



Beneficiation in the Mining Industry

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Proudly associated with



*Integrated Services and Consulting to
the Zimbabwean Mining Industry*

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- Overview of Manhize Projects
- Minerals Beneficiation – Introduction and Perspectives
- Four Stage Beneficiation Process
- Beneficiation Challenges
- Beneficiation Pipeline Value Accretion – Diamond and PGMs
- PGM Beneficiation Value Drivers
- PGM Beneficiation Capex and Opex
- Conclusion-Beneficiation Agenda for Zimbabwe



About Manhize Projects



- **Emergent resource consulting, services and investment company**
 - Zimbabwean owned and run company
 - Founded in 2007 by multi-disciplinary Zimbabwean mining professionals with 15 to 25 years experience in the industry
- **Capabilities**
 - Investment consultancy, advisory and facilitation in mining
 - Geological reconnaissance and pre-liminary project evaluation studies
 - Metallurgical process engineering and development of beneficiation projects
 - Optimisation of business processes and management of contract operations
- **Strategy**
 - Mutually re-inforcing partnerships to provide differentiated services and consultancy





Our Value Offering



Provide options for a differentiated fully integrated services to prospectors, developers, operators and investors in the areas of;

- Exploration
- Consulting
- Environmental
- Mining
- Project Management
- Investment Services

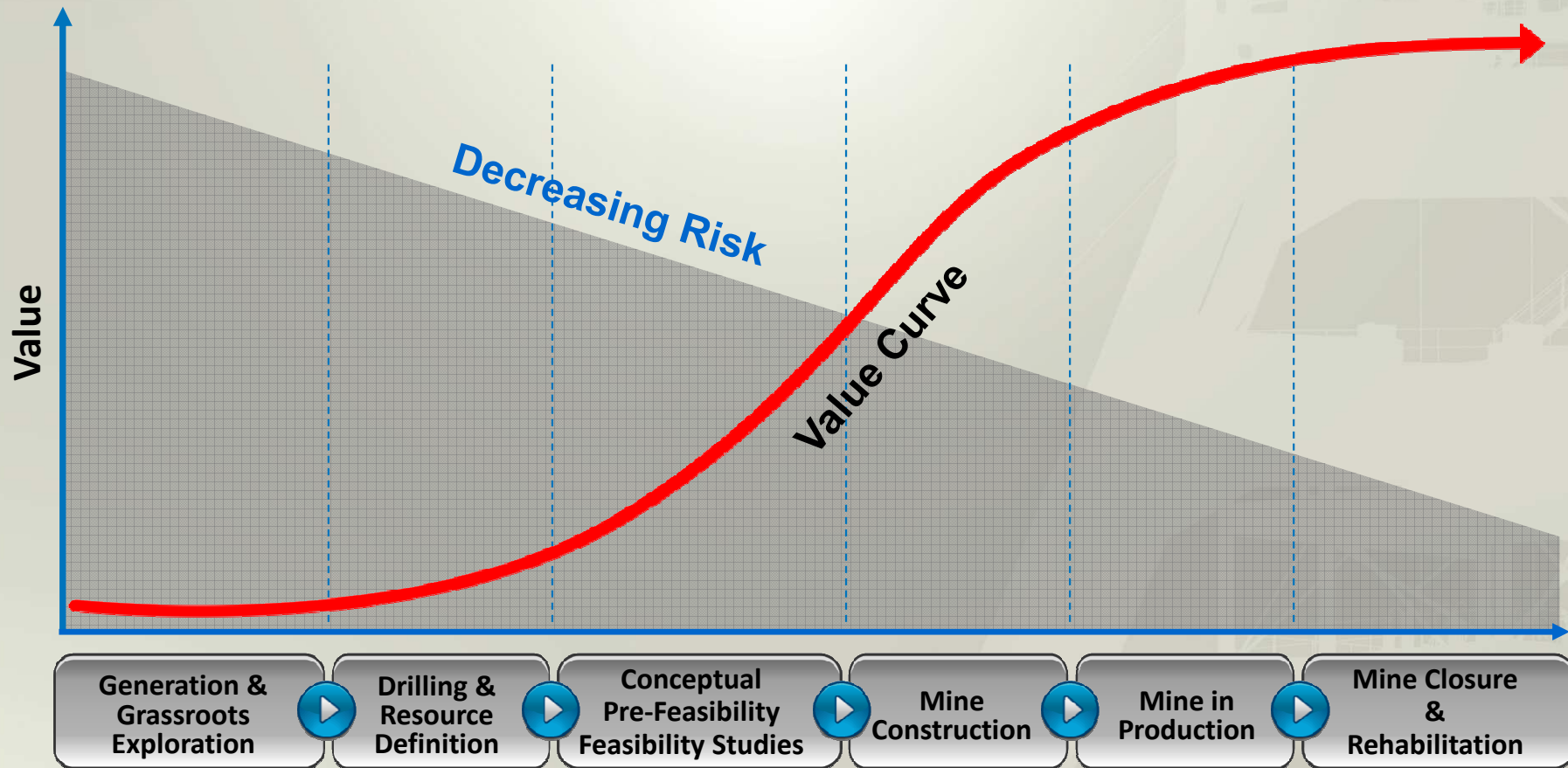


We are impressively differentiated with a corresponding “value add” to clients and developers.

We have an enviable track record of successfully managed projects throughout Africa with a focus on Southern Africa across a broad range of mineral commodities and clientele.

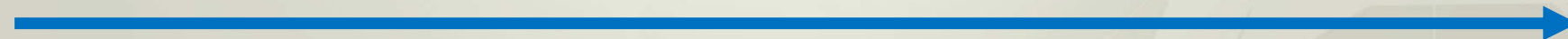


Our Value Offering





Our Value Offering



MANHIZE - Project Management & Process



The MSA Group - Exploration & Geology



PPM - Project Management & Engineering



SMS - Geology & Mining



RBS - Ops Readiness & HR Optimisation





Introduction to Beneficiation



■ Definition of Beneficiation

“Transformation of a mineral (or a combination of minerals) to a higher value product which can either be consumed locally or exported”

■ Two aspects of Beneficiation:

■ Down-stream

“Downstream value addition involves a range of activities including large-scale capital-intensive activities such as smelting and refining as well as labour-intensive activities such as craft jewellery and metal fabrication”

■ Side-stream

“Side-stream value addition refers to inputs, namely capital goods, consumable and services, into the value chain”

■ Total net beneficiation of minerals is maximised by a combination of down-stream and side-stream linkages





Beneficiation Perspectives



■ Political Perspective

“Trading structure of mineral commodities in Africa has essentially been premised on a model that sought to sustain a colonialist political configuration and serve its agenda”

■ Socio-Economic Perspective

➤ Realisation of downstream intrinsic value through:

- ✓ *Import substitution with local products*
- ✓ *Export of higher value added products*

➤ Realisation of Multi-tier value through:

- ✓ *New jobs creation*
- ✓ *Development of requisite skills*
- ✓ *Investment in R & D*
- ✓ *Sustainable development – communities and life after mine projects*

■ Inter-generational Equity and Moral Perspective

Need to transform under-developed mineral rich countries from being a resource based to a knowledge based economy, creating sustainability beyond the mining phase for future generations





Four Stage Beneficiation Process

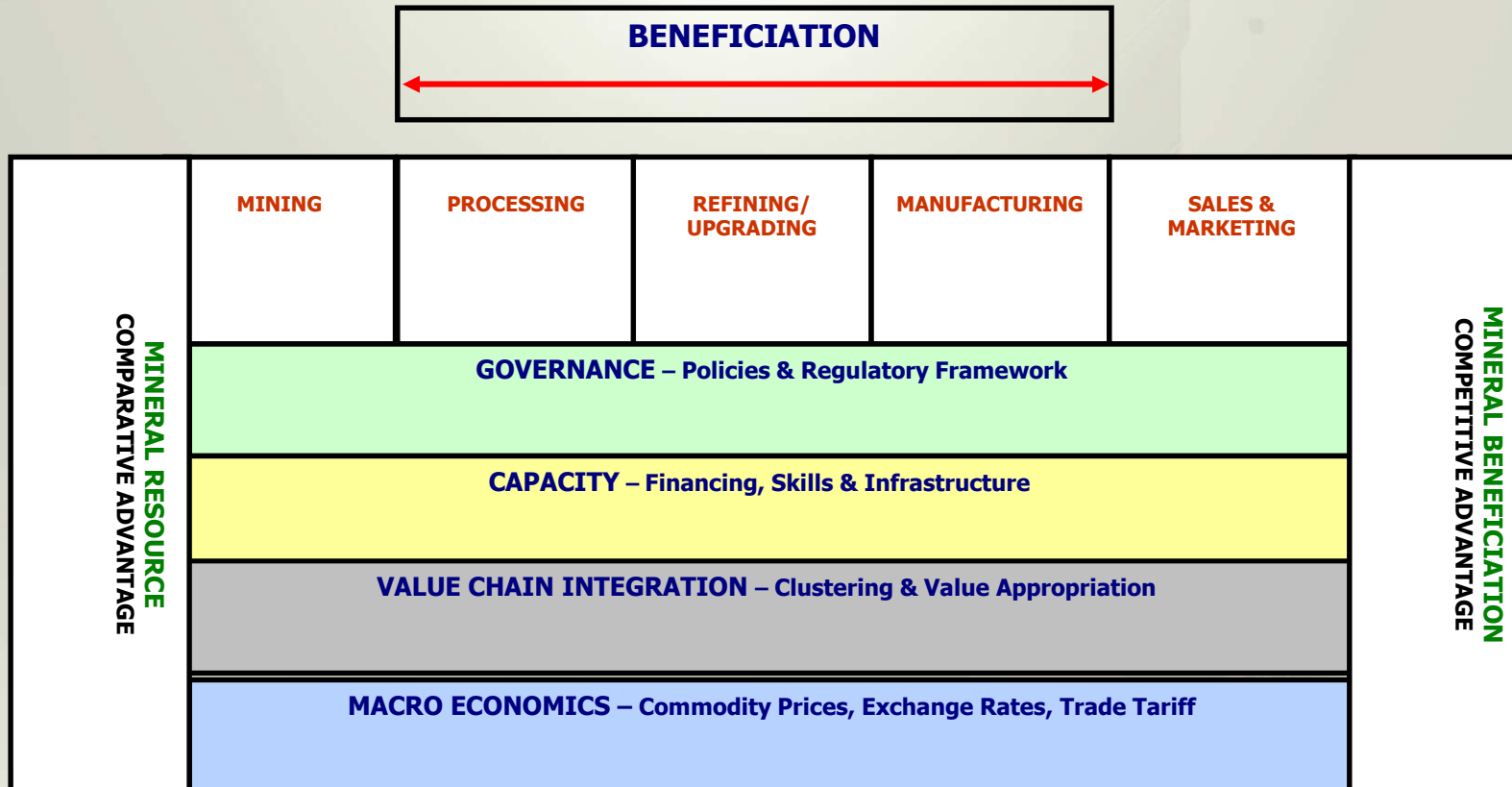


Stage	Mineral Beneficiation Process Category	Process Flow Chart	Capital Intensity	Labour Intensity	Skills Intensity
1	The action of mining to produce an ore or mineral concentrate	<pre> graph LR A[Run of Mine Ore] --> B[Mineral Concentrate] </pre>	High	High	Low
2	The action of converting concentrate into an upgraded bulk tonnage intermediate product	<pre> graph LR A[Matte/Slag Bulk Products] --> B[Refined Metals/Alloys] </pre>	High	Med	Med
3	The action of converting intermediate products into refined product suitable for purchase by small and sophisticated industries	<pre> graph LR A[High Purity Metals/Alloys] --> B[Final Products-Worked Shapes & Forms] </pre>	High	Low	High
4	The action of manufacturing final products for sale	<pre> graph LR A[Final Products-Worked Shapes & Forms] --> B[Final Products-Worked Shapes & Forms] </pre>	Med to High	Med to High	High





Beneficiation Challenges in Developing Countries

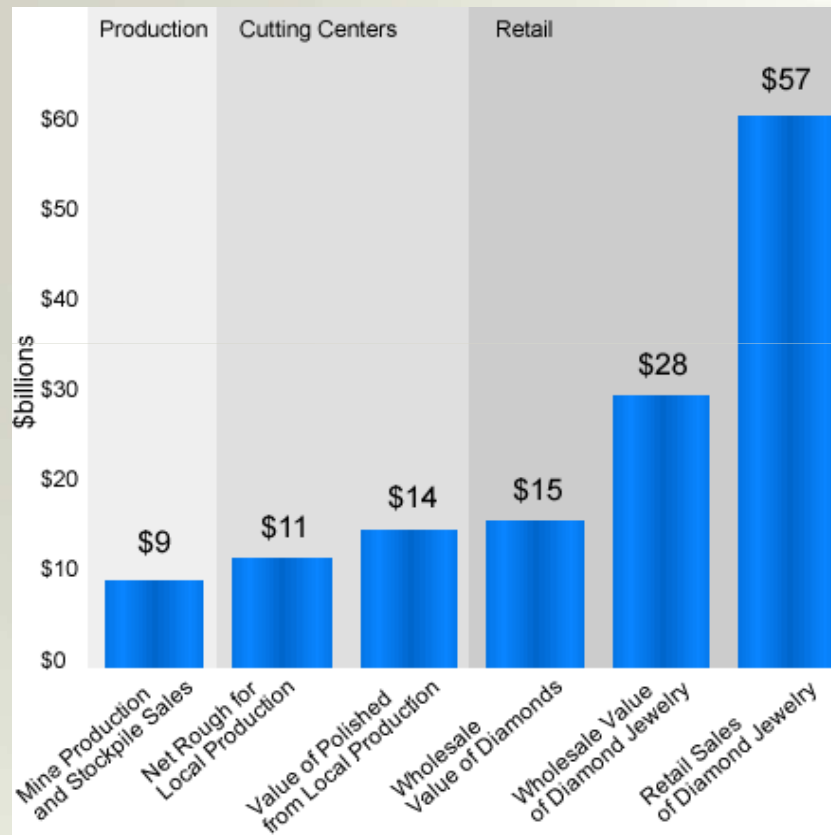




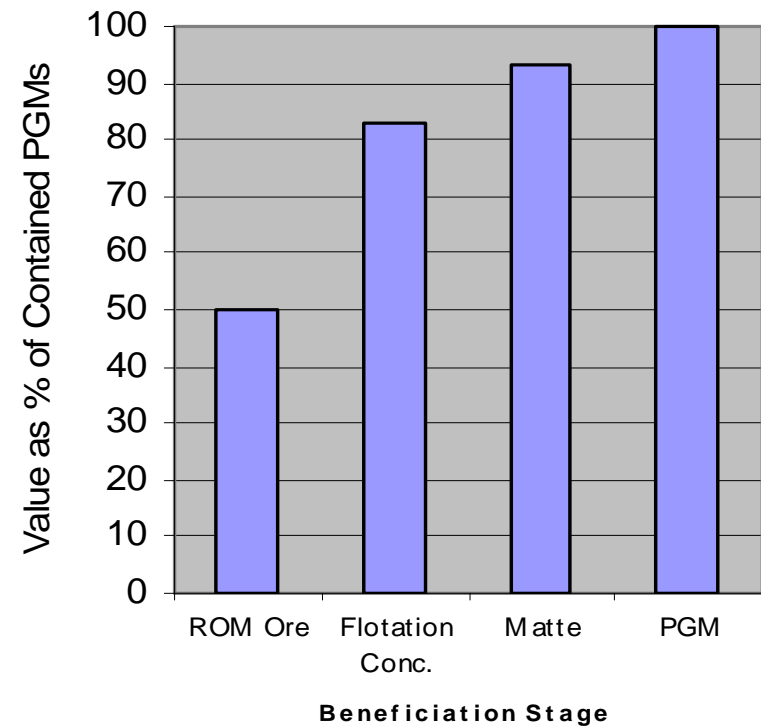
Beneficiation Pipeline Value Accretion

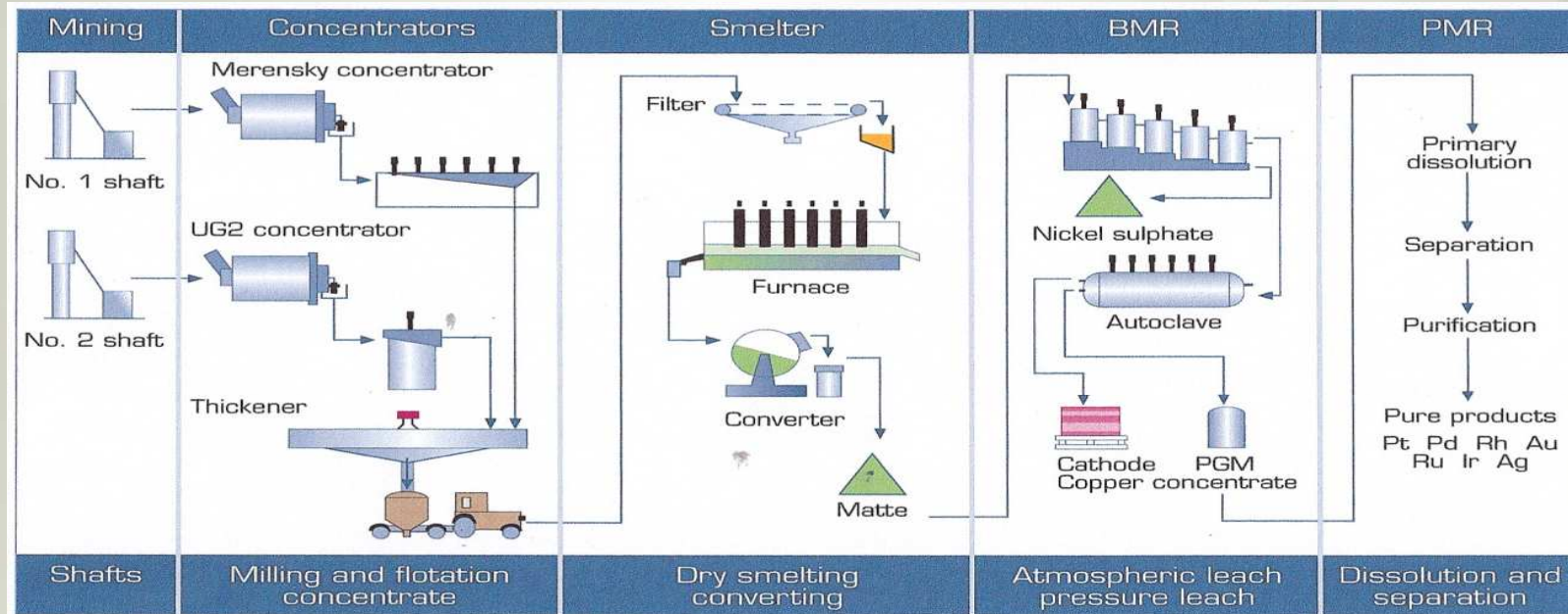


The Diamond Pipeline (in \$ billions)



Typical PGM Pipeline





<ul style="list-style-type: none"> ➤ Reserve tons ➤ Geology ➤ PGM Grade 	<ul style="list-style-type: none"> ➤ Milled Ore tons ➤ Mineralogy ➤ Base Metal Content ➤ PGM Grade 	<ul style="list-style-type: none"> ➤ Float Concentrate tons ➤ Base Metal Content Cu/Ni/Fe ➤ Mineralogy ➤ PGM Grade 	<ul style="list-style-type: none"> ➤ Matte tons ➤ Base Metal Content Cu+Ni ➤ PGM Grade ➤ Impurities 	<ul style="list-style-type: none"> ➤ PGM Conc. tons ➤ PGM Grade ➤ Impurities
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■ Throughput

■ Throughput & Efficiency

■ Efficiency





PGM Beneficiation - Capex and Opex (2009)

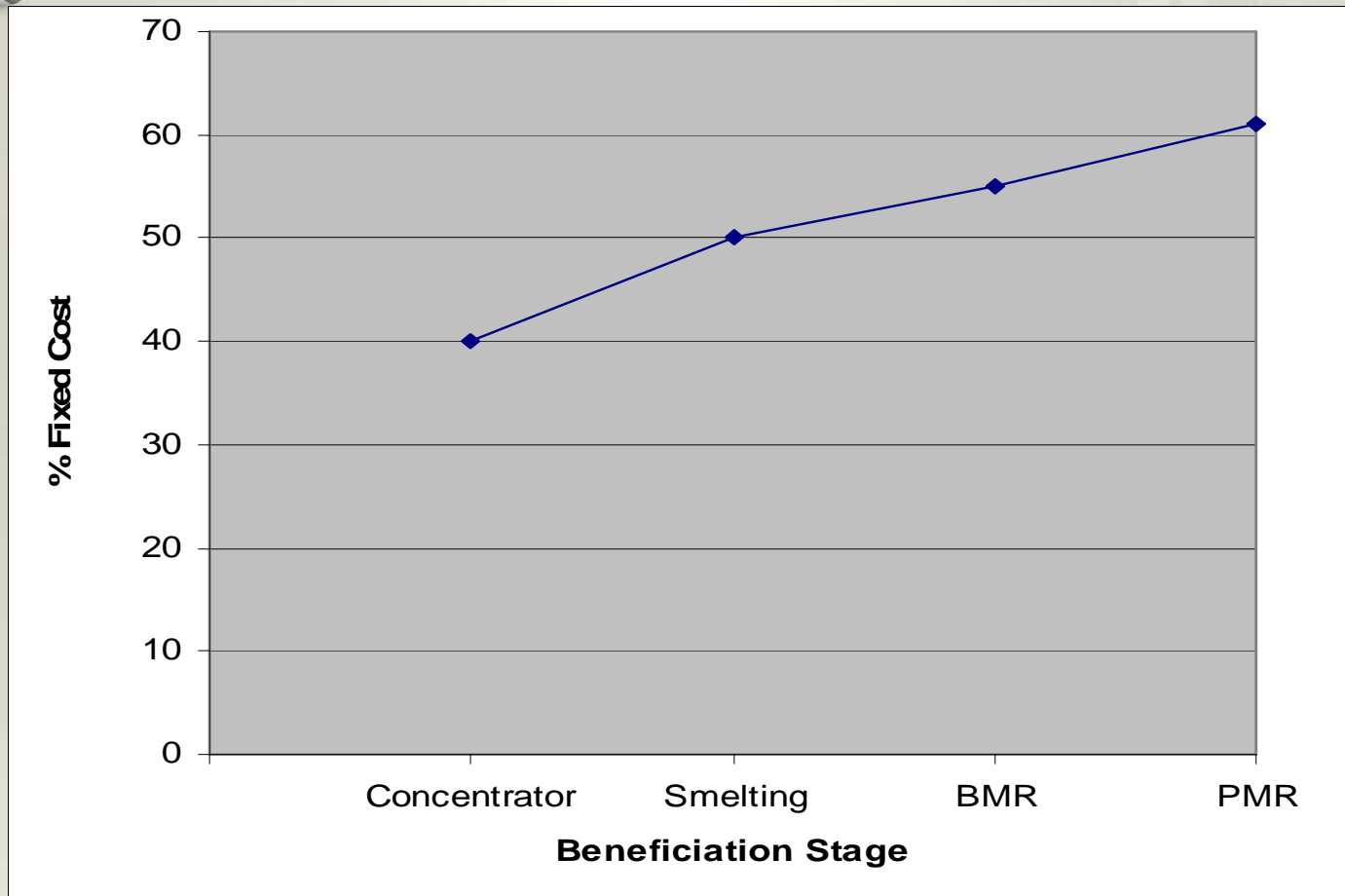


Capital Investment-Per ton or oz per annum	Min Cost	Max Cost
Mining	-	-
Concentrator per Ore tons	\$60	\$100
Smelter – per Conc tons	\$800	\$1000
BMR – per Matte ton	\$9 000	\$11 000
PMR – per 4E oz	\$160	\$210
Production Costs	Min Cost	Max Cost
Mining	-	-
Concentrator Costs	\$6	\$10
Smelter – per Conc tons	\$90	\$150
BMR – per Matte ton	\$1 200	\$1 600
PMR – per 4E oz	\$9	\$12





PGM Beneficiation – Fixed Cost Variation





Conclusion-Beneficiation Agenda for Zimbabwe



- Improved Governance – Politically, Economically and specifically within the minerals sector
- Create Beneficiation Enabling Structures- Beneficiation Task Teams
- Enabling Regulatory Framework
- Investment Promotion and Facilitation
- Invest in relevant R&D and Technology
- Infrastructure Development
- Skills Development





Thank You

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