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Assessment of Battery Market and Value Chain in South Africa and its Integration in Southern Africa

ESP Meetings 7th November, Pretoria

Market Overview

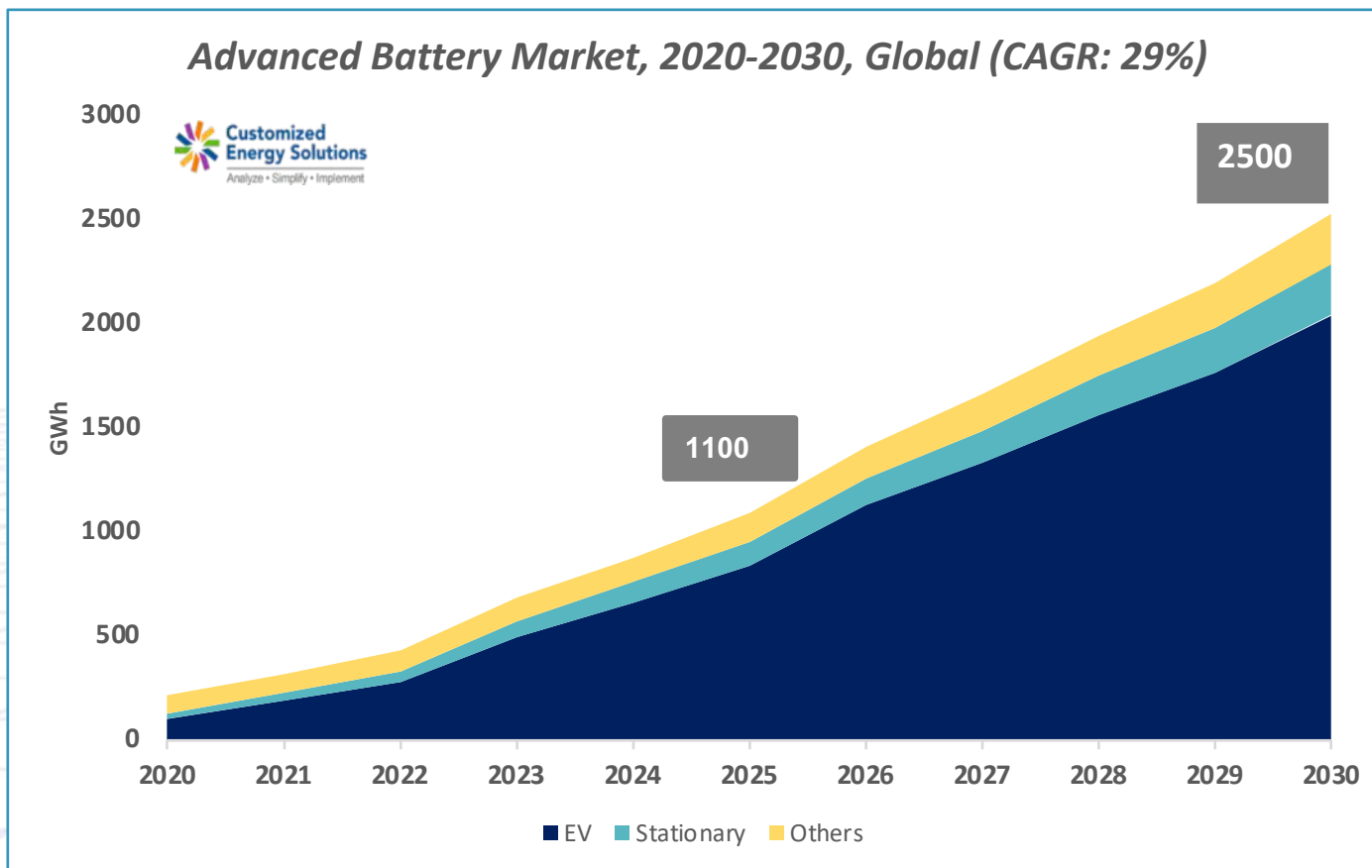
Defining the
Development
Scenarios for
South Africa
Battery Value
Chain

Recommendation
and Global
Benchmarking for
the Development
Scenarios

Year	Global Plugged-in EV sales (in million)	Market Share %	Battery Demand for e-cars (GWh)	Growth Rate (%)
2017	1.17	1.36%	35	
2018	2.02	2.34%	71	103%
2019	2.5	2.9%	88	24%
2020	3.1	4.6%	109	24%
2021	6.5	9%	286	162%
2022	10.4	14%	460	61%
2023	14.5	20%	650	41%
2024	?	?	?	
2025	30	40%	1500	

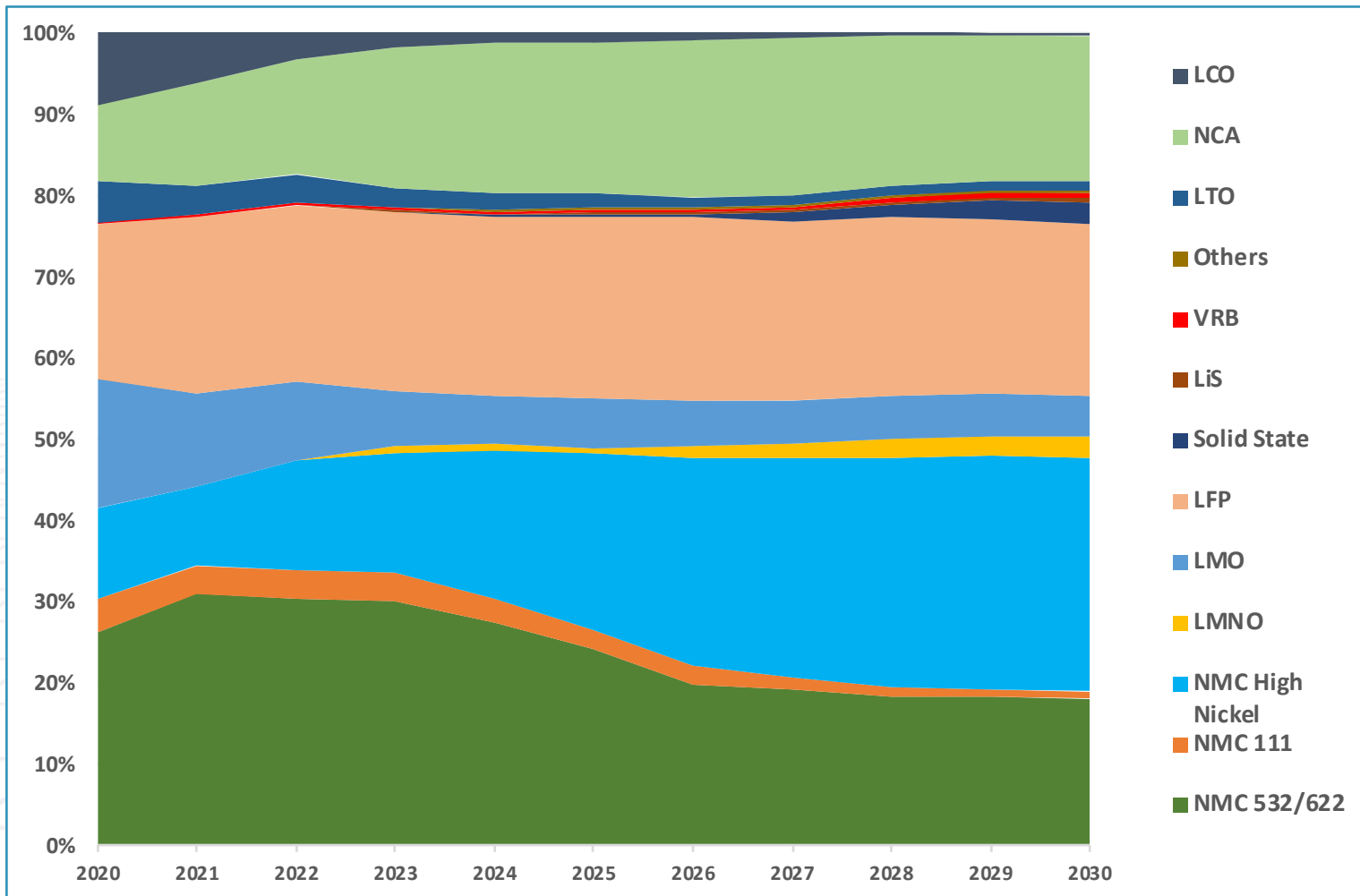
OEM	2025 EV target (in million)	% of their sales
VW	3.0	25%
Tesla	2.3	100%
Hyundai-Kia	1.7	20%
GM	1.0	10%
Toyota*	5.5	50%
BMW	0.8	50%
BYD + BAIC + Geely + SAIC + Other Chinese OEMs	10	30%
Ford	1.0	20%
Others	5.0+	-
TOTAL	30+	
Plugged in Targets (Total Minus Mild Hybrids (25%)	23	

Source: CES Analysis, OEM announcements, Inside EV, SNE Research

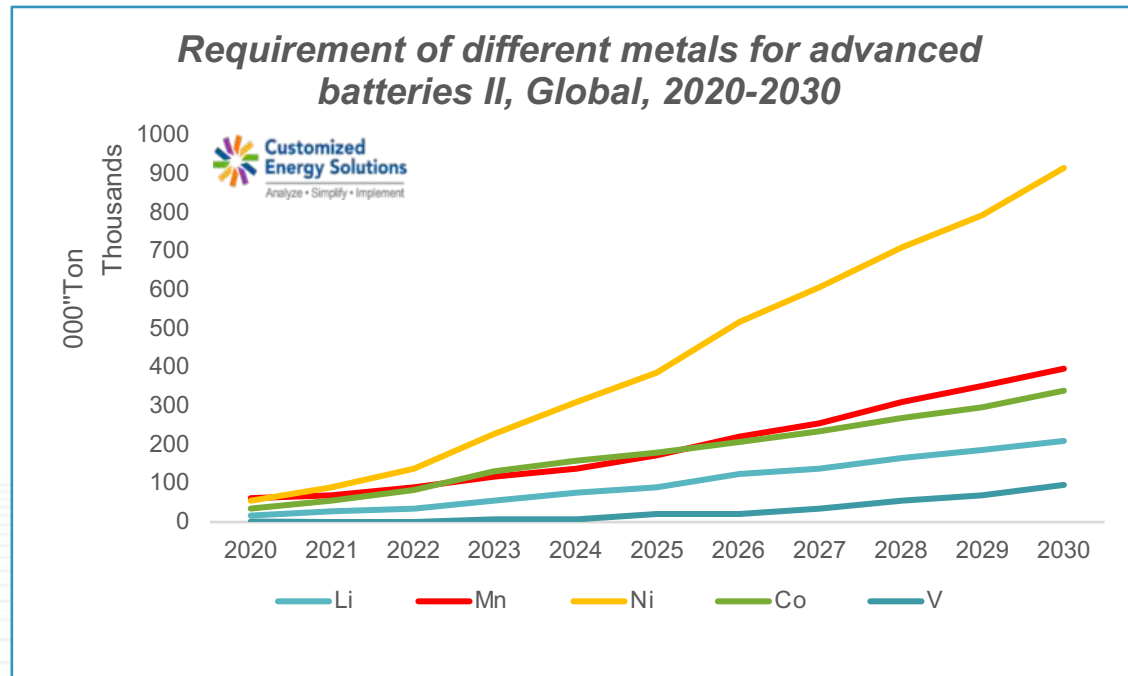
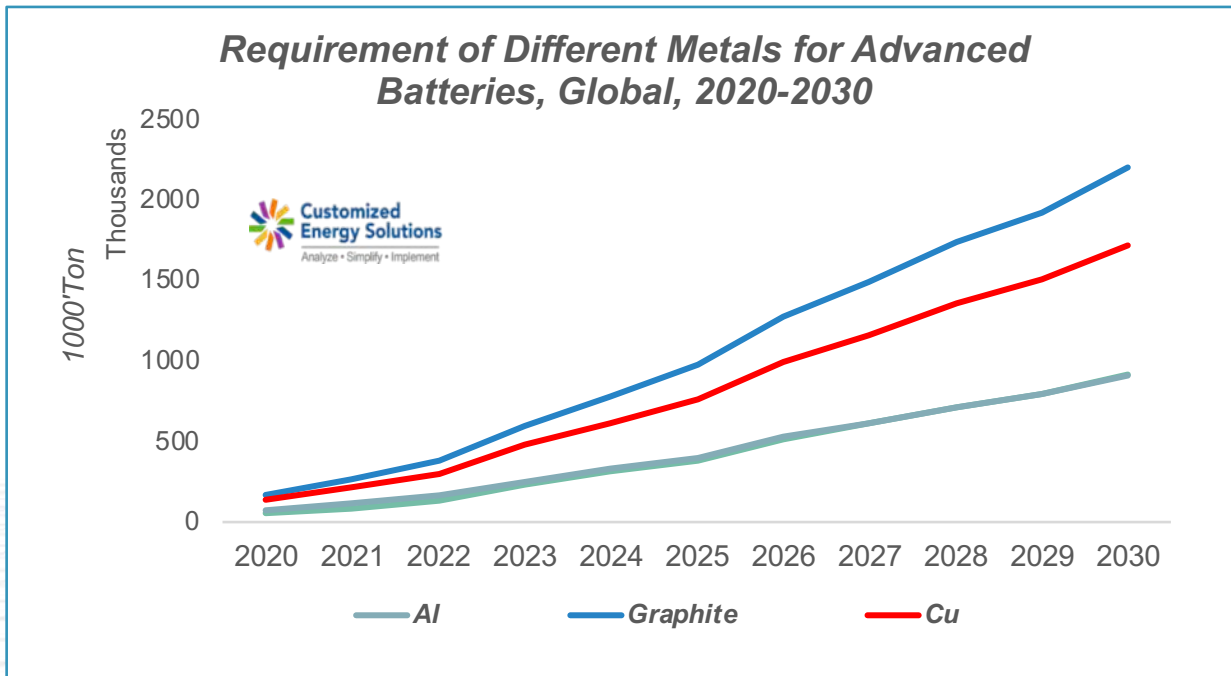


- The global automobile market in 2020 witnessed over 3% EV penetration and the European electric car market witnessed 8% penetration. China and Europe are likely to be the early growth engines for the EV sector since most of the carmakers in these markets are eyeing close to 25% EV penetration by 2025.
- To support this market growth, there are announcements of over 7000 GWh of manufacturing capacity by 2030. Most of the plants would be set up in Asia, especially in China

Technology-wise Split of Advanced Battery Chemistry, Global, 2020-2030

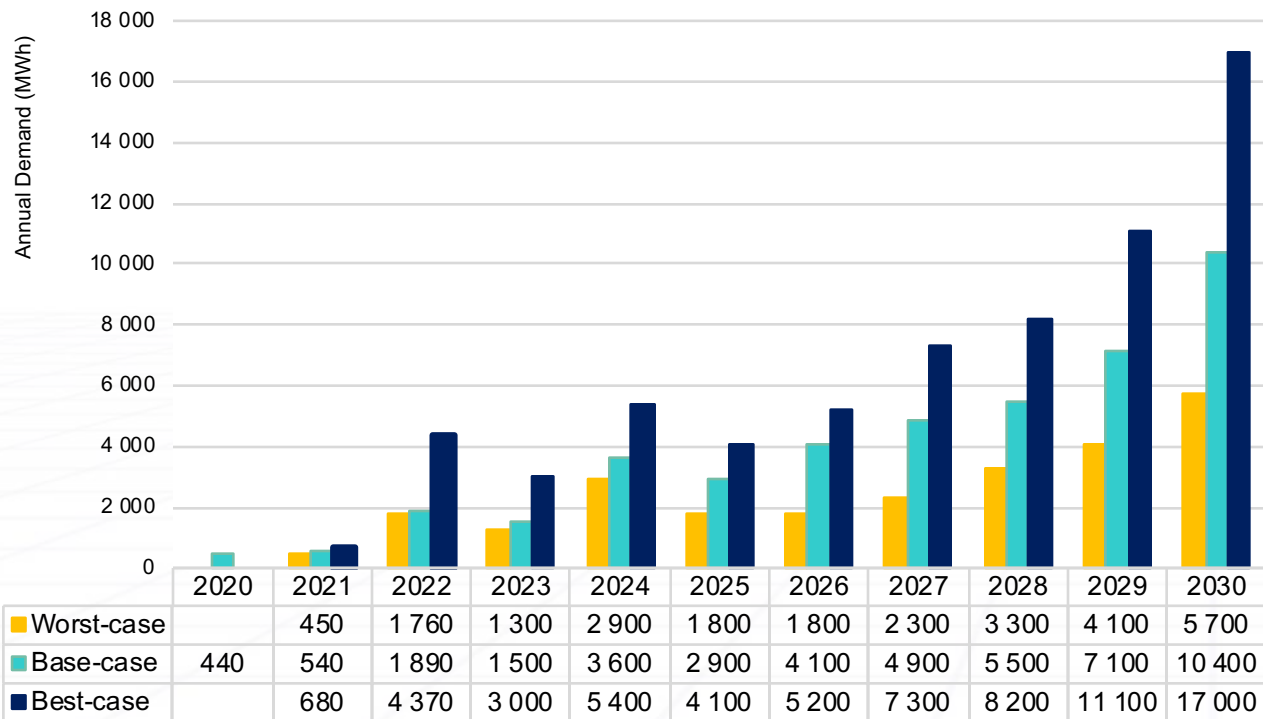


- Investments in cathode suppliers, cell manufacturers, and car OEMs indicates that the market is moving towards batteries with high energy density and faster charging capabilities. For stationary applications, the market is moving towards higher cycle life and long-duration batteries as RE penetration in the grid increases.
- NMC 532/622 will continue to dominate the market before the high nickel chemistries begin to rule the market from 2024 to 2026. On the contrary, cobalt-rich chemistries such as LCO and NMC 111 will continue to lose their market share due to the high costs associated with cobalt.
- LFP and LMFP will keep gaining share with significant improvement in energy density (180 Wh/kg) in 2023 and likely to hit 200 Wh/kg in 2025.

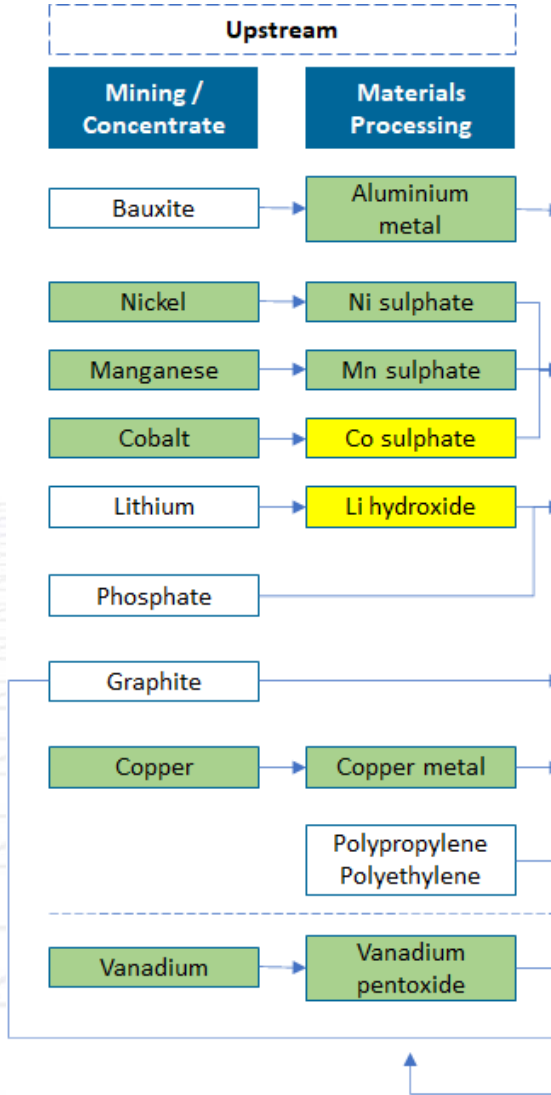


- The Li-ion battery market is expected to grow 12 times between 2020 and 2030. This will likely lead to higher demand for all the metals in different ratios. The requirement for graphite, copper, and aluminum will be highest followed by other metals such as Ni, Mn and Cobalt.
- In the other metals, the requirement for nickel is going to grow the fastest. the growth for manganese (Mn) and cobalt (Co) would be slower as most of the higher energy density chemistries are moving to higher nickel content at the expense of lower Co and Mn.

Total Battery Market Forecast, South Africa and Southern Africa, 2020-2030



- Currently, the battery market is driven by behind-the-meter (BTM) battery installations in UPS, telecom towers, solar home lighting systems, and microgrids. The BTM segment, which is presently dominated by Li ion batteries in South Africa & Southern Africa, is going to provide opportunities for advanced chemistries. Advanced chemistry penetration with lithium-ion batteries is witnessed in the telecom towers and solar home lighting systems.
- In grid-scale storage segment in South Africa, the targets set in the IRP-2019 document and the impact of new regulations and the latest trends in the market are also considered for forecasting the demand for batteries in South Africa. As for Southern African countries, the need for grid connected storage to support renewable integration is expected to be very low.
- In the automotive sector, electric penetration is expected to reach between 15-30% in various vehicle segments in base case scenario, by 2030.

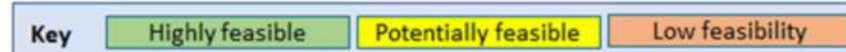


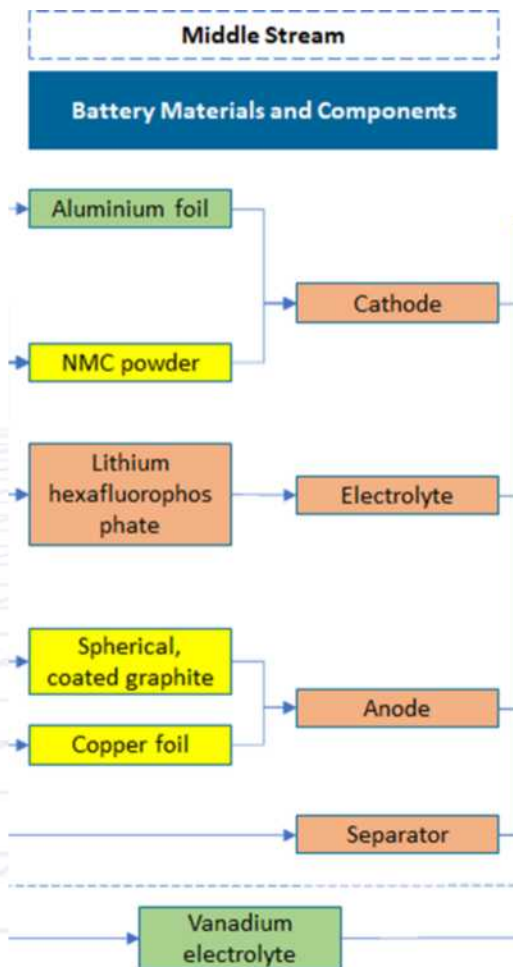
Lithium-ion Battery

- Apart from Mining of key mineral components in RSA and neighboring countries, there lies a great opportunity for material processing for Aluminium, Nickel and Manganese in South Africa.
- Lithium: It is extracted from minerals found in igneous rocks (pegmatite) called spodumene, or from brine pools containing high concentrations of lithium carbonate/chloride. Most of the upcoming projects are identified in and around Zimbabwe.
- Cobalt: Apart from nickel, cobalt is the most expensive metal in the NCM cathode material (3 times the cost of lithium). Cobalt is mainly produced as a co-product of copper and a by-product of nickel production.
- Manganese: Manganese, with its over 30% global reserve in South Africa, can provide the best beneficiation opportunity in the upstream value chain.
- Nickel: It occurs in two different types of ore, i.e. lateritic and sulphide. Laterite mining is essentially an earthmoving operation where nickel rich strata are excavated from open pits. Sulphide ores are usually found in combination with copper and are mined underground.
- Graphite: Natural flake graphite is typically mined in open pits with the terrace technique in Madagascar.

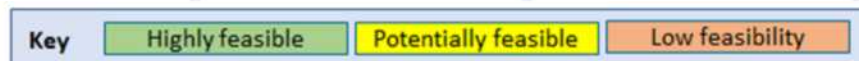
Vanadium Redox Flow Battery

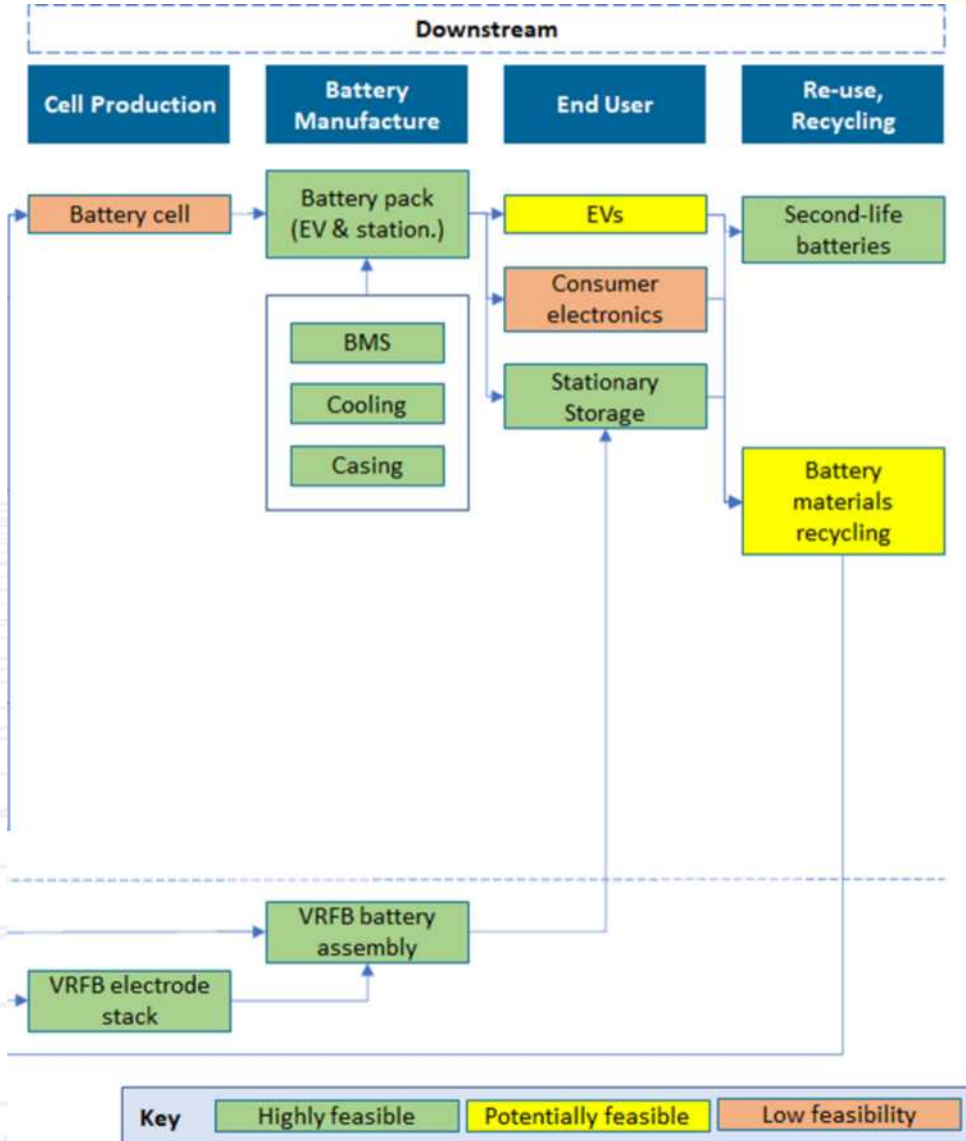
- Primary vanadium is mined from titaniferous magnetite ore and typically extracted directly from the ore using the salt roast or roast-leach process. This involves multiple steps of crushing-milling-roasting-leaching-precipitation and calcination to produce only vanadium in the form of vanadium pentoxide (V₂O₅) flakes.



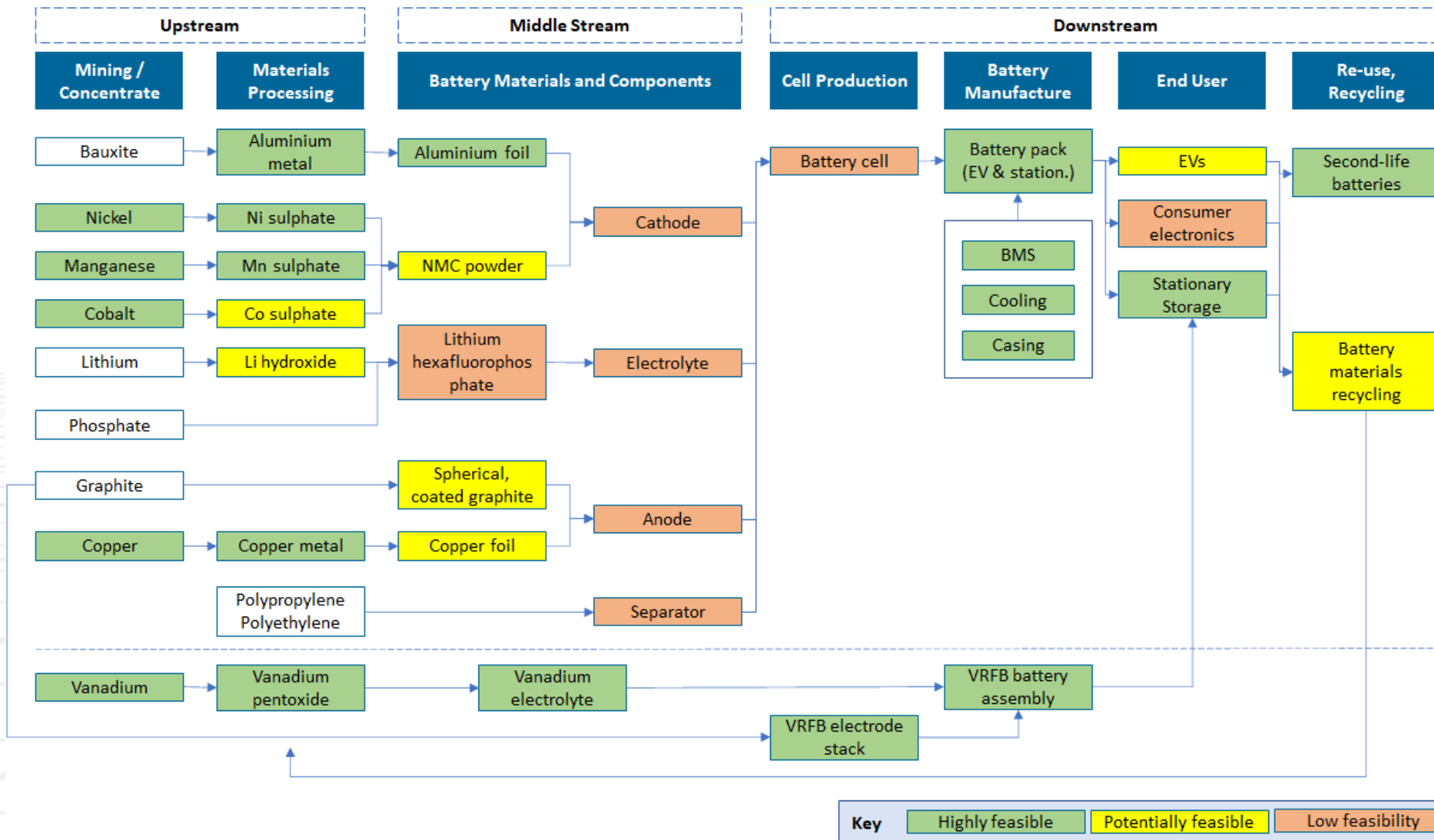


- Most of the mid-stream activities in battery value chain are tied up close to major cell producing countries like China, Japan and South Korea.
- Many of the plants like cathode active materials, Li salts, Copper foils, etc are feasible for size equivalent to 15-20 GWh of cell production. At a lower scale they might not be feasible.
- Most of the current Giga-factories of Europe are still relying on East Asian geographies for the supplies, but slowly plan to internalize the supply for materials like electrolyte, cathode active materials and anode active materials.
- For South Africa, Vanadium electrolyte (with downstream VRB manufacturing) and Aluminium foil are two easy options.
- Synthetic graphite is also a possible option which can be produced by coal tar but it takes massive amount of electricity as coke/coal tar needs to be heated for over 20 days in an heat oven.





- With the base case and best case scenarios, South Africa can advance to Li ion cell manufacturing by 2030 at 10 GWh. That would be the minimum size of feasibility for Gigafactory.
- Looking at scenario beyond 2030, the government can also design an incentive program for calling in capacity of 50 GWh by 2035.
- Battery pack assembling and VRB assembling are possible even if the market stays sluggish at worst case scenarios. The local industry would need support from the government to compete with imports here.
- Developing VRB ecosystem will be the low hanging fruit, with focus on long duration storage after 2030 for grid scale applications like RE shifting and grid balancing.



Overview of Study

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The Whole Nine Yards

- Battery Cell Manufacturing and EV Production
- Integrated Battery Value Chain

10 Years



Bridging the Divide

- Regional Battery Mineral Beneficiation Hub
- Larger Scale BESS Integration for FTM and BTM

5 Years



Easy Pickings

- Local Battery Mineral Beneficiation
- BESS Integration

Today



Increasing value addition, jobs

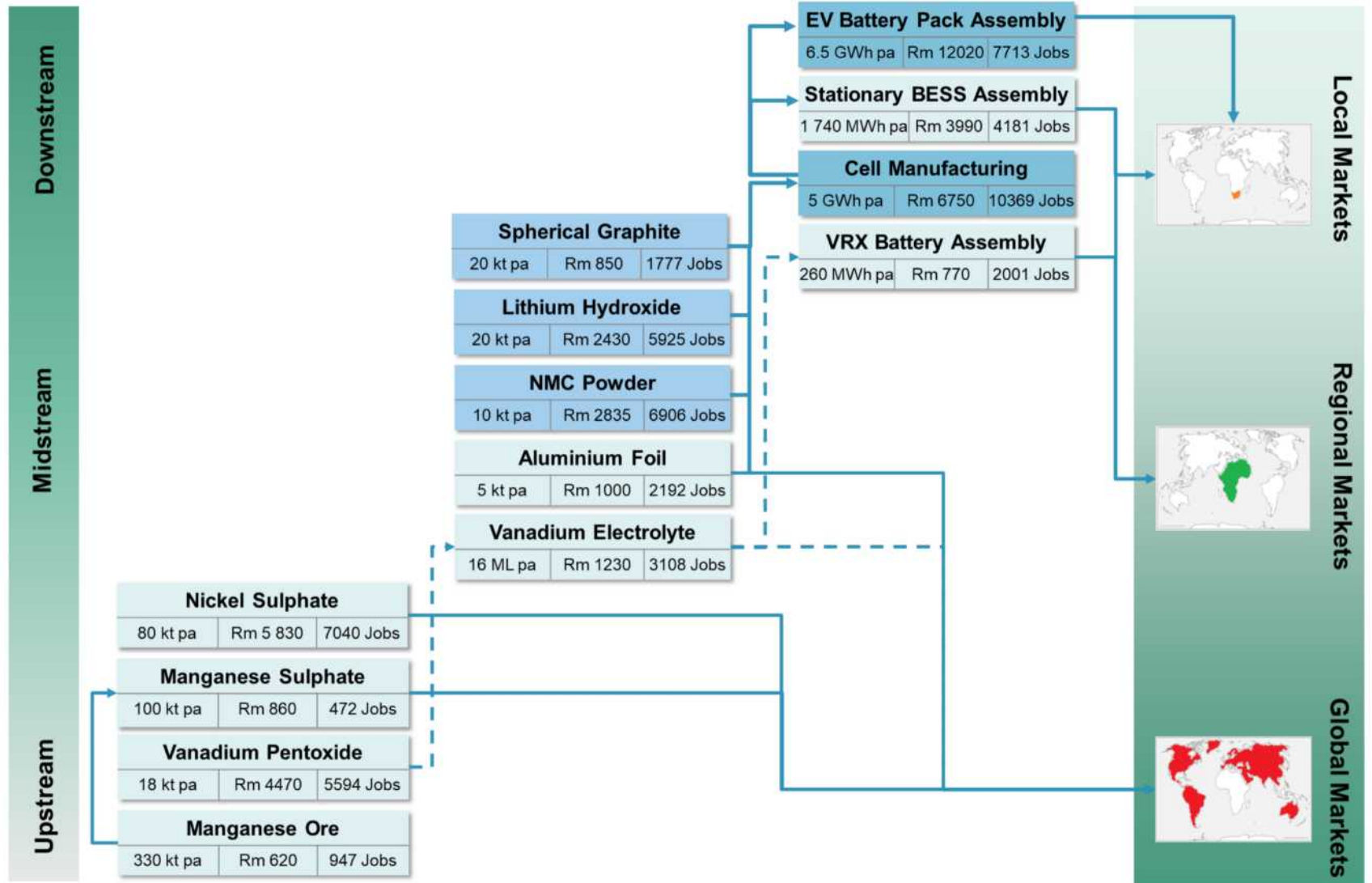


Contribution to GDP

Contribution to jobs

THE WHOLE NINE YARDS

R11 322 ml	Direct	4 085
	Indirect	54 867
R11 322 ml	TOTAL	58 952



Legend

Opportunity @ 2030			Scenario 1	Scenario 2	Scenario 3	Not unpacked yet
Volume	Revenue (2021 prices)	Jobs				

New Energy Vehicles

- Automotive manufacturing is South Africa's largest manufacturing industry (18.7% of manufacturing output in 2020)
- More than 60% of local production is exported, more than 70% of exports go to Europe
- Government and industry targets: increase local production to 1% of global production, local content to 60%
- Established ICE* automotive manufacturing value chain – vehicle manufacturers and components/subsystem suppliers
- Strategic imperative: automotive industry must survive, hence must pivot to EV production

LIB cell manufacture

- No established LIB cell production in SA
- Some local companies have LIB experience abroad (Metair), others have plans (Megamillion, AutoX). Unlikely that these will be able to successfully establish local cell production for automotive OEMs
- Cell production in South Africa is a medium to longer-term goal but would most likely be required to meet local content ambitions

* ICE = Internal Combustion Engine

Contribution to GDP

Contribution to jobs

THE WHOLE NINE YARDS

R11 322 ml	Direct	4 085
	Indirect	54 867
R11 322 ml	TOTAL	58 952

BRIDGING THE DIVIDE

R7 984 ml	Direct	3 195
	Indirect	37 765
R7 984 ml	TOTAL	40 870

EASY PICKINGS

R6 549 ml	Direct	2 455
	Indirect	23 807
R6 549 ml	TOTAL	26 262

Establishment of li-ion cell manufacturing facility and production of EV batteries for local automotive industry will create an **additional 890 direct FTE jobs in manufacturing** and **17 192 indirect FTE jobs** → a **total of 18 802 additional jobs** throughout the economy

Localisation of NMC powered production, manufacturing of spherical graphite and lithium hydroxide add **740 direct FTE jobs** in the manufacturing sector and **13 868 indirect FTE jobs** → a **total of 14 608 additional jobs** throughout the economy

Overview of Study

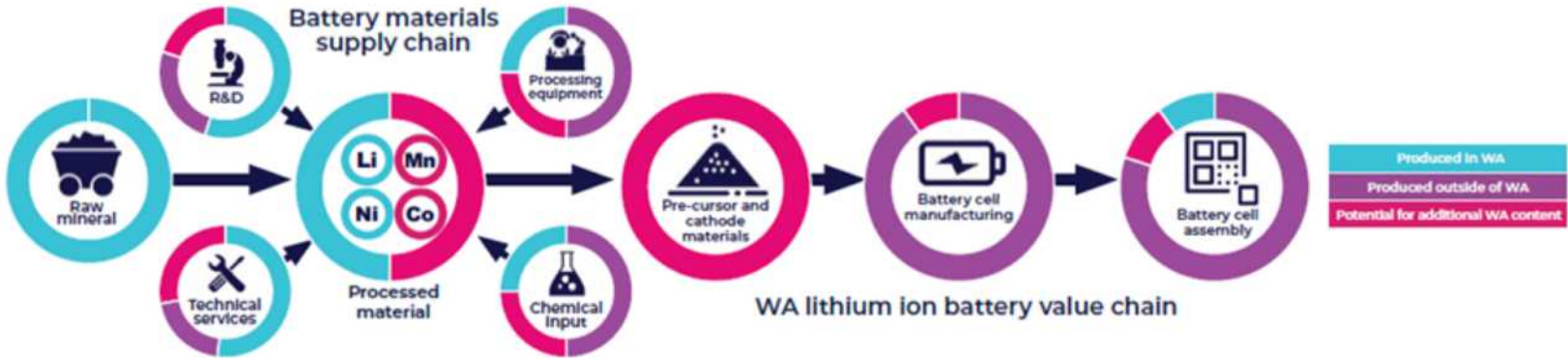
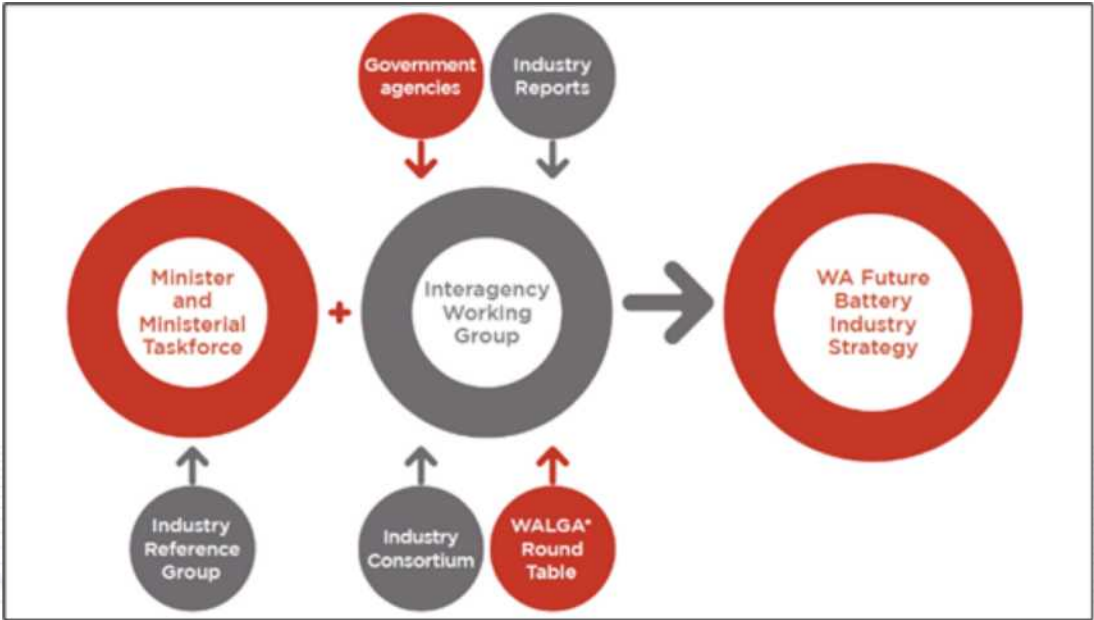
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Global Support Programs and Schemes: Giga-factories and supply chains

WA Government will deliver its vision by focusing on 5 objectives. Following are the objectives that have been documented in the strategy report:

- 1) Western Australia to be recognized as leading producer of battery minerals and materials, technology
- 2) Improve the competitiveness of WA's future battery minerals and materials industry
- 3) Expand the range of the future battery minerals extracted and processed in WA
- 4) Increase the scale of processing, manufacturing and service activities across the breadth of the value chain in WA
- 5) Increase R&D focused on battery materials and minerals, associated technology



	India 	Thailand 
Program	Advanced Chemistry Cell (ACC) Production Linked Incentive (PLI) Programme	Thailand Board of Investment (BOI) EV and components manufacturing package
Budget Outlay	\$ 2.5 Bn	\$ 1.1 Bn
Production Target	50 GWh by 2028	30% EV by 2030, estimated 20 GWh by 2025
Incentive Support	Sales linked subsidy of upto 20% of cell price for 5 years of production. Program requires local manufacturer to capture 60% of local value addition in first 5 years	3 years tax holiday, 8 years corporate tax exemption and 90% reduction in import duty on key raw materials to encourage cell and pack manufacturing The BOI approved the reinstatement of the International Procurement Office (IPO) category with the aim to strengthen Thailand's position as the regional business and investment hub.
Other Support	Apart from the ACC PLI, several state governments are also providing capital subsidy in tune of 10-25% and tax and duty exemptions on electricity tariffs/	IPO businesses will get import duty exemptions on machinery and raw materials for use in production for exports, as part of the policy to promote the development of the country's supply chain.

Expected benefits from the scheme

- Facilitate demand creation for battery storage in India.
- Facilitate Make-in-India, thereby emphasizing domestic value capture and reduction in import dependence.
- Facilitate demand for EVs, which are proven to be significantly less polluting. One of the key agendas for ACC battery storage will be to reduce India's Greenhouse Gas (GHG) emissions.
- Import substitution of around INR 20,000 crore – INR 25,000 crore (US\$2.76 – US\$3.45 billion) every year, on account of oil imports as this scheme is expected to accelerate EV adoption in India.
- Impetus to research and development to achieve higher specific energy density and cycles in ACC.
- Promote newer and niche cell technologies.

Case Study: Nickel Ore Export Ban in Indonesia

- Indonesia supplied around 30% of global Nickel production for the year 2021. the Indonesian Government introduced a ban on export of its Nickel ore in 2019
- In 2014, a similar ban on nickel ore export was imposed in Indonesia that resulted in a major Chinese stainless-steel manufacturer, Tsingshan, to invest locally in downstream nickel processing and nickel pig iron (NPI) manufacturing. NPI is a raw material used by steel industry. Indonesia's NPI production grew from zero in 2014 to 500,000 tons by 2020.
- To process the ban induced nickel ore, post 2019, the Government plans to expand the capacity of its nickel smelting industry and a State holding company called Indonesia Battery Corporation (IBC) is kept in charge. IBC is formed out of four State Enterprises operating in oil exploration (PERTAMINA), mining (MIND ID), Nickel & Gold mining (ANTAM) and Electricity (PLN).

Key Takeaway: South Africa can impose such restrictions on ore exports to boost local mineral beneficiation and processing. Through the African Continental Free Trade Agreement (AfCFTA), South Africa can call for such measures at regional level. When fully functional, the AfCFTA is expected to boast a total combined continental GDP of US\$2.1 trillion to benefit and a total population of 1.3 billion people. South Africa has also led and entered into a duty free Southern African Customs Union (SACU) and the Free Trade Agreement in the 14-membered Southern African Development Community (SADC) region. While most Intra-African trade comes from the SADC; the AfCFTA provides South Africa with an opportunity to realise a unified and diversified African market free of trade barriers.

To compete on this front with economies like China and India, through AfCFTA, South Africa must look at the regional integration plan for battery value chains in order front to attract more investments. As such, local projects and manufacturing industries may allow processed battery materials coming from AfCFTA region as part of the local content. There can be a single window facility created for clean tech investors to set up processing plants at suitable locations for mined material available in the neighbouring countries.

	Europe	United States	China
Scheme	Important projects of common European interest (IPCEI)	National Blueprint for Lithium Batteries	MIC (Made in China) 2025
Outlay/Funding	\$ 7 billion support for R&D and localization of supply chain. Additional incentives provided to plants in case to case basis	8 billion dollars	Estimated \$67 billion (over \$672 budget outlay for 10 key sectors)
Target capacity	Estimated 700 GWh (2030)	229 GWh (2025)	Estimated 1200-1500 GWh by 2030
Objective/focus areas	<ul style="list-style-type: none"> • Access to raw materials • Supporting cell manufacturing • Research and innovation • Developing workforce • Supporting a sustainable European battery industry • Ensuring consistency 	<ul style="list-style-type: none"> • Access to raw and refined materials • Support growth of US based material processing • Stimulate US electrode, cell and pack manufacturing • Enable end of life reuse and recycling • Research and development 	MIC strategy was documented in 2015 to catapult China's market share in some of the key industries to as high as 80% in Chinese market by 2025. These industries were classified under NEV, RE and supporting industries.
Incentive support	In case of aid to a project of first industrial deployment, the capital and operating expenditures (CAPEX and OPEX), as long as the industrial deployment follows on from an R & D&I activity and itself contains a very important R & D&I component which constitutes an integral and necessary element for the successful implementation of the project.	<ul style="list-style-type: none"> • Incentivizing private investment through federal grant processes, tax credits, federal loans and leverage existing programs 	"State-owned banks are distributing subsidies, low-interest loans, and bonds, direct financial support. For example, \$3 billion is available from the Advanced Manufacturing Fund .National Integrated Circuit Fund has access to\$21 billion. Importantly, funding is linked to the use of indigenous IP to push companies to replace foreign IP."

- The Biden Administration has laid out a bold agenda to address the climate crisis and build a clean and equitable energy economy that achieves carbon-pollution-free electricity by 2035 and puts the United States on a path to achieve net-zero emissions, economy-wide, by no later than 2050 to the benefit of all Americans.
- Establishing a domestic supply chain for lithium-based batteries requires a national commitment to both solving breakthrough scientific challenges for new materials and developing a manufacturing base that meets the demands of the growing electric vehicle (EV) and stationary grid storage markets.
- The announced National Blueprint for Lithium Batteries, developed by the Federal Consortium for Advanced Batteries will help guide investments to develop a domestic lithium-battery manufacturing value chain that creates equitable clean-energy manufacturing jobs in America while helping to mitigate climate change impacts.
- Attainment of the following five goals will position the United States to secure this vision



GOAL 1 Secure access to raw and refined materials and discover alternatives for critical minerals for commercial and defense applications



GOAL 2 Support the growth of a U.S. materials-processing base able to meet domestic battery manufacturing demand



GOAL 3 Stimulate the U.S. electrode, cell, and pack manufacturing sectors



GOAL 4 Enable U.S. end-of-life reuse and critical materials recycling at scale and a full competitive value chain in the United States



GOAL 5 Maintain and advance U.S. battery technology leadership by strongly supporting scientific R&D, STEM education, and workforce development

Source: national blueprint for Lithium batteries, DoE

	Electricity	Land Subsidy	Capital Subsidy % or INR Crore (if there is cap)	Other Incentive
Gujarat	5.8 US cents	50%	12.00%	
Tamil Nadu	7.6 US cents	- 50%	18%-30%	Training subsidy (TN -4000/Month per male for period of 6 month/ Female – 6000)(30000/employee) , pay role subsidy (additional incentive for TN), Environmental Protection subsidy (upto 25% of setting up the environmental plant). Qualitative – TN ease of doing then clearance within 30 days, provision of water and electricity at door steps.
Maharashtra	Tariff subsidy of 1.2 cents for 10 years and 100% electricity duty exemption for 15 years			Gross SGST subsidy of 100% For 10years
Karnataka	Power Tariff subsidy of 1.2 cents for 5 years and 100% electricity duty exemption for 5 year	25% land subsidy up to 50 acres.	20%	PLI incentive of 1% for 5 Years.



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Thank you

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