Calix Update + Battery Development Program

Post-AGM Webinar

November 11, 2020

calix | Solving global challenges

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Recap: Business Overview & YTD FY21 Progress

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Calix Limited is using its core mineral processing platform technology to grow multiple global businesses

Cash-positive and with no debt, growing revenues, secure supply chain, readily scalable and with a funded development pipeline.

Growing Sales Revenues
generated from water treatment products, with growing exports and recent US acquisition

Control of Supply Chain
from mine, to manufacturing facility, to local mixing plants, to customer / distributor

Quickly scalable
for minimal (organically funded) capex

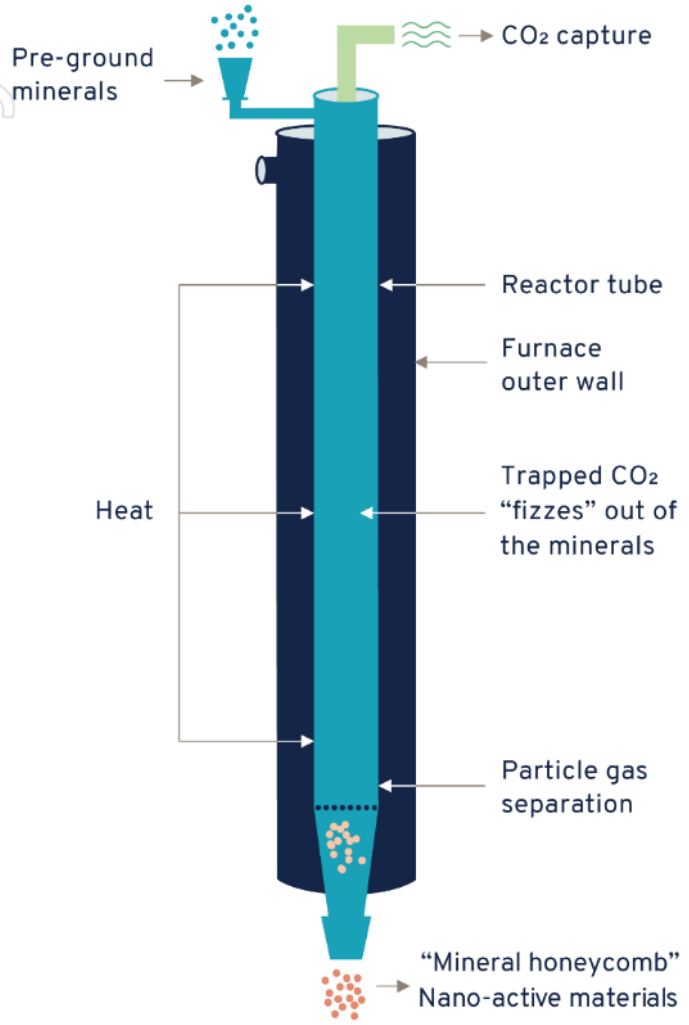
Robust business model
with existing commercialised markets in "essential services" waste water and food, largely unaffected by COVID-19

Funded Development
in Australia ($5m for agriculture, advanced batteries) and Europe (€28m for CO_2 capture for cement and lime)

Multinational Partners
HEIDELBERGCEMENT
Lhoist
CEMEX
SOLVAY
ENGIE Laborelec
TARMAC A CRH COMPANY

Calix's Core Technology

A PATENTED PLATFORM TECHNOLOGY WITH 2 KEY FEATURES



1

CO_2 Capture

When processing limestone, cement meal, or magnesite, gas exhaust is pure CO_2

2

Low Cost, Safe + Very High Surface Area (Reactive) Products

- Wastewater
- Aquaculture
- Lake remediation
- Crop protection
- Advanced batteries

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A New Type of Kiln...

The "Calix Flash Calciner" or CFC

27 patent families covering core technology and applications

>$60m has been invested to date in developing the technology.

Calix Limited FY20 Results Summary

A TRANSFORMATIONAL YEAR

operating cash profit
up 224% to $1.5m

net assets
$26m
Zero Debt

5 new patents
covering core technology and applications

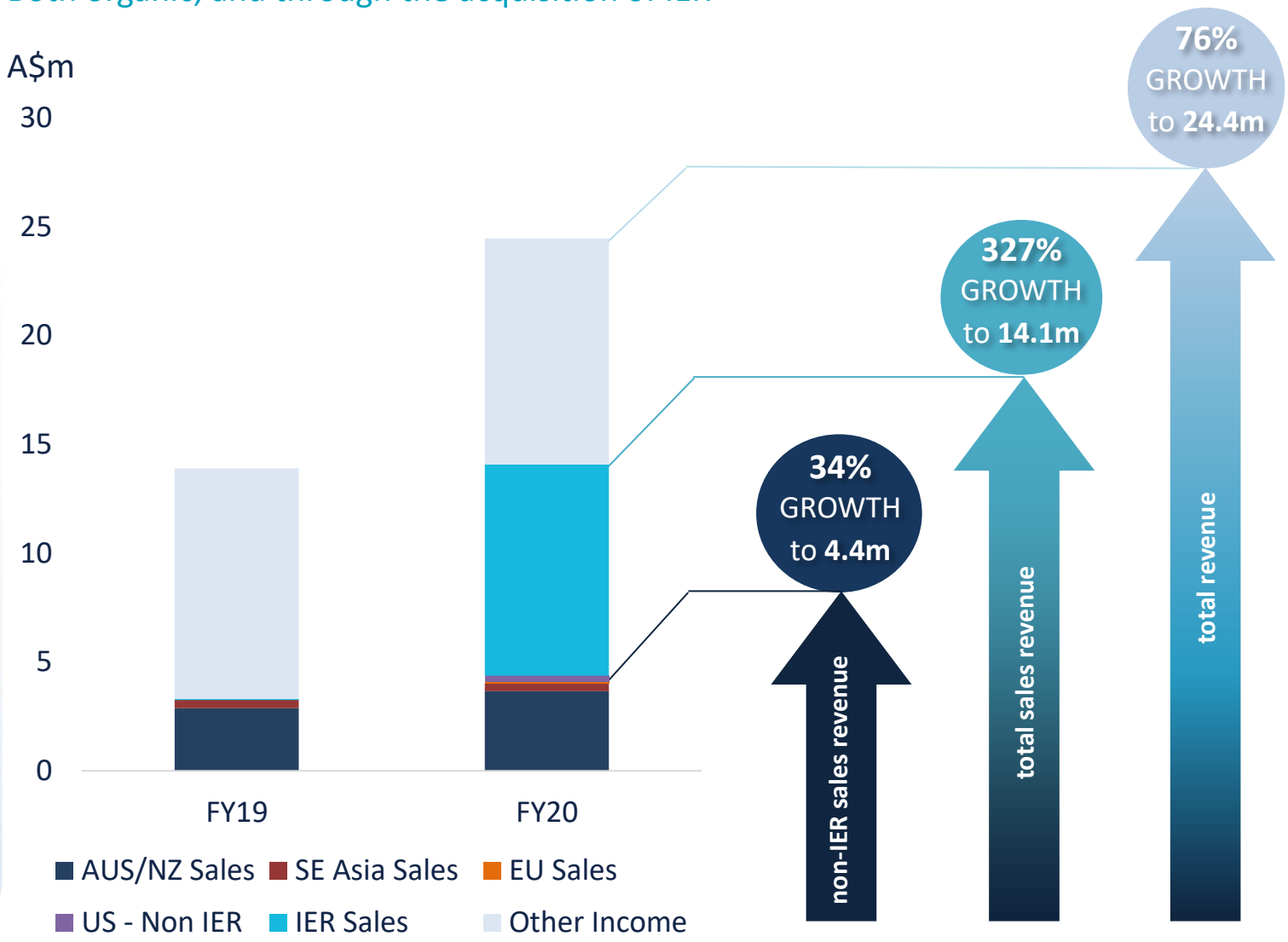
new funding
$30m in AU and EU Grants secured
$15.3m in new capital secured

major new project
$57m LEILAC-2 launched April 2020

1,334 shareholders*
* As of June 2020

REVENUE GROWTH

Both organic, and through the acquisition of IER



In Summary: Our Priorities for FY21

NWR Update Webinar 6/11

Today

	IN-MARKET	PRE-COMMERCIAL		R&D	
	WATER & WASTE WATER	**AQUACULTURE & FRESH WATER REMEDIATION**	**AGRICULTURE CROP PROTECTION**	**CO_2 MITIGATION LIME & CEMENT**	**ADVANCED BATTERIES**
Success in 12 months looks like?	US: 4 site upgrades, 1 new manufacturing site supporting new market growth European market entry and growth	Re-establish Asian growth esp. China Successful market entries – Indonesia, Vietnam, India	First European summer sales leads to strong initial orders for next EU summer APVMA Approval – Australia Another commercial license	Successful completion – LEILAC-1 test phase Successful Basis of Design milestone – LEILAC-2	Pouch cell prototypes tested – high prospective performance and/or economics
Strategic Options	Partnering / portfolio potential		License and possible spin-out play to crop majors	License and possible spin-out play to engineering / technology companies	License and possible spin-out play to battery / EV companies
Priorities	**Equal highest priority** – grow revenues and leverage technology into new market opportunities	Medium priority – huge potential and high growth but off small base via distributors, + COVID	High priority – good European and global tailwinds, but subject to COVID issues wrt market entry	**Equal highest priority** – grow value through de-risking – look for early value inflexion point	High priority – good global tailwinds, will take time

Focus remains on growing organic revenue base whilst strategically realising value in other R&D verticals

(1) *Frost & Sullivan: Market Opportunity for Calix Flash Calcination, dated 17 April 2018. Refer to Section 4 of the Calix Prospectus for risks associated with the competitive environment, retaining and winning customers and market development.*

Wastewater Treatment

A RAPIDLY GROWING BUSINESS

Key Milestones Targeted FY21

- Complete 3 more US plant upgrades – stable MHL technology
- Complete 1 new US plant
- Pursue revenue and gross margin growth
- Pursue European market entry and growth

FY21 YTD Key Achievements

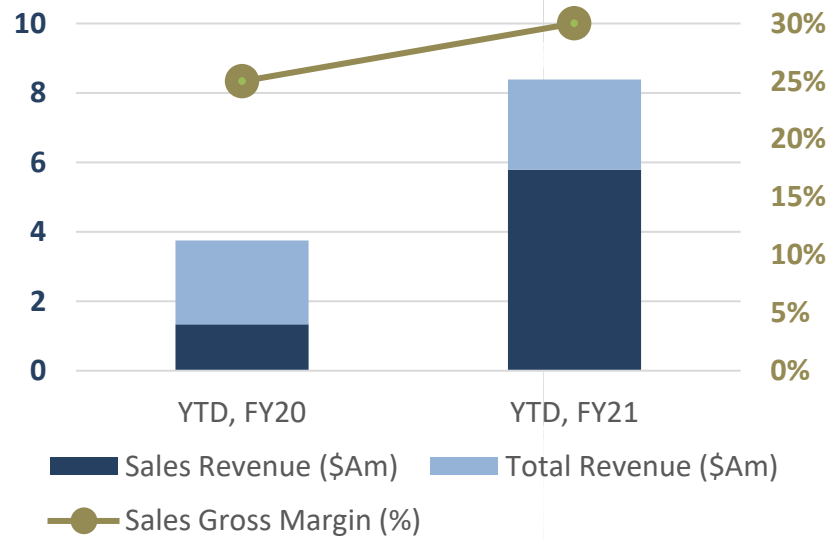
- Completed 1 plant upgrade – 2 more upgrades and 1 new plant to go this FY
- First EU paid trial achieved - Germany

YTD FY21 vs YTD FY20…*

- **Total revenue up 124% to $8.38m**
- **Sales Revenue up 333% to $5.78m**
- **IER Revenue up ~6% on pre-acquisition period (in $US)**
- **Gross Margin up 5% to 30%**

Revenue (A$m) and Gross Margin (%)

YTD FY21 vs YTD FY20



*All figures as at end-October, FY21 are Unaudited

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Business Model / Strategy

Direct sales model

Near Term: Roll-out and exploit technical advantages – US + grow margins and revenues

Medium Term: New Calix Calciner - Americas

Replicate US Market Entry - EU

CO_2 Mitigation

RAPID PROGRESS CONTINUES TOWARD COMMERCIALISATION

Key Milestones Targeted FY21

- Successful LEILAC-1 test campaign conclusion
- Successful Basis of Design milestone – LEILAC-2
- Continue to pursue licensing opportunities, and other CO_2 verticals (lime, refractories, etc)

FY21 YTD Key Achievements

- EU Approval - LEILAC-1 test campaign extended to mid-2021
- LEILAC-2 BOD on track

Coy's	Scope	Status	Targeted Next Steps – FY21
"A"	Refractories	Successful phase 1 test program complete Commercial T&C's under discussion	Phase 2 targeted from January 2021 Project / License Agreement covering first full-scale plant
"B", "C", "D", "E"	Cement	"LEILAC" 3 Concept under discussion for EU Innovation, and/or Country-Level funding	At least 1 Project / License Heads of Agreement + Commence Feasibility – full-scale plant
"F", "G"		Full Scale cement plants outside of EU – Feasibility projects – discussions	
"H", "I", "J", "K"	Lime	Application-specific concepts under discussion	

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Theoretically the lowest cost solution to CO_2 mitigation for cement and lime

- 2018 – EU ratifies phase 4 of the Emissions Trading Scheme, CO_2 permit price jumps from €5 to over € 25, where it has remained
- 2019 – HeidelbergCement pledges net zero CO_2 by 2050, and a 30% reduction by 2030
- 2020 – EU legislates net zero CO_2 by 2050. Several countries follow.

Business model

- Capital light / low risk
- Engineering services and license / royalty fees
- Consider equity interest to accelerate commercialisation

Update: Advanced Battery Materials Development Program

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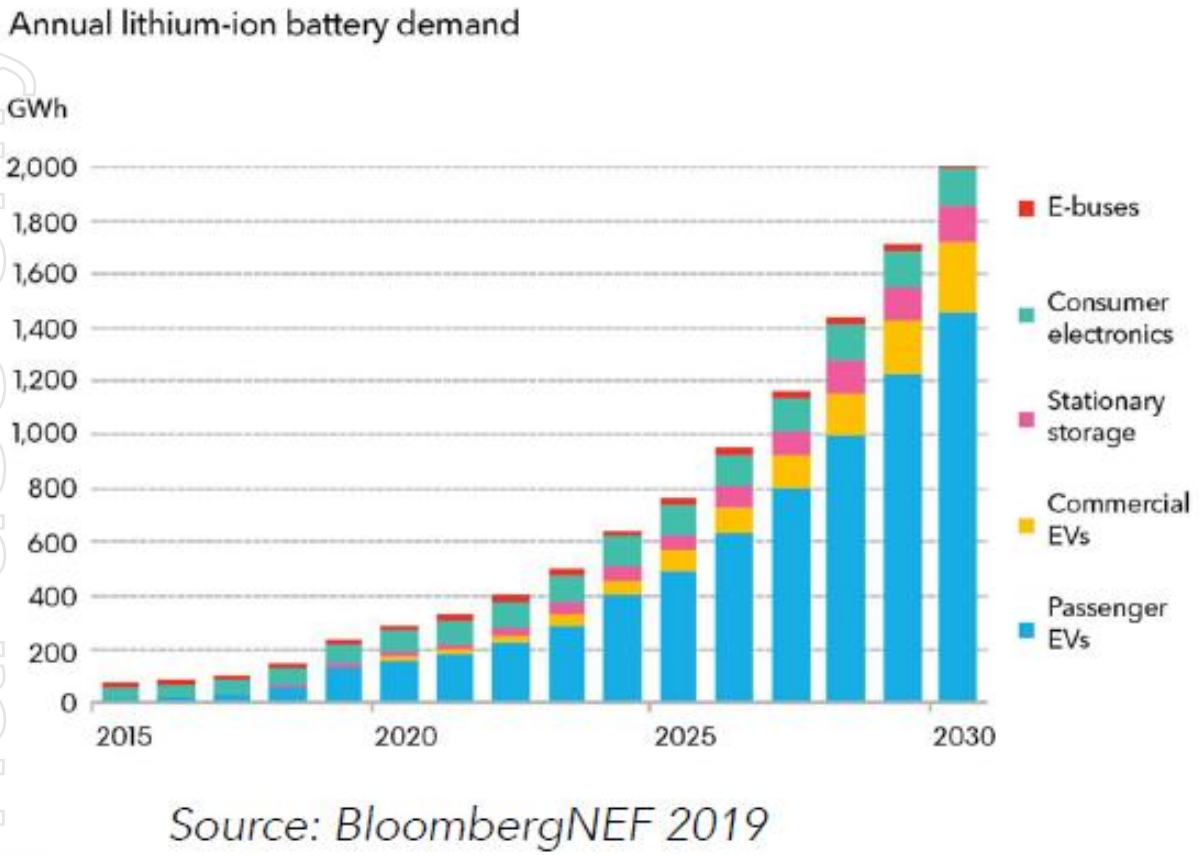
"...cheaper, safer, better and more environmentally friendly battery materials..."

Market opportunity – why are Li-Ion batteries of interest ?

The Li Ion battery market has grown very quickly, and is predicted to accelerate further…



Source: BloombergNEF 2019

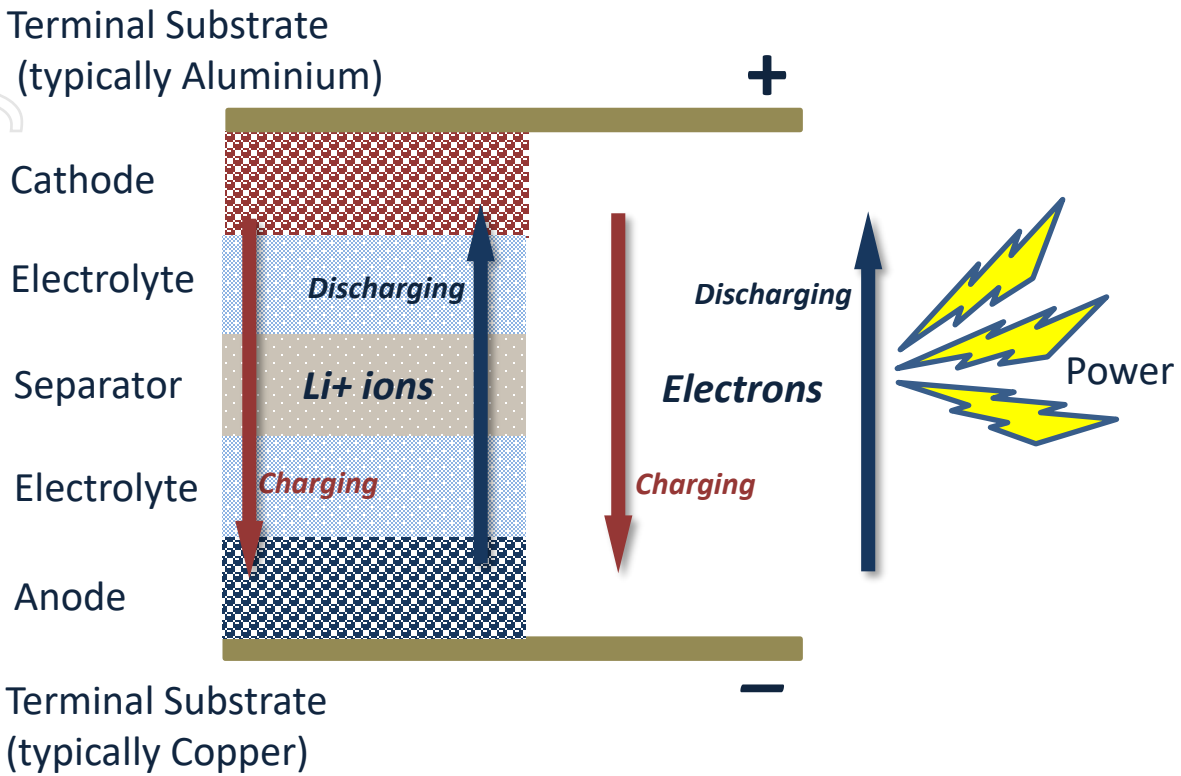
While there are varying predictions as to the growth of Li-Ion battery demand, there is consensus on two things…

- **Growth will be driven by electric vehicles, with significant growing contribution from stationary storage**

- **Growth will be very fast over the next decade**

How do lithium ion batteries work ?

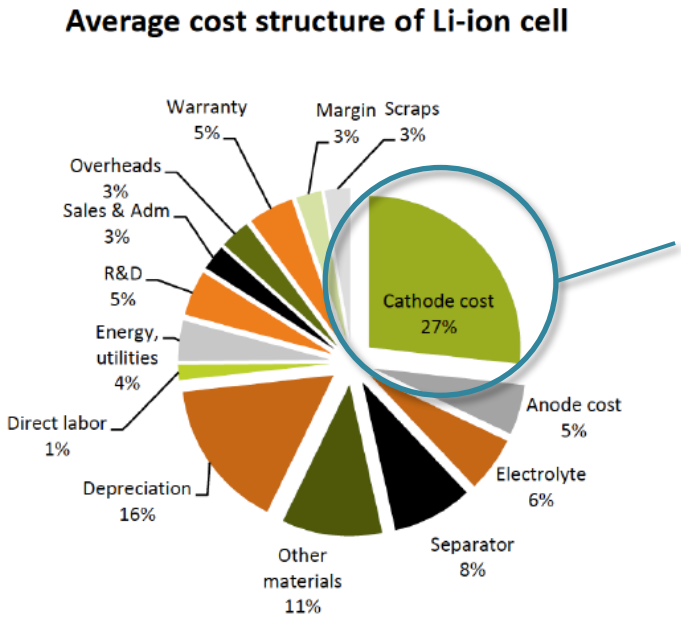
And why is the cathode so important ?



The cathode, as the source of Li+ ions, is the main determiner of the capacity and voltage of the battery

During **charging**, lithium (Li) ions flow from the cathode to the anode via an electrolyte, through a separator

During **discharge**, they flow back to the cathode, generating a flow of electrons from the anode into the external circuit (eg your phone, or car !) and back to the cathode also



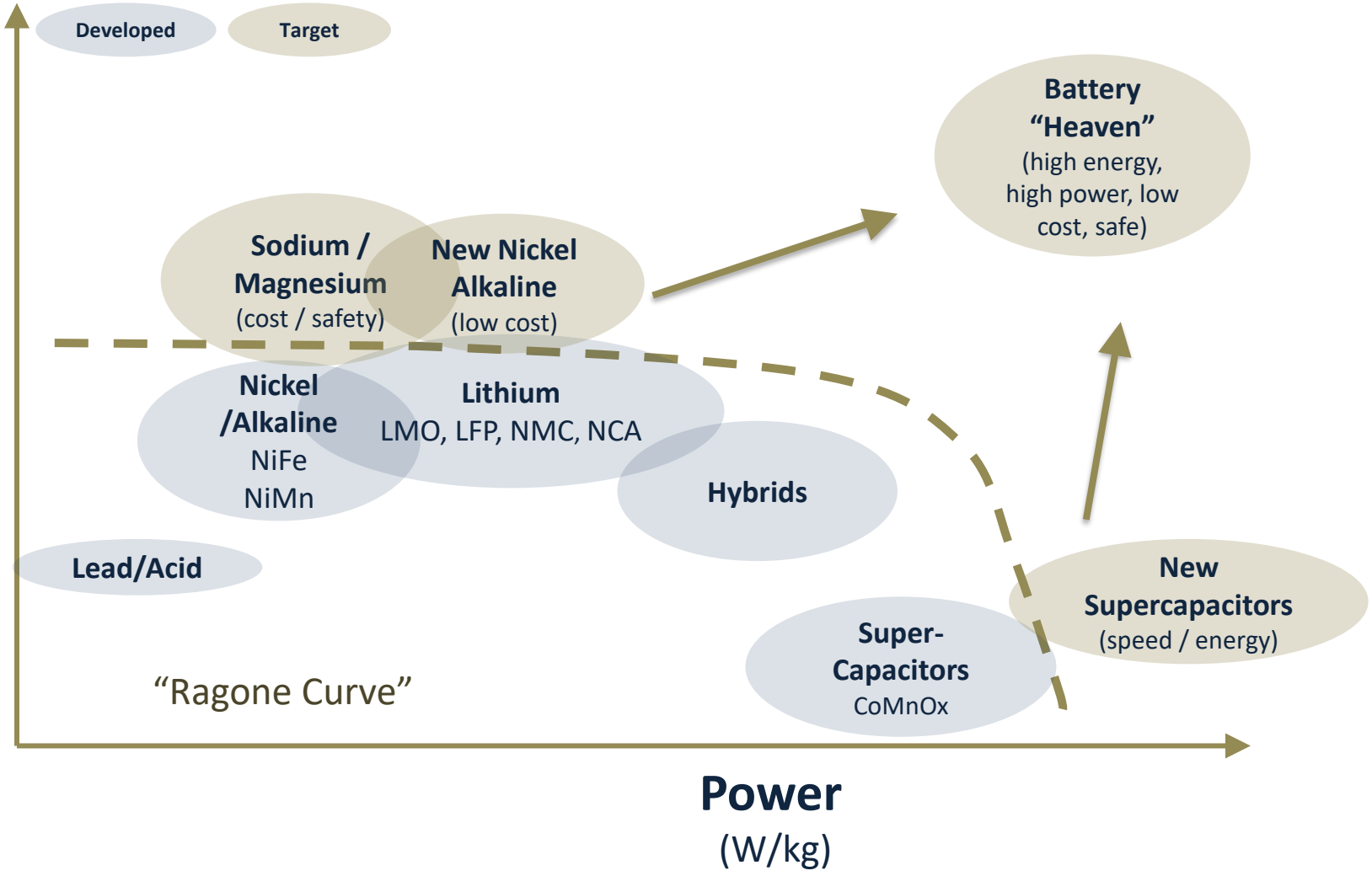
Source: Avicenne 2018

The cathode is also the most expensive component of a Lithium Ion battery – over ¼ of the cost ! – due to…

1. ***Materials***
2. ***Energy***
3. ***Capital***

What are the key operating properties of Li-Ion batteries?

So far (!) has been a trade-off between energy and power…



- "energy" defines how much "fuel" is in the tank
- "power" defines how quickly the energy can be used, and replenished
- EV's are driving development to push the Ragone Curve outward !
- But energy and power are not the only parameters of interest…

Energy and power important, but so is cost and safety…

How the top 4 chemistries stack up, and recent trends towards cost and safety…

Cathode Chemistry	Key Elements	Stability	Voltage (V, vs Lithium)	Specific Energy (Wh/kg)	Typical Cost ($/kg)	Cost / Energy ($/kWh)	Safety [1]
NMC or NCM	Ni, Mn, Co	Good	3.8	140-180	20 – 28	30 – 43	
NCA	Ni, Co, Al	Poor	3.8	80-220	23 – 30	30 – 40	
LFP	Fe, P	Excellent	3.4	80-130	10 – 12	18 – 22	
LMO	Mn	Poor	4.1	105-120	8 - 15	16 - 30	

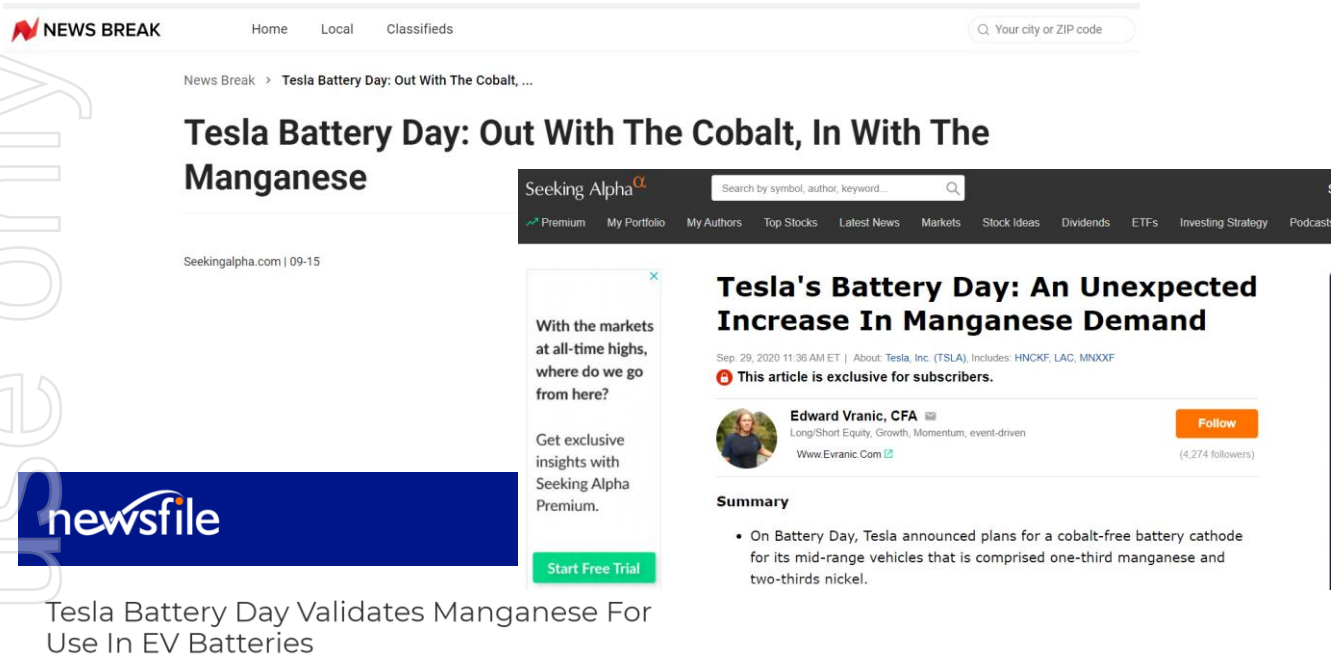
Very Safe *Unsafe*

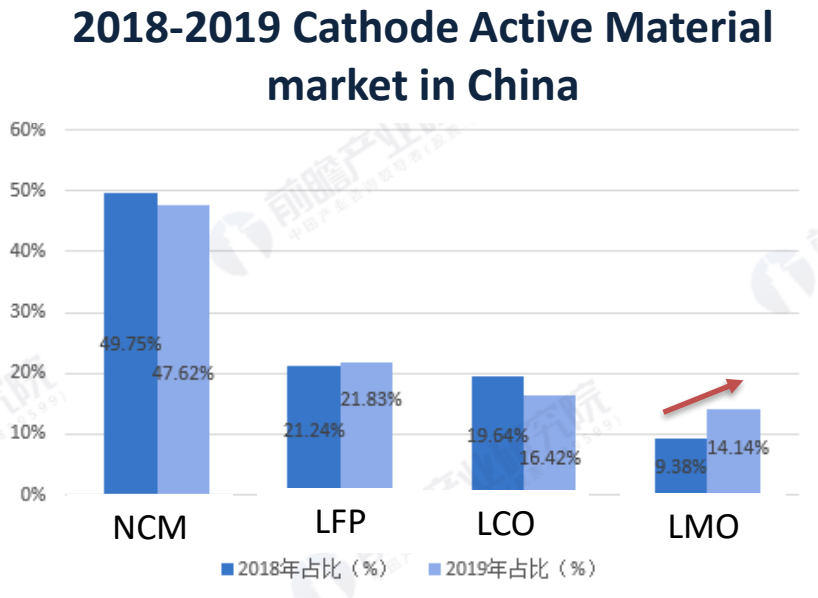
- The first modern electric cars such as the first generation Nissan Leaf, used **Lithium Manganese Oxide** (LMO) cathodes because of low cost and good intrinsic safety, at the expense of lower capacity and lifetime (stability)
- And Li-Ion **stationary energy storage systems** are less interested in energy density, and more in cost, safety and stability
- Tesla has used **Nickel Cobalt Aluminium** (NCA) and a lot of other car-makers use **Nickel Manganese Cobalt** (NMC) due to higher energy densities, albeit at higher cost and safety concerns
- However, Tesla has stated it will move to **Lithium Iron Phosphate** (LFP) chemistry for its Model 3 cars for the Chinese market, mainly driven by safety, cost and longevity, and….

1. Source except for NCA: Avicenne Energy http://www.avicenne.com/pdf/Fort_Lauderdale_Tutorial_C_Pillot_March2015.pdf , NCA: assumed the same if not slightly worse than NMC https://batteryuniversity.com/learn/article/safety_of_lithium_ion_batteries

Manganese – back with a vengeance ?!

Tesla is now targeting lower cost, safer, more environmentally acceptable chemistries, switching to Manganese…





- In an effort to reduce costs and increase safety further, Tesla announced at the recent “Battery Day” in September 2020, that it will be **pivoting battery strategic development back toward Manganese, along with Nickel,** and move away from Cobalt.

- In China over 2018-2019, **LMO was the fastest growing cathode chemistry**, and is being used to blend into NCM and LCO chemistries to reduce cost, and is also being driven by e-Bike growth

Why might Calix's technology be suited to battery materials ?

We make nano-porous particles, **cheaply**, and **already at scale**…

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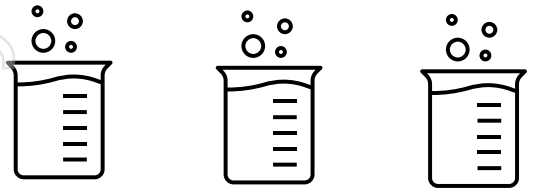
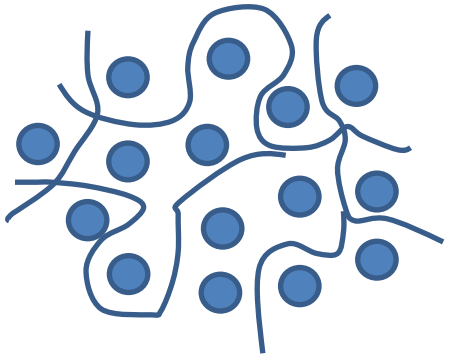
Australian Government
Department of Industry, Innovation and Science

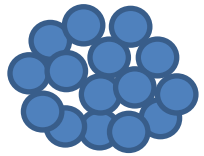
Current Manufacturing and Most R&D routes



- *Exotic Chemistries*
- *High purity pre-cursors*



- *Micro- and Nano-particles*
- *Multiple spacing / layering techniques*
- *Waste materials !*

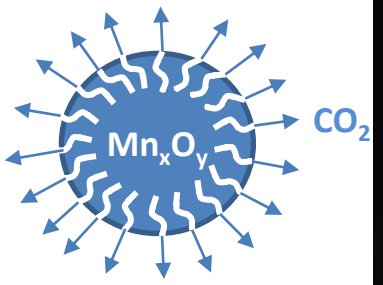


Assembled crystals

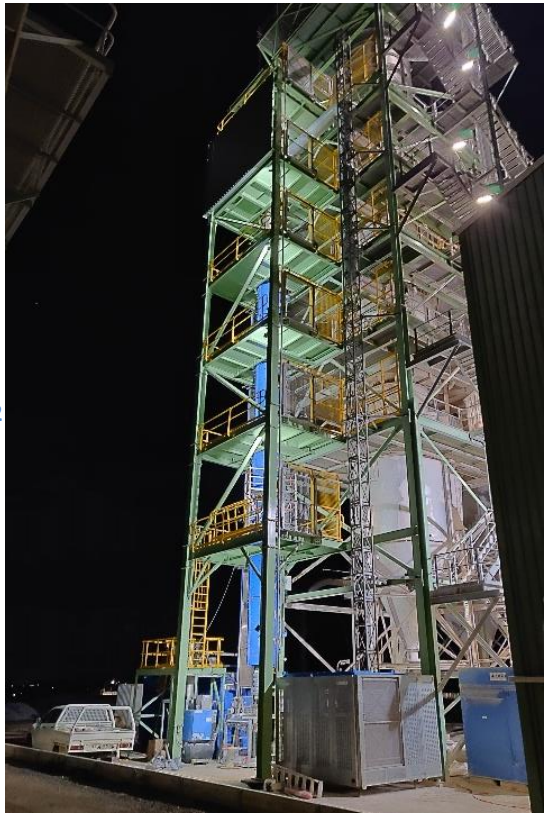
Calix route

Ag-grade Manganese Carbonate micro-particles

- *Calix BATMn Reactor*
  - *Controlled flash heating, oxidation*
  - *No waste*



Controlled nano-porosity, strong flexible micro-crystals



The more exotic, the harder + $$ to scale !

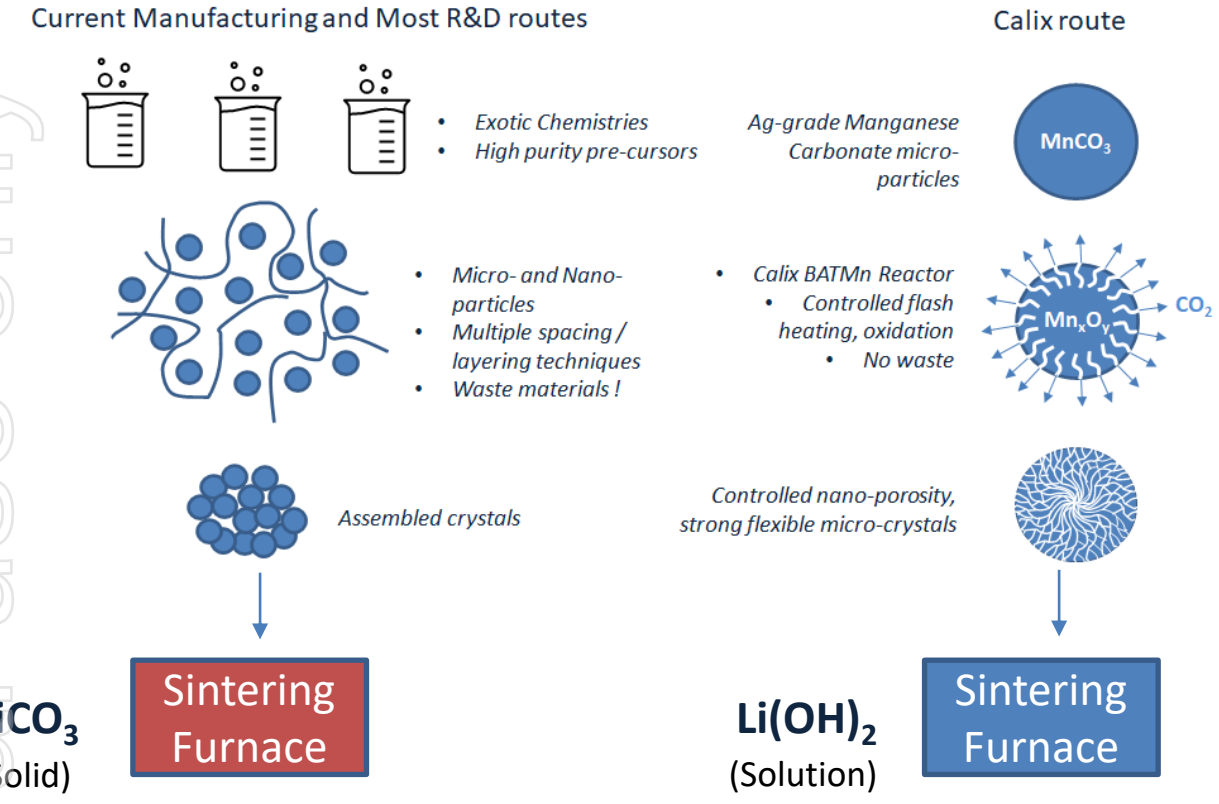
Already at Commercial Scale
2000 Tpa, ~A$2m

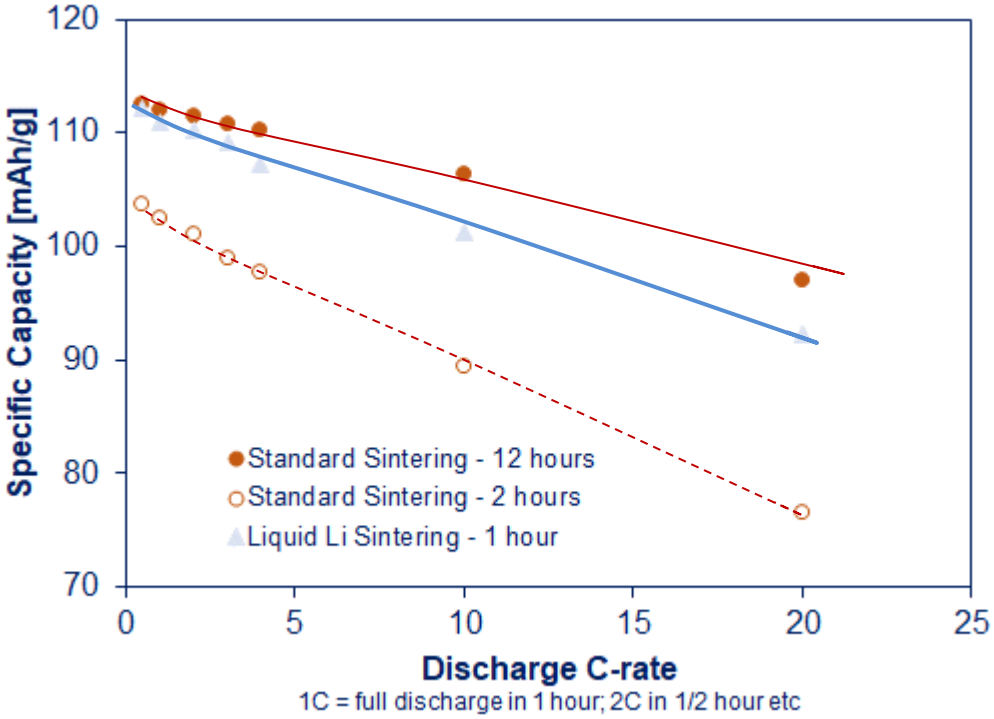
https://link.springer.com/chapter/10.1007/978-3-319-72138-5_14

https://www.researchgate.net/publication/340593316_Production_of_Lithium_Ion_Battery_Cathode_Material_NMC_811_from_Primary_and_Secondary_Raw_Materials_-_Techno-Economic_Assessment_with_SuperPro_Designer

Why might Calix's technology be suited to battery materials ?

Could the Calix technology also result in a cheaper way to add lithium ?





- Our battery performance[1] for a Li solution-soaked 1-hour sintering process is nearly as good as the 12-hour solid state sintering process

- These are early results and more testing is required, however more optimisation may also be possible !

1. All materials were tested under identical conditions in ½ cells

Can we use cheaper, less pure materials ?

Our early test work has concentrated on cheap, agricultural, **non-battery** grade manganese…

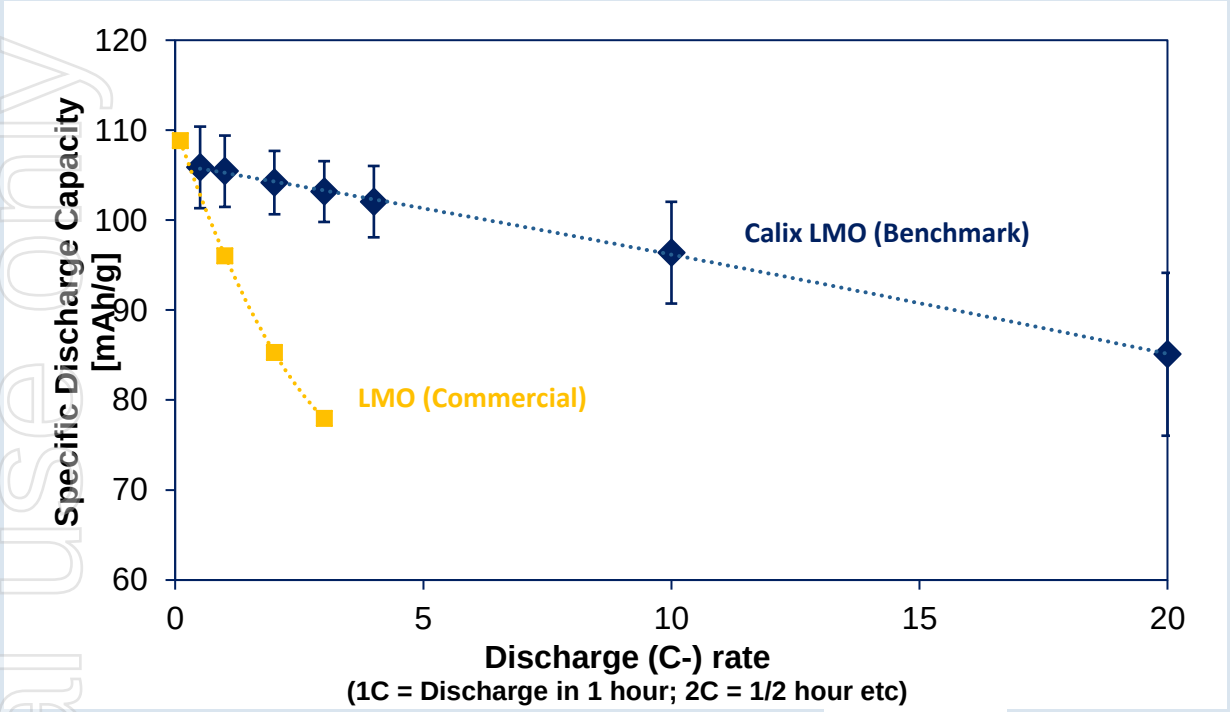
Chemical Composition (weight %)		Standards		Commercial LMO	Calix LMO	
		High Capacity [1]	High Power [1]	As tested	(washed)	(unwashed)
Main elements	Mn	58.0 ± 2.0	57.5 ± 2.0	59.5	58.2	56.3
	Li	4.2 + 0.4	4.1 + 4.0	3.97	3.84	3.76
Impurities	K	< 0.05	< 0.01	0.01	< 0.01	0.03
	Na	< 0.3	< 0.1	0.3	0.05	0.27
	Ca	< 0.03	< 0.03	0.02	0.32	0.78
	Fe	< 0.01	< 0.01	0.01	0.02	0.02
	Cu	< 0.005	< 0.005	0.0002	0.0018	0.0017
	S	-	< 0.167	0.5	0.31	0.91
	Mg	-	-	0.02	0.6	0.6

- Commercial LMO, and Chinese LMO Standards, show much lower concentrations in Ca, Fe, Cu and Mg impurities
- Simply washing with water lowered some of the impurities (K, Na, Ca and S)
- And the performance ?....see next few slides !

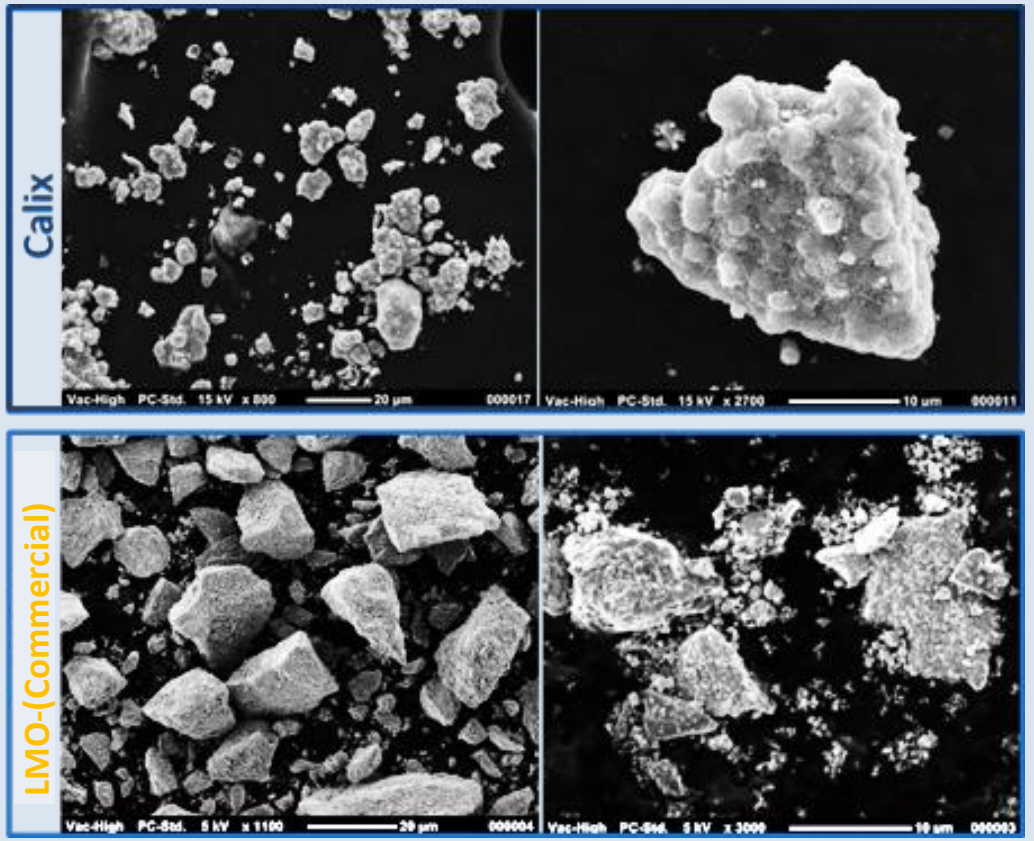
1. YS/T 677-2016, Lithium manganese oxide, People's Republic of China Nonferrous Metals Industry Standard

Despite lower purity – some encouraging performance…

Firstly – charge rate performance versus a commercial LMO appears very different…



- As the **discharge rate** increases, puts more strain on the cathode material – our early materials are already showing good stability at higher charge rates, above commercially available LMO[1]

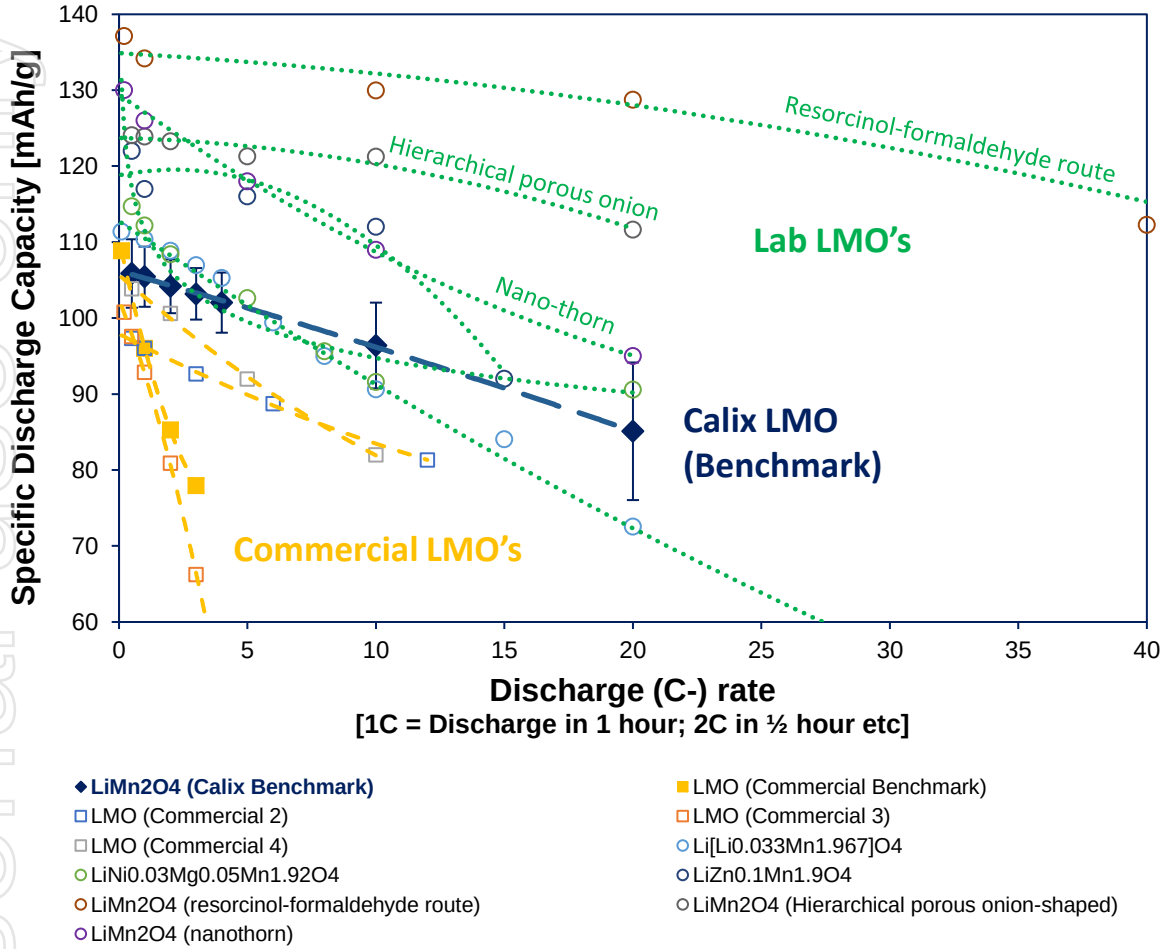


- High magnification images clearly show our material has a different structure

1. All materials were tested under identical conditions in ½ cells
2. The Calix LMO Benchmark / Baseline is currently made using the Standard Sintering Process (12 hours). Further work is being done to optimise the solution soaking process for comparative testing

How do we stack up compared to “the best” LMO’s in R&D ?

We’ve pushed some of our materials to very high discharge rates to see…

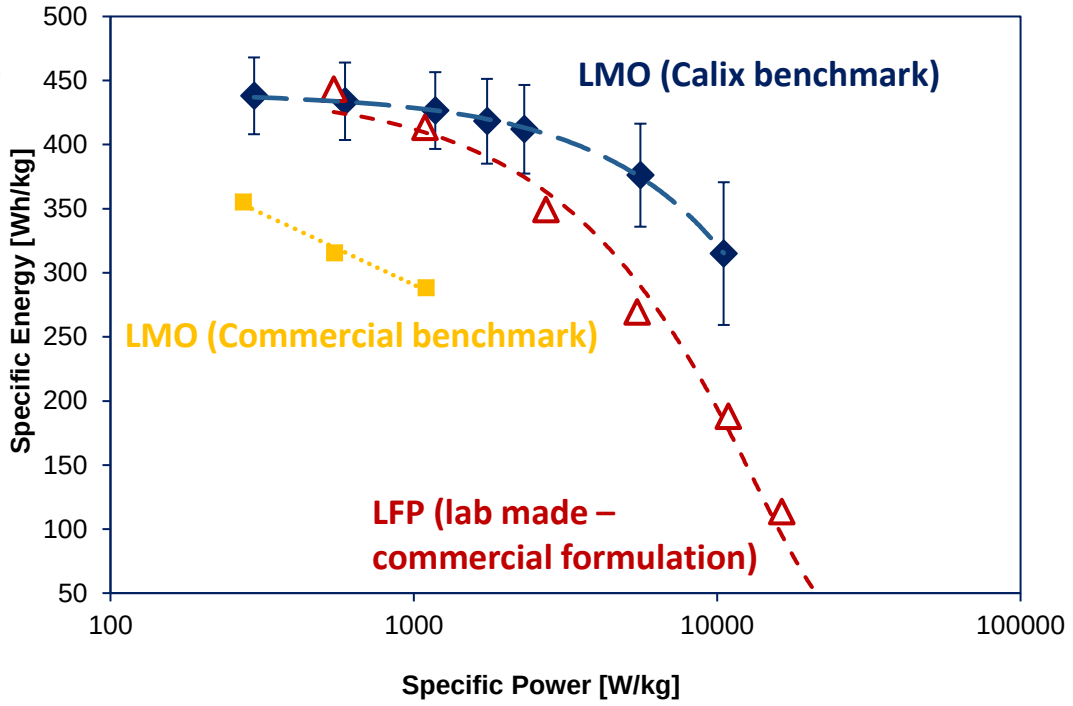


- Calix LMO was superior to the electrochemical performance data as reported from the top global LMO manufacturers *
- Calix LMO also compared favourably to the best performing exotic lab-produced LMOs as presented in the open literature
- **EARLY DAYS - but very encouraging !**

* Test methods may be different between the different results, and we have tried to compare under as similar conditions as possible
*http://www.avicenne.com/pdf/Fort_Lauderdale_Tutorial_C_Pillot_March2015.pdf)

How do we stack up compared to other Li-ion chemistries ?

We've compared results against literature for LFP's…



N.B. Energy and power densities presented per kg of cathode active material
LMO typically represents 33wt% of the total weight of a cylindrical battery cell
All results are for low CAM loadings (ca. 0.5 mAh/cm^2 or unknown)
Further work is needed to investigate how these results scale to commercial CAM loadings and full cell

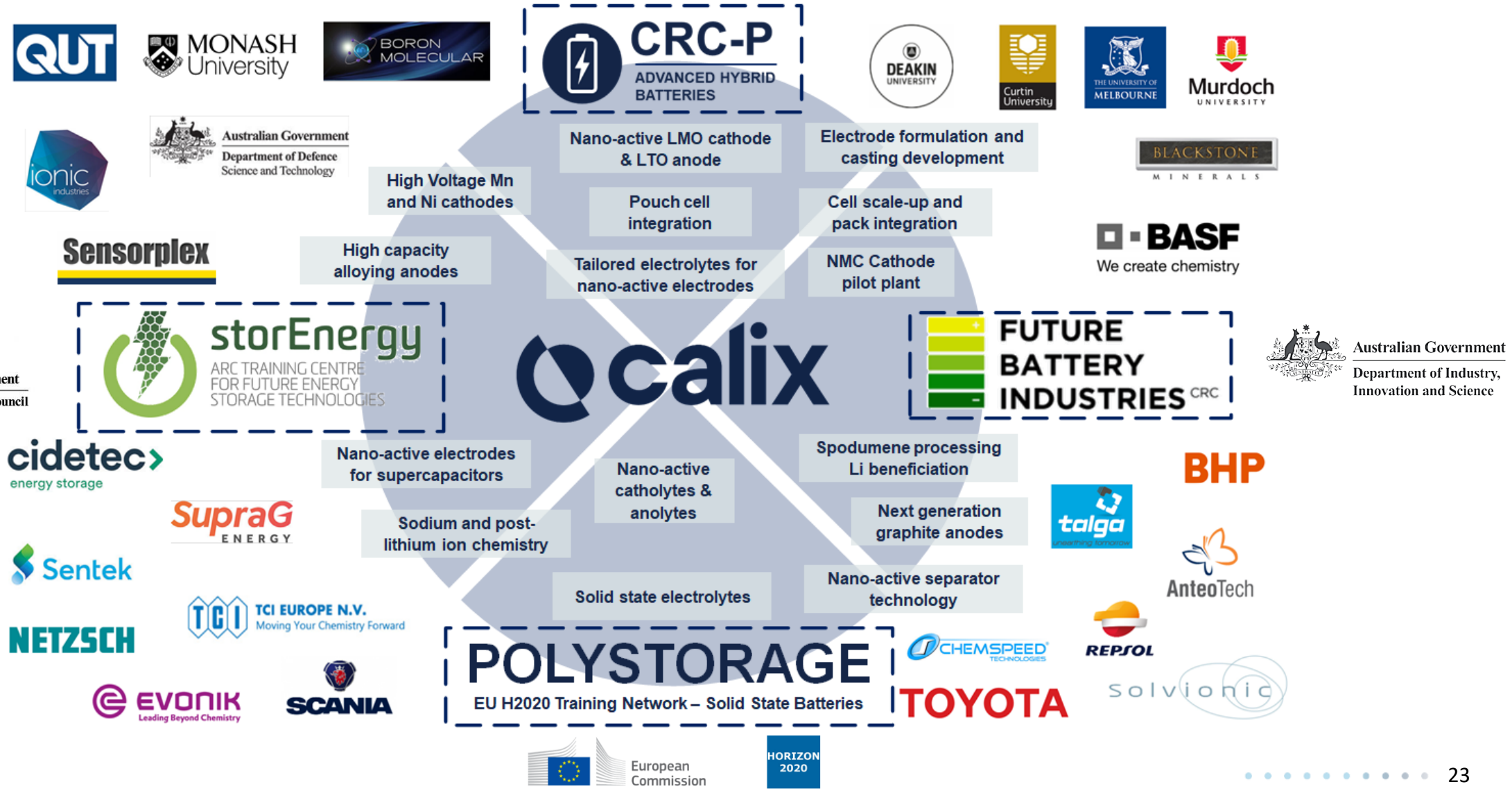
- Calix LMO materials (to date) also compare favourably to best performing LFP cathode materials as presented in the open literature*
  - LFP market expected CAGR of 8% between 2015-2025[1]
  - Uses include power tools, transit EV, xEV, e-bikes and stationary applications
  - **The Chinese-made Tesla Model 3 will feature a Co-free LFP battery chemistry[2]**
- **Can Calix LMOs compete for the LFP market???**
- Early results promising but more work is needed to investigate how these results scale

* Test methods may be different between the different results, and we have tried to compare under as similar conditions as possible

[1] http://www.avicenne.com/pdf/Lithium-Ion%20Battery%20Raw%20Material%20Supply%20and%20Demand%202016-2025%20C.%20Pillot%20-%20M.%20Sanders%20Presentation%20at%20AABCUS%20San%20Francisco%20June%202017.pdf
[2] https://www.reuters.com/article/uk-tesla-china/tesla-to-roll-out-china-made-model-3-cars-with-cobalt-free-lfp-batteries-sources-idUKKBN26L2J5

We've just started our journey…

We are year 1 into a multi-year, multi-program development, but very encouraged already…



We do have quite a bit of work to do…

The next stages of our program are critical to achieving commerciality…

Key Challenge	Description	2021	2022	2023
LMO Full Cell Performance	1. Commercially-relevant loadings of Cathode Active Material[1] 2. Long term 500-1000+ charge-discharge cycling performance			
Field Trials	Demonstration of the technology in a commercially relevant format at real world/application specific conditions[2]			
Scale-Up	Demonstrate electrochemical performance of materials produced in commercially relevant quantities (grams → kgs → tonnes) 1. Stage 1: Lab (grams) → pilot production (kgs) - underway 2. Stage 2: Pilot production (kgs) → Commercial demonstration (tonnes)	Stage 1	Stage 2	
Optimised / Combined / New Chemistries	1. Optimise LMO 2. Test new materials / chemistries	Iterative / On-going		
Electrode / Electrolyte Optimisation	Experiment with different combinations to maximise cycling stability	Iterative / On-going		

1. >2 mAh/cm²
2. (1- 10 kWh)

However - Early results are very promising!

LMO is just the start, even LMO has great potential…

- **Potentially far lower costs**:
  - The Calix process represents a potentially far lower cost material, and manufacturing process, to conventional and exotic processes
- **Strong early performance results**:
  - Half-cell tests of Calix LMOs at Deakin University have outperformed commercial benchmark LMO and LFP's and is in the mix of some of the high performing lab LMOs reported in the open literature
- **Highly prospective markets:**
  - Manganese "re-growing" in importance
  - Other chemistries still to be tested…(Ni etc)

calix

We believe our responsibility starts at home. That’s why we’re driven to use our unique skills to repair, preserve and prevent future harm to it. Because there’s only one Earth, and it’s already ours.

Because there's only one Earth…

…Mars is for quitters

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