TATA STRATEGIC MANAGEMENT GROUP

FICCI

CONFERENCE ON

Potential of Downstream Plastics Industry in North India

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Knowledge & Strategy Paper

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Executive summary



Plastic industry is making significant contribution to the economic development and growth of various key sectors in the country namely: Automotive, Construction, Electronics, Healthcare, Textiles, and FMCG etc. Its demand has been growing rapidly at ~10% p.a.to reach 8MnTPA by FY11.India is currently net importer of PE, however with the commissioning of IOCL plant at Panipat, the extent of imports is expected to go down significantly.

India observes significant regional diversity in consumption of plastics with Western India accounting for 47%, Northern India for 23% and Southern India for 21%. Bulk of the consumption in Northern India is from end use industries of Auto, packaging (including bulk packaging), plasticulture applications, electronic appliances etc. which are concentrated mostly in UP and Delhi- NCR (>50%). However plastic processing in other parts like Rajasthan, Punjab, Haryana, Uttarakhand, J&K and Himachal Pradesh are expect to grow based on increased availability of feedstock and increased focus on manufacturing sectors.

Northern India is said to have an inherent disadvantage of being away from ports hence a difficult target for low cost supply of plastics through import. However this same situation makes the domestic plastic processing more competitive and provides significant opportunity. Current low levels of per capita consumption (7 Kgs) along with increased growth in end use industries could propel the growth of plastics in North India further. Plastics industry is also a very good source for employment generation and the major share of this employment potential is due to plastic processing industry.

Indian Plastic industry faces environmental myths and lacks in technology. Going ahead recycling of plastics could be a foremost step towards fostering innovation and sustainability. Also increased awareness through help of industry groups and Government could help address some of these challenges.


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Introduction

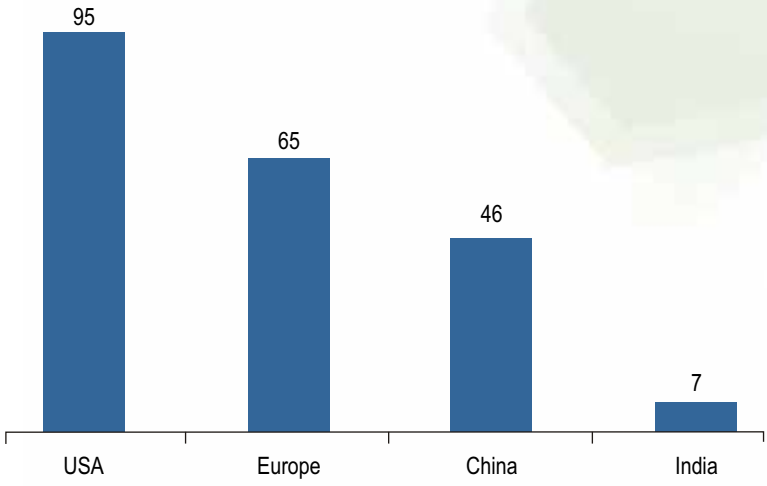


The chemical industry is critical for the economic development of any country. In 2011, Indian Chemical sector accounted for ~13% of the gross value added by the industries segment. Indian Chemical sector is also a net foreign exchange earner, accounting for ~10% of India's export in 2011.

With Asia's increasing contribution to the global chemical industry, India emerges as one of the focus destinations for chemical companies worldwide. The chemical market of India stood at $ 83 billion in 2010 and has been growing at ~11% p.a. over the last decade. Out of this, petrochemicals, a major segment, accounted for 20% with $16 billion market size in 2010.

Today, petrochemical products permeate the entire spectrum of daily use items and cover almost every sphere of life like clothing, housing, construction, furniture, automobiles, household items, agriculture, horticulture, irrigation, packaging, medical appliances, electronics and electrical etc. These industries hence drive the demand growth of petrochemicals. Current low per capita consumption level of plastic products as compared to developed countries per capita consumption suggests that India offers a huge opportunity over long term (Refer Figure II 1).

Figure II-1: Per capita plastics products consumption (Kg/ person)



***Source**: FICCI, Deutsche Bank, Research by Tata Strategic*

Also India offers strong opportunity for manufacturing of petrochemicals with its plan to increase the share of manufacturing in GDP from 16% to 25% by 2022. The increasing demographic dividend, urbanization, growing income levels all support a strong case of increase in both demand and supply of petrochemicals in India.

Plastics are the major product that account for bulk of the Indian petrochemical industry. The next section will talk about the plastic industry scenario in India with detailed focus on Northern India.



Plastic industry in Northern India





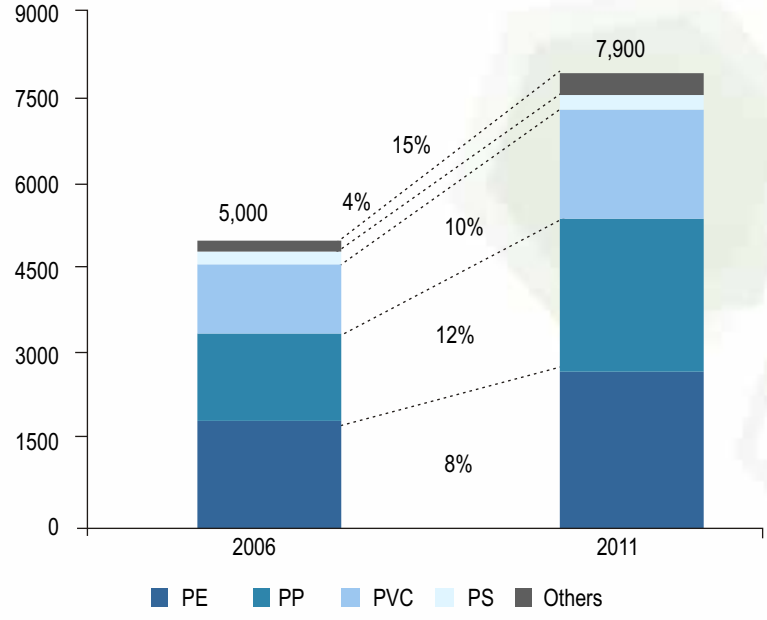
A wide variety of plastics raw materials are produced to meet the material needs of different sectors of the economy. These polymeric materials are broadly categorized as commodity, engineering and specialty plastics. Commodity plastics are the major products that account for bulk of the plastics and in turn for petrochemical industry. Commodity plastics comprise of Polyethylene (PE), Polypropylene (PP), Polyvinyl Chloride (PVC) and Polystyrene. While engineering and specialty plastics are plastics that exhibit superior mechanical and thermal properties in a wide range of conditions over and above more commonly used commodity plastics and are used for specific purpose. These include styrene derivatives (PS/EPS & SAN/ABS), polycarbonate, poly methyl methacrylate, polycarbonates, poly oxy methylene (POM) plastics etc.

There are three broad types of PE, viz: Low-density Polyethylene (LDPE), High-density Polyethylene (HDPE) and Linear Low-density Polyethylene (LLDPE).Major plastic materials like PE and PP are derived from Ethylene and Propylene respectively, while other plastics such as PVC, PS & ABS and PC are produced from benzene, butadiene and other feedstock.

1. Demand overview

Plastics industry is one of the fastest growing industries in India. It has expanded at a very impressive pace of ~10% p.a. over the last five years to reach ~8 MnTPA by FY11. (ReferFigure III 1).

Figure III-I -: Demand overview of plastics ('000 TPA), FY06-11



Source: Industry Reports, Secondary Research

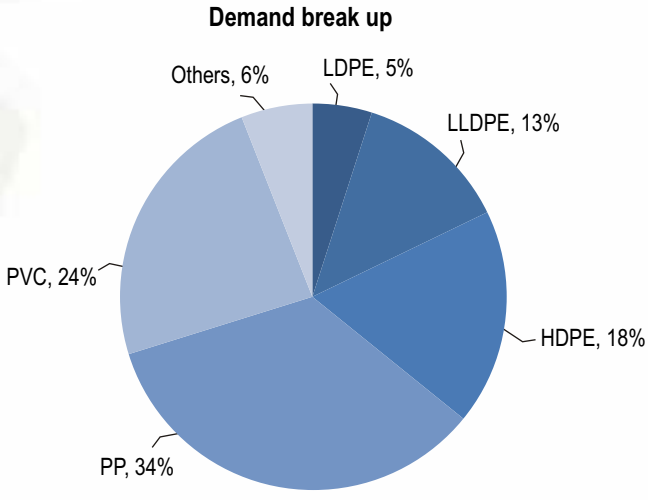
Polyethylene (PE) is the largest volume plastic raw-material used by the industry. Its demand has grown at 8% p.a. in last 5 years to reach ~2.8 MnTPA in FY11. Polypropylene (PP) is the second largest and fastest growing commodity plastics. Its consumption has grown from 1.5 MnTPA in FY06 to 2.6 MnTPA in FY11 at a steep growth rate of 12% p.a.

PVC demand has grown at 10% p.a. from 1.2 MnTPA to 1.9 MnTPA in FY11. PVC is mainly required by the infrastructure sector in the form of pipes, profiles, floorings and cables.

PS has observed a slower growth rate of 4% p.a. to reach ~240,000 TPA in FY11, while other (PC/ ABS etc.) have grown at a higher growth rate of 15% p.a. from 190,000 TPA to 380,000 TPA in FY11.

Figure below shows the current domestics demand breakup of these polymers based on their type.

Figure III-2 : Demand breakup of plastics by types, FY12



Source: Report of the Sub-group on Petrochemicals for the 12th Five Year Plan

Polyethylene accounts for the largest share i.e., 36% of total consumption, while PP accounts for 34% of total consumption. Within PE, HDPE is observing a moderate growth and has a consumption share of 18%. LLDPE is expected to grow at higher pace due to its increased penetration in LDPE applications. Others include PS/EPS, ABS and engineering plastics.

To manufacture finished products, polymers are processed through various types of techniques namely extrusion, injection moulding, blow moulding and rotomoulding. Various products manufactured through these processes are highlighted in the following table (Refer Table III 1)

Table III-1: Classification of plastic products by type of process

Plastic products	Extrusion	Films and Sheets, Fibre and Filaments Pipes, Conduits and profiles, Miscellaneous applications
	Injection moulding	Industrial Injection Moulding, Household Injection Moulding and Thermo-ware/ Moulded luggage
	Blow moulding	Bottles, containers, Toys and Housewares
	Roto moulding	Large circular tanks such as water tanks

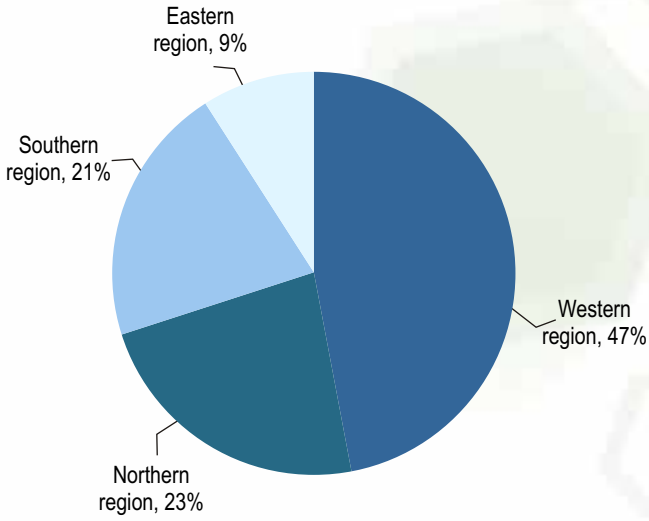
Source: CIPET

Roughly extrusion process is the most commonly used process in India and accounts for 65-68% of total consumption by downstream plastic processing industries. Injection moulding is the other popular process accounting for ~25% of the consumption. Blow moulding is used for ~ 5% while Rotomoulding 1% while the rest of the plastic is processed through other processes.

a. Scenario in Northern India

Western India has traditionally been the largest consumer of plastics accounting for almost 47% of the total consumption. The region wise distribution of consumption in 2010 is given below. (Refer Figure III 3).

Figure III-3: India – Region wise plastic consumption, 2010

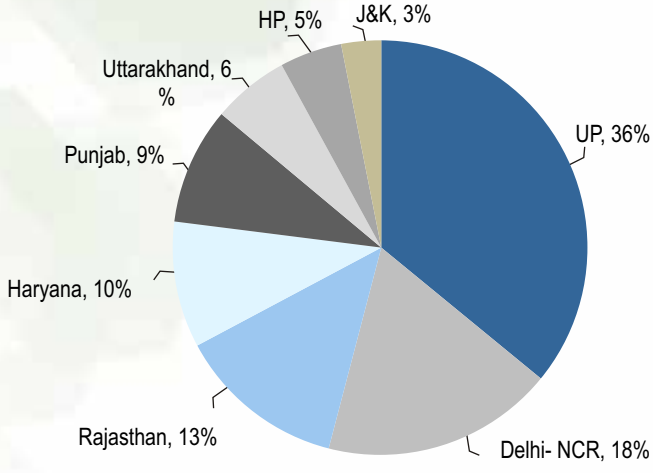


Source: IOCL, Industry reports, Research by Tata Strategic

Western region comprise of Maharashtra, Gujarat, the union territories of Daman and Diu & Dadra and Nagar Haveli along with Madhya Pradesh and Chhattisgarh. The total consumption of plastics in India in 2010-11 was ~ 7.9 MnTPA. Out of this Northern India accounted for ~23%. For the purpose of this report Northern India comprises of J&K, Himachal Pradesh, Punjab, Haryana, Uttarakhand, Rajasthan, UP, Delhi and NCR region.

Plastic industry in northern India is mostly concentrated in Uttar Pradesh and Delhi-NCR regions, along with Rajasthan. The figure below gives the state wise breakup of the total Northern India consumption of 1.8 MnTPA in 2010-11.

Figure III-4: State wise plastic consumption in Northern Region, 2011

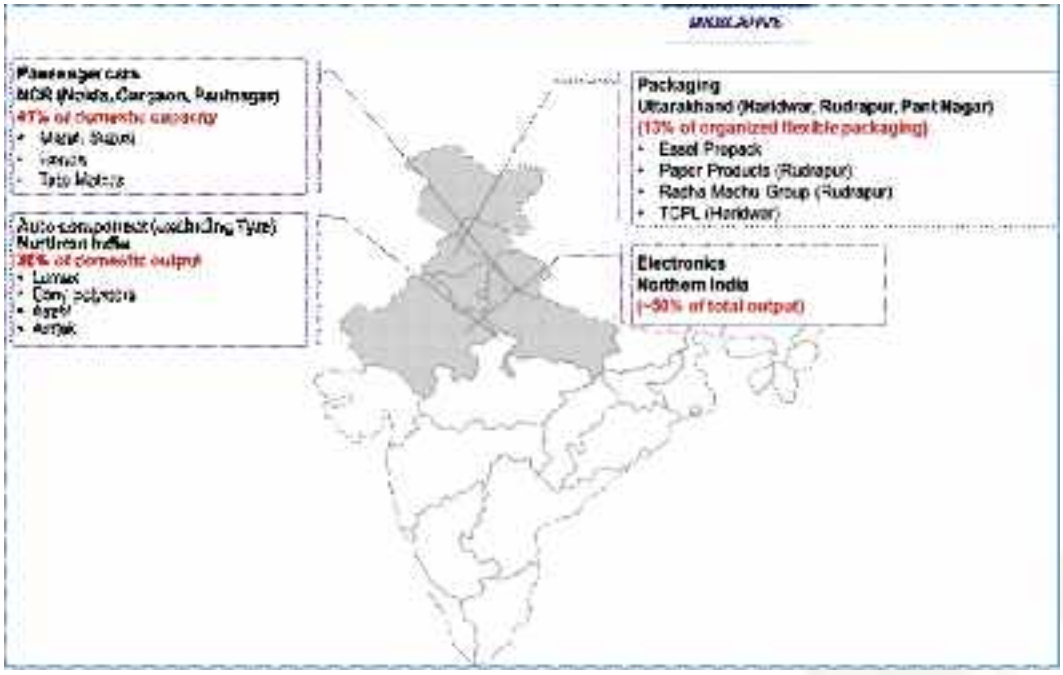


Source: IOCL, Industry reports, Research by Tata Strategic

Bulk of the consumption in Northern India is from end use industries of Auto, packaging (including bulk packaging), plasticulture applications, electronic appliances etc. Figure below reflects indicative list of some end use industries (Refer Figure III 5) in Northern India.

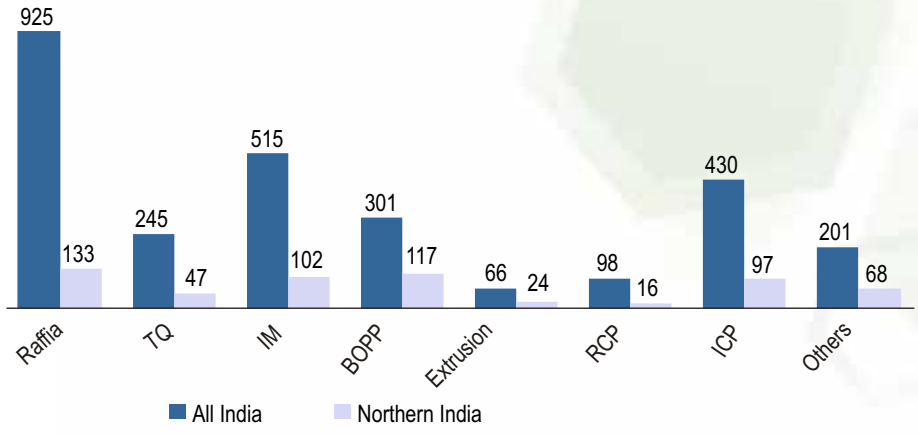


Figure III 5: Indicative list of some end use industries in Northern India



The consumption in Northern India is low in comparison to Western India (Refer Figure III 6) only because of lack of availability of raw material. Reliance the largest petrochemical player in India had all its cracking units in West and this facilitated the growth of downstream plastic processing industry in Western region. However with IOCL Panipat cracker and HMEL Bhatinda PP plant the availability of PE/ PP is not expected to be a constraint and hence facilitate downstream plastic processing units.

Figure III-6: Consumption levels of PP based on process



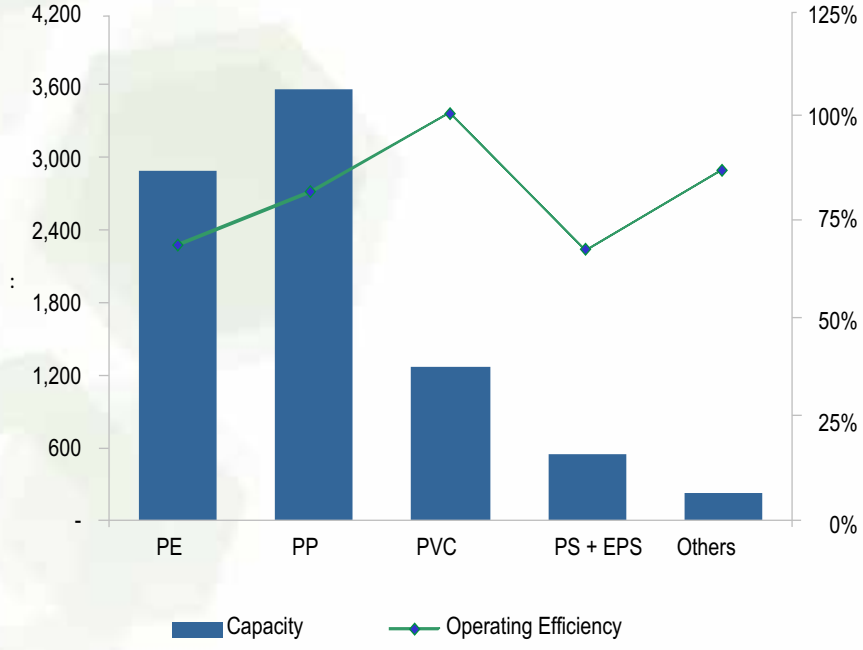
Notes 1) TQ: Tubular quenching, IM: Injection Moulding, BOPP: Biaxially Oriented Polypropylene, RCP: Random Copolymer, ICP: Impact copolymer

Source : HMEL, FICCI, Research by Tata Strategic

2. Capacity overview

India has significant production capacity of Plastics. Polyethylene (PE) continues to be the largest commodity with LLDE experiencing the fastest growth in this category.

Figure III-7 : Production Capacity and Operating efficiency of plastics, FY11



Source: Industry reports, Analysis by Tata Strategic

Current polymer capacities are mostly under-utilized with an operating efficiency varying from 66%-86%, expect for PVC, where production matches with capacity (Refer Figure III 7).

India has a ~2.9 MnTPA of PE production capacity out of which 1.6 MnTPA is HDPE capacity, 1 MnTPA is LLDPE and rest is LDPE capacity. PP and PVC alsohave the large production capacities, i.e., 3.5 MnTPA and 1.3 MnTPA respectively. PVC is one of the major products where capacity growth in past had been significantly lagging demand growth.

India has a ~360,000 TPA production capacity of PS and EPS. However, all these facilities are based on imported styrene since there is no local production of Styrene.In case of Engineering Plastics, there is a significant opportunity in India. ABS and Polycarbonate have huge demand in India. ABS has a 100,000 TPA production capacity, while PC base resins are all imported. Though, there are few compounding units of PC in India. Polyamides have a limited production capacity, while other major engineering plastics are being imported to cater the domestic demand.

Reliance Industries Ltd. (RIL) is the largest producer of commodity plastics in India. It has 1.12 Mn Tonnes per annum (TPA) capacity of PE, 2.6 MnTPA capacity of PP and 625,000 TPA capacity of PVC (ReferTable III 1). RIL's production facilities are located in Gujarat and Maharashtra. RIL is the only producer of LDPE in India.

Haldia Petrochemicals Ltd. (HPL) is another key player with PE capacity of 710,000 TPA and PP capacity of 330,000 TPA. HPL's Plants are located in eastern region of India. Other major players are Indian Oil (IOCL) & Gas Authority of India (GAIL) with their plants located at Panipat and Auraiya respectively. These plants mainly cater to the northern regional demand of plastics. IOCL have 600,000 TPA production capacities of both PE and PP, while GAIL has 510,000 TPA capacity of PE.

Table III- 2 : Production Capacity of plastics by major players, FY11

Producer	PE	PP	PVC	Others
RIL	1,115,000	2,635,000	625,000	-
IOCL	600,000	600,000	-	-
GAIL	510,000	-	-	-
HPL	710,000	330,000	-	-
Chemplast Sanmar	-	-	290,000	-
Finolex	-	-	260,000	-
Supreme	-	-		272,000
Ineos ABS	-	-	-	60,000

Source: Industry reports, Secondary Research

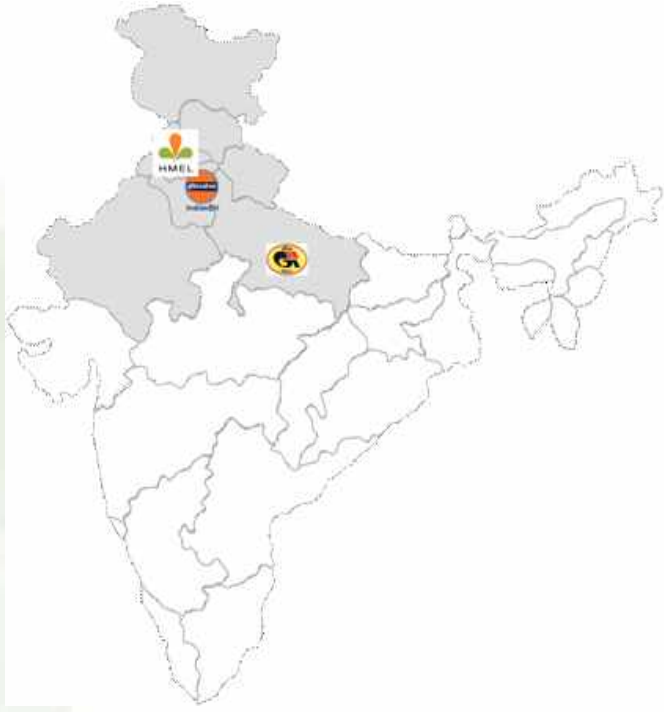
After Reliance, Chemplast Sanmar and Finolex Industries isthe major producer of PVC with a production capacity of 290,000 TPA and 260,000 TPA respectively.Supreme petrochemicals have a PS capacity of 272,000 TPA. Ineos ABS and Bhansali Polymer are the major ABS producers. Ineos has the production capacity of 60,000 TPA.

In downstream plastic processing, India has over 23,000 processing units. Total Machine installed for plastic processing were 97,400 by March, 2011. The total processing capacity has increased to 23.7 MnTPA in 2011 from 11.7 MnTPA in 2006. 32,000 machines were added at an investment cost of Rs 11,000 crores in the last 5 years out of which 21,300 injection moulding machines accounting for around 67%, while extrusion machines accounted for 27% and the rest 7% blow moulding machines.

a. Scenario in Northern India

In Northern India, IOCL and GAIL are the two plastic producers with plastic production capacity of 1.2 MnTPA and 0.5MnTPA. Indian Oil Corporation Limited (IOCL) is the largest chemical company in India. It is promoted by the Government of India with shareholding of 79%. IOCL has only recently commissioned its Panipat cracker in February 2011. The Group owns and operates 10 of India's 20 refineries with a combined refining capacity of 65.7 MnTPA. Govt. of India has 57% stake in GAIL. It is a dominant player in natural gas trading business and uses natural gas as the feedstock for production of ethylene and in turn produces Polyethylene. GAIL has plans to double its plastic production capacity by 2014. HMEL's Bhatinda Polypropylene plant (0.44MnTPA) is scheduled to commence operations during FY13. Altogether the plastic production capacity is expected to go up to 2.5MnTPA by 2014-15. The figure below maps the plastic production facilities along with their capacity.

Figure III-8-: Plastic production capacities in Northern India



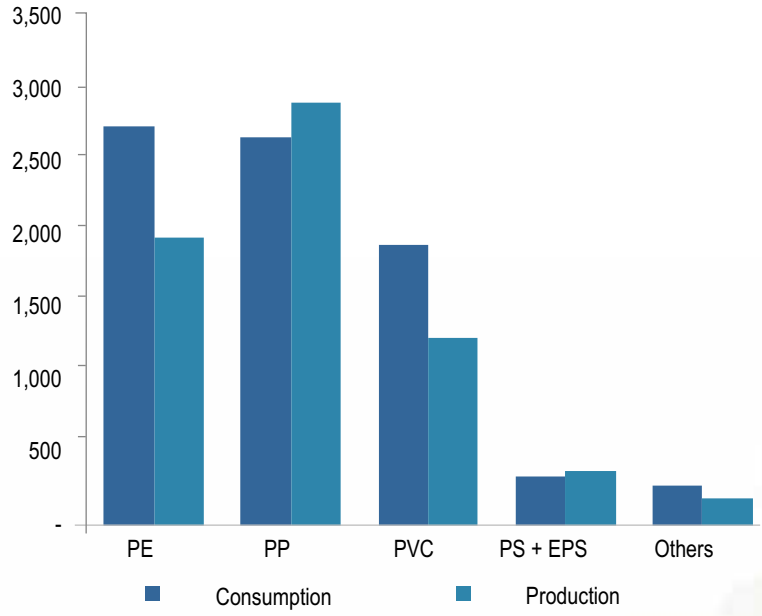
Availability of ~2.5 MnTPA of plastics in Northern region may result in spur of investments in downstream plastic processing. Moreover since the north region does not have access to ports, hence the import/ export potential is restricted because of additional cost of transportation. This could result in ensuring a self-sufficient demand-supply scenario for the north as the optimal solution

3. Import-export scenario

India is overall deficit in plastics and a lot of these materials are imported to cater the unmet domestic demand. The major import source countries are Saudi Arabia, Qatar, UAE, Korea, USA, Singapore, Thailand, Germany, Spain and Malaysia. As perFigure III 4, India is deficit in PE, PVC and engineering plastics. In FY11, ~2 Mn TPA of PE was produced while domestics consumption was ~2.8 Mn TPA. In case of PVC, the FY11 domestic demand stood at 1.9 Mn TPA and the domestic production was 1.3 Mn TPA. Polyamides consumption was 54,000 TPA, while domestic production was 13,000 TPA. Other major engineering plastics were imported.

Few Plastics materials are produced in surplus and these materialsare exported to international markets.Major export destinations are China, Egypt, UAE, Turkey, Vietnam, and Indonesia. In FY 11, Indian production of PP stood at 2.8 Mn TPA while demand was 2.6 Mn TPA only. Similarly domestic demand for PS/EPS was 340,000 TPA, while production was 370,000 TPA.

Figure III-9 : Demand-supply scenario of plastics, FY11

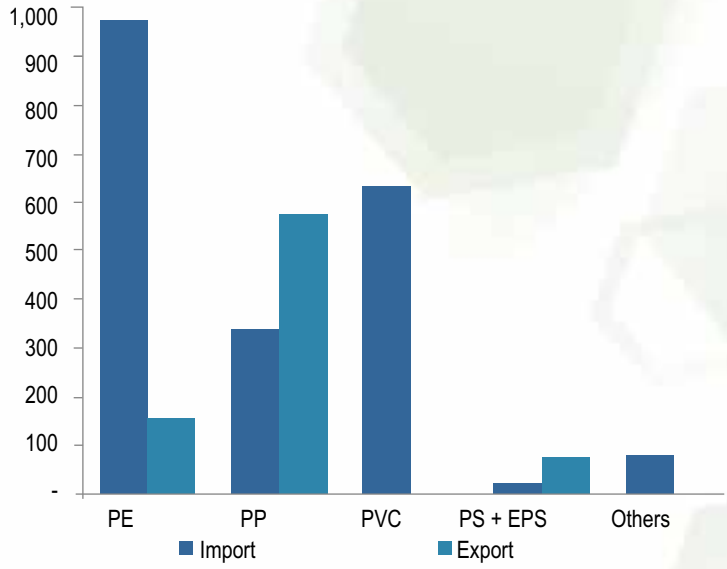


Source: Industry Report Secondary Research

Figure below provides detailed description of import and export trend of these polymers (Refer Figure III 10). India is deficit in PE and 1/3rd of its demand is met through imports. In FY11, 970,000 tonnes of PE was imported. PP production exceeds the domestic consumption and hence caters to international markets as well. India exported ~570,000 tonnes and imported ~330,000 tonnes of PP in FY11.

Domestic production of PVC is not enough to cater the demand and hence 30% of demand is met through imports. 630,000 tonnes of PVC was imported in FY11. India is a net exporter of PS, while most of the engineering plastics are being imported. Though, there are few compounding units of engineering plastics are present in India.

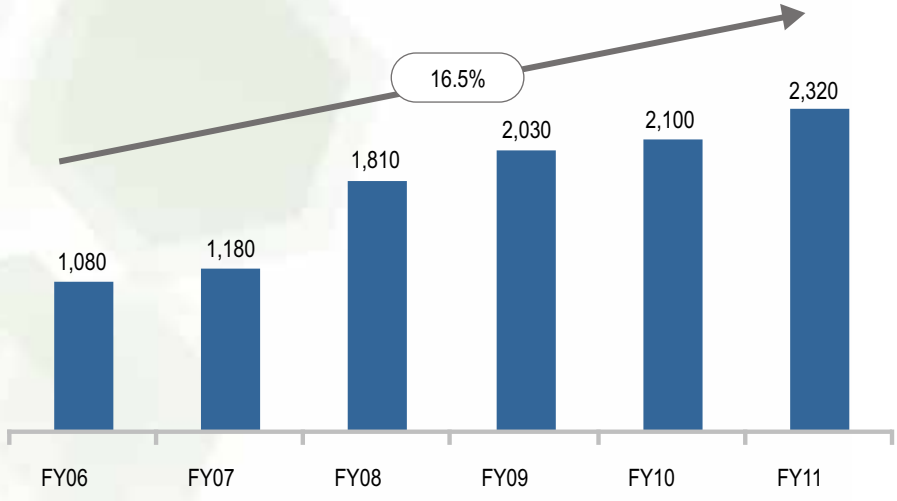
Figure III-10 : Import-export scenario of plastics, FY11



Source: DGFT, Secondary research

Exports of plastic finished goods have more than doubled in the last 5 years from ~$1 Bn in 2006 to $2.3 Bn in 2011. But fierce competition from countries such as China, Indonesia, Taiwan and other South Asian countries are restricting growth. The exports of these value added plastic products could be a huge growth opportunity if Indian manufacturers can increase/ maintain their manufacturing competitiveness while ensuring high quality.

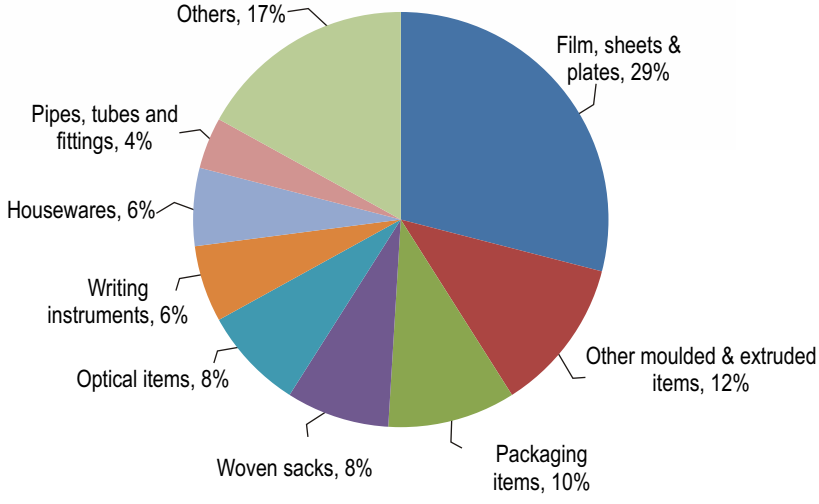
Figure III-11 : Exports of value added plastic products (Mn USD)



Source: Report of the Sub-group on Petrochemicals for the 12th Five Year Plan

The product wise breakup in 2010-11 is given below (Refer Figure III 12).

Figure III-12 : Product wise breakup of plastic product exports in 2010-11



Source: Report of the Sub-group on Petrochemicals for the 12th Five Year Plan

Opportunities for plastics in Northern




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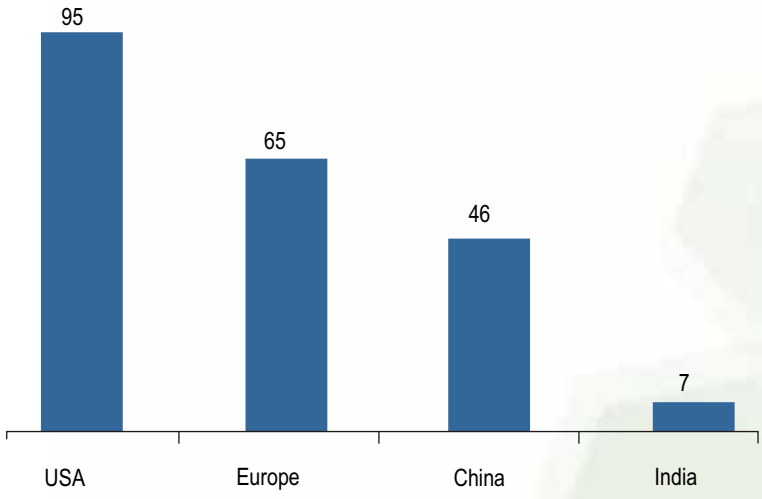
In general, opportunity for Indian plastic and plastic processing industry is promising based on the following parameters:-

1. Low per capita consumption

Plastics find applications in all the major industrial sectors and the demand for plastics is an indication of industrial growth and development. Currently India has a low per capita usage of Plastics, i.e., 7 kg with respect to the global average of 28 kg (Refer Figure IV 1). This represents a significant un-tapped potential in the nation.

An expansion of existing petrochemical complexes & setting up of new crackers is expected to boost the demand further for commodity plastics at a healthy rate.

Figure IV-1: Per capita plastics products consumption (Kg/ person)



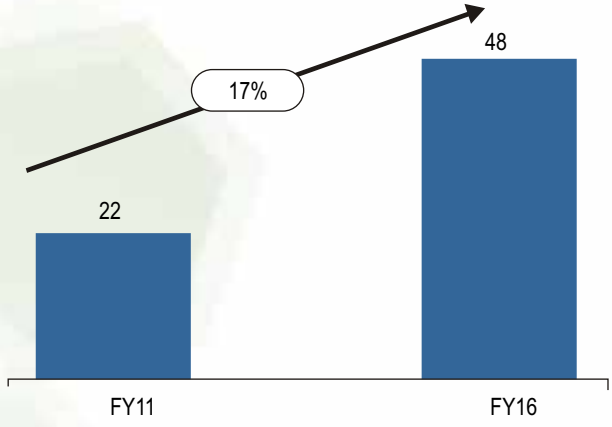
Source : FICCI, Deutsche Bank, Research by Tata Strategic



2. End use industry growth

a. Packaging

Figure IV-2: Packaging industry projection ($ Bn)



Source: Analyst reports, Investor Presentations, Tata Strategic Analysis

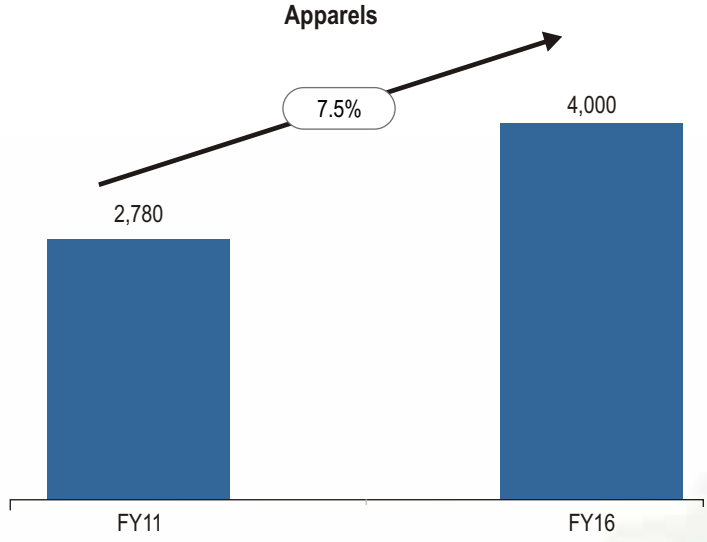
The Indian packaging industry is expected to grow at a rate of 17% p.a. over the next few years to reach a size of $48 Bn by FY16.

The accelerated growth in the future is expected to be driven by robust growth drivers as given below

- Growing end use industries e.g.
  - Home & personal care
  - Packaged food
  - Milk products
  - Pharmaceuticals
- Rising income and changing lifestyle
  - Increase in India's per capita income will lead to more disposable income
  - Increased consumer preference for packaged products
  - India is likely to witness change in food habits with processed foods finding more acceptance in Indian households
- Potential for increase in per capita consumption of packaging
  - India's current low level of per capita packaging consumption ($15) vis-à-vis global average (~$100) is expected to rise in the future
- Growing organized retail
  - This will enable easier availability of packaged food which will result in higher penetration of packaged foods in Indian households and thus a higher demand for packaging

b. Textile

Figure IV-3: Man-made fibers growth (Million Kgs)



Source: Analyst reports, Investor Presentations, Tata Strategic Analysis

The man-made fibers industry is expected to grow at a steady rate of ~7.5% p.a. over the next few years to reach a size of 4,000 Million Kg by FY16. The key drivers enabling the growth are:

Growth of domestic textile industry

- Increasing per capita spend
  - Domestic spend on clothes is expected to rise in future leading to likely growth in apparel industry at 13-14% p.a. by in next five years. This will consequently lead to growth in man-made fibers industry

Rising demand for technical textiles

- Demand for technical textiles expected to grow at 9-11% p.a. till FY15

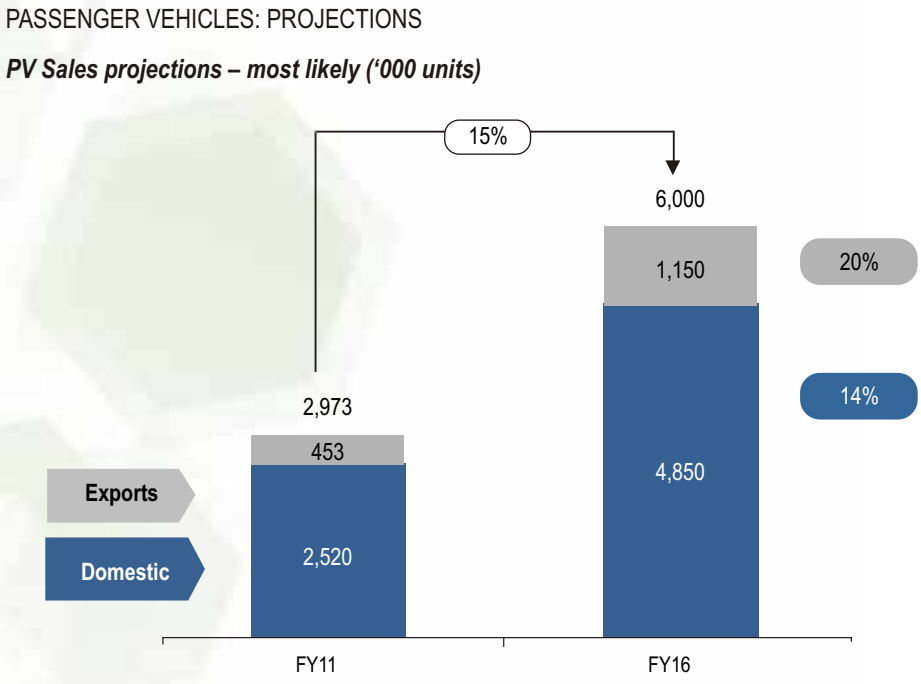
Increasing exports

- In the coming years, India is expected to become a global supply hub for polyester

The technical and high performance textiles are expected to grow much faster at ~16% p.a.

c. Automotive

Figure IV-4: Passenger vehicles projection ($ Bn)



Source: SIAM, CRISIL, Tata Strategic Analysis

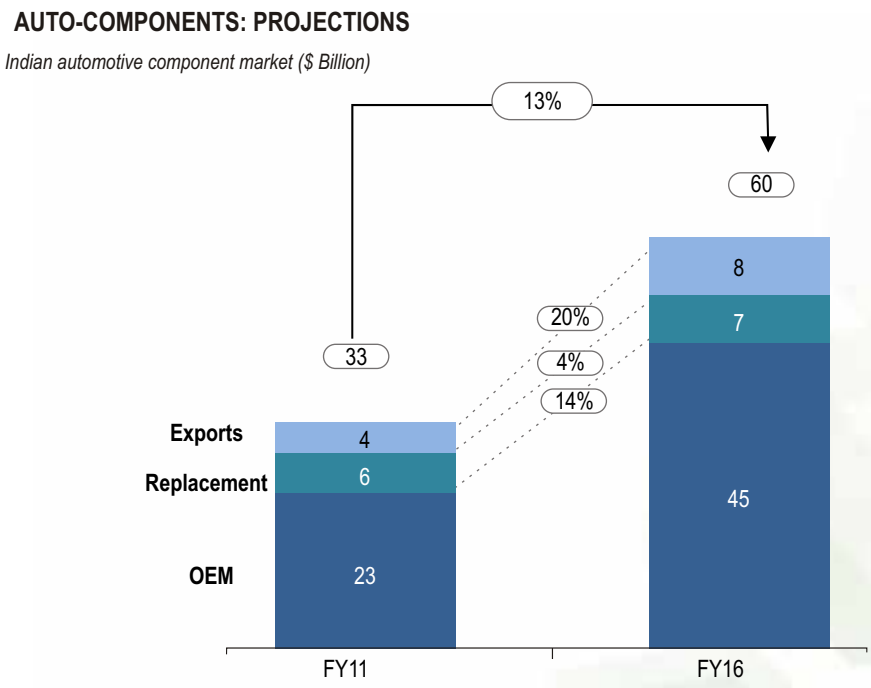
Passenger vehicle sales are likely to grow at a ~15% p.a. over the next five years to reach 6 million in FY16. The demand is expected to increase with economic and industrial development. Also, as India has low per capita vehicle ownership (passenger car stock of only around 13 per 1,000 populations), it possesses substantial potential for growth.

The key drivers enabling the growth are:

- Rising per capita income
  - Rapidly growing middle class and increasing disposable income leading to greater affordability
- Increased urbanization
  - Inadequate mass transportation infrastructure and increasing urbanization will also contribute to higher passenger vehicle domestic sales
- Increasing customer reach
  - With companies focusing on expanding dealer network and financers increasing their reach, previously untapped markets are now accessible

- Rising exports
  - Apart from domestic market, India's emergence as a hub for small cars supplying to world market is an important growth driver for exports
- Focus on R&D and product development is increasing

Figure IV-5: Auto-component industry projection ($ Bn)



Source: Crisinfac, ACMA, Tata Strategic Analysis

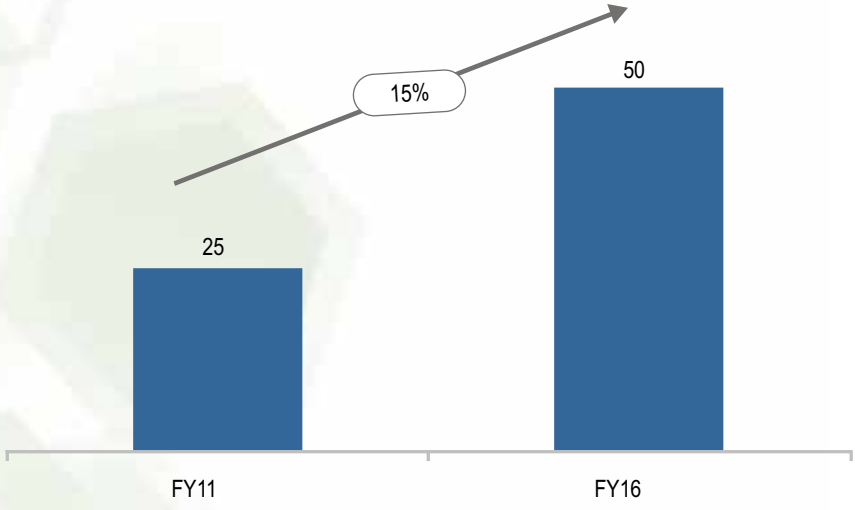
The Indian auto component industry is poised for robust growth till FY16. Strong domestic automobile industry growth indicates likely doubling of the India auto component industry by FY16. The industry is expected to grow at a steady rate of ~13% p.a. over the next five years to reach a market size of ~$60 billion by FY16. Exports are expected to grow the fastest at 20% p.a. over the next five years to reach a market size of $8 Bn. OEMs are expected to continue to account for the maximum share in the overall auto component market.

The key drivers enabling the growth are:

- Emergence of India as a manufacturing hub for small cars is expected lead to a surge in the auto component industry also
- Surge in exports expected with key Free Trade Agreements coming into effect
- Growing domestic demand for automobiles

d. Electronics

Figure IV-6 : Electronics industry projection ($ Bn)



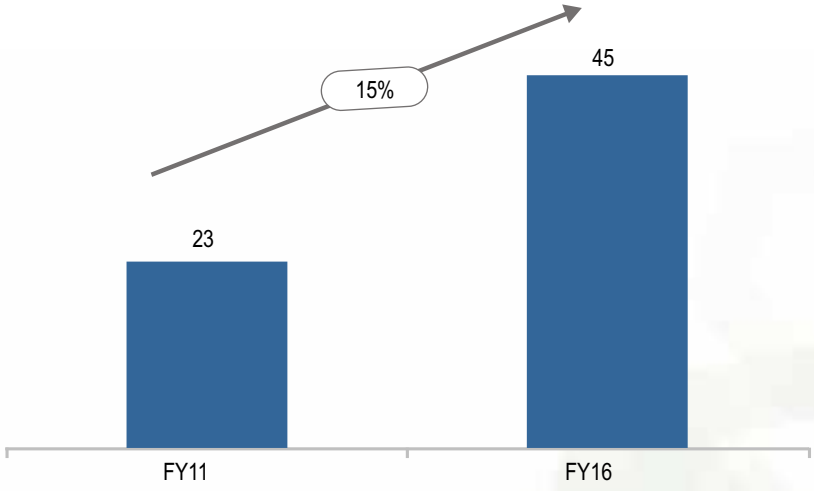
Source: Euromonitor, Images retail, Tata Strategic Analysis

Indian consumer electronics market is expected to grow at a robust pace of 15% p.a. over the next few years to reach a size of $50 Bn by FY16. The key drivers enabling the growth are

- Favorable demographics
  - Currently, over 30% of population is under 14 years. This factor combined with a rapidly growing middle class and increasing disposable income is expected to fuel the demand for consumer electronics
- Increasing usage of consumer electronics products
  - Low penetration rates for consumer electronics provides huge opportunities for companies
  - Relatively untapped rural markets provide opportunities to tap the latent demand for consumer durables
- Rapid increase of organized retail
  - Increasing expansion by regional multi-brand retailers e.g. Vijay Sales in Western India and Vasanth & Co., Viveks in South India is expected to lead to easier availability and cheaper options to consumers
  - Significant growth in single brand stores, e.g. Sony World (500 in 2008), Nokia Priority Centers (1,500 in 2008)
- Technology & Product Innovation
  - Shorter product innovation cycles & wider choice of products is leading to frequent upgrades by customers

e. Pharmaceuticals

Figure IV-7 : Pharmaceuticals industry projection ($ Bn)



Source: Crisil, Industry reports, Tata Strategic Analysis

The Indian pharmaceuticals sector is expected to grow at 15% p.a. over the next few years to reach a size of $45 Bn in Fy16.

The key drivers enabling the growth are:

- Increased Active Pharmaceutical Ingredients exports to regulated market
  - Exports are expected to grow at a brisk pace of 25% p.a. over the coming few years
  - A large number of drugs going off-patent in next 5 years will facilitate exports
- Increased formulation exports
  - Increasing global demand for generics
  - In the recent years India has been receiving a lot of new drug approvals which is evident from the fact that it had more than a third of total Abbreviated New Drug Application approvals globally in 2010
- Increased demand for formulations in domestic market
  - Given the fast changing lifestyle especially in urban India there is an increased incidence of lifestyle diseases
  - Strong growth in segments such as anti-diabetic, cardio vascular, gynecology and neuro segments

f. Other end usages

Apart from these conventional industries, Plastics consumption opportunity exists in plasticulture applications, Water management, Nursery management, Surface cover cultivation and controlled environment agriculture. Out of total 193.7 million hectares (mha) of cropped area in the country, 62.25mha is under different forms of irrigation sources out of which only about 5mha is under Micro Irrigation. Plastics are still underutilized in the agriculture sector in India @ 1% vis-à-vis 7% in developed countries. Thus there is huge unrealized potential in this sector too.

Factors promoting opportunity in Northern India

a. Increased feedstock availability

IOCL Panipat plant and HMEL Bhatinda plant has given an impetus to feedstock availability in Northern India which had minimal access to feedstock. GAIL also has plans to double its capacity which will further make the feedstock scenario more promising in Northern India. These should certainly lead to increased investments in downstream plastic processing.

b. Macroeconomic trends for end use industry growth

The macroeconomic trends for increase in demand of end use industry are more likely to impact regions of Northern India and Eastern India than rest of India. These two regions are in a growing phase and are facing significant change in lifestyle and in turn growth of domestic end use industries.

c. Current low consumption levels

As observed in Figure III 6, the consumption of plastics in northern India is much lower as compared to national average. Especially consumption of Raffia, Tubular Quenching and Injection Molding PP in North India is below than the national average consumption creating significant opportunity for setting up local units for the same.

India's increased focus on manufacturing is likely to provide boost to downstream plastic processing industries in Northern India too. Increasing urbanization, changing lifestyle and demographic dividend are other factors promoting the opportunity of downstream plastics. Especially in Northern Indian states and near-by states of Bihar and Jharkhand, the lack of plastic processing industries presents a huge unmet opportunity potential.

Following details may be seen in the Annexures attached:

Annexure I: Upcoming major applications of Plastics

Annexure II: Potential Industries that can come up in Northern India based on increased availability of polypropylene

Annexure III: Potential Industries that can come up in Northern India based on increased availability of polyethylene

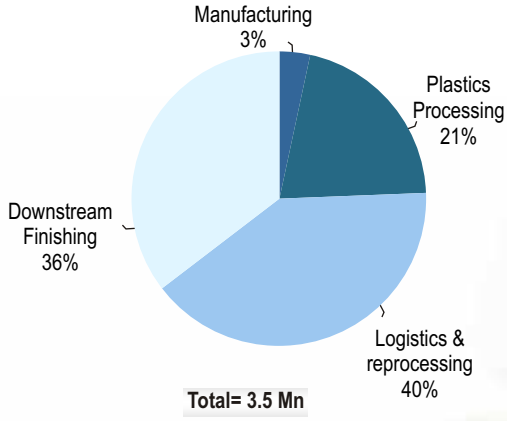
Employment potential





Currently, the Indian plastics industry provides employment to more than 3.5 Mn people both directly and indirectly (Refer Figure V 1). The major share of this large scale employment comes from the downstream plastics processing sector of this industry. The rough estimates for direct and indirect employments are ~0.9 Mn and ~2.6 Mn respectively.

Figure V-1 : Employment statistics from plastics (%), FY11



Source: Report of the Sub-group on Petrochemicals for the 12th Five Year Plan

The direct employment comes from manufacturing and the downstream processing i.e. plastic processing units converting commodity polymers into end products.Manufacturing mostly requires highly skilled workforce such as Engineers, Scientists, PhDs, Accountants, Technicians, MBA, etc. Plastic processing requires a mix of skilled and un-skilled employees. On an average a typical processing unit requires 16% of skilled, 35% of semi-skilled and 49% of un-skilled manpower. Presently India has 23000 small/medium and large converting units. These converting units employ from 10-15 to 130-150 people in one units (Refer Table V 1). Typical distribution of manpower, as per the skill, in select types of these units is given below.

Table V-1: Employment Generation in Downstream Processing Industry, FY11

S.No	Type of unit	Management	Production	Operator	Labour	Sales/ Purchase	Admin	Account	Misc.	Total
1	BOPP Film	1	15	30	60	6	2	2	6	122
2	Raffia Tape Line	1	2	2	50	2	1	2	4	64
3	HDPE Pipe	1	2	2	18	2	2	2	4	33
4	Compounding (SS)	1	1	2	20	2	1	2	4	33
5	Compounding (TS)	1	1	2	20	2	1	2	4	33
6	Air Bubble Film	1	1	2	20	2	1	1	4	32
7	PVC Calendering	1	2	4	16	2	1	2	4	32
8	RPVC Pipe (SS)	1	2	2	18	2	1	1	4	31
9	RPVC Pipe (TS)	1	2	2	18	2	1	1	4	31

Source: Report of the Sub-group on Petrochemicals for the 12th Five Year Plan

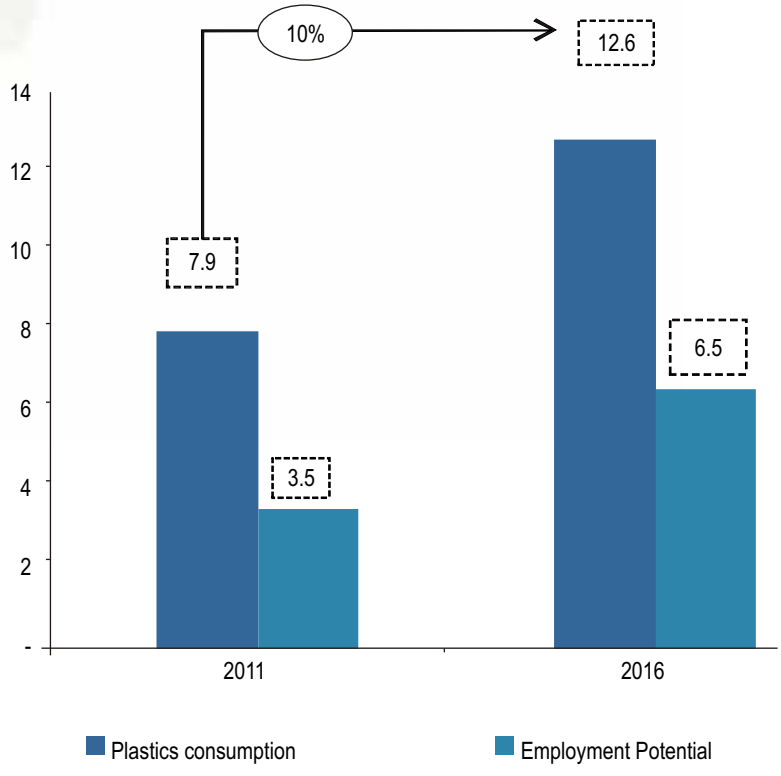
The major segments of indirect employment are logistics and reprocessing. The logistics sector mainly concerns with movement of manufactured goods. Unlike the building blocks, i.e., ethylene and propylene (captive consumption), commodity polymers are required to be transported from manufacturing plants to converting units. These units are usually located at a distance of 1 day to 7 days travel from the polymer manufacturing site. The current plastics consumption, i.e., ~ 8 Mn TPA leads to requirement of almost 5800 trucks with 24,000 driver and helpers to transport the goods.

Next largest segment of employment is reprocessing sector. Here the indirect employment potential comes from segregation and cleaning/washing of plastic waste. India has ~3500 recycling units in organized sector and 4000 units in unorganized sector. These units reprocess app 3.5 MMTA of plastics. The employment by these units is roughly 600,000 in direct employment and 10, 00,000 in indirect employment.

Future Prospects:

Indian petrochemical industry is expecting large capacity additions in coming years to cater the increased domestic demand. Consumption of plastics is expected to grow at ~10% p.a. in coming 5 years (Refer Figure V 2). This will result in generation of a large scale employment for ~1.8 Mn people. The major share of employment will come from direct processing and logistics segments.

Figure V-2 : Future Employment Potential from plastic industry



Source: Report of the Sub-group on Petrochemicals for the 12th Five Year Plan, Analysis by Tata Strategic

Challenges for plastics industry in Northern India





1. Addressing environmental myths

While the usage and benefits of plastics are manifold, it invariably gets branded as a polluting material. The myth regarding the polluting characteristic of plastics needs to be addressed. Plastics are chemically inert substances and they do not cause either environmental or health hazards. If plastics can be collected and disposed of or recycled as per laid down guidelines/rules then the issue of plastic waste can be suitably addressed. In fact there is wide scope for industries based on re-cycling of plastics waste.

2. Technology needs

Technology needs are not particularly pertinent only to Northern India; they are the common need across India. The Indian Plastic processing industry has seen a shift from low output/low technology machines to high output, high technology machines. There has been some major technological advancement of global standards leading to achievements like;

- World's largest integrated Clean Room FIBC manufacturing facility
- World's largest water tank manufacturer in India. The Indian market is world largest market for rotomolded water tanks.

However, India's technology needs are critical in areas like high production andautomatic blow molding machines, multilayer blow molding, Stretch/ Blow Moulding Machines, specific projects involving high CAPEX like PVC calendaring, multilayer film plants for barrier films, multilayer Cast lines, BOPP and Nonwoven depend solely on imported technology/machinery. Other technological needs are:

- Multilayer blown film line up to 9/11 layers
- Automatic Block bottom bags production line
- Higher tonnage Injection Moulding machine >2000 T
- Higher tonnage >500 T all electric Injection Moulding machines

3. Price pressure

The profits of plastics processing industry is facing tough times because of increased input prices. Increase in crude oil prices along with the continuous fall in rupee value has led to lowering profits in spite of higher volume realizations. This volatility has resulted in more export focus of manufacturer for plastic products. The export of plastics products in 2011-12 has observed a growth of ~47% as compared to 2010-11. The total export has reached ~$ 6,500 Mn (estimated value for FY12).



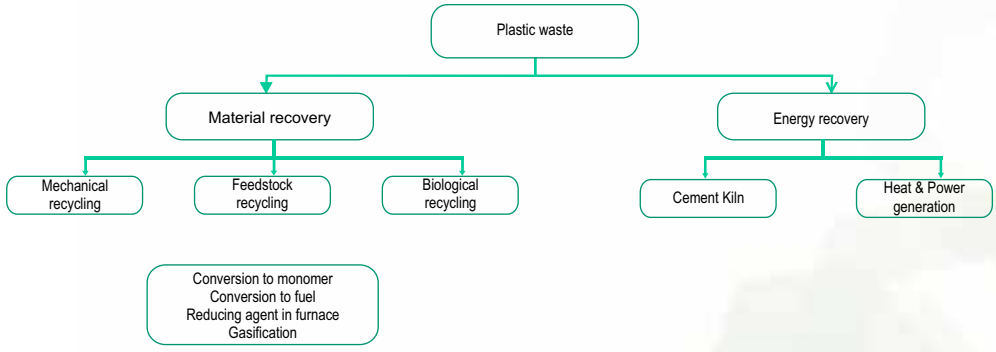
Recycling of plastics





Recycling of plastics is one of the foremost steps towards innovation and sustainability in this industry. Currently in India, number of organized recycling units for plastics is ~3,500 along with additional ~4,000 unorganized recycling units. Most of the plastics (PE, PP, PVC, PET, PS, ABS, PMMA) etc. could be recycled via mechanical route. Whereas, engineering plastics like PBT, SAN and Nylon etc. are recycled by selected recyclers. In India, recycling of plastics is currently 3.6MnTPA and it provides employment to almost 1.6 Million people (0.6 million directly, 1 million indirectly). The following figure shows the plastic recycling diagram. (Refer Figure VII 1)

Figure VII-1: Plastic recycling flow diagram



Source: Industry reports, Tata Strategic Analysis

The collection & segregation of recyclable waste is one of the important steps in taking this further. Many a times, households and establishments throw the waste on the street or dump it in open without segregating the waste which reduces the quality and at times could make it hazardous.It is essential to save the recyclable waste material from going to the waste processing and disposal sites and using up landfill space. Salvaging it at source for recycling could make profitable use of such material. This will save national resource and also save the cost and efforts to dispose of such waste. An optimum way to achieve it is by forming a habit of keeping recyclable waste material separate from food waste and other bio-degradable wastes, in a separate bag or bin at the source of waste generation, by having a two-bin system for storage of waste at homes, shops and establishments where the domestic food waste (cooked and uncooked) goes into the Municipal Solid Waste collection system and recyclable waste can be handed over to the waste collectors (rag-pickers) at the doorstep for transporting the same to the recyclers.

The Life Cycle Analysis of various plastics products reveals that plastics create lesser environmental pollution in the atmosphere compared to the alternatives. Energy consumption, emissions of Green House Gases like CO2 and CH4, quantum of water usage - in allparameters plastics create lesser foot print on earth.

Currently only ~40% of plastics produced is used for recycling whereas the potential is much higher. Also given that the expected growth rate of plastics consumption is almost more than 10%, the scope of recycling of plastics is huge.

Some form of plastics like plastics in packaging applications, plastics for some one-time use - like cups, plates etc. create waste management problems when the discarded plastics materials are not disposed of properly. Very thin plastic bags, though recyclable, are often left behind by the waste pickers due to economic reason. These very light weight plastic film waste do not pay a reasonable return to the waste pickers and hence they avoid picking these up. To avoid this problem, MoEF, Government of India had come up with rules in September 1999, restricting the thickness and size of plastic carry bags. These Rules have undergone modifications in June 2003 and later in 4th February, 2011 amended 2nd July, 2011. In the recent rules manufacturers and brand owners who use such bags have been made responsible for the waste management activity along with the Municipality / Local Bodies. Some state governments have also completely banned the use of plastic carry bags.

However the real solution should lie in segregation of waste at source and promoting creation of waste management infrastructure coupled with investment in developing recycling centers. Best practices of other developed nations could be adopted for packaging waste, which follow a covenant of better product design to ensure reduction, re-use and recycling of packaging materials. There is also a need for public awareness and discipline towards recycling of plastic waste. Responsibility for increasing awareness lies on both government as well as industry. Maximum participation of all stakeholders is very important to tackle the issue of Plastics Waste Management. The support of successful NGOs can be adopted as role model and emulate similar system at different parts of the country through PPP mode by involving NGO, Municipal Corporation, the respective State/Central Govt.

Going ahead it is expected that the awareness of consumers and support from government is likely to increase the recycling of plastics and increase the magnitude of plastic waste management.





Conclusion

Commodity plastics comprising of Polyethylene (PE), Polypropylene (PP), Polyvinyl Chloride (PVC) and Polystyrene account for bulk of the plastic consumption in India. India has ramped up its production capacity for plastic to reach 2.9 MnTPA for PE, 3.5 MnTPA for PP and 1.3MnTPA for PVC. IOCL Panipat refinery has been a game changer and along with upcoming HMEL Bhatinda plant and GAIL capacity expansion at Auriya it will increase the supply of plastics in Northern India. With sufficient supply of plastics, the focus should now be on the downstream plastic processing industries and how do they strategically grow.

There are several factors like low per-capita consumption, manufacturing focus, end use industry growth, availability of feedstock, increasing urbanization, changing lifestyle, demographic dividend etc. promoting growth of plastic across India. However specific to Northern India we observe a lack of planned downstream plastic processing plants within the region and near-by regions of Eastern India to make use of these factors. Spill off benefit of promoting plastic processing is the huge inherent employment potential.

Many application areas of plastics also have overlaps that make market driven material substitution a good possibility. There are strategic objectives driven by part consolidation and sustainability compulsions by the user industry that have made material selection converge to a polymer to promote recycling. An organized development addressing cost effective plastic processing along with streamlining operations of recycling of plastics could pave a growth path for downstream plastic manufacturers in Northern India.

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About Tata Strategic

About Tata Strategic:

Tata Strategic Management Group is the largest Indian Owned Management Consulting Firm. Set up in 1991, Tata Strategic has completed over 500 engagements with more than 100 Clients across countries and industry sectors, addressing the business concerns of the top management. Today more than half the revenue of Tata Strategic Management Group comes from working with companies outside the Tata Group. We enhance client value by providing creative strategy advice, developing innovative solutions and partnering effective implementation.

Our Offerings





Reports co-authored by Avinash Singh and Punit Rathi

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A non-government, not-for-profit organisation, FICCI is the voice of India's business and industry.

FICCI draws its membership from the corporate sector, both private and public, including SMEs and MNCs; FICCI enjoys an indirect membership of over 2,50,000 companies from various regional chambers of commerce.

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Our Vision

To be the thought leader for industry, its voice for policy change and its guardian for effective implementation.

Our Mission

To carry forward our initiatives in support of rapid, inclusive and sustainable growth that encompass health, education, livelihood, governance and skill development.

To enhance efficiency and global competitiveness of Indian industry and to expand business opportunities both in domestic and foreign markets through a range of specialised services and global linkages.



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Annexures

Annexure I: Upcoming major applications of Plastics

Plastics encompass every sphere of our life. Some of the areas where plastics would play a major role in the development of the country are given below:

I) **Agriculture:** Enhancing agricultural productivity to meet growing demand for food and achieving food security for the entire population is one of the key objectives of the country. In addition to using plastics for water conservation through mulching, improving post-harvest handling and packaging to enhance delivery efficiency by reduction of wastages is a key challenge. Plastics are vital inputs in all these areas and only through increased plastics usage can these targets be achieved. Plastic pipes, films, drip systems for micro-irrigation projects, packaging films, crates for handling and storage, etc. can improve agricultural productivity, food preservation and shelf life significantly and contribute to food security in India.

ii) **Water Management:** Making potable water available to both rural and urban population is a key component of the Governments' developmental programs. Efficient water distribution system is a pre-requisite for the same. Plastics can play a key role in the implementation of Government schemes like "Bharat Nirman" and "Rajiv Gandhi National Drinking Water Mission" for rural development and housing.

iii) **Infrastructure:** Improvement of infrastructure will remain a key determinant of sustainability of high growth in India. Improving urban infrastructure, in terms of greater and efficient use of energy, building roads, ports, airports and efficient drainage and sewerage systems along with other components of infrastructure can be made possible by increased use of plastics in different forms like plastic pipes, profiles, geo-textiles etc.

iv) **Public Health:** Role of plastics in helping enhance public health infrastructure isevident the world over. Plastic syringes, blood bags, drip pouches, etc. are central to any health infrastructure. The rural health infrastructure needs to be significantly improved in India and plastics would play a key role in the process.

v) **Conservation:** In fact any sector that uses conventional/natural resources which arelimited can substitute the same with different categories of plastics due to their properties. Across the globe, plastics play a major role in the process of conservation of natural resources like wood, metal, minerals, etc. by providing a cost-effective and environment-friendly alternative to natural resources.

Annexure II: Potential Industries that can come up in Northern India based on increased availability of polypropylene

POLYPROPYLENE

The versatility of Polypropylene enables the material to be converted into end use products through a wide variety of processes. It can be converted into films, injection moulded into diverse shapes and in different sizes, made in sheets, shaped into pipes and other profiles, drawn into fibers; it can be made into woven products like raffia; and non - woven products like wipes and filters; and there are many more ways it can be used to make an endless array of products.

Extrusion is the largest conversion process followed by injection moulding. Large auto parts, appliances components, and many other products used at home are injection moulded from Polypropylene. Polypropylene films and sheets primarily cater to packaging needs. Unlike other Polymers, Polypropylene offers a wide and balanced range of applications.

Polypropylene is an extremely versatile material. Because of this, newer uses continue to be developed replacing materials like metals, glass and other plastics and, the market for Polypropylene continues to expand.

While films and fibers were the first major applications, its versatility ensured very high growth in other areas as well.

Furniture, components used in automotive and appliances, and electrical components are some of the major products made with Polypropylene compounds. The excellent mechanical properties of Polypropylene obtained through compounding enables it to replace many metal parts; for example, Polypropylene, when compounded with long glass fiber, results in a material that is almost as stiff as metal, but nearly seven times lighter.

To the experts, the future of Polypropylene looked bright, right from the start. The well- known publication "Chemical Engineering Progress" had forecast in April 1965 that Polypropylene, along with PE and PVC, would enter "billion pound" plastic club in the early 1970s. And this prophecy has indeed come true!

Polypropylene based compounds are used for manufacturing many large components for cars and commercial vehicles: bumper, grill, front panel, side panel, interior trims, dash board, glove box assembly, etc.

Also interesting are parts of IV (Intravenous) Cannula used primarily for the administration of intravenous fluids, obtaining blood samples and administering medicines are some of the smallest parts made out from Polypropylene.

Some of the properties of polypropylene which makes their use very effective are:-

- Is the lightest thermoplastic
- Has very good chemical resistance; it does not react with most chemicals
- Has an excellent blend of rigidity and flexibility

- Has very good hinge properties, which is why it has replaced metals in many hinge applications
- Provides an excellent moisture barrier
- Is hot fill-able, which means hot liquid can be poured into Polypropylene containers
- Is fully recyclable, making it environment friendly

All these characteristics have made Polypropylene a common plastic in modern life, wherever we live and whatever we do.

Development of new generation catalysts and highly efficient production processes were matched by improved technologies in downstream industries. As a result, various types of Polypropylene resins were developed. It is now possible to make Polypropylene of different grades with widely varying properties. Functional additives could be mixed with Polypropylene to make compounds with properties which had been unimaginable even a few years ago. As a result, newer grades of Polypropylene became available, which were required by manufacturers of moulded luggage, appliances, batteries, and many other components for automobiles.

One such special type that was developed was impact Polypropylene. Traditional Polypropylene Homo polymers do not have high impact resistance. Polypropylene Copolymers were developed with high impact resistance, which made them eminently suitable for automobile bumpers, luggage, moulded furniture, buckets and other applications.

Similar advances in technology have created a wide variety of Polypropylene, making it an ideal material of choice for many applications that had been unthinkable in the past and the quest for newer application continues.

It took the industry almost a decade to reach on annual capacity of one million tons. In 1968, with major production facilities in the USA and Europe, and nominal capacities in Asia and other parts of the world, the global capacity was 1.09 million tons. By 1988, the industry reached 10 million tons per annum of production capacity.

Since then, growth has been spectacular; global capacity jumped to 30 million tons in 1999, and reached almost 60 million tons in 2010 - adding ten million tons every five years.

In recent years, India's importance in the global economy has steadily increased. Stable economic growth, a burgeoning middle class and liberalization of the economy have created hitherto unknown opportunities in India, and for the Indians.

Growing urbanization, a large educated population and open media have created aspirations for products and services that can only grow. As a result, industries like automobiles, appliances, packaging and others are large, stable and have enjoyed double- digit growth over the post decades.

Government policies are now industry-friendly, and private industry participation infrastructure is being actively encouraged, as witnessed by the creation of special economic zones and other opportunities. India's large, trained and skilled work force is acknowledged to be an asset in every sector.

The future of Polypropylene in India is indeed promising and its growth should continue to be spectacular.

Annexure III: Potential Industries that can come up in Northern India based on increased availability of polyethylene

POLYETHYLENE (PE)

Polyethylene is the most common thermoplastics material widely used in Polymer Industry for its versatility nature. It consists of long hydrocarbon chain of chemically repeated units known as monomer. The monomer is very simple hydrocarbon Ethylene. Ethylene can be prepared either by the hydrogenation of acetylene or by the dehydration of ethanol. It is produced from petroleum products viz. Naphtha or from Natural gas by the process of cracking. In this process, saturated hydrocarbons such as ethane or propane undergo catalytic degradation and dehydrogenation, forming ethylene. Ethylene is a gas at room temperature.

Polyethylene is classified into several different categories based mostly on density and branching. PE can be of low density, linear low density and high density. Low density polyethylene consists of molecules with branches, whereas the high density variety is essentially linear. Linear Low Density Polyethylene (LLDPE) has many short chain branching along the main chain and hence behaves differently to LDPE ad HDPE.

LDPE : It was the first grade of PE produced at ICI Laboratory using a high pressure process via free radical polymerization. LDPE has more branching of various sizes and has a few long braches also. Therefore, Low-density polyethylene melts at 110 to 125 ºC and is only around 40% crystalline. The density is around 0.91 to 0.924g/cc. While practically no solvent dissolves it at room temperature, several solvents can do so at high temperatures. Some of the useful solvents for polyethylene at high temperatures are carbon tetrachloride, toluene, xylene decline and trichloroethylene.

HDPE : High density polyethylene is produced in slurry process for the first time using chromium type Philips catalyst. Later Hoechst developed first industrial scale HDPE production plant by using Ziegler Titaium based supported catalyst. Subsequently solution and gas phase process developed by various licensors to produce HDPE and LLDPE in swing plant. HDPE density ranges from 0.940 to 0.965 gms/cc and has a melting point in the range of 144-150 ºC. Depending on the molecular weight, HDPE is also sub-classified as HDPE, HMHDPE, and HMW HDPE. HDPE is produced in solution and gas phase plants normally in a swing concept with LLDPE. HMHDPE is a versatile material finds unique applications like High Pressure Piping, Small, Medium and Large Blow Moulding, Thin Film Carry bags etc. HDPE is much stiffer than LDPE and LLDPE. HDPE has higher tensile strength and hardness. Chemically, it is more resistant than the low-density variety and has significantly lower gas permeability.

LLDPE : LLDPE is a linear Polyethylene with significant number of short chain branching, commonly made by copolymerisation of ethylene with longer chain olefins viz Butene-1 (C4), Hexene (C6) and Octene (C8). LLDPE differs structurally from conventional LDPE because of absence of log chain branching. In general, LLDPE is produced in low pressure process by transition metal catalysts, particularly Ziegler or Phillips with a comparatively narrow molecular weight distribution and significantly different rheological property. Comonomer type also influences LLDPE property remarkably in finished products. Offlate, a unique metallocene catalyst developed for LLDPE which

offers remarkable properties in terms of mechanicals, sealing properties and hence replacing traditional C4/C8 LLDPE in flexible packaging applications at present.

LDPE is very flexible and has excellent optical properties. LLDPE has high melt viscosity and hence difficult to process compared to other Polyethylene. LDPE has excellent melt strength because of presence of long chain branching, typically suitable for Blown film applications, exhibits strain hardening behaviour.

LLDPE has better mechanicals and better environment stress cracking resistance. It is the material of choice in flexible packaging applications viz. Milk, Oil, Vanaspati, ready to eat sacks because of its very good hot tack properties useful in high speed FFS machine. LLDPE also supports material saving trend without affecting quality much and hence it is the material of choice due to its down gauging possibilities in thin film.

In view of its superior properties, LLDPE has penetrated almost all traditional markets of PE like flexible packaging viz. stretch wrap, cling wrap film applications.

LLDPE is also preferred in rotational moulding application viz. Overhead tanks, loft tanks etc due to its unique combination of characteristics of processability with desired mechanical strength to outdoor application.

Cross linked Polyethylenes are also developed with LLDPE, LDPE combination for medium, high voltage cables.

In order to simplify the flexible film segments, extrusion coating of LLDPE/LDPE is growing replacing traditional adhesive lamination used in different segments.

To summarize characteristics and hence material of choice in different applications, it may be tabulated as give below :

Polyethylene Application Spectrum

Processing Technique	Application	Material of choice	Favourable Characteristics
Inj Molding	Crates, Household articles	HDPE	Rigid, Good impact strength
	Flexible baskets, Lids	LLDPE	Flexibility
Blow Film	Liquid Packaging - Milk, Oil etc	LLDPE + LDPE (HDPE is used as barrier layer where shelf life requiremet is high)	Flexibility, Hot tack strength need for FFS packing.
	Stretch Film, Cling Film, Soft Shopping bags	LLDPE	Flexible and good mechanical
	Shrink Film	LDPE	Shrinkability
	Shopping Bags, Jhabla bags	HDPE (High Molecular Weight)	Excellent load bearing capability, dowgauaging
	Wide width film for Greenhouse, Canal Lining	LDPE	High melt strength, Flexibility, Barrier to moisture
Extrusion Coating	Raffia , Film lamination, Sand witch of two substrates	LDPE+LLDPE	Bonding
Rotational Moulding	Over head tanks	LLDPE	Rotational mouldability to Strength balance
Powder Coating	Metal appliances, Metallic houseware	LDPE	Adhesion
	Fabric	LLDPE+LDPE	Adhesion , desired stiffness
Pipes	PE-100. PE-80 pipe for water , gas distribution	HDPE	Unique resistace to creep and hence used for 50 yrs life.
	Sprikler Pipe	HDPE	
	Drip Laterals	LLDPE	
Blow Moulding	Small to large volume container upto 230 Litres	HDPE, HMHDPE	Melt strength, Excellent drop impact strength.
Raffia Extrusion	Fertiliser Bag, Tarpaulin	HDPE	Orientation to give strength, UV stability on outdoor exposure.
Compression Moulding	Liners for Heavy industries, Dumpers etc	UHMHDPE	Excellent resistance to abrasion, chemical resistance, low COF
Compounding	Carrier resin for MB	LLDPE (High MFI)	Excellent let down ratio.
	XLPE medium. High voltage cable	LLDPE	Cross linkability due to presence of short chain branching.

History of Polyethylene

- LDPE first discovered accidentally in 1932 at ICI Chemicals Laboratory.
- First commercial production started in 1939 , just as World War II started.
- HDPE discovered in 1951 by P. Hogan and R. Banks
- Mid 1950s: commercial HDPE production in slurry process (Hoechst) and solution process (Phillips Petroleum)
- 1961: slurry loop reactor technology by Phillips Petroleum
- 1968: first gas phase process by Union Carbide
- Mid 1970s: first LLDPE process by Union Carbide
- Metallocene-based catalysts discovered by Kaminsky and Sinn in 1975-1980
- 1995 : First commercial metallocene catalyst based LLDPE produced wherein LLDPE property enhanced significantly.