Energy Supply Sector
Oil, Gas and Coal Production

Indonesia 2050 Pathway Calculator

Table of Contents

List of Tables

List of Figures

1. Overview of Fossil Energy Production

Based on the type of energy, the primary energy supply in 2011 was dominated by petroleum with 48% share, followed by coal 27%, gas 21% and 4% renewable energy. Based on national energy policy (KEN) as set out in Presidential Regulation No. 79/2014, the share of oil in the primary energy mix in 2050 should be lowered to 20% as well as the share of coal should be lowered to 25% in 2050. Meanwhile, the share of natural gas in the primary energy mix should be increased to 24% in 2050 (Figure 1).

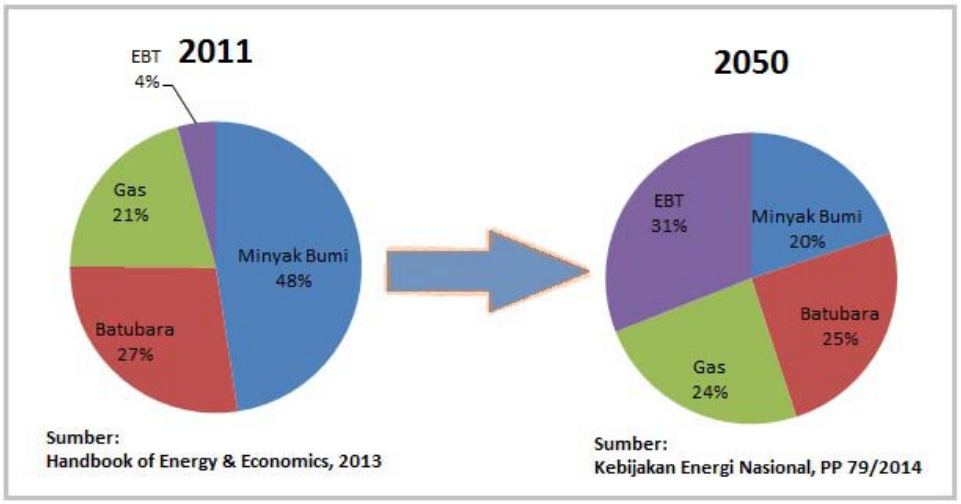


Figure 1. Primary Energy Supply by Type of Energy in 2011 and 2050 (Source: Handbook of Energy & Economics, 2013)

Historically, the primary energy supply of Indonesia has been always dominated by petroleum (Figure 2), but since 2004 the domestic oil supply is no longer able to meet the domestic needs and since then Indonesia has become a net oil importer. In the same year, Indonesia experienced a deficit of 176,000 barrels per day of oil.

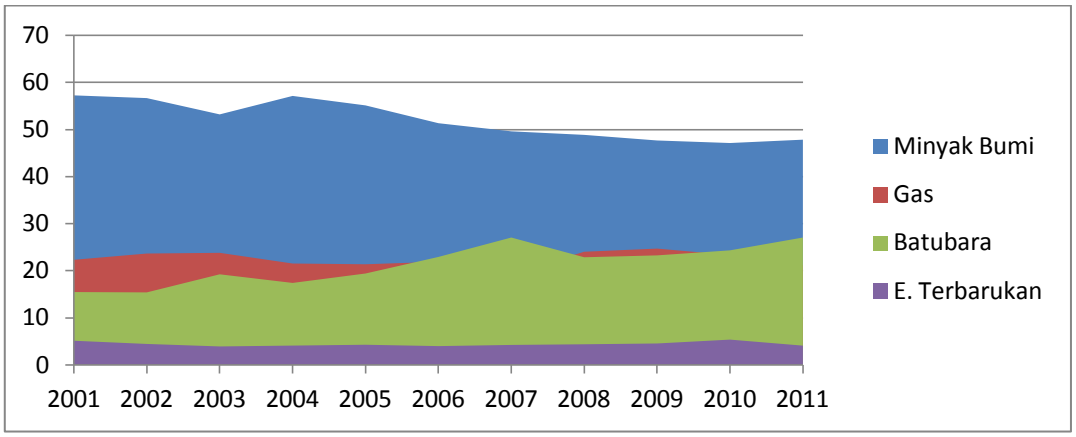


Figure 2. Historical Data of Primary Energy Supply Percentage by Type of Energy (Source: Handbook of Energy & Economics, 2013)

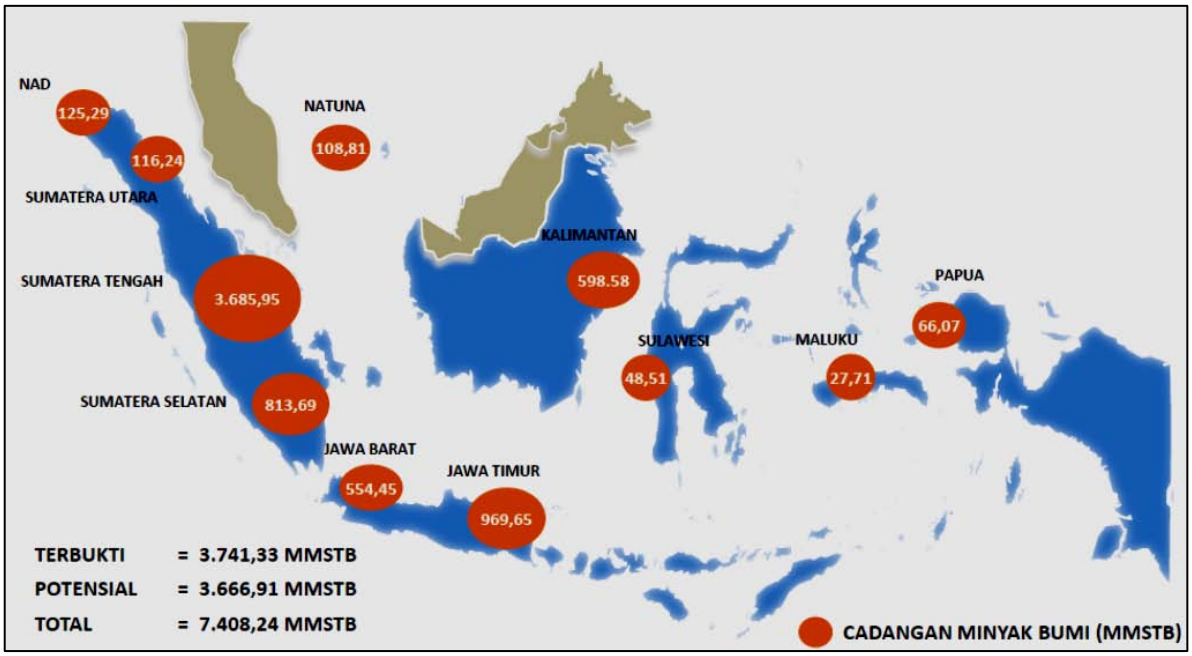
In Indonesia 2050 Pathway Calculator, the fossil energy production consists of three (3) types, namely oil, gas and coal. Each type of energy production will show a production pattern that increases following the level (scenario). Additionally, it will also display the amount of export and the reserve of each energy type.

2. Fixed Assumption

2.1. Reserve Discovery

2.1.1. Discovery Of The New Oil Reserves

Oil reserves data in the base year (2011) was derived from petroleum statistics. Proven and potential reserves of petroleum were recorded at 3741.33 and 3,666.91 million barrels, bringing the total reserves of fossil oil at 7,408.24 million barrels (Petroleum Statistics, 2012) (Figure 3).



Remark: MMSTB (Million Stock Tank Barrel)

Figure 3. Oil Reserve Map (Petroleum Statistic 2012)

Based on Figure 3 above, Indonesia's oil reserves spread from Aceh to Papua. The largest oil reserves are in the region of central Sumatra with 3685.95 MMSTB and followed by East Java with 969.65 MMSTB. Regions of East Java Province that produce oil are Kangean, Tuban, Cepu, Brantas, West Madura, Gresik, and Bawean.

The reserve performance and petroleum production in 1995 relatively declined since the 2nd peak of Indonesia oil production at 1.6 million barrels per day (bpd). This was due to the old oil field, production issues, non-technical factors, also due to the large oil reserves (big fish) which have not been discovered yet, as an addition to Cepu Block. Exploration performance or efforts to discover the reserves need to be intensified; because the annual amount of barrels of oil produced cannot be

offset by the amount of barrels of new reserves' discovery. The *Reserve to Production ratio* (R/P) in 2013 was around 0.53 where ideally R/P = 1.

In 2013, Indonesia's oil production only amounted to 824 thousand bpd, thus assuming the absence of the discovery of new oil reserves, the ability of Indonesia's oil supply is only up to about 12 years (based on proven reserves). In September 2014, oil production reached only 788 thousand Barrels of Oil per Day (BOPD) or 3.67% below the target of the state budget in 2014, which was amounted to 818 thousand bpd.

In Indonesia 2050 Pathway Calculator, the amount of barrels of oil reserves new findings is assumed by the multiplication of "figure of R/P (*Reserve to Production*)" with "*production*" of the corresponding year. Figure of R/P is based on the value of R/P at present time (figure of R/P in 2013) that is between 0.52-0.53. The figure of R/P is assumed to remain the same until 2050, while the production figures of corresponding year are assumed as oil production of Level 3 in Indonesia 2050 Pathway Calculator. Thus, it is assumed that the discovery of new reserves in 2015 and 2050 amounted to 160 and 86 million barrels (Table 1).

Table 1. Assumptions of new oil reserves discovery

	2015	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Production assumption per year (million barrels)	309	257	247	272	328	266	209	166
Reserve/Production (R/P) Assumption	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52
New reserve discovery assumption (million barrels)	**160.7**	**133.6**	**128.4**	**141.4**	**170.6**	**138.3**	**108.7**	**86.3**

2.1.2. The Discovery of the New Gas Reserves

Natural gas reserves in the base year (2011), is equal to 152.89 trillion standard cubic feet (tscf) consisting of proven reserves and potential reserves at 104.71 TSCF and 48.18 tscf (Natural Gas Statistics, 2012). Largest gas reserves are located in the Natuna (51.46 tscf) and Papua (23.91 tscf) (Figure 4). From 2005 to 2011, reserves in Natuna area are relatively constant because most reserves in the region are located in the D-Alpha field that is still in the stage of waiting for the commercialization process (Widarsono, 2013).

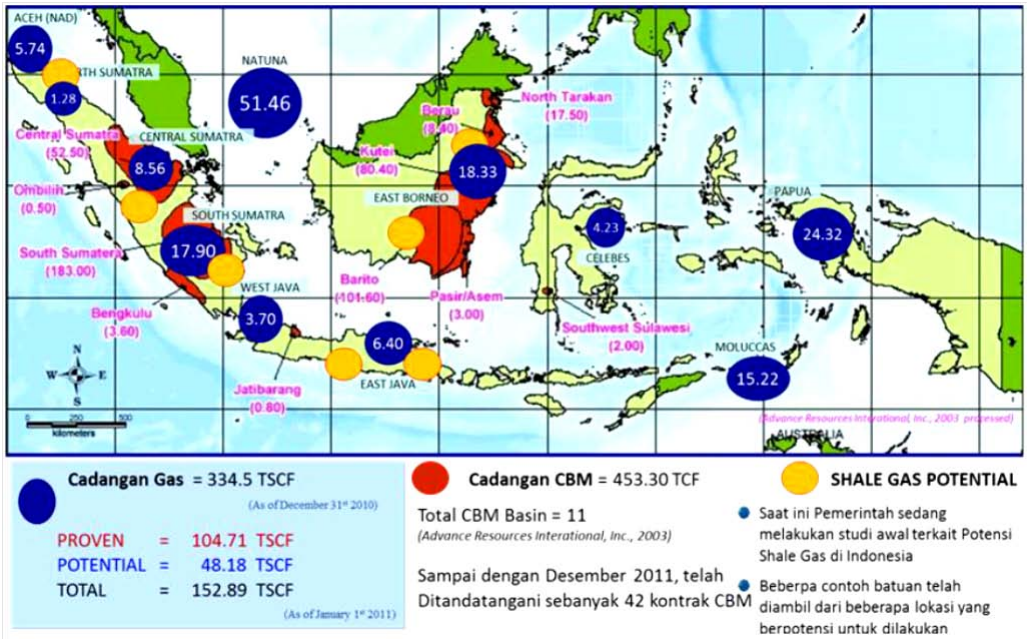


Figure 4. Map of Natural Gas Reserves (Ditjen MIGAS, 2012)

Historically Indonesia's natural gas reserves decreased, from 188.34 tscf in 2004 to 152.89 tscf in 2011. When looking at the data in 2013, natural gas reserves was decreased as much as 2.5 tscf, thus the reserve was approximately 150.4 tscf, while proven reserves of natural gas is 101.5 tscf and potential reserves at 48.9 tscf. Indonesia's natural gas production in 2013 is amounted to 8,130 mmscfd, which means when there will be an absence of new gas reserves discovery, the exisiting reserves of Indonesian natural gas is only for about 34 years (based on proved reserves).

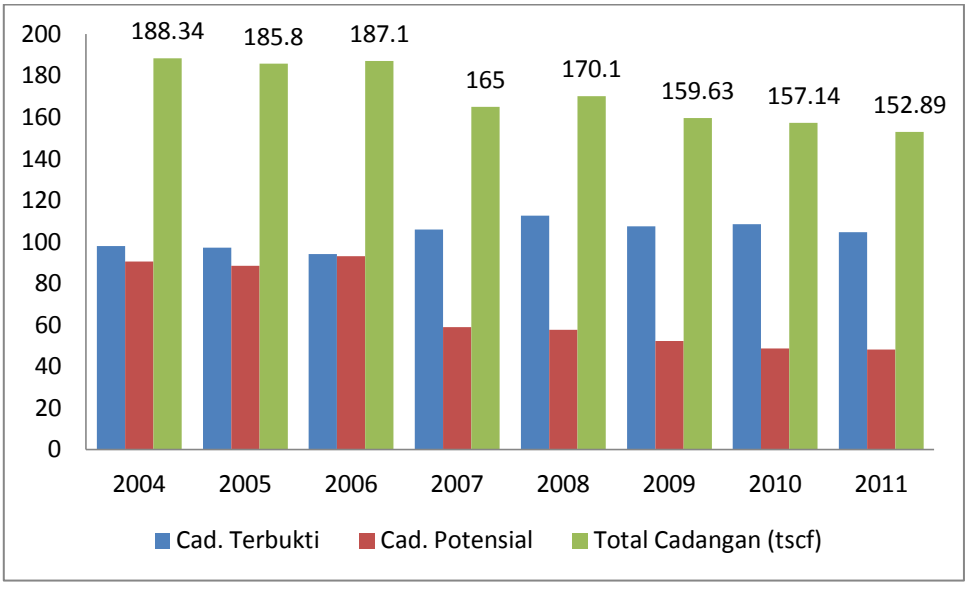


Figure 5. Reserves Gas Year 2004-2011 (Statistik Gas Bumi, 2012)

Natural gas production in 2011 reached 3,256,379 MMSCF. Despite a decline in the period of 2004-2008, gas production increased again in the period of 2009 to 2011 (Figure 6). Natural gas

production sites spread across some locations. The highest production came from East Kalimantan with a production share of 32% out of the national production, followed by the central and southern part of Sumatra with 21% share.

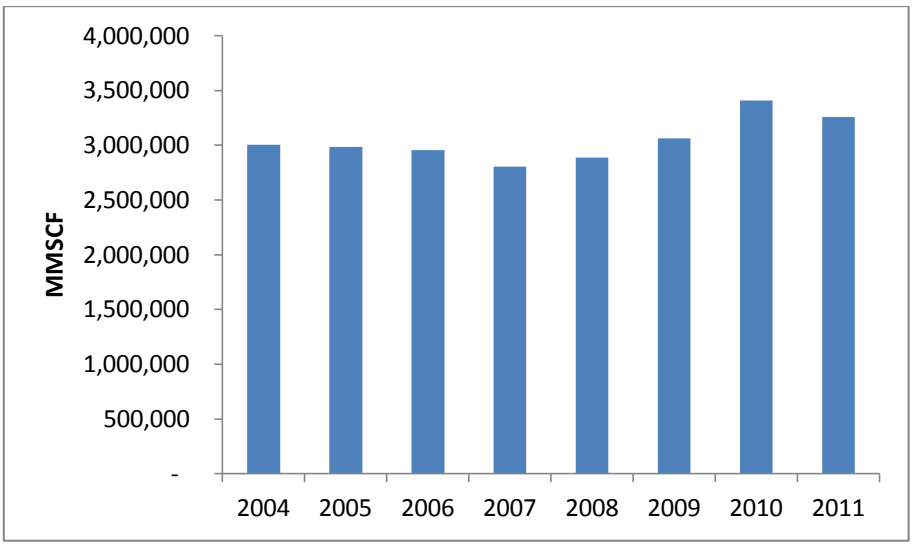


Figure 6. Natural Gas Production (2004-2011) (Natural Gas Statistic, 2012)

Based on the National Gas Balance (2010-2025), in 2015 with a total supply of approximately 10,000 MMSCFD, Eastern Kalimantan is projected to produce up to 2,900 MMSCFD gas, Central/Southern Sumatra at 2,000 MMSCFD, Papua at 1,200 MMSCFD, and Natuna at 675 MMSCFD. Gas reserves in Papua and Natuna are quite large and also considerably feasible for an accelerated development, so that production can be increased respectively to more than 2,000 MMSCFD

In Indonesia 2050 Pathway Calculator, the amount of barrels of new natural gas reserves discovery is assumed by the multiplying the R/P (Reserve to Production) figure with the "production" figure of the corresponding year. R/P figure is assumed to have a value of 0.52 and remained until 2050, while natural gas production figures of the corresponding year are assumed based on the Level 3 of Indonesian Pathways Calculator 2050. Thus, the assumptions of new reserves discovery in 2015 to 2050 are presented in Table 2.

Table 2. Assumption of Natural Gas New Reserves Discovery

	2015	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Production per year assumption (bscf)	2763	2998	2844	2501	2183	1654	1214	891
Reserve/Production (R/P) Assumption	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52
Discovery new reserves discovery (million barrel)	**1437**	**1559**	**1479**	**1301**	**1135**	**860**	**631**	**463**

2.1.3. The discovery of New Coal Reserves

Based on Coal Statistic 2012, Indonesia's coal reserve in 2011 was 21,131.84 million tons, while total coal resources is 105,187.44 million tons. The island of Borneo and Sumatra possess the largest reserves of coal resources that reached 52,326.23 million tons and 52,483.20 million tons respectively (Figure 7). Resource allocation of coal-producing region to the national production is still not balanced. For example Borneo, that shares 58% of total national resources, contributes up to 92% of Indonesia's annual coal production, while Sumatra that shares approximately 42% of total national resources contributes only around 8% of the annual production of coal in Indonesia. In Indonesia coal is generally classified as bituminous coal where its resources and reserves are spread from low calorie coal (<5,100 kcal/kg; adb) to very high calorie coal (> 7,100 kcal/kg; adb).

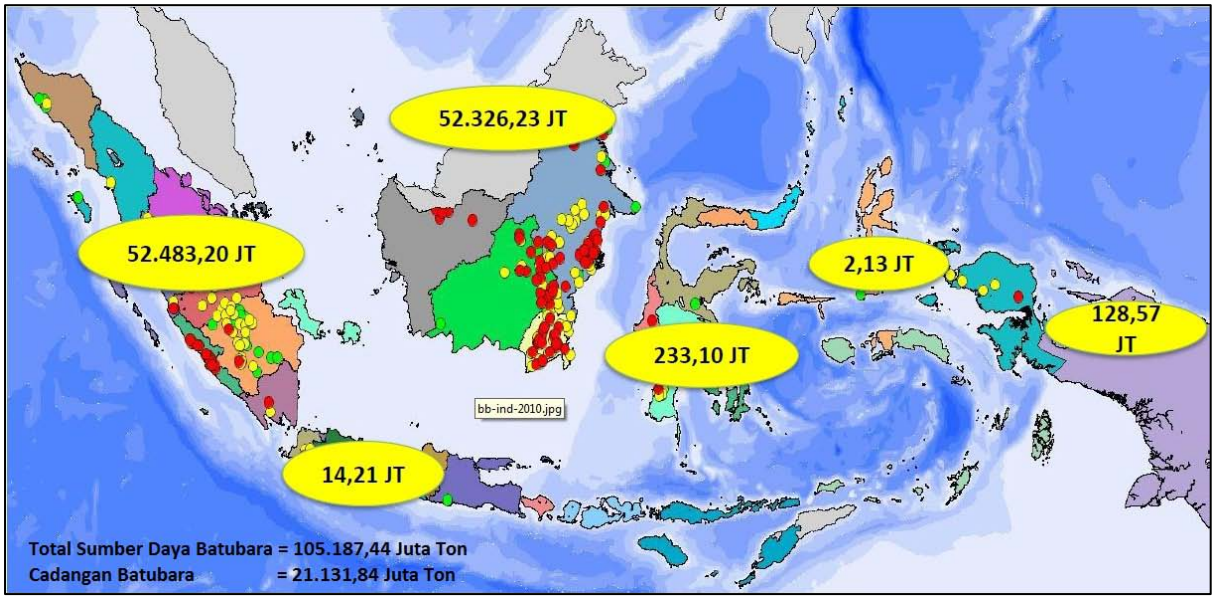


Figure 7. Location Map of Resources and Coal Reserves Distribution in 2011

Based on the 2013 data from geological agency, total coal resources and reserves of Indonesia rose to 120,525.4 million tons and 31357.1 million tons from 2011 to 2013 (Table 3). Indonesia's coal reserves are generally dominated by medium quality coal which reached 20133.1 million tons. Sumatra Island is dominated by the *low* quality coal.

Table 3. Indonesia's coal resources and reserves in 2013

Coal calorie levels	Resource (million tons)	Reserves (million tons)
Low	30.570,3	9.480,8
Medium	78.454,4	20.133,1
High	9.557,7	1.487,7
Very high	1.943	255,6
Total	**120.525,4**	**31.357,1**

Source: Badan Geologi ESDM, 2013

Based on the national energy policy, coal will become the main source of domestic energy needs by 2025, where the contribution of the primary energy mix is expected to reach 30% and will be decreased to 25% in 2050. Indonesia's coal production between 2008 and 2013 has increased from 235.2 million tons in 2008 to 421.5 million tons in 2013 (Table 4). In 2013, PT Kaltim Prima Coal as one of the largest producers of coal in Indonesia has managed to increase its production from 41.3 million tons to 53.5 million tons in 2012.

Table 4. Coal Production from 2008 to 2013

Coal	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Production (million tons)	235,2	257,7	275,2	353,3	407,5	421,5

Source: Directorate General of Mineral and Mining, 2014

Assuming the coal reserves at approximately 32 billion tons with the production of 400 million tons/year, Indonesia's coal supply is sufficient for the next 80 years (assuming there is no discovery of new reserves). In Indonesia 2050 Pathway Calculator, the assumptions of new reserves discovery of coal in the following years up to 2050 are based on the results of core team discussions (**Table 5**).

Table 5. Assumption of Coal New Reserves Discovery

	2011	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Coal Reserves (million tons)	21,131.84								
Discovery of new Reserves (million tons)		6.61	8.64	9.08	9.54	10.03	12.59	11.08	11.64

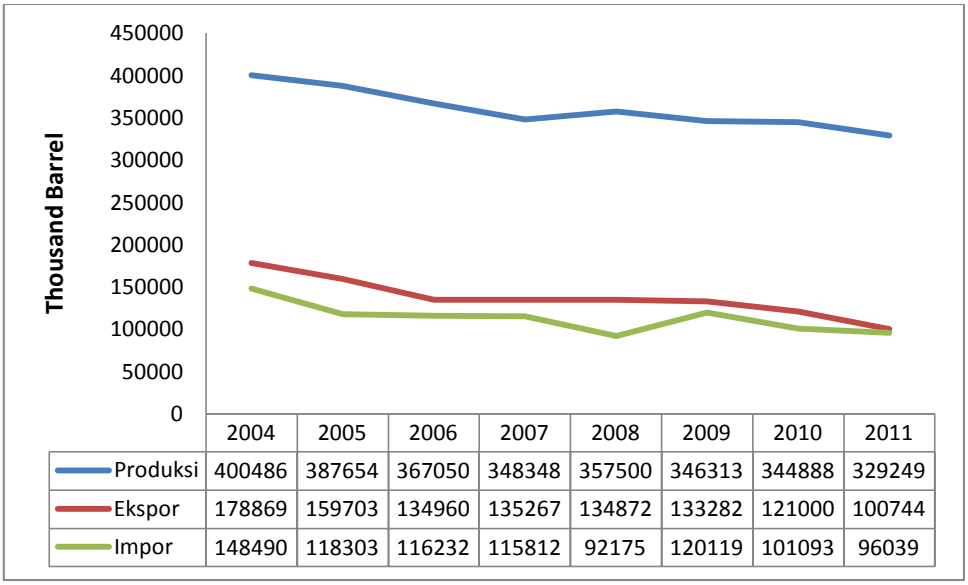
Source: Core Team Discussion Result

2.2. Export

2.2.1. Oil Export

Indonesia's crude oil exports continued to decrease following the production decrease; from 178,869 thousand barrels of crude oil exports in 2004 to 100,744 thousand barrels in 2011 (Figure 8). The number of Indonesia's crude oil exports in 2011 (100,744 thousand barrels) is almost equal to the amount of crude oil imported during the year (96,039 thousand barrels). Based on data from Petroleum Statistics 2012, only about 69.4% of which is used for domestic oil refinery inputs, where the remaining is used for export.

Indonesia's crude oil exports are carried out to several countries such as Japan, USA, Korea, Taiwan and Singapore. Besides exports, Indonesia also imports crude oil as domestic fuel refineries feedstock among others from Saudi Arabia, Azerbaijan, Brunei, Angola and Nigeria. The imports in the form of oil products are from Singapore, South Korea, Malaysia, Kuwait, China and India (Soemanto, 2014).



	2004	2005	2006	2007	2008	2009	2010	2011
Produksi	400486	387654	367050	348348	357500	346313	344888	329249
Ekspor	178869	159703	134960	135267	134872	133282	121000	100744
Impor	148490	118303	116232	115812	92175	120119	101093	96039

Figure 8. Production, Export and Import of Oil Year 2004-2011 (Statistik Minyak Bumi, 2012)

In Indonesia 2050 Pathway Calculator, the data on the percentage of Indonesia's oil export is sourced from *Handbook of Energy & Economics* in 2013, where oil production in 2011 reached 329,265 thousand barrels. Of this amount, about 135,572 thousand barrels were exported to several countries, therefore in percentage the amount of oil being exported is approximately less than 41%. The 41% figure is used as the assumption of export percentage of oil and this figure is assumed to remain constant until 2050.

2.2.2. Natural Gas Export

The share of domestic natural gas distribution increases every year, from 25% in 2003 to 57% in 2014. In contrast, the distribution share for export relatively declines (Figure 9). An export surge occurred in 2010 that caused the distribution share for export increases to 56%, it was mainly caused by the operation of the LNG Tangguh Train 1 and 2. Meanwhile, for the first time in the history of Indonesia, starting in 2013 the share of domestic gas distribution (57%) is greater than the exports.

In order to improve the utilization of domestic natural gas, a massive gas infrastructure is carried out, among others Floating Storage Regasification Unit (FSRU), LNG Receiving Terminal and gas transmission pipelines. Some strategic natural gas infrastructures that have been built, among others, were FSRU West Java 3 MTPA (metric tons per annum) and FSRU Lampung 3 MTPA. In addition there are also plans to install LNG Regasification Arun Unit 3 MTPA and gas transmission pipeline Arun-Belawan built by Pertamina and are expected to be operational in late 2014 or early 2015.

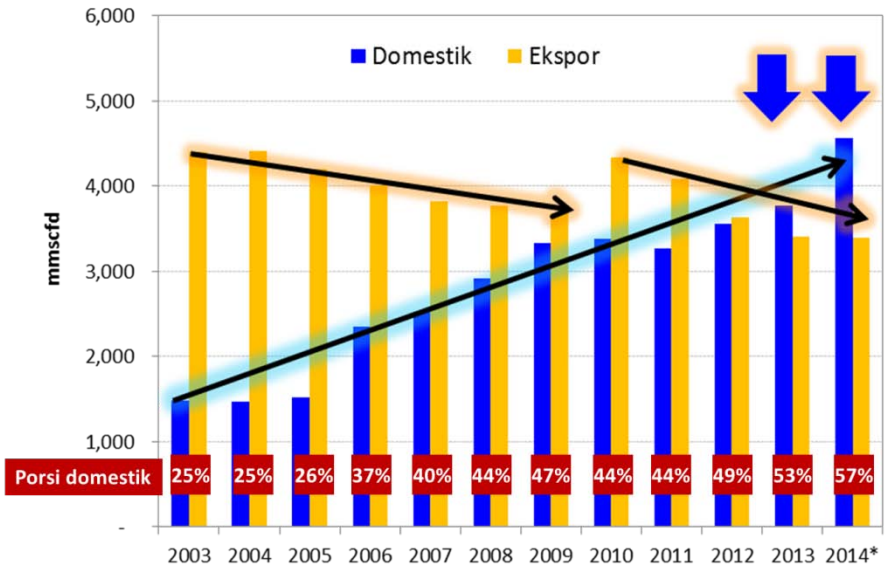


Figure 9. Natural Gas Fulfillment for Domestic and Export Distribution (Soemanto, 2014)

In Indonesia 2050 Pathway Calculator, the percentage of exports in the base year is 56% (Figure 9). The national gas export through the year 2050 is assumed to decline resulting from the government policies that prioritize the escalating domestic demand and domestic natural gas demand. This is in line with Indonesia's Energy Outlook 2014, which states that the percentage of Indonesian gas exports during the period of 2013-2050 will decrease. Furthermore the assumptions of the Indonesian natural gas export percentage in the Indonesia 2050 Pathway Calculator are presented in Table 6.

Table 6. Assumptions of Natural Gas Export Share

	2011	2015	2020	2025	2030	2035	2040	2045	2050
Natural Gas Export Percentage	53,00 %	55,28 %	54,38 %	53,49 %	52,59 %	51,69 %	50,79 %	49,90 %	49,00 %

2.2.3. Coal Export

Coal production continued to increase each year and reached 353.3 million tons in 2011. Along with the increase in production, coal exports also continued to increase up to 272 671 351 tons or 77.18% of the production (Figure 10). Indonesia's coal reserves are only 0.8% (BP Statistical Review) of the total world coal reserves. However, Indonesia is the largest coal exporter country and according to the International Energy Agency (IEA) in 2013, the amount of Indonesia’s coal export in 2012 was approximately 383 million tons (Figure 11). The amount of coal exports is even higher than Australia and Russia that possess more coal resources than Indonesia.

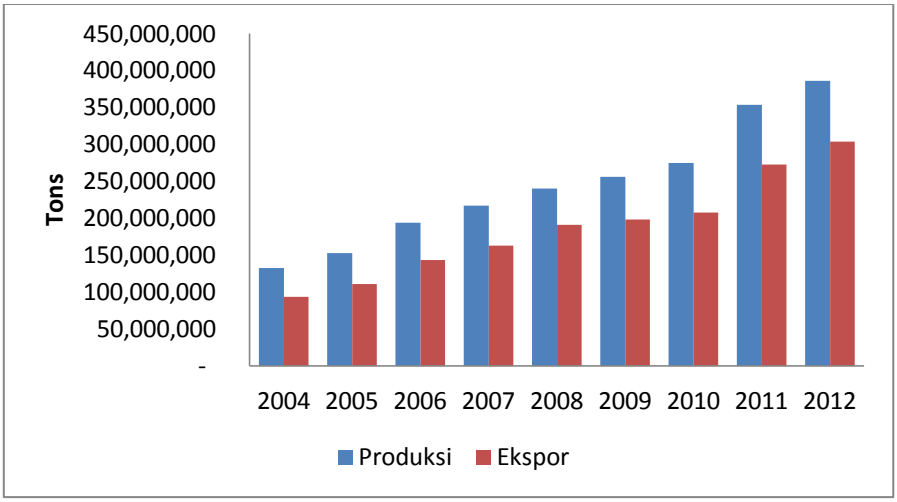


Figure 10. Production and Export of Coal Year 2004-2012
(Handbook of Energy & Economics, 2013)

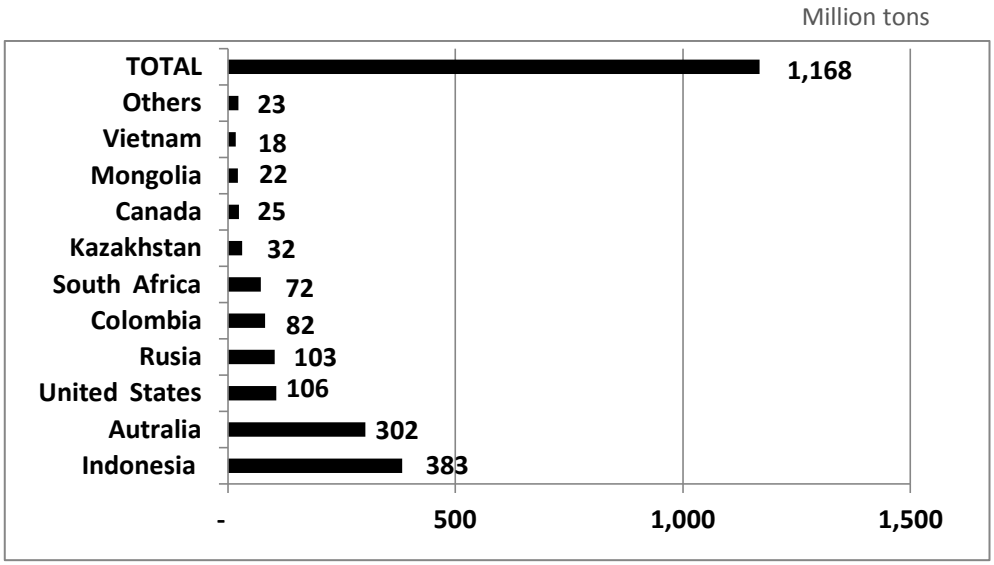


Figure 11. Indonesian coal exports compared to other countries in 2012
(Soruce: Key World Energy Statistic 2013 – International Energy Agency (IEA)

In Indonesia 2050 Pathway Calculator, it is assumed that the percentage of coal exports will continue to decline due to the policy to prioritize the coal supply for domestic demand and the increasing demand for coal from various industries in the country. Since there is no difference of selling price between the domestic and export, the coal producers are encouraged to sell their coal domestically. The assumptions of coal exports percentage from base year (2011) to 2050 are shown in Table 7.

Table 7. Assumptions of Coal Export Percentage

	2011	2015	2020	2025	2030	2035	2040	2045	2050
Coal Export Percentage	77,18%	72,69%	62,31%	51,92%	41,54%	31,15%	20,77%	10,38%	0,00%

3. Methodology

3.1. Domestic Production

Domestic production of oil, gas and coal follows the production assumptions given in each level (level 1-4). It depends on the level chosen by the user, for instance, when the user selects level 1; the domestic production will show the value of production at level 1

3.2. Remaining Reserves

Remaining reserves of petroleum, natural gas and coal in Indonesia 2050 Pathway Calculator are formulated by the following equation:

$$Reserves\ in\ the\ following\ year = Reserves\ in\ previous\ the\ year - Production + New\ Reserves\ Discovery$$

3.3. Total Exports

The total export in Indonesia 2050 Pathway Calculator is the result of multiplying the percentage of exports with the domestic production of corresponding year.

$$Total\ Exports = Export\ Percentage\ x\ Domestic\ Production$$

4. Level Assumption/Trajectory assumption

Fossil fuel production consists of three (3) one of pagers namely: the production of oil, natural gas and coal.

4.1. Oil Production

Indonesia used to be a member of the oil exporting countries. Now Indonesia's oil production continues to decline and even Indonesia has turned into a net oil importing country. In 2006, Indonesia was still able to maintain its production over 1 million barrels per day. However, oil production continues to decline, and in 2011 production reached only 902,000 barrels per day.

The level 1 scenario of the oil production section describes the same condition of Indonesia's oil production in the last 5 years, where the rate of production declined at 6%. The 6% assumption rate is obtained from SKK Migas historical data (2013) that showed that the crude oil production declined at the range of 3 to 6% (Figure 12). At level 2, the assumption is that despite a decline in production rate at 6% per year, there will be additional production from the existing fields and the Enhanced Oil Recovery (EOR) projects in some places. The existing fields that are assumed to contribute to the additional production are Cepu block and Bukit Tua, while the EOR implementation projects are in Tanjung, Limau and Minas fields.

EOR is an advanced technique to remove oil when various basic techniques have been done but the results are below the expectation or uneconomical. Some EOR techniques are including thermal

engineering, chemical, and miscible process. In Indonesia OER technique has been applied in Duri Field with PT Chevron Pacific Indonesia as the operator. With EOR technology, the field is capable of producing oil up to 296 thousand barrels per day. In addition, there are EOR trial that is carried out in Minas, Kaji, Tanjung, Widuri, and Limau fields. Of the fifth field, it was discovered that Minas and Kaji fields could potentially produce oil through EOR technique. Various efforts have been made to accelerate EOR activities, one of them by providing incentives to the production sharing contract PSC that carries out the EOR activities pursuant to the signed contract. The government also encourages EOR activities through the Presidential Decree No. 2 of 2012 on the National Petroleum Production Enhancement.

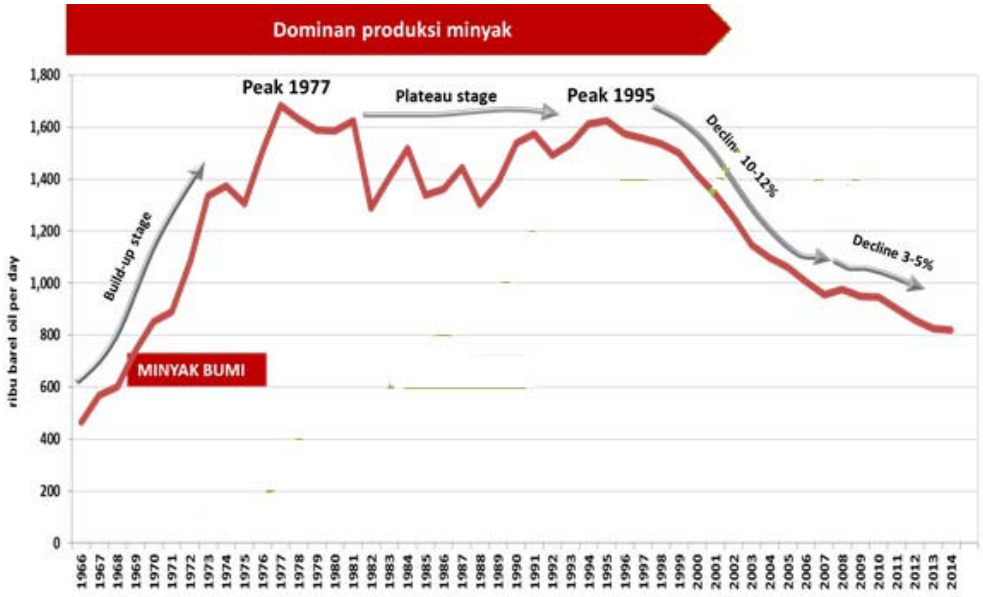


Figure 12. Historical Data of Oil and Gas Projection
(Source: SKK MIGAS, 2013)

Level 3 illustrates the production of oil is higher than Level 1 or 2. Assumptions at Level 1 and 2 are also applied to Level 3, however, there is an additional oil production from the new EOR projects and it is assumed that the existing fields have maximized the production through EOR. In addition, additional production is assumed from the offshore fields that would start their production in 2030. Level 4 describes the condition of oil production which is equal to Level 3 coupled with oil production from offshore-new fields which begin their production in 2035 and 2040. Investment in offshore fields happen through government support on permits simplification, improved data and technology, tax incentives and a more attactive PSC contracts.

Level 1

Level 1 assumes oil production in 2050 is estimated to reach 82 thousand bpd. This number is obtained from the rate of decline in production at 6% of the current production (860 thousand bpd).

At this level it is assumed that oil reserves at existing fields have been exhausted, but with the development of new fields, the production rate can be maintained at 6%.

Level 2

Level 2 assumes Oil production in 2050 is projected to reach 180 thousand bpd. This amount is assumed to come from the addition of production of Cepu Block and Bukit Tua in 2015 amounted to 130 thousand bpd, the existence of EOR projects in Tanjung field at 60 thousand bpd in 2022, the Limau field at 14 thousand bpd in 2023 and 184 thousand bpd from Minas field in 2030.

Level 3

Level 3 assumes oil production is projected to reach 454 thousand bpd. This amount is assumed to come from the additional production and EOR project as at Level 2, there is also an additional production from EOR project in which 50% of the existing fields reach their peaks in 2031. Another additional production also derives from the offsore project that commences in 2030.. This significant increase in production is assumed to occur due to the supports of Government such as permits simplification, improved data and technology and tax incentives.

Level 4

Level 4 assumes oil production in 2050 is projected to reach 1 million bpd. This amount is assumed to come from the increased production at 23% of the potency. Apart from the additional production from various efforts as stated in Level 3, there are also additional offshore projects in 2030, 2035 and 2040. A very significant increase in production is assumed to occur due to the the Government supports such as permits simplification, improved data and technology, tax incentives and the presence of more attractive PSC contracts.

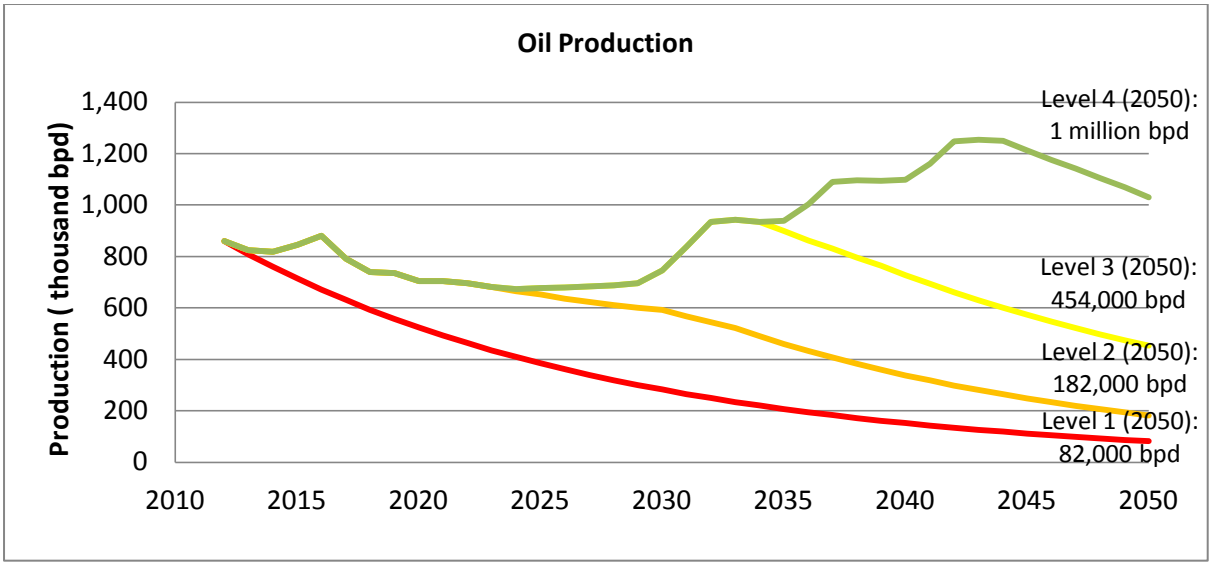


Figure 13. The levels of oil production in 2011-2050

4.2. Natural Gas

Currently, the natural gas reserves in Indonesia is estimated 150,700 bscf, consists of proven reserves at 103,300 bscf and potential reserves at 47,400 bscf. The Production of natural gas in the base year (2011) is 7,181 mmscfd. Natural gas production in the period of 1970 to 2005 continued to increase, but it tended to deacrease from within the period of 2011-2014 (Figure 14).

Besides conventional gas, Indonesia also has potential reserves of non-conventional gas. Based on Directorate General of Oil and Gas and Advance Resources International, Inc. (ARI) research in 2003, a non-conventional gas resource in the form of Coal Bed Methane (CBM) in Indonesia is estimated 453 trillion cubic feet (TCF). CBM can be a new source to address the increasing domestic gas demand. Until now there have been more than 54 signed CBM contracts, event though none of the contractors has entered into Plan of Development (PoD) stage. In addition to CBM, Indonesia also has other unconventional gas resources, namely shale gas, which is estimated at 574 trillion cubic feet (TCF).

The *one pager* of natural gas production is based on the rate of gas production decline that can be retained at 6% and also from the additional production of existing fields and new fields as well as the additional production of unconventional gas such as CBM and Shale Gas. Level 1 describes the production of natural gas continues to decline from current production, while level 4 illustrates the significant increased production from base year due to the additional production from existing fields and new fields; there are additional production from CBM and Shale Gas respectively at 4% and 1%

which will start the production after 2030. It is triggered by the attracative incentives from the government.

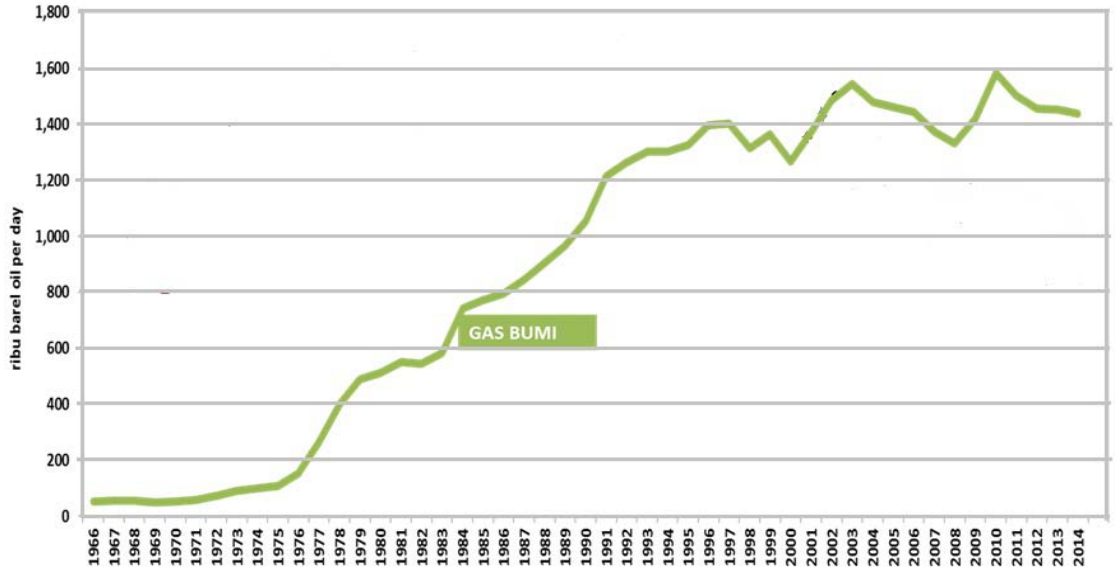


Figure 14. Historical Data of Natural Gas Production (Source: SKK MIGAS, 2013)

Level 1

Level 1 assumes natural gas production in 2050 is projected at 371 mmscfd. The natural gas production in 2012 was at 7,181 mmscfd. Due to the field development, the decline rate could be maintained at approximately 6%.

Level 2

Level 2 assumes natural gas production in 2050 is projected at 968 mmscfd. The production is assumed from the additional production of the supply projects, among others: Donggi Senoro, Masela, IDD and Tangguh; and also from the potential supply production of East Natuna field.

Level 3

Level 3 assumes natural gas production in 2050 is projected at 5,224 mmscfd. The amount of the production is assumed to come from the additional production such as project supply, potential supply, new gas discovery amounted to 26% of the potentials, CBM production that is amounted to 2% of the potential and begin its production in 2031, and also 0.5% of shale gas which begin its production in 2040. The significant increase in production is assumed to occur due to the supports of the Government, in the forms of permits simplification, improved data and technology as well as tax incentives.

Level 4

Level 4 assumes natural gas production in 2050 is projected at 9,479 MMSCFD. The amount of the production is assumed to come from the additional production such as project supply, potential supply, new gas discovery amounted to 34% of the potential, CBM production amounted to 4% of the potential and begin its production in 2031 and 1% of shale gas which begin its production in 2040. This significant increase in production is assumed to occur due to the efforts of the Government, such as permits simplification, improved data and technology, tax incentives and more attractive PSC contracts.

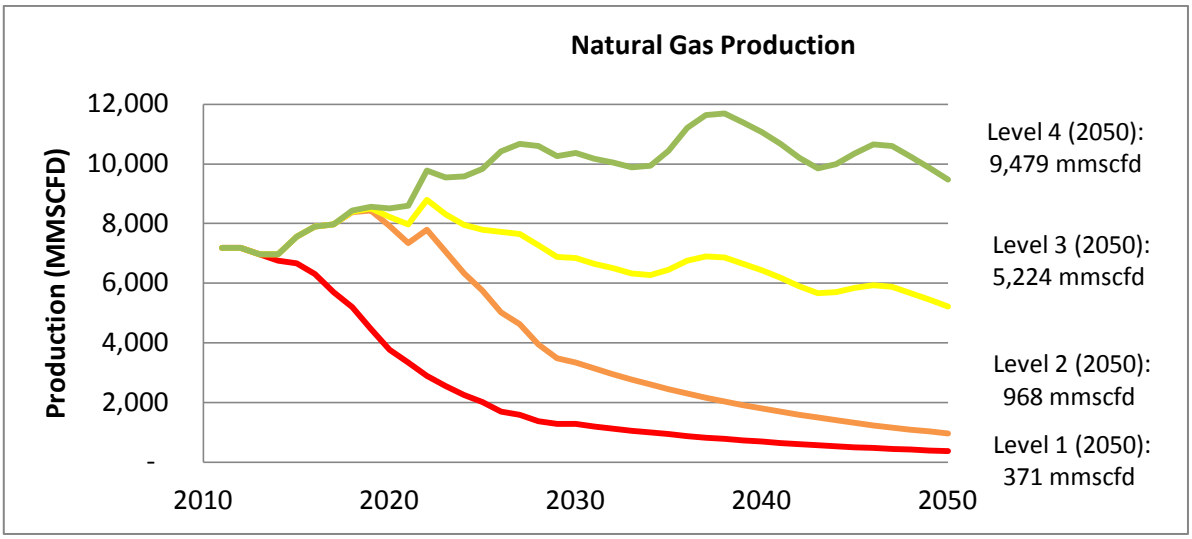


Figure 15. The levels of natural gas production in 2011-2050

4.3. Coal

Coal resources in Indonesia is estimated 119 million tons. In 2011, Indonesia's coal production reached 353 million tons and a large share of this amount (77%) is exported. Currently, the National Energy Policy has specific pathways regarding the energy resources, in which the energy resources are not used merely as exports commodities, but the resources supposed to be used as the capital for national development. *Asosiasi Pertambangan Batubara Indonesia* (APBI) or Indonesia Coal Mining Association (ICMA) has made projections on national coal production using the coal production control scenario. Based on these scenarios, the projected coal production within the period of 2015 - 2025 is assumed to increase between 1 to 1.2%, and the coal production in 2050 is projected to reach 685.13 million tons of which 90% is used for domestic needs (Figure 16).

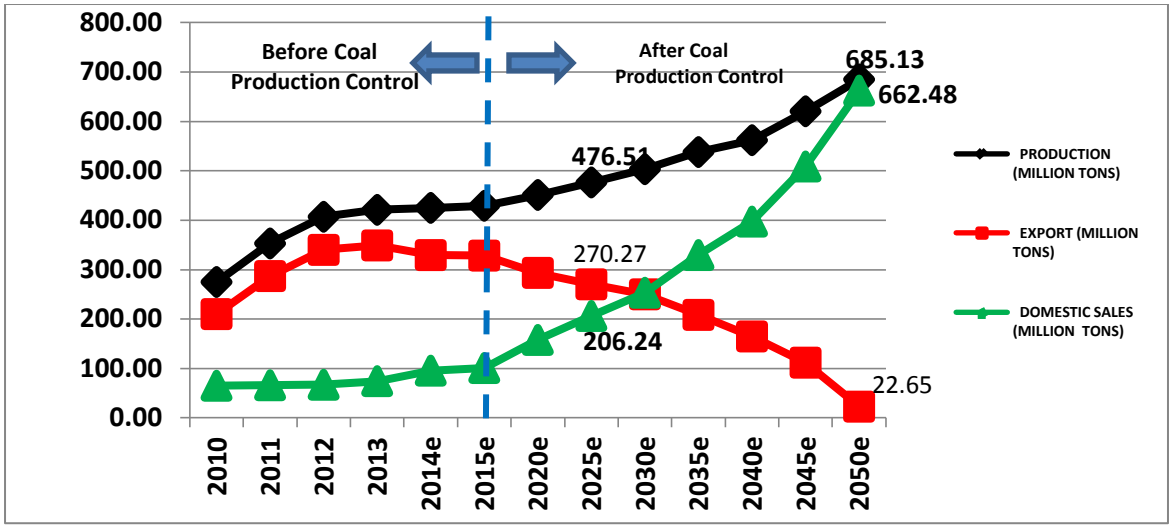


Figure 16. Coal production projection (APBI)

One pager of coal production describes the coal production forecast up to 2050. With the reference of projections results made by APBI/ICMA, the increase in coal production at level 1 (basic level) is assumed to be 1% per year. When looking at the results of the APBI/ICMA projection, the increase of 1% was obtained from the increase of coal demand in the electricity sector by 3% per year until 2022, while the industrial sector demand reached 8.5% per year. Projected coal production at level 4 is assumed to increase 4% per year; this condition is driven by a significant increase of coal demand from both domestic and overseas. Coal for domestic demand is needed to support the electricity sector that supposed to reach 430 GW by 2050, according to the National Energy Policy. The other sector which also requires a lot of coal in the volume is the industry sector. In terms of policy, at Level 4 even though the Government has implemented a policy to prioritize domestic needs rather than export, but due to the high demand of overseas market the export activity will still prevail. .

Level 1

Level 1 assumes that the coal production in 2050 will be 594 million tons. This number derives from the assumption of an increase in production at 1% per year since the base year (2011). At this level, it is assumed that due to the presence of coal production control policy from the Government in order to prioritize the domestic needs, most coal production will be used for domestic electricity and industry sectors since both sectors continue to grow. .

Level 2

Level 2 assumes that the coal production in 2050 will be 863 million tons. This number derives from the assumption of an increase in production at 2% per year since the base year (2011). At this level,

it is assumed that the coal production is still used to meet the domestic market. The absence of a price difference between the domestic and international markets drives coal producers to choose domestic market, such trend is also partly caused by an increasing demand of coal in the country.

Level 3

Level 3 assumes that the coal production in 2050 will be 1,251 million tons. The amount is based on the assumption of an increase in production at 3% per year since the base year. At this level, the coal diversification project such as gassification to support the electricity sector has been adopted. At this level, the government is assumed to restart the coal export in order to increase the state revenue.

Level 4

Level 4 assumes that coal production in 2050 will be 1,806 million tons. The amount is based on the assumption of an increase in production at 4% per year since the base year (2011). At this level it is assumed that coal production is used primarily to meet the needs of the electricity sector which increased in folds compared to level 1 as well as to meet the demands of the industrial sector which is steadily increasing. In addition, overseas demand for coal from remains is fulfilled in order to increase the state revenue.

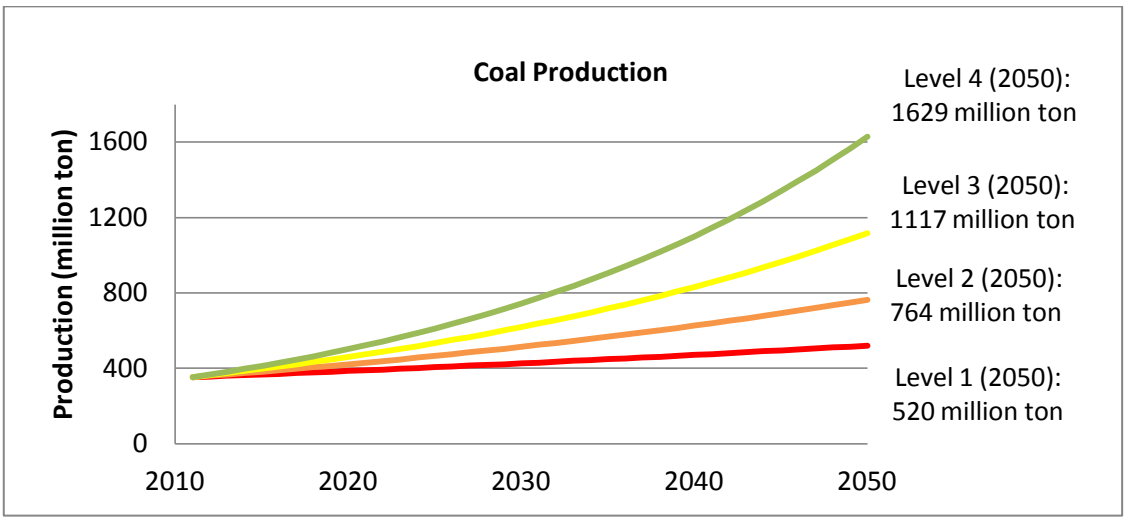


Figure 17. Coal production leveling year 2011-2050

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