REPORT ON MIGRATION OF CUSTOMERS AND PRICE ELASTICITY OF DEMAND ON THE IRAQ MINISTRY OF ELECTRICITY SYSTEM

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Executive Summary

The last time expenses and revenues from electricity tariffs in Iraq were in balance was 2002. Since then, expenses have soared and the tariff has remained the same, now requiring an increase of the Tariff for 2006 on the magnitude of at least 9 X. With an increase of this magnitude, it is desired to determine the approximate response from the customers as they migrate between rate blocks in the Tariff structure and make conscious efforts to conserve. A review of past studies in Iraq and other countries concludes that an increase of this magnitude will result in a higher response than typical and conservation will occur at all levels of customer usage. Although difficult to predict, it is estimated that the domestic usage of electricity will drop about 80 % in the highest two blocks of usage and between 20-50% in the rest of the rate blocks for an increase of price of such a magnitude. However, this will probably not occur in the summertime, when temperatures are so high that customers will pay any price for comfort. Customers will conserve in consumption but not in the demand that determines the summer peak.

Background

Price Elasticity of Demand is defined as the percentage change in the quantity of electricity demanded in response to a percentage change in the price of electricity.

Price elasticities are often reported for both the short run and long run. In the short run, energy consumers are assumed to have a fixed capital stock. In the long run, energy consumers are assumed to change their stock of energy consuming appliances and equipment. In this context, short run refers to two or three years, while long run refers to 10 to 20 years.

Two caveats need to be made in the context of price elasticities of demand. First, empirical estimates of price elasticities of demand represent the average relationship over time between quantity and price. However, the price elasticity of demand will depend upon the level of the price change. Engineering or end-use type models of energy demand

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show that the price elasticity of demand may be non-linear. That is, higher price changes could produce a larger unit response by energy consumers.

Secondly, it is unlikely that the responsiveness to price changes is symmetrical. That is, a 10 per cent increase in prices may lead to a larger percentage fall in demand than the percentage increase in demand associated with a 10 per cent fall in prices. Accordingly, price elasticity estimates should be very cautiously applied to estimations of demand responses.

This Study

This analysis reviewed a Migration of Customers and Elasticity Study done by the Ministry of Electricity in 2000 and Price Elasticity of Electricity Demand studies done in Australia and other countries, some of which are regarded as having "transition economies". Excerpts from those studies are shown in the Attachments and Tables.

Analysis

1. In Iraq there was a 50% Tariff increase from 1999 to 2000.
2. The reaction to the increase was not consistent throughout all usage levels. Cutbacks occurred at low and high usage levels, but there was no impact at medium usage.
3. No impact was seen during the summer period. This was expected, as the summer temperatures exceed 120 degrees F (50 C) in the peak months and consumers gladly pay any price to stay cool.
4. A reaction to price was seen in two groups of customer rate blocks, those at the very low usage end and those at the very high usage end. The reaction in the low end was due to cutbacks by customers with limited incomes. The reaction at the high end was due to the very high prices set in the upper blocks of the tariff structure and the high usage in those blocks. The lack of response to those customers in the middle was due to the extremely low tariff that is easily affordable and provides no incentive to conserve.
5. A review was made of the Price Elasticity of Demand Studies in other countries to compare the typical response in demand to a typical increase in price. However, with a required increase in Iraq

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of such a huge magnitude (about 9 X), a mathematical calculation of Price Elasticity becomes meaningless.

6. A review of the price increase in Iraq showed that, although the price increase of 50% for electricity was substantial, it was upon a very low base and middle usage customers showed no response to it. However, there was a drop in consumption by those at the low and high usage levels, where fixed incomes at the low end and a higher price base at the high end came into play. This shows that price elasticity of demand does exist and conservation will occur when the price increase impact is large enough.
7. The conclusion reached in the Australian study detailed in Attachment II supports the concept that the price elasticity of electricity demand is likely to change depending upon the magnitude of the price change. For example, it was shown in Australia that the price elasticity of demand could rise if:
   (a) there are significant increases in the customer terminal price above the 10-20 per cent range for medium sized customers;
   (b) There are significant increases in the price of electricity above the 5-10 per cent range for large customers of electricity; and
   (c) There is a significant increase in the price of electricity of the order of 20-30 per cent or above for small customers of electricity.
8. With a required increase in tariffs on the order of magnitude of about 9 x for 2006, and a higher increase imposed upon the middle usage level of customers, it is obvious that a sizeable response to price will result and conservation will occur. The size of the response is difficult to predict. However, it can be predicted that the price elasticity of demand will be above prior levels and it will be applicable to customers throughout all usage levels.

Conclusions

It can be concluded that the required price increase of electricity for 2006 on the order of 9 X will result in conservation in the last two rate blocks of the domestic Tariff structure comparable to that experienced in the past and the rest of the usage in the other rate blocks will respond to the typical response patterns found in other studies based on an increase no greater than 100% (resulting in conservation in the order of 20-50%). However, the conservation will occur only in months other than the summer, when temperatures are so high that customers will pay any price for comfort.

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Attachments

1. Attachment I
   Translated Report of Iraq Ministry of Electricity
   Informational Technology and Operations Research Department
   Operations Research Section
   "New Tariff 's Effect on Annual Customers ' Migration"
   May 2001
2. Table I
   Migration of Domestic Customers – Winter
3. Table II
   Migration of Domestic Customers – Summer
4. Table III
   Excerpt -Study by European Bank for Reconstruction and Development
   "Can poor countries pay for energy and water?
   An affordability analysis for transition countries"
   By Samuel Fankhauser and Sladjana Tepic
   May 2005
5. Attachment II
   Excerpt from "The Price Elasticity of Demand for Electricity in NEM Regions", A Report for the National Electricity Market Management Company, prepared by National Institute of Economic and Industry Research, June 2004.

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ATTACHMENT I
Informational Technology and Operations Research Department
Operations Research Section
May 2001

New Tariff 's Effect on Annual Customers ' Migration

Study Objective:
To know the range of effect of the new tariff on the consumption migration and residential customers.
Before starting work, we first should define the term MIGRATION: it means transferring of the customers from consumption category to another one, going up or down depending on many factors. The most important one is: high and low temperature. Increasing of electricity tariff can be one of these factors and that what we are trying to know from study. There are fixed work phases for this migration that are known by the Operations Research Section.

Management:
To realize the electricity tariff's effect on the amount of consumption and to verify that the changing in consumption caused by tariff and not because of side reasons and effects, we have to select some months of the year that do not have any other side effects.
For that, October and November of 1999 and 2000 have been selected for:

1. Having warm weather. Relative stability of temperature, which leads to reduce using both heating and cooling devices.
2. Absence of the programmed power cut in 2000 and absence of power shortage in 1999.

It makes a very small ratio of the total consumption, 1,2%. That means these tow months do not have side effects that may lead to moving or transferring the customers among the categories. These tow months have been considered as one period in 1999 and 2000. The consumption has been divided to categories according to electrical quotation.
The migration Quarism (Mathematic equation) that has been prepared by Operations Research Section has been used for this purpose. By comparing each category in 1999 with the same category in 2000 we will see a clear movement among the customers, figure 1. For example: the first category (300-1), the number of

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customers in 1999 was 132163 and in 2000 was 128931. That means 3232 customers have migrated from that category to the next one (600 – 301). This category itself has migrated customers. This example shows that there is a movement from lower category to upper one.
We notice that the number of customers became less in the last category (99999 – 5001) the tow years (721 – 540). That means the migration has been done from the upper category to the lower one. The migration also has been occurred in this category itself. That makes a balance in the category, which customers from the previous category migrate to it (2680) and from the following category (158).

When the customers migrate from one category to another one they take their consumption with them. That means the category that loses customers it also loses their consumption. Therefore this consumption could be a migrated consumption.
The migrated consumption contains: consumption that moves from a category to another + consumption moves in one category.

A comparison has been made among the categories in Summer (July and August) 1999 and 2000, figure 2 shows the details of the comparison. It has been noticed, all the categories (from the first to the one before the last) got migration towards the upper category (the figure shows the direction of the arrow).

If we say that the same categories in the same circumstances have a common action that goes up that means mostly a general comprehensive growth occurs in consumption of the electricity from 1999 to 2000. In fact, generally it occurs each year.

If we focus one figure 1, we will see a clear movement from the lower categories to the upper ones and a different movement from the upper categories to the lower ones till the balance in the fifth category (1500 – 1201).

Going up of the consumption explains the general growth happened in the consumption of the power each year. The annual growth is the reason behind the movement of the customers up to the higher category. Although there is no programmed power cut, the upper categories have a different behavior when they go down.

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The likely explanation for this phenomenon is:
After practicing the new tariff on the residential customers and as a result of the huge increasing of the unit's price (specifically in the upper categories), the customers became obliged to pay very expensive bills. That pushed the customers to reduce using the electricity and move to another category, which has less price.
To prove the correctness of this explanation we need to now the coefficient of the elasticity since it shows whether the consumption of the electricity change according to the changing of unit's price of this energy.
The Quarism of the quotation elasticity prepared by Operations Research Section has been used (depending on Quarism of migration).
The quotation coefficient of the elasticity for the chosen categories (the upper categories) has been extracted and was 1.79 for (5000 – 3001) and 1.57 for (3000 – 2001).
That means the consumption of the electricity of these categories has been reduced with the increasing of the unit's price of the energy. This supports the likely explanation because of the reduction of the consumption in the upper categories and leaving to lower ones.

Extraction: it is probably that practicing of the new tariff has contributed partly to make the customers reducing power use to avoiding the expensive bills.

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Table I
Iraq Ministry of Electricity

Migrating Domestic Customers - Winter

% Kwh	% Cus	10, 11 / 1999		10, 11 / 2000	Rate Block	Price
19%	0%	721	-181	540	5001-Rest	30 000
		755	↓	180		
5%	4%	4,162	-881	3,281	3001-5000	15 000
		1,444	↓	1,061		
5%	9%	12,258	-491	11,767	2001-3000	7 000
		1,095	↓	1,552		
3%	8%	19,650	1,394	21,044	1501-2000	4 000
		82	↓	158		
0%	1%	24,563	2,838	27,401	1201-1500	900
		862	↑	2,680		
2%	6%	48,265	4,945	53,210	901-1200	900
		2,651	↑	7,624		
4%	8%	96,384	3,204	99,588	601-900	600
		3,336	↑	10,829		
4%	6%	182,706	-7,597	175,109	301-600	600
		1,114	↑	3,232		
5%	2%	132,163	-3,232	128,931	1-300	500

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Table II
Iraq Ministry of Electricity

Migrating Domestic Customers - Summer

% Kwh	% Cus	7, 8 / 1999		7, 8 / 2000	Rate Block	Price
14%	0%	1,568	113	1,681	5001-Rest	30,000
		1,417		-113		
5%	1%	8,657	344	9,001	3001-5000	15,000
		1,398		-456		
3%	3%	17,152	2,442	19,594	2001-3000	7,000
		1,095		1,552		
6%	14%	20,973	2,973	23,946	1501-2000	4,000
		2,288		-5,871		
8%	27%	21,722	3,838	25,560	1201-1500	900
		10,783		-9,709		
25%	24%	41,057	-1,689	39,368	901-1200	900
		9,279		-8,021		
14%	9%	90,799	19,384	110,083	601-900	600
		12,046		-27,305		
17%	17%	160,290	-14,259	146,031	301-600	600
		10,236		-13,046		
65%	13%	98,160	-13,046	85,114	1-300	500

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Table III

Residential Price and Income Elasticities
in Electric Utilities, Empirical Estimates

Source	**Country**	**Price Elasticity**	**Income Elasticity**
Taylor(1997		Range from -0.81 to -1.66	
Bohi (1981)	U.S.	-0.7	
Baker et al (1989)	U.K.	-0.76	0.17
Bohi and Zimmerman (1984)		Range from -0.05 to -0.71	
Larsen (2002)	Norway		1.02
Dennerlein (1987)	Germany	-0.38	0.42
Silk and Joutz (1997)	U.S.	-0.5	0.5
Bernard et al (1996)	Canada	-0.67 Short run	0.14
EBRD (2001)	Transition economies	-0.5	
Halvorsen and Larsen (2001)	Norway	-0.442	Range from 0.06 to 0.13
Nieir (2002)	Australia	Range from -0.2 to -0.5	
Kamerschen and Porter (2004)	Northern Europe	Range from -0.85 to -0.94	

Source: Study for European Bank for Reconstruction and Development
"Can poor consumers pay for energy and water?
An affordability analyais for transition countries"
By Samue; Fankhauser and Sladjana Tepic May 2005

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Table IV
Iraq Ministry of Electricity
Tariffs Effective in 1999 and 2000

Domestic Class	ID/Kwh 1999	ID/Kwh 2000
1-300 kwh	0.1	0.5
301-900 kwh	0.25	0.6
901-1500 kwh	0.5	0.9
1501-2100 kwh	2	4
2101-3000 kwh	5	7
3001-5100 kwh	10	15
5101-more	20	30
Commercial Class		
1-300 kwh	1.5	2
301-600 kwh	3	4
601-900 kwh	8	8
901-1500 kwh	10	12
1501-3000 kwh	20	20
3001-more	25	25
Industrial Class		
11 KV	2.5	3
33 KV	2	2.5
132 KV	1.5	2
0.4 KV	8.5	8.5
Governmental Class	1	2
Agricultural Class	4	5

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ATTACHMENT II
Excerpt from "The Price Elasticity of Demand for Electricity in NEM Regions", A Report for the National Electricity Market Management Company, prepared by National Institute of Economic and Industry Research (NIEIR), June 2004.

In 1999, NIEIR undertook a review of the long run price elasticity of electricity demand. Their report was prepared initially in June of 2002 and subsequently updated for 2004. Based on NIEOR's work in this area, and the review of overseas and Australian literature, they recommended the following long run elasticities of electricity demand by sector:

Residential	-0.25
Commercial	-0.35
Industrial	-0.38

The price elasticities of demand presented above require some qualification.

- These figures were estimated over a period (1980 to 1995) when electricity prices rose generally in Australia (although prices did fall gradually over the 1990s).
- It is unlikely that the responsiveness of demand to price changes is symmetrical. Customers are likely to be less responsive to declining, prices, particularly in the short run.

The price elasticity of electricity demand is likely to change depending upon the magnitude of the price change. For example, the price elasticity of demand could rise if:

(d) there are significant increases in the customer terminal price above the 10-20 per cent range for medium sized customers;
(e) There are significant increases in the price of electricity above the 5-10 per cent range for large customers of electricity; and
(f) There is a significant increase in the price of electricity of the order of 20-30 per cent or above for small customers of electricity.

In NIEIR's view, the overall price response could rise by up to 30 to 40 per cent depending on the level of price change. For example, if the

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residential price of electricity demand was -0.25 this could rise to -0.4 for a price change of 30 to 40 per cent.

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