

# Predictive Analysis of Major Copper and Gold Mining Projects in Papua New Guinea

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**Abstract:-** The article provides some perspectives on the undeveloped Wafi copper-gold project, the option to re-open the troublesome Porgera gold mine and extension of Ok Tedi copper-gold mine. The existing Ok Tedi and the proposed Wafi have been megaprojects that could make substantial economic impacts on the economy of Papua New Guinea (PNG). The importance of prioritising these projects was that their total net ground values could be about 80 billion US dollars; and generate some 30 billion dollars in taxes, royalty and dividends in the next 20 years. The benefit distributions estimated comprised of direct revenue only and the method used did not capture the indirect benefits (employment and contracts). As such, predicting the value chain distribution could assist the government to timely make informed policy choices based on merits of individual mining projects under consideration as PNG continues to face unprecedented economic and social challenges.

**Keywords:-** Megaprojects, timely, resource revenue, direct and indirect benefits, value chain distribution, economic and social benefits.

## I. INTRODUCTION

PNG has been a mineral producer since 1972 where its production frontier increased significantly ever since copper and gold were first produced from the former Panguna copper mine on the Bougainville Island (Kellow and Simms 2021). Presently, PNG produces copper, gold, silver, nickel and hydrocarbon products (oil and gas) that constitute 80% of total exports, 28% of gross national product (GNP) and 8% of direct revenue, excluding the indirect benefits. The extractive sector has induced multiplier effects and created vertical linkages with the non-mineral sectors that encourage diversify into manufacturing, hospitality and telecommunication sectors. However, the industry has fallen far behind the global scene due to political and social disturbances that disorientated the decision-making processes (Harden and Sugden 2019). The quest for rent-seeking has become a futile ground for political meddling, while the industry productivity has declined and social unrests continue to disrupt smooth operation of resource projects. These issues have led to wasteful extraction and efficiency losses that, in turn diminished the resource revenue.

The situation suggests PNG could miss out on benefiting from the high copper, gold and nickel prices if it fails to timely develop the advanced mining projects and extend the lives of existing mines. Currently, the prices of

major minerals produced in PNG have been consistently at high percentile levels. The future market outlooks were likely to be attractive with demands triggered by post-conflict reconstruction, and the shift to industrial minerals (e.g., lithium and nickel/cobalt) as nations collaborate on mitigating climate change (Edition 2021). It could be a high time for PNG to grasp the opportunity by increasing extraction during the high mineral prices and slow down during low prices. However, it has slowed down at a wrong time with very few grass-roots exploration expenditure and delayed or abandoned some advanced exploration projects. It would be essential for PNG to timely develop these projects to stimulate the economic and social growth. Thus, the purpose of the study was to entice the GoPNG to fast-track the targeted mining projects in the near future.

## II. METHODOLOGY

The economic and financial benefits were estimated using the Marketable Asset Pricing and Input Output (MAPIO) model. The MAPIO model template was collaboratively constructed by a team of World Bank (WB) consultants in 2021 for restructuring the value chain distribution of the extractive sector in PNG. It was constructed in excel with fixed resource inputs, cost and market variables and taxation, including equity interests of the state, Provincial Governments (PG) and landowners. Various MAPIO models were constructed for each of the mining projects assessed in this article. The summaries of the results are given in *Appendices A* and *B*.

### A. Wafi/Golfu copper-gold project

The Wafi project has been an undeveloped copper-gold deposit, which has advanced towards licensing and permitting and social contract stages. The proposed US\$7.4 billion (K25 billion) (capital cost) was tipped to be a megaproject that could change the face of Morobe Province and the economy of PNG. It could produce 4.54 million metric tonnes copper and 7.5 million ounces of gold over the 28-year mine life. The whole of life ground value was estimated to be US\$34.6 billion at prices fixed at US\$6000 per tonne metric copper and US\$1200 per an ounce of gold (Roche, Brueckner et al. 2021). The Harmony-Newcrest Joint Venture having 50% stake would operate the mine with stake ownership structure that may include the state owning 30%, the Morobe Provincial Government (MPG) and landholder entities have 20%. The local entities may realise a net value of US\$19 billion derived from direct and indirect tax revenue. The economic results were derived from the MAPIO model of the Wafi project (Table 1).

Table 1: Cash flow statement of the proposed Wafi copper project

<b>Economic Variables</b>	<b>Capex (US\$M)</b>	<b>NPV (US\$M)</b>	<b>IRR (%)</b>	<b>DPBP (Year)</b>	<b>Capital Efficiency</b>
Wafi Project	7,377**	5,173	18	5+8*	0.72
External partner (50%)	3,582	4,660	20	5+8*	1.3
State (30%)	2,149	1,552	15	5+8*	0.72
MPG & Landowners (20%)	1,433	1,035	13	5+8*	0.72

<b>Benefits (direct &amp; indirect)</b>	<b>Amount (Nominal \$)</b>
<b>Net Project Cash Flow After Financing</b>	<b>25,653</b>
Royalties, Levies & import duty	1,320
Corporate income tax	6,175
Additional profit tax (APT)	1,341
Dividend withholding tax	1,109
Foreign contractor withholding tax	1,141
<b>Total benefits (direct &amp; indirect taxes only)</b>	<b>11,086</b>
<b>KMHL Share of Net Cash Flow</b>	<b>7,462</b>
Carry Interest Paid (8 years)	-843
Principal Paid	-2,149
<b>KMHL Net CF After Carry Debt Service</b>	<b>4,470</b>
<b>MPG &amp; LOs share of Net Cash Flow</b>	<b>5,092</b>
Carry interest paid (8 years debt period)	-562
Principal paid	-1433
<b>MPG &amp; LOs Net CF After Debt Service</b>	<b>3,097</b>
<b>Total Benefits Retained (excl. Payee tax)</b>	<b>18,653</b>

\*Proposed construction period of 5 years plus the computed payback period  
 \*\* Working capital, exploration and inflation added to the initial capital cost

The first part of Table 1 shows the Wafi project was financially viable with an NPV of US\$5.173 billion, 18% IRR, and 8-year payback period with a construction period of 5 years. The capital employed could add 72 cents to every dollar invested. The investor could contribute 50% of the capital cost to realise an NPV of US\$4.7 billion, 20% IRR, and similar payback period with 1.3 dollar being added to the investment. The state, through its nominee, Kumul Minerals Holding Limited (KMHL) may contribute 30% of the capital cost, which was estimated to be US\$2.2 billion. It could realise an NPV of \$1.6 billion, 15% IRR and an 8-year payback period. The MPG and the landowners indicated the

intention to negotiate to own about 20% interest in the project. Within this arrangement, their upfront capital cost contribution could be in excess of US\$1.4 billion. The NPV for the MPG and landowner equity interests was estimated to be \$1 billion, 13% IRR and identical payback period and 70 cents added to the equity capital invested. The significance of these results was that despite the risks involved in securing the equity capital, the benefits could be realised if the present market conditions persist. This could place the state and landowners in strategic positions to benefit from the megaproject as graphically represented in Figure 1.

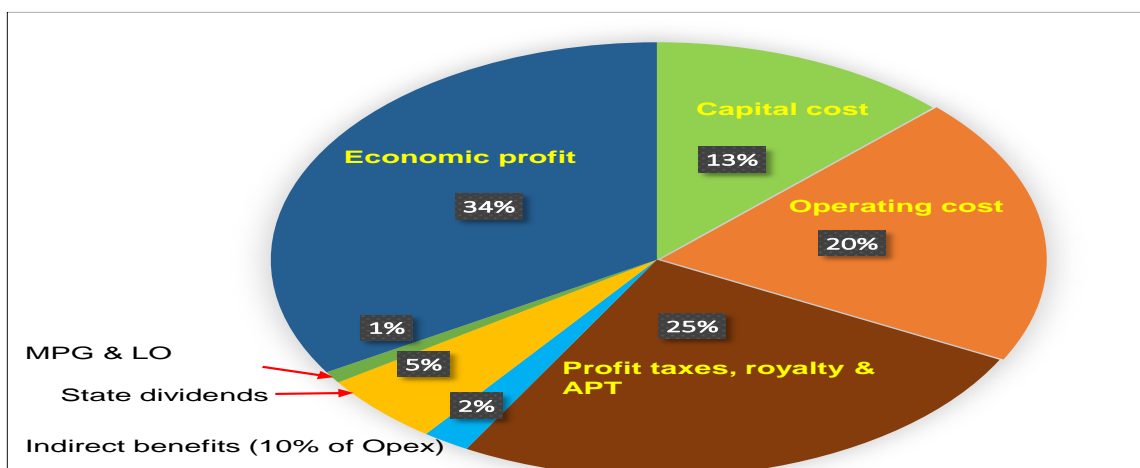


Fig. 1: Value chain distribution from the Wafi-Golfu project

Figure 1 show the value chain distribution where a net value of US\$19 billion (i.e., US\$680 million per year) could flow to PNG over the 28-year mine life. The cash flow configuration comprised of economic profit (34%), which exceeded the capital and the operating costs (33%) and 33% of the net revenue could flow to local stakeholders. These comprised of taxes and royalties and equity dividend turnovers from the KMHL and the MPG and landowner equity interests. The profit taxes, APT and royalty proceeds tend to exceed the dividends from direct equity participation (25% >7%). This reflected that equity ownership could be highly risky compared to raising revenue using taxes and royalties. Besides these, the indirect benefits comprised of inputs to production and fixed costs, including local contracts and employment during the construction stage. Conceptually, the costs, profits and fiscal revenue could be distributed equitably amongst the participating stakeholders. However, this may not be the case since the conceptual analysis omitted the revenue leakages that may arise from unethical behaviour of mine operator and efficiency losses.

The Wafi mining project could be the largest economic activity in the region as it being within PNG's industrial city of Lae, and vast agricultural region of the host Morobe Province. It may support the lagging non - minerals sector that could boost labour productivity in all sectors of the economy. This could occur if all layers of governments diversify the benefits to develop Morobe region's arable land to increase agriculture and livestock production to supply the local market and for export. This would trigger an increase in value added growth of manufacturing and services sectors. Thus, the Wafi copper deposit may transform PNG's economy and increase the productivity of the non-minerals sector.

#### *B. The Old Porgera Gold mine*

The Porgera gold mine was commissioned in 1990. Within three years, the mine attained normal rate of return (ROR) on the initial capital invested. It was developed with a low capital cost of US\$647 million. The low-cost mine had easy access to high-grade deposits in both surface and underground mines at early stages of the mine life. As a result, the mine was one of the richest gold mines outside South Africa (Burton and Banks 2020). The twin operation (surface and underground mines) raised the pre-tax and post-tax IRRs to 28% and 38 % over the 30 years of operation since commissioning in 1990. However, the corporate income tax (CIT) performance was unusually lower than expected despite it had high-quality deposits and a low-cost operation with an average production rate of 500,000 ounces of gold per year (Ail 2018). For instance, the Internal Revenue Commission (IRC) had a tax compliance dispute with the mine operator, Barrick Niugini Limited (BNL). The issue was resolved to make way for fast-tracking the mine re-opening. However, these irregularities could be common in the gold mining sector in PNG (Gillies 2019).

The initial special mining lease (SML) expired in 2018 and the BNL applied to renew the lease. Not surprisingly, it attracted political and social opposition that led to temporary closure where the mine remained under maintenance since

2019 (at the time of writing this article). The Porgera landowners, Enga Provincial Government (EPG) and the society at large staged overwhelming opposition in form of public protests against BNL's application to renew the initial SML. It was blamed for human right abuses, negligence of environmental impacts and inequitable benefit sharing (Connell 2001, Albin-Lackey 2011). Resoundingly, a sympathetic government decided to cancel the initial Porgera SML. This was followed by passing of the Mining Act (Amendment 2020) that was devised to legitimise the legality of State's decision to cancel the SML. The BNL threatened to take the case to an international arbitration. However, it restrained itself from any harsh actions that may expose PNG to sovereign risks. The BNL has been considerate and flexible to negotiate with the GoPNG that resulted in the Porgera Framework Agreement (PFA). The PFA attempted to win-back the social and political loyalty by increasing the local stake ownership to 51% while the BNL (including Zijin Mining Group Co Ltd) retained a balance of 49% interest in the mine.

The former owners deceptively operated the mine under an unincorporated entity, which was formerly the unincorporated Porgera joint venture (PJV). Indeed, there were no legitimate joint venture (JV) partners involved. The former owner Placer Dome and the BNL had 100% ownership with a 5% interest owned by Mineral Resource Enga (MRE) in the first 20 years of the mine life. As a result of this, the Porgera mine did not generate revenue relative to the tax base. The PJV was not transparent in financial disclosure and it secluded into consolidated financial statements. The lessons learnt suggest an incorporated JV could assist in measuring the tax liabilities; disclosure of project-specific financial statements; and share information and managerial obligations. The New Porgera Limited (NPL) was incorporated as a JV entity to manage the defunct mine, which was under preparation for the much-awaited re-opening at the time of writing this article. The NPL being an incorporated entity exists as a genuine JV entity with substantial local stake ownership that could retain some 53% of the value chain of the Porgera gold mine.

#### *C. The New Porgera Gold mine*

The existing mineral resource was about 4.79 million tonnes, which contained about 2 to 4 million ounces of gold (silver inclusive) according to the 2019 Financial Report. This in-situ reserve could lead to a mine life of less than 10 years. This could constitute the project to be a medium scale mine. The maintenance and preparation were expected to take place in 2023 and commence production in 2024 at an operating cost of US\$800/ounce of gold. These data were used to model the remaining resource by incorporating PNG's taxation regime and the 51%/49% share split between the participating stakeholders as shown in Table 2. A 20-year mine life model was constructed using the MAPIO model with an assumption of US\$3 billion capital cost of re-opening the mine. As such, there were many uncertainties associated with the troublesome Porgera gold mine in terms of generating the economic and financial and indirect benefits as estimated in Table 2.

Table 2: Financial cash flows and fiscal revenue of Porgera gold mine (20 years)

<b>ROJECT CASH FLOW</b>	Amount (Nominal US\$)
Total Net Revenue	16,938
Exploration	-
Total Capex	6,050
Total Opex	8,400
Capitalised Net Revenue (Pre-Start)	-
<b>Pre-Tax Cash Flow</b>	<b>2,488</b>
Royalties, Levies & Tax	1,727
Additional Profits Tax (APT)	-
<b>After-Tax Cash Flow</b>	<b>2,162</b>
Project Finance Debt Drawdown	-
Project Finance Debt Principal Repaid	-
<b>Net Project Cash Flow After Financing</b>	<b>2,162</b>
Net present value (NPV)	149
Internal Rate of Return (%)	7
Discounted payback period (DPBP) (years)	17
Kumul Share of Net Cash Flow	1,068
Carry Interest Paid	497
Principal Paid	459
<b>KMHL Net CF After Carry Debt Service</b>	<b>112</b>
<b>Payback period (10 years)</b>	<b>17</b>
<b>EPG &amp; LO Participation - Cost Before Operation</b>	
EPG & LOs Cost of Operations Funding Source	
State Transfer	-
Partner or Other Finance [if applicable]	311
<b>EPG &amp; LOs Share of Net Cash Flow</b>	<b>748</b>
Carry interest paid	348
Principal paid	321
<b>EPG &amp; LO Net CF After Carry Debt Service</b>	<b>78</b>

Table 2 shows the results of the Porgera model using a production rate of 462,672 ounces of gold, which assumed the mine life would be extended to 20 years. The model marginally improved the project economics to an NPV of \$149 million and an IRR of 9%. The Porgera gold mine may generate a net value of \$16.9 billion and a post-tax profit of \$2.2 billion over the 20-year mine life. The total revenue from taxes, royalty and levy could be \$1.7 billion. Additionally, the KMHL may receive \$112 million in dividends. Likewise, some \$78 million (dividend) could flow to the EPG and the Porgera landowners from owning the 5% and 15% interests respectively. Over the past 30 years, the Porgera mine did not consistently generate dividends for the EPG and the landowners having the 5% interest (Ail 2018). Moreover, the results strongly suggest a mine life less than 10 years could be uneconomical. The financial analysts may question the economic viability of the mine since reserve base was unknown at the time of re-opening the mine.

The model results showed that Porgera could be a medium scale mine that may gradually expand production over time with the geological information and data gathered through greenfield exploration. Over the past 30 years of mining, the high-grade epithermal resource has been depleted. The underground resource has declined to a low-grade mesothermal deposit, which overlies the porphyritic intrusion at a considerable depth (current depth was 1.9 km RL). At this depth, the operating cost could be high and the

grade would be predictably low. It may require strategic planning to increase the value-chain distribution from extracting the remaining resource (Ail, Campus et al.). Since the existing production plants and equipment were in serviceable condition, the mine could re-open at a reduced capital cost and start with a medium scale operation and progressively expand by adding reserves and allow the mine itself to raise the capital required for expansion. This could ease the financial burden of raising the equity capital on the part of the State, the EPG and the Porgera landowners' equity participation.

The BNL may take a social approach to resolve the outstanding liabilities (e.g., compensation and resettlement of SML communities) before commencing the mine. These costs should be recognised on carried-on sunk costs accrued from the past operation. Another option could be a contractor operating the mine on behalf of the State and Barrick. It may ease the long-term tensions amongst the local stakeholders and transparently disclose production, revenue, costs, project-based financial statements and tax liability. This may resolve the outstanding issues such as resettlement of communities within the SML, compensation for environment impacts and human right abuses (Albin-Lackey 2011). Further, the troublesome Porgera gold mine may not affect Barrick's net assets since it represented only 2% of its global position as a leading gold producer. While knowing the reserves had depleted, if the main partner illegitimately sells



its interests in the near future, the social cost and closure liabilities could be shifted to another entity. This action could ignite a cycle of social and political unrest if the present arrangements were prematurely disrupted within the 10 years without resolving the outstanding social and environmental issues.

*D. The Existing Ok Tedi Mine (1982–2020)*

The Ok Tedi copper-gold mine was constructed at a real capital cost of US\$878.8 million in 1984. It was timely commissioned to replenish the premature cessation of copper production at the former Panguna copper mine (Armstrong, Baillie et al. 2014). The Ok Tedi mine has been the major driver of PNG’s economy and forward linkages in the host region and the Western Province (WP). However, cost

challenges associated with environmental impacts and high production costs prolonged the payback period for 10 years. In 2001, the World Bank recommended the operator to close the mine due to pollution of the Fly River. Eventually, the former mine operator, Broken Hill Propriety (BHP), now BHP Billiton exited the mine in 2002. However, the GoPNG sought to continue to operate the mine through an alternative arrangement known as Community Mine Continuation Agreement (CMCA). Under the CMCA, the mine was operated by PNG Sustainable Development (PNGSD) on behalf of the affected region and the GoPNG (Carr and Filer 2012). Later, the GoPNG took over the mine in 2014 to have direct control with a 67/33% ownership split between the KMHL (state) and the WP Government and the landowners. The past value chain distributions are given in Figure 2.

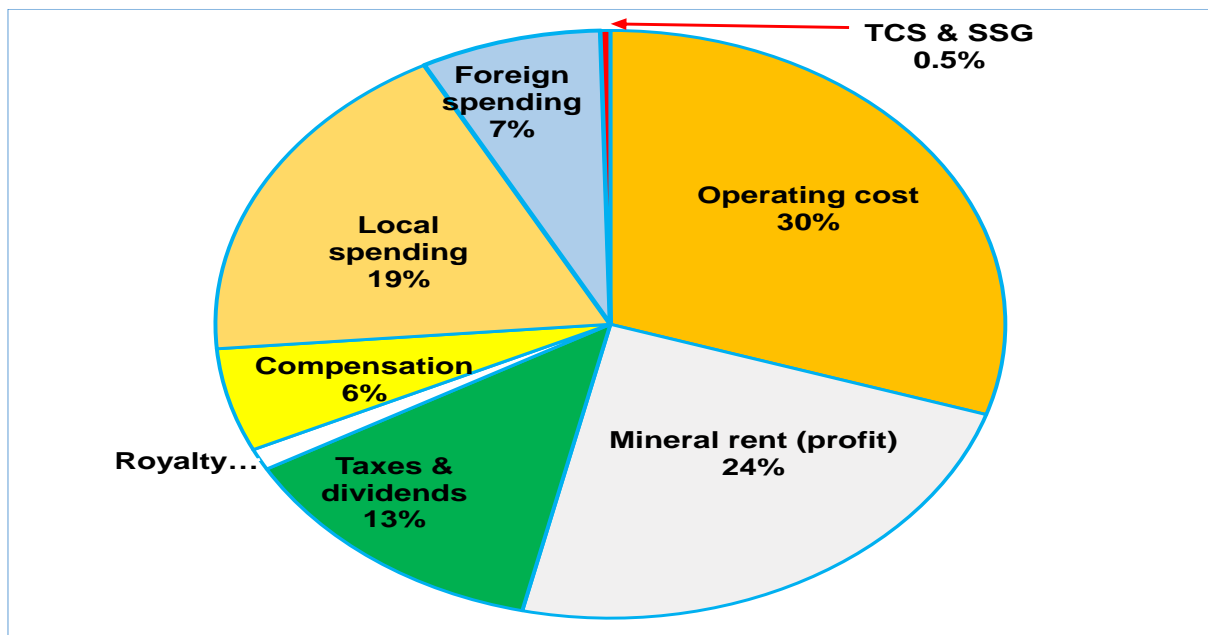


Fig. 2: Historical value chain distribution of the Ok Tedi mine (1984-2022)

Figure 2 shows the Ok Tedi copper mine generated a gross value of K37 billion between 1984 and 2022. The economic profit after tax was about K10 billion (24%) and 20% of the net revenue (K9 billion) flowed to PNG in taxes, royalty, levy, dividends and compensation payments. The Ok Tedi mine’s benefit distributions (including profit or economic rent) between 1982 and 2021 exceeded that of other mines that existed within that period. The direct and indirect taxes captured 86% of the revenue from the Ok Tedi mine. The local spending and contracts exceeded the foreign spending (19%>7%). These results indicate that there were substantial inflows of indirect benefits into the regional and the national economy (Togolo 2021). The Ok Tedi’s outstanding performance showed such results that could be possible if there were high level of transparency at the corporate management level. However, the performance did not reflect the fiscal landscape of PNG’s mining taxation regime, nor the results encourage nationalisation through expropriation of the existing mines (Pumuye, Farrar et al. 2022).

The manufacturing, construction and trade sectors had strong direct links with the Ok Tedi mine compared to the agriculture and service sectors and utilities. The mine created substantial multiplier effects in the region. The 17% local spending consisted of large national contractors. It represented the intensity of direct procurements from region’s agriculture sector and other household productive sectors, including local employment (Bainton and Jackson 2020). The local procurements mostly comprised of small contractors, catering, wholesale, and retail activities within the Tabubil Mining Town (TMT) and other centres, especially Kiunga and Daru. The low productive capacity of the region entices the Ok Tedi Mining Limited (OTML) to import agricultural products from other regions in PNG and abroad. There was high intensity of direct linkages associated with the local economy in the 1982-2020 periods despite there has been mixed blessings from the extractive sector (Analytica 2019).

The Ok Tedi mine represented a major advantage in which a large component of the accessible revenue, including indirect benefits, could be retained within PNG. As often the case, the extension of any operating mine would be financially cheaper and technically efficient than re-opening

a closed mine (e.g., Porgera) and/or developing a new mine (e.g., Wafi copper-gold deposit). The Ok Tedi could be a bonanza mine for PNG in the next 20 to 30 years if the copper and gold prices were sustained at the present levels. Also, the likelihood of increasing the copper reserve in the region would be an advantage for the region and PNG. The historical analysis suggests the GoPNG should endorse the extension of the Ok Tedi mine life.

#### E. The Ok Tedi Mine life extension (2023-2043)

The OTML's 2021 Financial Report showed the deposit resource increased to 489 Mt, whose copper and gold grades

were 0.51% copper and 0.61g/Oz gold and 230% of ounces of silver produced. The remaining resource contains 5.09 million metric tonnes of copper, 15.6 million ounces of gold and 35.8 million ounces of silver. Based on this data, and using Taylor's formula, the remaining mine life was estimated to be 21 years and could produce 23 million tonnes per year till 2043. The metal contents were computed based on 88% and 95% mill and refinery recovery rates respectively. The model applied the basic income tax, withholding, royalty and levy rates, including the 67%/33% interest split amongst the state and the WPG and the landowners (Table 3).

Table 3: Model results of the Ok Tedi mine extension (2023-2043)

<b>PROJECT CASH FLOW</b>	Amount (Nominal US\$)
<b>Total Net Revenue</b>	14,055
Exploration	-
Total Capex	3,285
Total Opex	2,426
Capitalised Net Revenue	(635)
Project Finance interest paid	-
<b>Pre-Tax Cash Flow</b>	<b>8,979</b>
Royalties, Levies & Tax	2,873
Additional Profits Tax (APT)	-
<b>After-Tax Cash Flow</b>	<b>6,106</b>
Project Finance Debt Drawdown	-
Project Finance Debt Principal Repaid	-
<b>Net Project Cash Flow After Financing</b>	<b>6,106</b>
Net Present Value (NPV)	1,876
Internal Rate of Return (IRR)	31
Discounted payback period	5
<b>STATE PARTICIPATION</b>	
<b>KMHL share of Net Cash Flow</b>	<b>3,666</b>
Carry Interest Paid	-
Principal Paid	-
<b>KMHL Net CF After Carry Debt Service</b>	<b>3,666</b>
<b>PROVINCIAL GOVERNMENT &amp; LO PARTICIPATION</b>	
<b>WPG &amp; LOs share of Net Cash Flow</b>	<b>1,806</b>
Carry Interest Paid	-
Principal Paid	-
<b>WPG &amp; LOs Net CF After Debt Service</b>	<b>1,806</b>

Table 3 shows the Ok Tedi mine could generate net revenue of \$14.1 billion over the next 20-year mine life. The free cash flow (post-tax profit) was estimated to be US\$6.1 billion. The revenue collected using taxes, royalty and levy could be \$2.9 billion, while the KMHL may benefit from a dividend of \$3.66 billion. The WPG and Ok Tedi landowners may realise a free carried dividend of \$1.81 billion. Moreover, the NPV and IRR were high and that could suggest the mine life extension seemed a viable option given the present high copper and gold prices. This coincided with a

31% IRR since Ok Tedi was an operating mine whose sustaining capital cost comprised of 30% to 40% of the fixed costs. Because it has been an ageing mine, any increase in price could be offset by cost increases and declining resource grade as expected. This, in, turn could cause the post-tax profits, the tax revenue and dividends to decrease. Further, the value chain distributions were estimated at conservative prices and the resource was assumed to decline starting 2033. The mine was likely to generate substantial direct and indirect benefits (Fig. 3).

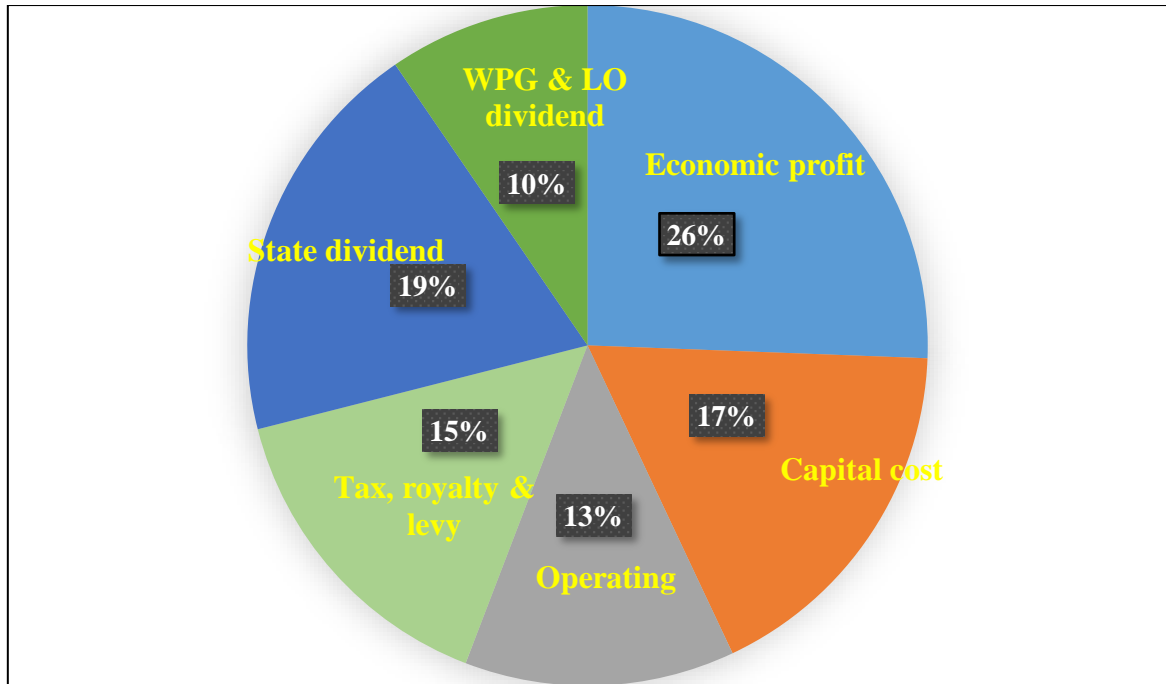


Fig. 3: Value chain distribution of the Ok Tedi mine (2023-2043)

The value chain distribution shown in Figure 3 reflect the capital and production costs take up 30% of the gross value of US\$14 billion over the 20 years of production. Since taxes, royalty and levies were part of the costs, the operating costs could account for 57% of the NSR value, which may narrow the profit margin to 26%. Further, the 15% revenue captured using taxes, royalty and levy could be in excess of \$2.9 billion. The state (KMHL) and the WPG and landowner’s equity dividends could be in excess of \$3.66 billion (19%) and \$1.81 billion (10%) respectively. However, it has been an ageing mine and any increase in price could be offset by cost increases and experience a progressive decline in the resource grade (Pollard 2014). This, in, turn would induce post-tax profits, revenue and dividends to eventually decrease. The importance of the results was the mine life extension tends to reassure that there could be positive economic impacts on the livelihoods of host communities, Western Province and PNG as a whole.

**III. CONCLUSION**

This article has sought to investigate the importance of developing these megaprojects that could rescue PNG from the present economic and the social challenges. The Ok Tedi being an existing mine offers far greater socio-economic benefits than the option to re-open the estranged Porgera gold mine. The Porgera gold mine has been facing a problem of fading loyalty of older generation who signed the initial MoAs. The younger generation intensified a strong challenge against all the odds to balance the socio-economic benefits and address the adverse environment impacts. The lesson learnt suggest that long-life mines need to build the skill capacity of the young generation to sustain them in the long-run, which could be a recipe for establishing sound relationship between the community and the investor. Further, the proposed Wafi copper-gold project would add value to PNG’s economy and increase the multiplier effects of the regional economy. The megaprojects identified in this

article were predicted to generate direct revenue and indirect benefits to support the economy to fulfil the goals of the Strategic Plan 2027. However, some overarching impediments if not addressed could adversely affect these projects. PNG has been very low in industry competitiveness and ranked a high-risk jurisdiction, which could have impeded attracting the capital required to timely develop the Wafi-Golgu project. Finally, the time could be running out for fast-tracking these megaprojects during the high mineral prices. Otherwise, PNG may miss out its luck in benefiting from the opportunities brought about by the mining boom globally.

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## TABLES OF APPENDICES

## APPENDIX A-I: WAFI COPPER-GOLD PROJECT MODEL RESULTS

<b>PROJECT FINANCE</b>		
Project Finance?	TRUE/FALSE	TRUE
CapEx	US\$m	7,085
Debt Share	%	70.00%
Financial Close	year	2023
Debt Share of CapEx	US\$m	2,129
Upfront Fees	%	1.50%
Upfront Fees	US\$m	32
Interest During Construction	%	5.60%
Interest During Construction	US\$m	119
Capitalized Financing Costs	US\$m	151
Debt Drawdown	US\$m	2,280
		71%
Post-Completion Interest	%	6.00%
Post-Completion Interest	%	6.00%
Post-Completion Interest Paid	US\$m	1,241
Project Finance Payback Period	years	15
Opening Balance	US\$m	26,242
Debt Drawdown	US\$m	2,280
Debt Repayment on Principal	US\$m	2,280
Closing Balance	US\$m	26,242
<b>PROJECT CASH FLOW</b>		
	nom	
Total Net Revenue	US\$m	55,200
Exploration	US\$m	770
Total CapEx	US\$m	7,377
Total OpEx	US\$m	11,606
Capitalised Net Revenue (Pre Commercial Start)	US\$m	(292)
Project Finance Post- Completion Interest Paid	US\$m	1,241
<b>Pre-Tax Cash Flow</b>	<b>US\$m</b>	<b>34,497</b>
Royalties, Levies & Tax	US\$m	11,581
Additional Profits Tax (APT)	US\$m	3,321
<b>After-Tax Cash Flow</b>	<b>US\$m</b>	<b>19,595</b>
Project Finance Debt Drawdown	US\$m	2,280
Project Finance Debt Principal Repaid	US\$m	2,280
<b>Net Project Cash Flow After Financing</b>	<b>US\$m</b>	<b>19,595</b>
<b>Present Value</b>		
<b>Cummulative Present Value</b>		<b>(6,906)</b>
<b>Net Present Value (NPV)</b>		<b>1,959</b>
<b>Internal Rate of Return (IRR)</b>		<b>18%</b>
<b>Undiscounted Payback Period (DPBP) (years)</b>		<b>7</b>

APPENDIX A-II: WAFI COPPER-GOLD PROJECT MODEL RESULTS  
STATE EQUITY PARTICIPATION

A. STATE PARTICIPATION		nom
Project Past Cost	US\$m	770
Project Cost Before Operations	US\$m	754
State Back-in Year (=Project Financial Close)	year	2023
Total State Participation	%	19.28%
Kumul Participation	%	16.50%
PG & MRDC Participation	%	2.78%
<b>Finance Terms [Must input in "Mining_ScenarioManager" tab if PartnerFinance or OtherFinance]</b>		
<b><u>Past Cost Finance Terms</u></b>		
Past Cost Interest Rate	%	7.00%
Past Cost Maturity	years	4
<b><u>Costs Before Operation Finance Terms</u></b>		
Costs Before Operation Interest Rate	%	7.00%
Costs Before Operation Maturity	years	16
B. KUMUL PARTICIPATION		
<b>A-I. Kumul Participation - Past Cost Funding</b>		
Kumul Past Cost Funding Source	<b>PartnerFinance</b>	
State Transfer [if applicable]	US\$m	-
Partner or Other Finance [if applicable]	US\$m	127
<b><u>PartnerFinance and OtherFinance only:</u></b>		
<b><u>Past Cost Principal</u> [Priority 4 for repayment]</b>		
Maturity	years	4
Opening Balance	US\$m	995
Carry Borrowing	US\$m	167
Principal Due	US\$m	167
Principal Paid	US\$m	167
Unpaid Principal	US\$m	-
Closing Balance	US\$m	
<b><u>Past Cost Interest</u> [Priority 2]</b>		
Interest	%	7.00%
Interest Due	US\$m	70
Interest Paid	US\$m	30
Unpaid Interest	US\$m	-
<i>*Interest accrued before project start is capitalized</i>		
<b>A-I. KMHL Participation - Cost Before Operations Funding</b>		
KMHL Cash Calls Funding Source	<b>PartnerFinance</b>	
State Transfer [if applicable]	US\$m	-
Partner or Other Finance [if applicable]	US\$m	124
<b><u>PartnerFinance and OtherFinance only:</u></b>		
<b><u>Costs Before Operations Principal</u> [Priority 3]</b>		
Maturity	years	16
Opening Balance	US\$m	1,520
Carry Borrowing	US\$m	136
Principal Due	US\$m	136
Principal Paid	US\$m	136
Unpaid Principal	US\$m	-
Closing Balance	US\$m	
<b><u>Costs Before Operations Interest</u> [Priority 1]</b>		
Interest	%	7.00%
Interest Due	US\$m	106
Interest Paid	US\$m	95
Unpaid Interest	US\$m	-
<i>*Interest accrued before project start is capitalized</i>		
		(1,380.00)
KMHL Share of Net Cash Flow		3,485
Carry Interest Paid		125
Principal Paid		303
<b>KMHL Net Cash Flow After Carry Debt Service</b>		<b>3,057</b>

APPENDIX A-III: WAFI COPPER-GOLD PROJECT MODEL RESULTS  
MOROBE PROVINCIAL GOVERNMENT AND LANDOWNERS

<b>A-II MOROBE PROVINCIAL GOVERNMENT &amp; LANDOWNER PARTICIPATION</b>		
<b>A-II. MPG &amp; LO Participation - Past Cost Funding</b>		
MPG & LO Past Cost Funding Source	<b>PartnerFinance</b>	
State Transfer [if applicable]	US\$m	-
Partner or Other Finance [if applicable]	US\$m	21
<b><u>PartnerFinance and OtherFinance only:</u></b>		
<b><u>Past Cost Principal</u> [Priority 4 for repayment]</b>		
Maturity	years	<b>4</b>
Opening Balance	US\$m	168
Carry Borrowing	US\$m	28
Principal Due	US\$m	28
Principal Paid	US\$m	28
Unpaid Principal	US\$m	-
Closing Balance	US\$m	
<b><u>Past Cost Interest</u> [Priority 2]</b>		
Interest	%	<b>7.00%</b>
Interest Due	US\$m	12
Interest Paid	US\$m	5
Unpaid Interest	US\$m	-
<i>*Interest accrued before project start is capitalized</i>		
<b>A-III. MPG &amp; LO Participation - Cost Before Operations Funding</b>		
MPG & LO Cost bf Operations Funding Source	<b>PartnerFinance</b>	
State Transfer [if applicable]	US\$m	-
Partner or Other Finance [if applicable]	US\$m	21
<b><u>PartnerFinance and OtherFinance only:</u></b>		
<b><u>Costs Before Operations Principal</u> [Priority 3]</b>		
Maturity	years	<b>16</b>
Opening Balance	US\$m	256
Carry Borrowing	US\$m	23
Principal Due	US\$m	23
Principal Paid	US\$m	23
Unpaid Principal	US\$m	-
Closing Balance	US\$m	
<b><u>Costs Before Operations Interest</u> [Priority 1]</b>		
Interest	%	<b>7.00%</b>
Interest Due	US\$m	18
Interest Paid	US\$m	16
Unpaid Interest	US\$m	-
<i>*Interest accrued before project start is capitalized</i>		
MPG & LO Share of Net Cash Flow		587
Carry Interest Paid		21
Principal Paid		51
<b>Kumul Net Cash Flow After Carry Debt Service</b>		<b>515</b>

APPENDIX B-I: PORGERA GOLD MINE RE-OPENING MODEL RESULTS  
PROJECT MODEL – 20-YEAR MINE LIFE

<b>PROJECT CASH FLOW</b>		nom
Total Net Revenue	US\$m	16,938
Exploration	US\$m	-
Total CapEx	US\$m	6,050
Total OpEx	US\$m	8,400
Capitalised Net Revenue (Pre Commercial Start)	US\$m	-
Project Finance Post- Completion Interest Paid	US\$m	-
<b>Pre-Tax Cash Flow</b>	<b>US\$m</b>	<b>2,488</b>
Royalties, Levies & Tax	US\$m	1,727
Additional Profits Tax (APT)	US\$m	-
<b>After-Tax Cash Flow</b>	<b>US\$m</b>	<b>2,162</b>
Project Finance Debt Drawdown	US\$m	-
Project Finance Debt Principal Repaid	US\$m	-
<b>Net Project Cash Flow After Financing</b>	<b>US\$m</b>	<b>2,162</b>
<b>A. STATE PARTICIPATION</b>		nom
Project Past Cost	US\$m	-
Project Cost Before Operations	US\$m	1,481
State Back-in Year (=Project Financial Close)	year	0
Total State Participation	%	51.00%
KMHL Participation	%	30.00%
PG & MRDC Participation	%	21.00%
Finance Terms [Must input in "Mining_ScenarioManager" tab if Partner Finance or Other		
<u>Past Cost Finance Terms</u>		
Past Cost Interest Rate	%	7.00%
Past Cost Maturity	years	4
<u>Costs Before Operation Finance Terms</u>		
Costs Before Operation Interest Rate	%	7.00%
Costs Before Operation Maturity	years	1

APPENDIX B-II: PORGERA GOLD MINE RE-OPENING MODEL RESULTS  
KMHL PARTICIPATION

A-I. KMHL PARTICIPATION		
<b>A-I. KMHL Participation - Past Cost Funding</b>		
KMHL Past Cost Funding Source	PartnerFinance	
State Transfer [if applicable]	US\$m	-
Partner or Other Finance [if applicable]	US\$m	-
<b><u>PartnerFinance and OtherFinance only:</u></b>		
<b><u>Past Cost Principal</u> [Priority 4 for repayment]</b>		
Maturity	years	4
Opening Balance	US\$m	-
Carry Borrowing	US\$m	-
Principal Due	US\$m	-
Principal Paid	US\$m	-
Unpaid Principal	US\$m	-
Closing Balance	US\$m	
<b><u>Past Cost Interest</u> [Priority 2]</b>		
Interest	%	7.00%
Interest Due	US\$m	-
Interest Paid	US\$m	-
Unpaid Interest	US\$m	-
<i>*Interest accrued before project start is capitalized</i>		
<b>A-II. KMHL Participation - Cost Before Operations Funding</b>		
KMHL Cash Calls Funding Source	PartnerFinance	
State Transfer [if applicable]	US\$m	-
Partner or Other Finance [if applicable]	US\$m	444
<b><u>PartnerFinance and OtherFinance only:</u></b>		
<b><u>Costs Before Operations Principal</u> [Priority 3]</b>		
Maturity	years	1
Opening Balance	US\$m	7,509
Carry Borrowing	US\$m	459
Principal Due	US\$m	7,324
Principal Paid	US\$m	459
Unpaid Principal	US\$m	6,865
Closing Balance	US\$m	
<b><u>Costs Before Operations Interest</u> [Priority 1]</b>		
Interest	%	7.00%
Interest Due	US\$m	782
Interest Paid	US\$m	497
Unpaid Interest	US\$m	239
<i>*Interest accrued before project start is capitalized</i>		
KMHL Share of Net Cash Flow		1,068
Carry Interest Paid		497
Principal Paid		459
<b>Kumul Net Cash Flow After Carry Debt Service</b>		<b>112</b>



APPENDIX B-III: PORGERA GOLD MINE RE-OPENING MODEL RESULTS  
EPG AND PORGERA LANDOWNER EQUITY PARTICIPATION

<b>B. EPG &amp; PORGERA LO PARTICIPATION</b>		
<b>B-I. PG &amp; MRDC Participation - <u>Past Cost Funding</u></b>		
EPG & LO Past Cost Funding Source	<b>PartnerFinance</b>	
State Transfer [if applicable]	US\$m	-
Partner or Other Finance [if applicable]	US\$m	-
<b><u>PartnerFinance and OtherFinance only:</u></b>		
<b><u>Past Cost Principal</u> [Priority 4 for repayment]</b>		
Maturity	years	<b>4</b>
Opening Balance	US\$m	-
Carry Borrowing	US\$m	-
Principal Due	US\$m	-
Principal Paid	US\$m	-
Unpaid Principal	US\$m	-
Closing Balance	US\$m	-
<b><u>Past Cost Interest</u> [Priority 2]</b>		
Interest	%	<b>7.00%</b>
Interest Due	US\$m	-
Interest Paid	US\$m	-
Unpaid Interest	US\$m	-
<i>*Interest accrued before project start is capitalized</i>		
<b>B-II. EPG &amp; LO Participation - <u>Cost Before Operations Funding</u></b>		
PG & MRDC Cost of Operations Funding Source	<b>PartnerFinance</b>	
State Transfer [if applicable]	US\$m	-
Partner or Other Finance [if applicable]	US\$m	311
<b><u>PartnerFinance and OtherFinance only:</u></b>		
<b><u>Costs Before Operations Principal</u> [Priority 3]</b>		
Maturity	years	<b>1</b>
Opening Balance	US\$m	5,257
Carry Borrowing	US\$m	321
Principal Due	US\$m	5,127
Principal Paid	US\$m	321
Unpaid Principal	US\$m	4,805
Closing Balance	US\$m	
<b><u>Costs Before Operations Interest</u> [Priority 1]</b>		
Interest	%	<b>7.00%</b>
Interest Due	US\$m	547
Interest Paid	US\$m	348
Unpaid Interest	US\$m	168
<i>*Interest accrued before project start is capitalized</i>		
EPG & LO Share of Net Cash Flow		748
Carry Interest Paid		348
Principal Paid		321
<b>EPG &amp; LO Net Cash Flow After Carry Debt Service</b>		<b>78</b>

## APPENDIX C-I: OK TEDI COPPER-GOLD MINE EXTENSION MODEL RESULTS

<b>PROJECT CASH FLOW</b>		nom
Total Net Revenue	US\$m	14,055
Exploration	US\$m	-
Total CapEx	US\$m	3,285
Total OpEx	US\$m	2,426
Capitalised Net Revenue (Pre Commercial Start)	US\$m	(635)
Project Finance Post- Completion Interest Paid	US\$m	-
<b>Pre-Tax Cash Flow</b>	<b>US\$m</b>	<b>8,979</b>
Royalties, Levies & Tax	US\$m	2,873
Additional Profits Tax (APT)	US\$m	-
<b>After-Tax Cash Flow</b>	<b>US\$m</b>	<b>6,106</b>
Project Finance Debt Drawdown	US\$m	-
Project Finance Debt Principal Repaid	US\$m	-
<b>Net Project Cash Flow After Financing</b>	<b>US\$m</b>	<b>6,106</b>
<b>A STATE PARTICIPATION</b>		nom
Project Past Cost	US\$m	-
Project Cost Before Operations	US\$m	-
State Back-in Year (=Project Financial Close)	year	0
Total State Participation	%	100.00%
KMHL Participation	%	67.00%
PG & MRDC Participation	%	33.00%
Finance Terms [Must input in "Mining_ScenarioManager" tab if PartnerFinance or Other		
<u>Past Cost Finance Terms</u>		
Past Cost Interest Rate	%	0.00%
Past Cost Maturity	years	0
<u>Costs Before Operation Finance Terms</u>		
Costs Before Operation Interest Rate	%	0.00%
Costs Before Operation Maturity	years	0

APPENDIX C-II: OK TEDI COPPER-GOLD MINE EXTENSION MODEL RESULTS  
KMHL PARTICIPATION

A-I: KUMUL PARTICIPATION		
<b>A-I. KMHL Participation - Past Cost Funding</b>		
KMHL Past Cost Funding Source	FALSE	
State Transfer [if applicable]	US\$m	-
Partner or Other Finance [if applicable]	US\$m	-
<b><u>Partner Finance and Other Finance only:</u></b>		
<b><u>Past Cost Principal</u> [Priority 4 for repayment]</b>		
Maturity	years	0
Opening Balance	US\$m	-
Carry Borrowing	US\$m	-
Principal Due	US\$m	-
Principal Paid	US\$m	-
Unpaid Principal	US\$m	-
Closing Balance	US\$m	
<b><u>Past Cost Interest</u> [Priority 2]</b>		
Interest	%	0.00%
Interest Due	US\$m	-
Interest Paid	US\$m	-
Unpaid Interest	US\$m	-
<i>*Interest accrued before project start is capitalized</i>		
<b>A-II. KMHL Participation - Cost Before Operations Funding</b>		
KMHL Cash Calls Funding Source	FALSE	
State Transfer [if applicable]	US\$m	-
Partner or Other Finance [if applicable]	US\$m	-
<b><u>Partner Finance and Other Finance only:</u></b>		
<b><u>Costs Before Operations Principal</u> [Priority 3]</b>		
Maturity	years	0
Opening Balance	US\$m	-
Carry Borrowing	US\$m	-
Principal Due	US\$m	-
Principal Paid	US\$m	-
Unpaid Principal	US\$m	-
Closing Balance	US\$m	
<b><u>Costs Before Operations Interest</u> [Priority 1]</b>		
Interest	%	0.00%
Interest Due	US\$m	-
Interest Paid	US\$m	-
Unpaid Interest	US\$m	-
<i>*Interest accrued before project start is capitalized</i>		
KMHL Share of Net Cash Flow		3,666
Carry Interest Paid		-
Principal Paid		-
<b>KMHL Net Cash Flow After Carry Debt Service</b>		<b>3,666</b>

APPENDIX C-III: OK TEDI COPPER-GOLD MINE EXTENSION MODEL RESULTS  
WESTERN PROVINCIAL GOVERNMENT AND LANDOWNER PARTICIPATION

<b>B. WESTERN PROVINCIAL GOVERNMENT &amp; LO PARTICIPATION</b>		
<b>B-I. WPG &amp; LO Participation - Past Cost Funding</b>		
WPG & LOs Past Cost Funding Source	<input type="text" value="FALSE"/>	
State Transfer [if applicable]	US\$m	-
Partner or Other Finance [if applicable]	US\$m	-
<u>Partner Finance and Other Finance only:</u>		
<u>Past Cost Principal</u> [Priority 4 for repayment]		
Maturity	years	<input type="text" value="0"/>
Opening Balance	US\$m	-
Carry Borrowing	US\$m	-
Principal Due	US\$m	-
Principal Paid	US\$m	-
Unpaid Principal	US\$m	-
Closing Balance	US\$m	
<u>Past Cost Interest</u> [Priority 2]		
Interest	%	<input type="text" value="0.00%"/>
Interest Due	US\$m	-
Interest Paid	US\$m	-
Unpaid Interest	US\$m	-
<i>*Interest accrued before project start is capitalized</i>		
<b>B-II. WPG &amp; LO Participation - Cost Before Operations Funding</b>		
WPG & LO Cost bf Operations Funding Source	<input type="text" value="FALSE"/>	
State Transfer [if applicable]	US\$m	-
Partner or Other Finance [if applicable]	US\$m	-
<u>Partner Finance and Other Finance only:</u>		
<u>Costs Before Operations Principal</u> [Priority 3]		
Maturity	years	<input type="text" value="0"/>
Opening Balance	US\$m	-
Carry Borrowing	US\$m	-
Principal Due	US\$m	-
Principal Paid	US\$m	-
Unpaid Principal	US\$m	-
Closing Balance	US\$m	
<u>Costs Before Operations Interest</u> [Priority 1]		
Interest	%	<input type="text" value="0.00%"/>
Interest Due	US\$m	-
Interest Paid	US\$m	-
Unpaid Interest	US\$m	-
<i>*Interest accrued before project start is capitalized</i>		
WPG & LO Share of Net Cash Flow		1,806
Carry Interest Paid		-
Principal Paid		-
<b>WPG &amp; LO Net Cash Flow After Carry Debt Service</b>		<b>1,806</b>