ENERGY WORLD CORPORATION LTD.

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The Manager
ASX Company Announcements
ASX Limited

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EWC Philippines Project Update - Summary of Senate Hearing

- **Philippines Department of Energy study shows imported LNG will provide the most cost-effective electricity in the Philippines**
- **Senate Requests the DOE, ERC and NGCP to assist Energy World in all ways possible to bring our power plant on stream**

On 18 June 2018, the Philippines Senate Committee on Energy held a Public Hearing on the development of the natural gas industry in the Philippines. Energy World Corporation ("EWC") was invited to present at the Hearing.

Imported LNG is the Most Economic Source of Fuel for Electricity

During the Hearing, The Philippines Department of Energy ("DOE") discussed a report entitled "The Economic Benefits of Switching to the Use of Natural Gas" which states that the use of imported LNG as a fuel source for power generation provides the most economic option for electricity generation in the Philippines. Their findings are as follows:

Fuel Type	Generation Costs (p/kWh)	More Expensive Than LNG By
Coal	P 5.49 /kWh	P 0.96 /kWh
Natural Gas (Malampaya)	P 4.67 /kWh	P0.14 /kWh
Natural Gas (Imported LNG)	P 4.53 /kWh	0
Diesel	P 14.40 /kWh	P 9.87 /kWh
Renewables	P 4.92 /kWh	P 0.39 /kWh

The study shows that electricity generated from imported LNG will be more economic than electricity sourced from Coal, the indigenous Malampaya Gas Field, Diesel and even Renewables.

The study also shows the significant economic advantages of switching to natural gas in the Industrial, Transport and City Gas sectors as well.

Please see attached a full copy of the Department of Energy's report.

Senate and Regulatory Support

In concluding the meeting Senator Sherwin Gatchalian, Chairman of the Committee on Energy requested the Department of Energy, Energy Regulatory Commission ("ERC") and National Grid Corporation of the Philippines ("NGCP") all to assist EWC to ensure that the EWC power plant could start operations at the earliest opportunity.

Graham Elliott, Executive Director of EWC, commented that:

"The Department of Energy study validates the strategy EWC has implemented to bring cost effective clean energy to the Philippines for the benefit of Philippine consumers with more reasonably priced electricity. There are also significant health benefits of using LNG relative to dirtier sources of energy such as coal and diesel.

We believe that once LNG is available in the Philippines demand will grow, not only from gas fired power plants, but also from the industrial, transport and city gas sectors given the economic benefits.

We are grateful for the support of the Philippines Senate and look forward to bringing our World class LNG Hub Terminal and 650 MW Power Station into commercial operations at the earliest opportunity."

Yours faithfully,
For and on behalf of
ENERGY WORLD CORPORATION LTD.

Brian Allen.

Brian Allen
Executive Director

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Graham Elliott, Executive Director of EWC with Senator Sherwin Gatchalian, Chairman of the Committee on Energy at the Senate Hearing on 18 June 2018

STUDY ON THE ECONOMIC COMPARISONS OF MALAMPAYA NATURAL GAS & IMPORTED LNG VS OTHER FUELS

The Economic Benefits of Switching to the Use of Natural Gas

Natural Gas Management Division
Oil Industry Management Bureau
Department of Energy
May 07, 2018

STUDY ON THE ECONOMIC COMPARISONS OF MALAMPAYA NATURAL GAS & IMPORTED LNG VS OTHER FUELS

I. INTRODUCTION:

Malampaya natural gas-field is the sole source of natural gas supply in the country. The successful launching of the Malampaya Deep Water Gas-to-Power Project in October 16, 2001 kicks-off the birth of the natural gas industry in the country with an anchor market of about 2,700 MW gas field power plants operated as base load.

Considering that natural gas infrastructure projects are capital-intensive and require an anchor market to justify the economics of the infrastructure projects, the power plant projects are the typically ideal anchor loads since power generating capacity can come on-line when the gas infrastructure is complete. Also, ramp-up period of the power plant could be less than one year; and no subsidy needed because the operational period of negative cash flow is very short including gas throughput build-up with further plant and even capacity expansion.

However, indigenous natural gas supply versus the additional capacity requirements finds significant challenges ahead for the downstream natural gas industry. Existing gas fields could not sufficiently provide the long-term requirements of the additional capacities. Large and timely investments are necessary to bring forth new domestic gas reserves which require more than five years to develop. In this scenario, new frontier resources such as liquefied natural gas (LNG) including a pipeline network are of crucial importance. Besides, developing LNG infrastructure for sustained market growth will require new capital investments. LNG as an option could be seen to complement with the indigenous natural gas resource, which in turn can be considered as an impetus to attain supply security for natural gas.

II. PURPOSE OF COMPARISON

Power plants run by natural gas employs efficient technologies such as Reciprocating Engines and Combined Cycle Gas Turbine (CCGT) which have different strengths and the ideal solution will depend on conditions and circumstances, and the way the power plant is utilized. However, the existing 2,700 MW gas-fired power plants operate as base load and employs Combined Cycle Gas Turbines in its operations. The strength of CCGT is known for its higher-efficiency when operating as continuous base load; it has lower Operating & Maintenance (O&M) costs and has no costs on lube oil in its operation.

The purpose of this simple study is to make cost comparisons in terms of Kilowatt-hours (kWh) considering actual conditions and realistic running load profiles of the plants with other fuels in the various energy sectors. It is aimed at showing the economic benefits of using or switching to natural gas as fuel. The study also aims to show the economic advantage of switching to natural gas in the Industrial, Transport and Residential Sectors as well by showing the cost comparisons of natural gas with other liquid fuels in terms of Pesos per Kilograms (P/kg).

III. STUDY METHODOLOGY

Research was used as research method wherein all available existing secondary data were gathered from various sources. Various data sources were used such as the Meralco website for P/kWh Generation Cost, DOE Price Watch for prices of Diesel & Gasoline, Wood Mackenzie for LNG Transport Cost, IHS Global for LNG Landed Cost, and the US EIA in establishing the electricity tariff structure.

From all available data gathered, various engineering and mathematical tools were used to derive formulas and desired results.

- The Running Averages Method was used to derive average P/kWh power generation costs from the latest 4 month data available.

- Sensitivity Analysis was used to derive a liner mathematical model attempting to define the correlation between natural gas or LNG Landed Cost prices and electricity prices in P/kWh. In the mathematical model, it was assumed that the relation between the dependent variable (P/kWh) and the independent variables ($/MMBTU LNG Landed Cost, FOREX, % Generation Cost, % Fuel Cost, among others) have a linear regression relationship.

- Engineering computations were used to compare "apple to apple" the energy content of different states of matter (gas vs. liquid) on a per mass basis along with the corresponding comparable costs in P/kg for industrial, transport and residential applications.

POWER GENERATION APPLICATION[1]

COAL PLANT	Average Generation Cost (P/kWh)				Average
	Feb	Mar	Apr	May	(4 month)
Sem-Calaca Power Corp	4.26	4.46	6.67	4.11	4.87
Masinloc Power Corp	6.88	5.82	5.34	5.76	5.95
Therma Luzon	5.61	5.12	5.17	7.16	5.76
San Miguel Energy Corp	6.19	4.46	5.44	5.95	5.51
Panay Energy Development Corp	7.08	4.99	4.05	5.38	5.37
4 Month Average Generation Cost					5.49

MALAMPAYA GAS	Average Generation Cost (P/kWh)				Average
	Feb	Mar	Apr	May	(4 month)
South Premiere Power Corp - Ilijan	4.74	4.46	4.45	4.66	4.58
First Gas Power Corp - Sta Rita	5.00	4.66	4.61	4.61	4.72
FGP Corp - San Lorenzo	4.88	4.70	4.55	4.69	4.71
					4.67

[1] Meralco website – Power Generation

POWER GENERATION (CONT'D)

RENEWABLES	Average Generation Cost (P/kWh)				Average
	Feb	Mar	Apr	May	(4 month)
Philpodeco & Net Metering Stations	4.20	4.95	5.05	5.48	4.92

DIESEL	Average Generation Cost (P/kWh)				Average
	Feb	Mar	Apr	May	(4 month)
Therma Mobile, Panay, Toledo	23.41	12.44	8.85	12.89	14.40

- For Imported LNG, Sensitivity Analysis using the mathematical model was used to derive the corresponding P/kWh Power Generation Cost.

FORMULA:

$$Z = \frac{(X + Y) * \left(\frac{FOREX}{293.10}\right)}{(\%\ Generation)(\%\ Fuel\ Cost)}$$

WHERE:

Z = Electric Power Rate (P/KWh)

INDEPENDENT VARIABLES:

X = Natural Gas Price ($/MMBTU)
Y = Transporation Cost depending on origin country
$FOREX$ = Foreign Exchange Rate (X Pesos/USD)
293.1 = Conversion Factor 1 MMBTU = 293.1 KWh
$\%\ Generation$ = Share of Generation Cost in Total Electricity Tariff Structure
$\%\ Fuel$ = Share of Fuel Cost in Total Generation Cost

Formula Derivation from EIA Table & Meralco kWh Consumption:

Electricity Tariff Structure (%)

Generation	40.71%
Transmission	9.49%
Distribution	30.09%
Taxes	13.01%
FIT-All	1.23%
Others	5.47%
Total	100%

Generation Tariff Structure (%)

Operation	5.50 %
Maintenance	4.63 %
Fuel	79.15 %
Capital Recovery	10.71
Total	89.29 %

% Fuel Cost to Total Electricity Tariff Structure = (% Generation)(% Fuel) 36.09%

Notes:

- Tariff structure already includes provision for Taxes (Ex 12% VAT...), and Capital Recovery (profit mark-up).
- Figures need to be updated from time to time due to constant changes in the LNG industry, among others.

Summary for Comparative Costing for Power Generation is as follows:

POWER GENERATION

FUEL TYPE	GENERATION COST (P/kWh)	MORE EXPENSIVE THAN LNG BY
Coal	P 5.49/kWh	P 0.96/kWh
Natural Gas (Malampaya)	P 4.67/kWh	P 0.14/kWh
Natural Gas (Imported LNG)	P 4.53/kWh	0
Diesel	P 14.40/kWh	P 9.87/kWh
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INDUSTRIAL & TRANSPORT APPLICATION

Specific heat or Cp is defined as the amount of heat per unit mass required to raise the temperature by one degree Celsius. Thus energy content of different states of matter (gas vs. liquid for example) can best be compared "apple to apple" on a per mass basis, such as per pound or per kilogram, rather than a per volume basis.

Corresponding Comparative Cost Computations are as follows:

1) Natural Gas: Landed Cost of $ 7.75/MMBTU (IHS Data)

$$\frac{\$7.75}{\text{MMBTU}} \times \frac{1\,\text{MMBTU}}{1{,}000\,\text{ft3}} \times \frac{1\,\text{ft3}}{28.32\,\text{liters}} \times \frac{1{,}472\,\text{liters}}{1\,\text{kg}} \times \frac{\text{P } 51.87}{\$1.00} = \frac{\text{P } 20.89}{\text{kg natgas}}$$

2) Diesel

$$\frac{\text{P } 43.95}{\text{liter}} \times \frac{1\,\text{liter}}{.832\,\text{kg}} = \frac{\text{P } 52.82}{\text{kg Diesel}}$$

7.75 : 4.53 = 10 : x 5.75

3) Gasoline

$$\frac{\text{P}54.82}{\text{liter}} \times \frac{1\,\text{liter}}{.745\,\text{kg}} = \frac{\text{P } 73.58}{\text{kg Gasoline}}$$

Where:

$ 7.75/MMBTU = Landed Cost of LNG in Japan-Korea-China Area, February 2018
$ 51.87/$ USD = Exchange Rate as of time of writing
.832 kg/liter = Density of Diesel
.745 kg/liter = Density of Gasoline
.0006789 kg/liter = Density of Natural Gas (CH4)

Note that Natural Gas would be a very cheap alternative fuel for Diesel (Transport and Industrial) and Gasoline (Transport).

INDUSTRIAL & TRANSPORT:[2]

FUEL TYPE	COST PER KILOGRAM	MORE EXPENSIVE THAN IMPORTED LNG BY
Natural Gas (Imported LNG)	**P 20.89/kg**	**0**
Diesel	**P 52.82/kg**	P 31.93 /kg
Gasoline	**P 73.58/kg**	P 52.69 /kg

RESIDENTIAL SECTOR:

Data is based on Energy World Corporation presentation in the recently held LNG summit 2017.

FUEL TYPE	COST
LPG	**$ 1,200/TON**
LNG	**$ 400/TON**

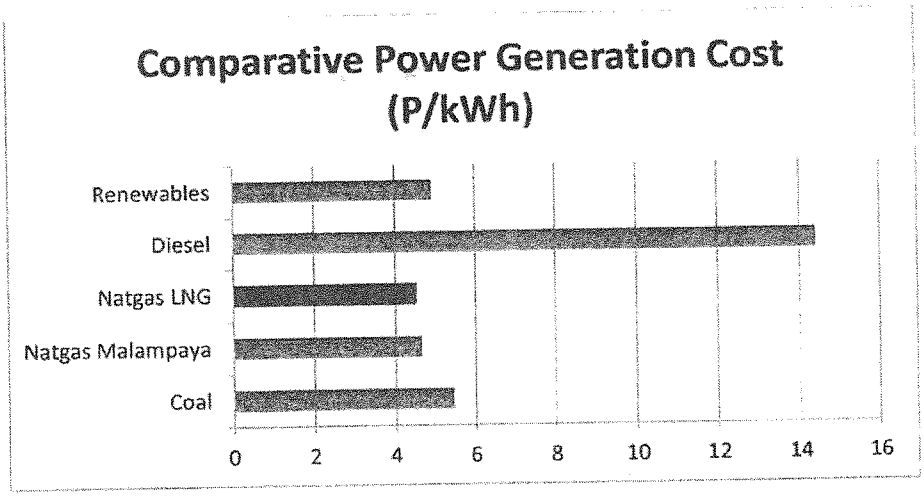
Note that LNG is only around 33% the cost of LPG. Thus natural gas would be a very cheap alternative as cooking fuel vs. LPG.

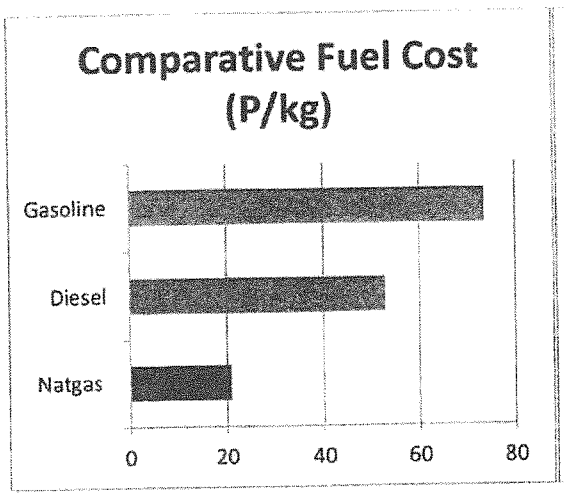
[2] Based on February 2018 data.

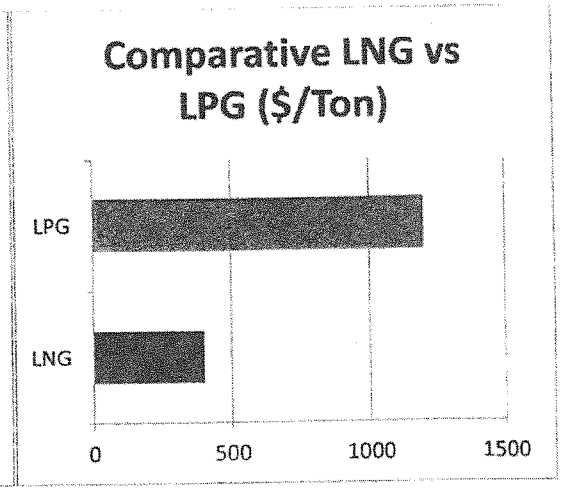
CONCLUSIONS OF THE STUDY

Based on available data and the numeric results of the study, the following can be inferred or concluded:

- Natural gas from imported LNG is the cheapest fuel for power generation.
- Coal has become more expensive than natural gas based on data from the past 4 months, compared to the previous years. The increase in P/kWh from Coal as fuel requires further research in another study.
- Diesel is the most expensive fuel for power generation.
- Natural gas would also be a very economic substitute for Diesel and Gasoline in the Industrial and Transport Sectors.
- Natural Gas would also be a very economic substitute for LPG as cooking gas in the Residential Sector.







REFERENCES:

Meralco Website for Power Generation Cost

DOE Website (Price Watch) for common prices of Diesel and Gasoline

Wood Mackenzie for LNG Transport Cost from various locations to the Philippines

IHS Global for LNG Landed Cost in $ /MMBTU

US EIA Table for Average Power Plant Operating Expenses

Engineering Toolbox for densities of various fuels

Energy World Corporation for LPG vs. LNG Prices, LNG Summit 2017