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IMPACT OF ENERGY CRISIS ON INDUSTRIES OF PAKISTAN: A CASE OF KHYBER-PAKHTUNKHWA INDUSTRIES

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Abstract: *Electricity energy crisis croppoed up in 2009 due to widening gap in demand and supply of power in Pakistan due to declining production and increasing demand resulting from growing population and economic activities. Resultantly the industrial poduction is worsely affected due to frequent power supply shortage which is still a serious challenge to development economists and power suppliers. Also adversly affected quality of production of industries which operate on delicate material. This study examines and quantifies the socio-economic impact of electricity outages in the "Hayatabad Industrial Estate" Peshawar, Pakistan. In order to identify multi-dimentional impact experienced by industries i.e. extra cost of energy generation including maintenance cost of additional power generating equipments, inevitable extra shift/ hours engagement, for production and sales, target acheivements etc an intensive study was made by collecting data through face to face interview. Data was collected through personally administered questionnaire for the analysis of the study. A cluster that is "Hayatabad Industrial Estate" was selected as it is one of the large and old industrial estate of KPK. This study encompasses 374 companies of Hayatabad Industrial Estate Peshawar, Pakistan as a sample representing all industries of the Khyber Pakhtunkhwa. Total cost of electricty outages is considered to be the sum of direct and indirect cost. The paper suggests that as an urgent measure the existing installed capacity be enhanced by upgrading the power production equipments. Immediate measures be taken to minimse silt deposition in all the three dames by silt clearing. To save energy from wastage illegal connection and stealing be checked through stern action by the state authorities. In the mean time solar energy system be encouraged by subsidisng the solar systems particularly for industrial installation.*

Keywords: *Energy Outages, Direct Cost, Indirect Cost, Maintenance Cost, Overtime Premium Cost, Additional Shifts Cost*

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Introduction

Pakistan is generously blessed with natural resources. Numerous water falls in the hilly tracts flowing to rivers offer good opportunities of hydel power generation. The feasible projects like Basha Dam, Kalabagh Dam, Mohmand Dam and many other local power generating sites have ample water sources to be taped and electricity to be generated. It is by irony of fate that with huge coal mines in Thar-parker and introduction of solar energy system, our existing industrial units could not be commissioned to full capacity merely because of power shortage. The exploitation of water resources alone could meet maximum requirements of industries. Generating power from coal could add to the existing supply at cost much lower than that supplied by Independent Power Producers. The shortage of energy and consequent impact on industrial production which again directly adversely affects the Govt. exchequer has been a serious problem to have been tackled much earlier. On account of non-availability of sufficient energy supply, the industries had to resort to alternative sources which added to their variable cost. The extra expense incurred by the industries due to power shortage added to cost and hence a loss to the industries and economy as well. This research is conducted to identify the impact of powers outages on industries and subsequently suggest the remedies to overcome the problem. The objective of this study is outages cost estimation and to find out financial impact of power shortage. The results of the study will provide guidelines to policy maker and help in decision making for future power production and supply distribution. Energy being one of the indispensable factors of production has revealed a continuous increase with the passage of time due to increasing industrialization and rapid growth of population. Following table shows details of electricity generation in different periods across the world. According to a World Bank Enterprise Survey Report carrying data on 135 countries across the world for the period from 2009 to 2015, revealed it was due to energy shortfall that their industrial production fell down by 4.7%.With the objective to encourage the use of renewable energy, a number of agreements were signed of which EU 2009 Renewable Energy Directives and National Energy Action Plans worth mentioning. It is believed that it reduce pollution which emerges as a result of usage of coal, oil etc(World Energy Council, 2016).

Table 1: Electricity Generation World Wide in Different Periods

#	Period	Generation (TWh)
1	2008	20433.3
2	2009	20269.3
3	2010	21574.3
4	2011	22258.7
5	2012	22807.8
6	2013	23449.8
7	2014	23914.6
8	2015	24286.9
9	2016	24956.9
10	2017	25676.6

Energy shortfall is one of the serious issues confronted by Pakistan. One of the main issues faced by Pakistan is the consistently increasing demand for electricity and depletion in existing capacity of power production. Existing resources are either insufficient to meet the demand, beside that available resources are further depleting (G. D. Valasai et al., 2017). In June 2016 electricity shortfall was found around 5,000MW. Meeting the demand of population, the production process is to be inevitably accelerated. The process of industrialization, though with slow speed, continues moving forward. Again the population explosion has necessitated construction of new housing units. Subsequently the energy consumption is also increasing at much speedy pace. This whole phenomenon is widening the gap between energy production and demand for energy resources. Resultantly the problem of energy shortage is aggravating putting the industrial growth at stake. Power has always remained one of the basic industrial inputs in the absence of which the industrialization cannot be imagined. Due to a number of reasons Pakistan is facing power shortage for industries, which is adversely affecting economic growth.

Energy in KP

Industrialization in Khyber Pakhtunkhwa (KP) could not be accelerated because of non-availability of sufficient power supply although there are numerous suitable locations where water fall provides opportunity for power generation which can help produce economical hydal power for supply to our industry. The exploitation of water potentials besides other sources can mitigate the risk of power shortage and assures continuity of industrial production.

Energy crisis has put serious challenge to households, commercial, industrial growth and others sectors of the economy. The crisis was adversely affecting the economic growth and particularly industrial sector of the economy. This study is undertaken to investigate the negative effect of power shortage on industries of KP.

Following are the objectives of this research.

1. To find out the reasons of decreasing quantum of energy required for industries in KP and resultant increasing cost of supply.
2. To find out direct cost of i.e. idle factor cost, spoilage cost and adjustment cost, of load shedding in industries of KP.
3. To find out indirect cost of load shedding i.e. Overtime cost (OTC), Additional shift cost (ASC)

This study has quantified the cost incurred due to severe load shedding in Pakistan. Furthermore, it will assist the authorities concerned to take corrective measures to overcome the crisis and help industries prosper and continue playing their constructive role in development of the country.

Literature Review

The World Electricity Supply Crisis

Electricity is one of the utmost technological innovations in the history of mankind which has introduced tremendous line of products for convenience of our daily life. Being living in the age of technology, electricity has attained ineluctable position in our lives. From household to the industries, all of them are in need of electricity. The demand for products is continuously growing due to increase in population and continuous innovations by industries as well. Up to the end of 20th century, population of the world turned three times, resulting in increase of energy with the same proportion (Three times). As per the record, increase in the world's population was recorded 2 billion approximately since 1970. While 1/6th per capita increase in consumption of electricity was recorded (Council, 2016).

Relationship of electricity with economic growth

Econom ic growth is found by multiple components including GDP. Industries play an important role in every country's economic growth. According to Hali, et al., it has been found by using growth hypothesis that electricity consumption has very strong and effective relationship with the economic growth (Hali, Iqbal, Yong, & Kamran, 2017). If there is load shedding or interruption in power supply, resultantly, the performance of industries is adversely affected (Yoo, 2006). Energy supply has importance for the process of production and GDP is directly affected by the energy consumption and vice versa (Hatemi-Ja & SalahUddin, 2012).The are adverse impacts of load shedding in south African industries (Goldberg, 2015). As the country's economicgrowth improves, consumption of electricity also increases (Chen, Kuo, & Chen, 2007). There is negative relationship between economic growth and electricity load shedding. The higher the load shedding the lower the growth rate (Bose, Shukla, Srivastava, & Yaron, 2006).

The Electricity Sector of Pakistan

According to National Transmission & Dispatch Company (NTDC), in 1947, after independence, Pakistan had the production capacity of just 60MW for coping with a demand of 31.5 million populations (Company, 2014). The generation capacity increased to 119MW till 1959. WAPDA was established in 1958 to start and streamline various projects of power generation. By the end of 1970s, the production capacity increased up to 3000 MW. In 1980s, domestic sources of power generation were able to fulfill 86% of the total demand and only 14% was fulfilled through imports. In 1990/91 the situation became worse, as the rate of increase in demand reached to 9-10% and gap between production and demand reached to 7,000 MW. This gap swelled up to 47% till 2000. According to Khan and Ashraf (2015), energy crisis due to deficiency of electricity started increasing in 2007. Electricity deficit is increasing continuously due to the reason of increasing demand in the country (G. Valasai et al., 2017).

Energy Mix of the Pakistan

Electricity sector of Pakistan is comprised of both Public and private sectors. Energy mix of the country is composed of Hydro, Thermal (gas/ steam/ furnace oil) and Nuclear Energy (Survery, 2009-10). Energy Sources i.e. water, oil, gas and nuclear sources of electricity production contribute almost 75% of Pakistan's total electricity produced (Sahir & Qureshi, 2007). Monetary impact of disruption in power supply creates difficulty for domestic consumers (Praktiknjo, Hähnel, & Erdmann, 2011). Crisis of energy in Pakistan has worsen due to selection of in-efficient energy mix, lack of will by the government, and absence of proper planning and corrective measures (Ioannis, 2013). If the load shedding continued with the same pace then crisis will result in initiation of developmental crunch (Adenikinju, 2003). Renewable energy has earned enough shares in total energy sources of Pakistan. Consequently, numerous renewable energy projects have been introduced and in progress now a days to overcome the demand and eliminate demand and supply gap in the county (Kamran, 2018).

Cost of Electricity Outages

Cost of electricity outages is the calculated cost of sacrificed amount that has been lost due to load shedding and can be divided in to two types. First the direct cost of electricity outages, which is directly lost in the course of production. And second is the indirect cost which is incurred due to alternative arrangements (Munasinghe & Gellerson, 1979). The unplanned load shedding cost is 75% higher than planned load shedding in high incidences(Pasha, Ghaus, & Malik, 1989). According to Pasha & Saleem (2013), economy was severely damaged by the electricity shortage in year 2009.

Direct Cost of Outages

Electricity outages have direct financial as well as non-financial cost. To estimate the direct cost, its components should be considered. (e.g., Reichla, Schmidthalera, & Schneider, 2013). Components of direct cost of electricity outages are Spoilage cost and Net idle factor cost (Munasinghe & Gellerson, 1979). Continuous flow of electricity play vital role efficient performance of industries i.e. higher production with least defects (G. D. Valasai, et al., 2017).

Indirect cost of Electricity outages

There are indirect and ongoing costs that researchers (e.g., Reichla, et al., 2013) believe have association with power outages. Indirect costs have also been classified into sub-classes e.g. additional shifts costs, overtime production costs etc. Components of indirect cost of electricity outages are overtime production cost and additional shifts cost (Munasinghe & Gellerson, 1979). Investors are going for purchase of generators, voltage increasing equipment, pumps etc (Klytchnikova, 2006). Financial costs from outages may also result from defects caused in electrical appliances, which may need to be repaired or replaced (KetelhodtI & Wöck, 2008). Continuous supply of electricity is prerequisite for any industrial setup for production of goods, services and distribution (Haanaes et al., 2011).

Methodology

Research Methodology

This is empirical study and has been conducted to find out potential and relevant factors of the energy crisis in the target sample.

Data Collection

Both Primary and secondary data have been collected with the help of personally administered questionnaire as done by Munasinghe & Gellerson (1979). Secondary data has also been used for selection of industries as sample from chamber of commerce.

Population and Sample

In this study population is industries of Khyber Pakhtunkhwa Pakistan. Multistage sampling has been used.Multistage sampling means dividing the whole population into different clusters or groups and then a group or cluster is selected for the study. Industrial estate Jamrud Road Peshawar have been selected as cluster representing all the industries of KP composed of 374 operational units because of the reason that this cluster is the biggest of all the industrial estates and consist of all the types of industries that can better represent industries of KP.

Methodology and quantifying energy loadshedding cost

First part of the load shedding cost is composed of direct costs (Munasinghe & Gellerson, 1979). Direct cost is primarily composed of the spoilage cost incurred due to load shedding and net value of lost production, hitherto denoted to as 'Idle Factor Cost'. Remaining is composed of adjustment costs. Total load shedding cost is comprised of direct cost (DC) and indirect cost (IC) (Munasinghe & Gellerson, 1979). Which are further divided into the following pattern: Direct cost = spoilage cost (SPC) + Net Idle factor cost (NIFC) Indirect cost = Overtime Production cost (OPC) + Additional shift cost (ASC)

Direct cost calculation and explanation

Spoilage cost

Spoilage cost shows the amount of raw material as well as other input wasted at the result of electricity shortage as well as the value added at the result of process that is wasted. Also the extent of spoilage could be a function, not only of the duration but also on whether the load shedding is anticipated or not.

For a particular we define the following:

$n^{o}i$ = no of time of happening of planned load shedding of duration d1 in the year.

$n^{1}i$ = no of time of happening of unplanned load shedding of duration d1 in the year.

$S^{O}(d_i)$ = spoilage cost in rupees at result of planned load shedding of duration d1.

$S^{1}(d_i)$ = spoilage cost in rupees at result of unplanned load shedding of duration d1

With $S° (di) > O$, $S^{1}(di) > O$, $S^{1}(di) > S°(di)$.

The total spoilage cost, SPC, then is given by

$$SPC = \Sigma_{t=1}^{m} S^{o} (di)\, n_i^{o} + \Sigma_{t=1}^{m} Si (di)\, n_i^{1} \qquad (1)$$

Idle factor cost

The cost of those units lost in this process is denoted as idle factor cost because during this period both the labor and capital are not working.

For a certain organization we describe the following further variables:

$^{o}{}_{1}$ (d_i) = percentage of output lost at result of planned load shedding of duration d1.

$^{1}{}_{1}$ (d_i) = percentage of output at result of unplanned load shedding of duration d1.

Y^{o} (d_i) = restart period following planned load shedding of duration dt.

Y^{1} (d_i) = restart period following unplanned load shedding of durationd.

$^{o}{}_{2}$ (d_i) = percentage of output lost during restart period following planned load shedding of duration d1.

$^{1}{}_{2}$ (d_i) = percentage of output lost during restart period following unplanned load shedding of duration d1.

V = represents the Value added by the company

h = Number of hours worked by the company.

The total equivalent number of hours of production lost, LSH is mentioned as under,

$$LSH = \sum_{i=1}^{m} \{o1 (di) (di) + o1(di) Y (di)\}noi + \sum_{i=1}^{m} \{ 11 (di)(di) + 12(di) Y1(di)\}n1i \qquad (2)$$

And the idle factor cost by

$$IFC = LSH.\ ^{V} \qquad (3)$$

Though, in the presence of excess capacity during the period not affected by load shedding, firms may recover a certain proportion, λ of the lost output. In order to determine λ we specify the following:

T = Target output of the company

Q = actual output of the company

= amount of deviation between the actual output and panned output at the result of power load shedding.

$^{-}$ = normal working hours of the company per year.

MQL is denoting maximum output loss due to power interruption is given by

$$MQL = \frac{LSH}{-} T \qquad (4)$$

Where LSH is obtained from equation 2

The corresponding actual output loss, AQL is

$$AQL = (T\text{-}Q) \qquad (5)$$

Therefor the extent of output recovered, λ is given by

$$\lambda = 1 \frac{-}{LSH}\left\{1 \quad \frac{Q}{T}\right\} \qquad (6)$$

It may be noted that in the special cases, first where = 0, λ = 1 and second when Q = T, λ = 1.

Given some recovery of output, the net idle factor cost, NIFC is defined as:

$$NIFC = (1 - \lambda)\ IFC \qquad (7)$$

And the total basic direct cost, DC as:

$$DC = SPC + NIFC. \qquad (8)$$

Adjustment costs

Following portion develops the methodology for quantifying these adjustment costs. At this stage, we define the following:

λ_1 = percentage of output recovered by more intensive utilization of existing capacity.

λ_2 = percentage of output recovered by working overtime

λ_3 = percentage of output recovered by additional shift.

With $\lambda_1 + \lambda_2 + \lambda_3 = 1$

Indirect Cost of Load Shedding

Overtime Costs

The period of overtime, h_o, is given by,

$$h_o = \lambda\ 2\lambda LSH \qquad (9)$$

With LSH from Equation (2) and λ from Equation (6), It is expected at this stage that labor productivity is same during overtime comparatively to normal production hours, and we define the following:

W = wage amount of the company

Θ = overtime wage premium, $\Theta > 0$

The Overtime Premium Cost (OPC), is given by

$$OPC = {}^{w} (1+ \Theta_1)\, h_o \qquad (10)$$

Additional shift cost

For calculating additional shift costs, similar methodology can be followed. The number of additional shifts, a_3 is obtained as

$$a_3 = \lambda_3\, \lambda \frac{LSH}{h} \qquad (11)$$

Where h* is the typical shift duration.

The additional shift cost, ASC, is given by

$$ASC = {}^{w} (1 + \Theta_2)\, h^{*} a_3 \qquad (12)$$

Where Θ_2 is the magnitude of the shift differential. The total indirect costs, IDC, are then derived as

$$IDC = OPC + ASC \qquad (13)$$

This leads to the total cost, OC (outage Cost or load shedding cost), of power load shedding as

$$OC = DC + IDC \qquad (14)$$

For a considerable section of companies' economic costs calculation due to load shedding, the above methodology is sufficient.

Analysis

Direct Cost (DC)

Direct cost is the cost incurred during production process and includes cost of raw material, labour etc. but does not include taxes and depreciation etc. however includes spoilage Cost (SPC) and Net Idle Factor Cost (NIFC). Direct cost is a component of Total Cost of Outages. Direct cost incurred by Pharmaceutical Industry is comparatively larger because of high cost of output. The input material used by Pharmaceutical industry is mostly imported is delicate to handle with more care. The minimal amount, if wasted, counts high from the cost point of view and bears comparatively heavy loss.

There are currently 60 units fully operational in Hayatabad Industrial Estate with highest cost. Loss of industries like Plastic, Printing is also of more severe impact. Industrial unit is adversely affected due to either failure in meeting market demand or because of lower quality of product resulting from power supply disruption. It is not only the financial loss alone but equally important the corporate manage of each.

Table 02: Direct Cost of Electricity Outages

#	Industry	Direct Cost (Rs)
1	Pharmaceuticals	68.16M
2	Plastic	66.63M
3	Printing & Packages	65.51M
4	Engineering	44.53M
5	Food	36.82M
6	Marble	16.40M
7	Match	12.59M
8	Chemical	12.06M
9	AdhesiveTape	5.52M
10	Electronic goods	4.41M
11	Pet Bottle Manufacturing	3.31M
12	Soap	8.75M
13	Steel	7.89M
14	AluminumFlush & PVC Door	5.79M
15	Beverages & Juices	2.66M
16	Polypropylene Woven Bags	4.87M
17	Fibre Glass	4.64M
18	Ceramics Tables Ware	4.55M
19	Vegetable Ghee Mills	3.31M
20	Dall Mills	2.15M
21	Flour Mill	2.10M
22	Paper Mill	2.32M
23	Others	13.34M
	Total	**398.31M**

Indirect Cost (IDC)

Indirect cost is in fact a cost paid by intensive utilization of productive capacity which includes services of the work force also. To recover the lost output, they run their production process in addition to their normal business hours and have to pay extra wages as an incentive. When energy supply is disrupted the total productive capacity is not fully utilized and factory unit has to employ extra hours to meet the market demand.

Table 3: Indirect Cost of Electricity Outages

#	Industry	Intensive Utilization Cost(Rs)	Overtime Premium cost (Rs)	Additional shifts cost (Rs)	Indirect Cost (Rs)
1	Pharmaceuticals	4.56M	5.85M	6.72M	17.13M
2	Plastic	4.36M	6.59M	7.46M	18.40M
3	Printing & Packages	4.36M	9.34M	10.58M	24.27M
4	Engineering	2.86M	5.31M	6.09M	14.26M
5	Food	2.51M	5.53M	6.24M	14.28M
6	Marble	2.05M	4.91M	5.64M	12.60M
7	Match	1.30M	3.14M	3.45M	7.89M
8	Chemical	0.77M	2.20M	2.54M	5.52M
9	Adhesive Tape	0.39M	2.59M	2.92M	5.90M
10	Electronic goods	0.31M	2.07M	2.34M	4.72M
11	Pet Bottle Manufacturing	0.23M	1.55M	1.75M	3.54M
12	Soap	0.60M	2.61M	2.94M	6.15M
13	Steel	0.58M	1.09M	1.25M	2.92M
14	Aluminum Flush & PVC Door	0.05M	0.07M	0.09M	0.20M
15	Beverages & Juices	0.38M	0.43M	0.49M	1.30M
16	Polypropylene Woven Bags	0.24M	0.41M	0.49M	1.14M
17	Fibre Glass	0.38M	0.69M	0.74M	1.81M
18	Ceramics Tables Ware	0.24M	0.64M	0.75M	1.63M
19	Vegetable Ghee Mills	0.19M	0.55M	0.62M	1.36M
20	Dall Mills	0.18M	0.78M	0.95M	1.90M
21	Flour Mill	0.11M	0.48M	0.59M	1.18M
22	Paper Mill	0.14M	0.88M	0.90M	1.93M
23	Others	0.98M	4.42M	4.96M	10.36M
	Total	**27.77M**	**62.13M**	**70.49M**	**160.39M**

Total Cost of Electricity Outages (TC)

Although, all industries have taken their possible remedial actions to reduce the loss of electricity outages to the extent possible, but still total cost of electricity outages is Rs. 559952713. This is a tremendous loss to the economy and GDP as well.

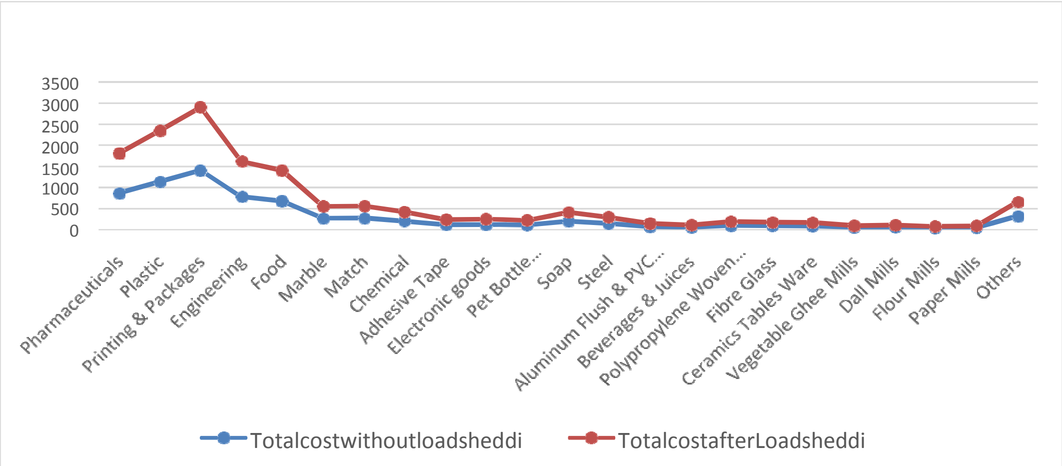
Table 4: Total Cost of Electricity Outages

#	Industry	Direct Cost (Rs)	Indirect Cost (Rs)	Total Cost (Rs)
1	Pharmaceuticals	68.16M	17.13M	85.28M
2	Plastic	66.63M	18.40M	85.03M
3	Printing & Packages	65.51M	24.27M	89.78M
4	Engineering	44.53M	14.26M	58.79M
5	Food	36.82M	14.28M	51.10M
6	Marble	16.40M	12.60M	29.00M
7	Match	12.59M	7.89M	20.48M
8	Chemical	12.06M	5.52M	17.58M
9	Adhesive Tape	5.52M	5.90M	11.41M
10	Electronic goods	4.41M	4.72M	9.13M
11	Pet Bottle Manufacturing	3.31M	3.54M	6.85M
12	Soap	8.75M	6.15M	14.91M
13	Steel	7.89M	2.92M	10.81M
14	Aluminum Flush & PVC Door	5.79M	1.45M	7.24M
15	Beverages & Juices	2.66M	1.30M	3.96M
16	Polypropylene Woven Bags	4.87M	1.14M	6.02M
17	Fibre Glass	4.64M	1.81M	6.45M
18	Ceramics Tables Ware	4.55M	1.63M	6.18M
19	Vegetable Ghee Mills	3.31M	1.36M	4.67M
20	Dall Mills	2.15M	1.90M	4.06M
21	Flour Mills	2.10M	1.18M	3.28M
22	Paper Mills	2.32M	1.93M	4.25M
23	Others	13.34M	10.36M	23.70M
	Total	**398.31M**	**161.64M**	**559.95M**

Table 5: Comparison of Total Cost with and without load shedding (Rs)

#	Industry	Without load shedding	Cost (SPC)	Cost (NIFC)	Cost (IUC)	Cost (OPC)	Cost (ASC)	(TC) Incurred	After Load shedding	Due to Load shedding
1	Pharmaceuticals	862.29M	61.78M	6.38M	4.56M	5.85M	6.72M	85.28M	947.58M	9.89%
2	Plastic	1129.72M	60.65M	5.98M	4.36M	6.59M	7.46M	85.03M	1214.75M	7.53%
3	Printing & Packages	1406.54M	59.81M	5.70M	4.36M	9.34M	10.58M	89.78M	1496.32M	6.38%
4	Engineering	781.05M	40.25M	4.28M	2.86M	5.31M	6.09M	58.79M	839.84M	7.53%
5	Food	678.88M	34.07M	2.75M	2.51M	5.53M	6.24M	51.10M	729.98M	7.53%
6	Marble	265.48M	14.23M	2.17M	2.05M	2.17M	5.64M	26.26M	291.74M	9.89%
7	Match	272.07M	11.23M	1.35M	1.30M	3.14M	3.45M	20.48M	292.55M	7.53%
8	Chemical	202.17M	11.23M	0.83M	0.77M	2.20M	2.54M	17.58M	219.75M	8.70%
9	Adhesive Tape	115.40M	5.19M	0.33M	0.39M	2.59M	2.92M	11.41M	126.81M	9.9%
10	Electronic goods	121.31M	4.15M	0.26M	0.31M	2.07M	2.34M	9.13M	130.44M	7.53%
11	Pet Bottle Manufacturing	107.28M	3.11M	0.20M	0.23M	1.55M	1.75M	6.85M	114.13M	6.39%
12	Soap	198.03M	8.24M	0.52M	0.60M	2.61M	2.94M	14.91M	212.93M	7.53%
13	Steel	143.60M	7.21M	0.68M	0.58M	1.09M	1.25M	10.81M	154.41M	7.53%
14	Aluminum Flush & PVC Door	70.78M	5.24M	0.55M	0.05M	0.54M	0.62M	7.00M	77.79M	9.89%
15	Beverages & Juices	52.65M	1.97M	0.70M	0.38M	0.43M	0.49M	3.96M	56.61M	7.52%
16	Polypropylene Woven Bags	94.29M	4.02M	0.85M	0.24M	0.41M	0.49M	6.02M	100.31M	6.38%
17	Fibre Glass	85.73M	4.21M	0.43M	0.38M	0.69M	0.74M	6.45M	92.18M	7.52%
18	Ceramics Tables Ware	82.06M	4.12M	0.43M	0.24M	0.64M	0.75M	6.18M	88.24M	7.53%
19	Vegetable Ghee Mills	47.22M	3.09M	0.22M	0.19M	0.55M	0.62M	4.67M	51.89M	9.9%
20	Dall Mills	53.89M	2.06M	0.09M	0.18M	0.78M	0.95M	4.06M	57.95M	7.53%
21	Flour Mills	37.74M	1.97M	0.14M	0.11M	0.48M	0.59M	3.28M	41.02M	8.69%
22	Paper Mills	42.96M	2.15M	0.17M	0.14M	0.88M	0.90M	4.25M	47.21M	9.9%
23	Others	314.90M	12.36M	0.99M	0.98M	4.42M	4.96M	23.70M	338.61M	7.53%
	Total	7166.06M	362.33M	35.99M	27.77M	59.86M	71.03M	556.97M	7723.04M	7.96%

Chart 1 Total cost with and without outages



Conclusions and Recommendations

Conclusions

From comprehensive research encompassed of huge gathered data of wide number and variety of sectors, which is properly processed, following conclusions have been drawn. Approximately all industries have been adversely affected by the electricity outages as found by Valasai, et al., 2017. The loss they have incurred is such a huge cost to the industry as well as to the economy, if controlled, can have tremendous contribution to the industries of Pakistan. From the establishment of Hayatabad Industrial Estate,492 Units have been established, of which only 374 are fully operational yet. All the operational units are facing the trouble of load shedding, consequently making huge losses. It has been concluded from the study that population comprised of 374 units under study have huge idle factor cost amounting Rs. 71,869,395 That is 1.28% of total Production cost.It has been inferred from the study that Industries have made significant loss due to spoilage of material amounting Rs. 362,325,600. Total material lost is approximately 6.4% of the total production of the industry which makes a significant portionand a huge loss to the industries as well as to the economy.

It has been concluded from detailed analysis that adjustment cost has heavily been incurred amounting Rs. 397,690,706. It is approximately 7.085% of the total production of all the industries; a significant amount of material is lost due to electricity outages. It has been concluded from detailed examination and evaluation that Overtime Premium Cost (OPC) valuing Rs. 59,860,682 has been incurred which is such a huge extra expense to the industries of Pakistan. It is approximately 1.066% of the total production value.It has been concluded from substantive evidence that Additional Shifts Cost (ASC) valuing Rs. 146,597,973 has been incurred. It is approximately 2.61% of the total production value and is considered one of the majorportions of total cost of electricity outages.

Recommendations

Government has to initiate remedial actions and accelerate those which are under process so that to manage the demand supply gap on priority. Following recommendations have been offered:

Upgradation of Existing Capacity

Urgent measure should be taken so that the existing installed capacity be enhanced by upgrading the power production equipments. Immediate measures be taken to minimse silt deposition in all the three dames by silt clearing.

To control stealth

To save energy from wastage illegal connection and stealing be checked through stern action by the state authorities.

Introduction of Renewable energy

In the mean time solar energy system be encourged by subsidisng the solar systems particularly for industrial installation and generally for power production connected to national grid. This is one of the most economical and environmental friendly remedy as well.

Limitations

This study has been conducted using all the possible resources to reach the best conclusions but still there were some inevitable constraints which can affect the details mentioned in this thesis. Some of them are as under:

1. Data of some years mentioned in the begining section of this thesis was not available. Due to which it is not mentioned in this report.
2. Alot of energy is wasted in those markets which are not possible to quantify i.e informal or temporary established markets.

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