AUVIV

THE NEW ERA

ENERGY STORAGE SYSTEMS
MATERIALS, DESIGN AND PRODUCTION
AS THE AVENUE FOR ZAMBIA'S PROSPERITY

Professor Clive Chirwa

22 June 2022

Technology Transfer Public Lecture
"Zambia's Natural Resources In Downstream Industries"
22nd June 2022, Government Complex, Lusaka, Zambia

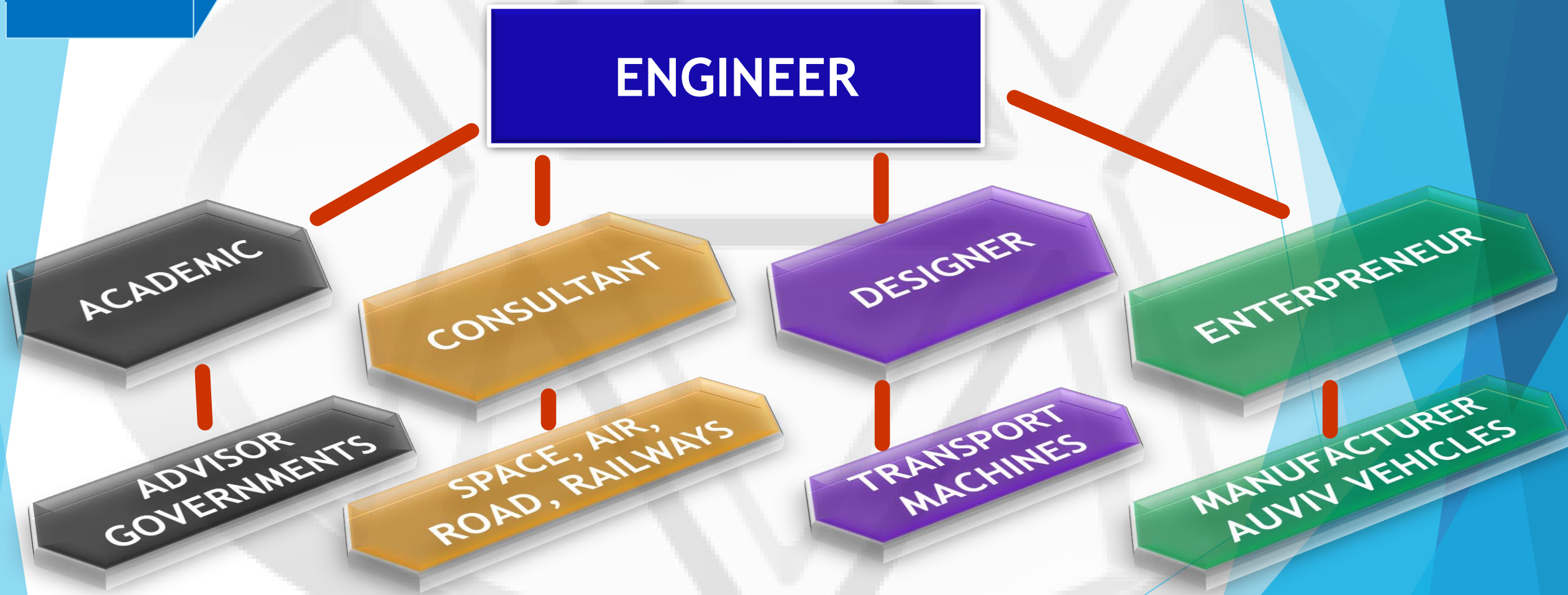
AUVIV® ENGINEERING DIVISION

The Engineering Institution of Zambia

PRESENTATION OUTLINE

1. Introduction
2. Background
3. Value Addition As the only way to help Zambia move out of poverty
4. Increase in National Revenue and improved “GDP”..Revenue….
4. Downstream activities propelling National Economy and Development
5. The creation of Primes by Government
6. The multiplier Tier Industries
7. Conclusions

LET ME INTRODUCE MYSELF



LET ME INTRODUCE MYSELF

BAARG
Bolton Automotive & Aerospace Research Group

FOUNDER
1992-2014

FOUNDER &
EDITOR-IN-CHIEF
1996

Clavel Group
Engineering Consultants

FOUNDER
1999-2014

AUVIV

FOUNDER
2017

www.auviv.com

AUVIV

PRODUCTS

PEOPLE CARRIERS

Minibus & Shuttle

AUVIV Maze Runner
16 Seater
5280L x 1700W x 2250H

AUVIV City Cruiser
22 Seater
5470L x 1885W x 2285H

AUVIV Cross Linx
26 Seater
5998L x 1885W x 2285H

AUVIV City Cruiser SE
15+ Seater
5470L x 1885W x 2285H

OPERATIONAL VANS

Security, First Aid, Dry Cargo & Perishable Goods

AUVIV Round Guard
Security Patrol Van

AUVIV Medix
Ambulance

AUVIV Enroute Pro
Dry Cargo

AUVIV Cool Ryder
Chiller & Freezer

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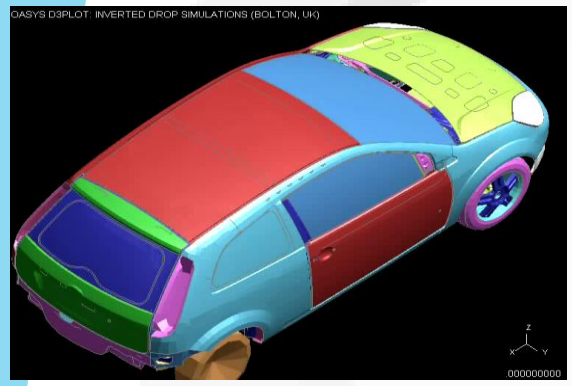
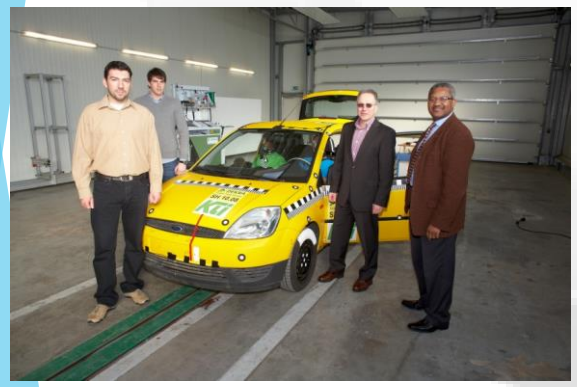
PRODUCTS FOR CLIENTS

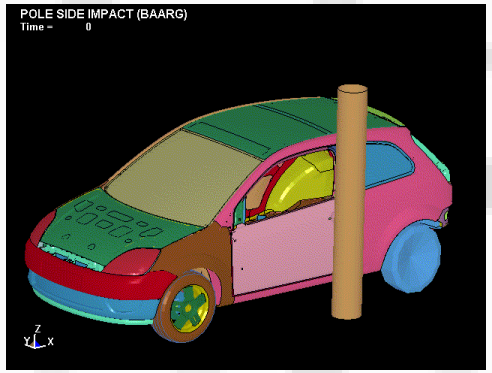
FORD FIESTA

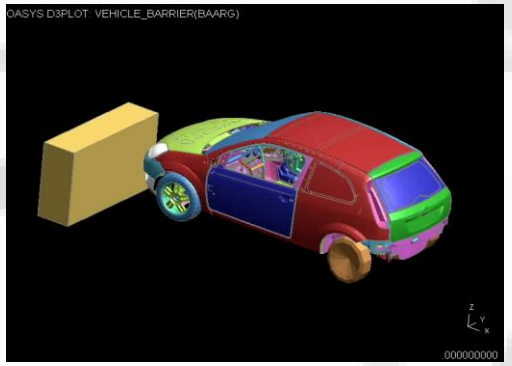
DESIGN & PROTOTYPE



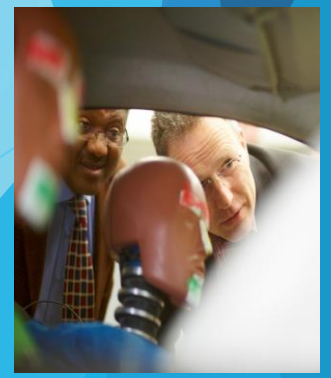


NUMERICAL & EXPERIMENTAL CRASH TESTING





POST CRASH ANALYSIS & VALIDATION



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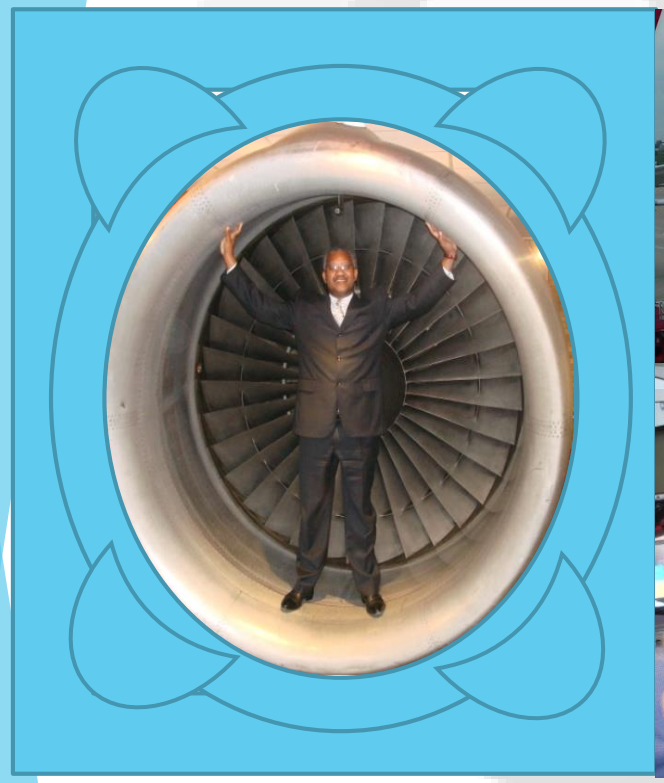
PRODUCTS FOR CLIENTS

DESIGN, SIMULATION & MATERIALS' TESTING



CELEBRATING THE SAFE LANDING OF CURIOSITY ROVER ON MARS

AIRBUS 380

NASA

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ADVISORY ROLE

Her Honourable The Secretary of State for Education Ruth Kelly MP with Prof Clive Chirwa at The University of Bolton Inauguration - 2005

His Honourable Under-Secretary of State for Science & Innovation Lord Sainsbury of Turvillle,Prof Mark Jones, Prof Clive Chirwa at the Aerospace Innovation Centre

UK GOVERNMENT

I HAVE ADVISED ON-AND-OFF
SINCE 1998 TO DATE:
UK DEPARTMENT FOR TRANSPORT
UK DEPARTMENT OF EDUCATION
UK TECHNOLOGY INCUBATOR

ADVISORY ROLE

EUROPEAN UNION

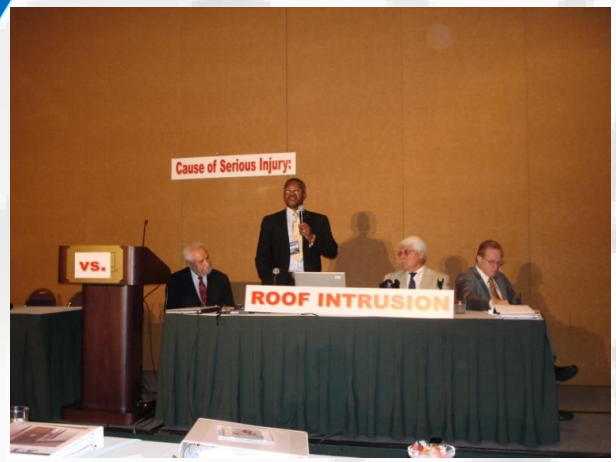
I HAVE ADVISED ON-AND-OFF
BETWEEN 1999 - 2013:
EU COMMISSIONER FOR TRANSPORT
EU REPRESENTATIVE IN TECHNOLOGY R&D

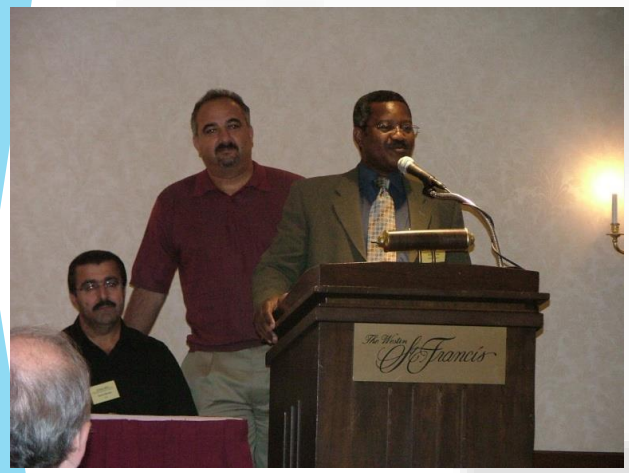
ADVISORY ROLE

REPUBLIC OF CHINA

I HAVE ADVISED ON-AND-OFF SINCE 2008 TO DATE:
FUJIAN-SHANGHAI TRANSPORT R&D
MINISTRY OF TRANSPORT

ADVISORY ROLE





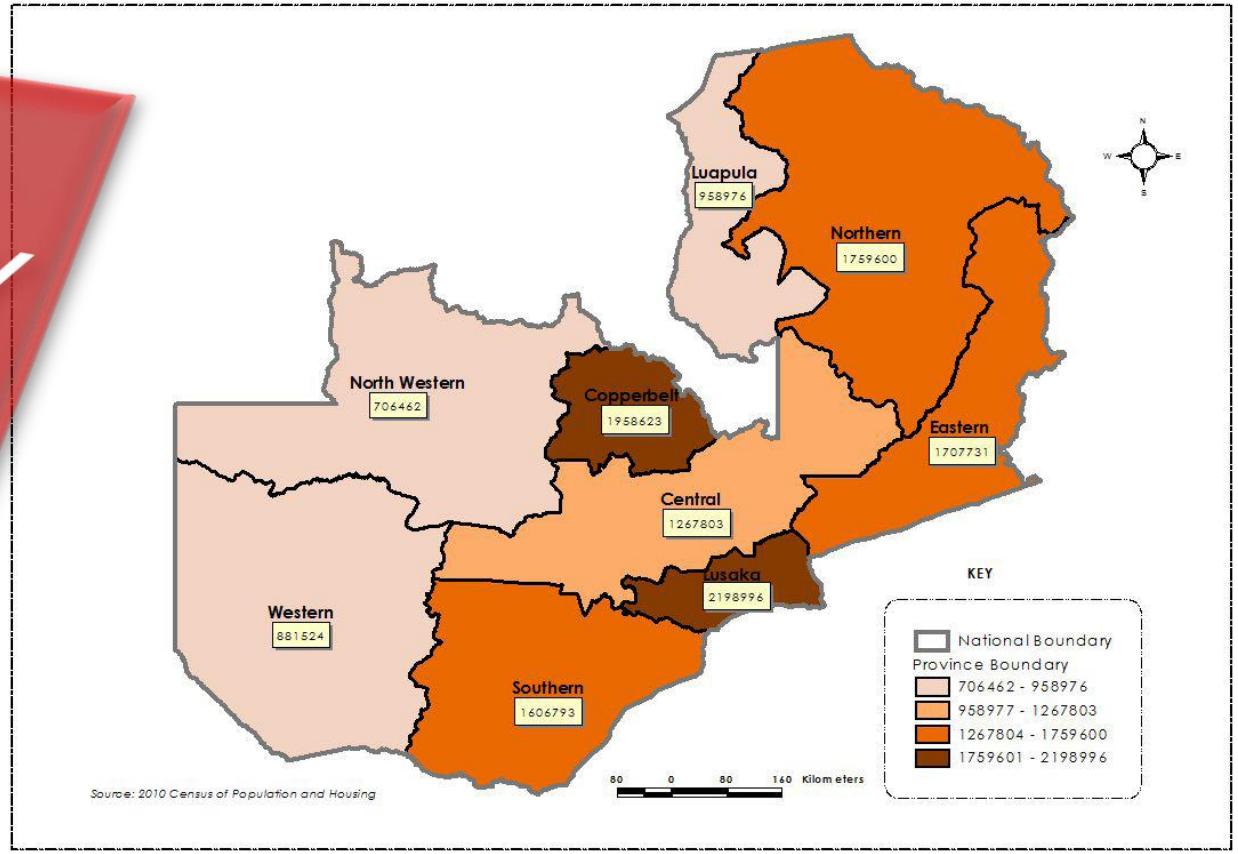
UNITED STATES OF AMERICA

I HAVE ADVISED ON-AND-OFF BETWEEN 2008-2012:
DEPARTMENT OF TRASNPORT
SENETORS ON CRASH ENGINEERING

ADVISORY ROLE

ADVISORY ROLE

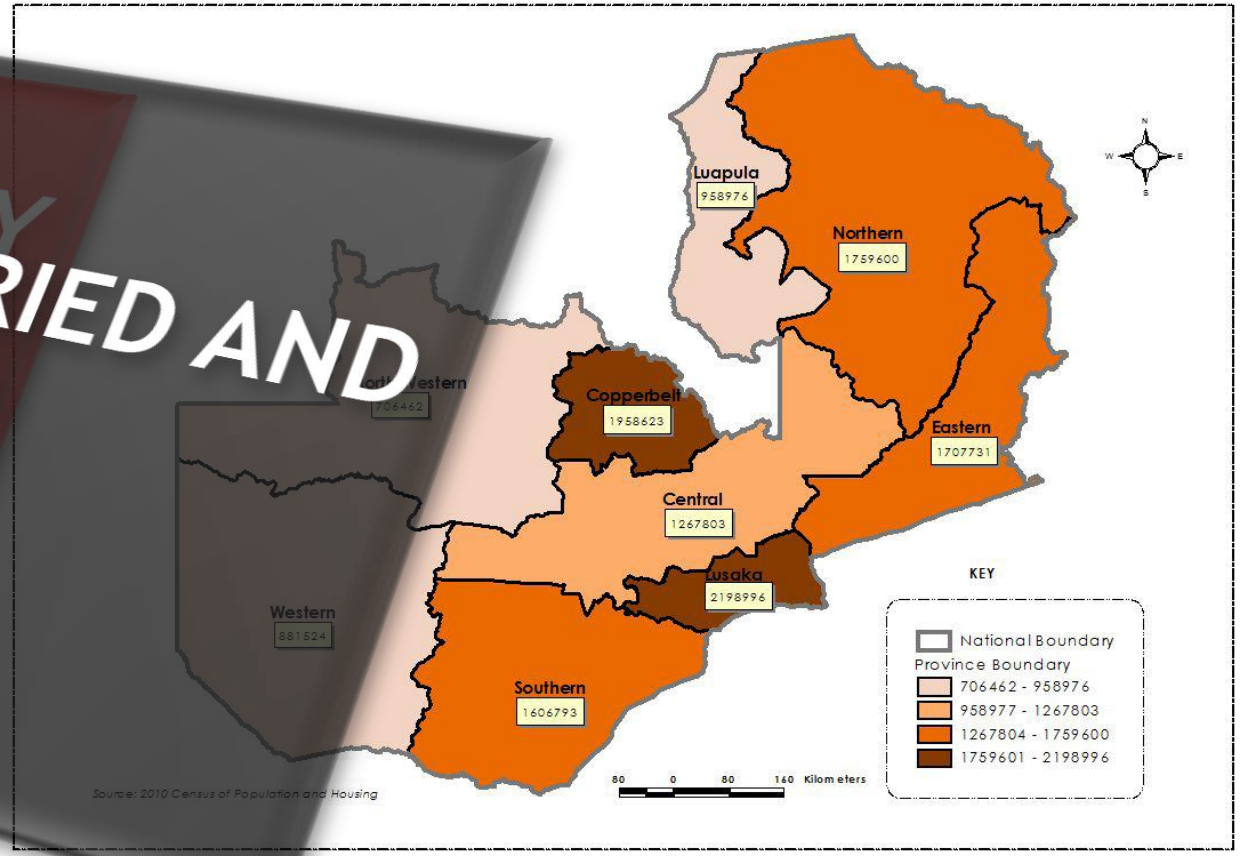
THE ONLY COUNTRY THAT I HAVE NEVER ADVISED IS.....



ADVISORY ROLE

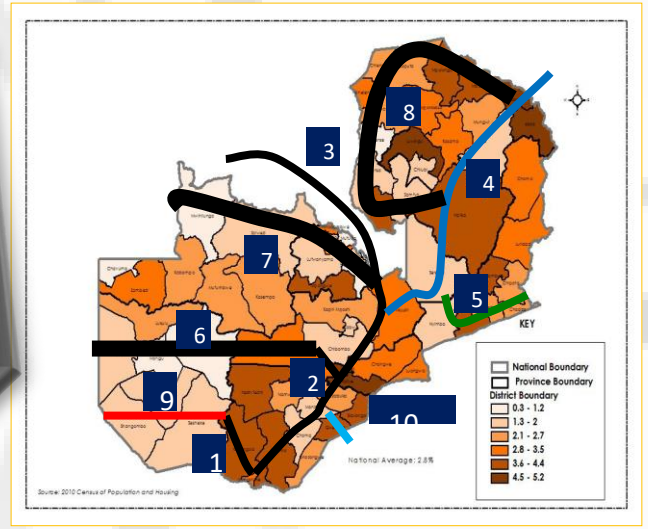
THE ONLY COUNTRY THAT HAS CATEGORICALLY REFUSED FOR ME TO ADVISE IT

BUT THE COUNTRY TRIED AND FAILED IN 2013



PRODUCT UNDELIVERED

MAKING ZAMBIA TO BE ECONOMICALLY LINKED TO OTHER COUNTRIES



PROPOSED ZAMBIA RAILWAYS NETWORK DESIGNED BY PROF CLIVE CHIRWA 2013

PHASE 1

1. Total/Partial reconstruction of the existing lines & extension

PHASE 2

4. -TAZARA & CHIPATA-MCHINJI LINES TO CONNECT
5.
9. -MULOBEZI-SHANGOMBO TO

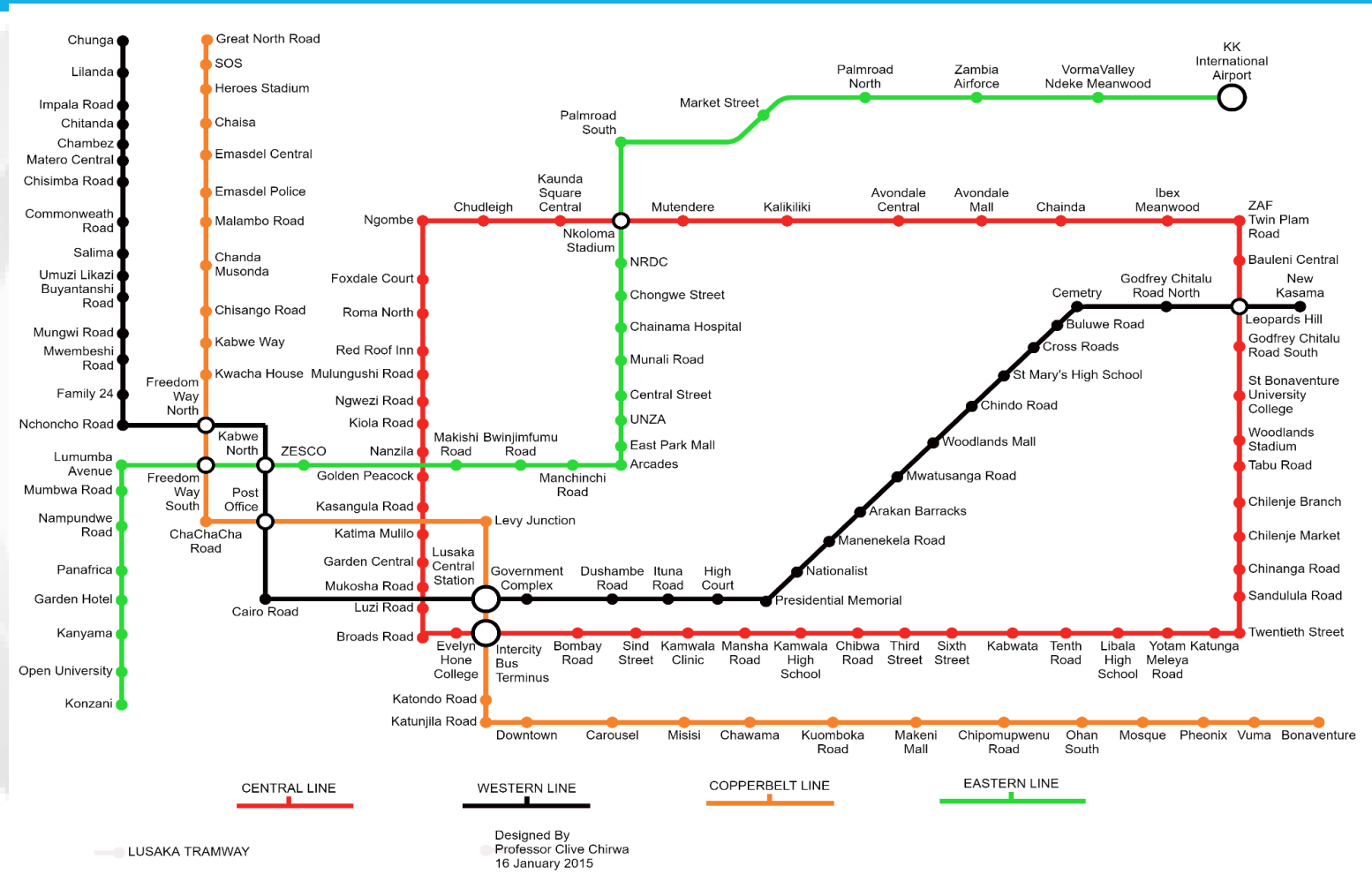
PHASE 3

6. Further railway tracks to service our mining & Agro Co. industries plus passenger transport
7.
8. -LUSAKA-MONGU
   -CHINGOLA-MWINILUNGA
   -KAFUE-HARARE
   -MPIKA-MANSA-KAPUTA-MPULUNGU/MBALA-CHOZI

1. Livingstone – Mulobezi lines
2. Livingstone – Chingola Lines
3. Inter-mines & Ndola – Sakania then Kolwezi (Congo)
4. TAZARA connect to Chipata-Mchinji & to Mpulungu
5. Chipata-Mchinji line (to Malawi/Mozambique)
6. Lusaka – Mongu
7. Chingola – Mwinilunga (On the way to Angola)
8. Mpika – Mansa – Kaputa – Mpulungu/Mbala – Chozi
9. Mulobezi-Shangombo (On the way to Bostwana)
10. Kafue to Harare (On the way to Zimbabwe)

PRODUCT UNDELIVERED

PRODUCT UNDELIVERED



LUSAKA

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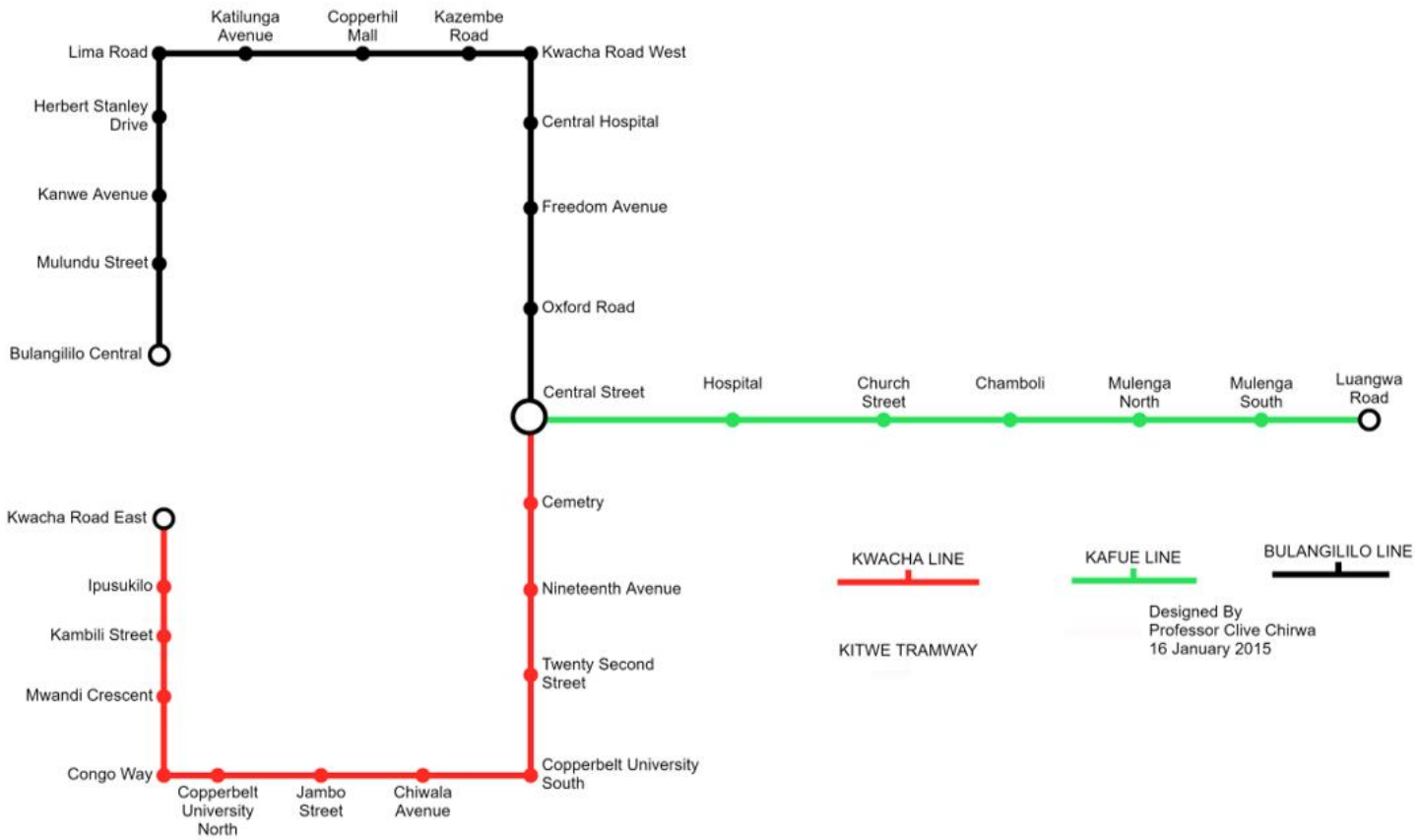
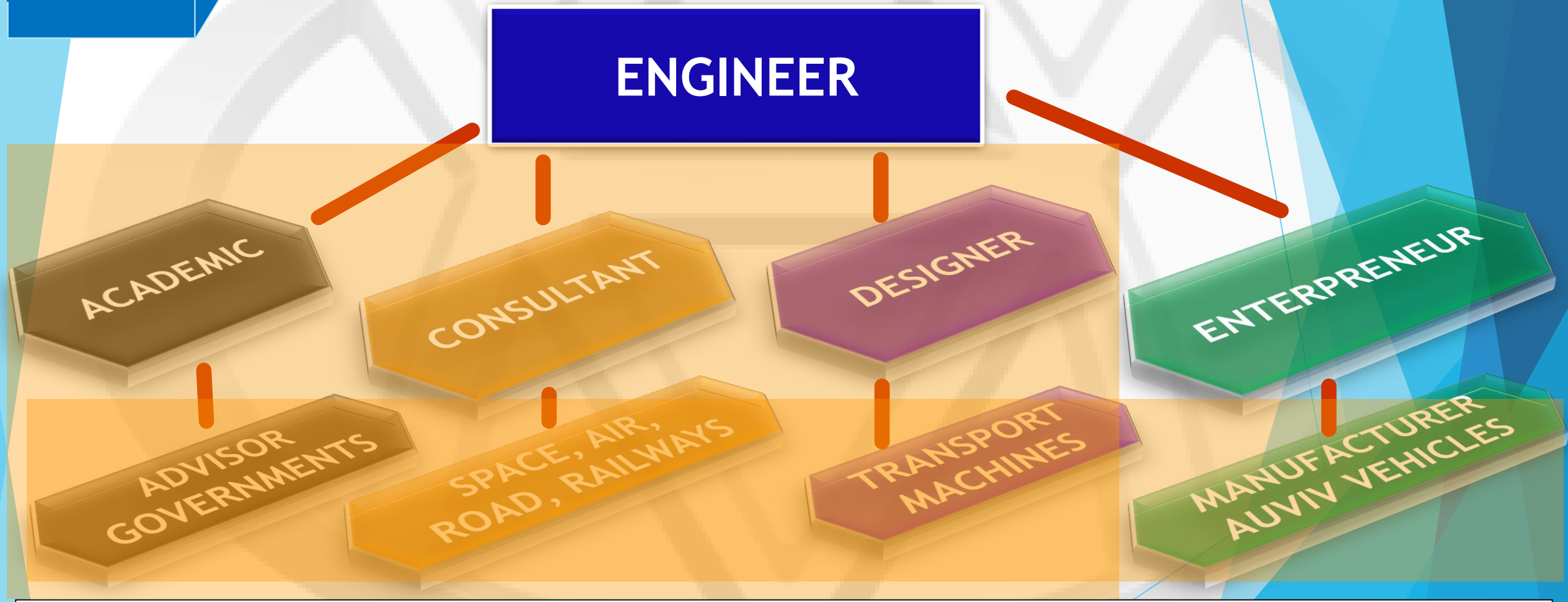
PRODUCT UNDELIVERED

KITWE



LET ME INTRODUCE MYSELF



PREAMBLE - JOBS CREATION

I HAVE FOR OVER 45 YEARS BEEN PUSHING ZAMBIA TO SELF RELIANCE THROUGH VALUE ADDITION OF NATURAL RESOURCES

EMPLOYMENT IS NOT RELATED TO TRADE BUT PRODUCTIVITY AND INNOVATION

Professor Mundia Muya et al published a position paper No. EIZ/2007/1 "Value Adding: The key to employment and wealth creation"

This was followed by the EIZ industrialisation blueprint published by Professor Clive Chirwa et al. 2015

Despite all the effort, politicians have never gathered courage to move into this direction. The 21st Century is different. We need to move fast otherwise we will be colonised second round.

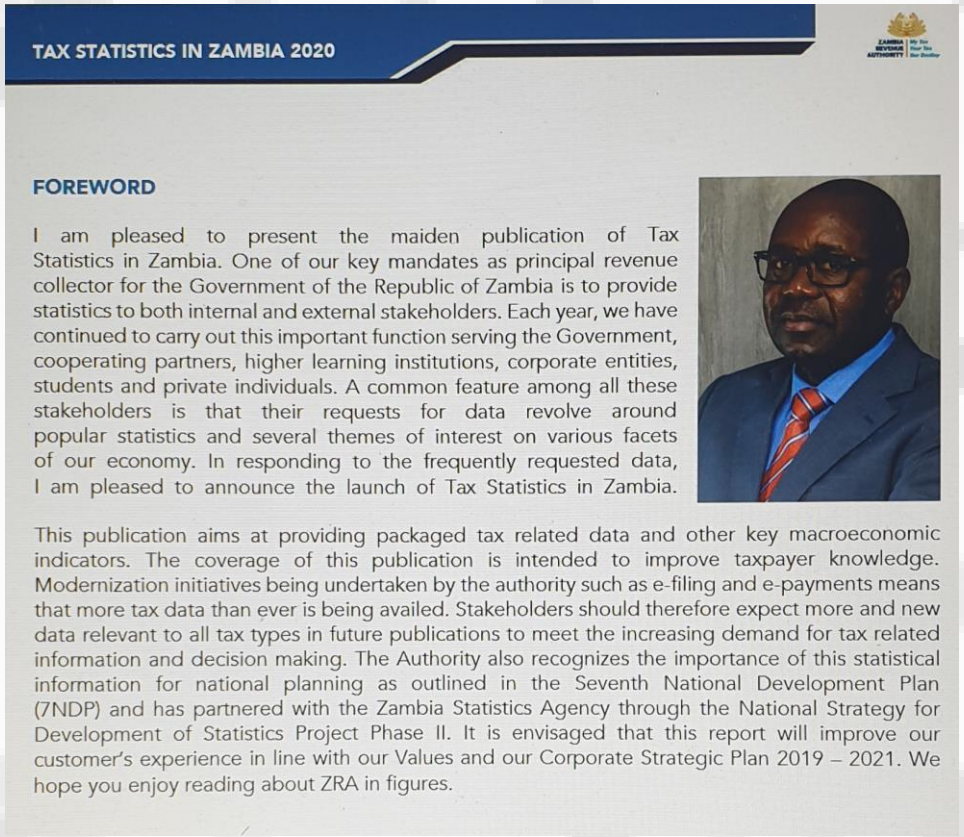
BACKGROUND – REVENUE PERFORMANCE

Courtesy of

Zambia Revenue Authority

Kingsley Chanda

Commissioner General

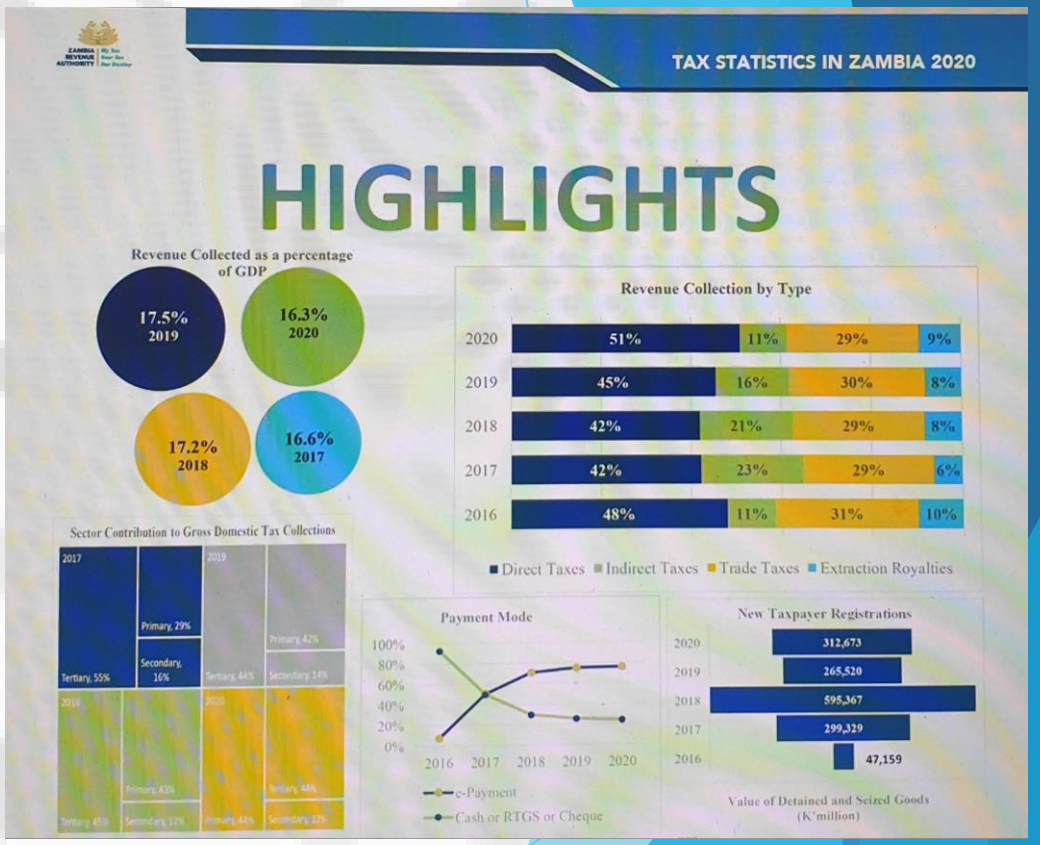


TAX STATISTICS IN ZAMBIA 2020

FOREWORD

I am pleased to present the maiden publication of Tax Statistics in Zambia. One of our key mandates as principal revenue collector for the Government of the Republic of Zambia is to provide statistics to both internal and external stakeholders. Each year, we have continued to carry out this important function serving the Government, cooperating partners, higher learning institutions, corporate entities, students and private individuals. A common feature among all these stakeholders is that their requests for data revolve around popular statistics and several themes of interest on various facets of our economy. In responding to the frequently requested data, I am pleased to announce the launch of Tax Statistics in Zambia.

This publication aims at providing packaged tax related data and other key macroeconomic indicators. The coverage of this publication is intended to improve taxpayer knowledge. Modernization initiatives being undertaken by the authority such as e-filing and e-payments means that more tax data than ever is being availed. Stakeholders should therefore expect more and new data relevant to all tax types in future publications to meet the increasing demand for tax related information and decision making. The Authority also recognizes the importance of this statistical information for national planning as outlined in the Seventh National Development Plan (7NDP) and has partnered with the Zambia Statistics Agency through the National Strategy for Development of Statistics Project Phase II. It is envisaged that this report will improve our customer's experience in line with our Values and our Corporate Strategic Plan 2019 – 2021. We hope you enjoy reading about ZRA in figures.



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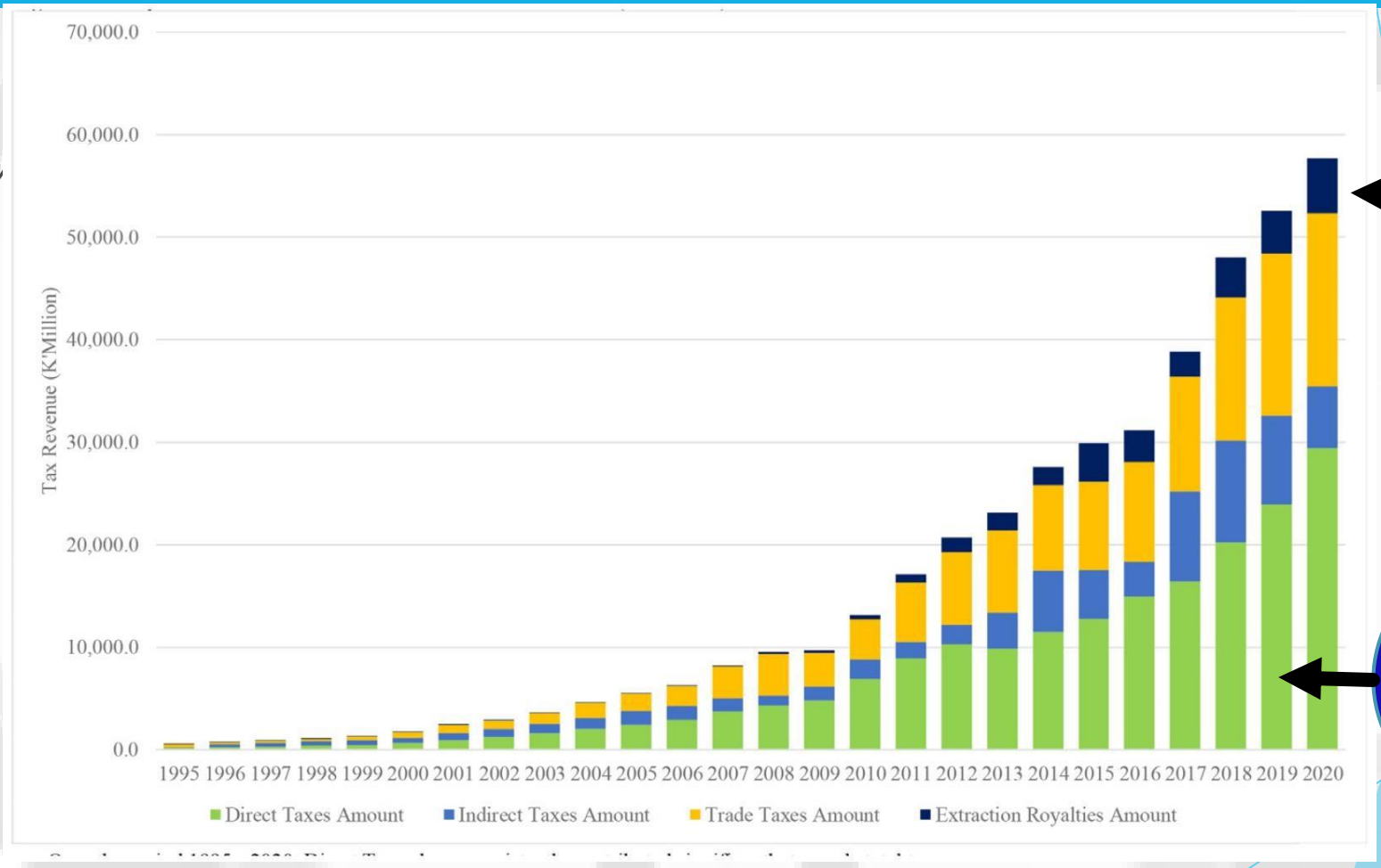
BACKGROUND – REVENUE PERFORMANCE

Courtesy of

Zambia Revenue Authority



The mining Business

Over half a million People In Recognised Employment

BACKGROUND – REVENUE PERFORMANCE

Courtesy of

Zambia Revenue Authority

President Levy Mwanawasa Action on Windfall Tax

MEETING AT INTERS HOTEL IN MAYFAIR LONDON 2007 -
- Job Creation plans
- Revenue from Mines. I proposed the windfall tax
- Presented facts in 5 min.

Year	Tax Revenue (A+B+C+D+E)	Direct Taxes Amount (A)	Direct Taxes % of Total	Indirect Taxes Amount (B)	Indirect Taxes % of Total	Trade Taxes Amount (C)	Trade Taxes % of Total	Extraction Royalties Amount (D)	Extraction Royalties % of Total	Other Amount (E)	Other % of Total
2020	57,422.6	29,172.7	51.0%	6,057.4	10.5%	16,844.3	29.2%	5,348.2	9.0%	0.0	0.0%
2019	52,681.4	23,918.6	45.4%	8,772.1	16.7%	15,805.9	30.0%	4,184.8	7.9%	0.0	0.0%
2018	48,176.7	20,199.9	41.9%	10,033.2	20.8%	14,007.0	29.1%	3,936.7	8.2%	0.0	0.0%
2017	38,899.3	16,394.4	42.1%	8,868.8	22.8%	11,200.9	28.8%	2,435.2	6.3%	0.0	0.0%
2016	31,188.8	14,937.9	47.9%	3,397.9	10.9%	9,799.9	31.4%	3,053.1	9.8%	0.0	0.0%
2015	29,927.8	12,758.7	42.6%	4,786.7	16.0%	8,633.3	28.8%	3,749.1	12.5%	0.0	0.0%
2014	27,604.2	11,458.2	41.5%	6,011.0	21.8%	8,368.1	30.3%	1,766.9	6.4%	0.0	0.0%
2013	23,154.8	9,869.9	42.6%	3,525.0	15.2%	7,999.1	34.5%	1,760.7	7.6%	0.0	0.0%
2012	20,719.1	10,275.2	49.6%	1,918.9	9.3%	7,066.5	34.1%	1,458.6	7.0%	0.0	0.0%
2011	18,889.0	8,898.9	47.1%	1,629.7	8.6%	5,739.7	30.4%	868.0	4.6%	1,752.6	9.3%
2010	13,125.6	6,914.3	52.7%	1,887.4	14.4%	3,911.9	29.8%	412.0	3.1%	0.0	0.0%
2009	9,660.0	4,837.7	50.1%	1,330.3	13.8%	3,257.1	33.7%	234.9	2.4%	0.0	0.0%
2008	9,670.1	4,334.6	44.8%	937.7	9.7%	4,033.7	41.7%	238.1	2.5%	126.0	1.3%
2007	8,184.3	3,764.7	46.0%	1,231.7	15.0%	3,120.7	38.1%	67.3	0.8%	0.0	0.0%
2006	6,322.9	2,901.4	45.9%	1,385.6	21.9%	1,977.4	31.3%	58.8	0.9%	0.0	0.0%
2005	5,521.8	2,422.3	43.9%	1,394.6	25.3%	1,665.7	30.2%	39.2	0.7%	0.0	0.0%
2004	4,554.3	2,033.3	44.6%	1,062.2	23.3%	1,454.2	31.9%	4.4	0.1%	0.0	0.0%
2003	3,549.5	1,613.2	45.4%	858.4	24.2%	1,069.7	30.1%	8.1	0.2%	0.0	0.0%
2002	2,848.8	1,244.0	43.7%	773.0	27.1%	829.2	29.1%	2.5	0.1%	0.0	0.0%
2001	2,448.6	938.7	38.3%	676.7	27.6%	826.6	33.8%	6.6	0.3%	0.0	0.0%
2000	1,739.5	629.6	36.2%	513.1	29.5%	592.9	34.1%	3.8	0.2%	0.0	0.0%
1999	1,289.6	466.8	36.2%	471.5	36.6%	336.3	26.1%	13.3	1.0%	1.7	0.1%
1998	1,090.3	406.6	37.3%	390.3	35.8%	250.4	23.0%	17.1	1.6%	25.9	2.4%
1997	954.4	313.1	32.8%	342.5	35.9%	239.0	25.0%	18.8	2.0%	41.0	4.3%
1996	725.2	227.3	31.3%	277.7	38.3%	203.5	28.1%	16.7	2.3%	0.0	0.0%
1995	550.5	163.3	29.7%	70.3	12.8%	288.1	52.3%	28.9	5.2%	0.0	0.0%

Note: Other income in 1997-1999 consisted of import declaration fees, in 2008 the other income was windfall fax and in 2011 other income consisted of Mining Tax arrears. Extraction royalty sometimes called mineral royalty.

BACKGROUND – REVENUE PERFORMANCE

Courtesy of

Zambia Revenue Authority

President
HE Mr Levy Mwanawasa
Action on Windfall Tax

2008

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1996	725.2	227.3	31.3%	277.7	38.3%	203.5	28.1%	16.7	2.3%	0.0	0.0%
1995	550.5	163.3	29.7%	70.3	12.8%	288.1	52.3%	28.9	5.2%	0.0	0.0%

Note: Other income in 1997-1999 consisted of import declaration fees, in 2008 the other income was windfall tax and in 2011 other income consisted of Mining Tax arrears. Extraction royalty sometimes called mineral royalty.

BACKGROUND

Courtesy of
Medium and Roe et al

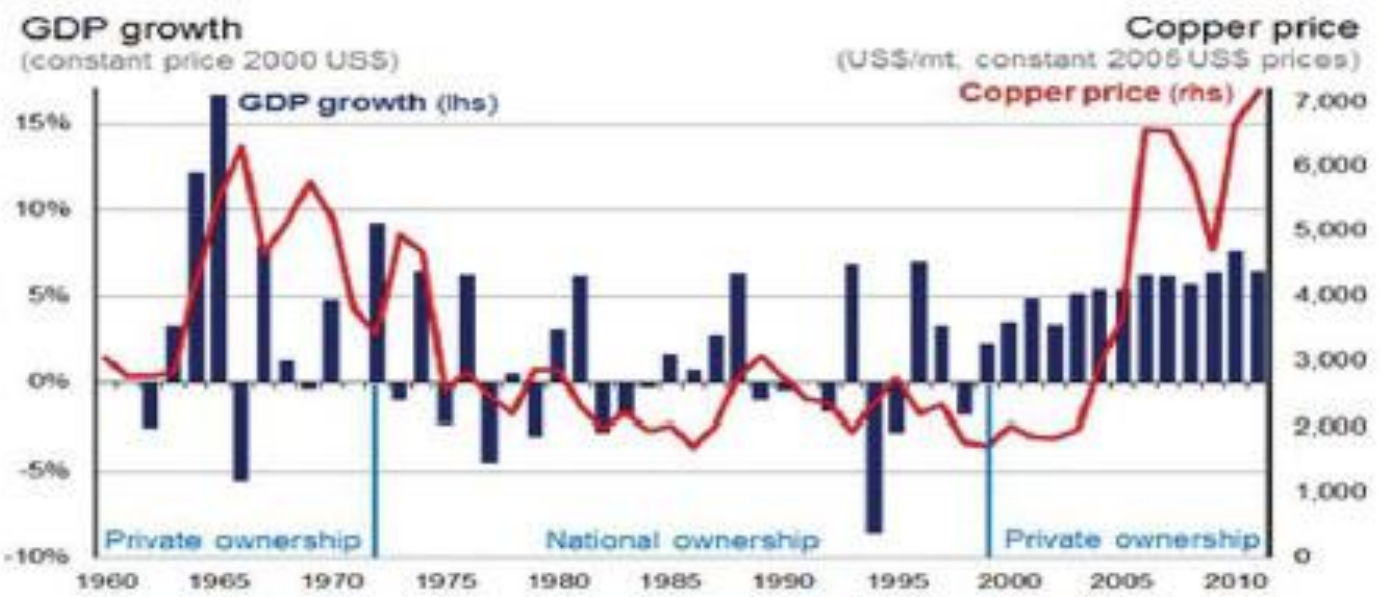


Figure 2—Zambia's GDP growth and copper prices between 1960 and 2010. (Source: Roe *et al.*, 2014)

BACKGROUND

Courtesy of Sikamo 2014

Figure 3—Zambia's copper production and its share in global production (Sikamo, 2014)

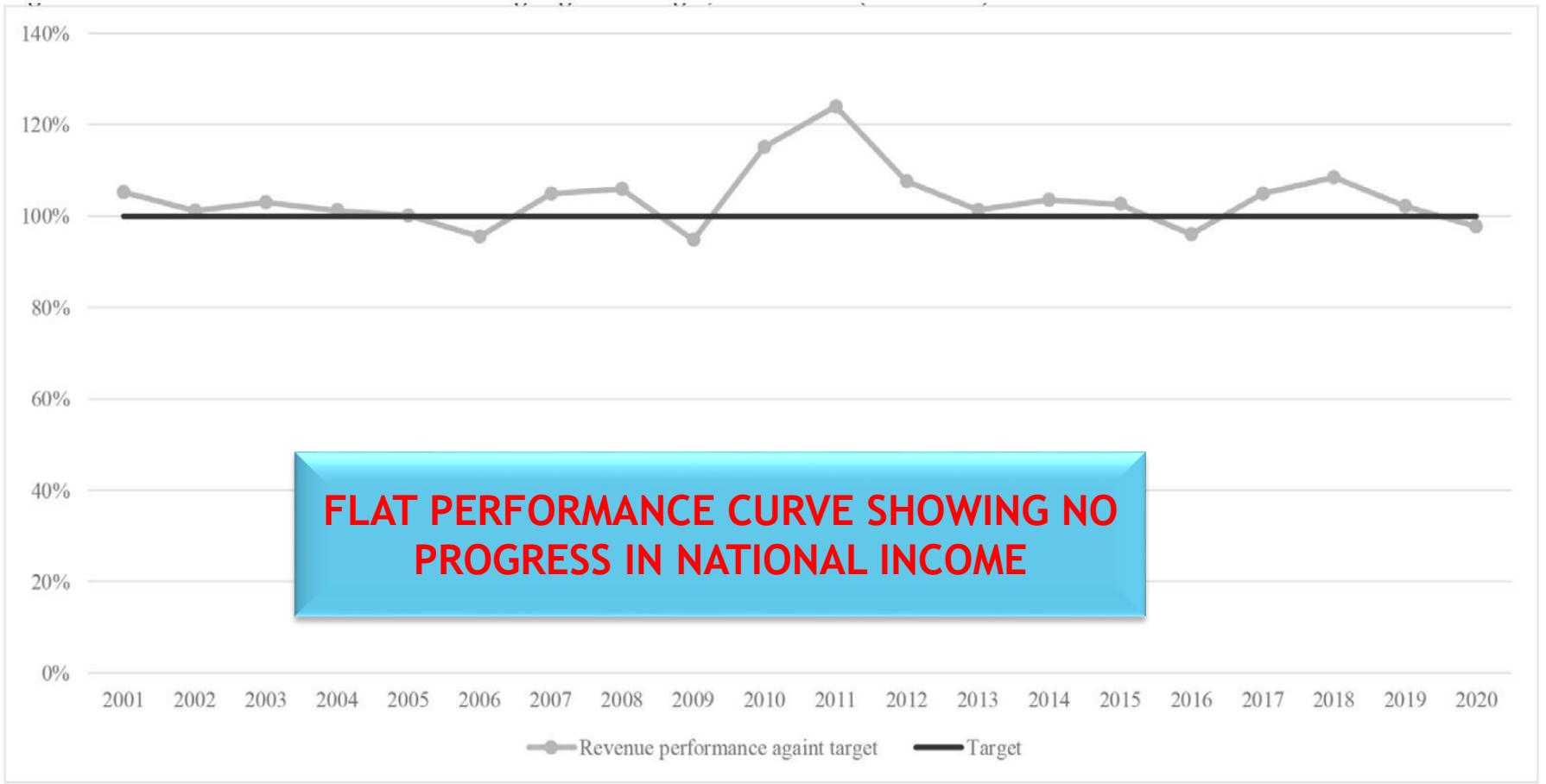
BACKGROUND – REVENUE PERFORMANCE

Courtesy of

Zambia Revenue Authority

TAX REVENUE PERFORMANCE AGAINST TARGET

- TOO LOW TARGET AMBITIONS FOR A COUNTRY WORTH TRILLION OF DOLLARS
- NOT MEETING THESE TARGETS SHOW STAGNATION OF ECONOMIC POLICIES OVER THE YEARS BY RESPECTIVE ADMINISTRATIONS



FLAT PERFORMANCE CURVE SHOWING NO PROGRESS IN NATIONAL INCOME

BACKGROUND – REVENUE PERFORMANCE

Courtesy of

Zambia Revenue Authority

TAX REVENUE PERFORMANCE AGAINST TARGET

- TOO LOW TARGET AMBITIONS FOR A COUNTRY WORTH TRILLION OF DOLLARS
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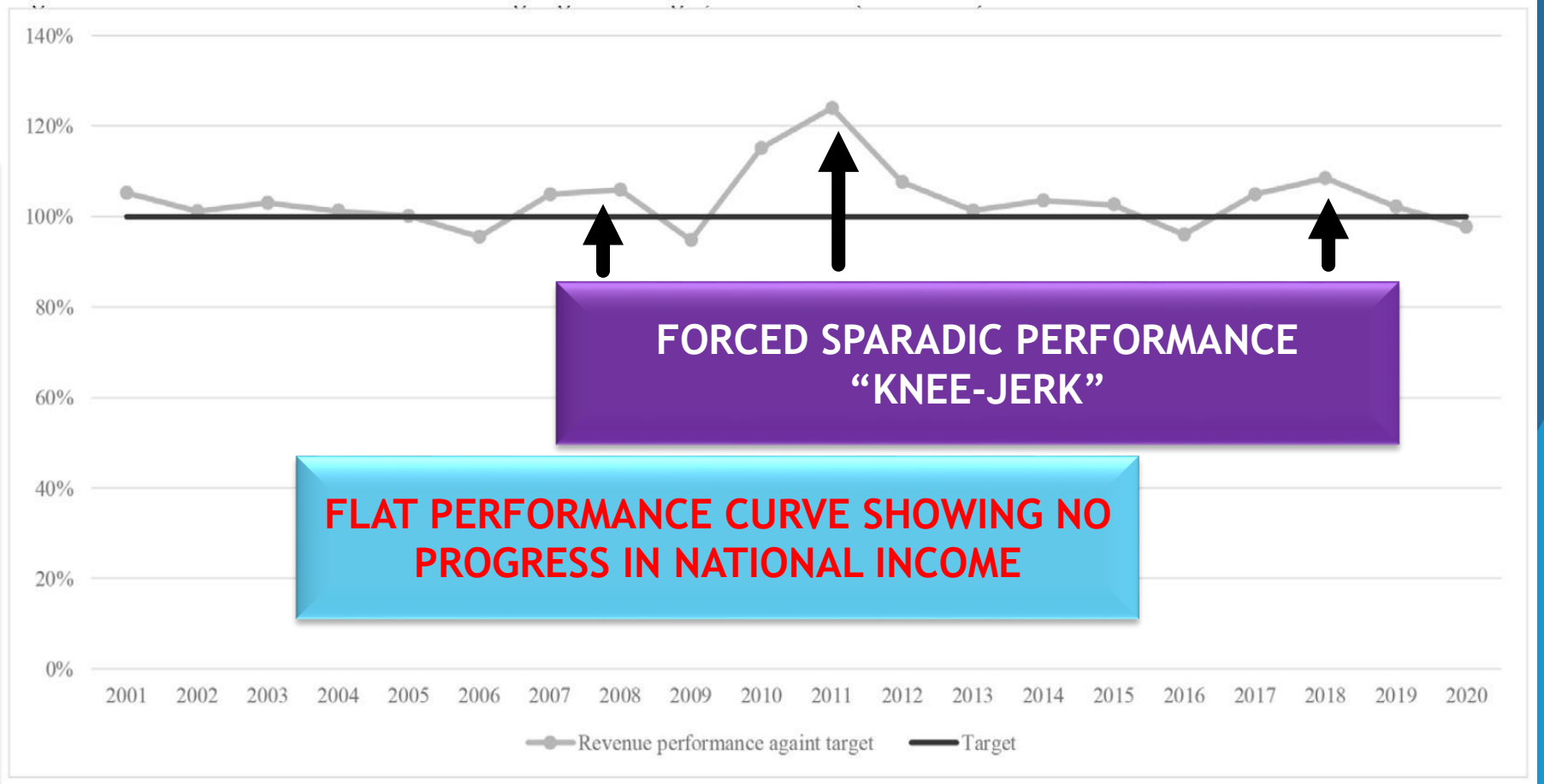

BACKGROUND – REVENUE PERFORMANCE

TAX REVENUE PERFORMANCE AGAINST TARGET

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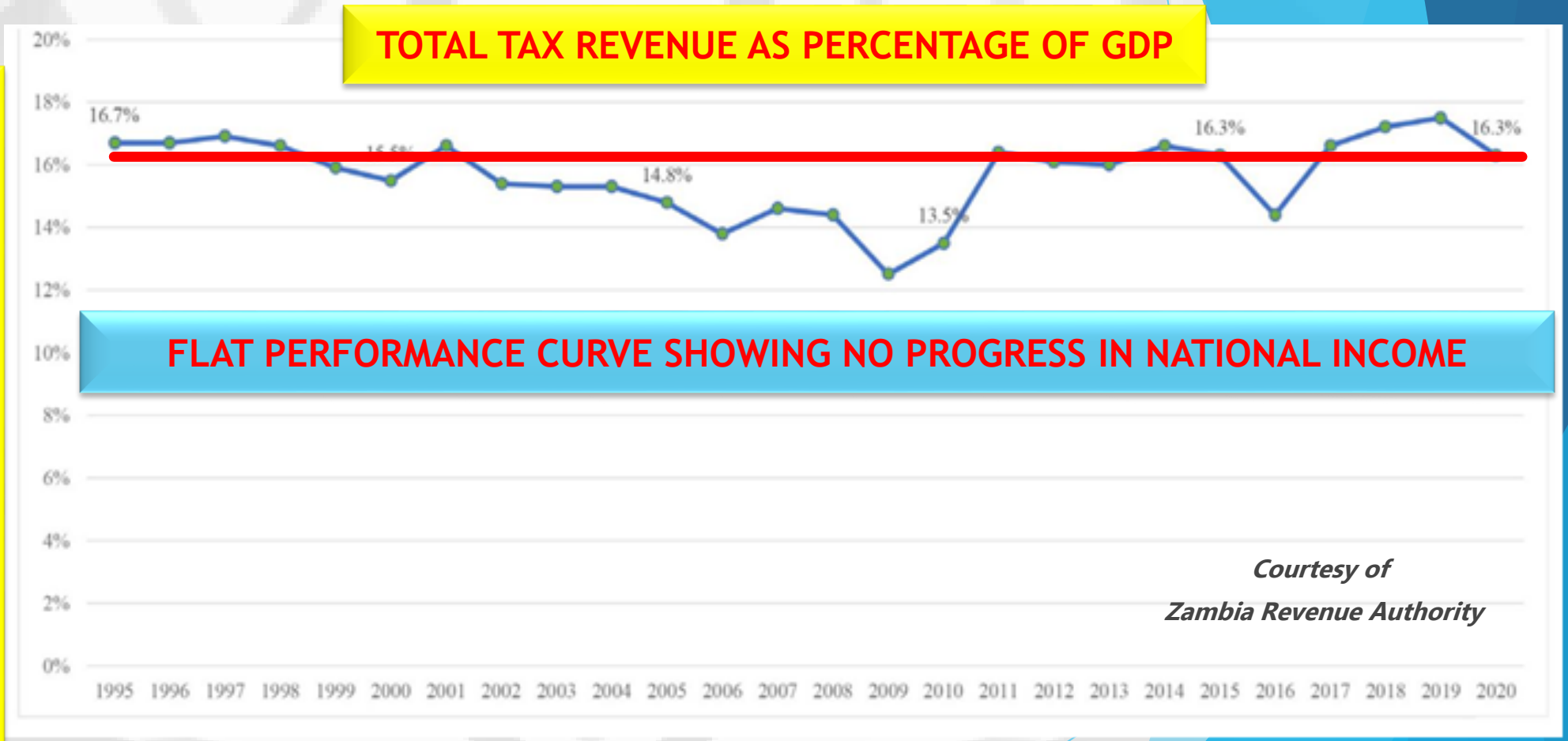
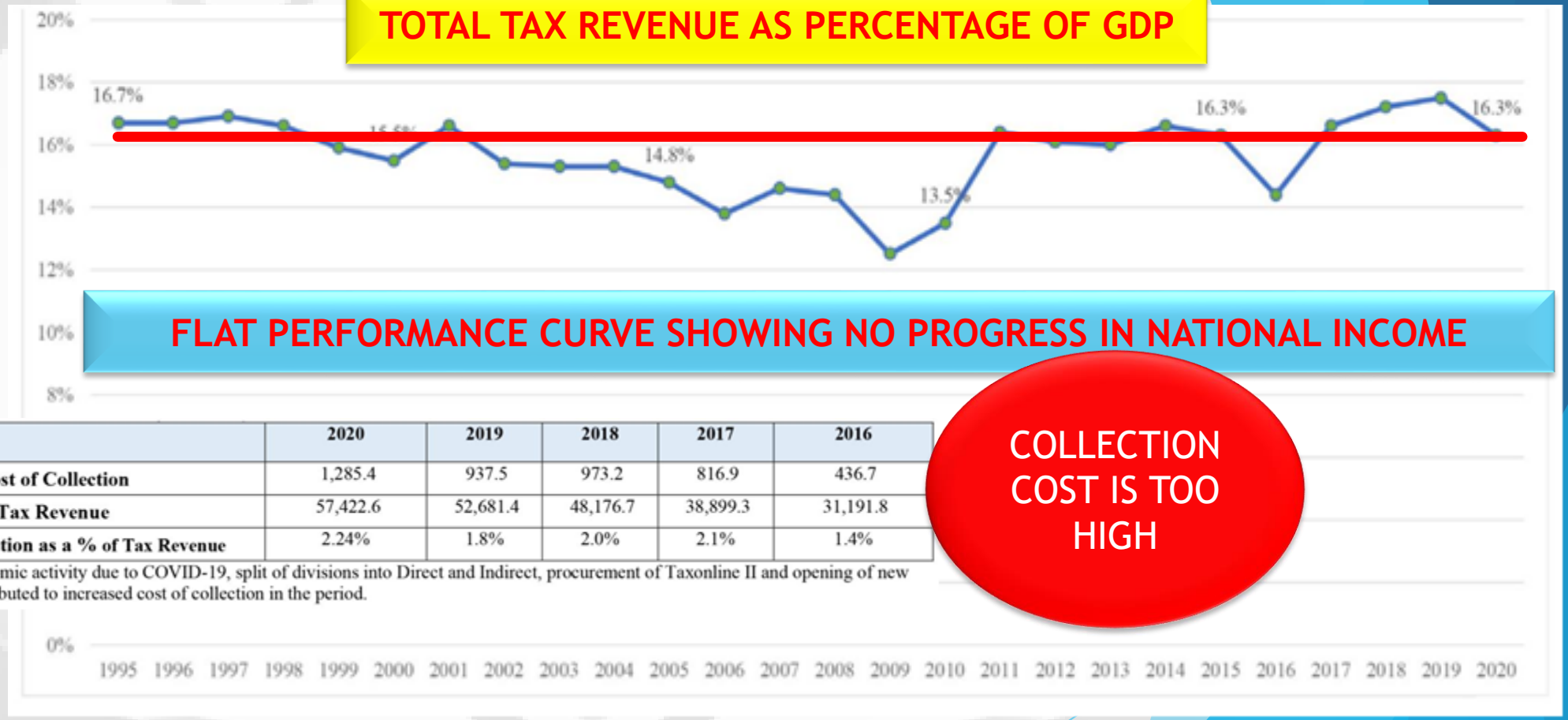


BACKGROUND – REVENUE PERFORMANCE

Courtesy of

Zambia Revenue Authority

TOTAL TAX REVENUE AS PERCENTAGE OF GDP



FLAT PERFORMANCE CURVE SHOWING NO PROGRESS IN NATIONAL INCOME

	2020	2019	2018	2017	2016
Cost of Collection	1,285.4	937.5	973.2	816.9	436.7
Tax Revenue	57,422.6	52,681.4	48,176.7	38,899.3	31,191.8
Cost of Collection as a % of Tax Revenue	2.24%	1.8%	2.0%	2.1%	1.4%

Note: Reduced economic activity due to COVID-19, split of divisions into Direct and Indirect, procurement of Taxonline II and opening of new service centers contributed to increased cost of collection in the period.

COLLECTION COST IS TOO HIGH

BACKGROUND – REVENUE PERFORMANCE

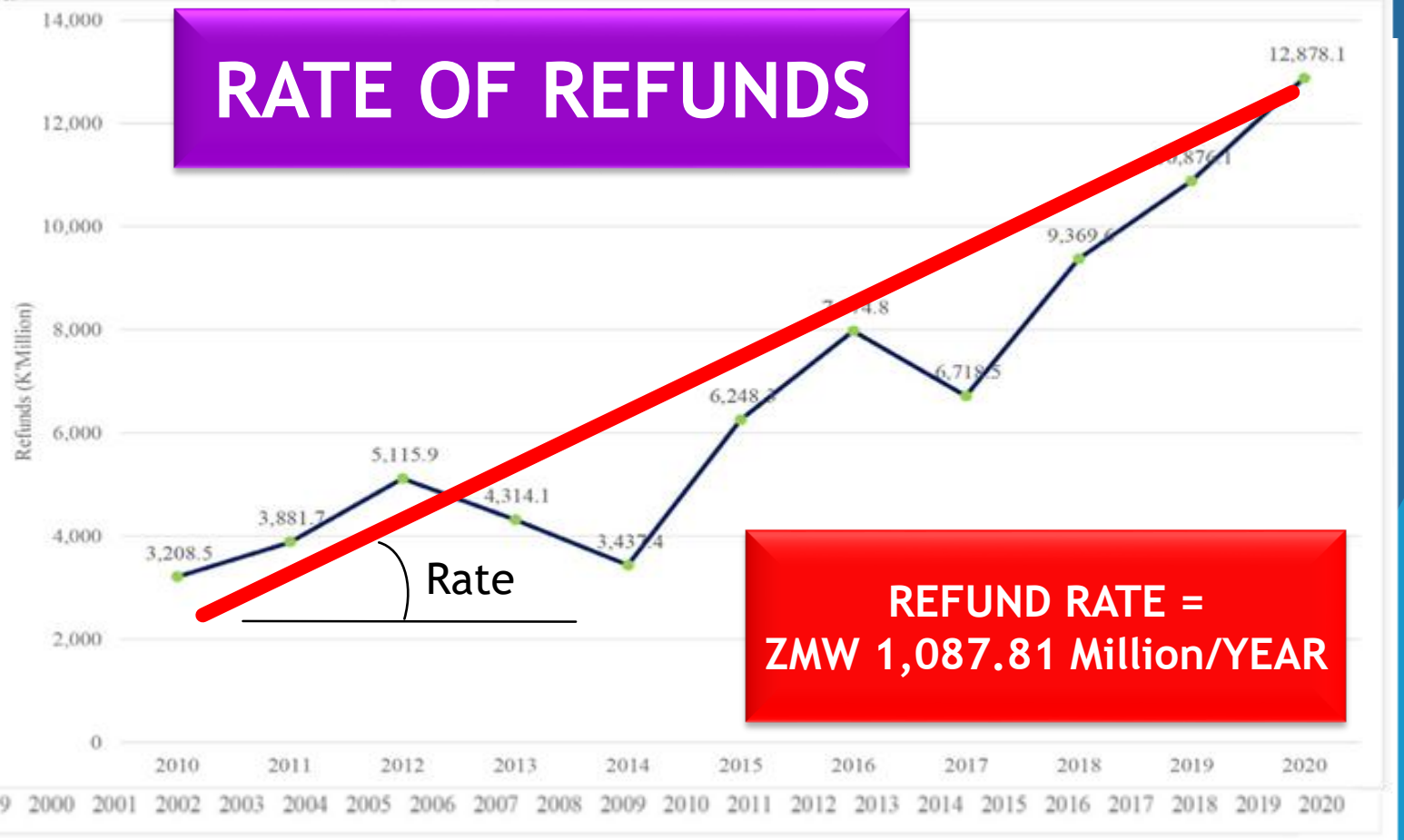
GOVERNMENT LOSING TOO MUCH MONEY IN

REFUNDS

Courtesy of

Zambia Revenue Authority

RATE OF REFUNDS



REFUND RATE =
ZMW 1,087.81 Million/YEAR

BACKGROUND – JOBS CREATION

Courtesy of

Zambia Revenue Authority

PARADOX

BETWEEN 2016-2020 : 222009 JOBS WERE CREATED

BETWEEN 2012-2020 : 351714 JOBS WERE CREATED

BACKGROUND – JOBS CREATION

Courtesy of

Zambia Revenue Authority

PARADOX

PAST ADMINISTRATION

DOUBLED THE NUMBER OF PEOPLE IN REAL JOBS DURING THEIR TIME IN GOVERNMENT

BETWEEN 2016-2020 : 222009 JOBS WERE CREATED

BETWEEN 2012-2020 : 351714 JOBS WERE CREATED

GDP NOT FIT FOR PURPOSE IN AFRICA

"Traditionally, one of the guiding factors for development has been per capita GDP - the value of goods and services produced by a country in a year divided by the country's population. Yet GDP may be a very inaccurate indicator in the poorest countries, particularly in Sub-Saharan Africa", .

"The challenges of calculating GDP are particularly acute in Sub-Saharan Africa, owing to weak national statistics offices and historical biases that muddy crucial measurements. Bothered by what he regarded as problems in Zambia's national statistics, Morten Jerven, an assistant professor at Simon Fraser University, spent four years examining how African countries obtain their data and the challenges they face in turning them into GDP estimates. His new book, *Poor Numbers: How We Are Misled by African Development Statistics and What to Do about It*, makes a strong case that a lot of GDP measurements that we thought were accurate are far from it.

GDP NOT FIT FOR PURPOSE IN AFRICA

• Moving beyond GDP opens up creative opportunities to fight poverty and achieve sustainable wellbeing

BECAUSE:

• GDP does not capture informal economies, the contribution of subsistence farming, non-commercial agriculture and other localized forms of production and consumption

• Through the introduction of new progress indicators that focus on human wellbeing, health and education, decent work and natural welfare, African countries may be encouraged to promote a different development paradigm

• A networked economy, founded on localized forms of self-production and consumption would empower the millions of people that are at the moment left out of the apparent African economic miracle

* Lorenzo Fioramonti (www.governanceinnovation.org).

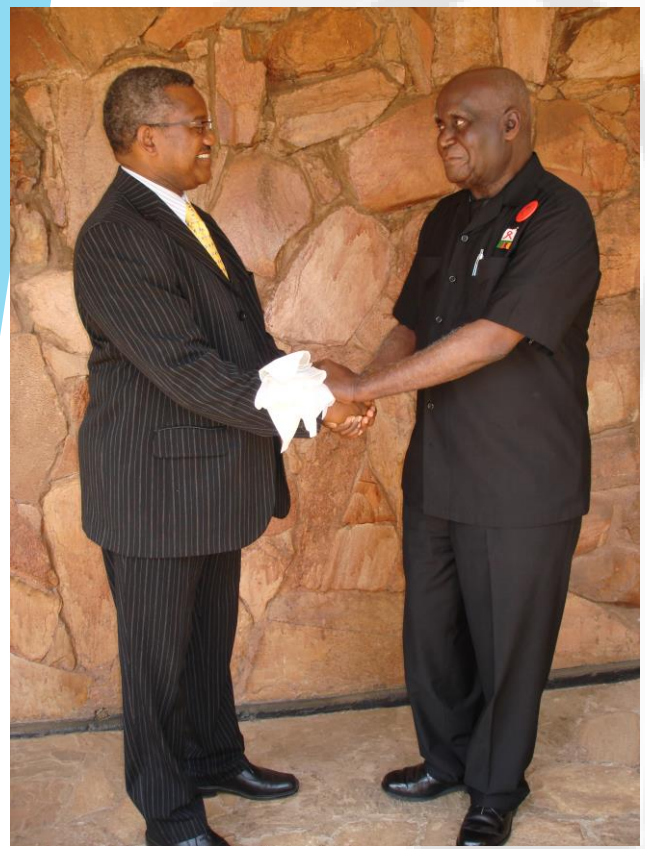
THIS NEEDS TO BE RECTIFIED IN THE 21ST CENTURY

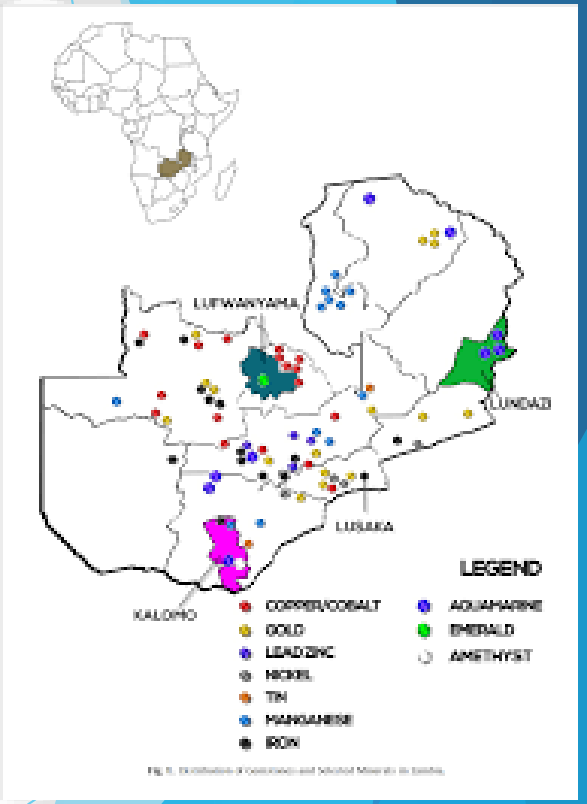
21ST CENTURY SOLUTIONS

ONE SUCH SOLUTION IS LOCAL VALUE ADDITION TO OUR NATURAL RESOURCES

VALUE ADDITION

PROPOSED IN 1990
TO
DR KENNETH DAVID KAUNDA

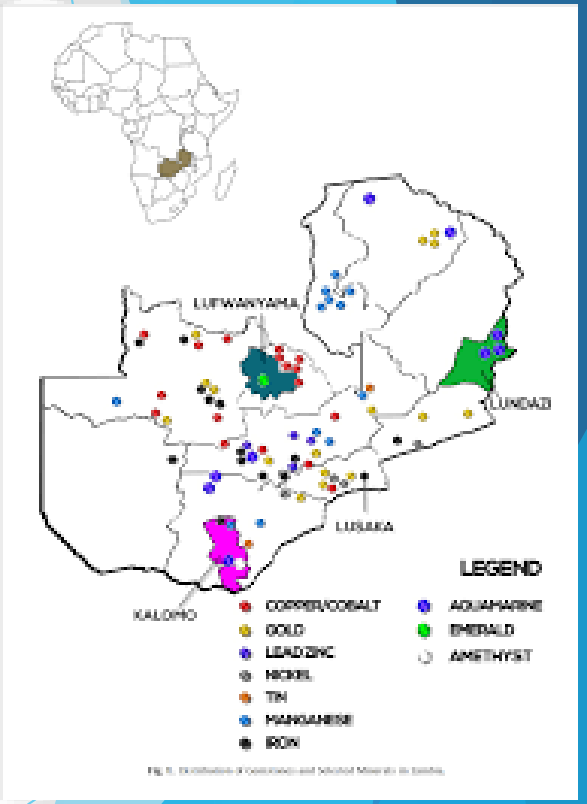




19TH AND 20TH CENTURY SOLUTIONS

21ST CENTURY SOLUTIONS ARE **NOT** BASED ON

MINING, MINING, AND MORE MINING



Courtesy of Mining weekly, Africa briefing, the week, Copperbelt-Katanga, Mining-Technology, Dw, International Growth Centre

Technology Transfer Public Lecture
"Zambia's Natural Resources In Downstream Industries"
22nd June 2022, Government Complex, Lusaka, Zambia

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NATURAL RESOURCE - COPPER

19TH AND 20TH CENTURY SOLUTIONS

21ST CENTURY SOLUTIONS ARE **NOT** BASED ON
MINING, MINING, AND MORE MINING

THIS IS RETROGRESSIVE, MAYOPIA, NO REAL VISION, COLONIAL 19TH & 20TH CENTURY SOLUTIONS

21ST CENTURY SOLUTIONS - VALUE ADDITION

21ST CENTURY SOLUTIONS ARE **NOT** BASED ON

MINING, MINING, AND MORE MINING

21ST CENTURY SOLUTIONS ARE BASED ON

SMART BUSINESS MODELS!!

VALUE ADDITION

ONE OF THE NEW BUSINESS MODELS FOR ZAMBIA IS MINERALS' VALUE ADDITION

NATURAL RESOURCES - VALUE ADDITION...

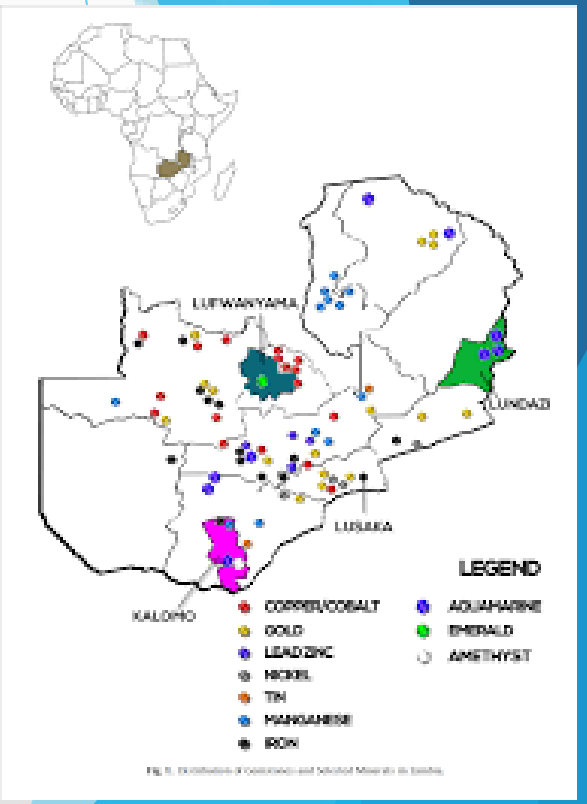
IS THE ONLY ANSWER TO HELP ZAMBIA MOVE OUT OF POVERTY

ZAMBIA...OUT OF POVERTY?
NO WAY?
HOW ARE YOU GOING TO REALISE THAT?
SIMPLE!!!!

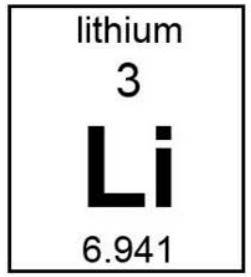
VALUE ADDITION

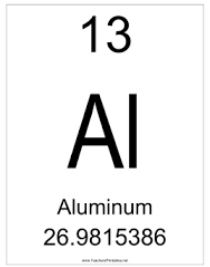
2011

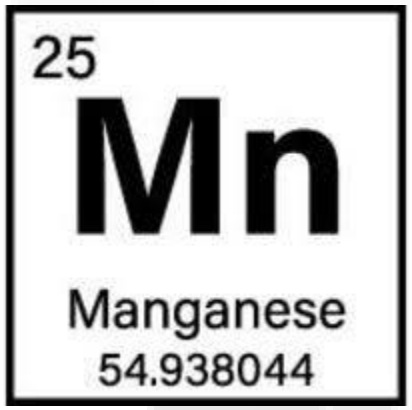
NEW PROPOSAL IN 2021
TO
HE Mr HAKAINDE HICHILEMA

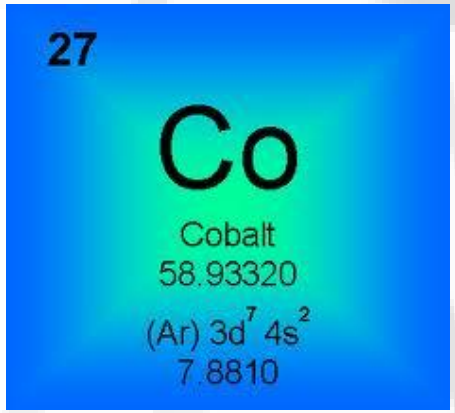


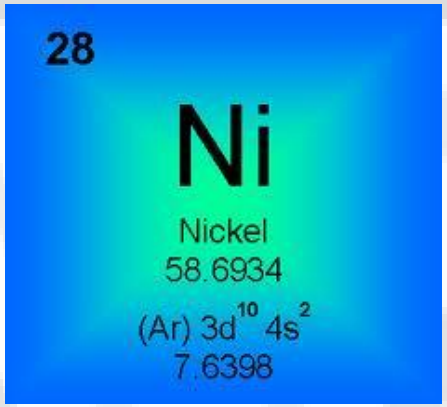
PRODUCT CHOICE

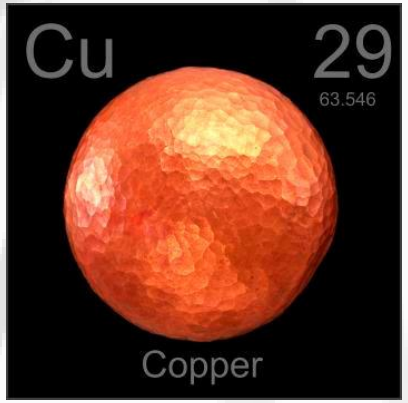












PRODUCT CHOICE

THE NATIONAL MARKET RESEARCH CARRIED OUT IN YEAR 1999 AND LATER IN 2011 SHOWED THAT ZAMBIA NEEDS TO INTENSIFY THE SEARCH FOR DOWNSTREAM INDUSTRIES IN MINERAL RESOURCES:

PHASE ONE: PRIMARY INDUSTRY

- **COPPER** FINISHED PRODUCTS
- **NICKEL** FINISHED PRODUCTS
- **COBALT** FINISHED PRODUCTS
- **ZINC** FINISHED PRODUCTS
- **MANGANESE** FINISHED PRODUCTS

PHASE TWO: SECONDARY INDUSTRY

- **ENERGY STORAGE SYSTEMS**

KEY CATALYSTS IN THIS ECONOMY

PRODUCT CHOICE

FUTURE TRANSPORT TRENDS:
ELECTRIC VEHICLES AND HOW ZAMBIA CAN BENEFIT

Technology Transfer Public Lecture
"Zambia's Natural Resources In Downstream Industries"
22nd June 2022, Government Complex, Lusaka, Zambia

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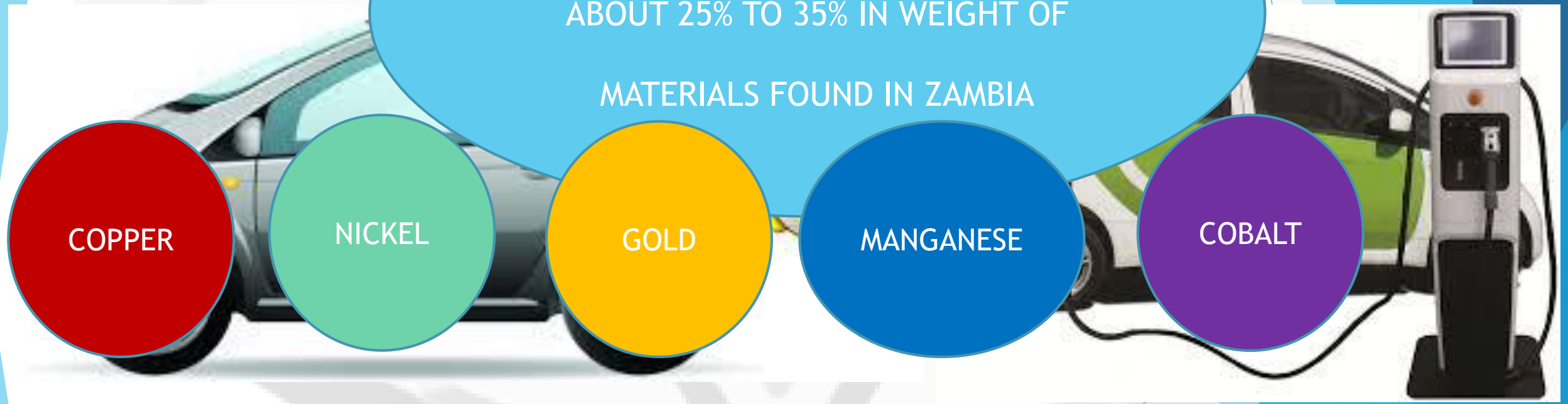
PRODUCT CHOICE

FUTU… …DS:
ELECTRIC VE… …N BENEFIT

EVERY ELECTIC CAR
HAS
ABOUT 25% TO 35% IN WEIGHT OF

MATERIALS FOUND IN ZAMBIA



PRODUCT CHOICE

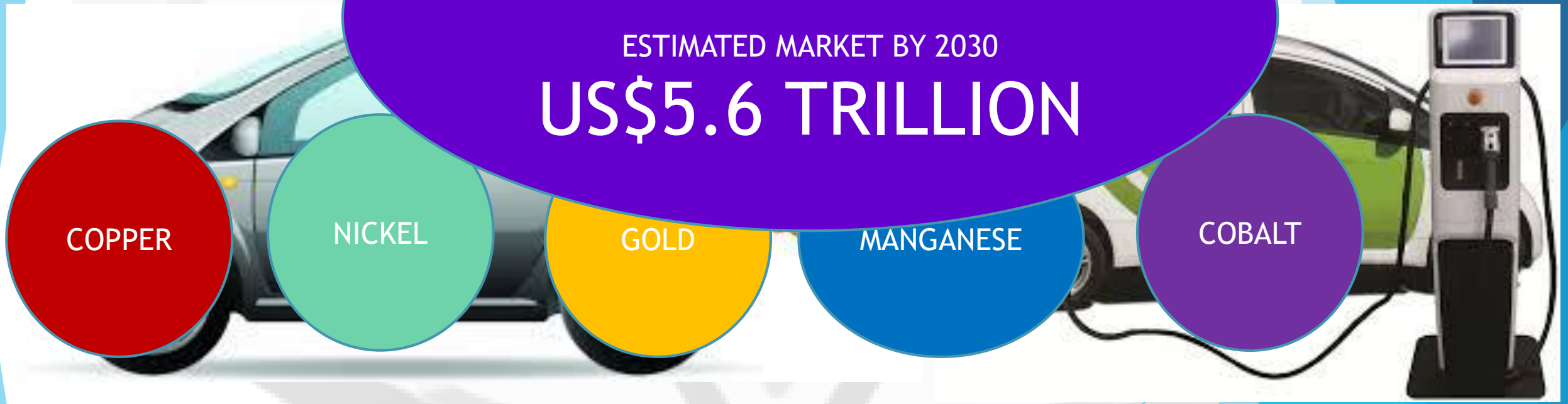
FUT… S:

ELECTRIC V… BENEFIT

ZAMBIA CAN MANUFACTURE THESE ELECTRIC PARTS RIGHT UP HERE AND SUPPLY EVEN THE DEVELOPED WORLD.

ESTIMATED MARKET BY 2030

US$5.6 TRILLION



FUTURE TRANSPORT TRENDS: ELECTRIC VEHICLES AND HOW ZAMBIA CAN BENEFIT

What you need in order to build an EV (besides batteries)?

- Motor
- Controller
- Charger
- DC/DC Converter
- Heater
- Instrumentation
- Contactor(s)
- Safety Equipment

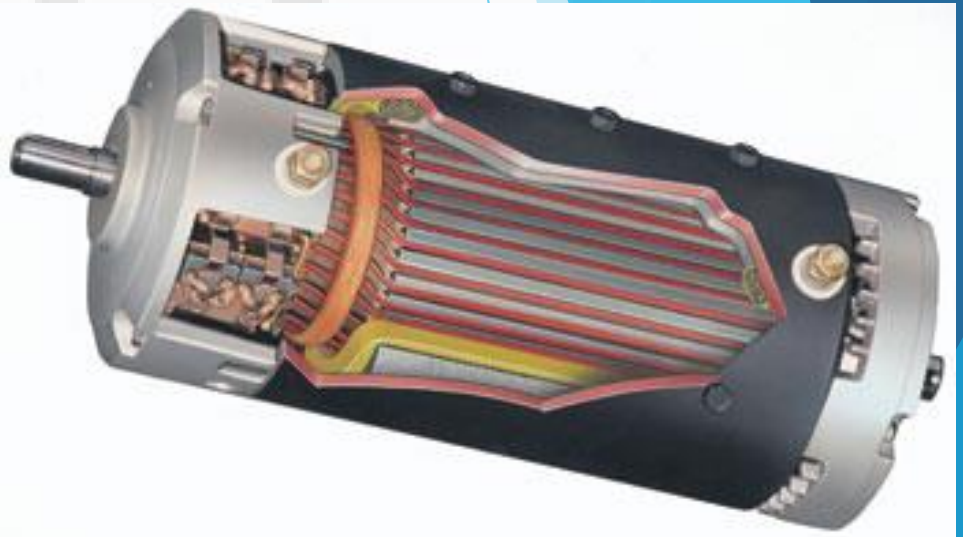
Components

PRODUCT CHOICE

FUTURE TRANSPORT TRENDS: ELECTRIC VEHICLES AND HOW ZAMBIA CAN BENEFIT

OEM's: typically AC drive

- Fail-safe design
- Low initial torque, higher at speed
- requires complicated electronics package
  - AC speed control (similar to industrial)
  - Inverter (convert DC to AC)
  - High voltage (240-350 VDC)
  - Bearings only mechanical maintenance item



Motor Technology

FUTURE TRANSPORT TRENDS: ELECTRIC VEHICLES AND HOW ZAMBIA CAN BENEFIT

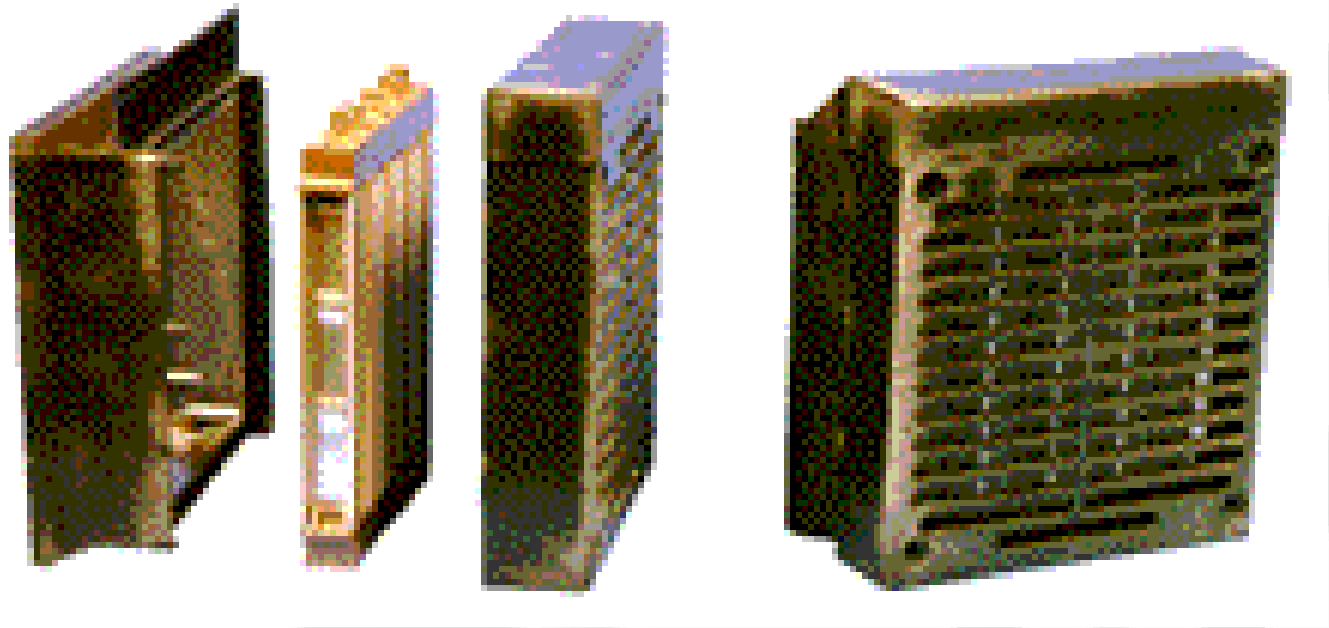
In General, Volts = Speed, Amps = Torque

- Curtis
  - to 144 VDC, 500 Amps
- Auburn Scientific
  - to 192 VDC, 1200 Amps
- DCP
  - to 336 VDC, 600/1200 Amps
- EVCL
  - "GODZILLA" to 336 VDC, 1200 Amps

Controller Technology

PRODUCT CHOICE

FUTURE TRANSPORT TRENDS: ELECTRIC VEHICLES AND HOW ZAMBIA CAN BENEFIT

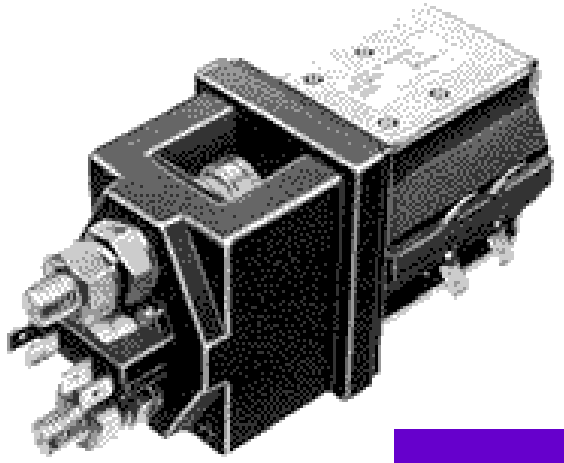


Heater Technology

PRODUCT CHOICE

FUTURE TRANSPORT TRENDS: ELECTRIC VEHICLES AND HOW ZAMBIA CAN BENEFIT

Battery pack



Relays

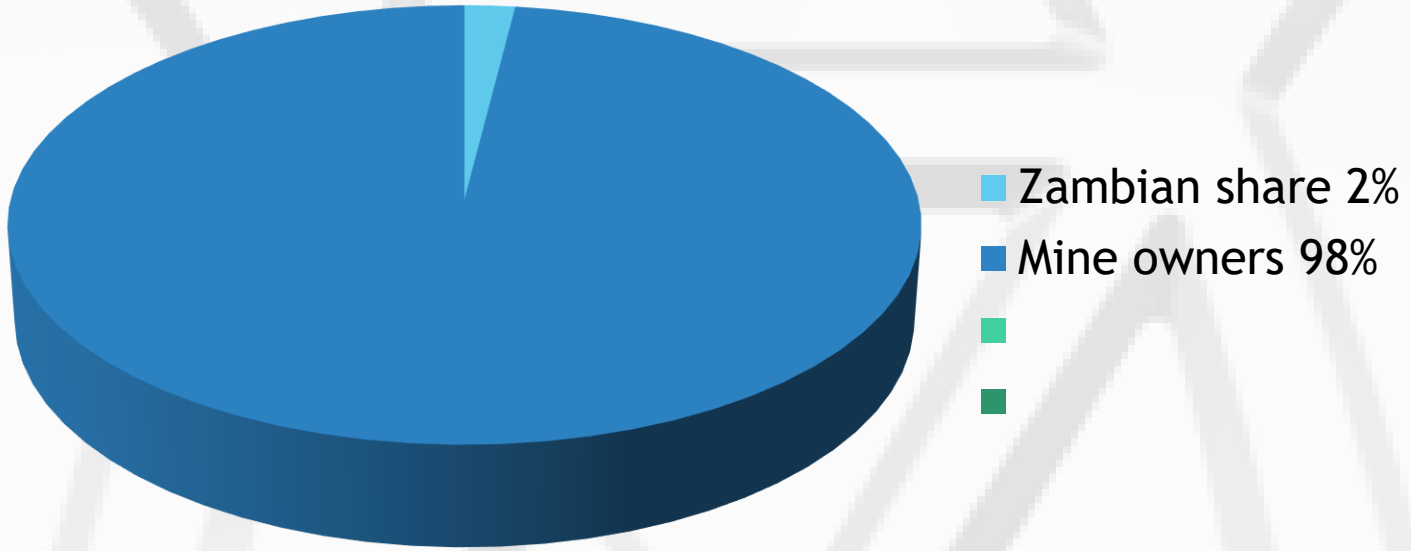
contactor Technology

FOR THE PURPOSE OF ANALYSIS FOR PHASE ONE INDUSTRY:

COPPER

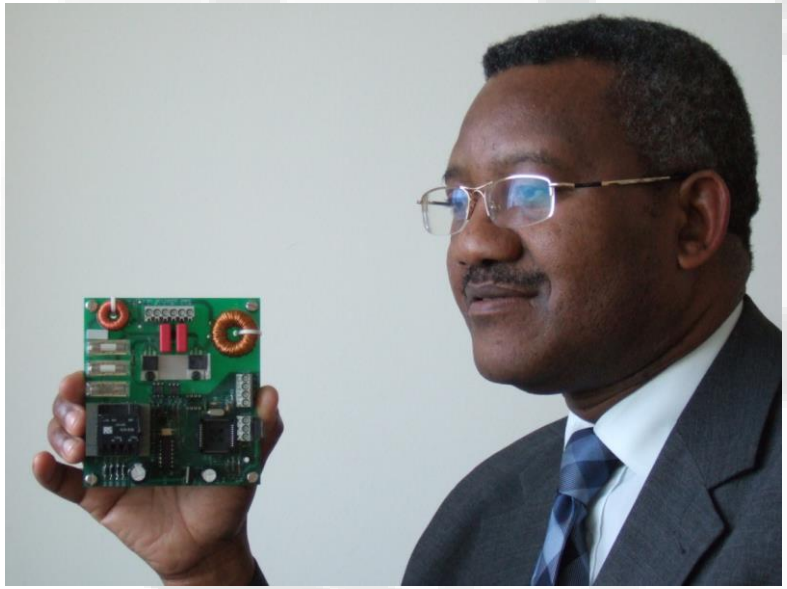
COPPER FINISHED PRODUCTS

HOW MUCH REVENUE DOES ZAMBIA GET FROM COPPER?



COPPER FINISHED PRODUCTS

I HAVE BEEN CALLING FOR YEARS



ARTICLE IN 2005 – THE POST NEWSPAPER

© **THE ZAMBIA'S RECOVERY PLAN:** WAS FIRST PUBLISHED IN MAY 2009 IN THE POST NEWSPAPER.
THE MATERIAL WAS RESEARCHED AND WRITTEN BY **PROFESSOR CLIVE CHIRWA**.

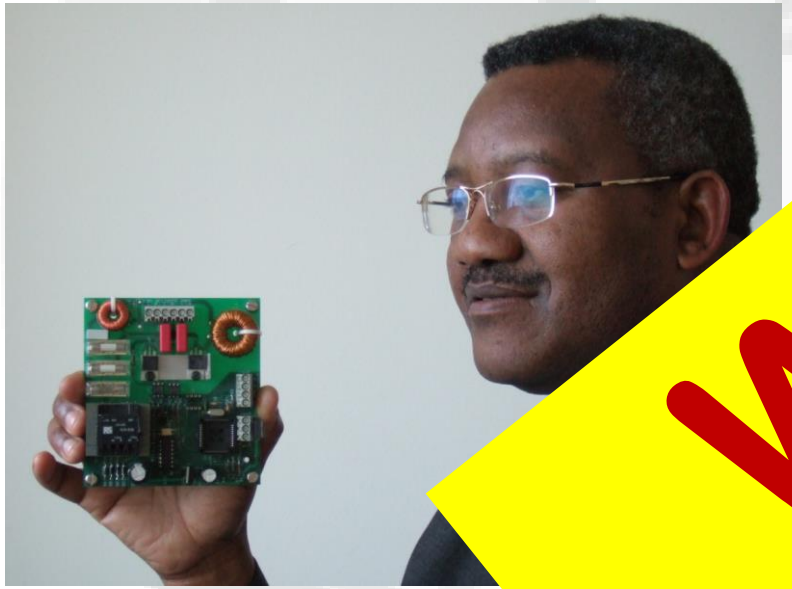
THESIS IN 2009 – THE POST NEWSPAPER. REVISED IN DEC 2020

ENGINEERING INSTITUTION OF ZAMBIA – INTERS HOTEL 10, 2012

COPPER FINISHED PRODUCTS

I HAVE BEEN ... FOR YEARS

WHY?



© THE Z...
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...VAS RESEARCHED ...N BY **PROFESSOR** ...**RWA**.

ARTICLE IN 2005 – THE ... NEWSPAPER

THESIS IN 2009 – THE POST NEWSPAPER. REVISED IN DEC 2020

ENGINEERING INSTITUTION OF ZAMBIA – INTERS HOTEL 10, 2012

REVENUE PERFORMANCE

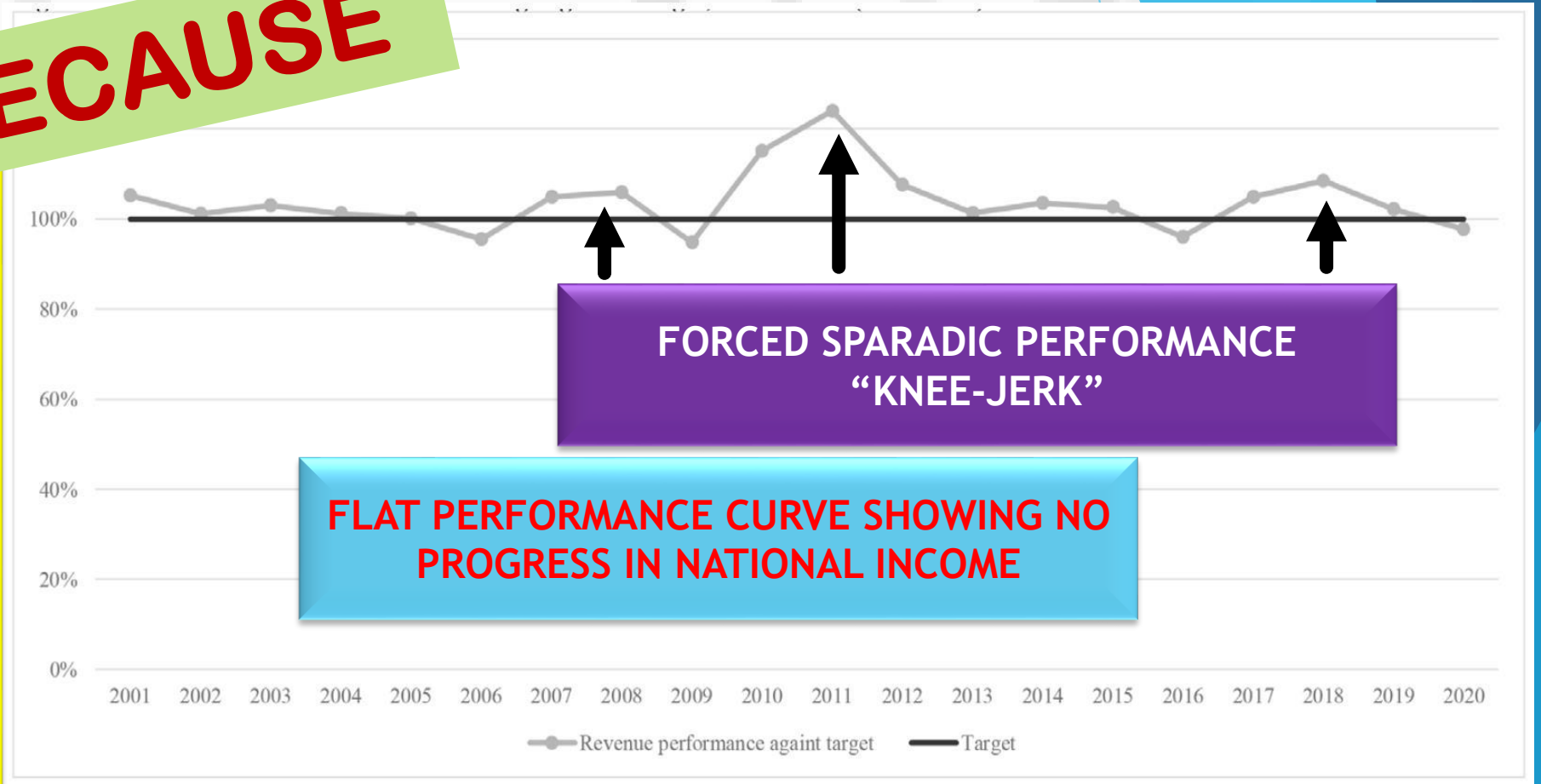
Courtesy of

Zambia Revenue Authority

BECAUSE

TAX REVENUE PERFORMANCE AGAINST TARGET

- TOO LOW TARGET AMBITIONS FOR A COUNTRY WORTH TRILLION OF DOLLARS
- NOT MEETING THESE TARGETS SHOW STAGNATION OF ECONOMIC POLICIES OVER THE YEARS BY RESPECTIVE ADMINISTRATIONS

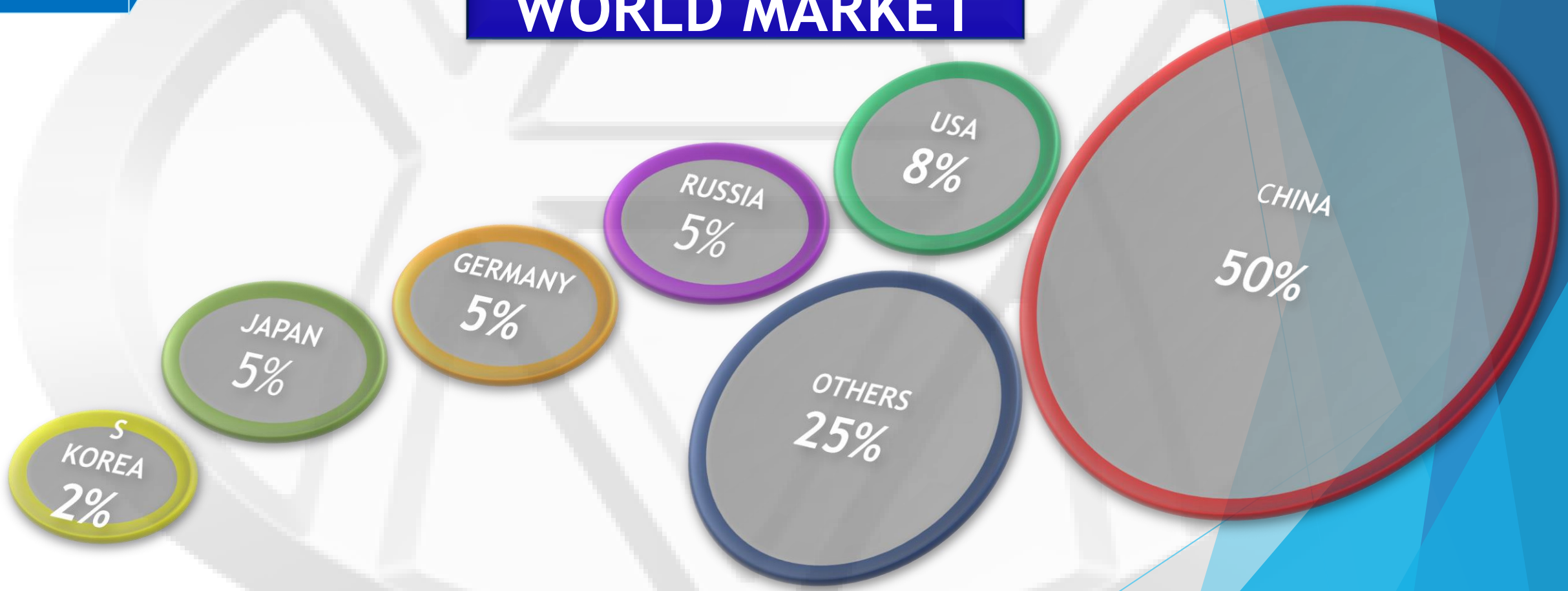


FORCED SPARADIC PERFORMANCE "KNEE-JERK"

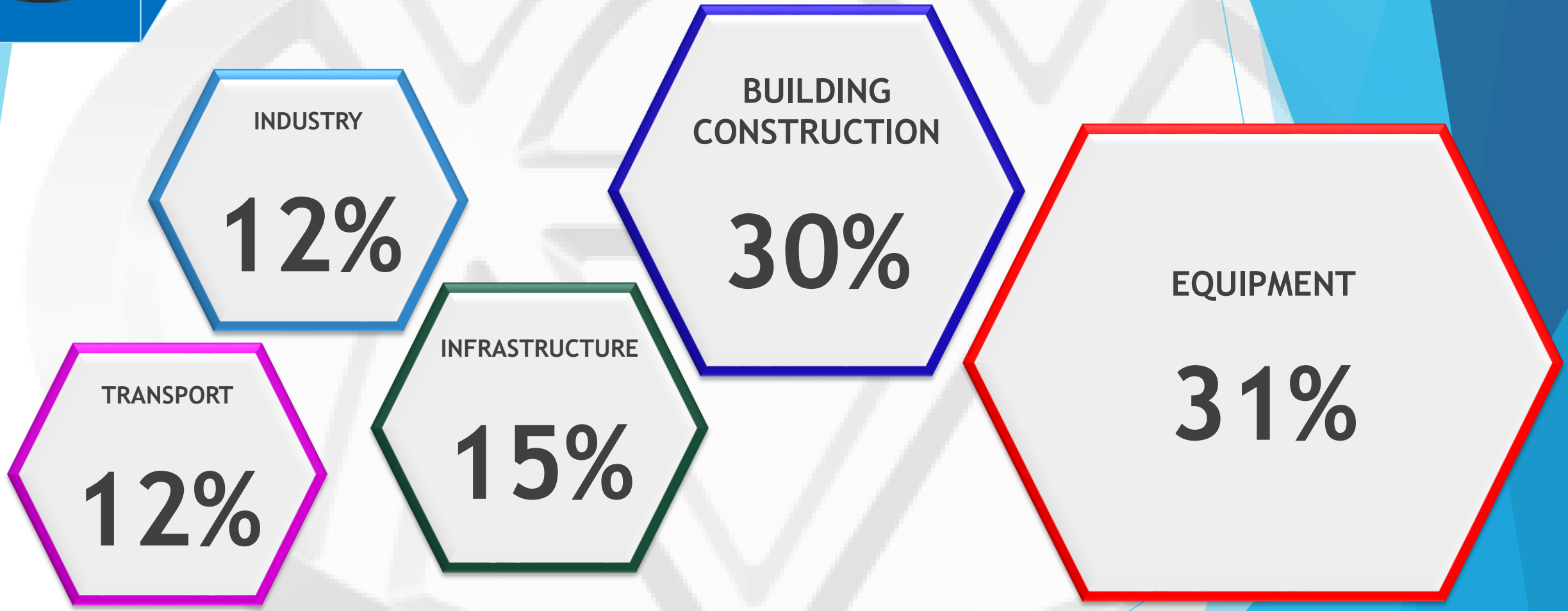
FLAT PERFORMANCE CURVE SHOWING NO PROGRESS IN NATIONAL INCOME

MARKETS – REFINED COPPER CONSUMPTION

WORLD MARKET



REFINED COPPER – END USER SECTOR



MARKETS – REFINED COPPER CONSUMPTION

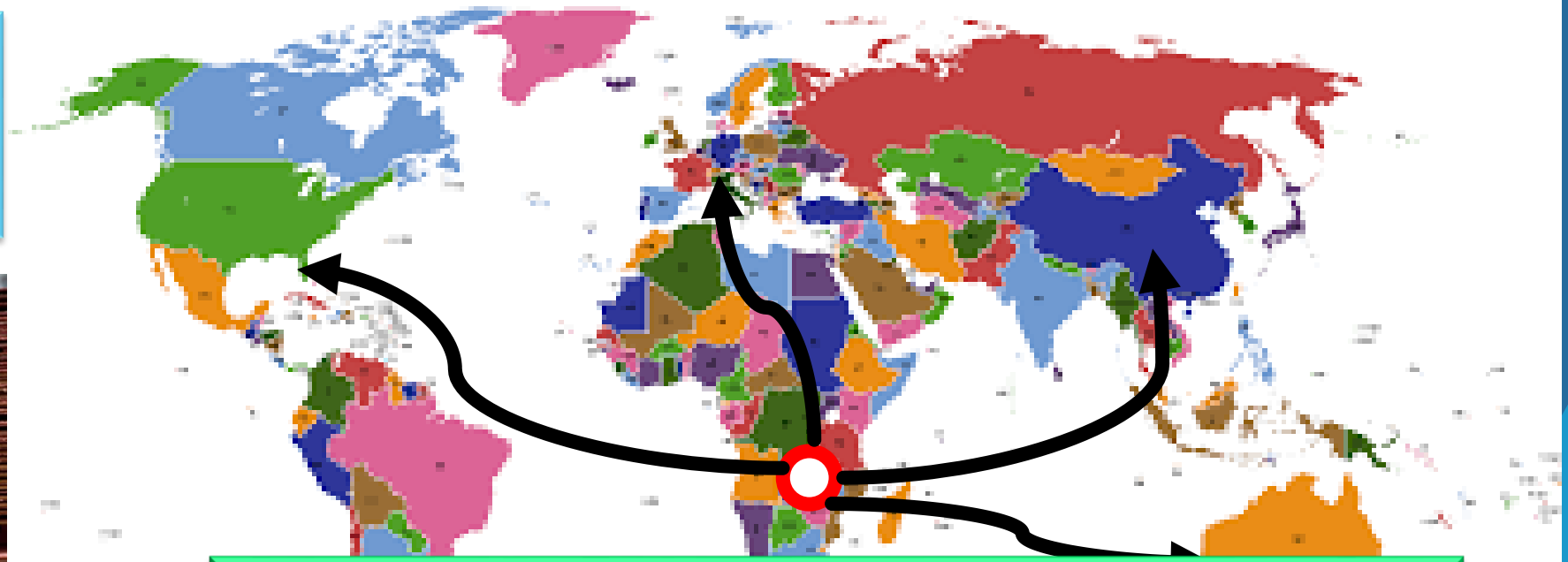
WORLD MARKET

WHERE ARE AFRICAN COUNTRIES?

TRADITIONAL COPPER MARKETS

ZAMBIA's COPPER MARKETS

FIRST MINE OPENED IN 1920



98% COPPER TO ASIA, EUROPE, AMERICA
1.6% AUSTRALIA, SINGAPORE BASIN
0.4% AFRICA

TRADITIONAL COPPER MARKETS

ZAMBIA's COPPER MARKETS

FIRST MINE OPEN

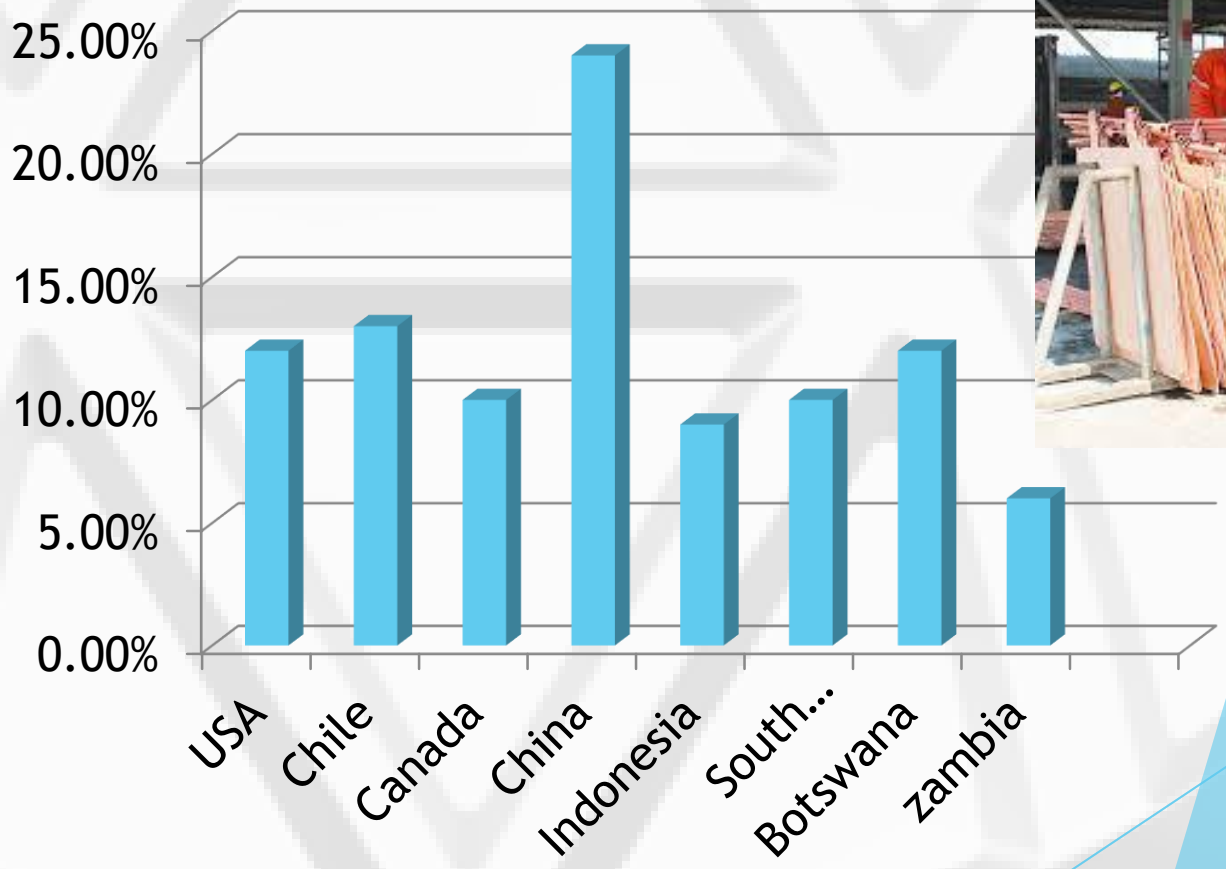
BENEFIT TO ZAMBIA
VERY, VERY, VERY LITTLE
AND MOSTLY LOSSES

% COPPER TO ASIA, EUROPE, AMERICA
1.6% AUSTRALIA, SINGAPORE BASIN
0.4% AFRICA

ROYALTY CLAIMED BY ZAMBIA

ROYALTY COMPARISON

ZAMBIA CLAIMED ONLY IN 2008 AND 2011



Courtesy of Copper Countries, 2011

MINING NO LONGER AN END OPTION

25.00%

21ST CENTURY SOLUTIONS ARE **NOT** BASED ON

MINING, MINING, AND MORE MINING…

NO BORROWING FOR CONSUMPTION

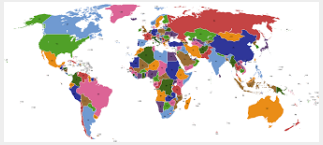
ZAMBIA SHOULD STOP CHASING ITS SHADOW WITH LIGHT BEHIND…

IT WILL NEVER BE CAUGHT

THE BEGINNING OF A PROSPEROUS LIFE IS TO LOVE YOURSELF

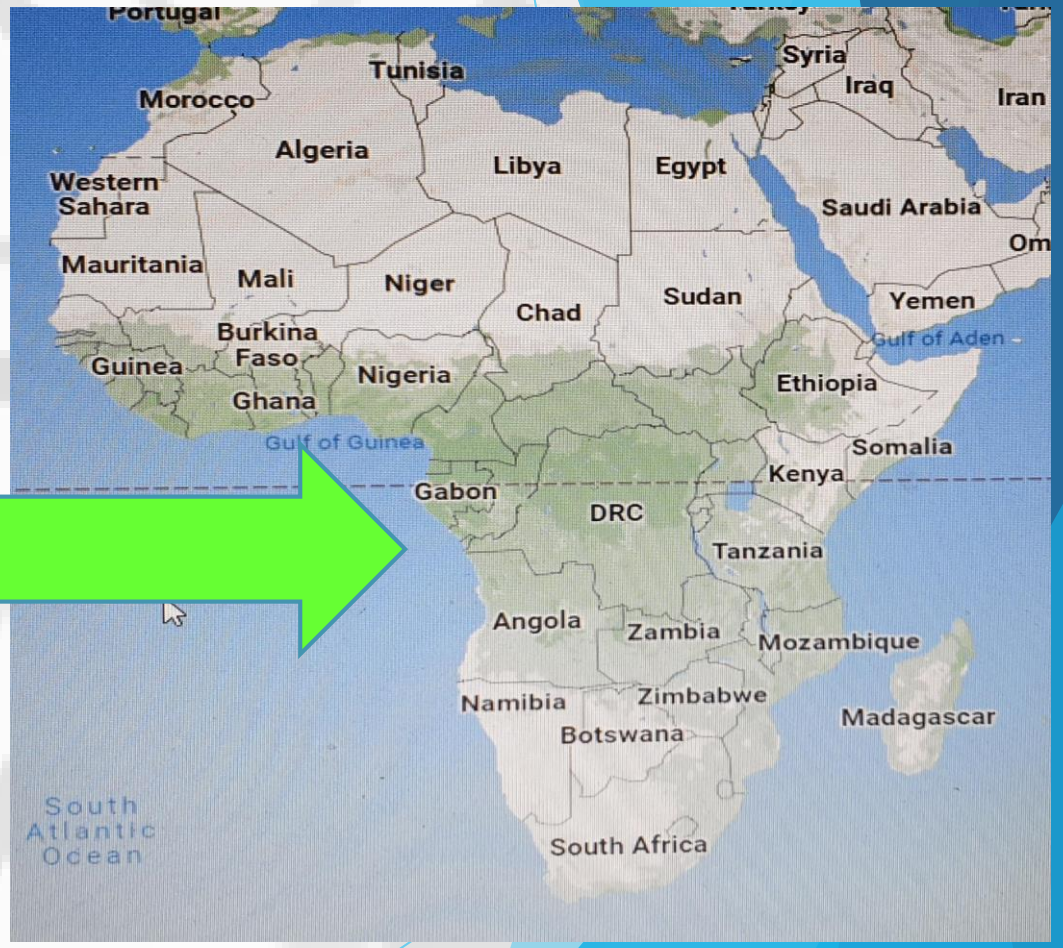
BORROW FOR INVESTMENT

CURRENT MARKET ALL FOR NON-AFRICANS



FINISHED PRODUCTS
WIRE & CABLE
COMING TO AFRICA

94.5%



Technology Transfer Public Lecture
"Zambia's Natural Resources In Downstream Industries"
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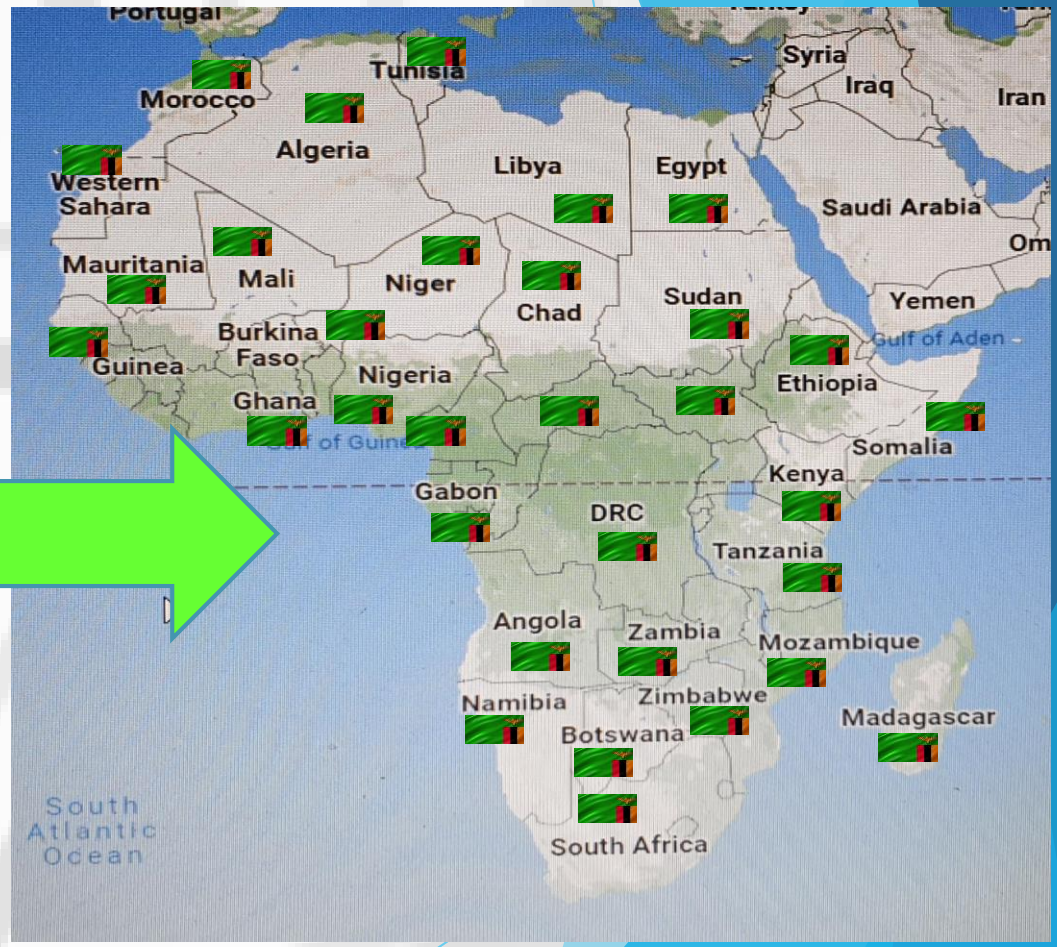
ZAMBIA'S NEW VIRGIN MARKET IN AFRICA

AfCFTA

AFRICAN CONTINENTAL FREE TRADE AREA



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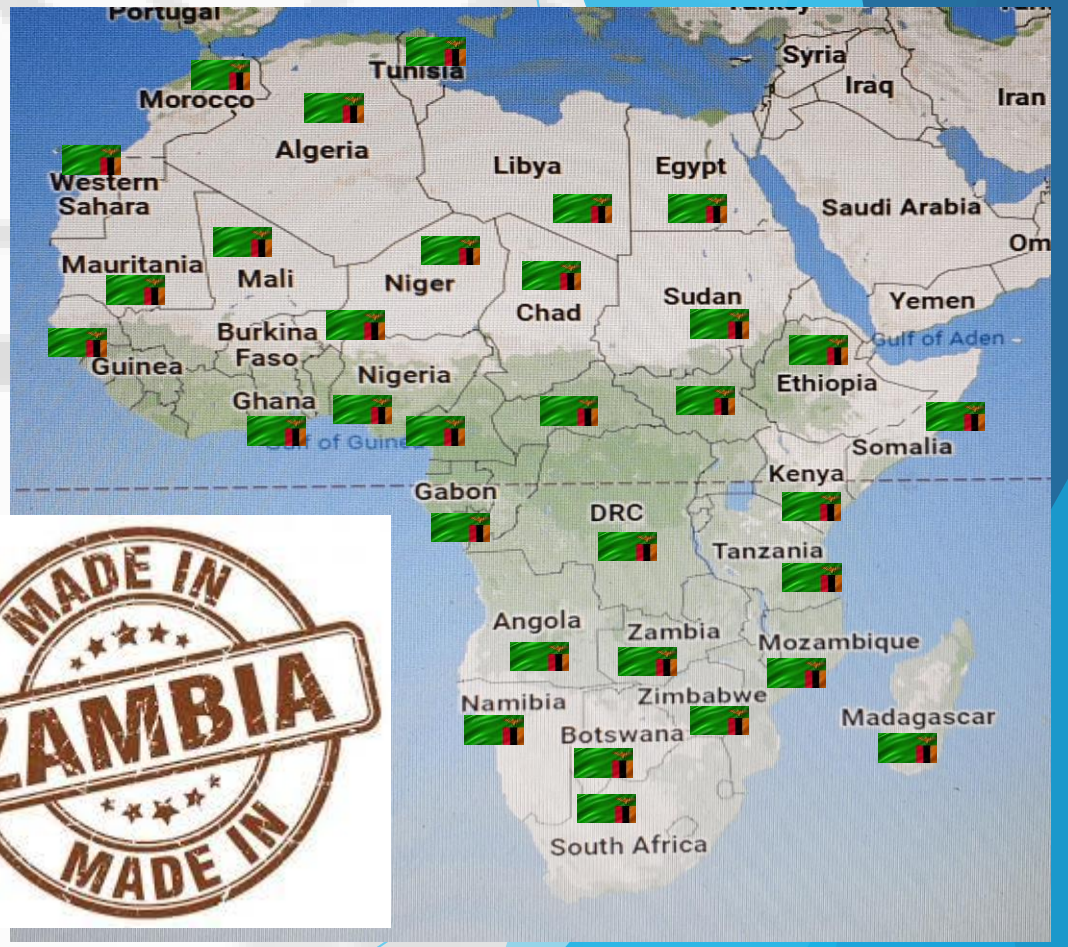
ZAMBIA'S NEW VIRGIN MARKET IN AFRICA









Technology Transfer Public Lecture
"Zambia's Natural Resources In Downstream Industries"
22nd June 2022, Government Complex, Lusaka, Zambia

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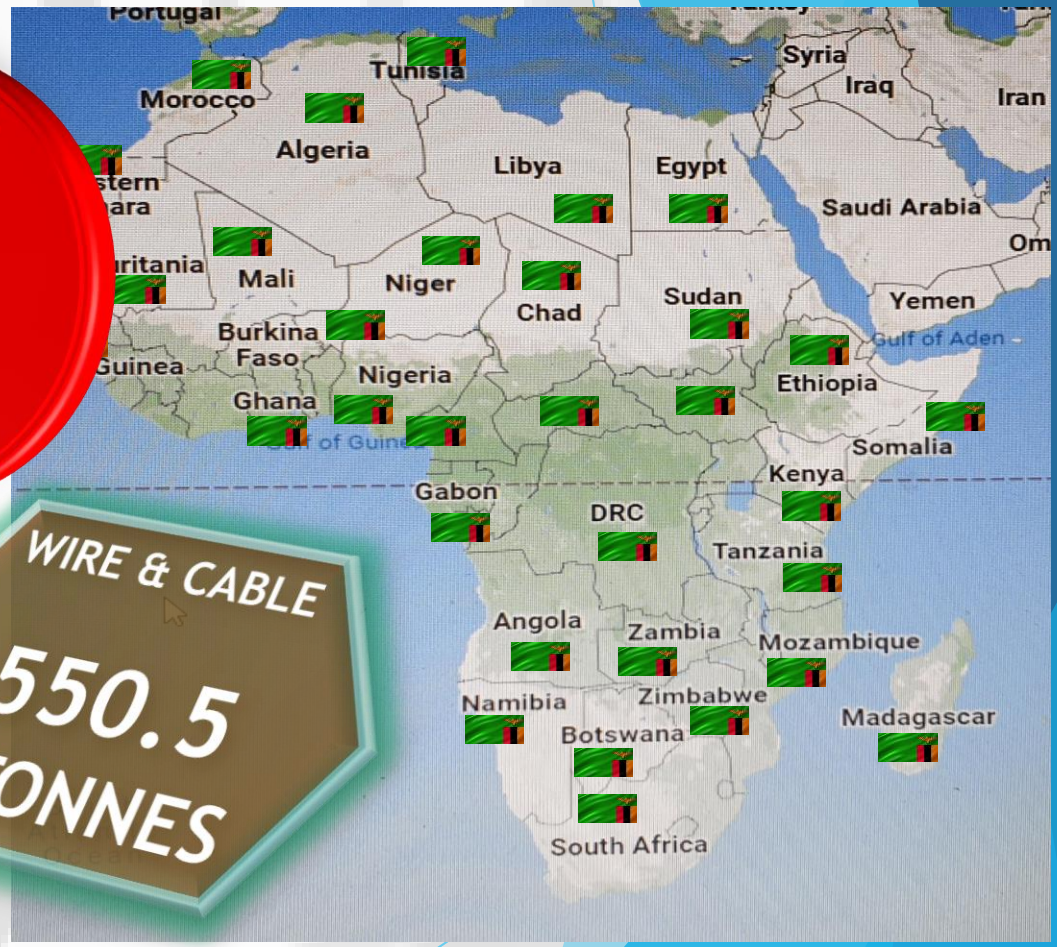
WIRE & CABLE MARKET IN AFRICA

THIS IS A BRAND NEW MARKET FOR ZAMBIA

COPPER FINISHED PRODUCTS WIRE & CABLE

CATHODE PRICE $5500 PER TONNE



Courtesy of
Industry Arc, Fortune Business Insights, ICF Congress
Marketwatch.com

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WIRE & CABLE MARKET IN AFRICA

THIS IS A BRAND NEW MARKET FOR ZAMBIA

COPPER FINISHED PRODUCTS WIRE & CABLE

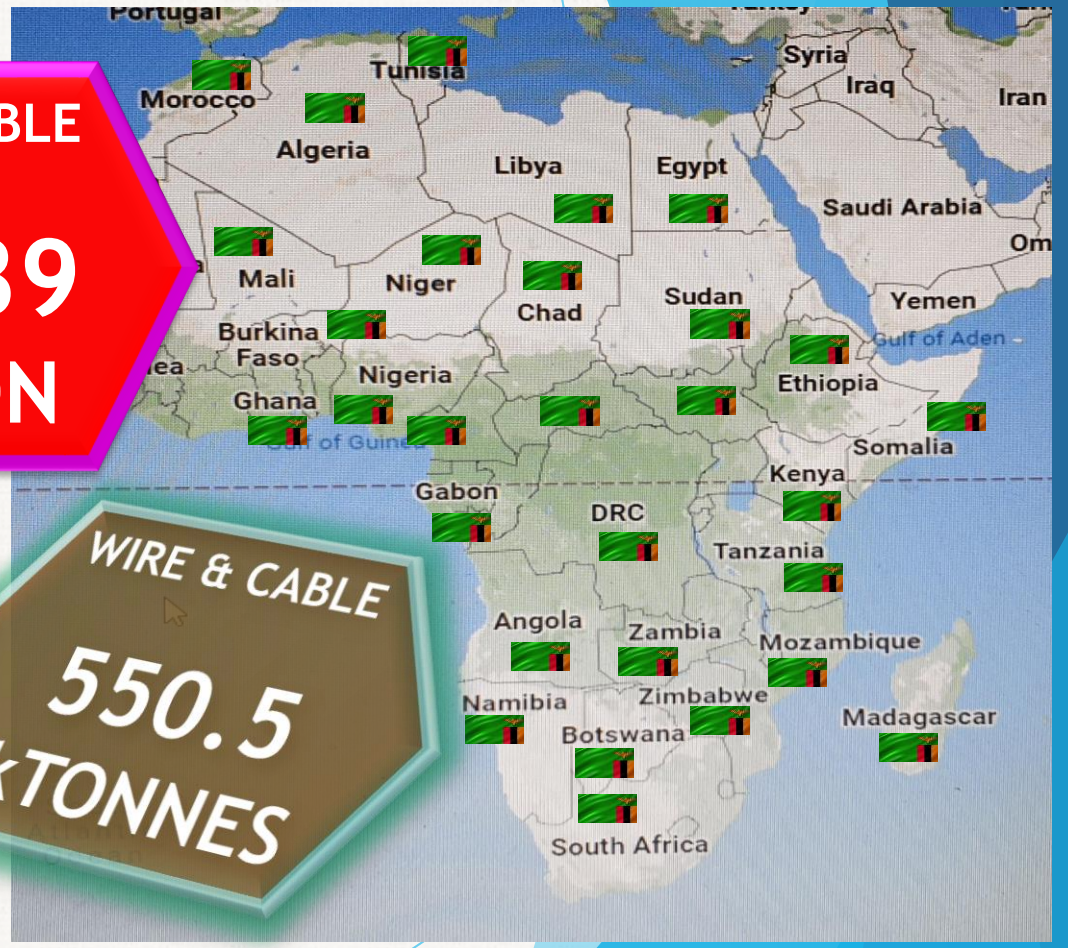
WIRE & CABLE

$51.39 BILLION

2022-2027 CAGR 5.5%

WIRE & CABLE

550.5 kTONNES



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WIRE & CABLE MARKET IN AFRICA

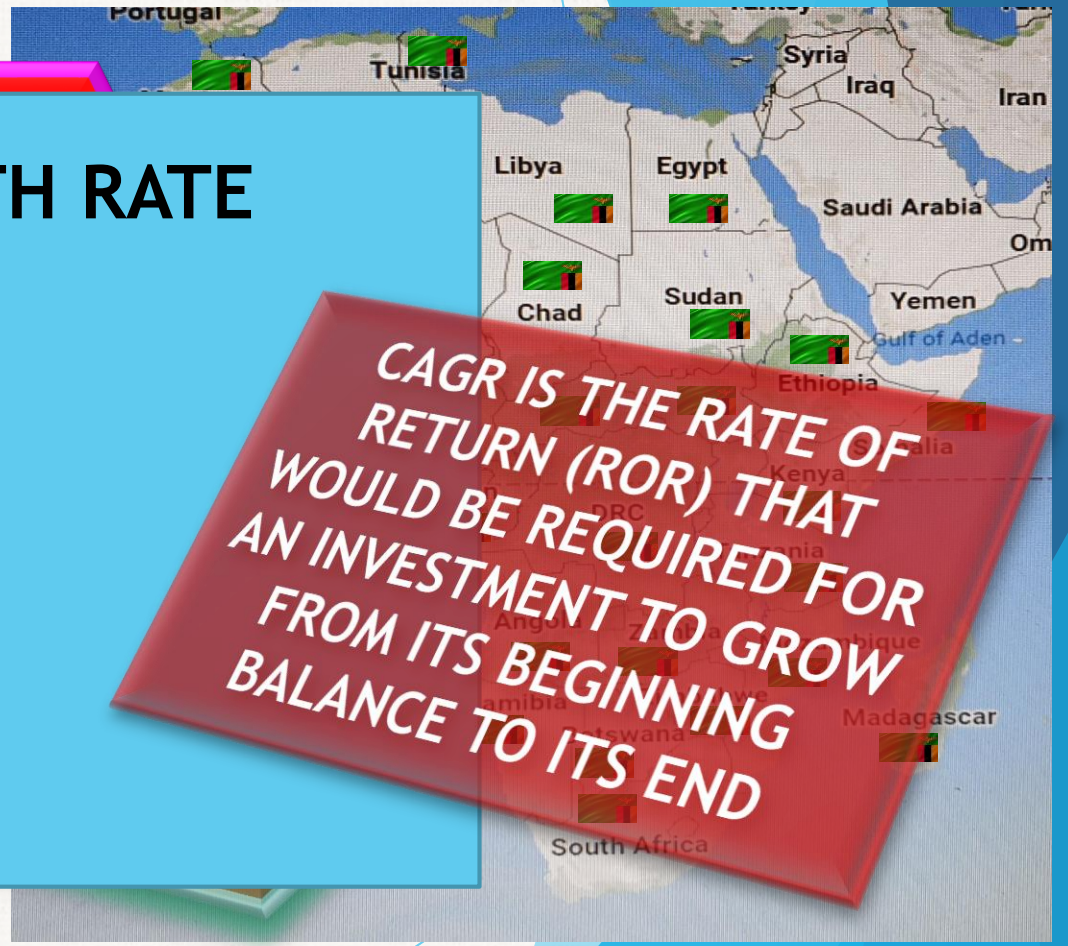
COMPOUND ANNUAL GROWTH RATE

$$\mathrm{CAGR} = \left(\frac{V_{\text{final}}}{V_{\text{begin}}}\right)^{1/t} - 1$$

V_{final} - Beginning value

V_{begin} - Final Value

t- Time in years

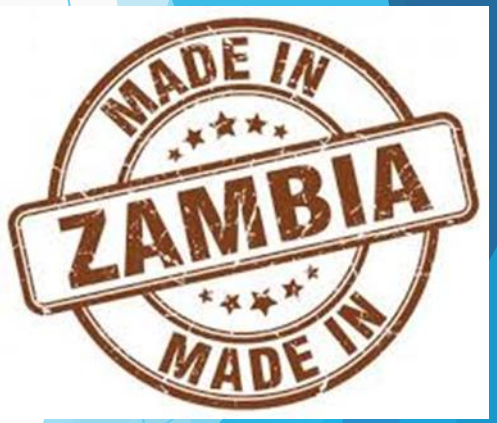


CAGR IS THE RATE OF RETURN (ROR) THAT WOULD BE REQUIRED FOR AN INVESTMENT TO GROW FROM ITS BEGINNING BALANCE TO ITS END

Marketwatch.com

COPPER WIRE ROD PRODUCTS

DOWNSTREAM PROCESS FIRST STAGE



COPPER WIRE PRODUCTS

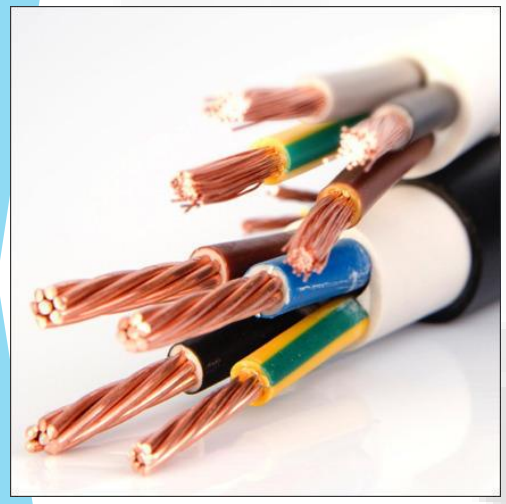
DOWNSTREAM PROCESS SECOND STAGE

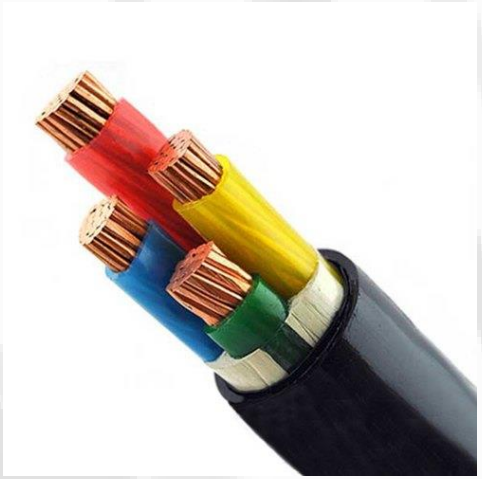
8 mm - 15 mm Copper Rods

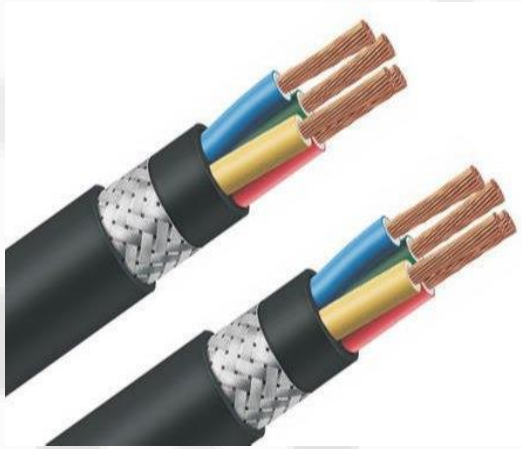
COPPER CABLE PRODUCTS

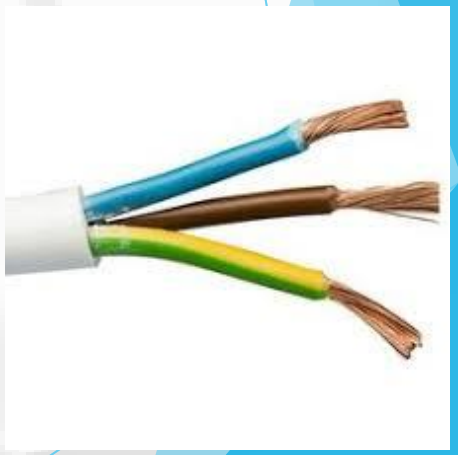
DOWNSTREAM PROCESS FINAL STAGE

Copper Cables









GLOBAL COPPER CABLE MARKET

DOWNSTREAM PROCESS FINAL STAGE

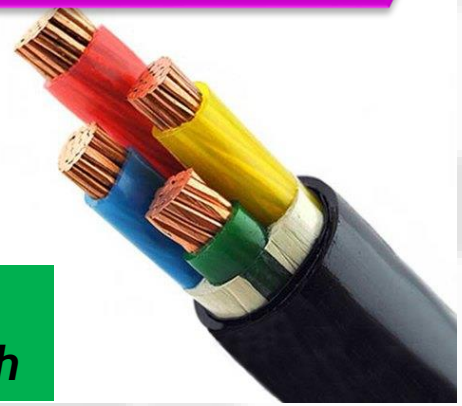
GLOBAL MARKET

Copper Cables

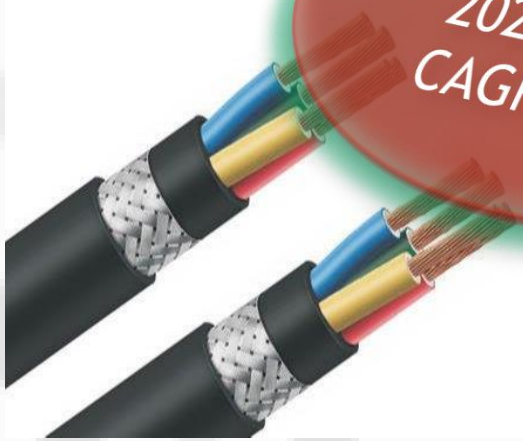
WIRE & CABLE

$267.17 BILLION

Courtesy of alliedmarketresearch



2020-2030 CAGR 6.0%



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ROUND COPPER BAR PRODUCTS

DOWNSTREAM PROCESS FIRST STAGE

Copper Round Bars For Export

Copper Round Bars

Copper Hexagonal Bars

SQUARE COPPER BAR PRODUCTS

DOWNSTREAM PROCESS FIRST STAGE

GLOBAL MARKET

Copper Square Bars

SOLID BARS

$2.11 BILLION

Copper Hexagonal Bars

2020-2030 CAGR 3.0%

Copper Rectangular Bars

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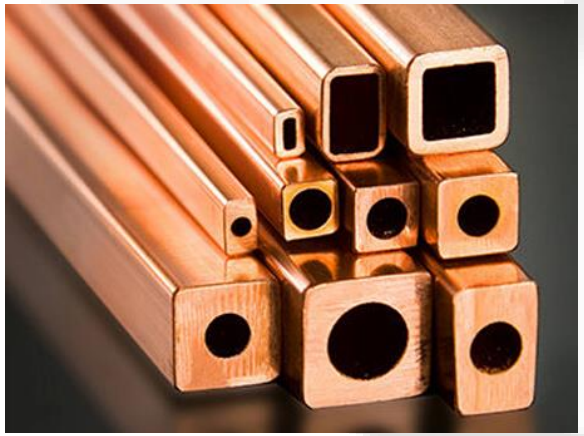
SQUARE COPPER TUBE PRODUCTS

DOWNSTREAM PROCESS SECOND STAGE

Copper Square Bars



ROUND COPPER TUBE PRODUCTS

DOWNSTREAM PROCESS SECOND STAGE

Courtesy of Marketwatch..com

Copper Round Bars to Tubes

GLOBAL MARKET

2020-2028 CAGR 3.3%

PIPES & TUBES

$129.63 BILLION

PLUMBING MARKET IN AFRICA

THIS IS A BRAND NEW MARKET FOR ZAMBIA

COPPER FINISHED PRODUCTS

PIPE & TUBE

PIPE & TUBE

$51.29 BILLION

2022-2027 CAGR 2.7%

PIPE & TUBE

549.4 kTONNES

Courtesy of
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COPPER PLATE PRODUCTS

DOWNSTREAM PROCESS SECOND STAGE

Copper Plates

AUTOMOTIVE COPPER STRIP PRODUCTS

DOWNSTREAM PROCESS FIRST STAGE

Copper Stirps & Cop
Flats
Thickness
1 mm (min)
2 mm (min)
3 mm (min)
5 mm (min)
6 mm -50 mm
Width
10 mm - 50 mm
10 mm - 100 mm
10 mm - 150 mm
10 mm - 200 mm
10 mm - 250 mm

Copper Bus Bars

AUTOMOTIVE COPPER STRIP PRODUCTS

DOWNSTREAM PROCESS FIRST STAGE

GLOBAL MARKET

BUS BARS

$624.2 MILLION

2022-2027 CAGR 7.6%

Copper Stirps & Cop
Flats

ess
in)
)
)
in)
50 mm

Width
10 mm - 50 mm
10 mm - 100 mm
10 mm - 150 mm
10 mm - 200 mm
10 mm - 250 mm

BUS BARS

66.87 kTONNES

Copper Bus Bars

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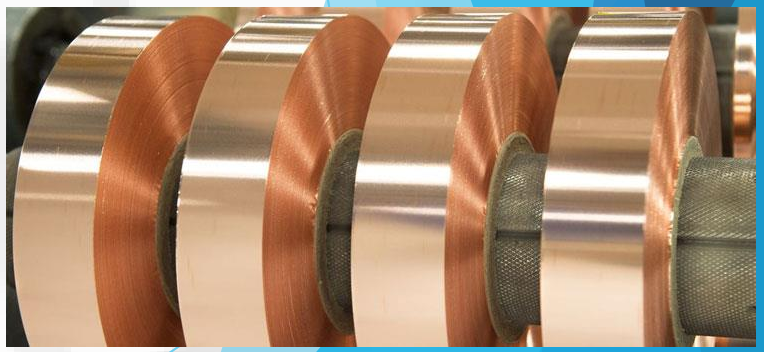
COPPER SHEET & FOIL PRODUCTS

DOWNSTREAM PROCESS FINAL STAGE

Copper Sheets/Foils



COPPER SHEET & FOIL PRODUCTS

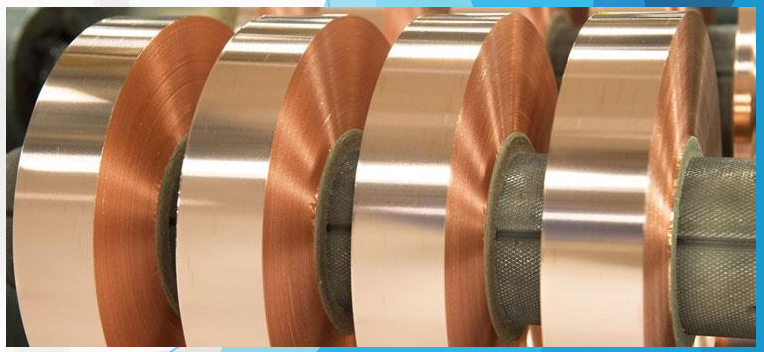
DOWNSTREAM PROCESS FINAL STAGE

GLOBAL MARKET

Copper Sheets/Foils

FOILS

$21.8 BILLION



READY MADE REVENUE FOR ZAMBIA

READY FOR ENERGY STORAGE SYSTEMS

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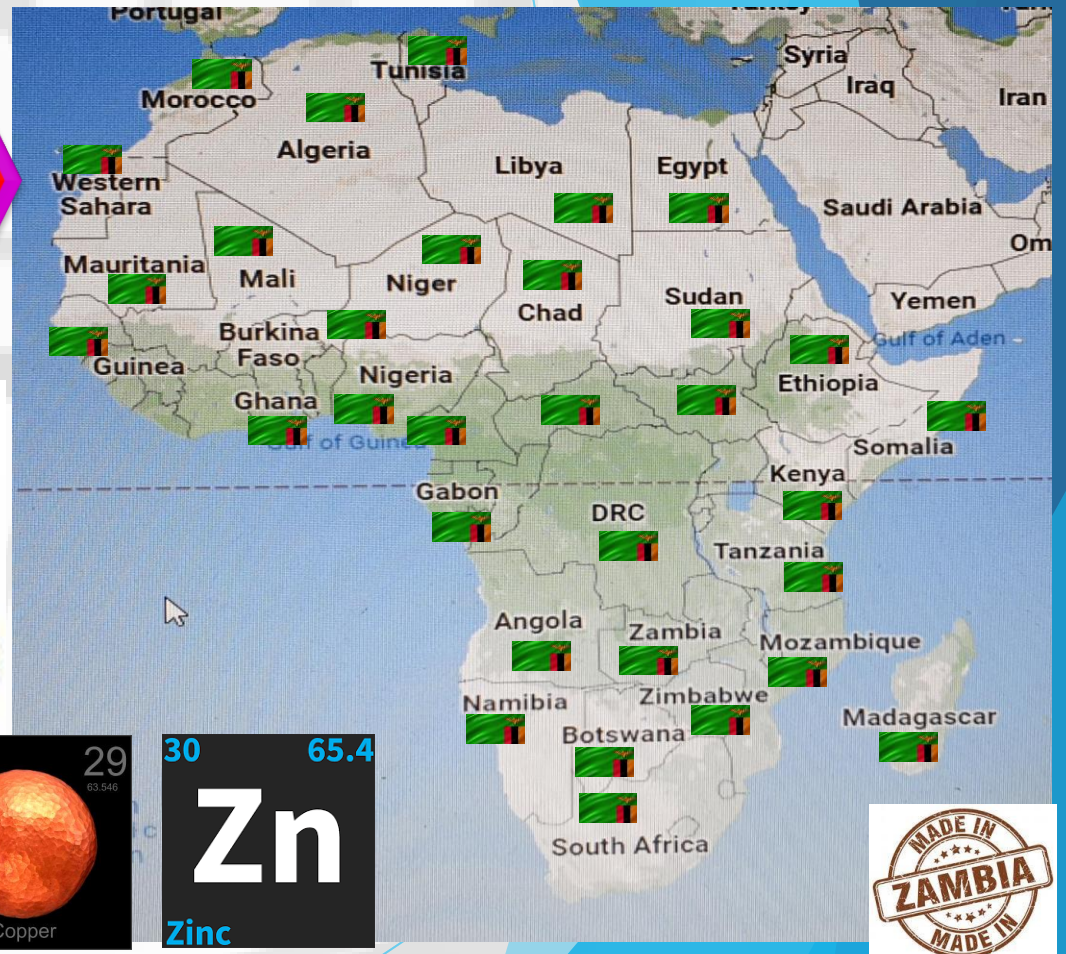
BRASS - READY MADE REVENUE FOR ZAMBIA

Courtesy of Reportlinker

BRASS ROD

$17.78 BILLION



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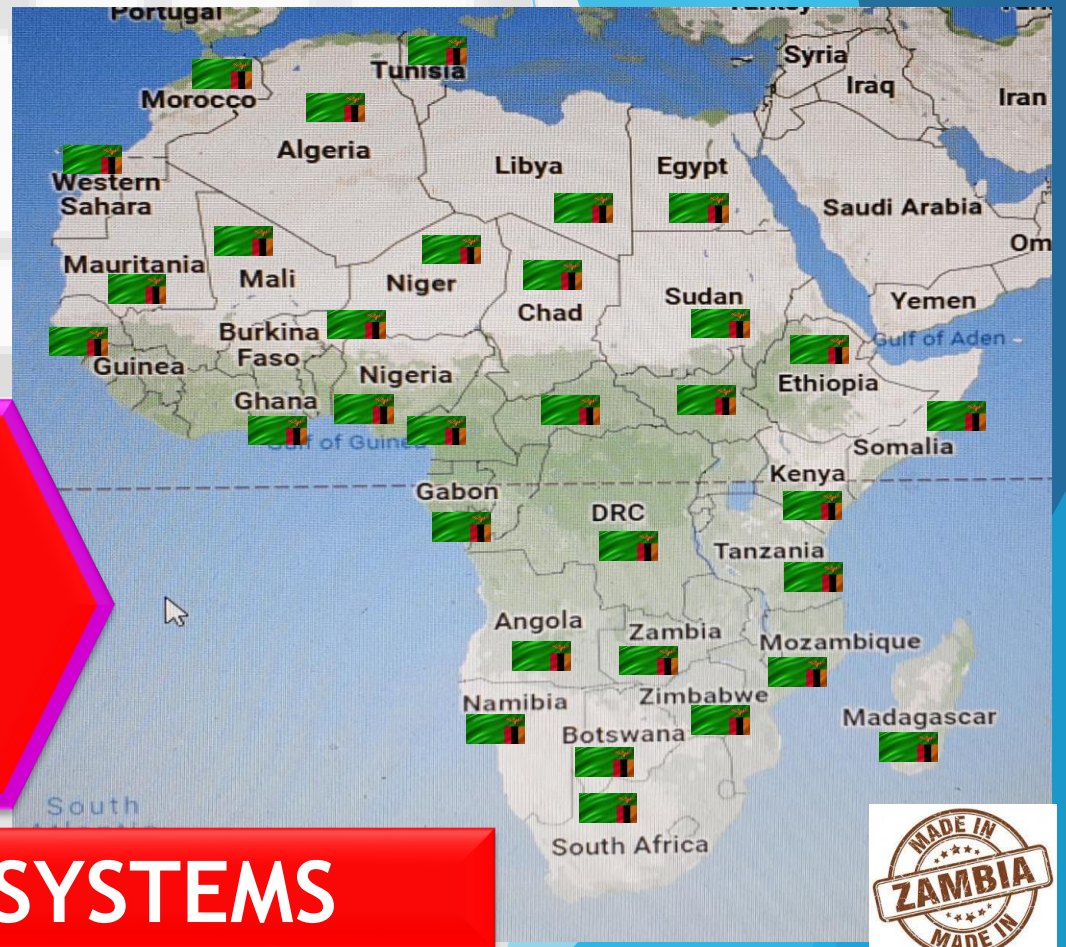
BRASS - READY MADE REVENUE FOR ZAMBIA

2020-2027 CAGR 3.0%

BRASS BARS

$10.00 BILLION



Courtesy of Reportlinker

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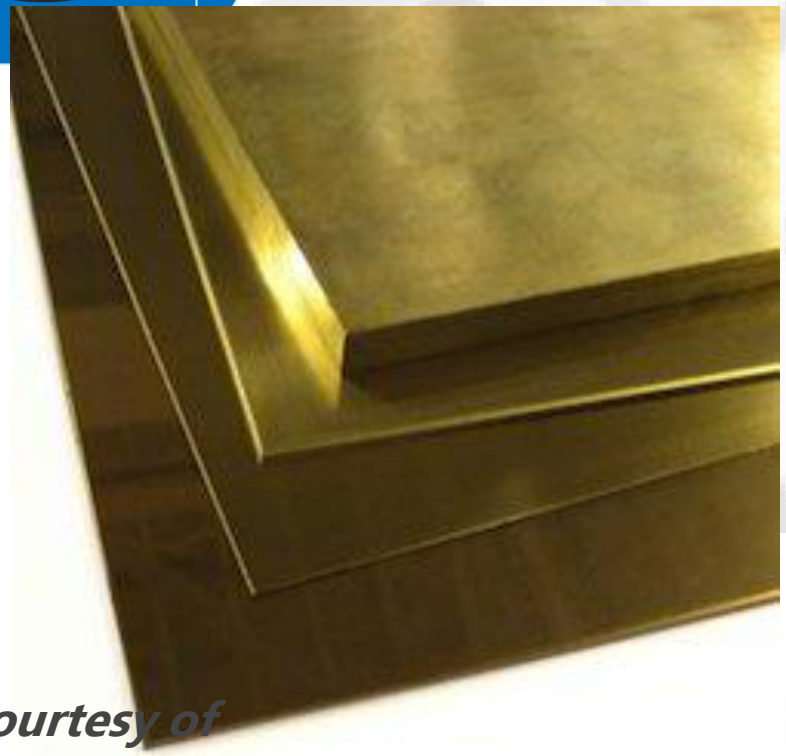
BRASS - READY MADE REVENUE FOR ZAMBIA

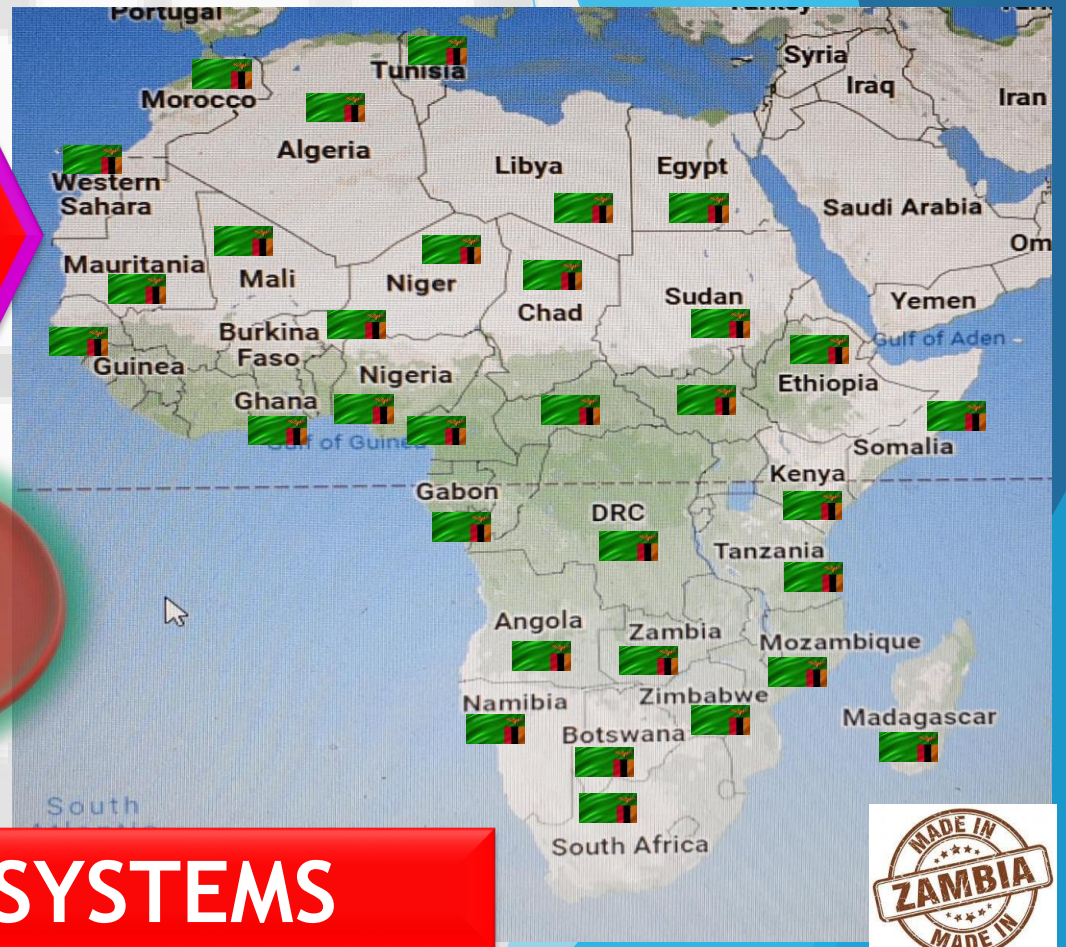


Courtesy of Reportlinker

BRASS SHEETS

$496.0 BILLION

2021-2031 CAGR 5.0%



READY FOR ENERGY STORAGE SYSTEMS

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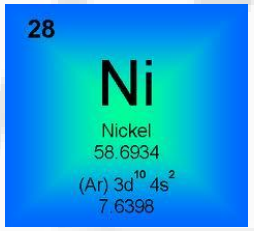
NICKEL - READY MADE REVENUE FOR ZAMBIA



NICKEL

$59.14 BILLION

Courtesy of Reportlinker

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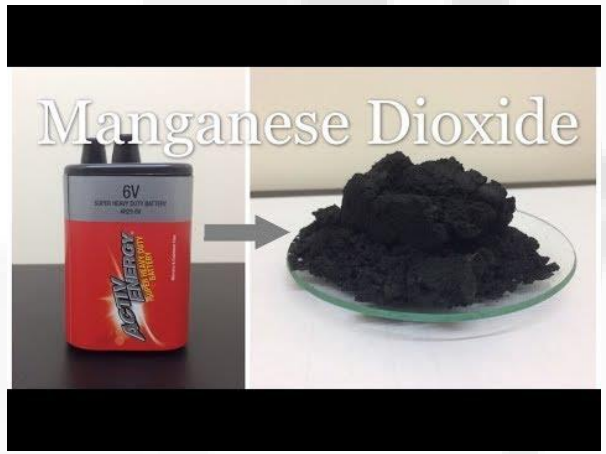
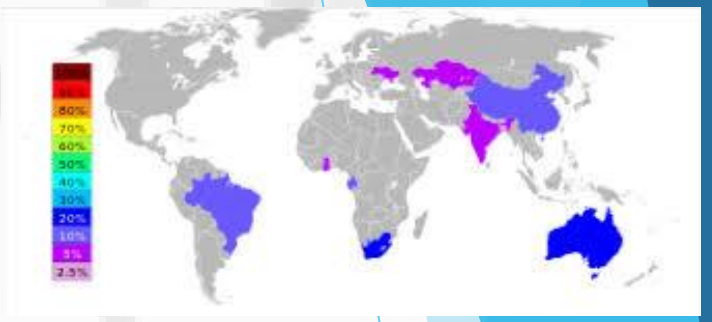
MANGANESE - READY MADE REVENUE - ZAMBIA



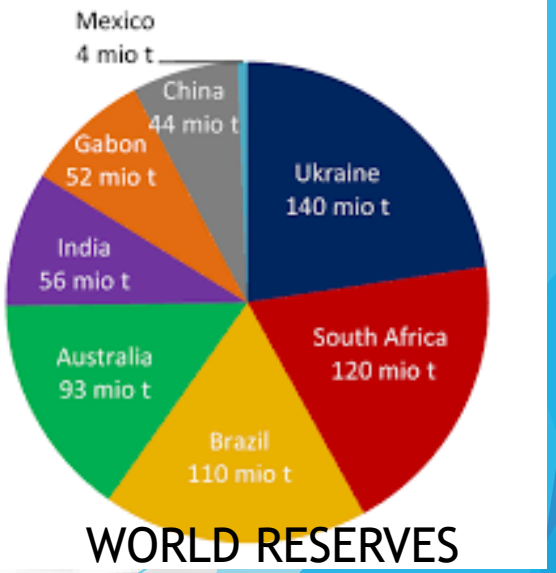
25
Mn
Manganese
54.938044



MANGANESE

$42.04 MILLION

2021-2028 CAGR 7.4%



WORLD RESERVES

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ENERGY STORAGE COMPONENT PRODUCTION

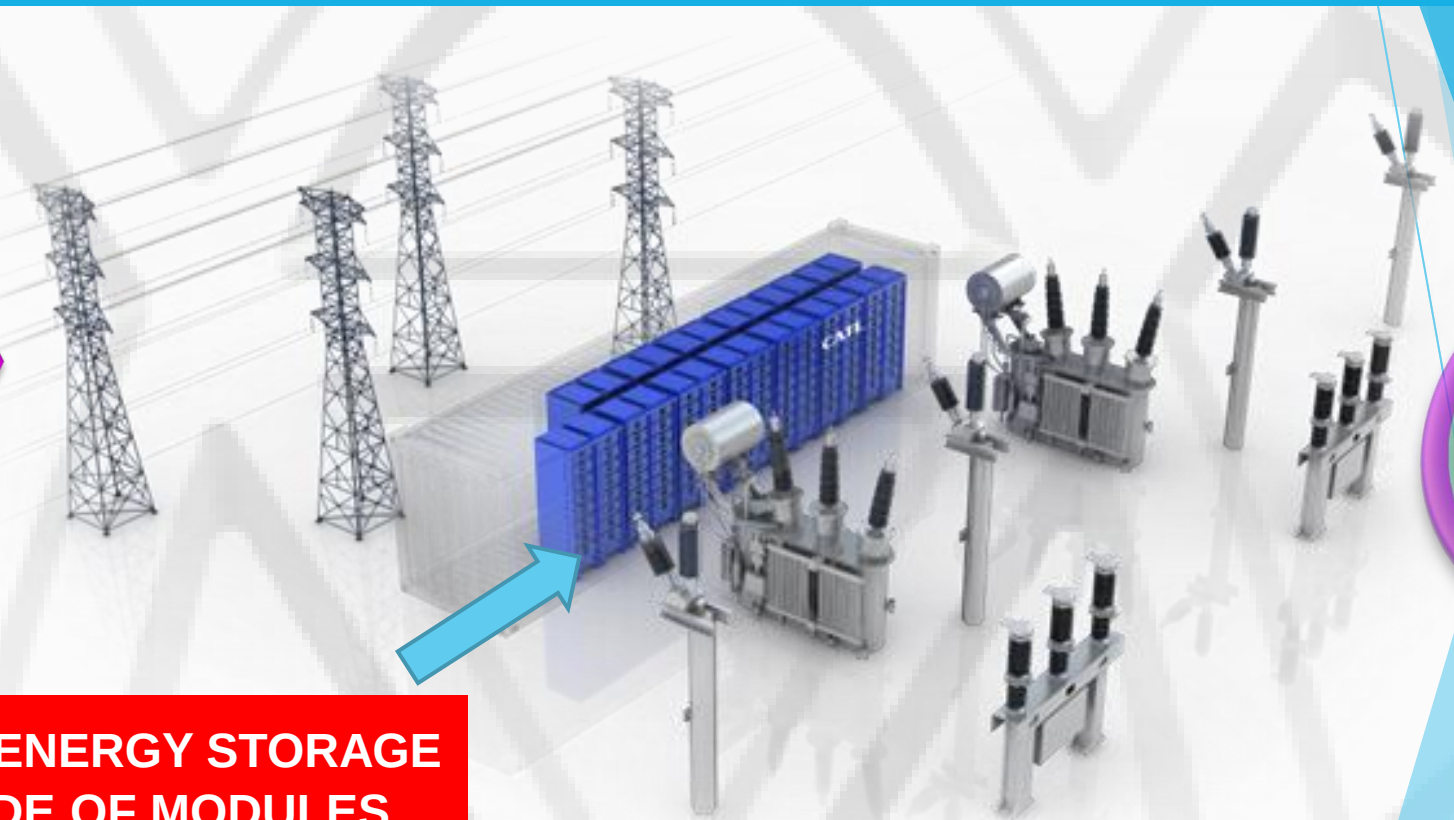
ONCE THE COPPER DOWNSTREAM PROCESSING FIRMS HAVE BEEN DEVELOPED

ONLY THEN

SHOULD ZAMBIA EMBARK ON PHASE TWO: SECONDARY INDUSTRY

CURRENT ENERGY STORAGE SYSTEMS

POWER PACK



NO MORE POWER CUTS

100MWh ENERGY STORAGE PACK MADE OF MODULES

Courtesy of CATL 宁德时代

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CURRENT ENERGY STORAGE SYSTEMS

POWER PACK

NO MORE POWER CUTS

50MWh ENERGY STORAGE PACK MADE OF MODULES

Courtesy of CATL 宁德时代

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CURRENT ENERGY STORAGE SYSTEMS

POWER PACK

Power consumption solar energy storage station

FUTURE SERVICE STATION

1000Wh ENERGY STORAGE PACK MADE OF MODULES

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CURRENT ENERGY STORAGE SYSTEMS

POWER PACK

32MWh ENERGY STORAGE POWER PACK

CEMENT COMPANY

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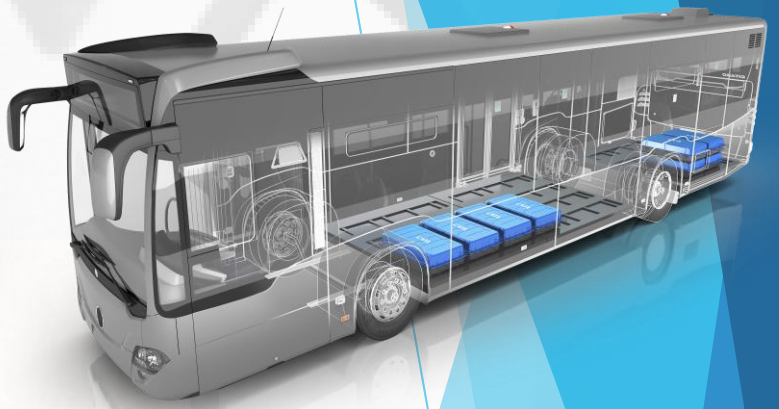
CURRENT ENERGY STORAGE SYSTEMS

BATTERY PACKS



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CURRENT ENERGY STORAGE SYSTEMS

BATTERY PACK

Courtesy of

BYD

CATL 宁德时代

CURRENT ENERGY STORAGE SYSTEMS

WHAT MAKES UP A LITHIUM-ION BATTERY PACK

POUCH CELL

CYLINDRICAL CELL

MODULE FOR POUCH CELLS

MODULE FOR CYLINDRICAL CELLS

PACK FOR POUCH CELLS

PACK FOR CYLINDRICAL CELLS

CURRENT LITHIUM-ion BATTERY CHEMESTRIES

	CATHODE/ANODE MATERIAL	STRENGTHS	WEAKNESSES
CATHODES	Lithium Cobalt Oxide	-High Energy -High Power	-Thermally Unstable & Relatively short life -Limited Load Capabilities
CATHODES	Lithium Manganese Oxide Spinel	-High Power & Thermal Stability -Enhanced Safety & Low Cost	-Low Capacity Compared to Other Cathodes -Limited Life & Needs thermal Management
CATHODES	Lithium Nickel Cobalt Aluminium Oxide	-High Specific Energy -Good Specific Power & Long Life Cycle	-Safety Issues -Cost is Prohibitive
CATHODES	Lithium Nickel Manganese Cobalt Oxide	-Ni has High Specific Energy & Mn has low resistance -Tailored to Offer High Specific Energy or Power	-Nickel has Low Stability -Manganese Offers Low Specific Energy
CATHODES	Lithium Iron Phosphate	-Safe; Tolerant to Abuse; Thermal Stability -High Current Rating & Long Cycle Life	-Lower Energy Density Due to Low Operating Voltage and Capacity
ANODES	Graphite/Carbon-Based	-Good Mechanical stability & Gravimetric Capacity -Good Conductivity & Li-ion Transport	-Low Volumetric Capacity
ANODES	Lithium Titanate	-Withstands Fast Charge/Discharge Rates -Inherently Safe & Long Cycle Life	-Lower Energy Density Compared to Graphitic Anodes & Cost is Prohibitive
ANODES	Silicon Alloy	-High Gravimetric/Volumetric Capacity -Low Cost & Chemical Stability	-High Degree of Mechanical Expansion on Charging

BATTERY ENERGY DENSITY

HOW GOOD IS YOUR BATTERY DESIGN

Li_2FePO_4

$LiMn_{1.5}Ni_{0.5}O_4$

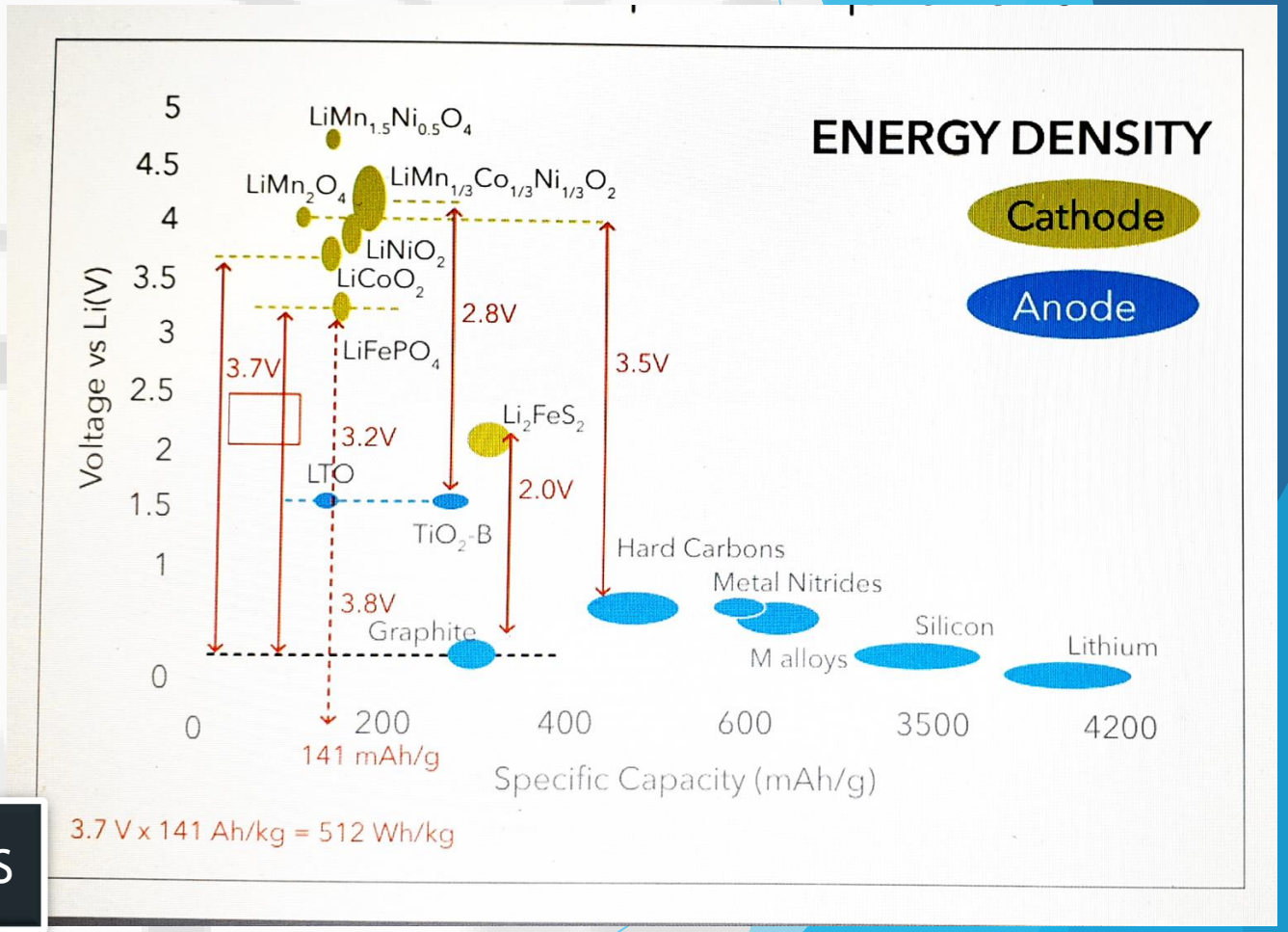
$LiMn_2O_4$

$LiMn_{1/3}CO_{1/3}Ni_{1/3}O_2$

$LiNiO_2$

$LiCoO_2$

Li_2FeS_2



DIFFERENT CHEMISTRIES SUIT SPECIFIC REQUIREMENTS

BATTERY PACK TEST BED

HONDA

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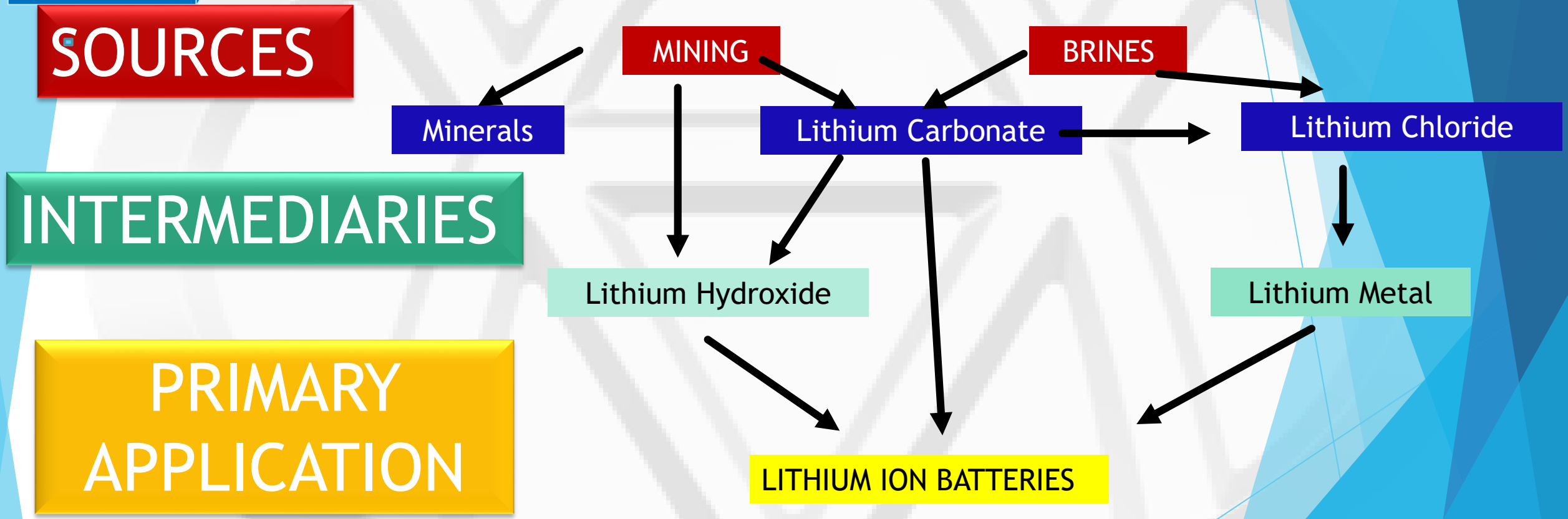
LITHIUM ION CELL ARCHITECTURE

ASSEMBLY

13-15

PARTS

LITHIUM MINING & PROCESSING



LITHIUM ION CELL ARCHITECTURE

Aluminium Foil - 350m Roll

This aluminum foil (15 um) is used as substrate (Al current collectors) for coating cathode materials in Li-Ion rechargeable battery

Specifications

- Material: Aluminum
- Purity > 99.3%
- Resistivity: 2.7 x 10^{-8} Ohm-metre
- Length: 350m
- Width: 280mm
- Thickness: 15um
- Density: 3.741 g·cm^{-3}
- Tensile Strength: ≥150N/m^3
- Net weight: 5.5 kg

PROCESSED POWDERS

Lithium Manganese Oxide powder $LiMn_2O_4$

Lithium Cobalt Oxide powder $LiCoO_2$

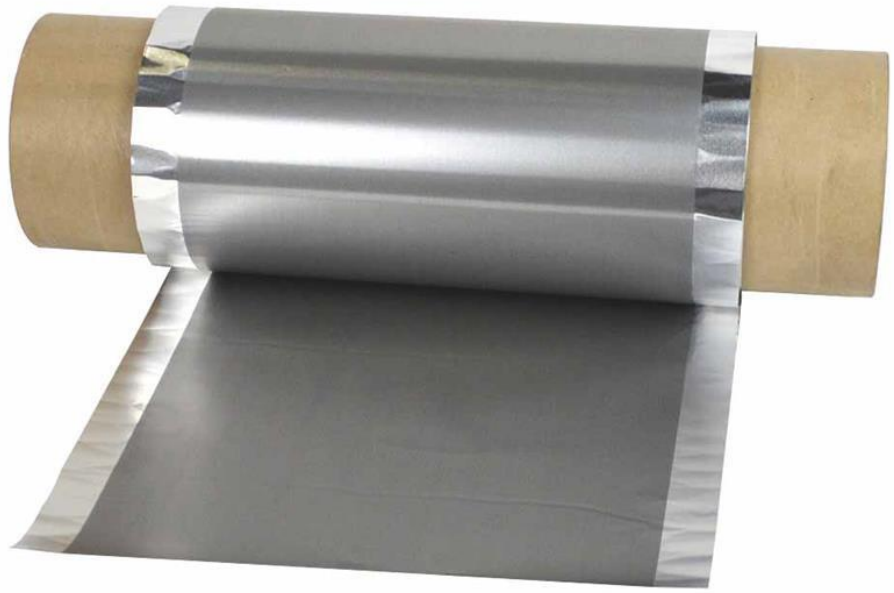
Carbon powder

Lithium Chloride powder

PVDF (Polyvinylidene Difluoride) Binder Powder

Polyvinylidene Difluoride resin is the homopolymer of vinylidene fluoride. It is suitable for Li-ion batteries as adhesive.

LITHIUM ION CELL ARCHITECTURE



Conductive Carbon Coated Aluminium Foil - 80m roll

Conductive Carbon Coated Aluminium Foil for battery cathode substrate

- Conductive carbon coating
  - Double side coating with 1-micron thickness each side
  - Density: 0.5 g/m2
  - Surface resistivity: < 30 ohms per 25um²
  - Binder: Modified acrylate adhesive (water based)
- The substrate of Aluminum Foil
  - Purity > 99.9%
  - Thickness: 16 micron
- Coated width: 200mm
- Total Width: 260 mm cathode substrate
- Total Thickness: 18 um

LITHIUM ION CELL ARCHITECTURE

Aluminium Double side LiFePO4 Foil

Aluminium Double side LiFePO4 Foil,

241mm x 200mm x 0.15mm

LITHIUM ION CELL ARCHITECTURE

Copper Foil - 190m Roll

Copper Foil (Roll) for Battery Anode Substrate

- Material: Copper, Purity> 99.99%
- Both sides polished
  - Length: 170m
  - Width: 280mm
  - Thickness: 9 um (-0, +3) um
  - Density: 8.94 $g \cdot cm^{-3}$
  - Net weight: 5 kg
  - Tube weight: 1 kg

LITHIUM ION CELL ARCHITECTURE

Nickel Foam

Nickel Foam for Battery or Supercapacitor Cathode Substrate

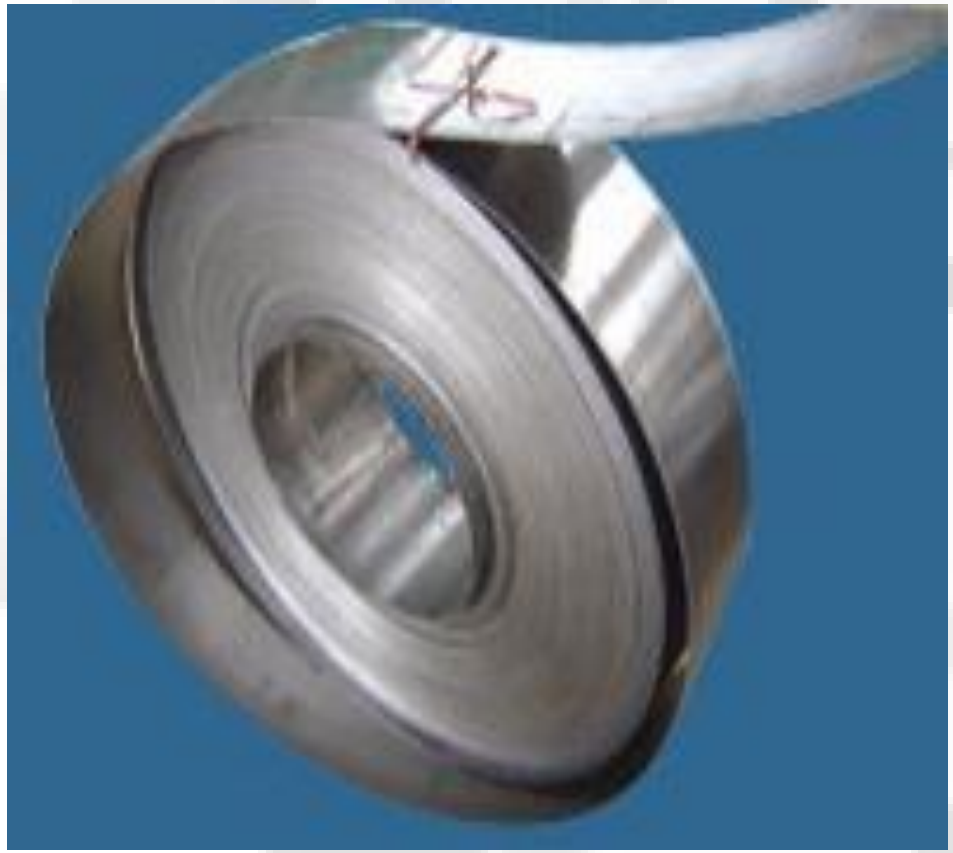
300mm length x 80mm width x 0.08mm thick

LITHIUM ION CELL ARCHITECTURE

Polyethelene Separator 1000m roll
Polyethylene separator
Length: 1000m
Thickness: 20um
Width: 100mm

Polypropylene/PP Separator 500m roll
Polypropylene separator
Length: 1000m
Thickness: 20um
Width: 100mm

LITHIUM ION CELL ARCHITECTURE



Stainless Steel Foil - 4000mm roll

Stainless Steel Foil

4000mm long x 300mm wide x 0.1mm thick

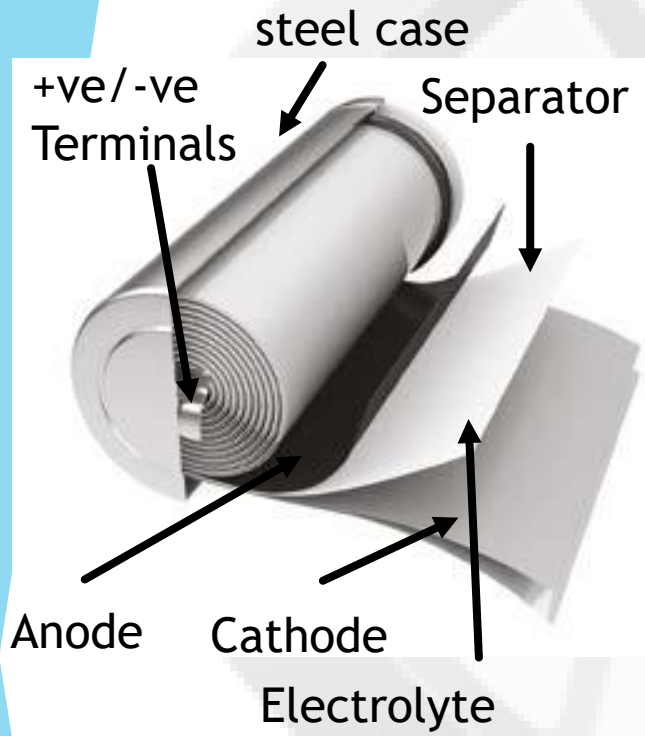
LITHIUM ION CELL ARCHITECTURE

26650 Cylinder Cell Cases
Cylinder Cell Case with Anti-Explosive Cap and Insulation O-ring
- Case: 26mm(OD) x 25.5mm(ID) x 68mm(H)
- Top Cap: 25.5mm dia x 5mm(H)

18650 Cylinder Cell Case
Cylinder Cell Case with Anti-Explosive Cap and Insulation O-ring
- Case:18mm(OD) x 17.5mm(ID) x 67mm(H)
- Top Cap 17.5mm dia x 4.05mm(H)
- Top Insulator: 12.5mm dia x 0.19mm(H)
- Bottom Insulator: 12.5mm dia x 0.19(H)

21700 Cylinder Cell Case -
Cylinder Cell Case with Anti-Explosive Cap
- Case: 21mm(OD) x 20.5mm(ID) x 70mm(H)
- Top Cap: 20.5mm dia x 4.05mm(H)

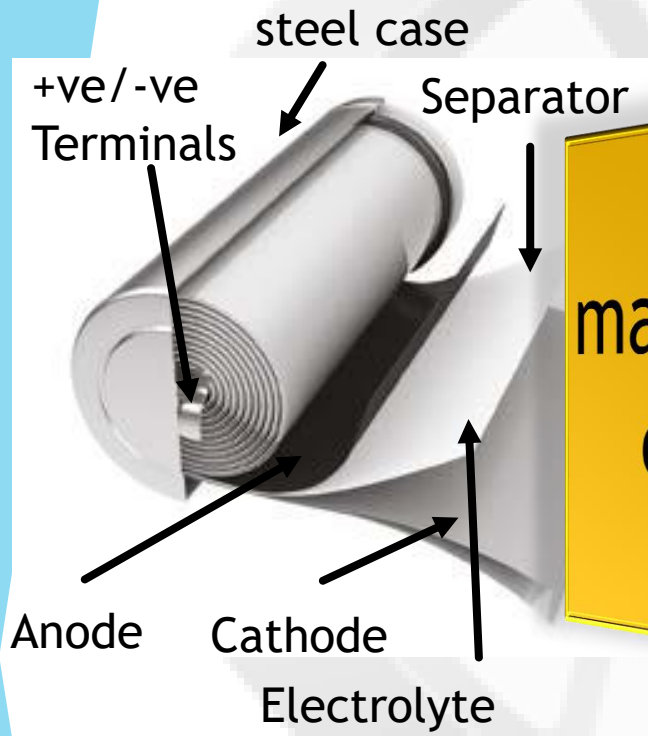
LITHIUM-Ion CELL ARCHITECTURE



Active electrodes: Thinly wound sheets: cathode – separator – anode.

- Cathode: Positively charged electrode often made of a lithium oxide and coated onto a current collecting aluminium **(ALUMINIUM)** foil.
- Anode: Negatively charged electrode in the battery cell, often made of graphite and coated on to a current collecting copper (COPPER) foil.
- Terminals: positive and negative contacts to connect the cells and module.
- Separator: Thin layer of polymer electrically isolates the cathode and anode from one another to prevent short circuit. Its structure allows lithium ions to pass through, allowing current to flow through the cell (microporosity). A liquid transport medium which surrounds the electrodes and soaks into the separator, allowing lithium ions to flow freely.
- Additives: Electrode and electrolyte properties can be improved by adding small amounts of other components, e.g. conductive additives
- Current Interrupt Device: A pressure valve disables the cell in case of over-charge/over-heating

LITHIUM-Ion CELL ARCHITECTURE

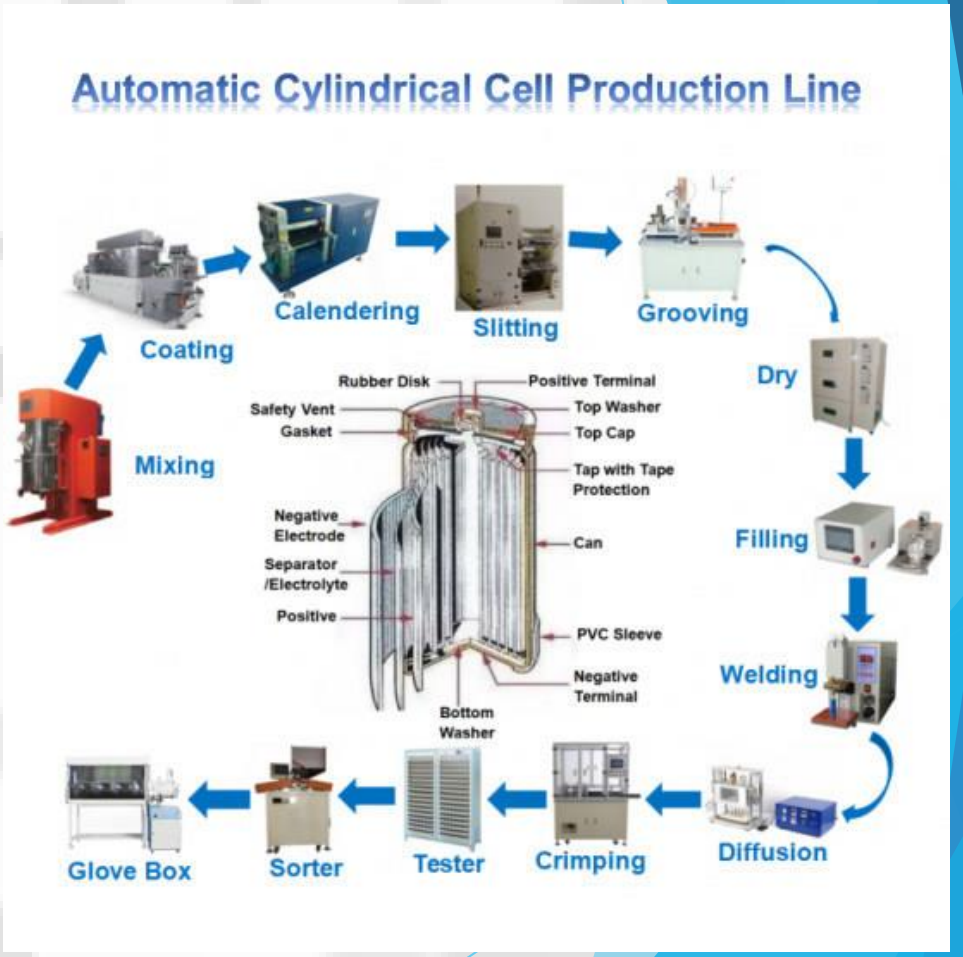


Active electrodes: Thinly wound sheet
• Cathode: Positively
onto a
amounts of othe
• Current Interrupt Device: A p
charge/over-heating

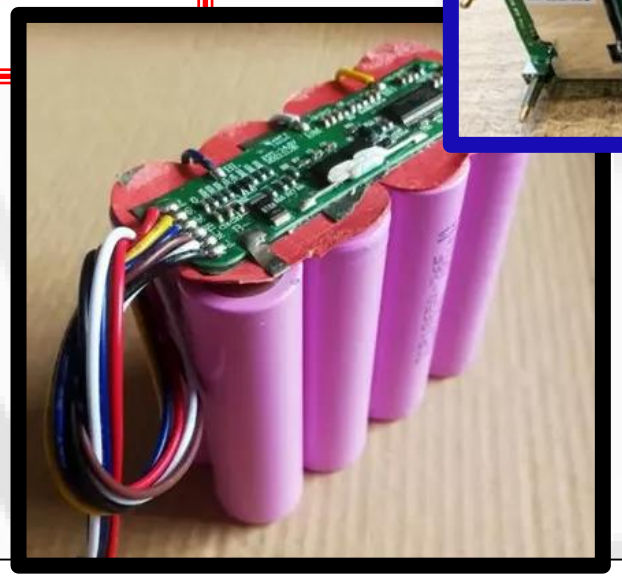
de.
xide and coated
nade of graphite
nd module.
e and anode from
ons to pass
. A liquid
he separator,
by adding small
se of over-

Quality and purity of material has an impact on charge efficiency and battery life

CYLINDRICAL LI-ion CELL MANUFACTURING



LITHIUM-Ion CELL FINISHED PRODUCT



ALL CAN BE MADE IN ZAMBIA

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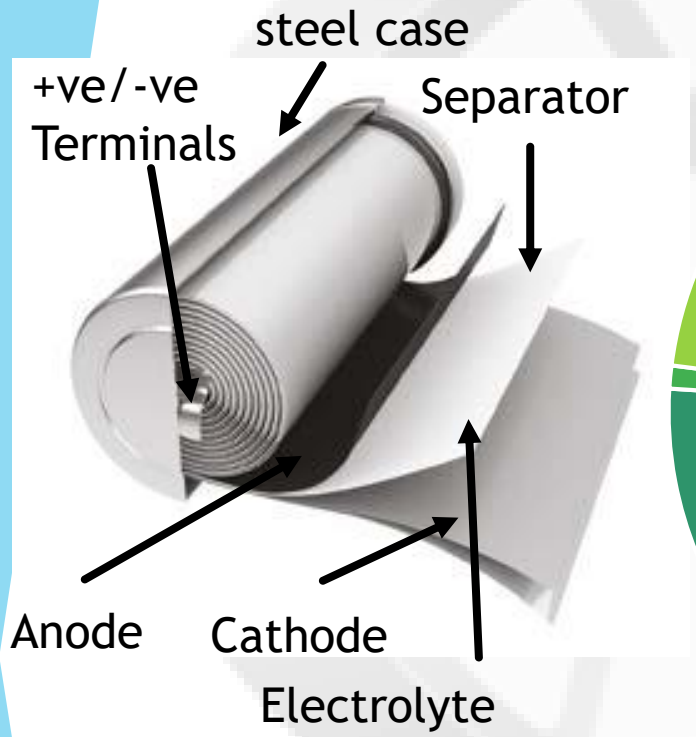
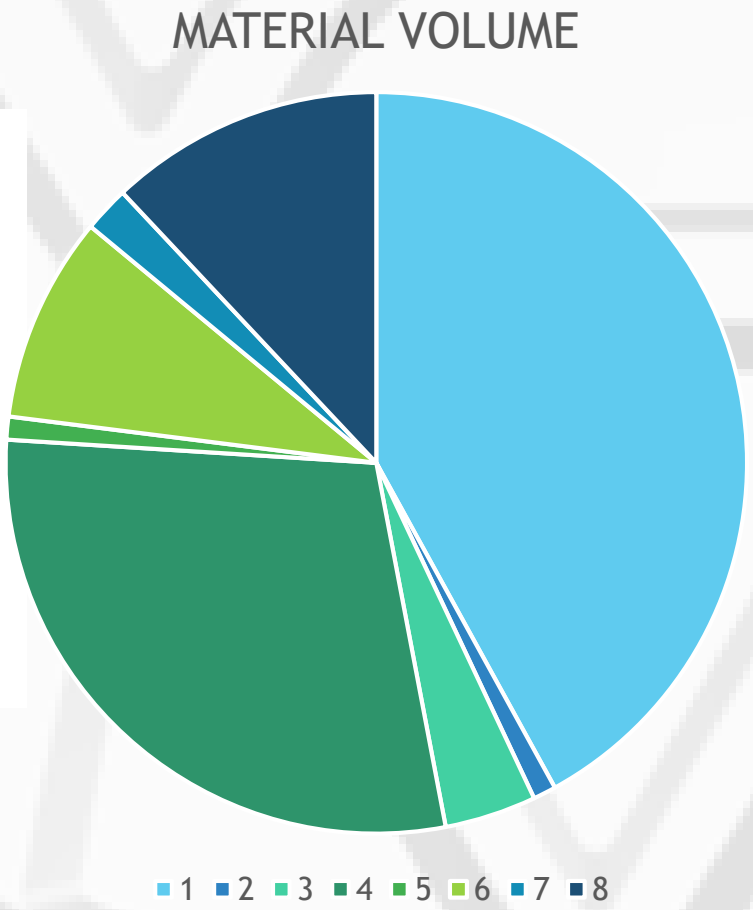
LITHIUM-Ion CELL MATERIAL VOLUME



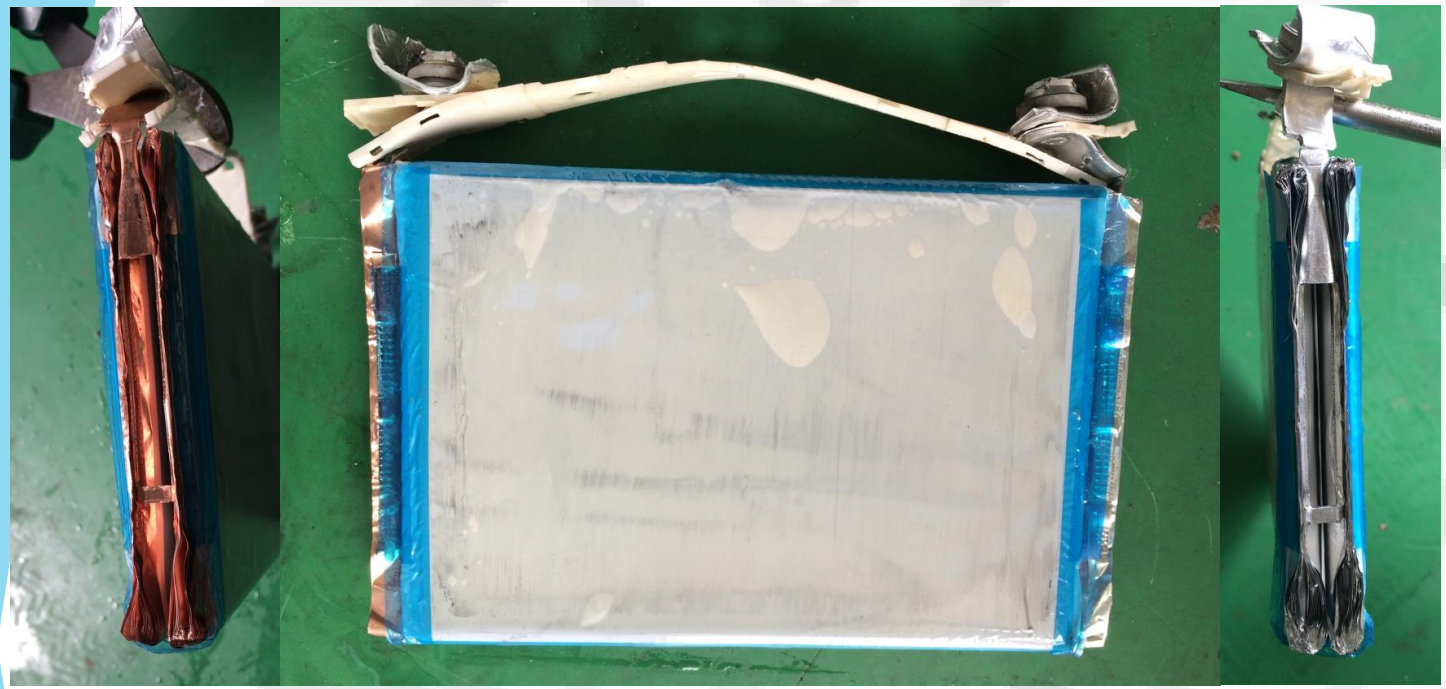


1. Cathode Material - 42%
2. Cathode Conductors - 1%
3. Cathode Current Collector (Al) - 4%
4. Anode Material (Graphite) - 29%
5. Anode Binders (PVDF) - 1%
6. Anode Current Collector (Copper) - 9%
7. Separator - 2%
8. Electrolyte 12%

LITHIUM-Ion PHOSPHATE POUCH CELL

1. Cathode Material - 42%
2. Cathode Conductors - 1%
3. Cathode Current Collector (Al) - 4%
4. Anode Material (Graphite) - 29%
5. Anode Binders (PVDF) - 1%
6. Anode Current Collector (Copper) - 9%
7. Separator - 2%
8. Electrolyte 12%

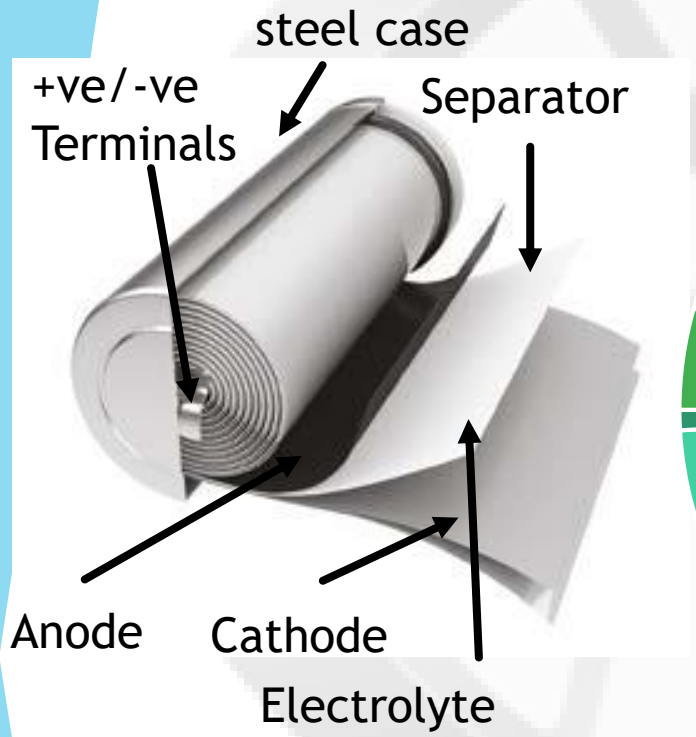
LITHIUM-Ion PHOSPHATE POUCH CELL

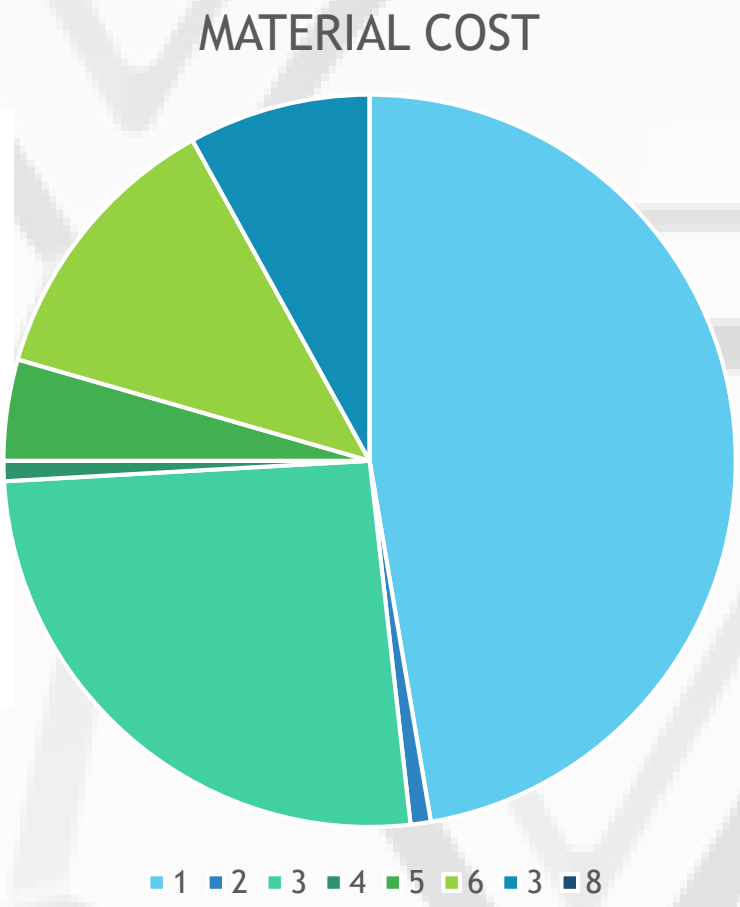


1. Cathode Material - 42%
2. Cathode Conductors - 1%
3. Cathode Current Collector (Al) - 4%
4. Anode Material (Graphite) - 29%
5. Anode Binders (PVDF) - 1%
6. Anode Current Collector (Copper) - 9%
7. Separator - 2%
8. Electrolyte 12%

LITHIUM-Ion PHOSPHATE POUCH CELL

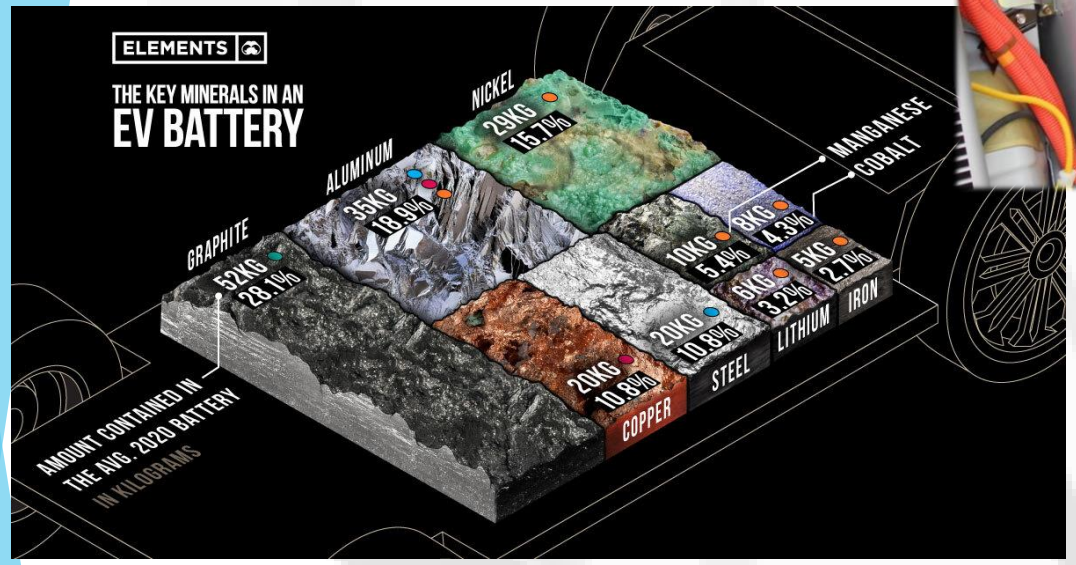
LITHIUM-Ion CELL COST



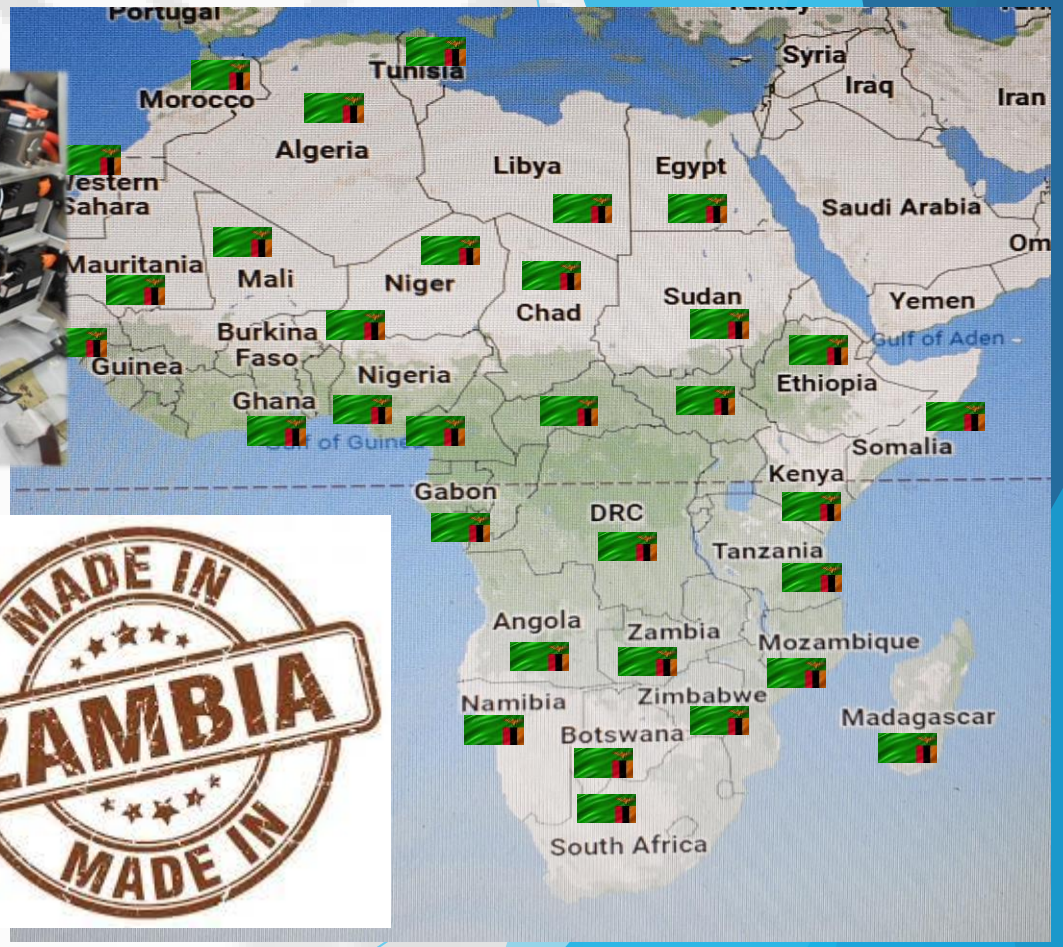


1. Cathode Material - 53%
2. Cathode Current Collector (Al) - 1%
3. Anode Material (Graphite) - 29%
4. Anode Binders (PVDF) - 1%
5. Anode Current Collector (Copper) - 9%
6. Separator - 14%
7. Electrolyte - 9%
8. Cathode Binders - 0%

ZAMBIA'S NEW VIRGIN MARKET IN AFRICA



Courtesy of
ELEMENTS



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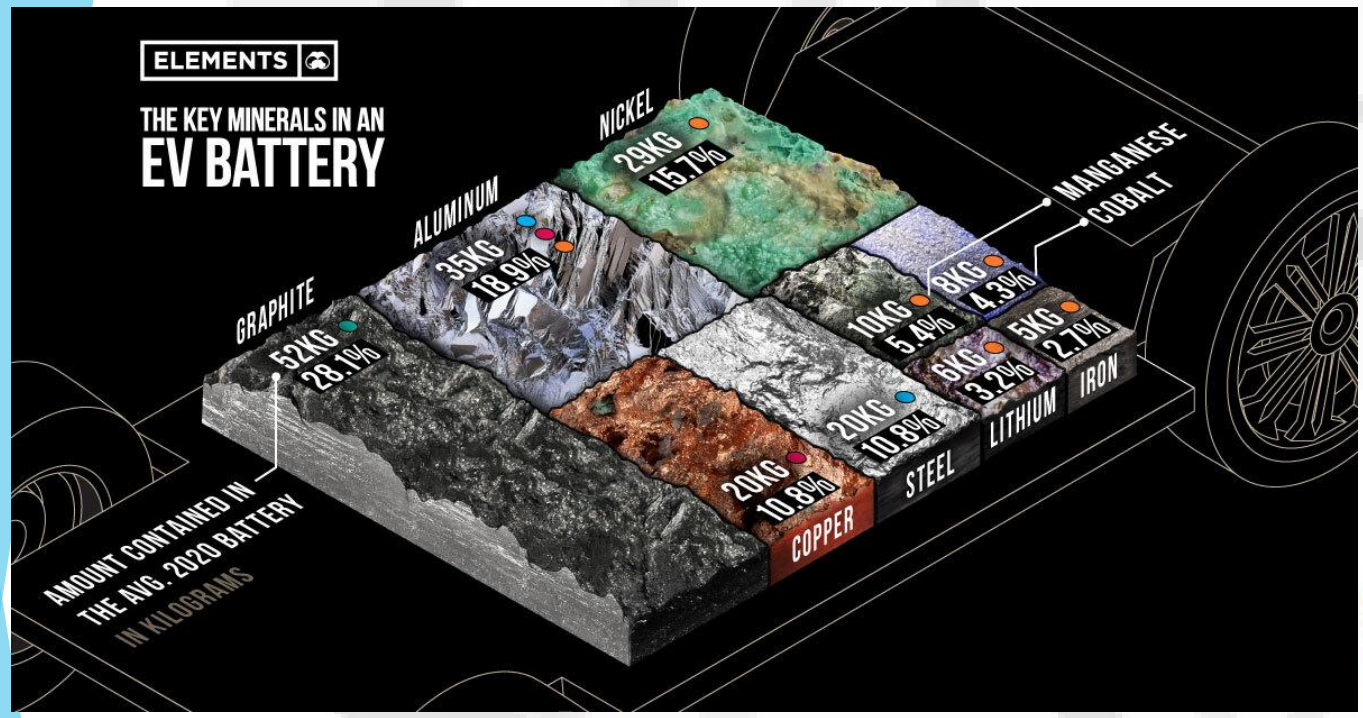
ZAMBIA'S NEW VIRGIN MARKET IN AFRICA



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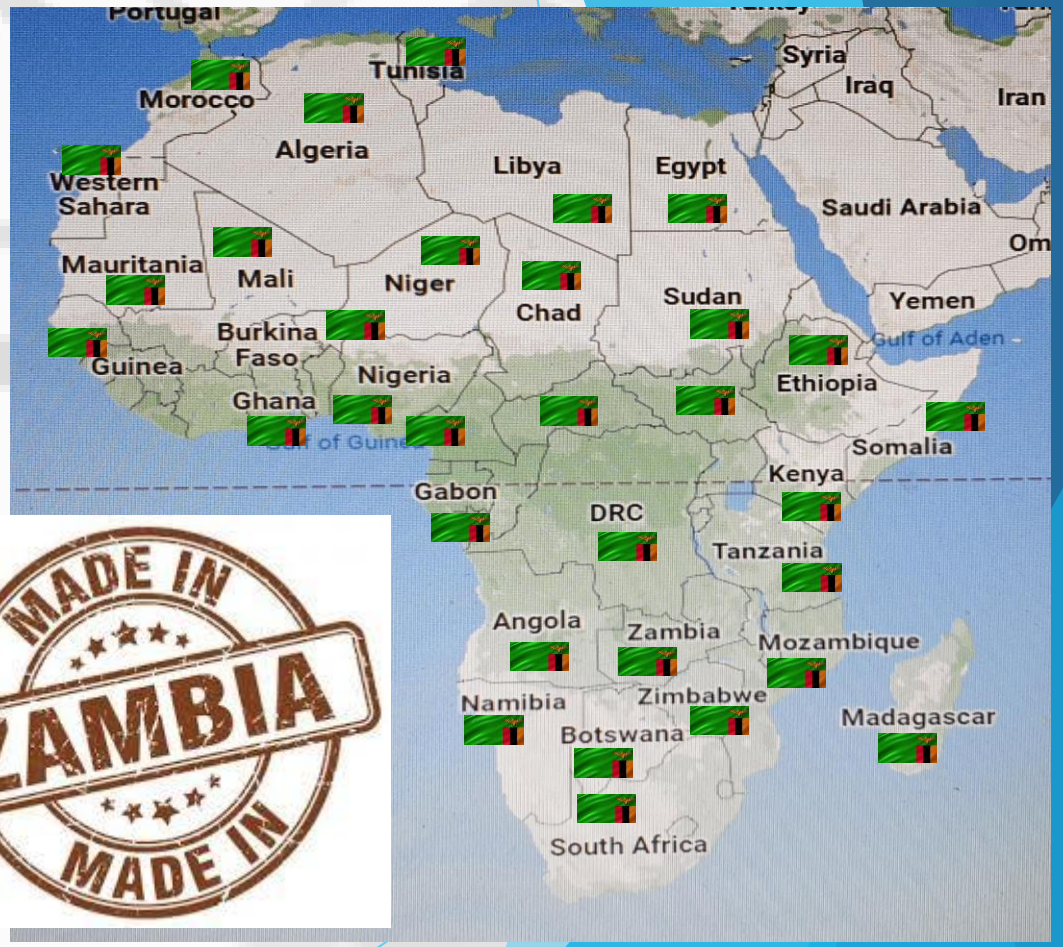

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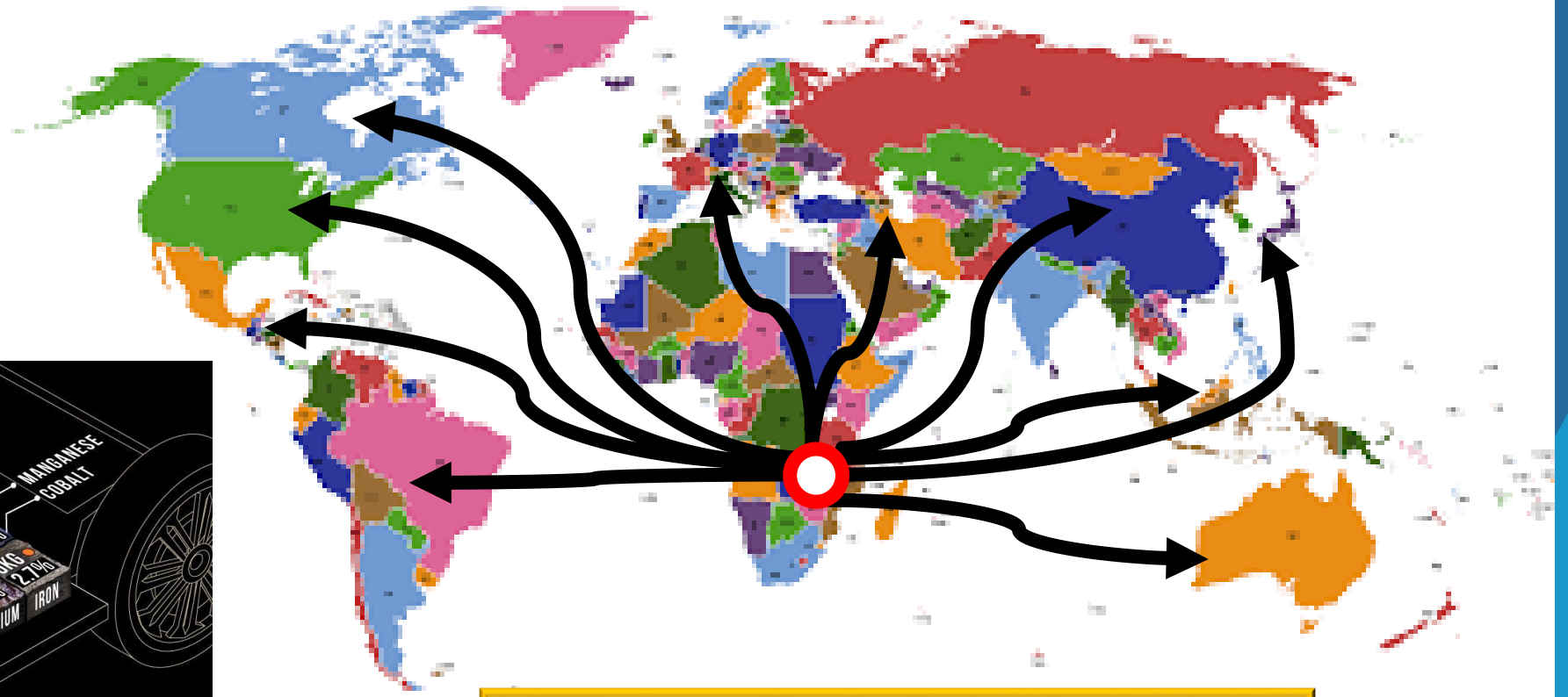
ZAMBIA'S NEW MARKET IN THE WORLD



Courtesy of
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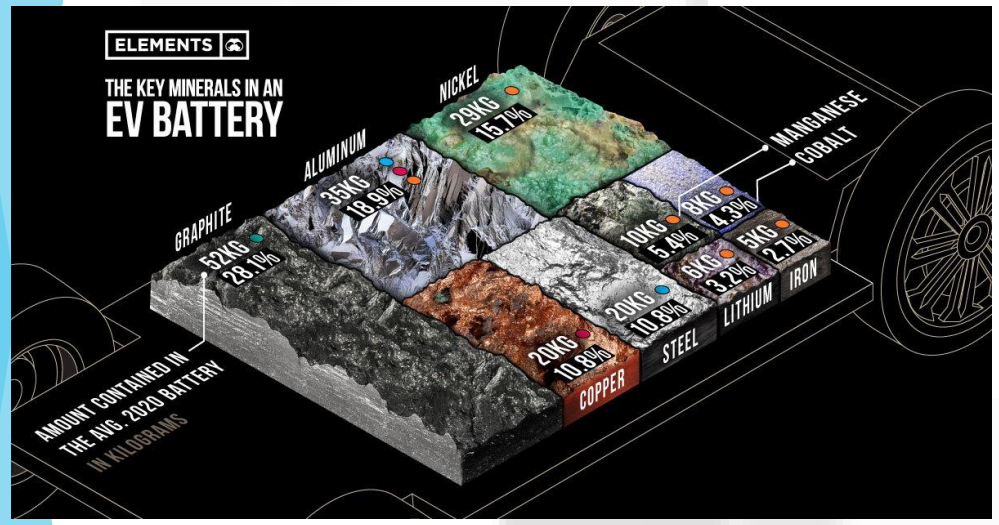

BLOSSOMING STRATEGY

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PROBABLE REVENUE FOR ZAMBIA

THIS LITHIUM ION 2020 BATTERY PACK
60-kilowatt-hour (kWh)
185kg of minerals
Current price US$350/kWh

Graphite 52kg -28.2% -
Aluminium 35kg – 18.9%
Copper 20kg – 10.8%
Nickel 29kg – 15.7%
Lithium 6kg – 3.2%
Manganese 10kg – 5.4%
Cobalt 8kg – 4.3%
Iron 5kg – 2.7%
Steel 20kg – 10.8%

Courtesy of ELEMENTS

EV BATTERY
60 kWh

US$21,000

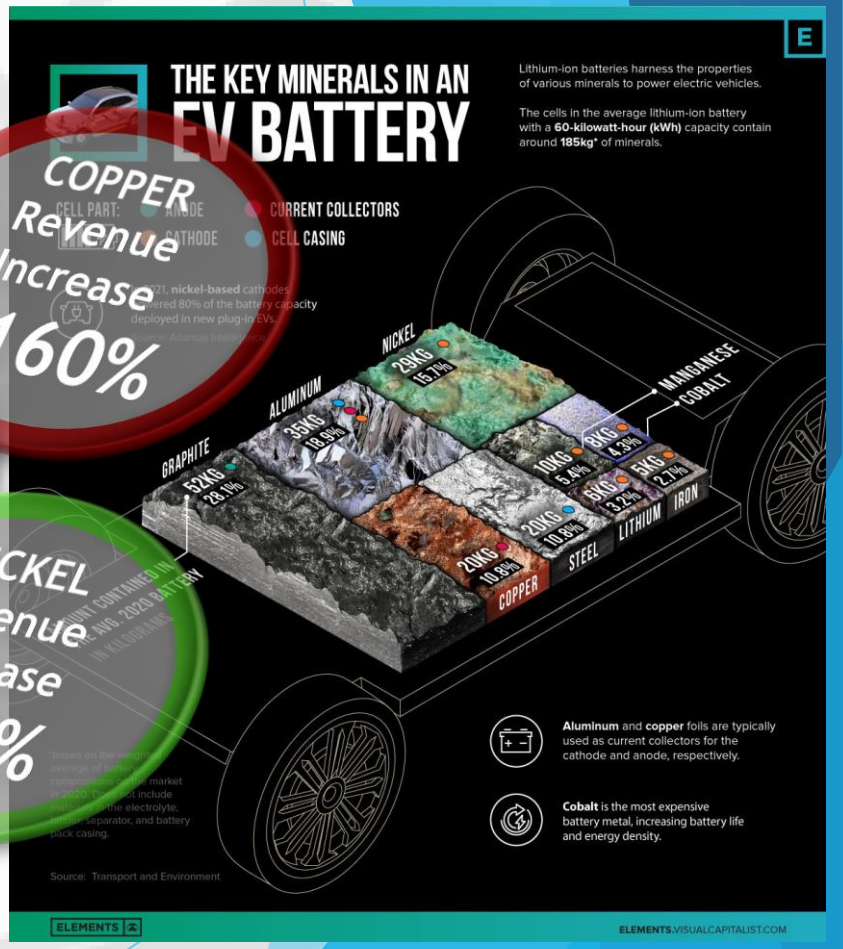
COPPER Revenue Increase 1160%

COBALT Revenue Increase 50%

MANGANESE Revenue Increase 1645%

NICKEL Revenue Increase 469%

LITHIUM Revenue Increase 37%



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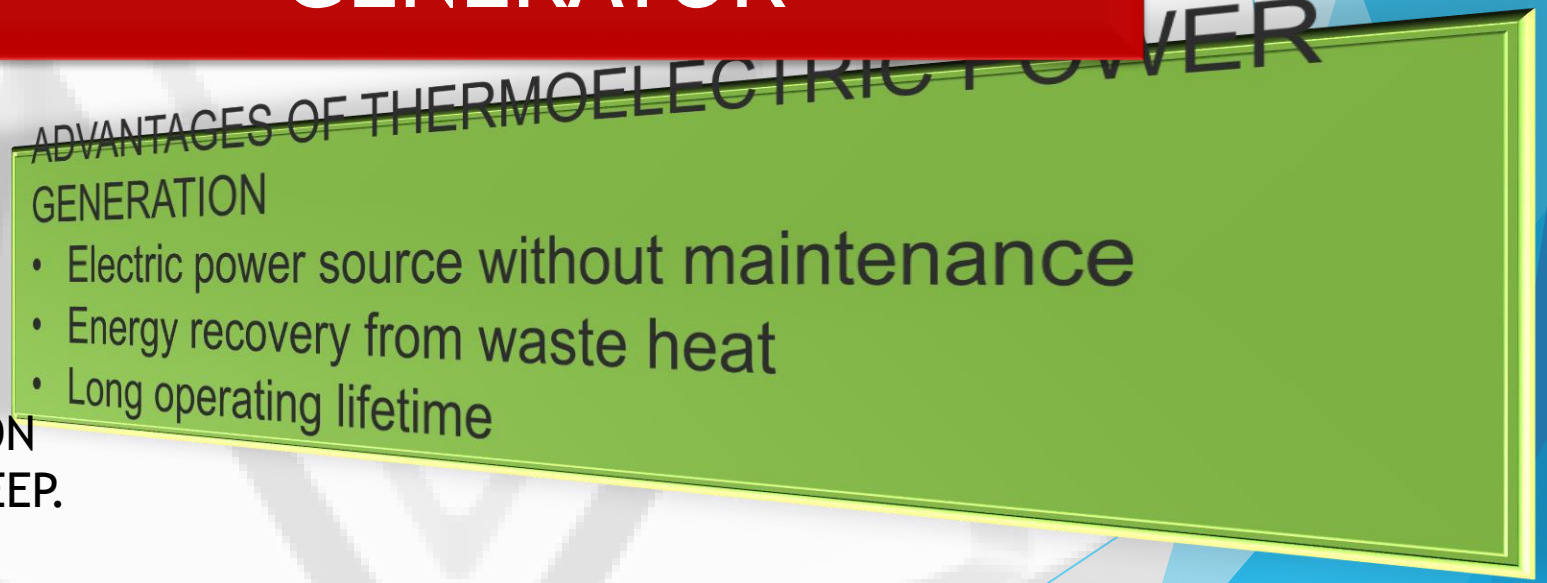
FUTURE ENERGY STORAGE SYSTEMS

ZAMBIA HAS TO MOVE FAST OR MISS THE TRAIN

ENERGY HARVESTING THERMOELECTRIC GENERATOR



NASA'S NEW HORIZON DID A FLYBY ON PLUTO JULY 14, 2016 AND GOING DEEP. ALREADY COVERED 300 MILLION KM

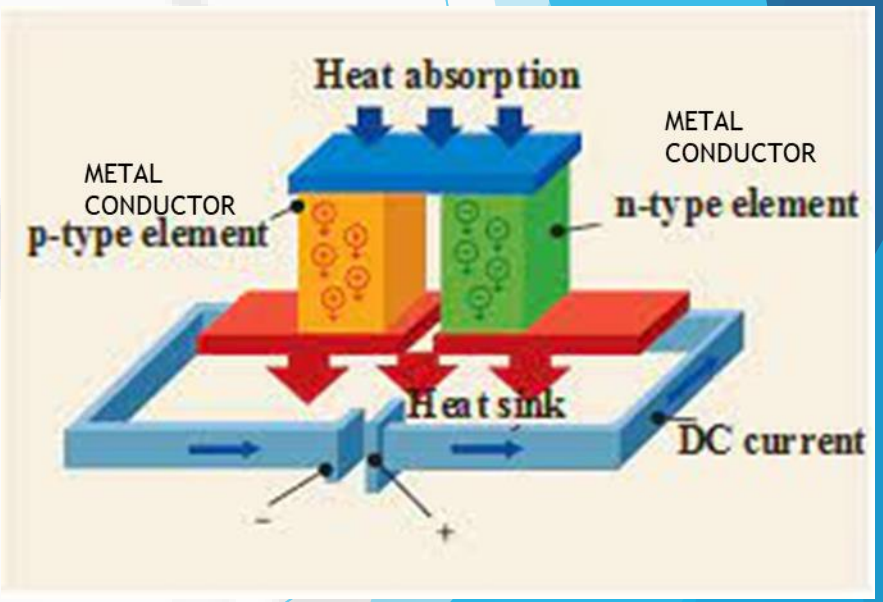
FUTURE ENERGY STORAGE SYSTEMS

HOW DOES IT WORK

ENERGY HARVESTING
THERMOELECTRIC GENERATOR

Thomas Johann Seebeck (1821) discovered this effect that describes the buildup of a potential difference ΔV across a conductor due to the diffusion of charge carriers along a temperature gradient ΔT = Thot – Tcold, as one side is heated.

Peltier did exactly this in 1834 by discovering the opposite effect from Cold point to the heated point



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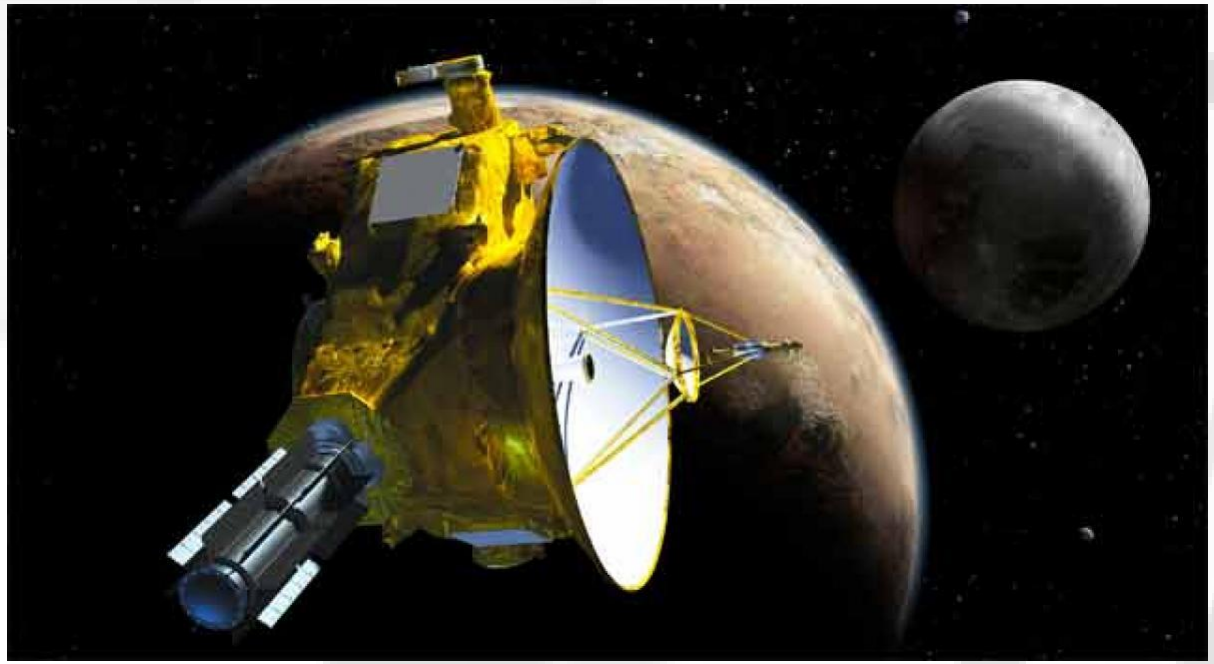
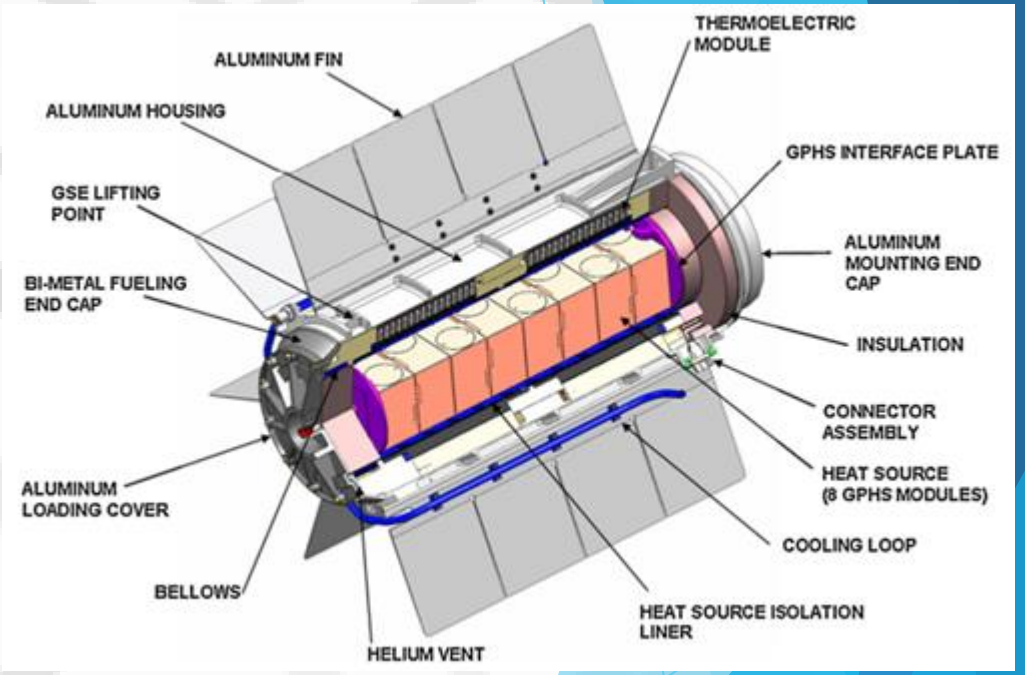




FUTURE ENERGY STORAGE SYSTEMS

CAPACITY BUILDING

ENERGY STORAGE SYSTEM PROGRAMMES

ZAMBIA HAS TO MOVE FAST OR MISS THE TRAIN

- YEAR 12 SCHOOL
- Vocational School
- Technical College
- University Under & Post Graduates

ENERGY STORAGE SYSTEM PROGRAMMES

ENERGY STORAGE TECHNOLOGIES

- Storage Types
- Components of a Energy Storage System
- Cell Type and Chemistry
  - Lead-Acid Battery
  - Lithium-Ion Battery
  - Nickel-Metal Hydride
  - Cobalt-Manganese Battery
  - Thermoelectric System

BUSINESS MODELS FOR ENERGY STORAGE

- Primary parts manufacture
- Secondary parts manufacture
- Final Assembly production
- Running an Battery Cell Business
  - Criteria for Economic Analysis
  - Cost Benefit Analysis
  - Managing People
  - Taxation
  - Strategic Thinking & Investment Analysis
  - Business Development & Marketing

GOVERNMENT PRIME INDUSTRY

MINERAL FINNISHED PRODUCTS & ENERGY STORAGE SYSTEMS GRZ LIMITED

JOBS CREATION

MINES

Government initiative based on wealth creation policy

PRIMES

Large single point jobs GRZ LIMITED

Government/private enterprises in a well structured hierarchical line of action

3RD TIER DOWNSTREAM

Large multi point jobs GRZ & PRIVATE CO.

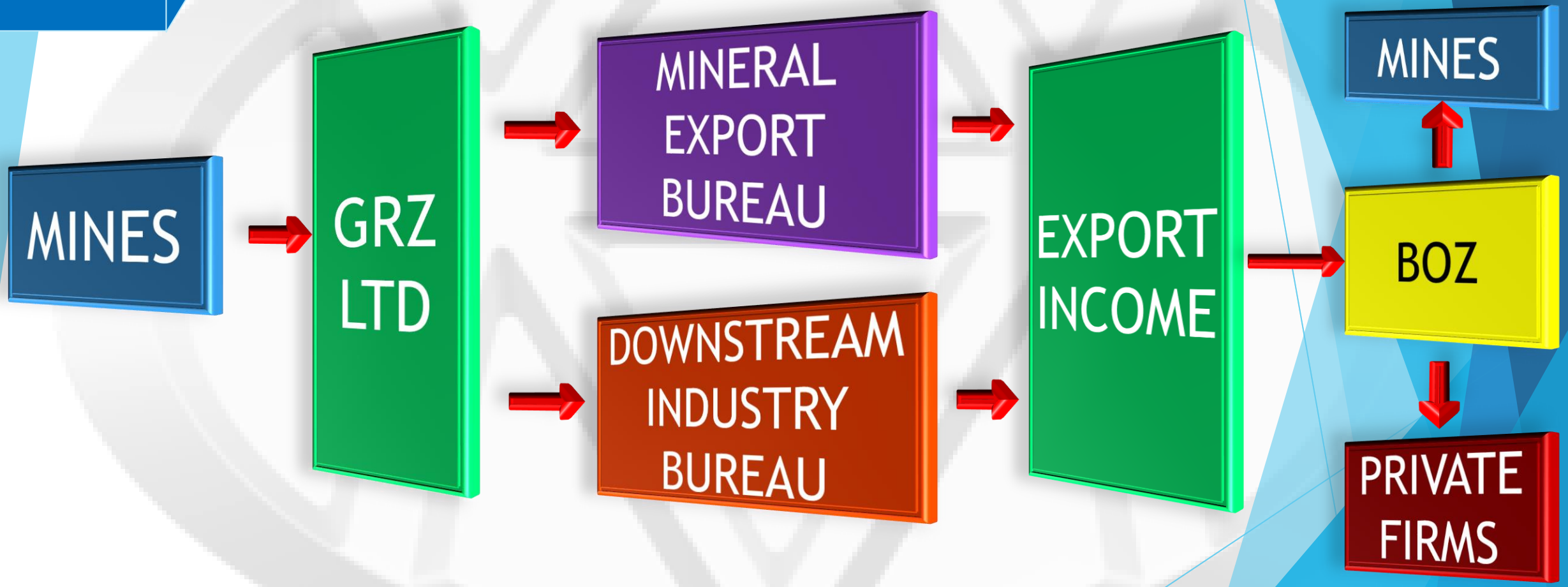
2nd TIER DOWNSTREAM

Very Large multi point jobs PRIVATE CO.

Private enterprises

1nd TIER DOWNSTREAM

PROPOSED NEW SMART BUSINESS MODEL



CONCLUSIONS

BY URGENTLY TAKING THESE REMEDIAL ACTIONS....

CONCLUSIONS

GOOD LUCK

BE LOYAL AND RESPONSIBLE

ALWAYS ADD VALUE TO A PROBLEM

THANK YOU