

THE 'BLACK GOLD' OF HWANGE

A PRESENTATION TO GEOLOGICAL SOCIETY OF ZIMBABWE BY T.P.NYIRENDA, 25 OCTOBER 2019

“To shipbrokers ,coal was black gold.”
By Roald Dahl

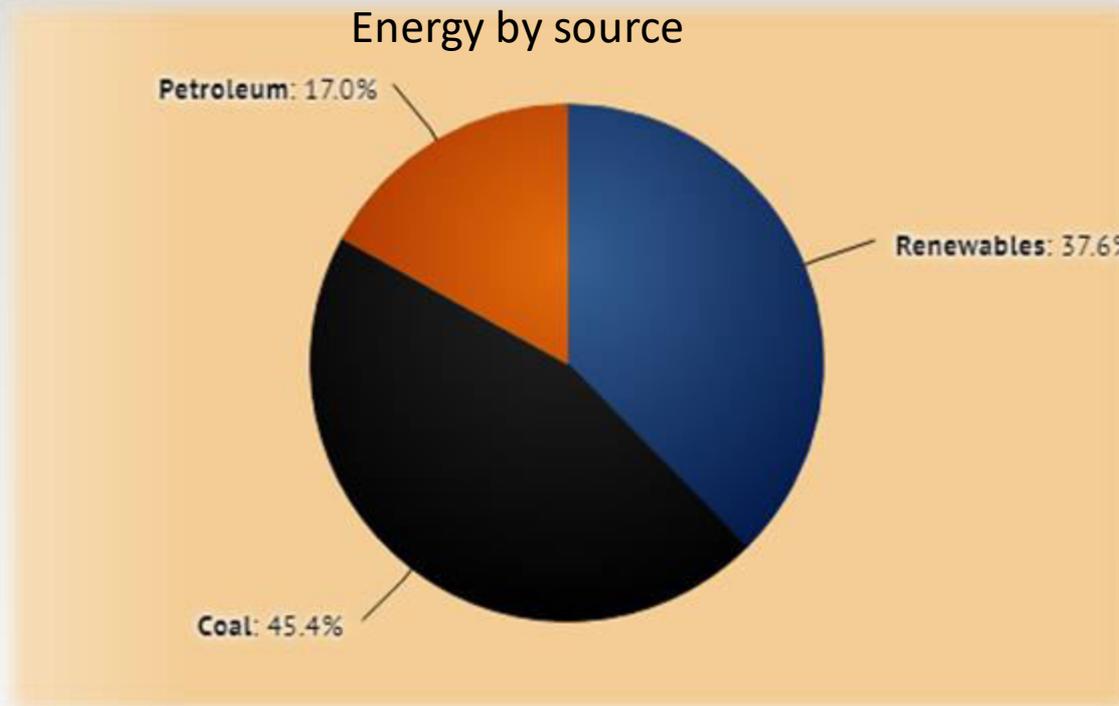


INTRODUCTION

It was coal, however, that underpinned the industrial revolution that changed the West from an agrarian backwater to the technological master of the world for the past three centuries. In recent decades emerging markets such as China have also embraced coal to power the factories that transformed it, and other Asian economies, into industrial powerhouses.



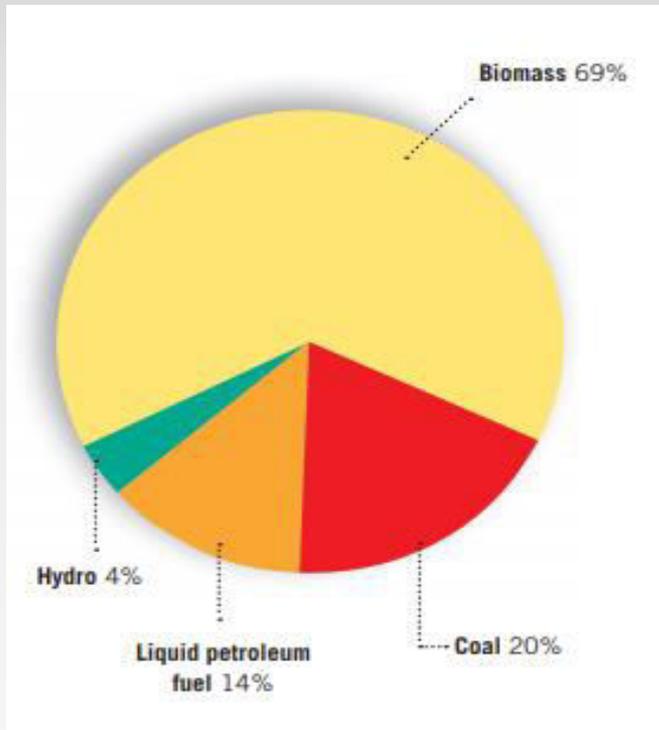
INTRODUCTION (contd)



International energy statistics 2015

Coal still provides around 45.4% of the world's electricity. However, climate change mitigation demands, transition to cleaner energy forms and increased competition from other resources are presenting challenges for the sector.

ZIMBABWE ENERGY USE



Zimbabwe source energy requirements are met through a combination of biomass, Domestic coal fired and hydro electric power plants and imports. The country is one of the developing countries with high dependency on coal as its energy.

COAL FORMATION

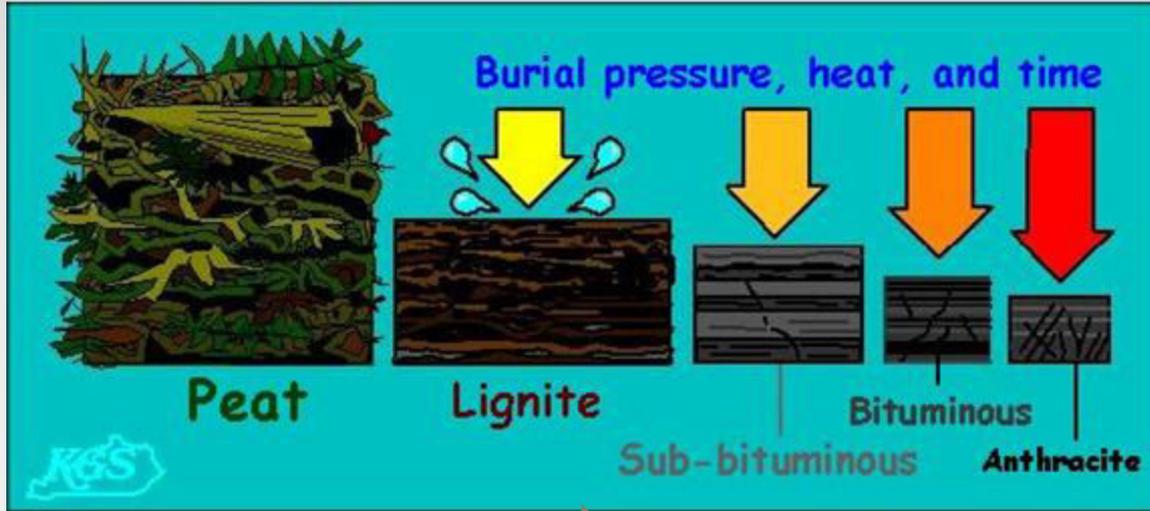


Coal is a black combustible sedimentary rock which was formed from prehistoric vegetation that originally accumulated in swamps and peat bogs.

It is made up of carbon, hydrogen, oxygen, nitrogen and lesser amounts of sulphur and other trace elements.

The process was preceded by compaction of the plant remains within the swamp. With time the swamp floor subsided creating a high energy environment which led to ingress of sediments that buried the vegetative matter.

COALIFICATION PROCESS



In the process the plant material was subjected to elevated temperatures and pressures leading to physico-chemical changes to the vegetative matter – transforming it into the organic rock or coal seam.

INCREASE: Relative density, Total fixed carbon, Calorific value, Vitrinite reflectance.

DECREASE: Porosity, Water, Volume

Ranking depends on the types and amounts of carbon the coal contains and on the amount of heat energy it produces.

COAL COMPOSITION

Coal is a complex commodity which is made up of:

- organic constituent-macerals analogous to minerals in organic rocks
- Inorganic components-mineral matter e.g quartz and feldspars
- Maceral determine coal type; while inorganic define grade of coal

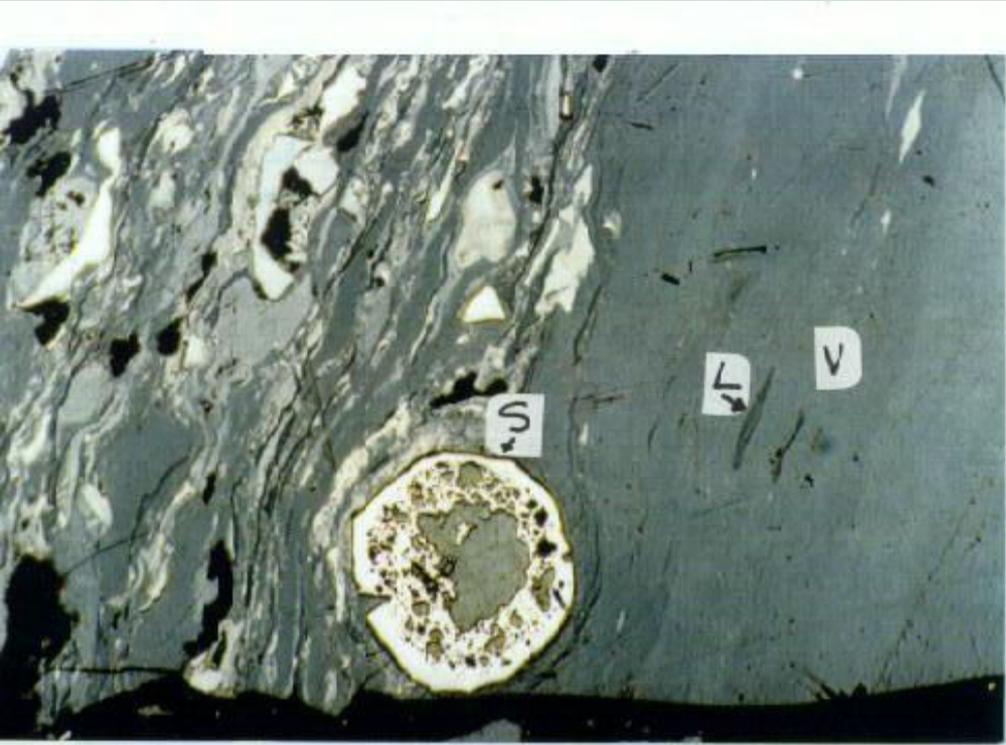
COAL COMPOSITION

Macerals fall into two main groups

REACTIVES-e.g. vitrinites formed under anaerobic conditions, decomposition of plant product of plant cellulose walls and lignin

NON REACTIVES- e.g. inertinites formed under aerobic conditions, charcoal from fires that occurred in the peat bogs during early deposition.

COAL MACERAL



Photomicrograph showing extensive vitrinite (V) on the right, notched and circular infilled sclerotinite (S), small spore (L) within vitrinite. The left of the photograph is characterised by mixed macerals

COAL QUALITY



Not all coal is composed of same compounds. Different types of coal are characterized by their unique properties, which produce different results when burnt.

These properties are empirically determined by coal quality tests

The most basic test is the proximate analysis that determines the amount of moisture, volatile matter, fixed carbon and ash that are in coal.

Another coal test is the ultimate analysis which indicates the major elements in coal such as sulphur, phosphorus, iron

COAL QUALITY (CONTD)

Ash

- consists of impurities(inorganic matter) in the coal such as silica ,iron aluminium and other incombustible matter(clay)

Volatile

- It is consist of various gaseous products which is generated when the coal is heated in absence of air at temperature more than 900 degrees. The gases, consists of combination of carbon and hydro-aromatic compound.

Moisture

Is the water in the coal.

KAROO BASINS OF ZIMBABWE

- These basins contain subsidiary basins (intrabasins) of deposition in which there are variations in lithology and succession, but the major ones can be correlated with each other.
- Karoo sedimentation commenced with deposition rocks of glacial origin known as the Dwyka Formation and terminated with extrusion of basaltic lavas known as Batoka Basalts.
- The interval between the two is made up of true sediments which have varying grain sizes and composition, depending on the source of the sediments and the environment of deposition prevailing at that time.

KAROO STRATIGRAPHY OF MID ZAMBEZI BASIN

PERIOD	SOUTH AFRICAN EQUIVALENTS	MID-ZAMBEZI VALLEY		
Lower Jurassic	Drakensberg Fm.	Batoka Basalt	(kB)	
	Clarens	Forest Sandstone	(k10)	
Triassic	Molteno Fm.	UPPER	Pebbly Arkose	(k9)
		KAROO	Fine Red Marley Sandstone	(k8)
			Ripple Marked Flags	(k7)
			Escarpment Grit	(k6)
		Beaufort Group	<i>Unconformity</i>	
Permian	Ecca Group		upper	
			middle	
		Ma dumabisa Mudstones	lower	(k5)
		LOWER	Upper Wankie Sandstone	(k4)
		KAROO	Black Shale & Coal Group	(k3+k2)
			Lower Wankie Sandstone	(k1)
Carboniferous	Dwyka Fm.	Glacial Beds	(k0)	

Sedimentation took place under climatic conditions that ranged from cold to warm temperate, hot and arid conditions.

THE HWANGE BASIN

Four coal bearing areas

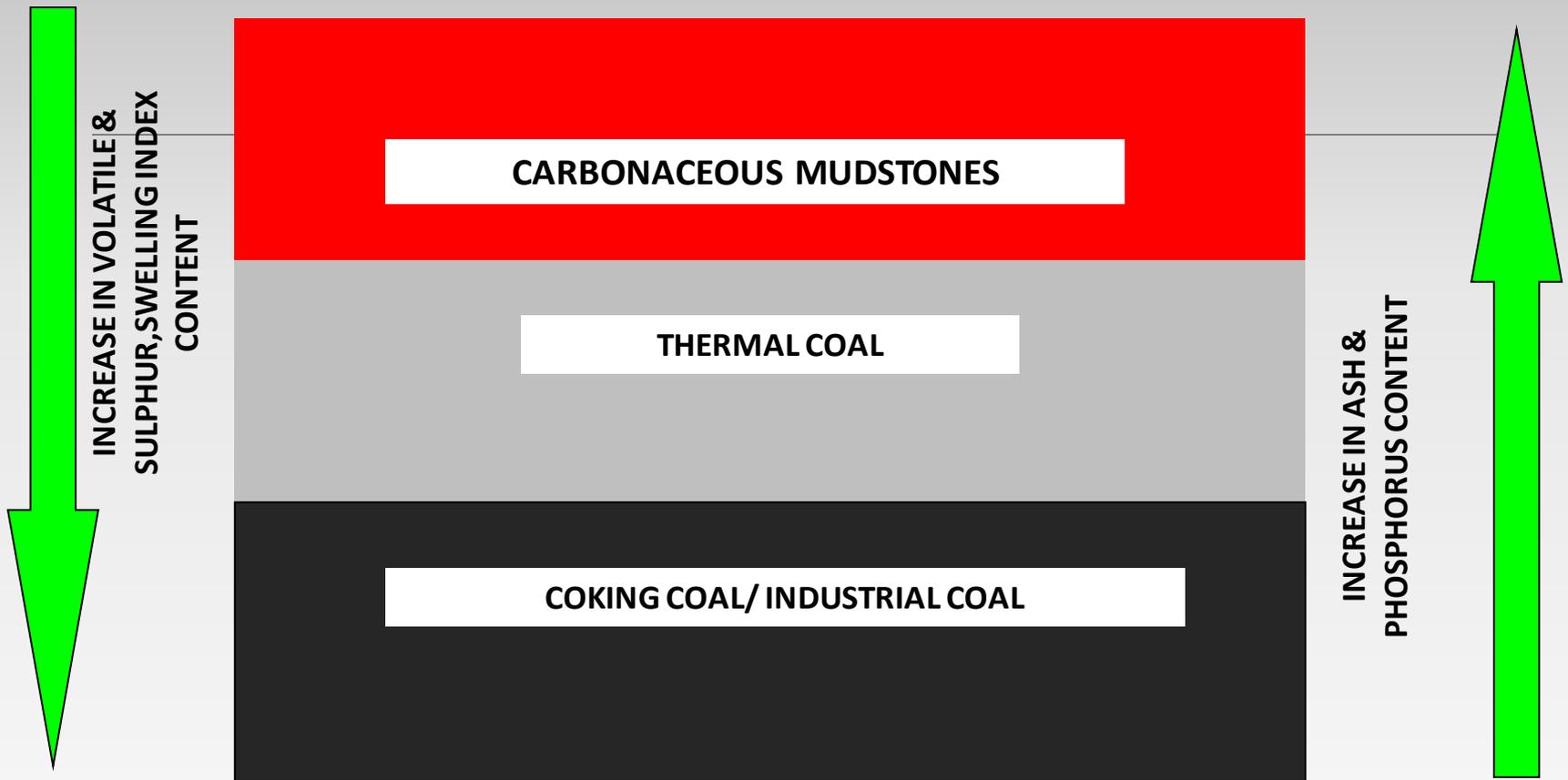
- ❖ Hwange concession
- ❖ Western Area
- ❖ Entuba –Lukosi
- ❖ Sinamatella

Data from Hwange Concession is used as reference for benchmarking. The concession has been developed and fully exploited for coal.

HWANGE COAL SEAMS

- ❖ Generally coal seams may differ from one deposit to another but they have similarities such as
 - ✓ Coal is mainly bituminous in rank
 - ✓ Coal seams are flat and un-deformed to moderately deformed.
 - ✓ Generally thick with systematic vertical variations of quality parameters e.g the Hwange Main seam.
- ❖ Coal seams depth ranges from ~10m-400m

HWANGE MAIN SEAM



Lower Hwange Sandstone

- The basal layer is rich in reactive macerals
- Non-reactive (inert) macerals predominate towards the top of the seam. The basal layer was formed from in situ vegetative matter, whereas the overlying layers were formed from accumulation of drift material.

COAL MINING IN HWANGE



- ❖ Mining claims were pegged in 1893.
- ❖ Main incline shaft (No.1 Colliery) completed in 1902 and production commenced with coal transported by ox-wagon.
- ❖ Currently the common method of mining is the Opencast by truck and shovel. Underground room and pillar mining is at Hwange Colliery.

COAL PROCESSING IN HWANGE

Coal in its raw state is rarely suitable for customers as it contains material that will not burn such as shale, sandstone, pyrites e.t.c. In order to convert coal to saleable product the raw coal goes through a series of treatment in the form of;

- Crushing to reduce the very large coal to smaller sizes which meet market demand.
- Screening to produce various sizes required by the customers
- ❖ Coal requirements are based on chemical characteristics such as calorific value, phosphorus, swelling index etc.

COAL PROCESSING IN HWANGE (Contd)



- Washing is done to remove the incombustible material, remaining with clean coal. techniques. Relies on gravity and difference of density between coal and impurities
- ❖ Washing increases its efficiency and quality, therefore increasing price
- ❖ Density separation or by froth flotation

COAL GRADES EXAMPLES

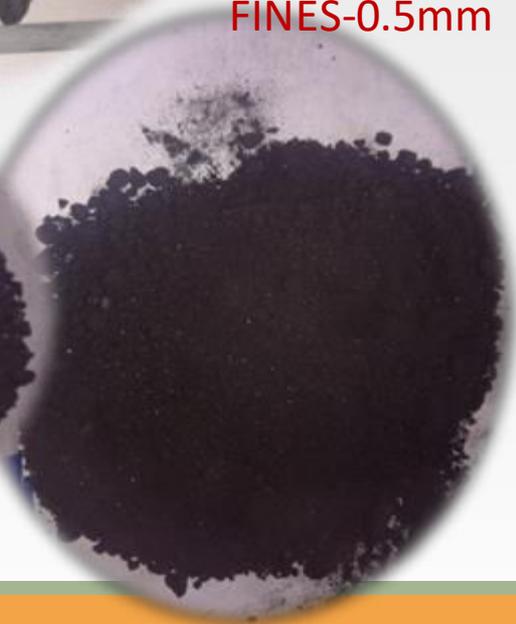
COBBLES +40mm to -100mm

NUTS +30mm to -40mm

DUFF +0.5mm to -10mm

FINES -0.5mm

PEAS +10mm to -30mm



COKE MAKING

- ❖ Coking coals are the coals which when heated in the absence of air, first melt, go in the plastic state, swell and resolidify to produce a solid coherent mass called coke. This is done in coke oven batteries.

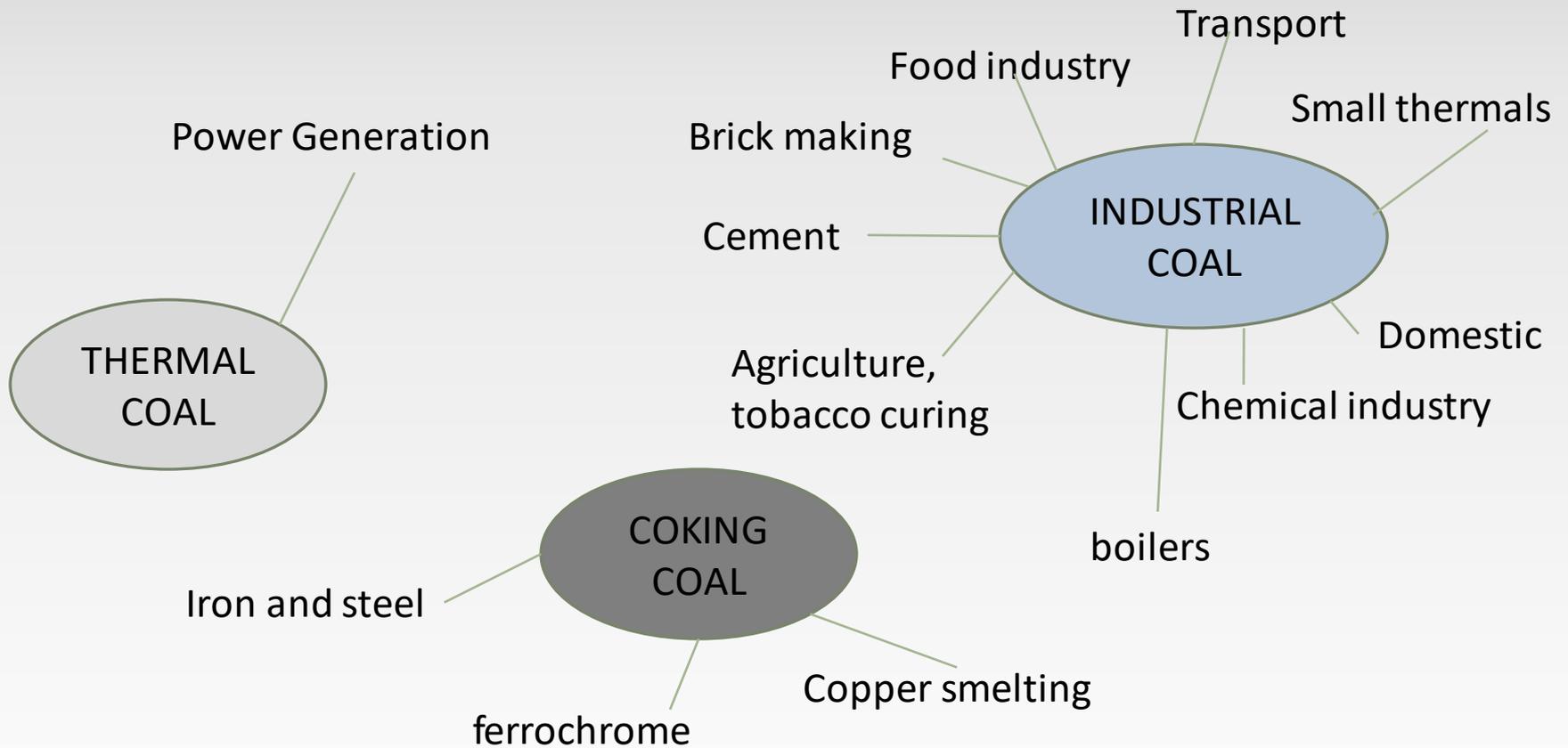


COKE PRODUCTS

GRADE	SIZE(mm)
Breeze	-10
Coke peas	-30+10
Coke nuts	-50+20
Metallurgical coke	-60+20
Foundry coke	+80



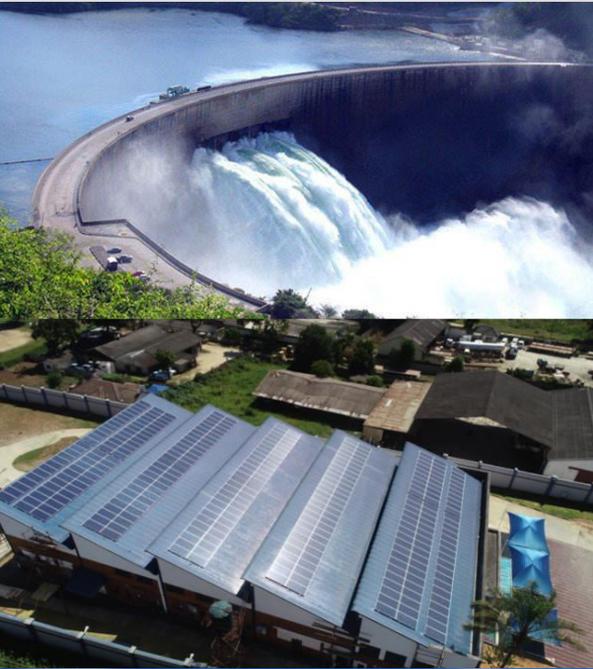
STRATEGIC IMPORTANCE OF COAL IN THE ECONOMY OF ZIMBABABWE



THREATS OF COAL MINING

- ❖ Spontaneous combustion
- ❖ Acid mine drainage
- ❖ Permanent changes to landform
- ❖ Air pollution
- ❖ Ill-Health

FUTURE OF COAL???



Coal is at the centre of debate on energy and climate policy.

In a growing number of countries, the elimination of coal-fired generation is a key climate policy goal while in others, coal is abundant and affordable and remains the key source of electricity.



CLEAN COAL TECHNOLOGIES?

Renewables Aren't Enough. Clean Coal Is the Future???

**CO-FIRING WITH BIOMASS – 1:1 coal:biomass
reduced CO₂ by 50% ?**

- **UNDERGROUND GASIFICATION ?**
- **CO-GENERATION - use of waste heat ?**
- **HYBRIDISATION - coal and solar ?**



THANK YOU!