states, far from the urban centers most in need of increased energy.

To keep Indians GDP growing close to double digit constant supply of energies like coal need to be fulfilled with the underdeveloped country like Indonesia plays a significant role in the future of India's coal supply to meet the demand of the Indian Economy.

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Academically yours

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