Forecasting and Modelling Onshore Gas Reserves in Indonesia Using the Creaming Curve and Linear Regression Analysis

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Abstract.
In early 2016, oil prices fell to its lowest level (30.32 US/bbl) over the last 12 years, and the coronavirus (Covid-19) outbreak that started at the end of 2019 has had a negative impact on the world economy (including the oil and gas industry). Since then, petroleum exploration and exploitation activities have decreased worldwide. The oil and gas companies must look for potential oil and gas reserves that can be produced and had to make extra cost savings and produce new strategies to avoid negative cash flow and keep the projects economically acceptable, such as: cost efficiency, proposed incentives (investment credit, interest cost recovery, etc.), proposed changes to the terms and conditions of the existing contract (depreciation acceleration, DMO holiday, share of First Tranche Petroleum (FTP), change of Split Ratio, etc.), etc.

In terms of oil and gas reserves, this paper will assist the Contractors and the Government in determining the area that has the highest and the lowest number of gas reserves per project using the Creaming Curve and Linear Regression method by processing statistical data from 165 data (onshore gas projects), so that Contractor are able to analyze which area is economically acceptable for oil and gas activities.

Based on the analysis of 165 onshore-gas reserves in Indonesia, Sulawesi is estimated to have the highest amount of onshore gas reserves by 521.90 BSCF per project, which means that these areas have become the most interesting areas for contractors to produce profitable gas projects. Meanwhile, Kalimantan is estimated to have the lowest amount of onshore gas reserves by 46.20 BSCF per project compared with other areas in Indonesia and this is because there are quite a lot of projects that are concentrated in one area (East Kalimantan) which causes the condition of reserves in that area to mature.

Key word (s): Creaming Curve, Oil and Gas Reserves, Plan of Development, Production Sharing Contract

INTRODUCTION

In early 2016, oil prices fell to their lowest level (30.32 US/bbl) over the last 12 years, and the coronavirus (Covid-19) outbreak that started at the end of 2019 has had a negative impact on the world economy (including the oil and gas industry). Since then, petroleum exploration and exploitation activities have decreased worldwide. The oil and gas companies had to make extra cost savings to avoid negative cashflow and keep the projects economically acceptable to Contractors such as; cost efficiency in general and administration (G&A), proposed incentives (investment credit, interest cost recovery, etc.), proposed changes to the terms and conditions in the existing contract (depreciation acceleration, DMO holiday, share of First Tranche Petroleum (FTP), change of Split Ratio, etc.), etc.

Based on Presidential Regulation Number 22 of 2001 and Number 9 of 2013, the Government of the Republic of Indonesia formed an institution called the Special Task Force for Upstream Oil and Gas Business Activities (SKK Migas). The institution is assigned to manage upstream oil and gas business activities under a Cooperation Contract. One of the functions of SKK Migas is to give approval of proposed Plan of Development (POD) documents based on technical and economic evaluations from both SKK Migas and the contractor.

As of December 2020, there were about 525 projects approved by the government of Indonesia, and 165 of them will produce gas in onshore area, which is expected to maintain the national energy supply and increase national income from the oil and gas industry. This paper will evaluate and analyse gas reserves per project and per area to help Contractors find the area in Indonesia that has the highest trend of gas reserves per project so that they can analyse which area is economically acceptable for oil and gas activities.

The purpose of this paper is, to divide the geographical areas of Indonesia into 5 different areas (Sumatera, Java, Kalimantan, Sulawesi and Papua). Then, to collect the data that related to projects number and gas reserves, the trend of gas reserves per project are calculated and analyzed by using the creaming curve and linear regression method, the result will be distributed to those aforementioned areas and finally define the area that has the highest and the lowest number of gas reserves per project.

This paper will provide an insight into the development of the oil and gas industry in Indonesia during the fall of oil prices and show a distribution map of estimated gas reserves per project in Indonesia. The paper is also expected to provide contractors with a quick look at the oil and gas industry in Indonesia, especially those who are looking for the giant gas reserves, and also help them create their petroleum exploration and exploitation strategy in Indonesia by considering this information, which will provide benefits for both the government and the contractor.

Oil and Gas Industry in Indonesia

Field Development Plan in Indonesia used to be called Plan of Development (POD). Definition of POD is a plan to develop one or more oil and gas field in an integrated way in order to produce the hydrocarbon reserves optimally by considering the technical, economic and HSE aspects.

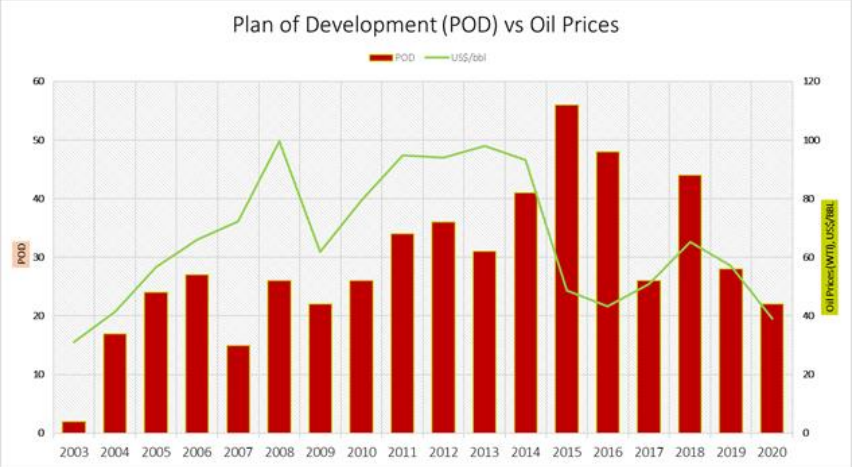

Figure 1 Plan of Development (POD) Approval vs Oil Prices

In 2020, there were 525 PODs approved by SKK Migas (including 165 PODs onshore-gas). Based on fig. 1, the COVID-19 pandemic year 2020 had an effect on the decrease in the number of projects in Indonesia, while the fall in oil prices in 2015 had no significant impact on the number of projects proposed by contractors. As oil prices in 2015 began to decrease, the number of PODs increased and reached the highest number since 2003 (fig. 1), and this might have been caused by the flexibility of the terms and conditions of PSC in Indonesia (fig. 3), which helped the projects become economically acceptable.

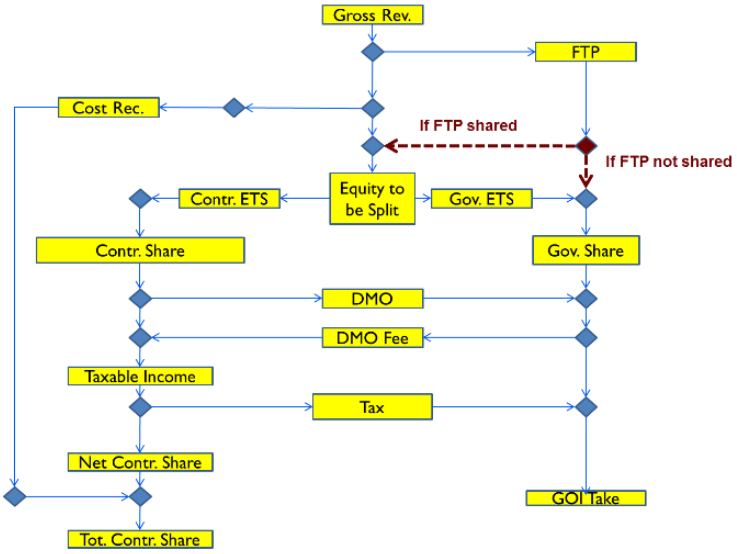

Figure 2 Production Sharing Contract (PSC) Diagram

In a Production Sharing Contract (PSC) fiscal regime like Indonesia's, the contractors can develop the projects economically by proposing some changes in terms and conditions of the production sharing contract, such as depreciation acceleration, incentive (investment credit and interest cost recovery), DMO holiday, and share of percentage of First Tranche Petroleum (FTP) or change of Split Ratio.

METHOD AND RESULTS

A "creaming curve" is a diagram used to present the relationship between aggregated or cumulative resource growth from discoveries and wildcats drilled. In this paper, the creaming curve will be used to identify whether the field (area) is performing (producing gas) better or worse than its peers. While the linear regression is used to produce the equations that will represent the creaming curve of gas reserves.

The 165 onshore - gas projects that were approved by SKK Migas are scattered all over Indonesia. The purpose of this paper is to divide the geographical areas of Indonesia into 5 different areas (Sumatera, Java, Kalimantan, Sulawesi, and Papua). Then, to collect the data related to projects' number and gas reserves, and the trend of gas reserves per project are calculated and analyzed by using the creaming curve method, the result will be distributed to those aforementioned areas.

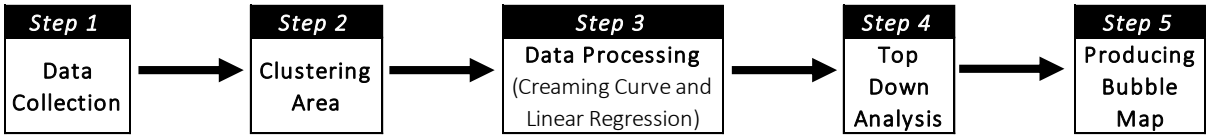

Figure 3 Methodology of Forecasting and Modelling the Gas Reserves in Indonesia

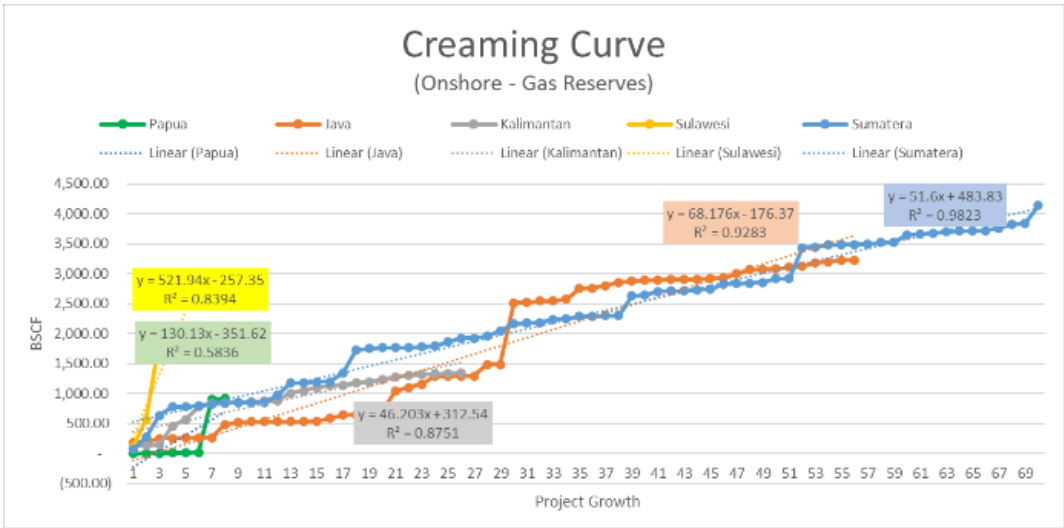

Figure 4 Modelling and Forecasting Gas Reserves in Indonesia (Creaming Curve and Linear Regression).

Based on fig. 4, the following are the equations for oil and gas reserves that are generated from the creaming curve and linear regression analysis.

Table 1 Onshore - Gas Reserves (per Project) using Creaming Curve and Linear Regression Methods

No.	*Area*	*Equation*	x *(Current POD)*	$x+1$ *(Current POD + 1)*	$y\ (x)$ *(MMBOE)*	$y(x+1)$ *(MMBOE))*	*Incremental (MMBOE/POD)*
					a	b	$c = b - a$
1	Sulawesi	$y = 521.9x - 257.3$	5.00	6.00	2352.20	2874.10	521.90
2	Papua	$y = 130.1x - 351.6$	8.00	9.00	689.20	819.30	130.10
3	Kalimantan	$y = 46.2x + 312.5$	26.00	27.00	1513.70	1559.90	46.20
4	Java	$y = 68.1x - 176.3$	56.00	57.00	3637.30	3705.40	68.10
5	Sumatera	$y = 51.6x + 483.8$	70.00	71.00	4095.80	4147.40	51.60

Where:
y = number of Reserves
x = number of Project (POD)

As for the way to read the table above, as in the following example:

"In Sulawesi area, one future project is estimated to produce gas reserves by 521.90 BSCF"

Here is the bubble map of gas reserves in onshore area in Indonesia.

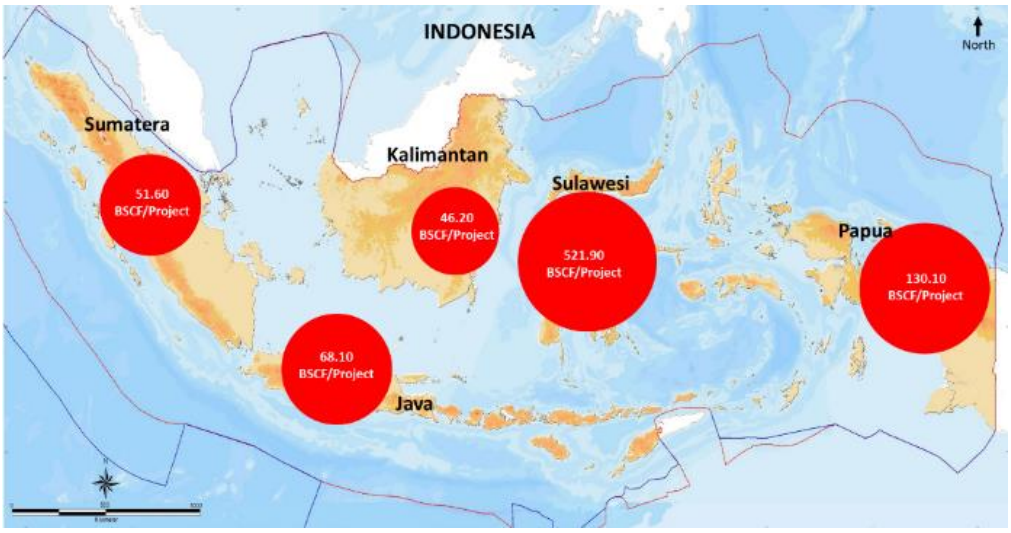

Figure 5 Bubble Map of Estimated Gas Reserves per Projects

Based on fig. 5, it can be concluded that Sulawesi is estimated to have the highest onshore gas reserves (521.90 BSCF per project), whereas Kalimantan had the lowest onshore gas reserves (46.2 BSCF per project) compared with other areas in Indonesia and this is because there are quite a lot of projects that are concentrated in one area (East Kalimantan) which causes the condition of reserves in that area to mature.

CONCLUSIONS

Based on the analysis of 165 onshore - gas reserves in Indonesia, Sulawesi is estimated to have the highest amount of onshore gas reserves by 521.90 BSCF per project, which means that these areas have become the most interesting areas for contractors to produce profitable gas projects. Meanwhile, Kalimantan is estimated to have the lowest amount of onshore gas reserves by 46.20 BSCF per project, which means that these areas are becoming the most mature areas in Indonesia.

These analyses showed that onshore-gas projects in the eastern part of Indonesia had the highest gas reserves, which consequently means that the onshore - gas petroleum exploration activity should be done by contractors in the eastern area of Indonesia.

Finally, this paper is expected to provide contractors with a quick look at the oil and gas industry in Indonesia, especially in onshore areas, and guide them in choosing which onshore area of Indonesia to explore and also help them create their petroleum exploration strategy in Indonesia by considering this information.

REFERENCES

[1] eia.gov [2020] Cushing, OK WTI Spot Price FOB. https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=RWTC&f=A.
[2] Lubiantara, Benny [2012] Ekonomi Migas. PT. Gramedia Widiasarana Indonesia.
[3] prokum.esdm.go.id [2001] Oil and Gas Law number 22 of 2001. http://prokum.esdm.go.id/uu/2001/uu-22-2001.pdf.
[4] prokum.esdm.go.id [2013] Presidential Regulation number 9 of 2013 the Government of the Republic of Indonesia. http://prokum.esdm.go.id/perpres/2013/Perpres%209%202013.pdf
[5] Pudyantoro, Rinto [2013] A to Z Bisnis Hulu Migas. Petromindo.
[6] Puligandla, Murthy [2018], Creaming Curves in Oil and Gas Exploration.
[7] skkmigas.go.id [2020] Profile. http://www.skkmigas.go.id/en/tentang-kami/profil
[8] skkmigas.go.id [2020], Annual Report. https://www.skkmigas.go.id/publikasi/annual-report