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Bambang Widarsono
bambang.widarsono@yahoo.com

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Indonesia's Natural Gas: Production, Reserves and Challenges

Bambang Widarsono*

Beberapa tahun terakhir telah terjadi penurunan drastis produksi minyak bumi Indonesia secara nasional dengan laju penurunan sekitar 10% per tahun. Pada kurun waktu yang sama pula situasi produksi dan cadangan gas bumi nasional justru menunjukkan perkembangan yang menggembirakan. Laju produksi dapat dipertahankan dan cadangan bahkan menunjukkan pertumbuhan yang baik dari tahun ke tahun. Analisis atas sejarah produksi dan cadangan, kegiatan eksplorasi, dan perbandingan antara penemuan minyak dan gas bumi pada tahun-tahun belakangan ini mendasari kesimpulan bahwa gas bumi dapat menjadi sumber energi dan pendapatan nasional alternatif terhadap minyak di masa yang akan datang.Meskipun demikian terdapat beberapa tantangan yang dihadapi dalam eksploitasi gas bumi terutama dalam kaitannya dengan penerapan teknologi, infra-struktur, penegakan hukum, keresahan sosial, peraturan yang terlalu ketat, dan insentif. Tantangan-tantangan tersebut harus diatasi jika tingkat produksi gas, dan juga minyak, yang berkesinambungan ingin dicapai.

* The author was graduated from University of Indonesia, Faculty of Mathematic & Natural Science Postgraduate Program and currently working in the PPPTMGB "LEMIGAS as Senior Manager of Formation Evaluation Group, Exploitation Division.

Introduction

From the birth of the Republic of Indonesia petroleum industry in Indonesia has played an important part in the national economy. The industry grew and reached its unprecedented importance during 1970s when oil price rocketed onto levels that never occurred before. The period of 1970s through 1990s is characterized by a strong dependence on oil, as well as natural gas, as a source of national income. Urgent requirement of petrodollar for national development in that period had often led into conditions in which oil and gas fields were producing at maximum capacity and well above the sustainable production level. This, inevitably due to various damages created, resulted in premature production decline. A commonly known example is the giant Minas oil field in Central Sumatra, which at present is producing at 98% water cut (i.e. only two barrels of oil per 100 barrels of fluid produced) even though it is estimated that the field still has significant amount of reserves. Another example is the Arun gas field in Aceh that experienced premature production decline due to excessive gas condensation in the reservoir caused by too large drop in reservoir pressure.

Apart from the fact that oil and natural gas are non-renewable energy by nature, those nationwide practices resulted in sharp decline in later years. The end of 20th century witnessed a drop in oil production by approximately 15% annually followed by gentler rates of decline of 6% - 8% annually up to the year of 2004 (Figure 1) and to present time. At present, national oil (plus gas condensate) production has reached a new low at daily production rate of less than one million barrel (TECP, 2007). Various efforts have been spent by the government in order to improve the production with very limited results.

A better outlook is shown by production of natural gas. Despite problems of production shortfall (unanticipated production period at a certain level that falls short of expectation) for some prominent gas fields, overall overview shows a far gentler decline in production (Figure 2) up to year 2004 and to present time. Indeed some production shortfall had led to production swap (support from other fields to fill in the shortage caused by the production shortfall) and import from other countries but in general national gas production and reserves are still in a better shape than the corresponding figures for oil. It is the objective of this paper to give a general overview over the national oil and gas production and reserves, and the challenges that lay ahead in the effort to sustain them.

Gas Production and Reserves

During its more than 100 year of history petroleum industry in Indonesia has been sustained by fields located in the 15 productive sedimentary basins out of 60 that Indonesia has. Most of those productive basins are located in western Indonesia (Figure 3). Big gas fields like Arun (North Sumatra basin) and Tunu (Kutei basin) are located in western Indonesia. Table 1 shows a list of sedimentary basins in Indonesia complete with their sizes.

Report released by the Directorate General of Oil and Gas, Ministry of Energy and Natural Resources show that national reserves per 1 January 2006 is 38,485.4 BSCF (billion standard cubic feet) of Proved reserves (volumes of reserves that can be produced with high degree of certainty) and 32,591.1 BSCF Potential reserves (volumes of reserves that can be produced with lesser certainty than Proved reserves) from producing fields and 58,770.8 BSCF Proved reserves and 50,113.6 BSCF Potential reserves from non-producing fields. The above reserves figures include both non-associated gas (gas that comes from gas reservoirs) and associated gas (gas that is byproduct of oil production).

From historical point of view (Figure 4), national gas reserves experienced a significant addition with the discovery of Arun field in North Sumatra basin by Mobil Oil (now ExxonMobil) with its huge limestone reservoir. Other big gas discoveries are Badak and Nilam fields in Kutei basin by Huffco (now VICO) and Tunu and Peciko fields by Total. Contribution from the state company Pertamina is an aggregate of medium and small-size fields mostly located in South Sumatra basin and North West Java basin.

General overview over the growth of national gas reserves, as represented by the Proved reserves in Figure 4, shows a promising situation indicated by the positive growth even though under relatively constant annual production in recent years (Figure 2). The situation for oil is different in which oil Proved reserves has been showing a steady decline by about 15% except in 1998 – 1999 when some discoveries of medium-size fields were made by Caltex and some other companies (Figure 5).

The relatively good trend shown by the growth of national gas reserves can further be underlined considering that the profile presented in Figure 4 is for Proved reserves from producing fields only and it does not include Proved reserves from non-producing fields. Data shows that there are several large non-associated gas fields that are in status of non-producing due to technical and commercial constraints. The existence of Potential reserves, which can change their status to Proved reserves whenever enough data is acquired to support it, further improves the overview over the national gas reserves.

From size point of view, gas fields in Indonesia ranges from small to large. Tables 2, 3, and 4 present fields with large reserves (> 1,000 BSCF), fields with medium reserves (200 – 1,000 BSCF), and fields with large and medium size reserves but in status of non producing, respectively. From the number of the fields it is obvious that Indonesia's gas reserves are spread among medium size reserves (fields with small reserves are not presented here due to their considerable number) and are by no means concentrated on large fields only. This certainly causes commerciality problem since gas from small and medium size fields often cannot be exploited economically in individual manner. Unlike in the case of oil which can be stored easily at any place, the gas need to be connected to certain market points and distance from those market points determines the economics and commerciality of the reserves.

As presented in Tables 3 and 4, some large and medium size fields have reached final stage (depleted stage) of their production lifetime indicated by the diminishing reserves had by the fields. For examples, Arun, Badak, and Parigi-L fields that have only 5% - 15% of their Proved reserves left. Nevertheless, most of the fields are still at the early and intermediate stages of their production lifetime implying a long supply lifetime nationally. In addition, the existence of non-producing fields (Table 4) further strengthens the national supply capacity. (As an example, the Natuna D-Alpha giant gas field with its 70% carbon dioxide contents still waits for an appropriate technology and a more favorable economics condition for its commerciality).

From regional point of view, data presented in Tables 2, 3, and 4 show that most of gas reserves are located in the productive and mature basins of western Indonesia (see also Table 1). However, large discoveries in recent years were made in eastern Indonesia non-productive basins such as Banggai and Bintuni. This undoubtedly underlines the potential of the remaining non-productive basins, which most of them are located in eastern Indonesia.

From location point of view, the national gas reserves are apparently divided evenly between onshore and offshore locations (Figure 6). No much difference in the way of producing onshore and offshore else than economics and commerciality aspects.

From business contribution point of view, multinational companies such as Total, ExxonMobil, VICO, ConocoPhillips, and BP still dominate the total reserves and production. Pertamina at present contributes with approximately 20% and 12% of the total Proved reserves and production, respectively. Some examples are Subang and Parigi-L fields in North West Java basin and Lembak, Musi, and Gunung Kemala in South Sumatra basin. National private companies such as Medco also contribute with the discovery of Senoro field in Banggai basin.

Prospect In The Future

As presented earlier, the national gas reserves and production is in a better situation than the national oil reserves and production. This is further added by the fact that if in the past medium and small size reserves tended to be 'avoided' for commerciality reason at present, and more likely in the future, conditions they will receive more 'attention' with the diminishing national oil reserves. In this condition commerciality status for medium and small size reserves are more easily achieved, which in turn will stimulate the efforts to discover new reserves.

Geographically, the data presented in this paper indicates that basins in eastern Indonesia have good prospect for new gas discoveries. Recent years have shown discoveries of large gas reserves of larger than 1,000 BSCF in eastern Indonesia. Senoro field (Banggai basin) and Vorwata and Wiriagar fields (Bintuni basin) are some examples. This does not include other possibly large discoveries in eastern Indonesia such as Donggi field (Lariang basin) and Masela field (Aru Trough basin). Constraints such as inadequate infra-structures in frontier areas have the capability to hinder exploration and exploitation of reserves in eastern Indonesia. It is the government's responsibility to provide the much needed infra-structure so that sustainable national gas, as well as oil, reserves and production can be maintained as long as possible.

Summary of Challenges

From the brief overview that we have seen above, it is clear that to maintain and to improve the current level of reserves and production – especially oil production – focused attentions should be given to a series of challenges. In general, the challenges can be divided at least into five groups: natural, technical, commerciality, social, and regulatory.

Natural challenges

Complexities that characterize geological setting in the Indonesian archipelago certainly impose problems for exploration activities in term of interpreting and determining prospects. This becomes even more complicated by facts that most of potential prospects are located in the so called 'frontier areas'(mainly in eastern Indonesia and in deep waters), which are characterized by remoteness and lack of infra-structures, which lead to very high operational costs. This can clearly be seen in the significant number of fields that are considered marginal economically. Many discovered fields are currently in a status of suspension. On the other hand, in recent years only a few discoveries in mature areas can be classified as sufficiently large.

Most of the unexplored basins are located in eastern Indonesia, which is geologically more complex than western Indonesia. This is indeed an additional challenge since it is acknowledged that in an area with complex geological setting, finding and describing potential reservoirs are not an easy task. Extensive experience and integrated know how is required to handle this situation.

For producing fields, most of Indonesia's large gas fields have reached mature stage, at which most of the recoverable part of total gas volume in the reservoir has been produced. Innatural forces that support production have been depleted. This condition needs various efforts, and therefore costs, to replace the natural forces and to enhance the depleted production.

Technical challenges

Effective and efficient exploration and production operations require optimum use of appropriate technology. For instance, as put forward earlier, the Natuna D-Alpha is a large gas field with about 70% carbon dioxide contents. No current technology at present can handle this problem economically. Thoughts have been given to options such as re-injecting the separated carbon dioxide into the field's aquifer or transmitting the unwanted gas into the nearest oil fields for enhanced oil recovery (EOR) processes. Nevertheless, none of the current options are feasible enough for improve the field's commerciality.

Another example is the potential hydrates (gas that is stored in solid state) accumulation in some parts of deep water areas. Specific technology and experience are needed to exploit, transport, and process the hydrates into the desired gas state.

Another ever-challenging problem for Indonesia in recent years is equipment unavailability. For instance, news over unavailability of drilling rigs is always in circulation. No exploration and production activities can be carried out without the availability of drilling rigs. Similar problems also occur for some production and transportation equipment.

Commerciality challenges

As pointed out earlier, one thing that differ gas production from oil production is the aspect of commerciality. In case of oil production, how ever small the amount of oil volume produced, as long as considered profitable, the reserves is considered commercial. For a gas field, an amount of reserves (both associated and non-associated gas) can be considered commercial if there is market available to absorb the production. This is due to the fact that natural gas cannot be stored in large quantity economically. Market has to be available to receive straightaway the day to day production. A 'market' for a gas reserves could be any industries that require the gas, liquefied natural gas (LNG) plant, households, or the nearest main gas transmission pipelines. This commerciality aspect serves as the most significant challenge to large gas reserves such as in East Natuna and Bintuni basins.

Social challenges

In years after the end of Suharto's 'New Order' governments, the upsurge of public open expressions over various sensitive issues hitherto were untouchable has gained its momentum. Issues such as regional autonomy, land condemnation, community development, and financial compensation for various things can almost be daily found in mass media. Apart from the correctness of the causes, they certainly impose additional challenges to any operator in many ways, which in turn may affect economic feasibility of exploration and production operations. The government, both central and local, has to facilitate and regulate the issues effectively.

The *Era of Reformasi* has also been witnessing leniencies in law enforcement in many sectors. In relation to social order, many cases of stealing, looting, and hijacking have been recorded. Stealing and looting of production equipment such as valves, gauges, auxiliary pumps, and other equipment may reduce operation efficiency. Violent demonstrations (riots) also sometimes take place. Some more serious cases such as hijacking of entire production facilities have lead to cease in production, which usually result in permanent damage to the field's productivity. The government must seriously address these social related problems through observing and enforcing law and order.

Regulatory challenges

In Indonesia's oil and gas industry, regulatory functions are performed by the Directorate General of Oil and Gas (*Direktorat Jendral Minyak dan Gas Bumi*, Ditjen Migas) while day-to-day supervisory on contractor's operation is the responsibility of Oil and Gas Supervisory Body (*Badan Pengawas Minyak dan Gas Bumi*, BP-Migas). Both organizations are under the Ministry of Energy and Mineral resources. The Ditjen Migas proposes regulations, awards contracts, and approves initial field plan of development, while the BP-Migas approves field's further plans of development and their related financial expenditures, which are later to be reimbursed by the government. Efficiency in executing these functions certainly affects production operations and has proved vital. In a recent unpublished report issued by the Ministry of

Energy and Mineral Resources (DESDM, 2007) some of the inefficiencies are highlighted as follows:

- The procedure for procurement, the *Pedoman Tata Kerja No. 007/PTK/VI/2004 Tentang Pengelolaan Rantai Suplai Kontraktor Kontrak Kerja Sama* by BP-Migas, based on the presidential decree or Keppres no. 80/2003 (see Agus Salim, 2004) is still considered too long and arduous. There are some instances showing that the long process for tendering the much needed drilling services have lead to the bidder's withdrawal for a more time efficient procurement process in other parts of the worlds. In current situation, with shortage in drilling rigs throughout the world, other parts of the world with more flexible regulations and more lucrative incentive such as in the Central Asia and the Middle East are certainly more attractive for rig owners.

- Long process for approval of work program and budget (WP&B), field's plan of development (POD), and authorization of financial expenditure (AFE). For instance, the regulation requires five separate approvals from BP-Migas for budget, Pre-AFE, tender plan, AFE, and tender award. Each of the approval requires some months (plus, there are many contractors in a long line for the process) meaning an approval, for instance, for a drilling service (especially offshore rigs) requires a long precious time (some examples have shown requirements of 12 to 30 months) to be spent. Elimination of one or two of the approvals through a more flexible approval scheme is suggested.

- Long approval process from related state departments. For instance, onshore exploration and production actives are often located in forest areas. Therefore, a permit is required from the Ministry of Forestry.

- Contractors are audited not only by BP-Migas but also, in a manner identical to state enterprises and institutions, by *Badan Pengawas Keuangan* (BPK) and *Badan Pengawas Keuangan Pemerintah* (BPKP). Since contractors are treated companies that use state income for operation, after approval from BP-Migas in the form of *cost recovery*, the uses of the state income are subject to auditing from the aforementioned institutions. These all demand precious time rom the limited human resources in the companies to prepare for the multiple auditing. This time-consuming redundancy has been claimed as reducing work efficiencies. A more integrated auditing may solve the problem.

- Uncertainty in land ownership has lead to a long process of land acquisition needed for exploration and production activities. For instance, land acquisition is required for oil and gas pipeline network. Uncertainties plus later claims complete with physical actions from the claimants often delay the commissioning of the installation.
- Uncertainty in taxation (e.g. import tax) in the form of ambivalence in the imposition of special taxation scheme for national oil and gas industry.
- At macro-scale, the production sharing scheme is considered by many as no longer attractive for foreign investment, especially for marginal fields and/or for 'frontier areas'. Indeed the split between governments and contractors have been flexible in practice. For instance the old production sharing split of 85: 15 is no longer in force for some cases to the favor of the contractors. However, this is often considered by potential contractors as unattractive. A re-evaluation has to be made upon the existing forms of contract agreement.

Some of the most crucial points listed above are indeed related to the regulatory scheme adopted by the Government of Indonesia (*Undang - Undang No. 22 Tahun 2001 tentang Minyak dan Gas Bumi)*, in which the government regulates the upstream oil and gas industry - through Ditjen Migas and BP-Migas – that is operated by contractors/operators. This regulation still underlines the centralism in the management of the national oil and gas industry – in the form of production sharing scheme - that in turn may result in problems such as bottle-necking for various detailed processes. Arguably, decentralization in the management – like in the schemes prevailing in many other countries – may minimize the problems.

Indeed the challenges listed above are by no means to represent all problems in the national upstream oil and gas industry, but at least those challenges are too significant for omission. By addressing the challenges appropriately it is hoped that the resilience of national oil and gas production can be strengthened.

Conclusions

From the study presented in this paper a set of main conclusions can be drawn:

1. Natural gas has the potential to replace oil as the primary hydrocarbon production along with the diminishing oil reserves and production.
2. The large amount of reserves left in most producing fields indicates the large national capacity for gas supply.
3. Some large discoveries of large gas reserves in eastern Indonesia recently indicate that Indonesia probably still has very vast gas reserves that has yet to be found. A bigger attention should also be given to that region.
4. The abundance medium and small size reserves require serious attention in order for them to acquire commerciality. This will enlarge the national gas reserves figures.
5. A set of challenges in forms of natural, technical, commerciality, social, and regulatory still lay ahead for the government to deal with. Arguably, further decentralization in the management of national oil and gas industry may solve at least a part of the problems.

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Table 1. Sedimentary basins in Indonesia (from Hadi Purnomo et al, 2003)

No.	Basin	Area (km²)	Locat	No.	Basin	Area (km²)	Locat
1	North Sumatra	10,500	WI	31	Banggai	10,670	EI
2	Sibolga	94,330	WI	32	Salabangka	8,600	EI
3	Bengkulu	98,000	WI	33	Manui	8,000	EI
4	Central Sumatra	45,000	WI	34	Buton	11,000	EI
5	South Sumatra	85,670	WI	35	Tukang besi	61,000	EI
6	Sunda	20,000	WI	36	Timor	20,330	EI
7	Northwest Java	61,000	WI	37	Sula	4,670	EI
8	Biliton	19,670	WI	38	South Sula	4,000	EI
9	South Java	164,670	WI	39	West Buru	6,670	EI
10	Pati	24,670	WI	40	Buru	15,000	EI
11	Northeast Java	79,330	WI	41	North Halmahera	3,000	EI
12	Northeast Java Sea	54,000	WI	42	East Halmahera	18,000	EI
13	West Natuna	89,670	WI	43	North Obi	5,330	EI
14	East Natuna	85,670	WI	44	South Halmahera	35,670	EI
15	Ketungau	20,000	WI	45	South Obi	6,000	EI
16	Melawi	36,330	WI	46	Seram	9,670	EI
17	Pembuang	64,000	WI	47	South Seram	4,670	EI
18	Barito	43,670	WI	48	West Weber	3,670	EI
19	Asem-asem	29,330	WI	49	Weber	35,000	EI
20	Kutai	149,000	WI	50	Tanimbar	5,330	EI
21	Tarakan	68,000	WI	51	Salawati	22,000	EI
22	Lariang	22,000	EI	52	Bintuni	53,000	EI
23	South Makassar	42,000	EI	53	Misool	34,330	EI
24	Lombok-Bali	43,670	EI	54	Aru Trough	51,000	EI
25	Sawu	56,000	EI	55	Waipona	60,670	EI
26	Flores	31,330	EI	56	Biak	19,330	EI

27	Spermonde	26,000	EI	57	Waropen	4,330	EI
28	Bone	61,670	EI	58	Akimeugah	91,330	EI
29	Minahasa	90,000	EI	59	Sahul	126,000	EI
30	Gorontalo	58,670	EI	60	Jayapura	2,330	EI

Note: WI = Western Indonesia
EI = Eastern Indonesia

Tabel 2. Indonesia's large size Proved reserves (> 1,000 BSCF) @ 1/1/2005 from producing fields.

Field	Operator	Basin	Location	Gas type(*)	Proved reserves @ 1/1/2005 (BSCF)	Remaining reserves @ 1/1/2005 (BSCF)
Arun	ExxonMobil Oil	N. Sumatera	On shore	Non-asso	13,354.00	430.00
Tunu	Total Indonesie	Kutai	Off shore	Non-asso	12,874.36	8,121.90
Badak	VICO	Kutai	On shore	Asso+non-asso	6,966.50	915.50
Peciko	Total Indonesie	Kutai	Off shore	Non-asso	4,886.69	3,426.15
Nilam	VICO	Kutai	On shore	Non-asso	4,778.90	1,016.70
Suban	ConocoPhillips	S. Sumatera	On shore	Non-asso	4,407.51	4,242.98
Arjuna	BP W. Java	N.W. Java	Off shore	Asso+non-asso	3,686.52	1,148.10
Attaka	Unocal Ind.	Kutai	Off shore	Asso	2,617.12	1,168.35
Handil	Total Indonesie	Kutai	Off shore	Asso	2,199.08	663.39
Tambora	Total Indonesie	Kutai	On shore	Non-asso	1,630.90	993.88
Parigi - L	Pertamina	N.W. Java	Off shore	Non-asso	1,412.85	192.18
Dayung	ConocoPhillips	S. Sumatera	On shore	Non-asso	1,394.87	1,008.68
Musi	Pertamina	S. Sumatera	On shore	Asso+non-asso	1,205.05	907.55
NSB A	ExxonMobil Oil	N. Sumatera	Off shore	Non-asso	1,179.00	783.43
Pagerungan	EMP Kangean	N.E. Java	Off shore	Non-asso	1,121.00	66.62

Note: (*) predominant gas type
Asso = associated gas
Non-asso = non-associated gas

Table 3. Indonesia's medium size Proved reserves (200 – 1,000 BSCF) @1/1/2005 from producing fields. Table covers only the top 30 fields.

Field	Operator	Basin	Location	Gas type(*)	Proved reserves @ 1/1/2005 (BSCF)	Remaining reserves @ 1/1/2005 (BSCF)
Mutiara	VICO	Kutai	On shore	Asso+non-asso	948.30	346.40
Jatibarang	Pertamina	N.W. Java	On shore	Asso+non-asso	878.36	632.96
Semberah	VICO	Kutai	On shore	Non-asso+asso	806.00	291.10
Subang	Pertamina	N.W. Java	On shore	Non-asso	778.89	702.78
Sumpal	ConocoPhillips	S. Sumatra	On shore	Non-asso	739.35	691.26
Anoa	Premier Oil	W. Natuna	Off shore	Non-asso+asso	678.85	352.50
Serang	Unocal Ind.	Kutai	Off shore	Non-asso+asso	629.95	277.70
Benuang	Pertamina	S. Sumatra	On shore	Non-asso	606.21	320.60
L Sukon DS	ExxonMobil Oil	N. Sumatra	On shore	Non-asso	575.94	145.80
Gun. Kemala	Pertamina	S. Sumatra	On shore	Asso+non-asso	564.96	277.28
Lembak	Pertamina	S. Sumatra	On shore	Non-asso	543.23	275.69
Raja	HEDI/Citra P.	S. Sumatra	On shore	Non-asso+asso	486.39	19.42
Bunyu+Nibung	Pertamina	Tarakan	On shore	Asso+non-asso	455.62	157.22
Belanak	ConocoPhillips	W. Natuna	Off shore	Asso+non-asso	436.00	435.10
Sepinggan	Unocal Ind.	Kutai	Off shore	Asso+non-asso	360.06	55.94
Poleng	Kodeco	N.W Java	Off shore	Asso	331.35	204.75
W+E Cemara	Pertamina	N.W. Java	On shore	Asso+non-asso	329.19	257.55
Kampung B.	Energy E	Bone	On shore	Non-asso	328.32	279.59
Belida	ConocoPhillips	W. Natuna	Off shore	Non-asso+asso	327.00	120.66
P Tabuhan T	Pertamina	N. Sumatra	On shore	Asso+non-asso	321.26	106.38
S. Mahakam	Total Indonesie	Kutai	Off-shore	Non-asso+asso	317.30	316.92
P Tabuhan B	Pertamina	N. Sumatra	On shore	Asso	312.04	195.84
Gelam	ConocoPhillips	S. Sumatra	On shore	Non-asso	307.16	142.64
Rantau	Pertamina	N. Sumatra	On shore	Asso	293.68	109.83
Betara NE	Petrochina	S. Sumatra	On shore	Asso	286.36	278.84

L. Sukon AS	ExxonMobil Oil	N. Sumatra	On shore	Non-asso	278.20	64.41
Libo SE	Caltex PI	C. Sumatra	On shore	Non-asso	262.94	36.19
Pasir Jadi	Pertamina	N.W. Java	On shore	Non-asso	255.86	145.94
KRA	Star Energy	W. Natuna	Off shore	Asso+non-asso	243.07	162.68
N. Cilamaya	Pertamina	N.W. Java	On shore	Non-asso	240.31	184.45

Note: (*) predominant gas type
Asso = associated gas
Non-asso = non-associated gas

Table 4. Indonesia's large and medium size Proved reserves (> 200 BSCF) @1/1/2005 from non-producing fields. Table has not covered some recent big discoveries with uncompleted reserves estimation.

Field	Operator	Basin	Location	Gas type(*)	Proved reserves @ 1/1/2005 (BSCF)
Natuna D - Alpha	Esso	E. Natuna	Off shore	Non-asso	28,900.00
Vorwata	BP Berau/Muturi	Bintuni	On shore	Non-asso	10,437.29
Wiriagar Deep	BP Wir./Berau	Bintuni	On shore	Non-asso	2,901.50
Senoro	Medco	Banggai	Off shore	Non-asso	2,276.90
Sisi + Nubi	Total Indonesie	Kutai	Off shore	Non-asso	1,636.58
Gendalo	Unocal Ind.	Kutai	Off shore	Non-asso	1,151.69
Terang	EMP Kangean	N.E. Java	Off shore	Non-asso	518.00
Roabiba	BP Berau	Bintuni	On shore	Non-asso	401.20
Bungin	ConocoPhillips	S. Sumatra	On shore	Non-asso	368.39
Kepodang	BP Muriah	N.E. Java	Off shore	Non-asso	360.00
Ofaweri	BP Berau	Bintuni	On shore	Non-asso	345.10
Gajah Baru	Premier Oil	W. Natuna	Off shore	Non-asso	344.38
Bungkal	ConocoPhillips	S. Sumatra	On shore	Non-asso	324.65
Sirasun	EMP Kangean	N.E. Java	Off shore	Non-asso	322.00

N. Belut	ConocoPhillips	W. Natuna	Off shore	Non-asso	313.00
Gandang	Unocal Ind.	Kutai	Off shore	Non-asso	304.59
Pulau Gading	Amerada Hess	N.E. Java Sea	On shore	Non-asso	298.20
Ubadari	BP Berau	Bintuni	On shore	Non-asso	281.00
Ujung Pangkah	Amerada Hess	N.E. Java Sea	Off shore	Asso	269.00
Stupa	Total Indonesie	Kutai	Off shore	Non-asso	207.24

Note: (*) predominant gas type
Asso = associated gas
Non-asso = non-associated gas

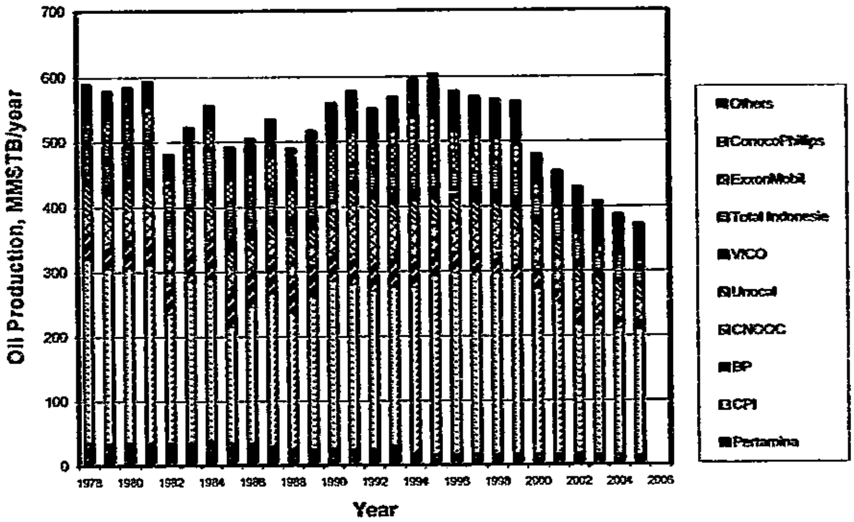


Figure 1. National oil and condensate production, period: 1978 – 2005.

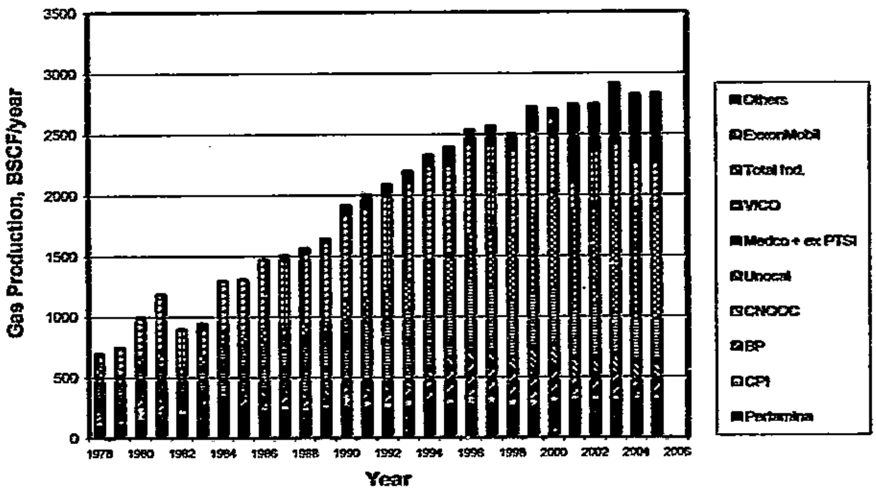


Figure 2. National gas production, period: 1978 – 2005.

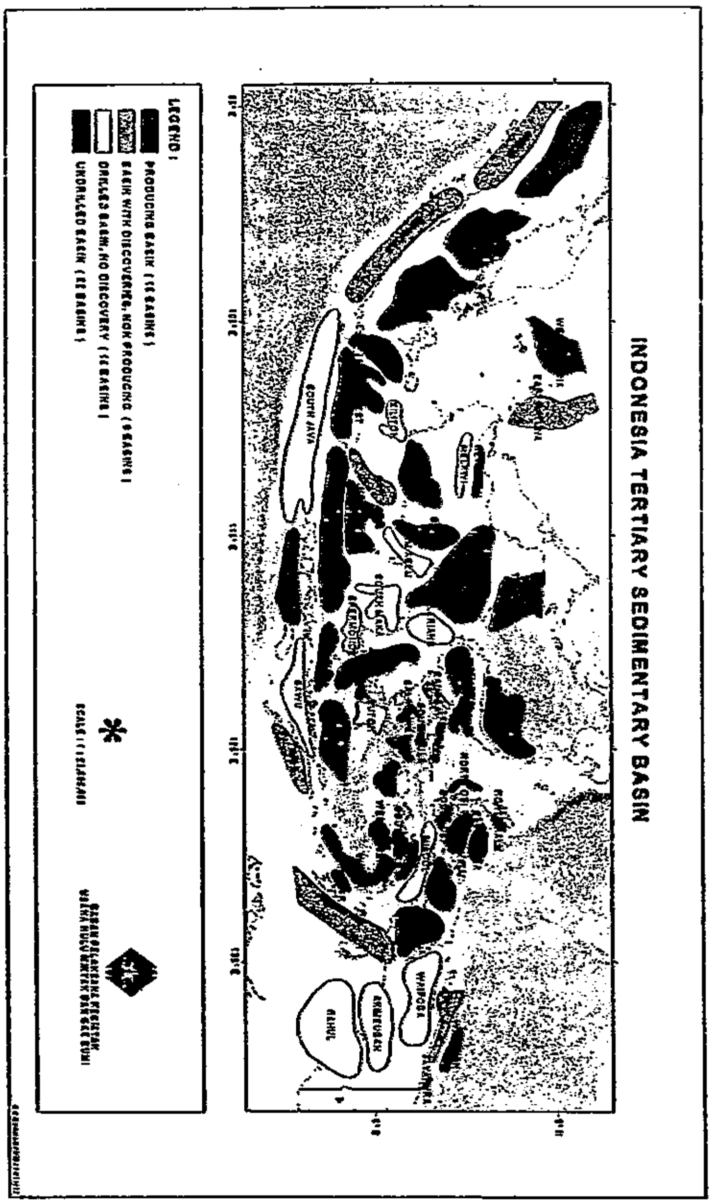


Figure 3. Sedimentary basins in Indonesia (source: BP – MIGAS).

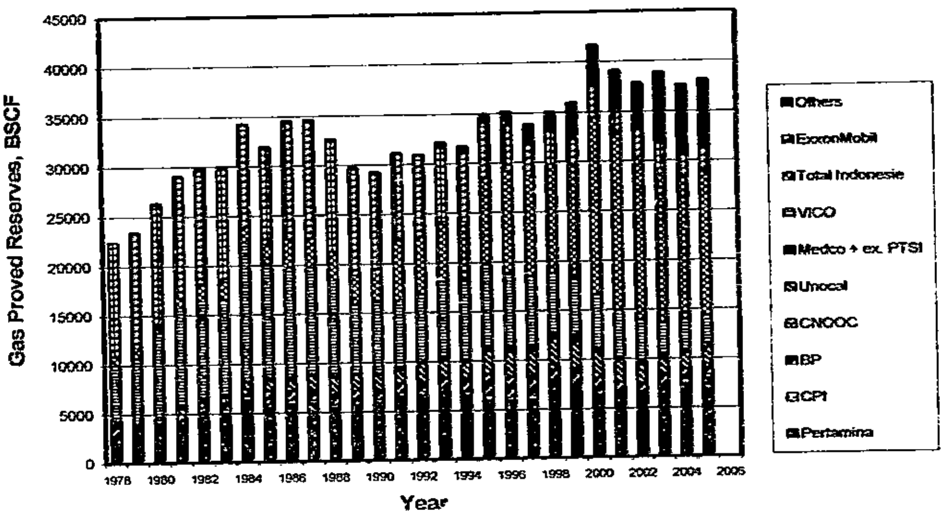


Figure 4. Growth of national gas Proved reserves of producing fields, period: 1978 – 2005.

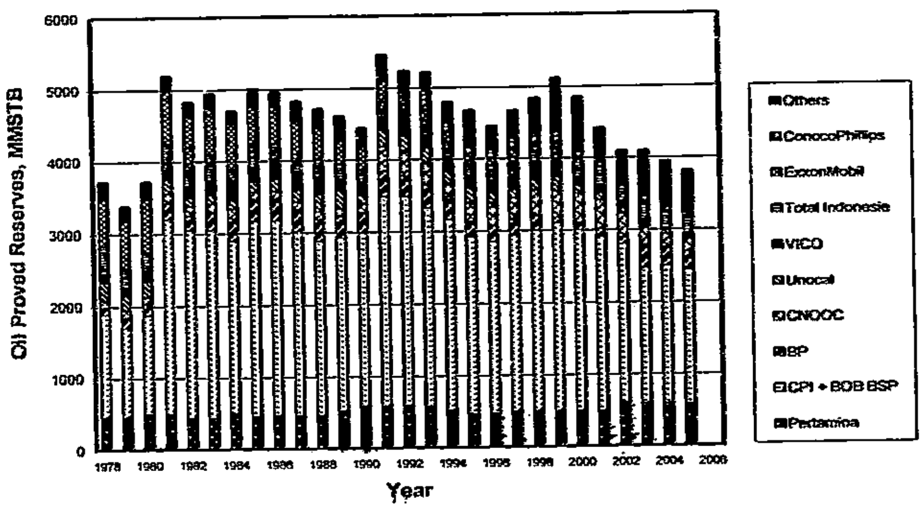
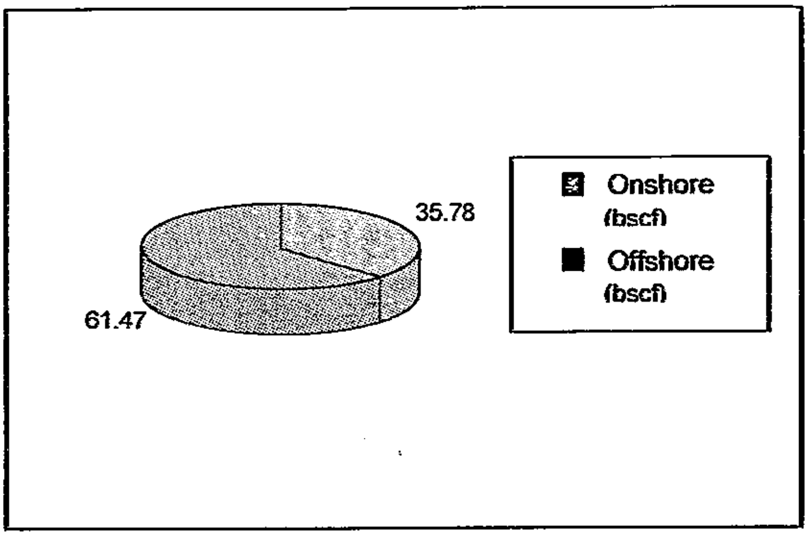
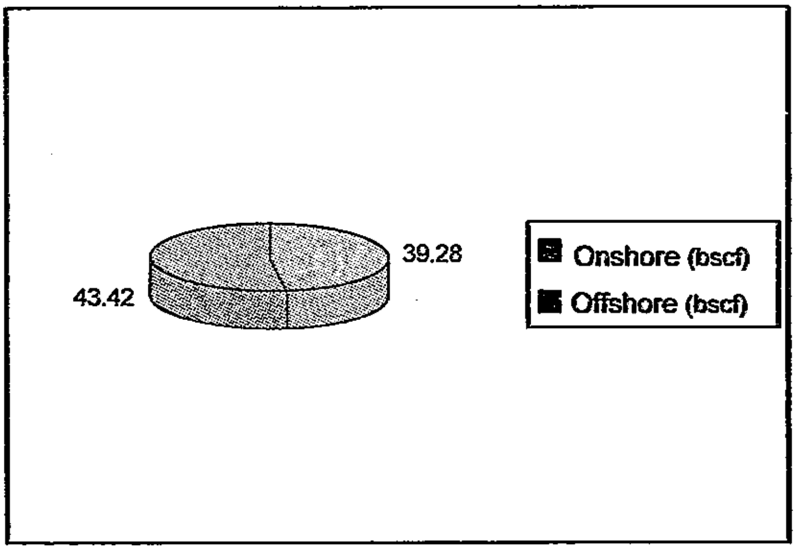


Figure 5. Growth of national oil Proved reserves of producing fields, period: 1978 – 2005.



(a)



(b)

Figure 6. Proved (a) and Potential (b) reserves from point of vew of locations: onshore and offshore. Reserves belong to both producing and non-producing fields.