Is the Lifeline a Viable Alternative to Kuwait's Fixed Electricity Tariff?

Sulayman 5. *Al-Qudsi and Abdul Majeed Al-Shatti*
Kuwait Institute for Scientific Research

Introduction

Following World War II, Kuwait became a major supplier of oil to industrialized nations. In the mid-1980s, the country produced about 6.4% of OAPEC's oil, and its reserves were estimated at 18.6% of OPEC's proven reserves (OAPEC, 1986). This resulted in her acquisition of a huge financial resource. It also resulted in changes in her product and labor market. In the product market, the economy became predominantly oil-based and experienced rapid growth rates of well over 10% per annum. Per capita income was ranked among the highest in the world - US. $15,000 in 1985. Despite its impressive growth record, the economy remains highly volatile because of its heavy dependence on two vacillating variables—volume and price of exported oil. In the labor market, high annual immigration rates produced a persistent anomaly in the country's population and labor mixes. In 1957, when the first population census was conducted, Kuwait had a population of 206,473, of which 45% were non-Kuwaitis. By 1985, the total population reached 1,697,301, of which 59% were non-Kuwaitis.

The driving force behind all domestic economic activities is the public sector, which, in essence, plays three major roles: as an investor, employer, and redistributor of oil wealth to the (particularly, indigenous) population. It performs the third function through a number of public sector activities ranging from education and health to cash, housing, and electricity and water subsidies. The subsidy programs are known for their comprehensive coverage and have earned Kuwait a reputation as a "Super Welfare State" (MEE, 1986).

Like many social goods and services, electricity is heavily subsidized. The Ministry of Electricity and Water estimates that the electricity subsidy is nearly 13 times the price residential electricity users pay for their electricity consumption. Heavy subsidization has allegedly contributed to wastage and hampered potential conservation efforts. This is infered from the

phenomenal growth rates of electricity use, particularly in the residential sector. The high growth rates of electricity use in the residential sector have led to a substantial increase in the sector's share of total sectoral use of energy fuels (mainly electricity, natural gas and refined products). Between 1970 and 1980, residential sector energy counsumption increased from the equivalent of 5.6 million barrels of oil (equal to 18% of Kuwait's total consumption) to 17.6 million barrels (or 27% of the total; Ministry of Electricity and Water, 1986). About 94% of all residential energy demand is in the form of electricity (Al-Qudsi, 1986). Indeed, about 49% of all electricity consumption in Kuwait occurs in the residential sector. With this bird's eye view of the overall Kuwaiti setting, we proceed to examine electricity price and cost structures. [d]

Electricity Price and Cost Structures

Historically, the price of electricity was influenced by costs of production. Until 1953, the selling price was the equivalent of 27 fils/kWh. Between 1953 and 1955, when domestic oil production was boosted, the selling price decreased to the equivalent of 18 fils/kWh; and between 1955 and 1960, it plunged further to the equivalent of 13.5 fils. A multitariff, decreasing-block rate was in effect from January to April 1961. Between May 1961 and March 1964, a two-tier rate was enforced that discriminated between sectors; the ordinary customers' rate was 6.0 fils/kWh and that of industrial and agricultural customers was 4.0 fils/kWh. Two price reductions took place between 1964 and 1966 that culminated in the enforcement of the tariff structure existing today. These pricing developments are shown in Table 1.

Estimates of cost data, however, indicate that a large, increasing gap exists between production costs and selling prices of electricity. In the early 1980s, the average cost of production was estimated at 26 fils/kWh, while the price was administratively set at 1-2 fils/kWh. A component breakdown is shown in Table 2.

It is apparent from Table 2 that total fixed costs exceed the selling price by a factor of 5.4. When measured against all costs components, the selling price represents a small fraction (7.7%). Furthermore, the magnitude of the subsidy has increased due to three interrelated factors:

1. The rise in the capital cost of increasing existing power station capacity.
.2. The escalation in the real value of wages and salaries. 3. The decline in the real price of electricity, due to the general increase in the domestic inflation rate.

Faced with an increasingly lopsided price/cost portfolio and the resulting wasteful consumption pattern, decision makers have proposed a reform of the rate structure. The proposal is timely, as the economy is going through a transition. The economic growth and financial reserves realized over the past two decades are

declining, following rapidly-decreasing oil prices and exponentially-rising government expenditure on numerous public spending programs and subsidies. These developments require a reappraisal of domestic economic policies.

Table 1. Development of Electricity Pricing in Kuwait, 1953-1981

PERIOD		PRICE (fils/kWh)
1. Up to 30 Sept. 1953		27.0
2. Fran 1/10/1953 to 31/3/1955		18.0
3. Frcm 1/4/1955 to 31/12/1960		13.5
4. Frcm 1/1/1961 to 30/4/1961	a Up to 2000 units	7.5
	b 2000 to 4000 units	6.0
	c) In excess of 4000 units	4.5
5. Fran 1/5/1961 to 31/3/1964	a) Ordinary consumers	6.0
	b Indust. & agricult. consumers	4.0
6. Fran 1/4/1964 to 31/5/1965	a) Ordinary consumers	5.0
	b) Indust. & agricult. consumers	4.0
7. Frcm 1/6/1965 to 31/5/1966	a) Ordinary consumers	3.0
	b) Limited income groups, those receiving state support, cooperative societies and clubs	2.0
8. Fran 1/6/1966	a) Ordinary consumers	2.0
	b) Industrial companies inside Shuaiba Industrial Area	1.0

Source: The World Bank. 1981. Long-Term Development Strategy: Vol.II. Annexes, Country Program Dept. II. Report to the Ministry of Planning, Kuwait (unpublished MS).

Tahle 2. Estimate of Electricity Oost Components

Components	Generation (fils/kwh)	Distribution (fils/kWh)	Total (fils/kwh)
Capital	2.42	4.18	6.60
Operating, Maintenance and Administrative	1.98	2.26	4.24
Total Fixed Costs (1+2) 4.40		6.44	10.84
Fuel Cost (valued at the export price) 15.16		-	15.16
Total Costs/kWh 19.56		6.44	26.00

Source: MEW, private coTmonication.

An Alternative Rate Structure

For the past 18 months, the Ministry of Electricity and Water has been pushing for higher electricity tariffs to bring average consumer prices of 2 fils/kWh closer to the estimated 26 fils/kWh production price. The proposed rate reform is a lifeline rate structure that emphasizes balancing efficiency and distributional equity. MEW's proposal distinguishes between two types of residential customers: (1) customers who live in spacious villas/ middle/and limited income housing units and (2) customers who occupy the typical 1-3 bedroom apartments. Customers living in type (1) housing are invariably Kuwaitis whereas non-Kuwaitis predominate in apartments. The proposed rate structures for (1) and (2) are:

	kwh/month	Price in fils/kwh	Housing Type
(1)	0 - 4500	2	Villas and
	4501 - 8000	7	Limited and
	>8000	12	Middle Income
(2)	0 - 1500	2	
	1501 - 3000	7	Apartments
	>3000	12	

The primary objective of this study is to evaluate the viability of the lifeline rate structure in Kuwait's setting from the perspectives of equity and efficiency. It aims to investigate the economic impact of a change in the electricity price structure from the fixed rate to the lifeline rate. Specifically, it addresses the following questions:

1. Would the burden of the lifeline rate fall predominantly onto low income consumers?
2. Would there be any reduction in the use of electricity?
3. Would overall efficiency be improved?

Methodology and Data

Our approach below is to stimulate the equity, conservation, and resource reallocation that are likely to emerge as a result of a switch from the fixed-rate tariff system currently in use to the proposed lifeline tariff structure. With knowledge of households' use under the fixed rate structure and of the demographic, economic and technological variables—electrical appliances in households-- it is possible to estimate the demand function in the form:

$$Q = f(Y, P, H, Z) \quad (1)$$

where

Q = quantity of electricity consumed
Y = income
P = average price of electricity
H = the housing stock
Z = vector of other variables

Specifications similar to equation (1) that incorporate a lagged electricity consumption variable were used to differentiate between short and long term elasticity parameters. The existing differentials in electricity use according to housing-type (villas versus apartments) require the estimation of demand functions that account for these spacial/ethnic differentials. To capture variations that may occur accross households in different housing types, two additional demand specifications were estimated. These are:

$$Q = f(Y, AC, APP, RM, Z) \quad (2)$$

where Q and Y are, respectively, monthly household consumption and income levels, AC is a binary variable for the air conditioning type (1 = central, 0 = other), APP is the number of electrical appliances the household has, RM is the number of rooms in the household, and Z is the household size. Equation (2) was estimated for all housing units and for each housing type (villas, limited/middle income and apartments) separately.

A variant of equation (2) was also estimated using two-stage least squares:

$$APP = 0(Y, V, RM) \quad (3)$$

$$Q = f(APP, AC, RM, Z, N) \quad (4)$$

where

V is a binary variable for housing-type (V = 1 for villas; 0 = other)

N is a binary variable for nationality (Kuwaitis = 1; 0 = other)

Two data sets were used to estimate equations (1) through (4): time-series and cross-section. Time-series electricity consumption data were gleaned from MEW records, and real price and income data were collected from Kuwait's national accounts series. Cross-section data were collected through a questionnaire carefully designed by the Economics Department at the Kuwait Institute for Scientific Research (KISR) in 1984. The questionnaire documented information on household structure, budget and expenditure, housing space, size, type and electrical appliances.

Equity and Efficiency Analysis

Consumer use analysis revealed the following:

1. The correlation between electricity consumption and household income is positive but far from perfect. The simple correla tion coefficient between income and consumption is 45%.
2. Income has a much more direct bearing on ownership of appliances and number of rooms in the house. The poorest 20% of households occupy, on average, less than four rooms, whereas the richest 20% occupy houses that have, on average about 16 rooms. Similarly, the number of electrical appliances increase with income, from 11.0 to 31.6 for the poorest and richest 20% of households, respectively.
3. Ethnic variables are important determinants of electricity use in Kuwait's setting. Ethnicity affects electricity use through income and wealth variables; i.e., the average levels of income and wealth variables are discernibly higher for Kuwaitis than for non-Kuwaitis. The proxy for wealth in our sample is housing type. The statistical analysis here indi cates that, although nearly 22% of Kuwaiti households use more than 7500 kWh per month, less than 1% of non-Kuwaitis fall into this high consumption category. In contrast, 99.36% of non-Kuwaitis use less than 4000 kWh/month compared with 43.3% of Kuwaiti households.

The results of estimating regression equations (1) through (4) are presented in Table 3. Since households in Kuwait have been buying electricity at the fixed rate, the proposed lifeline rate was not implemented by MEW, so it is not possible to estimate directly the average consumption and the demand function of the households under the lifeline rate structure. Therefore, the lifeline rate structure designed by MEW and the regression models in Table 3 were used to derive the average consumption and the demand

functions. Using these data, the equity, conservation and subsidy-reduction were simulated for households living in each housing type and according to the distribution of their income. The price elasticity estimates obtained from time-series regression models varied between an immediate-term rigid response, during which consumers have practically no choice but to pay the higher prices for the services rendered by MEW, to short term responses of - 0.09 and - 0.30. We used all three estimates in our simulation experiments to cover the full range of possible outcomes that higher electricity price schedules may induce. Further support for these estimates is available from empirical studies *on* price elasticity coefficients in other energy--intensive countries (IEA, 1982).

When the two distributions of villas and apartments were subjected to the two-tier multitariff pricing scheme proposed by MEW, the following results were obtained:

- For villas and middle and limited income housing types, average electricity expenditure increases from KD 10.1 per household per *month to KD* 20.7/mo and to KD 18.1/mo under the pre- and post-conservation simulations, respectively. In the pre-conservation simulation scheme, the lowest 40% of the households incur an increase in their average bill of 49%; the increase for the top 20% is 168%. The corresponding increases under the post-conservation scheme are 36 and 128%, respectively.
- Average price per kWh increases to 4.1 and 3.8 fils under the pre- and post-conservation schemes. The lowest 40% of households pay 2.85 and 2.77 fils/kWh under these two schemes, whereas the top 20% pay 5.35 and 4.93 fils.
- Electricity conservation efforts lead to a relatively small reduction in consumption (5.1%); this is because more than 60% of the households in this housing category fall into the exempted consumption bracket; that is, they belong to the low consumption category that pays 2 fils only, and because the employed price elasticity is small.
- The overall budget share in this housing category increases from its status quo of 0.71 to 1.5 a,nd 1.3% under the pre-and post-conservation schemes, respectively.
- As households of this housing category consume larger amounts of electricity than the overall household average, the per household government subsidy that accrues under the status quo (KD 131.4) is larger than the estimated overall household average (KD 84.4). Following the initiation of the lifeline rate structure, the per household government subsidy declines, on average, from KD 131.4 to KD 102.1 and KD 99.4 under the pre- and post-conservation schemes.

ro

Table 3. Coefficient Estimate for Residential Electricity Demand

Equation Number	Intercept	Y	P	H	Lag Q	Estim. Method	DW	Price Elast.	Income Elast.	No. of Observ.
(l.a)	- 1182		0.46	- 150		22139	0.77			
		-(3.00)	(3.30)	- (0.90)	(3.0)	(6.40)	Autoreg. 0.990 (1=0.49)	-0.09	0.28	13
(l.b)	2309		0.89	- 883						
		(3.40)	(2.60)	- (5.60)	-	-	OLS 0.870	1.80	-0.38	0.57	13

Parenthetical values are t-values. Abbreviations: Y, income level; P, electricity price; H, housing stock; Q, quantity consumed; The functional form used is linear.

Table 3. (continued)

Number	APP	RM	V	Nation.	Est.	R	Income	Size	No. of Observ.	Eqn. (K=l)	Intercept	Method	Y Elast.	Z Elast.	AC -2
(2)		5.40		0.0435	0.161	0.154	0.284	0.523							
	(25.10)	(1.12)		(2.98)	(1.75)	(3.05)	(5.80)	-	-	OLS	0.381	0.44	0.16	845	
(3)		0.856		0.0689	-			0.685	0.1886						
	(10.21)	(4.58)		-	-	-	(22.90)	(6.17)	-	2SLS	0.784	0.07	-	860	
(4)		5.77		-	0.167	0.167	0.261	0.459	-	0.206					
	(43.14)	-		(3.09)	(1.96)	(2.85)	(5.05)	-	(3.45)	2SLS	0.390	-	0.17	860	

Parenthetical values are t-values. Abbreviations: Y, income level; Z, household size; AC, airconditioning; **APP,** total number of appliances; RM, total number of rooms; V, housing type (villas*l); Nation., dummy for nationality (K=Kuwaiti=l). The funcitonal **form used** is **log-linear.** Equations (l.a) and (l.b) were estimated using time-series **data; while (2)-(4) employed** cross-section data.

For apartments, expenditure on electricity increases from KD 3.2 under the status quo to KD 4.6 and 4.2 under the pre-post-conservation schemes, respectively.

When the demand for electricity use by apartment customers is assumed to be perfectly inelastic, the lowest 40% of households would experience a 33.8% increase in their electricity bills, the middle 40% would encounter an increase of 49%, and the bills of the top 20% would rise by 63.7%. When a price elasticity of - 0.09 is employed, the respective increase in the electricity bills of the lowest 40%, middle 40%, and the top 20% would be 22.4, 35 and 45% respectively. The post-conservation budget shares would still lie between 1.3.and 0.60% for the bottom 40% and top 20% respectively. Average price to households living in apartments is likely to increase from its status quo level of 2 fils/kWh to 2.95 and 2.80 fils/kWh under the pre- and post-conservation schemes, respectively.

The electricity consumption would decrease, on average, by 4% per household following a conservation scheme. The government subsidy to apartment dwellers diminishes from KD 42.5 to KD 36.3 and 35.2, respectively, under the pre- and post-conservation scheme.

When a price elasticity of -0.30 is embedded, the salient results of the lifeline rate structure to villas/middle/1imited income housing are:

- Electricity bills increase, on average, from KD 10.1 to KD 12.5 per household per month, with the lowest 40% of households having to pay nearly KD 7.7, whereas the middle 40% and the top 20% of households would pay KD 13.3 and 20.5, respectively.
- Average budget share of electricity use increases from 0.71 to 0.88 after conservation. The budget shares of lowest, middle, and top segments of households would be 1.67, 1.20 and 0.65, respectively, up from 1.59, 1.00 and 0.47.
- Higher electricity prices would reduce wasteful consumption by 17% of the present 5052 kWh per month. The bottom 40% would reduce their consumption by 10% and the top 20% would cut down its use by 24.6%.
- Average price becomes 3.0 fils after conservation methods, with the top 20% having to pay an average price of 3.82 fils/kWh.
- The government subsidy falls from its current level of KD 131.4 to KD 90.4, i.e., by 31%, after conservation efforts.

When this pricing scheme was applied to households in apartments, the following results were obtained:

Electricity bills increase, on average, from KD 3.2 to KD 4.6 per household per month. Low income households experience a smaller increase in their electricity bills than households on the top of the income distribution scale.

Higher electricity prices reduce wastage by 13.5%. Poor households curtail their consumption by a smaller percentage than rich households.
The average price of electricity increases from 2.0 to 2.2 fils/kWh for the lowest 40% and to 2.36 fils/kWh for the top 20%.

Conclusions

In this paper, we examined the viability of replacing existing residential electricy tariffs with MEWs proposed lifeline rate structure. The analysis focussed on a few economic variables--equity, subsidy, and conservation. The paper employed econometric estimates of price and income elasticities in conjunction with pre-determined information about existing electricity and income distribution parameters within households living in apartments and villas to simulate demand functions and consumption levels under the proposed lifeline rate structure. The results indicate that the lifeline rate structure proposed by MEW is viable from the perspectives of equity, conservation and efficiency.

NOTES

1. This paper draws heavily on KISR's report "The Economic Impact of Changing the Structure of Electricity Prices in. Kuwait", Kuwait Institute for Scientific Research (KISR), July, 1984. The authors of the report are: Sulayman S. Al-Qudsi; M. Girgis; A. M. Al-Shatti; and S. Al-Asfour

REFERENCES

Al- Qudsi S. "The Electricity Demand Pattern in Kuwait's Residential Sector". Presented at the 12th Annual Convention of Eastern Economic Association, Philadelphia, May 1986.

Cooper, M.; T. Sullivan; S. Punnets; and E. Bernam. 1983. Equity and Rising Energy Prices and the Living Standards of Lower Income Americans" Boulder, Colorado: Westview Press.

International Energy Agency, World Energy Outlook, Organization for Economic Co-operation and Development, Paris, 1982.

Organization of Arab Petroleum Exporting Countries (OAPEC) 12th Annual Report to the Secretary General, 1985: Tables 7/2 and 9/2.

Middle East Electricity (MEE), September 1986: p.27.

Ministry of Electricity and Water. Electrical Energy and Water Statistical Yearbook, Kuwait, T955

Restructuring Existing Electricity Tariff: A Welfare Assessment

Sulayman S. Al-Qudsi
(Researcher)

and

Abdul Majeed Al-Shatti
(Associate Research Specialist)

Economics Department Kuwait
Institute for Scientific Research
P. 0. Box 24885 13109
- Safat - Kuwait

Abstract

Kuwait's electricity consumption has been increasing at phenomenal rates. On a per capita basis, consumption jumped from 2360 kWh to 9255 kWh per month over the 20-year period 1965-1985. A major stimulant to this growth pattern is the constancy of electricity prices at artificialTy low rates, less than 1 cent per kWh. The gap between per unit production cost and price has been widening due to discernible escalations in labor, machinery, transportation, and distribution costs.

In the presence of abundant oil reserves, the government has historically paid the difference. But, with the sharp decline in government revenue following the recent oil price collapse, thinking has been directed towards restructuring the electricity tariff pattern by introducing an increasing block system.

The objectives of this paper are:

1. To provide estimates of the distribution of electricity subsidy among its various users in the residential sector.
2. To approximate the welfare loss that would accrue to various classes of users.

The paper utilizes the social welfare concept in assessing the potential welfare losses that may accrue as a result of the proposed tariff restructuring.