India

**Underweight** *(no change)*

### Highlighted Companies

**Aarti Industries**

**REDUCE, TP Rs435,** Rs511 close

Aarti Industries has been heavily dependent on MMA export volume for growth. However, as UAWE has reduced MMA buying dramatically, Aarti Industries' exports are trending downwards. We maintain our REDUCE rating on the stock.

**Clean Science and Technology**

**REDUCE, TP Rs665,** Rs1527 close

The company's MEHQ business is under stress (spreads are at an eight-year low) and HALS' margins are even lower. As a result, it is margin dilutive. On the other hand, MEHQ is also facing margin pressure because of rising domestic competition and declining exports.

**Jubilant Ingrevia Ltd**

**REDUCE, TP Rs364,** Rs717 close

Jubilant Ingrevia faces several headwinds such as the overall demand for its products falling, product spreads at mean levels, a likely rise in raw material prices, and a risky new product portfolio. We retain our REDUCE rating on the stock.

### Summary Valuation Metrics

| P/E (x) | Mar24-A | Mar25-F | Mar26-F |
|---|---|---|---|
| Aarti Industries | 42.28 | 35.27 | 29.41 |
| Clean Science and Technology | 66.5 | 60.41 | 61.97 |
| Jubilant Ingrevia Ltd | 53.78 | 49.25 | 39.63 |

| P/BV (x) | Mar24-A | Mar25-F | Mar26-F |
|---|---|---|---|
| Aarti Industries | 3.52 | 3.25 | 2.97 |
| Clean Science and Technology | 14.08 | 11.68 | 10.02 |
| Jubilant Ingrevia Ltd | 3.61 | 3.11 | 2.69 |

| Dividend Yield | Mar24-A | Mar25-F | Mar26-F |
|---|---|---|---|
| Aarti Industries | 0.49% | 0.49% | 0.49% |
| Clean Science and Technology | 0% | 0% | 0% |
| Jubilant Ingrevia Ltd | 0.22% | 0.22% | 0.22% |

# Chemicals - Overall

## Export Chemicals-II

- In this week's edition, we will cover epoxy resins, mono methyl aniline (MMA), para dichloro benzene (PDCB), MEHQ, ethyl acetate and ketene/diketenes.
- Almost all of them are oversupplied commodities. In the case of ketene/ diketene, it's a fallacy that these are specialty chemicals.
- The makers of these chemicals are Clean Science, Atul Industries, & Aarti Industries. Laxmi Organic & Jubilant Ingrevia - our top REDUCE-rated stocks.

### Commodity chemicals - its déjà vu, recall the infra mania of 2005-08?

Every phase of a bull market has its own mania—in the post-Covid world, it was specialty chemicals. Any company just had to announce that they were making specialty chemicals, and the P/E would expand—no verification needed. We vividly remember the infrastructure mania of 2005–08, when an "expert" came on TV and proudly announced that a company only needed to announce a project, and the market would add its NPV to its market cap. No risk of execution, no clarity on where the money would come from, and no questions of governance. Think of companies like Lanco, Punj Lloyd, JP Infra, and many others who cashed in on this mania, made impressive analyst presentations, became market darlings, and no longer exist. The same thing will happen this time with commodity chemical manufacturers. Many of these commodity chemical manufacturers have not posted any returns in the last three years, but they could lose 50–60% of their market cap, especially in the case of Clean Science and Technology, Jubilant Ingrevia, and Laxmi Organic Industries.

### Keep clear of companies like Clean Science, Laxmi, Aarti & Jubilant

MEHQ, PDCB, ketene/diketene, ethyl acetate, and monomethyl aniline are low-grade commodity chemicals. Their recent spreads over raw material costs were driven purely by supply chain disruption related to China's Covid-19 lockdowns in 2022, not by a China+1 strategy or extraordinary demand. All these commodities are in significant oversupply, with low capital requirement to set up 100kt plants and easily accessible technology. CY22 success of Aarti, Clean, Jubilant and Laxmi was driven by luck as, 1) Aarti's MMA benefitted from exceptional UAE import demand, which is now fading. 2) MEHQ prices surged because China witnessed shutdown, and Clean Science's competitors faced production problems. 3) Aarti's PDCB prices were also driven by supply chain problems 4) Laxmi and Jubilant's Ethyl acetate & acetic anhydride also benefited from the supply chain crisis. Another prevalent trend in the chemical market is the positive reaction in stock prices on contract manufacturing order receipts. However, these are low-value manufacturing agreements. Unlike in the pharma sector, where companies add value and protect intellectual property or IP, contracts to produce generic agrochemicals like pyridine or mancozeb are often mere supply MoUs. Although some companies may sign 'take-or-pay' contracts, Indian chemical companies rarely enforce them, fearing harm to customer relationship. As a result, Indian companies not only carry the inventory and capital expenditure risk but also the risk of over-reliance on these contracts.

**Figure 1: InCred chemicals sector universe's EPS estimates and ratings**

| Company Name | Rating | Target Price (Rs) | INCRED's Estimates | | | Consensus Estimates | |
|---|---|---|---|---|---|---|---|
| | | | FY24 | FY25F | FY26F | FY25F | FY26F |
| Aarti Industries | REDUCE | 435 | 12.1 | 14.5 | 17.4 | 16.4 | 22.7 |
| Ami Organics | REDUCE | 714 | 21.9 | 22.8 | 24.1 | 29.3 | 46.3 |
| Astec Lifesciences | REDUCE | 778 | -12.1 | -4.8 | 7.8 | 4.2 | 25.6 |
| Clean Science and Technology | REDUCE | 665 | 23.0 | 25.3 | 24.6 | 28.0 | 36.4 |
| Deepak Nitrite | REDUCE | 1,514 | 57.5 | 55.7 | 59.3 | 70.7 | 90.7 |
| Gujarat Fluorochemicals | REDUCE | 1,946 | 39.6 | 48.3 | 64.5 | 66.3 | 99.4 |
| Jubilant Ingrevia | REDUCE | 364 | 13.3 | 14.6 | 18.1 | 16.0 | 21.6 |
| Laxmi Organic Industries | REDUCE | 168 | 3.9 | 5.1 | 6.3 | 5.7 | 7.2 |
| Meghmani Finechem | HOLD | 892 | 44.2 | 55.7 | 63.3 | 77.6 | 97.4 |
| PI Industries | REDUCE | 3,091 | 114.9 | 118.2 | 129.1 | 111.5 | 129.3 |
| SRF | REDUCE | 1,540 | 45.1 | 46.5 | 52.3 | 43.4 | 60.9 |
| UPL | ADD | 694 | -36.3 | 6.7 | 34.7 | 20.1 | 40.0 |
| Vinati Organics | ADD | 2,772 | 31.2 | 42.0 | 50.7 | 38.9 | 50.4 |

SOURCE: INCRED RESEARCH, COMPANY REPORTS

### Research Analyst(s)

**Satish KUMAR**
**T** (91) 22 4161 1562
**E** satish.kumar@incredresearch.com

**Abbas PUNJANI**
**T** (91) 22 4161 1598
**E** abbas.punjani@incredresearch.com

# Export Chemicals-II

Every phase of a bull market has its own mania—in the post-Covid world, it was specialty chemicals. Any company just had to announce that they were making specialty chemicals, and the P/E would expand—no verification needed. We vividly remember the infrastructure mania of 2005–08, when an “expert” came on TV and proudly announced that a company only needed to announce a project, and the market would add its NPV to the market cap. No risk of execution, no clarity on where the money would come from, and no questions of governance. Think of companies like Lanco, Punj Lloyd, JP Infra, and many others who cashed in on this mania, made impressive analyst presentations, became market darlings, and no longer exist. The same thing will happen this time with commodity chemical manufacturers.

## MMA - a commodity chemical’s earnings once got 70 P/E

### What is mono methyl aniline ➤

Mono methyl aniline (MMA) is an organic compound derived from aniline.

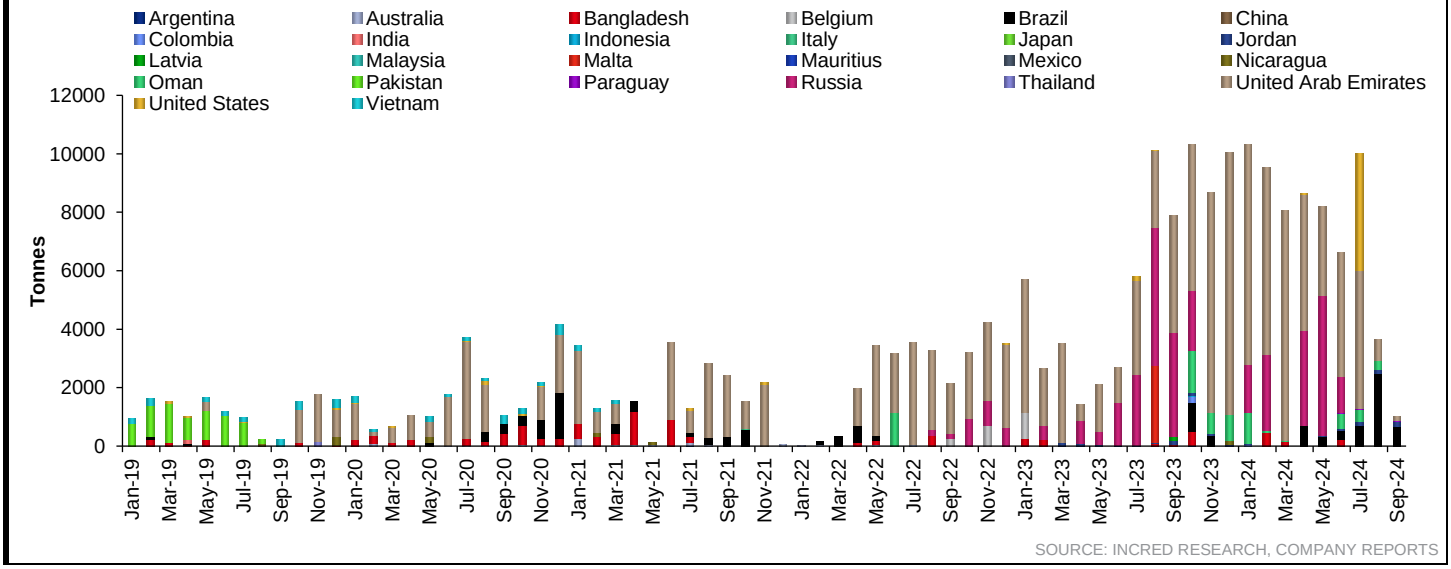
### MMA has various uses ➤

Mono methyl aniline, also known as N-methylaniline (NMA) or MMA, has several industrial applications. Here's a breakdown of its key uses:

1. **Fuel additive:** The most prominent use of MMA in refineries is as a fuel additive. It acts as an anti-knock agent, boosting the octane rating of gasoline. This improved octane rating enhances the fuel's resistance to knocking, preventing premature ignition that can damage engines.
2. **Industrial intermediate:** MMA serves as a building block in the production of various chemicals. It's a crucial intermediate for synthesizing 1) dyes used for colouring textiles, plastics, and other materials, and 2) in agrochemicals such as pesticides, herbicides, and fungicides used in agriculture.
3. **Solvent:** MMA finds its use as a latent solvent, dissolving other materials. It can also act as a coupling solvent, facilitating chemical reactions between different compounds.

### UAE is one the biggest importers of MMA ➤

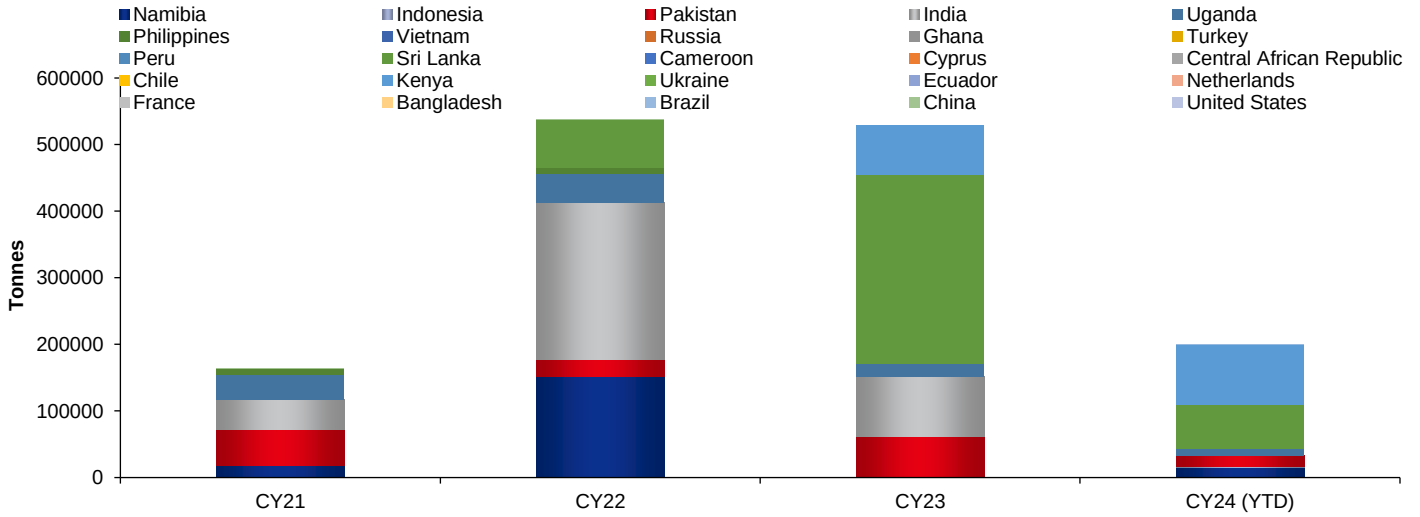
**Figure 2: The UAE has been one of the largest importers of MMA in the global market, but its imports have now collapsed**




SOURCE: INCRED RESEARCH, COMPANY REPORTS

## UAE's imports have coincided with higher gasoline exports from the country ➤

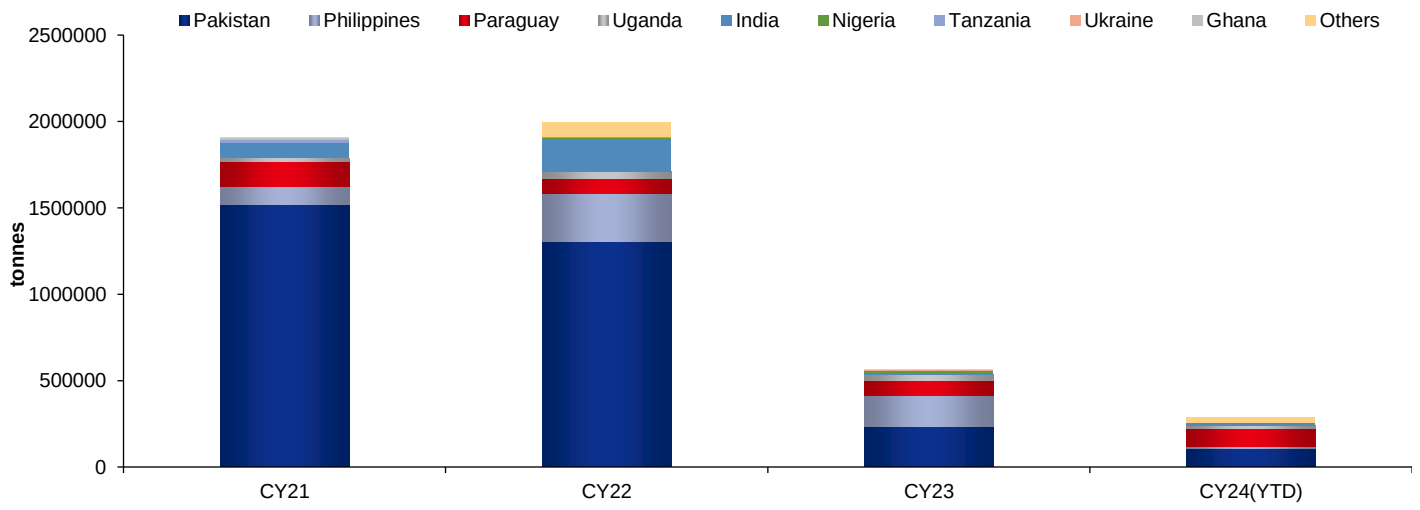
**Figure 3: UAE's gasoline exports have collapsed…**




SOURCE: INCRED RESEARCH, COMPANY REPORTS

## Gasoline was profitable in 2022, but since then its spreads have collapsed…➤

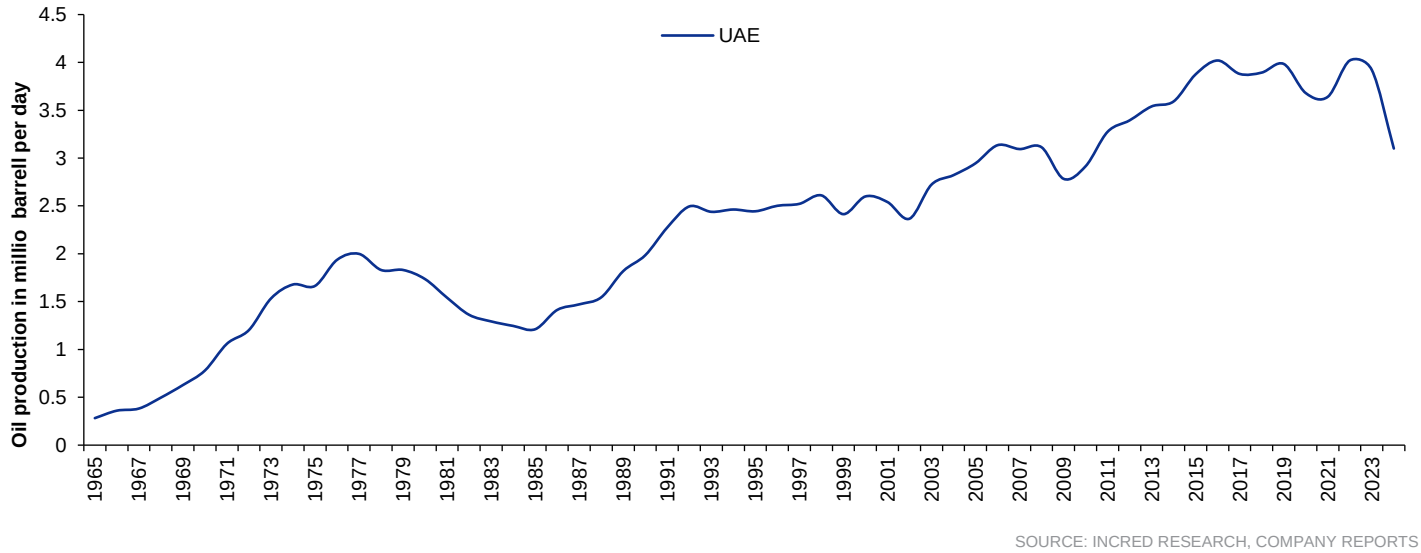
**Figure 4: …and even diesel exports have collapsed from the country as the UAE is refining less crude oil**




SOURCE: INCRED RESEARCH, COMPANY REPORTS

## …as the UAE crude oil production is trending downwards

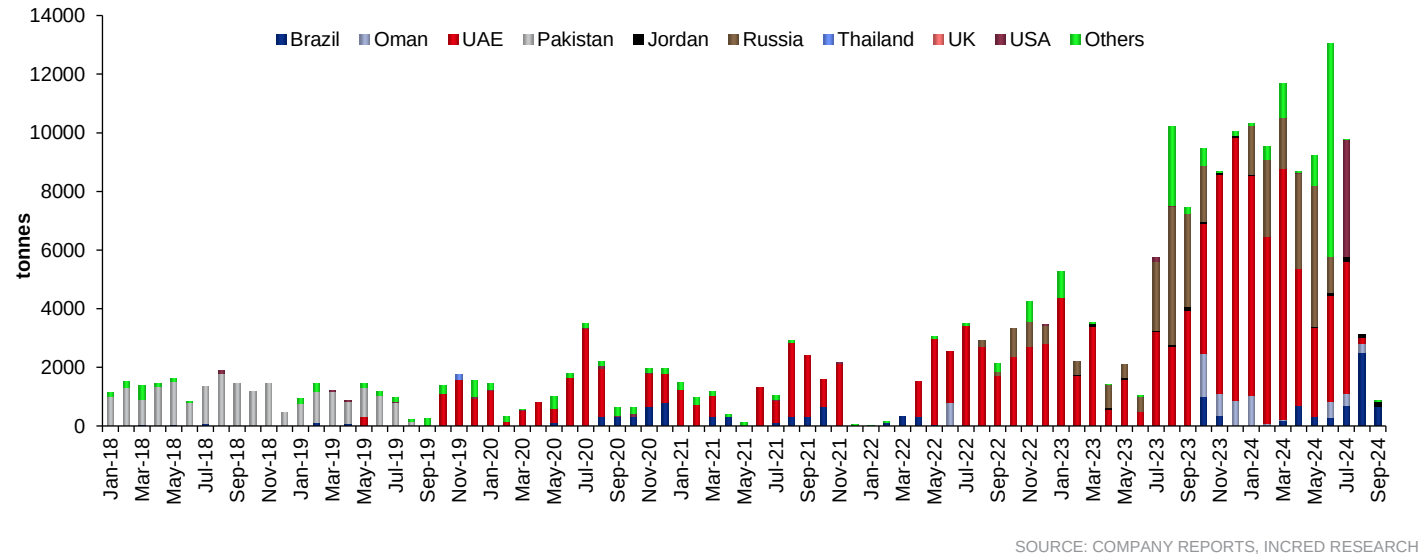
**Figure 5: In line with the OPEC directive to manage the decline in demand, the UAE has been cutting its crude oil production**




SOURCE: INCRED RESEARCH, COMPANY REPORTS

## The MMA export winter will continue for some time

**Figure 6: Aarti Industries' MMA exports have collapsed**




SOURCE: COMPANY REPORTS, INCRED RESEARCH

# Epoxy resins : Demand winter to continue; don't bet on Atul Industries' revival - the trade is over

## Epoxy resins have multiple usage ➤

Epoxy resins are versatile polymers widely used in various industries due to their excellent mechanical strength, chemical resistance, and adhesive properties. Here are some key applications and usage areas:

1. **Adhesives and Sealants**

   Structural Adhesives: Used in automotive, aerospace, and construction sectors for bonding metals, composites, and plastics due to high tensile strength and durability.

   Sealants: Applied in pipelines, oil and gas rigs, and machinery to prevent leaks and ensure durability.

2. **Coatings**

   Protective Coatings: Epoxy coatings provide corrosion resistance in pipelines, tanks, and marine structures.

   Industrial Floor Coatings: Widely used for flooring in factories, warehouses, hospitals, and commercial spaces due to their ability to withstand heavy loads and resist chemicals.

   Paints: Used in anti-corrosive paints for ships, oil rigs, and bridges. Also applied in decorative paints and automotive coatings.

3. **Composites**

   Aerospace and Defence: Epoxy resins are a key matrix material in carbon fibre-reinforced composites, which are used to build aircraft components, unmanned aerial vehicles (UAVs), and military gear.

   Automotive: Rising use in lightweight automotive parts to improve fuel efficiency and reduce emissions.

   Wind Energy: Key material in manufacturing wind turbine blades due to their high strength-to-weight ratio.

4. **Electronics and Electrical Applications**

   Encapsulation and Potting Compounds: Protect sensitive electronic components like capacitors, transformers, and circuit boards from moisture, dust, and mechanical stress.

   Printed Circuit Boards (PCBs): Used as an insulating layer in multilayer PCBs.

   Insulators: Applied in transformers and other electrical devices to enhance insulation and prevent short circuits.

5. **Construction and Civil Engineering**

   Grouts and Concrete Repair: Epoxy resins provide high adhesion and chemical resistance, making them ideal for concrete crack filling and structural repairs.

   Structural Composites: Used in reinforced concrete, bridges, and prefabricated sections to enhance load-bearing capacity and flexibility.

   Waterproofing: Used as a waterproofing layer in basements, tunnels, and reservoirs.

6. **Marine and Shipbuilding**

   Marine Coatings: Epoxy-based coatings protect ships from harsh marine environments, corrosion, and chemical exposure.

   Hull Construction: Essential in the construction and repair of boats and ships due to their strong adhesive properties and water resistance.

7. **Consumer Goods**

   Sports Goods: Used in manufacturing equipment like tennis rackets, golf clubs, and bicycles, where high strength and lightweight properties are desired.

Jewellery and Art: Widely used in creating resin-based jewellery, table tops, and decorative pieces.

8. **Medical and Dental Applications**

   Medical Devices: Used for bonding components of medical devices due to biocompatibility and chemical stability.

   Dental Fillings and Implants: Applied in dental restorations due to their strong bonding capabilities.

Epoxy resins' broad range of applications makes them a key industrial material in the modern economy.

## Naturally, demand for resins is closely linked to the global economy ➤

The demand for epoxy resins, or any resin in general, is closely tied to the global economy due to their widespread applications across various industries.

## Resin manufacturing is a simple process and hence, there is no entry barrier ➤

Epoxy resin is primarily manufactured through a chemical reaction between **epichlorohydrin (ECH)** and **bisphenol-A (BPA)**. This reaction results in a polymer with reactive epoxide groups. Here's a detailed breakdown of the manufacturing process:

1. **Raw Materials:**
   - **Epichlorohydrin (ECH):** A chlorinated hydrocarbon that contains an epoxide group.
   - **Bisphenol-A (BPA):** An aromatic organic compound that acts as the base for the polymer backbone.
   - **Catalysts and Additives:** Used to control reaction conditions and improve resin properties.
2. **Reaction Process:**

   The main chemical reaction to produce epoxy resin is called **polycondensation**. Here's how it works:

   a. **Epoxide Formation:**
      - **Epichlorohydrin** contains an epoxide group, which is the active part of the molecule that participates in the reaction.

   b. **Reaction with Bisphenol-A:**
      - The manufacturing process involves a reaction between **ECH and BPA** in the presence of a **catalyst** like sodium hydroxide (NaOH). This reaction forms di glycidyl ether of bisphenol-A (DGEBA), which is the most common epoxy resin type.

   c. **Chemical Reaction:**

      Bisphenol-A + epichlorohydrin→ DGEBA (epoxy resin)

      The resulting resin can be a liquid, semi-solid, or solid, depending on the degree of polymerization and specific formulation.
3. **Neutralization and Washing:**

   The mixture produced from the reaction still contains unreacted chemicals, salts, and by-products. These need to be neutralized using weak acids and washed with water to remove the remaining salts.
4. **Dehydration and Filtration:**

   The washed resin is dehydrated to remove excess water, resulting in a clean product. It is then filtered to remove impurities and unwanted particles.
5. **Molecular Weight Adjustment:**

   The molecular weight of the resin can be adjusted by controlling the reaction conditions or adding a specific amount of BPA or other reactive agents. This

step determines whether the resin will be a low-molecular-weight liquid or a high-molecular-weight solid resin.

6. **Formulation and Blending:**

   To achieve specific properties, other chemicals and additives may be blended with the resin. These include:

   - **Curing agents** (hardeners) such as amines, anhydrides, or polyamides.
   - **Fillers and modifiers** for mechanical strength, heat resistance, and electrical insulation.
   - **Colorants** and **diluents** to adjust viscosity or improve application characteristics.

7. **Final Processing:**

   Once all adjustments are complete, the resin is either:

   - **Packaged** in liquid form.
   - **Cooled** and solidified for storage and shipping if produced in solid form.

8. **Curing (Application-Specific):**

   The final use of epoxy resins typically involves mixing with a curing agent or hardener. During curing, the epoxide groups react with the hardener to form a cross-linked three-dimensional network, resulting in a hardened, durable material.

## Global epoxy resin market is hugely oversupplied ➤

The global epoxy resin market is significantly oversupplied. While demand stands at approximately 4.7mt, the global capacity exceeds 6mt. China alone accounts for around 4mt of capacity

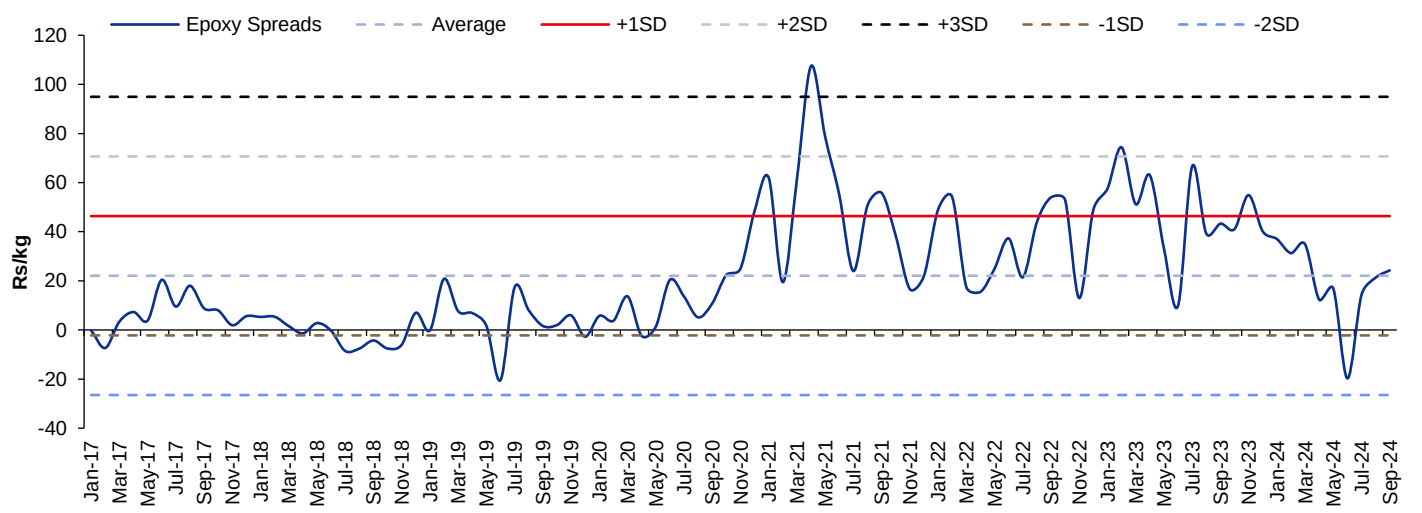
## Resin manufacturers have thin profits and generally cannot pass on raw material cost pressure, and backward integration is impossible for most resin manufacturers ➤

Backward integration in resin manufacturing requires setting up manufacturing plants of epichlorohydrin and bisphenol-A. It is virtually impossible for small resin manufacturers to incur the kind of capex required for bisphenol-A and epichlorohydrin.

1. A 100kt epichlorohydrin (ECH) capacity requires a capital investment of ~US$300m.
2. The capital expenditure (capex) required to set up a bisphenol-A (BPA) production facility typically ranges from US$250m to US$400m per 100,000t of annual capacity.
3. Compare it with epoxy resin manufacturing capacity, which requires as little as US$50-75m per 100Kt (kilo tonne).
4. The technology to manufacture ECH and bisphenol-A is difficult to master, and the raw materials for these chemicals are linked to crude oil prices. With both commodities being highly volatile, achieving margins is challenging unless one has significant economies of scale.

## Resin's spreads over its raw material are highly volatile ➤

**Figure 7: Epoxy resins just might have had inventory stocking-led bounce-back, but this will be short-lived**




SOURCE: INCRED RESEARCH, COMPANY REPORTS

# Ethyl acetate - simplest of commodity chemicals

Ethyl acetate is one of the simplest commodity chemicals, yet its manufacturers command a 60x price-to-earnings (P/E) multiple in the Indian market. While achieving the desired purity is possible, consider this: if whisky and vinegar are mixed, a small quantity of ethyl acetate will settle in the glass.

## Ethyl acetate is a basic commodity with multiple usage ➤

Ethyl acetate is a versatile organic solvent with widespread industrial and commercial applications due to its low toxicity, pleasant odour, and high solvency power. Here are some of its major uses:

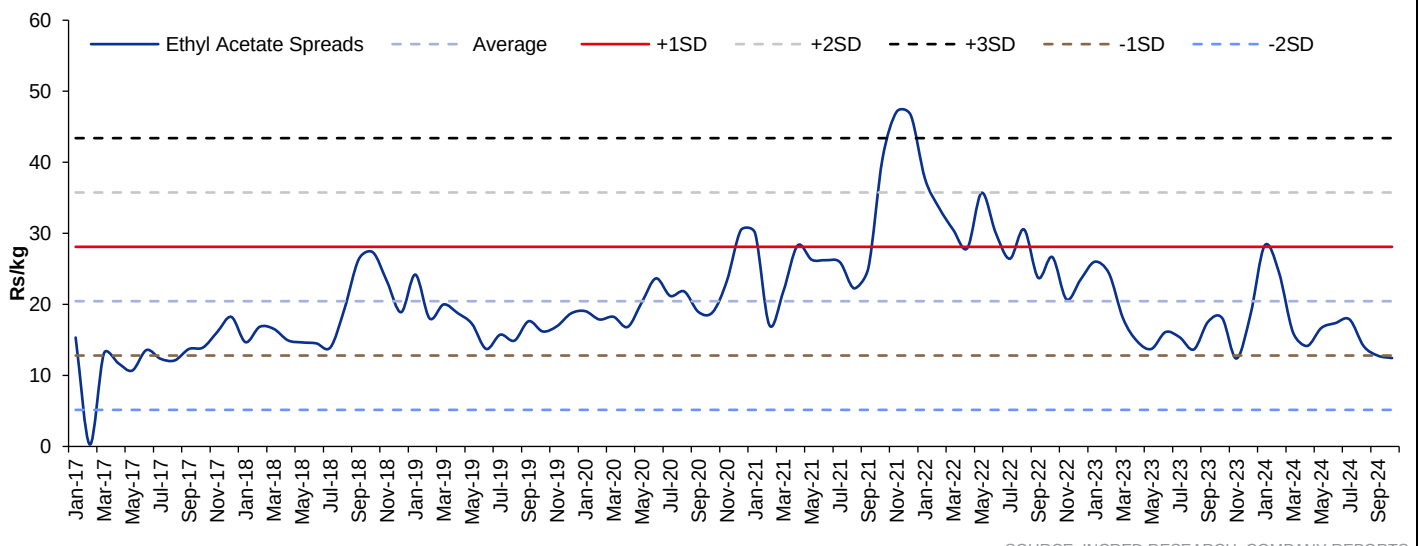
1. **Pharmaceuticals**: Ethyl acetate is commonly used as a solvent for producing pharmaceuticals, especially in drug formulation and extraction processes. Its effectiveness as a solvent makes it ideal for creating highly pure compounds in medications.
2. **Coatings and Paints**: In the paint and coatings industry, ethyl acetate serves as a solvent for lacquer, varnish, and other surface coatings, providing a smooth finish and quick evaporation rate. It's also used in ink formulations for printing applications.
3. **Adhesives**: Due to its solvency properties, ethyl acetate is often used in adhesive production, particularly for flexible packaging materials. Its volatility allows for quick drying, making it ideal for fast-paced manufacturing.
4. **Food and Beverages**: In the food and beverage industry, ethyl acetate is used as a flavour enhancer, providing fruity aromas. It's used in very small amounts in flavouring extracts, spirits, and perfumes.
5. **Laboratory and Chemical Processes**: Ethyl acetate is frequently employed in laboratory settings for chromatography, extractions, and recrystallization processes. It's also used in chemical reactions where it acts as a solvent or a medium for other reactions.
6. **Textile Industry**: It's used in textiles for producing artificial leather and in textile finishing processes to provide a specific texture or finish to fabrics.
7. **Automotive Industry**: Ethyl acetate finds application in the automotive industry in the manufacture of automotive finishes, coatings, and as a degreasing agent.

## Being one of the simplest to manufacture commodity chemical, it's no surprise that ethyl acetate is hugely oversupplied ➤

In 2023, the global ethyl acetate market attained a volume of nearly 4.53mmt or million metric tonnes. China, as usual, has the highest production capacity and its overall capacity stands at 3.5mt. The global capacity of ethyl acetate stands at ~6mt. The ease in manufacturing and shipping makes it one of the easily traded commodity chemicals in the global market.

## Post-Covid-19 pandemic, supply chain challenges led to a significant rise in the spread over raw material but since then it has subsided ➤

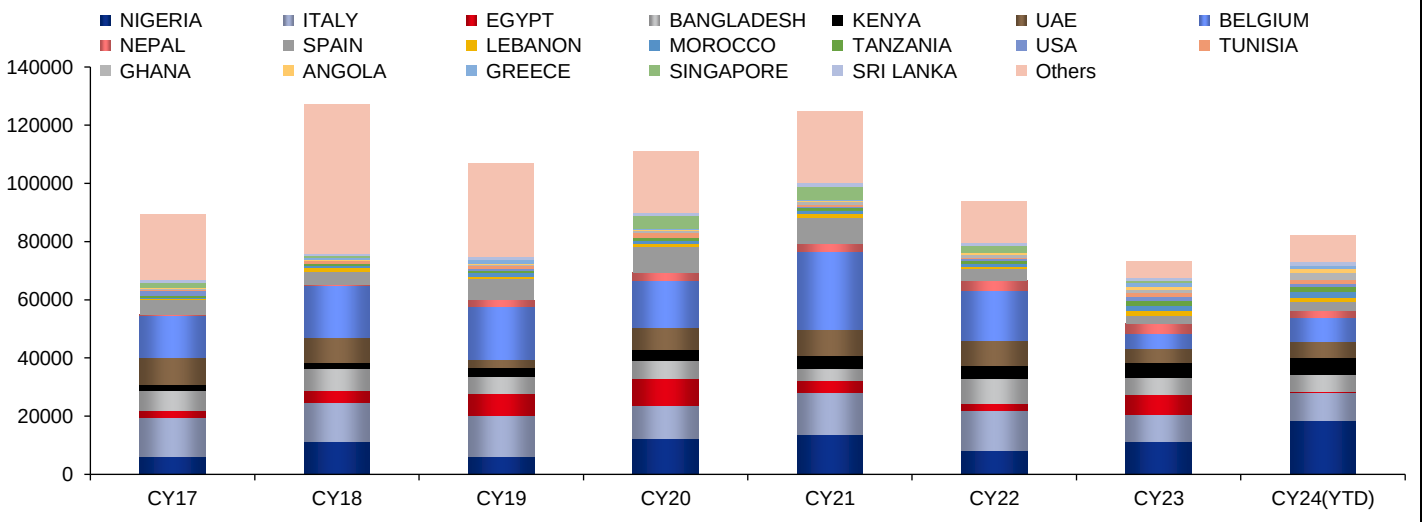
**Figure 8: Ethyl acetate spreads are collapsing**




SOURCE: INCRED RESEARCH, COMPANY REPORTS

## Even Indian market is oversupplied, and India is a big exporter of this chemical ➤

**Figure 9: Indian exports were declining over the years; however, post Covid-19 pandemic, the supply chain crisis led to a big spike in exports, which have subsided over the past few quarters**




SOURCE: INCRED RESEARCH, COMPANY REPORTS

## We haven't seen any premium for green ethyl acetate till now ➤

Green ethyl acetate refers to ethyl acetate produced through environmentally friendly, sustainable methods, often minimizing fossil fuel use and reducing carbon emissions. Traditional production of ethyl acetate usually involves petrochemical processes, but green ethyl acetate aims to use renewable sources and cleaner technologies.

In India, companies are using ethanol produced from sugarcane to produce green ethyl acetate. Ethyl acetate can be produced from bio-based ethanol derived from agricultural biomass, such as sugarcane, corn, or other crop residues. Through fermentation, ethanol is first produced, and then esterified with acetic acid to produce ethyl acetate.

While in theory green ethyl acetate can attract a premium, we haven't seen that happening practically. Please take companies' claims of fetching a premium for green ethyl acetate with a big pinch of salt.

## MEHQ is the most hyped chemical after $LiPF_6$

While $LiPF_6$ is the most hyped chemical in the Indian market, MEHQ is a close second. The global MEHQ market is no more than 8,000 to 9,000t, with most Indian companies exporting this chemical to China.

### MEHQ is a niche chemical with very small use cases ➤

MEHQ (4-methoxyphenol), or p-methoxyphenol, is commonly used as a stabilizer, inhibitor, and antioxidant in various industrial applications, helping to control unwanted polymerization and oxidation. Key uses include:

1. **Polymerization Inhibition**: MEHQ is widely used in the manufacture of monomers like acrylics and methacrylates, where it acts as a polymerization inhibitor to prevent the monomers from premature polymerization. This is critical during storage, transportation, and processing of monomers.
2. **Cosmetics and Personal Care**: It serves as an antioxidant in cosmetic formulations to maintain stability, especially in skincare products. MEHQ helps in protecting against oxidation that could degrade the product quality and reduce shelf life.
3. **Polyurethane Foam Manufacturing**: In the production of polyurethane foams, MEHQ prevents the reactive ingredients from polymerizing too quickly, providing better control over the process and the end properties of the foam.
4. **Pharmaceutical Industry**: MEHQ is used in pharmaceutical intermediates to stabilize certain chemical reactions. Its antioxidant properties help in preserving the efficacy and stability of active pharmaceutical ingredients (APIs).
5. **Industrial Coatings and Adhesives**: It is used in the production of paints, coatings, and adhesives to prevent unwanted polymerization and prolong shelf life. This ensures the materials maintain their desired properties and performance.
6. **Acrylic Emulsions**: MEHQ also serves as an inhibitor in acrylic emulsions and other water-based resins, which are essential for producing coatings, textiles, and paper products.

Please note that primarily MEHQ is used as a polymerization inhibitor and its other usage is very small.

### MEHQ can be manufactured by two different methods: 1) Anisole route, and 2) HQ route ➤

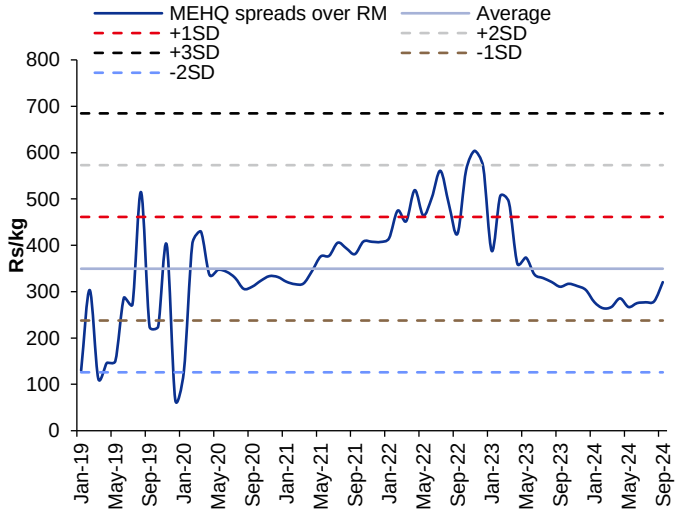
MEHQ can be manufactured through two main processes:

1. **Anisole Route**: In this method, MEHQ is synthesized, starting from anisole. This process involves the selective hydroxylation of anisole to yield MEHQ, leveraging anisole's reactivity and availability as a starting material. This route is generally favoured due to anisole's lower cost and ease of handling. However, it may involve complex reaction conditions, depending on the desired purity and yield.
2. **Hydroquinone (HQ) Route**: This route starts with hydroquinone as the precursor, which undergoes methylation to produce MEHQ. The HQ route can be efficient and provides a relatively straightforward pathway to MEHQ. However, hydroquinone is sensitive to oxidation, so handling conditions must ensure the stability of the intermediate and final product.

### The backward-integrated HQ-based MEHQ production cost is lower than that of anisole-based MEHQ production cost ➤

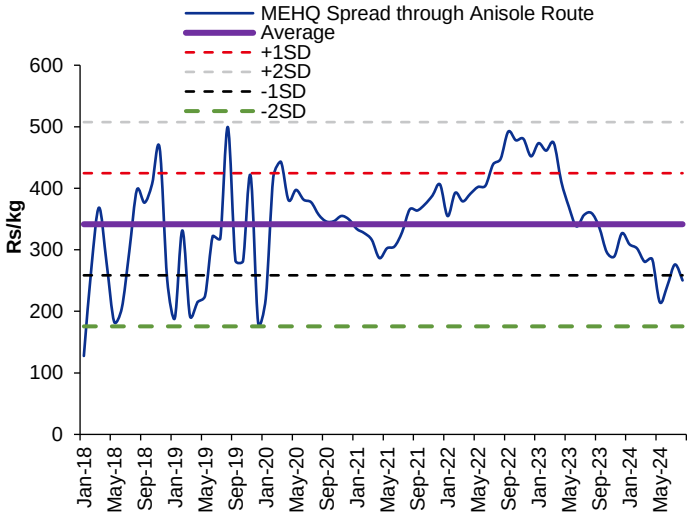
A backward-integrated MEHQ production process, which has captive HQ as an input, has a lower cost of production vis-a-vis the anisole route.

**Figure 10: MEHQ's spread over raw material (through the captive HQ route is around Rs350/ kg)**




SOURCE: INCRED RESEARCH, COMPANY REPORTS

**Figure 11: However, the spread of MEHQ through the anisole route is lower than that of the captive HQ route**

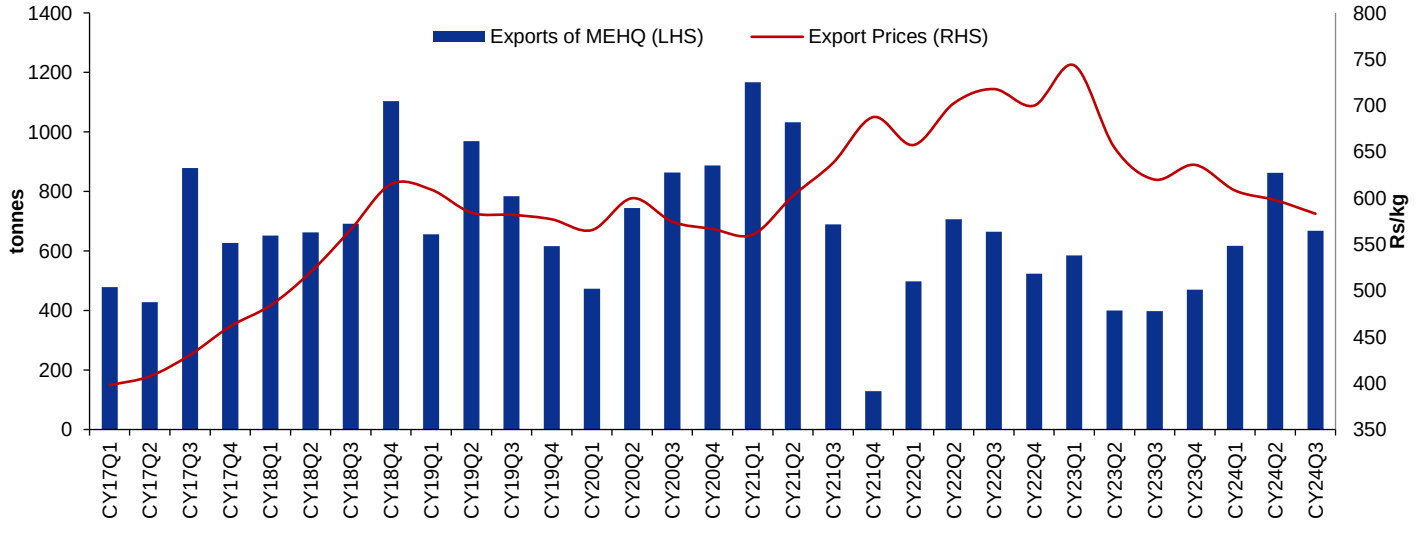



SOURCE: INCRED RESEARCH, COMPANY REPORTS

## Indian exports of MEHQ are coming down, which is exerting pressure on its prices ➤

There are multiple manufacturers of MEHQ in India, and all of them export to the same destination—China. Additionally, China has its own producers, creating competition for the product and leading to falling prices.

**Figure 12: Competition and declining exports have ultimately taken its toll and MEHQ prices are falling**

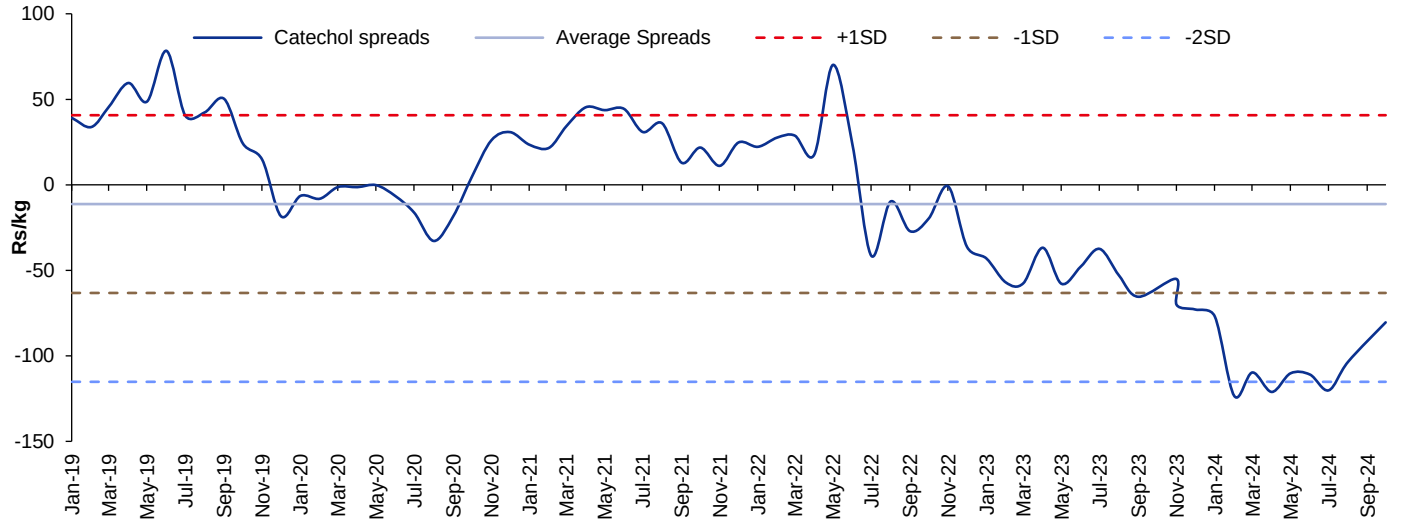



SOURCE: INCRED RESEARCH, COMPANY REPORTS

## The key for HQ-based producers is to use catechol as it is normally sold way below the cost price ➤

During the production process of hydroquinone (HQ), its isomer catechol is also produced. Note that catechol is oversupplied by 15–20kt, and unless the market balances, catechol will continue to be sold well below its cost.

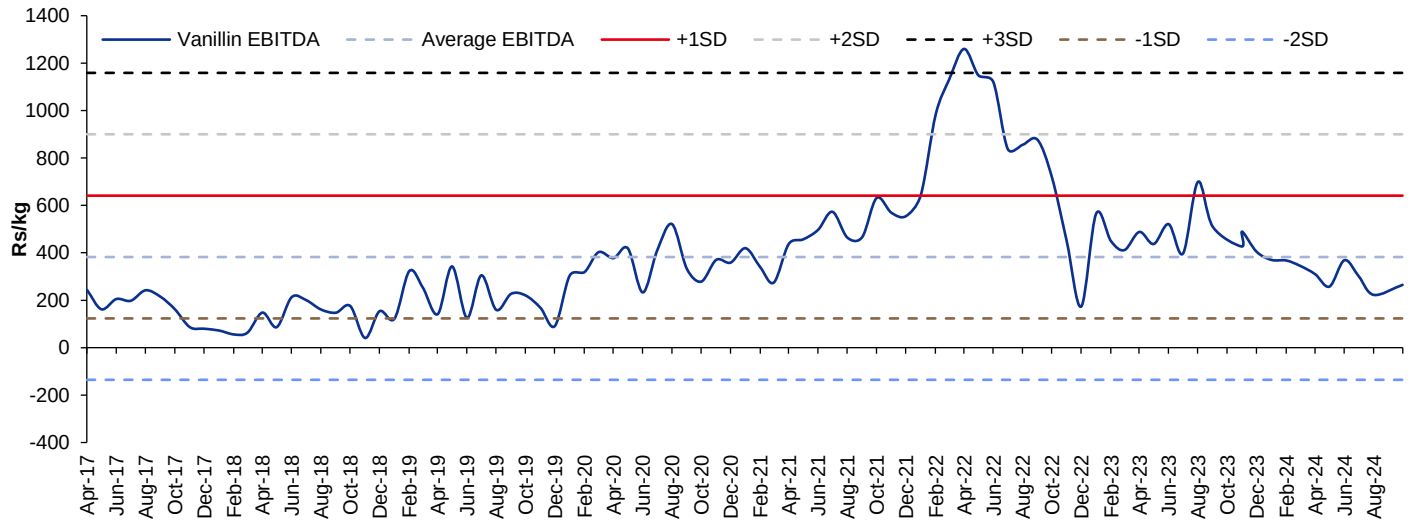
**Figure 13: As evident in the graph below, as of now, catechol sales result in a negative EBITDA of US$1/kg**




SOURCE: INCRED RESEARCH, COMPANY REPORTS

## The only way for catechol to recover its cost is by converting it to vanillin, as vanillin can generate positive EBITDA even after fully covering the cost of catechol ➤

**Figure 14: If catechol is converted into vanillin, it can fully recover the cost of catechol and still generate approximately US$2.5/kg in EBITDA**

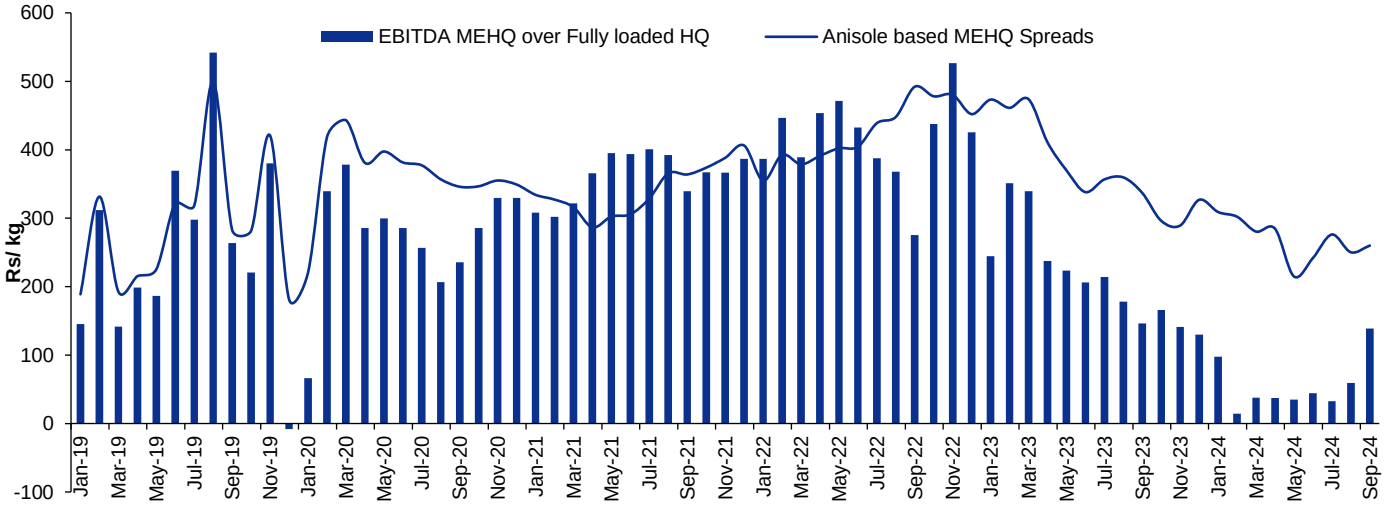



SOURCE: INCRED RESEARCH, COMPANY REPORTS

## Hence, sucessful vanillin production by HQ+ MEHQ producers will lead to a further downward pressure on MEHQ prices ➤

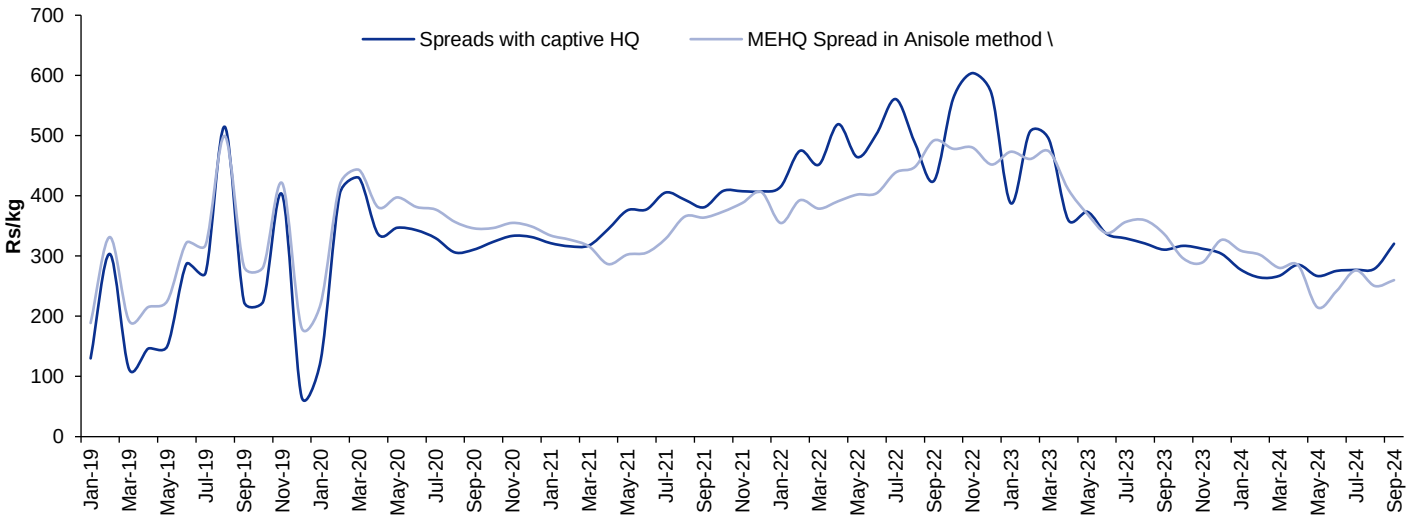
Adjusting for catechol losses, the HQ-based method to produce MEHQ stands no chance against the anisole-based method. However, if HQ-based MEHQ producers are able to make vanillin, then the situation changes completely and then anisole-based MEHQ producers lose their cost competitiveness.

**Figure 15: Assuming HQ-based MEHQ producers cannot produce vanillin, and they will load catechol losses on MEHQ, then their spread is below that of anisole-based producers**




SOURCE: INCRED RESEARCH, COMPANY REPORTS

**Figure 16: However, in a scenario of vanillin production, HQ-based MEHQ producers have an upper hand**




SOURCE: INCRED RESEARCH, COMPANY REPORTS

# PDCB (para dichloro benzene) is the simplest of commodity chemicals but somehow the market saw it as a specialty chemical

## PDCB has multiple usage - major among them is in agrochemicals ➤

Paradichlorobenzene (PDCB) is a chlorinated aromatic compound primarily used in a few applications due to its distinct properties:

1. **Mothballs and Insecticides**: PDCB is commonly used in mothballs as it sublimates (changes from solid to gas) easily, releasing a vapour that repels moths, termites, and other insects. This property makes it valuable for protecting clothing and other stored materials susceptible to insect damage.
2. **Deodorant Blocks**: PDCB is widely used in deodorant blocks found in toilets, urinals, and trash cans. Its ability to release a strong smell when sublimated makes it effective for masking unwanted odours.
3. **Intermediate in Chemical Synthesis**: PDCB serves as an intermediate in the production of various chemicals, including polymers and specialty chemicals. It's particularly valued in the production of polyphenylene sulphide (PPS), a high-performance thermoplastic polymer. PPS has applications in the automotive, electrical, and electronics industries due to its thermal stability, chemical resistance, and mechanical strength.
4. **Solvent and Degreaser**: It's also used in industrial applications as a solvent and degreaser due to its ability to dissolve oils, greases, and other organic materials.

## Major usage of PDCB is to make polyphenylene sulfide ➤

Paradichlorobenzene can be used in the production of polyphenylene sulfide, moth repellents, dyes and intermediates, etc. Among them, polyphenylene sulfide is a material widely used in aviation, automobiles, petrochemicals, medical equipment and other fields. It accounts for more than 50% of the downstream market demand for paradichlorobenzene, ranking first; anti-moth agents account for about 20%, ranking second. Changes in supply and demand in the downstream industry chain will also have a great impact on the price of paradichlorobenzene.

## PDCB manufacturing process is simple ➤

The manufacturing process of paradichlorobenzene (PDCB) from benzene and chlorine can be detailed as follows:

1. **Feedstock Preparation**:
   - **Benzene**: The process begins with benzene as the primary feedstock, which can be obtained from petroleum refining or petrochemical processes.
   - **Chlorine**: Chlorine gas, typically produced through the electrolysis of sodium chloride solution, is used in the chlorination reaction.
2. **Chlorination Reaction**:
   - **Reaction Set-up**: Benzene and chlorine are introduced into a reaction vessel, often equipped with a stirring mechanism to ensure thorough mixing. The reaction is usually conducted in the presence of a catalyst, such as **iron or iron (III) chloride** ($FeCl_3$), which promotes the chlorination process and improves the yield of PDCB.
   - **Temperature Control**: The reaction typically occurs at elevated temperatures (around 80–100°C) to enhance the reaction rate. Precise temperature control is crucial to minimize the formation of undesired byproducts.
   - **Reaction Equation**: $C_6H_6+2Cl_2 \rightarrow C_6H_4Cl_2+2HCl$
3. **Separation and Purification**:

- **Product Separation**: The resulting mixture contains PDCB along with other chlorinated byproducts (like ortho dichlorobenzene). The mixture is cooled and subjected to **fractional distillation** to separate PDCB based on its boiling point.
- **Further Purification**: Additional purification steps may involve crystallization or washing to remove impurities and achieve the desired product specifications.

4. **Crystallization and Packaging**:
   - PDCB is solid at room temperature, so it can be crystallized from the distillate. The solid product is then dried and packaged for distribution to various industries.

## Cost of a PDCB plant is also small ➤

The capital expenditure (capex) for establishing a 100kt per annum paradichlorobenzene (PDCB) plant can vary significantly based on factors such as location, scale of operations, local raw material availability, technology used, and regulatory requirements. However, due to the relatively simple manufacturing process for PDCB, as you must have noted, and the modest infrastructure required, the capex is generally lower than that of more complex chemicals.

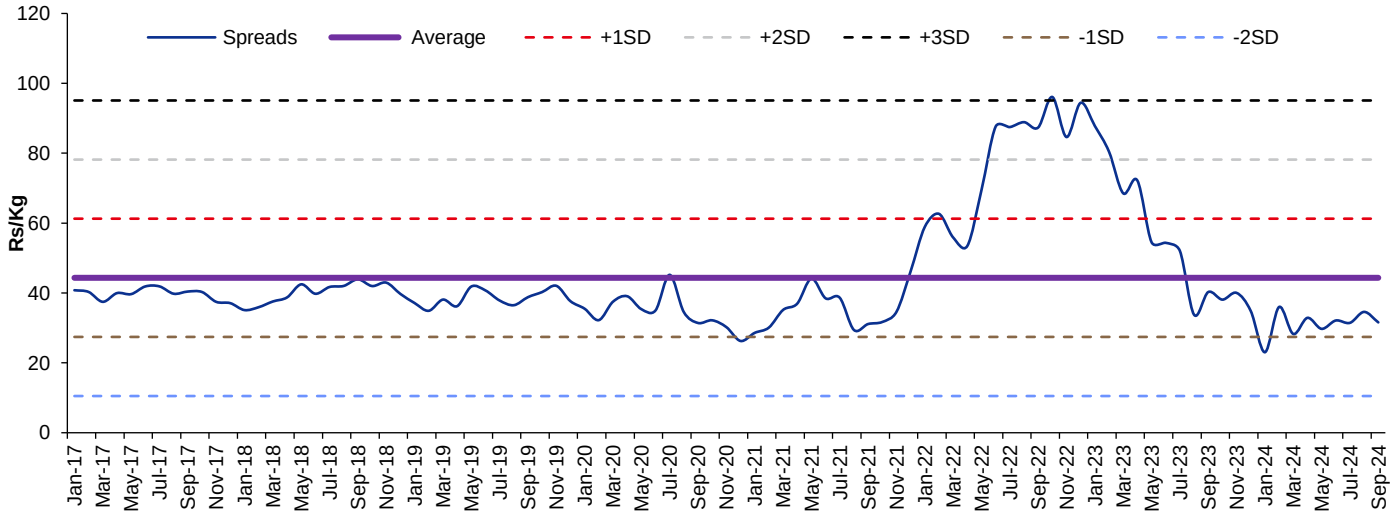
A high-level estimate for a 100kt PDCB plant could range anywhere from approximately US$20m to US$50m, depending heavily on these factors.

## As usual, there is huge overcapacity in the world ➤

Global demand for paradichlorobenzene (PDCB) is around 2.5mt, yet its capacity is at least double that, resulting in significant overcapacity. This oversupply leads to shorter market cycles and a lack of pricing power among companies. Producers are squeezed by raw material suppliers on the one hand and by customers on the other, with little differentiation between producers.

## As a result, the spread of PDCB over benzene is highly volatile ➤

**Figure 17: The spread of PDCB over benzene is highly volatile; except for the supply chain crisis driven by Covid-19 lockdowns in China during 2022, a typical PDCB spread over benzene remained around Rs25-30/kg**




SOURCE: INCRED RESEARCH, COMPANY REPORTS

# Ketene & diketene

Ketene and diketene are one of the simplest molecules but they were thought to be high profile speciality chemicals at the peak of the chemical mania. It takes time for the bubble to burst and two of the ketene and diketene manufacturers/ users, namely Laxmi Organic Industries and Jubilant Ingrevia, are down only 60% and 50%, respectively, from their respective peak levels. Normally, these commodity-based companies' stock prices fall much more from the top once the mania ends. We have been negative on both these stocks for the last three years and hence, missed the mania-driven rally. However, needless to say to the readers of this report that if Sell-side analysts were so smart, then he/she would not have been writing reports and making calls to clients to market their thesis.

## What are ketene and diketene?➤

### Ketene molecule

1. Ketene, with the formula CH2=C=O, is the simplest ketene. It has a structure with a central carbon atom doubly bonded to an oxygen atom and also connected by a double bond to a methylene group (CH2).
2. Due to its structure with two cumulative double bonds, ketene is very reactive. It readily undergoes reactions with various functional groups.
3. Ketene is not very stable at room temperature and tends to dimerize (form a double molecule) to form diketene. However, under specific conditions, it can be generated and used in organic synthesis.

### Diketene

1. Diketene, with the formula CH2=C(O)CH2CO, is a colourless liquid formed by the dimerization (*refers to a chemical process where two identical or similar molecules come together and bond to form a new molecule, called a dimer*) of ketene.
2. Diketene is a more stable compound compared to ketene. It is a useful reagent in organic chemistry for various applications such as acylation (introducing an acyl group) and Diels-Alder reactions (cycloaddition reactions between a diene and a dienophile).
3. Diketene readily hydrolyses (reacts with water) to form acetoacetic acid.

## Making ketene and diketene is challenging but human beings have been doing so for at least 100 years ➤

Ketene wasn't exactly 'invented' as it's not a man-made material. However, it was first discovered in 1876 by the French chemist, Charles-Adolphe Wurtz.

Wurtz was investigating the structure of benzene when he observed a new gaseous compound forming during the process. He named this compound as ketene.

**Making ketene can be challenging for some reasons:**

1. **Reactivity:** Ketene itself is highly reactive. It readily reacts with other molecules, making it difficult to isolate and purify.
2. **Stability:** Ketene is not very stable at room temperature. It tends to dimerize (form a double molecule) to form diketene, which is more stable. This means you might end up with the undesired product even if you manage to generate ketene.
3. **Preparation methods:** The common methods for generating ketene involve high temperatures or specific reagents that might not be readily available in a basic laboratory setting.

## Here's a breakdown of some common methods for making ketene:

1. **Thermal decomposition:** This involves passing a vapourized precursor, like acetone, over a hot surface. However, this method often has low yields of ketene and can lead to decomposition of products.
2. **Using dehalogenating agents:** Reacting a specific molecule with a dehalogenating agent like zinc can generate ketene, but the yields are often not very high.

**Overall, while ketene can be synthesized, it's not a straightforward process. Diketene, the more stable dimer of ketene, is often the preferred option due to its ease of handling and availability.**

## What is the normal example of ketene and its usage? ➤

1. Ketenes are carbonyl compounds that contain the CO group connected by a double bond to a carbon atom. The general formula for ketene is RR′C CO, where R and R′ are hydrocarbon radicals. The simplest ketene, ethenone (CH2CO), is also named as just ketene.
2. Ketenes are used in chemical synthesis as acetylating agents, especially in the synthesis of acetic acid and acetate esters. Ketenes are also used in the production of acrylonitrile, which is used in the production of plastics and synthetic rubber.
3. Ketenes are also used in the manufacture of acetic anhydride, sorbic acid, cinnamic acids, and chloroacetyl chloride.
4. Ketenes are highly reactive and readily undergo a wide variety of chemical reactions, including oxidation-reduction and nucleophilic addition. However, they have found only limited applications, as they are not as readily available like other acylating agents.

**Ketenes are prepared by heating acetic acid or acetone. They readily polymerize and cannot be shipped or stored. Instead, they are obtained, as needed, from diketene.**

## What are the common examples of diketene and its usage? ➤

Diketene is an organic compound with the molecular formula $C_4H_4O_2$. It is formed by dimerization of ketene, $H_2C{=}C{=}O$. Diketene is a member of the oxetane family. It is used as a reagent in organic chemistry. It is a colourless liquid.

1. Diketene is an important industrial intermediate used for the production of acetoacetate esters and amides as well as substituted 1-phenyl-3-methylpyrazolones.
2. Diketene is a chemical compound that is used as an intermediate in the production of pharmaceuticals, insecticides, and dyes. It is also used in the production of agrochemicals, such as pesticides, to prevent crops from weeds and pest.
3. Diketenes react with substituted aromatic amines to acetoacetanilides, which are important precursors for mostly yellow, orange or red azo dyes and azo pigments.
4. Diketene is also used in the synthesis of: Vitamin C, antibiotics, perfume ingredients, acetoacetic acid derivatives, and β-substituted propanoic acids.

## Global demand for ketene and diketene grows at a very low pace ➤

According to IndustryARC, the global demand for ketene is expected to touch US$1.5bn by 2026F, growing at a CAGR of 4.5% over 2021–2026F. The global demand for diketene is expected to touch US$624.4m by the end of 2032F, growing at a CAGR of 4.7%.

## Laxmi Organic Industries and Jubilant Ingrevia make a variety of ketene or diketene as a step in the manufacturing process ➤

1. **Acetoacetoxy ethyl methacrylate ester (AAEM**) - It has a more complex structure that incorporates both acetate and methacrylate groups. It's the product of a reaction between diketene and hydroxyethyl methacrylate.
2. **Acetyl butyrolactone** - Cyclic molecule with a ring of carbon atoms, containing a carbonyl group (C=O) and an ester group (C-O-O-C)cyclic molecule with a ring of carbon atoms, containing a carbonyl group (C=O) and an ester group (C-O-O-C).
3. **Ethyl-4-chloroacetoacetate (ECA) -** Ethyl-4-chloroacetoacetate (ECA) is commonly manufactured through a two-step process:

   ***Chlorination:***

   Diketene (CH2=C=C=O) is used as the starting material. Chlorine gas (Cl2) is introduced under controlled conditions to react with diketene.

   This reaction replaces a hydrogen atom on the diketene molecule with a chlorine atom, forming a chlorinated intermediate.

   ***Esterification:***

   The chlorinated intermediate from step 1 reacts with ethanol (CH3CH2OH) in the presence of an appropriate catalyst.

   This reaction converts the intermediate into the final product, ECA (C6H9ClO3), by attaching an ethyl group (CH3CH2-) to the molecule.
4. **Acetic anhydride -** Conventional method of making acetic anhydride uses ketene but a new method doesn't use ketene or diketene.

   ***Conventional method:***

   The most common industrial process for acetic anhydride production involves the reaction of acetic acid with ketene. However, handling ketene itself is challenging due to: A) **High reactivity**: It reacts readily with various components in the reaction mixture, leading to complex product mixtures and reducing the yield of the desired product (acetic anhydride). B) **Unstable nature**: Ketene readily polymerizes (forms long chains) at room temperature, making its handling and storage difficult.

   ***Alternative approach:***

   To overcome these challenges, industrial production often utilizes a two-stage process that avoids using ketene directly:

   **Dehydration of acetic acid**: This step involves removing the water from acetic acid using a catalyst.

   **Carbonylation**: The dehydrated intermediate reacts with carbon monoxide (CO) under pressure to form acetic anhydride.
5. **Acetoacetanilide**: The acetoacetanilides synthesis **does use diketene.** This molecule is formed by the reaction of aniline (C6H5NH2) with diketene (CH2=C=C=O) in a process called acetoacetylation. **Diketene's role:** It acts as a reactive intermediate that transfers the acetoacetyl group (CH3COCH2CO-) to the aniline molecule.
6. **Acetoacet-m-xylidide**: Synthesis follows the same principle as acetoacetanilide - it likely uses **diketene.**
7. **Tert-butyl acetoacetate (t-BAA):** Ester synthesis typically uses diketene, not ketene. Here's the breakdown:

   **Diketene's role:** It acts as a reactive intermediate that transfers the acetoacetyl group (CH3COCH2CO-) to tert-butanol (t-BuOH) in an esterification reaction.

   **Esterification:** This reaction involves the formation of an ester bond between the carboxylic acid group (COOH) of the acetoacetyl group and the hydroxyl group (OH) of tert-butanol.
8. **Acetoacet-o-anisidide synthesis:** Most likely uses **diketene,** not ketene. Here's why there is **diketene's role:** It acts as a reactive intermediate,

transferring the acetoacetyl group (CH3COCH2CO-) to o-anisidine (C6H4(OCH3)NH2) in an acetoacetylation reaction. This reaction results in the formation of the target molecule, acetoacet-o-anisidide.

9. **Methyl acetoacetate ester (also known as methyl acetoacetate or MAA):** Commonly uses diketene for its industrial production. Here's the breakdown:

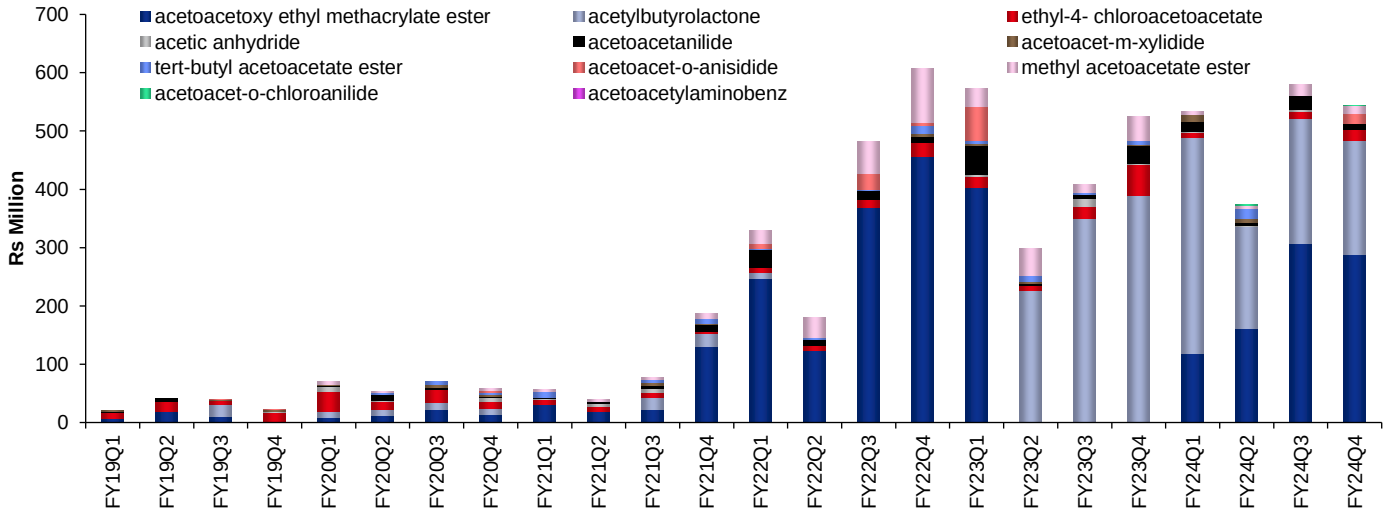
   **Diketene's role:** It acts as a reactive intermediate that transfers the acetoacetyl group (CH3COCH2CO-) to methanol (CH3OH) in an esterification reaction. This reaction results in the formation of MAA (CH3COCH2COOCH3).

10. **Acetoacet-o-chloroanilide:** Synthesis most likely utilizes diketene, not ketene. **Diketene's role:** It acts as a reactive intermediate, transferring the acetoacetyl group (CH3COCH2CO-) to o-chloroanilide (C6H4ClNH2) in an acetoacetylation reaction. This reaction forms the target molecule, acetoacet-o-chloroanilide.

11. **Acetoacetylaminobenz (likely referring to acetoacetylaminobenzene):** Diketene is the more probable choice. **Diketene's role:** It acts as a reactive intermediate, transferring the acetoacetyl group (CH3COCH2CO-) to aminobenzene (C6H5NH2), also known as aniline, in an acetoacetylation reaction. This reaction results in the formation of acetoacetylaminobenzene.

## Overall exports of all these molecules have been on the rise over the past few quarters »

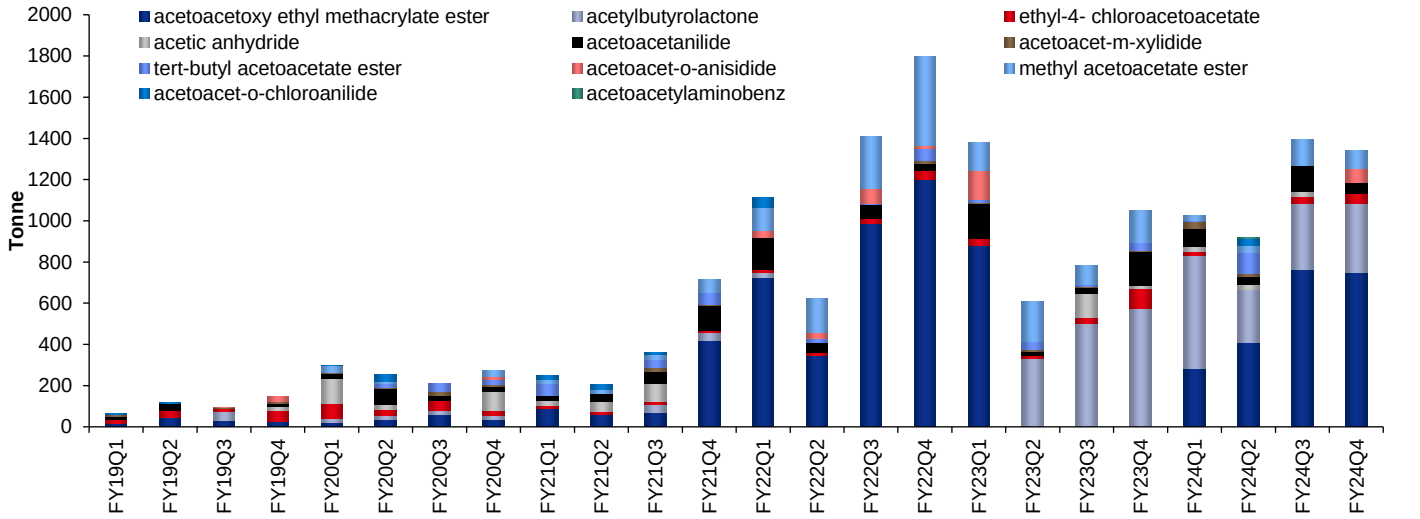
**Figure 18: Laxmi Organic Industries makes a variety by using its expertise in ketene/ diketene; exports of such molecules are given below**




SOURCE: INCRED RESEARCH, COMPANY REPORTS

## Export tonnage has come down after peaking in 4QFY22 ➤

**Figure 19: Tonnage of ketene/ diketene-based molecules has fallen from its peak of 4QFY22; please note that FY22 sales were never real as they were mainly driven by supply chain filling; now China is back in the fray, and it is setting prices and at the same time, the zero Covid policy-related shutdowns are a thing of the past**



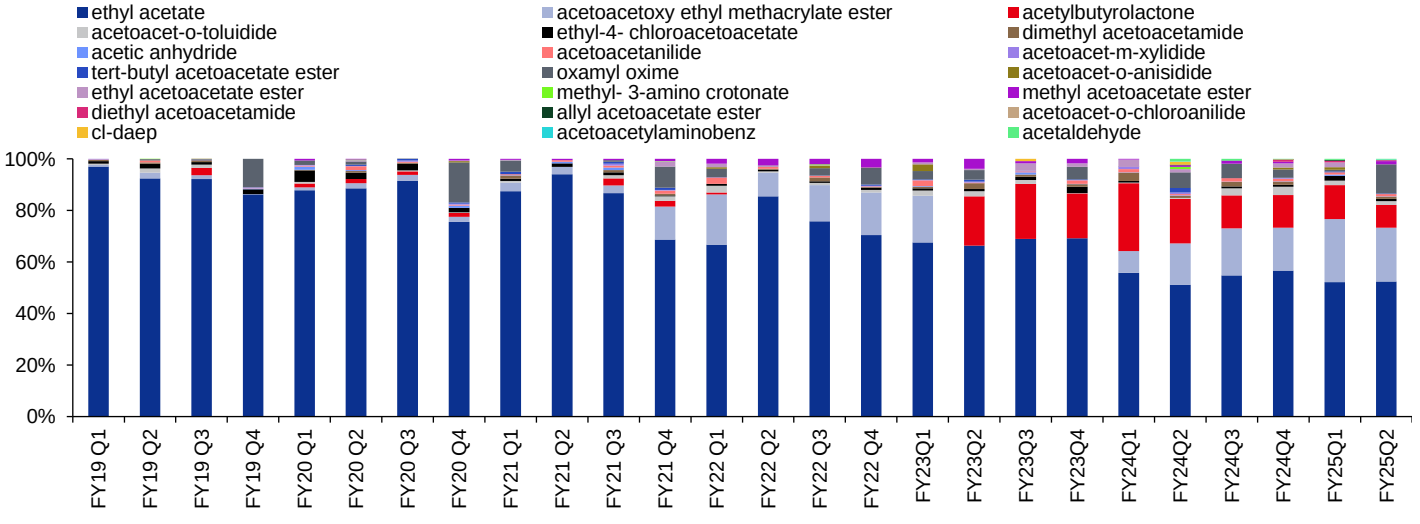

SOURCE: INCRED RESEARCH, COMPANY REPORTS

## There is no intrinsic advantage for Laxmi Organic Industries or Jubilant Ingrevia in these molecules ➤

Almost all molecules which Laxmi Organic Industries makes by using ketene or diketene doesn't have any intrinsic advantage vis-à-vis competition. Chinese companies have been manufacturing these molecules since long, and Indian companies are also joining the competition.

## Laxmi Organic Industries is still primarily an ethyl acetate maker ➤

**Figure 20: Approximately 60% of Laxmi Organic Industries' exports (in value terms) are still made up by ethyl acetate**



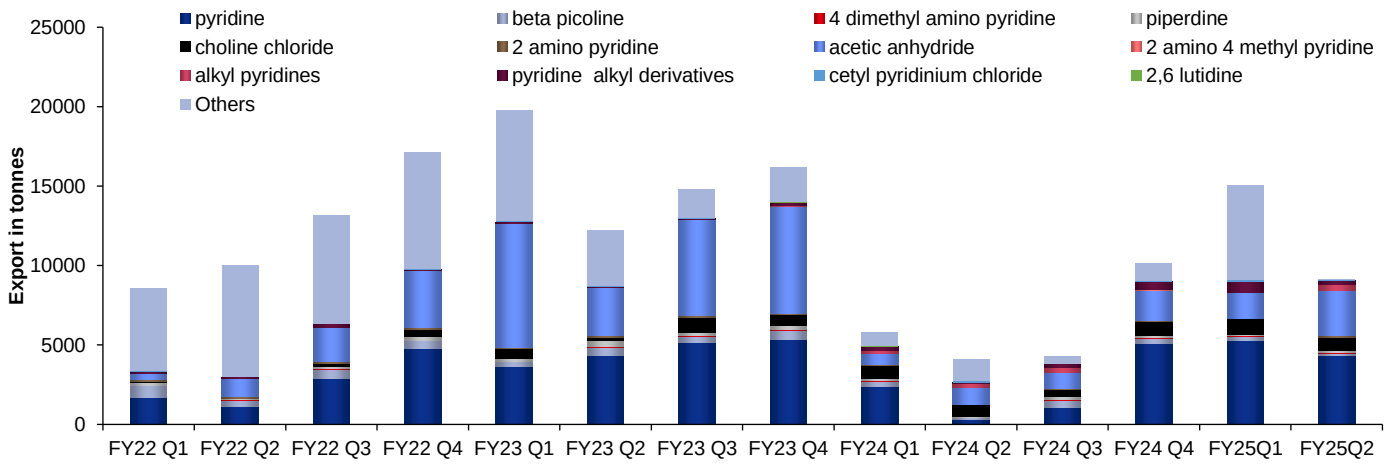

SOURCE: INCRED RESEARCH, COMPANY REPORTS

## On the other hand, Jubilant Ingrevia is primarily a pyridine maker with a small quantitiy of ketene/diketene usage ➤

Jubilant Ingrevia also makes a significant quantity of ethyl acetate, but it sells almost all of that in the domestic market. To the outside world, it sells pyridines, picoline, niacin, choline chloride, piroctone olamine and even zinc pyrithione.

## Exports of Jubilant Ingrevia or JIL mainly comprise pyridines, which are declining because of a slowdown in agrochemicals ➤

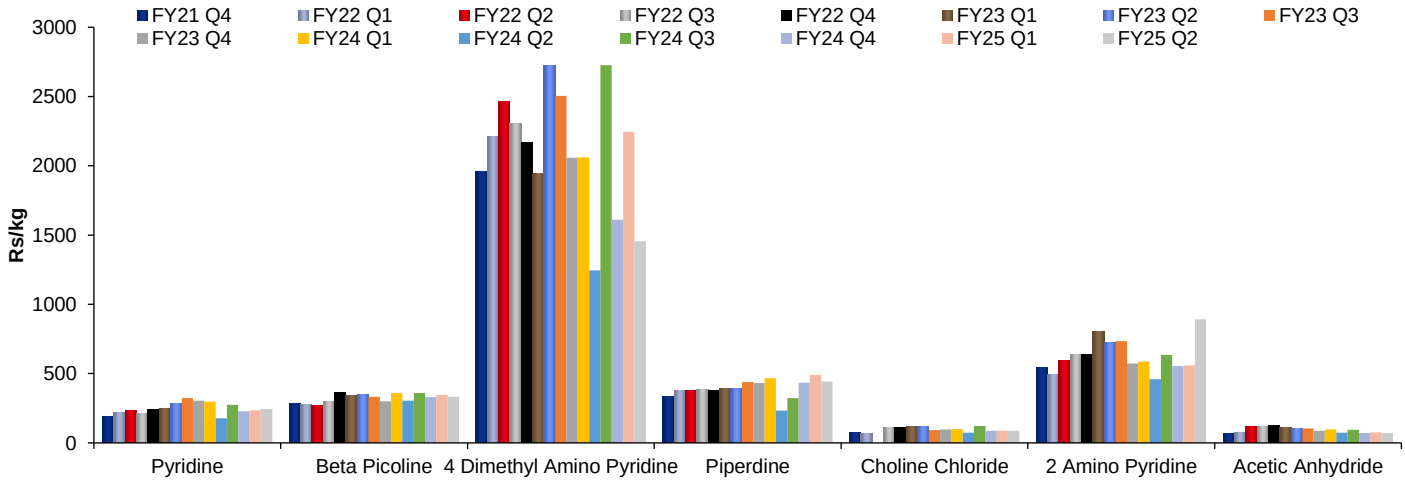
**Figure 21: JIL's exports of pyridines, picoline, etc. are coming down as the world is facing a slowdown in agrochemicals**




SOURCE: INCRED RESEARCH, COMPANY REPORTS

## Realization of important export molecules is coming down ➤

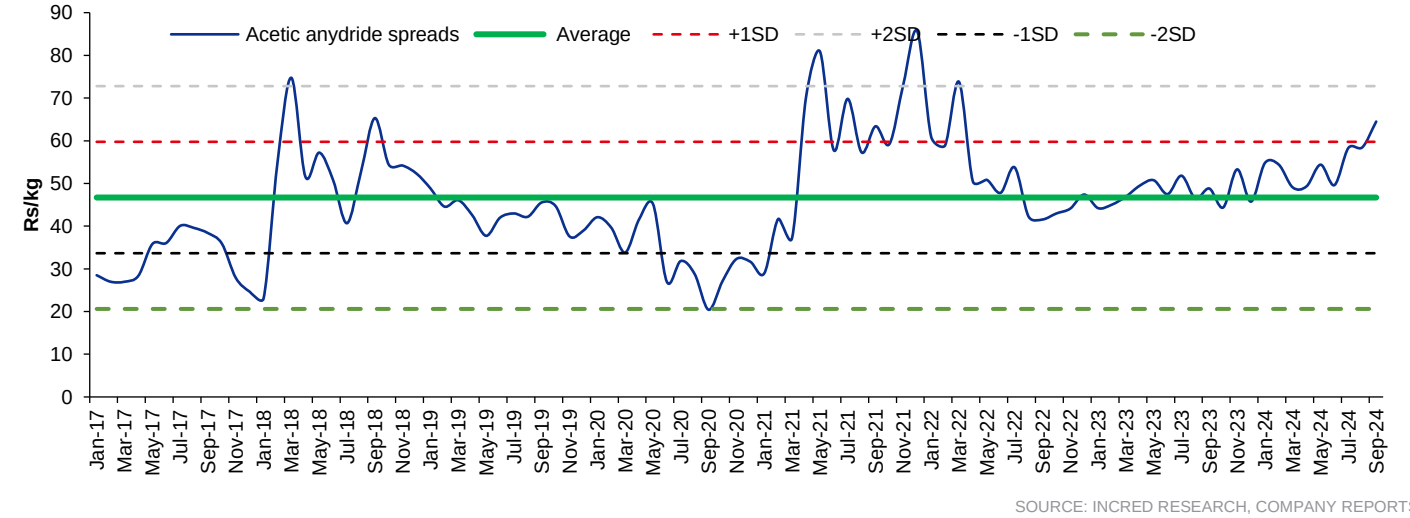
**Figure 22: Exports realization of almost all important export molecules are coming down; none of these chemicals show any signs of pricing power**




SOURCE: INCRED RESEARCH, COMPANY REPORTS

## JIL depends a lot on the profitability of acetic anhydride ➤

**Figure 23: Acetic anhydride is still doing well for JIL and Laxmi Organic Industries**




SOURCE: INCRED RESEARCH, COMPANY REPORTS

## DISCLAIMER

This report (including the views and opinions expressed therein, and the information comprised therein) has been prepared by Incred Research Services Private Ltd. (formerly known as Earnest Innovation Partners Private Limited) (hereinafter referred to as "IRSPL"). IRSPL is registered with SEBI as a Research Analyst vide Registration No. INH000011024. Pursuant to a trademark agreement, IRSPL has adopted "Incred Equities" as its trademark for use in this report.

The term "IRSPL" shall, unless the context otherwise requires, mean IRSPL and its affiliates, subsidiaries and related companies. This report is not directed or intended for distribution to or use by any person or entity resident in a state, country or any jurisdiction, where such distribution, publication, availability or use would be contrary to law, regulation or which would subject IRSPL and its affiliates/group companies to registration or licensing requirements within such jurisdictions.

This report is being supplied to you strictly on the basis that it will remain confidential. No part of this report may be (i) copied, photocopied, duplicated, stored or reproduced in any form by any means; or (ii) redistributed or passed on, directly or indirectly, to any other person in whole or in part, for any purpose without the prior written consent of IRSPL.

The information contained in this report is prepared from data believed to be correct and reliable at the time of issue of this report.

IRSPL is not required to issue regular reports on the subject matter of this report at any frequency and it may cease to do so or change the periodicity of reports at any time. IRSPL is not under any obligation to update this report in the event of a material change to the information contained in this report. IRSPL has not any and will not accept any, obligation to (i) check or ensure that the contents of this report remain current, reliable or relevant; (ii) ensure that the content of this report constitutes all the information a prospective investor may require; (iii) ensure the adequacy, accuracy, completeness, reliability or fairness of any views, opinions and information, and accordingly, IRSPL and its affiliates/group companies (and their respective directors, associates, connected persons and/or employees) shall not be liable in any manner whatsoever for any consequences (including but not limited to any direct, indirect or consequential losses, loss of profits and damages) of any reliance thereon or usage thereof.

Unless otherwise specified, this report is based upon reasonable sources. Such sources will, unless otherwise specified, for market data, be market data and prices available from the main stock exchange or market where the relevant security is listed, or, where appropriate, any other market. Information on the accounts and business of company(ies) will generally be based on published statements of the company(ies), information disseminated by regulatory information services, other publicly available information and information resulting from our research. While every effort is made to ensure that statements of facts made in this report are accurate, all estimates, projections, forecasts, expressions of opinion and other subjective judgments contained in this report are based on assumptions considered to be reasonable as of the date of the document in which they are contained and must not be construed as a representation that the matters referred to therein will occur. Past performance is not a reliable indicator of future performance. The value of investments may go down as well as up and those investing may, depending on the investments in question, lose more than the initial investment. No report shall constitute an offer or an invitation by or on behalf of IRSPL and its affiliates/group companies to any person to buy or sell any investments.

The opinions expressed are based on information which is believed to be accurate and complete and obtained through reliable public or other non-confidential sources at the time made (information barriers and other arrangements may be established, where necessary, to prevent conflicts of interests arising. However, the analyst(s) may receive compensation that is based on his/their coverage of company(ies) in the performance of his/their duties or the performance of his/their recommendations. In reviewing this report, an investor should be aware that any or all of the foregoing, among other things, may give rise to real or potential conflicts of interest. Additional information is, subject to the duties of confidentiality, available on request.

The report is not a "prospectus" as defined under Indian Law, including the Companies Act, 2013, and is not, and shall not be, approved by, or filed or registered with, any Indian regulator, including any Registrar of Companies in India, SEBI, any Indian stock exchange, or the Reserve Bank of India. No offer, or invitation to offer, or solicitation of subscription with respect to any such securities listed or proposed to be listed in India is being made, or intended to be made, to the public, or to any member or section of the public in India, through or pursuant to this report.

The research analysts, strategists or economists principally responsible for the preparation of this research report are segregated from the other activities of IRSPL. Information barriers and other arrangements have been established, as required, to prevent any conflicts of interests.

The research analysts, strategists or economists principally responsible for the preparation of this research report are segregated from the other activities of IRSPL. Information barriers and other arrangements have been established, as required, to prevent any conflicts of interests.

IRSPL may have issued other reports (based on technical analysis, event specific, short-term views, etc.) that are inconsistent with and reach a different conclusion from the information presented in this report.

Holding of Analysts/Relatives of Analysts, IRSPL and Associates of IRSPL in the covered securities, as on the date of publishing of this report

Research Analyst or his/her relative(s) or InCred Research Services Private Limited or our associate may have any financial interest in the subject company.

Research Analyst or his/her relatives or InCred Research Services Limited or our associates may have actual or beneficial ownership of 1% or more securities of the subject company(ies) at the end of the month immediately preceding the date of publication of the Research Report.

Research Analyst or his/her relative or InCred Research Services Private Limited or our associate entities may have any other material conflict of interest at the time of publication of the Research Report.

In the past 12 months, IRSPL or any of its associates may have:

a) Received any compensation/other benefits from the subject company,
b) Managed or co-managed public offering of securities for the subject company,
c) Received compensation for investment banking or merchant banking or brokerage services from the subject company,
d) Received compensation for products or services other than investment banking or merchant banking or brokerage services from the subject company

We or our associates may have received compensation or other benefits from the subject company(ies) or third party in connection with the research report.

Research Analyst may have served as director, officer, or employee in the subject company.

We or our research analyst may engage in market-making activity of the subject company.

**Analyst declaration**

- The analyst responsible for the production of this report hereby certifies that the views expressed herein accurately and exclusively reflect his or her personal views and opinions about any and all of the issuers or securities analysed in this report and were prepared independently and autonomously in an unbiased manner.
- No part of the compensation of the analyst(s) was, is, or will be directly or indirectly related to the inclusion of specific recommendations(s) or view(s) in this report or based on any specific investment banking transaction.
- The analyst(s) has(have) not had any serious disciplinary action taken against him/her(them).
- The analyst, strategist, or economist does not have any material conflict of interest at the time of publication of this report.
- The analyst(s) has(have) received compensation based upon various factors, including quality, accuracy and value of research, overall firm performance, client feedback and competitive factors.

IRSPL and/or its affiliates and/or its Directors/employees may own or have positions in securities of the company(ies) covered in this report or any securities related thereto and may from time to time add to or dispose of, or may be materially interested in, any such securities.

IRSPL and/or its affiliates and/or its Directors/employees may do and seek to do business with the company(ies) covered in this research report and may from time to time (a) buy/sell the securities covered in this report, from time to time and/or (b) act as market maker or have assumed an underwriting commitment in securities of such company(ies), and/or (c) may sell them to or buy them from customers on a principal basis and/or (d) may also perform or seek to perform significant investment banking, advisory, underwriting or placement services for or relating to such company(ies) and/or (e) solicit such investment, advisory or other services from any entity mentioned in this report and/or (f) act as a lender/borrower to such company and may earn brokerage or other compensation. However, Analysts are forbidden to acquire, on their own account or hold securities (physical or uncertificated, including derivatives) of companies in respect of which they are compiling and producing financial recommendations or in the result of which they play a key part.

**Recommendation Framework**

| Stock Ratings | 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. |