

# Fuel Consumption of Underground Mine Haul Trucks

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An investigation about fuel consumption of underground mine haul trucks was conducted by a group of researchers from The University of Queensland and was supported by CRCMining. This is the results ...

Fuel consumption in the Australian mining sector has been increasing more rapidly than in any other sector<sup>1</sup>. Loading, hauling and dumping operations consume up to 26% of the energy in underground mines<sup>2</sup>. Articulated Dump Trucks (ADTs) are frequently used in underground operations due to their low profile and capacity to deal with the poor haul road conditions and tight turns. The Key Performance Indicators (KPIs) that influence the fuel consumption of underground ADTs are payload, speed, wet conditions, fleet management, fuel quality, mine planning, truck and road maintenance, total resistance, driver skills and truck design. In this study, the relative importance of each KPI for the fuel consumption of underground ADTs have been identified (Figure 1) based on five design criteria defined in an online-survey. The criteria considered in the survey were: ease of measuring; ease of control; economics of any changes; availability of analytical models; and their significance to fuel consumption. The survey asked participants to rate each of the KPIs against the five design criteria on a scale of 0-100, with 0 being the lowest and 100 being the highest. Participants included 40 industry and academic personnel in Australia, Canada and the United States. Of the personnel surveyed, 30% worked at universities and research centres and 70% worked in underground mines.

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<sup>1</sup> R Memary, D Giurco, T Prior, L Mason, G Mudd, and J Peterseim (2011). "Clean Energy and Mining - Future Synergies." Second international future mining conference, Sydney, NSW, Australia, Proceeding, p. 217-226.

<sup>2</sup> LCG Energy Management Group (2009). "Investigation of Current Research Related to the Reduction of Energy Usage in Mines Through Recycling, Reuse, and Other Means."

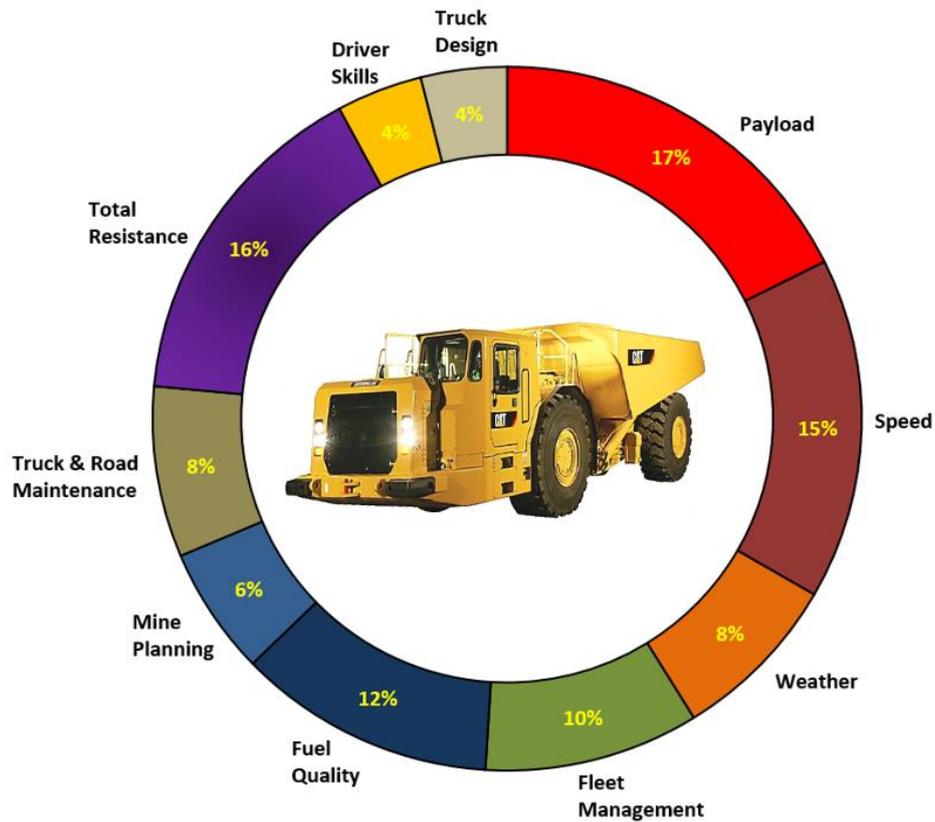


Figure 1: Relative Importance of KPIs for the Fuel Consumption of Underground ADTs

The Fuel Consumption Index ( $FC_{Index}$ ) for CAT AD45B were determined by developing a computer program in MATLAB based on the truck's best performance characteristics.  $FC_{Index}$  weights the rate of fuel consumption by the Gross Vehicle Weight (GVW) of truck. GVW is the sum of the truck's weight and its payload. Figure 2 presents  $FC_{Index}$  as a function of truck's GVW and Total Resistance (TR). TR is the sum of the Rolling Resistance (RR) and the Grade Resistance (GR) of the haul road mine. RR is defined as a measure of the force required to overcome the retarding effect between the truck tyres and the haul road. GR is the ratio between the rise of the road and the horizontal length, measured as a percentage.

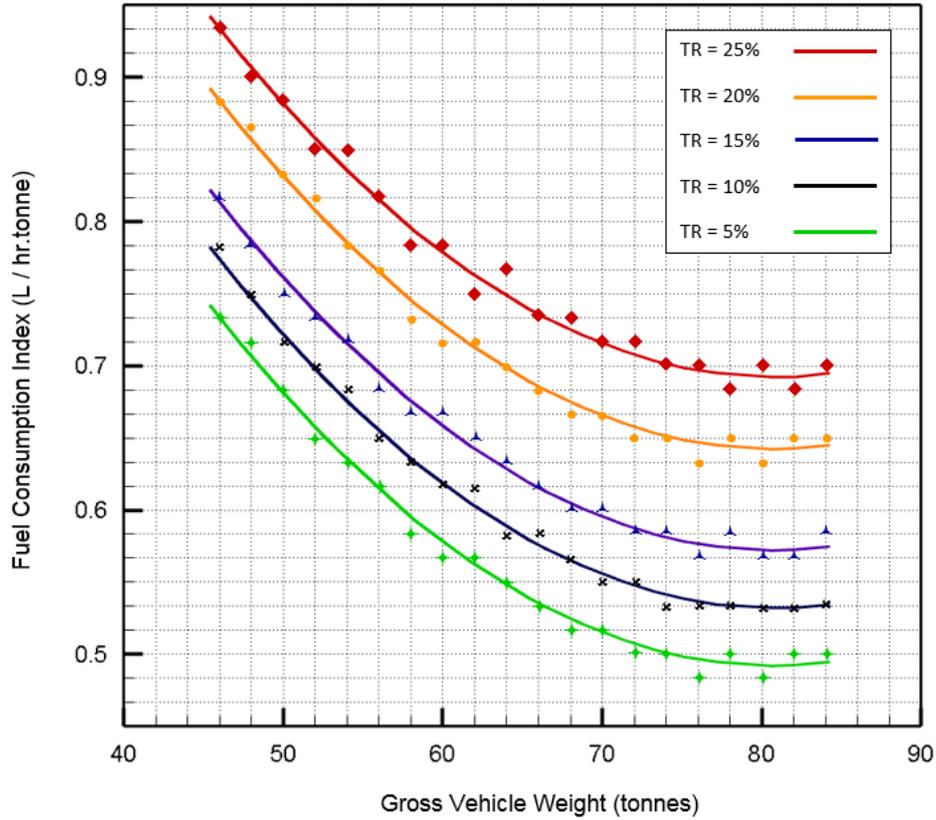


Figure 2: Fuel Consumption Index as a function of Gross Vehicle Weight and Total Resistance (CAT AD45B)

The results show that  $FC_{Index}$  has a non-linear relationship with GVW and TR. For every value of TR,  $FC_{Index}$  decreases up to an optimum value corresponding to the rated GVW. It is also noted that  $FC_{Index}$  decreases as TR decreases for a constant GVW. It can be concluded that a fully loaded truck is essential for minimising the fuel consumption index in underground hauling operations taking into consideration its impact on the productivity and cycle time. In addition, reducing TR, which can practically be implemented by reducing RR, results in a lower  $FC_{Index}$ .

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