LACK OF AFFORDABLE & QUALITY POWER: SHACKLING INDIA'S GROWTH STORY

[Federation of Indian Chambers of Commerce & Industry]

Presented by:

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ABSTRACT

Since the industrial revolution, power has become the most basic element required for any function in an economy. Each segment of modern society is dependent heavily on power, from domestic, agriculture and industrial to service and governmental operations, all require electricity and energy to function, without which the world, regardless of a specific sector, would come to a standstill and India is no exception to the rule. With a growing population, especially that in urban areas, this new industrializing country (NIC) has increasing demands of electricity and power production. India currently ranks at fifth in the global scale in terms of the power sector. With an installed capacity of 2, 07,006 MW, India is falling short to meet the demands of a rapidly growing economy and population. This excessive demand has put a strain on the power production facilities; especially as India's power production is derived primarily from conventional sources such as thermal generation or hydroelectric.

The strain on the current production facilities was recently evident by the failure of the Northern and Eastern grids, effectively halting two fifths of the country. These failures put cities such as Delhi on a standstill, not supplying electricity for almost two consecutive days. With the innovation of captive power generation units and power back-ups, the Indian economy did not shut down completely, but the affect of such a power failure were felt across segments and sectors throughout the country, most notably in the industrial sector.

Realizing that power shortages in India, especially the recent grid failure, has an immense impact on the industry of the Indian economy, the Federation of Indian Chambers of Commerce and Industry (FICCI) has proposed a study to understand the demand for power, the cost of use and production and the impact on industrial output due to power shortages in specified sectors within the industry, across India.

In this study, FICCI hopes to gain an understanding of the current state of the power sector (i.e. demand, supply, generation, use of alternative energy, investment), the impact of power shortages on the industry (i.e. losses in output, increase in costs, operational modifications to compensate for such losses) and the level of investment and knowledge of available power back-up options and facilities (i.e. methods of power back-up, investment in types of power back-up, captive power generation). Through this study, FICCI hopes to provide solutions and

policy recommendations that central powers can adopt, in a hope to curb the impact of power shortages and future grid failures on the Indian industry and thus the economy.

EXECUTIVE SUMMARY

POWER SECTOR OVERVIEW

India's power sector is one of the more ignored sectors in the Indian economy. While there has been some investment and calls for increase in capacity, a third of Indian citizens, especially in the rural parts of the country remains without power, as does 6% of the urban population.

India suffers from an acute shortage of electricity and power, even after being the fourth largest consumer of electricity and power in the world, following USA, China and Russia. According to the International Energy Agency (IEA), India requires a further US $ 135 billion in investment for the power sector. The shortages translate into massive power cuts and intermittent supply issues, which in turn affect all segments of the Indian economy.

The exponentially growing population of the country is creating more pressures on the power sector. Wherein countries like the United States and China, the per capita consumption of power stands at 11,919 KWh and 2559 KWh respectively, in India, with a population of 900 million (1.2 billion minus 300 million without power), the per capita consumption stands at 778.71 KWh.

The power sector of India has been scrutinized immensely in the past but no study has captured the impact the shortages and power cuts have on the Indian industry. Data and research collected shows a grim vision of the current situation of the Indian power sector. It is evident that, while supply of power and electricity in the country is increasing, it is not meeting current demands, let alone future demands. At current, the Indian power sector has an installed capacity of 2,07,006 MW, comprising of 66 percent from thermal, 3.7 percent from nuclear, 19 percent from hydro and 12 percent from renewable and alternate sources. While thermal power remains the highest source of power, hydro is becoming a major player as well. Nuclear power is still untapped as countries like France and Ukraine derive more than 77 percent and 46 percent of power from nuclear sources.

The Indian situation in demand and supply of power is best defined by the data available. In 2010-2011, the demand during non-peak periods stood at 8,61,691 GWh, supplied by one

7,88,355 GWh, showing a energy shortage of almost 8.5%. During peak hours on the other hand, the shortage was 9.8 percent. India's demand has been growing at a steady 3.5% annually for the last 30 years and is projected to continue growing at faster rates until investment and capacity cannot be increased. Western and Northern regions of India remain the highest consuming and demanding regions in the country with the southern region demand holding not too far behind. The only area to show a significantly smaller demand is the Eastern region, owing to the fact that industry is predominantly situated in the three other parts of the country, as is population.

According to research data available from various sources, the problems in the power sector or power shortages apart from the obvious shortage in supply result from issues like:

- High Aggregate Technical and Commercial losses (AT&C losses)
- Poor financial health of DISCOMs
- Shortage of fuel
- Low plant load factor

Five national grids manage the country's power supply. These grids maintained by the center are the primary sources of electricity in the country. The five grids, Northern, Western, Southern, Eastern and North Eastern, are spread across the country and cater mainly to their own region. Some grids are connected to each other and may occasionally share the load. For example, the Northern, Eastern, Northeastern and Western grids are interconnected to cater to the many spikes in demands during peak periods. The Southern grid remains isolated and thus is less prone to power shortages and failures.

This burgeoning demand with shortage in supply is one of the reasons behind intermittent power cuts across India. There have been two instances of major cuts in the country. Both major cuts have occurred in the Northern power grids. The first of these major breakdowns occurred on January 2nd, 2001 and resulted in the effective halting of most of the northern states. It was estimated that in the duration of this 'black out' the Indian industry lost close to Rs. 2-2.5 billion.

The second, more recent black out occurred on 30th July 2012. This black out further expanded to the Eastern and North Eastern grids on the 31st of July 2012, resulting in 22 states and union

territories being out of electricity for a number of hours. While the blackout brought most of the nation to a standstill, halting transportation and effectively shutting down industry and services while affecting millions of people, it did not affect the southern or western parts of the country.

Stemming from this recent major power failure, this study hoped to understand the financial and economic impacts of power failure and shortage, especially on the Indian industry. Commissioned by FICCI, Bureau of Research on Industry and Economic Fundamentals (BRIEF) conducted an All-India survey of companies in specified sectors within the industry. 650 companies were interviewed to gather information on how the various companies are affected by and/or respond to the intermittent power cuts and shortage in supply, what is the impact on their costs as well as their level of investment in power back-ups and to measure the impact of the recent power failure on the operations of their respective businesses. The list of sectors targeted in this survey is listed below-

Table 1: Sectors of Study	
Food and Beverage	IT Enabled Services
Diamond Processing	Infrastructure & Capital Goods
Textile & Apparel	Automobiles & Components
Telecom and Equipment	Hotels
Ceramics/Glass	Chemicals
Iron & Steel	Petro-Chemicals
Aluminum	Plastic/PVC
Fertilizer	Electronics & Equipment
Cement	Trading Units
Pulp & Paper	Others

While the research data paints a rather grim picture of the current scenario in the power sector, the survey results show a different view. Where the data may suggest that India Inc may be negatively impacted by the power situation of the country, it was surprising to discover that other than an increase in costs mainly that in fuel, there was minimal impact of power failures and outages on the various businesses. It revealed that the business owners across the country have adapted rather well, by installing back up or captive units negated the impact on operations, production and various other processes of their enterprises. The original premise that power failures, especially the larger 'black outs', were seriously negatively impacting Indian business, may not hold true after all.

Brief synopses of other key findings are given in the next section and further detailed analysis of the results of the survey is provided in the subsequent chapters.

KEY FINDINGS

Provided below is a quick synopsis of the key findings this study revealed. Though not the full results, this list provides an overview of the findings that the study achieved:

- As per sector wise average monthly electricity consumption, approximately 36 percent of the firms consume 10001-50000 KWh monthly, 25 percent of firms consume between 100001-500000 KWh, 50001-100000 KWh per month is consumed by 18 percent while 17 percent consume less than 10000 KWh. Only 4 percent show average monthly consumption of above 500000 KWh. This depended upon the size of the firms and the degree to which their production process relied on electricity.
- To maximize output and production, 39 percent of companies require 10001-50000 KWh monthly, 26 percent require 100001-500000 KWh and 6 percent require above 500000 KWh. Only 11 percent of companies mainly in the ceramics/glass sector require less than 10000 KWh per month. The remaining 18 percent require 50001-100000 monthly. This was again determined by their scale and intensity of operations.
- Average cost of electricity from the government sources in the country ranges between Rs 5 to Rs 8.50. Odisha and Delhi show lowest prices of electricity per unit, while Maharashtra, Jharkhand and West Bengal are the higher prices in the range.
- Majority of the firms (54%) spend Rs. 1.01-10 Lakhs on their monthly electricity consumption. Only 12 percent of the firms incur monthly electricity cost of above Rs. 25 lakhs while 22 percent spend less than Rs. 1 Lakh a month. The remaining share (12 percent) of the sample frame spends Rs. 10.01-25 Lakhs per month on electricity consumption.
- The analysis of duration of power cuts faced by industry reveals that approximately 37 percent of firms face less than 1 hour of power shortage in a week and at the same time 5 percent suffer 21-30 hours per week and 21 percent suffer more than 30 hours per week. 16 percent face 6-10 hours per week, while 15 percent face between 1-5 hours weekly. This is due to their location primarily. The location wise analysis revealed that while majority of the industries in Tamil Nadu and Andhra Pradesh suffer power shortage of more than 30 hours a week, majority of the industries in states like Gujarat, Maharashtra and Karnataka face power shortage of

less than 1 hour a week.

- The survey revealed 54% of companies, primarily from Odisha, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra, were aware in advance of the load-shedding schedule while the remaining 46 percent were unaware of such load shedding schedule of their DISCOM.
- As measures to manage operations during power cuts, highest mean ranking was secured by immediately running power back ups, followed by switching off air conditioner and using green technology in office.
- It was found that 38.83 percent firms use generators falling in the 101-500 KVA category and 34.95 percent of the sample frame employs generators with capacity ranging between 10-100 KVA. Above 500 KVA capacity generators are mainly employed by 19.42 percent companies and only 6.8 percent companies employ generators with less than 10 KVA power generations. The installed capacity of the generators is determined by firm's scale of operations, energy dependency and geographical location (units in states where power cuts are more frequent tend to have large capacity generators when compared to the units located in states with less frequent power cuts).
- The distribution of average fuel consumption, which essentially depends upon the capacity and brand of the generators, revealed that 25 percent of the total sample frame use generators which consume less than 10 litres an hour and 19 percent rely on generators that consume more than 100 litres per hour. The other consumption categories of 10-25 litres and 51-100 litres per hour of fuel were constituted by 23 percent and 18 percent of the total studied companies. The remaining 15 percent consumed 26-50 litres per hour.
- Assuming that the firms do not rely on power back up units to ensure continuous production activity, 61 percent of the firms suffer above 10 percent shortfall in production due to power cuts. 13 percent suffer 2-5 percent shortfall in production, 12 percent suffer 6-10 percent and only 14 percent, mainly in Gujarat, Karnataka and Maharashtra, suffer less than 2 percent production losses. More specifically, companies in Gujarat incur such low losses due to the fact that power shortages in Gujarat are negligible. Companies in Karnataka tend to be in the IT enabled services sector which is not as power intensive as Iron and Steel, Aluminium etc. and hence suffer less shortfall in production when compared to those electricity intensive sectors. It was observed from the survey, that Maharashtra, which as a

mix of both IT and manufacturing companies, like Gujarat, does not suffer as acutely by power shortages as some of the other states around the country.

- To evade shortfall in production, companies use power back up units, which ultimately increase their cost of production/operations. 61 percent of the firms suffer above 10 percent cost escalation due to power cuts. The highest cost escalation was observed in Andhra Pradesh, Tamil Nadu and Odisha where cost escalation even extended beyond 30 percent for few firms. With a smaller supply capacity and increasing demands on power, coupled with high costs of captive power facilities, these three states tend to not only pay higher in terms of regular supply but also for back-up facilities. Only 13 percent, mainly in Gujarat, Karnataka and Maharashtra, suffer less than 2 percent cost escalation. The other cost escalation categories of 2-5 percent and 6-10 percent were constituted by 14 percent and 12 percent of the total studied companies.
- The cost of electricity from captive sources range between Rs. 12-16. In Gujarat and Jharkhand, the cost per unit from captive sources is relatively lower while for Andhra Pradesh, Maharashtra, Odisha and Tamil Nadu, it is relatively higher.
- The revenue losses (due to costs incurred to mitigate any problems arising from power outages including use of power back-up facilities) range between less than Rs. 1000 to above Rs 40000 per day. Even small and medium firms incur losses above Rs. 40000 per day, mainly in states like Andhra Pradesh, Tamil Nadu and Odisha. In states like Gujarat, Karnataka and Maharashtra, the majority lose less than Rs. 1000 per day.
- The comparison of losses due to planned and unplanned power cuts for states like Andhra Pradesh, Tamil Nadu and Odisha revealed that losses due to planned power cuts were much lower as compared to losses due to unplanned power cuts.
- Losses due to voltage fluctuations were as low as Rs. 1000 (per day) for states like Karnataka and Maharashtra and as high as Rs. 40000 (per day) for Andhra Pradesh, Tamil Nadu and Odisha. In Gujarat and Delhi NCR, no voltage fluctuations were observed.
- 64 percent of the firms feel that erratic power supply affects their competitiveness in the international and domestic markets while 36 percent feel that such erratic power supply has no effect on their competitiveness. Sectors found to be more affected were diamond processing, textile and apparels, IT enabled services, trading units etc. The least affected sectors were hospitals, hotels and other service industry.

- It was also revealed that 61 percent of the firms were willing to pay more for reliable and uninterrupted power supply while 39 percent were not willing to pay an additional amount for a reliable and quality access power supply. As per state wise analysis that in Andhra Pradesh, Tamil Nadu and Odisha more than 85 percent of the firms were willing to pay an additional amount to avail an uninterrupted power supply. In Jharkhand, Madhya Pradesh and West Bengal, more than 70 percent of the firms were willing to pay an extra amount for quality power supply, while in Gujarat; only 9 percent were willing to do so.

CHAPTER 1: INTRODUCTION

1.1 OVERVIEW

India's power sector is the fifth largest in the world. It had an installed capacity of 2,07,006 MW (as on august 2012) comprising of 137936.2 MW thermal, 4780 MW nuclear, 39291.4 MW hydro and 24998.46 MW renewable (central electricity authority).

However, owing to India's growing industrialization, the generation from power utilities has always been unable to keep pace with the rapidly growing demand. Hence, a large number of captive plants have been set up by industries to ensure reliable and quality power supply.

As per Central Electricity Authority, Installed capacity of captive power plants increased from 21,468 MW in 2005-06 to 32,900 MW during 2010-11 and the energy generation grew from 697,459 GWh during 2005-06 to a significant 959,070 GWh during 2010-11. Earlier, surplus power from captive plants could not be used to cater to the overall system demand but with the introduction of the electricity act 2003, surplus power, if any, can be fed into the grid and used for serving the nation. Studies have inferred that encouraging growth of captive power in India can add the much-needed capacity, while increasing competition in the power market (Hansen 2008).

Apart from this utility and non utility based generation capacity, India also depends on Bhutan for electricity supply. During 2011-12, India imported 5586 million units of electricity from Bhutan, compared to 6500 million units in 2010-11. It is expected that power exports from Bhutan will decline further during 2012-13 due to Bhutan's own increasing electricity consumption.

Over the years, the share of state sector in installed capacity has gone down but it continues to be the largest owner with 42% share in 2011-12 and the share of private sector has been continuously increasing since 2007-08.

The majority of India's electricity production is derived from thermal power generation. Thermal power generation currently holds 66% of total energy production in the country. Thermal power

production is a conversion plants convert fuel into electricity and heat. The main raw material used to generate power through the thermal process is coal, the stock of which is driven by large domestic reserves. Gas, oil etc are other possible sources of fuel used for power generation in the thermal process as well. The government of India realizing that its coal reserves are finite has over the recent years shifted a proportion of total electricity production to hydro electricity generation.

Hydroelectric power is generated through the energy of falling water. As per assessment made by Central Electricity Authority, India is endowed with economically exploitable and viable hydro electric potential to the tune of 1,48,700 MW and hence ranks fifth in terms of exploitable hydro electric potential when considered globally. In addition, the introduction and implementation of mini (100 KW to 2 MW) and micro Hydel (5 KW to 100 KW) schemes is expected to generate an additional installed capacity of approximately 6,782 MW. However, this resource has not been explored to its full potential and contributes only 19% to total electricity generation.

As per International Energy Agency 2010 data, the contribution of Hydro power in total electricity generation is just 11.9% whereas for Brazil it is as high as 78.2%. Russia and china are also ahead of India, their hydro power contribution being 16.2% and 17.2% of total electricity generation respectively.

Although India's concentration has remained on hydroelectric energy in the past, there is a mild shift towards nuclear energy production. Development of Nuclear energy has been a controversial issue in the public forums but the need for this source is fast becoming paramount to India's economic development. At current levels, India is the 15th largest nuclear power producer with 1.2% of worldwide nuclear power generation. However, its contribution to domestic power generation is modest at best. In 2012, it provided only 3.7% of the country's total electricity generation whereas in other countries like France, Ukraine and U.S the contribution of nuclear power to power generation was 77%, 46.7% and 19.3% respectively.

India's substantial and sustained economic growth, coupled with rapid industrialization and population growth is placing immense pressure on the country's non renewable natural resources (fossil fuels and nuclear fuels) and increasing India's dependence on imported fuels. Thus there is a growing consensus that if the current rate of utilization continues, the conventional sources of power generation will soon be depleted and country's dependence on

neighboring countries for import of oil, gas and coal will increase, creating a serious effect on key macro indicators like inflation, growth, fiscal deficit and current account deficit. Also, continuous use of fossil fuels and nuclear fuels result in immense carbon emissions, deteriorating the environment quality. The government has thus realized the importance of exploring alternate sources of energy, particularly, renewable energy sources, for addressing the growing demand for electricity. The contribution of renewables is modest but increasing. The table below gives the available potential and the actual potential exploited till august 2012 for various renewable sources of energy:

Table 2: Available Potential and Achievement till August 2012

S. No.	Source/Technology	Approximate potential	Achievement as on 31.08.2012
1.	Wind energy	48,500MW	17967.15MW
2.	Small hydro	15,000 MW	3434.07 MW
3.	Biomass power (agro residues)	16,881 MW	1209.60 MW
4.	Cogeneration-bagasse	5000MW	2109.73 MW
5.	Waste to power	2700 MW	93.68 MW
6.	Solar power	> 100,000 MW	1044.16 MW

Source: Ministry of New & Renewable Energy

Wind power is the largest renewable source used in India. The wind potential in India is estimated to be about 48.5 GW and in June 2012, it generated 17.6 GW of the total installed capacity as compared to 13.2 GW in April 2010, registering a growth of 34% (MNRE). By august 2012, the total exploited potential of wind energy was 17967.15 MW. Apart from wind power, other renewable sources used for electricity generation are small hydro, biomass and solar.

As far as the use of biomass energy and cogeneration is concerned, ministry of new and renewable energy has installed 288-biomass power and cogeneration projects generating 2665 MW of energy and around 100 projects, capable of generating 1150 MW of power are under various stages of implementation.

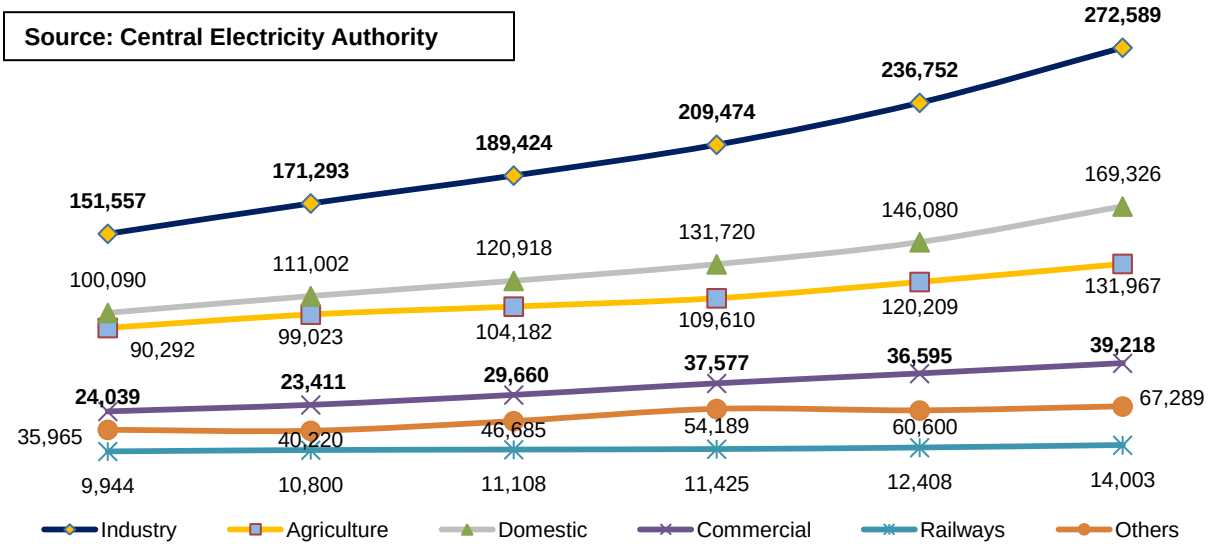
1.2 Demand and Supply Scenario

1.2.1 Demand

On the demand side, India is considered to be the fifth largest consumer of power in the world accounting for 3.4% of global energy consumption. Due to India's economic rise and population growth, the demand for power has grown at an average of 3.6% over the past 30 years. The electricity consumption increased from 411,887 GWh during 2005-06 to 694,392 GWh during

2010-11, showing a cumulative average growth rate of 11 percent. A sector-wise break up of electricity usage and trends of growth for each sector is provided below:

Figure 1: Sector-wise break up of Electricity Usage and Trends of Growth



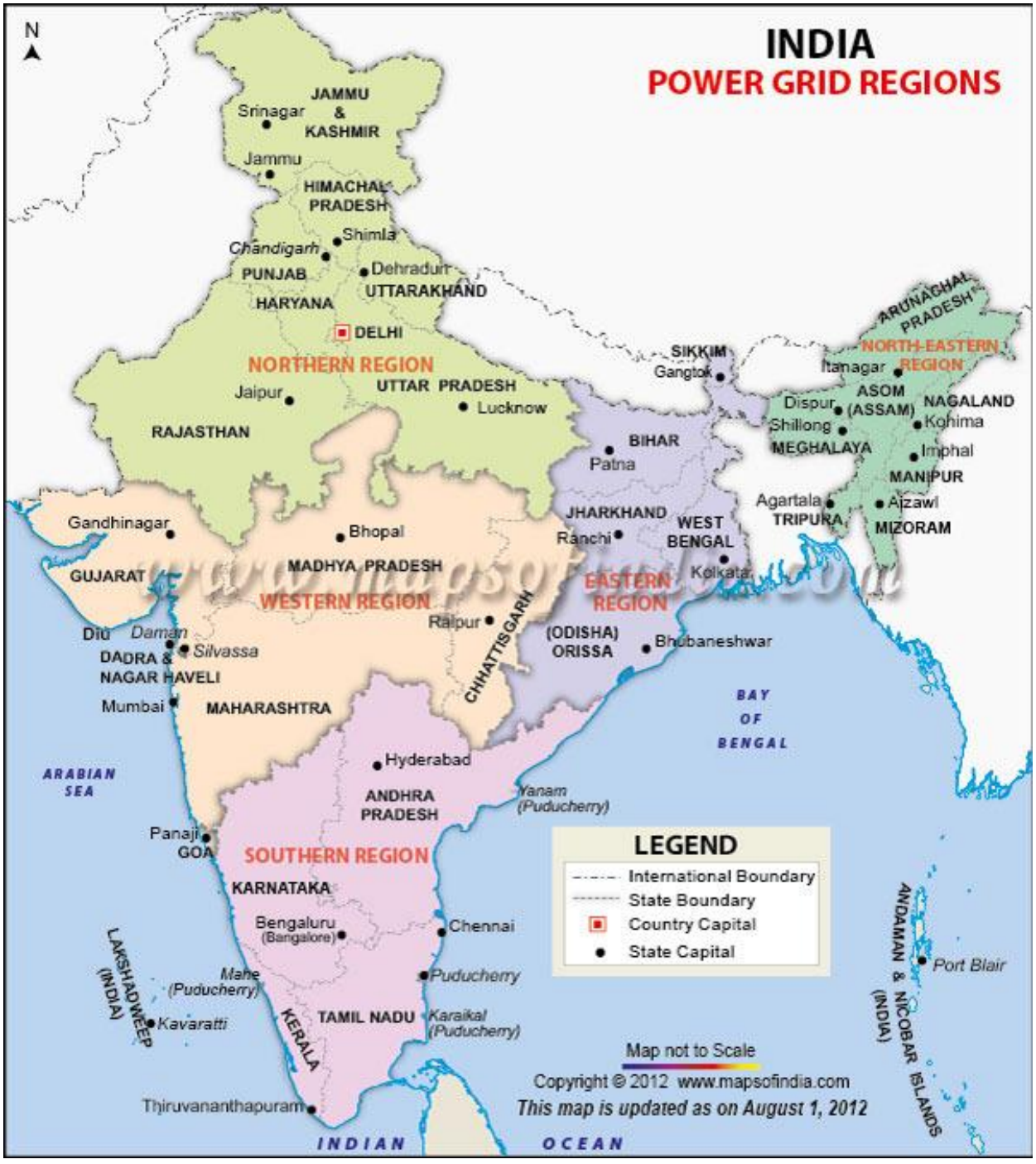
It showcases that of the total electricity consumed, the industry sector has always accounted for the largest share, followed by domestic and agricultural sectors respectively.

1.2.2 SUPPLY

Due to this fast growing demand for electricity, the generation capacity, though large, has not been sufficient to meet the demand, resulting insubstantial shortages. During 2010-2011, base load requirement was 861,591 Million Units (MU) against availability of 788,355 MU, which implied an energy shortage of 8.5%. During peak loads, the demand was for 122 GW against availability of 110 GW, leading to a peak shortage of 9.8% (Central Electricity Authority, Ministry of Power).

Despite the overall increase in demand for power, per capita power consumption in India is still very low compared to other countries. As per the state wise data on annual per capita electricity consumption in the country for the year 2009-10, Dadra & Nagar Haveli has the highest per capita electricity consumption in the country at 11,863.64 kWh while Bihar has the lowest at 122.11 KWh. National average is 778.71, which is three times lower than that of china (2,471 KWH).

1.3 National Grids



India is divided into five regions and hence has five electricity grids, namely Northern grid, Eastern grid, Western grid, Southern grid and North eastern grid. Except the Southern grid, all of them are interconnected. The northern grid spans through nine states, namely, Punjab, Haryana, Rajasthan, Uttar Pradesh, Uttarakhand, Himachal Pradesh, Jammu and Kashmir and

Chandigarh. Eastern regions like West Bengal, Bihar, Jharkhand, Odisha and Sikkim are covered by the Eastern grid. Arunachal Pradesh, Nagaland, Assam, Meghalaya, Manipur, Mizoram and Tripura are connected by north eastern grid while Tamil Nadu, Andhra Pradesh, Kerala, Karnataka and Pondicherry are connected by Southern grid. Maharashtra, Chhattisgarh, Goa, Madhya Pradesh, Goa are connected by Western grid.

The northern grid is the largest grid in the country by geographical area covered, encompassing 31% of the total area and servicing the largest number of constituents. 64% of power generation for the northern grid is through thermal sources while 36% is through hydro. The grid produces a total of 50,000 MW of power. Only 1620 MW of power is derived from nuclear sources.

The eastern grid produces 26838 MW of power. Of this 22545 MW is thermal, 3882 MW is hydro generated and 411 is generated from renewable energy sources.

The Western grid is a relatively large grid but serves less people than the Northern grid. It has an installed capacity of 66757 MW, beating the northern grid by 16000 MW of power. Within the 66757 MW, 49402 MW is from thermal sources, 7448 from hydro sources, 1840 MW from nuclear sources and 7910 MW from renewable energy sources.

The Northeastern grid is by far the smallest grid in the country. It also provides power to one of the smallest segments of the country. The unique characteristic about this grid is that it is interconnected/ interdependent with the northern grid. As of July 2012, the grid has an installed capacity of 2455 MW. Within this, 1027 MW is through thermal, 1200 MW from hydro and 228 MW from renewable energy sources. (GRID Enquiry Report, www.powermin.nic.in)

Also, following the recommendations of India Smart Grid Task Force, smart grid pilot projects have been initiated in 14 states with a view to mitigate frequent power failures and voltage problems faced by the industrial groups. This modern electricity distribution network would address issues related to energy theft and trace malpractices, besides making the billing system more transparent and effective. The automatic fault finding & rectification and advanced metering infrastructure are few of its others features that would enable this network to drastically resolve industrial power woes.

1.4 REASONS FOR POWER SHORTAGES

Despite impressive growth in power generation and huge investment in the power sector, power shortage still continues in our country due to:

1. **High Aggregate Technical And Commercial Losses (AT& C Losses)**

AT&C loss captures technical as well as commercial losses in the network. High technical losses in the system are primarily due to inadequate investment on transmission and distribution in comparison to the generation, too many stages of transmission, overloading of system elements like transformers and conductors, absence of up-gradation of old lines and equipments, etc.

The commercial losses are mainly caused by theft & pilferages; defective meters, errors in meter reading and in estimating unmetered supply of energy, absence of energy accounting and auditing, etc.

The Eastern region suffered the highest AT&C losses in 2010-2011. It was recorded at 38.24%, which when compared to the lowest losses, i.e. 19.26% in the southern region.

2. **Poor Financial Health of DISCOMs**

The financial health of the DISCOMs is extremely poor mainly because the pricing of power is far below the average cost of supply particularly for the agricultural consumers.

3. **Shortage of Fuel**

There is a finite reserve of coal in India. Due to poor management and lack of proper infrastructure, the country isn't producing enough to feed its power plants. This can be directly attributed to the Ministry of Environment and Forest's green activism. The long running tussle between the Ministry of Coal and Ministry of Environment and Forests over 'Go, No Go' classification is only partially resolved and hence continues to pose a problem for the Ministry of Coal. The permission to divert forest areas for coal is not given for areas classified as 'No-Go', leaving few virgin coal blocks to be capitalized by public sector companies like Coal India Ltd (CIL), Bharat Coking Coal Ltd., etc. Rail transportation of coal is another bottleneck in the sector. Inadequate placement of rakes delays the delivery of fuel to the various generation sites, leading to piling of fuel at company's various mines. Besides there is state level management problem also that aggravates the issue.

4. Low Plant Load Factor

Table 3: Sector Wise Plant Load Factor			
Sector	**2007-08**	**2008-09**	**2009-10**
State	71.9	71.2	70.9
Central	86.7	84.3	85.5
Private	90.8	91	83.9
All India	78.6	77.3	77.5
Source: Central Electricity Authority			

Plant Load Factor is a measure of the actual output of a power plant compared to the maximum output it can produce. The plant load factor for various sectors for 3 consecutive years can be seen in the table 3.

As per the sector wise plant load factor, the State sector is the least efficient. However, the private sector utilities and the Central utilities have managed to achieve competent efficiency rates.

With such problems, a clear shortage in supply and the heavy demand on the national grids and public power facilities, India has experienced two major power cuts in the last 11 years; apart from the many smaller cuts experienced by all parts of the country at any given time.

1.5 Major Power Cuts in India

On January 2, 2001, a massive breakdown in power supply affected Delhi, Haryana, and Punjab along with parts of Uttar Pradesh. Kashmir, Rajasthan and Himachal Pradesh were also affected. The disruption began with a fault in the Panki substation in Uttar Pradesh, which triggered a breakdown of the entire northern grid. Rail networks were hit as well as Delhi's international airport. Emergency services, utilities and telephone services were said to be affected in many states. Empirical evidence suggests that businesses lost between 2.5-5 billion rupees because of the breakdown.

On 30thJuly, 2012, there was a massive breakdown in the northern grid which is a transmission network that links nine northern states. The affected states were Delhi, Uttar Pradesh, Punjab, Haryana, Rajasthan, Himachal Pradesh and Jammu and Kashmir. The services of all the metro lines were disrupted due to tripping of power supply. On 31stJuly, 2012, the Northern, the Eastern and North Eastern grid collapsed impacting about 22 states and union territories. It was the biggest ever power failure in India, which affected hundreds of trains and millions of people.

A few of the factors for the failures of these grids between 30th and 31st of July, 2012 include:

- Weak Inter-regional corridors due to multiple outages: The system was weakened by multiple outages in the NR-WR corridors as well as the ER-NER corridors.
- High loading of the Bina-Gwalior 400 KVA line
- Inadequate response by officials to correct the looming catastrophe until it was too late.
- Loss of the Bina-Gwalior 400 KVA line causing the NR and WR region to separate, effectively leaving the largest northern region dependent only on the northern and north-eastern grids.

As shown by the secondary data available, India's power sector has been thoroughly studied over the years. What lacks in the research until now is a detailed study on the impact of the shortage in the power sector on specific segment of the economy. Industry, by far the most important sector, is dependent completely on power and thus intermittent supply; shortages and power failures like the two major mentioned above, have a real negative impact on India Inc. The quantitative impact on the backbone of the economy has never been undertaken. This study intends to fill this gap.

CHAPTER 2: THE STUDY

The present study was carried out at all-India level, spreading across major industrial (25 cities) cities, to understand the ways of tackling the frequent power cuts being faced by Indian Industry. This study carried out representing all the major regions i.e. North, South, East, West and Central. A total of 650 firms representing both the manufacturing as well as service group were canvassed with a structured questionnaire. The samples were selected from the Big, Medium and Small Business entities.

2.1 OBJECTIVES OF THE STUDY

- Estimation of industrial losses due to irregular power supply per day or Scheduled load shedding
- Preparedness of businesses for the power cuts – SMEs, Large industries
- Map the frequency of power cuts
- Additional Investments made on DG sets, inverters, etc
- Exploitation of subsidised diesel as a fuel on account of uninterrupted energy source
- Understand the level of Instability in the working cycle due to power cuts
- Impact on profitability due to power cuts

2.2 PARAMETERS OF THE STUDY

The study captured perceptions of the firms on various indicators related to power demand, consumption, expense, power tariff, supply, power cut, power shortfall, captive power generation, additional investment made for DG sets, level of Instability in the working cycle and losses incurred due to power failure. The survey was also extended further to know the perceptions of the firms on broader parameters like turnover, employees, government policy, and impact of power failure on industries, and affect on the competitiveness of business community, etc.

2.3 APPROACH OF THE STUDY

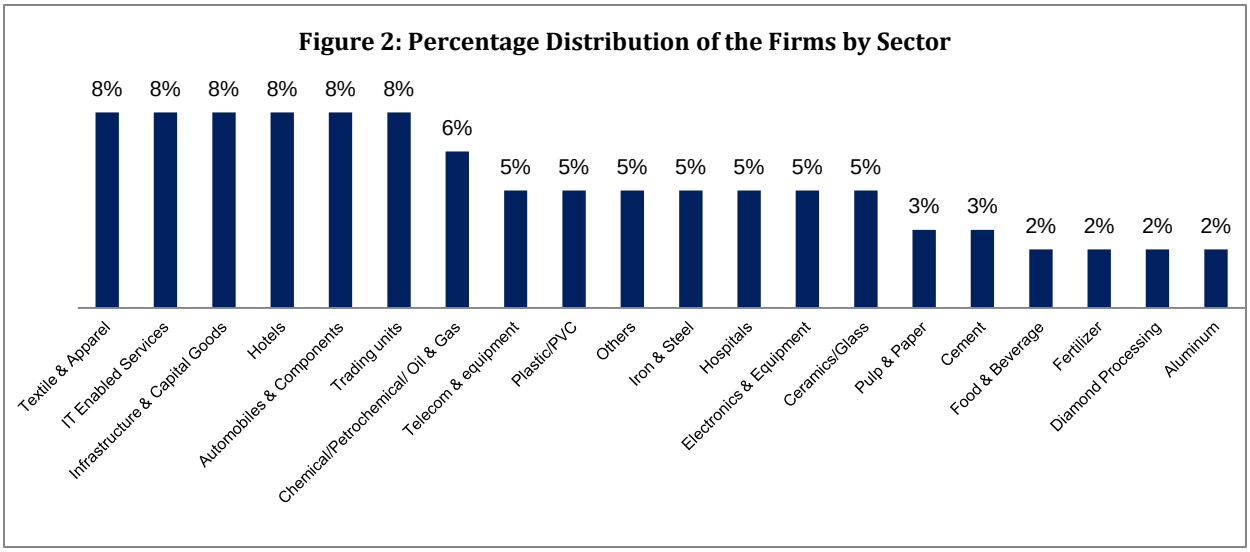
The primary research is based on 'Face-to-Face' interviews. The questionnaires prepared for the study were directed on the identified target audience (Owner/Senior Management) by the experienced field investigators. The questionnaire consisted of open ended as well as some close-ended questions for the purpose of attaining maximum information from the target audience. Then BRIEF research team scrutinized the filled up schedule and rechecked the information in order to examine the authenticity of data and gap filling. Filled in data were processed, cleaned and analyzed with the help of Statistical software SPSS. The data were analyzed both quantitatively and qualitatively.

The sample firms were selected randomly. The city-wise representation of the firms is as follows:

Table 4: City-wise Sample Break-up

State	Cities	Sample
Delhi NCR	Delhi, Gurgaon, Faridabad, Ghaziabad, NOIDA	100
Maharashtra	Mumbai, Pune, Nagpur	100
West Bengal	Kolkata, Durgapur	75
Andhra Pradesh	Hyderabad, Secunderabad, Vishakhapatnam	75
Tamil Nadu	Chennai, Coimbatore,	75
Karnataka	Bangalore, Mysore, Mangalore	75
Gujarat	Ahmadabad, Vadodara, Sanand	75
Jharkhand	Jamshedpur	25
Odisha	Bhubaneswar & Rourkela	25
Madhya Pradesh	Indore	25
	Total	**650**

Figure 2: Percentage Distribution of the Firms by Sector



It is observed from the above chart that 48 percent samples (8% each) were selected form Textile & Apparel, IT Enabled Services, Infrastructure & Capital Goods, Hotels, Automobiles & Components and Trading units. Another 35 percent (5% each) were selected from Telecom & equipment, Plastic/PVC, Iron & Steel, Hospitals, Electronics & Equipment, and Ceramics/Glass sectors. Six percent samples were selected from Chemical/Petrochemical/ Oil & Gas sector. Three percent each samples were selected form Pulp & Paper and Cement industries. Eight percent samples were selected (2% each) from sectors like Food & Beverage, Fertilizer, Diamond Processing and Aluminium industries. About 5 percent samples were covered from miscellaneous service category.

2.4 Sample Distribution

Of the 650 companies that were interviewed as a part of this study, 67% were privately owned. Additionally 28% of companies were either private partnership or individual ownerships. Only 3% of the total sample was public sector or government run units and 2% were from the multinational corporation category.

Figure 3: Ownership Wise Distribution of Sample

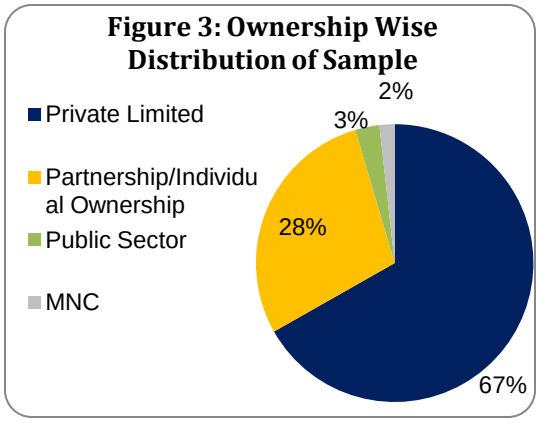
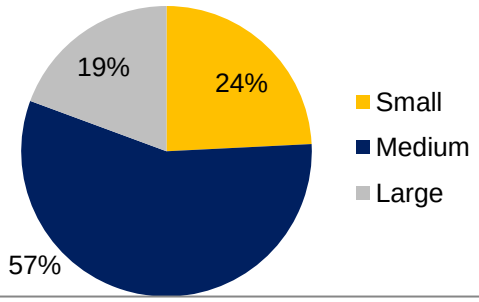


Figure 4: Distribution by Type of Enterprise



During the course of the study it was observed that medium and small enterprises were willing to provide detailed information more freely than the larger companies. Micro units were either unaware or did not have the necessary details available to answer the questions on the survey and hence were not targeted. This classification was based upon the department of industries norms. As per chart, 81 percent of the sample is derived from small and medium sized companies (24% and 57% respectively). Of the total sample size 19% were large companies as well.

The demographic analysis of the sample covered is given in the table below:

Table 5: Demographics of the Sectors Covered	
Sectors	**States**
Food & Beverage	Delhi, West Bengal & Karnataka
Diamond Processing	Karnataka, followed by Gujarat
Textile & Apparel	Delhi, followed by Gujarat
Telecom & Equipment	Tamil Nadu, West Bengal & Maharashtra
Ceramics/Glass	Andhra Pradesh, followed by Karnataka and Gujarat
Iron and Steel	Andhra Pradesh
Aluminium	Maharashtra and Andhra Pradesh
Fertilizer	Andhra Pradesh and West Bengal
Cement	West Bengal, followed by Andhra Pradesh
Pulp & Paper	Delhi NCR, followed by Andhra Pradesh and West Bengal
IT Enabled Services	Karnataka, followed by Delhi
Infrastructure & Capital Goods	Karnataka, followed by Tamil Nadu
Automobiles and Components	Gujarat and Maharashtra
Hotels	Maharashtra, followed by West Bengal
Chemicals	Gujarat, followed by Maharashtra
Plastic/PVC	Gujarat, followed by Karnataka
Electronics and Equipment	Tamil Nadu and Delhi NCR
Trading Units	Delhi NCR, followed by Tamil Nadu
Hospitals	Orissa, followed by Andhra Pradesh
Other Service Industry	Orissa, followed by Delhi

Some of the sector distribution as per geographical location is, as it is known to be. For example, IT enabled services and Infrastructure and capital goods are located primarily in Karnataka. Textile and Food and Beverage, two sectors that usually locate themselves close to populous areas are predominantly located in Delhi. Heavy industries that include, Iron and Steel, Aluminium, Cement, Automobile components etc are located in states that offer large spaces and lower population densities like Andhra Pradesh, Gujarat, Karnataka and Maharashtra. Smaller industries that are covered under the other service industry category are predominant in less developed states like Orissa, a state known to be in recent years, trying to improve its industrial attraction. Skilled labor intensive and technology dependant industries like chemicals, plastic/PVC and diamond processing seem to prefer Gujarat.

While some inferences can be made as to why the particular sector is predominantly located in one state over the other, it cannot be concretely said through the results of the survey on why it is so. The reasons for the location of these sectors can range from location, state government

incentives, skill and labor availability, availability of raw materials, but will need to be studied in a separate study, to understand the choice in location.

2.5 LIMITATION OF THE STUDY

The primary research was conducted during the festive months in few of the Western & Southern cities. The data collection was confined to only twenty five relatively large industrial cities of India since constraints were faced during data collection. The replication of the study at different regions of India would enable better homogenizations of the findings of the study. Since only face to face interview measures were used, common-method variance and response consistency effects may have biased the observed relationships.

CHAPTER 3: CONSUMPTION, LOSSES AND MITIGATION MEASURES

To fully understand the impact on the industry due to power cuts and outages, it is first imperative to understand the current situation that exists in the industry in terms of power, its usage, losses and measures used to correct any shortcomings. This chapter explores all three of these categories.

The first part is a detailed analysis of the consumption pattern as seen during the course of the study. It explains the consumption at a more specified sectoral level. Additionally, it describes the current requirements of the industry as well as providing information on the cost of procuring electricity from government sources.

The second part of the chapter is a description of the losses in power and their affects on the industry. The section gives a broad understanding of the power shortages experienced by state and also provides details on the awareness of load shedding and scheduled power cuts that industry faces in their respective states.

The last section of the chapter is a detailed explanation on the mitigating measures used by the industry to deal with power losses and shortages. It is an in-depth analysis of the current practices used by industry to help dampen the effects of power shortages from government sources. It explains in detail the use of captive power generation both at a state, industry and sector level.

3.1 CONSUMPTION DETAILS

Table 6: Monthly Maximum Demand (KVA)									
Sector	Small			Medium			Large		
	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max
Food & Beverage	240	33	808	341	103	900			
Diamond Processing				171	27	567	470	39	900
Textile & Apparel	176	38	750	191	79	1010	391	94	1500
Telecom & Equipment	195	34	489	303	49	750	520	60	1010
Ceramics/Glass	520	44	1200	625	130	1400	893	225	1680
Iron and Steel	810	59	1400	845	166	1525	1434	900	2400
Aluminium	676	101	950	728	323	1124	854	267	1625
Fertilizer	516	81	1010	645	124	1200	674	199	1200
Cement	60	60	60	1153	135	2171	1501	322	2680
Pulp & Paper	145	25	510	279	56	650	360	98	1010
IT Enabled Services	225	63	900	368	105	784	536	217	944
Infrastructure & Capital Goods	109	115	410	219	148	610	299	213	750
Automobiles and Components	103	53	600	325	79	875	462	123	1010
Hotels	98	24	225	164	48	325	392	126	750
Chemicals	107	46	225	263	98	1500	350	126	1875
Plastic/PVC	68	38	113	197	61	339	277	109	667
Electronics and Equipment	195	151	359	479	75	700	793	112	1680
Trading Units	28	41	210	99	91	268	154	106	221
Hospitals	127	35	250	173	111	401	218	210	275
Other Service Industry	83	31	146	128	45	375	212	86	529

The table above gives the average, minimum and maximum load requirement for all the sectors based on the scale of the company. It can be seen that in all the categories of the enterprises, electricity dependent sectors have the highest load requirement. In small-scale enterprises, iron and steel sector has the highest load requirement, followed by aluminium and ceramics/glass sector. With regard to the load requirement in medium scale enterprises, cement industry has the highest load requirement followed by iron and steel and aluminium sectors. In the large-scale enterprises, again cement industry has the largest load requirement and is closely followed by iron and steel and ceramics/glass. In all the categories, the lowest load requirement

has been observed for trading units that can be attributed to their comparatively low electricity intensive operations.

The monthly electricity consumption was an important factor to be considered so as to have an idea of the monthly electricity consumption by various sectors. The details are given below:

Table 7: Percentage Distribution of Monthly Electricity Consumption

Sectors	Less than 10000 Units	10001-50000 Units	50001-100000 Units	100001-500000 Units	Above 500000 Units
Food & Beverage	26.67	26.67	13.33	33.33	0.00
Diamond Processing	16.67	33.33	16.67	33.33	0.00
Textile & Apparel	15.09	49.06	5.66	30.19	0.00
Telecom & Equipment	15.38	38.46	7.69	38.46	0.00
Ceramics/Glass	25.00	25.00	16.67	16.67	16.67
Iron and Steel	6.67	6.67	23.33	50.00	13.33
Aluminium	6.67	6.67	20.00	60.00	6.67
Fertilizer	14.29	14.29	28.57	28.57	14.29
Cement	0.00	0.00	40.00	20.00	40.00
Pulp & Paper	5.00	15.00	50.00	25.00	5.00
IT Enabled Services	11.43	8.57	42.86	37.14	0.00
Infrastructure & Capital Goods	17.39	32.61	6.52	43.48	0.00
Automobiles and Components	22.00	40.00	6.00	30.00	2.00
Hotels	25.00	39.29	25.00	7.14	3.57
Chemicals	20.45	38.64	20.45	18.18	2.27
Plastic/PVC	20.83	58.33	12.50	8.33	0.00
Electronics and Equipment	16.67	26.67	13.33	30.00	13.33
Trading Units	14.00	70.00	16.00	0.00	0.00
Hospitals	17.39	34.78	30.43	8.70	8.70
Other Service Industry	20.00	50.00	23.33	6.67	0.00

The monthly consumption of electricity varied with the size of the firm and the degree to which it was mechanized and automated. The sector wise average monthly electricity consumption revealed that about 36 percent of the surveyed firms consume 10001-50000 KWh monthly. This category consists of firms from all the sectors but is majorly constituted by firms from Textile & Apparels, Pulp & Paper, Plastic/PVC, Trading units & other service industry. The

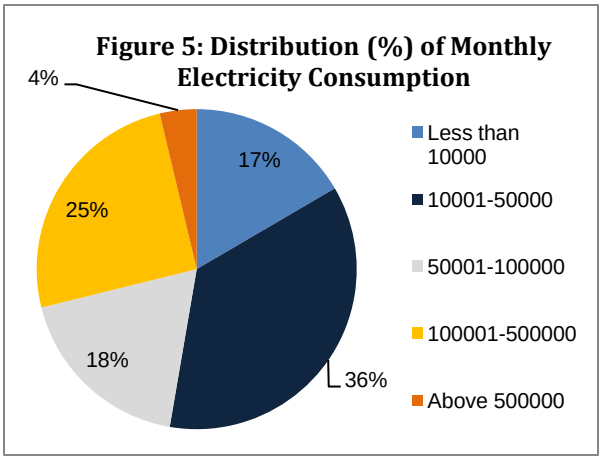


Figure 5: Distribution (%) of Monthly Electricity Consumption

second largest share (25%) comprises of firms consuming between 1000001-500000 KWh per month. Sectors in this category include the above-mentioned sectors as well as the electricity dependent sectors like Iron and Steel, Aluminium, Fertilizer, Infrastructure and capital goods and others. Consumption range between 50001-100000 KWh falls at 18 percent with units from Cement, Pulp & Paper and IT enabled services constituting the major share. 17 percent of the surveyed firms show an average monthly consumption of less than 10000 KWh. It is noticed that firms from food and beverage sector contribute to this average monthly consumption the highest. Only 4 percent show average monthly consumption of above 500000 KWh. This share comprises of mostly electricity dependent/intensive sectors such as Iron and Steel, Aluminium, Ceramics and Glass, Cement and electronic and equipment with a few Chemical and automobile sector companies, Hospitals and Hotels.

Understanding what the current electricity needs for maximizing production and output is another important aspect of the study as it reveals the actual demands of electricity as required by the players in the various industries. In the course of the study, firms across the sectors were asked to provide information on their current requirement of electricity for their specific activity. The results are illustrated below:

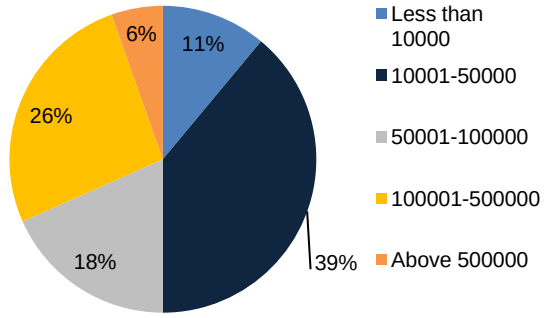
Table 8: Percentage Distribution of Normal Requirement of Electricity

Sectors	Less than 10000 Units	10001-50000 Units	50001-100000 Units	100001-500000 Units	Above 500000 Units
Food & Beverage	20.00	26.67	6.67	46.67	0.00
Diamond Processing	16.67	16.67	16.67	50.00	0.00
Textile & Apparel	13.21	47.17	9.43	30.19	0.00
Telecom & Equipment	7.69	46.15	7.69	38.46	0.00
Ceramics/Glass	25.00	25.00	16.67	16.67	16.67
Iron and Steel	0.00	10.00	26.67	43.33	20.00
Aluminium	0.00	13.33	26.67	53.33	6.67
Fertilizer	0.00	28.57	28.57	28.57	14.29
Cement	0.00	0.00	20.00	40.00	40.00
Pulp & Paper	0.00	20.00	30.00	45.00	5.00
IT Enabled Services	5.71	11.43	45.71	34.29	2.86
Infrastructure & Capital Goods	10.87	36.96	8.70	36.96	6.52
Automobiles and Components	10.00	52.00	4.00	28.00	6.00
Hotels	17.86	39.29	28.57	7.14	7.14
Chemicals	11.36	45.45	18.18	22.73	2.27
Plastic/PVC	20.83	58.33	12.50	8.33	0.00
Electronics and Equipment	16.67	26.67	10.00	33.33	13.33

Trading Units	8.00	70.00	22.00	0.00	0.00
Hospitals	14.29	33.33	28.57	14.29	9.52
Other Service Industry	16.67	53.33	20.00	10.00	0.00

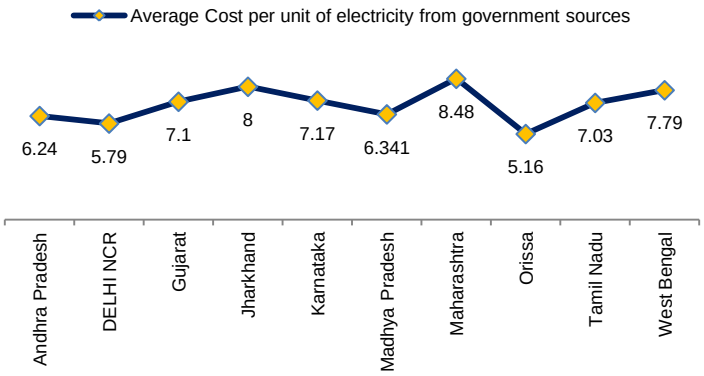
It was observed that 39 percent of companies require 10001-50000 KWh monthly to maximize their output and production. A further dissection of the results revealed that this category consisted of firms from all the sectors but is majorly constituted by firms from automobiles and components, plastic/PVC, trading units and other service industry. 26 percent of companies' surveyed lean towards a requirement of between 100001-500000 KWh, most notably in the Iron and Steel, Aluminium, Diamond Processing and Pulp and Paper sectors. Consumption range between 50001-100000 KWh falls at 18 percent with units from IT enabled services, pulp and paper, Hospitals, Hotels and fertilizer constituting the major share. As with monthly average consumption, Electronic and Equipments, Iron and Steel, Aluminum, Ceramics and Glass, Cement and Infrastructure and Capital Goods sector companies require highest levels of electricity at above 500000 KWh. The companies that require this amount of electricity make up 6 percent of the survey. Only 11 percent of companies mainly in the ceramics/glass sector require less than 10000 KWh per month.

Figure 6: Distribution (%) of Normal Requirement of Electricity



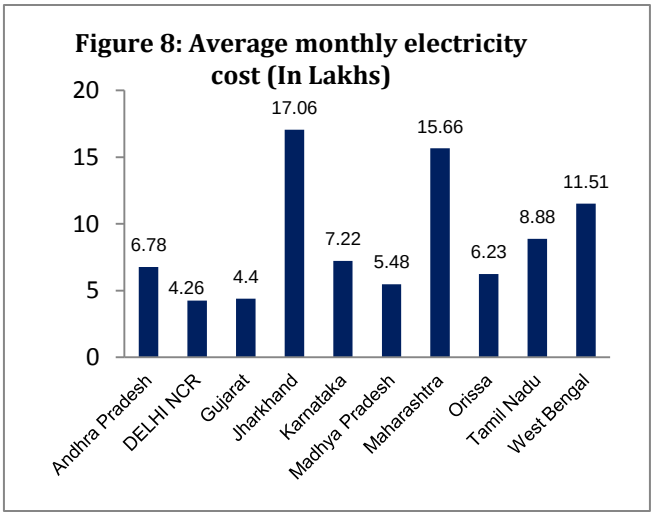
Government sources of electricity are the main sources of power generation for all aspect of the economy. The government sources thus price each unit of electricity at very uniform average across the country.

Figure 7: Average Cost per unit of Electricity from Government Sources (in Rupees)



From the graph, it can be ascertained that average cost of electricity in the country can range between Rs 5.16 to Rs 8.48. Odisha and Delhi show lowest prices of electricity per unit, while Maharashtra, Jharkhand and West Bengal are the higher prices in the

range. States like Gujarat, Andhra Pradesh, Karnataka, Madhya Pradesh and Tamil Nadu show prices at the median of the range, at around Rs 7 per unit.



Not surprisingly, average monthly electricity cost by state also reveals the pattern just highlighted by the graph above. States with high per unit cost of electricity, Maharashtra, Jharkhand and West Bengal, have the highest average monthly costs of electricity. The similar trend exists for Delhi as well. It shows a reasonable co-relatable pattern of monthly cost vis-à-vis average cost per unit. Andhra Pradesh, Karnataka, Madhya Pradesh and Tamil Nadu, which had cost of electricity at the median of the range, continue to follow the same pattern with respect to average monthly electricity cost as well. The only exceptions to the above mentioned trends are Gujarat and Orissa, which do not clearly show a co-relatable pattern vis-à-vis average cost per unit. Orissa shows the average monthly electricity cost at the median of the range while Gujarat has one of the lowest average monthly electricity costs. This could be due to the presence of comparatively less electricity intensive sectors like Textiles and Apparels in Gujarat and more electricity dependent sectors like Hospitals and service industry in Orissa, consequently leading to a lower consumption and hence average monthly electricity cost for Gujarat and higher consumption and average monthly electricity cost for Orissa. The sector wise analysis of the monthly electricity cost is given below-

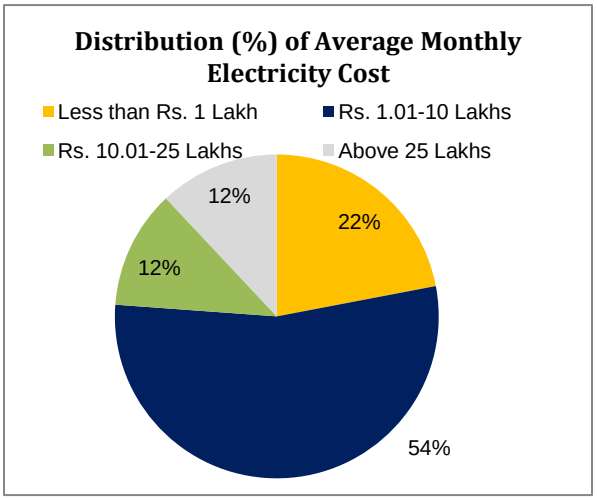
Table 9: Average Monthly Electricity Cost by Sector*

Sectors	Less than 1 Lakh	1.01-10 Lakh	10.01-25 Lakh	Above 25 Lakhs
Food & Beverage	33	53	14	0
Diamond Processing	20	73	0	7
Textile & Apparel	26	58	8	8
Telecom & Equipment	17	46	30	7
Ceramics/Glass	23	47	10	20
Iron and Steel	7	63	13	17
Aluminium	7	60	26	7
Fertilizer	13	60	13	14
Cement	0	50	10	40
Pulp & Paper	5	65	20	10

Table 9: Average Monthly Electricity Cost by Sector*				
Sectors	**Less than 1 Lakh**	**1.01-10 Lakh**	**10.01-25 Lakh**	**Above 25 Lakhs**
IT Enabled Services	14	50	20	16
Infrastructure & Capital Goods	32	26	34	8
Automobiles and Components	24	46	8	22
Hotels	26	62	0	12
Chemicals	20	60	0	20
Plastic/PVC	20	73	4	3
Electronics and Equipment	17	43	27	13
Trading Units	34	66	0	0
Hospitals	37	56	0	7
Other Service Industry	30	50	10	10

**Rounded to the nearest digit*

A further dissection of the average monthly electricity cost, now by sector reveals that *majority of the firms spend Rs.1.01-10 Lakhs on their monthly electricity consumption.* This range consists of firms from all the sectors but is majorly constituted by units from Diamond Processing, Pulp and Paper and Plastic/PVC. The second highest category, less than Rs. 1 Lakh, constitutes 22 percent of the entire sample and is again constituted by firms from all the sectors except cement. Cement being a highly electricity intensive sector does not fall within this range. The remaining cost ranges of Rs. 10.01-25 Lakhs and above Rs. 25 Lakhs consist of 12 percent of the sample frame and is spent by large scale units or heavily electricity dependent sectors.



3.2 Loss Details

An important point to understand is the duration of power cuts faced by industry per week that thus hampers production. In this regard, the survey questioned the number of hours firms face power cuts in a given week. The results show that 37 percent of firms across India face less than 1 hour of power shortage a week. At the same time 21 percent suffer more than 30 hours

Figure 10: Distribution of Industrial Power Shortage (hours per week)

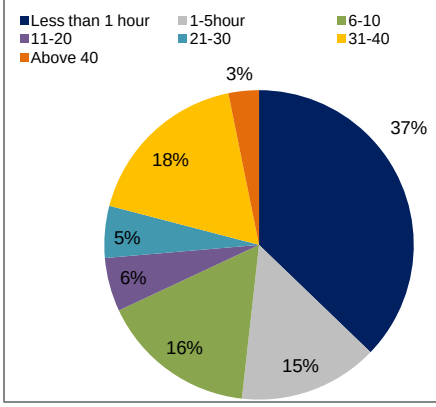
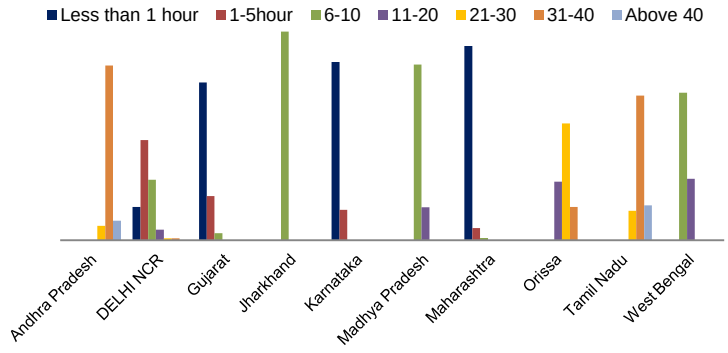
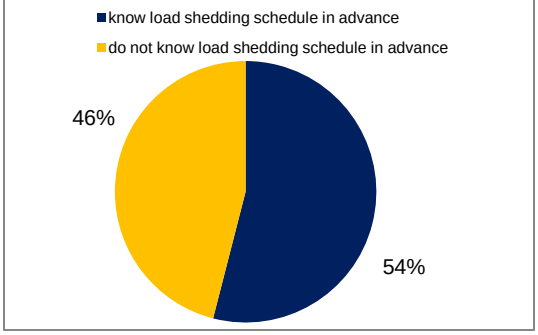


Figure 11: Distribution of Industrial Power Shortage in States (hours per week)



per week. 16 percent face 6-10 hours per week, while 15 percent face between 1-5 hours weekly. The state wise analysis shows that majority of the firms in Andhra Pradesh and Tamil Nadu face power shortage for more than 30 hours a week while in Odisha, the majority 21-30 hours per week with the exception of few, that face shortage of above 30 hours. This trend, where Andhra Pradesh, Tamil Nadu and Odisha show the highest impact or lowest results in various tables is evident across the study. This implies that the power scenario in these three states is by far the worst as compared to other states and thus tends to always show the worst results. This could be due to many reasons including issues in connectivity, absence of power grids or stark difference between demand and supply in these states. In Maharashtra, Gujarat and Karnataka, the majority of the companies surveyed face power shortage of less than 1 hour a week while a few face 1-5 hours per week. In Delhi, the majority face 1-5 hours a week while in West Bengal, Madhya Pradesh and Jharkhand, the majority face 6- 10 hours per week. In Andhra Pradesh and Tamil Nadu, the shortage even exceeds beyond 40 hours per week for few of the firms. It is obvious that a correlation between the duration of weekly power cuts and losses in production or escalation of costs exists and go hand in hand which will be proven in the subsequent sections.

Figure 12: Awareness About Load Shedding

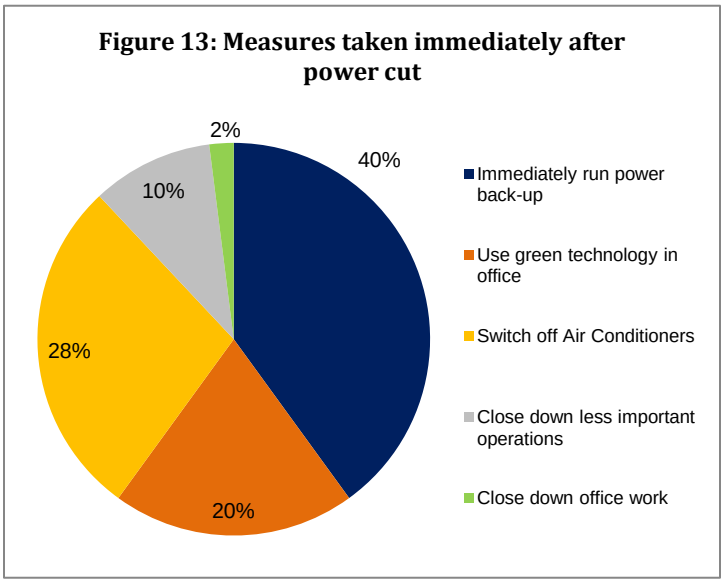


An important factor in understanding the preparedness of companies in regards to power outage is the awareness they have on scheduled power cuts or load shedding in their area.

The survey revealed 54% of companies were aware in advance of the load-shedding schedule. This

constituted companies from Odisha, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra. Companies in states like Delhi NCR, Gujarat, Jharkhand, West Bengal and Madhya Pradesh did not have any information about their Discom's load shedding schedule.

3.3 MITIGATING FACILITIES& MEASURES



While there are various methods available to manage times of power outages, the survey revealed a few key steps that are taken by companies as measures to manage operations during power cuts. The most significant step as observed is immediately running power backups (generators and invertors). 40 percent of the companies immediately run power back-up options that are available to them. In many cases, these systems come online as soon as a power outage occurs. This helps the companies maintain productivity levels at the same standard as when operating with power. Following closely, 28% of companies shut down the air conditioning units immediately after any power cuts. It is the belief of most companies that air conditioners are the heaviest electricity consuming machines and the stopping of their operation not only reduces cost in using power back-ups but allows measures like inverters to function better and longer. *About 20 percent of companies use green-technology sources for power in case of power cuts*. Though the exact procedure or technology in use is not known, this increasingly popular measure is both sustainable and helps companies keep costs relatively lower than when using other power back-up options. The last two measures noticed in the survey were closing down less important operations (10%) and shutting down operations completely (2%), indicating that these two options are almost last resort options and are rarely used.

From the evidence above, it is clear that the impact on the industry due to power shortages that India faces is generally negative. The impact has not only hurt industry in production and revenue generation but has increased their cost and made industry dependent on captive

sources much more than government sources. Worrying for the industry is the rising trends in costs simply as the increase in the usage of captive sources coupled with the rising costs of fuel, and with the both the power shortages and fluctuations is creating a grim picture for the sustainability and competitiveness of the Indian industry in the coming years. Strong steps, including direct and immediate action need to be taken if the risk of decline in industrial production is to be mitigated.

As the first choice of measures to mitigate the impact of a power outage or cut is to turn on back-up sources for the majority of the sample, it is important to study the captive sources or back-up generation facilities available for the use in case of a power outage. The next section of the study portrays the current use, costs and other aspects of using power back-ups and captive sources. For example, the subsequent chart gives the distribution of capacity of the generators used by the surveyed firms-

It was observed in the data that the capacity of generators falls between the following ranges: Less than 10 KVA, 10-100 KVA, and 101-500 KVA and above 500 KVA. Of this, most generators being used fall in the 101-500 KVA category, at 38.83 percent. Small and medium companies use this capacity category the most as do a few large companies. The above 500 KVA capacity generators are mainly employed by the larger companies and a few by medium sized companies. Of the total sample, 19.42 percent used generators with this capacity.

Figure 15: Distribution of capacity of Generator (in KVA) by Type of Enterprise

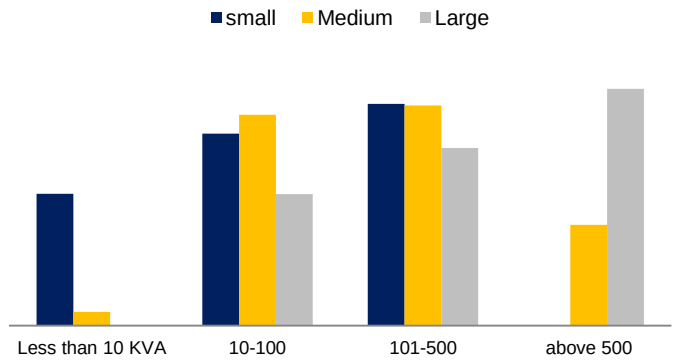
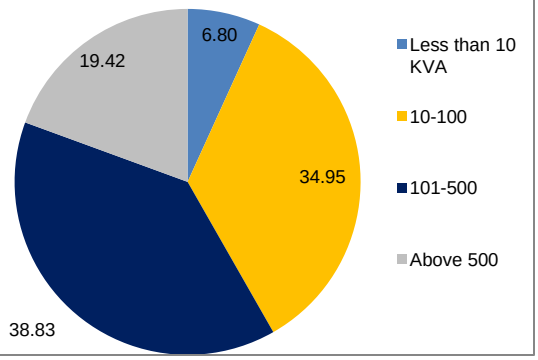


Figure 14: Distribution (%) Capacity of Generator (in KVA)



Large companies rarely use generators with capacity between 10-100 KVA. Out of the 34.95 percent of companies that use this capacity category most tend to be medium enterprise, followed closely by small firms. Last, only a few medium sized companies employ generators

with less than 10 KVA power generations. The primary users of this category are small companies and only 6.8 percent of the total frame was observed to employ these generators as power back-ups.

Table 10: Sector Wise Distribution of Capacity of Generator (In KVA)				
Sectors	**Less than 10**	**10-100**	**101-500**	**Above 500**
Food & Beverage	21.43	42.86	35.71	0.00
Diamond Processing	0.00	33.33	33.33	33.33
Textile & Apparel	12.50	45.00	35.00	7.50
Telecom & Equipment	0.00	46.15	30.77	23.08
Ceramics/Glass	0.00	33.33	22.22	44.44
Iron and Steel	0.00	19.23	42.31	38.46
Aluminium	0.00	25.00	50.00	25.00
Fertilizer	0.00	14.29	42.86	42.86
Cement	0.00	0.00	60.00	40.00
Pulp & Paper	5.56	44.44	33.33	16.67
IT Enabled Services	0.00	29.03	32.26	38.71
Infrastructure & Capital Goods	8.33	47.22	19.44	25.00
Automobiles and Components	9.68	29.03	41.94	19.35
Hotels	0.00	47.83	43.48	8.70
Chemicals	0.00	50.00	46.15	3.85
Plastic/PVC	0.00	23.08	38.46	38.46
Electronics and Equipment	7.69	23.08	42.31	26.92
Trading Units	20.59	44.12	35.29	0.00
Hospitals	9.52	19.05	66.67	4.76
Other Service Industry	0.00	23.81	71.43	4.76

The sector wise analysis showed the level of dependence of the various sectors on generator sets to ensure continuous production activities. The capacity of the generators held by firms depended upon the scale of the firms, degree to which their operations were energy intensive and the geographical location of the firms.

Table 11: State Wise Distribution of Capacity of Generator (In KVA)				
Sectors	**Less than 10**	**10-100**	**101-500**	**above 500**
Andhra Pradesh	-	14.29	52.38	33.33
Delhi NCR	4.0	55.0	38.0	3.0
Gujarat	23.81	33.33	38.10	4.76
Jharkhand	-	-	100	-
Karnataka	65.38	34.62	-	-
Madhya Pradesh	-	-	100	-
Maharashtra	1.67	85.0	6.67	6.67
Orissa	7.69	23.08	53.85	15.38
Tamil Nadu	-	15.38	12.82	71.79
West Bengal	-	1.96	98.04	-

Generator sets with capacity above 500 KVA were majorly found to be held by firms located in Andhra Pradesh and Tamil Nadu. It was interesting to see that this category of generators was held by firms located in Gujarat as well, where

power cuts are not so frequent. This could be due to the presence of electricity dependent sectors like Plastic/PVC, Ceramics/ Glass etc., which are some of the top consumers of this capacity generator, apart from other electricity dependent sectors like Iron and Steel, Fertilizer and Cement. The generators with capacity less than 10 KVA were found the most in Karnataka, may be due to the less frequent power cuts experienced by the state or the presence of some less electricity intensive sectors. The major users of this category generator in the sample were trading and food and beverage units. The remaining capacity ranges, 10-100 KVA and 101-500 KVA, were held by firms from almost every state and sector.

The age distribution of the generators held by the surveyed firms revealed that most firms (54%) had generators which were less than 5 years old, followed by 43 percent who had 5-15 years old generators. Only 3 percent had generators above 15 years old. This revealed that firms replaced generators from time to time so as to be able to tackle the power shortage in the most efficient way possible. While there is a continuous overhaul of technologies in captive sources, as shown above, the technology continues to require the same inputs it has since its inception. Fuel, remains the driver of any alternate power generation unit and fuel consumption for this activity continues to play an important role in the decision of industrial units on the use of captive sources for power generation.

Figure 16: Distribution of Age of Generators (in years)

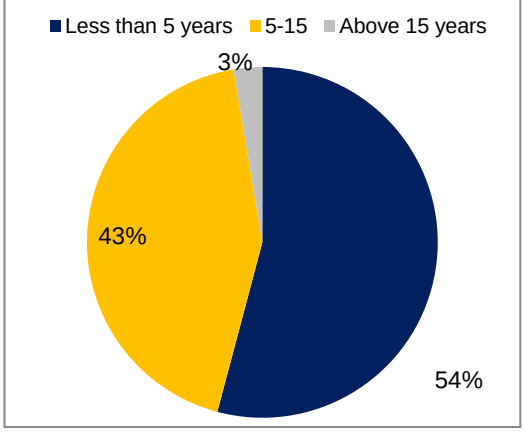


Figure 17: Distribution of Average Fuel Consumption (Litre/hour)

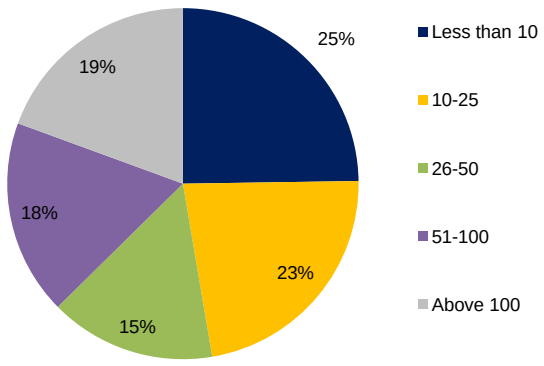
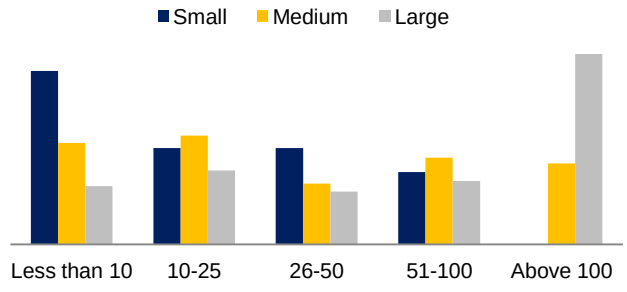
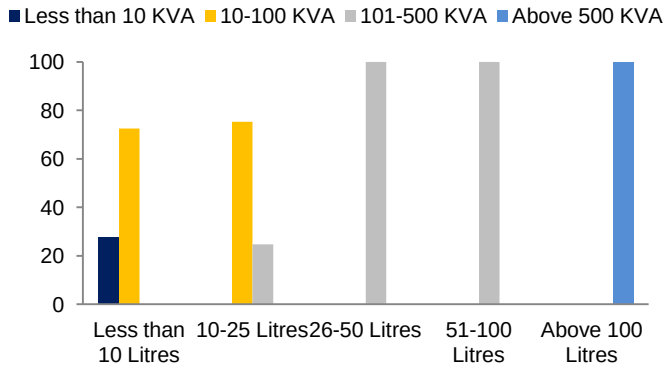


Figure 18: Distribution of Average Fuel Consumption (Litre/hour) by Type of Enterprise



The distribution of average fuel consumption by litre per hour shows the efficiency of the power back-up generators or facilities that are available. It shows that smaller companies majorly employ generators that consume less than 10 liters of fuel per hour. The distribution of average fuel consumption based on the capacity of generator shows that the generators consuming less than 10 litres per hour are primarily those with capacity in the lower range of the 10-100 KVA capacity range, with few being in the less than 10 KVA category. Consumption of more than 100 litres per hour, which forms 19 percent of the total sample, is predominantly constituted by large companies and is consumed by generators with capacity above 500 KVA. The other consumption categories of 10-25 litres and 51-100 litres per hour of fuel were predominantly constituted by medium companies and made up 23 percent and 18 percent of the total studied companies. The remaining 15 percent consumed 26-50 litres and majorly comprised of small companies. Generators with capacity 101-500 KVA were found to consume 26-100 litres fuel per hour and 10-25 litres per hour were consumed by generators with capacity between 10-100 KVA and in the lower range of 101-500 KVA. While the reasons for these numbers may vary, the reasons as understood by the study reveals that the higher consumption of fuel is a result of longer hours of operation and nothing else. The consumption of 100 litres per hour was by firms operating in sectors that are known to be energy dependant like cement, iron and steel and aluminium (and known to be large companies) and situated in states where power outages are frequent. In some states where the electricity supply is relatively better, the consumption is much lower. For example, a large number of small and medium enterprises (especially textile and apparel) are situated in Delhi (NCR), which is known to have a steady supply of electricity and thus the firms show a small consumption of fuel. Other sectors like IT enabled services in Karnataka, food processing in Maharashtra and trading units in Gujarat, all small or medium industries, located in states with little power shortages, support this analysis.

Figure 19: Distribution of Average Fuel Consumption (Litre/hour) based on Capacity of the Generator



It is thus evident that the industry in India is now heavily reliant on captive energy sources such as back-ups, generators and other measures needed to help mitigate the impact of power

shortages in government sources of electricity. As industry grows, consumption of electricity as well as normal requirement for each sector will continue to rise. Without additional capacity from government sources, power shortages and outages will keep rising requiring further need for captive sources to be used to maintain output maximization.

This chapter describes the current situation of the usage of power by the industry. It does not however show the impact power outages have on the industry functions. The subsequent chapter delves into understanding the impact given the current power situation in the country.

CHAPTER 4: IMPACTS

The main objective of the study has been to understand the impact of power outages on the Indian industry. An analysis of the shortfall or impact on production due to power cuts is thus paramount.

4.1 SHORTFALL

The survey revealed that firms generally do not suffer any shortfall in production due to the erratic power supply. This is because the firms have adapted themselves to the current power scenario so well that all that they suffer is cost escalation due to the use of power backups to support their production activity. However, it was considered important to ask the industrial groups about any shortfall that they might incur due to the intermittent power supply, in case they do not use power backups to support their operations. The results are as follows:

Figure 20: Distribution of Shortfall in Production (in percentage)

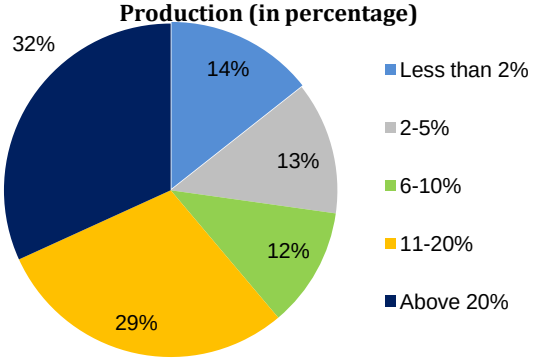
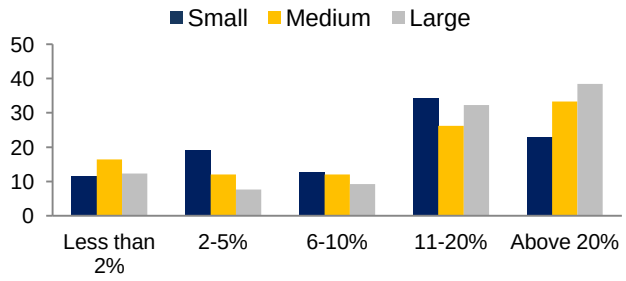


Figure 21: Distribution of Shortfall in Production (in percentage) by type of Enterprise



The survey revealed that 14 percent, majorly medium enterprises, suffer less than 2 percent shortfall in production. This was majorly constituted by firms from Maharashtra, Gujarat and Karnataka where majority of the firms faced power shortage for less than 1 hour a week. This category was majorly constituted by firms from textiles and apparels, diamond processing, automobiles and components, trading units and others. 32 percent of the firms suffered more than 20 percent production losses due to intermittent power supply. The majority of the companies that constituted this share were large companies, with some small and medium companies as well. Most of these companies operated in Tamil Nadu and Andhra Pradesh,

while a few operated in Madhya Pradesh and Odisha. The major sectors that constituted this category were the ones that had units in above mentioned regions. These were iron and steel, aluminium, fertilizer, cement, ceramics/glass, electronics and equipments, pulp & paper and others.

Table 12: Percentage Distribution of Shortfall in Production by Sector

Sector	Less than 2%	2-5%	6-10%	11-20%	Above 20%
Food & Beverage	9.09	9.09	27.27	36.36	18.18
Diamond Processing	33.33	33.33	0.00	0.00	33.33
Textile & Apparel	55.56	11.11	14.81	7.41	11.11
Telecom & Equipment	11.11	22.22	22.22	11.11	33.33
Ceramics/Glass	10.00	10.00	10.00	30.00	40.00
Iron and Steel	4.00	8.00	8.00	36.00	44.00
Aluminium	0.00	22.22	11.11	22.22	44.44
Fertilizer	0.00	0.00	16.67	33.33	50.00
Cement	0.00	0.00	20.00	20.00	60.00
Pulp & Paper	0.00	0.00	15.38	38.46	46.15
IT Enabled Services	8.00	8.00	20.00	24.00	40.00
Infrastructure & Capital Goods	19.23	3.85	3.85	30.77	42.31
Automobiles and Components	23.33	10.00	0.00	36.67	30.00
Hotels	6.67	40.00	26.67	20.00	6.67
Chemicals	17.65	29.41	23.53	29.41	0.00
Plastic/PVC	7.14	21.43	7.14	28.57	35.71
Electronics and Equipment	9.09	9.09	9.09	22.73	50.00
Trading Units	19.23	23.08	11.54	26.92	19.23
Hospitals	4.35	4.35	4.35	43.48	43.48
Other Service Industry	9.09	9.09	18.18	54.55	9.09

In Jharkhand, Madhya Pradesh, West Bengal and Odisha, the majority suffered production losses in the range of 11-20 percent. These were primarily small and large enterprises with only a few medium scale enterprises and constituted 29 percent. The major sectors that contributed to this range were automobiles and components, pulp and paper, hospitals and other service industry. In 6-10 percent range, more or less equal distribution of the type of companies existed, which formed a total of 12 percent of the sample. Losses of this range were majorly

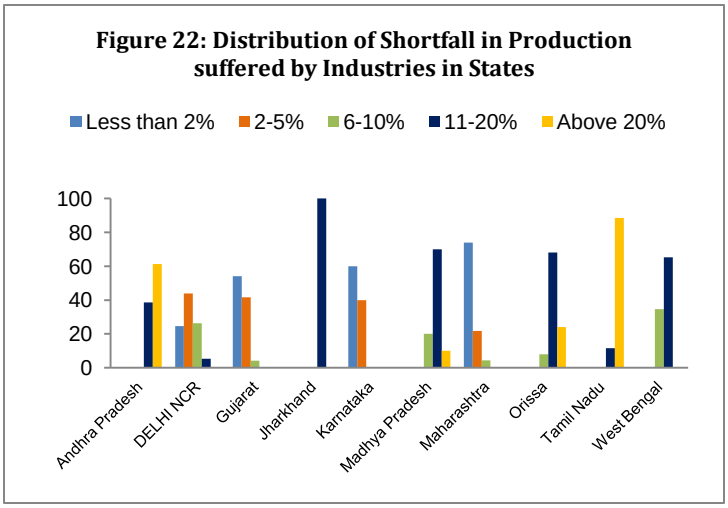
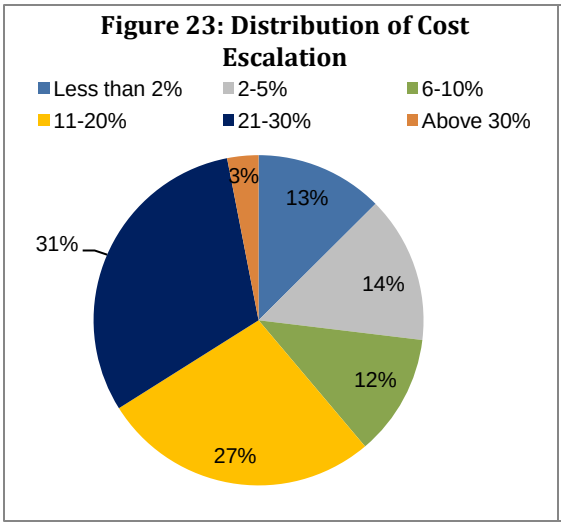


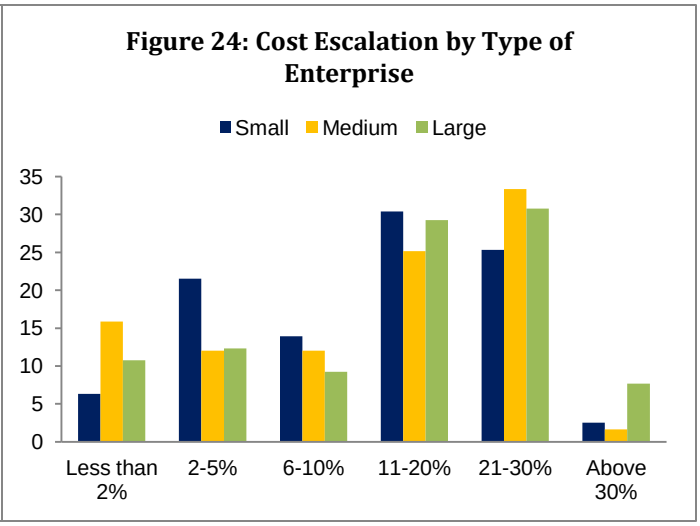
Figure 22: Distribution of Shortfall in Production suffered by Industries in States

suffered by companies having operations in Madhya Pradesh, Delhi NCR and West Bengal. The shortfall range 2-5 percent constituted 13 percent and was predominantly experienced by small firms and few medium and large firms of Delhi, Gujarat, Karnataka and Maharashtra. The major contributing sectors were diamond processing, chemicals, hotels and others.

As mentioned above, the firms do not really incur any shortfall in production and rely on power backups to support their production process, which ultimately leads to cost escalation as the cost of producing one unit of output using captive sources is higher than the cost of producing it using the government source of electricity.

4.2 Cost Escalation





The survey revealed that 13 percent of the companies, majorly medium enterprises; suffer less than 2 percent cost escalation due to erratic power supply. This was majorly constituted by firms from Maharashtra, Gujarat and Karnataka where majority of the firms faced power shortage for less than 1 hour a week. This category was majorly constituted by firms from textiles and apparels and diamond processing. 34 percent of the firms suffered more than 20 percent production losses due to intermittent power supply. The majority of the companies that constituted this share were large and medium companies, with a significant number of small

Table 13: Distribution of Cost Escalation by Sector

Sectors	Less than 2%	2-5%	6-10%	11-20%	21-30%	Above 30%
Food & Beverage	0.0	18.2	18.2	27.3	36.4	0.0
Diamond Processing	33.3	33.3	0.0	0.0	33.3	0.0

Textile & Apparel	48.1	14.8	7.4	14.8	14.8	0.0
Telecom & Equipment	11.1	33.3	11.1	11.1	33.3	0.0
Ceramics/Glass	20.0	20.0	10.0	10.0	30.0	10.0
Iron and Steel	8.0	0.0	0.0	8.0	76.0	8.0
Aluminium	0.0	11.1	22.2	22.2	33.3	11.1
Fertilizer	0.0	0.0	0.0	50.0	33.3	16.7
Cement	0.0	0.0	0.0	20.0	60.0	20.0
Pulp & Paper	0.0	0.0	15.4	30.8	53.8	0.0
IT Enabled Services	8.0	12.0	12.0	56.0	12.0	0.0
Infrastructure & Capital Goods	19.2	3.8	7.7	23.1	42.3	3.8
Automobiles and Components	10.0	16.7	13.3	33.3	26.7	0.0
Hotels	6.7	33.3	26.7	26.7	6.7	0.0
Chemicals	17.6	29.4	23.5	23.5	5.9	0.0
Plastic/PVC	7.1	14.3	21.4	21.4	28.6	7.1
Electronics and Equipment	4.5	13.6	9.1	22.7	40.9	9.1
Trading Units	11.5	26.9	15.4	30.8	15.4	0.0
Hospitals	9.1	18.2	9.1	36.4	27.3	0.0
Other Service Industry	8.7	4.3	8.7	43.5	34.8	0.0

companies as well. Most of these companies operated in Tamil Nadu and Andhra Pradesh, while a few operated in Madhya Pradesh and Odisha. The major sectors that constituted this category were the ones that had units in above mentioned regions. These were iron and steel, aluminium, fertilizer, cement, electronics, pulp and paper and others. In Jharkhand, Madhya Pradesh, West Bengal and Odisha, the majority suffered cost escalation in the range of 11-20 percent. These were primarily small and large enterprises with a significant number of medium scale enterprises as well and constituted 27 percent. The major sectors that contributed to this range were IT enabled services, fertilizers, service industry and others. In 6-10 percent range, more or less equal distribution of the type of companies existed, which formed a total of 12 percent of the sample. Losses of this range were majorly suffered by companies having operations in Madhya Pradesh, Delhi NCR and West Bengal.

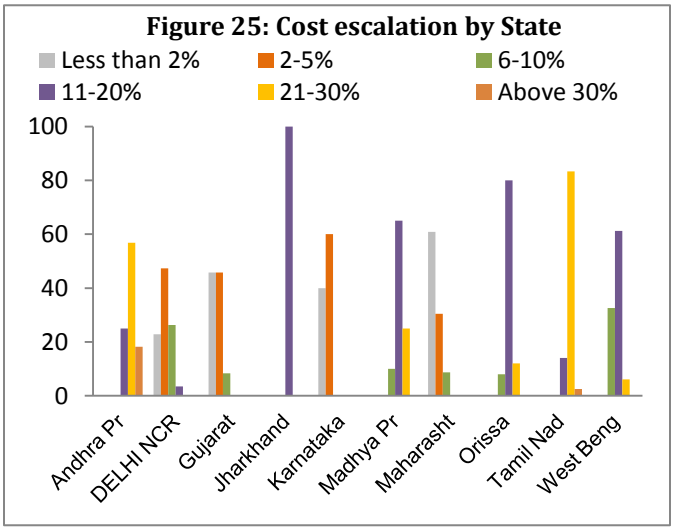


Figure 25: Cost escalation by State

The cost escalation range 2-5 percent constituted 14 percent and was predominantly experienced by small firms and an equal distribution of medium and large firms of Delhi,

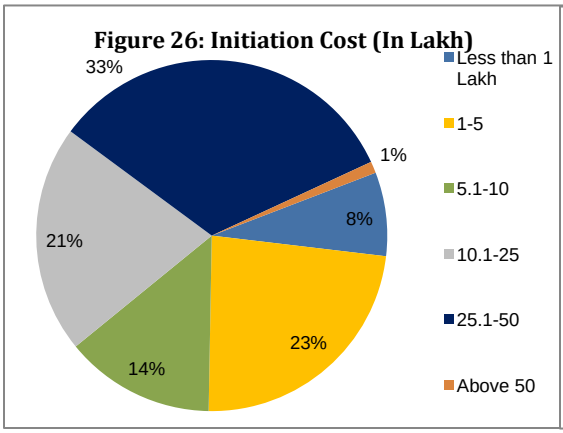
Gujarat, Karnataka and Maharashtra. The major contributing sectors were diamond processing, telecom and equipments, hotels and others.

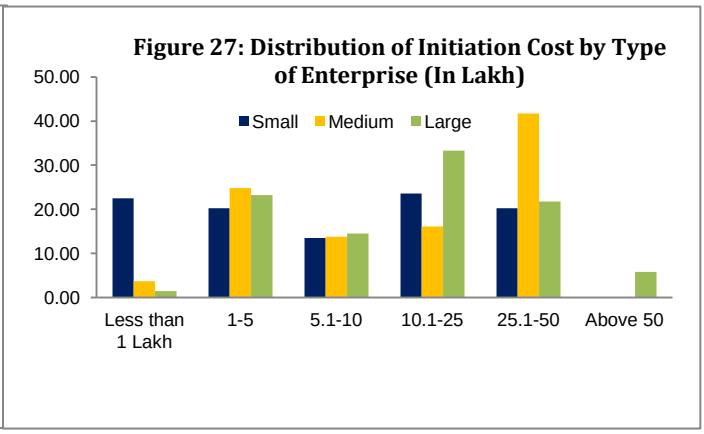
Thus, the firms suffer cost escalation due to their reliance on power backups to assure continuous production operations. The various factors that escalate their production cost are the initiation cost of the power back up facility and other variable expenses that are incurred on such mitigating facilities like average fuel consumption (rupees/hour), maintenance cost, and inventory cost etc.

4.3 Expenditure on Mitigating Facilities

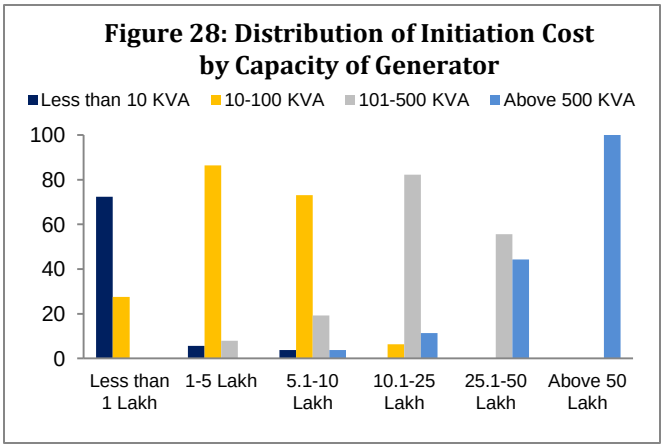
4.3.1 Initiation Cost

An interesting revelation showed that most companies, at almost 33% buy and install generators or power back-ups that cost between Rs 25-50 Lakhs. Of the 33% of total sample, the majority of the companies that prefer generators costing between Rs 25-50 Lakhs are



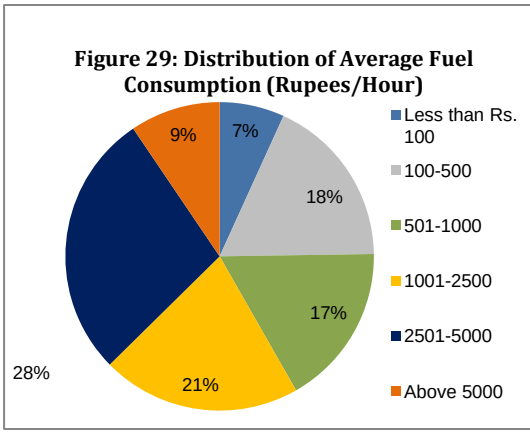


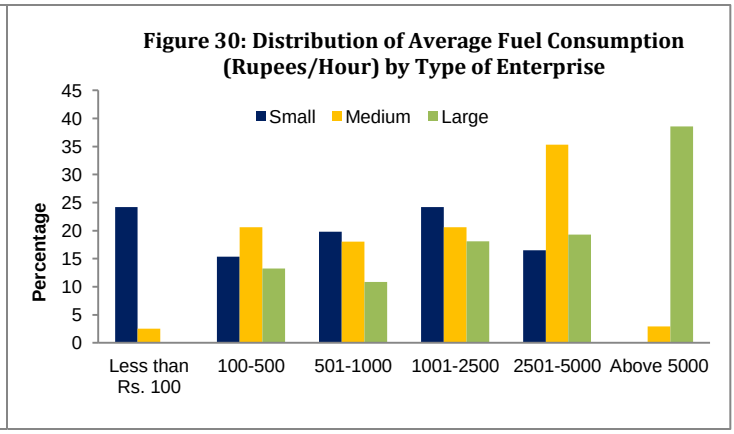
medium enterprises and the remaining share is equally divided between small and large companies. This range of expenditure is majorly incurred on generator capacity above 101 KVA. 1 percent, those too all-large companies buy generators costing more than Rs 50 Lakhs. This level of high expenditure is demanded by generators with capacity above 500 KVA. While only large companies buy power generators for more than Rs 50 Lakhs, the majority of large companies prefer the Rs 10-25 Lakhs generators, which is the cost primarily incurred on generators with capacity above 100 KVA. 21 percent of the sample falls in this price range preference. Given the smaller capital investment of small enterprises it is only right that most



small companies prefer generators that cost less than Rs 1 Lakh and primarily have a capacity of less than 10 KVA. Out of the 8 percent that prefer this price range the majority are small companies, that too by a fair margin. The enterprise distribution for the price range of Rs 1-5 Lakhs and 5-10 Lakhs, incurred majorly on generators with capacity 10-100 KVA, is relatively the same, though while 14 percent of all companies prefer the 5-10 Lakhs price, 23 percent prefer generators costing between Rs 1-5 Lakhs. It was interesting to see that even the generators with capacity between 101-500 KVA and above 500 KVA constituted a share, though small, of the generators requiring initiation cost between 1-5 and 5-10 Lakhs. This can be explained by the fact that some firms prefer to buy second hand generators to avoid spending huge sums on the initiation cost of the generators.

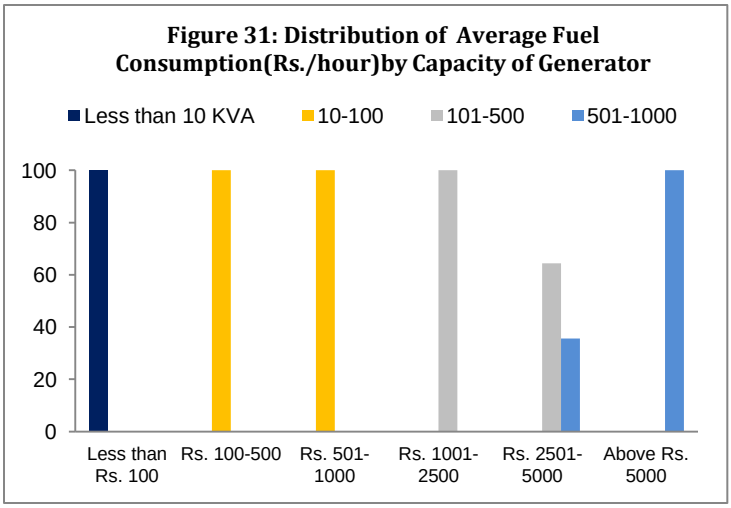
4.3.2 Average Fuel Consumption





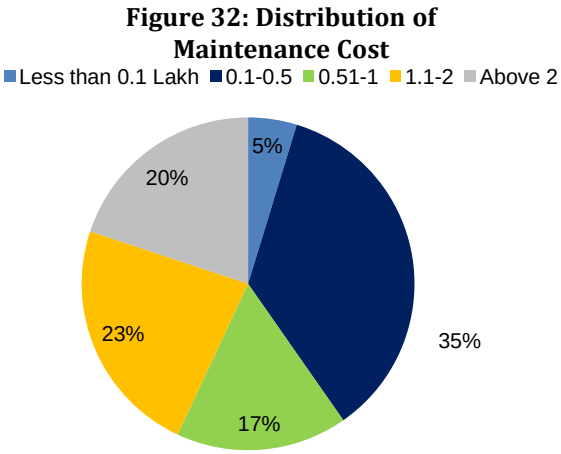
Average fuel consumption (rupees/hour) is a good indicator to gauge the cost incurred by companies in their efforts to mitigate their shortfalls in production by the use of power back-up facilities due to power shortages and cuts. The average fuel consumption (rupees/hour) depends upon the capacity of the generator that the firm is using.

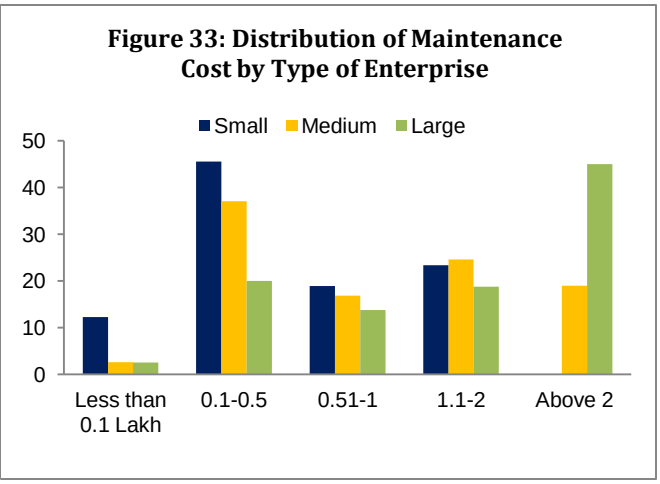
In this, it was observed that the majority of the firms (28%) spend an average of Rs 2501-5000 per hour. This share majorly consists of the medium particularly of the small enterprises and

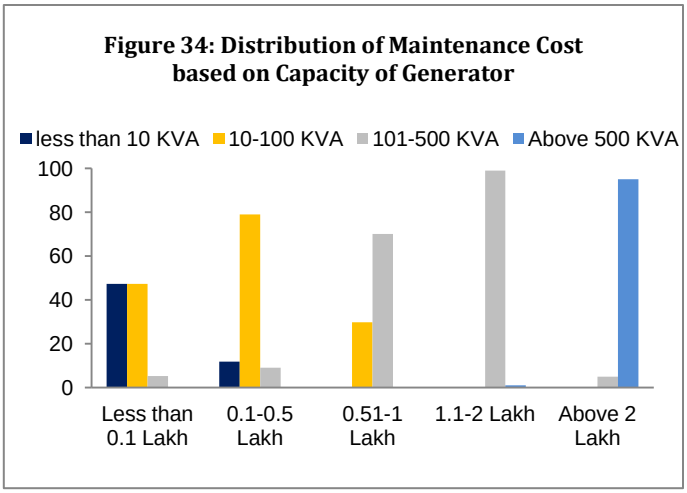


some medium enterprises and is incurred on generators with capacity less than 10 KVA and constitutes 7 percent. Rs 501-1000 and Rs 1001-2500 cost ranges, spent on 10-100 KVA and 101-500 KVA capacity generators respectively, are incurred by the companies of all sizes and17 percent and 21 percent of the total frame fall within these cost ranges respectively.

4.3.3 MAINTENANCE COST



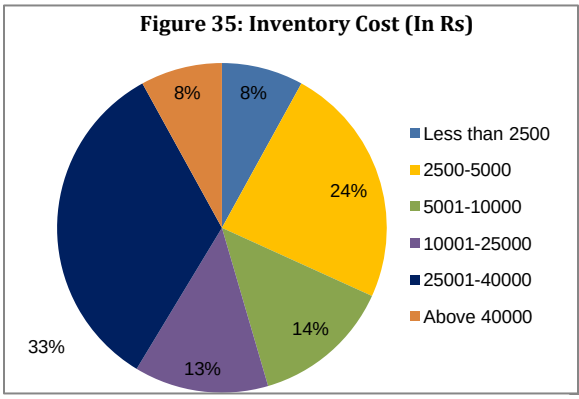


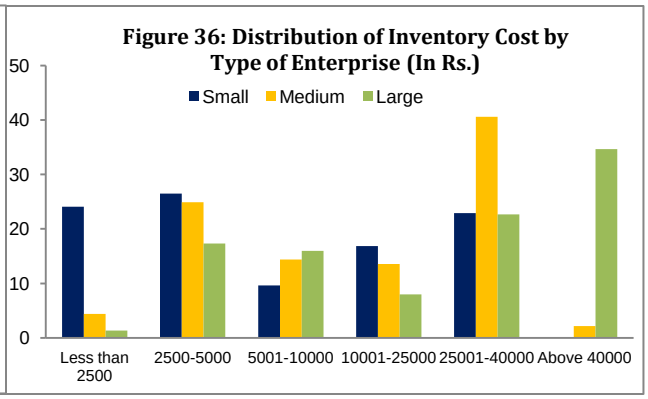


Maintenance cost is an additional expense to be incurred by the industrialists using generators as a means of generating electricity in case of power cuts. The survey revealed that only 5 percent of the surveyed firms had maintenance cost of less than Rs. 0.1 Lakh and was primarily constituted by small scale firms, with only a few medium and large sized firms. The majority, 35 percent, had generators with maintenance cost between Rs. 0.1-0.5 Lakhs and was

predominantly incurred by medium and small sized firms on generators with capacity less than 10 KVA and between 10-100 KVA. The majority of the large firms had Maintenance cost of above Rs. 2 Lakhs as they possessed large capacity generators of above 500 KVA. This category constituted 20 percent of the sample and was constituted by few medium firms as well. The remaining categories, 0.51-1 Lakh and 1.1-2 Lakhs, had more or less equal distribution of the size of firms and 17 and 23 percent of the total sample frame fall within these cost ranges respectively. The capacity wise distribution of the maintenance cost revealed that the maintenance cost between 0.51-1 Lakh and 1.1-2 Lakhs was incurred on generators with capacity 101-500 KVA and 10-100 KVA.

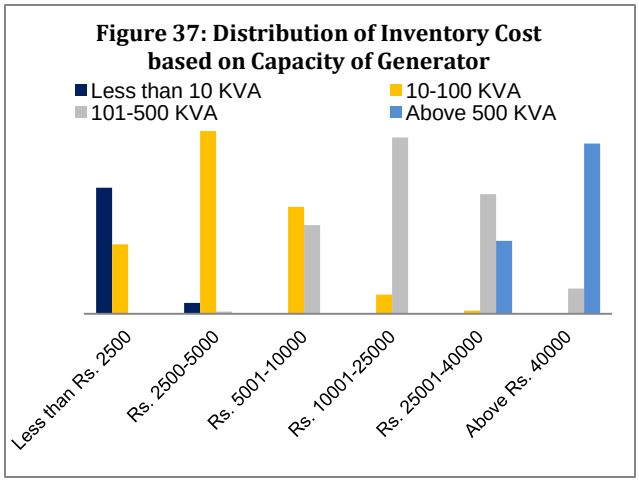
4.3.4 INVENTORY COST





In order to have power back-up and generator facilities ready for any power cut or shortage, companies across the board (i.e. in every category) need to have inventories of fuel available for the use of these machines and facilities. In studying this, it was noticed large companies tend to mainly keep inventories of fuel worth above Rs 40000. 8 percent of the total companies surveyed had inventories worth more than Rs 40000 for power back up. Medium sized companies on the other hand tend to keep inventories of fuel worth between Rs 25001-40000. In the same inventory value category, which constitutes 33% of the total sample, there is an even distribution among the small and large companies. As predicted, in the lower inventory value categories, which are less than Rs 2500 and Rs 2500-5000, which are the values of inventories for 8% and 24% of the sample respectively, small companies tend to fall within the categories, most notable in the lower of the two. The other inventory value ranges, Rs 5001-10000 and Rs 10001-25000, an almost equal distribution of types of companies exists and form 14 percent and 13 percent of the sample respectively. The decision to keep inventories depends upon the capacity of the generator and its average fuel consumption. The generators with

capacity above 500 KVA generally require fuel storage worth Rs. 25001-40000 and above. Inventory worth Rs. 5000 and above is primarily kept by firms with generators capacity between 101-500 KVA. Generators with capacity 10-100 KVA generally requires inventory worth less than Rs.2500 to up toRs.25000 while those with 10 KVA require less than Rs. 2500 or Rs.2500-5000 worth of inventory. This decision to invest in inventory can also be thought to be influenced by the level of power cuts experienced by firms, which depends upon the location in which the firms exist. Thus, if the firm exists in the states with frequent power cuts then it can be expected to keep large stock of fuel in buffer even if it holds a low capacity generator.

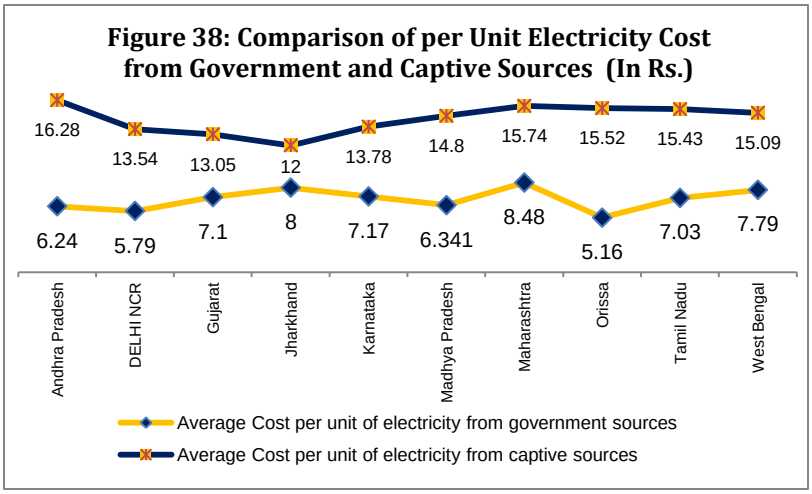


While average fuel consumption costs, maintenance costs and inventory costs are important in understanding part of the cost escalations as experiences by the industry, it is as necessary to understand the cost of using electricity from captive sources as compared to government sources. This not only shows the large disparity between the cost of procuring electricity from these two sources but more importantly the cost escalation industrial units are forced to undertake due to shortcomings of the power supply from government sources.

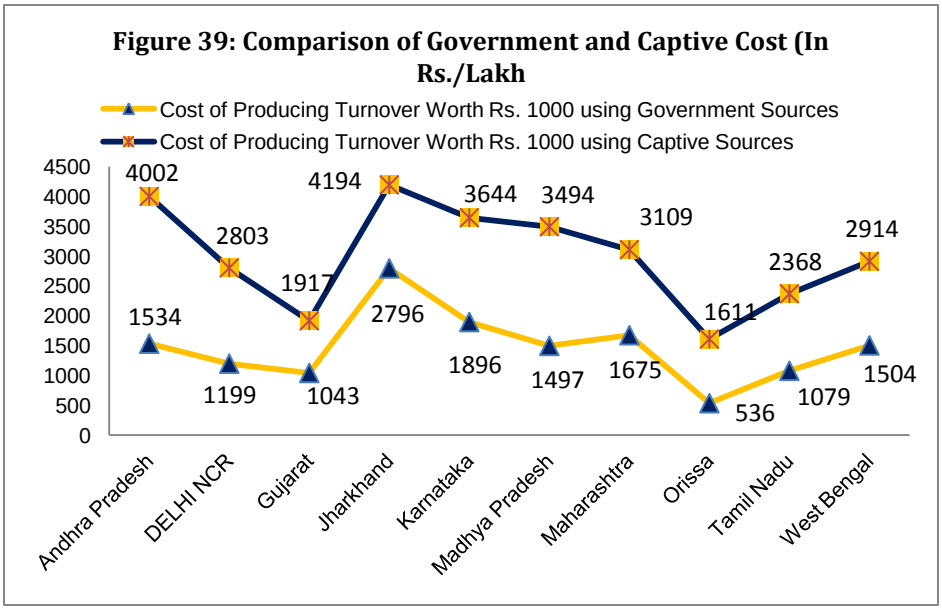
4.4 Comparison of Average Cost of Electricity from Government and Captive Sources

The study had previously discussed the average per unit cost of electricity from government sources and connected it to average monthly cost by state and sector. A further analysis compares this with the average cost per unit from captive sources. This is significantly important as it shows how much companies in their respective states have to spend additionally to Jharkhand, the cost per unit from captive sources is relatively lower, except for that in Maharashtra and West Bengal where cost per unit from government sources and from captive sources are toward higher portion of their respective Jharkhand, the cost per unit from captive sources is relatively lower, except for that in Maharashtra and West Bengal where cost per unit

from government sources and from captive ranges. Interesting, Andhra Pradesh and Madhya Pradesh, two states that boast a relatively cheaper cost per unit from government sources, the cost per unit from captive sources are relatively higher. Odisha too, which has the lowest cost per unit from government sources experiences high cost per unit from captive ones. Delhi NCR is the only exception to this pattern. It is the only state in which unit cost from both government sources and captive sources is on the lower part of the cost range for each source.



The comparison between per unit cost of electricity from government and power back up sources can be understood more clearly by comparing the costs of producing turnover worth Rs. 1 Thousand for various states and sectors. The graph reveals that the percentage difference in cost of obtaining electricity from government as compared to the cost of obtaining electricity from power back up utilities is lowest for Jharkhand and Gujarat. The highest percentage difference has been observed for Odisha, followed by Andhra Pradesh, Delhi and Madhya Pradesh. It just highlights the additional cost incurred by the industrialists to ensure continuous production activities.



The true impact of power shortages on the industry is gauged by the losses in revenue incurred by the firm during the phases of power outages.

4.5 Monetary Losses

Due to interrupted power supply, industrial groups suffer revenue losses. It must be noted, that losses in revenue are essentially due to costs incurred to mitigate any problems arising from power outages including use of power back-up facilities. The chart gives the revenue losses suffered due to unplanned longer power supply interruptions per day. As seen, most of the companies that lose less than Rs 1000 per day are the medium and small companies. Small companies mainly lose less than Rs. 1000 and between Rs 1000-5000 per day in revenues. Large companies, probably due to the size of production and thus cost of their operations tend to be dominant in the distribution of losses in all the higher categories from Rs 5001 to above Rs 40000 per day. In losses of between Rs 25001-40000 per day, there is more or less an equal distribution. It was interesting to see that even in the above Rs. 40000 category, more or less equal distribution of the small and large companies existed, showing that in some cases, even small and medium firms can incur losses at the same level as some large companies. These revenue losses depend upon the power scenario of the states in which the firms exist. If the firms exist in the states where power cuts are a regular phenomenon, the losses suffered will be more than the losses suffered those in the states with less frequent power cuts.

Figure 40: Distribution of Losses by Type of Enterprise (in Rupees per day)

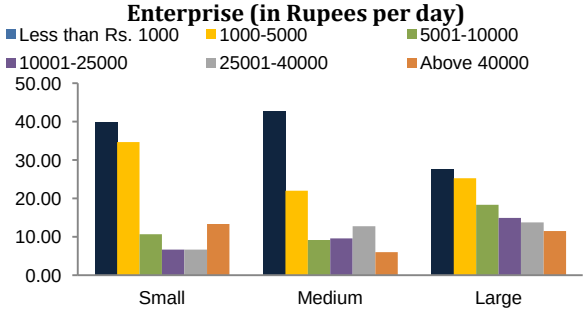
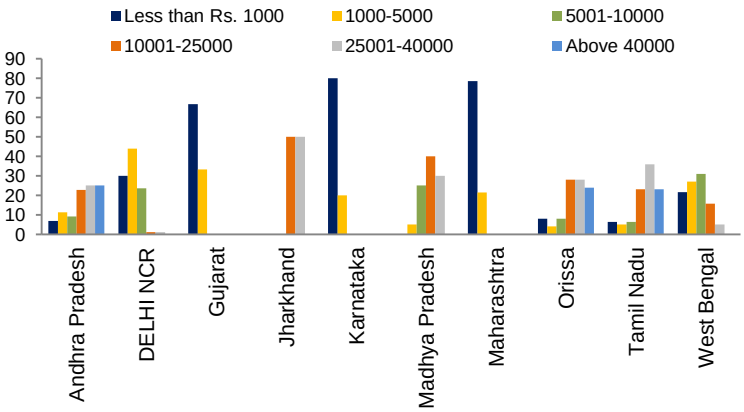


Figure 41: Distribution of Losses suffered in State (in Rupees per day)



This can be understood by a thorough analysis of the distribution of losses suffered in state. The analysis revealed that majority of the companies operating in Gujarat, Karnataka and Maharashtra incur losses less than Rs. 1000 per day while a few incur between Rs. 1000-5000 per day due to power cuts. This can be perhaps due to better power infrastructure, better generation capabilities and management or lack of power outages. In Jharkhand, industries lose between Rs. 10000-40000 per day while in Delhi; most firms lose between Rs. 1000-5000 per day with few losing less than Rs.1000 and between Rs.5001-10000 per day as well. In Madhya Pradesh and West Bengal, where majority of the companies face power cuts for 6-10 hours a week, companies lose revenue in each range of the spectrum. While some lose as low as Rs. 1000 per day, there are others that lose up to Rs 40000 per day. In Andhra Pradesh, Tamil Nadu and Odisha, which have been identified as the states with the worst power scenario, the majority suffer losses above Rs. 10000 per day. In these states, the losses incurred by the companies even go above Rs. 40000 per day.

According to the survey, planned power cuts exist in five states, namely, Karnataka, Maharashtra, Andhra Pradesh, Tamil Nadu and Odisha. In Karnataka and Maharshtra, no planned losses were observed as most firms during the survey revealed that if and when there was a planned power cut, it lasted for only 15-20 minutes and hence it was not difficult to avert losses due to those short lived planned power cuts. In the remaining three states, planned power cuts were much more frequent and hence it was difficult for them to escape losses due to

Figure 42: Distribution of Losses due to Planned Power Cut (in Rupees per day)

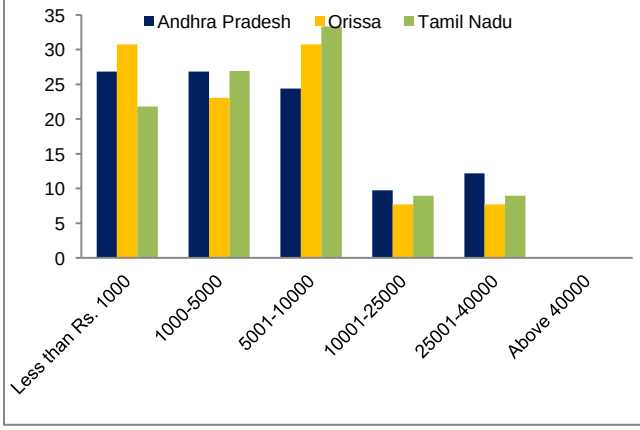
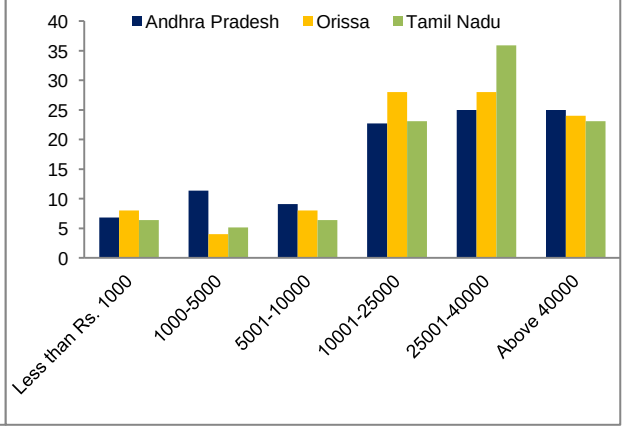


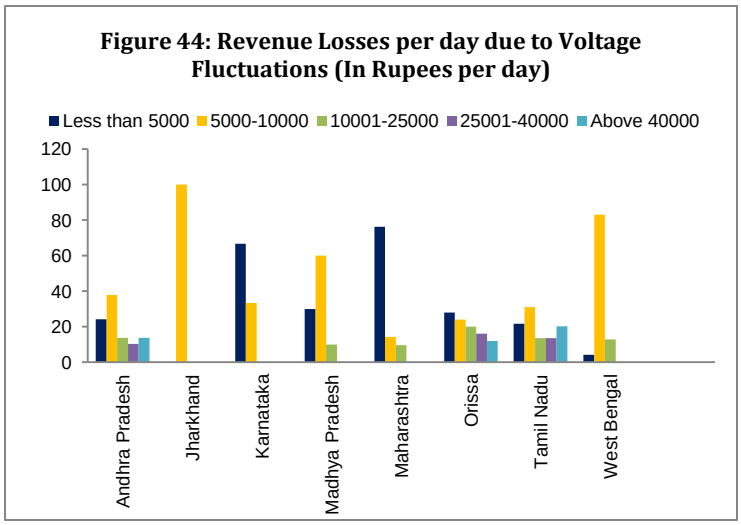
Figure 43: Distribution of Losses due to Unplanned Power Cut (in Rupees per day)



such power outages. Hence, in such states it was important to see how companies deal with unknown power outages or cuts as compared to ones they are prepared for and is there any difference in the losses incurred due to planned power cuts vis-a-vis unplanned power cuts. As

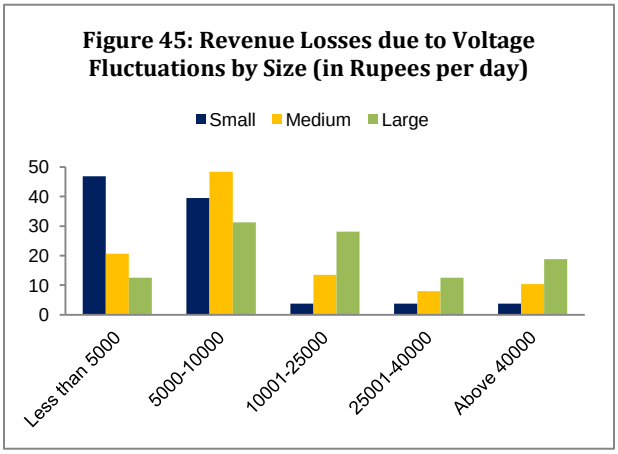
a result,a comparison of revenue losses due to planned and unplanned power cuts for Tamil Nadu, Andhra Pradesh and Odisha was made. As the charts show, while planned cuts tend to induce lower than Rs. 10000 losses per day for the majority, unplanned power cuts increase the losses suffered by the majority of the firms to between 10001-40000 per day, with a significant proportion suffering losses even above Rs. 40000 per day. Hence it can be inferred that planned power cuts are better as compared to unplanned power cuts as they give sufficient time to the industrial groups to plan their activities and minimise their losses.

Apart from losses due to planned and unplanned power cuts, industrial groups suffer revenue loses due to voltage fluctuations or erratic power supply as well. In order to have an insight on this category of losses, the firms were asked to reveal revenue losses due to voltage fluctuations (if any). It must be noted that these revenue losses are a combination of losses due to loss of raw materials and machinery damage (incurred due to voltage fluctuations) and the need to use upgraded technological gadgets, which add to their cost of production. It also includes revenue losses due to the use of power back-up facilities during voltage fluctuations. The charts illustrate the revenue losses suffered by state and various categories of enterprises due to voltage fluctuation.



It must be noted that Delhi NCR and Gujarat are not mentioned in the chart as power supply in these states seldom suffer from voltage fluctuations. Apart from theses states, all other states experience voltage fluctuations one day or the other. As per the graphs, voltage fluctuations can cause losses of revenue of up to Rs 40000 per day, especially for the larger corporations that employ heavier machinery. Voltage fluctuations cause the greatest losses in states like Tamil Nadu, Andhra Pradesh and Odisha, where the losses even go above Rs. 40000 per day. In Karnataka and Maharashtra, other cases, revenue losses remain between the range of less than Rs 5000 for the majority while a few suffer between Rs. 5000-10000 per day as well. Majority of the companies working in Madhya Pradesh and West Bengal estimate revenue

losses due to voltage fluctuations to range between Rs 5000 and Rs 10000 while a few estimate such losses to range between Rs. 10001-25000 per day. In Jharkhand, such losses range between Rs. 5000-10000 per day for all the companies.



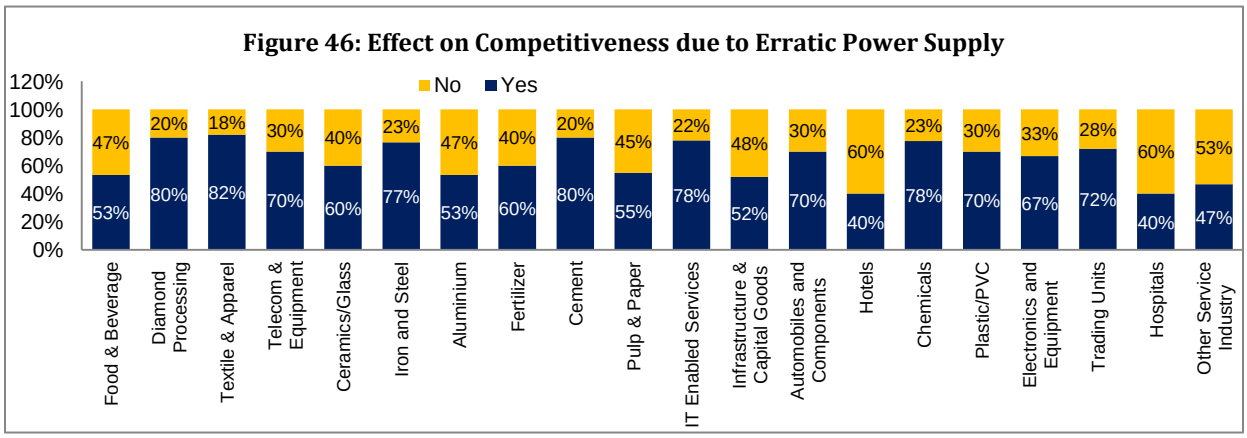
A further study by revenue losses due to voltage fluctuation by size reveals that small companies primarily report revenue losses of less than Rs 5000 per day as do, albeit a small proportion, large and medium sized companies. Majority of the small companies do not exceed losses of more than Rs 10000 per day due to the fluctuations. Most medium companies tend to lose between Rs 5000 and Rs 10000 per day due to voltage fluctuations, some companies as shown earlier do lose less than Rs 5000 but some lose between Rs 10001-25000 and above due to the same problem. Large companies can lose revenue in each range of the spectrum. While some may lose less than Rs 5000, there are others that lose upwards of Rs 25001 and even 40000.

Though it is important to simply understand the impact on production and revenue generation of the different sectors in the industry, it is also crucial for any study to investigate the effects of erratic supply or power losses on the competitiveness of the sectors. Impediments to competitiveness can potentially result in the stagnation or decline of industrial growth and all measures to keep sector competitive both in the domestic and especially in the international markets must be explored to protect the industry from losing its competitive edges.

4.6 Effects on Competitiveness

Erratic power supply is defined by a combination of successive and quick power cuts, low frequency or voltage and other factors that affect a steady supply of electricity. This, especially for companies that rely on uninterrupted and steady power supply is important as it plays with the competitiveness of the companies in the various sectors with their counterparts in other countries. The analysis revealed that 64 percent of the firms feel that erratic power supply affects their competitiveness in the domestic and international markets while 36 percent feel that

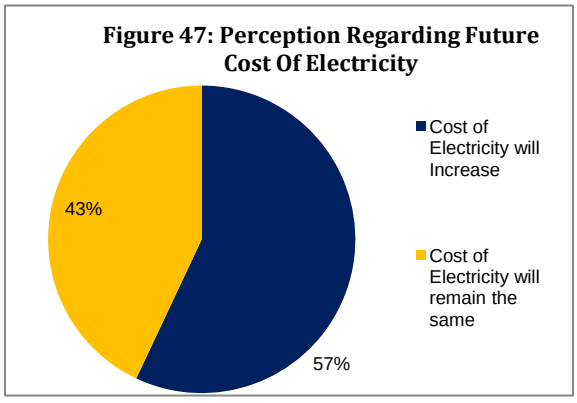
such erratic power supply has no effect on their competitiveness. Across the board, in all



sectors, more companies feel erratic power supply effects competitiveness most significantly in companies in diamond processing, cement, chemicals, textile and apparels, IT enabled services, iron and steel and trading units. Essential services like hospitals and luxury services like hotels do not feel that erratic supply affects their competitiveness as in hospitals patients will not and in most cases cannot leave hospitals and go to other institutions due to power cuts and in hotels, large back-up generators and systems do not let guests feel any inconvenience due to erratic supply. The only other sector to have a balances opinion, one where half felt that it affected competitiveness and half did not was paper and pulp.

4.7 View of Surveyed Firms on Cost of Electricity and Willingness to Pay

With a view to capture the expectation of firms regarding the future cost of electricity, the surveyed firms were asked about their perception regarding the cost of electricity in the next six months.



Most firms (57%) agree that cost of electricity will increase in the next six months while 43 percent believe that it will remain the same. No firm responded that cost of electricity will decline in the next six months.

Further, the analysis revealed that the impact on

the industry due to power cuts is negative. As a result, it was considered important to find out whether the industrial groups would be willing to pay higher tariff per unit of electricity in exchange for uninterrupted, reliable and quality power supply. The analysis revealed that 61 percent of the firms were willing to pay more for reliable and uninterrupted power supply while 39 percent were not willing to pay an additional amount for a reliable and quality access power supply. The table gives the state wise responses of the various categories of firms.

Table 14: View of Surveyed Firms on Willingness to Pay

States	Small		Medium		Large		Average percentage willing to pay more
	Willing to pay more	Not Willing to Pay More	Willing to pay more	Not Willing to Pay More	Willing to pay more	Not Willing to Pay More	
Andhra Pradesh	88%	12%	86%	14%	85%	15%	86%
Delhi NCR	75%	25%	84%	16%	89%	11%	83%
Gujarat	9%	91%	9%	91%	10%	90%	9%
Jharkhand	-	-	75%	25%	-	-	75%
Karnataka	12%	88%	24%	76%	-	-	18%
Madhya Pradesh	82%	18%	75%	25%	72%	28%	76%
Maharashtra	12%	88%	15%	85%	17%	83%	15%
Odisha	89%	11%	85%	15%	83%	17%	86%
Tamil Nadu	90%	10%	87%	13%	86%	14%	88%
West Bengal	71%	29%	75%	25%	-	-	73%

As illustrated above, in Andhra Pradesh, Tamil Nadu and Odisha, more than 85 percent of the firms were willing to pay an additional amount to avail an uninterrupted power supply. It must be noticed that in these states, the proportion of small scale firms that were willing to pay higher tariff per unit of electricity exceeded the proportion of medium and large scale firms. This trend could be attributed to the fact that the increase in cost of production, attributable to the carrying out of production activity using power back up facilities, can be considered to be relatively more for the small scale firms. This is because large firms, due to economies of scale and use of upgraded technology, optimized their level of electricity consumption, decreased their electricity consumption per unit of output and saved on electricity cost. In states like Maharashtra and Karnataka, where power shortage is not a major issue, only 15 and 18 percent (respectively) of the total firms were willing to pay more for uninterrupted power supply. In states like Jharkhand, Madhya Pradesh and West Bengal, where majority faced power shortage of less than 10 hours a week, more than 70 percent of the firms were willing to spend extra on government provided

electricity than power back up facilities. In Jharkhand and West Bengal, more medium scale firms were willing to pay extra for uninterrupted power supply while in Madhya Pradesh, more small scale firms constituted the share. 83 percent of the firms located in Delhi were willing to pay more. It must be noted that in Delhi, the majority of the firms faced power shortage of less than 5 hours a week but still a significant proportion of the firms were ready to pay more in exchange for a reliable and quality power supply. This could be attributed to the fact that Delhi had one of the lowest costs of per unit electricity and hence the industrial groups were not very apprehensive about paying an extra amount to ensure uninterrupted power supply for them. Gujarat had the lowest percentage of firms who were willing to pay an extra amount to ensure a reliable and quality access supply (9%). This could be due to the already existing or power efficient scenario in Gujarat.

CONCLUSION & FINDINGS

Through the study it is evident that the current power scenario of India is shackling India's growth story. The lack of affordable and quality power is impeding the potential that the Indian industry can achieve.

The study revealed a number of key issues with the current state of power. First, the installed capacity in the country is clearly lacking. The demand outweighs the supply and thus the country's industry as well as its general society is riddled by frequent power shortages.

Power shortages are most prominent in Andhra Pradesh, Tamil Nadu and Odisha, while Gujarat, Karnataka and Maharashtra have the least problems vis-à-vis power supply. The stark difference between the states is shown by the relatively larger impact power has on companies operating in AP, TN and Odisha as compared to the relatively minimal damage it has on companies operating in Gujarat, Karnataka or Maharashtra. In each of the major finds (which are explained below) it is clear that the system in place to manage, supply and distribute power is far better in these three states than in any other part of the country.

The impact on the micro level is a relatively obvious picture. The impact of the lack of quality and affordable power is proving difficult for the bulk of the industry made up largely by small and medium enterprises. Firms are facing cost escalation, losses in revenue, increased consumption of fuel, increased investment in captive facilities, higher inventory costs and loss in competitiveness and many other issues that are seriously detrimental to the health and stability of the Indian industry. A more detailed report on the key findings of this study and its analysis is provided below.

- Of the 650 companies interviewed, 67% were privately owned and 28% of companies were either private partnership or individual ownerships. Only 3% of the total sample was public sector or government run units and 2% were from the multinational corporation category.
- As per sector wise average monthly electricity consumption, approximately 36 percent of the firms consume 10001-50000 KWh monthly, 25 percent of firms consume between 100001-500000 KWh, 50001-100000 KWh per month is

consumed by 18 percent while 17 percent consume less than 10000 KWh. Only 4 percent show average monthly consumption of above 500000 KWh. This depended upon the size of the firms and the degree to which their production process relied on electricity.

- To maximize output and production, 39 percent of companies require 10001-50000 KWh monthly, 26 percent require 100001-500000 KWh and 6 percent require above 500000 KWh. Only 11 percent of companies mainly in the ceramics/glass sector require less than 10000 KWh per month. The remaining 18 percent require 50001-100000 monthly. This was again determined by their scale and intensity of operations.
- Average cost of electricity from the government sources in the country ranges between Rs 5 to Rs 8.50. Odisha and Delhi show lowest prices of electricity per unit, while Maharashtra, Jharkhand and West Bengal are the higher prices in the range.
- Majority of the firms (54%) spend Rs. 1.01-10 Lakhs on their monthly electricity consumption. Only 12 percent of the firms incur monthly electricity cost of above Rs. 25 lakhs while 22 percent spend less than Rs. 1 Lakh a month. The remaining share (12 percent) of the sample frame spends Rs. 10.01-25 Lakhs per month on electricity consumption.
- The results reveal that approximately 37 percent of firms, mainly in Gujarat, Maharashtra and Karnataka face less than 1 hour of power shortage in a week and at the same time 5 percent suffer 21-30 hours per week and 21 percent suffer more than 30 hours per week (primarily in Tamil Nadu and Andhra Pradesh). Further, it was also found that 16 percent face 6-10 hours per week, while 15 percent face between 1-5 hours weekly. This in itself gives a brief idea of the impact of the current power scenario in India and on the Indian industry. By this finding it is evident that no segment of the industry pan-India is safe from negative impact due to power losses and power outages.
- The survey revealed 54% of companies were aware in advance of the load-shedding schedule. While more than half of the companies are aware and the information is available, the awareness of load-shedding should be far more widespread. Within the 46%, the majority of companies that did not know the schedule were from particular states. This implies that the information though available is not as uniformly available as it should be and that stakeholders in certain states are hence unprepared for power cuts, increasing the negative impact of power outages on their

operations. A centralized information channel must be set up, such that the entire Indian industry, not just companies in a few states have the knowledge and information of schedules on planned power cuts or load-shedding.

- It was found that 38.83 percent firms have an installed captive facility in the 101-500 KVA category and 34.95 percent of the sample frame employs generators with capacity ranging between 10-100 KVA. Above 500 KVA capacity generators are mainly employed by 19.42 percent companies and only 6.8 percent companies employ generators with less than 10 KVA power generations. As Indian industry expands its demand on power increases. The finding above shows that as their demand has increased and the inability of the current power scenario to provide an uninterrupted supply of power, companies are increasingly investing in large captive facilities that not only act as substitutes to central power supply but also allow companies to satisfy their increasing demands on electricity or power.
- The age distribution of the generators held by the surveyed firms stated that 54% had generators which were less than 5 years old, followed by 43 percent who had 5-15 years old generators and only 3 percent had generators above 15 years old. The implication of this finding is simply that companies are willing to invest large amount of money (as is the cost of generators) in efforts to continuously upgrade their captive facility technology. If the government can harness this willingness to spend or invest by involving private companies in improving its own sources at a lower prices than at which generators are bought, companies would likely be willing to make such investments as the improvement will directly impact the companies' revenues.
- The average fuel consumption distribution revealed that 25 percent of the total sample frame use generators which consume less than 10 litres an hour and 19 percent rely on generators that consume more than 100 litres per hour. The other consumption categories of 10-25 litres and 51-100 litres per hour of fuel were constituted by 23 percent and 18 percent of the total studied companies. The remaining 15 percent consumed 26-50 litres per hour.
- Assuming that the firms do not rely on power back up units to ensure continuous production activity, 61 percent of the firms suffer above 10 percent production losses due to power cuts. 13 percent suffer 2-5 percent shortfall in production, 12 percent suffer 6-10 percent and only 14 percent, mainly in Gujarat, Karnataka and Maharashtra, suffer less than 2 percent production losses. As revealed throughout

the study, the three states mentioned above have consistently shown dampened negative impacts of power outages on companies operating within them. 10% production losses is no small figure, especially for the bulk of the countries industries that operate as small or medium enterprises. It is imperative thus the future studies be carried out that will explain in thorough detail on why the three states are better off in their electricity production and supply, which can then, by policy change, be applied to the other regions of the country reducing the number of companies that suffer more than 10% production losses due to the shortage in power, in case they do not use power backups to support their operations.

- Another clear indicator of the impact of power outages on the Indian industry is the cost escalation that companies face due to the intermittent power cuts faced in the country. To evade shortfall in production, companies use power back up units, which ultimately increase their cost of production/operations. Increases in costs lead to lower profits which tend to be the main reason for companies to shut down operations or limit production, thus decreasing the industrial productivity. In this regard, the study observed that 61 percent of the firms suffer above 10 percent cost escalation due to power cuts. The highest cost escalation was observed in Andhra Pradesh, Tamil Nadu and Odisha where cost escalation even extended beyond 30 percent for few firms. Only 13 percent, mainly in Gujarat, Karnataka and Maharashtra, suffer less than 2 percent cost escalation. The other cost escalation categories of 2-5 percent and 6-10 percent were constituted by 14 percent and 12 percent of the total studied companies.
- 33 percent of the surveyed firms had generators with price between Rs. 25.1-50 Lakhs and was majorly constituted by medium sized firms. Only 1percent, primarily large sized firms, had generators with price above Rs. 50 Lakhs. Generators with cost less than Rs. 1 Lakh were held by 8 percent of the firms, while those with initiation cost between Rs. 1-5 Lakhs were held by 23 percent of the firms. 35 percent of the total sample frame owned generators with initiation cost between Rs 5.1-25 Lakh. The initiation cost also varies with the capacity of the generator.
- The analysis of average fuel consumption (rupees/hour) revealed that a total of 18 percent of the entire sample pay Rs 100-500 per hour while 28 percent pay an average cost of Rs 2501-5000 per hour. Rs 501-1000 and Rs 1001-2500 cost ranges are incurred by the companies of all sizes and 17 percent and 21 percent of the total frame fall within these cost ranges respectively. The cost of above Rs 5000

per liter of fuel is mainly only paid by large companies and make up 9 percent of the total sample. With 28 percent of companies paying up to Rs 5000 per hour for fuel consumption, in a situation like the two-day power blackout that affected the north, a single company, operating for 12 hours a day, paid close to Rs 60000-Rs 120000 in two days alone. The cost of fuel is high for general purposes as is but for firms, especially small and medium enterprises, spending Rs 5000 per hour, to substitute for the lack of power, can be potentially bankrupting. The government thus needs to study the possibilities in providing subsidies or fuel at lower costs for use in captive facilities such that stability of the industry can be maintained.

- Only 5 percent of the surveyed firms had maintenance cost of less than Rs. 0.1 Lakh while 20 percent of the total sample frame had maintenance cost above Rs. 2 Lakh. The majority, 35 percent, had generators with maintenance cost between Rs. 0.1-0.5 Lakhs. The remaining categories, 0.51-1 Lakh and 1.1-2 Lakhs, constituted 17 and 23 percent of the total sample frame respectively.
- 8 percent of the companies, mainly large ones, had inventory cost of more than Rs. 40000. Inventory cost between Rs. 25001-40000 were spent by 33 percent of the total sample and was majorly constituted by medium sized firms. Inventory cost below Rs. 5000 made up 32 percent of the entire sample and was majorly constituted by small sized firms. The other inventory value ranges, Rs 5001-10000 and Rs 10001-25000, an almost equal distribution of types of companies exists and form 14 percent and 13 percent of the sample respectively.
- The cost of electricity from captive sources range between Rs. 12-16. In Gujarat and Jharkhand, the cost per unit from captive sources is relatively lower while for Andhra Pradesh, Maharashtra, Odisha and Tamil Nadu, it is relatively higher.
- The study revealed that a spectrum exists in terms of states and the power scenarios within them. On the bottom, throughout the study, firms in Andhra Pradesh, Odisha and Tamil Nadu have revealed the highest impacts due to the states power supply situation. On the other hand, states like Gujarat, Karnataka and Maharashtra have continuously shown the least impact on companies operating within these states. The one indicator that proves this point the best is the amount of losses that companies incur due to power outages. As observed, the revenue losses due to power cut range between less than Rs. 1000 to above Rs 40000. Even small and medium firms incur losses above Rs. 40000, mainly in the poorer performing states. In states like Gujarat, Karnataka and Maharashtra, the majority lose less

than Rs. 1000 implying that if the power scenario in the other states is made to mimic the scenarios in these three states, revenue losses can be brought down to as low as Rs 1000.

- The comparison of losses due to planned and unplanned power cuts for states like Andhra Pradesh, Tamil Nadu and Odisha revealed that losses due to planned power cuts were much lower as compared to losses due to unplanned power cuts. While the majority incurred less than Rs. 10000 losses due to planned power cuts, unplanned power cuts increased the losses to above Rs. 10000 for majority and above Rs. 40000 for some.
- Losses due to voltage fluctuations were as low as Rs. 1000 for states like Karnataka and Maharashtra and as high as Rs. 40000 for Andhra Pradesh, Tamil Nadu and Odisha. In Gujarat and Delhi NCR, no voltage fluctuations were observed.
- 64 percent of the firms feel that erratic power supply affects their competitiveness in the international and domestic markets while 36 percent feel that such erratic power supply has no effect on their competitiveness. Sectors found to be more affected were diamond processing, textile and apparels, IT enabled services, trading units etc. The least affected sectors were hospitals, hotels and other service industry. The international market provides a great business destination for Indian companies, helping not only themselves but the economy as a whole. If the competition in these international markets can produce at both a continuous output as well at a cheaper price, the Indian firms, bogged down by the power supply, which results in production losses and cost escalations will lose out in these highly lucrative international markets. Almost two-thirds of the firms in the Indian industry feel that because of the power shortage and intermittent supply, they are losing to their international competitors and thus losing their previously captured international markets. Not only does this limit future expansion as companies remain wary of not being able to compete, the Indian economy which depends highly on firms trading in the international markets is affected as well.
- As measures to manage operations during power cuts, highest mean ranking was secured by immediately running power back ups, followed by switching off air conditioner and using green technology in office. 40 percent of the firms immediately run power back up as and when the power goes off followed by 28 percent who immediately switch off Air conditioner and 20 percent who use green technology sources for power in case of power cuts.

- As per survey findings, 57 percent of the firms are of the view that cost of electricity will increase in the next six months while 43 percent believe that it will remain the same.
- It was also revealed that 61 percent of the firms were willing to pay more for reliable and uninterrupted power supply while 39 percent were not willing to pay an additional amount for a reliable and quality access power supply. As per state wise analysis that in Andhra Pradesh, Tamil Nadu and Odisha more than 85 percent of the firms were willing to pay an additional amount to avail an uninterrupted power supply. In Jharkhand, Madhya Pradesh and West Bengal, more than 70 percent of the firms were willing to pay an extra amount for quality power supply, while in Gujarat; only 9 percent were willing to do so. There is a clear indication by the firms surveyed that most are willing to pay extra if they were assured enhanced electricity or power supply. It was observed during conversations with the firms that price increases of electricity can nearly match the price of new generators if it can be assured that the supply of power would be enhanced and interruptions and outages would be minimized. This is the clearest policy recommendation as taken from the perspective of the industry, inviting the government to take steps to improve the current situation and operationalise open access with clear indication of support from India Inc.

POLICY RECOMMENDATIONS

Steps and measures must be undertaken to reduce the impact of the present power shortage on the industry and industrial production. These steps should include measures not only on to dampen the impact of power losses on production and revenue generation but also encompass cost reductions, subsidizing or tax relief for new and alternate technologies in power generation, better management of current the current power supply and stricter guidelines and fines for wastage, theft and losses in transmission.

Additionally, further studies need to be conducted to understand the needs of the industry both as a whole and by specific sectors. This will help the policy makers understand the demands on the industry of power and electricity supply and give them opportunity to solve the gaps and shortcomings of the current power generation situations.

A detailed list of policy recommendation or suggestions is provided below:

- Increase capacity of installed sources- this step is the most obvious measure. There is a clear shortage in terms of generation and thus is not being able to meet the growing demand from the expanding Indian industry. In this regard, exploration should be initiated to develop the generation capacity of existing power plants. Development of additional power plants must also be started.
- Ensuring communication to Load Despatch Centres from various transmission elements and generating stations and an extensive review and audit of the Protection Systems, suggested by the Ministry of Power, would be a good step towards strengthening the power sector.
- To cater to the growing power demand, implementation of smart grid is the only way forward. Further, a process to curb over drawing of power must be set in place.
- The Electricity Act had mandated the grant of open access option to the consumers, which will allow all the bulk consumers to choose their distributors. However, it has not yet been operationalised. It should be operationalised.
- Use of alternate sources of power generation must be encouraged. The development, installation and management of alternate sources like Nuclear, Wind, Hydro and Solar should be streamlined.

- Create industrial co-operatives that can source electricity or have a dedicated captive generation source. Any additional capacity that is not being used by the members of the co-operative can be sold on the market (Pune Model)
- Encourage industry usage of alternate sources of power in place of conventional methods of back-up power. Provide companies opting to use alternative sources of energy with tax exemptions and subsidize as to make the transition and shift to these sources easier on costs to the company.
- Require different types of industrial units to post requirements of electricity. Impose stricter fines and higher penalties if a company with the poster normal requirements exceeds that load. This will help negate wastage and inefficient use of the supplied electricity, forcing companies to only use what they need and nothing more.
- Investment in technology that will reduce transmission losses. This includes scheduled maintenance of transmission lines and power plants. Privatization of the installation, management and maintenance of these power lines can help relieve the government of some financial and manpower burdens.
- Clear and public information as well as awareness programs on scheduled load shedding or scheduled power cuts should be provided so industry can prepare or plan for loss of power in advance
- Provide schemes like Technology Up gradation Fund Scheme (TUFS) like that in textile for small and medium companies switching to cleaner, greener and more efficient machines for their production.
- Stricter laws and penalties for the theft and unsanctioned use of electricity.
- Incentivize 'green' architecture or building such that conventional energy usage can be minimized to its lowest possible amount.
- Awareness and education programs on green technology that is energy efficient, ways, means and benefits of efficient use and other such workshops to help industry owners understand the need and consequentially the benefits in energy efficiency.
- An in-depth study on the normal requirements of different sectors in the country. This will help the government indentify various sectors through a power consumption and requirement perspective. For example, IT enabled services may not require 24/7 operations as compared to aluminium or hotels. By this, policy makers will be able to gain a deeper and more thorough understanding of the requirements of each sector, helping issues like capacity increments, restructuring the loan, tax and subsidy schemes and creating solutions as per sector needs rather than industry as a whole.

WORKS CITED

1. Can R. Stephane, McNeil Michael and Sathaye Jayant. *India Energy Outlook: End Use Demand in India to 2020,* Ernest Orlando Lawrence Berkeley National Laboratory, January 2009
2. *India Energy Book 2012*, World Energy Council
3. *India Power Supply Position 2010*, Working Paper No. 1, Center for Study of Science, Technology and Policy (CSTEP), August 30, 2010
4. Nag, Tirthankar. *Captive Generation in India the Dilemma of Dualism*
5. *The Potential for Renewable Energy in India-2012*, Gyan Research and Analytics Pvt. Ltd, 2012
6. *Energy Statistics 2012,* Central Statistics Office, Ministry of Statistics and Programme Implementation, Government of India, New Delhi.
7. *Financial Issues in Power Sector Financing*, Working Group on Power for 12th Plan
8. *Load Generation Balance Report.* Central Electricity Authority, Ministry of Power, Government of India
9. *Report of the Enquiry Committee on Grid Disturbance in Northern Region on 30th July 2012 and in Northern, Eastern and North-Eastern Region on 31st July 2012,* Government of India, Ministry of Power, August 2012
10. *Report of the Working Group on Power for Twelfth Plan (2012-17),* Government of India, Ministry of Power, January 2012
11. *India Per Capita Power Consumption State Wise,* KSEB Officers' Association, 16 August, 2011
12. J.P. Chalasani, "India needs mix of green & traditional power sources." The Economic Times 5 June 2012.
13. Manjiri Damle, "Shortage of Coal Causes Concern for Power Sector". The Times of India, 25 July 2011.
14. Mohammad, Noor. "Bhutan Likely to Cut Power Export to India." *The Financial Express 16 April 2012,New Delhi*
15. S K Chand, "The Blame Game on Coal Shortage". The Financial Express, 7 June 2011

16. *Powering India: The Road to 2017,* McKinsey & Company
17. *Energy Risks-The Dangers of Power Cuts and Blackouts.* <http://www.agcs.allianz.com/insights/expert-risk-articles/energy-risks/>
18. *Indian Energy Sector: An Overview,* India Energy Portal.<http://www.indiaenergyportal.org/overview_detail.php>
19. *INDIA – Power Sector: Emerging Developments & Critical issues.* <http://www.ersaf.com/pdf/INDIA%20_Power_Sector.pdf>
20. *India's Renewable Energy Sector – Potential and Investment Opportunities.*<http://direc2010.gov.in/pdf/India's-RE-Sector-Potential-and-Investment-opportunites-SSM.pdf>
21. Joshi, Atul. *Short Essay on Frequent Power Cuts in India.* <http://www.preservearticles.com/201106027430/short-essay-on-frequent-power-cuts-in-india.html>
22. *Power in India, Overseas Indian Facilitation Centre, Oct. 30 2012.* <http://www.kpmg.de/docs/PowerSector_2010.pdf>

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