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NATURAL GAS PRE-PAID METERING FOR DOMESTIC CUSTOMERS: EVALUATION OF THE PILOT PROJECT BY TITAS GAS TRANSMISSION AND DISTRIBUTION COMPANY LIMITED

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ABSTRACT

There are different types of customers and tariff rates for natural gas in Bangladesh. All types except the un-metered Domestic customers are billed on meters. Un-metered domestic customers are billed at flat rates. They pay a fixed amount, whatever may be their actual gas consumption. As they need not pay for every unit of gas they use, they utilize gas for drying clothes, keeping room warm in winter and saving the expenses of match sticks. For this reason, most of these domestic customers use this nonrenewable fossil fuel inefficiently and they do not use efficient gas appliances to reduce the wastage of gas. This group of customers consumes about 11% of the total gas. Thus there is a scope for wasting a significant amount of gas. Pre-paid metering may reduce such wastage and also eliminate the problem of unpaid dues. Titas Gas Transmission & Distribution Company Ltd. (TGTDCL) undertook a pilot project in July 2005 to implement pre-paid metering on a limited scale. The outcomes of the pilot project are analyzed and presented in this paper. It is found that most of the customers under the project appear to be indifferent to the new system. The revenue of TGTDCL was less compared to the same number of un-metered customers. The pilot project was not designed adequately. Calculations are therefore made with assumed parameters. Clear and conclusive results regarding reduction of gas wastage and financial benefits cannot be obtained. More carefully designed pilot projects must be conducted before deployment of metering in a large scale.

Keywords: Natural Gas, Metering, Pre-paid, Domestic Consumption, Wastage.

1. INTRODUCTION

There are different types of customers and tariff rates for natural gas in Bangladesh. All types except the un-metered Domestic customers are billed on meters. For all metered customers, post-paid analogue meters are used for measuring the quantity of gas supplied. The quantity of gas consumed by an individual un-metered customer is insignificant compared to any of the metered customers. For this reason individual domestic metering was not considered worthwhile the extra investment. Rather a flat rate was imposed on them, based on the number of burners/stoves. In recent years however, the rapid demand growth in various sectors, together with the supply shortage, has created a situation where energy conservation has become a national priority. Therefore, metering of all domestic customers is being considered recently.

Though individual consumption is small, the total amount of gas consumed in the domestic sector is high-about 11% of the total gas consumed in the country. The number of domestic customers is increasing at a fast rate-which is directly related to the increasing population of the cities where piped gas supply exists, and the rapid growth in the housing development sector. The main problems of un-metered customers are wastage of gas and collection of dues. It is generally assumed that most of the customers unnecessarily keep the burners on, even when no cooking or heating activities are taking place. It is also known that in many cases a single stove is used by more than one family, thus significantly exceeding the estimated gas consumption by a single customer. This implies that gas is either wasted, or consumed but not paid for the correct amount. The pilot project was undertaken to quantify actual consumption and the wasted or un-paid for amounts, and test out the concept of pre-paid metering. This paper presents some findings and lessons from this project. A systematic financial analysis is beyond the scope of the paper.

2. GAS MARKETING IN BANGLADESH

Natural gas is produced by three national and four international companies from eighteen gas fields in Bangladesh. Transmission of this gas over long distances is entrusted to a single national company called

Gas Transmission Company Ltd (GTCL). There are four national distribution and marketing companies who supply the gas to the end users. The usage of natural gas is quite diverse, and the types of consumers and quantities consumed also vary greatly. Therefore different types of customers are defined, and corresponding tariff rates are fixed, as presented in the next section.

2.1. Customer Types and Tariff Rates

The Different types of customers and corresponding tariff rates are shown in the Table 1. These rates are reviewed from time to time. In recent years Bangladesh Energy Regulatory Commission (BERC) has been given the authority to conduct hearing, with representatives from all stake holders, regarding the tariff fixation.

Table 1: Tariff Rates for Different Customer Types (Taka/Nm^3) [1]

Type of customer			**2005**	**2009**
A. Non Bulk	1. Domestic	Metered	4.59	5.16
		Un-metered (flat rate) Taka/month	2 Burner Tk 400	2 Burner Tk 450
			1 Burner Tk. 350	1 Burner Tk. 400
	2. Commercial		8.23	9.47
	3. Industrial		5.23	5.86
	4. Seasonal		8.23	9.47
	5. Tea-state		5.23	5.23
	6. CNG		2.47/9.97	9.97/16.75
B. Bulk	7 Power production	Govt.	2.61	2.82
		IPP	4.41	4.41
		CIPP	3.73	4.18
		SIPP	3.73	4.18
	8. Fertilizer		2.24	2.58
	9. Captive power		3.73	4.18

The CNG tariff was increased again in May 2011 to Taka 25 per Nm^3. The work presented in this paper was based on the tariff rates prevailing in 2005.

There is a popular notion that a significant amount of loss occurs in the domestic sector since it is mostly un-metered. There is a scope of gas wastage by unnecessarily keeping the burners on. This fact was believed to be a major contributor to the large amount of unaccounted for gas (UFG) in the past years. However, systematic study to get a realistic estimate of the wastage in the domestic sector was never undertaken. It is remarkable that despite the growth of domestic customers, the overall UFG has gone down in last three years [2].

2.2. Distribution Companies

Four national companies are responsible for distribution and marketing of natural gas in Bangladesh [2]. These are i) Titas Gas Transmission and Distribution Company Limited (TGTDCL), ii) Bakhrabad Gas Systems Limited (BGSL), iii) Jalalabad Gas Transmission and Distribution Company Limited (JGTDCL), and iv) Pashchimanchal Gas Company Limited (PGCL). These companies were established at different times to meet the changing demand and requirements, and their sizes and roles also gradually changed. All distribution companies purchase gas from the production companies, and sell to the end users. In the process they are also responsible for laying and maintaining the distribution network, regulating and metering stations, etc., under their franchise areas. Table 2 shows some salient features of these companies.

Table 2: Natural Gas Distribution companies in Bangladesh

Company (Year)	Franchise Area	Total pipe length (April 2011), km	Total no of customers (April 2011)	Annual Gas sales , BCF (2009-10)	Market Share (%)
TGTDCL (1964)	Dhaka Division including Brahmanbaria	12,149.15	15,63,289	528.6	74.4
BGSL (1980)	Chittagong Division	3,553.75	1,90,596	105.7	14.9
JGTDSL (1986)	Greater Sylhet	3,117.51	1,47,344	50.2	7.1
PGCL (1999)	Northwest region.	444.13	59,116	25.8	3.6

2.3. Overview of TGTDCL

Established in 1964, it is the oldest and largest gas marketing company in Bangladesh. Its commercial operation began in April 28, 1968 by supplying gas to the Siddhirganj Thermal Power Station. Its franchise area covers Greater Dhaka, Greater Mymensingh and Brahmanbaria Districts. It buys gas from various gas fields including Titas, Habiganj, Narsingdi, Bakhrabad, Beanibazar, Kailashtila, Jalalabad, Fenchuganj, Bibiyana, Moulvi Bazar, Rashidpur and Bangura Gas Fields. It was listed with Dhaka Stock Exchange (DSE) on June 9, 2008. Currently the company supplies about 74% of the total gas in the country. The pipeline and gas sale figures are mentioned in Table 2. The customer base is shown in Table 3. Figure 1 shows the percent share of gas sold to the different types of customers [1]. From Table 2 and Figure 3, certain interesting points become evident. The power sector has only 34 customers, but it consumes about 39% of the total gas. If the captive generation is

included, about 57% of the total gas is consumed for power generation alone. The industrial sector has fewer than 5 thousand customers, yet it consumes about 19% of the total gas. The captive generation is mainly carried out by/for the industrial customers, thus the total consumption in this sector is about 37%. The commercial sector, despite having relatively high tariff, is very small. It might be worthwhile re-defining this sector and widen the scope of revenue from this sector. CNG is now an important fuel for the transportation sector, accounting for about 5% of total gas consumption.

Table 3: Gas customer status of TGTDCL
(As of June 30, 2010)

Customers Type	Number of Customers
Power-Public	11
Power- Private	23
Fertilizer	4
Captive power	1,043
Industry	4,557
Commercial	10,893
Seasonal	12
CNG	329
Domestic	1,539,691
Total	1,556,563

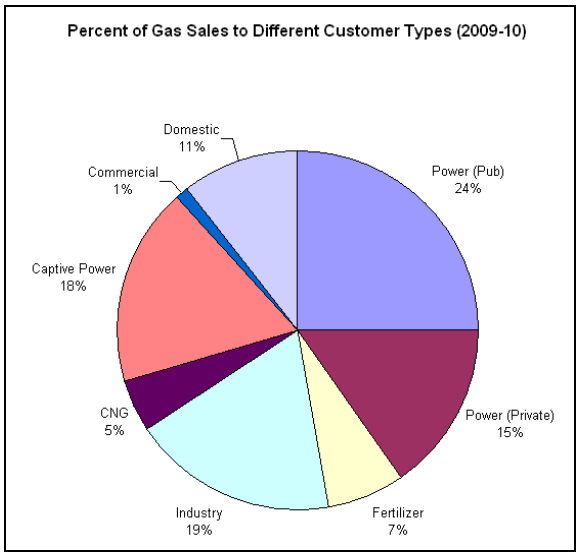

Fig 1. Percent Share of Gas Sales by TGTDCL to different Types of Customers (2009-10)

3. THE PILOT PROJECT

The pilot project was implemented in 2005, with pre-paid meters installed in 1,000 kitchens in the Banani residential area of Dhaka city. The desired properties of the meters were meticulously laid out in the project plan. Some important desired properties and features of the meters were:

i. Intrinsic Safety
ii. Security Sealing
iii. Automatic Turning on/off gas supply valve according to the situation of pre-paid amount
iv. Card Reader (IC-Chip) with high resistance to magnetic interference
v. Real time calculation and display of the balance
vi. Mechanical counter for direct reading in Nm^3
vii. LCD display for information of the IC card, messages, etc.
viii. Index Box to be secured and sealed against any illegal access.
ix. Back Stop device to prevent the reverse flow of gas.

The IC Chip would generate alarm and make the system inoperative to protect it from pre-set minimum and maximum gas flow rates. It should store information such as cumulative gas consumed, last prepaid volume, volume of gas left, card number, meter number etc. The valve would close instantly to stop the flow of gas when there is no balance from the pre-paid amount. The IC card cannot be pulled out until the storage of card value. After completion of storage the IC card value it would be ejected automatically. When the remaining volume of gas is less than 6 m^3 the meter will issue an alarm, then continue to issue alarms for each 1 m^3 and for every 0.1 m^3 intervals for the last cubic meter of gas left. In case of illegal gas use or meter bypassing the gas flow will be stopped automatically. The meter will have outlet pressure sensor. If the meter is dismantled, the motor valve inside the meter will be closed automatically and store the record in the meter. The meter would not be reusable without the help of Gas Company personnel.

Specifications of the meters used in the project:

Type	Diaphragm meter
Model	G-1.6 A
Q_{max}	2.50 Nm^3/hr
Q_{min}	0.16 Nm^3/hr
P_{max}	100 KPa

The meters had both digital and analogue display.

4. FINDINGS FROM THE PROJECT

There was no arrangement for measurement of gas consumption, such as a master meter on the supply main, in the area before the project implementation. Therefore no concrete data was available regarding the gas consumption before metering. Thus the savings of gas cannot be established with certainty; rather the analysis had to rely on assumed parameters.

4.1. Calibration and Testing of Meters

Initially the meters were tested in the Demra workshop of TGTDCL before installation and did not reveal any problem. After a few months into operation, a number of problems were found by a thorough inspection by TGTDCL representatives. Some randomly selected meters were sent to Institute of Information and Communication Technology (IICT), BUET, for further testing. Their major findings were:

i. The calibration of the meters was not accurate.
ii. The quality of the materials used for electronic module was poor.

iii. Power supply system of the meter was of lower quality.
iv. LCD display was of poor quality.

4.2. Survey and Inspection

Out of the 1,000 domestic gas customers, only 848 were available for survey. Some surveys were done as routine work. Some inspections were conducted due to complain lodged by customers. Complains included display problems, non-functioning meters, gas supply problems etc. Some customers were also inspected by the author for the study. Data were collected regarding different parameters such as flow condition, installation condition such as the locations of the meter and the stoves, verification of any technical fault, customer feedback etc. Some customers were not available while some refused to allow inspection. Tables 4 and 5 show the number of customers and types of residences under the project. It is noted from Table 5 that about 13% of the customers inspected were not ordinary domestic customers. These households were either being used as offices, or being inhabited by foreign citizens. Therefore the gas consumption pattern of these customers was likely to be quite different.

Table 4**:** Inspection data of pre- paid meters

Visited	848
Owner not available	105
Nobody resides	26
Refused to allow inspection	13
Staying abroad	8

Table 5: Category of the inspected customers

Home	718
Office	94
Foreigner	36
Total	848

4.3. Technical Faults

The total number of faulty meters was 503. Some meters had a single problem such as consumption error or battery damage etc, while others had multiple problems. Consumption error is defined as the difference between analogue and digital reading. Types of faults that were detected are shown in Table 6.

Table 6: Technical faults found in the meters

Fault Type	Fault Count
Consumption Error	375
Battery Damaged	45
Meter Damaged	18
Negative Digital Reading	4
Display Damaged	6
Meter Lock	112
Card Charging In Meter	178
Total fault count	738

It shows that consumption error is the highest among the different types of faults. About 44% of the meters were faulty in this regard. Significant number of meters also had card charging and meter lock problems.

4.4. Irregular Activities

A number of irregular activities were also detected in some meters (Table 7). Although the numbers are not very high, it is a matter of concern given the type of area where the project was implemented. It is likely that such activities would be more frequent in the less affluent areas of the city.

Table 7: Irregular activities

Type of irregularity	incident
meter by pass	6
no seal in meter	10
Total	16

4.5. Customer feedback

Satisfied customers commented that their bills were reduced with respect to flat rate billing, and that they were billed just for the amount consumed. Dissatisfied customers mostly pointed to the technical problems of the meters, and the associated hassle. Majority of the customers, however, were indifferent. The reason for indifference should be further investigated, however, it may be related to the usage pattern and income levels of the customers. Table 8 shows the summary of customer feedback.

Table 8: Customer Feedback

Overall Assessment	Number of Customers	% of Customers
Satisfied	162	19.10%
Not Satisfied	122	14.39%
Indifferent	564	66.51%
Total	848	100.00%

4.6. Financial Statement

Revenues earned by selling gas through the pre-paid meters are compared to the equivalent flat rate earnings in Table 9.

Table 9: Revenue Comparison (Oct 05 to April 06)

Month	Cards Sold (Taka)	Flat Rate Basis (Taka)
October 05	2,15,200	4,42,010
November 05	1,68,000	4,42,010
December 05	1,90,400	4,42,010
January 06	2,13,203	4,42,010
February 06	1,62,200	4,42,010
March 06	1,70,800	4,42,010
April 06	1,91,400	4,42,010
Total	13,11,203	3,0,94,070
% Difference		- 57.62%

It shows that in 7 months the actual earning was less by 57.62% compared to flat rate bill. The probable

reasons include error in digital reading (consumption error), and reduced consumption of gas by customers.

5. ESTIMATION OF WASTE GAS

The gas load calculation committee of TGTDCL experimentally determined that gas load for a domestic double burner was 0.6 Nm^3/hr. Independent tests by the author showed that at very low opening, gas consumption was about 0.1 Nm^3/hr [3]. Burning does not occur below this rate.

Past surveys by TGTDCL indicated that, about 6 to 8 hours a day of burner usage is enough to satisfy the cooking needs of an average domestic customer. This paper made independent calculations based on the following main assumption:

i. Burners are kept full open for 6 hours and partially open for 4 hours.
ii. Tariff rates are prevailing at the time of the project implementation (2005)
iii. Initial calculations are made for a group of 10,000 double burner stoves.

Thus, gas consumed per burner per month is estimated to be about 118.93 Nm^3. Flat rate for a double burner stove is Taka 400/month, and metered rate for domestic customer is Taka 4.59/Nm^3. Thus a flat rate customer actually paid for (400/4.59) about 87.15 Nm^3 of gas. The un-paid for gas is (118.93-87.15) about 31.78 Nm^3 per customer per month. This amount is termed as the "*Wasted Gas*". Annual Wasted Gas for 10,000 customers is about 3.81 MMCM, corresponding to an annual revenue loss of Taka 1.75 crore. If the same assumptions are made for the entire domestic customer base (10,97,478 in 2005), these amounts would be 418.14 MMCM and Taka 30.73 crore respectively.

6. DISCUSSIONS

There was no foreknowledge of the gas consumption in the area where the pre paid meters were deployed. If some special arrangement, such as a master meter was installed on the supply main to the said area, a better indication of gas consumption before and after the project could be obtained. That would have helped to establish the amount of gas wasted or saved with more reliability. Some gas is also wasted through leaks, and during the process of lighting the burners.

The project was implemented in an area where the income levels of the customers are supposed to be high; and their gas usage pattern was perhaps very similar. Moreover, 13% of the customers were offices and foreign citizens, whose gas usage should be quite different than regular domestic customers. It is easily understood that the usage trends between customers at different income levels would vary significantly. To address this problem, a comprehensive survey could be conducted to cover different types of neighborhoods. The pilot project in a medium to low income level neighborhood would yield more realistic results.

The project outcome is also greatly undermined by low quality meters. Reliable, accurate and durable meters are central to the success of such projects.

It is also interesting to note that the revenue of the gas company actually reduced after the project. Perhaps that is an indication of reduced consumption and wastage, but it cannot be quantified with certainty. Reduction of revenue may act as a barrier for a gas company to invest in large scale metering projects, and prompt the company towards tariff hikes.

7. CONCLUSIONS AND RECOMMENDATIONS

The results of the pilot projects are inconclusive, partly due to the design of the project, and partly due to the selection of the area. Diversity of customers is a very important point to consider. Low quality meters had a negative effect on the project. Although made on assumed parameters, calculations show significant amount of gas saving.

A comprehensive customer survey covering customers with a wide range of income levels should be conducted to develop a more effective metering program. Real-time measurements at selected points and in households selected at random should be performed. More pilot projects should be undertaken while keeping the above points in mind. Adequate arrangements such as master meters must be incorporated in the project design to reliably estimate the change of consumption before and after the projects. High quality of the meters must be ensured. Large scale deployment of pre-paid meters without sufficient background work would not be a prudent decision.

8. REFERENCES

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9. NOMENCLATURE

Symbol	Meaning
MMCM	Million Standard Cubic Meter
Nm^3	Standard Cubic Meter

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