PART 3

Cost of Loadshedding to Commercial/Services Sector

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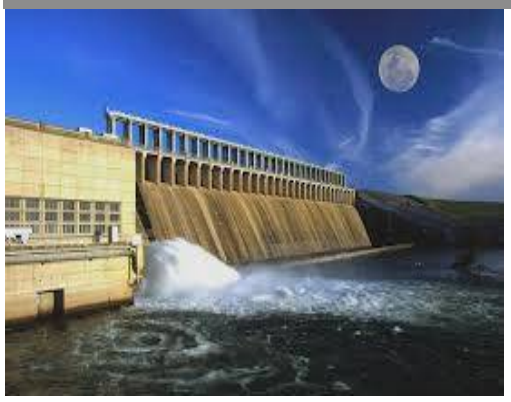

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ACRONYMS

CMI	=	Census of Manufacturing Industries
DISCO	=	Distribution Company
KESC	=	Karachi Electric Supply Corporation
K-PK	=	Khyber-Pakhtunkhwa
OLS	=	Ordinary Least Squares
PBS	=	Pakistan Bureau of Statistics
PES	=	Pakistan Economic Survey
WTP	=	Willingness to Pay

CHAPTER 1
INTRODUCTION

This part of the report presents the findings on costs of loadshedding to commercial/services establishments in Pakistan, quantified on the basis of data obtained from a nationwide survey of such units.

The report is organized in nine chapters. Chapter 2 presents the methodology used for qualification of costs due to outages. Chapter 3 describes the survey including the sampling methodology and assessment of the quality of data collected, given the complex technical nature of the survey. Subsequent Chapters up to Chapter 7 present the magnitudes of key parameters like the relevant characteristics of the responding units, incidence of outages, level and pattern of adjustments and the magnitude of different outages costs. Chapter 8 highlights the suggestions by sample units for reduction in incidence and costs of outages.

Chapter 9 gives a summary of the principal findings and the major policy implications emerging from the research. It is clear from the results that commercial sector has faced severe disruptions due to the high and growing incidence of loadshedding. As such, the economic return of reducing outages and of facilitating the process of adjustment to these outages is very high. This could contribute to some revival of the economy and reduce unemployment.

Thanks are due to the sample units for responding to a questionnaire, which was complex and difficult to administer. Thanks are also due to the survey team which travelled all over the country and sometimes found itself in a difficult law and order situation, especially in Karachi.

The main text of the report is presented in a non-technical manner. Technical analyses are included in the Technical Annexes.

Any defects which remain are of course, the responsibility of the authors.

CHAPTER 2
THEORETICAL FRAMEWORK

2.1 OUTAGES AND A FIRM'S BEHAVIOUR

The behavior of a firm in the presence of frequent and persistent outages has been modeled in the Technical Annex. The firm is assumed to be operating in a competitive environment, given the smallness of its size; and pursues profit maximization. The results derived from this theoretical framework are as follows:

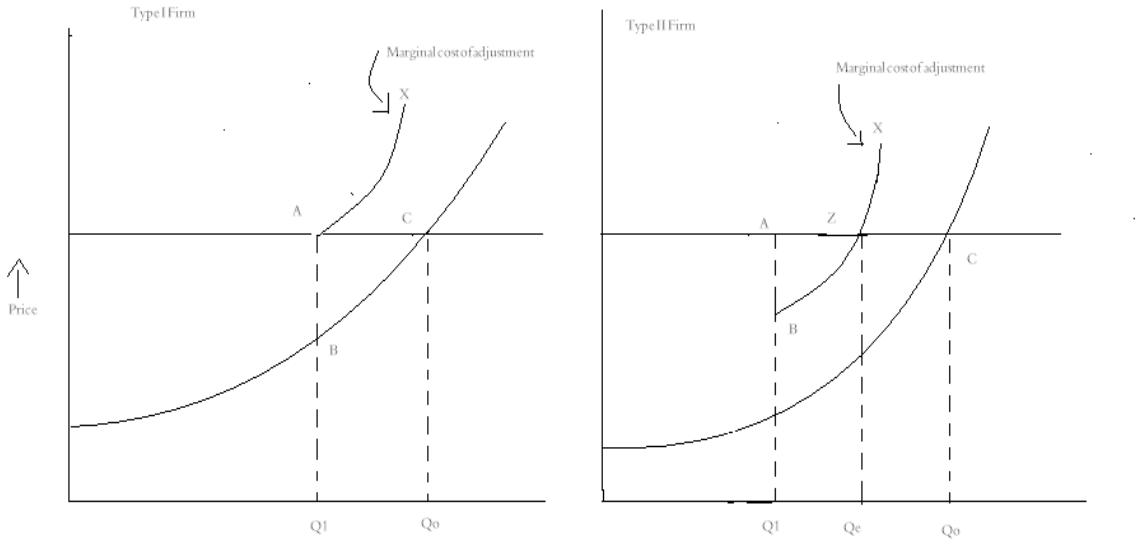
i. If outages are seen as, more or less, permanent in nature then the optimal size of the firm is lower than in the absence of outages. In particular, there is a tendency to shed some labor.

ii. The likelihood that the firm will make adjustments to recover some of the lost output depends on the following:

   a) The extent to which the market situation is favorable for the firm
   b) The electricity-intensity of the business; the lower the intensity the greater the likelihood that the firm will make an adjustment
   c) The lower the costs of adjustment.
   d) The larger the outage and the level of expectation that this will continue.

Based on the results from the theoretical analysis we present in Figure 2.1 visually the change in the equilibrium of a firm in the presence of outages

Figure 2.1
Adjustment by a Firm to Outages



Type I firm initially experiences outages which reduce production from $Q_0 - Q_1$. At Q_1 the gap between price and marginal cost is AB. AB is larger the bigger the outage. The marginal cost curve of adjustment by the firm is given by XY. If XY is too high, then the firm makes no adjustment.

In the case of type II firm, Y lies between A and B. As such, the firm makes an adjustment and the new output level is Q_e. Type I firm reduces output by $(Q_0 - Q_1)$ while the loss of output of Type II firm is $(Q_0 - Q_e)$. Also, the fall in profit of Type I firm due to outages is ABC. In the case of Type II firm it is BYZC.

The above theoretical framework is used to develop the methodology for quantifying the cost of outages.

2.2. METHODOLOGY FOR QUANTIFICATION OF COST OF OUTAGES

We have indicated above that in the presence of persistent outages firms will be inclined to make adjustments. The extent and nature of adjustments will depend on a number of factors which have also been identified above. The methodology used for quantifying the cost of outages is based largely on that developed by Pasha, Ghaus and Mallik [1989]. Fig 2.2 presents a flow chart for identifying the different types of outage costs.

There are two types of costs associated with outages. The first type is **direct costs** which consist primarily of the value of lost production and spoilage costs. The second type is **adjustment costs**. The particular mechanisms chosen for recovering some or all of the output lost will be based on cost minimization considerations. Accordingly, a firm will opt for a type of adjustment as long as it is cheaper than other options. Therefore, firms may opt for multiple adjustments, especially when the size of the outage is large.

Direct Costs

In order to derive the magnitude of direct costs, we designate the following:

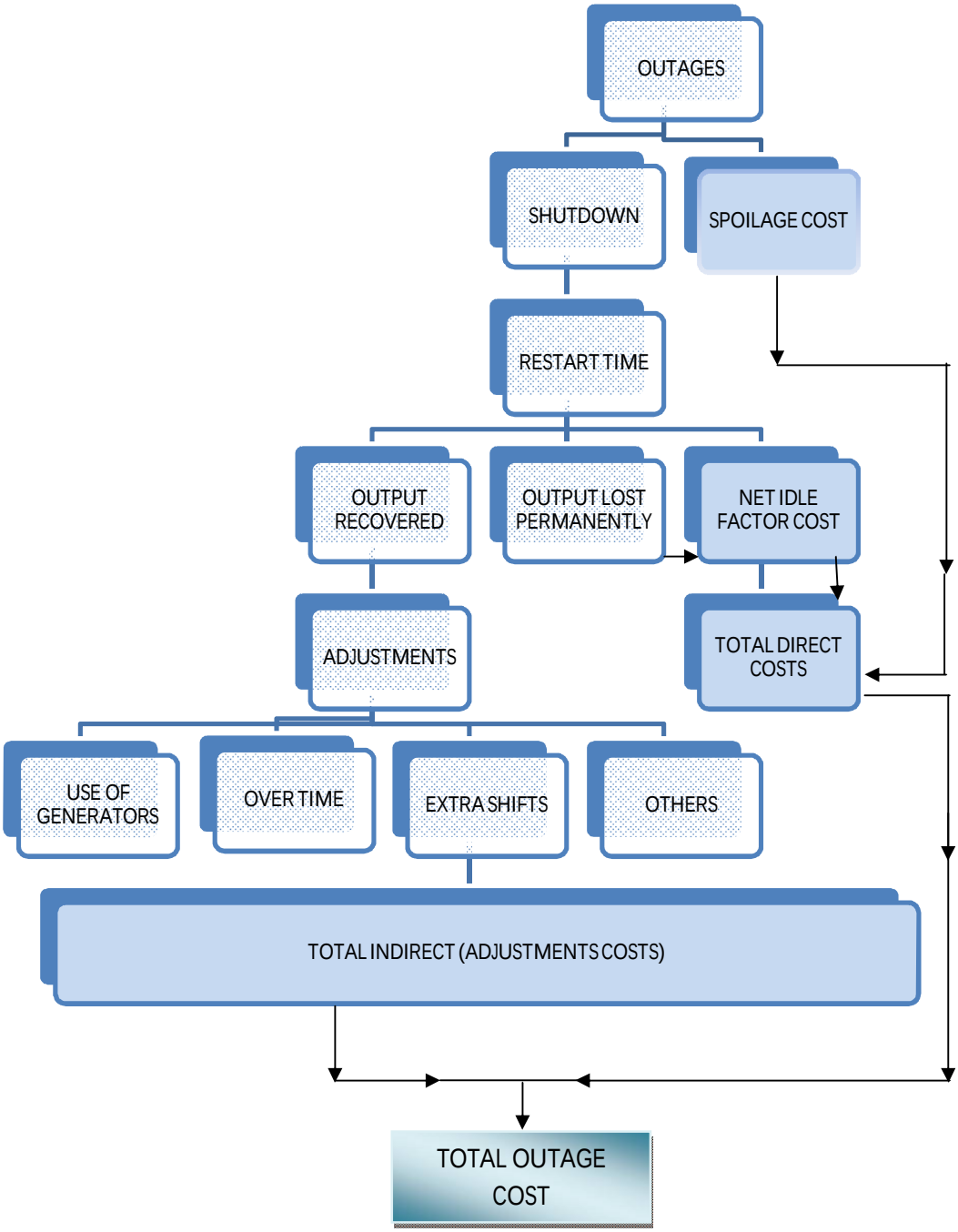
n_i = number of times of occurrence of outage daily on average of duration i. i = 1, 2, 3, 4, 5[1]

ϵ_i = proportion of output lost during an outage of duration i

γ_i = restart time after an outage of duration i.

[1] The durations are 0-1/2 hr; ½ hr to 1 hr; 1 hr to 2 hrs; 2 hrs to 3 hrs; 3 hrs and above.

Figure 2.2
Flow Chart Showing Costs of Outages



The total number of outages during the year is given by

NOUT = $\sum_{i=1}^{5} n_i$ × 365 ……..(2)

The total time lost due to outage is

TOUT = $\sum_{i=1}^{5}$($n_i[d_i + \gamma_i]$ × 365) ……(3)

Where d_i is the duration of the outage.

The potential extent of output loss due to outages is given by

LOUT = $\sum_{i=1}^{5} n_i[d_i + \gamma_i] \epsilon_i$ × 365 ……(5)

But the firm may not be operating throughout the year and for 24 hours each day. Therefore, if H is the normal hours worked during the year, the actual output lost is given by

ACOUT = $LOUT.\frac{H}{8760}$ ……(5)

And the value of this loss is as follows

VOUT = ACOUT.V ……(6)

Where V is the value added by the firm per hour.

However, the firm may recover some of the output lost through adjustments. If λ is the extent of output recovered then we have the expression for the net idle factor cost, NIFC, as follows:

NIFC = (1-λ) VOUT ……(7)

Box 2.1 gives a simple numerical example for calculation of the net idle factor cost incurred by a sample unit due to outages on the basis of data obtained from the survey.

The other part of direct costs is spoilage costs. We represent

S_i = spoilage cost (in rupees) in each outage of duration i

Then the spoilage cost, SPC, is derived as follows:

SPC = $\sum_{i=1}^{n} n_i s_i$. 365 × $\frac{H}{8760}$ ……(8)

And the total direct costs of outages are

TDC = NIFC + SPC ……(9)

Box 2.1
A Numerical Example of Quantification of Net Idle Factor Cost

Suppose a firm experiences outages of duration of one hour six times a day (over the 24 hours) and the restart time after the outage is half an hour.
Then
NOUT = 6 × 365 = 2190
TOUT = 6 × 365× 1.5 =3285
If the proportion of output lost is 50%. Then
LOUT = 3285 × 0.5 = 1642.5
The firm normally operates one shift (of 8 hours) for 300 days. Then
H = 8 × 300 = 2400
And, ACOUT = 1642.5 × $\frac{2400}{8760}$ = 450
If the value added per hour is Rs 1000, then
VOUT = 450 × 1000 = 450,000Rs
and if the proportion of output recovered through adjustments is 60%, then λ = 0.6 and NIFC is given by
NIFC = 450,000 × (1-0.6) = 180,000 Rs

Adjustment Costs

Generators Cost

A key response by commercial units, which is being observed in Pakistan, is the resort to own sources of energy supply through investment in generators. This is motivated by the high and rising incidence of outages since 2007 and the growing recognition that power loadshedding (along with gas shortages) could persist over the next many years.

In practice, the extent of substitution of the conventional power source (through DISCOs) depends on the energy-intensity of operations (as derived in the theoretical framework above), on the possibility of making other cheaper adjustments and the cost of capital for acquisition of generators. The latter is likely to be relatively high for small commercial units.

The survey of units has indicated, first, whether a unit has a generator or not, second, the capital cost of the generator, third, monthly running cost of fuel for operating the generator and fourth, other costs (including labor, repairs and maintenance cost, etc.) on a quarterly basis. As such, we designate the following:

K_g = capital cost of generator

FOC = fuel operating cost per month

OPC = other operating costs quarterly

This leads to the estimate of the overall annual generator cost, GENCO, as follows:

GENCO = $(\tau + \delta)K_g$ + 12(FOC) +4(OPC) ……..……(10)

Where, τ is the cost of capital and δ is the rate of depreciation. The combined value of τ *and* δ is taken as 0.32.

However, the use of generators implies savings in costs of power supply from the local DISCO. Therefore, the net cost, NGENCO, is given by

$$NGENCO = GENCO - k\ (TOUT) \times (ADJ_G) \times tf \cdot \frac{H}{8760} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(11)$$

Where

K = electricity consumption per hour in Kwh

TOUT = total hours lost as derived in equation (3)

ADJ_G = extent of adjustment by use of generators

tf = tariff per Kwh of the DISCO.

Other Adjustments

Other adjustments include the following and are more in the nature of short-run adjustments when loadshedding is seen as temporary in nature:

i. More intensive utilization of existing plant and machinery during times when there is no loadshedding
ii. Overtime or additional shifts to make up for at least part of the output loss
iii. Changes in working days or timings.

The survey reveals that the majority of establishments have not made significant adjustments of the above type and the costs associated with these adjustments are not large. The methodology used for quantifying these costs has been taken from Pasha, Ghaus and Mallik [1989]. They are represented by OTC.

Overall, the total adjustment cost, TAJCO, is derived as

$$TAJCO = NGENCO + OTC \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(12)$$

And the total outage out cost, TOUTCO, as follows:

$$TOUTCO = TDC + TAJCO \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(13)$$

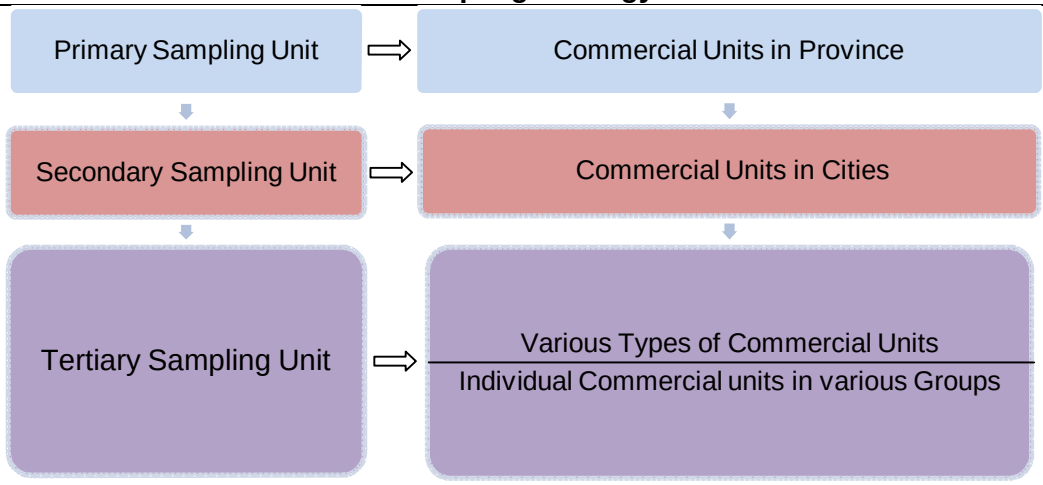
The magnitudes of the different components of outage costs are presented in Chapter 6, by location and type of business of the sample units.

CHAPTER 3
THE SAMPLING FRAMEWORK AND ITS DISTRIBUTION

3.1 SAMPLING FRAMEWORK

The primary instrument of data collection was a survey on a pre-designed and tested questionnaire of a stratified (by city, type of business) national random sample of commercial units (see Figure 3.1).

Figure 3.1
Sampling Strategy



The population of the establishments was obtained from the **Economic Census 2005**, published by the Pakistan Bureau of Statistics (PBS). The national distribution of commercial establishments by province and type of business is presented in Table 3.1 and Figure 3.2. The derived sample distribution by city and type of business is presented in Table 3.2.

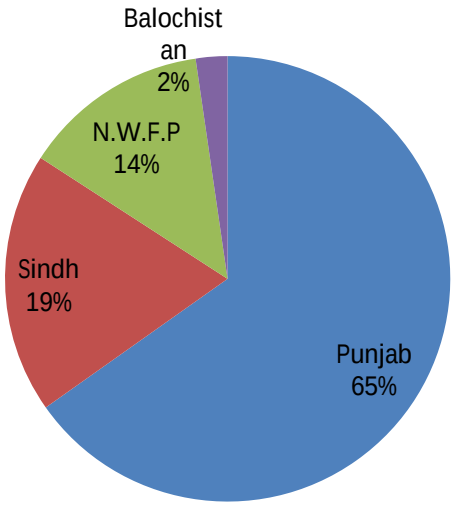
Once the sample distribution across cities and type of business groups was finalized, the individual sample units were selected from upper, medium and lower income commercial centers. The individual unit was selected through random walk.

The questionnaire administered on the sample respondents contains five modules: basic information on sales/employment/costs; incidence of outages; costs of outages; adjustment to outages, and, preferred load management practices. Though the questionnaire was structured, the last question was open-ended asking the respondents to make suggestions to reduce the costs of loadshedding. This provides the respondent's perspective on actions to counter the problem.

Table 3.1 National Distribution of Commercial Establishments in the Economic Census, 2005 by Province and Sector	
Distribution of Establishment*	
	Percentage
Punjab	64.6
Sindh	18.9
K-PK	13.5
Balochistan	2.3
Islamabad	0.6
Total	100
Distribution of National Employment in Commercial Sector	
	%
Wholesale & Retail Trade Establishments Restaurants & Hotels	67.3
Transport & Communications	2.2
Financing, Insurance, Real Estate & Business Services	2.1
Community, Social and Personal Services	28.4
Total	100.0

Figure 3.2
National Distribution by Province and Sector

By Province



By Sector

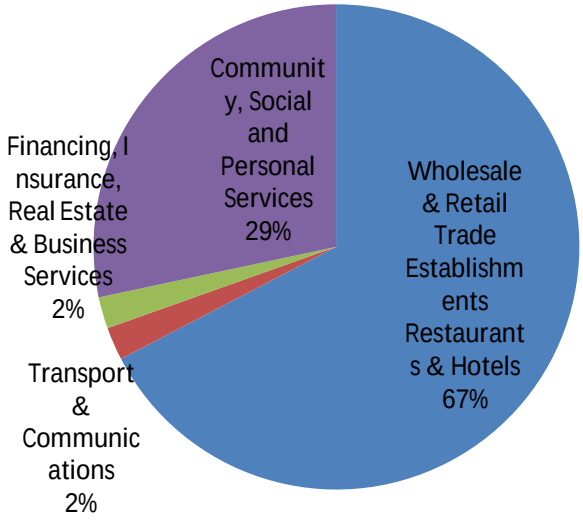


Table 3.2. Distribution of Sample units by City, Province and Sector							
Provinces	**Cities**	**Wholesale & Retail Trade Establishments**	**Restaurants & Hotels**	**Transport & Communications**	**Financing, Insurance, Real Estate & Business Services**	**Community, Social and Personal Services**	**Total**
Punjab	Lahore	22	5	3	4	9	43
	Faisalabad	12	3	1	2	5	23
	Sialkot	3	1	0	1	1	6
	Gujranwala	6	1	1	1	2	11
	Multan	9	2	1	2	3	17
	Rawalpindi/Islamabad	16	5	1	4	8	34
	Total	**68**	**17**	**7**	**14**	**28**	**134**
Sindh	Karachi	18	4	5	6	9	42
	Hyderabad	4	1	1	1	2	9
	Sukkur	2	1	0	1	1	5
	Total	**24**	**6**	**6**	**8**	**12**	**56**
KPK	Peshawar	12	2	3	3	4	24
	Mardan	3	1	1	1	1	7
	Abbottabad/Bannu	3	1	1	1	1	7
	Total	**18**	**4**	**5**	**5**	**6**	**38**
Balochistan	Quetta	10	3	2	3	4	22
	Total	**10**	**3**	**2**	**3**	**4**	**22**
Total		**120**	**30**	**20**	**30**	**50**	**250**

The survey was successfully administered on 250 units as targeted. Following the process of edit and consistency checking of the completed questionnaires, 241 units, over 96 percent of the sample, have been included in the analysis.

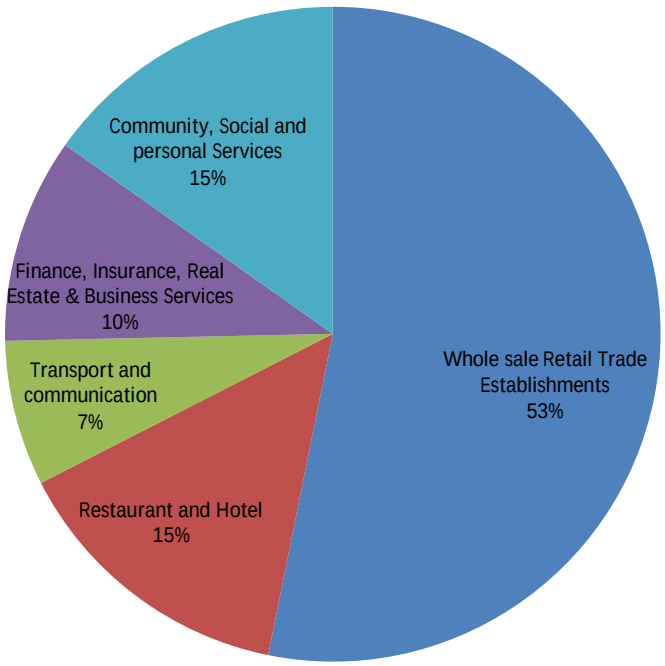
Table 3.3.
Distribution of Sample Analyzed by Cities

Cities	Numbers	%
Lahore	43	17.8
Faisalabad	21	8.7
Gujranwala	9	3.7
Multan	14	5.8
Sialkot	5	2.1
Rawalpindi / Islamabad	37	15.4
Karachi	43	17.8
Hyderabad	8	3.3
Sukkur	4	1.7
Peshawar	25	10.4
Mardan	6	2.5
Abbotabad	6	2.5
Quetta	20	8.3
Total	241	100.0

3.2 PROFILE OF RESPONDENTS

Distribution of selected units for analysis by city is given in Table 3.3. 54 percent of the sample units are in the province of Punjab, while about 23 percent are in Sindh. From the remaining, 15 percent are in Khyber-Pakhtunkhwa (K-PK) and 8 percent in Balochistan. The distribution by type of business is given in Figure 3.3. 53 percent of the sample respondents were from wholesale and retail sector while 15 percent each belonged to the restaurant and hotel sector and community, social and personal services.

Figure 3.3
Distribution of Selected Units by Sector



3.3 CHARACTERISTICS OF SELECTED UNITS

Basic Information

Establishments, on an average, worked 316 days a year, with hotels and restaurants working 331 days a year and transport and communication working 320 days annually. The sample units on an average employed about 6 persons, the average employment being 11 in hotels and restaurants and transport and communications (see Table 3.4).

Table 3.4.
Average Employment by Sector, 2012

Group	Employment (No)
Whole sale Retail Trade Establishments	3.8
Restaurant and Hotel	11.0
Transport and communication	10.5
Finance, Insurance, Real Estate & Business Services	4.2
Community, Social and personal Services	5.5
Total	**5.6**

Sales and Value Added

The average sales of the respondent units chosen for analysis in 2012 is projected at Rs 4.7 million (see Table 3.5) demonstrating a low growth of almost 7 percent over the 2011 level. Their operating expenses average Rs 3.3 million, implying an operating profit of Rs 1.4 million.

Table 3.5.
Average Sale and Operating Expenses of Sample Units 2012

(Rs in Thousands)

Industrial Group	Total	Total Operating Expenses	Operating Expenses as % of Sales
Whole sale Retail Trade Establishments	4124	3086	75
Restaurant and Hotel	6427	4790	75
Transport and communication	9138	6042	66
Finance, Insurance, Real Estate & Business Services	3622	1933	53
Community, Social and personal Services	3839	2529	66
Total	**4720**	**3341**	**71**

The average value added by sample units in 2012 is estimated at Rs 2.1 million, highest being in transport and communication followed by restaurants and hotel (see Table 3.6). Sample units have, on an average, purchased almost 10 thousand kilowatt hours (kwh) of electricity annually from the public distribution companies. Value added per kwh of electricity consumed is Rs 214.

This is the first estimate of the cost of loadshedding, not adjusted for any recovery of value added lost.

Table 3.6
Average Value Added, Electricity Purchased and Value Added per Kwh of Electricity of Sample Units

Industrial Group	Value Added (Thousands)	Electricity Consumed (Kwh)	Value Added Per Kwh (Rs.)
Whole sale Retail Trade Establishments	1675	10269	163
Restaurant and Hotel	2853	11761	243
Transport and communication	5458	14403	379
Finance, Insurance, Real Estate & Business Services	1742	6427	271
Community, Social and personal Services	1695	7365	230
Total	**2125**	**9949**	**214**

Operating Costs

Turning next to operating costs, as mentioned above, average annual operating cost of sample units is Rs 3.3 million. Out of this, the highest proportion, (74 percent), is spent on purchase of raw materials, followed by wages (17 percent) (See Table 3.7). Electricity costs purchased from the distribution companies and self-generation combined account for 6 percent of the costs.

Table 3.7
Operating Cost Structure of Sample Units

(%)

Industrial Group	Total Operating Cost (Rs. In Thousands)	(Percentage of Operating Cost)					
		Wages/ Salaries	Raw Material	Repairs/ Maintenance	Cost of Electricity	Cost of Self Generation	Others
Whole sale Retail Trade Establishments	3086	11.9	79.8	1.4	3.9	1.6	1.3
Restaurant and Hotel	4790	18.5	70.9	1.8	4.6	2.5	1.6
Transport and communication	6042	34.8	59.0	2.4	2.3	1.9	1.8
Finance, Insurance, Real Estate & Business Services	1933	17.7	73.1	1.9	3.6	2.7	1.1
Community, Social and personal Services	2529	20.4	71.6	2.0	3.4	2.0	0.7
Total	**3341**	**17.5**	**74.0**	**1.7**	**3.8**	**1.9**	**1.3**

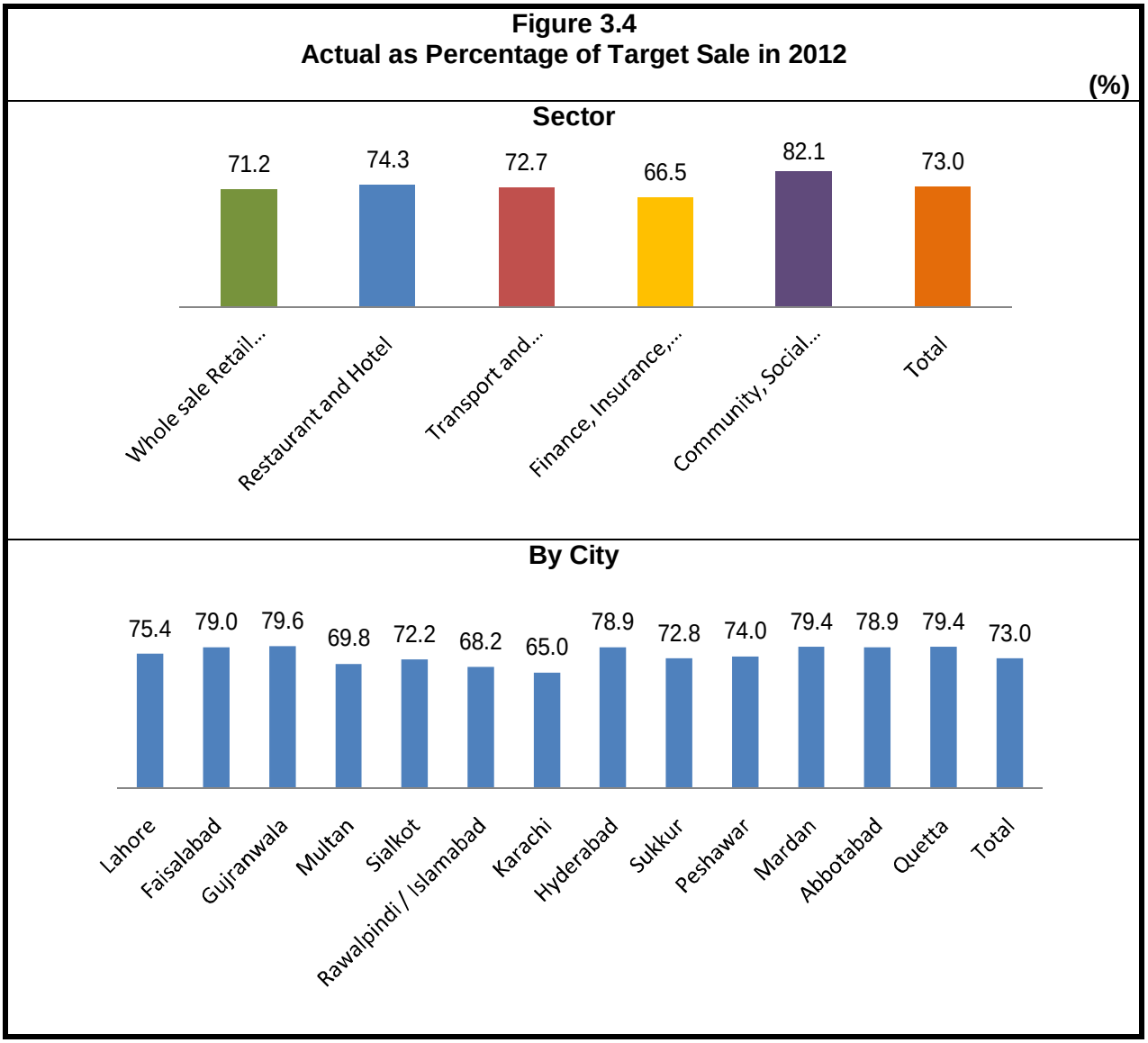
Attainment of Production Targets

Sample units, on an average, have been able to achieve 73 percent of their sales target, as shown in figure 3.4. The highest rate of target achievement is by community, personal and social services at 82 percent, followed by restaurants and hotels at 74 percent.

Interestingly, inter-city differences are prominent in the achievement of sales targets. While Faisalabad, Gujranwala, Mardan and Quetta were able to achieve over 79 percent of their target, possibly because the targets were already modified somewhat to allow for the presence of loadshedding, Karachi, Rawalpindi/Islamabad and Multan's achievement of target sales was among the lowest.

Figure 3.4
Actual as Percentage of Target Sale in 2012

(%)



When enquired as to why the sales target was not attained, the principal reasons given are bad law and order situation, high level of power outages, and market related factors, principally high inflation. (See Table 3.8).

Table 3.8
Reasons Why Production Target was Not Attained*

(%)

Reason for Not Attaining Targets	Whole sale Retail Trade Establishments	Restaurant and Hotel	Transport and communication	Finance, Insurance, Real Estate & Business Services	Community, Social and personal Services	Total
Power outages	83	79	29	29	88	73
Law and order	81	79	65	100	92	83
High inflation & market competition	46	55	47	50	44	48
Shortage or high cost or raw materials	16	12	18	8	20	15
Other reasons	66	52	53	38	72	60

*accounts for multiple responses

CHAPTER 4
THE INCIDENCE OF LOADSHEDDING AND OUTPUT LOSSES

This Chapter quantifies the incidence of loadshedding and the resulting output losses as revealed by the national sample of commercial/services establishments.

4.1 INCIDENCE AND PROFILE OF LOADSHEDDING

The costs of loadshedding will, to a large extent, depend on the frequency and duration of outages. The incidence of loadshedding is given in Table 4.1. Overall, the average number of outages in Pakistan in 2012 is estimated at 989[2]. Highest number of times outages have occurred in Punjab at 2189, followed by Balochistan at 1077, and K-PK, 947. Clearly, the average incidence is lower in Sindh, of 673 times a year at over 30% below the national average.

Table 4.1
Frequency of Loadshedding in 2012

By Province	
Location	**Average**
Punjab	2189
Sindh	673
KPK	947
Balochistan	1077
Total	**989**
By Sector	
Whole sale Retail Trade Establishments	1078
Restaurant and Hotel	834
Transport and communication	880
Finance, Insurance, Real Estate & Business Services	905
Community, Social and personal Services	933
Total	**989**

Sector-wise, the highest incidence was experienced by the wholesale and retail trade establishments (1078) followed by community, social and personal services (933) and finance, insurance, real estate and business services (905).

The distribution of outages by duration is given in Table 4.2. Generally, the outage duration is 1 to 3 hours a day. The highest number of outages occurs for 1 to 2 hours a day (61 percent), followed by outages of 2-3 hours a day (23 percent). 11 percent of outages have duration of half to one hour while 3 percent of outages last for over four hours. There is a divergence in the provincial patterns. In Punjab, over 80 percent of the outages last for 1-2 and 2-3 hours. In Sindh almost three-fourths of the outages last for 1-2 hours. In Balochistan 80 percent of the outages are of 2-3 hours. This pattern of outages is likely to have significant implications for the costs of outages as will be discussed in Chapter 6.

[2] from January to September 2012. The annual incidence was estimated by multiplying by 1.33.

Table 4.2
Percentage Distribution of Average Length of Outages, 2012

(%)

By Province					
Location	**Less than ½ hr**	**1/2 – 1hr**	**1-2 hrs**	**2-3 hrs**	**More than 4 hrs**
Punjab	0	15	66	15	4
Sindh	2	14	73	8	0
KPK	0	0	51	43	5
Balochistan	0	0	20	80	0
Total	**0**	**11**	**61**	**23**	**3**
By Sector					
Whole sale Retail Trade Establishments	0	15	57	24	4
Restaurant and Hotel	0	6	56	29	6
Transport and communication	0	0	71	29	0
Finance, Insurance, Real Estate & Business Services	0	4	75	21	0
Community, Social and personal Services	3	11	69	14	0
Total	**0**	**11**	**61**	**23**	**3**

Table 4.3
Duration of Outages
(Outage + Restart Time) [Hours]

By Province	
Location	**Average**
Punjab	1743
Sindh	979
KPK	2025
Balochistan	2618
Total	**1697**
By Sector	
Whole sale Retail Trade Establishments	1796
Restaurant and Hotel	1531
Transport and communication	1635
Finance, Insurance, Real Estate & Business Services	1550
Community, Social and personal Services	1633
Total	**1697**

The overall duration of outages, which includes both the time lost due to an outage and the restart time (time lost in restarting work following an outage), is presented in Table 4.3. The total hours, on an average, lost per annum due to loadshedding are estimated at 1697 for the sample units. The highest number of hours lost are in Balochistan and K-PK . Overall in Punjab, the average number of hours lost per annum is 1743, in Sindh 979, K-PK 2025 and Balochistan, 2618. These durations are for 24hrs a day for 365 days a year. Clearly, the actual total time lost depends on working hours during the year. Wholesale, retail trade, transport and communications and community, social and personal services establishments take the brunt, losing respectively 1796 and around 1635 hours.

4.2 EXTENT OF TOTAL TIME LOST

The proportion of production time lost is given in Table 4.4. Overall, commercial establishments in Pakistan, on an average, are likely to lose 19 percent of their working time in 2012 due to loadshedding. The highest, 30 percent, is lost in Balochistan, and the least, 11 percent, in Sindh. Wholesale, retail trade, transport and communications and community, social and

personal services establishments lose about 19-20 percent of their production time, while the minimum loss is for restaurants and hotels, at 17 percent.

Table 4.4
Proportion of Time Lost during outages

(%)

By Province	
Cities	**Average**
Punjab	20
Sindh	11
KPK	23
Balochistan	30
Total	**19**
By Sector	
Whole sale Retail Trade Establishments	20
Restaurant and Hotel	17
Transport and communication	19
Finance, Insurance, Real Estate & Business Services	18
Community, Social and personal Services	19
Total	**19**

4.3 SEASONALITY OF OUTAGES

A significant seasonality in the incidence of loadshedding emerges from the data (see Table 4.5). The peak loadshedding months are July (accounting for almost 16% of the hours of loadshedding) closely followed by June and August. May also emerges as a high incidence month, accounting for over 14% of loadshedding hours. The pattern appears to be similar for all four provinces and business establishments.

Table 4.5
Seasonality in Outages
(% of Outage)

By Province							
Province	**March**	**April**	**May**	**June**	**July**	**August**	**September**
Punjab	13	14	14	15	16	15	14
Sindh	14	14	14	14	15	15	14
KPK	11	12	14	17	18	15	13
Balochistan	13	14	14	15	16	15	14
Total	**13**	**13**	**14**	**15**	**16**	**15**	**13**
By Sector							
Whole sale Retail Trade Establishments	13	13	14	16	16	15	13
Restaurant and Hotel	13	13	14	16	16	15	13
Transport and communication	13	13	15	16	16	14	12
Finance, Insurance, Real Estate & Business Services	13	14	14	15	16	15	14
Community, Social and personal Services	13	14	14	15	16	15	13
Total	**13**	**13**	**14**	**15**	**16**	**15**	**13**

4.4 EXTENT OF OUTPUT LOST DURING OUTAGES

Loadshedding leads to a complete shutdown for 10 percent of sample units, with highest proportion being in Punjab. However, for 54 percent of the firm it results in partial shutdown. (see Table 4.6).

Table 4.6
Nature of Impact of Loadshedding

(%)

	Complete Shutdown	Partial Shutdown	No Impact
By Province			
Punjab	15	50	35
Sindh	6	41	53
KPK	3	73	24
Balochistan	0	80	20
Total	10	54	36
By Sector			
Whole sale Retail Trade Establishments	11	53	36
Restaurant and Hotel	0	71	29
Transport and communication	6	41	53
Finance, Insurance, Real Estate & Business Services	13	50	38
Community, Social and personal Services	14	53	33
Total	**10**	**54**	**36**

In the questionnaire the respondents were asked to rank 'what is most disruptive about an outage'. For about 37 percent of the respondents, loss of sales was the most disruptive consequence of loadshedding, for 30% it was establishment/equipment shut down and for, 26 percent, idle labor (see Table 4.7). Loss of customers was cited as the other disruption.

Table 4.7
Ranking of Disruptions Due to Outages

(%)

	Equipment Shut down	Labor will be idle	Sales will be lost	Loss of Customers	Total
By Province					
Punjab	30	27	33	9	**100**
Sindh	47	22	31	0	**100**
Karachi	44	26	30	0	**100**
KPK	11	30	46	14	**100**
Balochistan	25	20	55	0	**100**
Total	**30**	**26**	**37**	**7**	**100**
By Sector					
Whole sale Retail Trade Establishments	28	29	34	10	**100**
Restaurant and Hotel	32	15	41	12	**100**
Transport and communication	18	29	53	0	**100**
Finance, Insurance, Real Estate & Business Services	29	21	46	4	**100**
Community, Social and personal Services	44	28	28	0	**100**
Total	**30**	**26**	**37**	**7**	**100**

CHAPTER 5
ADJUSTMENTS TO LOADSHEDDING

This chapter focuses on the types of adjustments that firms make to outages in Pakistan. The extent of sales/output that is not recovered following the adjustments is also quantified.

5.1 NUMBER AND TYPES OF ADJUSTMENTS

Table 5.1 presents the estimates of frequency of different types of adjustments by commercial/service establishments. It appears that almost 39 percent of the firms in the sample are unable to make any form of adjustment. 57 percent make one adjustment, 2.5 percent make two types of adjustment while less than 2 percent are implementing three or more types of adjustments.

Table 5.1
Percentage of Sample Units by Number of Adjustments by Group

	No Adjustment	One Adjustment	Two Adjustments	Three or More Adjustments	Total
By Province					
Punjab	34.9	59.7	3.1	2.3	**100**
Sindh	33.3	60.8	3.9	2.0	**100**
KPK	48.6	51.4	0.0	0.0	**100**
Balochistan	60.0	40.0	0.0	0.0	**100**
By Sector					
Whole sale Retail Trade Establishments	46.8	50	1.6	1.6	**100**
Restaurant and Hotel	20.6	73.5	5.9	0	**100**
Transport and communication	35.3	64.7	0	0	**100**
Finance, Insurance, Real Estate & Business Services	37.5	50	4.2	8.3	**100**
Community, Social and personal Services	30.6	66.7	2.8	0	**100**
Total	**38.8**	**57**	**2.5**	**1.7**	**100**

The frequency of different types of adjustments is given in Table 5.2. The highest frequency of adjustment is in the form of self-generation. For the national sample, this is 60 percent. It is the highest in Punjab, follow by Sindh, and the lowest in Balochistan. On average generators are able to substitute for 58 percent of the public source.

Beyond the use of generators, some firms adjust by working overtime and some by changing shift timings. These adjustments are practiced in Punjab and Sindh while no adjustment, other than the purchase of generator, is tried in K-PK and Balochistan.

Clearly for the commercial/services sector the mechanism to reduce the impact of loadshedding is primarily limited to acquiring self- generation capability. As shown in Table 5.3, either the establishment runs a generator and recovers his lost time/sales or it makes no adjustment at all.

Table 5.2
Percentage of Sample units Adjusting through Various Mechanisms

(%)

	Buying or Operating Existing Generator	Working Overtime	Changing Shift Timings	Changing Working Days
By Province				
Punjab	64	5	3	0
Sindh	63	8	0	4
KPK	51	0	0	0
Balochistan	40	0	0	0
Total	**60**	**5**	**2**	**1**
By Sector				
Whole sale Retail Trade Establishments	52	4	1	2
Restaurant and Hotel	79	3	3	0
Transport and communication	65	0	0	0
Finance, Insurance, Real Estate & Business Services	63	13	8	0
Community, Social and personal Services	67	6	0	0
Total	**60**	**5**	**2**	**1**

Table 5.3
Number of Adjustments by Firms with and without Generators

(%)

Numbers of Adjustments	Units without Generators	Units with Generators*
None	96.8	0.0
One	2.1	93.7
Two	1.1	3.5
Three or more	0.0	2.8
Total	**100**	**100**

*including the one adjustments of use of generator.

5.2 EXTENT OF LOSS OF SALES/ OUTPUT IN OUTAGES

Table 5.4 highlights the extent of the permanent loss of sales/output which is not recovered through the various adjustments. Overall, it is over 4 percent nationally, 4 percent in Punjab, 2 percent in Sindh, 6 percent in K-PK and about 8 percent in Balochistan. These losses are a key indicator of the magnitude of net idle factor costs.

The losses of wholesale, retail trade and community, social and personal services establishments are 4-5 percent while losses of restaurants and hotels are the least, around 3 percent.

Table 5.4
Proportion of output Loss Not Recovered

(%)

By City	
Location	**Average**
Punjab	4.1
Sindh	2.1
KPK	6.2
Balochistan	7.7
Total	**4.3**
By Sector	
Industrial Group	**Average**
Whole sale Retail Trade Establishments	4.9
Restaurant and Hotel	3.1
Transport and communication	3.5
Finance, Insurance, Real Estate & Business Services	3.5
Community, Social and personal Services	4.2
Total	**4.3**

CHAPTER 6
OUTAGE COSTS

The objective of this chapter is to present the estimated magnitudes of different types of costs associated with outages. As identified in chapter 2, these include direct costs which consist of net idle factor costs and spoilage costs and indirect or adjustments costs which include generator costs and costs of other types of adjustments like overtime, additional shifts, etc.

Section 1 of the chapter presents the total outage costs by location (province), and sector. Section 2 derives the cost per kwh of load shedding. Finally, by blowing up the sample, the magnitude of outage costs to the commercial sector of Pakistan is derived.

6.1. TOTAL OUTAGE COSTS

Given the high frequency of outages, the outage costs are high in absolute terms even for small shops and other commercial establishments. Table 6.1 shows that the outage costs per sample unit are above Rs 100,000 on average.

Table 6.1
Total Outage Costs per Unit

(Rs in 000s)

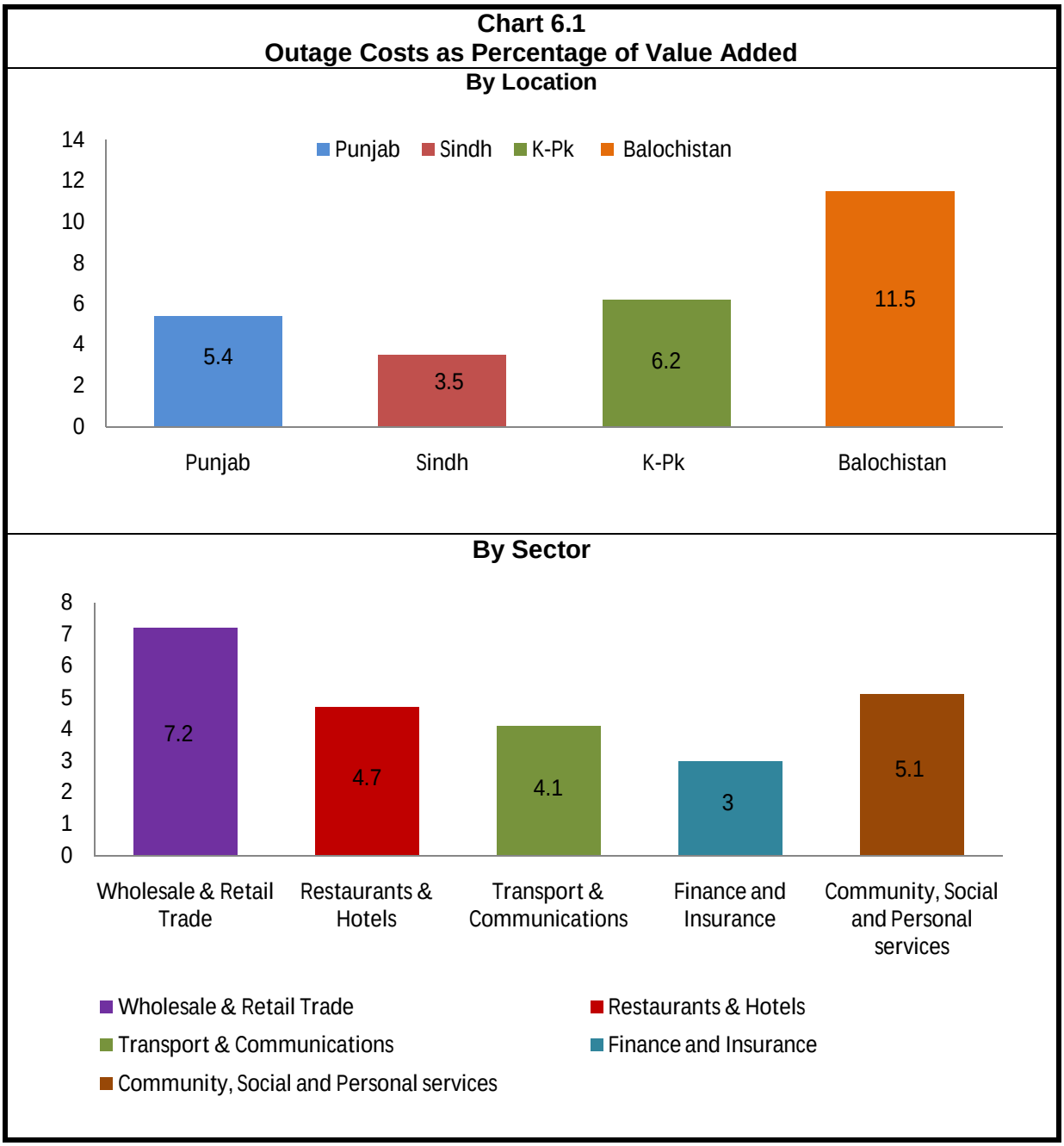
		Costs			
	Sample Size	**Net Idle Factor Cost**	**Spoilage Cost**	**Generator Costs**	**Total Outage Costs**
Location					
Punjab	129	76	10	36	122
Sindh	55	24	3	25	52
K-Pk	37	84	7	39	130
Balochistan	20	84	8	13	105
Sector					
Wholesale & Retail Trade	128	67	10	24	101
Restaurants & Hotels	35	57	9	50	116
Transport & Communications	17	155	3	51	209
Finance and Insurance	25	41	-	21	62
Community, Social and Personal services	36	47	2	44	93
Total	**241**	**66**	**7**	**32**	**105**
Share(%)		(63)	(7)	(30)	(100)

Outage costs per unit are the highest in the cities of Punjab and K-PK at Rs 130,000 and 122,000 respectively. They are the lowest in Karachi and other cities of Sindh at Rs 52,000, due primarily to substantially lower net idle factor costs.

Among sectors, the highest outage cost is observed in the case of transport and communications at an average of Rs 209,000, followed by restaurants and hotels at Rs 116,000. Units operating in the financial sector have the lowest cost of Rs 62,000.

Overall, the dominant component in outage costs is idle factor cost with a share of 63%. Next in importance are generator costs at 30%. Spoilage costs account for only 7 percent of the total outage cost.

Chart 6.1
Outage Costs as Percentage of Value Added



6.2. BURDEN OF OUTAGE COSTS

The burden of outage costs in relation to the value added is given in Table 6.2. Overall, for the sample units, outage costs are 5.4 percent of the value added. Within the provinces, the highest burden is in Balochistan, due particularly to a relatively value added per unit.

Within sectors, wholesale and retail trade establishments have the highest incidence of outage costs on value added at over 7 percent. This is the lowest in units operating in the financial sector.

Table 6.2
Outage Costs as Percentage of Value Added

(Rs in 000)

	Sample Size (No)	Total Outage Cost	Value Added	Outage Cost as % of Value Added
Location				
Punjab	129	122	2252	5.4
Sindh	55	52	1503	3.5
K-Pk	37	130	2106	6.2
Balochistan	20	105	917	11.5
Sector				
Wholesale & Retail Trade	128	101	1404	7.2
Restaurants & Hotels	35	116	2472	4.7
Transport & Communications	17	209	5062	4.1
Finance and Insurance	25	62	2062	3.0
Community, Social and Personal services	36	93	1824	5.1
Total	**241**	**105**	**1948**	**5.4**

6.3. OUTAGE COST PER KWH

Table 6.3 indicates that the outage cost per kwh is approximately Rs 68(70 cents). This is 33 percent higher than the outage cost per kwh to small-scale industry. As such, this is consistent with findings of studies in other countries, as highlighted in Part I of the Report.

The outage cost per kwh in commercial/service establishments is the highest in K-PK at Rs 97 ($1). Among sectors, the highest cost per kwh is observed in the case of units from transport and communications at Rs 102 (105 cents). The lowest cost is incurred per kwh in the case of wholesale and retail trade establishments at Rs 61 (63 cents).

6.4. NATIONAL ESTIMATE OF OUTAGE COSTS

Data on value added in different service sectors is available in the Pakistan Economic Survey for the latest year, 2011-12. As such, the ratio of the outage cost to the value added in each sector is used for blowing-up to arrive at the national estimate of outage costs in the commercial sector[3] of the economy. These estimates are presented in Table 6.4.

Table 6.3
Outage Cost per kwh

	Sample Size (No)	Total Outage Cost (Rs in 000)	Electricity not Provided (000 kwh)	Outage Cost per kwh (Rs)
Location				
Punjab	129	122	1.76	69.3
Sindh	55	52	0.73	71.2
K-PK	37	130	1.34	97.0
Balochistan	20	105	2.82	37.2
Sector				
Wholesale & Retail Trade	128	101	1.67	60.5
Restaurants & Hotels	35	116	1.69	68.6
Transport & Comm	17	209	2.05	101.9
Finance & Insurance	25	62	0.97	63.9
Community, Social and Personal Services	36	93	1.16	80.2
Total	**241**	**105**	**1.55**	**67.7**

Table 6.4
Total Cost of Outages to the Commercial Sector

	Outage Cost as % of Value Added (%)	Value Added 2011-12 (Rs in Billion)	Outage Cost (Rs in Billion)
Sector			
Wholesale & Retail Trade	7.2	3181	229
Restaurants & Hotels	4.7	393	18
Transport & Communication	4.1	2477	102
Finance & Insurance	3.0	460	14
Community, Social and Personal Services	5.1	2134	109
Total			**472**

The largest cost of outages is in wholesale and retail trade, which is also the largest sector in terms of value added. The other sectors which have high costs are community, social and personal services and transport and communications. **Overall, the total cost of outages in the commercial/service sectors is estimated in 2011-12 at Rs 472 billion, equivalent to almost 2.4% of the GDP.**

[3] Public administration and defense has been excluded from the analysis because the value added in this sector consists primarily of wages and salaries of employees. This is taken as the measure of value added. These are likely to be unaffected by outages, especially in the absence of adjustments. Also, spoilage costs are minimal.

CHAPTER 7
LOAD MANAGEMENT STRATEGY: CONSUMER'S PREFERENCES

The questionnaire contains a module to solicit consumer preferences regarding timing of loadshedding which can reduce the costs and disruptions due to the outages. These can provide guidance to the load management strategy by DISCOs, the formulation of which should be a priority since loadshedding is likely to persist over the next few years.

Table 7.1
Percentage of Time DISCOs Kept to the Announced Loadshedding Schedule

By Province	
	Average
Punjab	20
Sindh	5
KPK	11
Balochistan	4
Total	**14**
By Sector	
Whole sale Retail Trade Establishments	15
Restaurant and Hotel	12
Transport and communication	5
Finance, Insurance, Real Estate & Business Services	17
Community, Social and personal Services	14
Total	**14**

7.1 LEVEL OF SATISFACTION WITH CURRENT LEVEL OF SERVICE

Only 14 percent of sample firms indicated that DISCOs kept to the announced loadshedding schedule (see Table 7.1). The percentage is significantly higher for cities in Punjab. Performance of DISCOs in Sindh and Balochistan in this respect is particularly weak, with effectively no prior scheduling. This has had a significant impact on the costs of loadshedding. The time required for establishments to adjust to changes in the loadshedding schedule is 1 hour on an average. (See Table 7.2).

Table 7.2
Average Time Required for Adjustment to Changes in Loadshedding Schedule
(%)

By Province	
	Average
Punjab	1
Sindh	0
KPK	1
Balochistan	1
Total	1
By Sector	
Whole sale Retail Trade Establishments	1
Restaurant and Hotel	1
Transport and communication	0
Finance, Insurance, Real Estate & Business Services	1
Community, Social and personal Services	3
Total	1

The survey teams enquired from the respondents if they were satisfied with the current level of service by the DISCOs/KESC. More than half of the respondents ranked their satisfaction level as very low while about 30 percent ranked it as low (see Table 7.3).

Table 7.3
Level of Satisfaction with Current quality of Service by DISCOs/KESC

(%)

	Very high	High	Medium	Low	Very Low
By Province					
Punjab	1	0	11	31	57
Sindh	2	6	25	33	33
KPK	3	0	6	22	69
Balochistan	0	0	0	20	80
Total	1	1	12	29	56
By Sector					
Whole sale Retail Trade Establishments	2	1	14	29	55
Restaurant and Hotel	0	0	3	27	70
Transport and communication	0	0	0	35	65
Finance, Insurance, Real Estate & Business Services	0	4	21	17	58
Community, Social and personal Services	3	3	17	39	39
Total	1	1	12	29	56

The sample firms were also asked how much higher tariff they are willing to pay for better quality and reliability of power service–essentially with no loadshedding. This provides the first estimate of the respondent's perception of the cost of loadshedding. On an average, respondents are willing to pay an extra 35 percent for uninterrupted power supply as revealed by Table 7.4. The premium for better service is highest around 45 percent in K-PK.

Wholesale, retail trade and transport and communications units, it appears, have indicated their willingness to pay the highest additional premium for better quality service.

Translated into the subjective valuation of the outage cost per hour, the average for the sample units is Rs 38 per Kwh. The willingness to pay is highest, at Rs 73 per kwh in Sindh (See Table 7.5).

Table 7.4
Additional Tariff For Better Quality of Service (with No Loadshedding)

(%)

By Province	
	Average
Punjab	34.3
Sindh	36.2
KPK	45.4
Balochistan	25.3
Total	35.7
By Sector	
Whole sale Retail Trade Establishments	38.5
Restaurant and Hotel	33.1
Transport and communication	34.4
Finance, Insurance, Real Estate & Business Services	30.4
Community, Social and personal Services	32.2
Total	**35.7**

Table 7.5
Perceived Outage Costs per Kwh as implied by Willingness To Pay

Rs

Location	**Average**
Punjab	29.1
Sindh	73.0
KPK	32.6
Balochistan	12.2
Total	**37.7**
By Sector	
Whole sale Retail Trade Establishments	38.4
Restaurant and Hotel	31.8
Transport and communication	31.1
Finance, Insurance, Real Estate & Business Services	35.6
Community, Social and personal Services	45.3
Total	**37.7**

7.2 PREFERRED CHANGES IN TIMINGS OF LOADSHEDDING

About 96 percent of the sample firms reported summertime as the worst season for loadshedding (see Table 7.6). Winter time is the second worst season for loadshedding. Interestingly, transport and communications is the dominant industry categorizing wintertime as bad season.

Table 7.6
Worst Time of The Year for Loadshedding

	Rank				
	Summer	**Spring**	**Winter**	**Fall**	**Total**
By Province					
Punjab	97	0	3	0	100
Sindh	94	2	4	0	100
KPK	97	3	0	0	100
Balochistan	95	0	0	5	100
Total	**96**	**1**	**3**	**0**	**100**
By Industrial Group					
Whole sale Retail Trade Establishments	98	2	0	0	100
Restaurant and Hotel	94	0	6	0	100
Transport and communication	88	0	12	0	100
Finance, Insurance, Real Estate & Business Services	96	0	0	4	100
Community, Social and personal Services	94	0	6	0	100
Total	**96**	**1**	**3**	**0**	**100**

The questionnaire also contained a question regarding the worst day of the week for outages. While 35 percent of the respondents said all days are bad, about one-fourths said Monday is the worst day. Sunday was the worst day for about 15 percent of the respondents. The principal reasons cited for this is related to the fact that Monday is the start of a work week and an outage disturbs the working environment. Sunday, of course, is family/rest day and loadshedding disturbs it. Around 20 percent of the respondents indicate that will be helpful if the power companies provided more information relating to the methods to save electricity, information about outages and the scheduling of the outage (see Table 7.8). Clearly, these should be focused upon in the load management strategy of the distribution companies.

Table 7.7
The Worst Day of The Week for Outages

	Frequency	**Percentage**
Sunday	36	15.2
Monday	57	24.1
Tuesday	3	1.3
Wednesday	2	.8
Thursday	14	5.9
Friday	27	11.4
Saturday	15	6.3
All days equal	83	35.0
Total	**237**	**100.0**

Table 7.8
Information that can be provided by Distribution companies to Units

	Percentage
Save electricity	48.9
Information about outage	38.3
Time table for load shedding	23.4
Awareness about outage required	2.1
Others	17.0

CHAPTER 8
SUGGESTIONS BY THE SAMPLE UNITS

The questionnaire at the end solicited the respondent's views/ suggestions to help handle the loadshedding problem in the country. Specifically, the open ended question asked for "suggestions to reduce the costs of loadshedding". A number of interesting suggestions emanate from the survey responses. These can be categorized as relating to the following:

- Enhancing the supply of electricity
- Alternative sources of energy/ fuel use
- Improving governance or management
- Changes in pricing policy

Enhancing the Supply of Electricity: About half of the respondents are of the view that new dams, including Kala Bagh Dam, should be constructed to permanently enhance the supply of electricity in the country at low costs (see Table 8.1). This suggestion dominates the response not only from the sample units located in Punjab, but is also significant in the case of Peshawar and Quetta. One quarter of the respondents also think that new power plants should be built while close to a fifth of respondents each are also of the view that electricity should be imported and gas pipeline from Iran should be installed to avoid gas shortages. Responses are more or less, similar across type of commercial activities. (See Table 8.2**)**

Alternative sources of Energy Fuel for Energy: A number of suggestions have been given regarding resort to alternative energy and fuel sources by the respondents. Over one-fifths of the respondents suggested the use of different methods of electricity generation, while 20 percent specifically suggested the use of coal for electricity generation. Close to 7 percent of the sample units suggested introduction of solar energy systems (particularly by restaurants and hotels, finance, insurance, real estate and business services and transport and communications establishments).

Improving Governance/Management. The most dominant recommendation in this category is to minimization of electricity theft, with over a quarter of respondents emphasizing it. Curbing of corruption has been suggested by 17 percent of the respondents. Need for honest employees, minimization of line losses and awareness creation for proper use of electricity along with privatization of the DISCOs were also cited as possible mechanisms to lower loadshedding costs.

Table 8.1
Suggestions by Sample Units by City
(% of Respondents)

	Lahore	Faisalabad	Gujranwala	Multan	Sialkot	Rawalpindi / Islamabad	Karachi	Hyderabad	Peshawar	Mardan	Abbotabad	Quetta	Total
Enhancing Supply of Electricity													
Gas Pipe line from Iran to avoid gas shortage	14	14	22	0	0	27	30	13	8	67	17	15	19
Import Electricity	14	95	11	14	0	3	23	0	8	50	0	15	20
Construct new Dams (including Kala-Bagh Dam)	63	67	56	43	40	62	21	0	64	50	67	45	50
Use rental power system	7	0	0	0	0	0	12	0	0	0	0	0	3
Build new power plants	40	10	67	50	0	24	19	0	24	0	0	5	24
Alternative Energy Fuel Sources													
Use Coal for electric generation	12	29	44	7	0	8	44	13	16	0	0	20	20
Use different method of electric generation	37	10	78	0	60	14	9	25	24	0	17	30	22
Bio Gas system	0	0	0	0	0	0	2	0	0	0	0	0	0
Introduce solar energy System	12	0	0	14	0	5	2	13	20	17	0	0	7
Introduce wind energy	0	0	0	0	0	0	0	0	0	0	17	0	0
Governance/Management													
Privatize Electric department	0	0	0	0	0	0	2	0	4	0	0	0	1
Need Honest Employees	0	0	0	0	0	16	5	0	0	0	0	0	3
Minimize electric theft	28	14	11	14	20	24	35	38	16	0	50	40	26
Stop Corruption	19	19	0	14	0	16	7	63	28	0	17	20	17
Minimize line losses	0	0	0	0	0	3	0	63	0	0	0	0	3
Give awareness to people use of electricity	0	0	0	0	0	0	0	38	0	0	17	0	2
Pricing Policy													
Government give subsidy on electricity	26	19	11	14	0	5	23	0	4	0	0	40	16
Reduce price at source	21	10	0	0	60	46	30	13	4	0	17	5	20
Total	**18**	**9**	**4**	**6**	**2**	**16**	**18**	**3**	**11**	**3**	**3**	**8**	

Table 8.2
Suggestions by Sample Units by Sector
(% of Respondents)

	Whole sale Retail Trade Establishments	Restaurant and Hotel	Transport and communication	Finance, Insurance, Real Estate & Business Services	Community, Social and personal Services	Total
Enhancing Supply of Electricity						
Gas Pipe line from Iran to avoid gas shortage	21	18	18	13	17	19
Import Electricity	19	18	29	17	25	20
Construct new Dams (including Kala Bagh Dam)	44	59	41	71	50	50
Use rental power system	2	0	0	4	11	3
Build new power plants	24	21	29	21	25	24
Alternative Energy Fuel Sources						
Use Coal for electric generation	21	24	18	17	17	20
Use different method of electric generation	24	29	6	8	25	22
Bio Gas system	1	0	0	0	0	0
Introduce solar energy System	5	18	12	13	0	7
Introduce wind energy	1	0	0	0	0	0
Governance/Management						
Privatize Electric department	0	6	0	0	0	1
Need Honest Employees	3	6	0	4	3	3
Minimize electric theft	29	18	12	33	22	26
Stop Corruption	16	18	29	33	3	17
Minimize line losses	3	0	6	4	0	3
Give awareness to people use of electricity	2	3	0	0	3	2
Pricing Policy						
Government give subsidy on electricity	17	6	12	8	31	16
Reduce price at source	21	9	12	17	33	20
Total	53	14	7	10	15	

Pricing Policy Around one-fifth of the sample units suggested that the price (at source) should be reduced through economizing on costs while 16 percent requested for subsidy for electricity from the government.

To conclude, the top five suggestions emanating from the respondents of the survey are as following:

First: Construct Dams

Second: Minimize Electricity theft.

Third: Build New Power Plants

Fourth: Use Different Methods of Electricity Generation

Fifth: Import Electricity and Reduce Prices at Source (Cost Minimization)

CHAPTER 9
CONCLUSIONS AND POLICY IMPLICATIONS

We have highlighted in previous Chapters the principal findings on the incidence of outages in commercial/services sectors of the economy. In this concluding Chapter we derive the key policy implications, starting with estimates of the multi-dimensional impact of power loadshedding on service establishments in the country.

9.1. IMPACT OF OUTAGES

The estimated impact of outages is as follows:

(i) Outages, on the average, occur for 19 percent of the time available during operating hours. The proportion of business/sales/output lost permanently is 4 percent. This implies an over 15 percent fall in profitability.

(ii) The outage cost per kwh works out at Rs 68 per kwh (70cents). This is 33 percent higher than the corresponding cost to small-scale industry.

(iii) The employment in services, according to the Labor Force Survey of 2010-11 of PBS, is 17.6 million. With a lower output of 4 percent and an employment elasticity of 0.6, the employment level would have been higher in the absence of outages by about 422,000.

(iv) Within services, the cost of outages appears to be the highest in Punjab and K-PK and in establishments in transport and communications and wholesale and retail trade.

9.2. AFFORDABILITY OF HIGHER TARIFFS

The total costs of electricity consumption, that is, the costs of public supply and of outages costs, as a percentage of the value of production are given in Table 9.1.

On average, these costs aggregate to 6 percent of the value of production, with the highest percentage in Balochistan (due primarily to low value of production/sales) and in the case of wholesale and retail trade establishments. The corresponding percentage in the case of small-scale industrial sector is 12 percent. Therefore, the affordability of higher tariffs is somewhat higher in services. But the likelihood of organized large-scale protests by this sector is greater in response to a hike in tariffs, in the presence of poor quality of service by DISCOs/KESC.

Table 9.1
Total Costs of Electricity Consumption as a percentage of the Value of Production

(Rs in 000s)

	Electricity Cost			Value of Production/Sales*	Electricity Cost as % of the Value of Production/Sales
	of public supply	Total outage cost	Total Cost		
Location					
Punjab	220	122	342	5630	6.1
Sindh	161	52	213	3757	5.7
K-PK	145	130	275	5265	5.2
Balochistan	165	105	270	2293	11.8
Sector					
Wholesale & Retail Trade	171	101	272	3510	7.7
Restaurants & Hotels	334	116	450	6180	7.3
Transport & Comm	253	209	462	12655	3.7
Finance & Insurance	121	62	183	5155	3.5
Community, Social and Personal Services	135	93	228	4560	5.0
Total	**190**	**105**	**295**	**4870**	**6.0**

*Assumed at 2.5 times of value added

9.3. POLICY IMPLICATIONS FOR LOAD MANAGEMENT

(1) 60 percent of the Sample Units have acquired generators, mostly of small capacity (<5KVA). There is need to extend the sales tax exemption to small generators, beyond the elimination of import duty, in view of the high benefit-cost ratio of investment in generators of over 2.4:1.

(2) On the average, units are willing to pay 36 percent higher tariffs for reliable power supply (with minimal outages). The highest willingness to pay is in Sindh, followed by Punjab. The subjective valuation, of outage costs per kwh on average is Rs 37.7 kwh.
Therefore, the subjective valuation is 55 percent of the actual estimated outage cost per kwh. There is need to undertake cost-benefit analysis of improving reliability of supply. This likely to be very high at over 5:1.

(3) The sample units report that the DISCOs/KESC adhered to the announced loadshedding schedule only 14 percent of the time. The performance appears to be the worst of KESC and HESCO. On the average, commercial sector establishments require one hour to adjust to a change in the schedule of outages. Clearly, much more discipline has to be exercised by DISCOs/KESC in adherence to pre-announced schedule of outages.

(4) The worst season for outages is summer, as reported by 96 percent of the units. The two days of the week which are considered the worst for outages are Monday and Friday, as reported by 68% and 17 percent of the units respectively. Seasonal and day-to-day variation in tariffs may be considered.

(5) The level of satisfaction with the service provided is 'very low' in the case of 56 percent of the units and 'low' according to 29 percent of the units. This highlights the virtually total loss of confidence of consumers with the power distribution system.

(6) The principal suggestions by responding units for reducing the incidence of loadshedding can be classified in four categories as follows:

I.	**Better Management of the Power Sector**	**% of Units***
	• Minimize electricity theft	18
	• Stop corruption	16
	• Honest employees be hired	3
	• Minimize line losses	1
	• Give awareness to people for efficient use	2
II.	**Expand Capacity**	
	• Construct new dams (including Dam)	29**
	• Build new power plants	19
	• Import electricity	15
	• Gas pipeline from Iran	15
	• Use rental power	2
III.	**Develop Alternative Sources**	
	• Use coal for electricity generation	19
	• Use different method for electricity generation	16
	• Introduce solar energy	3
	• Use biogas	1
IV.	**Pricing Policy**	
	• Reduce price at source	9
	• Give subsidy	9

*The total adds up to more than 100 due to multiple responses by units.

**36% of the responses were from outside Punjab.

It is interesting to note the relatively higher incidence of suggestions for improving the management of the power sector and the development of alternative sources of energy. Also, the highest response relates to the construction of new dams.

TECHNICAL ANNEXURE
FIRM BEHAVIOR IN THE PRESENCE OF OUTAGES

We make the assumption that the firm is 'small' and competitive Input and Output Markets. We designate the following variables:

p = exogenously given price of output

w = wage rate

r = cost of capital

The firm is a profit maximising agent

We also have variables related to outages as follows:

ε = proportion of time lost due to outages

θ = proportion recovery through adjustments

CA = Cost of Adjustments

m = consumption of electricity per unit of time

π = pf(K,L) [$\underbrace{1 - \varepsilon + \theta_{\varepsilon}}_{B}$] – wL – rK- CA ($\theta \in m$)

$\frac{\partial \pi}{\partial K}$ = p$\frac{\partial F}{\partial K}$.B – r = 0 ……..(1)

$\frac{\partial \pi}{\partial L}$ = p$\frac{\partial F}{\partial K}$.B – w = 0 ……(2)

q = f(K,L)B

$\frac{\partial \pi}{\partial \theta}$ = p.q.ε - $\frac{\partial AC}{\partial KW}$. (m ε) = 0

= pq - $\frac{\partial AC}{\partial KW}$. m = 0 ……..(3)

Therefore, p.[$\frac{q}{m}$] - $\frac{\partial AC}{\partial KW}$ = 0

As such, the probability of $\frac{\partial \pi}{\partial \theta_{\theta=0}}$ > 0 depends on the following factors:

i. How high p is. That is the extent to which the market situation is favorable for the firm
ii. The electricity intensity of the firm, the lower the intensity the greater the likelihood of the firm making an adjustment
iii. The lower the marginal costs of adjustments by the firm to recover output lost.

It is also likely that in the long run the firm uses less capital and less labor if B < 1.