

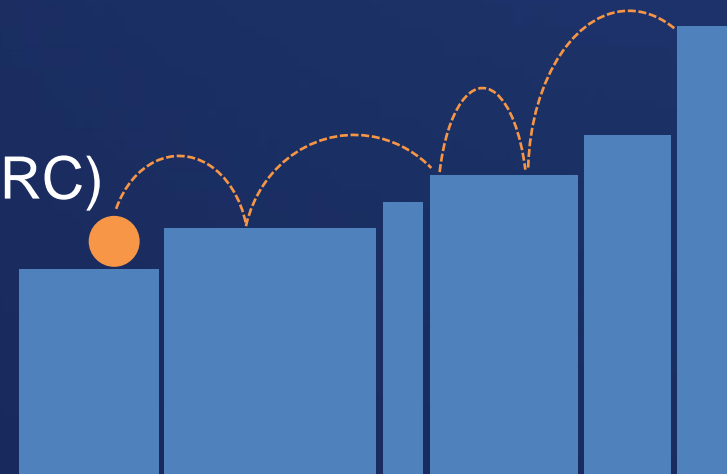


Introduction to energy curves and AngloGold Ashanti case studies

Grant Ballantyne, Malcolm Powell (JKMRC)

Nick Clarke, Mike Di Trento (AngloGold)

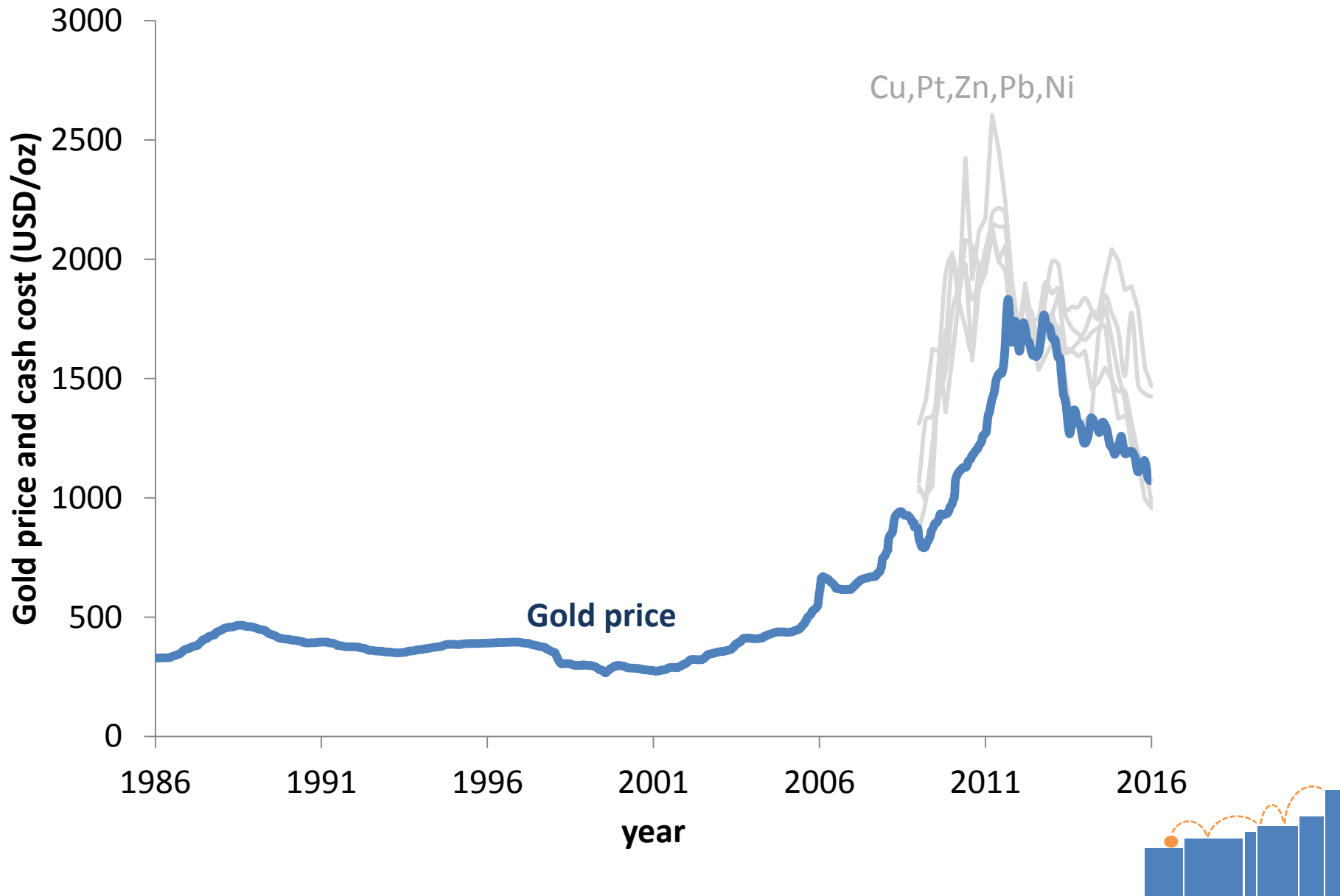
Fred Kock, Brian Putland (Orway)



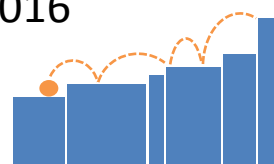
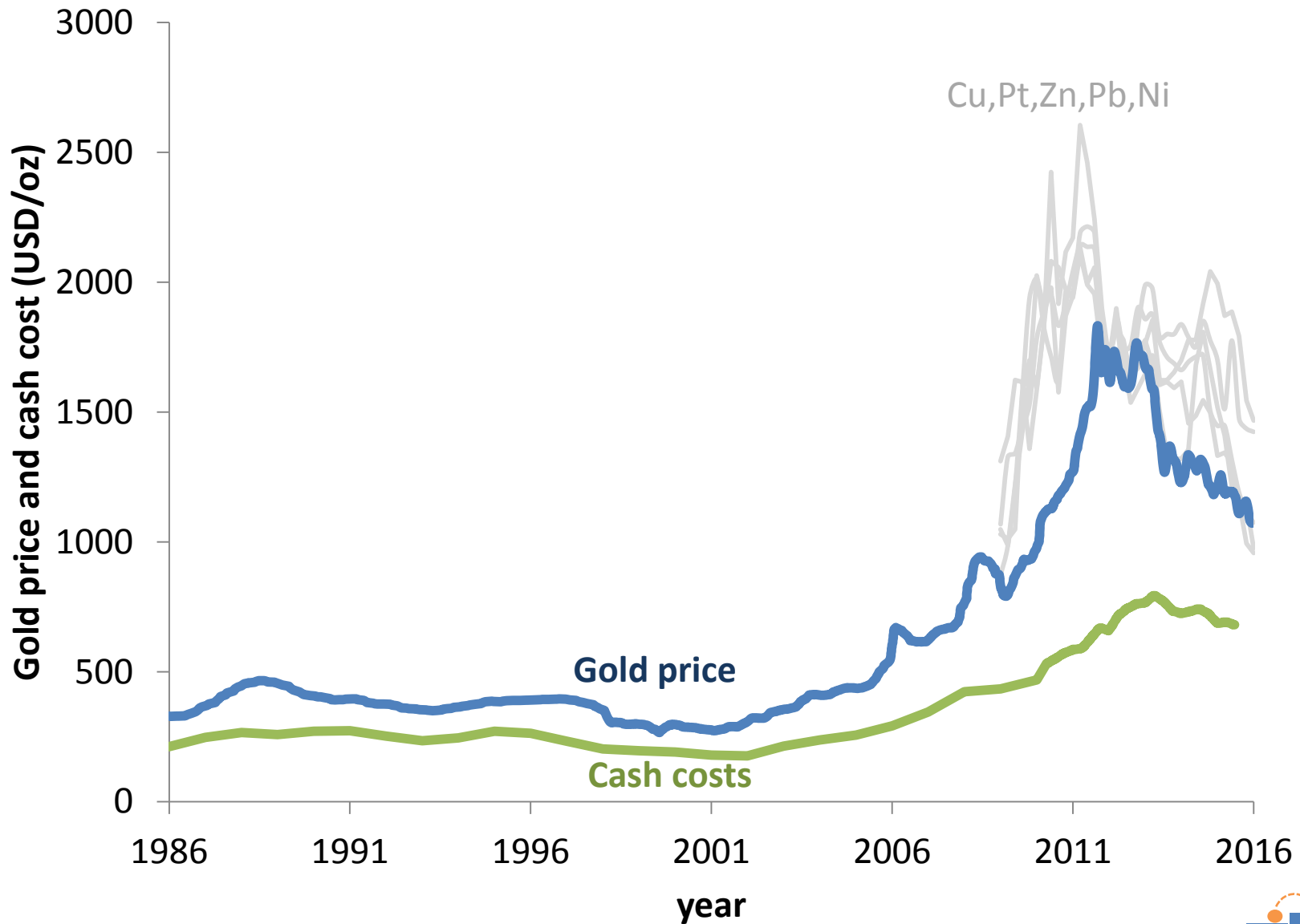
Industry context



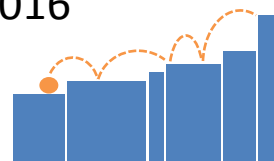
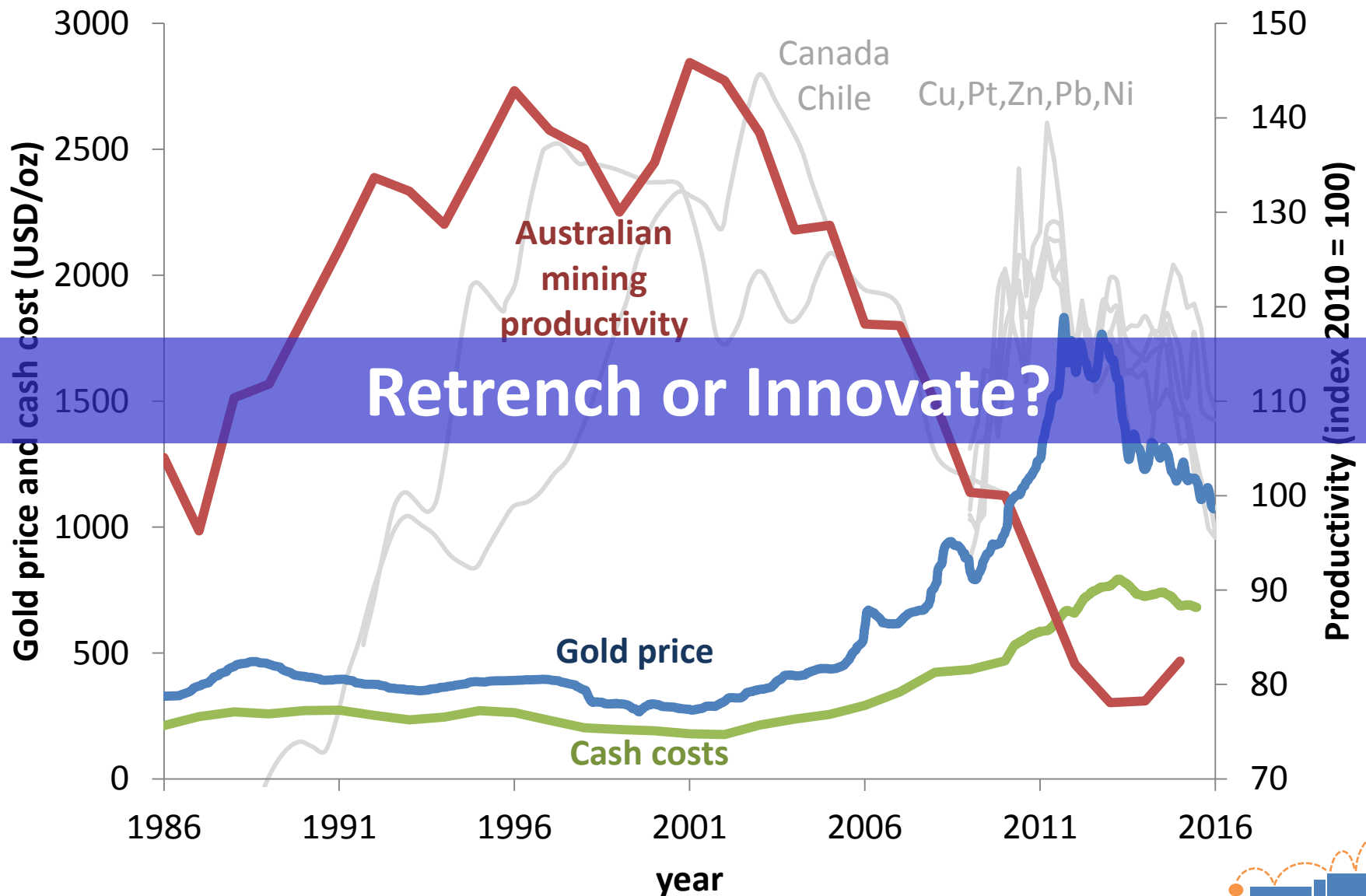
Industry context



Industry context



Industry context



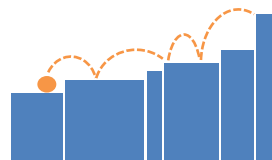
CEEC – Coalition for Eco-Efficient Comminution



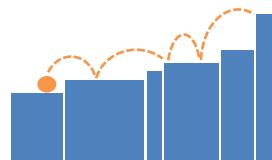
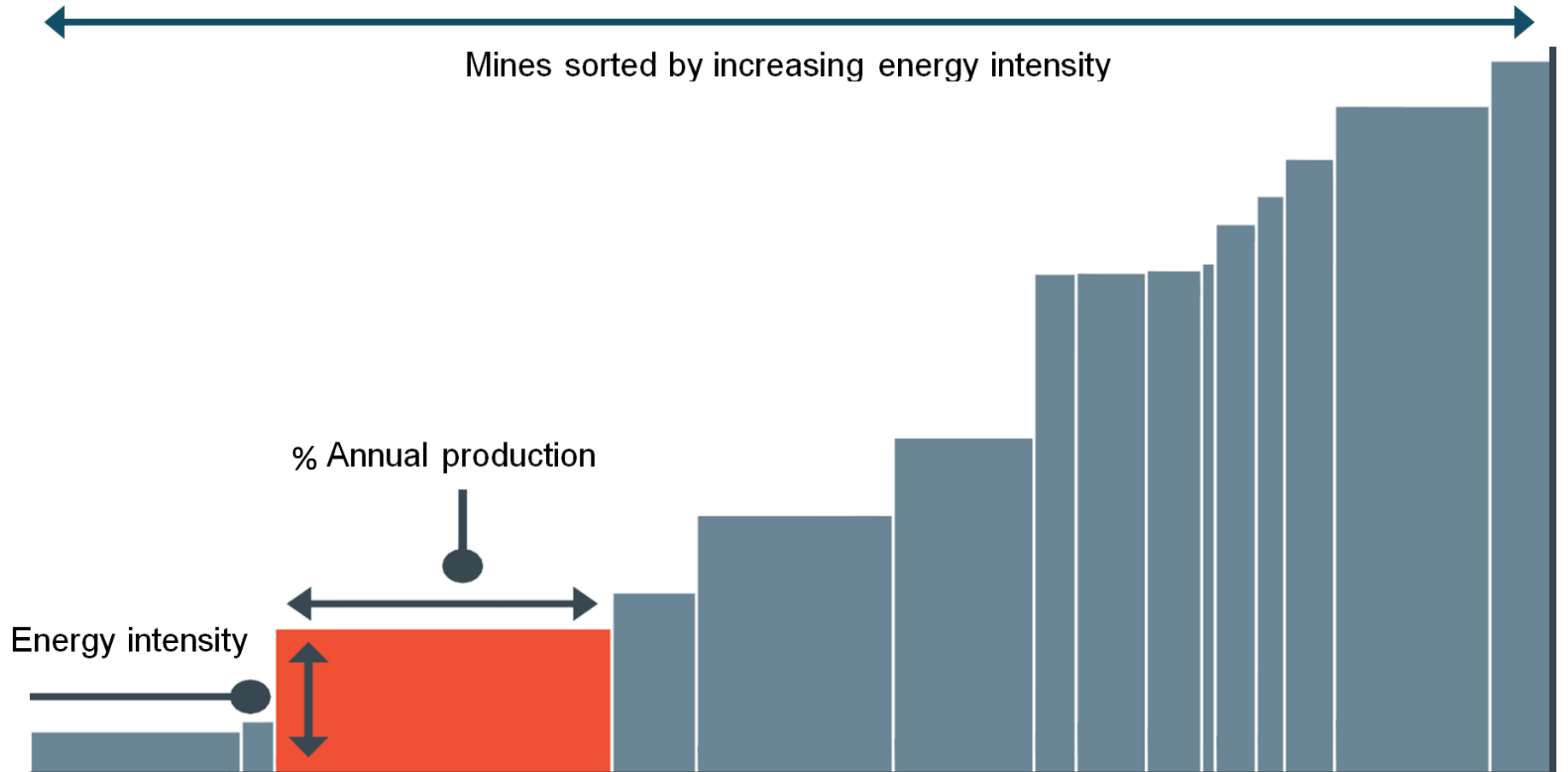
“Measure performance and produce **benchmarks** that allow energy efficiency performance to be quantified and evaluated”

“The outcome of the 2014 CEEC Workshop was cross-industry agreement to: Populate energy curves for gold, copper, platinum, nickel”

www.ceecthefuture.org/energy-curve-program

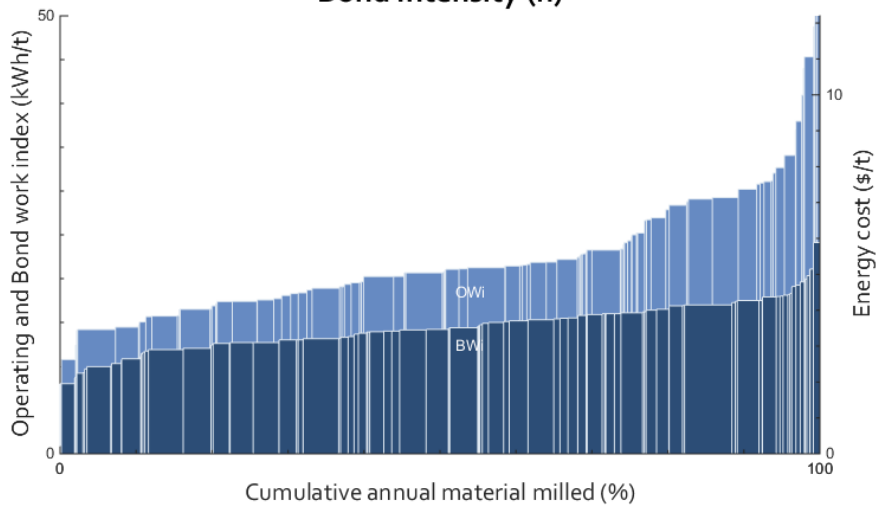


Energy benchmarking methodology (cost curve)

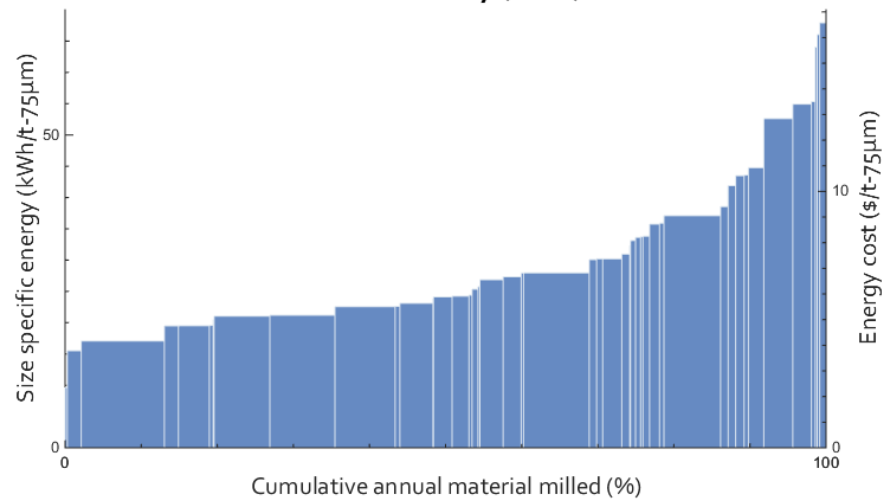


Suite of energy curves

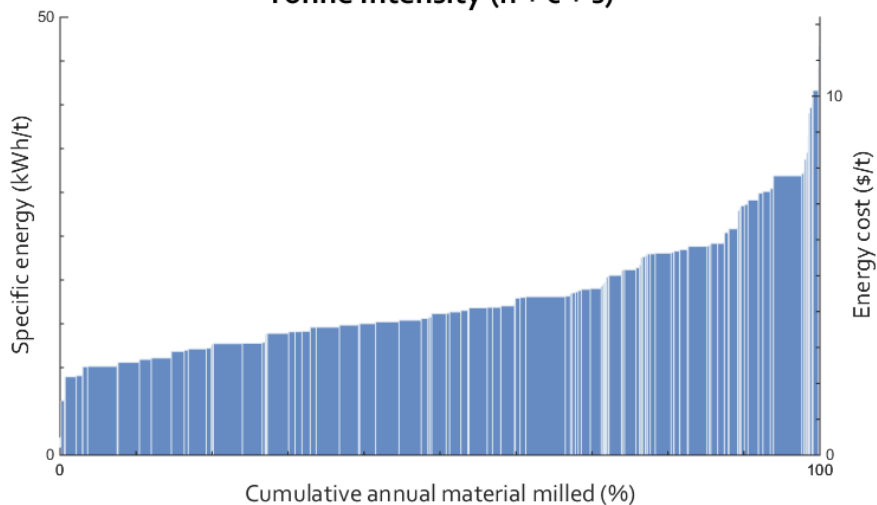
Bond Intensity (h)



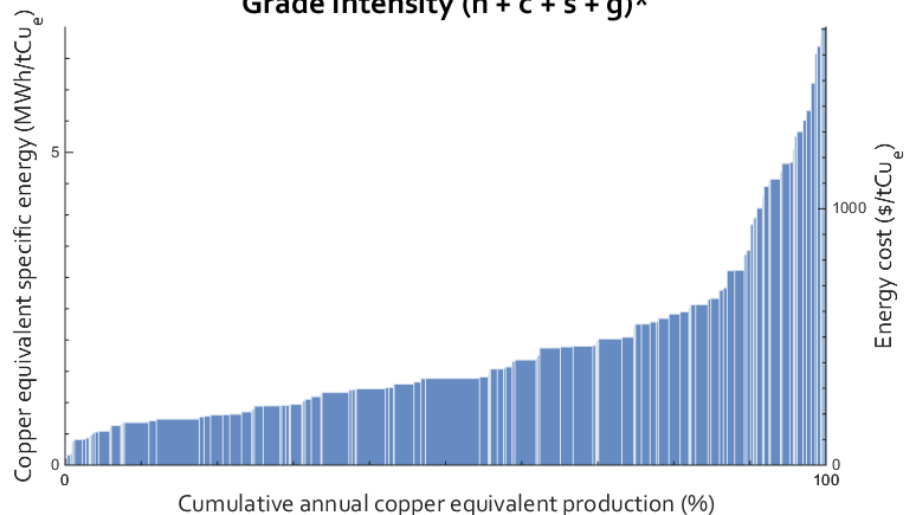
SSE Intensity (h + c)



Tonne Intensity (h + c + s)

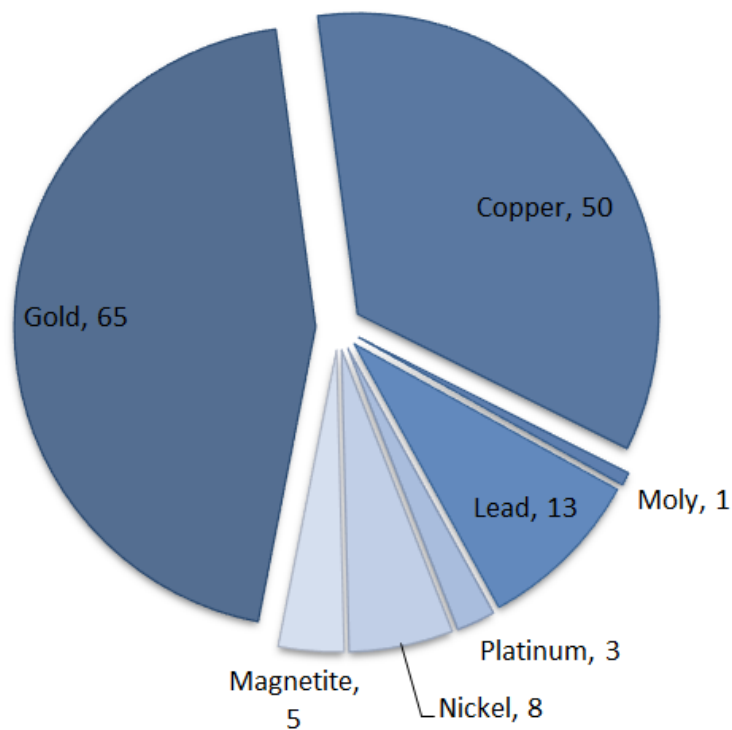


Grade Intensity (h + c + s + g)*

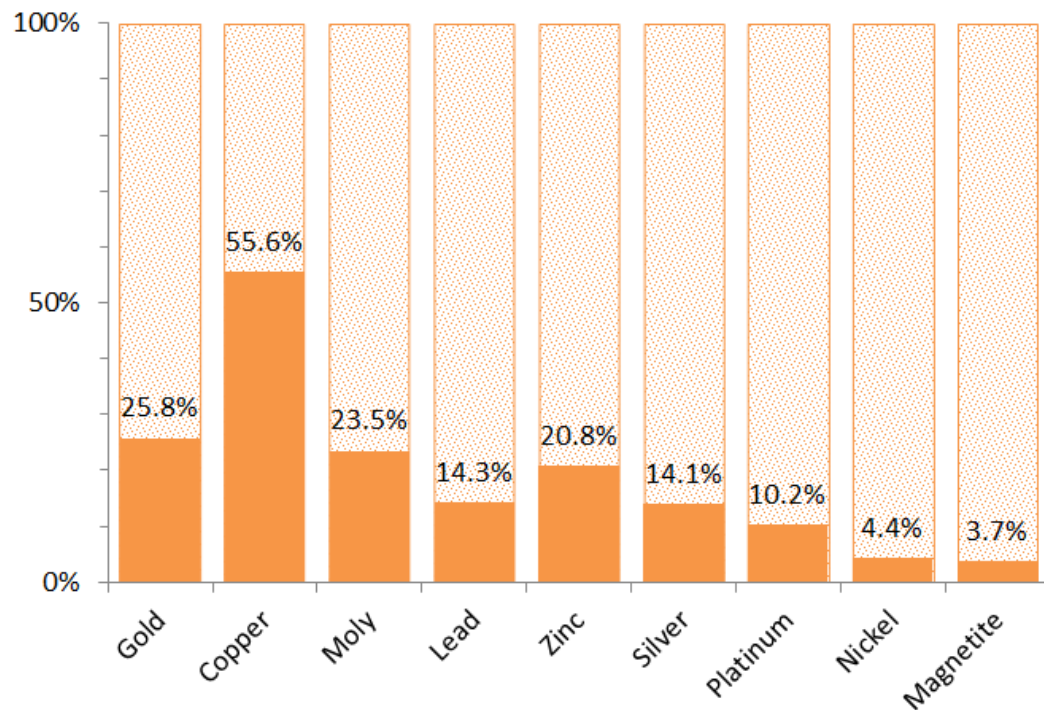


Size of the database

Number of mines by commodity

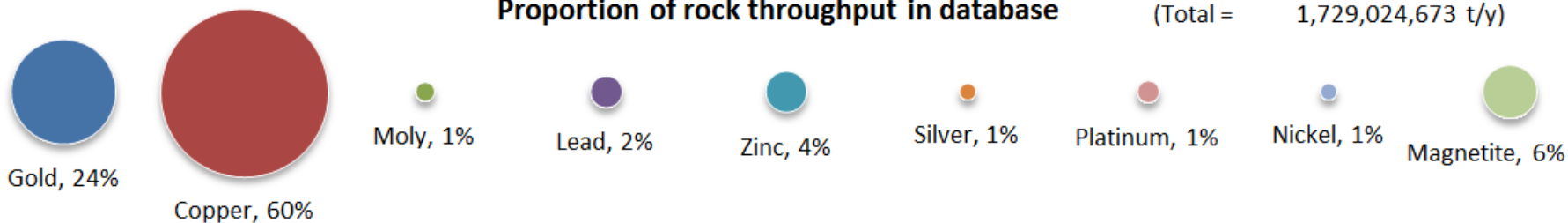


Proportion of global production in database

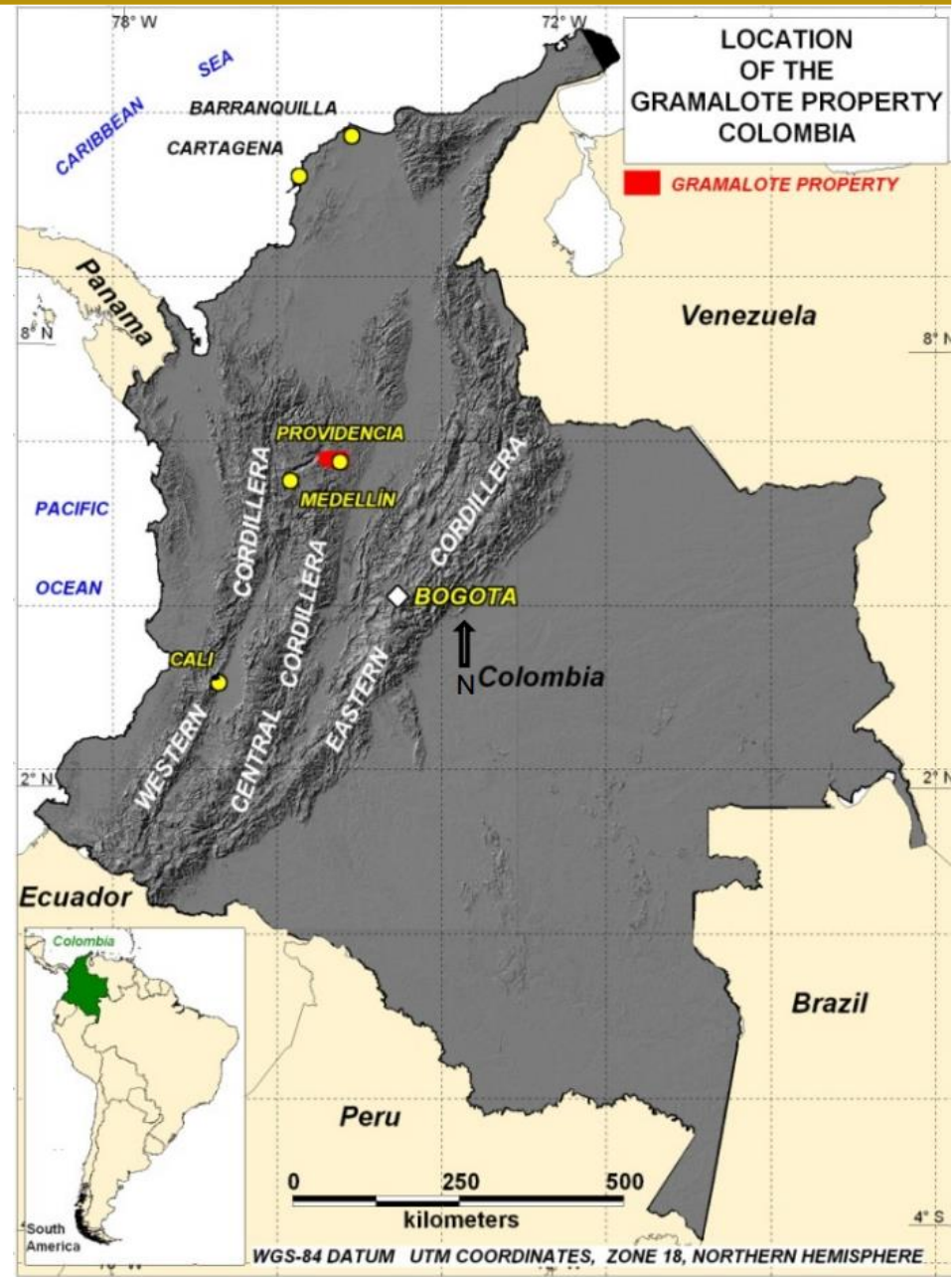


Proportion of rock throughput in database

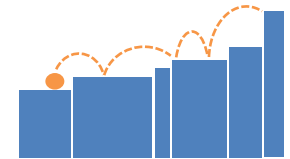
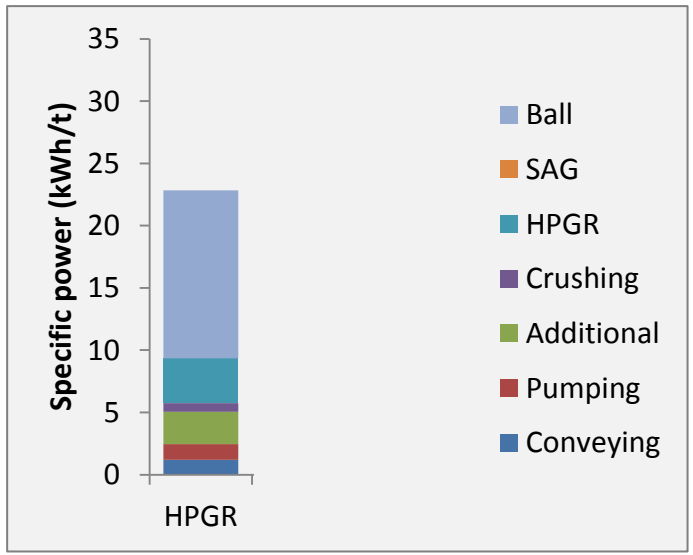
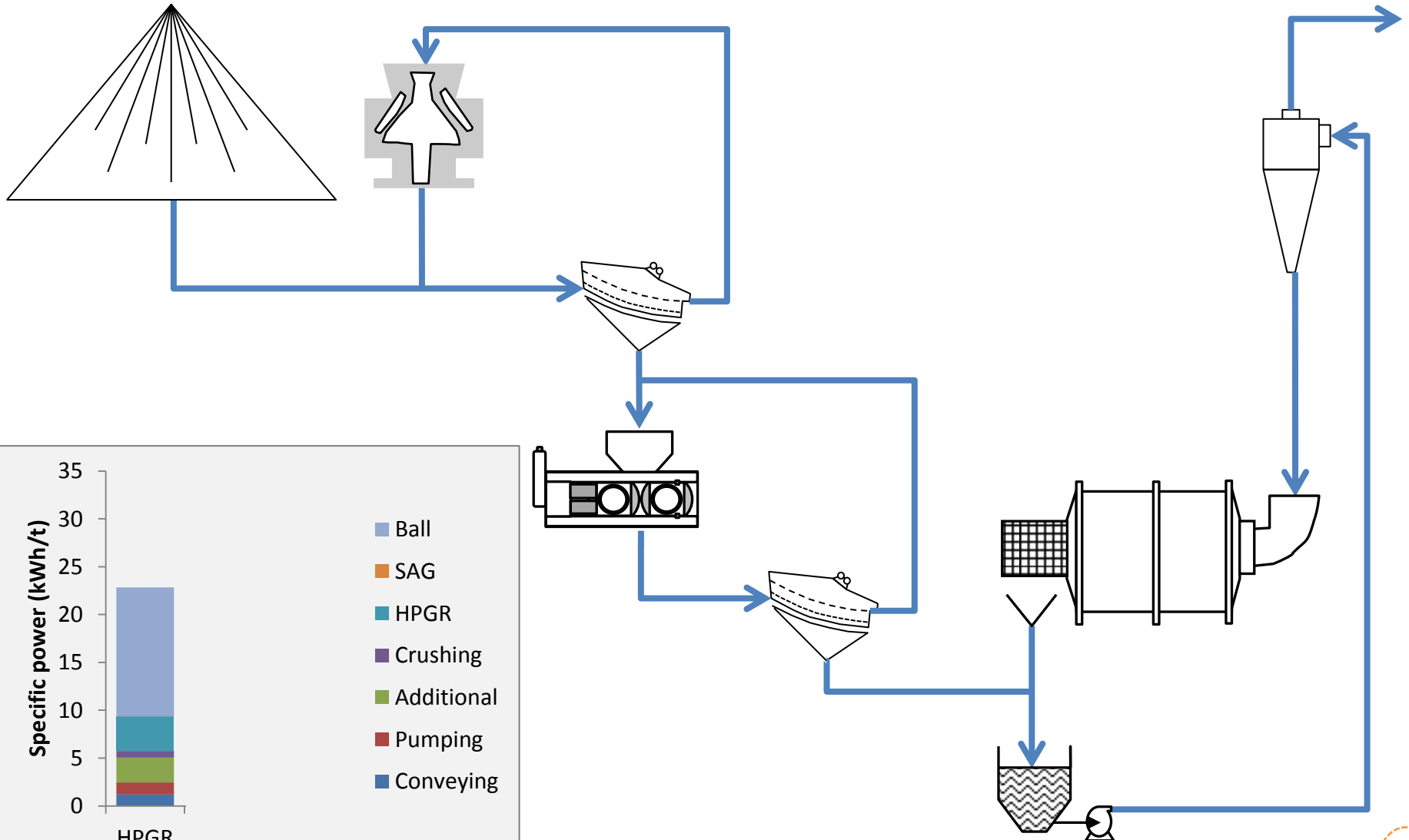
(Total = 1,729,024,673 t/y)



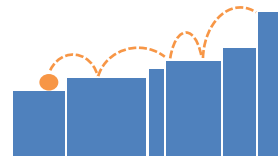
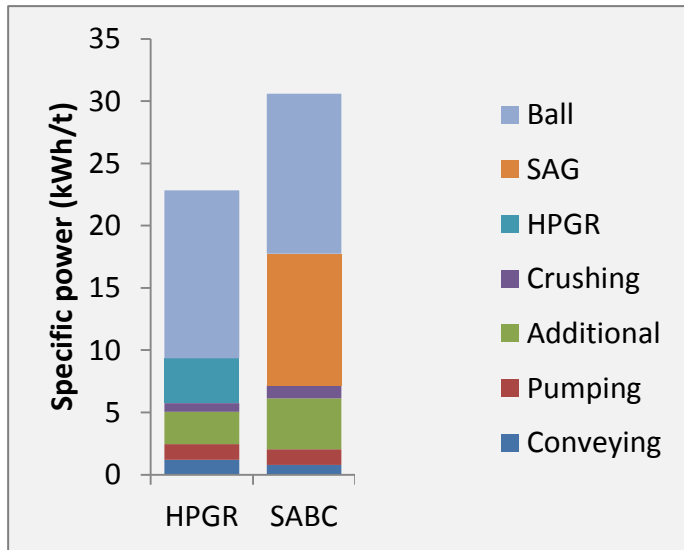
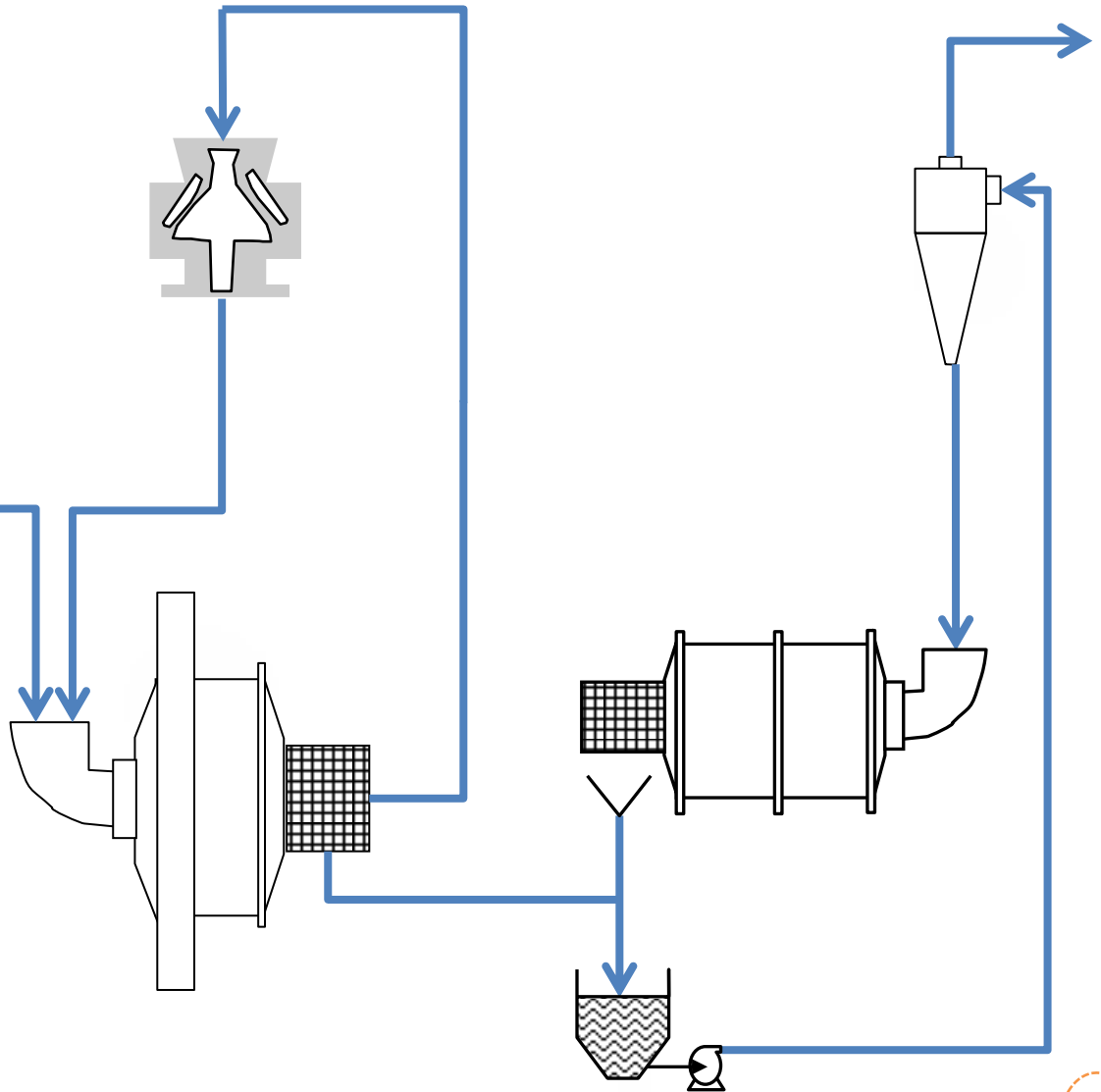
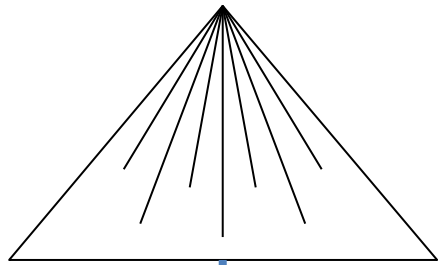
AngloGold Ashanti Case Studies



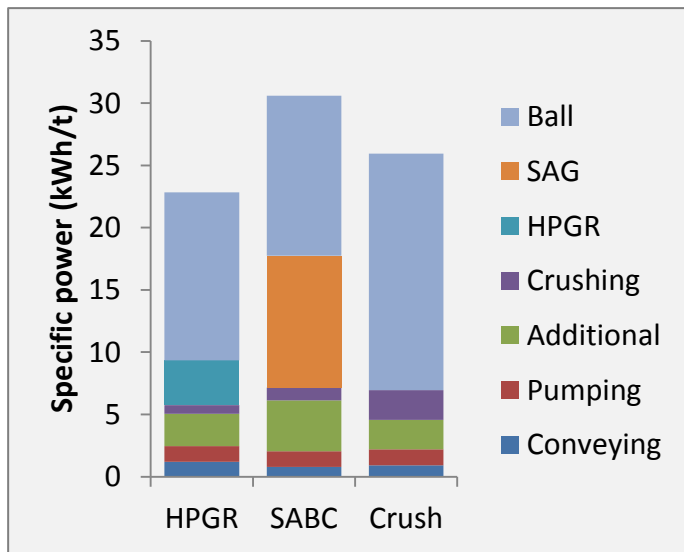
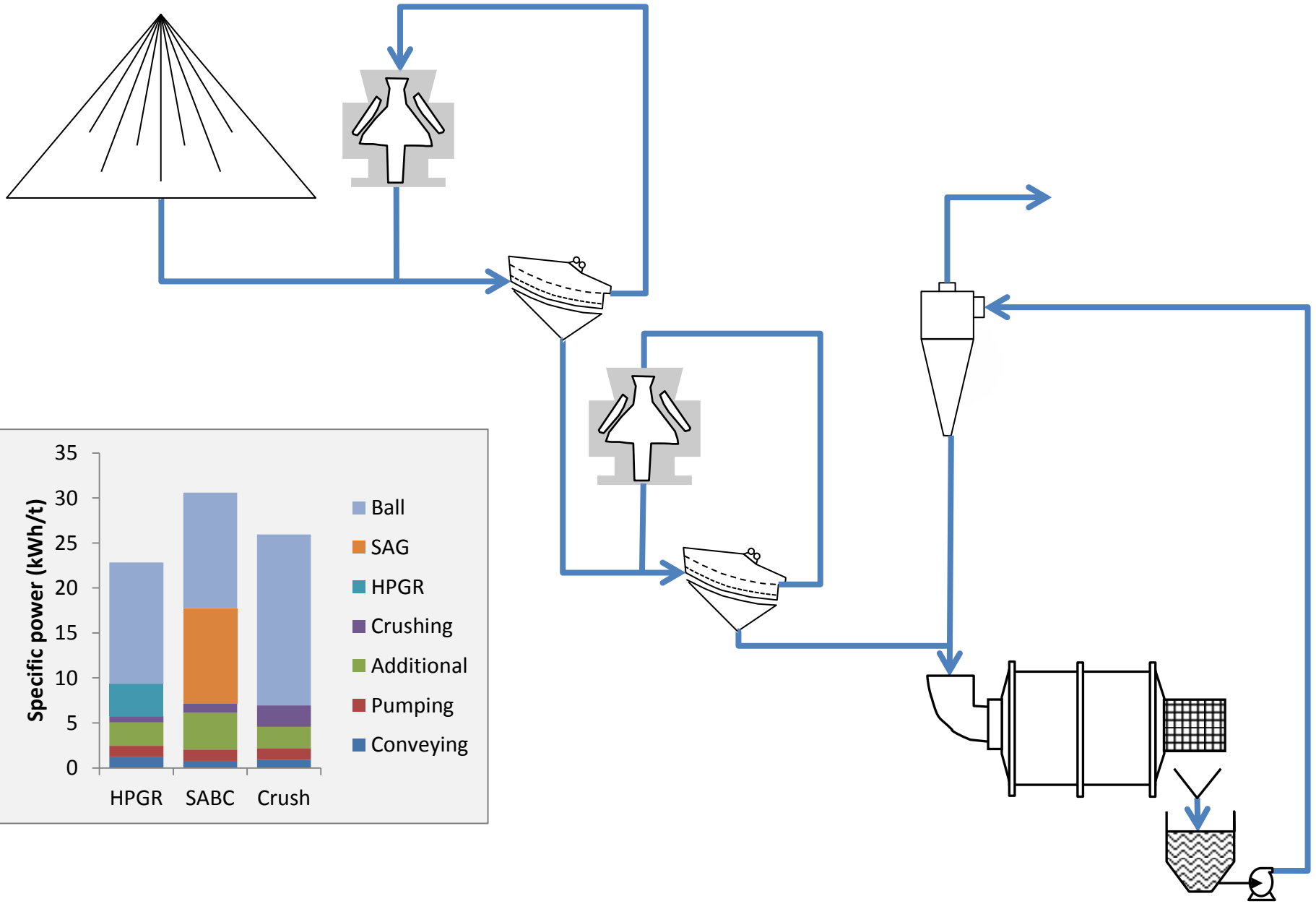
Circuit design trade-off – HPGR



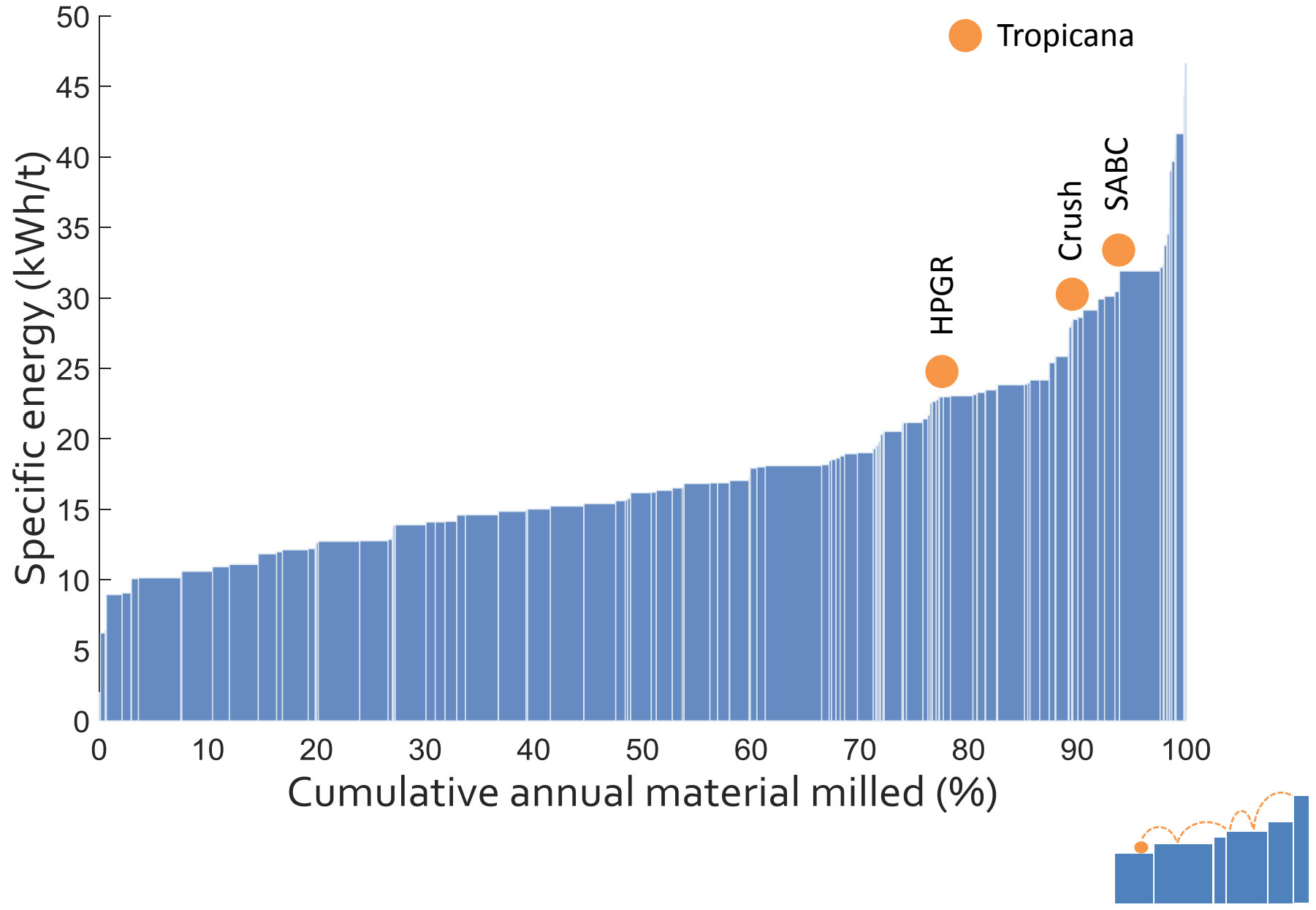
Circuit design trade-off – SABC



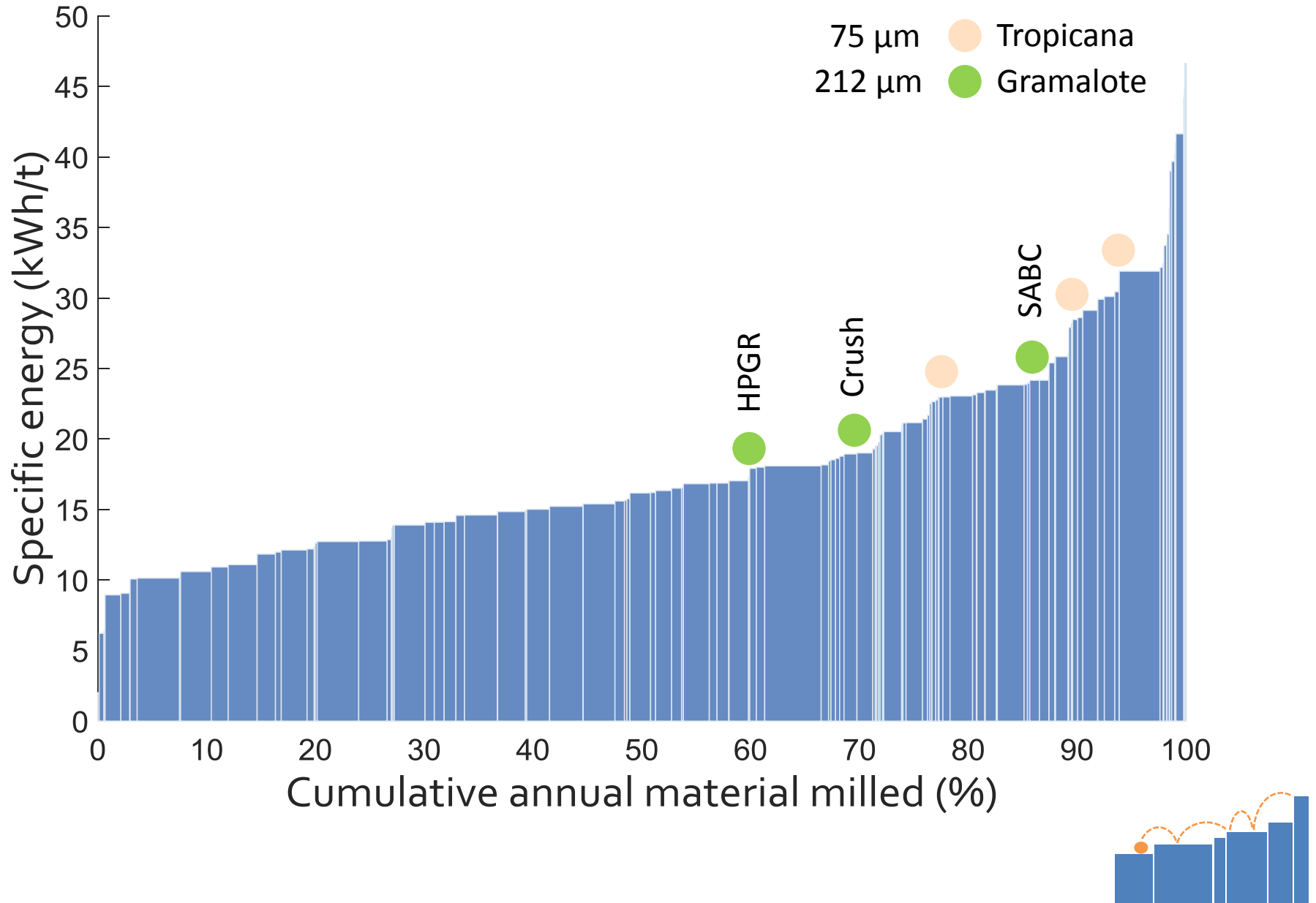
Circuit design trade-off – Crush



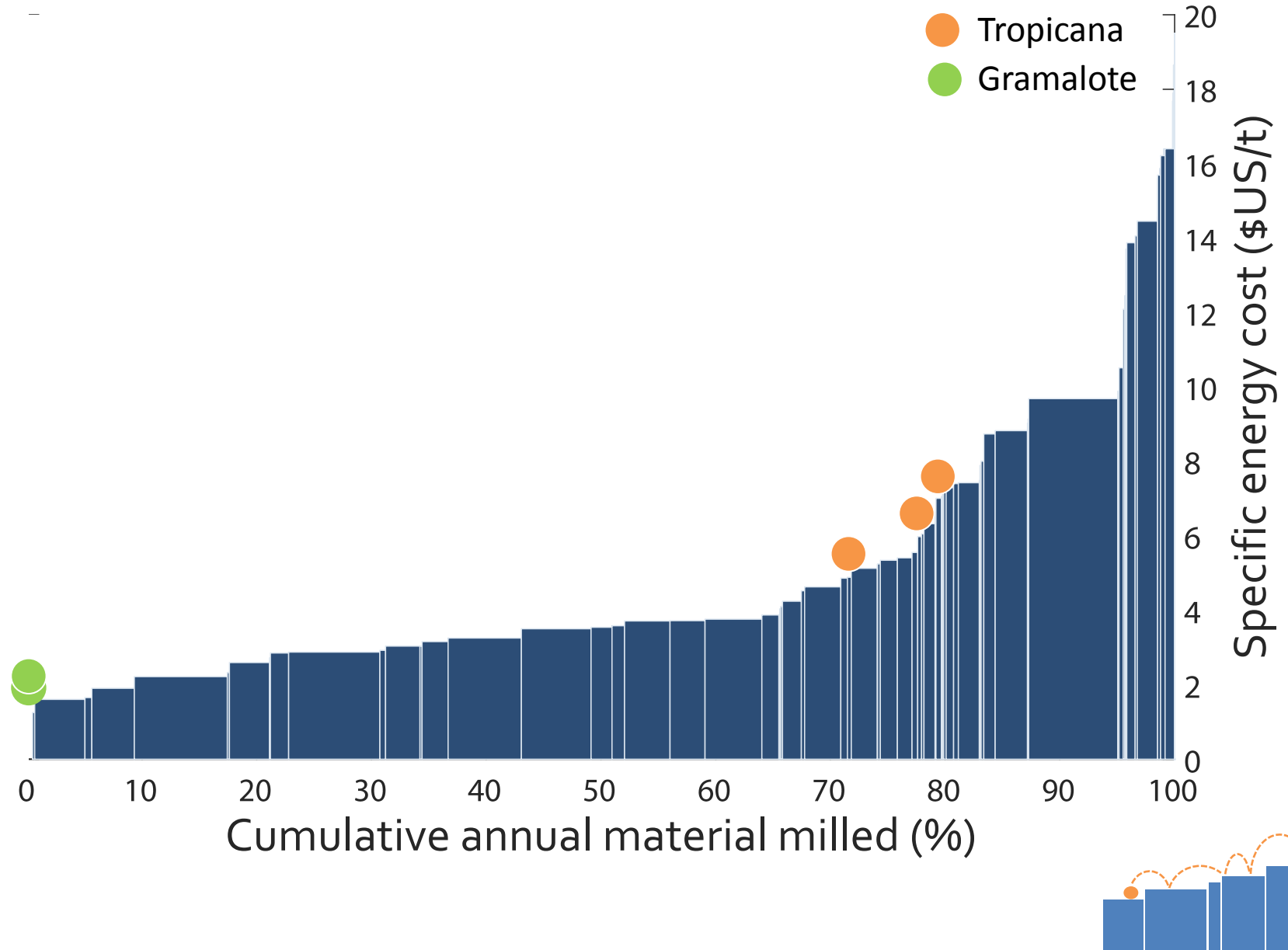
Tropicana trade-off study



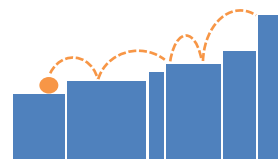
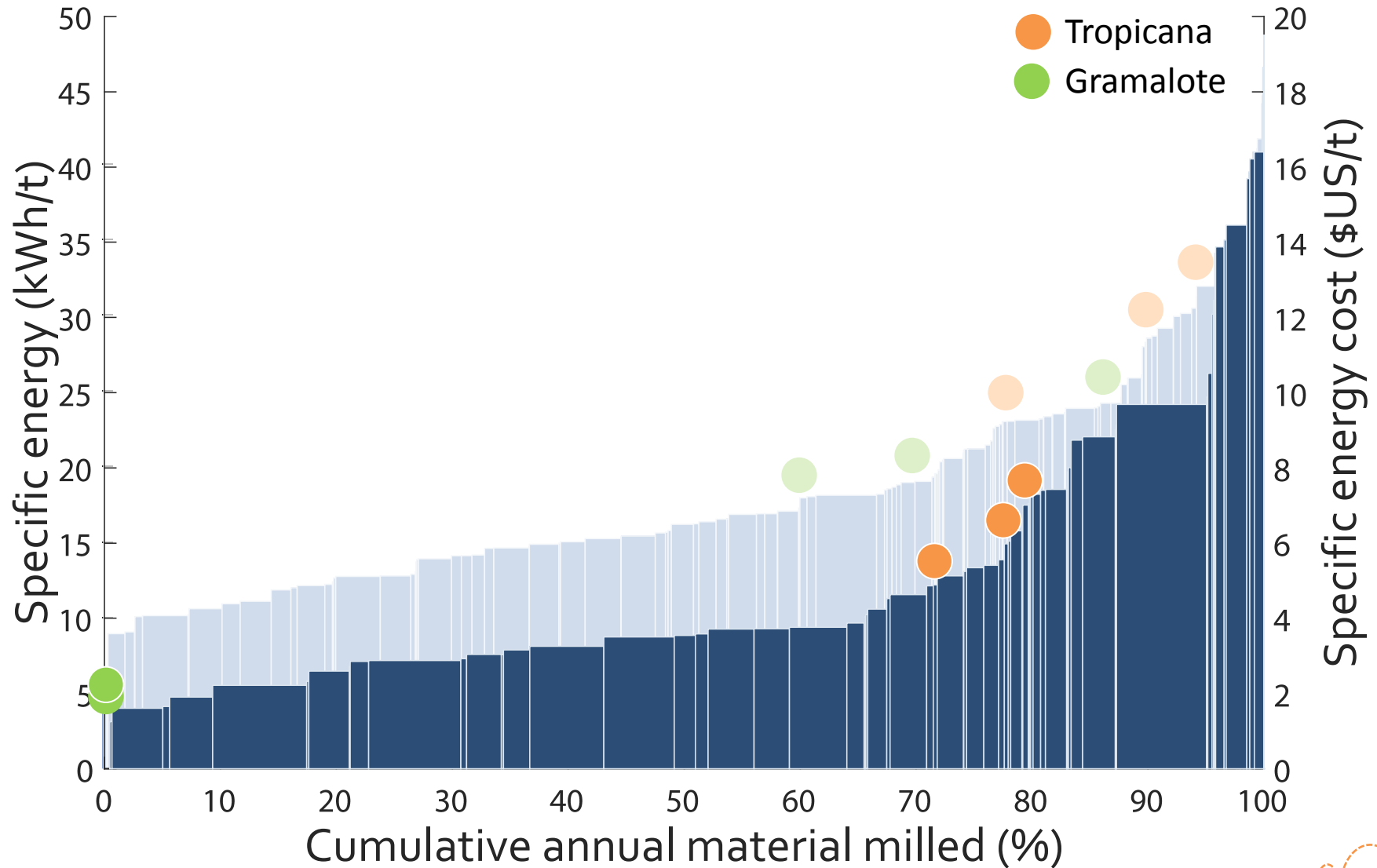
Gramalote trade-off study



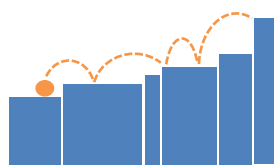
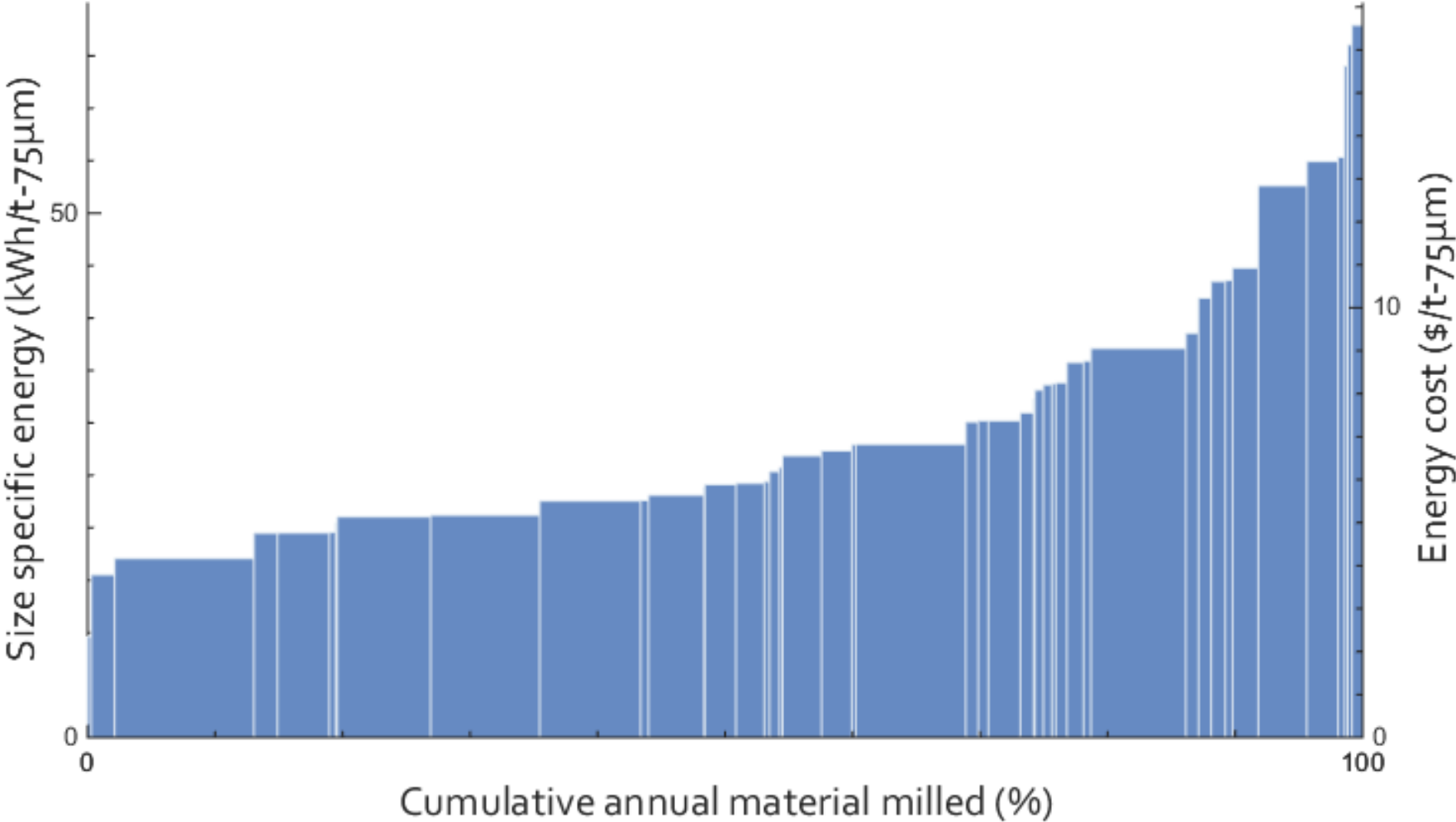
Influence of energy cost



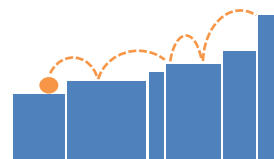
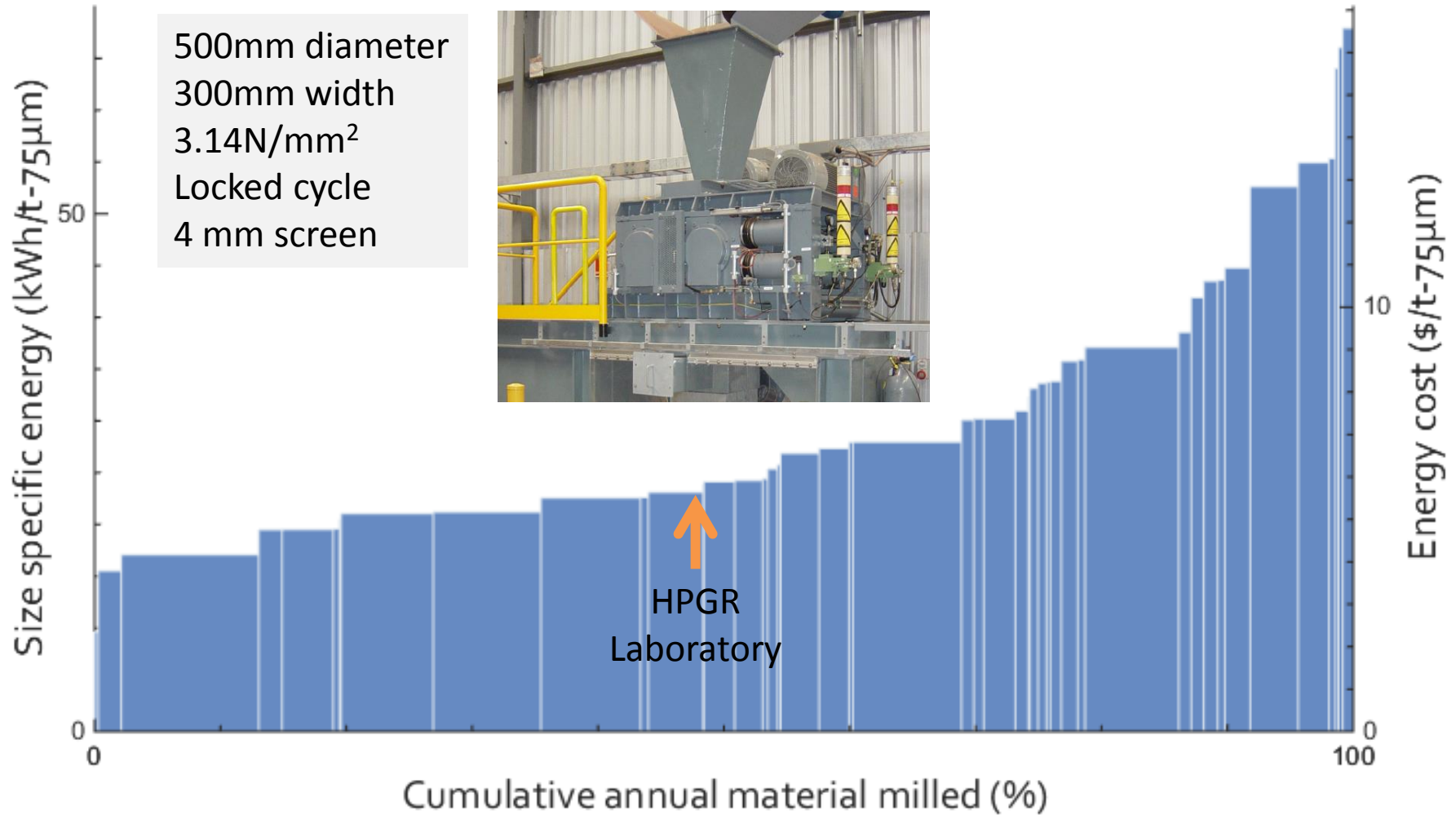
Influence of energy cost and specific energy



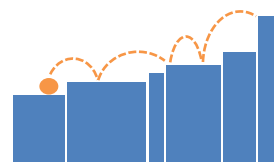
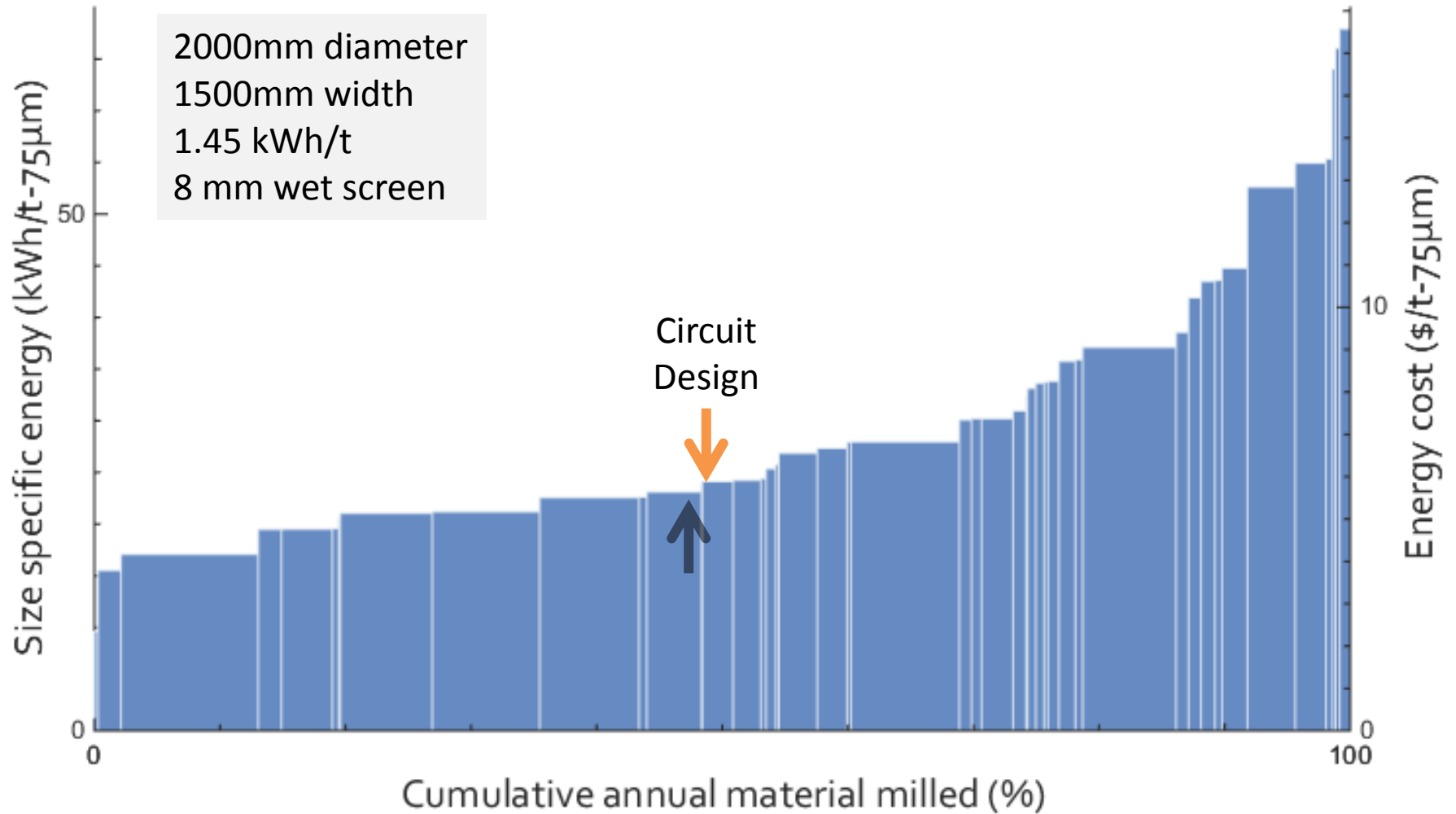
Comparison of laboratory, design and actual performance of HPGR at Tropicana using SSE75



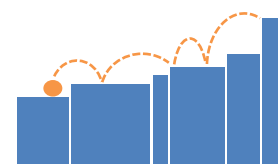
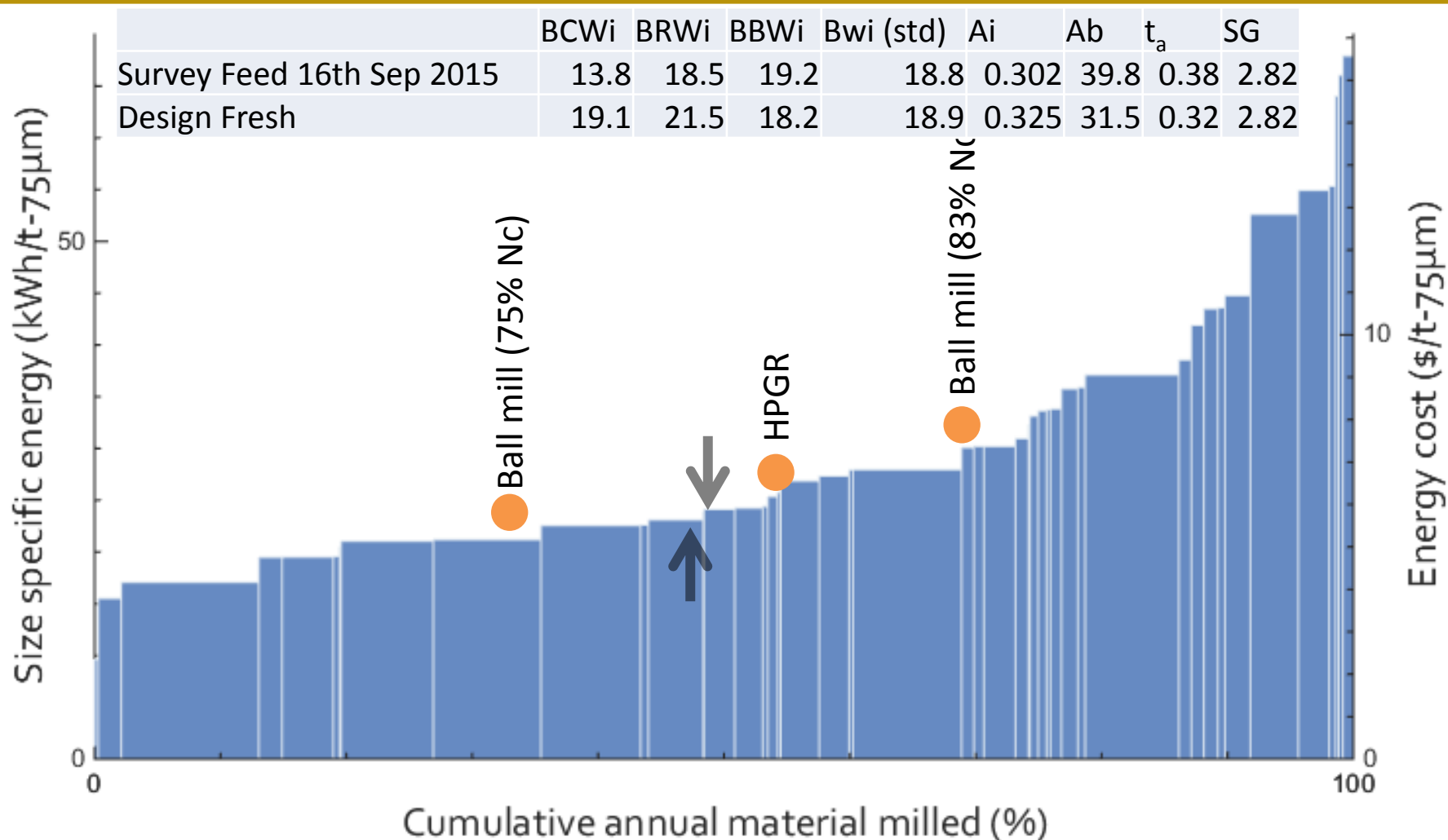
Tropicana circuit – locked cycle test



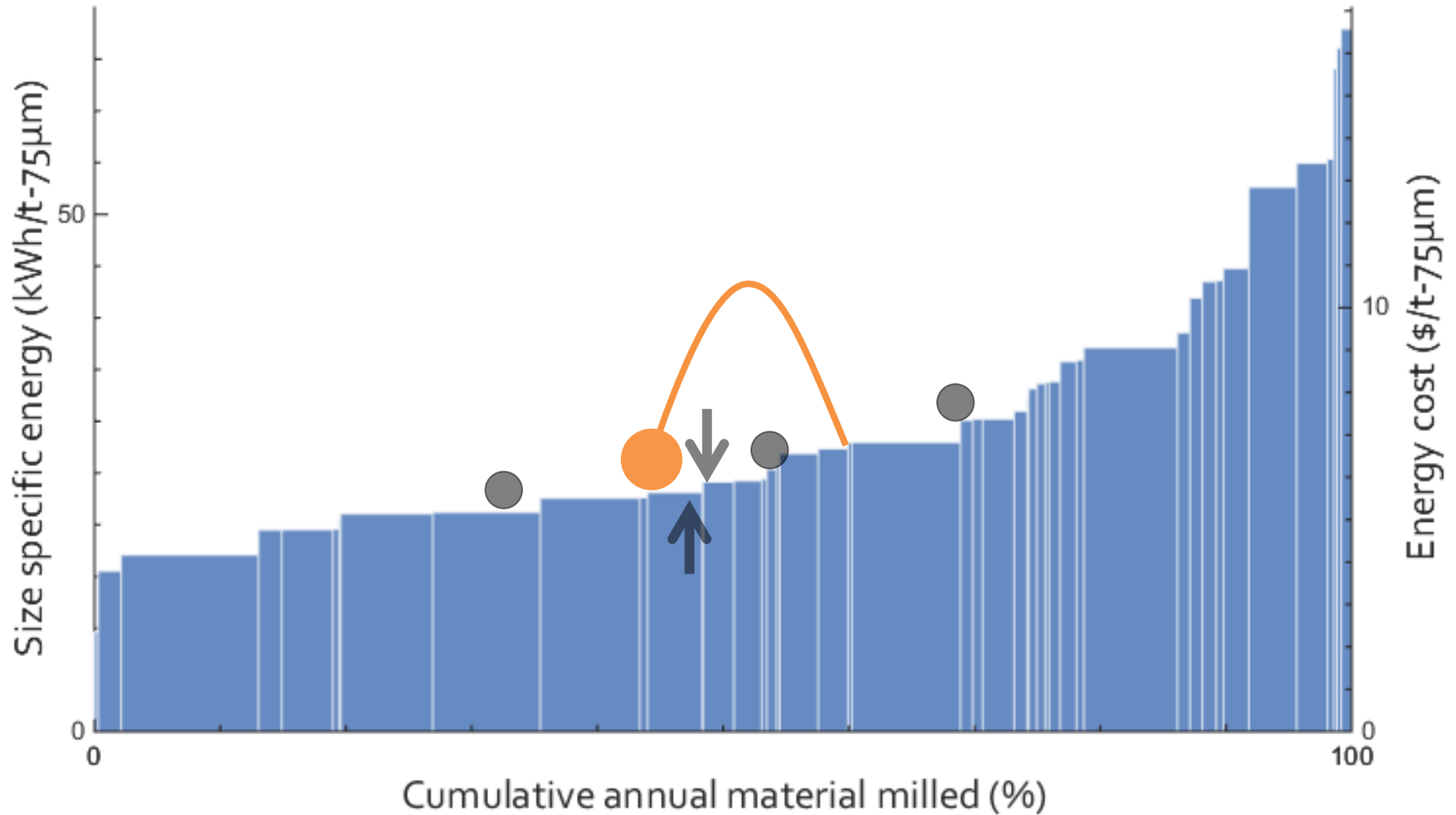
Tropicana circuit – Circuit design



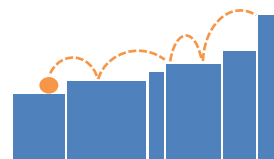
Tropicana circuit – Circuit survey



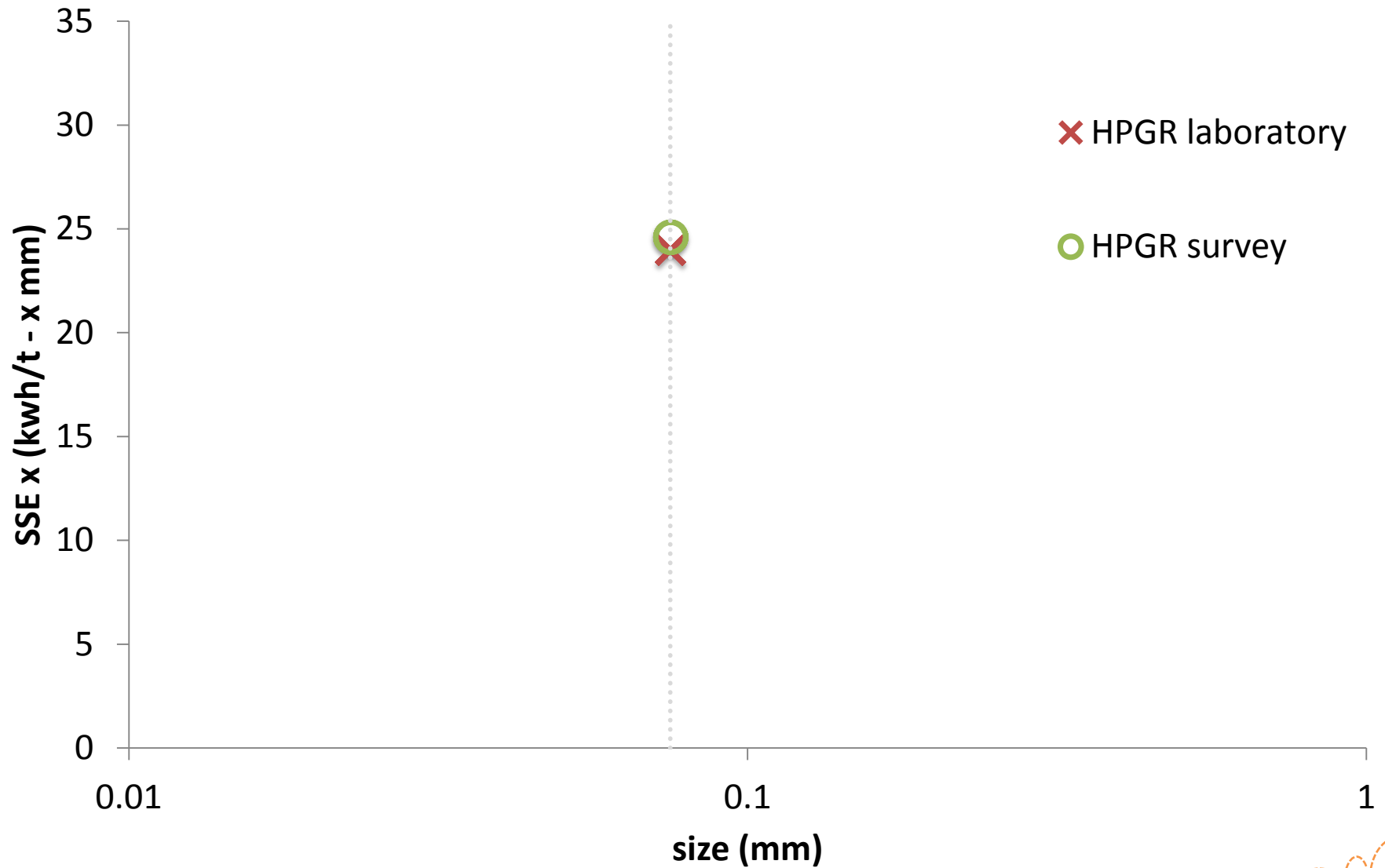
Tropicana circuit – Operational improvement*



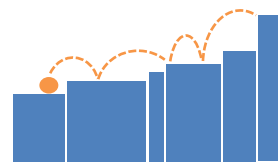
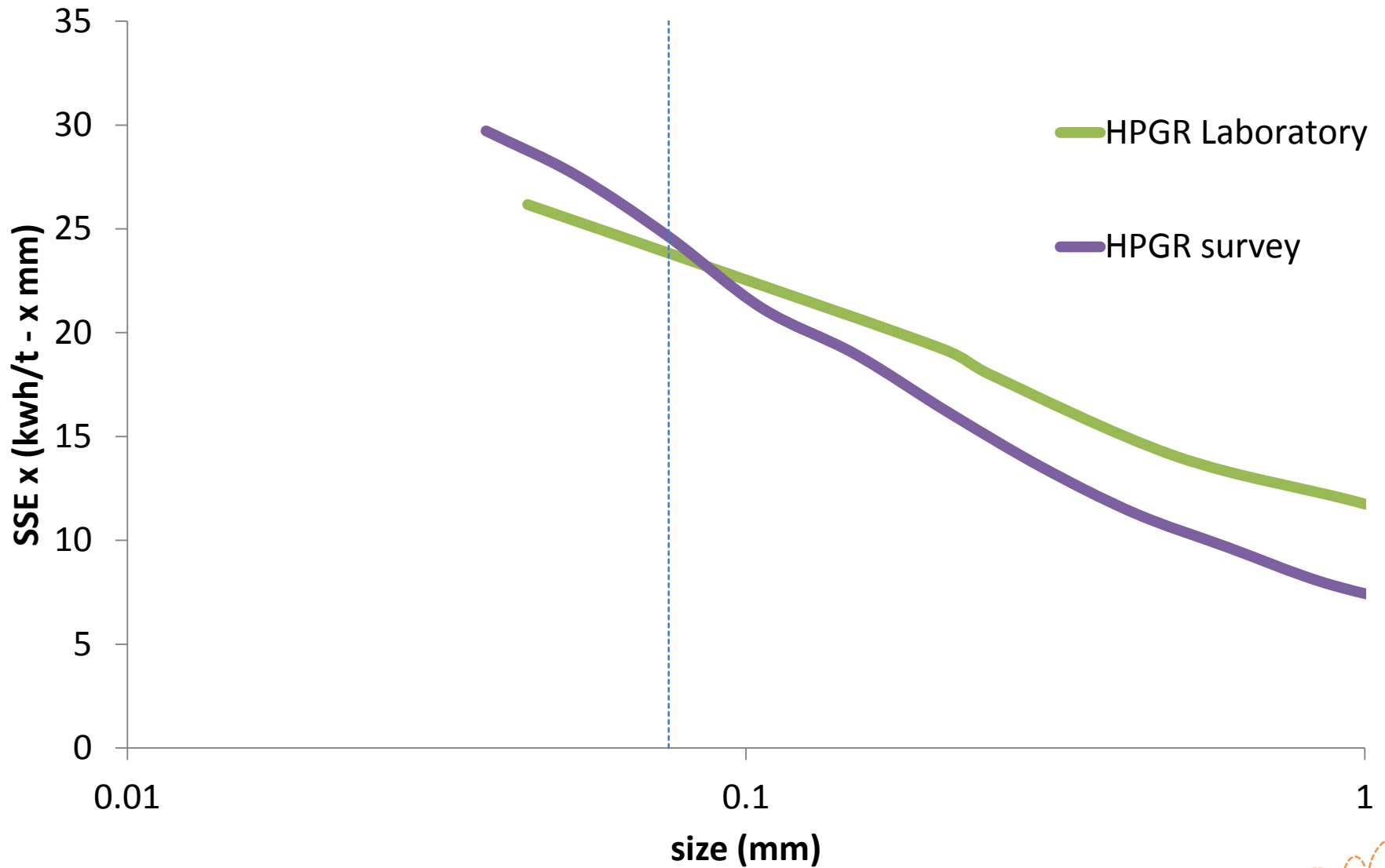
* to be validated



Size Specific Energy



Size Specific Energy (marker size dependency)



Next steps for the energy curve

individual site's energy costs

ancillary equipment such as conveyors and pumps

embodied energy of consumables

effect of circuit type

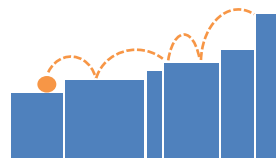
variability of individual equipment, rather than circuits

globally relevant hardness measurement combining Bond, A^*b and Morrell

calibration factor for fine grinding to obtain an equivalent SSE75

relationship between grind size, recovery and liberation

comparison of disparate commodities in a fair and equitable manner



Acknowledgements and Questions

Mike Di Trento and Nick Clarke from AngloGold Ashanti

Fred Kock and Brian Putland from Orway Mineral Consultants

Sarah Boucaut from the Coalition for Eco-Efficient Comminution

