Viability of Liquefied Natural Gas (LNG) in Pakistan

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ABSTRACT

This paper describes the viability of liquefied natural gas (LNG) for the domestic consumers, although Pakistan has commenced the import of LNG since 2015, but still a gap in supply and demand is constantly increasing. Currently, 1.2 BCF per day of re-gasified LNG is being injected into the gas pipeline network which is basically imported for the power plant sector in Punjab province. Yet the deficit of gas supply and demand is more than 2 BCF per day. The present study of local gas field projections tell that they will lose their strength to 1/3rd by 2025. It can be easily forecasted that by then, other sectors including industrial, commercial and maybe domestic will be forced to consume re-gasified LNG. Survey has been conducted from domestic consumers of Karachi and Hyderabad using a self-developed questionnaire and basic statistical tools are used to achieve the objectives. Findings of the study state that domestic consumers have little trust upon the gas suppliers as well as regulating authority (OGRA) in Pakistan. Domestic consumers have sufficient knowledge of natural gas situation in the country and are satisfied with the government subsidy on the natural gas billing, whereas they are not willing to accept LNG even at billing rate twice the current billing.

Keywords: Domestic Consumers, Liquefied Natural Gas, Resources
JEL Classifications: L95, O13, O38, P18, P43, Q43

1. INTRODUCTION

Till 2017, Pakistan has faced serious energy deficit and was unable to meet its domestic, industrial, power and other sector's energy requirement. The total energy supply in 2013 was recorded at 64.5 million metric ton of oil equivalent (MMTOE) (Wakeel et al., 2016). The total primary energy supply amounted to 66.8 MMTOE in 2014 (Pakistan Energy Yearbook, 2015).

1.1. Pakistan Energy Snapshot
Pakistan's energy snapshot according to Pakistan energy year book 2015 reveals a decrease in Natural Gas consumption to 43% from 48.2%, thereby increase in Oil consumption to 35% from 32.5% as recorded previously (Pakistan Energy Yearbook, 2015) (Figure 1).

1.2. Energy Demand Forecast
According to Pakistan institute of petroleum and recent statistics of Pakistan economic survey the gap between gas supply and demand has been stretched up to four (4) billion cubic feet per day (BCFD) i.e. the current total gas production/supply is 4 BCFD against the total unconstrained demand of 8 BCFD (Pakistan Economic Survey, 2017).

The gas supply-demand gap is continuously increasing raising an alarming situation for the authorities to patch the gap up with alternate source. Two of the major reason causing such a situation includes; (1) rapid depletion of existing fields that produces gas in Pakistan and (2) low cost of the gas for domestic consumers as its being subsidized by the government resulting in rapid increase in gas consumers in the fiscal year 2015-2016 in Pakistan. According to Pakistan Energy Book 2015, domestic sector consumer of natural gas was 22.7% in the fiscal year 2014-15 against that of 17.2% in the fiscal year 2009-10 (Figure 2).

The government of Pakistan, in such circumstances, had two options to solve the energy (natural gas) crisis:
a. Import of natural gas through Iran-Pakistan gas pipeline (IPGP) or TAPI (Turkmenistan, Afghanistan, Pakistan and

Figure 1: Energy snapshot of Pakistan
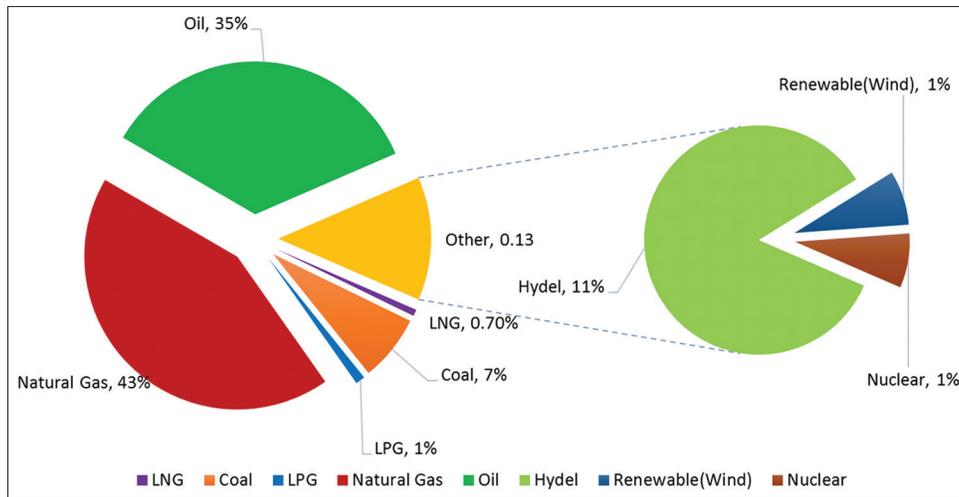
Figure 2: Natural gas supply and demand
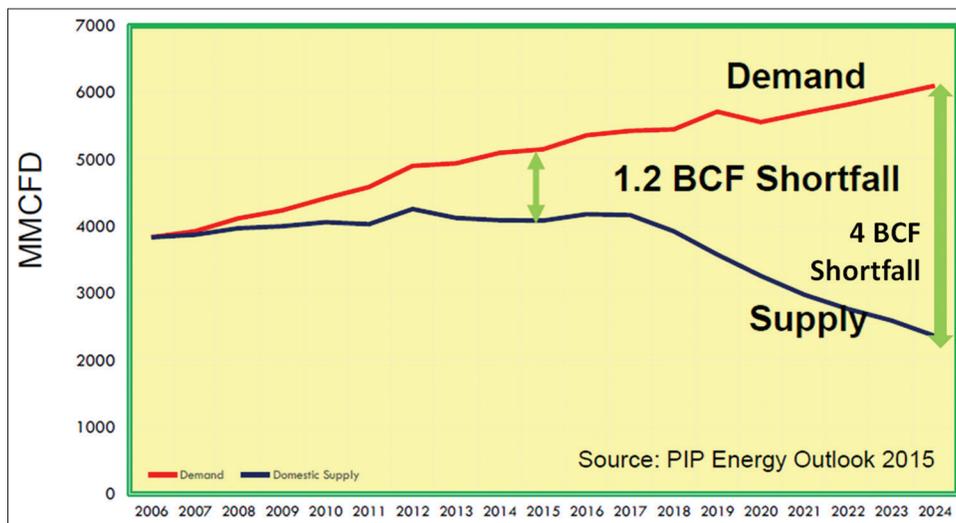
India) gas pipeline Projects.
b. Import of liquefied natural gas (LNG).

In Option "a"; IPGP has been continuously delayed due to international sanctions while first gas from TAPI is expected in 2019 with possible delay, thereby making option "a" a false solution to fulfil country current energy (natural gas) needs. While Option "b" seemed to be the only viable and fast-track solution to overcome energy shortfall.

In mid-2015, Government of Pakistan was successful in importing and bringing of 600 MMCFD (0.6 BCFD) of the gas in the form of re-gasified liquefied natural gas (RLNG) in Pakistan based on long-term (up to 15 years) contract with Qatar. Further to above, recently, another 600 MMCFD (0.6 BCFD) of RLNG has also been patched up there by stabilizing the economic gears to some extent.

Recent field gas supply projection reports depict that Pakistan will have its fields depleted in next 10 years if the production continues at current pace and it seems that more LNG import will the last resort for overcoming the needs of domestic consumers also. Cost of LNG and its regasification and transportation to end users approaches to three to four times the cost of field gas, for which the consumers are currently paying. The aim of this research is to describe whether the option of LNG import for domestic supply and charge a consumer with a bill three to four times higher than that of today is viable/practicable or not.

Main objectives of the study are:
*   To determine, whether a domestic consumer is ready to pay for the cost three to four times higher for re-gasified LNG than the cost of field gas.
*   Facilitating the government in forecasting the subsidized rate of natural gas for the domestic consumers.
*   To ascertain the benchmark price for LNG import in order to consider it as viable option over other alternatives.

2. LITERATURE REVIEW

In Pakistan RLNG (Re-gasified LNG) prices are regulated by the regulatory authority, the OGRA (Oil and Gas Regulatory

Authority). The weighted average sale price of RLNG as per decisions of Federal Government and advice from Ministry of Energy is set to be 11.484 US$/MMBtu for the month of April, 2018. (Oil and Gas Regulatory Authority, 2018) (Figure 3).

Abbasi and Kamal (2014) had carried out a descriptive study on "Importing LNG: A Policy Analysis" with findings that Asia has 68% of market share for LNG import. Therefore, Asia should create a new natural gas pricing hub via collective bargaining power of its countries with other continents. BP-International LNG trade Statistics stated the plan for LNG Import as (Table 1):

Pakistan has been importing LNG from Qatar at an average rate of 600MMCF per day since March 2015. Although collectively Asia has significant share of LNG import, still it has not been able to influence LNG pricing from Qatar rather the pricing mechanism is mostly dependent on the prevailing market price in the region. The landing price of LNG from Qatar to India in 2013 ranged between $ 10 and 12/MMBtu. (Argus Global LNG, 2013).

"The price of LNG may be the single biggest factor impacting economic activity in Pakistan. A look at the major gas fields of Pakistan (Table 2), constituting almost 85% of total production shows that domestic gas was no more than $4.78/MMbtu.

In fact, LNG would only be a viable option for Pakistan if it were to cost less than USD 12/MMBTU. However, media reports and statements from the Ministry suggest a price $17 per MMBTU for Qatari LNG. Additional costs of re-gasification and charges of SSGCL and SNGPL and other taxes will likely push up its price to not less than USD 18/MMBTU. The most compelling argument offered by the Ministry in favour of buying LNG has been that it is a cheaper fuel for electricity, but at anything more than USD 14/MMBtu, LNG loses its competitive advantage against oil. It is in terms of the British thermal unit (Btu) which is a basic measure of thermal (heat) energy." (Abbasi and Kamal, 2014)

Ledesma et al., (2014) had predicted that Australia might leave Qatar behind as the world's largest supplier of LNG by the end of the 2010s with seven new LNG projects under construction process which were due to completion by 2014-2018's timeframe (but that was not the case in actual –Figure 4). Australia's plentiful gas reserves, the prior track record of LNG project execution and operation and relative vicinity to the fast-growing Asian LNG markets offer it the degree of comparative advantage that would guarantee a benign investment environment.

Though the book claims that Australia will become the LNG export lead by 2018, still, it will not or somehow affect the least for price setting terms, Pakistan can negotiate with Qatar.

Kumar et al., (2017) have worked out on one of the methods for calorific value/quality/heating value management by using nitrogen blending technique in which different molar fractions
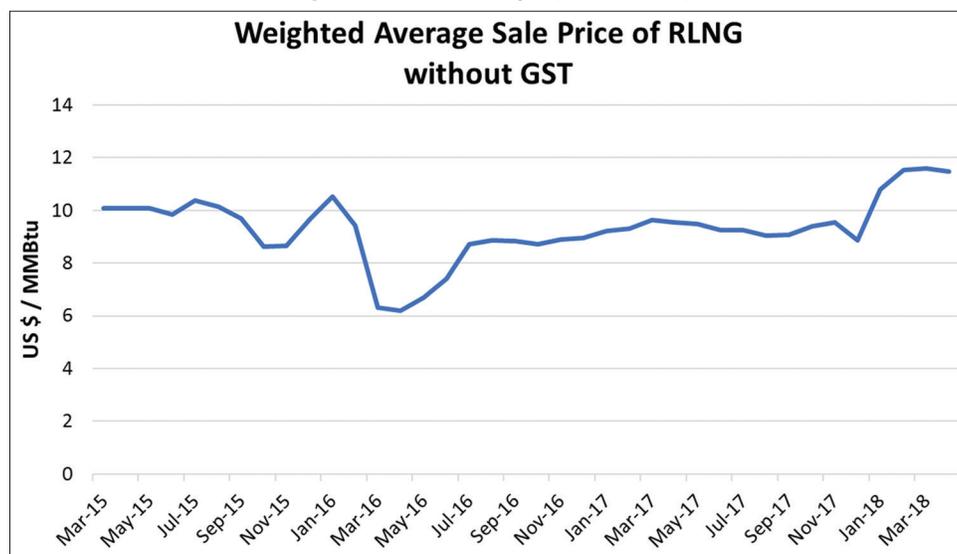
Figure 3: RLNG Pricing – (OGRA, 2018)

Table 1: LNG Trade Statistics

LNG Import in the Year 2012	Japan	South Korea	Pakistan*	India	China	Taiwan	Thailand
BCF per Annum	4,194	1,754	730	724	706	597	49

"Pakistan, with its rising natural gas demand and energy requirements must play a lead role through skilful diplomacy and the use of acumen towards a natural gas pricing hub that reflects the realities of the global gas market." (Abbasi and Maha, 2014)

Table 2: Major Gas Fields Statistics, Pakistan Energy Book, (2012)

Gas Field	Sui	Zamzama	Qadirpur	Mari	Bhit	Sawan	Uch	Manzalai	Kandhkot
MMCF/day	562	507	496	495	385	317	185	169	164
US $/MMBtu	2.02	4.36	2.80	0.74	4.78	4.45	3.92	2.87	2.11

of N_2 gas was ballasted with the high Btu RLNG limiting within the OGRA's sales specification. The study was aided by Aspen HYSIS Simulations and theoretical calculations which reveals the optimum operating values.

Natural gas consumed by the domestic consumers in Pakistan has the heating value of 980 Btu/Scf – 1000 Btu/Scf as prescribed by OGRA which limits the Natural Gas sellers to treat the Gas produced from the fields accordingly. RLNG imported from Qatar has a heating value of 1132 Btu/scf (Table 3) and sometimes even higher. This will result in technical malfunctioning of domestic and industrial equipment (can create potential havoc in the industry especially) because the burners and equipment are designed for low Btu Gas. Therefore, the quality of imported LNG must be managed prior to selling it to the destined consumer.

Thomas and Dawe (2003) have examined few technical ways for transportation of natural gas as a fuel, energy or commodity from the gas-rich states and those who want to monetize their reserves by exporting the gas. Since the time when the research was conducted, gas can be transported to other areas via pipelines and LNG. Cost for transportation through pipeline increases with increase in distance, whereas the cost of transportation of LNG through Cargoes have less steep rate but have high capital investment and installation of LNG Train for liquefaction at the export end and Regasification Units at import end.

3. DATA ANALYSIS

The research philosophy of this study will be Positivist. The approach of the study is deductive and cross-sectional and based on primary data. The purpose of the study is to describe whether the consumer is ready to accept a change in the quality of fuel which will be better, but almost at thrice the cost of the bill he pays currently provided he is left with no or few alternate options. In order to measure the quantitative response of the target population, nominal scale for the questionnaire is employed.

3.1. Data
The population of this study consists of natural gas consumers living in Karachi and Hyderabad City. The study was initially planned to be conducted at different forums which include manual filling of questionnaire by the consumers (i.e., on hard copy), the electronic version of the questionnaire which would be circulated to possible consumers through social media, and via emails, but later questionnaire was developed on the Google Survey form. The questionnaire (survey form) was then shared on social media (Facebook and WhatsApp). The purpose of selecting the area is to approach a mix of all classes of the population. In total 259 responses were received.

3.2. Proposed Framework
The viability of LNG for domestic consumers depends whether the consumer is voluntarily accepting it which can be predicted from the results of the survey carried out through closed-ended questionnaire, or the consumer is involuntarily/by-force accepting it as per the regulation by GoP. Chart 1 is self-explanatory in this regard:

3.3. Statistical Analysis
From responses received, following inferences can be deduced:
1. Dominating response for variable "Trustworthiness of Gas supplier and Regulating Authority" was "NO" indicating that Consumers have little or No trust upon Gas Supplier (SSGCL and SNGPL) and the Regulating Authority (OGRA).
2. Dominating response for variable "Knowledge of Gas Resources Depletion to the People" was "YES" indicating that Consumers have a great deal of knowledge that the Gas Fields in Pakistan are depleting at a steep rate.
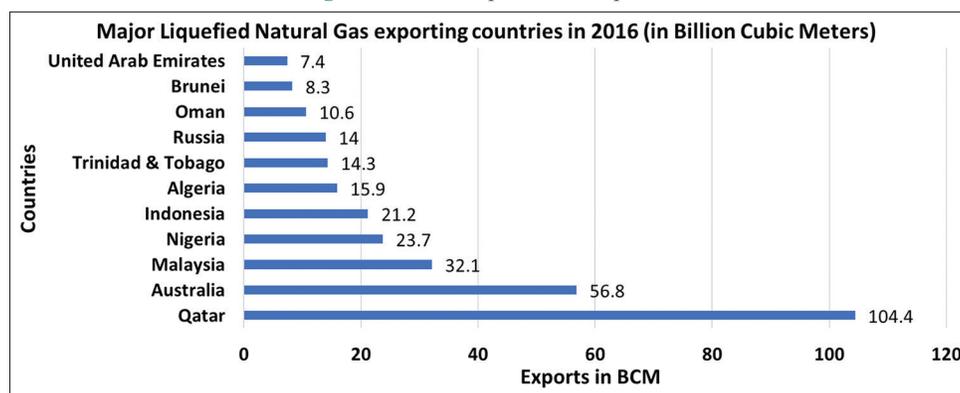
Figure 4: List of top 10 LNG exporters

Table 3: Natural Gas Export Compositions from Selected Countries (Patent: WO2006017579 A2)

Types of gas	Trinidad	Algeria	Oman	N. America	Norway	Qatar	Nigeria
HHV (Btu/scf)	1,048	1,103	1,168	1,096	1,087	1,132	1,125
Composition							
Methane (%)	96.13	89.57	86.52	92.77	91.94	89.18	89.07
Ethane (%)	3.40	8.61	8.315	3.36	5.44	7.07	7.67
Propane (%)	0.39	1.18	3.32	1.51	1.97	2.50	2.98
Butane (%)	0.07	0.31	1.70	0.24	0.24	1.155	0.34

Chart 1: Proposed farmework
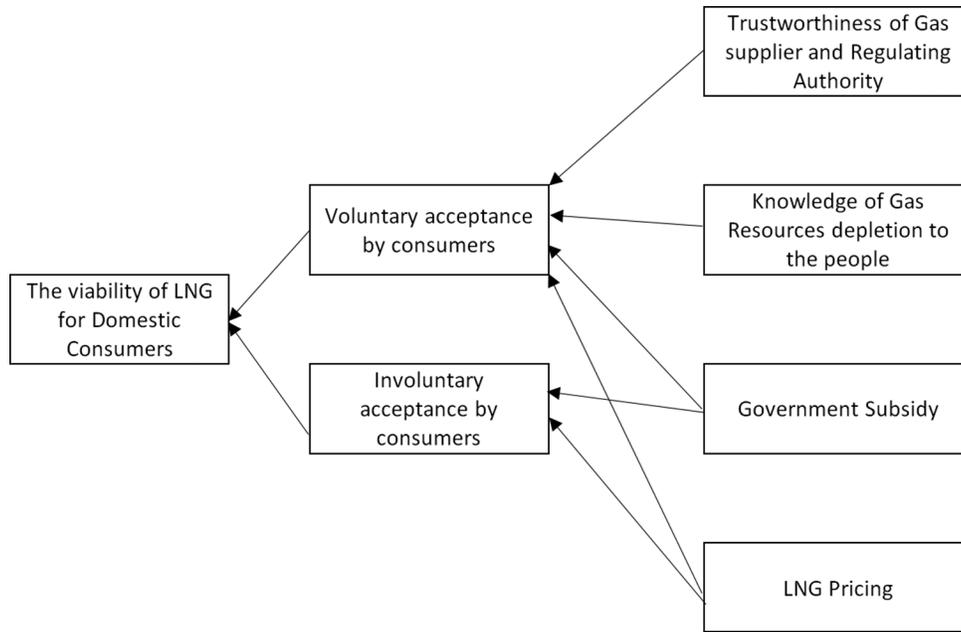
Graph 1: Consumers with age 20-30 years
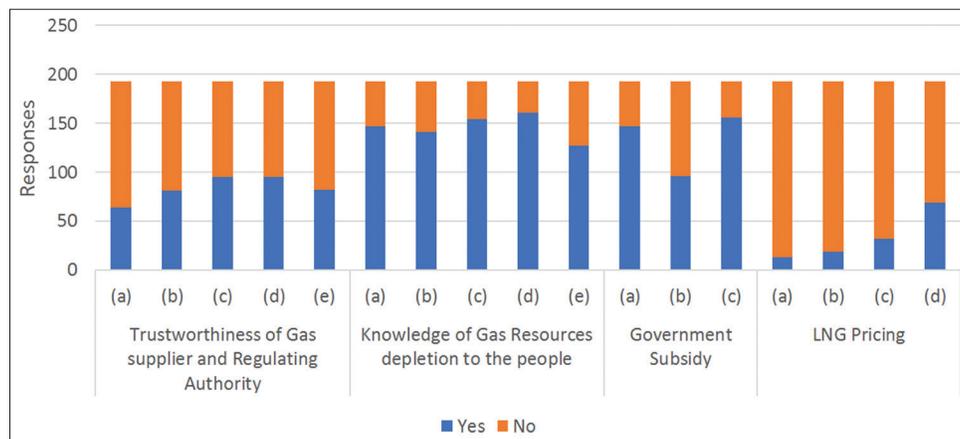
3. Dominating response for variable "Government Subsidy" was "YES" indicating that Consumers has a clear knowledge and accept the rate of subsidy Government is providing to the domestic sector.
4. Dominating response for variable "LNG Pricing" was "NO" indicating that Consumers are not willing to accept the price/billing of the Gas (LNG based) if exceeded to even twice the current rate (price/billing) even after 5-7 years.

3.3.1. Statistical analysis based on demography
3.3.1.1. Responses based on age of the consumers

Out of the total 259 responses, 193 responses received from consumers with age bracket (20-30 years), 52 responses received from consumers with age bracket (31-40 years), 14 responses received from consumers with age bracket (30-41 years). Results for each variable from different age brackets are presented in Graphs 1-3.

3.3.1.2. Responses based on income of consumers

Out of 259 responses received, a total of 170 responses received from consumers with a monthly income of more than 50,000 PKR and 89 responses received from consumers with monthly income <below 50,000 PKR. Results for each variable from different income level slabs are presented in Graphs 4 and 5.

### 3.3.2. Consumer's age x income – cross-tabulated responses
3.3.2.1. Description
3.3.2.1.1. Consumers with 20-30 years age and income more than 50,000 PKR/month
A total of 111 responses received from consumers with age bracket (20-30 years) and monthly income of more than 50,000 PKR, among which results for each variable is presented below:
a. Trustworthiness of gas supplier and regulating authority: 46% of consumers responded "yes" and 54% of consumers responded "no". A comparatively mixed response received.
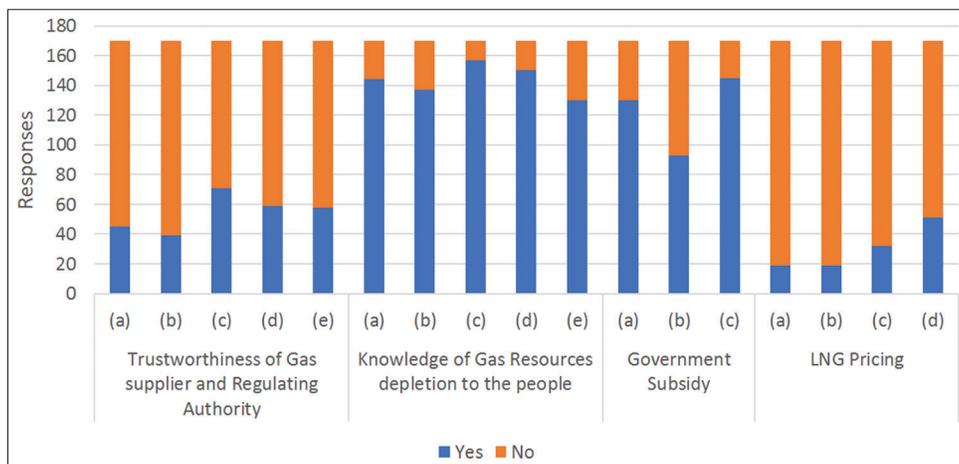
Graph 2: Consumers with age 31-40 years
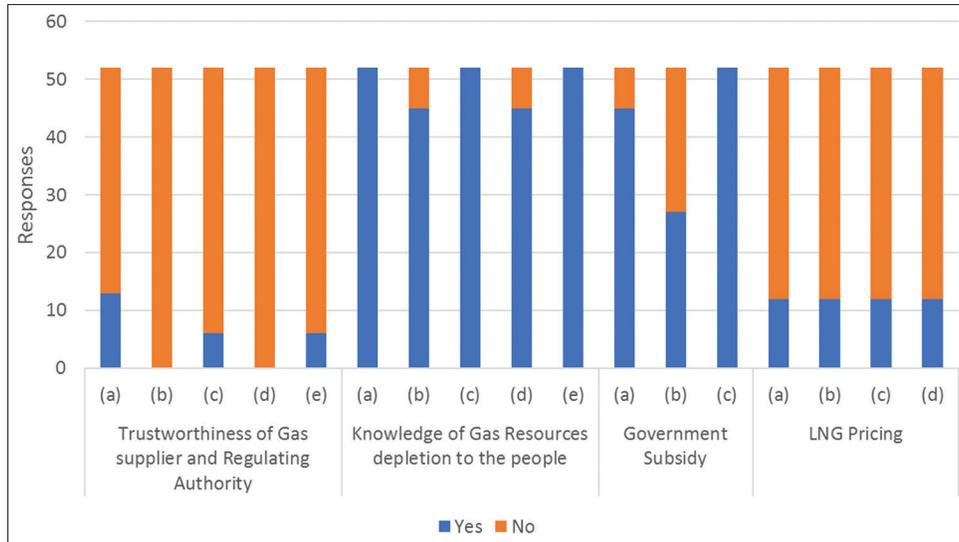
Graph 3: Consumers with age 41-50 years and above
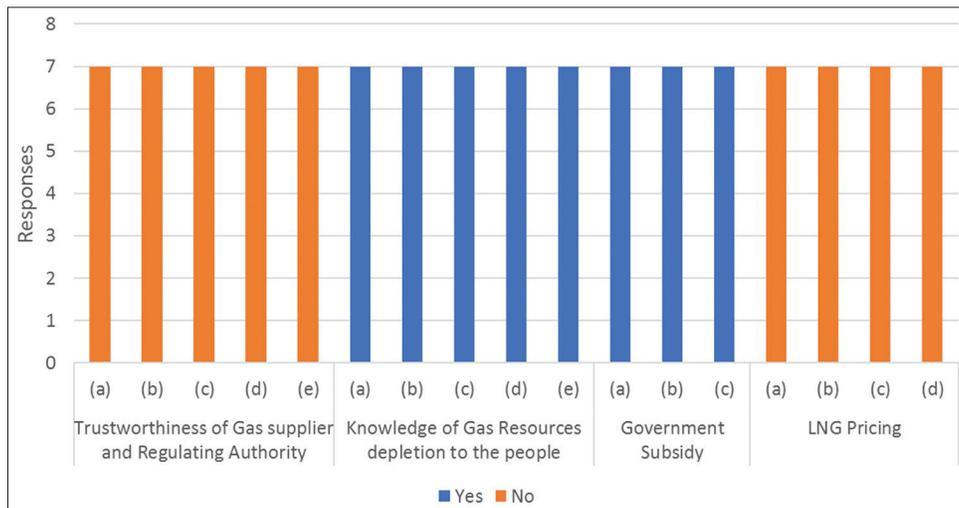
Graph 4: Consumers with income more than 50,000 PKR/mon

b. Knowledge of gas resources depletion to the people: 79% of consumers responded "yes" and 21% of consumers responded "no". A dominating response of "Yes" showing that the consumers have sufficient knowledge about gas fields being depleted.

c. Government subsidy: 67% of consumers responded "Yes" and

33% of consumers responded "No". A dominating response of "yes" showing that the consumers have sufficient knowledge and are satisfied with the Government Subsidy.

d. LNG pricing: 20% of consumers responded "Yes" and 80% of consumers responded "No". A dominating response of "No" showing that the consumers are not willing to accept LNG even at billing rate twice the current billing.

3.3.2.1.2. Consumers with 20-30 years age and income below 50,000 PKR/month

A total of 82 responses received from consumers with age bracket (20-30 years) and monthly income of <50,000 PKR, among which results for each variable is presented below:

a. Trustworthiness of gas supplier and regulating authority: 40% of consumers responded "yes" and 60% of consumers responded "no". A skewing response towards "no" is showing that the consumers have little trust on the gas suppliers and the regulating authority.

b. Knowledge of gas resources depletion to the people: 71% of consumers responded "Yes" and 29% of consumers responded "No". A dominating response of "yes" showing that the

consumers have sufficient knowledge about gas fields being depleted.

c. Government subsidy: 72% of consumers responded "yes" and 28% of consumers responded "no". A dominating response of "yes" showing that the consumers have sufficient knowledge and are satisfied with the government Subsidy.

d. LNG pricing: 22% of consumers responded "yes" and 78% of consumers responded "no". A dominating response of "no" showing that the consumers are not willing to accept LNG even at billing rate twice the current billing.

3.3.2.2. Description

3.3.2.2.1. Consumers with 31-40 years age and income more than 50,000 PKR/month

A total of 45 responses received from consumers with age bracket (31-40 years) and monthly income of more than 50,000 PKR, among which results for each variable is presented below:

a. Trustworthiness of gas supplier and regulating authority: 8% of consumers responded "yes" and 92% of consumers responded "no". A dominating response of "no" is showing that the consumers have no trust on the gas suppliers and the

Graph 5: Consumers with income below 50,000 PKR/mon
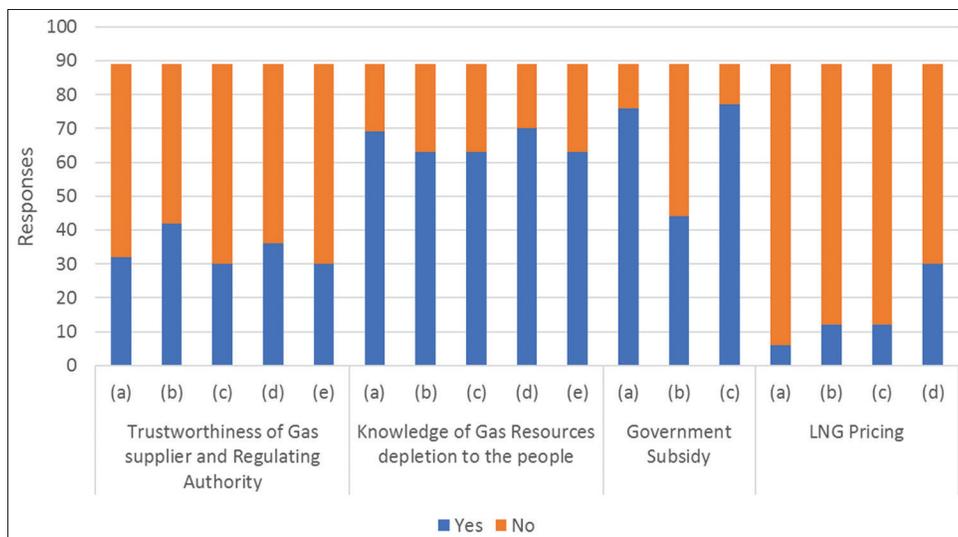
Graph 6: Consumers with age 20-30 years
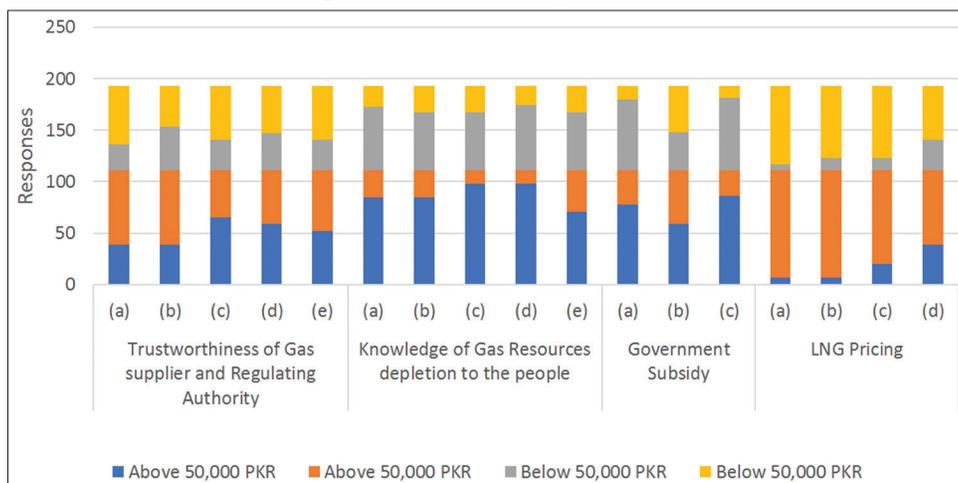
regulating authority.

b. Knowledge of gas resources depletion to the people: 94% of consumers responded "yes" and 6% of consumers responded "no". A dominating response of "yes" showing that the consumers have sufficient knowledge about gas fields being depleted.

c. Government subsidy: 76% of consumers responded "yes" and 24% of consumers responded "no". A dominating response of "yes" showing that the consumers have sufficient knowledge and are satisfied with the government subsidy.

d. LNG Pricing: 27% of consumers responded "yes" and 73% of consumers responded "no". A dominating response of "no" showing that the consumers are not willing to accept LNG even at billing rate twice the current billing.

3.3.2.2.2. Consumers with 31-40 years age and income below 50,000 PKR/month
A total of 7 responses received from consumers with age bracket (31-40 years) and monthly income of <50,000 PKR, among which results for each variable is presented below:

a. Trustworthiness of gas supplier and regulating authority: 20% of consumers responded "yes" and 80% of consumers responded "no". A dominating response towards "no" is

showing that the consumers have little trust on the gas suppliers and the regulating authority.

b. Knowledge of gas resources depletion to the people: 100% of consumers responded "yes" showing that the consumers have sufficient knowledge about gas fields being depleted.

c. Government subsidy: 100% of consumers responded "yes" showing that the consumers have sufficient knowledge and are satisfied with the government subsidy.

d. LNG pricing: 100% of consumers responded "no" showing that the consumers are not willing to accept LNG even at billing rate twice the current billing.
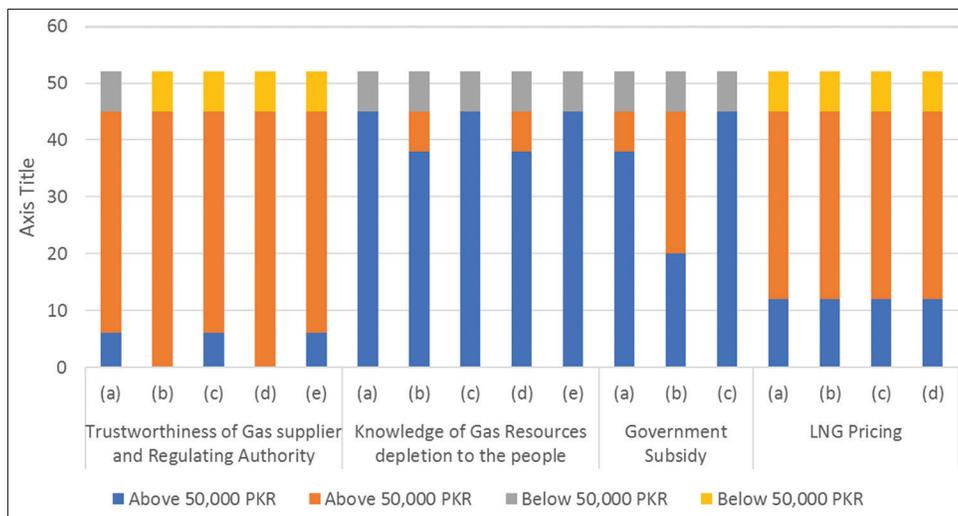
3.3.2.3. Description
3.3.2.3.1. Consumers with 41-50 and above years age and income above 50,000 PKR/mon
A total of 7 responses received from consumers with age bracket (41-50 years and above) and with a monthly income of more than 50,000 PKR, among which results for each variable is presented below:

a. Trustworthiness of gas supplier and regulating authority: 100% of consumers responded "no" showing that the consumers have no trust on the gas suppliers and the regulating authority.

b. Knowledge of gas resources depletion to the people: 100%

Graph 7: Consumers with age 31-40 years

Graph 8: Consumers with age 41-50 and above years
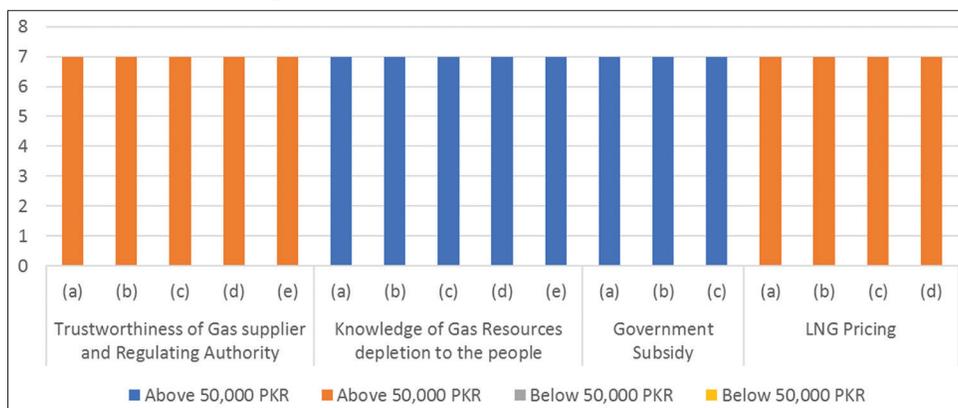
of consumers responded "yes" showing, consumers have sufficient knowledge about gas fields being depleted.

c. Government subsidy: 100% of consumers responded "yes" showing that the consumers have sufficient knowledge and are satisfied with the government subsidy.

d. LNG pricing: 100% of consumers responded "no" showing that the consumers are not willing to accept LNG even at billing rate twice the current billing.

3.3.2.3.2. Consumers with 41-50 and above years age and income <50,000 PKR/mon

No response received from consumers with age bracket (41-50 years and above) and monthly income of <50,000 PKR.

4. CONCLUSION

Domestic consumers have little trust upon the gas suppliers (SSGCL and SNGPL) as well as regulating authority (OGRA). They have sufficient knowledge of natural gas situation in the country and are satisfied with the government subsidy on the natural gas billing, whereas they are not willing to accept LNG even at billing rate twice the current billing.

It is proposed that the gas suppliers and regulating authority must try to build trustworthiness through quick, clear and proper responses to consumers' queries. Implications of alternatives to natural gas should be clearly communicated to the consumers by the responsible authorities. In addition the Government of Pakistan should establish economic stability and minimize the unpredictable risks.

The variables considered for the study were limited, also demographics used to describe the viability of LNG can be extended in order to get more precise results. Time limitations and other hindrances during research should have been avoided to get more precise results.

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