

High Energy Density Anodes with Lithium Metal and Pre-lithiation

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Supply Chain for Advanced Energy Storage Manufacturing - IESA Energy Storage Roadmap for India

50 years
of materials
innovation



APPLIED IN 1967

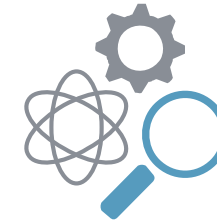
World's #1

semiconductor and display equipment company



\$14.6 billion
revenue

TOTAL FISCAL 2019



\$2.1 billion
R&D spending



~13,300
patents

4+ PATENTS PER DAY



~22,000
employees
in 18 countries

Data as of fiscal year end, October 27, 2019

Applied Materials India

A key R&D, Engineering,
Software & IT Infrastructure Center
for the company

4211 Employees
and Associates

FOUR locations across
the country

* Worker count includes managed services as on October 7th 2019



Applied India Footprint

MUMBAI

- Chemistry & Materials Lab at IIT Bombay
- ~40 employees

BENGALURU

- R&D and Engineering & Operations teams
- GIS - IT infrastructure / ERP / PLM / KM & Data Science
- ~4200 employees

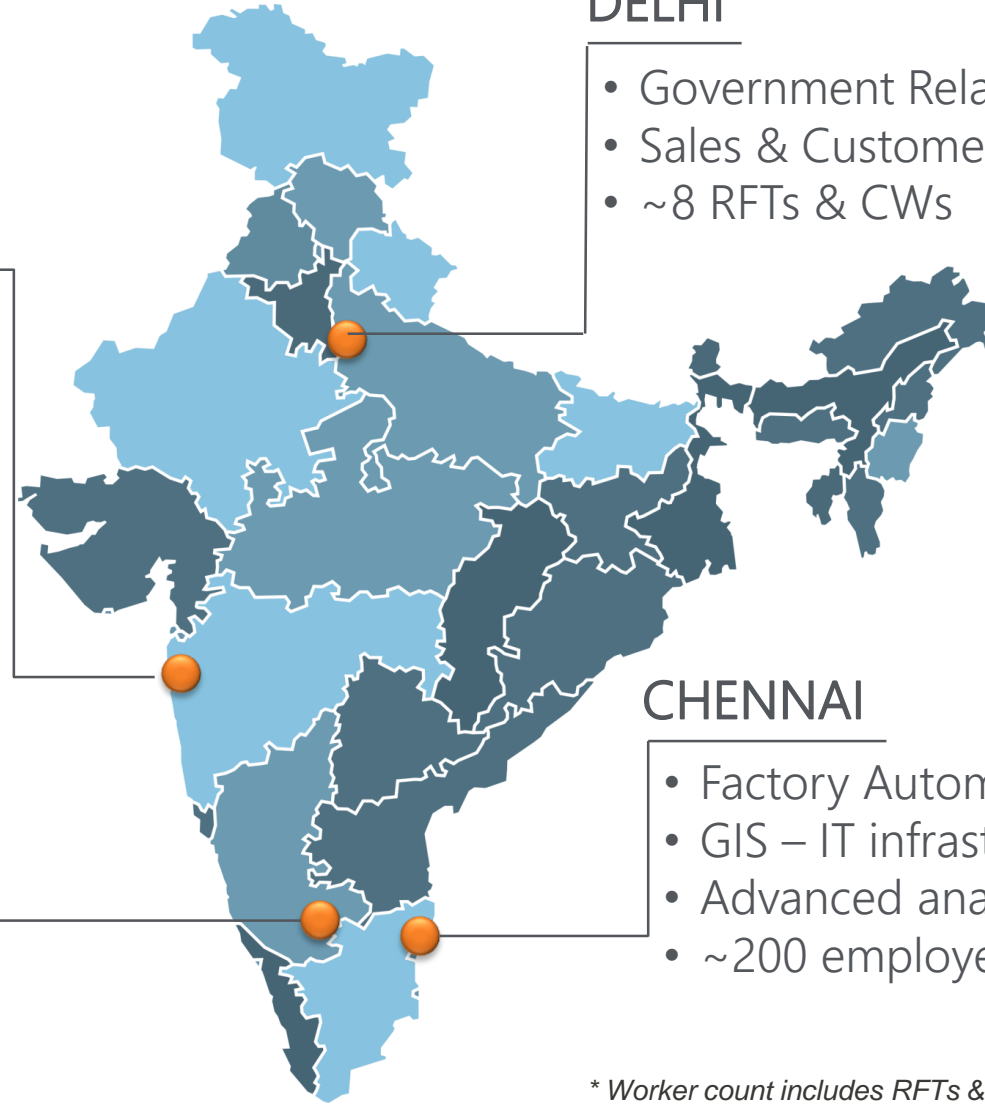
DELHI

- Government Relations
- Sales & Customer Support
- ~8 RFTs & CWs

CHENNAI

- Factory Automation Software
- GIS – IT infrastructure services
- Advanced analytics
- ~200 employees

Broad set of capabilities to make possible Applied products & services



* Worker count includes RFTs & CWs tied to AMIND legal entity as on July 15, 2019

WHERE WE WORK...

Materials Engineering

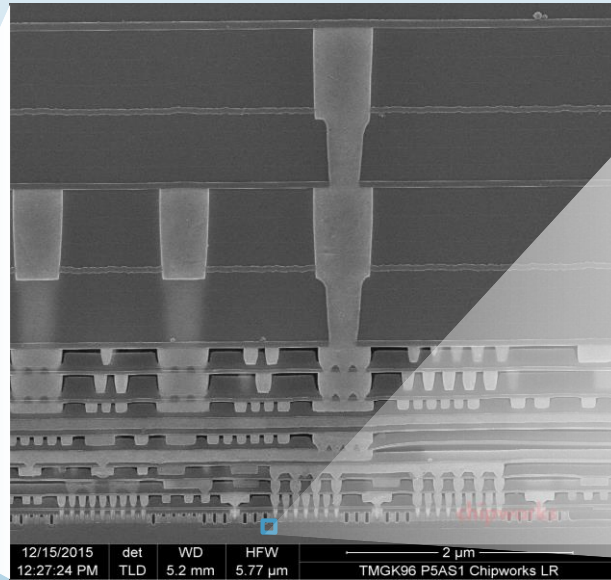
manipulating materials at an atomic level
and on an industrial scale



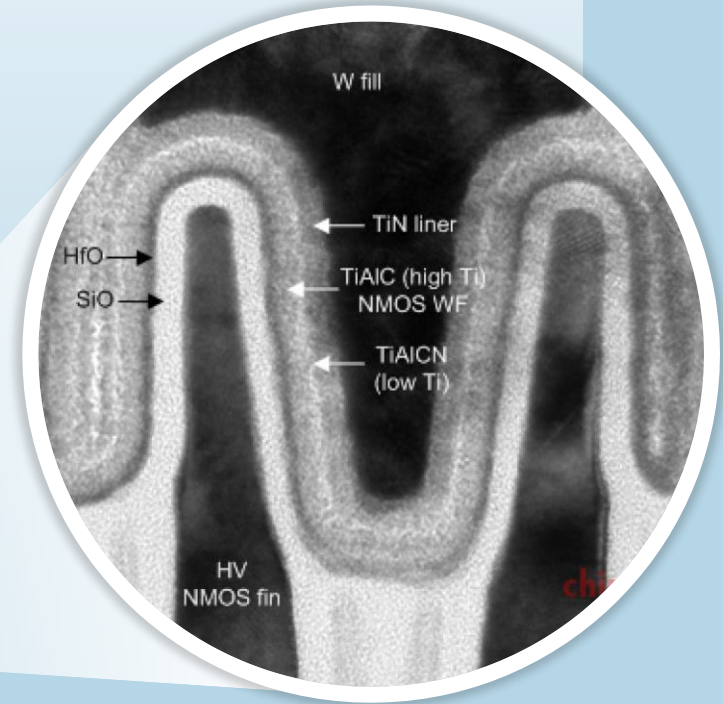
70mm



10mm



5µm



100nm

SOURCE: Chipworks



We provide sophisticated **manufacturing systems** and **comprehensive services** to the **semiconductor** and **display** industries

The Legacy of Materials Engineering: A Supercomputer in Every Pocket

IF BUILT USING
**1980s
Technology**



Cost: \$110 million

Power: 200kW
(enough to power two Tesla Model X's)



Our Innovations **Make Possible** the Technology Shaping the Future

From high-performance chips, higher resolution displays, billions of people around the world benefit from our **materials engineering solutions that transform possibilities into reality**

Our breakthrough innovations empower our success, customers' success, and shape the future

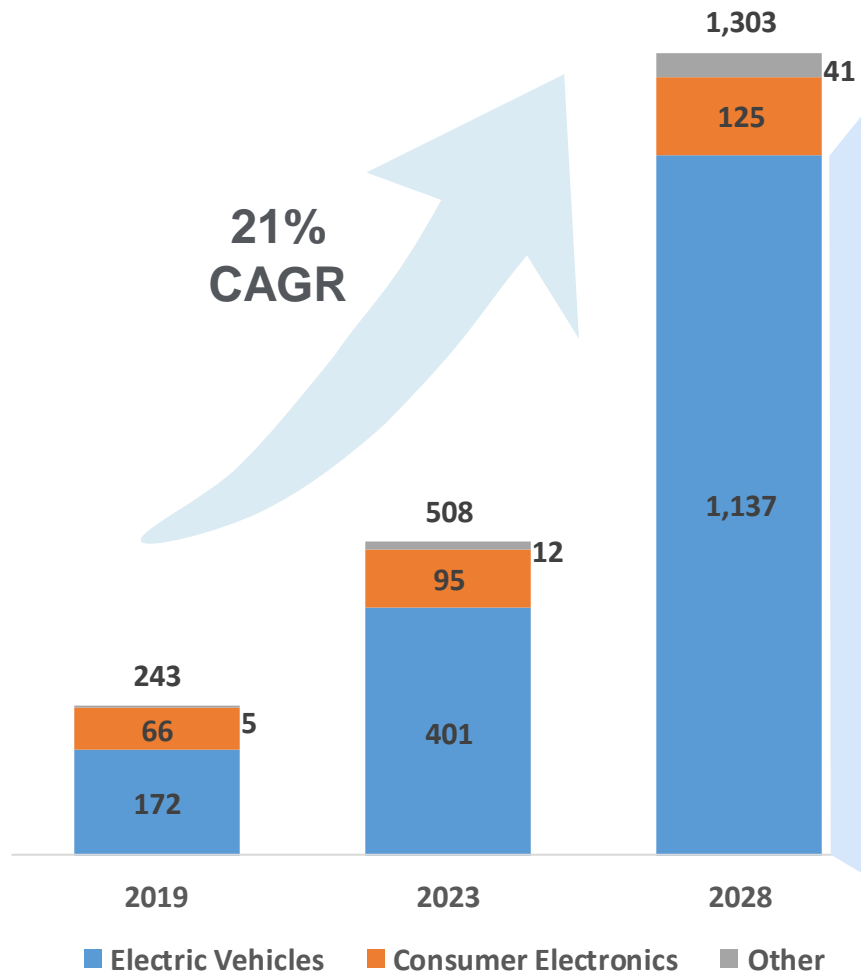




High Energy Density Anodes

Li-ion Market is Poised for Strong, Long Term Growth

Li-Ion Battery TAM (GWh)



Sources: Bloomberg, Nomura, Berenberg

Powered by Explosive Demand for EVs

Regulatory Tailwinds for EVs

- Ban of all gas and diesel cars by 2040
- Consider banning all gas vehicles within 10 years
- Sell only electric cars by 2030
- Phase out petrol and diesel cars by 2025
- Only electric cars will be on the road in 2040
- Germany could ban gas and diesel cars
- Ban all petrol and diesel vehicles by 2040
- Ban sale of new gas and diesel cars by 2032

Driving >\$90B Investment by Automakers

- Invest \$40B by 2030. xEV on 300+ models 2030
- Invest \$11.7B. 10 all EV, 40 hybrid.
- Invest \$11B by 2022. 40 new xEV models.
- 8 new xEV and sell >1M EV by 2022
- 10EV by early 2020s, sell >5.5M xEV by 2030
- 12 pure EV, 13 hybrid by 2025
- 20 pure EV by 2023
- 67% of cars sales will be xEV by 2030

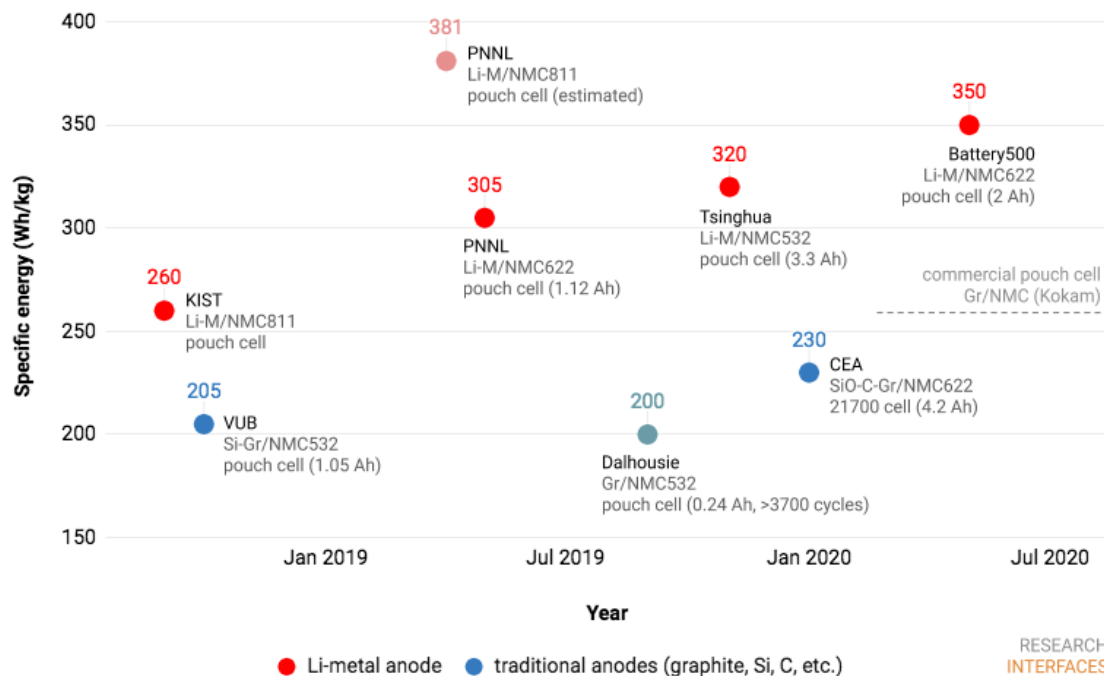
Source: T Milder, Ford, AABC 2018

High Energy Density Anodes – State of the Art 2020

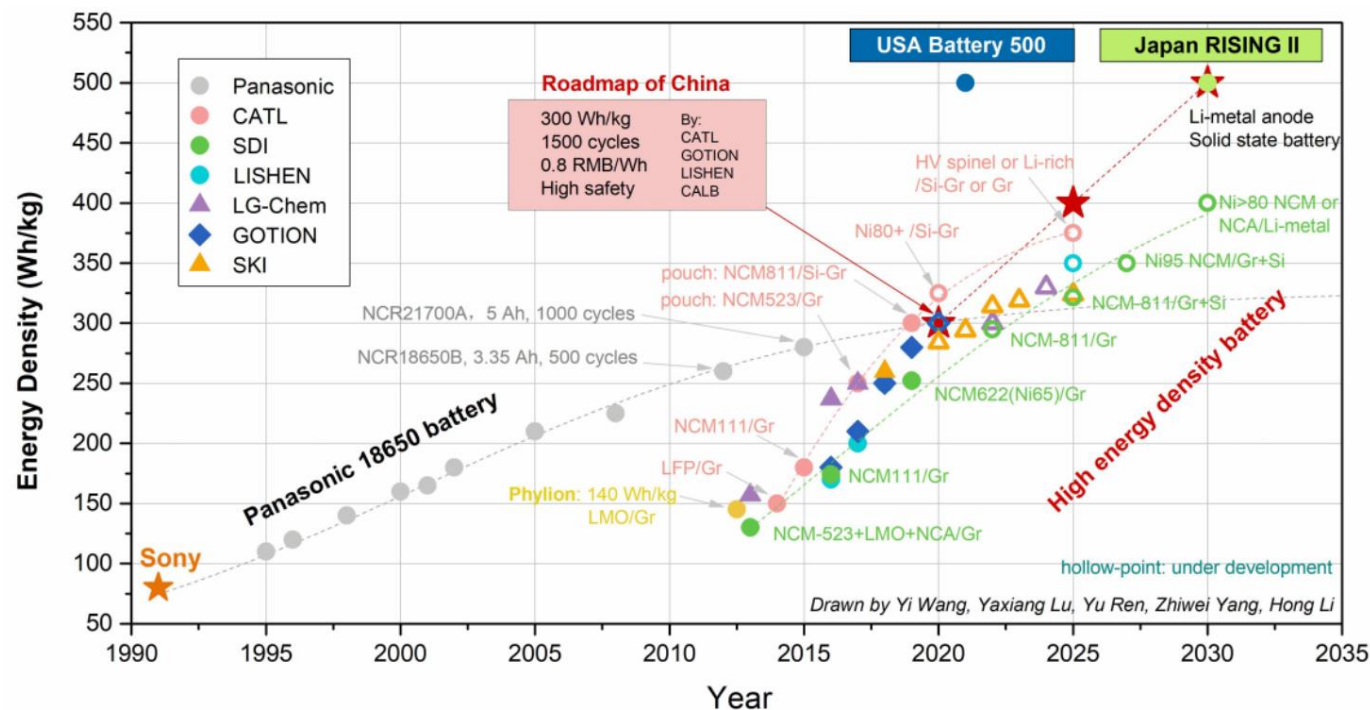
Million mile Li-metal batteries – Sep 22

Battery energy

State-of-the-art specific energy of Li-ion cells in academic research



Research Interfaces – July 2020



Source: Battery EU2030+ roadmap, <https://battery2030.eu/>

Wh/kg or Wh/L: High energy density anodes is the future of Li batteries

Li metal: Enable Pre-lithiated anode and Li-metal anodes

China: Leading Li-ion manufacturing overtaking other countries in last 5 years

Conclusion

- ✓ High Energy density is basic requirement for all energy storage applications in EVs, drones, Consumer electronics.
- ✓ Gr Anodes Li-ion battery for 30 years. Future batteries are Gr/Si with Pre-lithiation and Li-Metal anodes.
- ✓ High Volume Manufacturing of Li-Metal and Pre-Lithiated anodes available for the first time.
- ✓ Engineering and technology development with significant contribution from Applied Materials India.
- ✓ Applied Materials can supply pre-lithiated and Li-Metal anodes for large industrial requirements.



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make possible