ISSN 1884-8850

Proceeding

SustaiN 2011

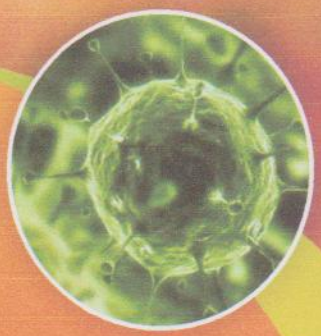
International Conference

The 186th Symposium on Sustainable Humanosphere

Kihada Hall, Uji Campus, Kyoto University
Kyoto, 8-10 October 2011







Sustainable Future for Human Security

Organized by

PPI Kyoto

PPI Kansai

Co-hosted by

CSEAS

RISH

Supported by

KBRI - Tokyo
KJRI - Osaka

PPI Jepang

Garuda Indonesia

SustaiN 2011
Kyoto, 8-10 October 2011

FUTURE NATURAL GAS PRICE PREDICTION IN INDONESIA USING NETBACK MARKET VALUE METHOD

Erwin Gitarisyana[1] Athikom Bangviwat[1*] Jaruwan Chontanawat[2] Djoni Bustan[3]
[1] The Joint Graduate School of Energy and Environment, KMUTT, Bangkok, Thailand
[2] Department of Social Sciences and Humanities, School of Liberal Arts, King Mongkut's University of Technology Thonburi, Bangkok, Thailand
[3] Department of Chemical Engineering of the Graduate Program of Sriwijaya University, Palembang Indonesia

*Corresponding author: athikom.bangviwat@hotmail.com

ABSTRACT

Natural gas prices in most countries are determined based on crude oil prices. The natural gas price may not reflect the actual cost especially when crude oil prices spike sharply. This study employed the netback market value (NMV) method to calculate natural gas price using weighting factors for competitive fuels of each sector. From data for 2000 – 2009, it was found that natural gas in Indonesia was sold to end users in the domestic market at average prices 15% - 96% cheaper than the calculated market values, and 16% - 145% lower than the export prices. By using data from Agency Assessment and Application of Energy in Indonesia or Badan Pengkajian and Penerapan Teknologi (BPPT), and adopting NMV and econometric forecasting methods, future gas market prices are calculated. From the calculation, the netback market value during 2010 – 2015 is 5.22 to 8.86 USD/ MMBTU. The calculated prices are useful to control supply and demand for natural gas, because Indonesia has plans to increase natural gas supply in the domestic market by building an LNG receiving terminal, which is targeted to be in operation in 2012.

Keywords: Natural gas price, Netback market value (NMV)

INTRODUCTION

The world proven reserves of gas as of January, 1, 2010 amounted to 6,609 TCF(trillion cubic feet)[1]. Indonesia was ranked 14th among the countries with natural gas reserves, of which its proven natural gas reserves totaled 108.40 TCF[2], while its natural gas production was 3.1 TCF. If the production is assumed to be constant, then reserve will last 37.4 years[3]. This could be less, because energy demand tends to increase each years, which will affect the energy security of the country. In the current year, Indonesia is the biggest natural gas exporter in Asia, and the second biggest natural gas exporter in the world after Qatar. Figure 1 shows natural gas production and consumption in Indonesia from 1980 to 2009, of which 50% of its production was exported to other countries[4]. From oil and gas exports which gives major effect to economic growth, Indonesia has earned more than 30% of it's national income in 2008[5]. In most countries, the natural gas price are determined by crude oil prices. This may not reflect the actual cost of the natural gas, especially when crude oil prices spike sharply as in the year 2008[6, 7].

In Indonesia the price of natural gas in the domestic market has been much lower than the export price, which causes the natural gas producer to export rather than to sell in the domestic market. Moreover, natural gas demand in Indonesia is still high, especially in the power plant sector where the electrification ratio in Indonesia is still low, around 66% in 2009. The ratio between natural gas for the export market and natural gas for the power plant sector in 2009 is still 3.54 : 1, of which 100% of LNG production was exported to other countries[8]. Despite of the export of LNG, Indonesia plans to operate the first LNG receiving terminal in 2012 in order to increase domestic natural gas consumption[9]. If the price of natural gas is not attractive to the gas producers, then they tend to give priority to the export market over the domestic market which requires a large investment cost to generate a higher rate of return.

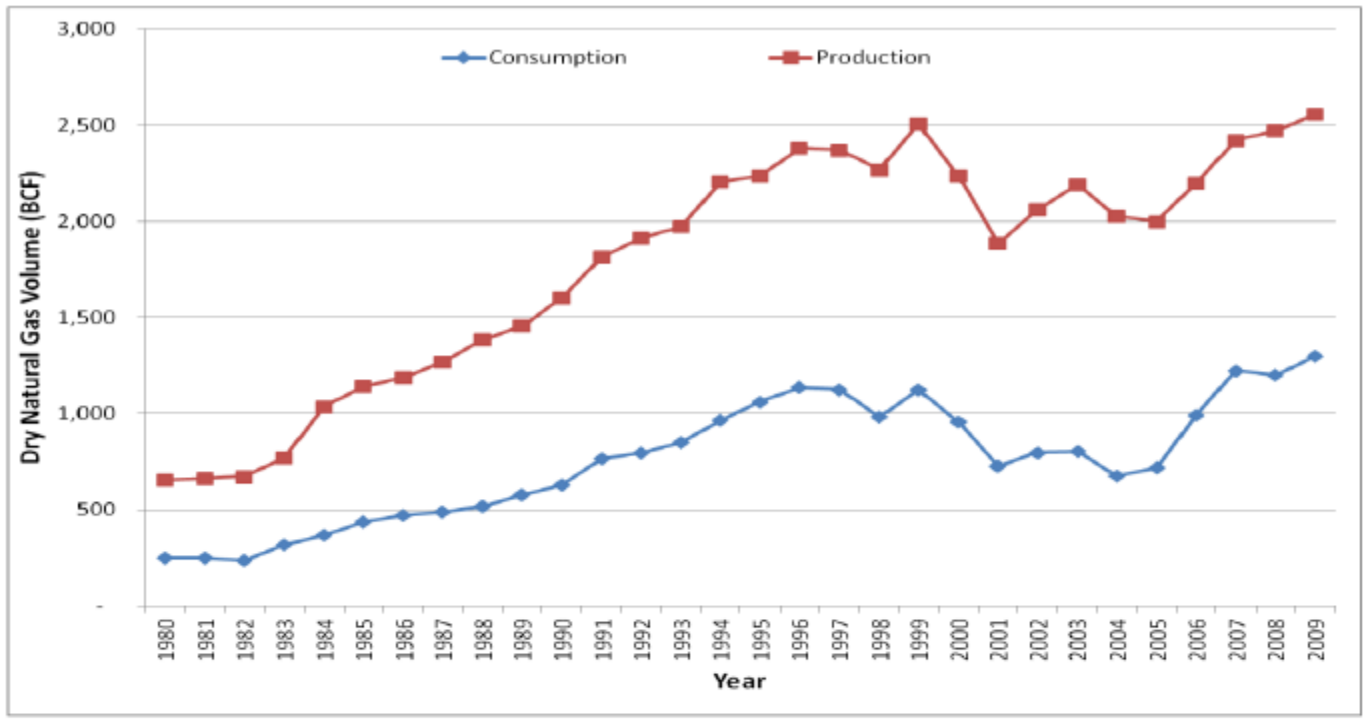


Figure 1 Natural Gas Production and Consumption in Indonesia in 1980-2009

Natural gas price prediction using netback market value is used to determine the value of natural gas on producer side in perspective of domestic market. This prediction will be useful to analyze the competitiveness of natural gas value in Indonesia compared to export. If the gap between export price and domestic price can be minimized, the producer will tend to deliver more natural gas to the domestic market, and the government's target to increase domestic consumption could be achieved.

METHODOLOGY

By applying the netback market value (NMV) method which calculates the price of natural gas by using the prices and the weighting factors of the competitive fuels, with data from 2000-2009[10] to determine the market price of natural gas on the same period, it has been found that the calculated market value is higher than the average selling price of the natural gas in the domestic market, but is still competitive to the export price. The NMV method is used to determine natural gas price at producer side with respect of domestic and export market by calculating the market price less its delivery cost.

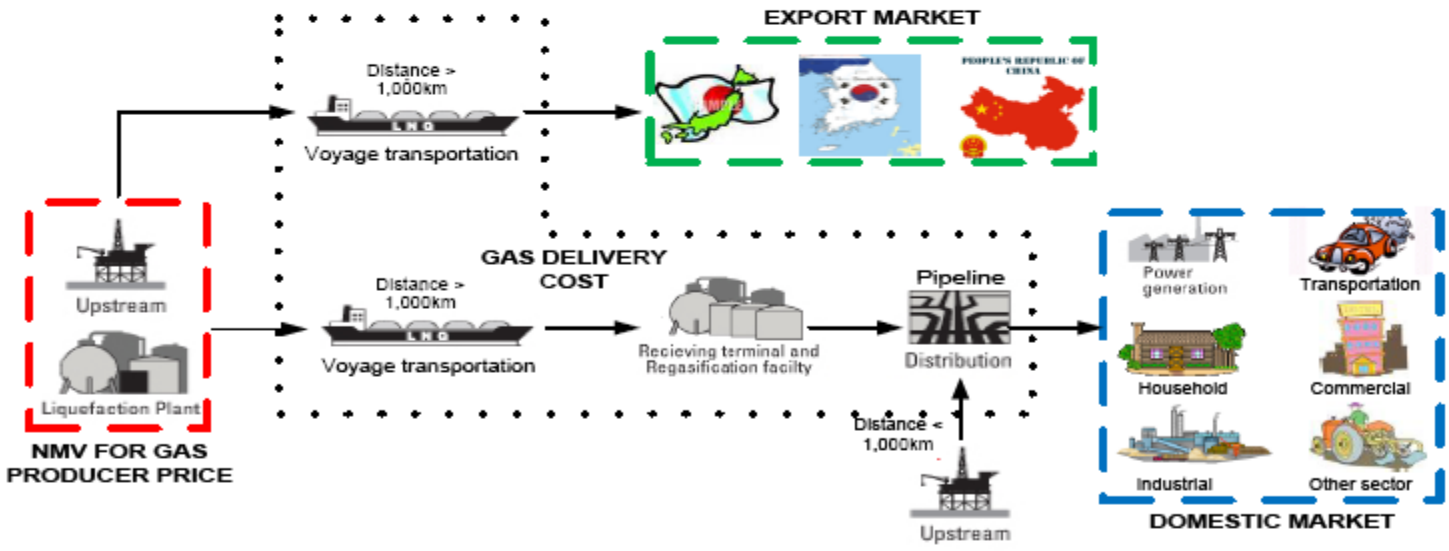


Figure 2 Netback Market Value Schematic Concept

Natural gas prices for 2010 to 2015 are predicted by using netback market value method and trend analysis. First, the share of other fuels competitive to natural gas for each sectors are determined. BPPT as agency assessment and application of energy in Indonesia provides data for future fuel consumption prediction for 2010 to 2015[11]. The data is used to calculate weighting factors[6, 7] for competitive fuels, using formula *(1)*:

$$WF = ESS \times CES \qquad (1)$$

where:

ESS : Energy sector share is the share of each sector in the total energy consumption. The main sectors are industrial, household, commercial, transportation, power plant and other sectors. Note that in order to obtain the summation of 100 %, the shares of certain sectors with low consumption were combined with others.

CES : Competing energy share signifies the market share of a competing energy in a consumption sector. It is calculated by identifying the competitors to natural gas and using the ratio of this competing energy to the total supply (excluding natural gas) of competing energies. Energies that clearly do not compete with natural gas are excluded.

.

Second, prices of natural gas competitive fuels are predicted using trend analysis and econometric forecasting methods based on data for 2000-2009 [8-10, 12-14]. Exponential, linear, polynomial and logarithmic models are employed to fit the data. The coefficient of determination R-squared of each model is calculated and used to determine the best fit. Third, the delivery cost from natural gas producer to domestic market is estimated. This cost includes transportation[15], receiving terminal and regasification[16], and pipeline transportation costs[9]. An inflation rate of 5.5% similar to BPPT prediction and average Indonesian inflation from 1971 to 2007[17, 18] is included in the calculation. Finally, the netback market value to determine natural gas price at producer side is calculated [6, 7] using formula *(2)*:

$$NMV = \sum(WFi \times Pi) - C \qquad (2)$$

where:

NMV : Netback Market value of natural gas in a country,

WF_i : Weighting factor for competing fuel i,

P_i : Price of competing fuel i, (retail price of competing energy in each consumption segment in price per unit of volume)

C : Domestic cost of delivery of natural gas (estimated cost of supply from gas producer to the end users in price per unit of volume).

DATA AND ANALYSIS

Total energy consumption prediction for natural gas competing fuels in Indonesia from 2010 to 2015 in BOE (barrel of oil equivalent) and percentages are shown in Table 1[11]. This data is needed to determine ESS (Energy Sector Shares). Industrial and power plant sectors are still dominant in total energy consumption, and the demand of energy will increase for several more years.

Table 1. Prediction of total natural gas competing fuels consumption in Indonesia for 2010 - 2015

Total energy consumption (BOE, barrel of oil equivalent)

Sector	Year					
	2010	2011	2012	2013	2014	2015
Industrial	313,096,776	331,777,022	350,462,969	369,150,289	387,836,038	406,518,319
Household	87,350,000	89,224,000	91,098,000	92,972,000	94,846,000	96,720,000
Commercial	32,274,043	33,999,056	35,724,310	37,449,746	39,175,319	40,900,997
Transportation	201,009,916	206,524,052	212,075,807	217,678,791	223,352,430	229,124,436
Power plant	257,637,484	287,698,241	317,695,189	347,638,663	377,536,858	407,396,379
Other sector	26,360,000	27,640,000	28,920,000	30,200,000	31,480,000	32,760,000
TOTAL	917,728,219	976,862,370	1,035,976,275	1,095,089,488	1,154,226,646	1,213,420,131

SHARE (%)

Sector	Year					
	2010	2011	2012	2013	2014	2015
Industrial	34.12	33.96	33.83	33.71	33.60	33.50
Household	9.52	9.13	8.79	8.49	8.22	7.97
Commercial	3.52	3.48	3.45	3.42	3.39	3.37
Transportation	21.90	21.14	20.47	19.88	19.35	18.88
Power plant	28.07	29.45	30.67	31.75	32.71	33.57
Other sector	2.87	2.83	2.79	2.76	2.73	2.70

Energy shares of the natural gas competing fuels per sector in Indonesia for 2010 to 2015 are shown in Table 2[11]. This data is needed to determine CES (Competing Energy Shares).

Table 2. Prediction of natural gas competing fuels consumption per sectors in Indonesia for 2010 - 2015

Sector	Competing fuel	Competing fuel shares year (%)					
		2010	2011	2012	2013	2014	2015
Industrial	Coal	62.06	61.94	61.83	61.72	61.63	61.55
	Briquette	0.08	0.09	0.10	0.11	0.13	0.14
	Kerosene	1.20	1.76	2.26	2.71	3.12	3.49
	ADO	11.94	11.82	11.71	11.60	11.51	11.43
	IDO	0.22	0.16	0.11	0.08	0.06	0.04
	Fuel Oil	3.65	3.47	3.31	3.16	3.03	2.91
	Other petroleum product	10.64	10.21	9.82	9.45	9.11	8.79
	LPG	0.53	0.56	0.59	0.61	0.63	0.65
	Electricity	9.68	10.00	10.29	10.55	10.78	11.00
Household	Kerosene	5.30	4.88	4.49	4.10	3.73	3.38
	LPG	49.34	49.30	49.26	49.22	49.19	49.15
	Electricity	45.36	45.82	46.25	46.67	47.08	47.47
Commercial	Kerosene	12.55	11.82	11.16	10.56	10.01	9.51
	ADO	18.34	18.32	18.31	18.29	18.28	18.26
	IDO	0.01	0.01	0.01	0.00	0.00	0.00
	LPG	5.08	5.08	5.08	5.08	5.08	5.09
	Electricity	64.01	64.77	65.45	66.06	66.62	67.14
Transportation	Premium	62.43	61.48	60.58	59.70	58.85	58.02
	Bio premium	0.93	1.09	1.24	1.38	1.51	1.64
	Pertamax	1.34	1.35	1.36	1.37	1.38	1.40
	Biopertamax	0.09	0.12	0.17	0.23	0.32	0.45
	Pertamaxplus	0.42	0.43	0.43	0.44	0.45	0.46
	Biosolar	0.85	1.07	1.28	1.48	1.66	1.84
	Kerosene	0.29	0.30	0.31	0.31	0.32	0.33
	ADO	33.47	33.98	34.46	34.91	35.32	35.70
	IDO	0.03	0.02	0.02	0.01	0.01	0.00
	Fuel oil	0.12	0.12	0.13	0.14	0.14	0.14

	Electricity	0.03	0.03	0.03	0.03	0.03	0.03
Power plant	Coal	80.70	82.38	83.76	84.91	85.89	86.74
	HSD	17.07	15.59	14.37	13.34	12.47	11.71
	IDO	0.01	0.01	0.00	0.00	0.00	0.00
	FO	2.22	2.02	1.87	1.74	1.63	1.54
Other sector	Kerosene	7.81	7.50	7.22	6.96	6.72	6.50
	ADO	77.81	78.19	78.54	78.86	79.16	79.43
	IDO	7.21	7.17	7.14	7.11	7.08	7.05
	Fuel oil	7.17	7.13	7.10	7.07	7.05	7.02

Weighting factors using formula *(1)* have been determined by multiplying ESS and CES as shown in Table 3.

Table 3. Prediction of weighting factors for competitive fuels to natural gas for 2010 - 2015

Sector	Competing fuel	WF year (%)					
		2010	2011	2012	2013	2014	2015
Industrial	Coal	21.17	21.04	20.91	20.81	20.71	20.62
	Briquette	0.03	0.03	0.03	0.04	0.04	0.05
	Kerosene	0.41	0.60	0.77	0.91	1.05	1.17
	ADO	4.07	4.01	3.96	3.91	3.87	3.83
	IDO	0.07	0.05	0.04	0.03	0.02	0.01
	Fuel Oil	1.24	1.18	1.12	1.07	1.02	0.98
	Other petroleum product	3.63	3.47	3.32	3.18	3.06	2.94
	LPG	0.18	0.19	0.20	0.21	0.21	0.22
	Electricity	3.30	3.40	3.48	3.56	3.62	3.68
Household	Kerosene	0.50	0.45	0.39	0.35	0.31	0.27
	LPG	4.70	4.50	4.33	4.18	4.04	3.92
	Electricity	4.32	4.18	4.07	3.96	3.87	3.78
Commercial	Kerosene	0.44	0.41	0.38	0.36	0.34	0.32
	ADO	0.65	0.64	0.63	0.63	0.62	0.62
	IDO	0.00	0.00	0.00	0.00	0.00	0.00
	LPG	0.18	0.18	0.18	0.17	0.17	0.17
	Electricity	2.25	2.25	2.26	2.26	2.26	2.26
Transportation	Premium	13.67	13.00	12.40	11.87	11.39	10.95
	Bio premium	0.20	0.23	0.25	0.27	0.29	0.31
	Pertamax	0.29	0.29	0.28	0.27	0.27	0.26
	Biopertamax	0.02	0.03	0.03	0.05	0.06	0.09
	Pertamaxplus	0.09	0.09	0.09	0.09	0.09	0.09
	Biosolar	0.19	0.23	0.26	0.29	0.32	0.35
	Kerosene	0.06	0.06	0.06	0.06	0.06	0.06
	ADO	7.33	7.18	7.05	6.94	6.84	6.74
	IDO	0.01	0.00	0.00	0.00	0.00	0.00
	Fuel oil	0.03	0.03	0.03	0.03	0.03	0.03
	Electricity	0.01	0.01	0.01	0.01	0.01	0.00
Power plant	Coal	22.66	24.26	25.69	26.96	28.10	29.12
	HSD	4.79	4.59	4.41	4.24	4.08	3.93
	IDO	0.00	0.00	0.00	0.00	0.00	0.00
	FO	0.62	0.60	0.57	0.55	0.53	0.52
Other sector	Kerosene	0.22	0.21	0.20	0.19	0.18	0.18
	ADO	2.23	2.21	2.19	2.17	2.16	2.14
	IDO	0.21	0.20	0.20	0.20	0.19	0.19
	Fuel oil	0.21	0.20	0.20	0.20	0.19	0.19

Prices of natural gas competitive fuels have been predicted using trend analysis and econometric forecasting methods as shown in Table 4.

Table 4. Prediction of natural gas competing fuels price for 2010 - 2015

Sector	Competing fuel	Price (USD/BOE) in year					
		2010	2011	2012	2013	2014	2015
Industrial	Coal	14.56	16.65	19.03	21.76	24.88	28.45
	Briquette	41.89	42.84	43.71	44.51	45.26	45.97
	Kerosene	43.81	45.38	46.83	48.16	49.41	50.57
	ADO	86.10	93.25	100.19	106.92	113.44	119.74
	IDO	147.28	167.68	189.17	211.77	235.46	260.25
	Fuel Oil	97.43	110.91	125.15	140.14	155.88	172.38
	Other petroleum product	105.14	109.09	111.94	113.69	114.35	113.91
	LPG	0.06	0.07	0.07	0.07	0.08	0.08
	Electricity	118.56	123.79	129.02	134.25	139.48	144.70
Household	Kerosene	43.81	45.38	46.83	48.16	49.41	50.57
	LPG	0.06	0.07	0.07	0.07	0.08	0.08
	Electricity	108.32	110.89	113.26	115.45	117.49	119.40
Commercial	Kerosene	43.81	45.38	46.83	48.16	49.41	50.57
	ADO	86.10	93.25	100.19	106.92	113.44	119.74
	IDO	147.28	167.68	189.17	211.77	235.46	260.25
	LPG	0.06	0.07	0.07	0.07	0.08	0.08
	Electricity	141.28	144.08	146.65	149.03	151.24	153.32
Transportation	Premium	111.97	133.91	160.16	191.56	229.11	274.02
	Bio premium	69.09	64.60	60.12	55.64	51.16	46.67
	Pertamax	128.52	136.00	142.87	149.24	155.17	160.71
	Biopertamax	143.88	175.04	212.94	259.05	315.14	383.37
	Pertamaxplus	131.25	138.49	145.16	151.33	157.07	162.45
	Biosolar	75.72	75.81	75.90	75.97	76.05	76.12
	Kerosene	43.81	45.38	46.83	48.16	49.41	50.57
	ADO	86.10	93.25	100.19	106.92	113.44	119.74
	IDO	147.28	167.68	189.17	211.77	235.46	260.25
	Fuel oil	107.98	116.94	125.90	134.86	143.82	152.79
	Electricity	111.90	114.07	116.06	117.91	119.63	121.24
Power plant	Coal	14.56	16.65	19.03	21.76	24.88	28.45
	HSD	86.10	93.25	100.19	106.92	113.44	119.74
	IDO	147.28	167.68	189.17	211.77	235.46	260.25
	FO	97.43	110.91	125.15	140.14	155.88	172.38
Other sector	Kerosene	43.81	45.38	46.83	48.16	49.41	50.57
	ADO	86.10	93.25	100.19	106.92	113.44	119.74
	IDO	147.28	167.68	189.17	211.77	235.46	260.25
	Fuel oil	107.98	116.94	125.90	134.86	143.82	152.79

Natural gas market value prediction has been calculated by multiplying the predicted weighting factor and the forecast price. The result in Table 5, calculated from the shares and prices of the competing fuels, show the values of natural gas in domestic market. The summation of the market values of all the natural gas competing fuels in each year has become the calculated natural gas market value in currency per unit of volume.

Table 5. Prediction of natural gas market value for 2010 – 2015

Sector	Competing fuel	Gas market value (USD/BOE) in year:					
		2010	2011	2012	2013	2014	2015
Industrial	Coal	3.08	3.50	3.98	4.53	5.15	5.87
	Briquette	0.01	0.01	0.01	0.02	0.02	0.02
	Kerosene	0.18	0.27	0.36	0.44	0.52	0.59
	ADO	3.51	3.74	3.97	4.18	4.39	4.59
	IDO	0.11	0.09	0.07	0.06	0.04	0.03
	Fuel Oil	1.21	1.31	1.40	1.49	1.59	1.68
	Other petroleum product	3.82	3.78	3.72	3.62	3.50	3.35
	LPG	0.00	0.00	0.00	0.00	0.00	0.00

	Electricity	3.91	4.20	4.49	4.77	5.05	5.33
Household	Kerosene	0.22	0.20	0.18	0.17	0.15	0.14
	LPG	0.00	0.00	0.00	0.00	0.00	0.00
	electricity	4.68	4.64	4.61	4.57	4.55	4.52
Commercial	Kerosene	0.19	0.19	0.18	0.17	0.17	0.16
	ADO	0.56	0.59	0.63	0.67	0.70	0.74
	IDO	0.00	0.00	0.00	0.00	0.00	0.00
	LPG	0.00	0.00	0.00	0.00	0.00	0.00
	electricity	3.18	3.25	3.31	3.37	3.42	3.47
Transportation	Premium	15.31	17.41	19.86	22.73	26.09	30.02
	Bio premium	0.14	0.15	0.15	0.15	0.15	0.14
	Pertamax	0.38	0.39	0.40	0.41	0.42	0.42
	Biopertamax	0.03	0.04	0.07	0.12	0.20	0.33
	Pertamaxplus	0.12	0.13	0.13	0.13	0.14	0.14
	Biosolar	0.14	0.17	0.20	0.22	0.24	0.26
	Kerosene	0.03	0.03	0.03	0.03	0.03	0.03
	ADO	6.31	6.70	7.07	7.42	7.75	8.07
	IDO	0.01	0.01	0.01	0.00	0.00	0.00
	Fuel oil	0.03	0.03	0.03	0.04	0.04	0.04
	Electricity	0.01	0.01	0.01	0.01	0.01	0.01
Power plant	Coal	3.30	4.04	4.89	5.87	6.99	8.29
	HSD	4.13	4.28	4.41	4.53	4.63	4.71
	IDO	0.00	0.00	0.00	0.00	0.00	0.00
	FO	0.61	0.66	0.72	0.77	0.83	0.89
Other sector	Kerosene	0.10	0.10	0.09	0.09	0.09	0.09
	ADO	1.92	2.06	2.20	2.33	2.45	2.57
	IDO	0.30	0.34	0.38	0.41	0.45	0.50
	Fuel oil	0.22	0.24	0.25	0.26	0.28	0.29
TOTAL (USD/ BOE)		57.75	62.57	67.81	73.60	80.05	87.30
TOTAL (USD/MMBTU) divided by 5.8		9.96	10.79	11.69	12.69	13.80	15.05

The result of market value calculation has been converted from USD/BOE to USD/MMBTU to make it uniform unit in natural gas business. Natural gas market value prediction from 2010 to 2015 tends to increase following other competitive fuels price. The price increases from 9.96 USD/ MMBTU (US dollars per million BTU) to 15.05 USD/MMBTU. Delivery costs from natural gas producer to the end user in domestic market, estimated in Table 6, are used to determine natural gas prices at producer side. Potential gas resources are located in Bontang, East Kalimantan, and potential customers are located in West Java. Natural gas will be converted into LNG for transport from Bontang to West Java(A), then re-gased at the first re-gasification terminal in West Java (B), and distributed through the existing gas pipeline (C). The total cost is determined by summing all costs above.

Table 6. Prediction of natural gas delivery cost for 2010 – 2015

Delivery cost of natural gas	USD/MMBTU in year					
	2010	2011	2012	2013	2014	2015
LNG from Bontang to West Java (A)	0.22	0.23	0.25	0.26	0.27	0.29
Regasification cost (B)	0.51	0.54	0.57	0.60	0.64	0.67
Domestic cost from LDC (by pipeline) (C)	4.00	4.23	4.46	4.70	4.96	5.24
Total domestic cost (A+B+C)	4.73	5.00	5.28	5.56	5.87	6.20

RESULT AND ANALYSIS

The result from the calculation using netback market value is shown in Figure 3, the cost of transportation and distribution has been subtracted from the market value to determined netback market value, or natural gas value at producer side. Average natural gas price at natural gas producer in domestic market in 2002 to 2009 is around 86% - 406% cheaper than export price and around 4% - 177% lower than netback market value to stimulate economic growth[8, 10]. Natural gas price

prediction from 2010 to 2015 tends to increase following other competitive fuels price. The price increases from 5.22 USD/ MMBTU to 8.86 USD/MMBTU. The NMV price drops from 5.98 USD/MMBTU in 2009 to 5.22 USD/MMBTU in 2010 due to the decreases in other competitive fuel price, but rises afterwards till 2015.

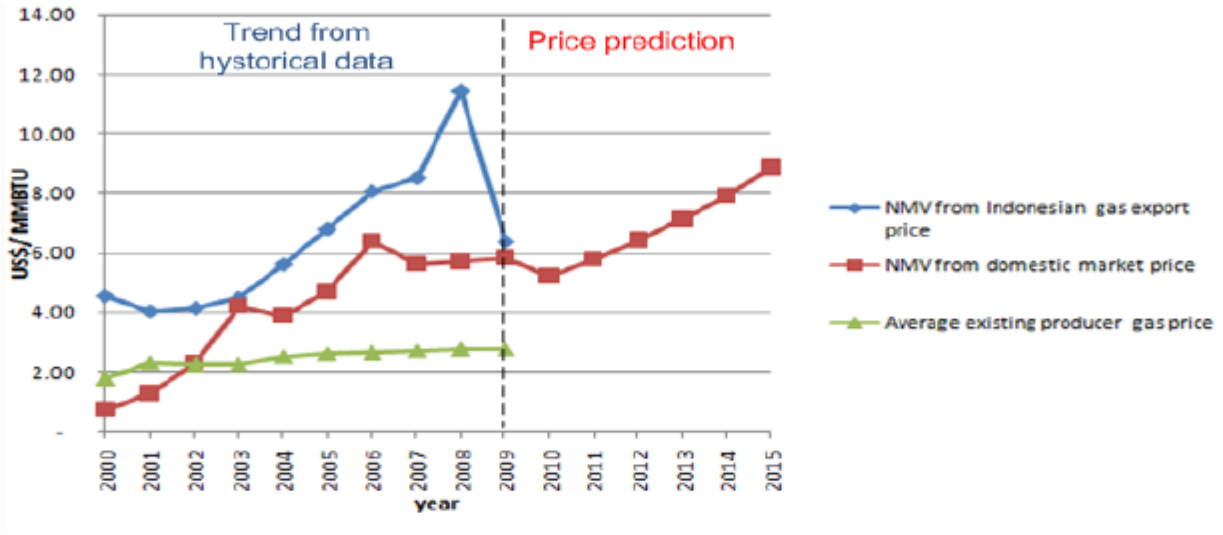


Figure 3. Historical data and predicted trend of the natural gas price in Indonesia

The details of natural gas prices are shown in Table 7 below:

Table 7. Detail of natural gas prices in Indonesia[8, 10]

Gas Price (USD/MMBTU)	Year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
A. ACTUAL PRICE										
Average existing selling price to the end user for domestic market	2.81	3.29	3.26	3.67	3.70	3.88	5.21	5.23	4.88	6.03
Average existing producer price for domestic market	1.79	2.32	2.24	2.41	2.44	2.40	2.64	2.61	2.26	2.66
Average existing export price	4.82	4.31	4.45	4.84	6.00	7.19	8.49	9.04	11.97	6.98
B. CALCULATED NETBACK MARKET VALUE										
Calculated market value in domestic market	2.07	2.59	3.75	5.80	5.65	6.80	9.52	8.98	9.56	10.04
Calculated market value less delivery cost (NMV) for domestic market	0.73	1.28	2.33	4.13	3.94	4.82	6.39	5.76	6.28	5.98
NMV for export market	4.57	4.05	4.16	4.51	5.64	6.81	8.07	8.55	11.45	6.41

Gas Price (USD/MMBTU)	Year					
	2010	2011	2012	2013	2014	2015
C. PREDICTION OF NETBACK MARKET VALUE						
Calculated market value for domestic market	9.96	10.79	11.69	12.69	13.80	15.05
Calculated market value less delivery cost (NMV) for domestic market	5.22	5.79	6.42	7.12	7.93	8.86

CONCLUSION AND REMARKS

The prediction of natural gas price using NMV method will be useful for the determination of an attractive price, which is also competitive with the export price, for the natural gas producers to deliver natural gas to domestic market. The discrepancy between the natural gas price for domestic consumption and the export price is narrowed to make government's target of increasing domestic natural gas consumption possible.

ACKNOWLEDGMENT

The author thankfully acknowledges Dr. Athikom Bangviwat, Asst. Prof. Dr. Jaruwan Chontanawat and Dr. Ir. H. Djoni Bustan, M.Eng for their helpful consultation on this conference paper. This work was supported by *beasiswa unggulan*, Bureau for Planning and International Cooperation, Ministry of Education Republic Indonesia and *PT PGN (Persero) Tbk.*

References

[1] EIA, 2010, *International Energy Outlook*, Washington, DC, USA.
[2] MEMR, 2010, *Indonesia Energy Statistic 2010,* Jakarta, Indonesia.
[3] BP, 2011, *BP Statistical Review of World Energy,* London, UK.
[4] IEA, 2010, *Natural Gas Production and Consumption,* Paris, France.
[5] MEMR, 2009, *Blueprint National Energy Management 2010-2025,* Jakarta, Indonesia.
[6] Miyamoto, A., Ishiguro, C., Yamada, T, 2009, *Irrational LNG Pricing Impedes Development of Asian Natural Gas Markets: A Perspective on Market Value,* Osaka, Japan.
[7] Miyamoto, A. Ishiguro, C., 2009, *A New Paradigm for Natural Gas Pricing in Asia: A Perspective on Market Value,* Oxford Institute for Energy Studies.
[8] MEMR, 2010, *Handbook of Energy & Economics Statistics of Indonesia,* Jakarta, Indonesia.
[9] PT PGN (Persero) Tbk, 2000-2009, *Natural Gas LDC State Owned Company, Annual Report,* Jakarta, Indonesia.
[10] Gitarisyana, E., Bangviwat, A., Bustan, D., 2011, *Determination of Natural Gas Price by Netback Market Value Method*, 4th International Conference on Sustainable Energy and Environment (SEE 2011): A Paradigm Shift to Low Carbon Society , Bangkok, Thailand.
[11] BPPT (Badan Pengkajian dan Penerapan Teknologi), 2010, *Indonesian Energy Outlook,* Jakarta ,Indonesia.
[12] PT Bukit Asam Tbk Coal Company, 2000-2009, *Annual Report,* Tanjung Enim, Indonesia.
[13] Pertamina, 2000-2009, *Oil and Gas State Owned Company: Annual Report,* Jakarta, Indonesia.
[14] PLN, 2000-2009, *Electricity State Owned Company: Annual Report.* Jakarta, Indonesia.
[15] Maulidiana, M, 2008, *Modeling of LNG Value Chain To Optimize The Gas Value For Domestic Advantage.* University of Indonesia, Jakarta, Indonesia.
[16] EIA, 2003, *The Global Liquified Natural Gas Market: Status and Outlook, Washington, DC,*USA.
[17] IEA, 2010, *Key world Energy Statistic, Paris, France.*
[18] IMF, 2009, *World Economic Outlook Database, Washington, DC,* USA.