CHAPTER -2

LITERATURE REIVEW

Power sector and its role in infrastructure development have been a subject of discussion and debate among academia and policy making bodies. As it is undergoing radical structural and policy changes for the last two decades all over the world, there has been lot of discussion and scholarly research on the various aspects of reform and performance of power sector across the globe. Though, there are a large number of studies available to review the power sector reforms across various countries, it is useful to make references of some studies which are highly relevant to the study area. Therefore, an extensive review of the relevant studies is under taken.

A plethora of literatures has been studied and their dimensions are explored. These studies have played a vibrant role in the formulation of objectives for this study. On the basis of the set objectives, the reviewed studies are categorised systematically into four distinguished sections hereafter in this chapter.

The first section is devoted to the literatures related to the infrastructure development in India. It discussed the various aspects of infrastructure and economic development in India.

Infrastructure and power sector gained interest among Indian researcher in late sixties. Shah (1970) studied the pattern and level of infrastructure amenities inherent by India after the independence during the first fifteen years of planning. This study has also attempted to co-relate per capita income of the states of India with their condition of infrastructure development and suggested that a well-built correlation exits between them. Parkash (1977) examined the extent of inequalities in the availability of infrastructure facilities in India. This study observed that inequalities were low or decreasing in the field of installed power capacity, buses, good vehicles, road length, post offices and number of bank offices. High or increasing trends in inequalities were also exhibited by agriculture implements, per capita consumption of power, and power consumption by industries, population served per bank

office and per capita credit and deposit ratio. It also commented that different states have different ranking with different indicators and suggested that instead of labeling states as developed or under developed in blanket term, it is better to look at individual areas of deficiency and proposing appropriate policies.

Elhance (1982) examined the role of social overhead capital for initiating and sustaining growth at the regional level. He constructed a model with social overhead capital as an integral factor input in to the regional production system. This input comprises different components of both the social physical capital and social welfare capital. Social physical capital in the form of transportation, irrigation, power, communication, sewerage and water, housing and land improvement infrastructure is recognized as a pre-requisite for attracting modern and more productive economic activities into the target region. Social welfare capital comprises such social amenities as education, housing, entertainment facilities, shopping etc. This study selected four factors, namely private capital, labour, energy and material as a variable inputs and social overhead capital is a vector quasi-fixed inputs which is provided by the public sector while production takes place in private sector. The model is helpful in assessing the relative effectiveness of physical capital vs. human capital strategies for balanced regional growth.

Tewari (1984) looked at inter regional disparities in Indian context and commented that there exist a gap between the developed group of States and the group of developing states. He noted that infrastructure facilities seem to be the major cause in the path of progress of the developing states. He further examined the inter-relationship between economic development and infrastructure and tried to identify the effect of infrastructure on economic advancement using state level data at two different points of time 1970-71 and 1980-81. The result suggested in 1970-71, four states (Punjab, Haryana, Goa, Kerala,) had both higher levels of

infrastructure and higher level of development; five states had both lower levels of infrastructure and lower level of development. He also takes power sector. He regressed index of power sector on the index of infrastructure. It was found that the coefficient of infrastructure index was significantly positive and had the highest magnitude among the variables. He concluded that economic infrastructure has a substantial positive effect on economic development in India.

Kumar (1985) analyzed the pricing policy followed by the power sector. He found that the average revenue collected from the agriculture and domestic sector's consumer was lower than customers of the service sector. Recommendations of the study are that subsidies should be on the bases of social cost benefit analysis and further, it suggests the tariff making process should be fully depoliticized. Subsides should be provided to needed sectors like agriculture as their need.

Joshi (1987) tried to examine inter-state disparities and economic development in India at state level. This study analyzed the magnitude and trends in inter-state disparities in infrastructural development over the period 1961-81 with 11 indicators of infrastructure of viz transport, power, irrigation, banking, education, health and 24 indicators of development. He computed indices of composite development for the 15 states taking the value of each indicator as a percentage of the average value of corresponding indicator at the national level. It measured the magnitude of regional disparities in levels of infrastructure and development with weighted coefficient of variations for the years 1960-61, 1970-71 and 1980-81.The study concluded that a positive affiliation exists between infrastructure and development at the state level.

Sarkar and Kodekadi (1988) expressed a macroeconomic to find the impact of electricity price changing on the various variables viz. are growth, inflation and income distribution, etc.

The result of the study considered that the change in price had also effected these variables. Thus, the numerous changes in the cost for electricity should be escaped.

Amin (1990) studied the role of infrastructure in determining distribution of small scale industries at the regional level in Gujarat state. This study divided the state into three regions; backward, developing and developed; based on their infrastructure development level for the period of 1984-85. And found that the industrial development also follows the similar patterns. This study stated that there is strong correlation between infrastructure and level of industrial development. So policy makers must pay their attention to the backward regions.

Applying educational and health facilities as the key indicators, Dadibhavi (1991) surveyed the level of social infrastructure at state level in India for the period of fifteen years i.e. 1970-71 to 1984-85. He prepared a composite index of social infrastructure using principal component method. It was observed that there has been remarkable progress in the availability of social infrastructure, the spread had been unequal across states. The heterogeneity was found to be more in health than educational facilities. A positive and significant association was observed between the level of social infrastructure and economic development level of the states.

Singh and Singla (1995) analyzed the role of infrastructure in agriculture development and the contribution of individual factors in explaining inter-district variation in agriculture productivity through regression analysis supplemented with factor analysis.

Sharma (1999) analyzed the inter-state variations in infrastructure development and the relationship between infrastructure and economic development in general and sectoral development in the Indian states .The study constructed composite indexes of infrastructural facilities and agriculture development, industrial development and general development for each state at four points of time 1970-71, 1980-81, 1990-91. This study classified the states

into three categories of development viz. developing, developed and backward. Study found that the ranking as well as the position of the states has changed during the periods of 24 years. The top five states improved their position much higher than the national level. Gujarat, Madhya Pradesh and Andhra Pradesh moved up from their respective position and the backward states continued to hold the same position below the national average. In 1970-71 the relationship between infrastructure and development was weak but in subsequent years their relationship turned strongly positive and highly significant.

Ghosh (2002) examined the relation between communication development and labor income. The study has included 15 states of India and constructed a composite index of communication facilities such as road, railways, power, part, for the regions dominated by wheat and rice crop. Regression analysis was conducted to analyze the impact of communication development on cost. Such as labor cost, operational cost, and wages. The result shows that communication variable has a negative significant impact on labor cost, whereas for wheat the coefficient is positive but insignificant.

Singh (2004) examined inter-state disparities in rural infrastructure in India and its impact on rural poverty and agricultural output. This study constructed composite indices for the economic and social infrastructure using the Principal Component Analysis at three references years' viz. 1980-81, 1990-91, and 2000-01. Kerala, Punjab, Tamil Nadu and Haryana were developed state in terms of economic and social infrastructure indicators.

In many studies it is found that there is relationship between electricity consumption and economic growth in Indian context. Literatures state about the causal relationship tween electricity consumption and economic growth. In this section those studies are presented which reveals the story of the causal relationship between them.

Masih and Masih (1996) has used the Johansen Co-integration algorithm to check the presence of co-integration between real GDP and total energy consumption using data during the period of 1955 to 1990 for India, Pakistan, Indonesia, Malaysia, Singapore, Philippines, Taiwan, and South Korea. Further for the relative causal relationship either the vector error-correction model (VEC) or the vector autoregressive model (VAR) was used. It is indicated by the test that there is no co integration in Malaysia, Singapore, and the Philippines. Thus the neutrality hypothesis were supported. Other five nations have a co-integration between energy consumption and economic growth. The results reveal that in India, the direction of causality goes from energy consumption to economic growth. But, in Indonesia, the causality goes from GNP to energy consumption. There is bi-directional causal relationship between energy consumption and GNP in Pakistan, Taiwan, and South Korea.

Sahoo and Saxena (2000) analyzed the extent of relationship between infrastructure variable and GDP at market price for India. Using time series data, Cobb –Douglass production function was estimated in which GDP at market price was assumed to be output and various infrastructure facilities along with employment were taken as inputs. In their study they found that infrastructure facilities along with employment were taken as inputs. In their study they found that infrastructural variables and employment has a significant progressive effect on economic growth with increasing profits to scale .They suggested that the elasticity would be useful in future investment decision making.

Soytas and Sari (2003) investigated the casual relationship between energy consumption and GDP in the top 10 developing countries. This study used the time –series data from 1950 to 1992 on energy consumption and economic growth. This study has been applied Granger Causality test. The result shows unidirectional causality with energy consumption leading

GDP in Turkey, West Germany, France, Japan and bi-directional causality in Argentina, in Italy and Korea causal relationship between electricity consumption and economic growth.

Paul and Bhatiyacharya (2004) used the Johnson multivariate co-integration technique on four variables (GDP, energy consumption, labour and capital) they results reveals that there is bi-directional causality between economic growth and energy consumption.

Oh and Lee (2004) used panel co-integration and panel error correlation models to examine the causal relationship between energy consumption and economic growth in 18 developing countries. The study used the time period of 1975 to 2001. The results reveals that there is a long run and short run unidirectional causal relationship between GDP and energy consumption.

Narayan and Smyth (2007) studied the long run relationship between GDP energy consumption and also examine the impact of economic growth on energy consumption for G-7 countries during the time period from 1980 to 2006. This study used unit root tests and co-integration test. Granger test with in an error-correlation framework found that there is bidirectional causality between economic growth and electricity consumption.

Oztirk (2010) deliver four assumptions about the direction of causality between economic growth and electricity consumption. The first is the assumption of impartiality which grips that there is no causality between these two variables. The second is energy conservation, which grips that there is indication of unidirectional causality from energy consumption to economic growth. He also used third assumption which is known as growth. He found that there is a bidirectional relationship between economic growth and energy consumption.

Lau and Tan (2014) investigated the long run relationship between energy consumption and economic growth in Malaysia. For empirical study of the Malaysian economy a time series data set from 1954 to 1997 has been taken. In this paper, the researchers have taken four variables like Gross Domestic Product (GDP) energy supply i.e. oil, petroleum, gas and coal. By using vector Auto regression model (VAR) researcher found that long run relationship are detected between energy supply and GDP (in oil and coal types) and short run unidirectional relationship exits GDP to energy supply (petroleum and gas). This study found that economic growth is short term granger cause for electricity consumption and vice versa. It also proves that electricity supply and consumption plays an important role to affect economic growth in Malaysian economy.

Hamden et. al. (2014) investigated the relationship between and gross domestic product (GDP) and per capita electricity consumption per capita for India, Brazil, Indonesia, South Africa and China. This study used panel co-integration analysis and Granger causality test. The study found that GDP and electricity consumption are co –integrated and granger causality test found a long run relationship between GDP and electricity consumption growth for all countries excluding for South Africa. The study found that there is unidirectional and relationship between these two variables.

Bayar and Alpozed (2014) investigated the relationship between economic growth and electricity consumption in the emerging economies. The study took the data from 1970 to 2011. The main objective of this paper is to find out and check the relationship between economic growth and electricity consumption. The researchers have used the Pedroni, Johansen Co-integration test and Granger causality tests. This paper found that electricity consumption had a positive impact on the economic growth. This paper uses that there was a

bi-directional causality between economic growth and electricity consumption. Paper also shows that electricity consumption can be an important engine for the growth of an economy.

Srivastava (2016) investigated the long run relationship between GDP and electricity consumption. The study used cross state panel data from 2000 to 2013. On this study the granger causality test has been utilized. The result shows the bi-directional relationship between electricity consumption and GDP.

Tursoy and Resatoglu (2016) have tried to define the relationship between electricity consumption and GDP in Russia. He analyzes the time series data from 1990-2011. In this study two variables are used which are Gross Domestic Product (GDP) and electricity consumption. In this study the methods of Granger Causality test is used. The empirical results in this study found that there exists the bi- directional causality from electricity consumption to GDP. The estimated results found that both the economic growth and electricity consumption empirically support each other and have a mutual and complementary relationship. But on the other hand the energy sector of Russia has no impact on the economic growth for a period 1990-2011.

Power generation depends on several factors. In those factors technical efficiency of power generating sectors are significant. Plenty of studies have discussed about the analysis of efficiency of power generating sectors. In this section this study has put those studies which has emphasised the technical efficiency of power sector.

Charnes et. al. (1978) applied a nonlinear programming model which gave an innovative definition of efficiency for the purpose of measuring functions of not-for-profit organisations taking part in public programs. He provided the ways to determining weights using observed data for a number of outputs and a number of inputs that portray such programs. Gelersion (1979) made an attempt for the estimation of marginal cost pricing for electricity

undertakings in India. Analysis was made using average incremental cost method. After estimating marginal cost prices, it compared them with the prevalent electricity tariffs. It concluded that the marginal cost approach of pricing is the more appropriate method in ensuring price stability. Under this method, it is ensured that the generation capacity is fully utilized. It further concluded because of differences in the technologies used, the marginal cost of energy was higher in the northern as well as southern regions in relation to eastern as well as western regions.

Bjurek (1996) applied the definitions of the Malmquist input and output quantity indices as stated by Caves et al. (1982) in his study. On the basis of these indices, a Malmquist total factor productivity index is obtained for general production structures. This index keeps the basic feature of a productivity index as a ratio of an output quantity change index and an input quantity change index. This index proposes a solution for the limitation of the classical definition of the Malmquist productivity index. The classical definition of the Malmquist productivity index fails to measure correctly changes in productivity in the existence of changes in returns to scale. The Malmquist productivity index has now become the regular approach in productivity measurement, especially when nonparametric specifications are applied. Furthermore, the Malmquist input and output quantity indexes provide important information that can be used to explain the aspects of productivity changes caused by underlying economic decisions and activities.

Fare et. al. (1997) has analysed the rates of productivity growth from 1979 to 1988 in 17 OECD nations. In this study the DEA method was used to measure the Malmquist productivity index for individual countries. In this research the indices were calculated by the ratio of the values of the output distance functions for a mentioned technology based on constant returns to scale at input output bundles of the same country observed in adjacent

years. At first malmquist index is distributed into two parts. One of the parts shows the technical change and other part shows changes in technical efficiency. These are interpreted as the term catching up. This term is further separated into two terms. One of them represents pure efficiency change and the other represents the changes in scale efficiency. This comprehensive decomposition conceptualizes as a technology characterized by variable returns to scale (VRS).The use of CRS and VRS within the same decomposition of the Malmquist index raises a problem of inner consistency. Their technical changes (TECHCH) determine corresponds to shifts over time in the CRS frontier. The other factors- scale efficiency change (SCH) and pure efficiency change (PEFFCH) are derived from VRS frontiers from two different periods, however. If CRS is assumed to hold, the term TECHCH has correctly showed the shift in the frontier. But, no scale effect exists under CRS. Hence, the extensive decomposition is misleading. On the other hand, if the VRS assumption is correct, TECHCH does not show how the maximum producible output changes due to technical change holding the input bundle constant.

Azadesh et. al. (2007) Banker Charnes Cooper (BCC) input-oriented model of DEA (Data Envelopment Analysis) has been used as methodology in the study. This model has been followed for the calculation and optimization traditional thermal power plants such that steam, gas and collective cycles. As input parameters, this study had used fuel consumption, Installed capacity, internal power, labour cost, forced operating hours and outage hours although total power generation had been used as output parameter. Most of the power plants in Iran were used DEA-BCC model and decision-making units (DMUs) to evaluate their efficiency and productivity rank during 1997-2000.

Jha (2007) conducted the study for the purpose of estimating the relative operational efficiency performance in hydro power plants which come into the Nepal Electricity Authority (NPA).

Behera et.al. (2010) conducted a study to evaluation surplus consumption of inputs although the level of output is same for India's 74 coal fired power plants during the period 2003-04 to 2007-08. Based on selected five inputs variables viz PM, capacity, FO, SCC, APC and as output: - Generation, conclusion of the study is that the fuel efficiency as well as the capacity factor significantly affects Technical Efficiency (TE) of China's thermal power generation. The private ownership provinces and autonomous regions achieved higher levels of efficiency. It was analyzed that regions with rich supplies of coal had higher technical efficiency. Technical efficiency of approximate 51 per cent of units lies below the average technical efficiency i.e. 83.20 percent; it means that there is need to improving the technical efficiency by reducing the inputs consumption to desire level as suggested by input oriented VRS model. From 74 units, 2.70 per cent shows CRS over a period of 5 years.

Liu et. al. (2010) analysed the relationship between energy consumption and economic growth in China. This study is based on the panel data for the period 1985-2007. In this study a unit root and the granger causality test is used. The result of Granger Causality between energy consumption and economic growth. Co-integration test result reveals that there is long term relation between the variables taken in this study.

Chen and Yang (2011) conducted a study on "A cross-country comparison of productivity growth using the generalized met a frontier Malmquist productivity index: with application to banking industries in Taiwan and China". This paper is an extension of the met a frontier Malmquist productivity index, which takes into account the effect of scale efficiency change in its decomposition for both the non-parametric and parametric frameworks.

Fatima and Barik (2012) analyzed the performance of the power sector of fourteen major states of India form time period 2000-01 to 2007-08. It estimated the stochastic translog production frontier. It found that there is deterioration in the technical efficiency of the Indian power generation sector over the period of the study. It also found that the power sector unsuccessful to bring the preferred results in terms of technical efficiency enhancement. The total factor productivity (TFP) of the power generation industry, which involved technical efficiency change, technical change, and scale change, though, had shown some improvement. Technical efficiency of the power generation industry was clarified by technical manpower engaged, year of unbundling of State Electricity Boards (SEBs), per capita state domestic product, and time variable.

After reviewing a plethora of literatures, this study found the need to analyse the financial performance of power sectors in India. Such literatures are presented in this section.

Gupta (1996) made a study on electricity pricing in India. This study has selected three SEBs which are Gujarat State Electricity Board, Maharashtra State Electricity Board and Rajasthan State Electricity Board. Mainly this study concerned with the electricity generation cost, interests & charges of finance. It also concerned with average cost of power supply and the tariff structures. This study critised the low tariff facility for the rich farmers and also advised that the amusing agrarians ought to be charged on the base of marginal costs of supply. For the sake of small farmers study has also suggested that if it is necessary subsidy may be provided to them. On the other hand, the amount of subsidy paid by the government ought to be comparable to the difference between marginal cost based tariff and actual revenue realized from agricultural consumers.

Parikh et. al. (1996) analyzed the performance of various SEBs and found urgent requirements to receive proper pace for the improvement of the working as well as financial

enhancement. It is also found that the help of with accepting several measures of the upliftment of performance, the State Electricity board can not only maintain their daily procedures but also produce surplus revenue inside to fund the capacity accumulation program.

Rao (1996) has studied the performance of SEBs in India. This study has examined the technical as well as financial aspects of power sector and found, in efficient operational performance of power plants of SEBs in pre- reform period. Some improvements were reported in the Plant Load Factor (PLF) after the introduction of medium size gas based power plants (200 MW to 500 MW). There were not any notable evolution in introducing renewable programs in the pre reform era. It has also marked some issues on the poor efficiency of the SEBs. in supplying electricity. It revealed that poor commercial outlook was the main reason, which was responsible for deteriorating financial performance of the SEBs. Sector. In the study, they made an attempt to estimate the power consumption of irrigation pump-sets. The prime motto of this study was to improve a method to make a reliable estimates for the transmission and distribution losses. It came in to the notice that utmost the agrarian intakes is unmetered. Thus the consistency of estimation of energy losses depends on the accuracy ensured in calculating the electricity consumption made by the farming sectors. The stealing of power has been found as the chief ingredient of transmission and distribution. Apart from this, the overstaffing was underlined as one of the key problems in the evolution of power sector in Karnataka.

Amulya et. al. (1997) examined the present situation of Karnataka power sector and looked at the trend of demand and supply of electricity of its state electricity board. It also checks the financial problems, important policies and technical landmark in the evolution of the state power sectors of Karnataka. It does not only investigate the problems, but also provide the

map forward. They conveyed the opinion that Karnataka power sector uses the irrigation pump sets package for the sake of hiding various technical and marketable short comings particularly in distribution and transmission losses. They also corrected the offer to private power to all allied profits including in the situation of foreign private power. As per this research

Rao et. al. (1998) analysed in the study that existing structure of tariff had been responsible to provided wrong signals to the consumers' of electricity. There were some categories of consumer which were charged significantly less than cost of supply. The historic cost of assets was the base for the tariff structure. Wastage of energy was led across various sectors by it. The charge should emulate the social supplying cost of power without only if unwarranted rewards to the political involvements in the executive process on charges related issue.

Ghose (1998) conducted a study to examine the economic benefits of subsidy provided to farmers. The study found that large size farmers have been availed with the actual benefits of the subsidy in power sector. In agriculture sector, only little farmers were using segment of power supply to agriculture sector. Study founded that the political interventions were responsible behind this discrimination. So, there is an ominous necessity to moderate the political interferences in the resolution constructing process of the State Electricity Boards (SEBs).

Singh (1998) has checked the level of economic efficiency in the power consumption. In the study, it is analysed that the state electricity boards follow useless and conflicting pricing policy. It gives to rise the demand for electricity and as a result appears as the unreasonable use of power. The study suggests the tariff should be linked to the height of financial

effectiveness consumption. It also urged to discourage the farmers to use needless and uneconomic use of power.

Reddy and Murthy (1999) made an attempt on power sector of Karnataka's. The study evaluate the power consumption of irrigation pump-sets. The main objective of this study was to develop a methodology for making a consistent evaluation of the losses in distribution and transmission of electricity. In this study found that the consumption in agriculture sector is un-metered. So approximation consistency of energy losses depends on truth warranted in the calculating of power consumption prepared by the agriculture sector. Conclusion of the study reveals that major factors of distribution and transmission is the theft of power. In Karnataka power sector overstaffing is also main problem.

Antointte et. al. (1999) made an attempt on the capacity and efficiency of the power generating in India. Moreover, the study also explained the participation of public and private sectors in power generating. The results of the study revealed that investment in infrastructure has been made by state governments rather than private sector. Due to the basically long gestation periods together with the relatively low rates of return from serving all categories of consumers had reduced such projects commercially useless.

Das and Parikh (2000) made an attempt to evaluate the financial strength of the Maharashtra State Electricity Board. In this study MSEB pricing policy was examined. It pricing policy analysed in this study which is adopted by the Board was full of inappropriate. There was found huge discrimination in the tariff structure across numerous groups of consumers. Consumer of some categories such as domestic and agriculture were charged at very low rates. Further, the subvention paid on part of the state government was not suitable to cover the cost of power supply to the agriculture sector. It was advised that tariff should be on the

bases of cost involved in supply of power. The Adequate subsides should be paid by the state government to the governing body to fill the revenue gap on account to agriculture sector.

India Infrastructure Report (2000) made an attempt to evaluate the financial performance of the utility of power depends upon policy of pricing and achieved level of pure efficiency by relevant utility. In the pre-reform era, decisions of the financial and administrative utility were vastly influenced by political interventions. It led to reduce utilities and creates huge financial crisis. As the result of these interferes, the utilities were not able to manage the operational firms/decision making units efficiently.

Ahluwalia and Sanjeev (2000) have conducted a study to assess the pricing policies followed by the commissions of electricity regulatory in India. They found that to determine the electricity tariff, the upmost regulatory commissions has followed the cost of service methodology for electricity consumers.

George (2000) uttered that various indicators named high levels of distribution and transmission losses, increasing domestic consumption by a only some, subsidized supply electricity to the tourism and industrial sector, decreasing capacity of reservoirs, the irregularity of monsoons etc., have led to a very weak electricity generation system in Kerala. The study of Kannan and Pillai (2001) is an attempt to investigate the financial and physical presentations of several SEBs in India before the period of reform. Time period taken in this study is 1970 – 71 to 1997- 98. Its main concerns regarding the study are installed production capacity to technical efficacy, distribution & transmission losses and some other aspects like managerial and institutional efficiencies. Financial performance has been studied by comparing the average revenue to the cost of supply, costs of power to several categories of consumers. This study has compared the various SEBs in India. It is highlighted in this study that, as usual country has recorded an important progress in installing new generating

capability. Yet, in some states the capacity generating steps were not up to mark. In Andhra Pradesh and Jammu Kashmir, the average of Annual Compound Growth Rate (CAGR) to add the installed capacity was about 8 per cent during the period 1970- 1998. in Orissa, Delhi and West Bengal, the growth rate was reported about 4 per cent. In addition to this, study found that the country could not tap the hydropower potential, available in many states. The study reported that the level of the Plant Availability Factor and Plant Load Factor (PLF) were very low. There are some states, where the Plant Load Factor was below 50 percent. Losses of Transmission and Distribution were near to be in the range of 20-30 per cent for most of the State Electricity Boards (SEBs). The states like Jammu & Kashmir, Delhi, and Orissa, the losses of energy were estimated more than 40 percent. But in the real term it is higher than what was reported by the SEBs. In agriculture sector the unmetered supply of power was over estimated. It was estimated up to 30 percent to 40 percent. Thus the unaccounted consumption of power and theft of power was considered as the consumption made by agriculture sector. In India, labour productivity of SEBs has been compared with some other countries such as Chile, Norway, USA, etc. It has been calculated in terms of the number of power units (KWH) sold per employee during the time period 1990-91. This study got that labour productivity of power sector in India was very low in comparison to these countries. In this analysis, it is come into knowledge that there are categories of consumer, charged at very low price, due to which the commercial losses has increased over the years. High subsidies go to the domestic and agriculture sectors at the cost of SEBs as well as other categories of consumer. These categories consist commercial and industrial users.

Study conducted by *Pryas* (2001), an institution in Pune city the role of regulatory commission. In this study the issue of accountability has been taken as the major plank. It was focused out that the main problem was accountability with former SEBs. There was extreme intervention of state governments in the functioning of SEBs. This was the main

cause for the poor financial and technical performances of SEBs. In the present study the reform process were introduced that provided the extensive power to controllers without holding them responsible to the public. Unaccountable interference by politicians was the major reason for the crisis. This model does not ensure any mechanism for solving these problems. Hence, the model was not an appropriate model.

Gurtoo and Pandey (2001) studied the previous difficulties of power sector and its primary stage of reforms. It states about the poor financial condition of Uttar Pradesh State Electricity Board and also said about rising power lacks required the drastic reforms of the state power sector in state. It debates about high cost of power purchase, illogical devaluation norms, twisting of agricultural consumption and over reporting of effect of grant, were reasons as poor maintenance and poor productivity, high distribution and transmission losses, high subsidy to agriculture and poor billing efficiency in disturbing the financial performance of the Board. They advised that further lack of appreciation of the former set of causes, the reforms process is bothered with other major drawbacks like shortage –disposed to gaps in the planned model and handling of its application. It seemed to them that the planned reforms model looks to have considered out of fear to escape from financial problem forced by past mistakes, rather than out of a sensible reorientation of past strategies, arrangements and systems in keeping with global changes in scientific and economic situation.

Ruet (2001) analyzed the development in the Plant Load Factor and decrease in the non-technical losses at smallest price current tariffs can rise 17 percent energy level. These will allow us not to go in for unpopular events such as tariff rise. He also said the opinion that these schedules are not done because of the aims that state electricity boards are worked based on self-enforcing administrative expensive order, absence of emphasis on costs and budgets.

Ninth Five Year Plan (1997-2002) recommends that 'the most essential reason of the difficulties being handled in the power sector is illogical and non –remunerative tariff structure. Though the tariff is stable and recognized by SEBs, the state Government have frequently obstructed in tariff background subsidization SEBs for the losses rising out of state government need to deliver power at low rates to assured sections mainly agriculture. Therefore, power supply to domestic and agriculture consumers is deeply subsided. SEBs through irritated subsidization of cost from industrial and commercial consumers is capable to protections only a part of this subsidy. The SEBs in the method, have been suffering substantial sufferers. If the SEBs were to stay on the same lines, their internal source creating during the next ten years will be negative, being of the order of Rs. (-) 77000 crore. This increases serious fears about the facility of the states to contribute their share to capability addition during the ninth plan and thereafter. This shows the need of power sector reforms and the importance of tariff justification.

Sinha and Sidharth (2003) had examined the usefulness of the power sector reforms developed in the Orissa state. The main objective of the study was to review the outcomes of electricity reforms and draw lesson for other states that are in the process of 42 restructuring of power sector. In the study, key steps taken by the Government of Orissa such as unbundling and privatization of Orissa State Electricity Board have been highlighted. The study has used the information available from the annual revenue reports of the companies and tariff orders delivered by Orissa Electricity Regulatory Commission. It was revealed that there was no development in the technical performance of the scattering companies even after privatization of distribution business. The level of distribution losses and transmission was described to be very extraordinary. The level of losses was described more than fifty per cent for the financial year 1997-1998. In the crucial years of its structure, OERC agreed tariff hikes practically every year to reward the commercial losses of the distribution firms.

However, the utilities were not able to produce any income surplus and help to better quality of service to the users. Therefore, the Orissa model was not appreciated and followed by other states while undertaking the power sector reforms appropriate model.

Jain and Varinder (2004) made an attempt to evaluate the power sector reforms procedure being originated in Punjab. He founded that these reforms are not sufficient and indicated that the State Government should afford extra attention to take more suitable reforms creativities in the power sector. The State Government should not come below the unjustified burdens of numerous international agencies such as World Bank for reforms. There is need to attention on the improving the active efficiencies and state government should attempt to improve the financial and operational performance of the Panjab State Electricity Board (PSEB). The main recommendations of the study were that transparency, accountability and reliable metering in electricity grant may be used as basic processes to stop the operational disorganizations in the power sector.

Majumdar (2005) found that inter-regional disparities in infrastructural facilities have been reason behind uneven development in India .This study examined the validity of this argument at district level using composite indices of power and infrastructure availability at four points of time 1970-71, 1980-81, 1990-91 and 2000-01.significant association between infrastructure and power level of region observed, though the greatness had dropped in current years.

Indian Institute of Public Administration (IIPA) conducted a study to examine the outcomes of restructuring of SEBs in 2006. The objective of the study was to evaluate the outcomes of the restructuring process across various states so that lessons may be drawn for other states which were still undertaking the reforms in the power sector. This study has been taken twelve states to extent the developments in the operational performance caused from the

process of power sector restructuring. The crucial conclusions of the study were fast need of operative restructuring process and independence of power sector improve the performance of the limitations.

Singh (2006) the study had measured the financial and technical performances of Punjab state electricity Board (PSEB). It decorated some inefficiencies in the process of the transmission, generation and distribution utilities of PSE This study has highlighted that PSEB has seen high energy losses and there were no such steps taken to enhance the financial performance of the electricity board. It was suggested that Punjab State Electricity Board should take step to improve the technical and financial performance.

Dubash and Rao (2008) have examined the political and social framework in which power sector reforms have been occupied place in India. The study have claimed that the shape of the restructuring process should aim increasing the economic efficiency on the one hand, and on the other hand the larger public interest should be protected. It is a matter of public anxiety that most of the international contributor bodies were not very sensitive to the regional issues related to power sector. Further, it is also recommended that the electricity consumers particularly the civil culture players should play a more dynamic role in the process of restructuring the power sector industry in India. The paper argued that improved access to the electricity, the promotion of sustainable energy policy and social pricing should be the significant issues in global development of power sector reforms in the kingdom.

In the study of Chang and Yang (2010) Data Envelopment Analysis approach has been used to estimate the operational performance of nine out of fifteen thermal power plant of Taiwan during the study period 2004-06. Installed capacity, electricity used, heating value of total fuels taken a input variables and net electricity produced as output variable in DEA approach. Then, Stability test was applied to check the reliability of DEA's result and found stable

results across all specializations. Spearman rank correlation test was applied between four models to know the order of their efficiency and results ranged from operational performance 0.626 to 0.880 that means there was positive relationship between different models. All selected power plants were performing above acceptable operational efficiencies. Average CCR and BCC efficiency was 0.902 and 0.945 respectively (Banker, Charnes & Cooper). Scale Efficiency was higher than BCC efficiency that means IRS. Efficiency of combined power plants were more than the comparison of other power plants like steam and coal. From this study, it was concluded that input variable heating value of total fuels was most significant among all power generators. The study also highlighted the slack variables which were the possible ways to improve the performance of thermal power plants.

Jain and Thakur (2010) conducted a study to measure the efficiency of State owned electricity generation companies in India during the period of 2006-07. Data Envelopment Analysis (DEA) has been used to evaluate the performance of 30 State owned generation companies. Installed capacity, auxiliary consumption, energy losses has been taken as input parameters and total energy generated as output parameter. An input-oriented approach of DEA was chosen for analysis of these generation companies which helps to increase efficiency by minimizing the input. Results of the study revealed that companies still on an average can improve their performance by 24%. Nine companies turned out to be efficient as well benchmark for others too. This study has also analyzed that majority of the companies are working at the inefficient scale.

CUTS International (2010) examined on the subsidy and pricing policy disputes in power sector. The main objective of the study was bringing to light very distortion existing in the subsidization of agriculture sector. In the study electricity pricing policy for the agriculture sector for the selected states has been examined. Time period of the study was 2004-05 to

2006-07. In the study area various states has been included such as Punjab, Andhra Pradesh, Tamil Nadu, Rajasthan and Haryana. The study found that in most of the state, tariff of agriculture sector was unfixed. The main suggestion of the study was that the regulatory commission should be provided more independence to establish the tariff on the source of cost of supply.

CRISIL (2010) made an attempt for the assessment of the financial possibility of the distribution companies. The major objective of the study was to put a light on the financial viability of the electricity utilities. Concentrating on the Punjab power sector, this study concluded the major problem here in Punjab was the declining financial performance of the sector. With the passage of time, the revenue realized and cost of supply has been enlarged. The deteriorated financial viability has a long term financial implications. Because of high energy losses and poor financial performance, the Punjab State Electricity Regulatory Commission (PSERC) has decreased the evaluations of revenue necessity recommended made by the distribution firm.

Campo and Sharminto (2013) investigated the long run relationship between economic growth and energy consumption for 10 countries in Latin America. This study has used data from 1971 to 2007. Applied econometrics techniques like co-integration method and granger causality model for analysis. This study found that there is a bidirectional relationship between electricity consumption and GDP.

Thus, after an extensive survey of literatures, it can easily be said that there are several researches that talk about the power generation and its relationship with economic growth. Apart from global context, there are several studies in India which discussed about several various models of relationship between power generation and economic growth. The present study is an edition to the existing literature as it analyses the causal relationship between

power and economic growth in India during the first fifteen years of the new millennium. Although, there are some studies which deliberated the financial performances of power generation and economic growth in India, yet no study is found that analysed the technical efficiencies of thermal power and hydro power separately and exclusively.