COAL AND THE ZIMBABWEAN ECONOMY

A PRESENTATION TO THE
GEOLOGICAL SOCIETY OF ZIMBABWE
25/09/20

1.0 INTRODUCTION

- By way of an introduction, coal is a major energy source for many countries, including Zimbabwe;
- Energy is a prerequisite to economic development; and
- The prosperity that economic development brings, in turn, stimulates demand for more and better–quality energy services.

1.1. ENERGY A PREREQUISITE FOR ECONOMIC DEVELOPMENT

- Energy is a prerequisite to economic development of any nation; and
- Energy is deeply implicated not only in the **economic**, but also in **social** and **environmental dimensions** as follows:

1.1. ENERGY A PREREQUISITE FOR ECONOMIC DEVELOPMENT

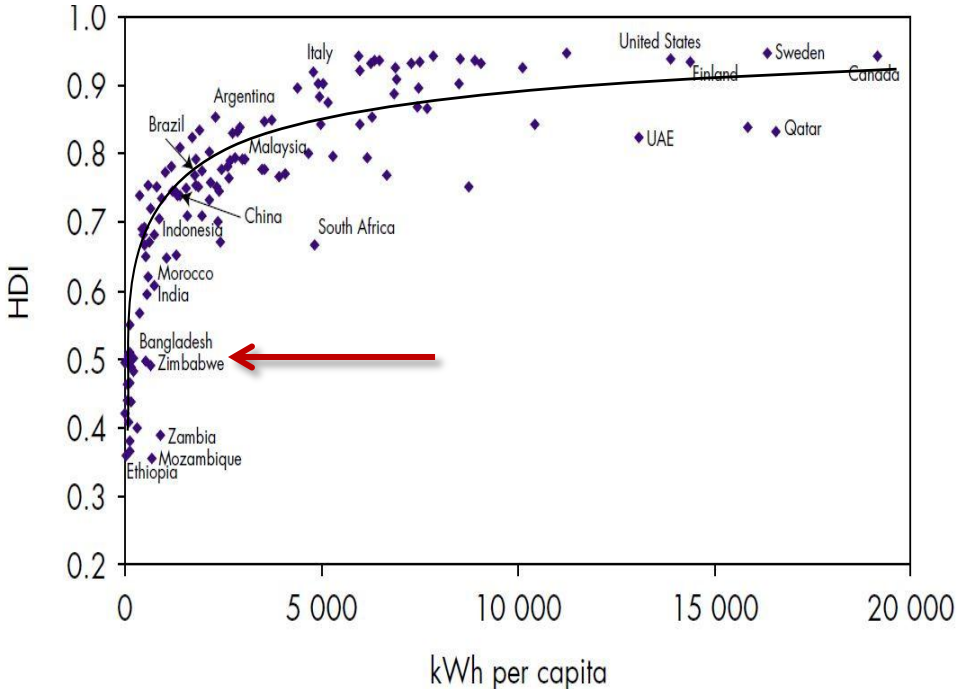
- It is an essential input to economic activity (mining, manufacturing, etc);
- Energy services enable basic human needs (e.g., food, and shelter) to be met;
- Building of infrastructure (towns, transport network, etc);
- Contributes to social development by improving education and public health; and
- Modern energy services can improve the environment (e.g., by reducing pollution caused by using inefficient equipment and by slowing deforestation).

1.2 ENERGY & HUMAN DEVELOPMENT

- Economic development is only one means, **although a vitally important one**, of extending the range of human choices;
- Studies by the UNDP has established a complementary relationship between the level of energy utilisation and economic growth; leading to the emphatic statement: “The **economic development** of any nation is directly **proportional to the production and utilisation of energy**.”

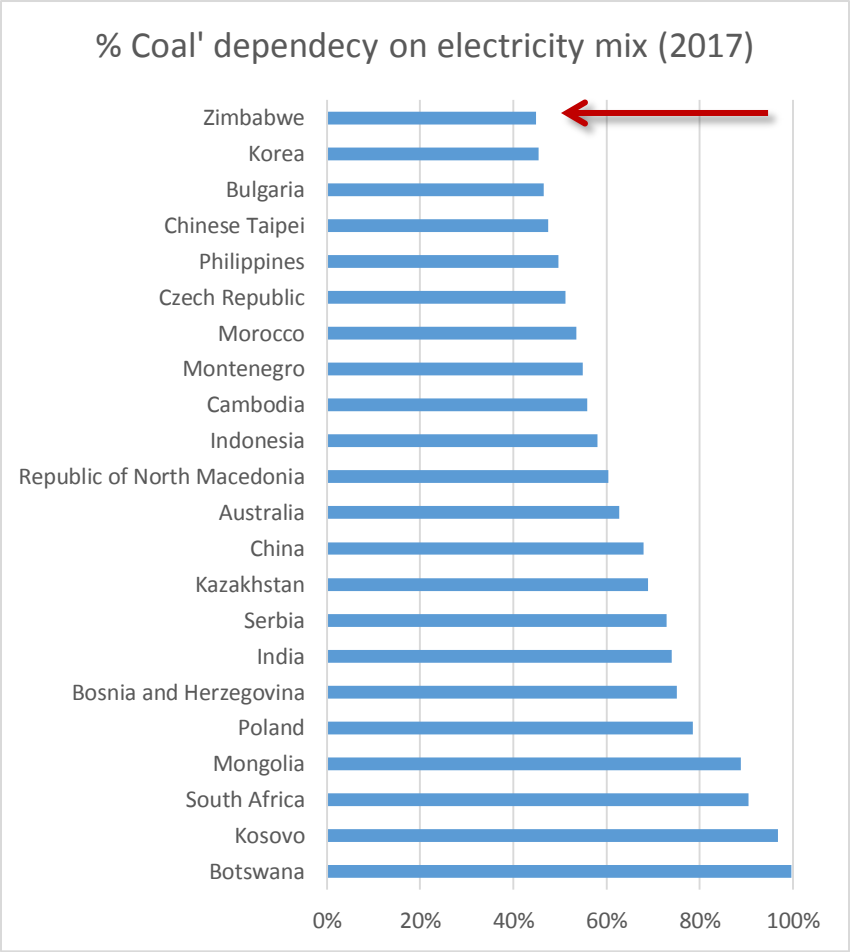
1.2 ENERGY & HUMAN DEVELOPMENT (Cont'd)

- UNDP has developed a set of numerical indices designed to measure the stage of human development in individual countries
- One such indices is the ***Human Development Indices (HDI)*** *shown on the graph opposite (Source IEA 2004)*
- This measures life expectancy at birth; adult literacy and school enrolment; and per capita GDP (adjusted for purchasing power parity). The relevance of the HDI to my presentation lies in the role of coal in the human development in Zimbabwe; and
- Access to electricity is particularly crucial to human development.



2.0 ROLE OF COAL IN ZIMBABWE ECONOMY

- Endowed with abundant coal resources, some of which are of high quality, Zimbabwe, a developing country, was in 2017 reported to be one of the world's top 22 countries with heavy dependence on coal (graph opposite) for their energy needs (IEA Statistics, 2017).



2.0 ROLE OF COAL IN ZIMBABWE ECONOMY (Con'd)

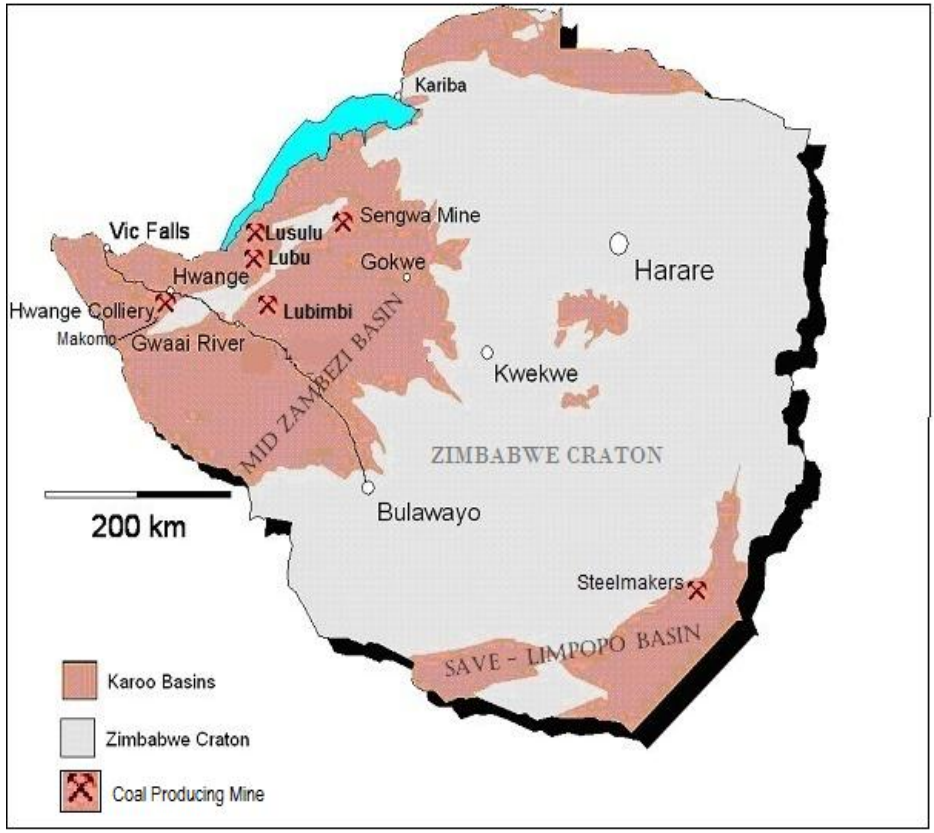
- From 1902, when the first coal load left the Hwange Colliery No.1 Underground Mine for the market, up to the commissioning of the Kariba Hydroelectric Power Plant in 1961, the country depended solely on coal for its energy requirements, except for the basic forms of energy sources such as firewood and cow dung utilized mainly by the rural population;

2.0 ROLE OF COAL IN ZIMBABWE ECONOMY (Con'd)

- While the International Energy Association (IEA) Statistics (2016) reports a global drastic decrease in coal combustion over the last decade and that hydro has been playing an increasing role as a source for electricity, in Zimbabwe coal remained the major source, as hydroelectricity has severely been affected by the vagaries of weather; and
- The country's Kariba Hydro-electric Plant has been forced into temporary decommissioning due to the dam water falling below critical levels for power generation.

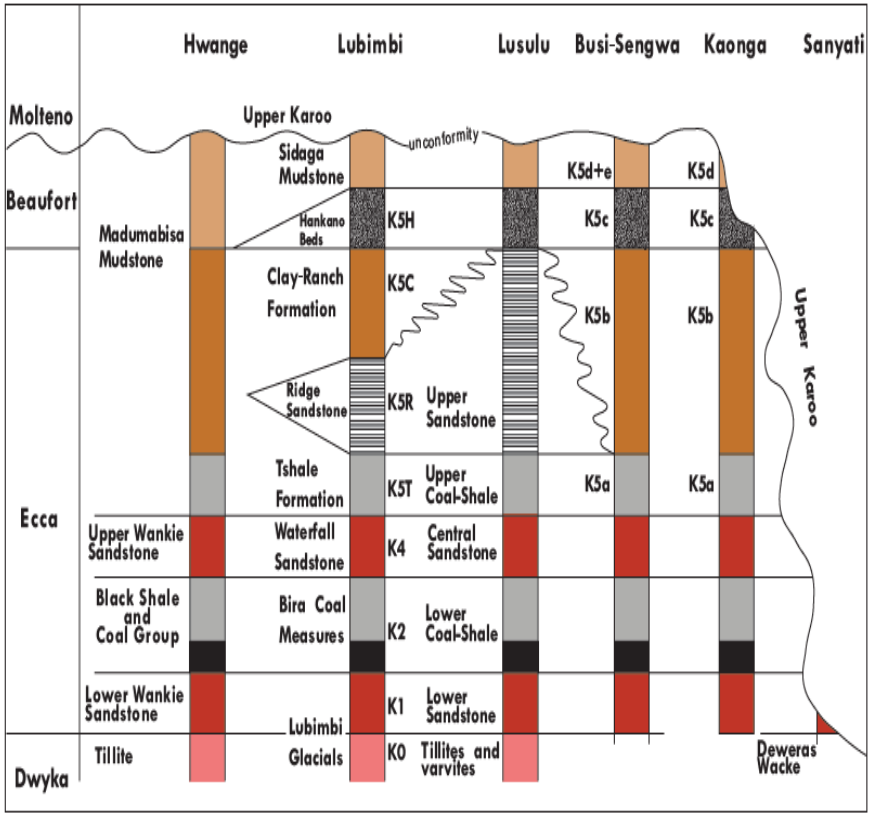
3.0 THE GEOLOGY OF ZIMBABWEAN COAL

- Coal measures are part of the Karoo sequence preserved within the confines of modern day Zambezi and Save-Limpopo valleys;
- At least 26 coal-bearing areas are known todate, with many more yet to be discovered;



3.0 THE GEOLOGY OF ZIMBABWEAN COAL (Cont'd)

- For most of the deposits exploited todate, only one seam, the main seam, (K^2) is economically workable and is todate the source of coal for the industry; and
- The K^2 is correlateable across the Mid-Zambezi coal-bearing areas (see stratigraphic diagram opposite (after Lepper, 1987)



4.0 COAL THE BLACKSTONE THAT BURNS

- Coal is the end product of a sequence of biological and geological processes;
- It is a complex and heterogeneous combustible sedimentary rock that comprises organic and inorganic material containing as ash content of up to 50%;
- This complexity largely determines coal's acceptability and convenience in use, and creates a need for high-quality research work;
- To utilise coal most effectively in various technological processes, it is necessary to understand its as much of its properties as possible;

4.0 COAL THE BLACKSTONE THAT BURNS (Con'd)

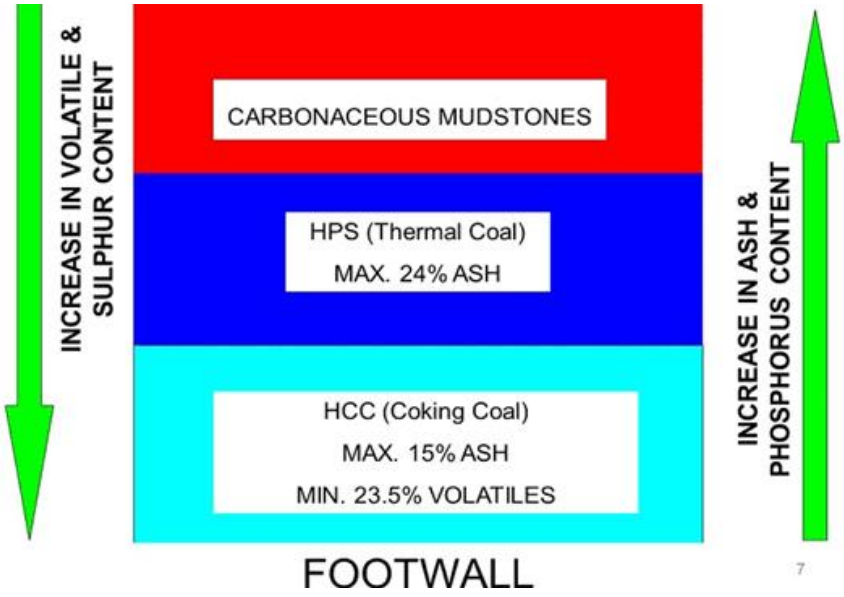
- The properties commonly considered include:
  - Coal grade: level of impurities in it and is a measure of the coal's quality;
  - Coal type: relative proportions of and organic matter (macerals: building blocks) and inorganic material;
  - Calorific value (CV): the amount of heat generated by combusting a specific amount of coal; and
  - Coal rank: the level of maturity or degree of metamorphism/maturation.

5.0 PROPERTIES OF THE HWANGE K^2

- Coal Grade
- Coal Type
- Calorific Value
- Coal Rank

5.1 COAL GRADE

- Typified by the K^2 at Hwange, there is systematic vertical variation in coal quality (ash, volatile matter and sulphur and phosphorus) from the bottom to the top of the seam.
- Based on this variation the seam is subdivided into three geological horizons as seen on the diagram opposite;
- Low ash and high volatile matter coal (high grade) at base and high ash and low volatile matter (low grade coal) towards top of seam.

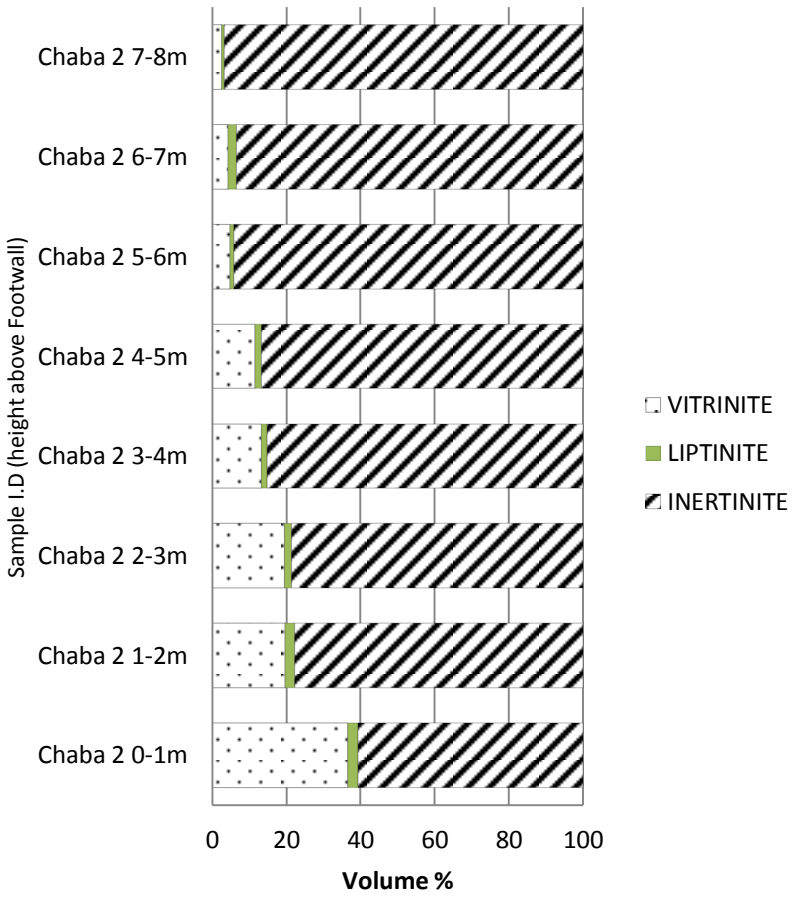


5.2 COAL TYPE

- Reactive (vitrinite) dominates at the base
- Inertinite progressively becomes the dominant maceral towards the top of the seam.
- Thus the first metre above coal footwall, which has sufficiently high vitrinite content will make good coking coal, while the progressively high inertinite supernatant layer is non coking.

NB i)Liptinite which typically occurs is small amount is also reactive.

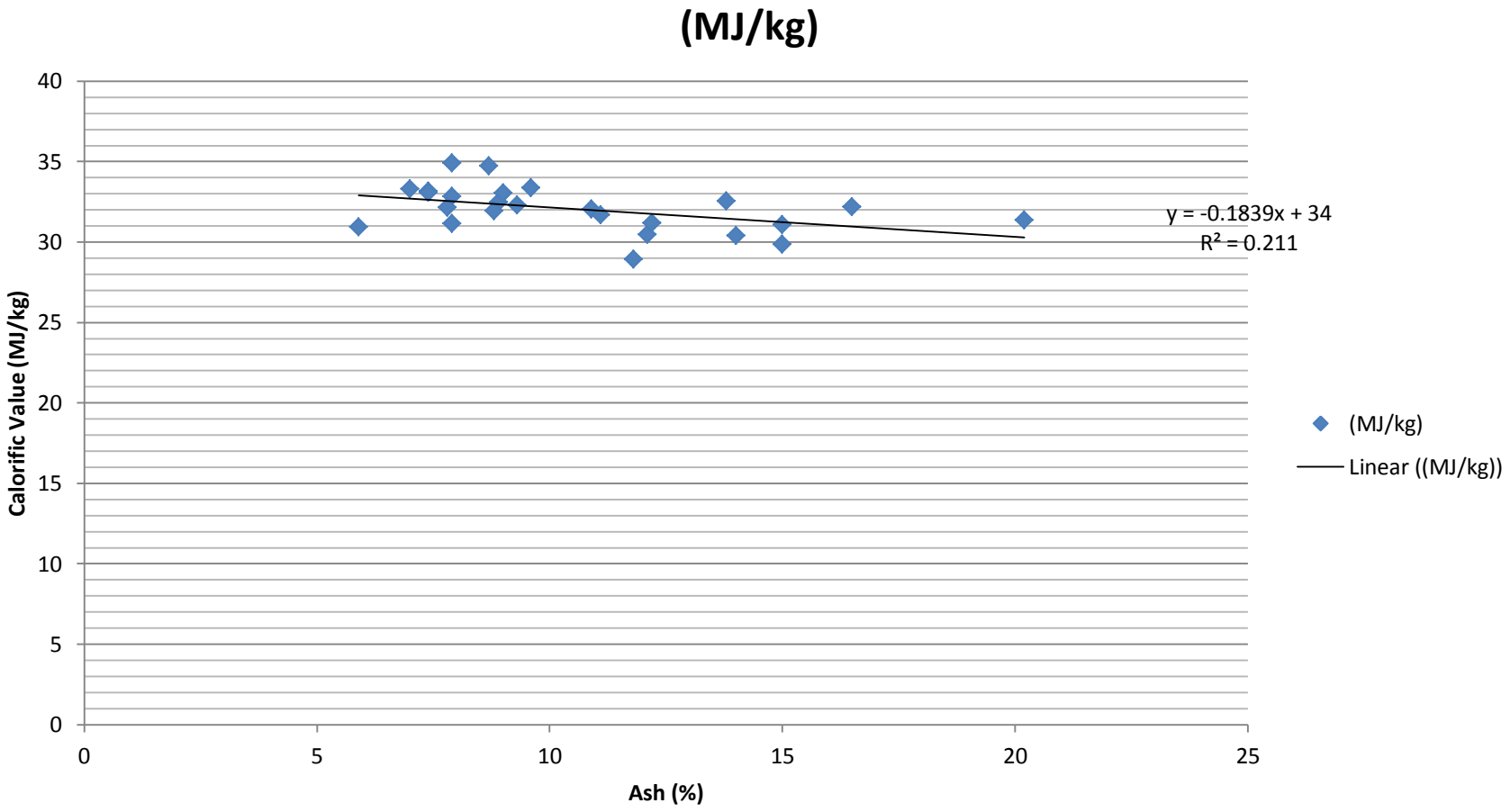
ii) The mineral matter (inorganic component) increases with distance above footwall.



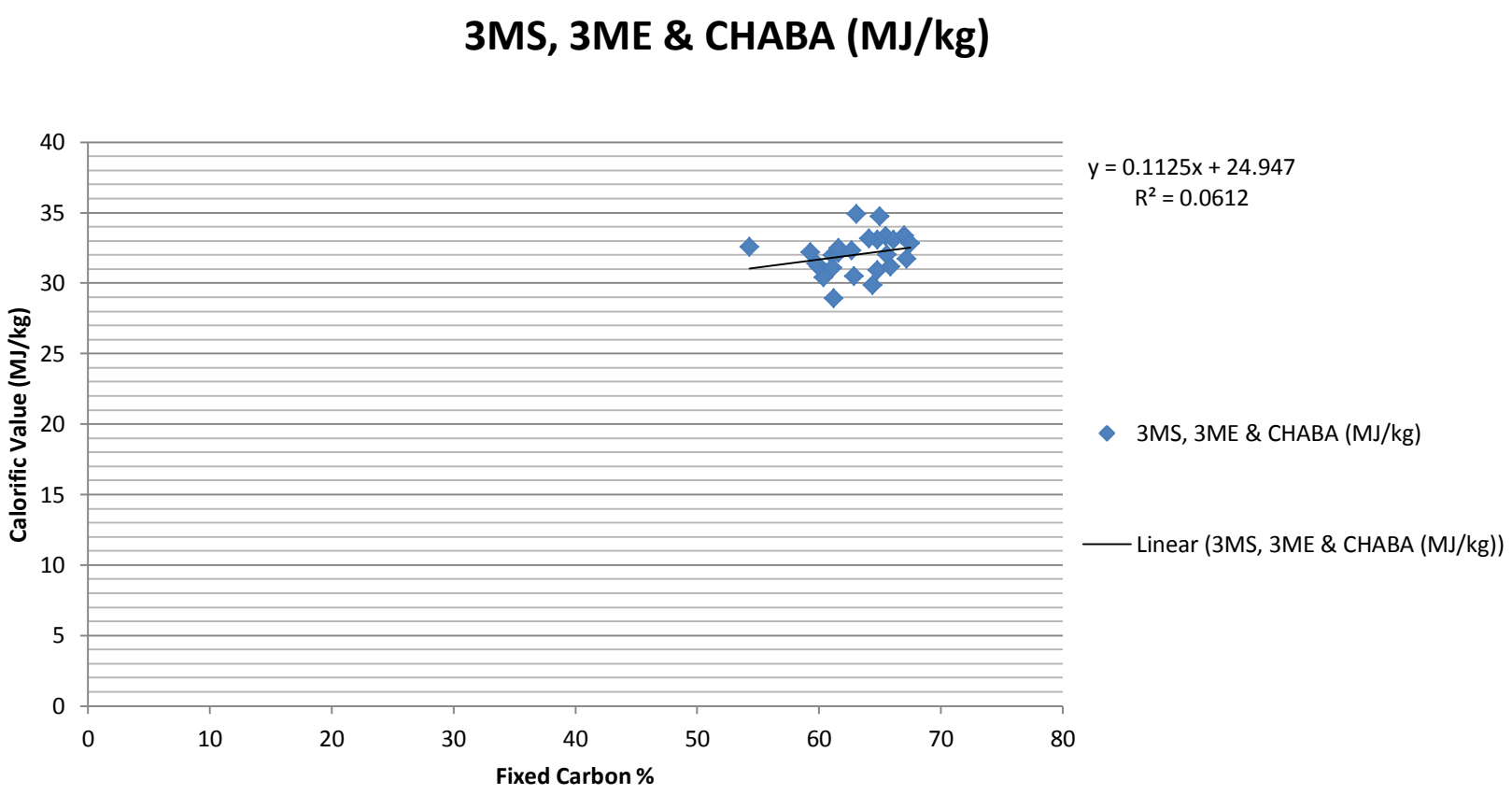
5.3 CALORIFIC VALUE OF HWANGE ^{K2}

- Studies carried out on the K^2 of the Hwange Coalfield reveal that the calorific values of the coal range from 28 MJ/kg to 35MJ/kg;
- The relationship of CV and Ash as well as Fixed Carbon is shown on the slides below;
- There is a linear relationship between CV and ash yield, as well as CV and Fixed Carbon; and
- The correlation coefficient (R^2) between CV and yield and that between CV and Fixed Carbon are 0.211 and o.0612, respectively.

CROSS PLOT OF CV AND ASH CONTENT FOR K[2]

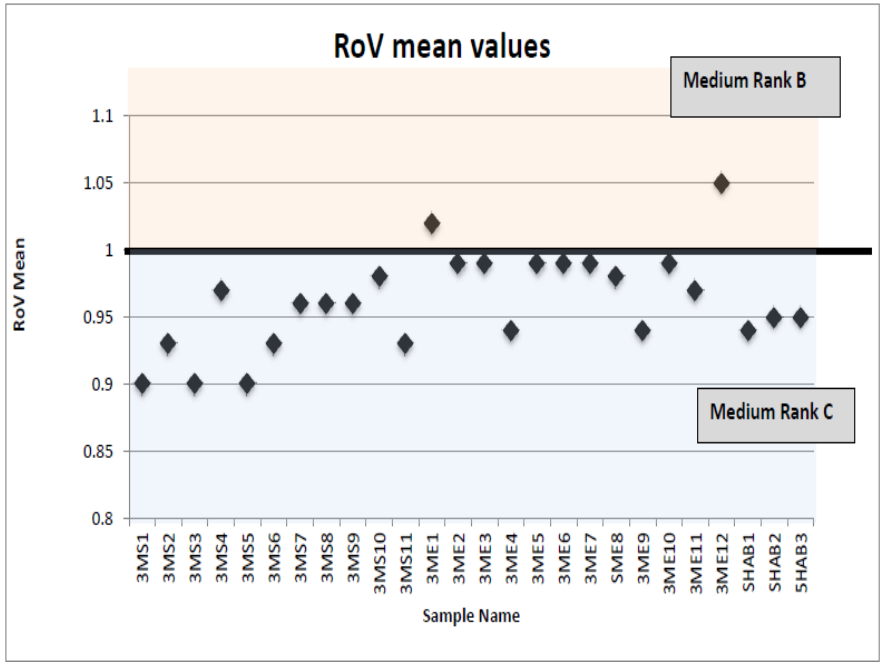


CROSS PLOT OF CV AND FC FOR K²



5.4 COAL RANK

- The K^2 is Bituminus in rank.
- It is dominantly of Medium Rank C, with a two samples falling in the Medium Rank B, but outside the range of 1.1 -1.45 which defines the prime coking coal. However;



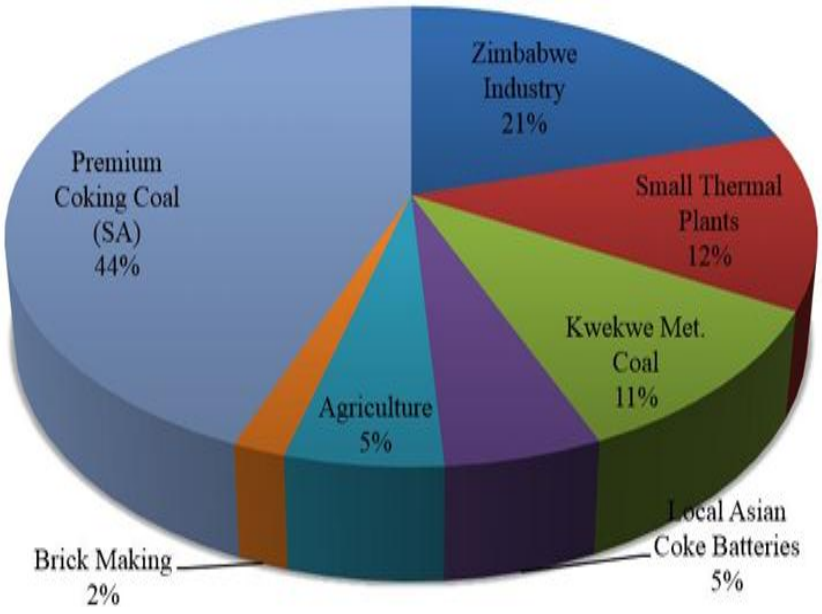
5.4 COAL RANK (Con'd)

- Vitrinite reflectance determination puts the Hwange coals into a blend of Medium Rank C and B bituminous coal, with mean random vitrinite reflectance values ranging from 0.90 to 0.98%. The samples' reflectance values render coals to be considered accepted as blend coals;
- In terms of coal classification and utilisation, the results corroborate well with requirements of global and locally acceptable blend coking coal and are marginally acceptable for some prime coking coal ranges of rank.

5.0 ENABLERS

- Water: The coal-bearing areas occur in basins – along major rivers; while major aquifers do complement water resources;
- Transport: The main railway lines along the watershed, into neighbouring countries;
- Skills: Universities and Polytechnics producing thousand of graduates with the requisite skills;
- Labour-force: A trainable labour force (operators and artisans) is available; thanks to post independence policy on education for all at least to ‘O’ Level;
- Electric transmission lines – Zimbabwe is linked to the regional grid, besides the internal network of transmission lines.

6.0 MARKET STRUCTURE FOR COKING COAL, BLEND COKING COAL AND INDUSTRIAL COAL



- The pie graph (opposite) is the generalised market structure for coking coal, blend coking coal; and general industry coal (including small thermal power generation plants in Bulawayo, Munyati and Harare).
- It excludes the ZPC Thermal Plant in Hwange, which takes coal with ash values 16 – 30% (average 24%) and their off take accounts for at least 70% of coal production in the Hwange area.
- The pie chart represents some 30% coal production in the Hwange area where the Coal-fired electricity production plant is located. The rest is classified as Thermal coal is fed to the Hwange coal-fired electricity generating plant

NB. Premium coking coal refers to straight coking coal.

7.0 CONCLUSIONS

- Coal is a major source of energy in Zimbabwe.
- The properties of the Main Seams (K^2) as discussed above are consistent with almost, if not all, energy-related applications.
- These include:
  - Power generation,
  - Coke making for the metallurgical industry,
  - Cement making,
  - Agriculture
  - Gasification

7.0 CONCLUSION (Con'd)

- Manufacturing
- Food processing
- Petrochemicals
- Mining
- Socials (army, schools, hospitals and laundries heating).

- The application of coal in these technological processes have also enabled Zimbabwe human development to reach at the level it is now.
- In a developing country such as Zimbabwe coal will remain as a major source of energy. **Hydroelectricity** faces challenges from the **vagaries of weather**.

8.0 RECOMMENDATIONS

- With a growing global lobbying against coal, "the once **Super Energy** now a **Super Polluter",** Zimbabwe needs to embrace clean coal technologies such as:

➢ Using circulating fluidised beds coal combustion;

➢ Integrated coal gasification combined cycle (ICGCC)

➢ Underground coal gasification

➢ Coal-to-Liquid

For **King Coal** to retain its glory.

A holistic approach will see coal enabling Zimbabwe to meet the **UN Millennium goals**.

THANK YOU