EXECUTIVE SUMMARY

Coaltech commissioned an independent coal transport investigation to identify alternative transport modes and technologies, with the aim of determining which technologies are best suited for specific coal transport requirements. These transport requirements may vary according to the lead distance, terrain, throughput requirements and geographical location, to name but a few factors. It is the intention of the study however, to provide guidance on a very high level, in terms of selecting the most appropriate technology that would best satisfy these requirements in a cost effective and safe manner, while minimising any negative socio-economic impacts.

This coal transport research was based on a hybrid research strategy. The first stage comprised a phenomenological based, inductive approach to evaluating the literature available on different coal transport technologies, but moreover to conduct primary evaluative research into the subject. The second positivist based, deductive approach included primary research, based on the outcome of the first stage, aimed at fully evaluating, understanding and quantifying the characteristics, capacities, costs and socio-economic impacts of each transport mode. Due to the research being based on this hybrid strategy, it required a multi-method data gathering approach, which included focused desktop research and more than 15 general interviews with various senior managers from a number of different organisations within the coal and transport industries. Based on the initial information garnered, selected technology modal specialists were targeted for in-depth interviews, further data gathering, cross referencing and validation. In total, 16 specialist interviews and targeted discussions were completed.

Different transport options are generally classified into modes, based on the infrastructure that is required to enable such transport. Similar guidelines have been used during this coal transport investigation and the 18 identified transport modes were grouped as indicated in **Table 1** below.

Table 1: Available Transport Modes

Transport Mode	In Commercial Use	Feasible in SA
Road Based Transport Options		
Current Road Transport	Yes	Yes
Quantum 1 Road Transport	Yes	Yes
PBS Vehicles	Yes	Yes
Roadtrains	Yes	Yes
Rail Based Transport Options		
General Freight Rail Transport	Yes	Yes
Heavy Haul Rail Transport	Yes	Yes
Magnetic Levitation Systems	Not for Freight	No
Pipeline and Tube Based Transport Options		
Coal Log Pipelines	No	To Be Validated
Slurry Pipelines	Yes	To Be Validated
Tube Freight Transportation System	Not for Bulk Materials	No
Continuous Articulated Rail in a Tube (CARIAT)	No	To Be Validated
Conveyor and Cable Transport Options		

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Transport Mode	In Commercial Use	Feasible in SA
Overland Conveyor Systems	Yes	Yes
Aerial Ropeway Systems	Yes	Yes
Rope Conveyor Systems	Yes	Yes
Combination Transport Options		
Rail-Veyor System	Yes	Yes
Bimodal Transport Options	Yes	Yes
Other Transport Options		
Water Based Transport Options	Yes	No
Air Transport Options	Yes	No

Eleven of these identified transport options are already being used commercially and are applicable under South African conditions, while a further three options need further evaluation and testing before a definitive answer can be provided.

To accurately compare transport modes against each other, it was imperative that these technologies be evaluated using the same criteria. To achieve this objective, the evaluation criteria were structured according to the physical system characteristics, the socio-economic impacts of each system, its local applicability and any further research requirements that were uncovered. In order to coherently report on and logically compare each option, based on these criteria, the completed evaluation matrices for the physical system characteristics, the system capacities and the socio-economic impacts can be viewed under section 9 of this document. The subsequent section 10 contains the evaluation from a capital, operating and maintenance cost perspective. Section 11 then presents the cost comparisons, based on the transport unit cost, at various lead distances ranging from 1 to 1,000 kilometres, based on three distinct freight volume scenarios of 1, 5 and 50 Million Tonnes per Annum (MTPA), respectively. This comparison is summarised and the transport options are ranked in order of economic competitiveness in **Table 2** below.

Table 2: Summary of Feasible Transport Options per Scenario

SHORT (<10 KM)					
Scenario A 1 MTPA	Rank	Scenario B 5 MTPA	Rank	Scenario C 50 MTPA	Rank
Rail-Veyor	1	Rail-Veyor	1	Conveyor	1
Roadtrain (180 t)	2	Aerial Ropeway	2	Pipe Conveyor	2
Roadtrain (105 t)	3	Conveyor	3	Rail-Veyor	3
PBS Vehicles (48 t)	4	Pipe Conveyor	4	Rope Conveyor	4
Aerial Ropeway	5	Roadtrain (180 t)	5	Aerial Ropeway	5
Quantum 1 Road (38 t)	6	Roadtrain (105 t)	6	Roadtrain (180 t)	6
Conveyor	7	PBS Vehicles (48 t)	7	Roadtrain (105 t)	7
Current Road (31 t)	8	Quantum 1 Road (38 t)	8	PBS Vehicles (48 t)	8
Pipe Conveyor	9	Current Road (31 t)	9	Quantum 1 Road (38 t)	9
Rope Conveyor	10	Rope Conveyor	10	Current Road (31 t)	10

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INTERMEDIATE (10 - 100 KM)					
Scenario A 1 MTPA	Rank	Scenario B 5 MTPA	Rank	Scenario C 50 MTPA	Rank
Heavy Haul Rail (Current Rates)	1	Rail-Veyor	1	Conveyor	1
PBS Vehicles (48 t)	2	Heavy Haul Rail (Current Rates)	2	Pipe Conveyor	2
Quantum 1 Road (38 t)	3	Roadtrain (180 t)	3	Rail-Veyor	3
GFB Rail (Current Rates)	4	Conveyor	4	Rope Conveyor	4
Roadtrain (180 t)	5	Coal Log Pipeline	5	Coal Log Pipeline	5
Roadtrain (105 t)	6	Roadtrain (105 t)	6	Roadtrain (180 t)	6
Current Road (31 t)	7	PBS Vehicles (48 t)	7	Heavy Haul Rail (Current Rates)	7
Coal Log Pipeline	8	Aerial Ropeway	8	Roadtrain (105 t)	8
Rail-Veyor	9	GFB Rail (Current Rates)	9	Heavy Haul Rail (Private)	9
Conveyor	10	Pipe Conveyor	10	PBS Vehicles (48 t)	10
Aerial Ropeway	11	Quantum 1 Road (38 t)	11	GFB Rail (Current Rates)	11
Pipe Conveyor	12	Slurry Pipeline	12	GFB Rail (Private)	12
Slurry Pipeline	13	Current Road (31 t)	13	Quantum 1 Road (38 t)	13
GFB Rail (Private)	14	Heavy Haul Rail (Private)	14	Slurry Pipeline	14
Heavy Haul Rail (Private)	15	GFB Rail (Private)	15	Current Road (31 t)	15
Rope Conveyor	16	Rope Conveyor	16	Aerial Ropeway	16

LONG (100 - 1,000 km)					
Scenario A 1 MTPA	Rank	Scenario B 5 MTPA	Rank	Scenario C 50 MTPA	Rank
Heavy Haul Rail (Current Rates)	1	Heavy Haul Rail (Current Rates)	1	Coal Log Pipeline	1
GFB Rail (Current Rates)	2	Coal Log Pipeline	2	Rail-Veyor	2
Coal Log Pipeline	3	Slurry Pipeline	3	Heavy Haul Rail (Current Rates)	3
PBS Vehicles (48 t)	4	GFB Rail (Current Rates)	4	Slurry Pipeline	4
Quantum 1 Road (38 t)	5	Rail-Veyor	5	Heavy Haul Rail (Private)	5
Roadtrain (180 t)	6	Roadtrain (180 t)	6	GFB Rail (Current Rates)	6
Current Road (31 t)	7	PBS Vehicles (48 t)	7	GFB Rail (Private)	7
Slurry Pipeline	8	Roadtrain (105 t)	8	Roadtrain (180 t)	8
Roadtrain (105 t)	9	Quantum 1 Road (38 t)	9	Roadtrain (105 t)	9
Rail-Veyor	10	Current Road (31 t)	10	PBS Vehicles (48 t)	10
GFB Rail (Private)	11	GFB Rail (Private)	11	Quantum 1 Road (38 t)	11
Heavy Haul Rail (Private)	12	Heavy Haul Rail (Private)	12	Current Road (31 t)	12

CRICKMAY SUPPLY CHAIN EVOLUTION

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The individual transport modes were ranked per lead distance segment for each of the three volume scenarios and then averaged per distance grouping, which resulted in the overall ranking indicated in **Table 2**. From **Table 2** it is possible to ascertain which transport mode, based on cost only, is the most competitive option at a given lead distance and for a specified product throughput.

It should be noted that six transport options, which are applicable to the Medium lead distance applications, were omitted from **Table 2** for the Short lead distance applications below 10 km, as these rail and pipeline type options are simply not competitive at such short distances. Similarly, four transport options were also omitted from the Long lead distance applications above 100 km, as conveyor type technologies are not practically suited to such long distances.

The outcome of the research broadly conformed to expectations, where conveyor type technologies are suitable across shorter lead distances, with the flexibility and scalability of road transport ensuring that it remains an option in most applications. The different versions of rail transport further indicated that it is very competitive at intermediate to long lead distances, while the pipeline based technologies also seemed to be an option at mid-volume and long lead distance applications. The most surprising outcome of this research, however, is the comprehensively competitive possibilities of the Rail-Veyor system, which proved to be the only technology that was competitive under every single scenario. However, the selection of a specific transport mode is not a simple economic calculation, but rather a complex decision based on various influencing factors including the availability of infrastructures, individual system characteristics, system integration possibilities and various socio-economic implications.

The main conclusion from this research is therefore that no single transport technology exists that could cost effectively satisfy all the divergent transport requirements, across all distances, at different volumes and across all types of terrain. The optimum coal distribution solution lies in the effective combination of all the available transport options into an integrated and well managed network, where individual technologies are applied on merit. This approach allows for the safest and most cost effective transport application for each individual route, with the lowest socio-economic impact, while protecting and enhancing the available transport infrastructure.

The research was conducted at a very high level and intentionally kept as generic as possible. The results are valuable and adequate for guiding selected transport and distribution related decisions, in cases where the lead distance, basic geography and product volumes are known. However, a logical next step in this field of research would be to investigate the integrative and cooperative approaches that could be followed to improve distribution productivity, efficiency, reliability and cost effectiveness of the coal supply chain at an industry level. The introduction of an industry wide supply chain network optimisation initiative and the establishment of coal hubs are two possible options to achieve this level of cooperation, which warrants further investigation.

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