

India

Underweight (no change)

Highlighted Companies

Gujarat Fluorochemicals Ltd

REDUCE, TP Rs1946, Rs2141 close

Gujarat Fluorochemicals has witnessed substantial re-rating in past six months, from 19x one-year forward to 42x P/E. We don't find any justification for such a high valuation and hence, downgrade the stock to Reduce with a TP of Rs1,946.

Navin Fluorine International Ltd

HOLD, TP Rs3476, Rs3852 close

Business fundamentals are in place but stretched valuation doesn't leave any upside potential from current levels.

SRF Limited

HOLD, TP Rs8481, Rs2075 close

A major portion of earnings is driven by commodity verticals like nylon tyre cord and BOPP/PET films. We have concerns over sustainability of earnings and hence, our HOLD rating on the stock.

Summary Valuation Metrics

P/E (x)	Mar22-F	Mar23-F	Mar24-F
Gujarat Fluorochemicals Ltd	39.41	38.2	30.2
Navin Fluorine International Ltd	63.44	50.82	40.45
SRF Limited	9.42	7.79	6.73
P/BV (x)	Mar22-F	Mar23-F	Mar24-F
Gujarat Fluorochemicals Ltd	5.43	4.76	4.11
Navin Fluorine International Ltd	10.05	8.57	7.24
SRF Limited	1.53	1.3	1.1
Dividend Yield	Mar22-F	Mar23-F	Mar24-F
Gujarat Fluorochemicals Ltd	0%	0%	0%
Navin Fluorine International Ltd	0.2%	0.25%	0.32%
SRF Limited	0.93%	1.13%	1.13%

Analyst(s)



Satish KUMAR

T (91) 22 4161 1562
E satish.kumar@incredcapital.com

Shaily RUPARELIA

T (91) 22 4161 1556
E shaily.ruparelia@incredcapital.com

Chemicals - Overall

Li-ion battery – Deep dive into its chemicals

- For 50GWh of Li-ion battery-making capacity under India's PLI scheme, the requirement of PVDF will be ~8KT, graphite anode ~45KT, and LiPF6 84KT.
- PLI (performance-linked incentive) scheme for 50GWh Li-ion battery capacity requires the winner to increase domestic value addition to 60% over five years.
- Identifying a winner is not possible currently, but the opportunity is large over five-to-seven years and new/existing players can emerge. Keep a close watch.

Graphite meets a major portion of anode material requirement

In case of Lithium-ion or Li-ion battery manufacturing, anode material should meet the requirements such as porosity, conductivity, durability, light weight, low cost, voltage match etc. Most of these requirements are fulfilled by graphite. The material is mined in flakes and then milled to form a spherical shape. Apart from mining, spherical graphite can be made synthetically from needle coke. The spherical shape is essential to spread thinly and uniformly during the manufacturing process. It also helps in better packaging and a longer life. Anode material demand for a 50GWh Li-ion battery set-up can be ~46,500t. Currently, the cost of anode is around US\$8000/t, which indicates that the Indian market can be worth around Rs30bn. The companies that can manufacture anode are 1) Epsilon Carbon, 2) Himadri Specialty Chemicals Ltd, and 3) Tirupati Graphite Ltd.

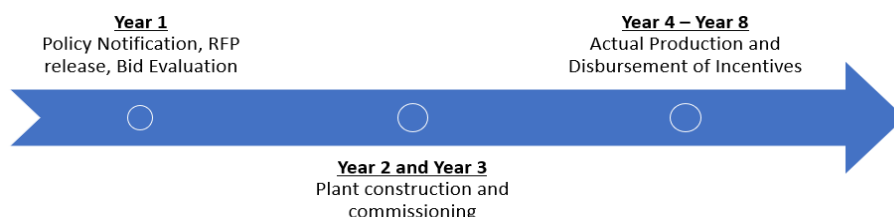
Li-ion battery binders – PVDF will give way to CMC very soon

Among all binders like 1) PVDF-polyvinylidene fluoride, 2) CMC - carboxymethyl cellulose, and 3) SBR- styrene-butadiene rubber, PVDF is the costliest and heaviest binder. The requirement of water-based binders like CMC and SBR is less as compared to PVDF. However, the price of PVDF is higher compared to CMC and SBR. Gujarat Fluorochemicals Ltd (GFL) imports R-142B and makes PVDF from the same. However, PVDF spreads over R-142B have collapsed in Nov 2021 to Rs14.1/kg as compared to Rs551.4/kg in Oct 2021. This may be negative for GFL in the short-term, apart from the structural replacement risk of PVDF with CMC. Because of frequent breakage, PVDF is increasingly becoming a menace in solar batteries and may have a short lifespan there as well. ([Link](#))

Li-ion battery electrolytes – LiPF6 is front runner

LiPF6 is the most widely used electrolyte in Li-ion batteries. Raw materials for LiPF6 are lithium carbonate, sodium hydroxide, phosphorous pentachloride, acetonitrile and anhydrous hydrogen fluoride. Though the chemical reaction to make LiPF6 is quite simple, controlling it is tricky as the reaction can be violent. The basic raw material cost to manufacture LiPF6 has remained around US\$12,000/t. Based on our assumptions mentioned in this report, we believe that the potential market of LiPF6 for 50GWh of Li-ion battery capacity in India is around 84,000t. Multiple Indian companies have developed fluorine skills such as GFL, Navin Fluorine Ltd, SRF Ltd, etc. Any one of them can become a winner in the electrolyte race or a new name can emerge, but it's too early to predict.

Figure 1: India's PLI scheme for Li-ion battery is one of the most attractive in terms of incentives and timeline



SOURCES: INCRED RESEARCH, PLI SCHEME FOR BATTERY: OPINION: HOW PLI SCHEME FOR ADVANCED CHEMISTRIES WILL REMOVE STORAGE BOTTLENECK FOR E-MOBILITY ECOSYSTEM, AUTO NEWS, ET AUTO (INDIATIMES.COM)

Li-ion battery – Deep dive into its chemicals

Our first report on this topic was a primer on Li-ion. We also covered India's PLI scheme and how it can help create an ecosystem for domestic companies. In this report, we will focus on only the chemical opportunities for Indian companies. We will also try to map the existing skills of companies and their complementarity in developing the requisite skills for making chemicals for Li-ion batteries. We have covered four parts of a Li-ion battery in separate sections and potential skillset match with Indian companies. The four parts are 1) cathode, 2) anode, 3) binder, and 4) electrolyte.

Li-ion battery anode - graphite is the king

Most lithium-ion batteries use graphite powder as anode material. Graphite material is either synthetically produced (artificial graphite) or mined from the ground (natural graphite), and then heavily processed before being baked onto a copper foil to serve as anode. Graphite anode meets the voltage requirement of most common Li-ion cathode, are relatively affordable, extremely light, porous and durable.

Anode material requirement is fulfilled by spherical graphite➤

To be suitable for lithium-ion battery manufacturing, anode material should meet the following requirements:

1. Excellent porosity and conductivity.
2. Good durability and light weight.
3. Low cost.
4. Voltage match with preferred cathode.

Graphite is mined in flakes and milled to form a spherical shape➤

Spherical graphite is manufactured from flake graphite concentrate produced by graphite mines and is the battery anode material used in lithium-ion batteries .

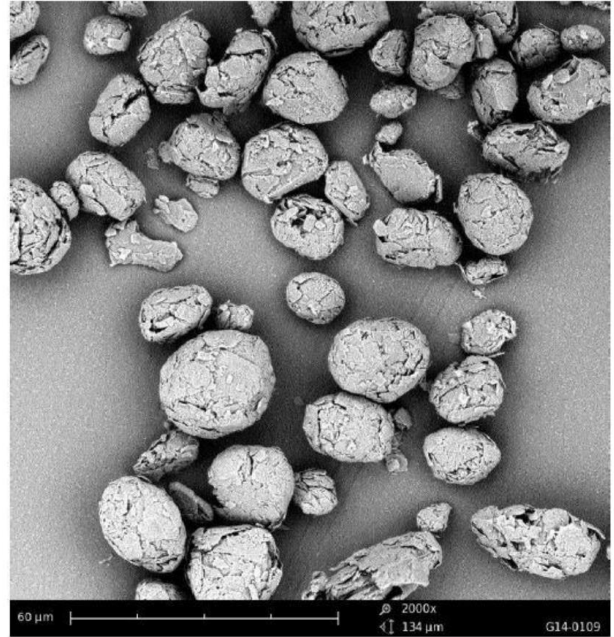
1. The first part of the process consists of micronizing, rounding and purifying flake graphite to produce uncoated material.
2. Micronizing involves reducing the flakes in size to approximately 10 to 15 microns.
3. This is done in a step-by-step process as the flakes move through a cascading series of jet mills.
4. They are crushed by impact, collision, friction and shearing using a high-speed rotating plate and classified to separate the target size range, which then goes into the next mill.
5. Once the final target size has been achieved, the micronized graphite is then "rounded" which essentially involves rolling the flakes up like a snowball in similar mills (with different "beaters" on the plates), again using a cascading, step-by-step approach.
6. The final size varies between 5 and 20 microns, depending on the application.

Figure 2: Graphite flakes from natural mines



SOURCES: INCRED RESEARCH, NORTHERN GRAPHITE | THE FUTURE OF NORTH AMERICAN GRAPHITE PRODUCTION

Figure 3: Spherical graphite material after production process



SOURCES: INCRED RESEARCH, NORTHERN GRAPHITE | THE FUTURE OF NORTH AMERICAN GRAPHITE PRODUCTION

Why a round shape is necessary for anode? ➤

1. The round shape is necessary for the spheres to be spread thinly and uniformly during the high-speed LiB manufacturing process.
2. The round shape also results in better packing, i.e. a higher density in the battery, more active sites for lithium to intercalate into graphite (better rate capacity) and a longer life.

Can spherical graphite particles be formed by a synthetic process? Yes, they can be made ➤

Synthetic spherical graphite is made from needle coke which is produced in refineries. While natural graphite production is limited, several refineries in India make needle coke availability relatively easy.

Anode requirement for a 50GWh Li-ion battery set-up can be~46,500t ➤

Our calculations based on extrapolation of requirement of Tesla Giga factory indicates that India may need around 46,500t of anode material. As of now, the cost of anode is around US\$8,000/t which indicates Indian market can be worth around Rs30bn.

Who can manufacture Li-ion anode in India?➤

Following companies can manufacture anode, as per information on their websites:

1. Epsilon Carbon- <http://www.epsiloncarbon.com>
2. Himadri Specialty Chemicals Ltd- <http://www.himadri.com/>
3. Tirupati Graphite Limited-[Tirupati Graphite | Fully integrated flake graphite and graphene producer](#)

Li-ion battery binders – PVDF will give way to CMC pretty soon, in our view

Among binders, one can use 1) PVDF-polyvinylidene fluoride 2) CMC - carboxymethyl cellulose, and 3) SBR- styrene-butadiene rubber. PVDF is the costliest and heaviest binder.

Why do we need a binder in Li-ion battery? >

In a lithium battery, a binder performs multiple tasks:

- It must hold the coating particles together and assist in adhering the coating to the metal or separator membrane.
- Aids in film formation.
- Helps form a good particle dispersion in solvent or water. The binder must help the coating disperse to deliver a uniform slurry and discrete particles in the cathode and the anode.
- Remain stable inside the harsh environment of a battery, where multiple reactions happen. The binder should not break apart or get destroyed in this difficult environment.

Binder is essentially of two types - solvent and water-based >

Binder can use either solvent-based or water-based technologies.

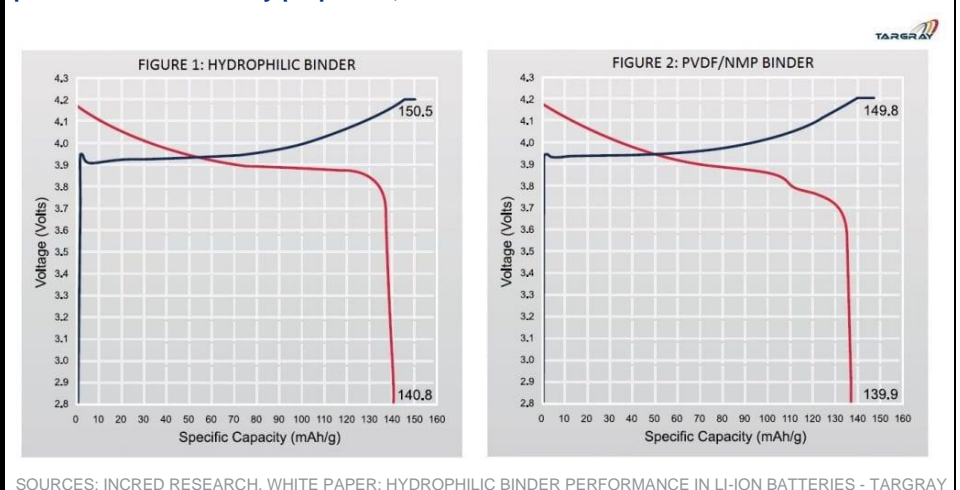
1. Solvent-based binder requires added costs for recovery, collection and environmental compliance.
2. Water-based binder is often preferred for cost and environmental reasons.

Binder is very important for battery performance and its life span >

1. When choosing a binder, there are several factors one should consider.
2. As mentioned above, a binder must perform a number of tasks and do them well—disperse, adhere, bind particles, survive in a harsh environment... plus, it must facilitate the performance of the battery as it is charged and discharged.
3. A battery can slowly lose capacity over cycling and charging/discharging hundreds or thousands of times.
4. A binder plays an important role in maintaining capacity. With a cell phone, a reduction of battery capacity over time could be a nuisance, but with an electric car, it's more than a nuisance. The binder can influence the capacity and stability of a battery, and ultimately battery life.
5. Binder must also have a certain degree of pliability so that it does not crack or develop defects. If there is brittleness, it can create problems during manufacturing or battery assembly during which a coated electrode is wound or wrapped.

PVDF and water-based binder like CMC provide similar battery characteristics >

Figure 4: The Targray white paper shows that PVDF and hydrophilic binders like CMC provide identical battery properties, but CMC comes at a lower cost



However, the requirement of water-based binders like CMC and SBR is less compared to PVDF ➤

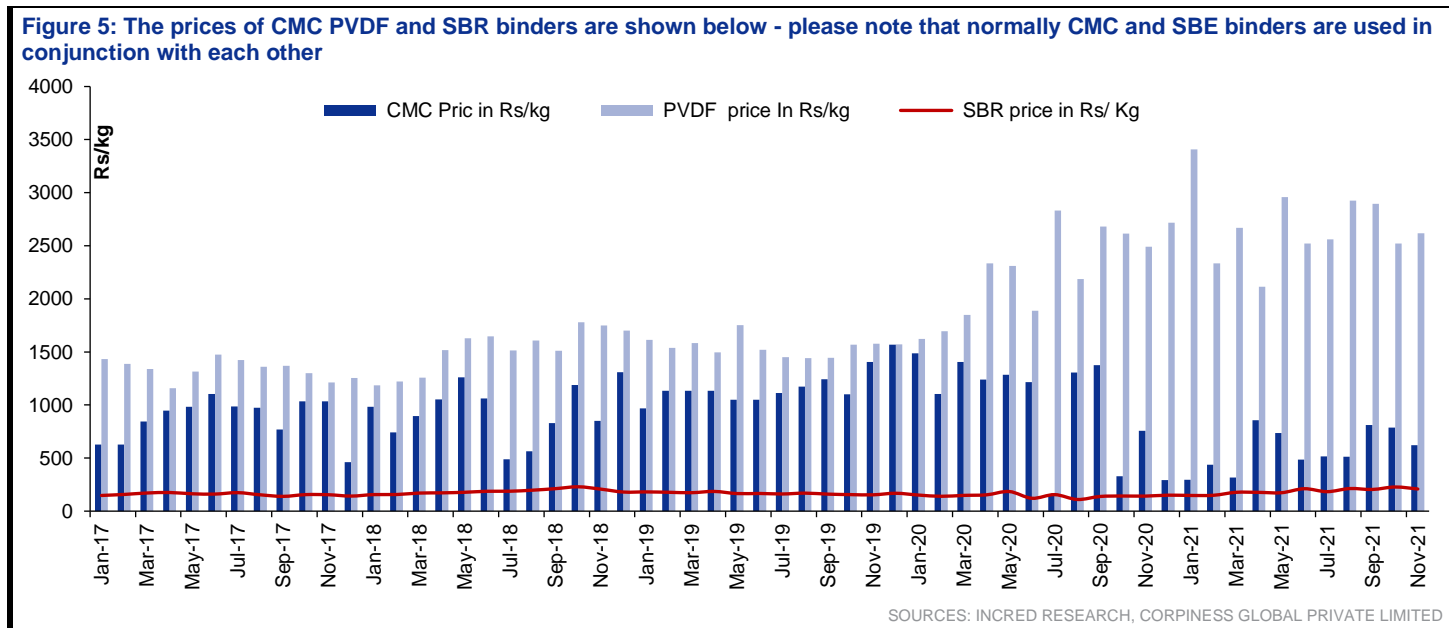
The authors of this report are first to admit that they are not battery scientists, and their knowledge is based on the study of numerous research papers available on the internet. Some of them are listed below:

1. [Polysaccharides for sustainable energy storage – A review - ScienceDirect](#)
2. [Energies | Free Full-Text | A Bottom-Up Approach to Lithium-Ion Battery Cost Modelling with a Focus on Cathode Active Materials \(mdpi.com\)](#)
3. [Suitable binder for Li-ion battery anode produced from rice husk | Scientific Reports \(nature.com\)](#)
4. [Current and future lithium-ion battery manufacturing - ScienceDirect](#)
5. <https://www.frontiersin.org/articles/10.3389/fchem.2021.712225/full>
6. [Built to last: New copolymer binder to extend | EurekAlert!](#)
7. [The 2021 battery technology roadmap \(iop.org\)](#)

Based on studying on the above seven reports and many other research papers we have come to the following conclusions:

1. PVDF requirement is around 8% Wt./Wt. of a Li-ion battery.
2. Requirement of CMC and SBR is around 40% lower compared to PVDF requirement.

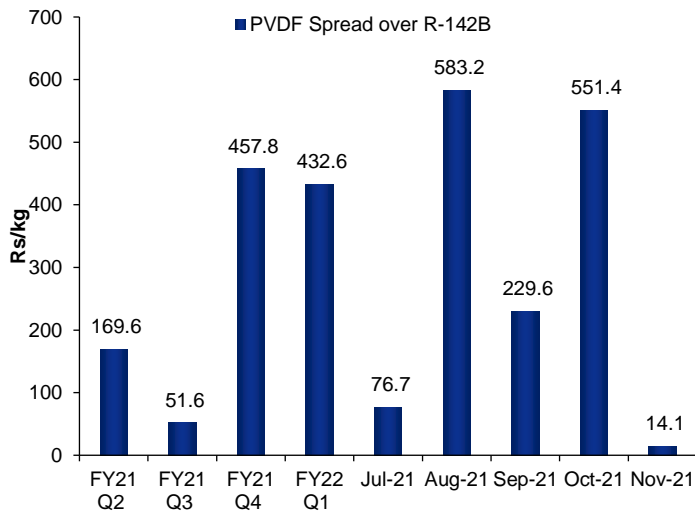
However, the price of PVDF is much higher compared to CMC and SBR binders ➤



GFL (Reduce, TP Rs1,946) makes PVDF from R-142B, but its spread over raw material is falling ➤

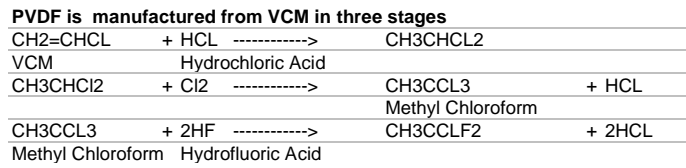
GFL imports R-142B and makes PVDF from the same. GFL has announced that it intends to make R-142B from VCM (vinyl chloride monomer).

Figure 6: PVDF spreads over R-142B have collapsed in Nov 2021



SOURCES: INCRED RESEARCH, CORPINNESS GLOBAL PRIVATE LIMITED

Figure 7: PVDF is manufactured from VCM in three stages - please note that it also needs imported HF acid whose prices are also volatile

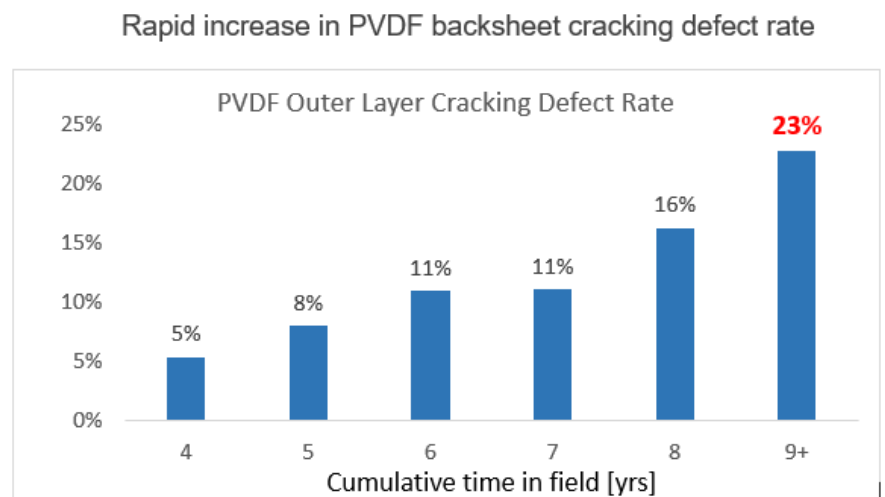


SOURCES: INCRED RESEARCH, COMPANY REPORTS

Can PVDF become big in solar batteries? Unlikely, as per DuPont field tests

DuPont field tests indicate that PVDF cracking rates increase to high as 23% after nine years of service in a solar panel. Normal solar panel life is 25 years and hence, if a part of it or only one-third of the promised life span, then it can create a big problem for solar cell makers. Please read the article here: (<https://www.pv-tech.org/dupont-exposes-rapid-increase-in-pvdf-backsheet-material-failures-used-in-s/>)

Figure 8: PVDF cracking rate is 23% after more than nine years of service



Source: DuPont Global Field Reliability Analysis, 2020

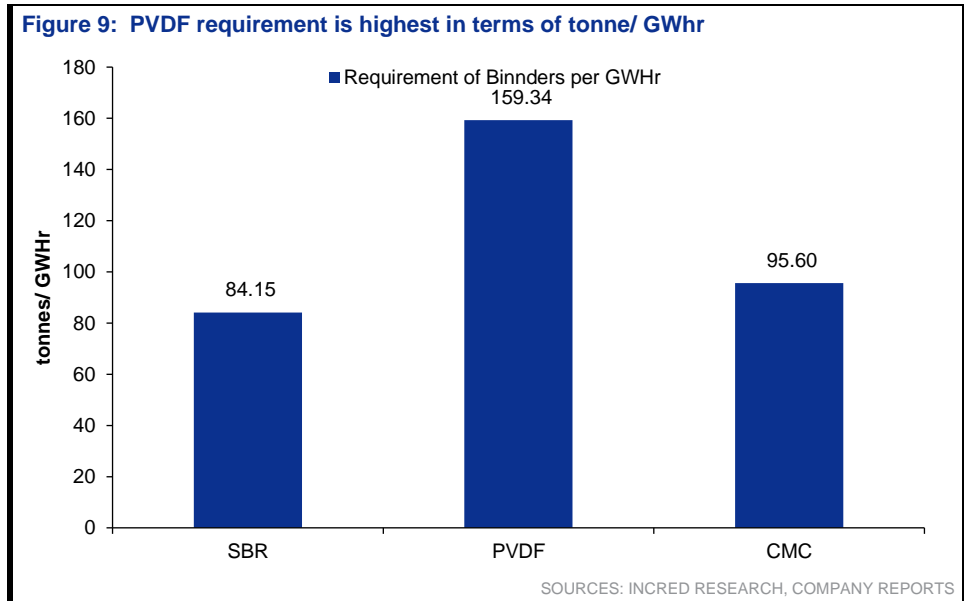
SOURCES: COMPANY REPORTS, INCRED RESEARCH

For 50GWh battery capacity, the requirement of different binders is given below:➤

As of now, CMC and SBR are used in a combination or CMC is used alone many times. We have made the following assumptions for the requirement calculations in general:

1. For 52Ah, 3.7V Li-ion battery, PVDF requirement is around 29gm. Linear extrapolation means 0.16kg of PVDF is needed per KwHr.
2. CMC requirement in Li-ion battery is around 40% lower (in weight) compared to PVDF requirement.

3. Assuming SBR's volume in millilitre will be same as of PVDF, the required SBR weight in 1KwHr battery will be nearly 45% lower.



Li-ion battery electrolytes – LiPF6 is the front runner

LiPF6 is the most widely used electrolyte. While other electrolytes are also being tried, they are very few and far in between.

There are five basic ingredients of LiPF6 ➤

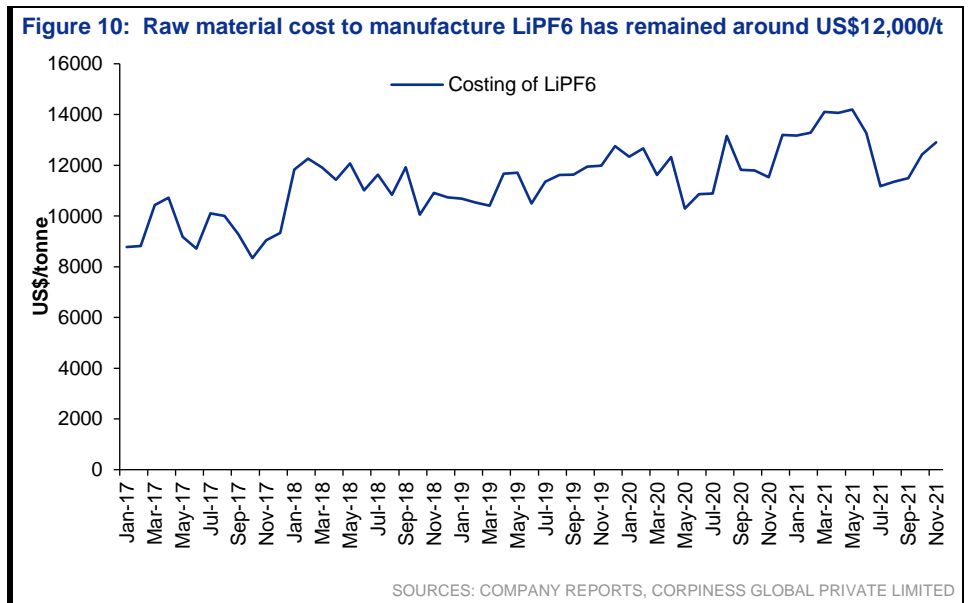
1. Lithium carbonate
2. Sodium hydroxide
3. Phosphorous pentachloride
4. Acetonitrile
5. Anhydrous hydrogen fluoride.

While chemical reaction to make LiPF6 is all over in chemistry books, controlling it is tricky ➤

How to manufacture LiPF6 can be found in 10th standard chemistry textbook. The reaction is quite simple as one has to replace chlorine atoms with fluorine (which are present in anhydrous hydrofluoric acid) but the reaction is violent as:

1. Fluorine, by its very nature, is highly reactive and violent.
2. Even PCl₅ reacts violently with moisture, and if not controlled properly can cause a big explosion.

Basic raw material cost to manufacture LiPF6 has remained around US\$12,000/t ➤



What can be the potential market of LiPF6 for 50GWh of Li-ion battery capacity in India? It is nearly 84,000t or US\$2.1bn ➤

We make the following assumptions for calculation of potential Indian market size for LiPF6:

1. Our sample battery for the data is a 52Ah and 3.7V Li-ion battery.
2. This battery needs around 204ml of LiPF6.
3. Density of LiPF6 is 1500Kg/m³.
4. On this basis, in a 0.18Kwh battery the electrolyte requirement is 0.306kg.
5. We then extrapolate the requirement of electrolyte in a 52Ah and 3.7V Li-ion battery.
6. Hence, for 1GWh, the electrolyte requirement is 1,681t per annum.
7. For 50GWh, the overall requirement is 84,000t.
8. On an average price of US\$20,000/t, this market is worth around US\$2.1bn.

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Description:	Excellent	Very Good	Good	N/A	N/A

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ADVANC – Excellent, Certified, **AMATA** – Excellent, Certified, **ANAN** – Excellent, n/a, **AOT** – Excellent, n/a, **AP** – Excellent, Certified, **ASP** – Excellent, n/a, **AWC** – Excellent, Declared, **AU** – Good, n/a, **BAM** – Very Good, Certified, **BAY** – Excellent, Certified, **BBL** – Excellent, Certified, **BCH** – Very Good, Certified, **BCP** - Excellent, Certified, **BCPG** – Excellent, Certified, **BDMS** – Excellent, n/a, **BEAUTY** – Good, n/a, **BEM** – Excellent, n/a, **BH** - Good, n/a, **BJC** – Very Good, n/a, **BLA** – Very Good, Certified, **BTS** - Excellent, Certified, **CBG** – Very Good, n/a, **CGET** – n/a, n/a, **CENDEL** – Excellent, Certified, **CHAYO** – Very Good, n/a, **CHG** – Very Good, n/a, **CK** – Excellent, n/a, **COM7** – Excellent, Certified, **CPALL** – Excellent, Certified, **CPF** – Excellent, Certified, **CPN** - Excellent, Certified, **CPNREIT** – n/a, n/a, **CRC** – Excellent, Declared, **DELTA** - Excellent, Certified, **DDD** – Excellent, n/a, **DIF** – n/a, n/a, **DOHOME** – Very Good, Declared, **DREIT** – n/a, n/a, **DTAC** – Excellent, Certified, **ECL** – Excellent, Certified, **EGCO** - Excellent, Certified, **EPG** – Excellent, Certified, **ERW** – Very Good, Certified, **GFPT** - Excellent, Certified, **GGC** – Excellent, Certified, **GLOBAL** – Excellent, n/a, **HANA** - Excellent, Certified, **HMPRO** - Excellent, Certified, **HUMAN** – Good, n/a, **ICHI** – Excellent, Certified, **III** – Excellent, Declared, **INTUCH** - Excellent, Certified, **IRPC** – Excellent, Certified, **ITD** – Very Good, n/a, **IVL** - Excellent, Certified, **JASIF** – n/a, n/a, **JKN** – n/a, Certified, **JMT** – Very Good, n/a, **KBANK** - Excellent, Certified, **KCE** - Excellent, Certified, **KEX** – Very Good, Declared, **KKP** – Excellent, Certified, **KSL** – Excellent, Certified, **KTB** - Excellent, Certified, **KTC** – Excellent, Certified, **LH** - Excellent, n/a, **LPN** – Excellent, Certified, **M** – Very Good, Certified, **MAKRO** – Excellent, Certified, **MC** – Excellent, Certified, **MEGA** – Very Good, n/a, **MINT** - Excellent, Certified, **MTC** – Excellent, Certified, **NETBAY** – Very Good, n/a, **NRF** – Very Good, Declared, **OR** – Excellent, n/a, **ORI** – Excellent, Certified, **OSP** – Excellent, n/a, **PLANB** – Excellent, Certified, **PRINC** – Very Good, Certified, **PR9** – Excellent, Declared, **PSH** – Excellent, Certified, **PTT** - Excellent, Certified, **PTTEP** - Excellent, n/a, **PTTGC** - Excellent, Certified, **QH** – Excellent, Certified, **RAM** – n/a, n/a, **RBF** – Very Good, n/a, **RS** – Excellent, Declared, **RSP** – Good, n/a, **S** – Excellent, n/a, **SAK** – Very Good, Declared, **SAPPE** – Very Good, Certified, **SAWAD** – Very Good, n/a, **SCB** - Excellent, Certified, **SCC** – Excellent, Certified, **SCGP** – Excellent, Declared, **SECURE** – n/a, n/a, **SHR** – Excellent, n/a, **SIRI** – Excellent, Certified, **SPA** – Very Good, n/a, **SPALI** - Excellent, Certified, **SPRC** – Excellent, Certified, **SSP** - Good, Certified, **STEC** – Excellent, n/a, **SVI** – Excellent, Certified, **SYNEX** – Very Good, Certified, **TCAP** – Excellent, Certified, **THANI** – Excellent, Certified, **TIDLOR** – n/a, Certified, **TISCO** - Excellent, Certified, **TKN** – Very Good, n/a, **TOP** - Excellent, Certified, **TRUE** – Excellent, Certified, **TTB** - Excellent, Certified, **TU** – Excellent, Certified, **TVO** – Excellent, Certified, **VGI** – Excellent, Certified, **WHA** – Excellent, Certified, **WHART** – n/a, n/a, **WICE** – Excellent, Certified, **WORK** – Good, n/a.

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Definition:

Add	The stock's total return is expected to exceed 10% over the next 12 months.
Hold	The stock's total return is expected to be between 0% and positive 10% over the next 12 months.
Reduce	The stock's total return is expected to fall below 0% or more over the next 12 months.

The total expected return of a stock is defined as the sum of the: (i) percentage difference between the target price and the current price and (ii) the forward net dividend yields of the stock. Stock price targets have an investment horizon of 12 months.

Sector Ratings

Definition:

Overweight	An Overweight rating means stocks in the sector have, on a market cap-weighted basis, a positive absolute recommendation.
Neutral	A Neutral rating means stocks in the sector have, on a market cap-weighted basis, a neutral absolute recommendation.
Underweight	An Underweight rating means stocks in the sector have, on a market cap-weighted basis, a negative absolute recommendation.

Country Ratings

Definition:

Overweight	An Overweight rating means investors should be positioned with an above-market weight in this country relative to benchmark.
Neutral	A Neutral rating means investors should be positioned with a neutral weight in this country relative to benchmark.
Underweight	An Underweight rating means investors should be positioned with a below-market weight in this country relative to benchmark.