PART 4

Cost of Loadshedding to Domestic/Residential Sector

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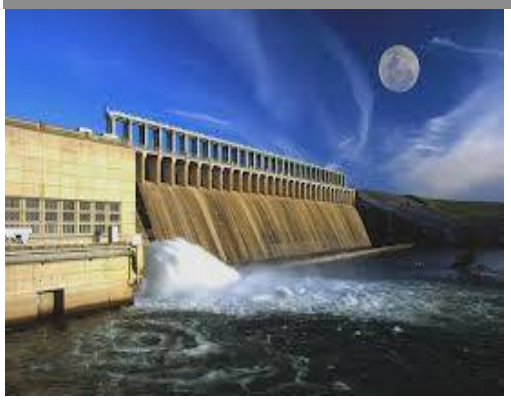

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ACRONYMS

CMI		Census of Manufacturing Industries
DISCO		Distribution Company
HIES		Household Integrated Economic Survey
KESC		Karachi Electric Supply Corporation
K-PK		Khyber-Pakhtunkhwa
OLS		Ordinary Least Squares
PBS		Pakistan Bureau of Statistics
PES		Pakistan Economic Survey
PSLSMS		Pakistan Social and Living Standards Measurement Survey
UPS		Un-interrupted Power Supply
WTP		Willingness to Pay

CHAPTER 1
INTRODUCTION

This part of the report presents the findings on costs of loadshedding to the domestic/residential sector in Pakistan, quantified on the basis of data obtained from a nationwide survey of households.

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. Subsequent Chapters up to Chapter 7 present the magnitudes of key parameters like the relevant characteristics of the responding households, experience of outages, level and pattern of adjustments and the magnitude of different outages costs. Chapter 8 highlights the suggestions by sample households 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 households have faced severe disruptions due to the high and growing incidence of loadshedding. These have led to mass protests on streets resulting in disruption of other economic activities including those of the commercial/industrial sectors. As such, the economic return of reducing outages and of facilitating the process of adjustment to these outages is high.

Thanks are due to the sample households 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
METHODOLOGY FOR QUANTIFICATION OF COSTS

The approach to quantification of outage costs in the case of domestic consumers used by various studies referred to in part I of the Report is one of the following:

2.1. APPROACHES TO QUANTIFICATION OF COSTS TO DOMESTIC CONSUMERS

i. **Value of Leisure**: This approach uses the income per kwh as a measure of the outage cost on the assumption that the value of leisure corresponds to income.

ii. **Standby Generator Cost**: The adjustment to outages by domestic consumers is assumed to be primarily in the form of self-generation. As such, the cost of using the generator is used as the measure of outage cost.

iii. **Willingness to Pay**: In this approach consumers are asked the magnitude of higher tariff that they are willing to pay for reliable public supply (with minimal outages).

Only one study by Balducci [2002] in USA has adopted the survey approach to quantification of the outage cost to consumers.

We review each of the above approaches to quantification of outage costs to domestic consumers in light of the data obtained from the survey of 500 households.

VALUE OF LEISURE APPROACH:

Munasinghe [1980][1] had first suggested this approach based on the observation that outages during the day normally do not affect the performance of household activities like cooking, washing, laundry, etc,. which can be performed at other times when there are no outages. As such, he argued that the only activity which is affected is watching TV and other forms of leisure in the evening. Therefore, the outage cost corresponds to the

Table 2.1
Outage Cost per kwh according to the Value of Leisure Approach*

Group (Rs per Month)	Income** per hour	Electricity Consumption per hour***(kwh)	Outage Cost per kwh (Rs)
0-15000	67.5	0.9	75
15001-35000	144.8	1.5	97
35001-70000	295.5	3.3	90
Above 70000	612.6	5.7	107
Total	**218.3**	**2.4**	**91**

*Y = income per hour worked based on 8 hours a day for 22 days a month.
Kwh = normal power consumption per hour (in public supply)
**Proxied by consumption expenditure, which is assumed to correspond to permanent income
***On the assumption that electricity is consumed 16 hours a day. The consumption of electricity in the evenings is assumed to be three times the daily average.

[1] "Costs Incurred by Residential Electricity Consumers Due to Power Failures", Mohan Munasinghe, Journal of Consumer Research, Vol. 6, March 1980.

value of leisure, which he proxies by income.

The estimated outage cost per kwh for domestic consumers based on this approach is derived from the Survey as Rs 91 per kwh in Table 2.1. This is higher than estimates obtained of outage cost per kwh for small-scale industry and commercial consumers. Therefore, the Munasinghe approach yields very high estimates.

There is another way of examining the validity of assumptions made by Munasinghe. Respondents were asked which activities are disrupted most in the household by loadshedding. The frequency of different responses is given in Table 2.2.

Table 2.2
Activities most Disturbed by Loadshedding

	% of sample units
Cooling/heating	24.4
Studies (home work) of children	18.2
Preparation for work/school	17.4
Regular household work (cooking, cleaning, etc.)	14.6
Shortage of water	13.0
Income generating activities (home based)	8.2
Social Activities	2.2
Entertainment, leisure	2.0
Total	**100.0**

Leisure is reported by only 2 percent of the sample households as the activity most disturbed by loadshedding. Other activities are of greater importance to households, including cooling/heating, studies of children and preparation for work/school reported 24 percent, 18 percent and 17 percent respectively as the principal activity affected by outages. Therefore, the Munasinghe hypothesis that leisure is the activity most disrupted is not borne out by the data obtained from households in Pakistan.

It is our view that the Munasinghe approach has a developed country bias. It cannot be applied in the context of low-to-middle income countries like Pakistan. A significant and new finding is the **impact of outages on children**, either in terms of the ability to undertake studies (homework) or in preparation to go to school.

GENERATOR COST APPROACH

This approach is based on the assumption that the principal form of adjustment to outages by households is the acquisition of a generator and/or a UPS (Uninterrupted Power Supply). As such, the cost of self-generation corresponds to the outage cost.

The question that arises is if a household does not have a generator/UPS then is the outage cost zero? Clearly, this is not the case.

It is likely that there are outage costs, especially in terms of the monetized value of the utility lost due to disturbance to some household activities, but these costs may not be large enough to justify the resort to self-generation.

Table 2.3 gives the percentage of households by level of consumption expenditure with generator and/or UPS. Overall, 28 percent of the households have a generator and 30 percent have UPS. Poorer households generally are unable to self-generate electricity. However, majority of the households in the upper most income group have made arrangements for alternative sources of power at the time of loadshedding.

Table 2.3
Percentage of Sample Households with Generator and/or UPS

	% of Sample Households	
Level of monthly consumption expenditure (Rs)	**With Generator**	**With UPS**
0-15,000	2	4
15,001-35,000	17	26
35,001-70,000	45	47
70,001 and above	75	43
Total	**28**	**30**

Given the high percentage of households which do not have self-generation the issue is one of quantifying the cost of outages in the case of such households.

WILLINGNESS TO PAY

The willingness to pay approach provides the basis for determining the subjective valuation by households of the cost of outages to them. There is, of course, the likelihood of a 'free rider' problem here. A household may understate its willingness to pay on the expectation that other households may reveal a high enough WTP to justify investment in improving the reliability of the power system.

Table 2.4 indicates the outage cost per hour as implied by the WTP. This can be estimated as follows:

$$SOCKW = \left(\frac{WTP}{100}\right)\frac{AEB}{ENS} \quad \ldots\ldots (1)$$

Where,

SOCKW = subjective valuation by household of the outage cost per kwh

WTP = % higher tariff that the household is willing to pay for improved reliability of power supply (with minimal outages)

AEB = Annual electricity bill paid to the DISCO/KESC

ENS = electricity not supplied in the outages.

Table 2.4 Subjective Valuation of the Outage Cost per Hour				
Monthly Expenditure Group	**Willingness to Pay**	**Annual Electricity Bill**	**Electricity not Supplied**	**Subjective Valuation by Household of Outage Cost per Hour**
(Rs)	(%)	(Rs)	(kwh)	(Rs per kwh)
0-15000	30.3	15330	479	9.70
15001-35000	28.7	28836	732	11.31
35001-70000	28.3	65094	1599	11.52
70001 and above	31.8	130590	4299	9.66
Total	**29.2**	**46734**	**1289**	**10.59**

It is interesting to note that while the subjective valuation of the outage cost per hour is somewhat low at below Rs 11 per kwh, it is higher for households belonging to the 'middle class'.

2.2 METHODOLOGY FOR QUANTIFICATION OF OUTAGE COST

The methodology for quantification of outage cost to domestic consumers is qualitatively different from that used in the case of small-scale industry and commercial consumers. The basic reason for this is that there is no notion of 'output' in the case of a household[2], which is more of a consuming unit. As such, outages impact on the level of utility/quality of life of a household.

The exposure to outages daily is given by DLOUT where

$D = \sum_{i=1}^{n} n_i d_i$ ..... **(1)**

Where n_i = number of outages of duration d_i , i = 1, ...n.

The normal level of electricity consumption per hour is given

$e = \frac{(Kwh_1 + Kwh_2)}{8760 - 365D}$ ..... **(2)**

Where, Kwh_1 = electricity purchased from the distribution company during summer months

Kwh_2 = electricity purchased from the distribution company during winter months

The normal consumption of electricity during times when there are no outages depends upon the number of electrical appliances at home. As such,

[2] With the exception of households which engage in some economic activity at home.

*The β_j is estimated by OLS regression across the sample households of electricity consumption per hour with ownership of different types of appliances.

$e = \beta_o + \sum_{j=1}^{m} \beta_j A_j$ ..... (3)

Where, β_j *= electricity consumption by appliance j, where j =1,2,3,……..,m.

A_j = number of appliance j

β_o = basic electricity consumption (e.g. for lighting).

Depending upon the nature of use of particular appliances the share of electricity consumed in different activities like heating/cooling, household functions, entertainment/leisure is derived. That is

$\sum_{k=1}^{r} W_k = 1$ ..... (4)

Where W_k= share in electricity consumption of activity k, k=1,2,……,r.

If a household has a generator then the sample household has reported if a particular activity can be performed during the outages in the presence of a generator, and

P_k^1 = 1 if activity k can be performed during the outage.

P_k^1 = 0 if activity k cannot be performed during the outage.

Then the extent of substitution, S, by the generator of public supply during outages is given by S_1 where

$S_1 = \sum_{k=1}^{r} W_k P_k^1$ ..... (5)

Similarly, the extent of substitution by a household which has a UPS can be derived

$S_2 = \sum_{k=1}^{r} W_k P_k^2$ ..... (6)

It may, of course, be noted that in the case of household which has neither a generator nor an UPS, S_1=0, S_2=0.

For a household which has a generator the costs of operation have been obtained as

$G_c = K(i + \delta) + 12f + 4(m + o) - T$ ..... (7)

Where, K = capital cost, I = annual interest rate, δ = annual rate of depreciation, f = monthly fuel cost, m = quarterly maintenance costs, o = quarterly other costs, T = savings in terms of payment to the utility.

Similarly, the cost of a UPS can be derived as G_u . In this case T = 0 because the UPS stores electricity obtained at the time when there are no outages.

There are also other costs arising from the outages, including spoilage cost[3], SPC, damage to appliances[4], DAC and miscellaneous costs[5], MC.

The last part of the methodology relates to the valuation of costs arising from disturbance of activities which cannot be performed or only partially performed during the outages either because of the absence of self-generation or because of only partial substitution by generator/UPS.

These costs are subjective in nature in terms of a loss of utility and are, therefore, not observed. We use the willingness-to-pay (WTP) as a measure of the subjective costs and apply this magnitude to the part of the electricity consumption which is not substituted by self-generation during outages. As such,

$$MUTL = WTP(B_1 + B_2)(1 - S_1 - S_2) \quad \text{.....(8)}$$

Where, WTP = extent of higher tariff that household is willing to pay for better quality of service (with minimal outages)

B1 = electricity bill of the distribution company during summer months

B2 = electricity bill of the distribution company during winter months

The overall outage costs to the household, OTC, is given by

$$OTC = G_c + G_u + SPC + DAC + MC + MUTL \quad \text{.....(9)}$$

In the case of a household with no self-generation capacity

$$OTC = SPC + DAC + MC + MUTL$$

Where, $MUTL = WTP(B_1 + B_2)$

This methodology is new and has not been used yet in other studies.

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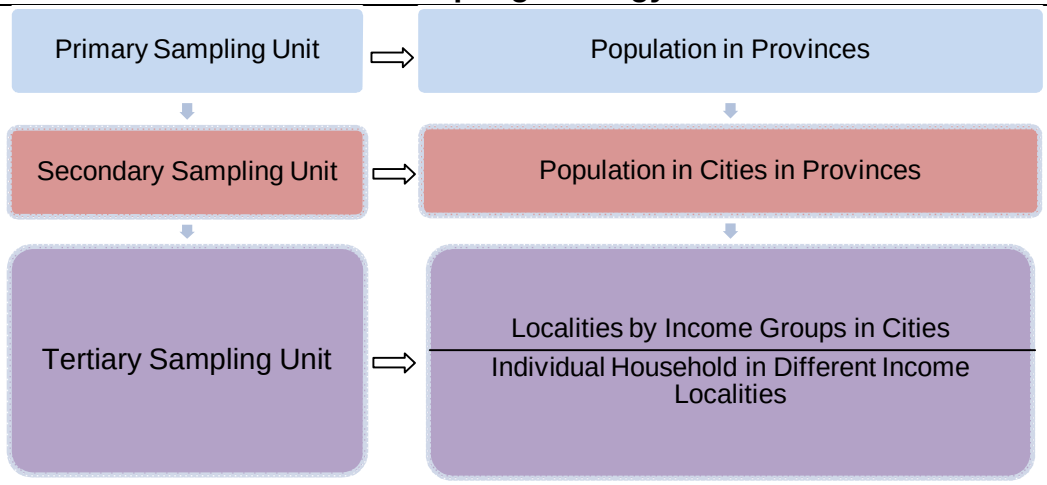
CHAPTER 3
THE SAMPLING FRAMEWORK AND ITS DISTRIBUTION

3.1 SAMPLING FRAMEWORK

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

Figure 3.1
Sampling Strategy



The provincial population was obtained from the Census Report while city-wise population was obtained from the Development Statistics of the provinces, published by the Provincial Governments. The national distribution of population by province is presented in Figure 3.1 and city wise population in Table 3.1. The derived sample distribution by city is presented in Table 3.2.

Once the sample distribution across cities was finalized, upper, medium and lower income residential localities were selected within each city for survey. Individual household within a locality was selected through random walk procedure.

Table 3.1.
National Distribution of Population in the Census, 1998 by City

Cities	Percentage
Lahore	4.8
Faisalabad	4.1
Gujranwala	2.6
Multan	2.4
Sialkot	2.1
Rawalpindi	2.5
Islamabad	0.6
Karachi	0.7
Hyderabad	2.2
Sukkur	0.7
Peshawar	1.2
Mardan	1.5
Abbotabad	1.1
Quetta	0.6

The questionnaire administered on the sample respondents contains five modules: basic information on households; experience of loadshedding; adjustment to outages; costs of outages/ brown outages (voltage fluctuations); 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.

Figure 3.2
National Distribution of Population by Province

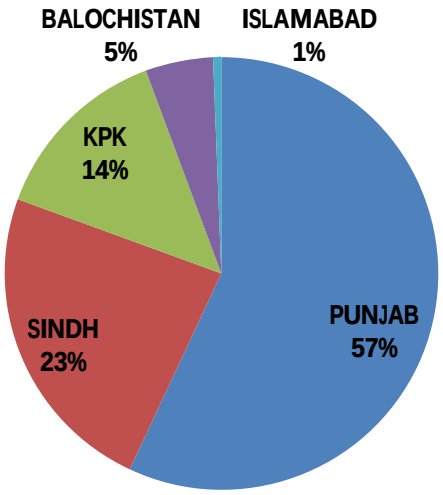


Table 3.2.
Distribution of Sample by Province and by City

Provinces	Cities	Numbers	Percentage
Punjab	Lahore	96	19
	Faisalabad	51	10
	Sialkot	13	3
	Gujranwala	26	5
	Multan	38	8
	Rawalpindi/Islamabad	61	12
	Total	**285**	**57**
Sindh	Karachi	80	16
	Hyderabad	20	4
	Sukkur	10	2
	Total	**110**	**22**
KPK	Peshawar	50	10
	Mardan	13	3
	Abbotabad/Bannu	12	2
	Total	**75**	**15**
Balochistan	Quetta	30	6
	Total	**30**	**6**
Total		**500**	**100**

The survey was successfully administered on 500 households as targeted. 57 percent of the sample household units are in the province of Punjab while about 22 percent are in Sindh. From the remaining 33 percent, 15 percent are in Khyber-Pakhtunkhwa (K-PK) and 6 percent in Balochistan.

3.2 CHARACTERISTICS OF SELECTED HOUSEHOLDS

Over 30 percent of the sample head of households were in business while 18 percent were employed in the private jobs. 11 percent were in government jobs (See Table 3.3). The average family size of the sample households is 7 persons, being the highest in Balochistan (See Table 3.4). The average number of children in the household is 2. Also, other than the lowest income group, there is an average of two earners per households. 18 percent of sample households had a member working from home.

Table 3.3.
Occupation of the Head of the Households

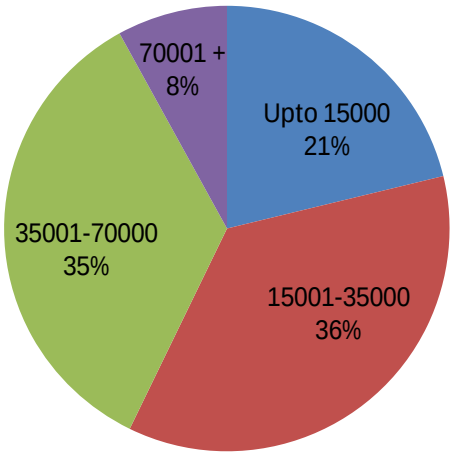
Occupation	Percentage
Business	30.6
Private job	18.4
Government job	11.4
Teacher	5.6
Retired person	4.8
Engineer	4.2
Driver	3.8
Others	21.2
Total	**100**

The distribution of sample households by income group is given in Figure 3.3. About 21 percent of the households have permanent monthly income, proxied by monthly consumption expenditure, of upto Rs. 15000, 36 percent have income between Rs 15000 to Rs. 35000, 35 percent have income between Rs. 35000 to Rs.70000 while 8 percent have income above 70000 per month. The overall average monthly income of sample households is Rs. 38429.

Table 3.4.
Average Number of Family Members by Income Group, 2012

	Average Family Size	Average Number of Adults	Average Number of Children	Number of Earning Members in Household
By Province				
Punjab	6	4	2	2
Sindh	6	5	2	2
KPK	9	6	3	2
Balochistan	10	5	5	3
Total	**7**	**5**	**2**	**2**
By Income Group				
Upto 15000	6	4	2	1
15001-35000	7	5	3	2
35001-70000	7	5	2	2
70001 +	7	5	2	2
Total	**7**	**5**	**2**	**2**

Figure 3.3
Distribution of Selected Households by Income Group



Almost 86 percent of the sample households owned their home, with 4 rooms on an average. Lower income households lived in 2 room houses.

The profile of ownership of assets is given in Table 3.5. Since these consumer durables operate on electricity, the demand for electricity in the household depends on the ownership of such assets, some durables being more electricity—intensive than others. 72 and 61 percent of lower income households own televisions and washing machines, which indicates that they also have a significant demand of electricity. However the more electricity consuming appliances is owned by upper-middle and upper income households. Multiple ownership of ACs, TVs, DVDs, fridges and heaters emerges from the survey.

Consequently, sample units, on an average, are spending almost Rs. 7800 a month on electricity (see Table 3.6). This is equivalent to 20 percent of their monthly expenditure. The average monthly expenditure on electricity for low income families is Rs. 2500 per month increasing to Rs. 21000 for the upper income households. The highest burden of the electricity bill appears to be on the lowest income group at 21.5 percent of monthly expenditure, declining somewhat to 20.2 percent for the upper income households.

Table 3.5
Profile of ownership of Assets
(%)

	CAR	TV	Air Conditioner	Micro wave/ Oven	DVD players	Radio	Fan	Fridge	Deep Freezer	Electric Heater	Washing machine	Internet	Computer
By Province													
Punjab	34	86	36	44	30	27	100	76	21	34	79	43	54
Sindh	35	93	26	40	30	15	100	94	29	5	93	45	58
KPK	43	89	48	44	24	21	100	95	29	20	96	49	57
Balcohistan	50	97	23	57	50	20	100	97	23	37	100	60	80
By Income Group													
Upto 15000	2	72	1	5	12	14	100	58	5	7	61	8	18
15001-35000	16	89	8	24	18	24	100	88	9	23	89	31	47
35001-70000	67	97	71	78	44	26	100	94	44	34	95	75	85
70001 +	88	98	93	88	73	30	100	93	60	50	95	80	88

Table 3.6 Average Monthly Expenditure, Electricity Bill and Electricity Bill as % Monthly Expenditure Electricity of Sample Units			
	Average Monthly Expenditure	**Electricity Consumed (Rs)**	**Electricity bill as monthly expenditure (%)**
By Province			
Punjab	41051	7319	17.8
Sindh	33482	8371	25.0
KPK	36973	7333	19.8
Balochistan	35300	11247	31.9
Total	**38429**	**7788**	**20.3**
By Income Group			
Upto 15000	11882	2555	21.5
15001-35000	25489	4806	18.9
35001-70000	52034	10849	20.9
70001 +	107825	21765	20.2
Total	**38429**	**7788**	**20.3**

CHAPTER 4
THE EXPERIENCE OF LOADSHEDDING

This Chapter discusses the incidence of loadshedding and the disruptions leading to costs and to utility losses of households.

4.1 INCIDENCE AND PROFILE OF LOADSHEDDING

The costs of loadshedding, to a large extent, depend on the frequency and duration of outages. The incidence of loadshedding is given in Table 4.1. Overall, on an average outages occurred 5 times a day in Pakistan in 2012, highest being in Punjab, 6 times. Households, on an average did not have electricity supply from power distribution companies for 1453 hours in 2012. The highest loadshedding has occurred in Punjab at 1683, followed by K-PK, 1216. Clearly, the average incidence is lower in Sindh and Balochistan.

Table 4.1
Average number of times there is loadshedding in a day

By Province	
Location	**Average**
Punjab	6
Sindh	3
KPK	4
Baluchistan	4
Total	5
By Income Group	
Upto 15000	5
15001-35000	4
35001-70000	5
70001 +	5
Total	5

Table 4.2
Hours of Outages

By Province	
Location	**Average**
Punjab	1683
Sindh	1123
KPK	1216
Balochistan	1069
Total	**1453**
By Income Group	
Upto 15000	1498
15001-35000	1394
35001-70000	1430
70001 +	1702
Total	**1453**

The distribution of outages by duration is given in Table 4.3. The highest number of outages occurs for 1 to 2 hours a day (70 percent), followed by outages of one-half to an hour a day (25 percent). 3 percent of outages each have duration of half to one hour and for over two hours. There is some divergence in the provincial patterns. In Punjab, 64 percent of the outages last for 1-2 hours while in Sindh almost 85 percent of the outages were for that duration. In Balochistan 8 percent of the outages are of over 2 hours while this duration of outage was not reported in the survey in Sindh.

Table 4.3
Percentage Distribution of Average Length of Outages, 2012

(%)

By Province				
Location	**Less than ½ hr**	**1/2 – 1hr**	**1-2 hrs**	**More than 2 hrs**
Punjab	3	29	64	3
Sindh	2	12	85	0
KPK	0	20	78	2
Balochistan	0	22	68	8
Total	**3**	**25**	**70**	**3**
By Income Group				
Upto 15000	3	18	76	3
15001-35000	1	25	73	2
35001-70000	3	28	66	3
70001 +	8	26	63	3
Total	**3**	**25**	**70**	**3**

The pattern appears to vary across different income localities. Over one-third of upper income households experienced outages of up to 1 hour while this proportion for lower income households is one-fifths. As compared to this, 69 percent of upper income households experienced outages exceeding 1 hour while this percentage for lower income households is 80.

Table 4.4
Timing of Loadshedding

(%)

	6 am - 12 noon	**12 noon - 6 pm**	**6 pm - midnights**	**Midnights - 6 am**	**Total**
By Province					
Punjab	41	28	12	19	**100**
Sindh	35	31	28	6	**100**
KPK	36	27	23	15	**100**
Balochistan	30	28	14	28	**100**
Total	39	28	17	16	**100**
By Income Group					
Upto 15000	39	26	17	19	100
15001-35000	37	29	18	17	100
35001-70000	41	29	15	15	100
70001 +	38	30	17	15	100
Total	39	28	17	16	100

Half of the respondents indicate that the pattern of loadshedding typically varies on a daily basis while the other half does not. Currently, 39 percent of the households experienced loadshedding in morning hours while 28 percent experience it in afternoons (See Table 4.4). Loadshedding in evenings and nights were experienced by one-third of the sample households.

Table 4.5
Experience of Voltage Fluctuations
(%)

	Power Fluctuations			Frequent Fluctuations		
	Yes	**No**	**Total**	**Yes**	**No**	**Total**
By Province						
Punjab	68	32	100	41	59	100
Sindh	41	59	100	76	24	100
KPK	57	43	100	58	42	100
Balochistan	93	7	100	71	29	100
By Income Group						
Upto 15000	63	37	100	72	28	100
15001-35000	68	32	100	54	46	100
35001-70000	59	41	100	38	62	100
70001 +	48	53	100	32	68	100
Total	**62**	**38**	**100**	**51**	**49**	**100**

The respondents were asked if they experienced brown outages (voltage fluctuations) and whether these were frequent. 62 percent of respondents indicated that they have brown outs while 51 percent reported

Table 4.6.
Disruptions Due to Loadshedding
(%)

	Very high	High	Medium	Low	Very Low
By Province					
Punjab	53	17	23	2	5
Sindh	46	32	16	4	2
KPK	64	17	15	1	3
Balochistan	63	10	0	23	3
By Income group					
Upto 15000	60	18	14	6	2
15001-35000	52	21	17	4	5
35001-70000	52	21	23	2	3
70001 +	50	18	20	5	8
Total	**54**	**20**	**19**	**4**	**4**

them to be frequent(See Table 4.5). Some inter-provincial differences also emerge from the survey. Brown outs are more of a phenomenon in Balochistan than in Sindh, However, those who experience voltage fluctuations in Sindh, have it frequently.

4.2 EXTENT OF DISRUPTION DUE TO OUTAGES

To understand the nature of loadshedding cost on households, the respondents were asked how disruptive loadshedding was. Table 4.6 shows that three-fourth of the sample households think that outages are highly disruptive. The disruptions are higher for the lower and middle income households as they are unable to make adjustments to reduce the costs of

loadshedding. 78 percent of lower income, as compared to 67 percent of upper income households rated loadshedding highly disruptive.

The nature of disruption, already identified in chapter 2, are elaborated in Table 4.7. While children's school preparations/home work are ranked as important disruptions in Punjab, lack of cooling/heating is by far the most important disruption in Sindh according to the survey. Shortage of water and children's studies emerge as important disruptions in K-PK while lack of cooling/heating bothers the sample households of Balochistan the most.

The importance of disruptions also varies somewhat across income groups. Top three disruptions of loadshedding for different income groups are: for lower income groups resultant shortage of water(due to inability to pump water) ,no cooling and children's studies; for lower middle income group no cooling/heating, children's studies and preparation for school/work; for upper middle income group no cooling/heating, regular household chores and preparation for school/work; and for upper income group no cooling/heating, preparation for school/work and children's studies.

43 percent of sample households are of the view that change in loadshedding timing can make loadshedding less disruptive (See Table 4.8). Sample preferences with respect to loadshedding timing are given in Chapter 7.

Table 4.7
Ranking of Disruptions Due to Outages

(%)

	Preparation for work/school	Studies (home work of children)	Income generating activities work	Regular household work	Entertainment/ Leisure	Social Activities (visits to/ of friends, etc	No cooling/ heating	Shortage of water	Total
By Province									
Punjab	19	21	9	12	3	3	20	13	**100**
Sindh	9	16	11	13	1	2	44	5	**100**
Karachi	25	7	3	28	0	0	17	20	**100**
KPK	17	27	0	17	3	0	10	27	**100**
Balochistan	17	18	8	15	2	2	24	13	**100**
By Income Group									
Upto 15000	12	18	13	11	2	2	19	23	**100**
15001-35000	17	22	8	9	2	0	27	16	**100**
35001-70000	21	16	6	23	1	2	25	6	**100**
70001 +	20	13	8	10	10	13	23	5	**100**
Total	**17**	**18**	**8**	**15**	**2**	**2**	**24**	**13**	**100**

Table 4.8
Change in the Timing to make Loadshedding Less Disruptive

(%)

By Province			
	Yes	**No**	**Total**
Punjab	43	57	100
Sindh	45	55	100
KPK	32	68	100
Balochistan	73	27	100
By Income Group			
Upto 15000	56	44	100
15001-35000	44	56	100
35001-70000	39	61	100
70001 +	28	73	100
Total	**43**	**57**	**100**

CHAPTER 5
ADJUSTMENTS TO LOADSHEDDING

This chapter focuses on the types of adjustments that households make to outages in Pakistan.

5.1 NUMBER AND TYPES OF ADJUSTMENTS

As identified in Chapter 2, households have adapted to loadshedding through behavioral changes. An important adjustment is acquisition of back-up power supply devices like generators and UPSs. 28 percent of the sample households have acquired generators (see Table 5.1).

Table 5.1
Household with Generator and UPS
(%)

Location	Residents with Generators	Residents with UPS
By Province		
Punjab	23	35
Sindh	32	21
KPK	41	27
Balochistan	33	23
By Income Group		
Upto 15000	2	4
15001-35000	17	26
35001-70000	45	47
70001 +	75	43
Total	**28**	**30**

The pattern differs by province and income groups. A lower proportion of households in Punjab have purchased generators, 23 percent, as compared to 41 percent in K-PK, and about one-third in Sindh and Balochistan. Expectedly, purchase of generator differs with income. While about three-fourths of upper income households have generators, this proportion is lower for middle and low income households. Overall, small capacity generators have been acquired, of average capacity of 3.5 kva. Consequently they only partially substitute for power supply from public utility for 91 percent of the sample with self generator (See Table 5.2).

Table 5.2.
Is Generator a Partial or Full Substitute of Electricity Supplied Publically?
(%)

	Partial	Full	Total
By Province			
Punjab	92	8	100
Sindh	86	14	100
KPK	94	6	100
Balochistan	100	0	100
By Income Group			
Upto 15000	100	0	100
15001-35000	100	0	100
35001-70000	88	12	100
70001 +	90	10	100
Total	91	9	100

However, for 14 percent of the sample households in Sindh, 8 percent in Punjab and 6 percent in K-Pk, generators fully substitute for public electricity supply. Generators are largely able to smooth the disruption in children's studies, cooling (principally through fans) and some social activities while they are less able to ensure continuation of leisure/entertainment and regular household work See Table 5.3)

Table 5.3. Use of Generator for Various purposes										
	Leisure/Entertainment		Cooling/Heating		Social Activities		Home-based/Economic		Children Study	
	Yes	No	Yes	No	Yes	No	Yes	No	YES	No
By Province										
Punjab	58	42	74	26	69	31	65	35	89	11
Sindh	49	51	69	31	63	37	54	46	91	9
KPK	16	84	55	45	35	65	42	58	68	32
Balochistan	30	70	60	40	70	30	30	70	80	20
By Income Group										
Upto 15000	100	0	100	0	100	0	100	0	100	0
15001-35000	48	52	65	35	61	39	42	58	81	19
35001-70000	37	63	62	38	54	46	53	47	85	15
70001 +	57	43	83	17	73	27	70	30	87	13
Total	**45**	**55**	**67**	**33**	**60**	**40**	**55**	**45**	**84**	**16**

Households rely more on UPSs in Punjab, 35 percent, than in the other provinces where more households have acquired generators (See Table 5.1). Affordability and perhaps the pattern of loadshedding (with somewhat more outages of an hour duration) may explain this pattern. Also, a higher proportion of lower and lower middle households have UPSs, about 30 percent, as compared to generators at 19 percent. UPSs are partial substitute for public supply of electricity for 94 percent of the sample households (See Table 5.4). They are partially fulfilling the leisure/entertainment and cooling requirements, social activities, household chore needs for about 35-45 percent of the sample households (See Table 5.5).

Table 5.4. UPS a partial or full substitute of electricity supplied publically (%)			
By Province			
	Partial	**Full**	**Total**
Punjab	97	3	100
Sindh	96	4	100
KPK	75	25	100
Balochistan	100	0	100
By Income Group			
Upto 15000	100	0	100
15001-35000	96	4	100
35001-70000	91	9	100
70001 +	100	0	100
Total	94	6	100

Table 5.5.
Use of UPS for Various purposes

(%)

	Leisure/ Entertainment		Cooling/Heating		Work/Economic Activities		Social Activities	
	Yes	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
By Province								
Punjab	42	58	31	69	42	58	37	63
Sindh	35	65	70	26	39	61	48	52
KPK	10	90	60	40	70	30	10	90
Balochistan	14	86	0	100	29	71	43	57
By Income Group								
Upto 15000	50	50	25	75	50	50	25	75
15001-35000	33	67	41	57	41	59	39	61
35001-70000	34	66	35	65	46	54	32	68
70001 +	47	53	59	41	47	53	47	53
Total	**36**	**64**	**40**	**60**	**45**	**55**	**36**	**64**

Beyond the use of generators and UPSs, some households adjust by shifting timings of various activities to avoid loadshedding. These adjustments are presented in Table 5.6. 77 percent of the sample households reported shifting timings of studies and regular household work while 45 percent said that they shifted the time of economic activities because of loadshedding. Over and above these, households have made purchases of battery operated appliances like emergency lights/fans to minimize the impact of loadshedding. These practices are in all provinces and in all income groups.

Table 5.6.
Various Other Adjustments made to Deal with Loadshedding

(%)

	Changed the timing of study		Changed the timing of regular household work		Changed the timing of economic activities		Bought battery operated electrical appliances	
By Province								
	Yes	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Punjab	81	19	78	22	47	53	36	64
Sindh	70	30	72	28	28	72	67	33
KPK	70	30	81	19	68	32	42	58
Balochistan	80	20	73	27	43	57	80	20
By Income Group								
Upto 15000	79	21	81	19	47	53	45	55
15001-35000	85	15	83	17	49	51	58	42
35001-70000	76	24	74	26	44	56	41	59
70001 +	40	60	50	50	33	68	25	75
Total	**77**	**23**	**77**	**23**	**45**	**55**	**46**	**54**

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 spoilage costs and indirect or adjustments costs which include generator costs and UPS costs.

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

6.1. TOTAL OUTAGE COSTS

Table 6.1 shows that the total outage cost on average to each residential consumer is almost 31,000 Rs per annum. The variation in outage costs is not very large among Provinces, ranging from about Rs 29,200 per consumer in Punjab to Rs 34,100 in K-PK.

Table 6.1
Total Outage Cost per Residential Consumer
(Rs)

	Monetization of Utility Loss	Cost of Self-Generation		Other Costs	Total Outage Cost
		Generator Cost	UPS Cost		
By Province					
Punjab	7355	11263	3864	6747	29229
Sindh	7626	17562	2054	6075	33317
K-PK	4954	18964	2037	8104	34059
Balochistan	3530	18120	2573	5235	29458
By Income Group(Rs)					
0 – 15000	3828	290	400	4262	8780
15001 – 35000	5655	6380	2734	6749	21518
35001 – 70000	9544	22370	4831	7053	43798
70001 and above	8193	50900	4550	4549	75192
Total	**6824**	**14215**	**3114**	**6712**	**30865**
Share (%)	**22**	**46**	**10**	**22**	**100**

Outage costs rise sharply by consumption (income) level of a consumer. For households with monthly consumption expenditure of upto Rs 15000, the outage cost annually is Rs 8800. For the highest expenditure group of households the cost rises to Rs 75200.

Overall, for the sample as a whole, the largest component of outage costs is self-generation costs at 56 per cent. Monetization of utility loss and other costs (spoilage costs, income foregone in household economic activity, etc. each account for 22 per cent.

For lower income households, the share of monetization of utility loss is higher at 44 per cent because a low proportion of such households have either a generator or an UPS. As opposed to this, the share of self-generation costs for the highest expenditure households is high at 74 per cent.

6.2. BURDEN OF OUTAGE COSTS

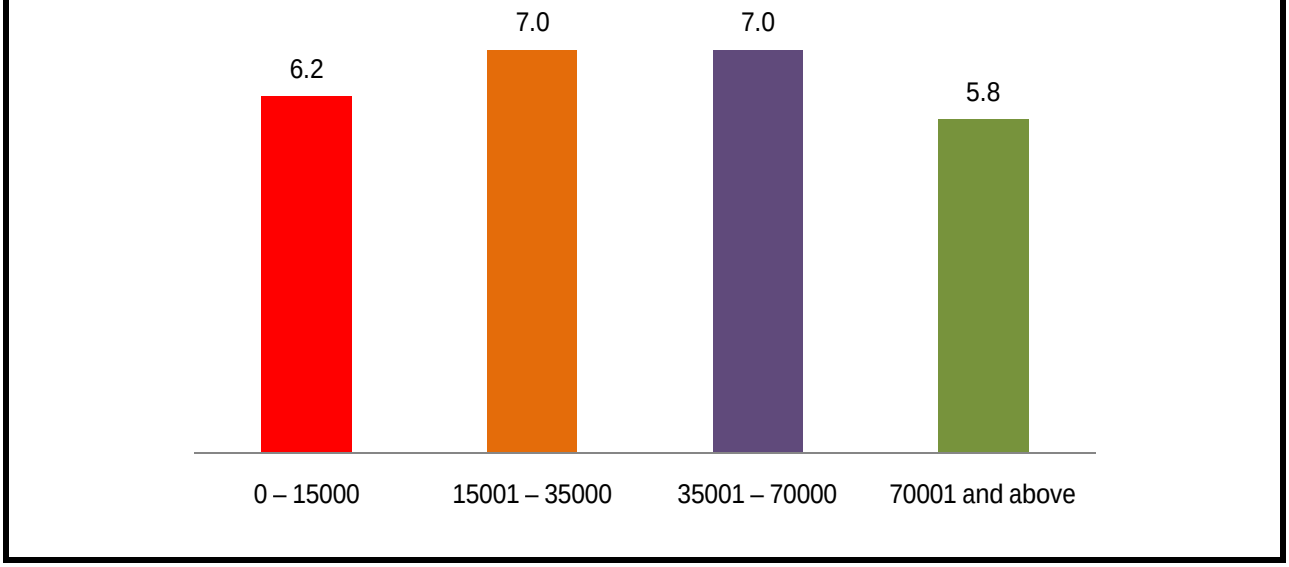
The burden of outage costs as a percentage of total consumption expenditure by a household is given in Table 6.2. It appears that the highest burden is on the 'middle class' living in the cities of Pakistan. It is 7 per cent for such households as compared to 6.2 for low income households and 5.8 per cent for the richest households.

Table 6.2
Total Outage Cost as Percentage of Total Household Consumption Expenditure

(000Rs)

	Annual Outage Cost	Annual Consumption Expenditure	Outage Costs % of Consumption Expenditure
0 – 15000	8.8	142.5	6.2
15001 – 35000	21.5	305.9	7.0
35001 – 70000	43.8	627.6	7.0
70001 and above	75.2	1293.9	5.8
Total	**30.9**	**461.1**	**6.7**

Figure 6.1
Outage Costs as % of Annual Household Consumption Expenditure



6.3. OUTAGE COST PER KWH

Table 6.3 indicates the total outage cost per kwh for residential consumers on average is close to Rs 24 (25 cents) per Kwh. This is substantially lower than the outage cost to small-scale industry and commercial consumers of Rs 51 (53 cents) and Rs 68 (70 cents) respectively.

Table 6.3
Total Outage Cost per kwh to Residential Consumer
(Rs)

	Total Outage Costs	Electricity not provided (Kwh)	Outage Cost per Kwh (Rs)
By Location			
Punjab	29229	1655	17.66
Sindh	33317	830	40.14
K-PK	34059	865	39.37
Balochistan	29458	1474	20.00
By Income Group			
0 – 15000	8780	479	19.32
15001 – 35000	21518	732	29.40
35001 – 70000	43798	1599	27.39
70001 and above	75192	4299	17.49
Total	**30865**	**1289**	**23.94 (25 c)**

The highest outage cost per Kwh is observed in Sindh at Rs 40 (42 cents) per Kwh, while the lowest cost is in Punjab at Rs 18 (19 cents) per Kwh. In line with the pattern observed in figure 6.1 the outage cost per Kwh is the highest for the `middle class` at Rs Rs. 27 (28 cents)- Rs 29 (30 cents).

6.4. NATIONAL ESTIMATE OF OUTAGE COSTS

Blowing-up of the sample to arrive at a national estimate requires, first, estimation of the number of urban households in the country. According to the PES the population of Pakistan in 2011-12 is 180.7 million, out of which 37.4 percent is located in the urban areas. The average household size is given in the latest HIES of the PBS at 6.19. This implies that there are 10.9 million urban households in the country.

Table 6.4
National Estimate of Outage Costs to Urban Residential Consumers, 2011-12

Monthly Total Consumption Expenditure Group(Rs)	Number of Households (000s)[a]	Outage Cost per Household (Rs)	Total Outage Cost (Rs billion)
0 – 15000	5014	8780	44.0
15001 – 35000	4360	21518	93.8
35001 – 70000	763	43798	33.4
70001 and above	327	75192	24.6
Total	**10464[b]**		**195.8**

[a] adjusted on the basis of distribution in the HIES, 2010-11
[b] 10.9 million households in urban areas with 98 percent of households having access to electricity according to PSLSMS, 2010-11

Second, there is need to determine the distribution of urban households by level of monthly consumption expenditure. This has also been derived from the HIES and is presented in Table 6.4.

Overall, **the total outage cost to residential consumers in the urban areas of Pakistan is Rs 195.8 Billion in 2011-12.**

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.

7.1 LEVEL OF SATISFACTION WITH CURRENT LEVEL OF SERVICE

Only 43 percent of sample firms indicated that DISCOs kept to the announced loadshedding schedule (see Table 7.1).

Table 7.1
Power Companies Kept to Loadshedding Schedule
(%)

By Province			
Location	**Yes**	**No**	**Total**
Punjab	33	67	100
Sindh	75	25	100
KPK	45	55	100
Balochistan	10	90	100
By Income Group			
Upto 15000	40	60	100
15001-35000	44	56	100
35001-70000	44	56	100
70001 +	35	65	100
Total	**43**	**57**	**100**

The survey teams enquired from the respondents if they were satisfied with the current level of service by the DISCOs/KESC. 43 percent of the respondents ranked their satisfaction level as very low while over one-third ranked it as low (see Table 7.2). Clearly, the consumers' level of satisfaction with the public distribution companies is very low.

Table 7.2
Level of Satisfaction with Current Quality of Service by DISCOs/KESC
(%)

	Very high	**High**	**Medium**	**Low**	**Very Low**
By Province					
Punjab	1	5	10	39	44
Sindh	6	6	24	27	36
KPK	0	4	25	31	40
Balochistan	3	0	0	23	73
By Income Group					
Upto 15000	2	4	9	34	51
15001-35000	2	3	17	35	43
35001-70000	2	6	16	38	39
70001 +	10	13	18	18	43
Total	**2**	**5**	**15**	**34**	**43**

The questionnaire solicited the preferred type of load shedding from the sample households. Specifically, they were asked: what type of loadshedding is preferred- longer each time but fewer outages or shorter each time but more outages. Table 7.3 shows that 65 percent of the consumers prefer the latter. Residential consumers in Sindh and Punjab clearly prefer shorter though more outages for the same total time of outages. The

preference is for the opposite in K-PK, that is, longer each time but fewer outages, while the preference between the two types of loadshedding is evenly distributed in Balochistan.

Table 7.3.
Preference for the type of Loadshedding
(%)

	Longer each time but fewer outages	Shorter each time but more outages	Total
By Province			
Punjab	34	66	100
Sindh	15	85	100
KPK	64	36	100
Balochistan	50	50	100
By Income Group			
Upto 15000	40	60	100
15001-35000	32	68	100
35001-70000	34	66	100
70001 +	45	55	100
Total	**35**	**65**	**100**

7.2 PREFERRED CHANGES IN TIMINGS OF LOADSHEDDING

About 97 percent of the sample households reported summer time as the worst season for loadshedding (see Table 7.4). Winter time is the second worst season for loadshedding.

Table 7.4
Worst Time of The Year for Loadshedding

	Rank				
	Summer	**Spring**	**Winter**	**Fall**	**Total**
By Province					
Punjab	93	1	4	0	100
Sindh	97	0	1	1	100
KPK	92	3	5	0	100
Balochistan	100	0	0	0	100
Total	**97**	**1**	**1**	**1**	**100**
By Industrial Group					
Upto 15000	97	1	1	1	100
15001-35000	97	1	2	0	100
35001-70000	90	2	7	1	100
70001 +	95	0	2	3	100
Total	**97**	**1**	**1**	**1**	**100**

The questionnaire also contained a question regarding the worst day of the week for outages. While 27 percent of the respondents said all days are bad, about one-thirds said Sunday is the worst day and Friday was the worst day for about 20 percent of the respondents. Friday, of course, is the prayer day.

Over one-third of the sample households preferred loadshedding in the first half of the day, that is, between 6:00 am-12noon. 27 percent of the respondents preferred loadshedding in the second half (12noon-6:00pm) while close to one-fifth each preferred it to be during 6:00pm-midnight and mid-night-6:00am (see Table 7.6).

Around 31 percent of the respondents indicate that it will be helpful if the power companies provided more information relating to the methods to save electricity while about one quarter said that information about outages and the scheduling of the outage will be useful (see Table 7.7). Clearly, these should be focused upon in the load management strategy of the distribution companies.

Table 7.5
The Worst Day of The Week for Outages

	Frequency	Percentage
Sunday	165	33.0
Monday	68	13.6
Tuesday	1	0.2
Wednesday	2	0.4
Thursday	4	0.8
Friday	99	19.8
Saturday	24	4.8
All days equal	137	27.4
Total	500	100.0

Table 7.6
Preference of Loadshedding Time
(%)

	Rank				
	6am-12 Noon	**12Noon-6:00pm**	**6 pm-Midnights**	**Midnight-6am**	**Total**
By Province					
Punjab	31	26	22	21	100
Sindh	29	45	12	15	100
KPK	47	8	24	21	100
Balochistan	47	20	17	17	100
Total	34	27	20	19	**100**
By Income Group					
Upto 15000	21	34	25	21	100
15001-35000	32	24	21	23	100
35001-70000	44	24	16	16	100
70001 +	35	33	20	13	100
Total	34	27	20	19	**100**

Table 7.7
Information that can be provided by Distribution companies to consumers

	Percentage
Save electricity	31.2
Information about outage	25.5
Time table for load shedding	26.1
Awareness about outage required	14.6
Others	2.5

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 43 percent 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. Over 27 percent of the respondents also think that new power plants should be built while close to a fifth of respondents are also of the view that electricity should be imported. Responses are more or less, similar across income groups. (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 14 percent specifically suggested the use of coal for electricity generation. Close to 8 percent of the sample units suggested introduction of solar energy systems (particularly by respondents in Multan and Mardan).

Improving Governance/Management. The dominant recommendations in this category are to minimization of electricity theft and to stop corruption, with 17 percent of respondents each emphasizing it. 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)

Reasons	Lahore	Faisalabad	Gujranwala	Multan	Sialkot	Rawalpindi /Islamabad	Karachi	Hyderabad	Sukkr	Peshawar	Mardan	Abbotabad	Quetta	**Total**
Enhancing Supply of Electricity														
Gas Pipe line from Iran to avoid gas shortage	9	8	8	3	0	18	25	5	0	20	92	0	13	15
Import Electricity	16	69	46	3	0	10	31	10	0	12	23	0	20	22
Construct new Dams (including Kala Bagh Dam)	59	53	19	63	31	57	18	25	0	40	77	58	27	43
Use rental power system	8	0	0	3	0	10	10	0	0	2	0	0	0	5
Build new power plants	27	24	27	18	31	51	20	30	30	22	0	8	40	27
Alternative Energy Fuel Sources														
Use Coal for electric generation	13	10	35	3	0	16	24	5	0	16	23	0	10	14
Use different method of electric generation	36	14	19	29	46	20	14	40	20	24	15	25	3	23
Bio Gas system	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Introduce solar energy System	15	2	15	24	0	7	0	10	0	6	23	8	3	8
Governance/Management														
Privatize Electric department	1	0	0	0	0	3	5	0	0	0	0	0	3	2
Need Honest Employees	0	10	15	5	0	8	3	0	0	10	15	0	0	5
Minimize electric theft	10	8	12	50	15	16	15	30	40	10	0	25	30	17
Stop Corruption	16	6	23	8	8	20	4	60	50	30	0	25	17	17
Minimize line losses	1	0	0	3	0	3	0	10	0	0	0	8	0	1
Give awareness to people use of electricity	1	0	0	11	0	0	0	0	0	0	0	0	0	1
Pricing Policy														
Government give subsidy on electricity	5	12	12	5	0	11	28	5	0	8	0	8	43	13
Reduce price at source	4	0	0	13	54	18	8	30	0	10	0	0	13	10

Pricing Policy Around 13 percent of the sample units requested for subsidy for electricity from the government while 10 percent suggested that the price (at source) should be reduced through economizing on costs.

Table 8.2
Suggestions by Sample Units by Income Group
(% of Respondents)

Reasons	Upto 15000	15001-35000	35001-70000	70001 +	Total
Enhancing Supply of Electricity					
Gas Pipe line from Iran to avoid gas shortage	8	15	20	10	**15**
Import Electricity	19	21	25	23	**22**
Construct new Dams (including Kala Bagh Dam)	38	39	47	60	**43**
Use rental power system	3	3	6	10	**5**
Build new power plants	28	32	21	30	**27**
Alternative Energy Fuel Sources					
Use Coal for electric generation	8	11	18	28	**14**
Use different method of electric generation	26	19	24	25	**23**
Bio Gas system	0	1	0	0	**0**
Introduce solar energy System	7	9	6	18	**8**
Governance/Management					
Privatize Electric department	1	1	1	0	**2**
Need Honest Employees	3	7	5	3	**5**
Minimize electric theft	22	17	15	18	**17**
Stop Corruption	17	21	14	8	**17**
Minimize line losses	0	2	2	0	**1**
Give awareness to people use of electricity	3	1	0	0	**1**
Pricing Policy					
Government give subsidy on electricity	13	13	11	15	**13**
Reduce price at source	12	10	7	10	**10**

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

First: Construct Dams

Second: Build New Power Plants

Third: Use Different Methods of Electricity Generation

Fourth: Import Electricity

Fifth: Minimize Theft and Stop Corruption

CHAPTER 9
CONCLUSIONS AND POLICY IMPLICATIONS

We have highlighted in the previous chapters the principal findings on the incidence of outages in the residential sector. In this concluding chapter we derive the key policy implications.

9.1. IMPACT OF OUTAGES

The estimated impact of outages on households is as follows:

(i) Outages on the average occur almost five times a day for 17% of the time. The highest incidence is in Punjab at 1683 hours annually, 16% above the national average. The lowest incidence is in Sindh at 23% below the national average.

(ii) Outages are disruptive most of heating/cooling, household activities, preparation for work/study (especially by children) and any home-based economic activity.

(iii) The outage cost per kwh works out as Rs 24(25c). This is 53% less than the cost to small-scale industry and 65% less than the cost faced by the commercial sector. These results are consistent with the findings of the other studies.

9.2. AFFORDABILITY

Table 9.1 presents the total cost of electricity consumption to household at different levels of total consumption expenditure (proxy for income). Overall, this is estimated at close to 17%. A striking finding is that the cost is the lowest for the upper most income group.

In the pre-loadshedding period, in 2005-06, according to the HIES, the share of electricity cost in total consumption expenditure was 5% on average for urban households. Following the high levels of loadshedding this share has jumped up by over **three** times.

TABLE 9.1
Total Cost of Electricity Consumption Per Residential Consumer

(Rs in 000)

Monthly Expenditure Group(Rs)	Annual Electricity Cost		Annual Consumption Expenditures	Total Electricity Cost as % 0f Consumption Expenditure
	of Public Supply	Total Outage Cost		
0-15000	15.3	8.8	142.5	16.9
15001- 35000	28.8	21.5	305.9	16.4
35001-70000	65.1	43.8	627.6	17.4
70001 and above	130.6	75.2	1293.9	15.9
Total	**46.7**	**30.9**	**461.1**	**16.8**

It is clear that the high share of expenditure on electricity is cutting into consumption of food, clothing and basic services (like education and health), especially by the low income groups. As, such an indirect impact of the high level of loadshedding in the country is the reduction in nutrition levels, particularly of children. Along with impact on preparation for school and home work, the impact of outages on children needs to be more strongly highlighted.

Overall, limits of affordability to power tariffs have been reached by bulk of the households and the scope for further enhancement in tariffs is very limited.

9.3. PRICING POLICY

There are concomitant implications of the above findings in affordability on the power tariff structure for the residential sector. The present structure is given in table 9.2, excluding taxes and other charges.

The average tariff for different levels of electricity billing (in kwh) is given in figure 9.2.

Table 9.2
Present Tariff Structure on the Residential Sector

(Rs)

	Actual Per kwh	**Proposed Per kwh**
Up to 50 units	2.00	2.00
For consumption exceeding 50 units		
1 – 100 units	5.79	4.50
101 – 300 units	8.11	7.50
301 – 700 units	12.33	13.00
Above 700 units	15.07	17.50

Given the regressive burden of electricity costs, as shown in table 9.2, there is need to make the tariffs structure more progressive in a revenue-neutral way. In line with these considerations the proposed tariff structure is also given in table 9.2. Beyond 300 units it is proposed to enhance incremental tariffs and reduce them before this level of consumption.

9.4. SELF-GENERATION

The prevalence of self-generation is relatively low among residential consumers. 28% have generators and 30% have UPS. Resort to self-generation is the highest is Sindh and K-PK and among consumers in the highest income category.

The average capacity of generators in use is under 3.5 KVA. The proposal for eliminating the GST on small generators and UPS is justified in this case also, as for commercial consumers.

9.5. LOAD MANAGEMENT STRATEGY

Based on responses by the sample households, the following proposals are presented for reducing the level of outage costs:

(i) The majority, 65%, of respondents prefer, given the total duration of loadshedding, shorter though more frequent outages. Higher duration of a typical outage is one of the main reasons why outages costs are higher in Karachi, despite lower incidence of outages.

(ii) Bulk of the loadshedding is in the morning from 6:00 am to 9:00 am. This creates disturbance in preparation for work/school and heating during winters. Over 43% of sample households report that changing loadshedding times to later in the day would be less disruptive, especially to low income households.

(iii) The worst time in year for load shedding is summer and worst day are Sunday, Monday and Friday. To the extent there is scope, the pattern of loadshedding needs to be adjusted accordingly.

(iv) There has been a clear vote of non-confidence against the services provided by the power sector. 43% rate the quality of services as 'very low' and 35% as 'low'. Distribution companies, in particular, will have to work very hard to rehabilitate their image.

(v) A series of recommendations have been made for reducing the costs of loadshedding, as follows,

Construct New Dams	43%
Build New Power Plants	27%
Import Electricity	22%
Minimize Electricity Theft	17%
Stop Corruption	17%
Use Coal	14%
Gas Pipeline From Iran	15%
Subsidy	13%
Reduce Price	10%
Solar Energy	8%

Therefore the largest responses relate to enhancement in electricity supply and to improved management of power sector.