



都市가스 計量 偏差 및 解消方案에 關한 小考

박상철 · 방선혁

한국산업기술대학교, *한국가스공사
(2010년 4월 13일 접수, 2010년 6월 19일 수정, 2010년 6월 29일 채택)

A Study on the Discrepancies of Gas Measurement and the Solution Measures between Suppliers and Consumers in South Korea

Sang-Chul Park · Sun-Hyuk Bang

Dept. of School of Knowledge-based Technology and Energy, Korea Polytechnic University, Seoul 429-793, Korea

*Director of Korea Gas Corporation, Korea

(Received 13. April. 2010, Revised 19. June. 2010, Accepted 29. June. 2010)

요 약

한국가스공사는 1983년 가스의 안정적인 공급을 위해 특별법에 의거 설립되었으며 30개 지역의 가스소매를 담당하는 도시가스회사에 천연가스 도매공급을 전담하고 있다. 가스공사가 수입하는 가스의 측정방식은 LNG 하역 전후의 수송선 액위를 측정함으로써 계량한다. 이때 가스성분분석은 수입가스의 가격이 열량에 의해 산정되기 때문에 필수적이다. 또한 터빈미터는 도시가스사로 공급하는 가스의 계량에 널리 쓰이고 있다. 그러나 발전용으로 공급되는 가스의 계량설비와는 달리 도시가스사로 공급되는 가스를 계량하는 설비에는 가스요금이 열량에 의해서가 아니라 부피에 의해서 부과되기 때문에 가스성분을 측정하는 분석기가 없다. 따라서 도시가스사가 가스공사로부터 구입하는 가스량과 소비자에게 판매하는 가스량이 일치하지 않는 문제점이 발생한다. 그 이유는 소매용 가스미터에 내재하는 오차와 운용상의 문제로 인해 도매용 계량설비와 소매용 가스미터의 수치는 차이가 있기 때문이다. 본 논문에서는 도시가스사와 일반 소비자 간의 실제 가스량에 대한 논쟁에 관해 조사하였으며 가스 계량오차에 관한 문제점을 해소하기 위한 바람직한 기술적, 경제적 정책방향을 제안하는데 중점을 두었다.

Abstract - KOGAS, established in 1983 by law to ensure stable gas supply to the public, is responsible for the wholesale distribution to 30 city gas companies that deal with the retail distribution of natural gas in their geographic areas. The gas imported by KOGAS is measured by checking the level difference of LNG shipped in tankers before and after unloading. The analysis of gas composition is essential because the imported gas price is determined by its calorific value. The turbine meter is widely used for measuring the gas sold to city gas companies. Unlike the metering system for power plants, there is no gas chromatograph since the custody transfer of gas to the city gas companies is not billed by calorific value, but by volume basis. The gas quantity that a city gas company has bought from KOGAS is not equal to the quantity that the company sold to its customers. There have been some discrepancies between the wholesale gas meter readouts and retail ones due to some inherent errors of meters and some operational issues of the meters. This paper investigates the controversies regarding the real quantity of gas between distributors and consumers. It will discuss and suggest desirable policies, both technically and economically, in order to solve the discrepancies of gas measurement.

Key words : natural gas, discrepancy, gas measurement, solution measure, LNG market

*주저자: scpark@kpu.ac.kr

1. Introduction

It was in October 1970 that the first city gas was delivered to the public in South Korea, which is when the Municipal Gas Company was established by the City of Seoul[1]. However, the gas was actually Liquefied Petroleum Gas (LPG), containing some air. In February 1987, the natural gas was introduced to the Seoul metropolitan area by the Korea Gas Corporation (KOGAS) through some city gas companies. It has now become one of the major energy sources in South Korean households with its usage in more than 70 % of total households by the end of 2006.

KOGAS was established in 1983 by the Korea Gas Corporation Law to ensure stable gas supply to the public. Its major business areas are exploration, import, export, re-gasification, distribution and wholesale of natural gas.

Since the introduction of KOGAS and its completion of the Nationwide Natural Gas Pipeline Network in 2000, the distribution system of city gas has been solved. KOGAS is responsible for the wholesale distribution while the city gas companies are responsible for the retail of natural gas in their provinces. Under the distribution system, it is necessary to make a custody transfer of gas between wholesaler and retailers as well as between retailers and consumers. Accordingly, the gas measurement has to be obtained at each transfer.

There have been some discrepancies between the wholesale gas meter readouts and retail readouts due to some inherent errors of meters and some operational issues with the meters. There have been many controversies in this country for the last several years after the

press reported that the city gas companies had taken advantage of the benefits from the measurement discrepancies and consumers overpaid for gas.

In this paper, the controversies regarding the real price for distributors and consumers are examined, and their desirable policies, both technically and economically, are investigated.

2. City Gas Distribution System

South Korea imports all natural gas in the form of LNG except for a small quantity of gas from East Sea (Dong-Hae) gas well operated by the Korea National Oil Corporation. For a description of the entire process of LNG from production to consumption, the term ‘LNG Chain’ is generally used. The LNG Chain includes production, liquefaction, transportation, storage, re-gasification, distribution, and consumption. In some natural gas producing countries, the liquefaction and re-gasification processes can be omitted for their domestic use of gas.

LNG is generally regarded as clean gas, since in its liquefaction process almost all the impure materials including sulfur dioxide are extracted. Additionally, due to its cryogenic characteristic LNG does not contain any moisture. This means that at the re-gasification terminals in LNG importing countries there is no need to facilitate any further purification process.

With the exception of industrial use, when transported by tanker truck, imported gas is put into the re-gasification process at LNG re-gasification terminals. It is then supplied to the city gas companies and power generation plants through high pressure pipelines. The city gas companies then deliver the gas to households through

Table 1. National Distribution of LNG for Households in South Korea (2004~2006).

Area	Number of Households [Distribution Rate (%)]		
	2004	2005	2006
Seoul Metropolitan Area	6,886,136 [85.7]	7,123,788 [86.1]	7,328,993 [86.4]
Region	3,522,160 [48.5]	3,831,671 [50.2]	4,182,452 [52.7]
Nation	10,408,296 [68.0]	10,966,459 [68.9]	11,511,445 [70.1]

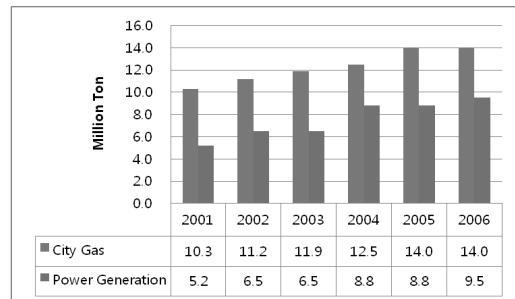


Fig. 1. LNG Demands in Sectors in South Korea (2001~2006) (Million Ton).

their low pressure pipelines.

Among the processes of the LNG Chain, KOGAS is responsible for the middle stream of transportation, storage, re-gasification, and distribution to the city gas companies and power plants, also called wholesale. KOGAS operates 3 LNG terminals and 8 pipeline offices for 2,511 km of high pressure pipeline nationwide.

Unlike oil, natural gas reservoirs are spread relatively evenly all over the world. Thus, the Middle East dependant ratio of the gas sources is much less than that of oil. Despite the less dependant ratio of the Middle East, the ratio is still over 50 % at a global scale. In 2006, South Korea imported approximately 23.5 million tons of LNG from Indonesia, Malaysia, Brunei, Oman, Qatar, and Australia, and its portion of the primary energy sector of the nation marked 13 %. Natural gas was mainly used for power generation in the late 1980s and early 1990s. In time, however, its usage for city gas has gradually increased to be marked over 60 %. The LNG demands for city gas and power generation have increased in the last six consecutive years.

The billing for gas delivery, which is regulated by the guideline of the authorities, is determined based on both the price of imported gas and the cost of distribution. Some margins are added to the wholesale and retail gas prices. KOGAS announces its wholesale gas price every second month under the approval of the central government since the imported gas price varies according to the international oil price. The city gas companies then publish their retail gas prices under the approval of the local governments.

3. Measurement of Custody Transfer Gas

It is difficult to measure the custody transfer of gas. The imported gas is usually measured by checking the level difference of LNG shipped in tankers before and after it's unloading. The analysis of gas composition is essential because the imported gas price is determined by its calorific value.

The gas re-gasified at KOGAS terminals is supplied to city gas companies and power plants through city gate stations and governor stations respectively. The standard gas pressure for city gas companies is $8.5 \pm 1.4 \text{ kg/cm}^2$ whilst for power plants it is $27.0 \pm 3.0 \text{ kg/cm}^2$ except for some local power plant[2]. In the stations, some pressure reducing valves are equipped for regulating gas pressure

at proper levels.

At every gas delivery point, a flow measurement system is installed at KOGAS' expense for measuring the custody transfer of gas. For the power plants, a metering system with several orifice meters are utilized for the fluctuations of gas demand, and a gas chromatograph is equipped to analyze calorific values for billing purposes. In LNG Sales and Purchase Contracts, the LNG price is determined by a formula which serves to protect LNG sellers from the risk of a drop in LNG price, in addition to a correlation coefficient with the crude oil price. Whether the formula is complex or simple, the LNG price is based on calorific value, i.e. BTU.

The turbine meter is widely used for measuring the gas to city gas companies. There were 33 city gas companies around the country in 2009. Among these, 30 companies buy the natural gas from KOGAS at 93 delivery points. Unlike the metering system for power plants, there is no gas chromatograph in the metering system for the city gas companies since the custody transfer of gas to the city gas companies is not billed by calorific value, but by volume basis. The gas measurement to the city gas companies, the turbine meter equipped with pressure and temperature correction, is used to calculate the gas at its normal condition of $0 \text{ }^\circ\text{C}$, 1 atm.

Hence, flow calculators at KOGAS stations utilize constants for the factors which are taken from the accumulated data for the previous year. Most LNG purchase contracts that KOGAS has committed to are 20-year-long terms. Thus, the gas composition within a contract is difficult to be valued in the short term while that of spot LNG is not. Due to this reason, no calorific value adjustment including the nitrogen injection for the send-out gas at the re-gasification terminals in KOGAS has been carried out. Accordingly, it is safe to say that the factors from previous years can be used without controversy for the calculation of custody transfer of gas volumes for city gas.

A diaphragm meter, a type of positive-displacement flow meter, is commonly chosen by city gas companies for measurement of gas for residential use. This type of flow meter has a very simple structure because it measures gas volume directly, and is not related to a time frame. However, it is impossible for the meter to correct the inflation and/or deflation of gas caused by pressure and temperature changes unless the meter is equipped with any type of volume corrector.

It is required that the city gas companies maintain the

gas pressure at the gas meter for each household to be 100 ~ 250 mmH₂O (1.0 ~ 2.5 kPa) by the city gas service regulations either approved or enacted by local governments. (The Council of City Gas Service of Seoul, 2003; Gyeong-Gi Province, 2002; Dae-Gu City Gas Co. Ltd., 2006)

4. Discrepancies in Measurement

The gas quantity that a city gas company bought from KOGAS is not equal to the quantity that the company sold to its customers. There may be several reasons for this. However, the following three reasons are regarded as the major causes for describing the phenomena.

The primary discrepancy is caused because the flow of gas is carried out by pipeline while the transportation of electricity is carried out by over head power lines which transmit with light speed. Hence, there is no difference between inlet and outlet of an electric circuit provided that there is no loss. However, in the case of gas pipelines, a common type of transportation medium, some gas accumulates or discharges causing some differences between its input and output.

One case is that the input quantity of a pipeline is larger than that of the output while another case is vice versa. In addition, the time difference of meter reading also causes some discrepancies. Therefore, KOGAS and the city gas companies read the wholesale gas meters in KOGAS' stations at 24:00 of the last day every month, but the city gas companies read the meters in every house before or after the 5th day of every month. Consumers need not worry about this time discrepancy because it is in their favor to have 5 days unaccounted for.

In Korean Measurement Law there is an accuracy related article, in which gas meters for residential use should be certified by authorities. Nevertheless, this law indicates that the gas metering system which is installed by KOGAS for wholesale measurement is excluded from the application of the law because its capacity exceeds 1,000 m³[3].

Meanwhile, the gas sales and purchase contracts between KOGAS and city gas companies state that the metering system accuracy should be 1.0 % or better, and the operation accuracy should be 2.0 % or better. In the case that measured accuracy is worse than that figure the two parties have to take proper action. It is no surprise that most city gas companies install check meters to verify

whether their readouts are similar to those of KOGAS' or not.

Taking the accuracy of the metering systems into consideration, the ratio of input to output of natural gas of KOGAS in a period can be expressed as follows:

$$\text{Ratio} = (\text{Output}/\text{Input}) \times 100 (\%)$$

Where

$$\text{Input} = \text{Imported}$$

$$\text{Output} = \text{Sold} + \text{Technically Consumed} + \text{Stored in LNG Tanks and Pipelines}$$

The ratio is equal to or higher than 99.5 % in every year. On the other hand, the operational accuracy of the residential gas meter should be 3.0 % or better according to the City Gas Service Code[4],[5],[6].

The third and largest factor which causes the discrepancy in measuring gas volume originates from the problem that the residential gas meters do not have any function of correcting the pressure and temperature effects. The wholesale gas is measured as its flow condition and then corrected at normal condition, i.e., 0 °C at 1 atm, while the retail gas is not. Therefore, the error caused by this difference in measurement is added to the discrepancy directly.

An example of measurement discrepancy calculation is shown below. Assuming that the gas pressure and temperature at the delivery point to a house are 2.5 kPa and 9.0 °C respectively, the relation between uncorrected volume at flow condition V₁ and corrected volume at normal condition V₀ is simply;

$$\begin{aligned} V_0 &= V_1 \times [(P_0/P_1) \times (T_1/T_0)] \\ &= V_1 \times \{[101.325/(101.325 + 2.5)] \times [(273.15 + 9.0)/273.15]\} \\ &= V_1 \times 1.008076574 \end{aligned}$$

Where

P₀ = Absolute Pressure at Normal Condition (kPa)

P₁ = Absolute Pressure at Flow Condition (kPa)

T₀ = Absolute Temperature at Normal Condition (°K)

T₁ = Absolute Temperature at Flow Condition (°K)

This formula can be understood as approximately 0.8 % more gas that is measured than the value measured at the normal condition. Of course, in this formula, the compressibility and effects from pressure increase by temperature changes and atmosphere pressure changes from installation altitude etc. are not considered. However, this result can be regarded as reasonable when taking it into consideration that both the average annual temperature of the 10 largest cities in Korea in 2006 was 13.0 °C, that ex-

cluded 15.5 °C of Je-Ju city, and the gas consumption during the winter season is greater than that of the summer season[7].

5. Voices from Related Parties

The Board of Audit and Inspection (BAI) in South Korea required the Korea City Gas Association (KCGA) to take a measure on the city gas billing since BAI found during its auditing on KOGAS that there were some 1.89 % of sales gas surplus in the city gas companies in 1999. The surplus seemed to be caused by the customer metering errors. The surplus was compared to the gas amount bought from KOGAS for the last 3 years. Therefore, the surplus was regarded as an unfair profit for the city gas companies[8].

In addition, BAI notified the Ministry of Commerce, Industry and Energy (MOCIE) in a March 2000 audit that MOCIE should review the city gas billings accounting for the surplus of sales gas and city gas companies' additional profit. Following the controversy in the National Assembly, MOCIE, with cooperation of KCGA, asked the Korea Research Institute of Standards and Science (KRISS) in 2001 to study and make an improvement on the discrepancy of city gas measurement[8].

Furthermore, the economic committee of the National Assembly in Feb. 2006 insisted that city gas companies had taken advantage of 297.7 billion Won with the measurement surplus of city gas from 1996 to 2004, and MOCIE, as a supervisory authority, did not take any measure for the matter even though BAI had notified them many years before[9]. In the same month, Citizen's Coalition for Economic Justice (CCEJ) also released an official statement insisting the city gas companies should return the improper surplus caused by the measurement errors to the consumers, and announced that it will endeavor to protect consumer's right through activities such as requiring BAI to audit related organizations, and requiring the city gas companies to open information for making improvements of gas billing system. In a statement, CCEJ insisted that according to the data from MOCIE and the city gas companies, there were 21.2 billion Won worth of discrepancies nationwide in 2001, 39.4 billion Won in 2002, 20.0 billion Won in 2003 and 25.6 billion Won in 2004 respectively[10].

In April 2006, one of the citizen coalitions in Dae-Gu Metropolitan City sued Dae-Gu City Gas Co., Ltd. to re-

turn the unreasonably collected gas fares under the name of several apartment residents. The area has 21,038 residents living in 5,539 houses in 11 apartment complexes. It was the first incident in the whole peninsula to make the issue go through the court[10]. The organization insisted in the complaint that approximately 8 % of the gas had been lessened in a gas measurement experiment with a volume corrector compared to the measurement without the volume corrector.

Along with the legal conflict between the two parties, Korea Apartment Coalition (KAC) launched the Unreasonably Collected Gas Fares Payback Center (UCGFPC) and fostered the citizens to participate in their movement of payback, insisting that the city gas companies pay the extravagant money back.

In April 2006, CCEJ requested BAI to notify the city gas companies that they had an unfair profit of 573 billion Won for the period of 1989 to 2004 by selling 956,603,000 m³ more than they bought from KOGAS. This amount was based on customer metering errors. Among the companies, Samchully Co. had an unfair profit of 139.7 billion Won. Seoul City Gas Co. had 59.1 billion Won, Yesco Co. had 52.4 billion Won, and Dae-Han City Gas Co. had 50.1 billion Won. The total amount of the unfair profit in four greater Seoul city gas companies accounted for 248.9 billion Won which relates to 43.4 % of the total unfair profit[11].

Based on the findings, the CCEJ declared that there will be continuous public suspicion of the city gas companies' unfair profit until MOCIE takes action to prevent consumers from suffering further losses. The CCEJ directly places blame on MOCIE for not preventing consumer loss through its negligence. Therefore, BAI should be committed to carry out the following two measures. First, figuring out the exact amount of the discrepancy between the quantities bought and the quantities sold. Second, clarifying the exact amount of the unfair profit in the city gas companies as well as compensating the consumers' loss.

MOCIE responded immediately to the request and explained that since the quantity discrepancy is caused within the accuracy allowance of the meter by the law, the city gas companies' profit is not unfair but merely additional. Therefore, the issue the CCEJ raised will not be a controversy. Additionally, MOCIE presented the Article 9 of Measurement Law as its basis. As a respond to MOCIE's explanation, CCEJ stated again that MOCIE's

Table 2. The Estimated Total Amount of Discrepancies in the Nation (2001~2004) (billion Won).

Year	2001	2002	2003	2004
Amount of Discrepancies	21.2	39.4	20.0	25.6

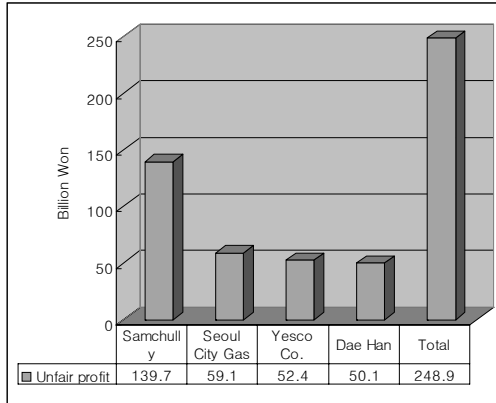


Fig. 2. Estimated Unfair Profit made by 4 Major Gas Companies (1989~2004) (Billion Won).

explanation could rationalize the city gas companies' unfair profit, and the true nature of CCEJ's request to BAI could be distorted although the discrepancy can not be prevented from occurring, and its audit request to BAI is to foster the improvement on the city gas metering and billing systems.

As a next step, CCEJ announced the results from a survey to 132 lawyers in June 2006 whether the Article 9 of the Measurement Law which MOCIE mentioned as a basis is appropriate to allow or rationalize the measurement discrepancy or not. In the survey report, 100 of the 132 lawyers (75.8 %) said it is not appropriate while only 19 (14.4 %) opposed and 13 withheld, proving that the MOCIE's explanation is not correct. CCEJ also added that Article 9 of the Measurement Law is made to restrict the use of a meter which exceeds the limit of designated accuracy and is not a basis to rationalize the measurement discrepancy.

Meanwhile, KCGA has 33 member companies nationwide working to figure out what causes the measurement discrepancy and what will be the answer to mitigate

the problem. It also expressed that the measurement discrepancy can be regarded as unaccounted-for gas. Additionally, KCGA pointed out that the measurement discrepancy occurs in measuring petroleum products, electricity, and district heating as well. Therefore, a certain range of discrepancy must be allowed in the Measurement Law. The unfair profit which was raised by CCEJ can only be brought about when the city gas companies get a profit from other's provision or effort without legal causes and others are damaged by that[12].

6. Roles of the Regulator in Using Natural Gas

The MOCIE is responsible for the energy policy of nation including natural gas, while KOGAS is responsible for its import and distribution. Additionally, Korea Gas Safety Corporation (KGSC) is responsible for managing and supervising the safety of using various gases[13]. The government has set up a legal framework for the use of natural gas which consists of: the Korea Gas Corporation Law, City Gas Business Law, Safety Management Law for High Pressure Gas, and Safety Management and Business Law for Liquefied Petroleum Gas.

The power of the government in the natural gas industry is very strong. The government retains all permission rights at any level when KOGAS imports natural gas, preserves it and expands its supply facilities. In addition, the government is the largest shareholder of KOGAS and participates intensively in the management of KOGAS activities. However, KOGAS does not have any direct control over any of the city gas companies, which are controlled by provincial governors and mayors in case of the cities under the direct control of central government. Governors supervise the city gas companies and control the number of gas line permits in a given geographic area. They have relatively weak power in comparison to the influential power of the government over KOGAS.

The wholesale price of natural gas is regulated by the City Gas Business Law and the Price Stability Law. In fixing the wholesale price, MOCIE needs to cooperate with the Ministry of Planning and Finance (MOPF) and obtain the permission of the Minister of MOCIE after debates are held in the Committee of the Natural Gas Wholesale Price (CONGWP). The retail price of natural gas is regulated by the governors in the each region and their regulation is based on local laws.

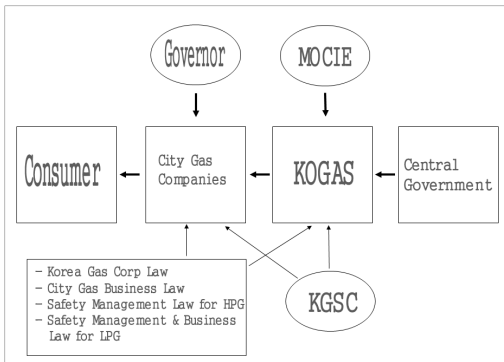


Fig. 3. City Gas Business Flow in South Korea.

Given the legal framework, MOCIE seems to have power only to control the wholesale price of natural gas because governors control the retail price in their regions. However, MOCIE can deeply influence all city gas companies through KOGAS which maintains the nationwide network. It means that MOCIE can adjust the Article 9 of the Measurement Law if the action does not impact the gas industry severely in terms of suppliers and consumers price levels. It may not be an easy task for the government to read just the allowance of measurement discrepancy by treating supplier and consumer equally because their points of view are based on their own interests. Despite the difficulty, the government as a regulator needs an approach that maximizes its credibility by rationalizing the measurement discrepancy.

7. Desirable Policies for Solution Measures

MOCIE is responsible for supervision of energy supply and management. It announced that the city gas companies will reduce the measurement discrepancy by 235.2 billion Won around 2015 by enhancing the gas meters with volume correctors. The amount is accounted by 5,880,000 sets \times 40,000 Won in 10 years. According to the plan, current measurement error of 0.73 % will be decreased to 0.16 % by 2015 and consumer's gas fare savings will reach 23.6 billion Won per year on average. Furthermore, related articles of the law will be prepared by MOCIE for payback of adjusted amounts of gas fare by measurement discrepancy, and the city gas companies will extend their installation of telemetering systems to

reduce the discrepancy caused by time differences of metering between purchase and sale[14].

The above context is worthwhile because MOCIE acknowledged the metering discrepancy as a numerical value turning from the year-long standpoint. However, its amount of investment is considered insufficient as the number of natural gas consumers nationwide exceeded 10 million already in 2005. By the end of 2006, the total number of natural gas consumers had already reached 11.5 million households.

In order to maximize the consumers' interest as well as to crystallize the energy market, the opposition party, the Grand National Party (GNP), proposed an amendment of the City Gas Business Law in April 2006, which includes articles enforcing the city gas companies either to apply a factor to correct pressure and temperature effects to gas volume calculation or to equip its meters with a volume corrector for ensuring accurate metering at their costs. Furthermore, the GNP proposed amendments of the City Gas Business Law, and Energy and Natural Resources Business Accounting Law in June 2006, which include articles enforcing the city gas companies to pay its profit into a special account designated by the law according to the annual settlement of their account.

The opposition party proposed the amendments because the idea of making the city gas companies equip a volume corrector on every gas meter requires a huge amount of capital. The total amount of the capital can be calculated such as 11.5 million household \times 40,000 Won/meter = 445 billion Won. Additionally, the domestic production of the volume corrector for this purpose does not seem to be realistic. It may take at least five years for domestic manufacturing companies to produce the volume correctors.

At the same time, there is a critical opinion on the amendment that it is not proper for a non-governmental enterprise to enforce the payment even though the gas business is one of the utilities which are served through a network. Therefore, it is desirable for the city gas companies to contribute their profit to a public fund. However, the key point to success in this method is how many and how often the companies participate in the plan voluntarily since it is true that some major shares of the city gas companies belong to foreign enterprises.

The question then becomes, what is the most practical countermeasure? The most accurate method is to equip a volume corrector on every gas meter. However, this

should be postponed until the corrector has a proper price level or proper production technology is developed. A compromised answer to the question may be to install a volume corrector in one residential complex to figure out a representative correction factor for a certain period. Since dwelling apartment complexes become more and more popular to South Korean residents, a properly installed volume corrector can have a high probability to represent the whole meters in one complex. The method can be applied to individual houses if similar conditioned houses are selected. Although the measurement of individual houses is somewhat inconvenient to re-calculate the gas volume with the correction factor, the information technology can reduce the process of re-calculation work.

There are, of course, some weak points to this method in comparison with the method that every meter has a volume corrector. In a selected complex, the metering circumstances are different according to their location. For instance, one meter can be exposed to direct sunshine while the other is in the highest floor of a tall building causing some pressure and temperature changes. Even in the case of foreign countries, it is not yet common that a type of volume corrector is equipped on every residential gas meter[15].

Therefore, the most desirable policy to solve the problem will be to correct the measured gas volume with proper factors which the two parties, the city gas companies and consumers, can agree upon.

8. Conclusions

For the last several months in early 2007, the most discussed topic among the city gas industry was the measurement discrepancy and its countermeasures. This issue was put into the National Assembly to be reviewed, for the BAI to audit, and the courts to decide in the provinces.

The authorities' slow movement toward positive problem solving could not contribute to improving mutual understanding between the two parties. Some citizens' coalitions insisted that it resulted from authorities' prejudicial policy in favor of the city gas enterprise so called connections between policy makers and advantage groups. The city gas companies' dishonesty resulted in negative consumers' sentiment[16].

As the result of a collective movement from the consumer side, 33 city gas companies in the nation proclaimed the Customer Service Charter (CSC) in April

2006. They promised the public in its execution norm that they will reduce the measurement discrepancy step by step. While it is fully justified that the naturally occurred unfair profit should be paid back to the consumers, the city gas companies' promise is far less than the citizen coalition's requirement. The CSC mentions nothing of returning the past unfair profit amounts or the topic of any unfair profits in the future. That is why their promise to offer the best service to consumers seems to serve as little consolation to consumers who are seeking an active plan to correct the operational errors of measurement which determine their prices.

As seen in advanced countries, the current situation in which the city gas companies take advantage of the profit should not be maintained. Authorities and the city gas industry have to tackle the unfair profit issue and to take proper measures as quickly as possible. Those measures should not allow the city gas companies to extort unreasonable profits from consumers. In fact, it is an extremely important issue for all parties to solve wisely because energy consumption is one of the most important basic consumption for the daily life. To create a fair price mechanism based on a fair profit is an urgent task for all parties.

References

- [1] www.seoulgas.co.kr, (2007.14)
- [2] KOGAS, "*Natural Gas Supply Handbook*," p.18 Seoul (2004)
- [3] Measurement Law, Korea (2006)
- [4] The Council of City Gas Service of Seoul, "*City Gas Service Code*," Seoul (2003)
- [5] Gyeong-Gi Province, "*City Gas Service Code*," Su-Won (2002)
- [6] Dae-Gu City Gas Co. Ltd., "*City Gas Service Code*," Dae-Gu (2006)
- [7] Korea Meteorological Administration, "*Statistics 2006*," Seoul (2006)
- [8] Korea Gas News, p.7,(2000.1.12)
- [9] Korea Gas News, p.5, (2004.1.12)
- [10] www.ccej.or.kr, (2007.15)
- [11] The Energy Economic News, p.5, (2006.4.15)
- [12] Citizen's Coalition for Economic Justice, "*Public Release*," (2006.4.26)

- [13] www.kgs.or.kr, (2008.4.30)
- [14] The Energy Economic News, (2006.7.19)
- [15] Ministry of Commerce, Industry and Energy,
"Public Release," (2006.4.11)
- [16] Korea Research Institute of Standards and Science,
*"An Analysis on the City Gas Metering Technology
and Marketing System,"* p.25 Seoul (2003)