

## CHAPTER TWELVE - RECOMMENDATIONS

From the research undertaken a number of new perspectives on the production of low grade export higher ash products have been formulated. These include positive and negative effects on environmental issues, economic and techno-economic aspects and marketability options. The work undertaken covered a comprehensive investigation into aspects designed to prove the hypothesis highlighted in Section 1.1.1, and during the course of this work, a vast list of research questions arose that should be considered in more detail at micro-level in future research. Of these, the following topics are considered to be the most important and are therefore recommended for follow up research:

1. The behavioural aspects during utilisation of minerals in the high ash, low grade thermal exports need to be quantified in greater detail. This should include the role of the minerals and their ash constituents in co-firing processes, circulating fluidised bed combustion, fluidised bed gasification and potential IGCC utilisation applications. This research should include ash handling improvements and importantly thermal export blending opportunities.
2. Dry beneficiation has only been developed to the level of advanced industrial scale de-stoning applications of coarse coal in South Africa. This is undertaken using processes such as XRT Sorting, FGX Sorter Separation and Dry Jigging. However, it is recommend that further research be conducted on
  - a) the potential of dry separation to de-stone medium to fine (-10+0.5mm) sized coal fractions and also
  - b) the potential to beneficiate low ash coal products from higher ash ones using dry dense medium separation of South African coal.
3. In the research undertaken it was found that integrated wet and dry processing circuits could provide an optimised environmental and economic model for the production of both high and low grade thermal coal exports. However, further research is required to establish detailed resource and environmental models for resource-to-market thermal coal operations in order

- a) to limit the use of water and the potential impacts of water through acid mine drainage and
  - b) to reduce carbon footprint both on mine and operations through use of less power in the wash plants
5. It is recommended that the research undertaken be applied to other coalfields where the raw coal qualities vary considerably and similar resource limitations exist like in the Botswana Coalfields.
6. Future research on the petrographically-determined microlithotype associations of mineral and maceral distributions should also be undertaken and the results applied to coal processing parameters. Such characterisations would undoubtedly correlate with washability analyses, yields and quality relationships. They could provide reasons, for example, for the correlation between carbominerite, surface chemistry and near gravity material all of which have been shown in this thesis to influence beneficiation effectiveness. In addition to thermal coal, this could also prove essential in predicting the yields and optimising the production of coking coal fractions in beneficiation processes.
7. It is furthermore recommended that the philosophy and process of optimal thermal coal grade product identification presented in this thesis be used for maximum triple bottom line benefit and actualisation. This could be of considerable relevance for the assessment and evaluation of thermal coal resources in South Africa in future. This process would entail an investigation into the following aspects:
- a) Whether the colliery or coal reserve under review can provide reasonable market flexibility with the coals on hand
  - b) Which combination of thermal coal export products, high or low grade, would will deliver maximum techno-economic value.
  - c) What impact the ash constituents in the various products grades would have on utilisation, as determined by the models developed in this thesis.
  - d) What the effect of blending of high and low ash products would have on the ultimate product when used in a thermal process.

- e) Whether the occurrence of various petrographic components in the various grade thermal coal products would permit the prediction of reactivity of the coal in various processes.
- f) Whether it would be possible to estimate and compare the energy recovered in relation to the emission index (CO<sub>x</sub>, SO<sub>x</sub>, NO<sub>x</sub>, HAP's including trace elements) for the various grade thermal coal products as modelled.

In closing, it is recommended that the research undertaken in this thesis be utilised as a forerunner in the estimation of the role that thermal coal exports could play in the future of South Africa as seen from GDP and foreign exchange generation and domestic power production perspectives. The characterisation methodology and modelling concepts developed in this thesis may well give clarity on the true techno-economic value of lower grade thermal coal production for export and the impact that this would have on the supply of thermal coal for domestic power generation. Energy security is of paramount importance the world over and the balance of export to domestic use of coal is vital to this country's economy, both now and into the future. It is hoped that the research undertaken in this thesis, and the recommendations listed above, will aid in establishing the answers to these issues.