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

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INDEX

TABLE

FIGURE

Abbreviations

1	2-EH	2-Ethyl Hexanol
2	ABS	Acrylonitrile Butadiene Styrene
3	ACC	American Chemistry Council
4	ACN	Acrylonitrile
5	AL	Adhesive Laminates
6	AMC	Ahmedabad Municipal Corporation
7	AP	Asia Pacific
8	APIC	Asian Petrochemical Industry Conference
9	ASEAN	Association of South East Asian Nation
10	BIS	Bureau of Indian Standard
11	BMC	Bombay Municipal Corporation
12	BOPP Film	Biaxilly Oriented Polypropylene
13	BPA	Bisphenol-A
14	BPCL	Brahmaputra Chemical Petrochemical Ltd/Bharat Petroleum
15	BR	Butyl Rubber
16	BTU	British Thermal Unit
17	BTX	Benzene Toluene Xylene
18	C1	Methane/Methanol
19	C2	Ethylene
20	C3	Propylene
21	C4	Butene/Butadiene
22	C5	Pentene/Cyclopentene
23	C6	Benzene/Hexene
24	C7	Toluene/Heptene
25	C8	Xylene/Octene
26	CAFÉ	Corporate Average Fuel Efficiency
27	CARG	Cumulative Annual Rate of Growth
28	CD	Compact Disk
29	CE	Central Europe
30	CECA	Central Economic Cooperation Agreement
31	CEPA	Comprehensive Economic Partnership Agreement
32	cf	Cubic Feet
33	CIPET	Central Institute of Plastics Engineering & Technology
34	CMAI	Chemical Marketing Associates Inc
35	CO2	Carbon Di-Oxide
36	COE	Centre of Excellence
37	CPCL	Chennai Petroleum Corporation Limited
38	CPMA	Chemicals & Petrochemicals Manufacturer’s Association
39	CPP Film	Cast Polypropylene Film
40	CPRI	Central Potato Research Institute
41	CR	Chlorinated Rubber
42	CSIR	Council of Scientific Industrial Research
43	CST	Central Sales Tax
44	CTV	Colour Television

45	DCM	DCM Shriram Industries Limited
46	DCPC	Department of Chemical & Petrochemical
47	DEG	Di-Ethylene Glycol
48	DIN	European Standard
49	DMT	Di-methyl Terephthalate
50	DSIR	Department of Science Industrial Research
51	DTH	Delhi Test House
52	DVD	Digital Video Disk
53	EC	Extrusion Coating
54	EDC	Ethylene-Di-Chloride
55	EDP	Entrepreneur Development Programme
56	EIL	Engineers India Limited
57	EO	Ethylene Oxide
58	EoS	East of Suez
59	EPDM	Ethylene Propylene Di Monomer
60	EPS	Expanded Polystyrene
61	EU	European Union
62	EVA	Ethyl Vinyl Acetate
63	F&F	Fibre & Filament
64	F&V	Food & Vegetable
65	FCC	Fluidized Catalyst Cracker
66	FIBC	Flexible Intermediate Bulk Container
67	FMCG	Fast Moving Consumer Good
68	FSU	Former Soviet Union
69	FTA	Free Trade Agreement
70	GAIL	Gas Authority India Limited
71	GCC	Gulf Cooperation Council
72	GDP	Gross Domestic Product
73	GI	Galvanised Iron
74	GIDC	Gujarat Industrial Development Corporation
75	GOI	Government of India
76	GP	General Purpose
77	GST	Goods Services Tax
78	HAD	Hydro-de-alkylation
79	HAO	High Alpha Olefins
80	HD	Heavy Duty
81	HDPE	High Density Polyethylene
82	HMEL	HPCL Mittal Energy Limited
83	IARI	Indian Agriculture Research Institute
84	IBB	Iso Butyl Benzene
85	ICAR	Indian Council of Agriculture Research
86	ICI	Imperial Chemical Industries
87	ICMR	Indian Council of Medical Research
88	ICP	Impact Co-Polymer
89	ICPE	Indian Centre of Plastic & Environment
90	IEMC	Indian Energy Management Consultant
91	IERI	Institute of Economic Research on Innovation
92	IGSMRI	Indian Grain Storage Management Research Institute
93	IICT	Indian Institute of Chemical Technology

94	IIP	Indian Institute of Packaging
95	IIP	Indian Institute of Petroleum
96	IIT	Indian Institute of Technology
97	IM	Injection Moulding
98	IOC	Indian Oil Corporation
99	IPCL	Indian Petrochemicals Corporation Limited
100	ISO	International Standard Organisation
101	ITC	Indian Tobacco Company
102	ITRC	Indian Toxicology Research Centre
103	JNPT	Jawahar Lal Nehru Port Trust
104	JPMA	Jute Packaging Mandatory Act
105	KPI	Key Performance Indicators
106	KT/kt/Kt	Kilo Tonnes (1000 MT)
107	LAB	Linear Alkyl Benzene
108	LCA	Life Cycle Analysis
109	LCP	Liquid Crystalline Polymers
110	LDPE	Low Density Polyethylene
111	LLDPE	Linear Low Density Polyethylene
112	LNG	Liquefied Natural Gas
113	LPG	Liquefied Petroleum Gases
114	MCM	Million Cubic Meter
115	ME	Middle East
116	MEG	Mono Ethylene Glycol
117	MI	Micro Irrigation
118	MLL	Metallocene Linear Low Density Polyethylene
119	MMA	Methyl Methyl Acrylates
120	MOEF	Ministry of Environment and Forest
121	MP	Milk Packaging
122	MRPL	Mangalore Refinery Petrochemical Ltd
123	MSW	Municipal Solid Waste
124	MT	Metric Tonne (1000 kgs)
125	MTBE	Methyl Tertiary Butyl ether
126	MTO	Methanol to Olefins
127	MTP	Methanol to Propylene
128	MWH	Mega Watts Hour
129	NA	North America
130	NBR	Nitrile Butadiene Rubber
131	NCL	National Chemical Laboratory
132	NEA	North East Asia
133	NFY	Nylon Filament Yarn
134	NGL	Natural Gas Liquid
135	NIY	Natural Intermediate Yarn
136	NKID	New Kolkata International Development
137	NMC	National Manufacturing Council
138	NOCIL	National Organic Chemical Industries Limited
139	NRCOG	National Research Centre for Onion & Garlic
140	NSI	National Sugar Institute
141	OECD	Organisation of Economic Co-operation Development
142	ONGC	Oil & Natural Gas Commission

143	OPAL	ONGC Petro Additions Limited
144	OX	Ortho Xylene
145	PA	Poly Acetal
146	PA	Pthalic Anhydride
147	PBR	Poly-Butadiene Rubber
148	PBT	Poly butadiene Terephthalate
149	PC	Polycarbonate
150	PCPIR	Petroleum Chemical Petrochemical Investment Region.
151	PE	Polyethylene
152	PEEK	Poly Ether Ether Ketone
153	PEI	Poly Ether Imide
154	PEN	Polyethylene Napthalate
155	PES	Poly Ether Sulphone
156	PET	Polyethylene Terephthalate
157	PF	Phenol Formaldehyde
158	PFY	Polyester Filament Yarn
159	PIY	Polyester Intermediate Yarn
160	PLA	Poly Lactic Acid
161	PMMA	Poly Methyl Metha Acrylate
162	PP	Polypropylene
163	PPCP	Polypropylene Copolymer
164	PPE	Poly Phynylene Ether
165	PPO	Polypropylene Oxide
166	PPP	Public Private Partnership
167	PPR	Polypropylene Random
168	PPS	Poly Phenyl Sulphide/Sulphone
169	PRDF	Petroleum Research Development Fund
170	PS	Polystyrene
171	PSF	Polyester Staple Fibre
172	PTA	Pacific Trade Agreement
173	PTA	Preferential Trade Agreement
174	PTA	Purified Terepthalic Acid
175	PTE	Polyester-based Thermoplastic Elastomer
176	PVC	Polyvinyl Chloride
177	PVOH	Poly Vinyl Alcohol
178	PX	Paraxylene
179	R&D	Research & Development
180	RCC	Reinforced Concrete Cement
181	RCP	Random Co-Polymer
182	RPET	Recycled Polyethylene Terepthalate
183	RTA	Road & Transport Authority
184	SA	South Asia
185	SAFTA	South Asian Free Trade Agreement
186	SAN	Styrene Acrylonitrile
187	SBR	Styrene Butadiene Rubber
188	SCI	Sustainable City Investment
189	SEA	South East Asia
190	SEZ	Special Economic Zones
191	SSP	Solid State Polymerisation

192	STDP	Selective Toluene Dispropionate
193	TCF	Trillion Cubic Feet
194	TDF	Technology Development Fund
195	TDI	Toluene Di-Isocynate
196	TDP	Toluene Dispropionate
197	TPA	Tonnes per Annum (1000 kgs/annum)
198	TPE	Thermoplastic Elastomers
199	TQ Film	Tubular Quench Film
200	UHMW-PE	Ultra High Molecular Weight-Polyethylene
201	UNCTAD	United Nation Council of Trade and Development
202	USAID	United States Aid for Industry Development
203	VAM	Vinyl Acetate Monomer
204	VAT	Value Added Tax
205	WE	West Europe
206	WoS	West of Suez

1 Executive Summary

1.1 Preamble

1.1.1 Petrochemicals play a vital role in economic development & growth. Output of global petrochemical industry valued at 1.3 trillion US$, is growing @ 5.3 %. The growth is closely linked to economic growth of the economy. Global petrochemical industry is currently growing at 1.2 – 1.3 times the global GDP growth.

1.1.2 Range of products and usages of petrochemicals is extremely wide and diverse. Petrochemicals are broadly categorized into building blocks, plastics, synthetic rubbers, synthetic fibers, fiber intermediates and basic chemicals.

1.1.3 Petrochemicals are enablers for growth of other sectors of the economy. Sectors like agriculture, housing, textile, health-care, infrastructure, consumer goods use a variety of petrochemical products for their versatility, cost efficiency and affordability. The industry is the primary source of synthetic materials that are essential to support the present level of human development across the globe.

1.1.4 While the industry has matured in the developed world, with growth equaling or marginally ahead of GDP growth, it is the emerging economies that are currently driving the growth. In this Asia, with its large and growing market, and Middle East, with its major feed-stock advantage driven by state subsidy, had been the prime mover for the growth of the industry.

1.1.5 In the early stage of its development, coke ovens and renewable feedstock like ethanol derived from molasses were the source of feedstock for this industry. Since then it has come a long way and the existing petrochemical plants in the world are mainly based on naphtha or natural gas with some renewed interest in renewable as well as alternative feed-stocks like coal.

1.2 Global Scenario

1.2.1 Basic petrochemicals fall in two major categories – Olefins and Aromatics. Olefins comprise of Ethylene, Propylene, Butadiene and alpha olefins like Butene, Octene and Hexene. These are used for production of Polymers as primary building blocks or as co-monomers.

1.2.2 Ethylene and Propylene are the two major building blocks. While Ethylene is derived from Naphtha or Gas Crackers, Propylene is derived as a co-product from Naphtha Cracker and from Refinery FCC streams. There are also alternative on-purpose routes commercially available (e.g. Propane Dehydrogenation).

1.2.3 Aromatics comprises of Benzene, Toluene and Xylenes. While Benzene is used for a variety of chemical usages, Paraxylene (PX) is mainly used for production of intermediates for Synthetic Fibers.

1.2.4 Polyester chain is based on PX, the feedstock for production of Purified Terephthalic Acid (PTA) and Di-methyl Terephthalate (DMT). PTA or DMT, along with Mono-Ethylene Glycol (MEG) are used for production of Polyester fibre yarn, PET Chips for bottles and film. Benzene and PX are obtained from Steam Crackers as well as Refineries.

1.2.5 Range of chemicals derived from petrochemical is extremely wide. These comprise of solvents, surfactants and a variety of basic organic chemicals required by downstream sectors like Dyes & Pigments, Paints & Varnishes and Specialty Chemicals.

1.2.6 Ethylene, the primary building block, is often considered a proxy to the overall size of petrochemical industry. Global ethylene capacity was 143 million tonnes in 2010 against a demand of 120 million tonnes. The capacity is expected to increase to 165 million tonnes in 2015 with demand reaching 151 million tonnes.

1.2.7 World Propylene capacity was 94 million tonnes in 2010 and demand at 75 million tonnes. These are expected to reach 113 million tonnes and 94 million tonnes, respectively by the year 2015.

1.2.8 Global demand for Butadiene is estimated to be 9.6 million tonnes, primarily driven by demand for Synthetic Rubbers followed by Acrylonitrile-Butadiene-Styrene (ABS), an engineering plastic raw-material.

1.2.9 Benzene is the third largest and one of the most versatile chemical feed-stock used for a wide variety of Plastic raw-materials, Synthetic Fibers and Chemicals. Initially Benzene was obtained from Coke Ovens during World War – II. Subsequently, Refinery and Naphtha Crackers became more preferred sources due to product quality and cost efficiency.

1.2.10 World capacity of Benzene, derived from Steam Cracker as well as Refinery Streams, is 56 million tonnes with demand estimated at 41 million tonnes. The capacity is expected to reach 62 million tonnes by 2015 and demand 47 million tonnes.

1.2.11 Paraxylene (PX) is the feedstock for PTA and DMT, required for production of Polyester fibres, Chips for Bottles and Films. PX is derived primarily from refinery operations. Current global capacity of PX is 35 million tonnes with demand estimated at 28 million tonnes.

The capacity is expected to reach 45 million tonnes by 2015 and demand to 37 million tonnes.

1.2.12 Due to conversion cost economics, most of the capacity expansion has taken place in PTA with DMT capacities being rationalized or closed.

1.2.13 Current global capacity of PTA is 49 million tonnes with demand estimated at 41 million tonnes. Large capacity addition on the back of healthy demand for Polyester Fibre in the Asian region has resulted in more capacity addition in this part of the world. It is estimated that the capacity would reach 68 million tonnes with demand reaching 55 million tonnes by 2015.

*1.3 **Plastics***

1.3.1 A Wide variety of plastics raw materials are produced from petrochemicals to meet the material needs of different sectors of the economy. These polymeric materials are broadly categorized as commodity, engineering and specialty plastics. Global demand of plastics have reached nearly 199 million tonnes with commodity plastics like Polyethylene (PE), Polypropylene (PP), Polyvinyl Chloride (PVC) and Styrenics (PS/EPS & SAN/ABS) accounting for bulk of the demand.

Table 1: Global Polymers Consumption in 2010 & Its Share

Plastics	Million Tonnes	% Share
PE (LDPE+HDPE+LLDPE)	72.5	36
PP	48.5	24
PVC	34.8	18
PS & ABS	18.0	9
PET	16.0	8
PC	4.0	2
Others	5.0	3
Total	**198.8**	**100**
Source: CMAI		

1.3.2 While major plastic materials like PE and PP are derived from olefins, namely Ethylene and Propylene, other feedstocks and building blocks are also necessary for production of PVC, PS & ABS, PET and PC. This makes the product-feedstock linkages quite complex.

1.3.3 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.

1.3.4 Polyethylene (PE) is the largest volume plastic raw-material used by the industry. There are three broad types of PE, viz: Low-density Polyethylene (LDPE), High-density Polyethylene (HDPE) and Linear Low-density Polyethylene (LLDPE). All these are derived from Ethylene with small amount of co-monomers used in the production of HDPE & LLDPE.

1.3.5 Global capacity of PE is 91 million tonnes with demand estimated at 71 million tonnes. These are likely to reach 109 million tonnes and 95 million tonnes, respectively by 2015. While LDPE was the first polymer to be commercialized, over a period of time HDPE and subsequently LLDPE overtook the demand of LDPE. Current global demand supply scenario and estimates for 2015 is given below.

Table 2: Global Polyethylene Capacity & Demand

Polyethylene	Capacity		Demand	
(MMT)	2010 A	2015 E	2010 A	2015 E
HDPE	41	50	33	44
LLDPE	28	34	21	29
LDPE	22	25	19	22
Total	**91**	**109**	**73**	**95**

Source: CMAI

1.3.6 Polypropylene (PP) is commercially available in three different varieties viz: Homopolymers, Impact and Random Copolymers. PP today is the second largest and fastest growing commodity plastics. Global capacity in 2010 was 60 million tonnes and estimated demand 49 million tonnes. Due to its versatile property profile, global demand is expected to grow @ 5.7% reaching 64 million tonnes by 2015 and capacity 75 million tones.

1.3.7 Due to its versatile property profile, PP had initially been replacing HDPE and Polystyrene and has now replaced engineering plastic in many applications in automotive and appliance sector. Its lower density, balanced properties and competitive cost structure has made the material a preferred option in various demanding applications.

1.3.8 Polyvinyl Chloride (PVC) is the oldest variety of commodity plastics. By composition, the product has nearly 50% Chlorine embedded in its molecular structure which is supplied primarily by the Chlor-Alkali industry where Chlorine is a co-product. The difficulty in transportation of Chlorine has resulted in large volume Chlor-Alkali unit to convert this into Ethylene-Di-Chloride (EDC) and ship to producers of VCM and PVC.

1.3.9 Significant volume of PVC is also produced through alternative route – Calcium Carbide which has been phased out in other part of the world but is widely prevalent in China.

1.3.10 Global demand of PVC in 2010 was 35 million tonnes from a capacity of 46 million tonnes. These are estimated to reach 44 million tonnes and 55 million tonnes, respectively by 2015.

1.3.11 Global demand for Polystyrene (PS) and other Styrenics like Styrene-Acrylonitrile (SAN) and Acrylonitrile-Butadiene-Styrene (ABS) was 18 million tonnes during 2010. Demand growth for PS had been relatively slower as compared to PE & PP since some of its application areas were converted to PP. However, due to its wide ranging usages in consumer electronics, appliances and automotives, both ABS and SAN had been witnessing healthy growth. It is estimated that by 2015, global demand for Styrenics would reach 22 million tonnes.

1.3.12 Polyethylene Terephthalate (PET) is Thermoplastic polyester widely used for production of beverage bottles. It is also used for flexible packaging film due to its high clarity, low permeability and excellent printability. Global demand for PET resin is estimated to be 15.3 million tonnes and is likely to reach 20.6 million tonnes by 2015. Current production capacity of 19 million tonnes is expected to reach 27 million tonnes by 2015.

1.4 Synthetic Rubbers

1.4.1 History of Petrochemicals goes back to pre-World War II period when disruption in supply of natural rubber to Germany triggered development of “Buna” rubber initially produced from coke oven by-products. The major synthetic rubbers used by the industry today includes Poly-butadiene Rubber (PBR), Styrene Butadiene Rubber (SBR), Polyisoprene Rubber (IR), Butyl Rubber (IIR), EPDM, and Nitrile Rubber (NBR). Global demand for synthetic rubber is currently estimated to be 14 million tonnes and is expected to reach 16 million tonnes by 2015.

1.5 Fibre Intermediates

1.5.1 Polyester is produced from Purified Terephthalic Acid (PTA) or Di-Methyl Terephthalate (DMT) with Mon-Ethylene Glycol (MEG). While initially DMT was the primary fibre intermediate, over past two decades, PTA has emerged as the preferred source due to its cost economics and share of Polyester produced from DMT has become almost negligible.

1.5.2 Both PTA and DMT are produced from Paraxylene (PX). World polyester market is expected to grow @ 3.5 MTPA (6-7% pa) in next 5-

10 years. This translates into incremental PX demand growth of 2 MTPA. The consumption of PX during 2010 was 28 million tonnes. This is likely to reach 37 million tonnes and the corresponding capacity increase from 35 million tonnes to 45 million tonnes.

1.5.3 Global PTA demand is estimated to be 41 million tonnes with capacity of 49 million tonnes. These are expected to reach 55 million tonnes and 68 million tonnes respectively by 2015.

1.5.4 Mono-Ethylene Glycol (MEG) is the other raw-material required for production of Polyester. Global demand for MEG is estimated to be 22 million tonnes with capacity of 28 million tonnes. Based on demand for Polyester, demand for MEG continues to remain healthy and is likely to reach 29 million tonnes by 2015.

1.6 Synthetic Fibres

1.6.1 Need for clothing and higher disposable income in the emerging economies of China and India has driven the demand for textile products. With limited supply of Cotton, Synthetic Fibres has overtaken the consumption of natural fibres.

1.6.2 Global fibre demand is estimated to be 70 million tonnes of which synthetic fibres accounts for 65% of the demand. Amongst synthetic fibre, Polyester constitutes to be the major fibre. Other synthetic fibres are Polyamides often called Nylon, Polypropylene, Acrylic and other specialty fibres.

1.6.3 Current global demand of Polyester fibre is 48 million tonnes which is expected to reach 65 million tonnes by 2015. Most of the Polyester capacity is located in the Asia. China and India are the major locations of recent investments in this sector.

1.7 Surfactants & Other Chemicals

1.7.1 Petrochemicals offer a wide variety of basic organic chemicals. Some of these were initially obtained from coke ovens during 1940s in Europe and USA but subsequently from petrochemical sources due to technological advancements making this source more efficient and cost effective.

1.7.2 The large volume chemicals produced through these routes are the traditional BTXs (Benzene, Toluene and Xylenes) range. The three isomers of Xylene viz: Orthoxylene, Paraxylene and Meta Xylene constitute the major part of BTX used by the industry.

1.7.3 Next large volume basic organic chemical is Benzene. Besides these a wide range of chemicals and solvents required in down-stream segments like Synthetic Detergents, Agrochemicals, Surface Coating, Dyes & Pigments, Pharmaceuticals, Specialty Chemicals are also obtained through Petrochemical route.

1.7.4 Of the many chemicals derived from Benzene, Phenol is one of the major products. It is produced with Benzene and Propylene and is used for a wide variety of chemicals which are precursors for thermosetting and thermoplastic resins.

1.7.5 Phenol is used for production of Phenol Formaldehyde (PF), a thermosetting resin, and for production of Bisphinol-A as well as Caprolactum. Both these are widely used for production of thermoplastic resins like Polycarbonate and Nylon, respectively.

1.7.6 About 20% of Benzene in the world is converted to Phenol. Present demand of Phenol is estimated to be 9 million tonnes growing at 4% and is likely to reach 10 million tonnes by 2015.

1.7.7 Linear Alkyl Benzene (LAB) and Ethylene Oxides (EO) are the major synthetic intermediates used for production of Surfactants and Synthetic Detergents. LAB is produced from N-paraffin (extracted from Kerosene) and Benzene.

1.7.8 Toluene is used by the pharmaceutical, specialty chemicals, dyes and pigment industries. There are other chemicals derived from petrochemical sources like Acrylonitrile (ACN), Hydrocarbon resins and a wide variety of solvents.

1.8 ***Indian Scenario***

1.8.1 Petrochemical industry had a humble beginning in mid-sixties when the first 20 KTA Naphtha Cracker was established in Mumbai by Union Carbide closely followed by 60KTA cracker by NOCIL. Prior to that small polymer plants were operated based on ethanol derived from molasses, the LDPE plant of the then ICI at Rishra near Kolkata, and the PS plant of Polychem was based on imported monomers.

1.8.2 The large integrated complex of 130 KTA Naphtha cracker commissioned in 1978 at Vadodara, gave the early impetus to the initial growth of this industry. However, the main thrust came with liberalization and in post reform period when large capacity came on stream in private sector and the industry subsequently invested nearly Rs.350 billion.

1.8.3 Since then the petrochemical industry in India has come a long way with global sized plants operating in few product categories not only meeting local demand but also exporting products to global markets.

1.8.4 Due to recent adverse investment climates, interest in investment in this sector has waned. Large scale capacity established in the Middle East on the back of subsidized feedstock, low import duties in petrochemicals and high energy cost coupled with high internal transaction costs have resulted in reduced interest in this sector.

1.9 Building Blocks

1.9.1 Olefins are the major building blocks of the petrochemical industry. Of these Ethylene and Propylene capacities in India has reached significant levels. However Styrene continues to be in deficit.

Table 3: Building Blocks Demand Supply Gap

Products	Demand		Capacity		Gap	
(KTA)	2011-12	2016-17	2011-12	2016-17	2011-12	2016-17
Ethylene	3785	6805	3867	7087	82	282
Propylene	3700	4823	4117	4987	417	95
Butadiene	124	470	295	528	171	58
Styrene	496	647	0	0	-496	-647

Source: Industry

1.9.2 During the 11th 5 yr plan period, demand for olefins increased by 2.8 million tonnes. Partial de-bottlenecking of capacity by GAIL and HPL and the start-up of IOC complex at Panipat, were primary contributors to this growth in Ethylene capacity. Extraction of Propylene by RIL at its Refinery Complex augmented the supply of Propylene.

1.9.3 Butadiene is obtained from C4 stream from Naphtha Cracking units. There was no import of C4 due to poor economics. Reliance and Haldia are currently the two Butadiene producers in India. The number of butadiene producers is likely to increase by 2013-14 when additional extraction capacity will start supported by crude C4 supplies from new steam crackers planned during this period (IOC & OPAL).

1.9.4 OPAL (a subsidiary of ONGC) is planning a grass roots petrochemical complex at Dahej, Gujarat which includes a 95 KTA Butadiene extraction unit. The complex is likely to come on stream by 2014-15.

1.9.5 Indian oil Corporation Ltd (IOC) is also in the process of commissioning 138 KTA Butadiene extraction unit at Panipat Haryana by 2013-14.

1.9.6 By 2015 total availability of Butadiene, including new capacities will be sufficient to cater to existing and upcoming downstream synthetic rubber projects such as SBR, BR & Polychloroprene rubber.

1.9.7 India would, however, continue to be import dependent for Styrene. There is no capacity planned and any decision to invest in this feedstock might only fructify beyond the 12th, plan period.

1.10 **Plastics**

1.10.1 Commodity plastics are the major products that account for bulk of the petrochemical industry. India has significant production capacity and demand for commodity plastics had been growing at a healthy rate.

1.10.2 Reflecting global pattern, Polyethylene (PE) continues to be the largest commodity with LLDE experiencing the fastest growth in this category. Amongst commodity plastics, PP had been the fastest growing polymer.

Table 4: Polymers Demand Supply Gap

Products	Demand		Capacity		Gap	
(KTA)	2011-12	2016-17	2011-12	2016-17	2011-12	2016-17
LDPE	405	597	205	605	-200	8
LLDPE	1198	2076	835	1960	-363	-116
HDPE	1657	2573	1825	3090	168	517
PP	2993	5015	4140	4715	1147	-300
PVC	2087	3102	1330	1635	-757	-1467
PS+EPS	340	638	640	666	300	28

Source: Industry

1.10.3 Amongst commodity plastics, PVC is one of the major products where capacity growth in past had been significantly lagging demand growth. PVC is mainly required by the infrastructure sector in the form of pipes, profiles, floorings and cables. There is, thus, an opportunity for a large scale PVC plant in India which requires competitively priced energy for production and supply of Chlorine and adequate supply of Ethylene.

1.10.4 Low pace of capacity addition in PVC is going to see widening gap between demand and supply of PVC during the next plan period.

1.10.5 India has large capacity of PS and EPS between three major producers. However, all these facilities are based on imported monomer since there is no local production of Styrene.

1.10.6 A range of Engineering Plastics would provide significant opportunities in India. While there exists reasonable capacity for production of ABS and to a limited extend Polyamides, most of the other engineering plastic demand is met through import.

1.10.7 Next to ABS, Polycarbonate (PC) is second large volume engineering plastics with a demand of 130 KTA which is likely to exceed 200 KTA by the end of plan period. Except for some compounding facilities, the

PC base resins are all imported. Similarly the limited capacity of Polyamide would necessitate significant import.

1.10.8 Plastics are used in all the major sectors and the demand for plastics is an indication of industrial growth and development. Current per capita usage of Plastics in India is approximately 7 kg. vis-à-vis global average of 28 kg. This is an indication of substantial un-tapped potential in this country.

1.11 Synthetic Rubbers

1.11.1 Since India has a large production base for natural rubber, demand for synthetic rubber had been structurally very different. The share of synthetic rubber consumption in India is only 30%, whereas global average is 55%.

1.11.2 Reliance is the sole manufacturer of PBR which account for ~60% of total domestic synthetic rubber capacity of 124 KT (2010-11). This is the only major synthetic rubber operating unit in India.

1.11.3 Synthetics and Chemicals Limited (S&C), a major producer of SBR, is under prolonged closure. Unimers India Limited too have idled their 10 KTA EPDM plant since 2008.

1.11.4 Other manufacturers of synthetic rubber in the country mostly operate relatively small plants catering to specialty segments. As of date, domestic production of synthetic rubber is meeting only one-fourth of demand.

Table 5: Rubber Demand Supply Gap

Products	Demand		Capacity		Gap	
(KTA)	2011-12	2016-17	2011-12	2016-17	2011-12	2016-17
PBR	131	193	74	164	-57	-29
SBR	186	275	20	370	-166	95
NBR	31	47	20	40	-11	-7
Butyl	87	127	0	100	-87	-27
EPDM	27	79	10	90	-17	11

(*Including capacities under shut-down/closer).

Source: Industry

1.11.5 During 2005-06 to 2010-11 demand for synthetic rubber grew at an impressive annual rate of 11.5% while the demand for natural rubber grew at CAGR of 3.4% and overall demand of rubber registered CAGR of 5.5%.

1.11.6 There are capacities planned in SBR and Butyl rubber during 12th 5 yr plan period. This, to some extent would mitigate substantial short-fall in domestic non-availability of synthetic rubber.

1.12 Fibre Intermediates

1.12.1 India has a strong synthetic fibre base integrated to large production capacity of fibre intermediates. Global demand of fibre (all categories) is growing by about 3-4 million tonnes per annum. Polyester holds better prospects to capture this growth and is forecasted to account for around 70% of incremental fibre demand in the next decade. This translates in healthy demand for synthetic fibre, and in particular Polyester, and its intermediates in India.

1.12.2 The Indian Polyester demand is expected to grow at 0.5 MTPA (12% pa). This translates into PX demand growth of 0.3 MTPA. In line with growing demand, it is expected that PX capacity addition in India in 2014 to the extent of 900 KTA by ONGC-Mangalore Petrochemical and 1.5 MTPA by Reliance will fructify. PET demand is expected to grow at 19.5% CARG during 12th 5yr Plan (2011-12 to 2016-17).

Table 6: Fibre Intermediate Demand Supply Gap

Products	Demand		Capacity		Gap	
(KTA)	2011-12	2016-17	2011-12	2016-17	2011-12	2016-17
PX	2306	4576	2477	5201	171	624
PTA	4350	7992	3850	7130	-500	-862
MEG	1836	3024	1300	2000	-536	-1024
PET	542	1319	814	2310	272	991

Source: Industry

1.12.3 The first PTA capacity of 150 KT was installed in India in 1988 and it has grown to 3050 KT by 2006 driven by growth in demand. The current PTA capacity is 3850 KT and is projected to grow to 7130 KT by 2014-15. The demand has shown a consistent growth of 8-10% and future growth projections are 12-13% driven by downstream investments in Polyester capacities.

1.12.4 Investment in PTA in India has come from both domestic private and public sectors companies as well as from foreign entities. All the PTA plants in India are of global scale and employ world class technology.

1.12.5 IOC has already made investment in the polyester feedstock chain PX-PTA-MEG at Panipat and has further plans in Gujarat. MRPL has planned PX-PTA complex as part of its downstream investment with Mangalore refinery.

1.13 Synthetic Fibres

1.13.1 At present Asia serves as the primary base for production of synthetic fibre led by China and India. In coming years it is expected that the Asian dominance in global textile trade would continue. A historical perspective reveals that not only textile and clothing, the Asian base has also strengthened in production of synthetic fibre raw materials. Polyester companies that were largely based in western hemisphere have either closed or have shifted to Asia.

1.13.2 Domestic availability of raw material has been a unique advantage enjoyed by the Indian polyester industry as against China where import dependence was as high as 64% during the growth phase. The raw material self-sufficiency has provided a boost to the growth of the industry in India and has driven investment plans for future.

1.13.3 The total polyester production has grown to 4.35 MMT in FY 10-11 and around 2-3 MMT of new capacities are slated to come up in next few years.

1.13.4 Indian textile industry has been growing @ 11% during the last five years. Maintaining this growth rate, the Indian textile industry is likely to reach a $ 220 bn size by 2020. At present per capita fibre consumption in India is only 5 Kg vis-a-vis global average of 10 Kg per capita. This offers tremendous future opportunities.

Table 7: Synthetic Fibre Demand Supply Gap

Products	Demand		Capacity		Gap	
(KTA)	2011-12	2016-17	2011-12	2016-17	2011-12	2016-17
PSF	1214	1600	1334	2000	120	400
PFY	1973	3500	2582	5216	609	2276
NFY	48	71	32	32	-16	-39
NIY	115	125	74	74	-41	-51
PIY	40	68	21	68	-19	0
Source: Industry						

1.13.5 In the Polyester segment, India would continue to be a global leader. Production capacities for both filament yarn and staple fibre would stay ahead of local demand during the plan period. Export of polyester yarn would thus continue to be substantial.

1.14 Surfactants

1.14.1 Indian industry made a modest beginning in 1978 with the commissioning of first LAB plant at Vadodara. Subsequently Reliance Industries Ltd (RIL), Tamil Nadu Petrochemicals Limited (TPL) and Nirma Ltd. set up facilities for manufacture of LAB. Indian Oil Corporation Ltd (IOC) commissioned a plant of capacity of 120 KTA in August 2004 and is the latest entrant. The current installed capacity of LAB in India is 530 KTA.

Table 8: Surfactants Demand Supply Gap

Products	Demand		Capacity		Gap	
(KTA)	2011-12	2016-17	2011-12	2016-17	2011-12	2016-17
LAB	480	627	530	530	50	-97
EO	173	241	209	254	52	13

Source: Industry

1.14.2 Demand for LAB had been growing @ 8% during 11th, five year plan period. This growth is likely to be sustained necessitating creation of additional capacity to address the shortfall.

1.14.3 There has been a steady increase in demand and supply of EO over last few years, driven mainly by demand for Ethoxylates, Glycol Ether and Dyes intermediates. EO is neither imported nor exported because of its hazardous nature.

1.14.4 Demand for EO had been growing @ 13% during 11th, plan period and this healthy growth is likely to be sustained during the next phase as well.

1.15 Other Basic Organic Chemicals

1.15.1 Other major petrochemicals are Benzene, Toluene, Ortho-Xylene, Phenol, Acetone, and Acrylonitrile. These are used as feedstock for plastics, fibre or a range of downstream chemicals.

1.15.2 Indian Benzene production for 2010 was approximately 1.1 million metric tonnes against a capacity of 1.2 million tonnes, an increase of 10% from 2009. The main source of benzene supply is pygas and reformate/toluene transalkylation based production units, each accounting for about 400 KTA and 620 KTA, respectively. There is also small supply of relatively lower purity Benzene from coke ovens.

1.15.3 Mangalore Refinery, a subsidiary of ONGC, has announced a new aromatics complex at Mangalore. The aromatics complex is expected to produce 275 KTA of benzene. Completion is delayed, and the start up is now expected in early 2013. OPAL (a subsidiary of ONGC) is also planning a grass root petrochemical complex at Dahej, Gujarat that includes a 135 KTA benzene extraction unit.

1.15.4 Domestic demand of Benzene in India has grown at a steady pace over the past few years and has reached nearly 600 KTA now. This is expected to reach nearly a million tonnes by end of 12th five year plan period. Export volume is expected to increase substantially to over 1.2 million metric tonnes by 2016.

1.15.5 Bulk of domestic demand is expected to come from Cyclohexane, Cumene/Phenol sectors which are likely to see substantial growth through 2015. However, local availability will increase even faster, surpassing domestic demand.

Table 9: Other Basic Organic Chemicals Demand Supply Gap

Products	Demand		Capacity		Gap	
(KTA)	2011-12	2016-17	2011-12	2016-17	2011-12	2016-17
Benzene	590	935	1235	2110	645	1175
Toluene	440	650	270	270	-170	-380
OX	266	379	420	420	154	41
Phenol	212	288	74	374	-138	86
ACN	125	181	40	40	-85	-141

1.15.6 Reliance is the largest producer of TDI Grade Toluene in India. Only three refineries produce ‘On purpose Toluene’. Toluene is also produced as a byproduct via coal carbonization process. This is low purity product mostly used as solvent. With very little Toluene capacity planned, India will continue to rely heavily on imports for meeting rising demand for Toluene.

1.15.7 Ortho Xylene is used for a variety of applications. A majority (92%) of Ortho-Xylene produced globally is used for production of Phthalic Anhydride (PA). PA is a very versatile intermediate used for phthalate plastcizers and paints.

1.15.8 Reliance is the sole producer of Ortho-Xylene and the largest producer in Asia. The country is self-sufficient in this product and would continue to be a net exporter.

1.15.9 ACN is the key ingredient for production of Acrylic Fibre and for SAN/ABS. Demand for ACN from the Acrylic Fibre segment had been weaning whereas SAN/ABS segment continue to remain buoyant.

1.15.10 Reliance is the sole producer of ACN with a capacity of 40KTA. The downstream industry remains a net importer of this intermediate.

1.15.11 Indian demand for phenol is 189 KTA growing at 6.5% p.a. India imports about 114 KTA of phenol. With domestic phenol capacity stagnating at 75 KTA, import is expected to reach 250 KTA by 2014.

1.15.12 Contrary to the global trend, Indian phenol demand is not based on BPA and its derivatives PC. Phenolic resins, alkyl phenols and pharma intermediates are the major end uses of phenol in India. By the year 2014 India is likely to have some surplus of Phenol for exports after meeting domestic demand. Exports volume will come down in subsequent years due to the growth in domestic market.

1.16 *Summary of Consumption and Capacity in 11th Plan*

Table 10: 11th Plan overall Summary of Consumption and Capacity

11th Plan Over all		Consumption			Capacity		
All Fig in KTs		Actual	Estimated	CARG	Actual	Estimated	CARG
Group	Product	2006-07	2011-12	2006/07- 11/12	2006-07	2011-12	2006/07- 11/12
Building Blocks		5337	8105	8.7%	4993	8279	10.6%
Comm Plastics		4869	8555	11.9%	5569	9338	10.9%
Syn Rubbers		269	462	11.4%	124	124	0.0%
Surfactants		425	648	8.8%	655	739	2.4%
Solvents and Int		1371	1726	4.7%	1924	2129	2.0%
Fibre Intermediates		5728	9034	9.5%	6752	8441	4.6%
Syn Fibres		2193	3405	9.2%	3174	4527	7.4%
Total		20193	31934	9.6%	23191	33578	7.7%

1.17 Summary of Consumption and Capacity for 12th Plan

Table 11: 12th Plan Overall Summary of Consumption and Capacity

12th Plan Overall		Consumption			Capacity		
All Fig in KTs		Actual	Estimated	CARG	Actual	Estimated	CARG
Group		2011-12	2016-17	2011/12-16/17	2011-12	2016-17	2011/12-16/17
Building Blocks		8105	12746	9.5%	8544	12602	8.1%
Comm Plastics		8555	14001	10.4%	8975	12671	7.1%
Syn Rubbers		462	721	9.3%	124	764	43.9%
Surfactants		648	868	6.0%	733	784	1.3%
Solvents and Int		1726	2563	8.2%	2129	3304	9.2%
Fibre Intermediates		9034	16911	13.4%	8977	17664	14.5%
Syn Fibres		3405	5364	9.5%	4527	7390	10.3%
Total		31934	53173	10.7%	34010	55179	10.2%

1.18 Policy Initiatives

1.18.1 For a balanced growth of Indian economy, National Manufacturing Council (NMCC) has envisaged the share of manufacturing to GDP to grow from current 16% to 25% by 2022. This would be in line with the pattern prevailing in Asian countries like Korea, Malaysia and Indonesia but still short of China where it is currently at 34%.

1.18.2 Petrochemicals is a major segment of manufacturing industry and plays a pivotal role in agriculture, food-processing, clothing, consumer durables, building and construction, infrastructure, healthcare, communications and other critical areas supporting welfare of common man.

1.18.3 Petrochemicals are major contributor to the exchequer and the polymer industry alone annually contributes over Rs 8,000 crores by way of taxes and duties. Hence, stagnating demand in the sector would have adverse impact not only on employment but also on contribution to the exchequer.

1.18.4 Taking cognizance of the huge potential, Government of India had identified the petrochemical industry as one of the key driver to GDP growth. National Policy on Petrochemicals released by the Government

("Policy Resolution for Petrochemicals" published in Gazette on April 30, 2007) recognizes the necessity of sustained growth of this sector.

1.18.5 However, realization of the growth potential is possible only with a supportive policy regime and a facilitative business environment. A facilitative fiscal regime would revive industry growth, attract investments and promote petrochemical usage, which in turn, would bring in multiple cascading benefits, tangible and intangible, to the national economy.

1.18.6 It is ironical that India is a net exporter of Naphtha, the basic feedstock, and at the same time imports large quantity of petrochemical products, thereby discouraging value addition within the country.

1.18.7 **The key issues in the petrochemical industry are detailed below** along with suggestions for mitigating some of the deterrents to future investment in this sector through facilitative policy initiatives.

1.18.7.1 **VAT/GST:** India has one of the highest indirect tax incidences as compared to most developing and many developed countries. Continuation of Indirect Tax reforms to bring in uniformity in rates across India and also to put a check on cascading effects of existing Central and State VAT system would be imperative to support investment.

1.18.7.2 There is a compelling need to establish a **single national level VAT / GST on plastics and articles of plastics at a uniform 4% across states**. Key petrochemical inputs such as Naphtha should also fall under a national level VAT/GST regime at a uniform 4% rate across states, with complete input tax credit.

1.18.7.3 **Vat on Natural Gas** – a key petrochemical feedstock – should be included in the list of "Declared Goods" under CST Act and be taxed at a uniform rate of 4% across the country. In the event of abolition of CST, a maximum VAT of 4% may be fixed for natural gas. (Sales Tax currently varies significantly from state to state) GST should be finalized expeditiously and implemented before the 12th 5yr Plan period which would help develop a Common Market for enhanced Inter-state commerce with reduced tax-arbitrage inefficiencies, boost exports with a competitive edge in the international markets and remove fiscal and regulatory elements that contribute to higher transaction costs to Indian manufacturers.

1.18.7.4 **Import duty rationalization across petrochemical value chain:** While the internal taxes are relatively high, India has very low import tariff on polymers and key petrochemicals, lower than most SEA countries (For Polymers India: 5%, Malaysia: 20-30%, Thailand: 5%, Philippines: 15%, Indonesia: 20%, China: 6.5-8.4%), affecting the competitive viability of the domestic investment.

1.18.7.5 **This duality in fiscal structure has resulted in a high cost economy that discourages local investment**. Further, Indian import duty structure provides for NIL incremental tariff protection between key petrochemical inputs (Naphtha, LNG, and Propane) and their end products (building blocks such as Ethylene, Propylene, Benzene, Butadiene) as well as major petrochemical products such as Polymers. With preferential duty for countries that have signed FTA with India, the tariff protection is even negative for many products like polymers.

1.18.7.6 **Import duty for all petrochemical feedstock and products should be recalibrated providing adequate incentive to attract investment** in this sector. The Government has taken a partial step by reducing the import duty on naphtha which, unfortunately, has company specific applicability and not for the sector as a whole.

1.18.7.6.1 Import duty on feed-stock for petrochemicals need to be at zero rate to make investment in this sector financially viable. This would include naphtha, NLG, Propane and Butane. All these currently have higher duty resulting in nil to negative protection to the sector.

1.18.7.6.2 The import tariff for the next level of products can be at slightly higher level with progressive increase in duty rates to encourage domestic value addition. There are compelling reasons to remove the duty anomaly prevailing in this sector so that domestic investment becomes financially viable.

1.18.7.7 **Infrastructure and PCPIR** has long been recognized as a critical enabler in enhancing competitiveness of industry to be able to produce and distribute goods both for the domestic market and for exports. As a result of under-developed trade and logistics infrastructure, the logistics cost of the Indian economy is over 13%of GDP, compared to less than 10%of GDP in almost the entire Western Europe and North America.

1.18.7.8 Although significant progress has been made, much needs to be done, along the lines recognized by the Planning Commission. In this direction expediting PCPIR projects would help in growth of this sector.

1.18.7.9 **Regulatory initiatives** are also required to help growth of Petrochemical sector by discarding act like JPMA and supporting mandatory standardization of products, promoting energy efficient building codes, aseptic packaging of milk, mandatory unitized packaging of oil and other food products susceptible to adulteration in the overall interest of the economy and the society.

1.18.7.10 **Environment & Sustainability** is a major global issue. Chemical industry has poor image of being a polluter and plastic use is erroneously perceived as harmful to environment. Contribution of petrochemicals and plastics to all the critical sectors of the economy is inadequately appreciated and understood by other stake holders.

1.18.7.11 Industry and Government can collaborate and support communication programmes to dispel the myths. It is also desirable that pursuit of global initiatives like **"Responsible Care"** is incentivized to address the issue of sustainability in the chemical industry.

1.18.7.12 **R&D** is the key factor for growth of the chemical industry. Quantum of research and its focus varies across sectors different segments of the industry. Typically petrochemicals being a basic chemical industry the main focus will be on optimizing the processes to reduce cost and application development to boost demand. Huge amount of effort is also directed towards energy management since energy is the significant element of conversion cost.

1.18.7.13 In petrochemical sector application **R&D is very critical** as new applications have to be identified in order **to synthesize new and advanced class of polymers**. India has been making considerable effort in strengthening its R&D potential. In a recent UNCTAD report India was highlighted as one of the most preferred R&D destinations outside the US. Past 2-3 yrs has seen a preponderance of companies looking at India as an R&D destination.

1.18.7.14 **Alternative Feedstock:** Basic petrochemicals such as ethylene, propylene and aromatics are the building blocks of the petrochemical industry. Currently, most of them are produced via conventional routes utilizing naphtha (derived from crude oil) and Ethane (derived from Natural gas). These building blocks can also be produced from alternate sources like coal, bio-mass etc. These alternative routes need to be explored.

1.18.7.15 **Plastic development council** will be an advisory body with members from industry, academia and the Government. This will work for a sustained development of plastics processing sector including technology and R & D Initiatives.

1.18.7.16 **Dedicated plastic parks** can be evaluated to promote cluster approach in the areas of development of plastic applications and plastic recycling.

1.18.7.17 **Centers of Excellence** can be set up in existing educational and research institutions working in the field of polymers viz. National Chemical Laboratory, CSIR Institutions, Indian Institute of Chemical

Technology, Indian Institutes of Technology, National Institutes of Technology and others established R & D set ups.

1.18.7.18 Petrochemical industry can play a significant role is growth of manufacturing sector. It is estimated that an additional investment of US$ 20 billion (Rs.90,000 Crores) envisaged during next plan period would result in additional employment of over 4 million in the upstream and downstream converting sector.

1.18.7.19 **Technical textiles** are among the most promising and faster growing areas for the global and the Indian textile industry. Globally, technical textiles account for more than 25% of all textile consumption in weight terms. Considering the growing and versatile economic and infrastructural development needs in India, technical textiles are likely to play a facilitative role across key sectors like road construction, packaging, agriculture and horticulture, etc. in the coming years and an enabler of infrastructure development in the country. The distinguishing feature of the technical textiles industry is the range and diversity of raw materials, processes, products and applications that it encompasses.

1.18.7.20 **Technical textiles** are defined as comprising all those textile-based products which are used principally for their performance or functional characteristics. Depending on the product characteristics, functional requirements and end-use applications, technical textiles are broadly grouped into 12 segments. Technical textiles markets in developed countries have matured and hence its growth in these regions is expected to be moderate. Developing economies like China and India are expected to register a robust growth in Technical Textiles on account of heavy infrastructure activities in these regions. Also, as the consumption of disposable Technical Textiles products (like wipes, sanitary napkins, and adult/baby diapers) is directly related to disposable income, an increase in disposable income of a country is expected to drive the demand of these products. India has huge advantage in manufacturing of textiles and garment due to its inherent low cost advantage. Therefore, in niche segments of technical textiles India can gain cost advantage through tie-ups with research institutes for the development of new technologies. This was showcased appropriately in the recent conference on Technical Textiles with support from Ministry of Textiles and Ministry of Chemicals & Fertilizers.

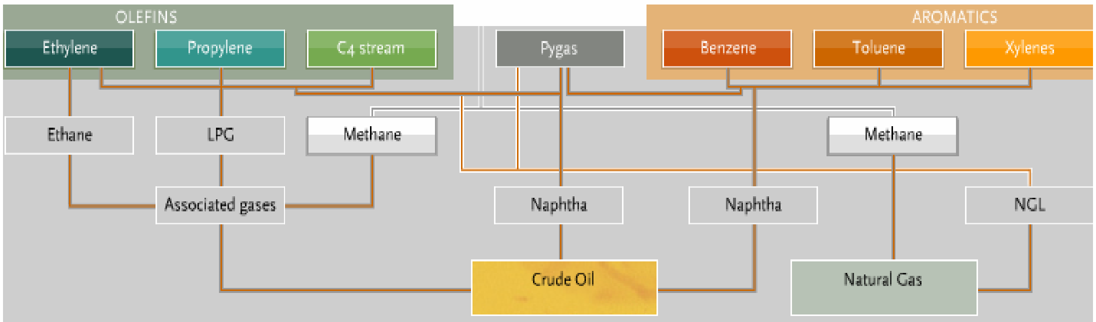
1.18.7.21 The downstream plastic processing industry is extremely fragmented often operating at sub-optimal scales and using dated technology, which, in turn, inhibits its international competitiveness and hence, exports. A **Technology Up gradation Fund (TUF),** similar to that in the textile industry, which will provide funds to small processing units at interest rates which are lower than market rates, will go a long way towards upgrading the technology used in these small units as these units are not in a position to fund the up gradation on their own. The TUFs scheme presently is implemented by Ministry of Textiles.

2 Role of Petrochemicals in the National Economy

2.1 What are Petrochemicals

2.1.1 Chemicals derived from petroleum or natural gas - petrochemicals - is an essential part of the chemical industry today. Petrochemicals are a fairly young industry; it only started to grow in the 1940s, more than 80 years after the drilling of the first commercial oil well in 1859. During World War II, the demand for synthetic materials to replace costly and sometimes less efficient products caused the petrochemical industry to develop into a major player in today's economy and society.

Figure 1: Crude to Petrochemicals



2.1.2 Before then, it used to be a tentative, experimental sector, starting with basic materials: synthetic rubbers in the 1900s, Bakelite, the first petrochemical-derived plastic in 1907, the first petrochemical solvents in the 1920s, polystyrene in the 1930s. And it then moved to an incredible variety of areas - from household goods (kitchen appliances, textile, furniture) to medicine (heart pacemakers, transfusion bags), from leisure (running shoes, computers...) to highly specialised fields like archaeology or crime detection.

2.2 Possibilities from C1 to C8

2.2.1 Petrochemicals do not reach the final consumer - the man in the street; they are first sold to customer industries, undergo several transformations, and then go into products that seem to bear no relation whatsoever to the initial raw material.

2.2.2 The starting point for petrochemicals is Naphtha or Gas. Olefin rich Naphtha is cracked to produce Ethylene, Propylene and Butadiene, popularly known as C2, C3 & C4 streams. Aromatic rich Naphtha is preferred to produce Benzene, Toluene and Xylenes, popularly known as C6, C7 & C8 streams. Associated gases are rich source of Methanol i.e. C1. These materials i.e. C1 to C8 are the basic building blocks for a host of day to day consumer and industrial products. The figure below indicate multitude of products which can be produced and their applications.

Figure 2: C1 Chain

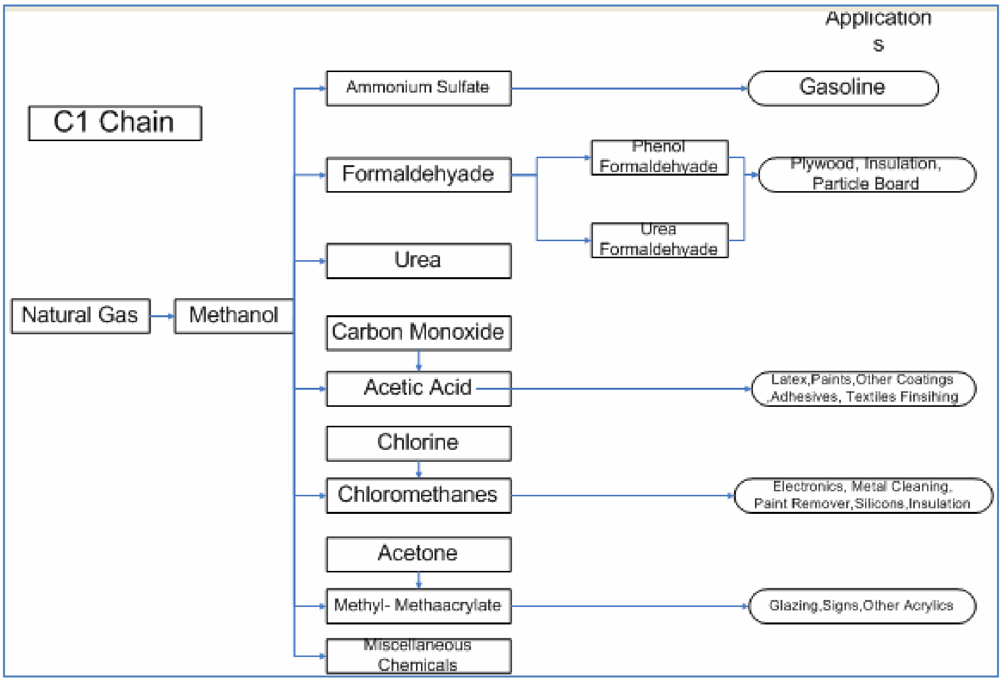


Figure 3: C2 Chain

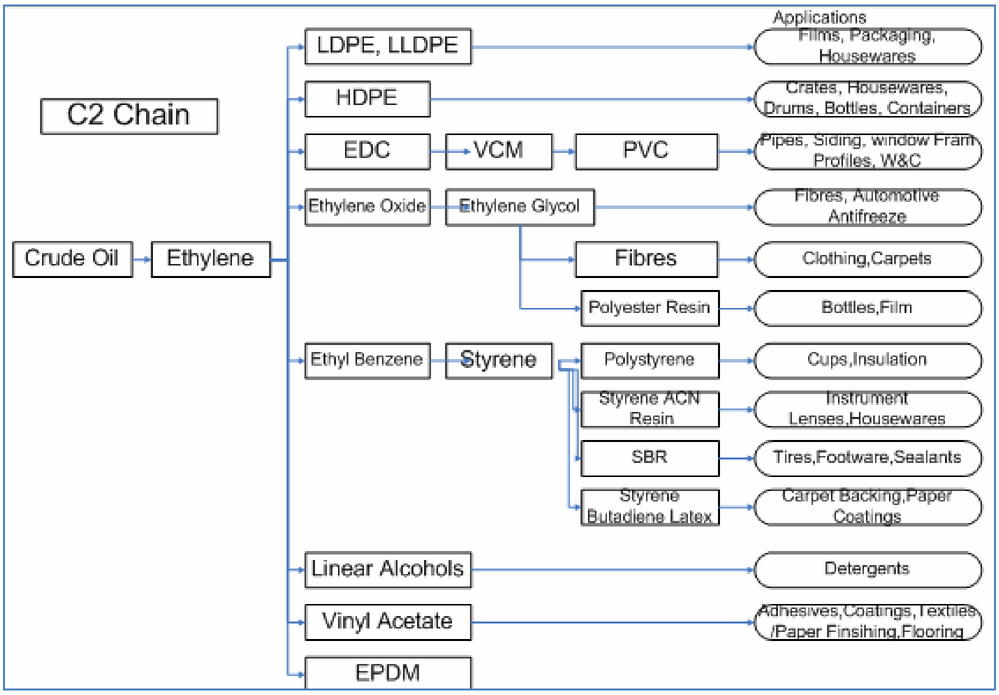


Figure 4: C3 Chain

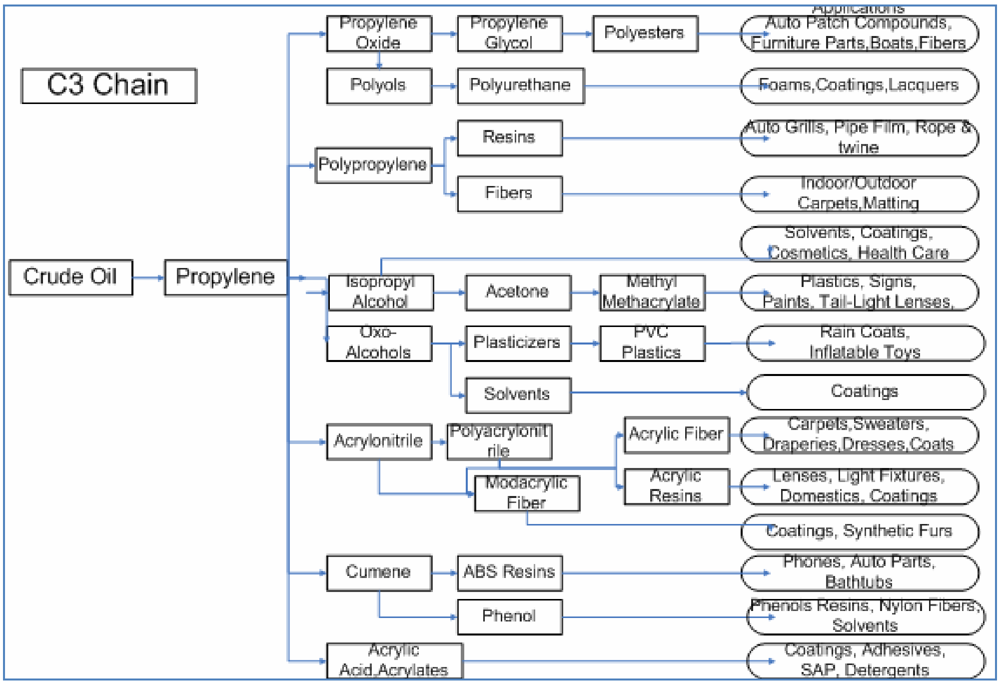


Figure 5: C4 Chain

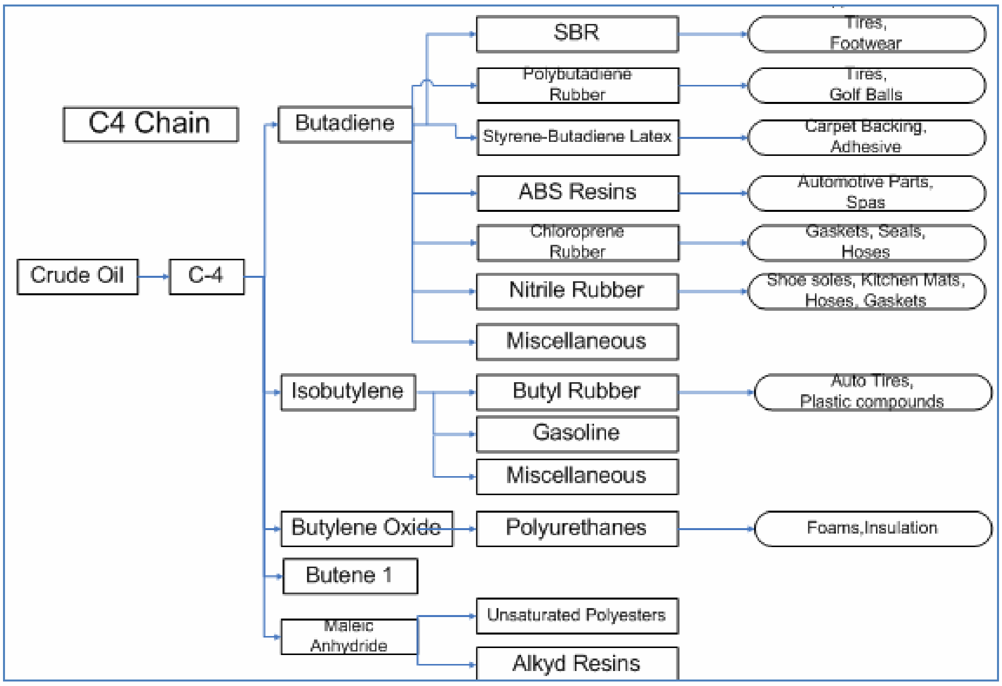


Figure 6: C5 Chain

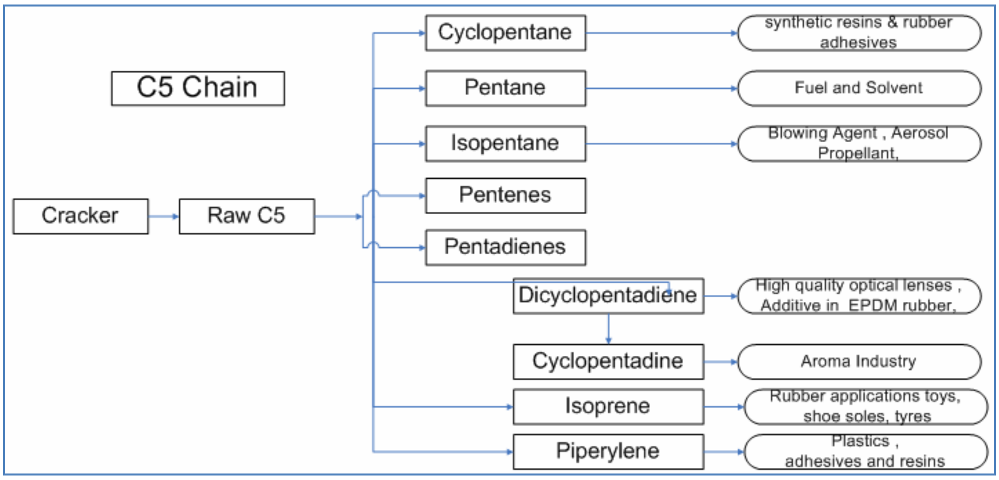


Figure 7: C6 Chain

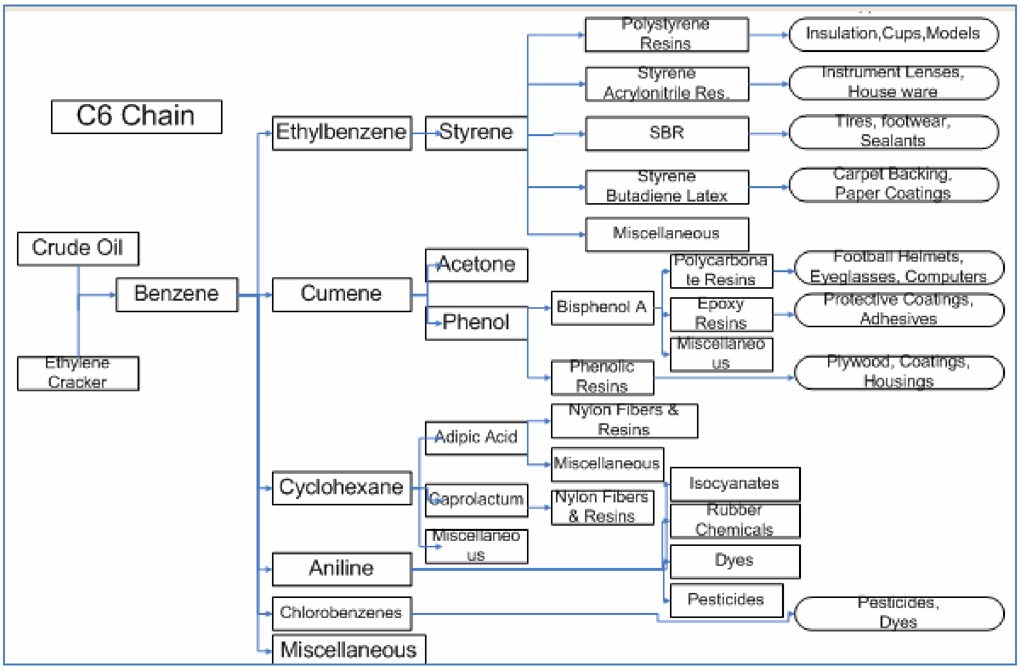


Figure 8: C7 Chain

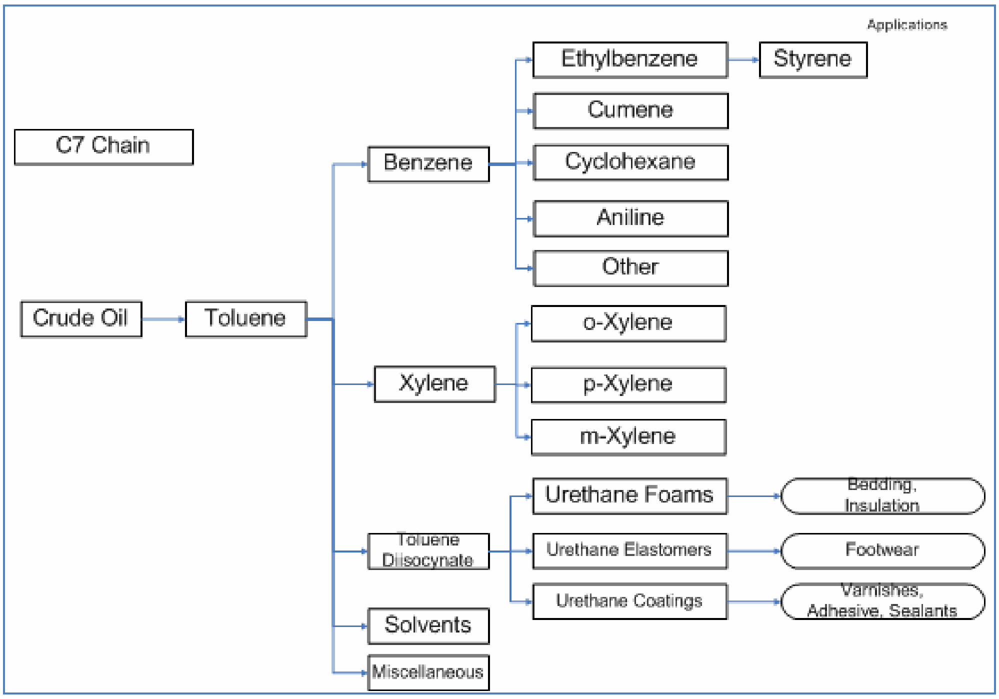


Figure 9: C8 Chain

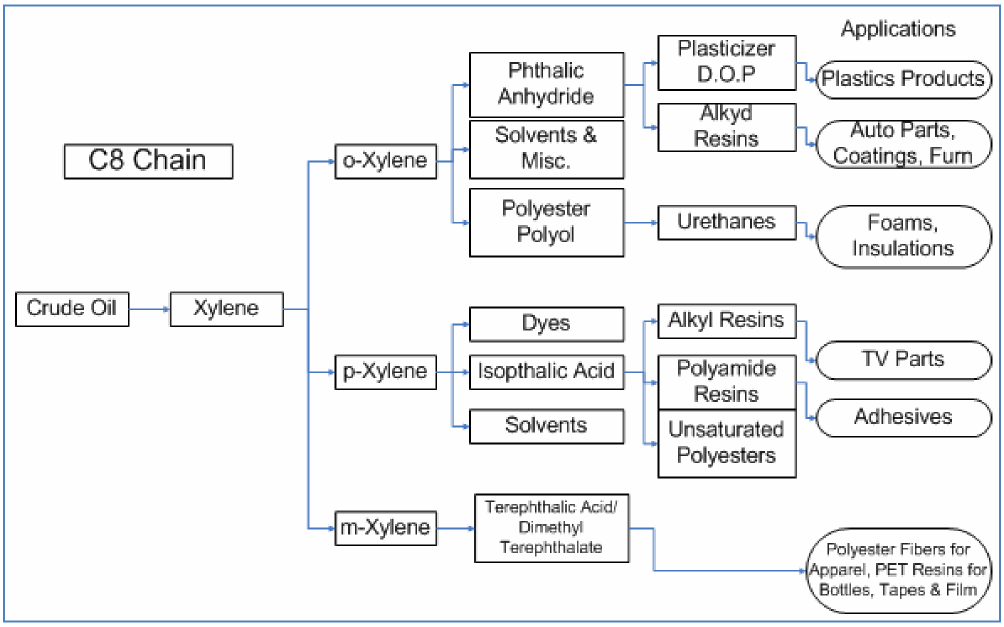
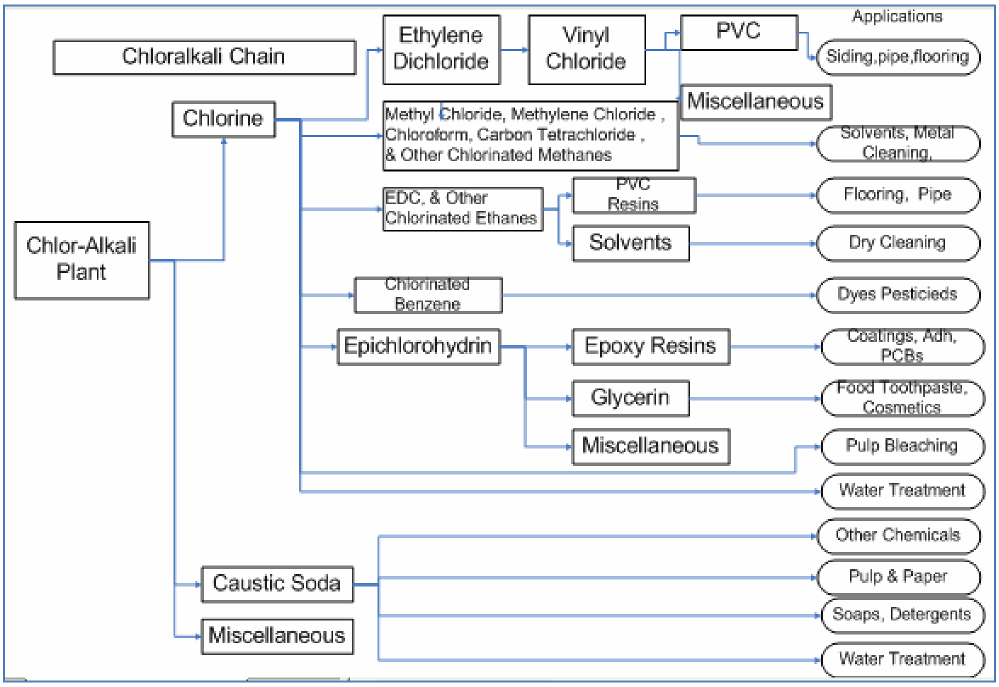


Figure 10: Chlor Alkali Chain



2.3 *Value Additions*

2.3.1 Petrochemical offer one of the highest value additions in manufacturing sector. Crude, which is predominantly used for fuel application is 200% value addition and converting to consumer end products is 2000% value addition. Figure below indicate what all can be produced with one barrel of oil.

Figure 11: Value Addition to Crude

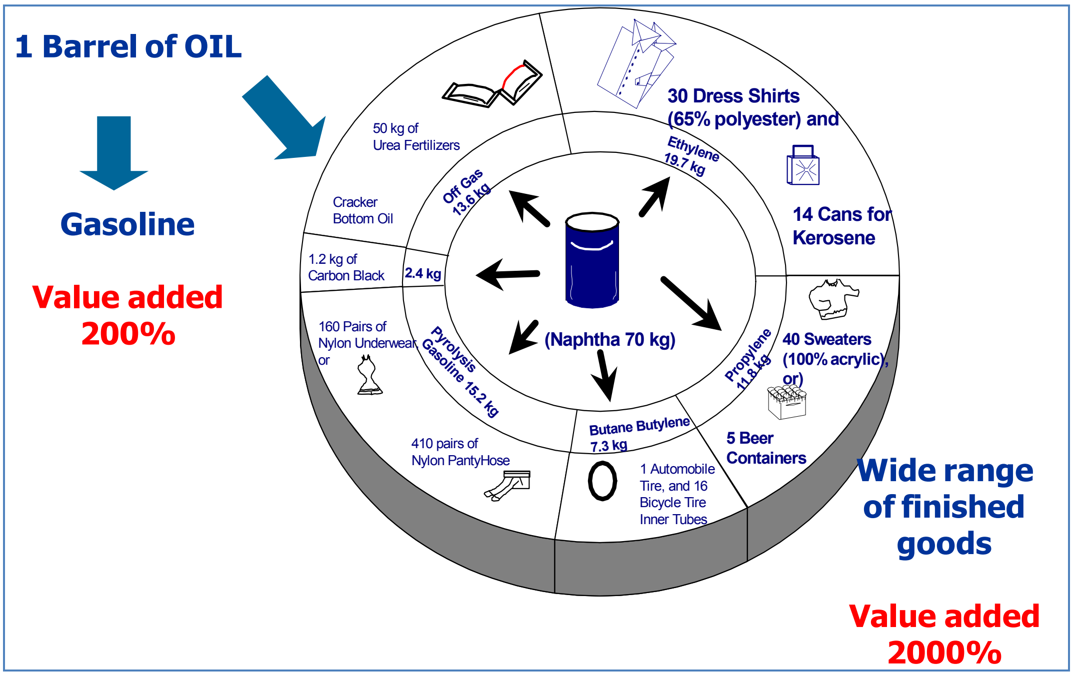
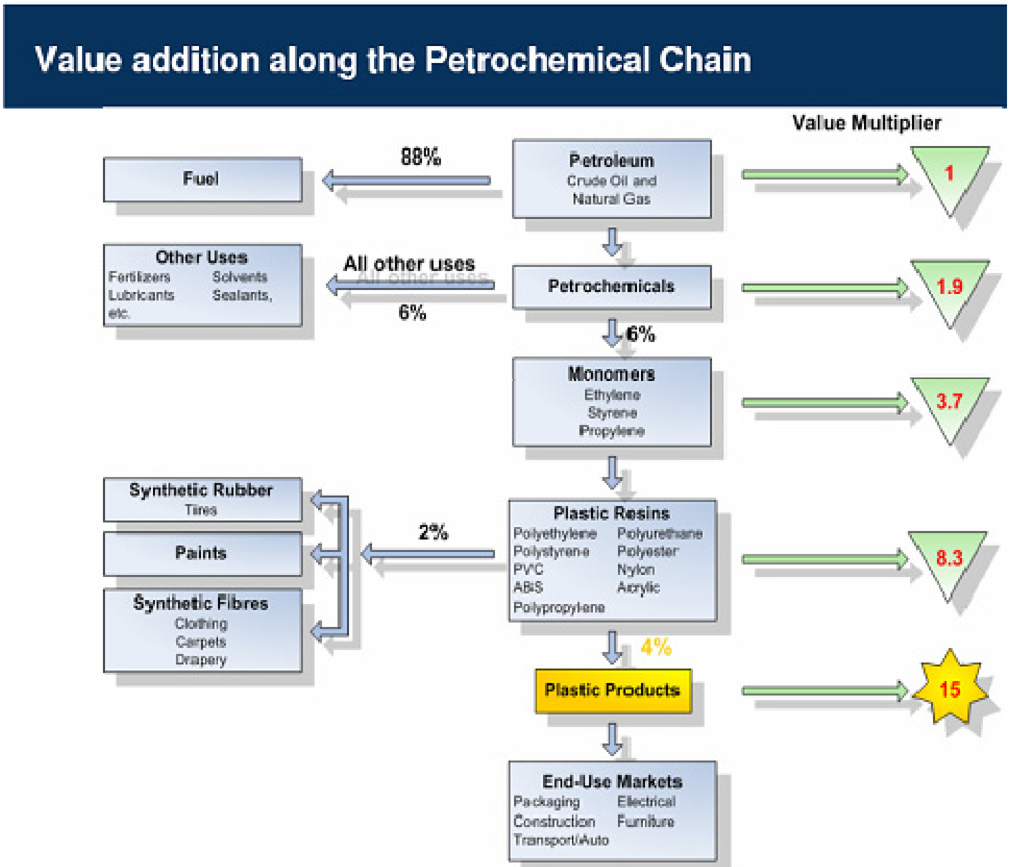


Figure 12: Value Addition in Petrochemical Chain



2.3.2 So far India has worked towards self sufficiency in petrochemicals, which has been achieved. Time has come to look at export of finished products exports and create export oriented petrochemical capacities. China has excelled in it, while India has grown due to its domestic demand, China bet on export demand.

2.4 *Petrochemicals as "Enablers"*

2.4.1 Petrochemicals industry plays a vital role in economic growth & development as one of the pillars of material industry. The three main materials include metal, inorganic material and synthetic polymers. Petrochemicals are the primary source of synthetic materials.

2.4.2 Due to its very nature Petrochemicals is an "enabler" industry playing a vital role in the functioning of virtually all key sectors in the economy including packaging, agriculture, infrastructure, healthcare, textiles and consumer goods. Petrochemicals provide critical inputs which enable other sectors to grow.

2.4.3 The petrochemical industry, as part of the chemical industry, provides the vital link between natural resources and value-added products.

Figure 13: Uses of Crude Oil

2.4.4 The importance of the petrochemical industry as a value creator for the economy is because these value-added products create additional wealth when compared to its alternative use as fuel.

2.4.5 Products made from petrochemicals are essential to modern life. These include plastic products, medicines and medical devices, cosmetics, furniture, appliances, TVs and radios, computers, parts used in every mode of transportation, solar power panels and wind turbines.

2.4.6 Petrochemicals provide inputs to other industry in the form of polymers, synthetic rubber and synthetic fibre. Automotive industry depends on synthetic rubber, tyre-cord and carbon black for the tyres, numerous plastic parts for body, under-hood applications and paint for the body.

2.4.7 Similarly construction industry depends on petrochemical industry and its downstream sector for supply of building components, pipes, profiles, technical textile and paint.

2.4.8 Synthetic fibre for the textile industry has supplemented and complemented limited availability of cotton and other natural fibre. Also most of the dyes and colourants used by the industry are derived from petrochemicals. Polyester, Polyamide (Nylon), Acrylic and Polypropylene fibre are also derived from petrochemicals.

2.4.9 However, the largest contribution of petrochemicals would be in agriculture and food industry during production, handling and in distribution. Modern farming technology uses plastic products, nutrients and agro-chemicals which are derived from petrochemicals. Packaging, handling and distribution use petrochemical products in different form and at different stages.

2.4.10 On account of their versatility, multiple advantages, easy availability and cost-effectiveness, petrochemicals have become indispensable to modern life. Consumption of petrochemicals has a strong correlation with economic growth. Petrochemical demand is essentially derived demand and heavily depends on overall growth and development of the economy and its constituent sectors.

2.5 Benefits to "Aam-Aadmi" (Common Man)

Roti, Kapda, Makaan and other life supporting applications

2.5.1 The common man is touched by petrochemical products across all walks of life. Mass products like tooth brush; tiffin box, low cost footwear, healthcare items, public transport, packaging of consumables like milk, etc are affordable for the common man for daily use, thanks to petrochemicals.

Roti (Food)

2.5.2 The food chain, from “farm-to-fork”, to sustain a large and growing population depends on petrochemicals to support the production, distribution and storage / shelf-life of food.

2.5.3 Farm productivity and yield enhancements are driven by modern agricultural techniques involving:

- *Herbicides reduce effects of non-productive plants*
- *Pesticides minimize wastage to pests*
- *Irrigation by plastic pipes (e.g. micro-irrigation) saves water and enhances production*
- *Agro-machinery / Tractors (polymer parts, lubricants) improve productivity*
- *Synthetic fertilizers (based on hydrogen from natural gas)*

2.5.4 Transportation / Distribution / Storage for reducing spoilage, wastage and maintaining quality of grains, fruits, vegetables, sugar, etc.

- *Plastic Woven sacks for grains, sugar.*
- *Cold storage refrigerants enhance the shelf life of produce making it available round-the-year*

- *Plastic & Leno bags are convenient for storage, handling and retail maintenance" (wash n wear).*

Figure 14: Petrochemicals in Food / Agriculture

Kapda (Clothing)

2.5.5 Affordable, durable, low-maintenance and attractive clothing for the masses is made possible by petrochemicals based synthetic fibers providing alternatives to natural fibers like cotton and wool.

- *Polyester, Nylon and Acrylic fibers are affordable, durable and "low-*
- *Synthetic dyes provide attractive and fast "non-fading" colors and designs*
- *Synthetic detergents make life easier for the housewife*
- *Other chemical auxiliaries help the feel, luster and durability of fabrics*

Figure 15: Petrochemicals in Clothing

Makaan (Housing)

2.5.6 Affordable, durable and attractive housing and an improved quality of life for all strata of society is made possible by the use of petrochemical products:

- *Construction chemicals enhance the strength and life of RCC buildings*
- *Plastic sheets provide shelter for the poor from the elements*
- *Paints / Coatings not only improve the attractiveness of a dwelling, but also protect the structure from corrosion and deterioration*
- *Appliances and Consumer Electronics made with plastics reduce the drudgery of the housewife and entertain the family, enhancing their quality of life*
- *Plastic pipes for water distribution and sewage disposal are lightweight and non-corrodible (durable)*

Figure 16: Petrochemicals in Building

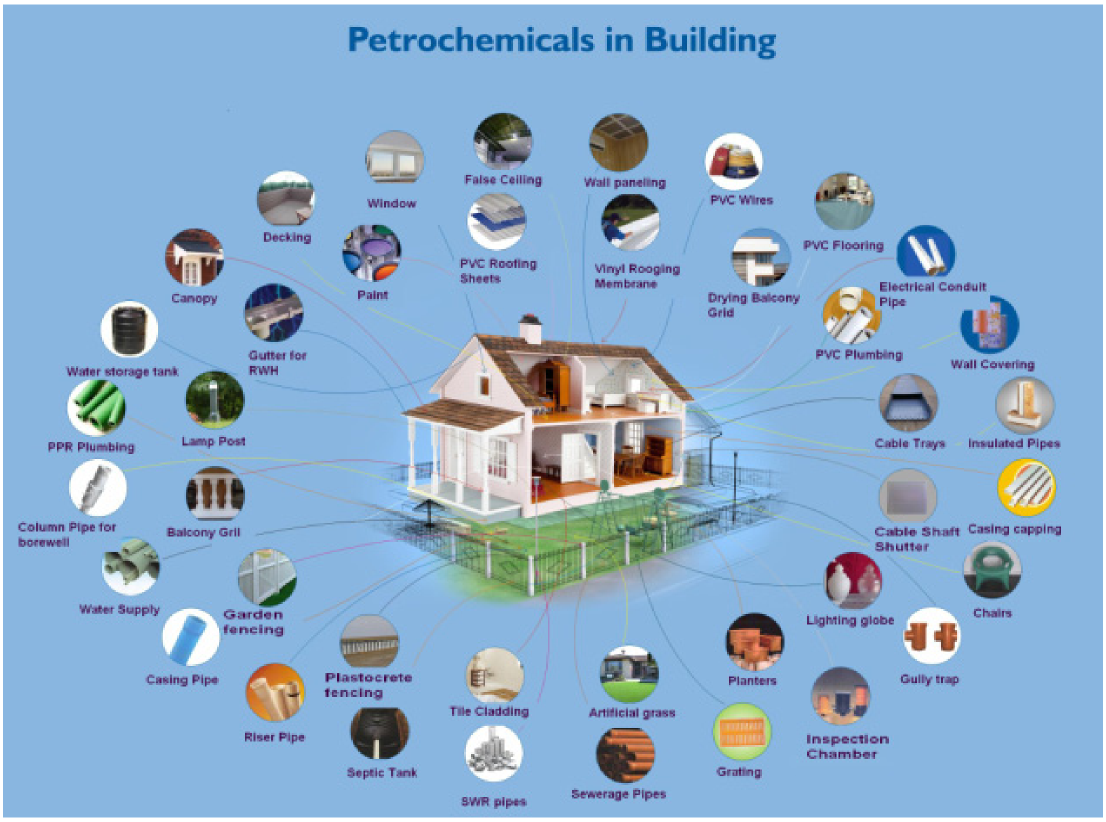


Figure 17: PVC Home

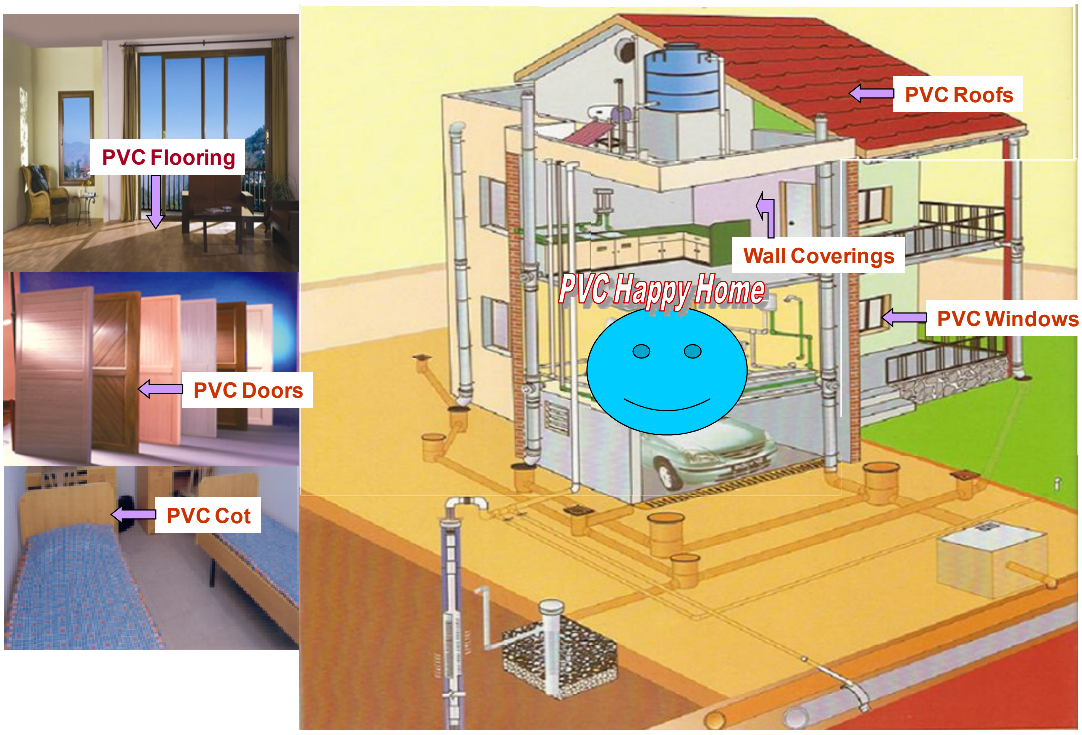
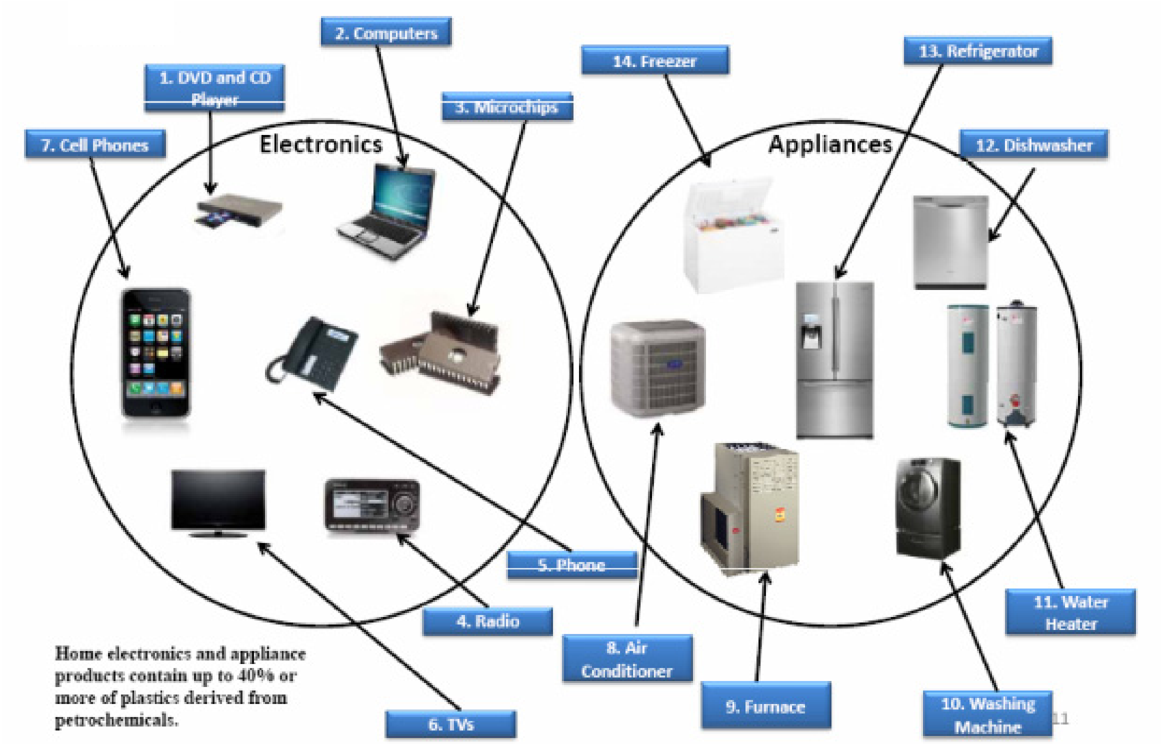


Figure 18: Petrochemicals in Consumer Electronics



Transportation

2.5.7 Petroleum not only provides the fuel to drive transportation, but perhaps more importantly, many petrochemicals which make the ride comfortable.

- *Plastic parts in automotives are light weight to enhance fuel efficiency*
- *Lubricants help automotive engines run smoothly*
- *Refrigerants make for a comfortable ride*
- *Bitumen, a petroleum derivative, helps construct good quality all-weather roads*
- *Numerous aircraft components are made from high performance polymers*

Figure 19: Petrochemicals in Automobile

2.5.8 **Health & Hygiene**

2.5.8.1 A whole lot of hygiene and cleaning products have petrochemicals as their main ingredients apart from packaging.

2.5.8.2 Shampoos for hair-care are formulated with petrochemical cleaning agents (detergents)

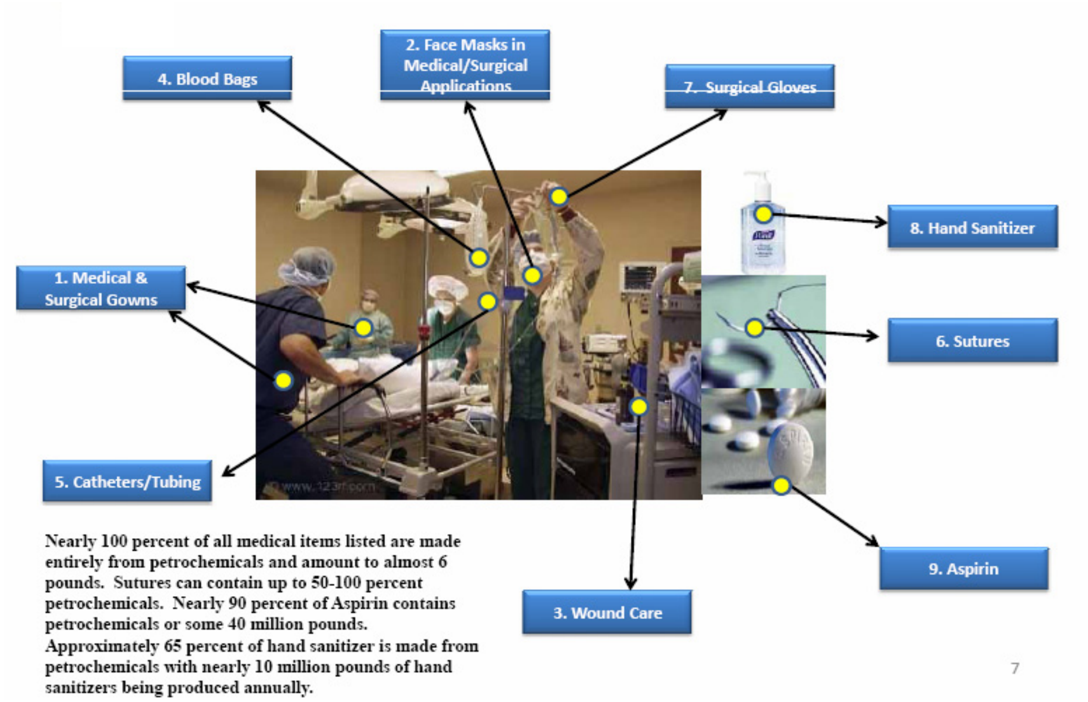
2.5.8.3 Detergents make for a clean laundry and household.

2.5.8.4 High absorbing materials and polymer non-woven films are vital ingredients for Feminine Hygiene, Diapers, and Incontinence pads to help keep users dry.

2.5.8.5 Plastics do play a major role in healthcare like blood bags, syringes, masks and gloves and implants.

2.5.8.6 Numerous “disinfected” products in the hospital as indicated in figure.

Figure 20: Petrochemicals in Healthcare



2.6 Employment

2.6.1 Even though this industry is capital and technology intensive, the downstream sector is a major avenue for large scale employment. The downstream plastic processing is the largest employer with over 3.53 million people deriving their livelihood from this sector.

2.6.2 Given below are rough estimates:

A. **Direct:**
a) Direct Manufacturing: 0.12 million
b) Downstream converting: 0.74 million

B. **Indirect:**
c) Downstream: 1.25 million
d) Reprocessing, logistics, etc: 1.41 million

C. **Total: 3.53 million**

2.6.3 The petrochemical sector employs manpower basically in the following five broad segments

a) Direct manufacturing i.e. crackers and derivative units like GAIL, HPL and Reliance Industries etc
b) Downstream processing i.e. plastic processing units converting commodity polymers into end products
c) Logistics: i.e. movement of manufactured products

d) Reprocessing – Collection / Segregation and converting the used plastics into granules.
e) Downstream indirect, i.e., ancillary (packing & finishing, assembly units, maintenance shops like electrical & machinery maintenance), mould & die making, testing, master batch & additives, support institutions like training & development, trading & export promotion/exhibition centres, etc.

2.6.4 **Direct manufacturing involves high level of skill of manpower,** Engineers, Scientists, PhDs, Accountants, Technicians, MBA, etc. A typical 1 mmt cracker with derivative units needs following manpower.

Table 12: Employment Generation in 1 mmt Cracker

	Cracker	MEG	LLD/HD	EB/SM	Total
Capacity	1000	500	600	450	
Process	60	40	70	40	**210**
Maintenance	35	35	35	35	**140**
Lab	20	10	20	10	**60**
Contract	20	20	100	20	**160**
Administration, Medical, Fire, Safety & Security	30	30	30	30	**120**
Offsite	40	20	100	20	**180**
Business	20	20	100	20	**160**
Finance & Commercial	10	10	30	10	**60**
Shared services like IT/MIS	5	5	10	5	**25**
Total	**240**	**190**	**495**	**190**	**1115**

2.6.5 **Downstream processing has huge impact on employment.** Presently India has 23000 small/medium and large converting units. These converting units employ from 10-15 to 130-150 people in one units. Typical manning of various types of units and their manpower requirement is as below.

2.6.6 Next segment of indirect employment is logistics. Building blocks i.e. Ethylene, Propylene and Butadiene are mainly consumed captively, where as commodity polymers are required to be moved from manufacturing plant to converting units which may be from located at distance of 1 day to 7 days travel from the polymer manufacturing site. Assuming average transit of four days, No of trucks and driver/ helpers required exclusively for polymers will be equivalent to transporting four days production and then they becoming free either for reloading same or any other commodity.

2.6.7 Consumption 8.5 MMTA translates to 93000 MTS or 5800 trucks or approx 24000 drivers and helpers assuming two drivers and 2 helpers per truck.

Table 13: Employment Generation in Downstream Processing Industry

S No	Type of M/c	Mgt	Prod/QC	operator	labor	Sales/ Purchase	Admin	Acc	Miscell	Total
1	Injection Moulding	1	1	2	6	1		1	2	14
2	Blow Moulding	1	1	2	6	1		1	3	15
3	Extrusion	1	1	2	5	1		1	3	14
4	Monolayer Film	1	1	2	3	1			3	11
5	Two Layer Film	1	2	2	4	2		1	3	15
6	Multilayer Film	1	2	2	15	2	1	2	4	29
7	PPTQ Film	1	1	2	3	1		1	3	12
8	BOPP Film	1	15	30	60	6	2	2	6	122
9	Cast Film	1	2	2	15	1	1	2	4	28
10	Air Bubble Film	1	1	2	20	2	1	1	4	32
11	PVC Film	1	1	2	8	1		1	2	16
12	PVC Calendering	1	2	4	16	2	1	2	4	32
13	Raffia Tape Line	1	2	2	50	2	1	2	4	64
14	Box Strapping Line	1	1	2	4	2		1	3	14
15	Monofilament	1	1	2	3	2	1	1	4	15
16	Sutli	1	1	2	2	2		1	4	13
17	Nonwoven	1	1	2	5	2	1	1	4	17
18	Fiber & Filament	1	1	2	10	2	1	2	4	23
19	HDPE Pipe	1	2	2	18	2	2	2	4	33
20	Drip Lines	1	2	1	15	2	1	2	4	28
21	PPR Pipe	1	2	2	12	2	1	2	4	26
22	RPVC Pipe (SS)	1	2	2	18	2	1	1	4	31
23	RPVC Pipe (TS)	1	2	2	18	2	1	1	4	31
24	RPVC Profile (SS)	1	2	2	12	2	1	1	4	25
25	RPVC Profile (TS)	1	2	2	12	2	1	1	4	25
26	Wire / Cable Coating	1	2	2	5	2	1	2	3	18
27	Extr. Coat.	1	1	2	5	2	1	1	3	16
28	Sheet Lines	1	1	2	5	2		1	3	15
29	Compounding (SS)	1	1	2	20	2	1	2	4	33
30	Compounding (TS)	1	1	2	20	2	1	2	4	33
31	Palletising	1	1	1	5	2	1	1	2	14
32	Bare Extruders	1	1	1	4	2	1	2	4	16

2.6.8 **Next largest segment of employment is reprocessing** sector. Here the indirect employment potential is at the bottom of the pyramid i.e. rag pickers and people from lowest strata of the society involved in segregation and cleaning/washing of plastic waste. India has app 3500 recycling units in organised sector and 4000 units in unorganised 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.

2.7 Conservation of Energy

2.7.1 Over the years, as awareness of the multiple benefits of petrochemicals usage increased, Petrochemicals like plastics can play an important role in energy conservation and bring substantial economic benefits to the economy. It is estimated that energy consumption for plastic doors and windows is about one-fourth to one-eighth of that for steel and aluminum. Additionally, usage of plastics doors and windows results in 30-50% savings in terms of building heating/cooling load.

2.7.2 Compared to its substitute materials like glass, wood, galvanized iron, etc. plastics are much more energy-efficient. Replacement of traditional materials with plastics in applications like transportation and distribution of water, packaging, automotive parts, door and window profiles, etc results in substantial energy savings.

2.7.3 Today, plastics touch every sphere of life and are indispensable to modern day living.

2.7.4 Apart from its multiple functional advantages over other conventional materials like metals, glass, jute, paper, etc., plastics consume lesser energy during its life cycle and hence reduce the energy cost burden on the exchequer.

2.7.5 Energy conservation in plastics takes place in two ways.

i) The process of manufacturing plastic products consumes less energy compared to what the energy consumption would have been using conventional materials.
ii) Energy recovery through incineration after the life cycle of the plastic product is over.

2.7.6 A study titled "Resource & Environmental Profile Analysis" conducted by Franklin Associates Ltd had concluded that 53 billion units of electricity are saved annually by improvements in appliance energy efficiency brought about by application of plastics.

2.7.7 The energy content of waste plastics is higher than coal or oil. Sweden already recovers energy from 56% of its plastics in domestic waste, providing 15% of its total district heating needs. In Denmark, 62% of plastics in domestic waste are recovered for conversion to energy. In Switzerland, the figure is 72%.

2.7.8 Use of plastics, actually saves more oil than is needed to manufacture them. Plastics due to their unique properties like light-weight, durability, malleability, etc. coupled with low temperature required for processing vis-à-vis other materials save significant amount of energy across applications. Some of the energy-saving applications of plastics are as follows.

2.7.9 **"Energy Saving & Energy Efficiency Program: Ahmedabad's Experience",** Ahmedabad Municipal Corporation (India)➔ Ahmedabad Municipal Corporation's efforts to save energy saving were greatly assisted when USAID initiated a process to save energy in Ahmedabad under the Sustainable Cities Initiatives (SCI) program managed by the Alliance to Save energy (Washington, DC) along with its Indian counterpart, Energy Management Consultation (IERMC). Under this program, a preliminary energy audit of AMC water pumping stations was conducted. Based on the audit results, a series of measures were initiated to ensure:

a. Reduction in peak demand,
b. Reduction in power losses,
c. Reduction in power consumption.

2.7.10 The Society for Research in Packaging Market (Germany) in its study titled **"Packaging Without Plastics: Ecological & Economic Consequences from a Packaging Materials Market without Plastics"** inferred that American manufacturers saved 338 trillion btu of energy equivalent to 58 million barrel of oil or 325 billion cft of natural gas or 32 billion pounds of coal, using plastics in packaging replacing metals, glass & paper.

2.7.11 **Energy Efficiency PPR (Polypropylene Rigid) Pipe Vs GI Pipe-Project** done by IIT Bombay. The study led to the following salient conclusions a) Frictional pressure drop in PPR pipes are about 40% less as compared to GI pipes of same ID in general, b)For identical water quality, the scale formation on PPR pipes is about 35% less at room temperature and about 60% less at 75^0 c.PPR pipes also do not forma hard scale and the scale peels off after attaining a certain thickness, c)PPR pipes develop significantly lower skin temperature for hot water service as compared to GI pipes under identical conditions. The low skin temperature will translate into lower heat losses to atmosphere.

2.7.12 Manufacturing of plastic bags requires 1/3rd less energy than paper bags and disposable plastic containers consume 30% less energy compared to paper board containers and hence, are more energy efficient as a packaging material vis-à-vis metals, glass and paper.

2.7.13 Similarly, plastic pouches consume one-tenth the amount of energy for packaging & delivering milk compared to glass bottles, which were earlier, used for the purpose.

2.7.14 Bulk commodities have traditionally been packed in either Jute or paper sacks. The sacks for bulk packaging are required to be strong, light and easy to handle and safe from the point of hygiene. In addition to above attributes of sacks for bulk packaging must be environment-friendly, energy-efficient.

2.7.15 Table below compares the merits of packaging milk in plastic pouches vis-à-vis glass bottles. As shown in the table, for packaging of 1 lac liters of milk in glass bottles 45.4 MT of glass is required in sharp contrast to only 0.4 MT of plastics which translates to a requirement of

450 gms glass and only 4 gms of plastic for packaging of 1 litre milk. Over all, for packaging of 1 lac liters of milk and recycling of the packaging material, total energy requirement for glass bottles is 1980 GJ compared to only 184.4 GJ for plastic pouches.

Table 14: Energy Savings in Milk Packaging: Glass Bottles vs. Plastic Pouch

	Unit	Glass Bottle	Plastic Pouch
Material Required	MT	45.5	0.4
Energy Required for Raw Materials Production	GJ	1202	36.8
Energy required for 100% Recycling	GJ	501	4.6
Energy required for 95% Reuse	GJ	277	143
Total Energy Required	GJ	1980	184.4
Note : For packaging of 1 lakh litre milk			
Source: LCA, IIT Delhi			

2.7.16 In addition, glass requires 32 times more energy for unit packaging vis-à-vis plastic pouch. Transportation of 1lac litre milk in plastic pouches rather than in glass bottles results in fuel savings of 929 litres.

2.7.17 Apart from energy savings, reuse of glass bottles may pose serious issue of hygiene. Waste plastic pouch on incineration leads to energy generation while waste glass has no incineration value

2.8 Advantages of Plastic Pipes

2.8.1.1 Plastic pipes are increasingly being used in water management owing to their enormous techno-commercial advantages including

- Non Corrosive
- Low weight & ease of installation
- Low coefficient of friction
- Abrasion resistance
- Low thermal conductivity
- Flexibility
- Non-toxic
- Biological resistance
- Excellent jointing techniques
- Maintenance free

2.8.1.2 On a life cycle cost comparison they are preferred over the traditional material pipes such as ductile iron (DI), galvanized iron (GI) pipes.

2.8.2 **Current Usage of Major Plastic Pipes**

a) **PVC Pipes:** During 10th Five year plan consumption of PVC pipes in India was 3100 KT and it is estimated that during the 11th Five year plan this consumption will reach a figure of 6000 KT.
b) Plastic pipes save energy at all the stages of their life cycle viz. extraction of raw materials, production of pipe, transportation, usage and recycling.
c) Table below lists the resultant energy savings with PVC pipes. The energy saving during the 11th Five year plan translates into average annual energy savings of 6 million MWh/year.

Table 15: Energy saving & Reduction in CO_2 emission due to use of PVC pipes

5 Year Plan	PVC Usage in Pipes	Energy Consumption during the Life Cycle (Million MWh)		Energy saving with PVC Pipes (Million MWh)	CO_2 emission during the life cycle (Million tonnes)		CO_2 Reduction with PVC Pipes (Million tonnes)
	KT	PVC Pipes (110 mm)	DI-Pipes (125mm)		PVC Pipes (110mm)	DI-Pipes (125mm)	
10^{th} 2002-07	3100	40.0	56	16.0	173.5	231.2	57.7
11^{th} 2007-12	6000*	76.6	108	31.4	332.4	443.0	110.6
Total	**9100**	**116.6**	**164.0**	**47.4**	**505.9**	**674.2**	**168.3**
*: Estimated							

2.8.3 Besides saving energy, plastic pipes also help to protect environment by reducing CO_2 emission. Most of the stages in the life cycle of a pipe require energy wherein green house gases; particularly CO_2 gets released. Reduction in CO_2 with the usage of PVC pipes during the 10th and 11th Five year plans is also depicted in Table.

a) **PE Pipes:** During 10th Five year plan consumption of PE pipes in India was ~500 KT and it is estimated that during 11th Five Year plan this will double up to a level of ~1000 KT.

b) Table below covers the resultant energy saving and reduction in CO_2 emission with the usage of PE pipes in place of traditional DI pipe.

Table 16: Energy saving & Reduction in CO_2 Emission due to use of PE Pipes

5Year Plan	PE Usage in Pipes	Energy Consumption during the Life Cycle (Million MWh)		Energy saving with PE Pipes (Million MWh)	CO_2 emission during the life cycle (Million tonnes)		CO_2 Reduction with PE Pipes (Million tonnes)
	KT	PE Pipes (125mm)	DI Pipes (125mm)		PE Pipes (125mm)	DI Pipes (125mm)	
10th 2002-07	500	4.3	8.0	3.7	18.6	33.0	14.4
11th 2007-12	1000*	10.0	18.6	8.6	43.0	76.3	33.3
Total	**1500**	**14.3**	**26.6**	**12.3**	**61.6**	**109.3**	**47.7**

***: Estimated**

c) Investment of about Rs. 20 Lakh Crores is targeted in the 11thFive Year Plan for infrastructure development. This would result in estimated consumption of 6 million tonnes of PVC pipes and 1 million tones of PE pipes in various sectors of infrastructure development.

d) With a major usage in Water management, energy savings during the 11th Five year plan with usage of PVC and PE pipes is expected to be 31 and 9 million MWh respectively. Similarly reduction in CO_2 emissions is expected to be 110 million tonnes and 33 million tonnes respectively.

2.8.4 Future Projections

2.8.4.1.1 In 12th Five year plan, investment in Infrastructure development is projected to be double of that during the 11th Five year plan, i.e. Rs. 40 lakh crores. During the 12th Five year plan, the consumption of PVC pipes is estimated to reach 10 million tonnes; whereas that of PE pipes to 1.7 million tonnes.

2.8.4.1.2 This is expected to result in a saving of 65 million MWh energy with PVC and PE pipes contributing 52 MWh and 13 MWh each. Also a total reduction in CO_2 emission is estimated to the tune of 233 million tonnes; PVC and PE pipes having a share of 182 and51 million tonnes respectively.

Table 17: Estimated Energy saving and Reduction in CO2 emission due to use of PVC Pipes in 12th 5 yr Plan

5 Year Plan	PVC Usage in Pipes	Energy Consumption during the Life Cycle (Million MWh)		Energy saving with PVC Pipes (Million MWh)	CO_2 emission during the life cycle (Million tonnes)		CO_2 Reduction with PVC Pipes (Million tonnes)
	KT	PVC Pipes (110 mm)	DI Pipes (125mm)		PVC Pipes (110mm)	DI Pipes (125mm)	
12th 2012-17	9790*	126.4	178.0	51.6	549.0	731.0	182.0
*: Estimated							

Table 18: Estimated Energy saving and Reduction in CO2 emission due to use of PE Pipes in 12th 5 yr Plan

5 Year Plan	PE Usage in Pipes	Energy Consumption during the Life Cycle (Million MWh)		Energy saving with PE Pipes (Million MWh)	CO_2 emission during the life cycle (Million tonnes)		CO_2 Reduction with PE Pipes (Million tonnes)
	KT	PE Pipes (125mm)	DI Pipes (125mm)		PE Pipes (125mm)	DI Pipes (125mm)	
12th 2012-17	1665	15.4	28.7	13.3	66.4	117.8	51.4
*: Estimated							

Note – To have a common flow rate of the liquid flowing through all the 3 pipes considered above, viz. PVC, PE and DI; different diameters of the pipes are taken into account.

2.9 ***Advantages of PVC windows***

2.9.1 PVC Windows are being preferred over the traditional Aluminum windows due to the techno-commercial benefits which include:

a. Excellent thermal insulation
b. Practically no ingress of sound, dust and rainwater
c. Save energy during all the stages of their life cycle
d. Durable & Long life
e. Design flexibility and versatility

f. Stylish, elegant and aesthetically pleasing
g. Easy to fabricate, and install
h. Can be recycled at the end of its useful life
i. Save forests and environment

2.9.2 **Current Usage of PVC Windows**

2.9.2.1 With well established status all over the world, PVC windows are finding more and more usage in India in major metro cities to begin with. From a figure of <1.5 KT in 2002-03; consumption of PVC in windows increased 3 times (4.6 KT) in 2006-07. During the current financial year, the consumption is estimated to reach a figure of 26 KT.

2.9.1 **Energy saving – Case Study (Hotel Vivanta by Taj*):** The table below explains savings in energy for using AC, where plastic frame window is used Vs Aluminum frame window.

Figure 21: Case Study by Hotel Vivanta, TAJ

	Elgi – Infinity(RTVP) Windows	Aluminum Windows
No. of windows (Guest rooms)	58	58
Area of one window	=7.45 Sq.M	7.45 Sq.M
Glass area	=6.16 Sq.M	6.83 Sq.M
Frame area	=1.29 Sq.M	0.62 Sq.M
Relative heat gain (RHG) through glass	=567 W/m 2 x 6.16m2 =3492.72W	663W/m2 x 6.83 m2 =4528.29 W
Direct energy transfer (DET) through frame	=1.4 W/m2.K x 8 K x 1.29m2 =14.44 W	16 W/m2.K x 8 K x .62m2 =79.36 W
Total heat gain	=3492.72 W +14.44 W =3507.16W i.e.3.51 KW	4528 W + 79.36 W =4607.65W i.e.4.61 KW
For 58 windows	3.51 KW x 58 =203.58 KW	4.61KW x 58 =261.38 KW
Assuming, 10 hours of a/c usage per day and 80 % occupancy rate: Annual usage	10 x 365 x 80/100 =2920 hours	10 x 365 x 80/100 =2920 hours
Annual power consumption to compensate the heat gain	203.58 KW x 2920 hr. =594454 KWhr.	261.38 KW x 2920 hr. =763230 KWhr.

Savings : 1,68,776 KWhr

The calculations are based on test results

SARA ELGI ARTERIORS LTD.

* Then Taj Blue Diamond

2.9.1.1 Energy saving with PVC windows in comparison with Aluminum windows during all the major stages of life cycle viz. production, transportation, usage and recycling is represented in Table below. It also covers the reduction in CO_2 emission because of the usage of PVC windows.

Table 19: Energy saving and Reduction in CO2 emission using PVC Windows

5 Year Plan	PVC Usage in Windows	Energy Consumption during the Life Cycle (000 MWh)		Energy saving with PVC Window (000 MWh)	CO_2 emission during the life cycle (Million tonnes)		CO_2 Reduction with PVC Windows (Million tonnes)
	KT	PVC Windows	Aluminum Windows	PVC Windows	PVC Windows	Aluminum Windows	
10th 2002-07	14.5	697.0	964.0	267.0	0.3	0.43	0.13
11th 2007-12	81*	3933.0	5436.0	1501.0	1.7	2.4	0.7
Total	95.5	4630.0	6400.0	1770.0	2.0	2.83	0.83

*: Estimated

2.9.2 **Future Projections**

2.9.2.1 It is estimated that during the period of 12th Five Year Plan (2012-13 to 2016-17), consumption for PVC in window profiles would reach a figure of 205 KT. The projected energy saving and reduction in CO_2 emission details are covered in Table below.

Table 20: Energy saving and Reduction in CO2 emission using PVC Windows

5 Year Plan	PVC Usage in Windows	Energy Consumption during the Life Cycle (Million MWh)		Energy saving with PVC Windows (Million MWh)	CO_2 emission during the life cycle (Million tonnes)		CO_2 Reduction with PVC Windows (Million tonnes)
	KT	PVC Windows	Aluminum Windows		PVC Windows	Aluminum Windows	
12th 2012-17	205*	9905	13690	3785	4.3	6.1	108
*: Estimated							

References:

1) *"Estimate of energy consumption and CO_2 emission associated with the production, use and final disposal of PVC, HDPE, PP, Ductile Iron and Concrete Pipes" by Dept. de Projects d'Enginyeria, Universiat Politecnica De Catalunya, Barcelona Spain.*

2) *"Estimate energy consumption and CO_2 emission associated with the production, use and final disposal of PVC, aluminum and wooden windows" by Dept. de Projectes d'Enginyeria, Universiat Politecnica De Catalunya, Barcelona Spain.*

3) *www.planningcommission.nic.in/plans/planrel/fiveyr*

*2.10 **Plastics Use in Automotives***

2.10.1 Plastics have enabled auto manufacturers to produce lightweight vehicles at an economical cost, enhancing safety, strength, reliability & comfort in addition to fuel economy.

2.10.2 The following distinct advantages of using plastics in automobiles had prompted automakers to switch from traditionally used metals to plastics.

- Cost-effective and cheaper material
- Weight reduction (Energy / Fuel Savings)
- Styling potential
- Functional design
- New effects

- Reduced maintenance
- Corrosion & chemical resistance

Figure 22: Plastics in Automobiles

2.10.3 The fuel economy resulting from replacement of metals with plastics has been a key consideration for the switch over to plastic auto components, which in today's spiraling oil prices has become increasingly important to customers & vehicle manufacturers. Several countries have passed legislation stipulating minimum fuel economy for vehicles. As an example, the US has 'Corporate Average Fuel Economy' (CAFÉ) legislation since 1985 to ensure every car sold gives a minimum mileage of 11Km/litre.

2.10.4 Replacement of iron and steel with plastics to make fuel tank & battery boxes reduces the weight of the components by 40% & 70% respectively making the vehicle more fuel-efficient. It is estimated that 100 Kgs of plastics replaces ~300 Kgs metals in cars and results in 30% reduction in the weight of the vehicle due to plastics use, improving fuel economy by 2.1 Km/litre.

2.10.5 Increased usage of plastics in a car running 15000 Km, results in fuel savings of 750 liters corresponding to oil savings of 21 million barrels per annum, which, in turn, reduces 50 MMT CO_2 emission per year worldwide.

2.10.6 Share of iron and steel in a typical vehicle has declined from 75%-78% in 1980 to 58%-63% currently, while that of plastics has increased from 4% to 9.3% and is expected to grow to 15% in near future.

2.10.7 For a country like India, the threat from rapid depletion of forest cover becomes even more critical as income of almost 60% of the population is dependent on agriculture which is a thrust area for the Government and declining forest cover is likely to adversely affect the performance of the agriculture sector.

2.11 Furniture & Builders ware: Major Wood Consumers

2.11.1 During the 1990s around 2 million hectares of land were deforested to meet the growing demand for wood in the country. The furniture and construction sectors are two of the largest consumers of wood in India. Table below shows the estimated share of these 2 sectors in the total wood consumption in India in the coming years.

Table 21: Projected Wood Consumption in India (Mn Cubic Mtrs)

	Total wood consumption in India	Wood consumption in construction & furniture sectors	Share of construction & furniture sector in total wood consumption
2005	74	23	31.1%
2010	95	27	28.4%
2015	123	32	26.0%
2020	152	36	23.7%

Source: FAO

2.11.2 As shown in the table, wood consumption in India is forecasted to grow from 74 million cubic meters in 2005 to 152 million cubic meters in 2020 of which 36 million cubic meters is projected to be consumed in construction & furniture sectors.

2.11.3 Replacement of wood with plastics only in the furniture and construction sectors will go a long way towards arresting the rapid depletion of forests in India thereby helping the country to meet one of its toughest challenges and bringing substantial benefits to both the national economy as well as the consumers.

2.11.4 Increased usage of plastics in furniture and construction is likely to bring several tangible and intangible benefits to the country. To illustrate the likely benefits, the benefits in terms of aforestation or preventing deforestation are depicted in the following table.

Table 22: Gains from Petrochemicals (Plastics) Use in Furniture & Profile

(at 10% replacement rate)	Unit	Cost
Area covered under aforestation	Mn hectares	6
Cost of aforestation	Rs.lakhs	102500
Cost of aforestation/hectare	Rs/hectares	1708
Forest saved through plastic use	hectare	640000
Gain from plastic use in aforestation equivalent	Rs. crores	109

Source: Industry

2.11.5 As shown in the table, at a 10% replacement rate use of plastics in furniture and profiles can save 640,000 hectares of forest, equivalent to 2.7 million cubic metres of wood. Also with cost of aforestation at Rs. 1708/hectare the above translates to a national savings of Rs 109 crores.

2.12 Petrochemicals Use in Agriculture: Plasticulture & Water Management

2.12.1 India accounts for 16% of the global population with 2.4% of the total world's area and 25% of livestock but only 4% of global water resources –major challenge to Government's objective of food security, employment creation, poverty alleviation and self sufficiency in the country. With rapidly increasing population, India today is facing major challenge of achieving water use efficiency and food security.

2.12.2 **Plasticulture** - The Use of Plastics in agriculture, horticulture, water management and allied areas offer following benefits:

a) Water Savings- 60 - 70%
b) Productivity enhancement by 50-60%
c) Enhanced quality of agricultural & horticultural produce.
d) Reduction in Post Harvest Losses – 30 - 35%of the agricultural produce can be added to the food basket.
e) Optimum utilization of various inputs as seeds, fertilizers, pesticides, etc.
f) Conserving soil fertility

2.12.3 Technology not only helps in saving water, mitigates environmental problems arising out of water logging & soil salinity but also helps in productivity enhancement & improved quality of produce. Networking of plastics pipes for water conveyance helps in reducing seepage /

evaporation losses, enhancement of irrigated area with the available water & avoids tail end problems in canal command areas.

2.13 Micro Irrigation

2.13.1 As per the Sub- group constituted by DCPC, Ministry of Chemicals & Fertilizers, GoI the proposed area coverage under micro irrigation during 12th Five Year Plan period (2012-2017) along with the estimated polymer requirement & technology cost is given below.

Table 23: Projected Area Coverage of MI for 12th Five Year Plan Period (2012-2017)

Sl. No.	Year	Proposed area for adoption (Lakh ha)			Plastics Requirement ('000 MTA)				Total Fund Requi-rement (Rs.Cr)
		Drip	Sprinkler	Total	PVC	PE	PP	Total	
1	2012-13	5	6	11	35	124	5	164	4660
2	2013-14	7	8	14	46	161	7	213	6050
3	2014-15	9	10	19	60	212	9	280	7950
4	2015-16	12	13	25	84	287	12	383	11000
5	2016-17	16	17	33	109	373	16	498	14300
Total		48	53	101	333	1156	48	1537	43960

2.13.2 As per the projections estimated, 100.8 lakh hectares of land is expected to adopt micro irrigation covering 47.6 Lakh hectares under drip irrigation system and remaining 53.2 Lakh hectares under sprinkler irrigation system.

2.13.3 The projected coverage of micro irrigation above is expected to raise domestic plastics consumption by 1537.2 KT with polymer requirement for PE, PP and PVC of 1156.4 KT, 47.6 KT and 333.2 KT respectively. It has been estimated that implementation of the above coverage of micro irrigation would necessitate funds requirement to the tune of Rs.43960 crores.

2.13.4 Benefit to the Nation:

- Savings in infrastructural costs on medium / minor irrigation projects.

- Savings on account of electricity subsidies given to the agriculture sector as micro irrigation increases water use efficiency and reduces pumping hours.
- Savings in subsidy support for the fertilizers due to savings in fertilizer consumption by adopting micro irrigation.
- Productivity Enhancement
- Employment Generation

Table 24: Irrigation potential resulting into higher productivity

Sl. No.	Year	Projected Area (Lakh ha)				Water Saving	Value of Infrastructure saved @ Rs1.5 crore per MCM
		Wide Spaced Crops under Drip Irrigation	Closed Spaced Crops under Drip Irrigation	Area under sprinkler Irrigation	Total	MCM /Year	Rs in crores
1	2012-13	2.0	3.0	5.8	10.8	1970	4455
2	2013-14	2.6	3.9	7.5	14.0	3855	5783
3	2014-15	3.4	5.1	10.0	18.5	5070	7605
4	2015-16	4.8	7.2	13.0	23.0	6990	10485
5	2016-17	6.2	9.4	16.9	32.5	9087	13631
Total		**19.0**	**28.6**	**53.2**	**100.8**	**27972**	**41958**

2.13.5 The total value of the 27972 MCM of water savings to the nation on account of bringing an area of 100.8 lakh ha under micro irrigation which otherwise had to be incurred for creating equal amount of irrigation potential works out to be Rs 41958 crores.

2.13.6 **Electricity Savings**

2.13.6.1 Electricity for irrigation in the agriculture sector is subsidized and the huge subsidy bill for the same is one of the key reasons for the mounting losses of the State Electricity Boards. Adoption of micro irrigation and the resultant efficient water utilization is likely to reduce the requirement of electricity for the purpose of irrigation, thereby reducing the Government's subsidy burden.

2.13.6.2 The savings in electricity/ hectare on account of adoption of micro irrigation in agriculture by switching over from conventional flood irrigation to drip irrigation results in electricity savings of ~278

KWhr/ha and is likely to reduce the Government's subsidy bill substantially.

Table 25: Electricity Savings through Micro Irrigation

S No	Components	Flood	Drip
1	Water Requirement, mm	900	600
2	Water Requirement, m^3/ha/annum	9000	6000
3	Water Requirement	9000000	6000000
4	No. of Irrigation days in a year	200	200
5	No. of Irrigation hours in a year @8 hrs./day	1600	1600
6	Average flow/ha	1.56	1.04
7	Average pumping head, m	40	50
8	Average HP/ha based on flow and head	1.4	1.16
9	Average KW/ha	1.0	0.9
10	Total Annual Energy kWh/ha	1666.7	1388.9
			277.8 kWhr/ha

Source: Report of the Task force on Micro Irrigation, GoI,2004

2.13.6.3 Based on the Savings in Electricity consumption and yearly targets for adoption of micro irrigation, the potential annual savings in electrical power due to micro irrigation have been worked out.

2.13.6.4 Electricity savings per hectare through use of micro irrigation for various categories of crops is in the range of 116 – 370 KWhr. For closed space crops suitable for drip irrigation, energy savings are the highest at 370 KWhr/ha, followed by wide space crops suitable for drip irrigation with the energy savings of 278 KWhr/ha.

Table 26: Reduction in Annual Energy Requirement using Micro Irrigation

Sl. No	Crop	Av.Annual Irrigation depth,mm		Av.Annual Energy Requirement, KWhr/ha		Saving
		Flood	Drip/Spnk	Flood	Drip/Spnk	
1	Wide Spaced crops suitable to Drip Irrigation	900	600	1667	1389	278
2	Close Spaced crops suitable to Drip Irrigation	1700	1200	3148	2778	370
3	Crops suitable to Sprinkler Irrigation	500	350	926	810	116

Source: Based on Report of the Task Force on Micro Irrigation, GoI, 2004

2.13.6.5 The potential savings from the areas brought under micro irrigation will be accruing every year after the adoption of micro irrigation and hence, the cumulative savings show the true potential of micro irrigation. The saving of subsidy towards the electricity saved alone amounts to Rs 1128.4 crores as detailed below.

Table 27: Saving in Subsidized Electricity supplied to Agriculture Sector

Saving in Subsidized Electricity supplied to Agriculture Sector

SN	Year	Proposed area for adoption, lakh ha				Cost of Electrical Power Saved or Reduction in Loss to SEBs, Rs Crores				
		Widely Spaced Crops for Drip Irrigation	Closely Spaced Crops for Drip Irrigation	Crops for Sprinkler Irrigation	Total	Widely Spaced Crops suitable for Drip Irrigation	Closely Spaced Crops suitable for Drip Irrigation	Crops suitable for Sprinkler Irrigation	Total	Cumulative Savings
1	2012-13	2.0	3.0	5.8	10.8	14.0	28.5	17.4	59.9	59.9
2	2013-14	2.6	3.9	7.5	14.0	18.2	37.1	22.5	77.8	137.65
3	2014-15	3.4	5.1	10.0	18.5	23.8	48.5	30.0	102.3	239.9
4	2015-16	4.8	7.2	13.0	25.0	33.6	68.4	39.0	141.0	380.9
5	2016-17	6.2	9.4	16.9	32.5	43.7	88.9	50.7	183.3	564.2
	Total	**19.0**	**28.6**	**53.2**	**100.8**	**133.3**	**271.3**	**159.6**	**564.2**	**1128.4**

2.14 Potential for Employment Generation

2.14.1 Successful adoption of micro irrigation is expected to generate significant employment opportunities in rural areas, which is one of the thrust areas for the Government. As per the Task Force report, adoption of micro irrigation would create additional jobs in the following areas**.**

- For every Rs 100 crores of size of the micro irrigation industry employment opportunities for ~500 skilled/unskilled people is generated.
- For every 100 hectares coming under micro irrigation, generate employment for 2 semi-skilled persons for installation and maintenance.
- With intensive agriculture being possible with adoption of micro irrigation, direct employment in agriculture will also increase at the rate of one additional person per hectare of area brought under micro irrigation.
- Indirect employment in allied sectors such as post-harvest handling, processing, transportation, etc will also be generated at the rate of one person for every 5 hectares of area under micro irrigation

2.14.2 Table below shows the potential for employment generation on account of adoption of micro irrigation in the country as per the yearly targets proposed for the XII plan period. *Successful adoption of micro irrigation as per the road map recommended for the XII plan period achieving the coverage targets for the same is likely to generate additional employment opportunities for over 8.4 million people in the country*.

Table 28: Employment potential due to adoption of MITs

Sl. No	Year	Estimated Cost Of MTs. Rs.crores	Employment Potential, nos.				
			Required for Drip Industry	Required for installation & maintenance	Direct employment in intensive farming	Indirect employment in allied services	Total Employment generation
1	2012-13	3660	18300	21600	108000	216000	930675
2	2013-14	4750	23750	28000	140000	280000	1302945
3	2014-15	6250	31250	37000	185000	370000	1489080
4	2015-16	8600	43000	50000	250000	500000	1984100
5	2016-17	11180	55900	65000	325000	650000	2730650
	Total	34440	172200	201600	1008000	2016000	8437450

2.15 Summary of Benefits to the Indian Economy & Farmers by bringing 10.08 Million Hectare Area under Micro Irrigation during 12th plan period

2.15.1 The table below summarises the benefits likely to accrue to the farmers as well as the Indian economy on account of increasing the coverage of micro irrigation to 10.08 million hectares during the 12th Five Year Plan period.

Table 29: Summary of Benefits from Adoption of Micro Irrigation

Particulars	Amount (Rs.Crores)
Savings in Water required for irrigation & indirect benefit on infrastructure cost	41958
Savings in Subsidised electricity due to reduction in electricity consumption	1128
Savings in fertilizer consumption due to adoption of Micro irrigation	507
Incremental benefits due to increase in yield	46418

Total benefits to the Nation	90011
Total Investments on Micro Irrigation Systems	43960
Additional employment generation during 12th Plan period	8437450

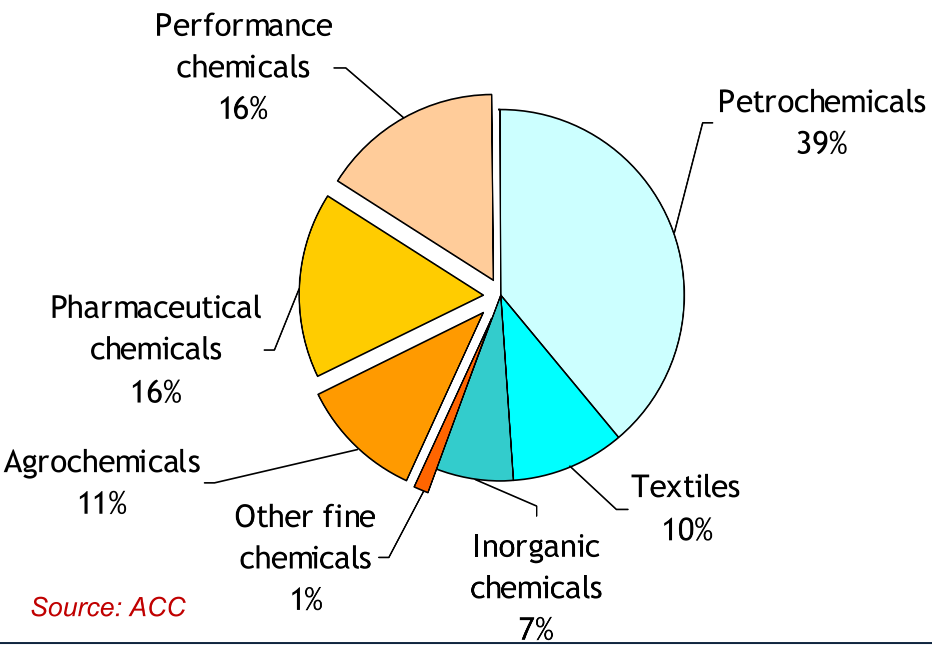
2.15.2 As shown in the above table, the total benefits due to adoption of micro irrigation during XII plan is estimated at Rs 90011.1 crores along with creation of employment opportunities for 8.43 million people in rural India.

3 Global Scenario of Petrochemicals

3.1 Growth of Global Petrochemical Industry

3.1.1 In 2010, the size of the global chemical market was estimated to be US$ 3.3 trillion, within which, petrochemicals constitute the single largest segment accounting for 40% (US$ 1.3trillion) of the chemical market.

Figure 23: Global Chemicals Industry



3.1.2 The inception and the growth phase of the petrochemical industry in the initial years was in the West but 1990 onwards there was a gradual shift of the industry towards Asia and Middle East. The trend further strengthened post-2000 as this region steadily emerging as a major driver of the global petrochemicals market. With large markets like China and India offering massive consumption potential and the feedstock advantage of Middle East, bulk of petrochemicals activities is shifting to this region.

Table 30: Global Demand Growth

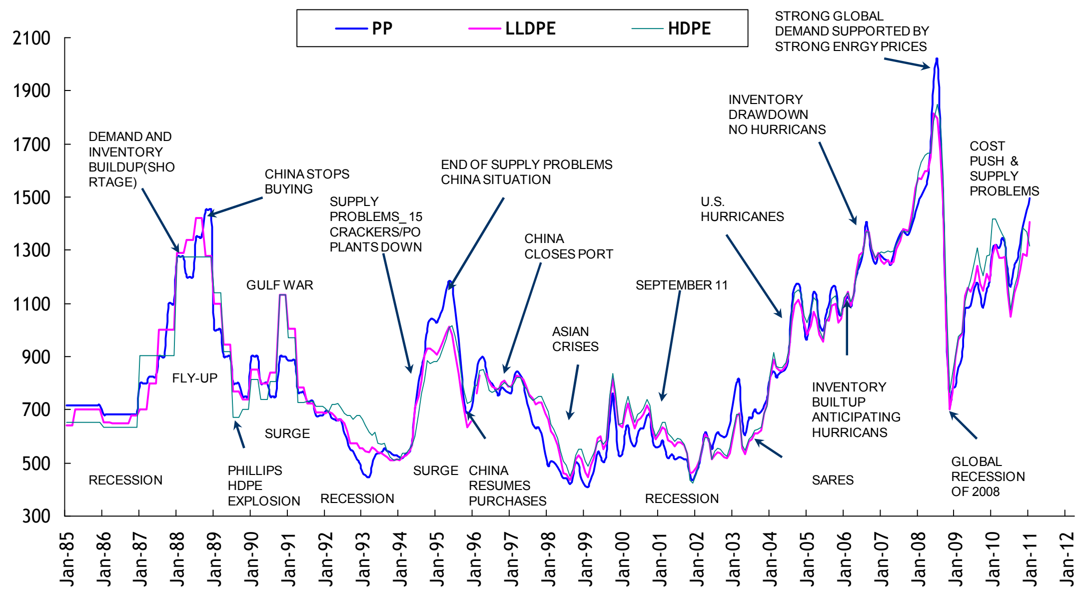
Product	Demand			CARG (%)	
MMT	2005	2010	2015	2010/2005	2015/2010
C2	105	120	151	2.8%	4.6%
C3	63	75	94	3.5%	4.7%
LDPE	17	19	22	1.5%	3.5%
LLDPE	17	21	28	3.8%	6.4%
HDPE	28	33	44	3.3%	5.8%
PP	40	49	64	3.9%	5.6%

PVC	32	35	44	1.7%	4.9%

Source: CMAI

3.1.3 Volatility in prices is rather a norm in petrochemical industry. The industry passes through 6-8 year cycle of peaks and troughs. This is essentially due to planning of large capacities during margin peaks and startup reduces operating rate and margins, In addition to capacity built ups, political and economic events also influence polymer prices. Global fluctuations in petrochemical industry in last 25 years are shown in the figure below.

Figure 24: Global Meltdown



3.1.4 **Import Duties:** India has the highest import duty on Naphtha at 5% has resulted in nil duty differential between raw materials (Naphtha) and finished products (polymers) which is threat to financial viability of polymer manufacturing from Naphtha. This is shown in Table given below. Secondly, low duty makes India an attractive market to offload surplus by Mid East and Singapore producers.

Table 31: Cross-country Comparison of Import Tariff in 2011

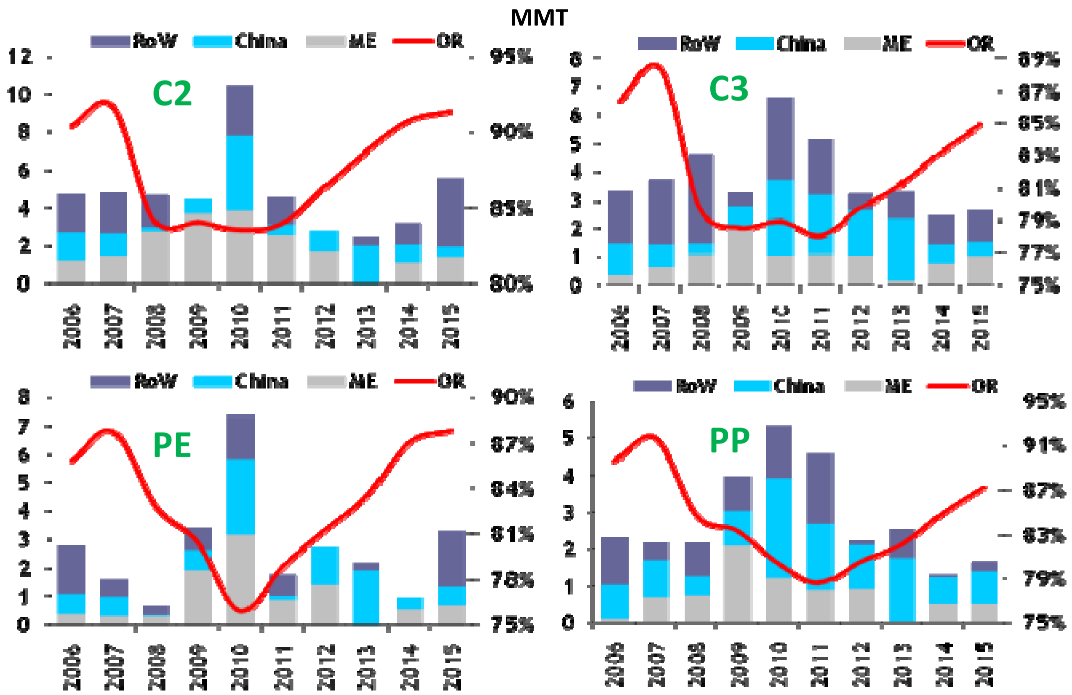
HS Code	Product	India	China	Malaysia	Thailand	Philip-pines	Indonesia	Saudi Arabia	Japan	US	EU
27101190	Naphtha	5%	1%	0%	0%	3%	0%	5%	0%	0%	0%
390110	LDPE	5%	6.5%	30%	5%	15%	15%	12%	6.5%	6.5%	6.5%
390110	LLDPE	5%	6.5%	30%	5%	15%	15%	12%	6.5%	6.5%	6.5%
390120	HDPE	5%	6.5%	30%	5%	15%	15%	12%	6.5%	6.5%	6.5%
390210	PP	5%	6.5%	30%	5%	15%	15%	12%	6.5%	6.5%	6.5%
390410	PVC	5%	6.5%	20%	5%	15%	10%	5%	6.5%	6.5%	6.5%
390311	PS	5%	6.5%	20%	5%	15%	10%	12%	6.5%	6.5%	6.5%
Duty Differential		0%	5.5%	30%/20%	5%	12%	15%/10%	7%	6.5%	6.5%	6.5%

3.2 *Global Ethylene & Propylene Scenario*

3.2.1 Ethylene and Propylene being the two major basic building blocks in the petrochemicals industry, their demand is often reflective of the overall petrochemicals market.

3.2.2 As per CMAI, in 2010 global ethylene capacity was 147 MMT as against total ethylene demand of 120 MMT. This capacity is expected to increase to 165 MMT in 2015 with demand reaching 151 MMT for the year.

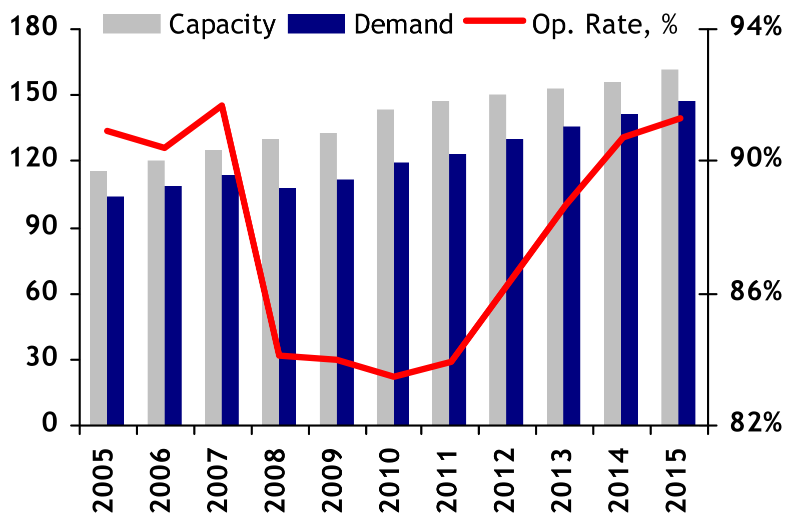
Figure 25: Polymers' Capacity Additions



Source : CMAI

3.2.3 **Super Cycle:** Global ethylene operating rates are indicators of the margins enjoyed by industry. For next 3-4 years rate of capacity addition is lower than demand growth. This will lead to improvement in operating rates and global industry is believed to be leading towards a super cycle.

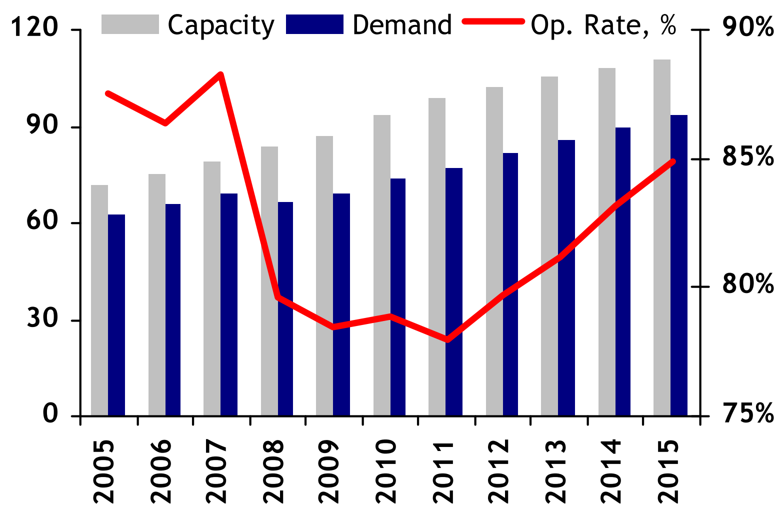
Figure 26: Global Ethylene Scenario



Source:CMAI

3.2.4 World propylene capacity was estimated at 94 MMT and demand is 75 MMT in 2010, which are expected to rise to 112 MMT and 94 MMT respectively by the year 2015.

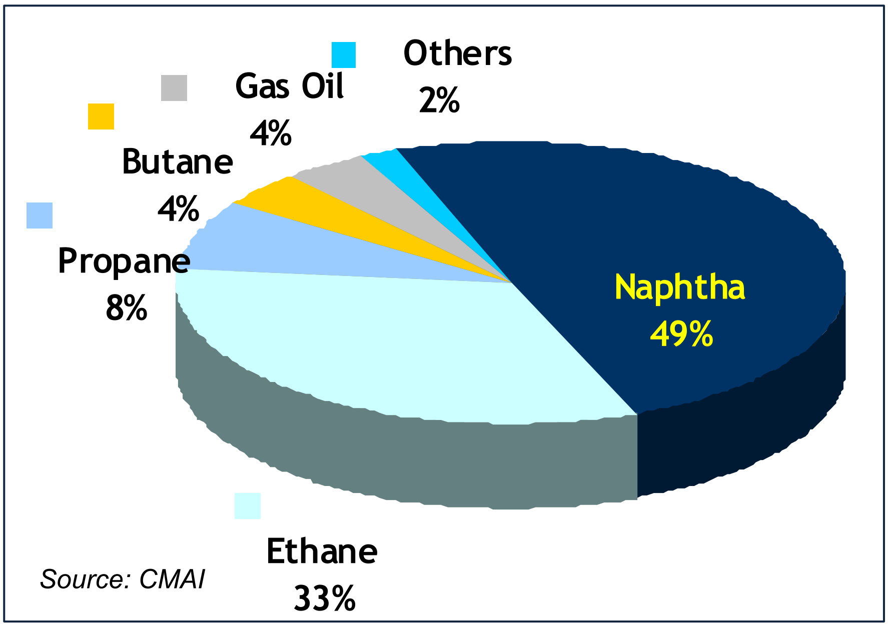
Figure 27: Global Propylene Scenario



Source: CMAI

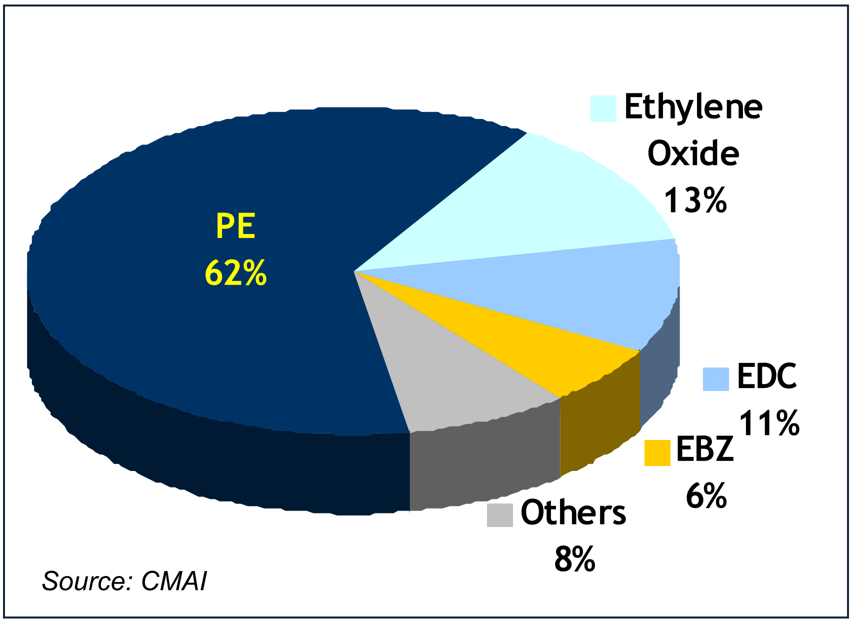
3.2.5 Ethylene, the key petrochemical building block is produced through multiple routes using different feedstocks like Naphtha, Natural Gas (Ethane), Propane, Butane, etc. However, Naphtha and Ethane are the most commonly used feedstocks, accounting for 82% of global ethylene production. Today, 50% of the ethylene produced in the world is through Naphtha cracking while one-third is produced through the Ethane route.

Figure 28: Shares of Feed Stocks in Global Ethylene Production in 2010



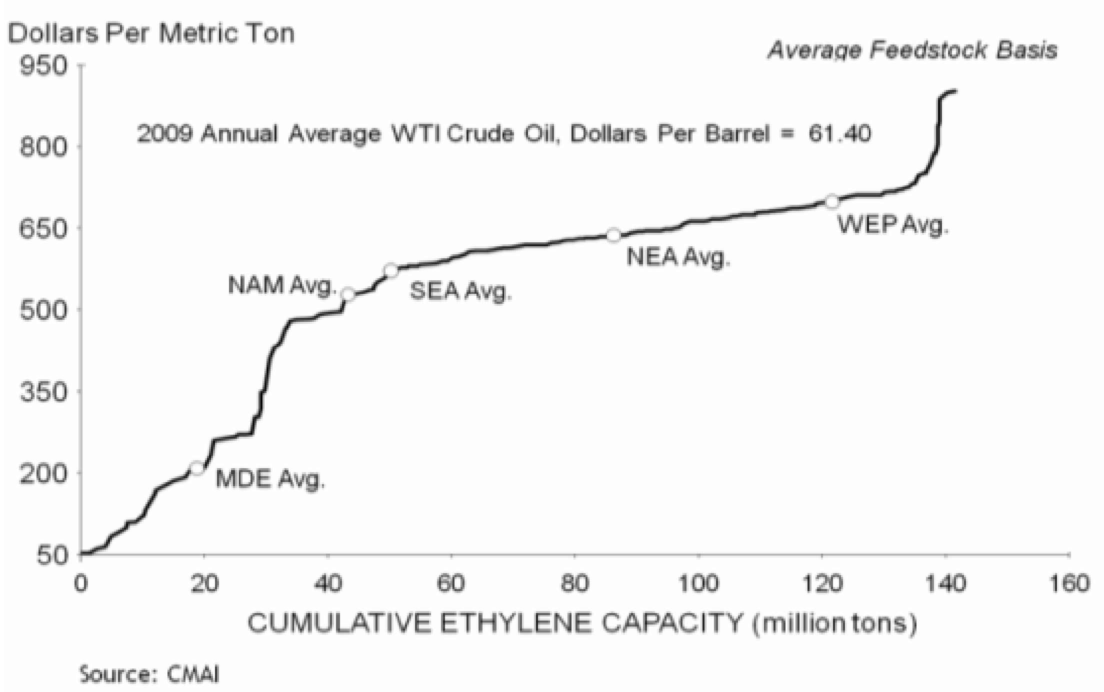
3.2.6 Over 60% of global Ethylene production is used for manufacturing Polyethylenes, 13% for EO, 11% for production of EDC, and the residual Ethylene goes in producing a wide array of petrochemicals.

Figure 29: Global Ethylene Demand by End-use in 2010



3.2.7 Ethylene cost of production varies widely across regions depending on feedstock costs, conversion costs, technology, the location of the cracker, etc. Figure below is a chart where crackers cumulative capacity is plotted against cost of production. Ethane based cracker in Middle East and North America are towards the lower end of cost curve and Naphtha based crackers in Asia and West Europe are towards the higher end of cost curve.

Figure 30: Global Ethylene Cash Costs by Location in 2010

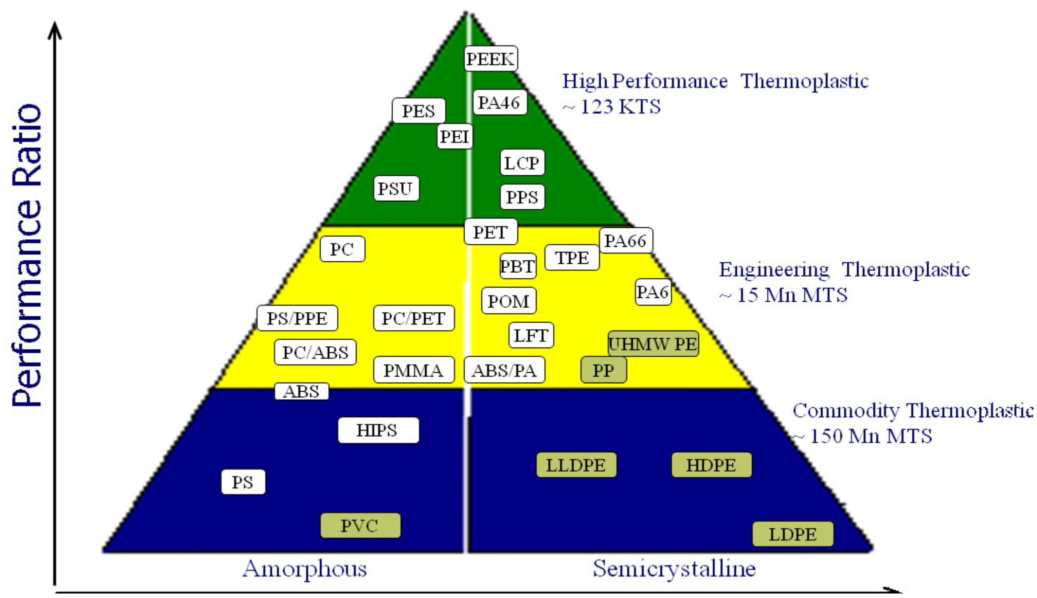


MDE Avg: Based on subsidy

3.3 Polymers

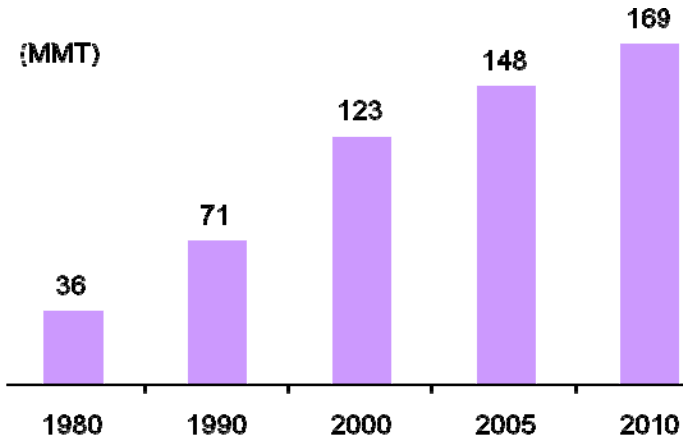
3.3.1 The inception of the polymer industry was in the West during the 1930s but its widespread commercial use in various sectors replacing traditional materials like metals and wood picked up in the 1950s.

Figure 31: The World of Thermoplastics



3.3.2 The multiple benefits offered by polymers compared to traditional materials like metals, paper and wood, are high value addition and versatility of their applications across sectors which can be gauged from the fact that even after several decades since its birth, the industry continues to grow ahead of GDP growth. Between 1980 & 2010, global polymer demand i.e. demand for commodity plastics has grown almost 5 fold from 36 MMT in 1980 to 169 MMT in 2010.

Figure 32: Global Commodity Polymers' Demand



Source: CMAI

3.3.3 Global polymer demand i.e. demand for commodity plastics increased from 123 MMT in 2000 to 169 MMT in 2010 while global polymer capacity went up from 142 MMT to ~213 MMT in the same period.During 2005-2010 period global polymer capacity & demand increased at a CARG of 4.6% and 2.8% respectively. Among the polymers, demand for LLDPE & PP registered the fastest growth with a CARG of over 3% during 2005-10 followed by HDPE with a CARG of 2.9%.

Table 32: Global Polymer Capacity & Demand

	2000		2005		2010		CARG 2005 over 2000		CARG 2010 over 2005	
(MMT	C	D	C	D	C	D	C	D	C	D
LDPE	19	16	20	18	22	19	1%	2%	2%	1%
LLDP	16	13	20	18	28	21	5%	6%	6%	3%
HDPE	27	23	33	29	41	33	4%	5%	4%	3%
PP	35	30	44	41	60	49	5%	6%	6%	3%
PVC	31	25	37	31	46	35	4%	4%	4%	3%
PS	14	11	15	12	17	14	2%	2%	2%	3%
Total	**142**	**119**	**170**	**148**	**213**	**169**	**4%**	**4%**	**5%**	**3%**

Source: CMAI, C=Capacity, D=Demand

3.4 *Shift of Industry from WOS to EOS*

3.4.1 During 1950-1990, countries in the West of Suez (WOS) region viz. the US and European countries essentially dominated the polymer industry. Demand for petrochemicals having a strong positive correlation with economic growth, consumption of polymers rapidly rose in the WOS on the back of the strong economic performance of the countries in the region.

Figure 33: Share of EOS in Global Ethylene Capacity

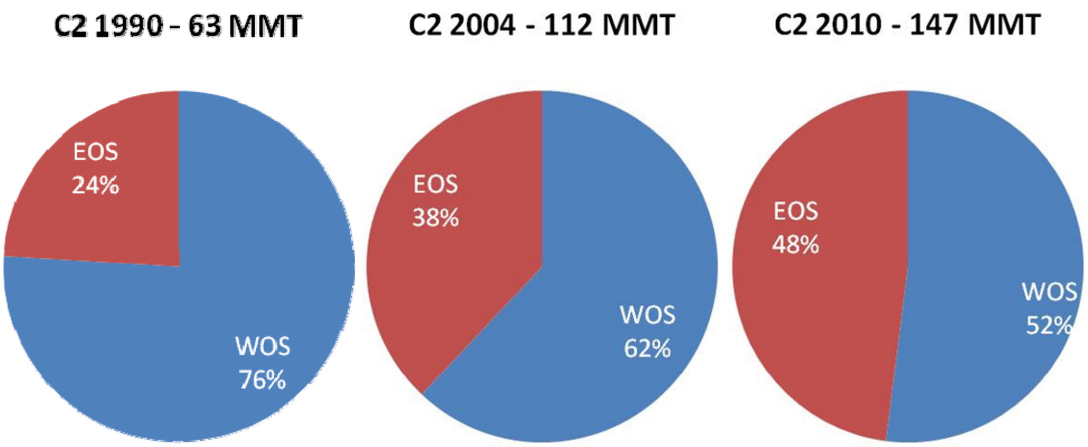
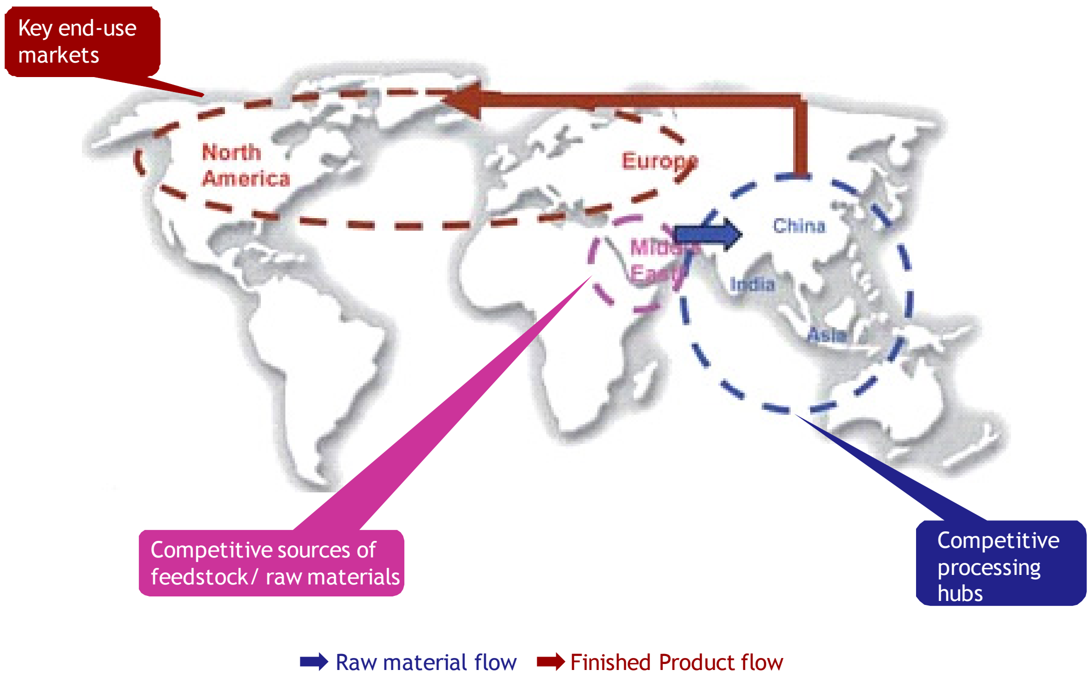


Figure 34: Petrochemicals Material Flow



3.4.1 However, as a result of sustained growth over 4 decades, polymer consumption levels in WOS countries reached a saturation point in the late 1980s limiting the industry's growth potential. As the petrochemical industry matured in the WOS, it was just making a beginning in the East of Suez (EOS) comprising Asia & the Middle East. The huge disparity in petrochemical consumption between WOS, where the industry has grown rapidly for 4 decades & the EOS where the industry had just made inroads prompted a fundamental shift in the industry from the WOS to EOS.

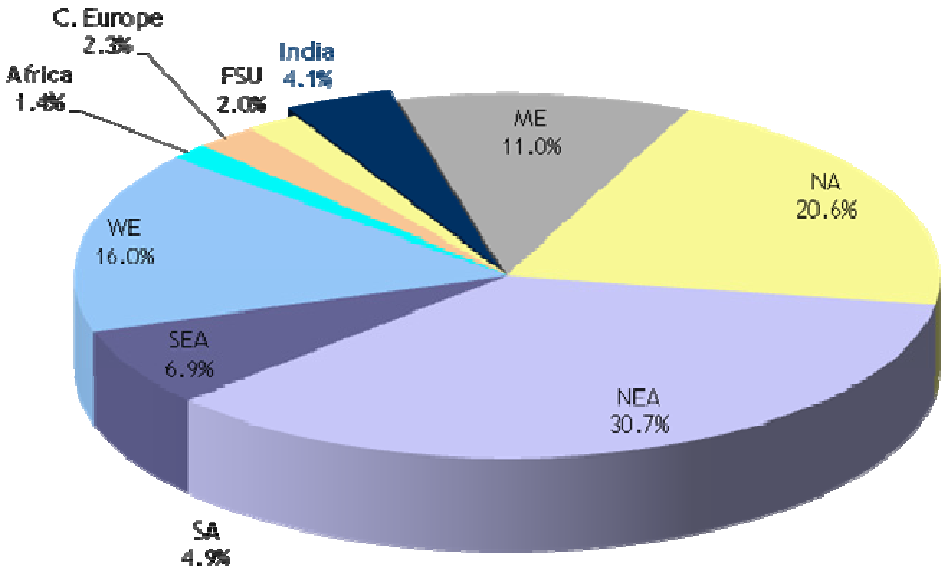
Figure 35: Global New Cracker Startups 2012-2016 (Kt of C2 Capacity)

Region	Country	Company	Location	S/u	Capacity
ME	S Arabia	Saudi Polymers	Al Jubail	Jan-12	1,200
NE Asia	China	Fushun PC	Fushun, Liaoning	May-12	800
SE Asia	Singapore	ExxonMobil	Pulau Ayer Chawan	Jul-12	1,000
				2012	3,000
ME	Iran	Kavyan PC	Bandar Assaluyeh	Jan-13	1,000
ME	Iran	Kavyan PC	Bandar Assaluyeh	Jan-13	1,000
NE Asia	China	Daqing PC	Daqing, Heilong.	Jan-13	600
NE Asia	China	Nanjing Wison	Nanjing, Jiangsu	Jan-13	295
NE Asia	China	SINOPEC Wuhan	Wuhan, Hubei	Feb-13	800
NE Asia	China	Yulin Energy & Chem.	Yulin, Shaanxi	Apr-13	300
NE Asia	China	Yulin Energy & Chem.	Yulin, Shaanxi	Apr-13	300
NE Asia	Taiwan	CPC-Taiwan	Lin Yuan, Kaohsiung	Apr-13	800
ISC	India	BCPL	Dibrugarh, Assam	Jul-13	220
NE Asia	China	PuCheng Clean Energy	Pucheng, Shaanxi	Jul-13	300
SE Asia	Philippines	JG Summit PC	Batangas, Batangas	Aug-13	320
NE Asia	China	Sichuan PC	Chengdu, Sichuan	Oct-13	800
				2013	6,735
CIS & Baltics	Russia	Novy Urengoy GCC	Novy Urengoy	Jan-14	420
ISC	India	OPAL	Dahej, Guj	Jan-14	1,100
NE Asia	China	Ningbo Heyuan Chemical	Ningbo, Zhejiang	Jan-14	300
NE Asia	China	Shanghai PC	Jinshan, Shanghai	Jan-14	300
ME	UAE	Borouge	Abu Dhabi, Ruwais	Apr-14	1,500
Africa	S Africa	SASOL	Sasolburg	Jul-14	48
NE Asia	China	Shaanxi Yanchang	Yan'an, Shaanxi	Jul-14	450
NE Asia	China	Yankuang Guohong Chem.	Zoucheng, Shandong	Jul-14	300
ISC	India	GAIL	Auraiya, UP	Oct-14	450
NE Asia	China	Shanxi Coking Corp.	Hongtong, Shanxi	Oct-14	300
				2014	5,168
ME	Iran	Ilam PC	Ilam	Jan-15	458
NE Asia	China	Sinopec-KPC PC JV	Zhanjiang, Guangdong	Jan-15	1,000
Africa	Egypt	SIDPEC	Alexandria	Jul-15	460
ISC	India	Reliance Industries	Jamnagar, Guj	Jul-15	1,350
				2015	3,268
ME	S Arabia	Sadara Chemical	Al Jubail	Jan-16	1,500
NA	Mexico	Braskem-Idesa JV	Coatzacoalcos, Ver	Jan-16	1,000
NE Asia	China	CNOOC & Shell PC	Huizhou, Guangdong	Jan-16	1,000
NE Asia	China	Hainan JV	Yangpu, Hainan	Jan-16	500
NE Asia	China	Yili Meidianhua	Yili, Xinjiang	Jan-16	300
				2016	4,300

Source: CMAI

3.4.2 The above developments ushered in the emergence of EOS not only as a key polymer consumption centre but also as a key-manufacturing base. For ethylene – the basic building block for polymers – the share of EOS in global C2 capacity rose from only 24% in 1990 to 38% in 2004 and further to 48% in 2010 – indicative of the rising importance of EOS in the global petrochemical industry.

Figure 36: Regional share in Global Polymer Production (2010)



Source: CMAI

3.5 *Global Petrochemical Trade*

3.5.1 Trade remains a vital part of the global petrochemical supply/demand balance as a little above one third of the total global production is consumed outside the country of origin. Since 2009 the Middle East region has become the number one net exporter for total polyethylene (LDPE + LLDPE + HDPE); and by the end of 2010, surpassed West Europe as the largest net exporting region of polypropylene.

Table 33: Polyethylene (PE) Regional Trade

Region	2011 Demand (KTA)	Last 5 year CARG (%)	Next 5 Year CARG (%)	2011 Surplus/Deficit	2016 Surplus/Deficit
Africa	2328	2.6	6.0	-1368	-1717
Central Europe	1941	1.9	2.3	-340	-720
CIS & Baltic States	2397	4.3	5.5	-453	-660
Indian Subcontinent	3598	7.6	10.6	-1566	-658
Middle East	4983	10.8	7.7	7325	11323
North America	15246	0.3	1.3	3041	2846
Northeast Asia	23815	6.2	6.0	-5005	-7461
South America	5088	3.6	4.2	-1494	-2701
Southeast Asia	5709	5.2	4.6	582	922
West Europe	11869	-1.0	1.3	-722	-1174

Table 34: Polypropylene (PP) Regional Trade

Region	2011 Demand (KTA)	Last 5 year CARG (%)	Next 5 Year CARG (%)	2011 Surplus/Deficit	2016 Surplus/Deficit
Africa	1383	7.1	8.3	-566	-648
Central Europe	1464	1.6	1.5	-238	-612
CIS & Baltic States	1072	8.4	8.7	-243	130
Indian Subcontinent	3380	12.0	6.6	-197	-945
Middle East	3428	18.0	6.7	2300	3460
North America	7181	-2.3	0.8	426	-453
Northeast Asia	19665	6.1	5.0	-1642	-769
South America	2684	5.6	3.2	-164	-699
Southeast Asia	3975	7.5	3.6	-256	689
West Europe	7815	-0.8	1.4	580	-153

Table 35: PVC Regional Trade

Region	2011 Demand (KTA)	Last 5 year CARG (%)	Next 5 Year CARG (%)	2011 Surplus/Deficit	2016 Surplus/Deficit
Africa	977	6.5	5.0	-588	-639
Central Europe	847	-1.8	4.0	-68	-65
CIS & Baltic States	1253	6.7	5.2	-599	-421
Indian Subcontinent	2332	11.2	8.3	-933	-2107
Middle East	2040	4.9	7.3	-1241	-1400
North America	4738	0.7	2.9	2615	3254
Northeast Asia	15796	4.3	4.6	722	1998
South America	2167	5.6	4.3	-784	-1072
Southeast Asia	1936	2.7	3.6	144	152
West Europe	4690	-2.4	0.6	732	300

Source: CMAI World Olefin, Polyolefin & Vinyls Analysis 2012

3.6 *Alternative Feedstock – Shale Gas, Coal & Bio-Feedstocks*

3.6.1 **Shale Gas**

3.6.2 Shale gas is natural gas produced from shale formation. Gas shale's are organic – rich shale formations. In term of its chemical makeup, Shale gas is typically a dry gas primarily composed of methane.

3.6.3 Shale hold large amount of organic matter from which oil and gas can be extracted by destructive distillation. Wet gas contains some of the heavier fluid hydrocarbons, as vapour and is more valuable because it contains extractable liquids it contains.

3.6.4 Dry gas differs from wet gas is that it does not carry appreciable amounts of the heavier hydrocarbons as vapors.

3.6.5 This is where our opportunity lies. These hydrocarbon by products have a lot of value – They include some familiar household names like butane, propane, and ethane.

3.6.6 Ethane particularly can be cracked to make ethylene, a common feedstock for plastic industry. This sector is sold to explode with demand in the coming years, so the added feedstock supply is very welcome and profitable.

3.6.7 In US few month back, "wet with other liquids like butane, propane, ethane could get $ 8 per mmbtu, far more rate of $ 4.32 for dry gas.

3.6.8 Securing a license to tap resources below the surface is not an easy task in India, the expert said. The companies that would eventually win rights to explore shale gas in the country also need access to technology that reduces demand for water and controls effluents.

3.6.9 **Shale Gas & USA**

3.6.9.1 At the end of 2008, the US had 244.7 trillion cubic feet of proved gas reserves.

Shale gas	13%	(32.8 tcf)
Coal bed methane	9%	(20.8 tcf)
Conventional	78%	(191.1 tcf)
Total	100%	(244.7 tcf)

3.6.9.2 The U.S is unlikely to emerge as a major global gas supplier, but the shale gas should allow it to become more self-sufficient, reducing the need for imports. In less than two years, the US has sharply reduced imports from Canada & liquefied natural gas (LNG) receipts. There new technical discoveries have vastly extended reserves and will offset decline in conventional associated natural gas production.

3.6.9.3 With the development of low cost shale gas resources in US, the oil-to-gas ratio has improved from non-competitive ratio of 5.1:1 in 2003 and 6.3:1 in 2005 to 15.9:1 in 2009 and 17.9:1 in 2010. The current ratio is very favourable for US competitiveness on exports of petrochemicals, plastics and other derivatives. Abundant availability and economic viability of shale gas at prices supports continued crude oil natural gas prices disconnect. Moreover, forecasters at the EIA and energy consultants expect high oil-to-gas ratios to continue.

3.6.9.4 As a result of shale gas (and weak industrial demand for gas) the US oil-to-gas ratio has been above 7.1 for several years. The ratio of oil prices to natural gas prices has been over 22.1 recently.

3.6.9.5 This position is very favourable for US competitiveness and exports of petrochemicals, plastics and other derivatives. As a result, for example, US Plastic exports are up nearly 10% due to this improved position.

3.6.9.6 The shale gas is thus a 'game changer'. In the decade to come, shale gas could provide 25% of the natural gas needs, compared to 13% at the end of 2008.

3.6.9.7 The availability of this low priced natural gas (and ethane) could improve U S Chemical & other industry competitiveness. A number of other leading industries, including aluminum, cement, iron and steel, glass, and paper are large consumer of natural gas that would benefit from shale gas developments and could conceivably boost capital investment and output.

Table 36: Economic impact from Expanded Production of Petrochemical and Derivatives from a 25% increase in Ethane Production

Impact Type	Employment	Payroll ($ Bn)	Output ($ Bn)
Direct Effect	17,017	2.4	32.8
Indirect Effect	79,870	6.6	36.9
Induced Effect	85,563	4.1	13.7
Total Effect	**182,450**	**13.1**	**83.4**

3.6.9.8 In addition, the increased use of ethane by the chemical industry would generate purchases of raw materials, services, and other supplies throughout the supply chain. Thus, nearly another 80,000 indirect jobs would be supported by the boost in ethane production. Finally, the wages earned by new workers in the chemical industry and workers throughout the supply chain are spent on household purchases and taxes generating more than 85,000 jobs induced by the response of the economy to changes in household expenditure as a result of labor income generated by the direct and indirect effects. All told, the additional $ 32.8 billion in chemical industry output from a 25% increase in ethane production would generate $ 83.4 billion in output to the economy and more than 1,82,000 new jobs in the United States generating a payroll of $ 13.1 billion. This comes at a time when 15 million Americans are out of work. Moreover, the new jobs would primarily be in the private sector.

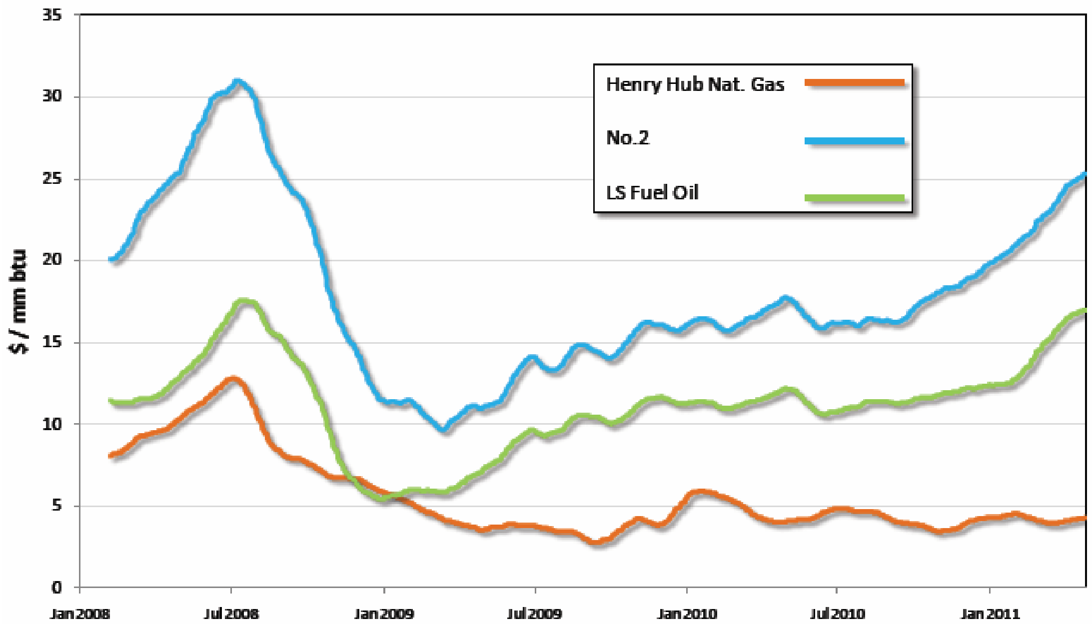
3.6.10 Natural gas from previously untapped shale deposits is one of the most exciting domestic energy developments of the last 50 years.

3.6.11 After years of high volatile natural gas prices, the new economics of shale gas are a 'game changer' creating a competitive advantage for

US petrochemical manufacturers, leading to greater U S investment and industry growth.

3.6.12 American's Chemical Companies use ethane as feedstock in numerous applications. Its relatively low price gives U.S manufacturers an advantage over many competitors around the world that rely on naphtha, a more expensive, oil based feedstock. Growth in domestic shale gas production is helping to reduce U.S natural gas prices and create a more stable supply of natural gas and ethane.

Figure 37: US Price of Energy Content



Source: KBC

3.6.1 **Conclusion**

3.6.1.1 To summarize, US shale gas resources will lead to a significant expansion in domestic petrochemical capacity. Indeed, a new competitive advantage has already emerged for US petrochemical producers. And this comes at no better time: The United States is facing persistent high unemployment and the loss of high paying manufacturing jobs. Access to these new resources, building new petrochemical and derivative capacity, and the additional production of petrochemicals and downstream chemical products will provide an opportunity for more than 400,000 jobs – good jobs. A large private investment initiative would enable a renaissance of the US petrochemical industry and in this environment, a reasonable regulatory regime will be key to making this possible.

3.6.2 **Shale Gas in India**

3.6.2.1 For India, data adequate enough to generate estimates of shale gas available from 4 sedimentary basins. These were Cambay Basin, Krishna Godavari Basin, the Cauvery Basin and the Damodar Valley Basin. These basins are estimated to contain about 63 tcf of recoverable shale gas; there are many other sedimentary basins which are relatively unexplored for shale gas potential.

1. Cambay Basin

3.6.2.2 This is an elongate intra-cratonic rift basin of late Cretaceous-Cenozoic age situated in western Indian state of Gujarat. The formation of interest is the Palaeocene-Eocene Cambay black shale. Technically recoverable shale gas is estimated to be about 20 Tcf.

2. Krishna Godavari Basin

3.6.2.3 A Late Permian to Tertiary age basin in eastern India consisting of a series of horst and graben. The prospective formation is the Permian age Kommugudem shale. Technically recoverable resources are estimated to be about 27 Tcf.

3. Cauvery Basin

3.6.2.4 The Cretaceous-Cenozoic Cauvery basin in south eastern India is another basin with horst and graben structures and prospective shales. The formations of interest are the early Cretaceous Andimadam Formation and the Sattapadi shale. Technically recoverable resources are about 9 Tcf.

4. Damodar Valley Basin

3.6.2.5 This basin is part of the "Gondwana" basins of India characterized by their mostly non-marine sedimentary fill and narrow graben structures. Although filled with mostly Late Permian to Triassic terrestrial sediment, there is a significant thickness of a marine shale known as the Barren measures, so called as it is barren of coal. The technically recoverable resources from this shale are estimated to be 7 Tcf.

3.6.2.6 As the report makes clear, these are initial estimates (not proven reserves) based on available data on shale formations from basins that already have seen substantial exploration for oil and conventional natural gas. As more focused exploration for shale gas continues from these basins and as more basins are explored these estimates of shale gas resources will likely change.

3.6.2.7 "ONGC created an exploration landmark when gas flowed out from the Barren Measure shale at a depth of around 1,700 meters, in its first R&D well RNSG-1 near Durgapur at Icchapur, West Bengal," the company said in a statement here. Though the well is still under assessment, the breakthrough is significant as India is the first Asian country where gas was discovered from shale outside US and Canada.

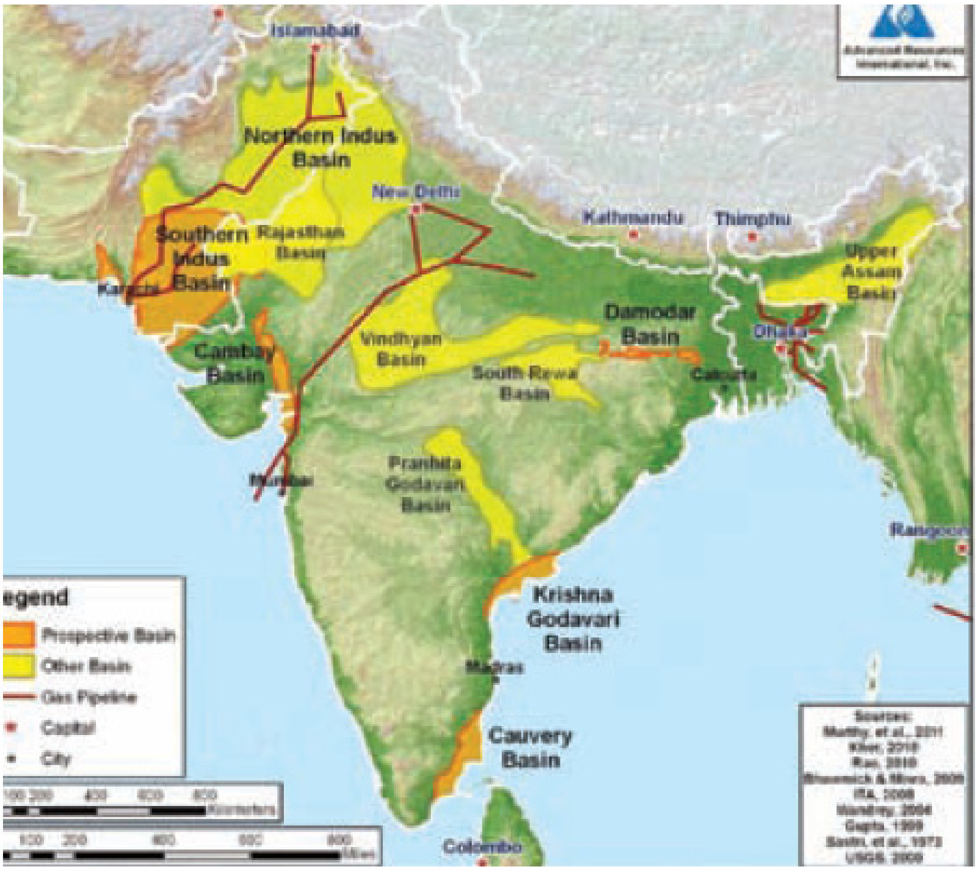
3.6.2.8 According to sources, the New York-listed Schlumberger, which is carrying out a comprehensive shale gas pilot project for state-owned ONGC in the Damodar Valley basin, has made an initial gas-in-place estimate of 300-2,100 trillion cubic feet (tcf) in Indian shale gas basins. In comparison, Reliance's KG D6 field has proven reserves of just 7-8 tcf.

3.6.2.9 Schlumberger says that to in order to realise its shale gas potential, India needs to create a conducive regulatory environment and the local oilfield services industry has to double or triple in size so that producers can tap the resource economically.

3.6.2.10 Service providers will have to step up rig availability three-fold to 300 units across the eight shale gas basins including Cambay and Damodar. That is not an insurmountable task but service providers would need a clear market signal to make the investment.

3.6.2.11 Such resources have the potential to move the Indian gas market from gas-constrained to gas-balanced, if not turn the country into a gas-surplus one.

Figure 38: Shale Gas Availability in India



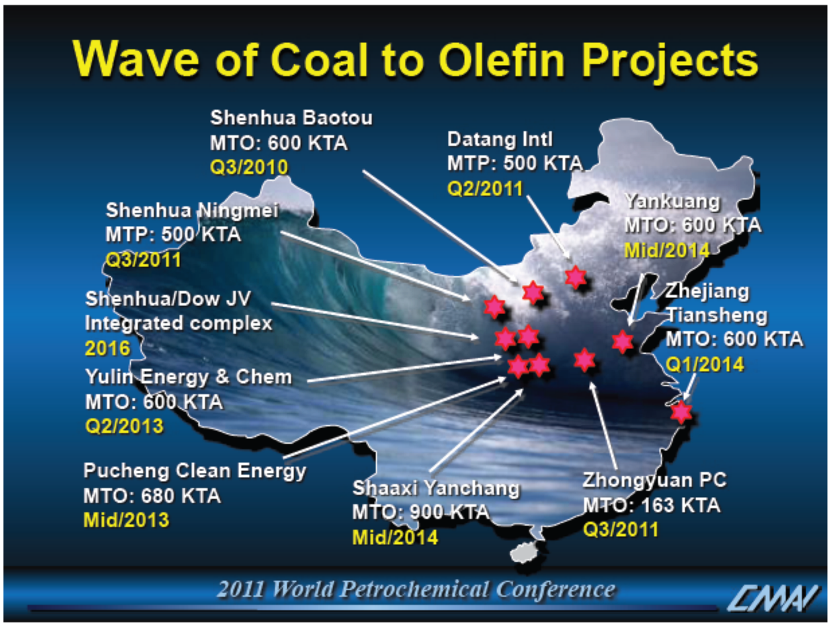
Source of map: World Shale Gas Resources: An Initial Assessment of 14 Regions outside the United States; U.S. Energy Information Administration, April 2011 and EIA Lower 48 states shale plays, May 2011.

3.6.3 Coal

3.6.3.1 While Coal to Liquid Fuels has been practiced by Sasol Ltd. in S. Africa as part of the apartheid era isolation to produce petrol and diesel from coal and natural gas using Fischer-Tropsch process, lately China has been in the forefront of new developments to convert their coal resources to value added chemical (erstwhile petro-chemicals) products.

3.6.3.2 The attached figure indicates the scope of coal to olefin projects, typically through the syn-gas (to methanol to olefin) route, which have been undertaken by China. (MTO → Methanol to Olefins, MTP → Methanol to Propylene).

Figure 39: Coal to Olefin Projects



3.6.3.3 Another alternative route is in-situ gasification of coal to monetize these resources in the ground.

3.6.3.4 Some of the issues affecting economic viability include the quality of coal (typically the ash content) and its location as well as transport infrastructure, necessitating plant location near the source of coal, as well as environmental issues related to the burning of vast quantities of coal with concomitant levels of sulfur and ash.

3.6.3.5 India has large coal reserves at 7% of world reserves (Table 41), albeit of poor quality, which could presumably be considered for conversion to bulk chemical products in addition to the traditional use for power generation.

Table 37: Estimated World Energy Reserves by Country

Coal		Oil		Gas	
United States	28.8%	Saudi Arabia	19.2%	Russia	25.4%
Russia	19.0%	Canada	12.9%	Iran	15.8%
China	13.9%	Iran	10.2%	Qatar	13.6%
Other Non-OECD Europe and Eurasia	10.5%	Iraq	8.5%	Saudi Arabia	4.0%
Australia and New Zealand	9.3%	Kuwait	7.5%	Turkmenistan	4.0%
India	7.1%	Venezuela	7.3%	United States	3.7%
Africa	3.9%	UAE	7.2%	UAE	3.2%
OECD Europe	3.5%	Russia	4.4%	Nigeria	2.8%
Other Central and South America	1.1%	Libya	3.3%	Venezuela	2.7%
Rest of World	3.0%	Rest of World	19.5%	Rest of World	24.8%
Total	100.0%	Total	100.0%	Total	100.0%

Source: Energy Information Administration, USA

3.6.4 **Bio-Feed stocks**

3.6.4.1 The giant strides in the development of Biotechnology have led to the potential for use of plant based renewable raw materials to produce value added chemicals. Although the process for fermentation of sugars to produce ethanol is ancient, the new developments allow for the selective fermentation to produce fuels and a wide range of building blocks which are further converted to value added chemicals.

3.6.4.2 Generation I technologies were based on the conversion of sugars to fuels, which led to land use conflict between food and fuel applications, Generation II technologies are based on non-food raw materials such as bio-waste (such as stems, stalks, leaves, etc.) or use of non-food producing arid lands to produce non-food crops (such as the production of Jatropha for fuel).

3.6.4.3 Fuels, such as Bio-Ethanol and Bio-Butanol being a large volume opportunity are most commonly targeted for possible commercialization. Cargill has commercially produced PLA (poly-lactic acid), a versatile polymer for many years in the US. Dow has teamed up with Braskem in Brazil for the production of poly-ethylene from sugars, building on the large bio-ethanol industry in that country. The attached table indicates the wide range of potential chemicals technically possible from bio-based renewable raw materials, and is limited only by the comparative economics vis-à-vis petroleum. As the price of petroleum keeps rising, these become all the more viable.

3.6.4.4 Brazil’s Braskem has started in Sept 2010 a 200 Kt PE plant based on sugarcane Ethanol. Setting up a PP plant based on renewable feedstock is in pipe line.

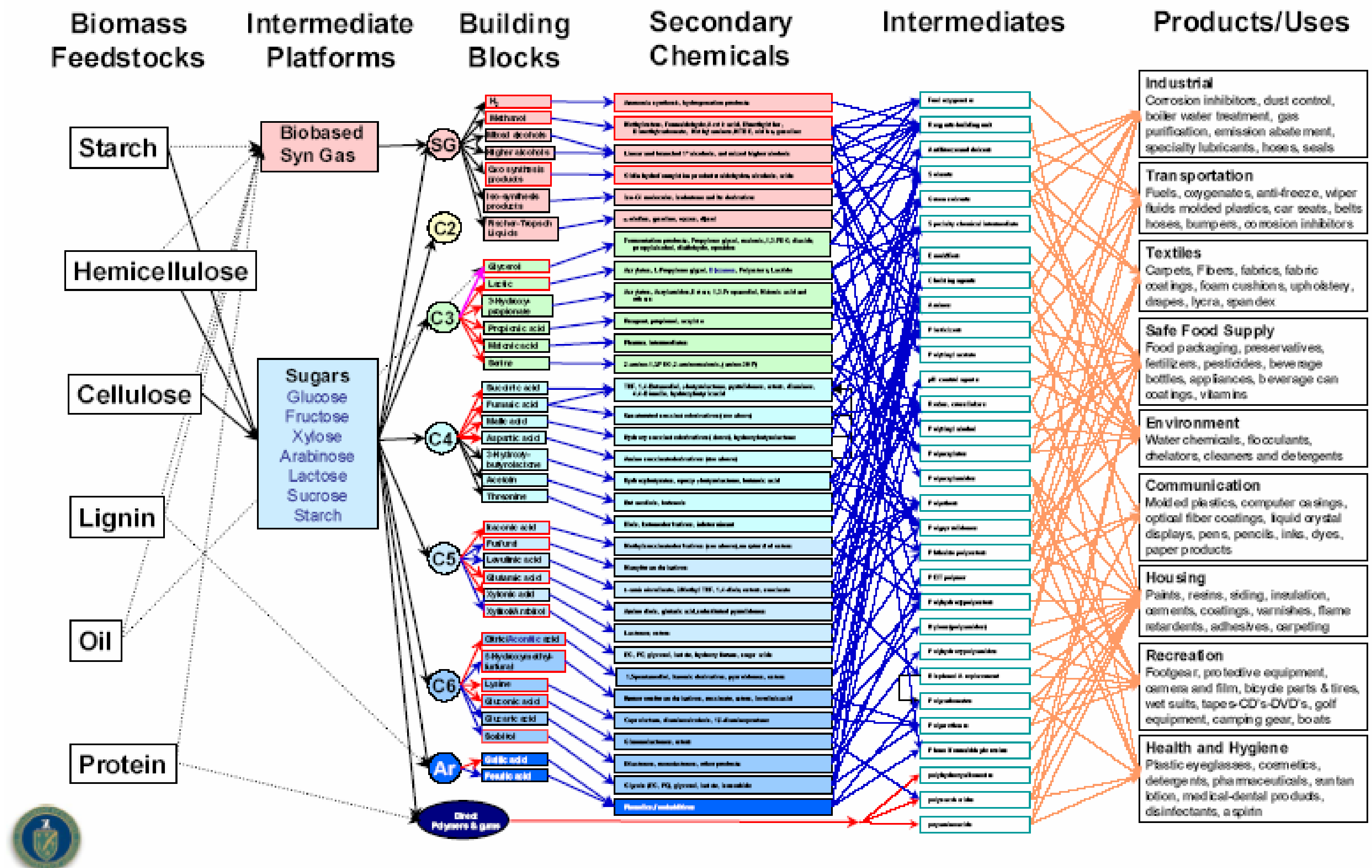


Figure 3 – Analogous Model of a Biobased Product Flow-chart for Biomass Feedstocks

4 Middle East and China

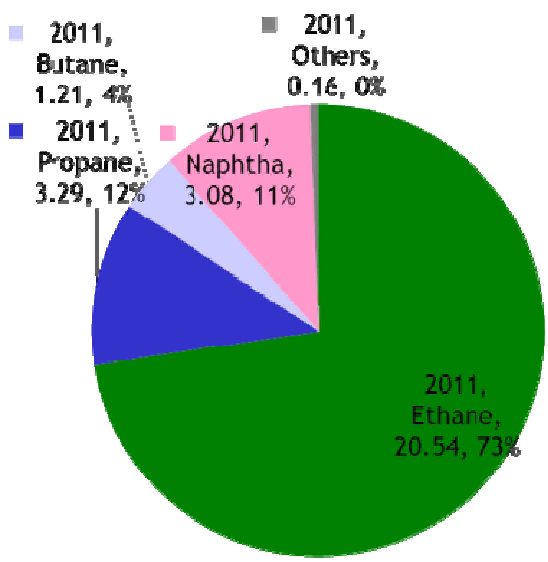
4.1.1 Some countries in the Middle East provide cheap alternative feedstocks like Ethane and NGLs (Natural Gas Liquids) to domestic producers. Countries like Saudi Arabia, for example, apply pre-determined factors to FOB Ras Tanurah Naphtha Price for determining prices of Propane, Butane & Natural Gasoline for producers in Saudi Arabia, which make these prices 30% cheaper than international prices paid by manufacturers in other countries.

Table 38: Factors for NGL Pricing in Saudi Arabia

Year	A-180	Propane	Butane
2002	0.658	0.621	0.655
2003	0.666	0.632	0.66
2004	0.674	0.643	0.665
2005	0.682	0.654	0.67
2006	0.69	0.665	0.675
2007	0.698	0.676	0.68
2008	0.706	0.687	0.685
2009	0.714	0.698	0.69
2010	0.722	0.709	0.695
2011	0.73	0.72	0.7

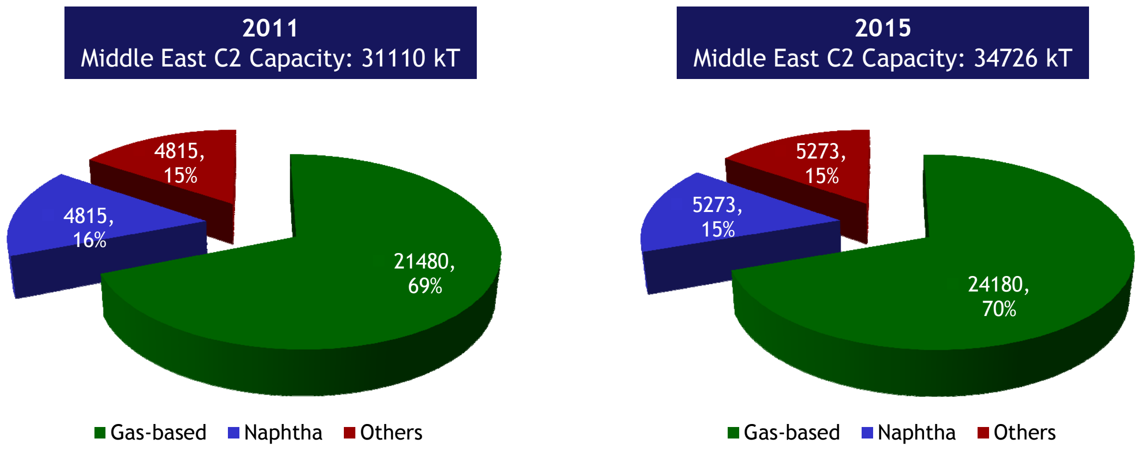
Source: WTO

Figure 40: Ethylene Capacity in the Middle East



Source: CMAI

Figure 41: Middle East Ethylene Capacity Predominantly Ethane-based



Source: CMAI

4.2 ***Feedstock Subsidy in GCC & Its Implications for the India-GCC FTA***

4.2.1 **India-GCC FTA Negotiations**

4.2.1.1 India signed the framework agreement to enhance economic cooperation with the Gulf Cooperation Council (GCC; comprising Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and UAE) on 25th August, 2004. As per the framework agreement, both the sides were supposed to pursue ways and means for extending and liberalizing bilateral trade relations and examine the feasibility of FTA between them. With that mandate the 2 sides initiated the negotiations process in March 2006 and 2 rounds of bilateral negotiations have already been held.

4.2.1.2 First round of negotiations was held in the Headquarters of GCC, Riyadh on 21st – 22nd March, 2006. During this round, GCC side agreed to include services as well as investment and general economic cooperation along with FTA in goods in the scope of the India-GCC FTA. In the first round of negotiations, the modalities for negotiations were deliberated upon and finalized.

4.2.1.3 The second round of negotiations was also held in Riyadh on 9-10 September, 2008 wherein the mechanism for tariff liberalization was discussed.

4.2.1.4 Subsequently, the third round of bilateral negotiations was scheduled and postponed several times and a date is yet to be firmed up for the same. In the mean time, the onset of the global economic slowdown in 2008, the focus shifted towards limiting the adverse impact of the slowdown on the Indian economy and India-GCC negotiations took a back seat.

4.2.1.5 In recent times, however, media reports indicate that both the sides are considering reviving the stalled negotiations.

4.2.1.6 Ever since the framework agreement was signed by India and GCC in August 2004, the domestic petrochemical industry has brought its serious concerns and apprehensions about the unfair feedstock advantage enjoyed by the petrochemical industry in GCC to the notice of the Government from time to time. The domestic chemical and petrochemical industry strongly believes that Indian petrochemical manufacturers are not on a level playing field with their counterparts in GCC countries. Offering preferential tariffs on petrochemicals to GCC will adversely affect it and represented against granting tariff concessions on petrochemicals to GCC under the proposed FTA several times in the past.

4.2.2 Subsidized Feedstock in GCC

4.2.2.1 Petrochemical industry in GCC countries is predominantly based on heavily subsidized feedstock. Prices of Ethane, which is the main feedstock in GCC countries range between US$ 0.75- 2.0/mmbtu as shown in table below (global spot international price is currently in the range of $ 4-5.1/mmbtu).

Table 39: Feedstock (Ethane) Pricing in GCC

Country	*US$/mmBTU)*
Saudi Arabia	0.75
Bahrain	2.00
Kuwait	1.00-2.00
Qatar	1.70-2.00
UAE*	1.15
Oman	0.80
Source: CMAI, *Price in Abu Dhabi	

4.2.3 Large Investments for Exports

4.2.3.1 This gives manufacturers in GCC unfair cost advantage. The heavily subsidized feedstock has attracted large investments in GCC from global petrochemical giants like ExxonMobil, Chevron Philips, etc. The massive capacities augmented in GCC are primarily for exports to large markets like China and India since demand for petrochemicals in GCC countries is only a fraction of the capacity being built there. GCC countries esp. Saudi Arabia and Qatar are building substantial petrochemical capacities on the back of subsidized feedstock, primarily meant for exports.

4.2.3.2 Table below shows the Demand-Supply balance for building blocks and polymers in GCC. As shown in table, over next 4 years ethylene capacity in GCC will rise from ~21 MMT in 2011 to 24.5 MMT in 2015 and propylene capacity will increase from 7.1 MMT to 9.8 MMT during the same period.

Table 40: Polymers Demand – Supply in GCC

	Capacity				Domestic Demand				Exportable Surplus			
('000 MT)	2005	2010	2011	2015	2005	2010	2011	2015	2005	2010	2011	2015
Ethylene	9880	18560	20910	24535	8797	14278	16450	22067	1083	4282	4460	2468
Propylene	1708	6023	7122	9826	1246	4201	5186	8872	462	1822	1936	954
LDPE	585	985	985	2040	116	177	191	259	469	808	794	1781
LLDPE	2540	4735	4825	5508	348	550	600	898	2192	4185	4225	4610
HDPE	3154	5205	5984	7624	341	667	727	1064	2813	4538	5257	6560
PP	1510	5035	5910	7770	309	579	644	927	1201	4456	5266	6843
PVC	406	406	406	856	516	679	722	934	-110	-273	-316	-78
Polymers Total	8195	16366	18110	23798	1630	2652	2884	4082	6565	13714	15226	19716

Source: CMAI 2011

4.2.3.3 Table above also shows that around 5.6 MMT of new polymer capacity will be added in GCC during 2011-15 and consequently polymers exportable surplus will increase from 15.2 MMT currently to 19.7 MMT in 2015. India's geographical proximity to GCC makes it vulnerable to threat from GCC imports.

4.2.3.4 According to latest statistics, the polyethylene production capacity in the GCC will increase from 11.7 million tonnes in 2011 to 15.1 million tonnes by the year 2015. The capacity of polypropylene will also increase from 5.9 million tonnes in 2011 to 7.7 million tonnes in 2015, an increase of 31%. This will bring the combined production capacities of the two major polyolefin resins to over ~23 million tonnes in 2015.

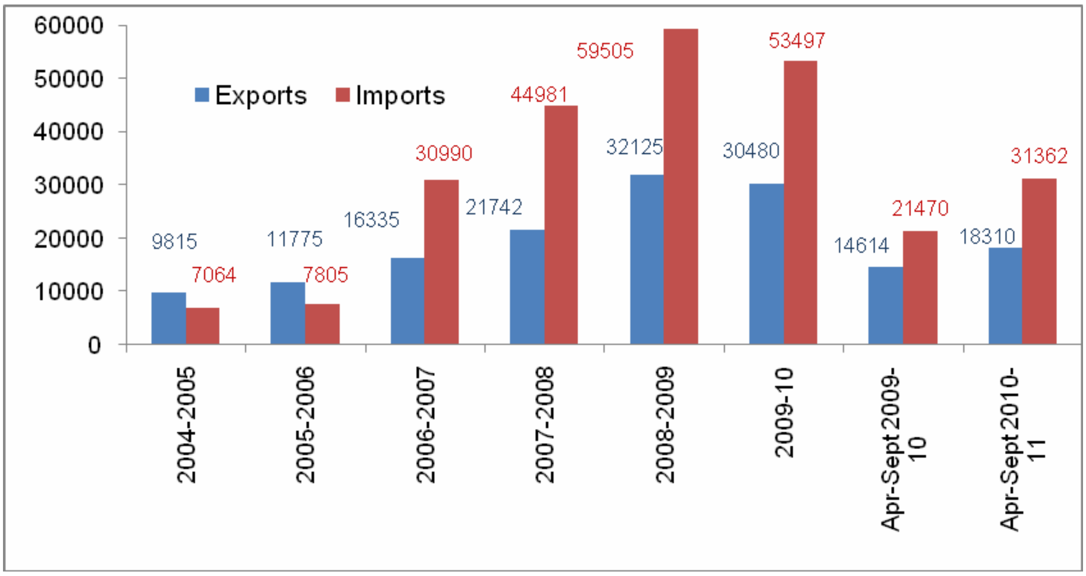
4.2.3.5 With rapid expansion of raw material (resin) capacity GCC countries are also aggressively promoting downstream converting industry for local manufacture of articles of plastics. Due to limited local demand, bulk of these would be exported to other countries including India. This, we believe, would pose major threat to our downstream converting industry adversely impacting employment since the sector is highly labour intensive.

4.2.3.6 The GCC countries, despite huge cost advantage, have erected high tariff and non-tariff barriers around petrochemical sector. As shown in table, Saudi Arabia, the dominant member of GCC with a huge exportable surplus, levies import tariff of 12% on polymers vis-à-vis 5% import duty on polymers prevailing in India.

4.2.4 **India-GCC Trade**

4.2.4.1 From a situation of trade surplus with GCC countries, India is now running substantial trade deficit as shown in the Figure below. The India-GCC FTA will exacerbate the situation further.

Figure 42: India-GCC Trade



4.2.4.2 Even with individual GCC countries, the trade balance is against India as Table below shows.

Table 41: India's Trade with GCC

									Apr-Sept			
In US $ million	2006-07		2007-08		2008-09		2009-10		2009-10		2010-11	
	E	I	E	I	E	I	E	I	E	I	E	I
Bahrain	182	468	252	829	287	1443	250	503	135	272	223	326
Kuwait	611	5985	682	7690	798	9594	783	8250	386	2601	875	4361
Oman	627	460	937	1134	779	1206	1033	3500	528	1162	552	1468
Qatar	329	2091	538	2456	674	3499	537	4649	343	2122	173	3291
Saudi Arabia	2581	13353	3707	19401	5110	19973	3907	17098	2079	7098	2214	9753
UAE	12005	8632	15627	13471	24478	23791	23970	19499	11144	7216	14272	12163
Total GCC	16335	30990	21742	44981	32125	59505	30480	53497	14614	21470	18310	31362

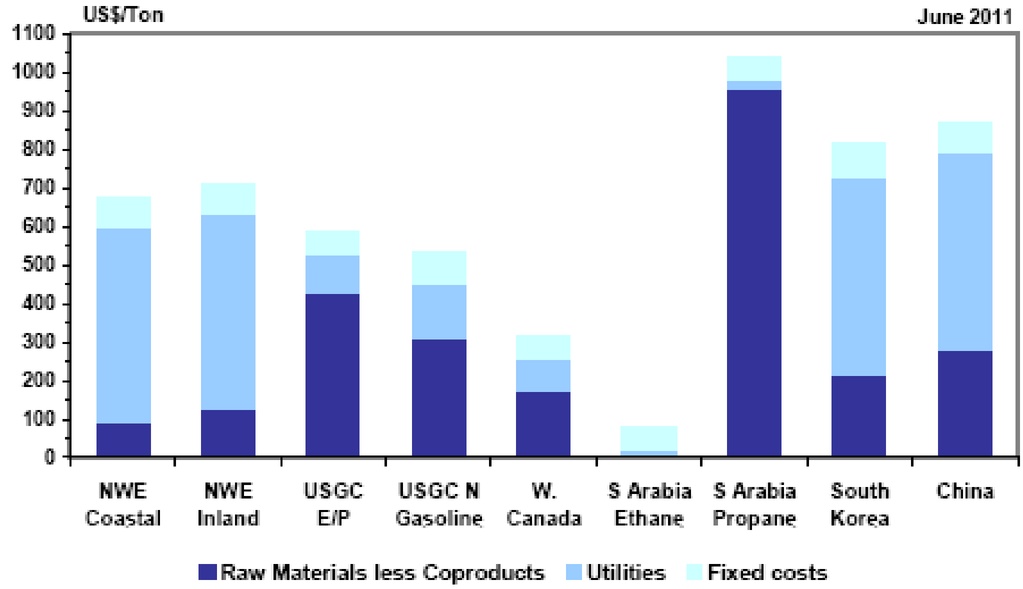
Source: Annual Reports of Ministry of Commerce & Industry, E=Exports, I=Imports

4.2.5 **Competitiveness of GCC Petrochemical Industry and perceived threat & disadvantages to the Petrochemical Industry in India.**

4.2.5.1 Globally reputed consultancy firm in petrochemicals, Jacob Consultancy, has studied the cost competitive for various countries / regions and have concluded the enormous advantage enjoyed by producers in Middle East due to availability of subsidized feedstock.

4.2.5.2 As shown in figures below, the cost of production of ethylene in Saudi Arabia (based on Ethane) is only $ 73/MT as against $ 970/MT in South Korea. India's cost disadvantage is similar to that of South Korea.

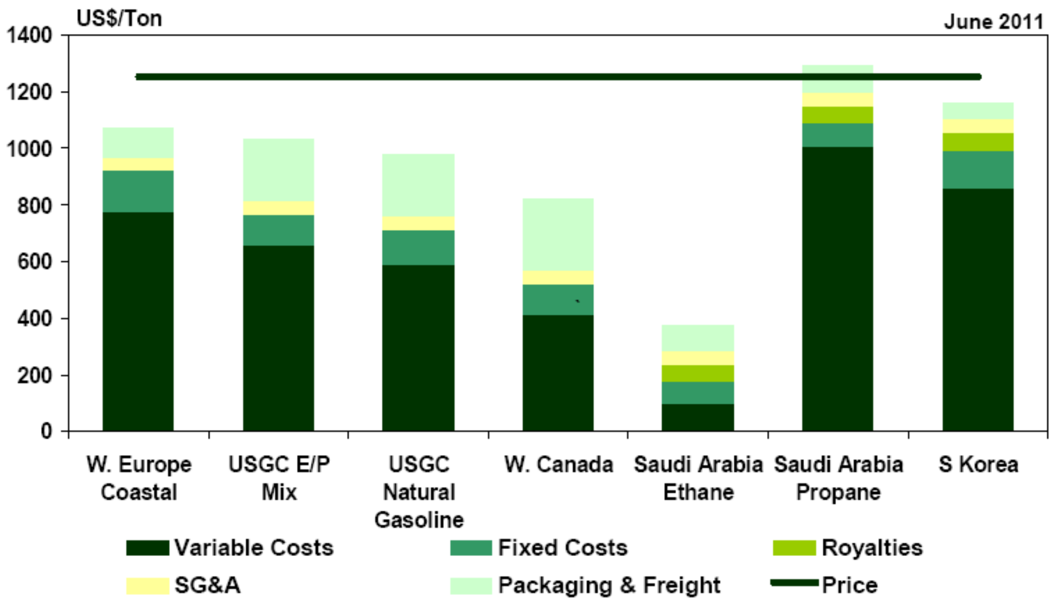
Figure 43: Ethylene Cost of Production



Source: Jacobs Consultancy

4.2.5.3 Similarly the cost of one representative downstream petrochemical product **LLDPE delivered from Saudi Arabia to market in China is $ 367/MT compared to $ 1284/MT from South Korea**.

Figure 44: LLDPE Cost of Supply – C&F HK/China



Source: Jacobs Consultancy

4.2.5.4 The huge cost difference on account of availability of subsidized feedstock is further aggravated by several incentives/concessions offered by the Governments in GCC countries. In contrast, Indian manufacturers even today are grappling with infrastructural constraints and high cost factors.

4.2.5.5 Tariff elimination on key petrochemicals under the proposed FTA would result in a massive surge in imports, which would further deteriorate India's existing trade imbalance with GCC countries.

4.2.6 **Possible Duty Inversions Due to India-GCC FTA**

4.2.6.1 Granting tariff concessions on polymers to GCC countries under the India-GCC FTA will distort the tariff structure and result in duty inversions. Currently import duty on Naphtha – the basic feedstock for petrochemicals used in several existing key crackers in India – is 5%, same as that on polymers. Any tariff concession on polymers under the India-GCC FTA will make the effective duty on end-products like polymers lower than the duty on feedstock Naphtha.

4.2.6.2 The same is true for all key petrochemical products.

4.2.7 **Technical Barriers to trade with GCC Countries**

4.2.7.1 Experience of our members is that exporting petrochemicals from India to GCC countries is extremely cumbersome and time consuming on account of the following factors.

a) Non-transparent legal system
b) Lack of basic information on trade procedures
c) Lack of a comprehensive central source of information
d) Complex customs procedure and administration like document authentication by embassies.
e) Compliance to GCC-specific trade requirements
f) Stipulation of specific ports for particular type of cargo

4.2.7.2 The above is just an indicative list and by no means exhaustive.

4.2.8 **Tariff Line-wise Submissions for Petrochemicals from Chapters 29 & 39**

4.2.8.1 Global petrochemical industry is characterized by intensely competitive trade environment. Exposing the domestic petrochemical industry to subsidy-driven import competition from GCC (by granting preferential access to the domestic petrochemicals market in India) at this juncture would not only impair the existing petrochemical assets but would also jeopardize future investments of over Rs. 180,000 crores, planned by the industry including state-owned enterprises like IOC, ONGC & GAIL.

4.2.8.2 Elimination of tariff on key polymers and petrochemicals under the proposed FTA could, therefore, prove detrimental not only for the domestic petrochemical industry but also to the national economy. There are, however, feedstocks, intermediate chemicals & building blocks where elimination of tariff could benefit Indian industry.

4.2.8.3 Polymers like **PE, PP, PVC, PS, EVA, PET** etc and select articles of plastics under Chapter 39 along with other key petrochemicals like **MEG, DMT, PTA, LAB, Benzene, Butadiene**, **Toluene, Paraxylene, Mixed Xylene, Cyclohexane, Acetone, VAM, MTBE, Acrylic Acid & Its Salts and Esters of Acrylic Acid, PVOH**, etc. be included in India's Negative List and be excluded from all tariff concessions under the India-GCC FTA.

4.2.8.4 Building blocks like Ethylene, Propylene, etc be placed under phased tariff elimination by the terminal year when the FTA becomes fully effective.

4.2.8.5 Select articles of plastic be placed under phased tariff reduction to 5% by the terminal year when the FTA becomes fully effective.

4.2.8.6 Feedstock and building blocks like Naphtha, Natural Gas, Propane, Butane, Styrene, Vinyl Chloride, Ethylene-Dichloride may be placed in the category for immediate tariff elimination.

Table 42: for Inclusion in Negative List (No Concession)

HS Codes	Description (Chapter 39)
Polymers Of Ethylene In Primary Forms	
390110	Polyethylene Hvng A Spfc Grvty Below 0.94 (LDPE, LLDPE)
390120	Polyethylene Hvng A Spcfc Grvty 0.94/More (HDPE)
390130	Ethylene-Vinyl Acetate Copolymers (EVA)
390190	Other Polymers Of Ethylene In Primary Forms
Polymers of Propylene/Other Olefins in Primary Forms	
390210	Polypropylene (PP)
390230	**Propylene Copolymers (PPCP)**
390290	Other Polymers Of Propylene or Of Other Olefins in Prmry Forms
Polymers of Styrene in Primary Forms	
390311	Expansible Polystyrene (EPS)
390319	Other Polystyrene (incl. Moulding Powder) (PS)

390320	Styrene Acrylonitrile (SAN) Copolymers
390330	Acrylonitrile Butadiene Styrene (ABS) Copolymers
390390	Other Polymers Of Styrene in Primary Forms
Polymers of Vinyl Chloride or of Other Halogenated Olefins in Primary Forms	
390410	Poly (Vinyl Chloride), Not Mixed With Other (PVC)
390421	Other Polyvinyl Chloride Non-Plasticised (PVC)
390422	Other Plasticised Polyvinyl Chloride (PVC)
390490	Polymers Of Vinyl Chloride Or Of Other Halogenated Olefins in Primary Forms

Table 43: Items for Inclusion in Negative List (No Concession), Other Key Petrochemicals

S No.	HS Codes	Description
		Chapter 29
1	290123	Butene-1
2	290124	Butadiene, Isoprene
3	290211	Cyclohexane
4	290220	Benzene
5	290230	Toluene
6	290242	Mixed-Xylene
7	290243	Paraxylene
8	290270	Cumene
9	290513	N-Butanol
10	290516	2-Ethyl Hexanol
11	290531	Mono Ethylene Glycol
12	290711	Phenol
13	290919	MTBE
14	291411	Acetone
15	291521	Acetic Acid
16	291532	VAM
17	291611	Acrylic Acid & Its Salts
18	291612	Esters of Acrylic Acid
19	291614	MMA
20	291736	Terephthalic Acid & Its Salts
21	291737	Dimethyl Terephthalate
		Chapter 38
22	381700	Linear Alkyl benzene (8-digit HS code: 38170011)
		Chapter 39

Table 44: Items for Inclusion in Negative List (No Concession), Article of Plastics

S No	HS Code	Product Description
1	391510	Waste, parings and scrap, of plastics: Of polymers of ethylene
2	391520	Of polymers of styrene
3	391530	Of polymers of vinyl chloride
4	391590	Waste Parings & Scrap Of Other Plastic
5	391610	Monofil, Rods, Sticks Etc Of Polyethylene
6	391620	Of polymers vinyl chloride
7	391690	Of other plastics
8	391810	Floor coverings of plastics, whether or not self adhesive, in rolls or in the form of tiles wall or ceiling coverings of plastics, as defined in Note 9 to this chapter: of polymers of vinyl chloride
9	391890	Of other plastics
10	391910	Self Adhsv Plts Etc In Rls, Wdth < = 20Cm
11	391990	Other Self-Adhsv Plts etc
12	392010	Plates Sheets etc of Polymers of Ethylene
13	392020	Plates Sheets etc of Polymers of Propylene
14	392030	Plates Sheets etc of Polymers of Styrene
15	392051	Plates Sheets Etc of Plymthyl Methacrylte
16	392059	Of acrylic polymers:Other
17	392061	Of polycarbonates
18	392062	Plates Sheets Etc of Polyethylene Terephthalate
19	392069	Plates Sheets Etc of Other Polyesters
20	392099	Plates Sheets Etc of Other Plastics
21	392111	Plates Etc of Polymers of Styrene
22	392112	Plates Etc of Polymers of Vinyl Chloride
23	392119	Other Plates Sheets Etc of Other Plastics Cellular
24	392190	Other Plts, Shts, Film Foil, Strip Etc, Noncllr
25	392321	Sacks & Bags of Polyethylene (Incl Cones)
26	392329	Sacks & Bags (Incl Cones) of Other Plastics
27	392340	Spools, cops, bobbins and similar supports
28	392350	Stoprs Lids Caps & Other Clsres Of Plastics
29	392410	Tableware and kitchenware
30	392490	Other
31	392530	Shutters Blinds (Incl Venetian Blinds)& similar Articles & Parts thereof
32	392620	Articles of Apprl & Clthng Acsors (Incl Glvs)
33	392630	Fittings for Furniture Coachwork/The like
34	392690	Other Articles of Plastics
35	950210	Dolls, whether or not dressed
36	950349	Toys representing animals or non-human creatures:--Other

Table 45: Products for Phased Tariff Elimination by the Terminal Year When the FTA Becomes Fully Operational

S No	HS Code	Product Description
1	290121	Ethylene
2	290122	Propene (Propylene)
3	290129	Acyclic Hydrocarbons-Other
4	290241	O-Xylene
5	290244	Mixed Xylene Isomers
6	290260	Ethyl benzene

Table 46: Products for Phased Tariff Reduction to 5% by the Terminal Year When the FTA Becomes Fully Operational

S No	HS Code	Product Description
1	391710	Artificial guts (sausage castings) of hardened protein or of cellulosic materials.
2	391721	Tubes Pipes & Hoses Of Polyethylene Rigid
3	391722	Tubes Pipes & Hoses Of Polymers Of Propylene
4	391723	Tubes Pipes & Hoses Of Polyvinyl Chloride
5	391729	Tubes Pipes & Houses of other Plastics Rigid
6	391731	Flexible tubes, pipes and hoses, having a minimum burst pressure of 27.6 Mpa
7	391732	Other, not reinforced or otherwise combined with other materials, without fittings
8	391733	Other, not reinforced or otherwise combined with other materials with fittings
9	391739	Other
10	391740	Fittings
11	392063	Of unsaturated polyesters
12	392071	Of regenerated cellulose
13	392072	Plates Sheets Etc of Vulcanised Fibre
14	392073	Of cellulose acetate
15	392079	Of other cellulose derivatives
16	392091	Of other plastics: Of polyvinyl butyral
17	392092	Of other plastics: Of polyamides
18	392093	Of other plastics: Of amino-resins
19	392094	Of other plastics: Of phenolic resins
20	392113	Of polyurethanes
21	392114	Of regenerated cellulose
22	392210	Baths Shower-Baths and Wash-Basins
23	392220	Lavatory seats and covers
24	392290	Other Sanitary Articles
25	392310	Boxes Cases Crates & Smlr Articles of Plastics
26	392330	Crbys Bttls Flsks & Smlr Artcls of Plstcs
27	392390	Other Artcls For the Cnvynce/Pckng of Goods
28	392510	Resrvs Tanks Vats & Smlr Contnr Upto 300L
29	392520	Doors Windows & There Frms Thrshlds for Doors
30	392590	Other Builders Ware of Plastics
31	392610	Articles of Office Or School Supplies
32	392640	Statuettes & Other Ornamental Articles

33	940370	Furniture of Plastics

Table 47: Items for Immediate Tariff Elimination

S No	HS Code	Product Description
1	270900	Petroleum oils & oils obtained from Bituminous minerals, crude.
2	271000	Naphtha
3	271111	LPG
4	271112	Propane
5	271113	Butanes
6	271121	Natural gas
7	290250	Styrene
8	290315	1,2 Dichloromethane (Ethylene Dichloride)
9	290321	Vinyl Chloride (Chloroethylene)

4.3 Dominance of China

4.3.1 China, the fastest growing major economy in the world, is witnessingmassive investments in new projects and plant upgrades inalmost all segments of the chemical process industries, especially in the petrochemical sector as one of the basic industries.

4.3.2 In 2005, China overtook Germany to become the world's third-largest chemical producer, behind the U.S. and Japan. Growth of China's chemical industry witnessed intermittent brief periods of slowing down, over the medium and long term the sector has experienced sustained high growth which even today remains robust in comparison with the rest of the world.

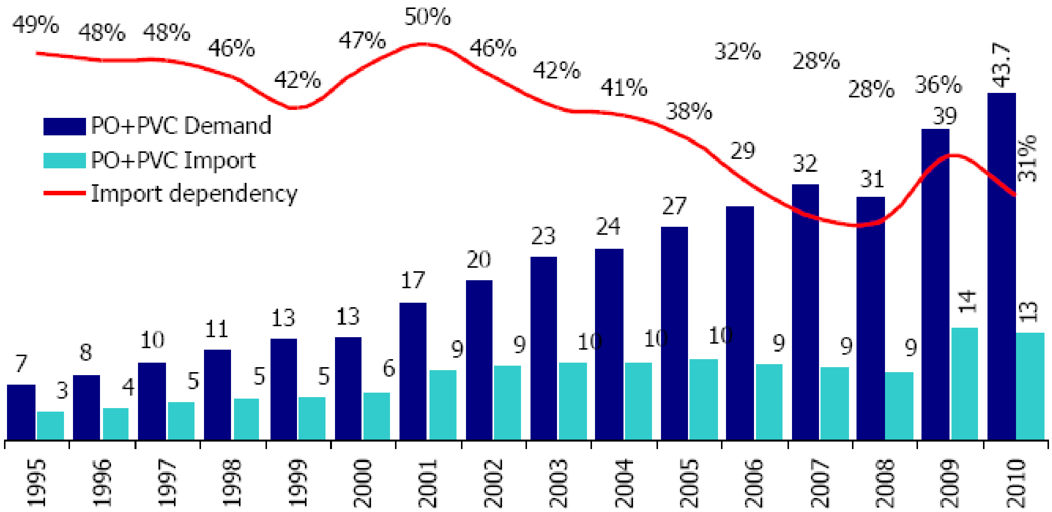
4.3.3 Assessments by the American Chemistry Council (ACC) put China at an average growth rate of over 16%, compared to less than6% for the entire Asia/Pacific region and less than 4% worldwide. Annual output growth of China's chemical industry is expected to average 10.4% between 2010 and 2016, as the growth of the surrounding region and world markets stay on course.

4.3.4 For foreign process-industry investors, such rapid growth is even more enticing when China'scurrent appetite for petrochemicals is factored in. China has been a major importer of petrochemicalproducts for many years and petrochemicals has been one the handful of Chinese industry sectors with a large trade deficit. SRI Consulting (SRIC) has forecast that China will remain a major importer in the next decade or so, despite rapid capacity increases to date.

4.3.5 Even though petrochemicals is dominated by state-owned companies, foreign investment in the petroleum and chemical industries in China has been substantial, with more than 2,000 projects. Almost all of the world's top 50 oil and petrochemical companies have set up joint or wholly owned ventures in China.

4.3.6 Despite the above fact, China continues to remain the largest importer in the world for certain segments of the petrochemical industry like plastics.

Figure 45: Chinese Polymer Demand & Imports



Source: CMAI

4.3.7 **Petrochemicals Capacity Additions in China**

4.3.8 Despite substantial petrochemicals capacity build-up since the 1990s and the consequent higher production capacity achieved, China continues to add further petrochemical capacities and its dependence on imports for sourcing of petrochemical raw materials is likely to steadily decline. China's ethylene and propylene capacities, which are projected to increase by 9.4 MMT and 11.7 MMT respectively, during 2010-16 illustrates the point. As a result, countries exporting petrochemical raw materials to China are expected to witness significant fall in their export volumes.

Table 48: Petrochemical Capacity Additions in China -2011-16

(Kt)	Capacity		Capacity Addition					
	2010	**2016**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
C2	15043	24425	568	702	2695	2017	1600	1800
C3	12909	24653	2079	1432	3310	2460	1368	1095
Total	**27952**	**49078**	**2647**	**2134**	**6005**	**4477**	**2968**	**2895**
HDPE	4912	8650	113	383	1367	563	462	850
LDPE	2361	3080	19			400	300	
LLDPE	3764	6605	221	195	1000	538	437	450
PP	11465	21679	1706	1538	2235	1980	1455	1300
PVC	17330	25406	3724	2145	1367	690	150	
Total	**39832**	**65420**	**5783**	**4261**	**5969**	**4171**	**2804**	**2600**

Source: CMAI

4.4 *China's 12th 5yr Plan for the Petrochemicals Industry*

Sections below are highlights of China's 12th 5 year plan for petrochemical industry. This is being included in the report to give a glimpse of China's planning process. China has successfully developed the industry based on end product exports and is aggressively building domestic capacities. China is also planning massive capacity built up based on coal. They already have large PVC production from carbide process.

4.5 *Strategic Vision*

4.5.1 Move from being a giant country to becoming a superpower by modifying the development approach and improving the Petroleum and Chemical industry.

4.5.2 Strategic targets for 12th plan: Key targets are quantified with specific growth numbers, broken up by several factors (could be a target for individual departments) to bring about the desired outcome.

4.5.2.1 Maintain steady and rapid industrial development

a) Maintain industry annual growth rate above ~10%.
b) The total output of the industry to RMB 16 trillion by 2015.
c) Labor productivity to increase by more than 6%.

4.5.2.2 Notable Increase in the independent innovation ability

a) Target Research investment at >3% of sales income in key enterprises.
b) Break 80 to 100 major generic technologies to seize the high ground in major industrial areas.
c) Construct a number of national engineering (technology) research centers, technology innovation alliances, national engineering laboratory and the enterprise technology centers.

4.5.2.3 Optimize industrial structure significantly.

a) Form a number of new growth carts of strategic emerging industries to further enhance industry competitive advantages and industry concentration.
b) Increase the proportion of Natural gas in the total energy consumption.
c) The proportion of fine and specialty chemicals will rise to 45%.

d) The number of enterprises whose annual sales income over trillions will exceed 15 by 2015.

4.5.2.4 Improvements in energy conservation and environmental protection. By 2015, reduce both energy consumption and carbon dioxide emission load per 10,000 Yuan (value added) of industry by 15% compared to the 11th five-year plan, reduce total discharge value of COD and nitrogen oxide, ammonia nitrogen, sulfur dioxide by 10%, 12%, 8% respectively, and get sewage discharge up to standards. The treatment and reuse proportion of chemical industry solid wastes reaches 75%, and the effective disposal rate reaches 100%.

4.5.2.5 Improve quality and brand competitiveness significantly.

a) Further strengthen quality consciousness, improve management of enterprises substantially, enhance the quality of main products to approach or even reach the advanced world standards, and form a group of industry-famous and world-class self-owned brands with leading technology and high quality.

b) Further improve trade standards to lay a foundation for supporting technological innovation and structural readjustment.

4.5.2.6 Improve safety levels by a large margin.

a) Set up people oriented system of Responsible Care generally, increase the number of enterprises carrying out Responsible Care substantially, rigidly execute advanced production supervision systems, further perfect supervision and management mechanism of hazardous chemicals and serious industrial accidents.

4.6 Major tasks

4.6.1 **Readjust and optimize industrial structure.** Industrial restructuring is the main lever to alter the development pattern; a target which should be stuck to persistently. Effective measures aimed at existing conflicts and main problems of traditional development pattern should be taken to promote overall structural optimization and upgrading of industry.

4.6.2 **Reconstruct conventional industries.** Improve energy saving and consumption reducing, safety and environmental protection, and quality of varieties of conventional industries through technology and equipment upgrading, further strengthen comparative advantage of conventional industries, increase added value and competitive power of products.

4.6.3 **Develop advanced exploiting technology** in petroleum and natural gas industries, perfect processing equipment of petroleum refining and ethylene industries, promote integration of refining and production and enhance efficiency of integrated utilization of resources.

4.6.4 **Execute differentiated development strategies** in the synthetic materials and organic chemical materials industries, develop products of high added value and technical content vigorously, and speed up transformation of products from general type to special type.

4.6.5 **Encourage large projects and discourage small** energy-inefficient power plants, control production capacity, produce specialized as well as slow and controlled release fertilizers in fertilizer industry.

4.6.6 **Intensify efforts to develop new products,** accelerate weeding out varieties which is highly toxic and of high residue level in pesticide industry, and raise the proportion of efficient, secure and environmental friendly products.

4.6.7 **Lower the proportion of solvent based coating and adhesive.**

4.6.7.1 As to industries of severe structural surplus such as methanol, calcium carbide, dye, tire, soda ash, caustic soda and PVC, control inventory strictly, raise standards for admittance into industries, speed up developing new technology and grades, extend the value chain of products.

4.6.7.2 As to industries of certain technology, scale, and competitiveness such as dye, soda ash, inorganic salt and tire, further expand domestic as well as foreign markets through technological and management innovation.

4.6.8 **Cultivate and strengthen strategic recently emergent industries.**

4.6.8.1 Develop fluoro alkyl silane materials, specialty Elastomers, thermoplastic Elastomers, polyurethane, engineering plastics, functional high polymer materials and polymeric composite materials with specialty fiber as framework.

4.6.9 **Speed up developing high-end specialized chemicals** such as energy saving and environmental friendly electronic chemicals, water-treatment chemicals, feed additives, surfactants, fire retardant and paper chemicals of high-performance.

4.6.10 **To match the development of new energy industry,** develop lithium cell and photovoltaic cell materials of high capability, improve the producing technology and capability of products such as epoxy resin, accelerate the development of unconventional oil gas resources such as shale gas and coal seam gas, promote the clean utilization of coal, develop biomass energy industries such as non-grain fuel-alcohol and biological diesel oil to local conditions.

4.6.11 **Accelerate the development of industrial biotechnology to replace traditional products,** develop biochemical products and bio-surfactant polymer materials such as biological pesticide, new enzymatic preparations, and decrease dependence on petroleum.

4.6.12 **Accelerate promoting exploitation and industrialization** of waste processing and integrated utilization, develop energy saving and environmentally friendly industries.

4.6.13 **Carry out the evaluation and consummation of projects in coal** chemical industry, moderate promotion of mature technology and promote the healthy and ordered development of new coal chemical industry.

4.6.14 **Normalize the development of chemical industrial parks**, encourage enterprises to centralize towards specialized parks. Plan and manage the park well to highlight industrial characteristics, optimize admission programs, intensify public services, strengthen safety and environmental protection, perfect logistics and transport, and formalize a model for sustainable development with correlated enterprises for high efficiency logistics, unified environment administration, comprehensive utilization of resources and improved management.

4.6.15 **Coordinate industrial area transfer,** encourage superior enterprises to merge and reorganize, optimize the allocation of resources and raise the level of industry concentration.

4.6.16 **Working around the pipe networks,** build up large base for refining – chemical, crude oil and oil products, strictly control new sites of petroleum refining, limit petroleum-refining projects in areas of excess capacity.

4.6.17 **Station pilot projects of new coal chemical industry** mainly in areas of rich coal resources, abundant water resources, large environmental capacity, and transport facilities. Limit the development of coal chemical industry in coal transfer-in provinces.

4.6.18 **Continue the transfer of large fertilizer materials** to origins of coal and phosphorus resources, the transfer of compound fertilizers and formula fertilizers to consumption markets, and the structural readjustment of small and medium enterprises to secondary operation of fertilizers.

4.6.19 **Improve the overall capability of science and technology innovation**. Give full play to the supporting and leading function of science and technology, put forth effort to solve the technological bottleneck constraints in industrial development, seize the commanding heights of technological innovation, promote the upgrading of industrial structure, raise the level of safety in production as well as energy saving and environmental protection to strengthen the industry core competitiveness.

4.6.20 **Obtain breakthroughs in a batch of critical and universal technologies**. Take efforts to develop new technology for producing bulk and pivotal synthetic materials, exploit new manufacturing technology of engineering plastics, membrane materials, specialty fibers, and polymeric composite materials, exploit chemical products and technologies matching strategic and emerging industry goals such as energy saving and environmental protection, new energy and biomedicine, and foster new growth areas in the economy.

4.6.21 **Develop clean manufacturing technology for products** such as high-performance radial tires, green pesticides, electronic chemicals and refined chemical products. Raise the degree of self-sufficiency of high-end chemicals. Develop new catalyzing materials and technologies, new parting materials and technologies, nano materials and technologies, chemical process intensification technology as well as energy saving and emission reduction technology and improve the level of core technology.

4.6.22 **Develop prospecting and mining technology of new oil &gas**, technology for high-efficiency utilization of inferior resources such as medium and low grade chemical ores and reduced fuel oil, new coal chemical technology, and high-value reuse of chemical wastes and scrap.

4.6.23 **Improve the utilization rate of resources and energies,** and reduce the discharge of pollutants. Develop green chemical technology such as photochemistry, ionic liquid, emission reduction and utilization of carbon dioxide, and lend technological support to the industry's sustainable development.

4.6.24 **Promote a batch of mature technologies and equipmen**t. Accelerate the industrialization and demonstration of key technologies, strengthen the engineering development and application sectors, promote the coordination of engineering design, equipment manufacturing and technology, improve the set-nature, reliability and practicability of technical development, improve the overall ability of science and technology achievement transformation.

4.6.25 **Centered on product upgrading, energy saving and emissions** reduction, promote a batch of mature advanced appropriate technologies and equipment; accelerate the promotion of the industry's transformation and upgrading.

4.6.26 **To further improve technology and innovation systems**, enterprises should gradually increase R&D investment as a proportion of sales. Further reinforce the creation of technology innovation platforms by setting up 8-10strategic alliances of industrial technology innovation in key areas and construct 5-8 National Engineering Research Centers, 8-10 National Engineering Laboratories and 15-20 State-level Enterprise Technology Centers. Implement the National Strategic Outline of Intellectual Property and strengthen the creation, utilization, protection and management of intellectual property. Reinforce foreign communication and cooperation of technology, put emphasis on digestive absorption / innovation of the imported technologies and catch up overall with the international advanced level.

4.6.27 **Promote the economical, safe and clean development of industry**. Adhering to the "people-oriented" principle, grounded on green and low-carbon development, strive to develop sustainable economy through sustainable development with high technology content, high economic return, low resource consumption, low environmental pollution and high inherent safety level.

4.6.28 **Strive to promote energy saving and emission consumption.** Strengthen the energy saving management of major energy consumption enterprises, promote the construction of enterprises' energy management center and perfect the system of energy consumption limit standard of main energy-consuming products. Promote advanced energy-saving technologies and equipments; get the transformation of energy-saving technologies of high energy consuming industries done. To promote clean production overall, for main industries, Set up a system of clean production indicator, system of clean production assessment standard, system of pollutant discharge standard and system of environmental protection management.

4.6.29 **Get the clean production demonstration projects done in industries** such as pesticide, dye, and painting, build up a batch of green parks of clean production in the chemical industry. Seize the structural readjustment of industries of high pollution such as pesticide and dye, adopt advanced technologies of environmental protection and accelerate the reform of backward production equipments. Strive to develop regenerated resources and process discharge technologies, reinforce the headstream and process management and reduce the discharge of these wastes and carbon dioxide. Encourage the development of new products, technologies and equipments for the capture, storage, and comprehensive utilization of carbon dioxide.

4.6.30 **Promote the implementation of Responsible Care.** To proceed from the development reality of the petroleum and chemical industry, use the advanced notion and experience of international implementation of Responsible Care as reference, make system of Responsible Care type standard with Chinese characteristics, combine Responsible Care, HSE and safety inspection of chemicals together, further improve the level of enterprises' safety and health, resource economy, environmental friendly and clean production, promote the safety and pollution control of chemicals in the whole process of production, transportation, storage and utilization. Strive to propagate the notion of Responsible Care, carry out pilot plots of Responsible Care in enterprises and parks, implement Responsible Care to enterprises' overall development plans and guidelines, take effective measures to reduce and prevent environment and safety accidents and risks, promote continuously the enterprise image and enhance the industrial competitiveness.

4.6.31 **Take efforts to improve the inherent safety level of the industry.** Adhering to the implementation of the "safety first, precaution crucial" principle, set up a scientific system of safety standards in production for petroleum and chemical industry, revise the safety standards, research and put forward the industry's safety admission rules.

4.6.32 **Implement the regulations on the control over safety of dangerous chemicals,** lead enterprises to establish and improve the supervision and management system of dangerous chemicals and form an effective mechanism of safety for work with dangerous chemicals. Carry out safety management research of chemical industry parks, explore the safety management mode of chemical industry parks and put forward relevant content of safety plan and safety admission condition of chemical industry parks, promote the existing chemical industry enterprises with insufficient safe distances, excessive major hazards or dispersed enterprises to shift to the parks gradually. Encourage enterprises to conduct R&D and adopt appropriate advanced safety production technology as well as new products, new technologies, new equipment and new standards.

4.7 Petrochemical industry

4.7.1 **Ethylene**

4.7.1.1 Take advantage of the restructuring and expansion projects of oil refining enterprises as well as new large oil refining projects, balance overall regional market capacity, properly arrange construction of large scale ethylene projects and improve the self-sufficiency in ethylene. Encourage diversified development of ethylene as a raw material; promote the construction of integrated comprehensive large petrochemical bases such as oil refining, ethylene and aromatics. Keep close track of and absorb foreign advanced technology, carry out independent innovation study of basic and common key technology and equipment for olefins, improve the localization rate of technology and equipment. Make overall plan for ethylene "by-products” such as C4, C5 and C9 resources, select varieties rationally, form scale economy, highlight features of products and improve the economic benefit.

4.7.1.2 Restructure and expand existing large ethylene enterprises for efficient energy and raw materials consumption, take efforts to get the standard oil consumption per ton of product to <600 kg. Strive to get the national capacity of ethylene and propylene to about 26mlnand 22mlntpa respectively to bring the self-sufficiency rate of ethylene and propylene to 70% and 75 % respectively.

4.7.2 **Synthetic materials**

4.7.2.1 **Synthetic resin:** Encourage the development and commercialization of new technologies and new products of synthetic resin. While increasing the output of polyolefin resins, develop specialty polyolefin resins over general types, improve quality and increase the technology content and value addition of products. As to thermosetting resins, improve the quality, increase the product varieties and reinforce application development. Accelerate the development and production of functional resins such as water-absorptive resin and electrical-conductive resin, as well as biodegradable polymers. Reinforce R&D of the regenerated green resins and the recovery and utilization of waste plastics. Accelerate the technical progress, promote the localization of key equipment, research and develop new polymerization technology and new high-efficiency catalysts.

4.7.2.2 **Synthetic rubber:** Accelerate development of world class commercial scale technology and equipment of butyl rubber (especially halogenated butyl rubber), EPR and IR. Accelerate the development and production of specialty Elastomers such as AR and poly-epichlorohydrin rubber. Strive to increase new products and grades of SBR, BR, NBR and CR, with a relatively high domestic market share, especially for energy saving and environmental protection applications. Solve the domestic supply of environmentally friendly rubber content oil for E-SBR, realize the commercialized production of oil-extended SBR with low PAH content, prevent new construction of small oil refining projects in the name of processing bitumen and crude oil. Develop the products of SIS and SEBS products of styrene type, and increase the proportion of specialized products. Strive to develop new synthetic rubber products in favor of improving the quality and class of rubber products, promote the application of energy conservation SSBR, accelerate the industrialization of LCBR, carry out the application of trans IR and increase the specialty varieties such as powder rubber and liquid rubber, and their output.

4.7.2.3 **Synthetic fiber:** Improve the quality of general type fibers, develop new varieties of special use, focus on developing differentiated fibers and multi fiber materials of high added value and increase the proportion of functional fibers. Strive to develop specialty synthetic fibers such as high strength and high modulus Carbon fiber, Aramid fiber, ultra-high molecular weight Polyethylene fiber, Polyphenylene sulfide fiber, research and develop PTT fiber and promote the auxiliary industrial process of 1,3 Propanediol. Accelerate the technological reform of equipment such as CPL, Acrylonitrile and ethylene glycol; increase the supply of PAN-based carbon fiber precursor. Further increase PX capacity and strive to get the self-sufficiency rate to about 85 %.

4.7.2.4 **Organic chemical raw materials (Coal):** Carry out orderly R&D demonstration of new coal chemical processing, make further efforts to develop new coal chemical processing with independent intellectual property, improve continuously the level of system integration, promote the longer cycle stable operation of demonstration projects in new coal chemical processing such as coal to olefins, coal to methane, coal to liquid fuel and coal to glycol, make efforts to improve the new coal chemical processing demonstration projects' level of technology, economy and environmental friendly management.

4.7.2.4.1 Based on overall conclusion of experience with demonstration projects, assess the advanced status, reliability and economical efficiency of technologies and indicators of carbon emission and proceed steadily for industrial development. On the assumption of ensuring economic efficiency, properly station imported methanol to olefins projects in coastal areas.

4.7.2.4.2 Reinforce the development and application of basic technologies such as core technology equipment, priority areas include advanced coal gasification technology, large air separation technology, transform and clarify technology of synthesis gas, coal derived poly-generation specialty technology, high-efficiency clean comprehensive utilization of lignite, methanol aromatization technology, methanol protein industrialization technology, key technology of exploiting and utilizing coal seam gas and methanol synthesis technology with a scale of more than 600 thousand tonnes annually. Proceed with the clean utilization of coal; improve the level of comprehensive utilization of high-ash, high-sulphur and low-value coal.

4.7.2.4.3 Prevent the blind expansion of methanol and dimethyl ether, resolutely close down backward production facilities of methanol and dimethyl ether, develop new downstream products, proceed with orderly demonstration and development of alcohol ether fuel and alleviate the conflict of over capacity.

4.7.2.5 **Basic chemicals:** It is important for basic chemicals such as sulfuric acid, hydrochloric acid, nitric acid, soda, caustic soda and calcium carbide to control total production and eliminate “backward” production capacity. Make greater efforts to save energy, reduce emissions and implement clean production. Strive to develop cyclical economy and increase the level of comprehensive utilization of resources. Develop new downstream products and extend the industry chain.

4.7.2.6 **Chlorine-alkali:** Strive to popularize in the entire industry advanced technologies developed domestically, such as acetylene production by dry process, cement production by dry process using calcium carbide sludge, ion membrane and low mercury catalyst. Accelerate the production of PVC by calcium carbide process using solid mercury as catalyst and the research and development of non-mercury catalysts; push the research and application of advanced technologies such as the oxygen cathodetechnology and the technology of chlorine production. In accordance with relevant regulations and management systems of the state, strengthen the cogeneration technology and direct power purchase and increase the efficiency of energy utilization. Develop soda and chlorine consuming products of high added value, develop fine, specialized and compounded PVC products, cultivate competitive brands in the market and further extend the application area of these products. By the year of 2015, all of the PVC production by acetylene process to use low mercury as catalyst and the mercury consumption per ton PVC to decrease by 50%.

4.7.2.7 **Soda:** Control expansion of production capacity of soda, further bring down energy and material consumption and reduce discharge of waste liquid and sludge. Encourage the adoption of advanced automatic process control technology and large high-efficiency equipment in soda production and popularize double-filtering technology of heavy alkali and belt alkali filter. As to ammonia soda process, popularize the technology of adding in ash by dry process, vacuum distillation process, desulphurizing technology using sludge of stock gas and other comprehensive technologies for utilization of sludge. As to Hou’s soda process, popularize granulating technology of ammonium chloride to increase its separate fertilizer volume, further perfect technology of non-cooled carbonization, technology of Hou’s ammonia process by thermal process and new cogeneration technology of melamine and combined-soda. Continue to improve the quality of soda, especially the quality of soda produced in Hou’s soda process and expand the production capacity of heavy soda and dry ammonium chloride to reach the level of 60 % of the total capacity respectively.

4.7.2.8 **Inorganic salts:** Make greater efforts in the prospecting of important mining resources such as phosphorus, potassium, sulfur, fluorine and manganese, and improve the resource guarantee capability. Reinforce the ecological protection and develop resources in an orderly manner. Encourage the exploitation of medium and low grade mines and the comprehensive utilization of resources and increase the comprehensive utilization rate of by-products and wastes. Decrease the proportion of high energy consumption products, put emphasis on new industries such as lithium salts and improve the proportion of fine inorganic salt products. Focus on the development of inorganic nano-powder materials, inorganic functional materials, organic-inorganic composites and high-end specialized inorganic chemicals. Make greater efforts in research and development of new technologies and push the implementation of promotion plan for the clean production of inorganic salts. Accelerate the construction of demonstration projects of chromate production by gas fluidized fluid-tower continuously pressurized liquid-phase oxidation process, chromate production by chromium iron alkali soluble oxidation process and popularize non-calcium roast. Strengthen exhaust recovery and utilization of yellow phosphorus production, popularize the advanced refinery and the production of high-tech and high added value C1 chemicals, use dry dust removing technology in place of the wet one, reinforce the research and demonstration projects' construction of liquid iron saturated with phosphorus vis-à-vis thermal energy and the comprehensive utilization of residuals and reinforce the popularization of technologies such as recovery of exhaust thermal heat in barium carbonate industry and electrical precipitation, popularize calcium carbonate production by rotary kiln process and fluid-bed celestite roasting reduction technology. Encourage phosphate production by wet process. And reinforce the elimination of backward capacity and technologies.

4.7.2.9 **Sulphuric acid:** Continue the structural readjustment of raw materials, build no new equipment in 3 to 5 years and especially build no equipment of sulphur-burning and pyrite-based sulphuric acid production for those enterprises with no downstream acid consuming products. Do not build sulphur-burning sulphuric acid production for the purpose of energy and make the best of sulphuric acid resource as by-products of smelt. Encourage the recovery of sulphur resource in industries such as petroleum, natural gas, crude oil processing, coal and electricity. Encourage increasing mine selection capability of accompanying sulfide enriched concentrate and pyrites, centralize supply of large-scale acid producing enterprises with high grade mines and increase the % recovery of pyrites cinder. Continue the recovery and utilization of high and medium temperature thermal heat in sulphuric acid equipment, popularize the recovery technology of low temperature thermal heat in sulphur-burning sulphuric acid production, develop and improve the technology of waste heat utilization in mine sulphuric acid production and roast sulphuric acid production and increase the total % recovery of waste heat of the industry. Eliminate water scrubbing purification technology and improve utilization of recycled water. Accelerate technical innovation and transformation; ensure indicators such as sulfur dioxide and acid mist in the exhaust to attain the new emission standards.

4.7.2.10 **Calcium carbide:** Strictly implement the new project criteria for the industry, eliminate backward production capacity and control total capacity. Push the concentration of calcium carbide capacity towards resource and energy origins, encourage enterprises to merge and reorganize to form a batch of large-scale enterprises with capacity over 200kta and construct 5 to 8 bases of mega tonnage calcium carbide production. Encourage construction of several “coal, pyro - electricity (coke), chemical industry (calcium carbide-acetylene) building materials” integrated industry bases using the advantage in energy and resource of the central and western areas of our country. Develop downstream products of carbon carbide, encourage the development towards pesticide and medicine and reduce the impact PVC exerts on the development of carbon carbide industry. Push forward the industrialization of oxygen-thermal carbon carbide furnace, and make more efforts in the popularization of large-scale closed furnace, accelerate the technical transformation of internal combustion furnace of 16.5 thousand KVA or above, realize the comprehensive utilization of the furnace gas. By the year of 2015, strive to achieve the capacity proportion of closed furnace to achieve 80% and decrease the comprehensive energy consumption per ton of calcium carbide to less than 1 ton coal.

4.7.2.11 Control the total capacity, strictly implement the new project criteria for the industry and limit the construction of monomer projects below 100 kt. Increase the technical level of production and the product quality of the organic silicon monomer, accelerate the development and processing application of downstream products and continuously strengthen the products’ competitiveness in technology, quality and market. Accelerate the development of key technologies, push the process of industrialization, which mainly includes the optimization and comprehensive utilization of synthetic technology of organic silicon methylic monomer, R&D of the commercial scale technology of methyl phenyl dichlorosilane, the development of commercial technologies and products of functional organic silicon rubber, especially heat-resistant silicon rubber, mono component addition cure LSR, the development and production of methyl phenyl silicone rubber and specialty silicon rubber and their products, the development of advanced synthetic technology of alkoxysilane by direct process and new variety of silane coupling agent, the development of mass production technology of organic silicon and organic modified materials, the development of the key technology of the comprehensive utilization of silicon tetrachloride as the by-product of polycrystalline silicon, the development of new preparation technology of silicone oil and downstream products and the development of new products and technologies of silicon resin.

4.7.2.12 **Fluorine chemicals:** Strengthen the protection and comprehensive utilization of fluorine resource, strictly limit the export of fluorite and hydrogen fluoride and encourage the selection and utilization of medium and low grade fluorite and hydrogen fluoride production using fluorosilicic acid as by-product of phosphate fertilizer. Encourage the development of high-performance inorganic fluoride salt such as aluminum fluoride production by dry process and macromolecular cryolite. Encourage the development and mass production of new environmentally friendly fluorine refrigerant. Push forward the development and industrialization of downstream specialty fluorine “mono component”. Accelerate the production as well as the processing and application technology of high-performance PTFE, melt-processable fluorine resin and fluorine membrane materials. Encourage the development of low-temperature resistant fluorine rubber, fluorine rubber for automobiles and new products of premix and compounded rubbers, transform gradually the supply model of fluorine rubber which is mainly based on raw rubbers and improve the added value of products. Encourage the development of fluorocarbon dope, and solve the industrial scale-up problem of high-end PVDF coating grades. Encourage the development towards the direction of high value addition fluorine intermediates of hetero aryl cyclic aliphatic type as well as LCD and FPD type and low-toxicity fluorine pesticide and fluorine pharmaceutical intermediates. Encourage the development of fluorine electronics and fluorine materials for new energy applications.

4.7.2.13 **Engineering plastics:** Popularize the application of downstream products with independent intellectual property of PAEK, PPS and PAES. Improve the quality and diversify the range of products such as POM and PBT. Strengthen the research of new products and application of functional and specialized engineering plastics. Further push forward the development of polycarbonates, nylons of long carbon chain, high-temperature resistant nylons and LCP. Accelerate the process of blending, modifying and alloying resins and encourage the development of environmental friendly modified materials and new flame retardant materials.

4.7.2.14 **Thermoplastic Elastomers (TPE):** TPE, a kind of new material, partakes of both plastic and rubber, has sealing, seismic, waterproof, and antiseptic qualities, and is also easy in processing, therefore applied widely in fields such as electronic devices, automobiles, high-speed rails and architecture. Focus on the development of TPU, TPE, SPA and SBC, and accelerate the research and development of auxiliaries and their processing and application.

4.7.2.15 **Composite materials**: Strive to develop resin group composites with specialty fibers such as carbon fiber, aramid fiber, UHMW-PE, and PPS fiber as backbone. Grasp as soon as possible the key technology of precursor carbon fiber production and carbonization, capture the technology of high tensile and high modulus carbon fiber production above T700. Improve the quality of base epoxy resin. Reinforce application research, especially the application of composite materials in aeronautic, astronautic and industrial fields.

4.7.2.16 **Polyurethanes:** Accelerate the research and development of photochemical reaction equipment and technology of TDI, systems engineering of gas-phase phosgene process, industrialization of aliphatic isocyanate, large-scale technology of propylene epoxide production by propylene HPPO process, continuous production technology of polyether polyol by bimetallic catalytic process, production technology of waterborne polyurethane resin, and polyurethane foam stabilizer as well as high-efficiency and low-toxicity flame retardant. Encourage research and development of biodegradable polyurethane raw material as a recyclable resource, sectioning technology of melt-spinning polyurethane fiber, technology of high-performance CPUE material mainly designed for automobile tread, and cyclic utilization technology of chlorine in the process of isocyanate production by ODC process. Accelerate laying down new standards for polyurethane, strive to push forward the popularization and application in all fields of the national economy, especially application in the aspect of energy saving and heat preservation. To strengthen the competitiveness of polyurethane, make efforts to form several internationally competitive production bases of isocyanate during the Twelfth Five Year period.

4.7.3 **New energy and biochemical**

4.7.3.1 **New energy:** Improve the auxiliary support industries for nuclear energy, wind energy and solar energy in raw materials, for instance, heavy water, sodium, organic fluorine materials, epoxide resin for fan blade, carbon fiber, polycrystalline silicon for photovoltaic battery, basement membrane materials and packaging materials. Develop lithium battery materials for energy storage and conversion, such as lithium iron phosphate, lithium hexafluoro phosphate, lithium cobalt oxide and its separator, and lithium battery electrolyte, and perfect extraction technology of lithium in salt lake. Accelerate development and application of coal seam gas, further perfect and improve technical level of non-conventional oil and gas resources' exploitation, such as tight sandstone gas, shale oil, and oil sands, reinforce technical innovation of shale gas's prospecting and exploitation, push the transformation from technical advantage to industrial advantage of oil gas production from shale, and continue to push forward the research, development and application technology of natural gas hydrate.

4.7.3.2 **Biochemical engineering**: As to conventional biochemical industries such as citric acid, lysine, humus acid, and lactic acid, improve the added value of products and the level of exported products. Strive to develop bio-pesticide, humus acid pesticide, bio-fertilizer, humus acid fertilizer, and plant growth regulator. Accelerate the development of high-end products such as single cell proteins, enzymatic preparations, biological reagents, biochips, interferon, and biosensors. Push forward industrial biotechnology to replace conventional technologies, encourage the development of new biomaterials such as bioethylene, biological organic raw materials, biochemical fibers, bio-nylon, and bio-rubber, develop synthetic technology, polymerization and modification technology of polymeric materials with renewable resources as feedstock and reduce industry's reliance on fossil raw materials. Develop and popularize biosynthetic technology in fields such as pharmaceutical intermediates and pesticide intermediates.

4.7.3.3 Adhere to the principle of **"Don't contend with people for grains, and don't contend with grains for lands",** and gradually expand the production scale of fuel ethanol by nonfood process and biodiesel. Accelerate technical R&D and industrialization demonstration of ethanol production with crop stalk and lignin as feedstock, and realize diversified supply of feedstock.

4.7.3.4 **Focus on development of key technology of bio-ethylene industrialization,** synthetic technology of salt-resistant polymeric polyaspartic acid, key technology of bio-energy generation and conjugate technology of bio-energy and chemicals, high-efficiency construction of strains and high throughput screening technology, new high-efficiency aerobic, anaerobic and compound reactors, and new technology and application technology of high-efficiency de-nitrification and de-phosphorization.

4.7.3.5 **Rubber products:** Control the total quantity of tires, limit the development of bias tires and further increase the proportion of radial tires. Continue to increase the output of heavy-duty radial tires and engineering tires, especially the output of tubeless heavy-duty radial tires. Continue to increase the proportion of light-load and homemade cars' radial tires, in the meantime increasing downstream products, increase the proportion of low-section, flat-structure, big-rim and high-performance cars' radial tires and make efforts to expand production of high-performance radial tires.

4.7.3.6 **Further perfect and improve the performance and quality of transmission bands for conventional use**, focus on the development of transmission bands of functional and special request, such as flame-retardant transmission band of all uses, heat, cold, oil, acid and alkali resisting, and high inclination-angle transmission bands, as well as light-duty transmission bands. As to carbon soot industry, accelerate R&D, popularization, and application of low rolling resistance and functional products, develop new high-performance and appropriate automobile rubber products in urgent demand, and develop new functional products such as new rubber additives, as well as colored carbon soot and conductive carbon soot of better performance.

4.7.3.7 **As to sneaker industry, readjust and optimize the structure of products** and raise the proportion of high and medium class products from current below 50 % to about 65 %, foster enterprises' own brands and construct a batch of world famous brands.

4.7.3.8 **Focus on the development of new low-temperature rubber refining technology,** preparation and processing technology of trans-isoprene rubber, giant all-steel system engineering technology of radial tire production, key technology of air-captive tire industrialization, key preparation technology of fuel-saving tire and intelligent tire, preparation and application technology of downstream and high-performance rubber products for automobile and high-speed train use, and preparation technology of high-end tube and tape products such as heat-resistant, high flame-retardant and high-strength transmission bands.

5 Asian petrochemical Industry

5.1.1 As the petrochemical industry has shifted to the East of Suez, Asian countries have joined together and hold APIC (Asia Petrochemicals Industry Conference) every year. The last one was in May 2011 in Fukuoka, Japan. For the first time, CPMA, India hosted APIC in May 2010 in Mumbai. APIC has seven member countries which are Japan, South Korea, Malaysia, Singapore, Thailand, Taiwan and India. A brief about petrochemicals scenario in these countries and their issues are given below.

Table 49: Petrochemical Capacity in 2011

(KTA)	Japan	Korea	Singapore	Thailand	Taiwan	Malaysia	India
Ethylene	7279	7770	1880	4436	4015	1723	3867
Propylene	6573	5801	1055	2156	3093	1192	4298
Butadiene	1040	1257	60	190	620	100	295
Benzene	6659	4834	420	1437	1772	350	1235
Toluene	2317	2537	145	816	93		270
Xylene	7804	4228	495		2902		90
Para-Xylene	3974	5180	870	2149	2280	550	2477
PE	3657	5318	1270	3480	1424	1070	3228
PP	3268	3958	370	1950	1360	550	4140
PVC	2115	1380		982		275	1330
PS	769	802		430			640
EO	911	1010	45			385	209
MEG	589	1352	122	395	2130		1300
Acrylonitrile	722	550			475		40
PTA	1300	6390		2660	5550	600	3850
Styrene	3278	3383	360	520	1910		0
VCM	3515	1507		900	1965	400	0
SBR	1966	1598		122	194		20
Source: APIC Country Paper May 2011 & CMAI							

5.2 Japanese Petrochemical Industry

5.2.1 Having passed through the global financial crises, Japanese GDP recovered from figure of minus 6.3% recorded 2009 to plus 3.9% in 2010 and hopes to maintain the same.

5.2.2 Domestic sale of Automobile and Consumer goods increased with govt. policy of encouraging energy-saving through the provision of subsidies and tax cuts.

5.2.3 **Ethylene** production in Japan in 2010 increased by 1.5% over 2009. The growth in domestic demand for ethylene was caused principally by recovery from global financial crisis and various measures taken by the Govt. to boost the economy.

Table 50: Changes in Production, Exports & Imports of Main Products (Unit: 1,000 MT)

	Production			Import			Export		
	2008	2009	2010	2008	2009	2010	2008	2009	2010
Ethylene	6,882	6,913	7,018	142	42	60	196	588	459
LDPE	1,818	1,605	1,704	261	177	246	189	303	242
HDPE	1,052	986	1,015	27	30	48	139	275	238
PP	2,870	2,411	2,709	194	115	146	388	388	238
PS(GP.HI)	829	690	698	7	13	21	84	64	56
PVC	1,797	1,668	1,749	9	11	6	595	728	683
Total Main5 Resins	8,365	7,360	7,875	498	346	467	1,396	1,758	1,457
EG	629	581	596	20	2	9	44	176	75
SM	2,847	2,996	2,939	3	3	0	1,132	1,599	1,398
AN	600	602	663	37	5	7	117	262	212

5.2.4 **PE**: In 2010 the domestic demand for resins & finished products increased by about 8% from previous year. The China & Asia market will give boost to export business with high economic growth rate. It is going to be tough because of oversupply from new PE plants in Middle East Asia, the unstable situation around North Africa and the steady conditions of strong yen.

5.2.5 **PP**: The domestic demand increased by 10%. The industrial sector such as automobile applications skyrocketed by 21%, Fibres increased by 11% because of the hygiene products. Domestic demand is expected to grow gradually. The expected growth rate of domestic demand is likely to slow down due to increase of both resin & finished products imports.

5.2.6 On the other hand, while exports from Japan are expected to be increased slightly supported by continuous & solid growth of Asian market, especially China.

5.2.7 **PVC**: Demand for PVC profiles is expected to increase; though there is a decline in infrastructure projects due to reduced public work projects. The introduction of the eco-point system for housing will give major boost to PVC demand.

5.2.8 **Ethylene Glycol**: The demand for polyester film & electronic goods will remain healthy & cover the weak demand for polyester fibres.

5.2.9 **Styrene**: The domestic demand is anticipated to decline slightly due to a reaction against the effects of home appliances “Eco-points”. The Japanese Govt. economic policy to assist consumer to purchase air-conditioners, refrigerators & flat screen TVs with high energy saving.

5.2.10 **Acrylonitrile**: Demand for ABS is considered to be steady backed by China's high economic growth & demand for the other derivatives will keep growing.

5.2.11 Japanese policy makers strongly believe that petrochemical business plays an important role in the supply chain for consumer goods that are indispensable in many different fields. There are many hidden opportunities to make further contribution to society through technical innovation in the petrochemical field.

5.2.12 Such cutting-edge technical innovation is sure to render the lifestyle more eco-friendly and to transform it in a more energy-conserver and sustainable.

5.3 Korea Petrochemical Industry

5.3.1 Since the 1960s, South Korea has achieved an incredible record of growth and global integration to become a high-tech industrialized economy. Four decades ago, GDP per capita was comparable with levels in the poorer countries of Africa and Asia. In 2004, South Korea joined the trillion dollar club of world economies, and currently is among the world's 20 largest economies. Initially, a system of close government and business ties, including directed credit and import restrictions, made this success possible. The government promoted the import of raw materials and technology at the expense of consumer goods, and encouraged savings and investment over consumption.

5.3.2 Korea adopted numerous economic reforms following the crisis, including greater openness to foreign investment and imports. Growth moderated to about 4-5% annually between 2003 and 2007. With the global economic downturn in late 2008, South Korean GDP growth slowed to 0.2% in 2009. In the third quarter of 2009, the economy began to recover, in large part due to export growth, low interest rates, and an expansionary fiscal policy, and growth exceeded 6% in 2010. The South Korean economy's long term challenges include a rapidly aging population, inflexible labor market, and overdependence on manufacturing exports to drive economic growth.

5.3.3 Korea has GDP of ~ 1.459 Trillion USD and inflation remained ~3% in 2010.

5.3.4 The key industry in Korea includes electronics, telecommunications, automobile production, chemicals, shipbuilding and steel.

5.3.5 Korea has exports of 466 billion USD.

5.3.6 Korea exported chemical & chemical products of 48.9 Billion USD and petrochemicals worth 35.7 billion USD.

5.3.7 The major exported products are semiconductors, wireless telecommunications equipment, motor vehicles, computers, steel, ships and petrochemicals.

5.3.8 Korea's economy is expected to grow 4% in 2011 as fast as the world economy. Though the manufacturing sector will lead economic growth thanks to an increase in export and equipment investment, the domestic demand remains weak.

5.3.9 Despite of no new addition and decrease in export to China, production of 2010 grew 1% to mark 21201 KT. There is an improvement in the operating rate driven by domestic demand recovery.

5.3.10 The domestic market grow 6% to mark 10,232 KT due to recovery of frontline industries such as automobile, home appliance and chemical, fibre & export fell 2.4% to 11,822 KT.

5.3.11 South Korea's petrochemical industry is set for a massive rise in Xylenes capacity to serve demand in China's polyethylene Terephthalate (PET) market, which is a significant gamble given slowing Chinese imports amid a growing problem of overcapacity and saturation.

5.3.12 In 2010, South Korea's combined olefins capacities included 7.73mn TPA ethylene, 5.87mn TPA propylene and 1.25mn TPA butadiene. Intermediate and aromatics capacities include 4.06mn tpa benzene, 330,000tpa Ethyl benzene, 1.3mn tpa ethylene oxide/ethylene glycol, 6.63mn tpa Terephthalic acid, 3.28mn tpa styrene monomer, 1.51mn tpa vinyl chloride monomer and 4.83mn tpa Xylenes. Polymer capacities include 1.92mn tpa high density polyethylene, 1.03mn tpa low density polyethylene, 1.22mn tpa linear low density polyethylene, 1.09mn tpa PET, 4.04mn tpa polypropylene, 1.38mn tpa polyvinyl chloride and 975,000tpa polystyrene. It also possesses capacities of 565,000tpa styrene-butadiene rubber and 1.48mn TPA Acrylonitrile-butadiene-styrene.

5.3.13 The dependence on the Chinese market to soak up Korean production exposes the industry to significant risks. China's growth in capacity in 2010 has been accompanied by a sharp downturn in domestic demand due to tightened bank lending conditions and a more restrictive fiscal policy. This led to a large rise in Chinese production and a sharp slowdown in imports. If sustained, such trends will undermine Asian petrochemicals prices and squeeze South Korea's exports. On the upside, the efficiency of the country's highly integrated petrochemicals industry should ensure competitiveness and secure profit margins over the medium term. South Korean production more competitive against Japanese rivals; by mid-2010, the yen was trading at a 15- year high against the US dollar. Rising interest rates in South Korea and efforts to stabilise the won could shave off the won's competitiveness.

Table 51: Production & trade scenarios in Korea for various products

PRODUCT		2004	2005	2006	2007	2008	2009	2010 (Est)
HDPE	Production	1,889	2,011	1,965	1,981	2,073	2,180	2,226
	Import	10	12	12	7	9	8	9
	Export	1,083	1,204	1,139	1,127	1,204	1,345	1,380
PP	Production	2,859	2,893	2,942	3,084	3,333	3,710	3,869
	Import	14	14	15	18	24	21	21
	Export	1,579	1,616	1,653	1,792	2,026	2,376	2,490
PVC	Production	1,231	1,339	1,373	1,377	1,365	1,476	1,530
	Import	21	51	48	26	28	32	32
	Export	392	499	518	463	534	682	726
PS(GP/HI)	Production	791	770	655	681	638	611	621
	Import	8	15	27	32	30	28	28
	Export	545	551	452	498	461	429	438
EPS	Production	365	373	407	395	354	330	335
	Import	1	4	7	3	3	5	5
	Export	138	161	184	174	135	112	115
ABS	Production	1,198	1,188	1,282	1,364	1,240	1,404	1,457
	Import	5	5	6	6	7	6	6
	Export	966	975	1,082	1,217	1,240	1,249	1,299
AN	Production	457	490	513	492	442	545	552
	Import	153	148	122	131	92	82	76

Source: APIC Country Paper 2011

5.4 Outstanding issues – Korean Petrochemical Industry

5.4.1 **Advancement of the Petrochemical Industry and Enhancement of Competitiveness**

5.4.1.1 Due to new players rising from Middle East, high oil prices and stricter regulations on greenhouse gases, the growth fundamental is weakening fast. Thus, major companies are increasing the gap with their advanced technology and new players are trying to close the gap with large investments.

5.4.1.2 Especially, severe environmental regulations have a great impact on the petrochemical industry as it consumes energy and emits greenhouse gases significantly. To secure fundamental competitiveness and reduce greenhouse gas emissions, the petrochemical complex is being converted into green facilities. This will contribute to better energy efficiency of the petrochemical industry and national energy savings, resulting in enhanced competitiveness.

5.4.2 Increased Attention to the Future Growth Business

5.4.2.1 To cope with structural oversupply and maintain sustainable growth momentum, the petrochemical industry has felt the needs for future growth business.

5.4.2.2 Thus, for a brighter future of the petrochemical industry, Korea’s petrochemical companies endeavor to develop polysilicon, monosilane, films, solar energy materials and secondary batteries as well as add new lines.

5.4.3 Climate Change Convention

5.4.3.1 The international community is discussing how to control greenhouse gas emissions when the Kyoto Protocol expires in 2012. Korea will be obliged to reduce greenhouse gas emissions from the 2nd commitment period 2013.

5.4.3.2 Thus, the Korean government enforced Basic Act for Low Carbon Green Growth to prepare for greenhouse gas reduction obligation. In November 2009, the national greenhouse gas reduction target was set to be 30% against BAU by 2020. And detailed greenhouse reduction targets will be decided for each business sector.

5.4.3.3 Therefore, to enable Korea’s petrochemical industry to remain as Korea’s core industry in the future while maintaining its current scale, there should be the greenhouse gas policy based on the industry’s international competitiveness. Korea’s petrochemical industry is preparing the plan to comply with greenhouse reduction regulations by combining their resources through its association.

5.4.4 Environment/Health & Safety

5.4.4.1 As the environment regulations are getting stricter around the world, Korea’s petrochemical industry is making proactive efforts to meet such global requirement. As well as enhanced activities related to climate change and environmental safety, Korea’s petrochemical companies are taking proactive measures such as responsible care programs.

5.4.4.2 For environment conservation, petrochemical plants are monitoring contaminants at major outlets in real time, and making efforts to reduce discharged chemicals by signing the chemical reduction agreement with the Ministry of Environment. They have begun to release information on discharged hazardous chemicals to locals and interested parties for a better understanding.

5.4.4.3 To improve the petrochemical industry's image and regain trust, the responsible care program is a place to protect environments and people's health overall production processes and enhance environment/safety/health levels continuously.

5.4.4.4 Raising awareness of environment, safety and health as well, the responsible care program started in 2003 to help children to understand the petrochemical industry. Also the chemistry frontier festival is held for high school students to motivate them, and various seminars are held to share information.

5.5 Malaysia Petrochemical Industry

5.5.1 Malaysian economy experienced a strong resumption of growth in 2010 with an expansion of 7.2%. Growth was driven mainly by robust domestic demand, with strong expansion in private sector activity. Meanwhile, the public sector continued to support the domestic economy through the implementation of programmes to further enhance the country's infrastructure and the public sector delivery system.

5.5.2 Robust consumer spending was reflected in the strong performance of major consumption indicators such as passenger car sales, retail sales and imports of consumption goods. Private investment rebounded strongly to register a double-digit growth of 13.8% in 2010 (2009: -17.2%). Capital spending expanded across all sectors following favourable domestic economic conditions and improvements in external demand.

5.5.3 The petroleum and petrochemicals industry is one of the leading industries in Malaysia. From being an importer of petrochemicals, Malaysia is today an exporter of major petrochemical products. A wide range of petrochemicals are produced in Malaysia, such as olefins, polyolefins, aromatics, Ethylene Oxides, Glycols, Oxo-alcohols, Exthoxylates, acrylic acids, Phthalic anhydride, Acetic acid, Styrene monomer, Polystyrene, Ethyl benzene, vinyl chloride monomer and Polyvinyl chloride.

5.5.4 Malaysia holds the world's 24th largest crude oil reserves. According to BP's "Statistical Review of World Energy 2008", Malaysia is also the world's 14th largest natural gas reserves with a capacity of 88 trillion cubic feet. Besides, Malaysia also possesses the world's largest production facility at a single location of liquefied natural gas (LNG) with production capacity of 23 million metric tonnes per year. Through efforts provided by the government and Petroliam NasionalBerhad (PETRONAS), Malaysia has attracted investors and major industry players such as Shell, ExxonMobil, Dow Chemical, ConocoPhilips, Kaneka, Polyplastic, Toray, Dairen, Mitsui, BP, BASF, Idemitsu, Titan and Eastman Chemicals. The rapid growth of the industry is mainly attributed to the availability of oil and gas as feedstock, a well-developed infrastructure, a strong base of supporting services, and the country's cost competitiveness, as well as Malaysia's strategic location within ASEAN and its close proximity to major markets in the Far East. The long term reliability and security of gas supply ensures the sustainable development of the country's petrochemical industry. Feedstock at competitive prices have made Malaysia a viable petrochemical hub in the ASEAN region attracting more than USD$9 billion in investments from leading petrochemical and chemical manufacturers.

5.5.5 There will be considerable potential for the export of higher value-added products, for example, petrochemical derivatives, to the People's Republic of China. Demand for commodity-type petrochemicals higher value-added products, such as fine and specialty chemicals, from other ASEAN countries from ASEAN countries, especially Cambodia, Lao PDR, Myanmar and Viet Nam, is expected to increase, in tandem with the growth of their economies. Demand for, namely Thailand, Indonesia and the Philippines, is also expected to increase. Malaysia has an advantage in that there are downstream industries using the products produced. Based on the present and future market trends, there is potential to create greater synergies, by increasing Malaysia's share in both the domestic and regional markets for petrochemical products. To sustain the competitiveness of the Malaysian petrochemical industry, value integration through inter-plant synergies is promoted. The development of petrochemical zones where petrochemical plants are clustered together has created a value chain, which ensures the progressive development of downstream petrochemicals activities.

5.5.6 In the case of Polyolefins and PVC, Malaysia has the excess capacity vis-à-vis demand and exported 350 KT, 190 KT, and 230 KT in LD, HD and PP respectively. Approx 300 KT of Imports was witness in LL. In PVC though surplus in supply over demand but due to removal of 5% ASEAN countries post AIFTA tariff effective 1 January 2010 lead to influx of resins and further compounded by strong Ringgit appreciation against USD.

5.5.7 Malaysia is currently the world's ninth largest consumer of all rubber, following China, USA, Japan, and the fifth largest consumer of natural rubber behind China, the USA, and Japan. Malaysia is a global player in the export of high quality, competitively priced rubber and rubber products to the international market. Due to the large quantity of planted rubber trees in Malaysia, the consumption of synthetic rubber (which is a petrochemical-based extraction) lags behind the consumption of natural rubber. This phenomenon happens as there are fewer producers of synthetic rubber in Malaysia. However, the consumption of synthetic rubber is increasing year by year due to the research and developments done by the related organisations in promoting and enhancing the usefulness of synthetic rubber in the market. Efforts have been made to improve efficiency, productivity, and new product development in the downstream activities to produce high value-added and high technology rubber products such as for engineering, construction, and marine applications. R&D is also required to comply with stringent standards and regulations imposed by export markets, particularly in the EU.

5.5.8 Malaysia's domestic Ethylene Glycols (MEG & DEG) market is anticipated to be stable until 2015. The stagnant market is due to no known new expansion / investment or new capacity planned to be built in Malaysia, as demand growth is forecast to be rather limited. Malaysia's only EG producer is OPTIMAL with the capacity of 380kta having local demand at 215kta, whereby the Reliance subsidiary consumes 84% of the total demand to produce Polyester. Meanwhile, other market segments such as Unsaturated Polyester Resin and Automotive are expanding very well. Nevertheless, these market segments consume very low quantity and will not be significant in driving future Ethylene Glycols demand.

5.5.9 Based on market analysis, the world Polyester demand is rapidly growing at 7 – 7.5% for the next three years and Asian demand is growing at a15% rate. This rapid growth had equally countered with new capacities in China, India and Middle East which are perceived to introduce additional 1.5 mil tonnes per annum of polyester supply. Eventually, this new market demand will gradually increase the demand of Ethylene Glycols in Asia.

5.5.10 The chemical industry is one of the leading industries in Malaysia. The industry is not only capable of fulfilling the nation's requirement of chemical products, but also exports to other countries. This is because Malaysia is endowed with huge amount of petroleum and palm oil resources. The industry has very strong linkages towards other sector such as automotive, electrical & electronics, and etc. As the chemical industry is a high-tech and capital intensive industry, the players are mostly multinational companies who have highly trained human resource for its research & development and operating activities.

5.5.11 Malaysia has the infrastructure and system in place for petrochemical manufacturers to compete favourably with regional players. Manufacturers based in Malaysia will also benefit from the access to a much larger Asia Pacific market. With China being a net importer of petrochemicals and its entry into the WTO will also open up new business opportunities for petrochemical manufacturers in Malaysia. The Malaysian government continues to implement measures to further enhance the business environment, infrastructure development, human resources support and the position of feedstock supply, in which all appear to be contributing factors for a stable and conducive investment environment for the future development of Malaysia’s petrochemical industry.

5.6 Singapore Petrochemical Industry

5.6.1 It has an open business environment, relatively corruption-free and transparent, stable prices, and one of the highest per-capita gross domestic products (GDP) in the world. Singapore GDP was 309 Billion USD in 2010.

5.6.2 Singapore could thus be said to rely on an extended concept of Entrepôt trade, by purchasing raw goods and refining them for re-export, such as in the wafer fabrication industry and oil refining.

5.6.3 Singapore's strategic locations on major sea lanes and industrious population have given the country an economic importance in South-east Asia disproportionate to its small size. The Singapore Government adopted a pro-business, pro-foreign investment, export-oriented economic policy combined with state-directed investments in strategic government-owned corporations.

5.6.4 Singapore is also ranked third in the World Economic Forum’s Global Competitiveness Report behind Switzerland and Sweden.

5.6.5 In 2010, Singapore was the third fastest growing economy in the world behind Qatar and Paraguay with a real GDP growth rate (constant prices, national currency) of 14.471%.

5.6.6 Singapore has a relatively small domestic market, and thus has to open its economy to external markets in order for the economy to thrive.

5.6.7 Singapore is also the only Asian country to have AAA credit ratings from all three major credit rating agencies – Standard & Poor’s, Moody’s and Fitch.

5.6.8 Singapore’s business freedom score is exceptionally high – it takes three days to start a business in Singapore compared to the world’s average of thirty-four days.

5.6.9 Singapore is manufacturing hub for petroleum & petrochemical products, pharmaceuticals& electronic wafers.

5.6.10 Singapore’s economy contracted more than expected in the second quarter due to weakening global demand and supply-chain disruptions caused by the Japanese earthquake in March.

5.6.11 Gross domestic product shrank an annualised 7.8%from the previous quarter. In the first three months of 2011, the economy had expanded by 27.2%.

5.6.12 The manufacturing sector was the main drag on growth with a 20.5% quarter-on-quarter contraction, largely due to a temporary output decline in the highly volatile pharmaceutical industry.

5.6.13 Electronics makers were also hurt by a slowdown in global semiconductor demand and a shortage of components brought on by the natural disasters which hit Japan in March.

*5.7 **Thailand Petrochemical Industry***

5.7.1 Thai economy is 24th largest economy in the world and 2nd largest economy in the South East Asia after Indonesia.

5.7.2 Thailand’s GDP growth rate was 7.8% in 2010 and is expected to be 3.5% in 2011 as a result of an expected slowdown in external demand and high base effects. Thailand ‘s GDP shall be around ~ 320 Billion USD with almost 40% dependency on exports .Thai petrochemical industry is around 20 billion USD contributing 6% to the GDP. Out of which almost 8 billion USD is from exports of petrochemical products.

5.7.3 A more challenging external environment will be compounded by the appreciation of the Thai baht due to Thailand's strong current account position and continued monetary normalisation by the central bank.

5.7.4 With low unemployment and growth in wages, there is a likelihood of strong growth from a broad range of domestic plastics consuming industries.

5.7.5 Generally, Thailand's polymer manufacturing industry enjoys high operating rates, with production consistently at 90% of capacity and exports performing strongly, although this is dependent on export demand, with the domestic market too small to soak up output.

5.7.6 Thailand has strong automobile industry which grew by 63% in 2010 with 1.6 million cars produced ranking it as 13th in the motor vehicle producing countries in the world. Experts predict that by the year 2015 Thailand will be one of the top 10 motor vehicle producing countries in the world.

5.7.7 Machinery and parts, vehicles, electronic integrated circuits, chemicals, crude oil and fuels, and iron and steel are among Thailand's principal imports.

5.7.8 The petrochemical industry began in Thailand about five decades ago, at a time when the industry was fully dependent on imports, and when all but 20% of economic activity was in agriculture. It was only towards the end of the 1970's, early 1980s, that the industry really began to take shape as a significant regional and global force. This was due in large measure to the discovery of significant reserves of natural gas in the Gulf of Thailand, which provide a source of higher value ethane, propane and butane, and other liquid gases. Truly Thailand's natural gas reserves have generated a leap forward for the petrochemical industry.

5.7.9 In the early stages, the government took the decision to concentrate its efforts on developing the upstream sector, with the cooperation of the private sector, while leaving downstream development solely to the private sector. This so called "first wave" of petrochemical industrial development lasted from 1980 to 1989. The second phase, which last from 1989 to 1995, saw increased liberalization and private sector interest, and the development of olefins and aromatics that resulted in a substantial reduction of imports. Currently in "the 3rd wave", 2004 to 2018, the focus is now on competitiveness, asset integration and strategic alliances for growth and added value. The petrochemical plan foresees considerable growth and opportunity for investors.

5.7.10 Thailand is no longer import dependent. Over the last 25 years, Thailand has become a net exporter in upstream petrochemical, polymer and plastic products, with the fast growing economy in China and ASEAN as its major outlets, and the United States and South America surging forward. The country has attracted global investments from blue chip corporations including Dow Chemical, ESSO, Mitsui Chemical, Mitsubishi Chemical, TPI, Siam Cement, and PTT to name a few.

5.7.11 Thailand is home to a strong downstream industrial sector, exporting more than 40% of major polymers to international markets.

5.7.12 In the near future, Thailand is expected to remain a net exporter of five major polymers - PE, PVC, PP, PS and PET.

5.7.13 The combined domestic consumption of the five polymers is forecast to rise from an estimated 3.2mn TPA in 2008 to 5.5mn TPA in 2015

5.7.14 This impressive expansion is supported by significant growth in such sectors as automotives, packaging, electrical and electronics, construction and agriculture.

5.8 ***Taiwan Petrochemical Industry***

5.8.1 The Taiwan GDP during current year is expected to be in the vicinity of 4.5%. Looking at the development of 2010, everything seemed to back to normal. The whole situation has been directing toward a better recovery.

5.8.2 The petrochemical consumption is directly proportional to the GDP growth, since petrochemicals are used not only in different phases of people's life, but also in a wide range of related industries. A booming economy may surely build up market strength for petrochemical products.

5.8.3 The foreign trade has been a driving motor for the Taiwanese economy advancement. As Taiwan is a country short in natural resources, the export trade has played a primary role in creating the national economic growth. In 2010 the total volume of export were seen a little leap, ranking 16th largest in the world, according to a preliminary statistics issued recently by the WTO. One thing worthy to note is that the petrochemical products have been accounting for about 30% of the total Taiwanese exports.

5.8.4 In the year of 2010 most of the Taiwanese petrochemical producers enjoyed normal business operations; the average plant capacity utilization was above 85%, and the profitability was fairly good. As reflected from the company performance, the industry has entirely gotten rid of the global economic recession. Taiwan is now the 9th largest petrochemical –producing country in the world; however, further capacity expansions have been restrained. Last year various progresses were seen. The industry carried out product upgrading, energy conservation, CO2 reduction, and the development of renewable energy as well as green manufactures. These progresses have been achieved through the joint effort of the government and the industry.

5.8.5 Taiwan's ethylene production amounted to 3.93 million MT in 2010, an all-time high figure and equaled to an operation rate of 98.3%. Naphtha crackers were nearly under full operation last year, although there were several shutdown maintenances and accidents. The per capita petrochemical consumption of Taiwan, as counted by ethylene equivalent, was 55Kg, according to a report. This is the highest level in Asian region.

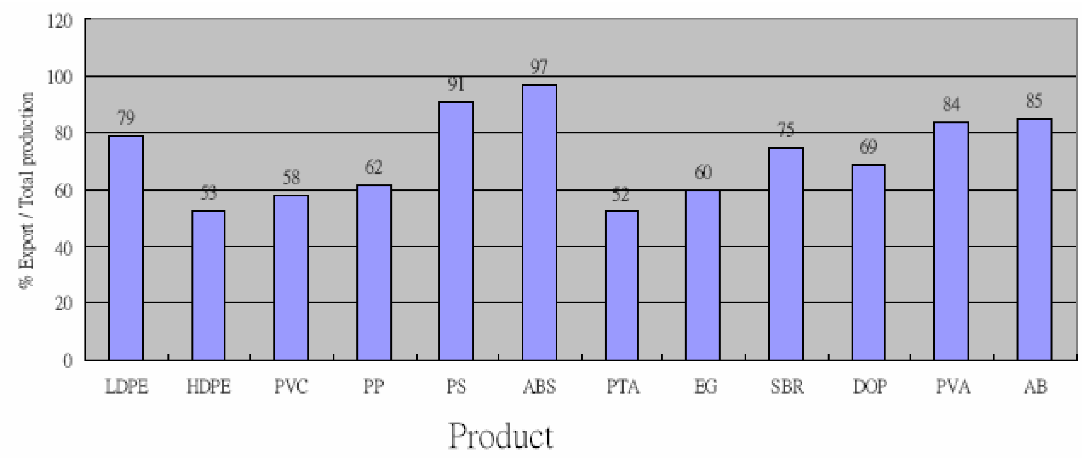
5.8.6 The total demand of upstream petrochemicals in Taiwan last year was 26 million MT, with a break down as: olefins 29%, aromatics 24%, plastics 22%, synthetic fibers intermediates 18%, synthetic rubbers 1%, and others 6%. The demand is consisted of domestic consumption and exports. Exports have been the major part of Taiwanese petrochemical supplies. Taiwan's petrochemical industry is characteristic of its high export ratio. Over 70% and even 90% of the commodity plastics and synthetic fibers materials produced in Taiwan was exported, mostly to

China. Quite a many of Taiwanese petrochemical firms set up production facilities in China and obtain raw material supplies from Taiwan. Accordingly, Taiwan has been among the biggest players in the regional petrochemical markets.

5.8.7 Taiwan's per capital annual consumption of petrochemical product (counted as ethylene equivalent) is the highest in Asia region. It is 54.7 kg / head, followed by Korea 82.4, Singapore 57.5, Malaysia 41.7, Japan 34.3, Thailand 23.5, China 18.5, Vietnam 8.0, Indonesia 5.1 and India 3.7, according to a research report released recently. The basic factor for such per capita consumption is said to be related to the population, the buying power, and the living standard.

5.8.8 Taiwan used to be a world processor, 30 year earlier than China .The reason behind the high export ratio of petrochemical raw materials nowadays is that a lot of the downstream processing plants have been out-moved because of labor cost. These processors have relocated their production facilities to overseas countries where labor supply is abundant and the wage is relatively lower. Taiwan continues to supply raw materials for their needs.

Figure 46: Production & Export



6 Indian Petrochemical Industry

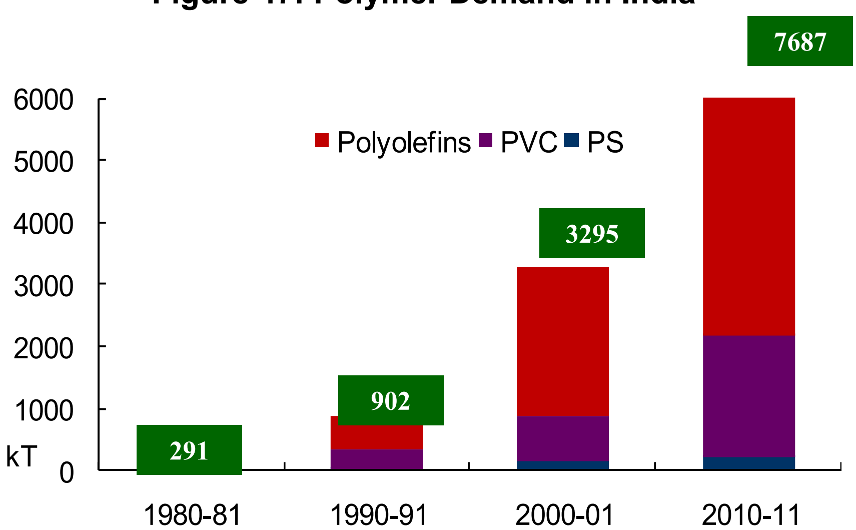
6.1 Genesis of Indian Petrochemical Industry

6.1.1 The Indian petrochemical industry is a relatively new entrant in India. It made a modest beginning with the first naphtha cracker set-up in the early sixties by Union Carbide India Ltd. at Mumbai with an installed capacity of ethylene of 20,000 tpa. This was followed by another naphtha cracker of ethylene capacity of 60,000 tpa by National Organic Chemical Industries Ltd. (NOCIL), at Thane. In 1978 the Indian Petrochemical Corporation Ltd (IPCL) then state-owned, commissioned a naphtha cracker with ethylene capacity of 130,000 tpa alongwith a large number of downstream plants at Baroda which gave impetus to the growth of petrochemical industry in the country.

6.1.2 The economic reforms initiated in 1991 brought major changes in the structure of the domestic petrochemical industry. Delicensing and deregulation allowed the market forces to determine growth and investment. Liberalization of trade policies and lowering of tariffs geared the domestic industry to align itself with the global petrochemical industry. Taking advantage of liberalization, the Indian petrochemical industry invested approximately Rs.350 billion in the 1990s, raising the domestic polymer capacity from less than 0.5 million tones to the current level of over 4 million tones. Mega sized cracker complexes using the state-of-the-art technologies were set up and the ethylene capacity increased from 0.22 million tonnes in 1990 to 2.4 million tones in 2001

6.1.3 Post reforms in 1991 there was major investment in petrochemical capacities, which have tapered off by Year 2001-2002. Due to this major capacity additions import dependency has been brought down substantially saving the country foreign exchange.

Figure 47: Polymer Demand in India



6.1.4 In the new millennium, all the key segments of the Indian petrochemical industry have experienced what has been a distinguishing characteristic of the petrochemicals business cyclicality and wide fluctuations in performance. The initial years post 9/11 in the US, had been relatively lackluster for the various sub-sectors of the industry. Just when the industry's growth prospects were showing signs of improvement, the sub-prime crisis followed by the global economic slowdown dampened the growth prospects.

6.1.5 While sporadic new investments in the various petrochemical segments in India have materialized once the process of economic recovery set in and market sentiments improved in the last couple of years, those have essentially been intermittent occurrences rather than an across-the-board industry trend. Business environment in the petrochemicals sector and business outlook have improved and some of the planned projects like IOC petrochemicals complex, HMEL, expansions by GAIL and HPL, etc have fructified and some of the greenfield investments including PCPIRs are being pursued but without adequate support from the Government, realization of the full growth potential in all the key segments of the domestic petrochemicals sector is unlikely in the near future.

Table 52: Planned Investments

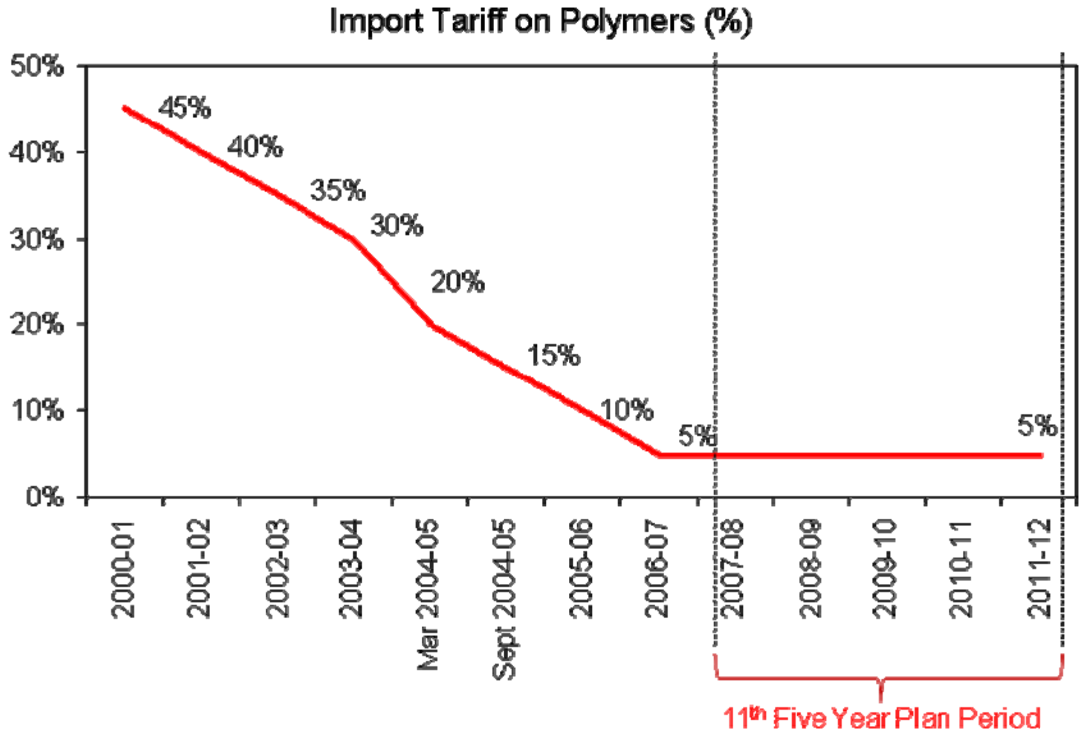
Company	Locations	Investment $ Billion
*ONGC Petro Additions	Dahej, Gujarat	2.7
*Mangalore Refinery	Mangalore, Karnataka	2.6
*IOC	Panipat, Haryana	3.1
*GAIL	Lapetkata,Assam	1.2
#HMEL	Bhatinda,Punjab	4.1
#Haldia Expansion	Haldia, West Bengal	0.3
#GMR	Kakinada, Andhra Pradesh	8.7
Essar	Vadinar, Gujarat	5.4
Reliance	Jamnagar,Gujarat	8.8

Table 53: Indian Polymer Industry Profile

Major Raw Material Producers	Nos.	8
Processing Units	Nos.	>20,000
Turnover (Processing Industry)	Rs. Cr.	85000
Capital Asset (Polymer Industry)	Rs. Cr.	55000
Raw Material produced	MMT	7.3
Raw Material consumed	MMT	8.5
Employment (Direct, Indirect / Downstream)	Million	3.3
Export value (Mainly Polymers)	USD Bn	1.9
Revenue to Government	Rs Cr.	>18000

6.1.6 **Import Tariff**: After liberalization, Import tariff in India were reduced on all products. Polymer import tariffs were reduced aggressively. Falling tariffs impacted polymer producers adversely. Producers have adjusted to low tariff regime. It had dual impact. One, the domestic producers became internationally competitive. Secondly, the domestic consumption in India has a healthy growth due to lower prices and converting industry could focus on product development with raw material availability improving.

Figure 48: Tariff Movement – 2000-01 to 2011-12



6.2 *SWOT Analysis of Indian Petrochemical Industry*

6.2.1 **Strengths**

- Strong domestic demand.
- Adequate domestic availability of naphtha and raw materials for the downstream processing industries.
- End-products markets widely spread out in sectors and geographic.
- World-class upstream integrated complexes for Polymer production.
- Supportive Government policies.
- Presence of a vibrant entrepreneur base.
- Advanced domestic technology and processes.

6.2.2 **Weakness**

- Inadequate availability of natural gas which prevents entry of new players for expansion.
- Zero import duty differentials between polymers and feed stocks.
- Lack of refinery and petrochemical integration (with reference to propylene/butadiene recovery).
- Majority of processing sector is still in sub optimal range. Low focus on value added exports of end products.
- Fragmented downstream absorption capacities.
- Inadequate infrastructure for exports.
- Inadequate availability of quality power and high cost of energy.
- High capital cost. (High CAPEX, cost of interest and utilities cost).
- Cyclical and volatile nature of business with fluctuating product prices affecting margins.
- Shortage of skilled manpower.

6.2.3 **Opportunities**

- Large and rapidly growing domestic market for end products.
- Large head-room for future growth (Indian per capita at – 7kg compared to 109 kgs in US, 32 kgs in Brazil and 29 kgs in China), due to favorable demographics, rising disposable income, development of rural marketing, growth of organized retailing, developments in agriculture, automobile, telecommunication, health care, etc.
- Rising labour costs in developed markets in plastic converting sector – an opportunity for India to expand capacities and export.
- Development of niche products for exports.
- Scope for increased value addition.
- Favourable trade agreement.

6.2.4 **Threats**

- Dumping by low cost producers.
- Trade deficit in plastic products rapidly rising.
- Negative public perception about plastics.
- Pipeline for technically skilled manpower relatively narrow.
- Low feedstock cost in Middle East (a fraction of Indian cost) for petrochemicals offering huge competitive advantage to producers in that area.
- Emerging low cost economies.
- Trade agreements with countries having less penetration potential in petrochemicals (i.e economies with highly exportable surplus in petrochemicals).
- Reduced rate of growth in domestic demand due to high inflationary pressures.

*6.3 **Competitiveness of Indian Petrochemical Industry***

6.3.1 Petrochemicals are derived from various chemical compounds, mainly hydrocarbons. These hydrocarbons are derived from crude oil and natural gas. Among the various fractions produced by distillation of crude oil, petroleum gases, naphtha, kerosene and gas oil are the main feed-stocks for the petrochemical industry. Ethane, propane, butane and natural gas liquids obtained from natural gas are the other important feed stocks used in the petrochemical industry. Olefins (ethylene, propylene & butadiene) and Aromatics (benzene, toluene & xylenes) are the major building blocks from which most Chemicals and Petrochemicals are produced.

6.3.2 Petrochemical manufacturing involves manufacture of building blocks by cracking or reforming operation; conversion of building blocks into intermediates such as fibre intermediates (acrylonitrile, caprolactum, dimethyl terephthalate/purified terephthalic acid, mono ethylene glycol); precursors (styrene, ethylene dichloride, vinyl chloride monomer etc.) and other chemical intermediates; production of synthetic fibres, plastics, elastomers, other chemicals and processing of plastics to produce consumer and industrial products. In addition building blocks (benzene, toluene, OX, PX, etc) are basic raw materials for manufacture of pesticides, dyes and dyes intermediate and pharmaceutical bulk drugs, etc.

6.3.3 Petrochemical products namely synthetic fibres cater to the clothing needs of mankind and are used in both apparel and non-apparel applications. Polymers find major applications in packaging for preservation of food articles, moulded industrial and home appliances, furniture, extruded pipes, electronics, telecommunication, aeroplanes, etc. Synthetic rubbers are used for making various types of tyres and non-tyre rubber goods and supplement natural rubber. Surfactant intermediates used in detergents and surfactants.

6.3.4 Petrochemical downstream processing units are major contributors to employment generation and entrepreneurial development, thereby serving a vital need of the economy. Starting from the raw material production to conversion into finished products, the employment potential (both direct and indirect) is generated in a cascading manner, which is currently estimated at over one million.

6.3.5 Petrochemicals industry consists of upstream integrated naphtha / gas cracker complexes which are technology intensive and operating with state-of-the-art technology and economic scales of operation. Downstream plastic processing industry is fragmented spread throughout the country. Some of the units are operating with sub-optimal capacities.

6.3.6 The competitiveness lies in the strong domestic demand from the downstream consuming sectors, which are widely spread out in sectors and geographic. Plastic processing industry is dominated by SMEs with substantial portion with first generation entrepreneur. The rising labour costs in developed markets in plastic converting sector offers an opportunity for India to expand capacities and export.

6.3.7 The planned capacity additions in upstream petrochemical industry are by the crude oil refineries for integrating refinery petrochemical complexes to increase the hydrocarbon value addition and to remain cost competitive. In case of downstream plastic processing industry the technology is in-built in the processing machinery. Major Plastic Processing international companies have put up fabrication shops. There are domestic plastic processing machinery manufactures that meets the international standards and are also exporting plastic processing machinery. Multinational companies are entering Indian markets through mergers & acquisition

6.3.8 Downstream plastic processing industry is dominated by tiny, small and medium scale industry. Large number of first generation entrepreneurs has entered the plastic processing sector. The increase in investment limits in the small scale industry up to Rs 5 crore in plant and machinery has contributed significantly to the upgradation of this industry.

6.3.9 Trade: The trade in polymers over a period of time has become relatively easy. Even small parcel of 20-50 Mts can be imported. Large number of traders present in India in polymer trade. India is already short in PVC, LDPE, Metalocene PE and Engineering Plastics. Large quantities are being imported.

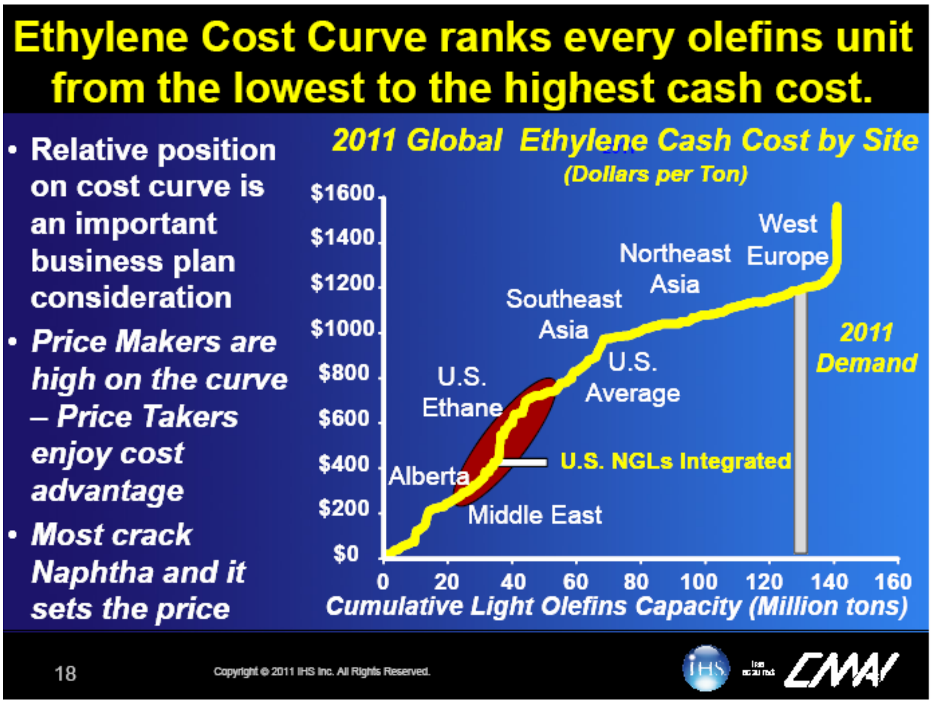
6.3.10 Prices: Market prices are determined based on SEA prices plus import duties (Presently 5% for polymers). As imports are relatively free, domestic producers have to price their products in line with the prices prevailing in SEA region. As end product prices are market driven, most producers irrespective of their cost of production have to maintain the selling prices in line with market prices. This results in varying margins for producers having different feedstocks.

6.3.11 In Middle East, one striking feature is that the gas is supplied at highly subsidized price. Also, in the Middle East crackers, the cracking of gas into ethylene has huge cost advantage and these crackers are integrated to add value to ethylene to yield polymers, mono ethylene glycol etc. These Middle-East producers sell their products at the market driven prices which are essentially in line with naphtha-based product price band. This enables them to reap higher profit margins. This creates significant challenge to the naphtha-based cracker elsewhere in the world.

6.3.12 As far as the profitability of Indian companies is concerned, they will be somewhere in the middle of the cost curve and margins will be moderate compared to Mid East producers. Major impact will be felt by companies who are at the top of cost curve like some of the European producers.

6.3.13 In the figure given below, on the X axis is global cumulative capacity of individual plants and on the Y axis is the cost of production from lowest to highest. The chart indicates that global C2 capacity is app 142 MMT and the cost of production varies from $ 40-50 PMT to as high as $ 1500 PMT. Towards lower end are Mid East and US ethane based crackers and towards higher end are NE Asia and WE crackers.

Figure 49: Ethylene Cost Curve Rank



6.3.14 **Price makers** - In case the global demand is app 130 MMT, theoretically crackers which add upto 130 MMT will produce to meet the demand and price will be set by cost of production of those which are towards the higher end and will have lowest margins. They become the price makers in the market. All those crackers whose cost of production is more than market price will have to shut their operations.

6.3.15 **Price Takers** - On the other hand the producers at the lower end of the cost curve, take the prices set by naphtha based producers and enjoy highest margins. They do not sell on cost plus basis. This ensures that Cracker in India which are somewhere in the middle, will have moderate margins and will survive and will not be effected by low cost of production of Mid East producers. Mid East producers will have higher margins as their capacities are limited and cannot meet global demand.

6.4 ***Polyethylene***

6.4.1 Ethylene is the monomer for manufacturing Polyethylene. Polyethylene is broadly classified into High Density Polyethylene (HDPE), Linear Low Density Polyethylene (LLDPE) & Low Density Polyethylene (LDPE). Historically ICI Scientist produced polyethylene by accident while studying the relation between Ethylene & Benzaldehyde.

6.4.2 **High Density Polyethylene**

6.4.2.1 High Density Polyethylene is predominantly linear structure, closely packed with density of 0.960 – 0.980 gram/cm3, crystalline as high as 95% and a melting point as high as 138.5.c.

6.4.2.2 Currently High Density Polyethylene is showing a growth of 10-12%. It finds its major application in Raffia, Blow Moulding, Film, Pipes and Injection Moulding. Consumption wise it is in order of HD-Film GP Blow Moulding, Raffia, Pipe, have the major share.

6.4.2.3 Large and Medium Blow Moulding containers, Pipe, General Purpose BM containers are currently the leading growth sectors.

Figure 50: PE Flexible Packaging

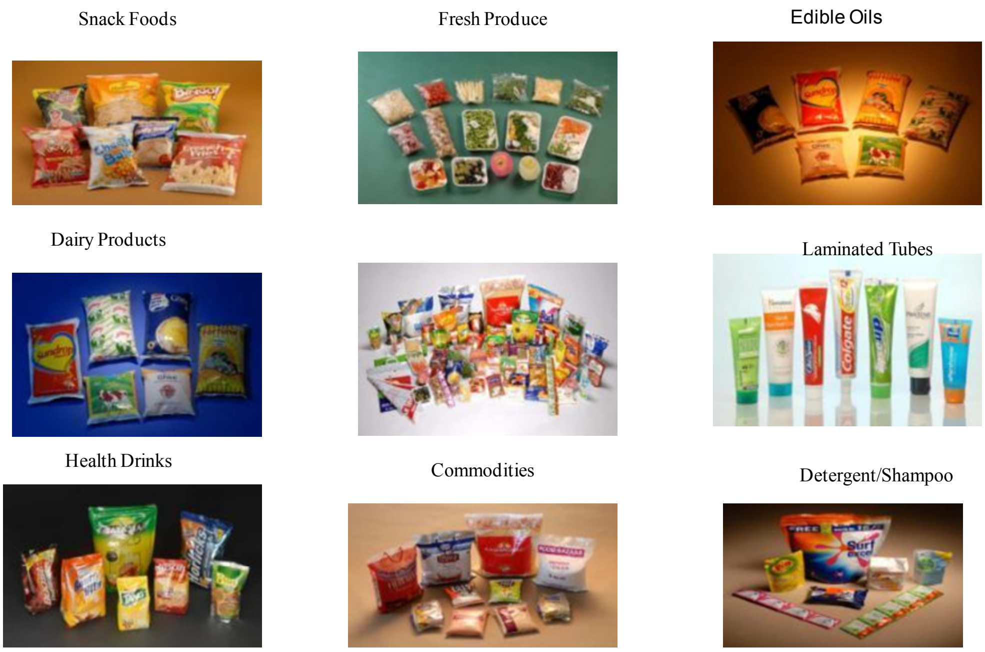
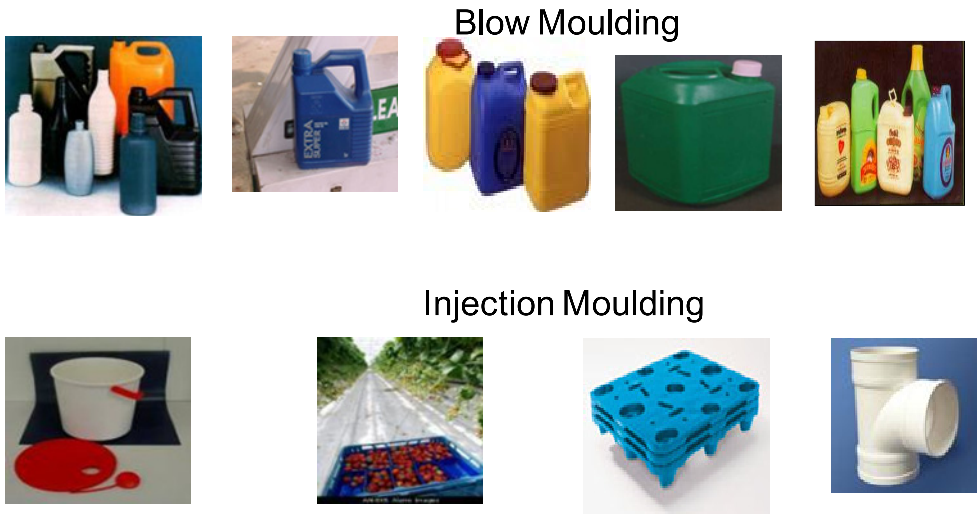


Figure 51: PE Blow Molding/Injection Molding



6.4.2.4 Global capacity of HDPE (2010) was close to 40.8 MMT, with consumption close to 33 MMT. The capacity is growing at 4.5% & demand is seeing a growth of 2.9%.

Table 54: Sector - wise HDPE Industry Consumption 10-11

HDPE (Kt)	
Raffia+MF	269
GP Blow Moulding	282
Medium/Large Blow Moulding	131
HD/HM Film	329
Pipe	221
IM	216
Others	33
TTL	**1481**

6.4.2.5 The domestic capacity during the end of 10th plan was 1177 KT and by the end of 11th plan it is 1885 KT & an increase of 788 KT. The growth in capacity has been 9.9% & demand has increased by 10.9%.

6.4.2.6 We expect to see a capacity growth of 940 KT during 12th Five Year Plan & an increase in consumption from 1657 to 2573 KT i.e. by 916 KT. The capacity growth in PE (HD /LL) will mainly be from OPAL (510 KT) RIL – 550 KT (1460 KT from existing 910 KT), GAIL 620 KT (1120 KT from 500 KT), though the major share of it will be in High Density.

6.4.2.7 HDPE because of its unique properties and increased availability offers abundant opportunities for growth. There is a huge untapped potential for the sector like for e.g. by the dilution of JPMA , loose to packed packaging in Blow moulding containers , automotive sector, infrastructure , and in installing drinking water and sewerage system etc.

6.4.3 LLDPE - Linear Low Density Polyethylene

6.4.3.1 LLDPE is linear in structure. The branches are formed due to presence of co monomer. The co-monomer used is Butene (C4), Hexene (C6) & Octene (C8). The low pressure used in manufacture of LLDPE does not allow the formation of large branches.

6.4.3.2 LLDPE finds its application in mono and multi-layered films, roto-moulding, wire & cables and high flow LL is used in master batch compounds etc.

6.4.3.3 Currently 59% of LL share comes from Butene film, followed by HAO & Metallocene LL film, roto-moulding, wire & cables, high flow LL grades.

6.4.3.4 Currently the fast growing sector in LL is Metallocene, followed by wire & cable & high flow grades. Metallocene LL grades are fast moving due to its properties like better strength, high dart, higher line speed, better sealing, downsizing of the film etc.

Table 55: Sector - wise LLDPE Industry Consumption 10-11

LLDPE (Kt)	
Butene Film	568
HAO Film	113
Roto Moulding	112
Extrusion Coating	84
High Flow	91
Others	13
TTL	**981**

6.4.3.5 The global capacity of LL in (2010) was 27.7 MMT though the demand is 20.8 MMT. The capacity has been increasing by 6.3% & demand by 3.2% in last five years.

6.4.3.6 Domestic capacity has increased by 601 KT in last five years i.e. from 591 KT (2006-07) to 1198 KT (2011-12). The growth in capacity has been 14.9%.

6.4.3.7 Demand has grown from 631 KT (2006-07) to 1198 KT (2011-12) during the period i.e. an increase of 13.7%.

6.4.3.8 Demand is likely to increase in 12th Five Year Plan from 1319 KT to 2076 KT i.e. a growth of 11.6%. It will be met by coming capacities of OPAL & expansion plan of RIL/GAIL.

6.4.3.9 LLD is the major constituents of flexible packaging growing at more than 17%.Key end uses of flexible packaging being lamination, edible oil and milk.

Figure 52: mLLD Application

6.4.4 Low Density Polyethylene – LDPE

6.4.4.1 LDPE is predominantly a branched polymer. The properties depend upon the frequency and the length of branches.

6.4.4.2 LDPE helps in processibility, has excellent transparency & good sealing properties & low glass transition temp. Due to its inherent strength, LD is extensively used as a blend with other polymers.

6.4.4.3 LDPE finds its application in general purpose film, heavy duty film, liquid packaging, injection moulding, extrusion coating, wire & cables, adhesive lamination.

Table 56: Sector - wise LDPE Industry Consumption 10-11

	LDPE (Kt)
GP	99
HD	49
MP	56
EC	64
IM	16
W&C	8
AL	18
Others/Pharma	15
TTL	**325**

6.4.4.4 The major application wise share is in the order of general purpose film, extrusion coating, milk packaging, heavy duty, injection moulding, wire & cables & others. Flexible Packaging constitutes 84% of the LD consumption.

6.4.4.5 The growing sectors are general purpose film, heavy duty, milk packaging, injection moulding sectors, adhesive laminates.

6.4.4.6 The global capacity of LDPE is 22 MMT and the demand is 18.7 MMT. The capacity & demand for last five years have grown 1.9% & 1.1% respectively.

6.4.4.7 Domestically there has been an increase in demand of 9.9% from 2006-07 to 2011-12 from 253 KT to 405 KT. The capacity has remained the same i.e. 205 KT. Excess demand over & above capacity is being met by Imports. The major imports are from Basell, Qapco, Sasool, Tasnee.

6.4.4.8 It is expected that demand will grow at 8.1% during 12th plan period i.e. from 438 KT to 597 KT. M/s RIL has been contemplating to put up the plant of LD (400 KT) at Jamnagar.

6.5 ***EVA***

6.5.1 Ethylene Vinyl Acetate is manufactured from polymerisation of Ethylene and Co-monomer (Vinyl Acetate/Ethyl Acrylate/Acrylic Acid/Methyl Acrylate).EVA is the most popular ethylene copolymer. Vinyl Acetate (VA) content in EVA varies from 9% to 40%.The increase in VA content improves the properties like flexibility, ESCR, compatibility, filler acceptability, X-likability adhesion. etc.

6.5.2 EVA due to its flexibility for various processing techniques like (Foaming, Moulding, Coating, blending, extrusion) makes it useful for broader application range.

6.5.3 Resin properties which makes it unique and useful are: very high low temp impact strength, good elasticity & resilience, high resistance to flex cracking & high ESCR, excellent clarity and gloss, good resistance to weathering.

6.5.4 Global demand for EVA copolymers was 2.8 MMT in 2009 and is expected to grow @ 5.6% from 2009 to 2015.The growth of EVA was 9% as against the 0.7% growth of LDPE (2004-2009) and the average price delta of $ 283/ton was witnessed (last 10 years) over LDPE..North America & AP (including Japan) constitute – 82% of total market.

6.5.5 Asian economies key driver behind an increased global demand for EVA with the Chinese economy being the leader, followed by India and

South Korea. Shift in manufacturing of footwear to Asian countries like China has created a demand growth in the Asia pacific region.

6.5.6 EVA consumption grew in India @ 18% (2004-2010). Market is expected to grow from 116 KT (2010-11) to 200 KT (2016-17). Significant growth of EVA has been possible due to tremendous technological developments in shoe manufacturing technology by IM process. Apart from footwear (shoes, slippers, beach sandals, etc) market other applications like film; HMA are also witnessing a healthy growth. Emerging sector "Solar Film" is highly technical and quality sensitive film produced from high VA and growing at a very healthy pace.

6.5.7 High growth in India gives immense opportunity for capacity expansion

6.6 Polypropylene

6.6.1 Polypropylene today is one of the youngest members of the polymer family after being invented some five decades ago in the year 1957. This wonder polymer became one of the most invented inventions touching our lives in every possible way almost 24*7.

Figure 53: PP Applications - Homopolymers

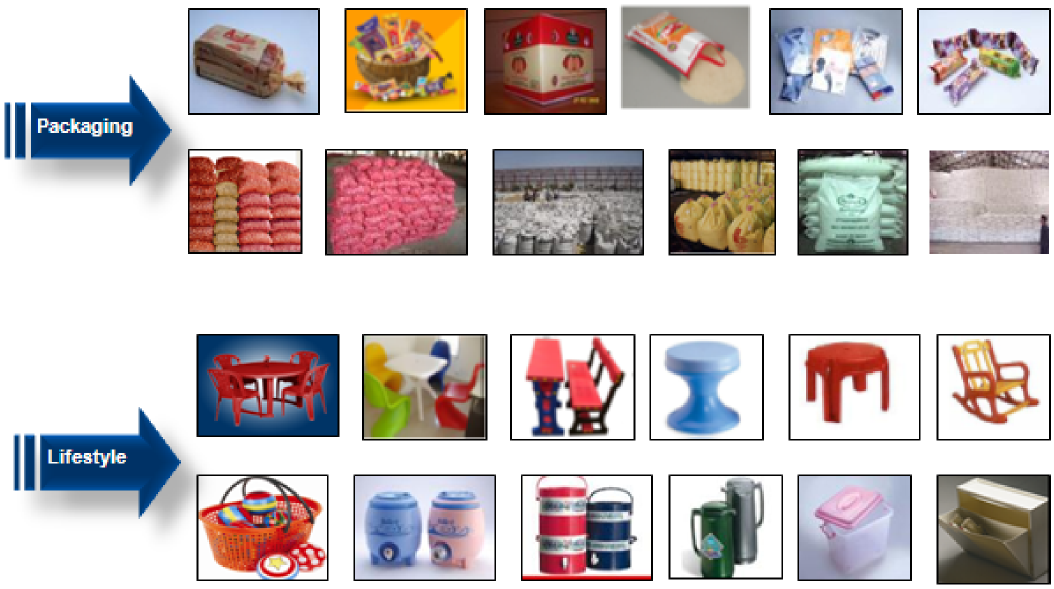


Figure 54: PP Applications – Copolymer

6.6.2 Globally PP has seen phenomenal growth over the last five decades to become a 48 million tonnes product with an overall capacity of 61 million tonnes with over 150 prominent Producers. Polypropylene Global demand witnessed a robust growth of 7.5% in 2010 and is expected to grow at a healthy AAGR of 5.7% up to 2015 well above the expected global GPD growth. Asia in line with its growing global stature has taken a dominant position in the PP Industry both in terms of demand and capacities. For all additions up to 2015, about 98% of incremental capacities are to come up in Asia reflecting the regions increasing global prominence.

6.6.3 The Indian Polypropylene story though a late starter has caught up with the global industry and over the past decade has grown at a phenomenal pace riding on India's growth story. At the start of the century the PP industry in India was at 839KT and was a small player in the global market. In a span of ten years the industry has now grown up over 3 times to 2638 KT. The future is expected to be no different with the industry expected to cross the 4 million tonnes mark by 2014-15 growing at a healthy CAGR of almost 11%.The average historical PP multiplier of 1.5 times of the GDP growth reflects the strong fundamentals driving PP growth in India. The current per capita global consumption of Polypropylene stands at 7 kg per person vis a vis 2.2 Kg per person in India. This presents a wonderful opportunity for Indian Plastic industry in the coming years.

Table 57: Sector-wise PP Industry Consumption 10-11

PP (Kt)	
RAFFIA	899
TQ	220
IM HP	483
ICP	423
RCP	92
BOPP	281
EXT	77
F&F	160
Total	**2635**

6.6.4 This has been backed up by significant investments by major players like IOCL, HMEL, OPal & BCPL with some capacities already commissioned and few scheduled to be commissioned in the next few years ensuring surplus availability for the Domestic Market. The Current domestic capacity stands at 3.7 million tonnes which is well over the current consumption of 2.6 million Tonnes. The new facilities will take the total Indian capacity to over 4500 KT by 2012-13 which is going to create surplus in the Domestic industry with Indian PP Exports reaching a peak of over 0.9 million tonnes by 2012-13. At the same time India has ambitious plans to significantly augment its petrochemical capabilities which include polymers through mega PCPIR's.

6.6.5 With this, stage is ready for Polypropylene upstream and downstream investment, by both Public and Private sector players, Indian Polypropylene Market is poised to grow at healthy double digits rates far surpassing the global growth rates.

6.7 PVC

6.7.1 The world's most versatile plastic had a rather humble beginning: A rubber scientist during the early 1920s stumbled onto a new material with fantastic properties during his search for a synthetic adhesive. Waldo Semon was intrigued with his finding, and experimented by making golf balls and shoe heels out of the versatile material called polyvinyl chloride, or Vinyl or PVC.

6.7.2 Soon after his discovery, PVC-based products such as raincoats, shower curtains and insulated wire hit the market. PVC today is recognized as 'an infrastructure plastic' finding applications in pipes, conduits, ducts, wire & cables, flooring, windows & doors and roofing etc. It is also used in many other sectors including automobiles, medical & healthcare, packaging, sports & leisure.

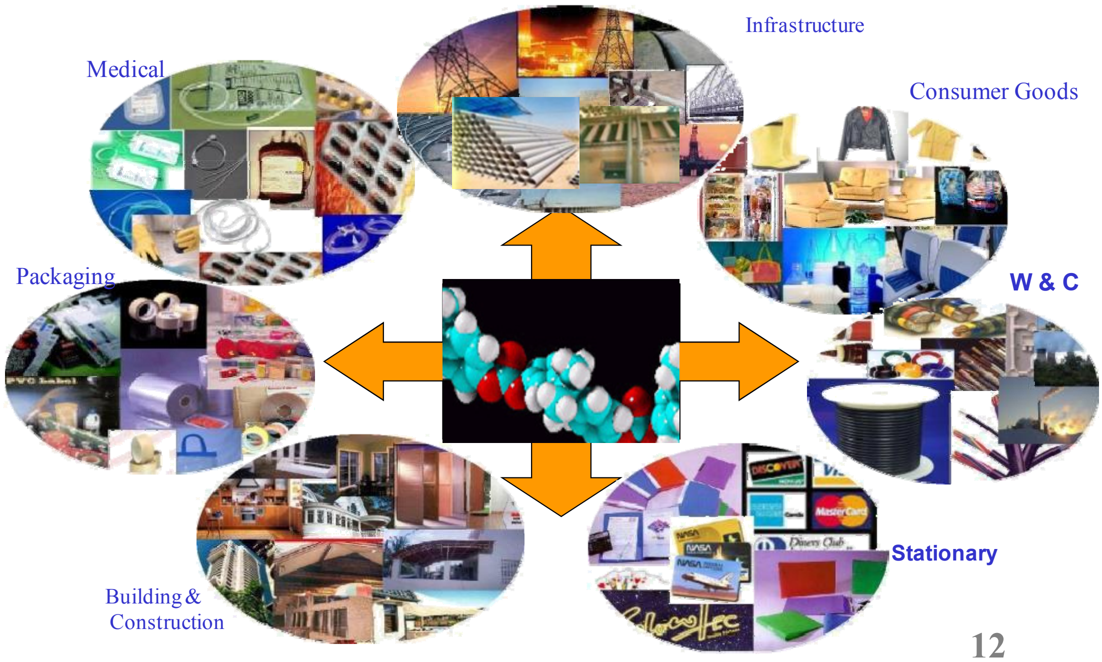
6.7.3 Indian PVC manufacturing is now 60 years old. In the year 1951, Calico started the first PVC plant in Mumbai with a production capacity of 6 KTA. Today the capacity has increased many folds to 1.3 MMTA with Chemplast Sanmar, DCM Shriram Consolidated, DCW, Finolex and Reliance Industries contributing to the same. Vivanta group has recently announced their entry in PVC manufacturing with a capacity of 240 KTA which is supposed to be operational by 2013.

Table 58: Sector-wise PVC Industry Consumption 10-11

	PVC (Kt)
Pipe- WS	594
Pipe- Irrigation	372
Pipe- Sewerage	163
Pipe- Plumbing	155
Pipe- Flexible	51
Pipes Total	**1335**
Wire & Cables	124
Films	92
Calendered Products	135
Sheets	21
Fittings	63
Profiles	58
Foot wear	43
Blow moulding	3
Others	15
Total	**1889**

6.7.4 However the consumption at 1.9 MMTA is resulting in almost 600 KTA being imported from different parts of the world. There are 2000+ processors converting this PVC into various end use applications in the country.

Figure 55: PVC Applications



6.7.5 Pipes continues to be the biggest end use sector with a share of ~ 70%, other sectors being calendered products, wire and cables, films & sheets, profiles, footwear and medical & healthcare.

6.7.6 PVC demand in the country is increasing @ ~10% which is more than twice compared to the world average of 4%. Heavy investments by the Government in infrastructure projects and focus on increase in irrigational land are the main growth drivers for the increased consumption of PVC. Funding by various International Agencies such as World Bank, Asian Development Bank for water management projects in the country is also creating huge potentials for PVC.

6.7.7 Green Building concept is increasingly being accepted in the country. Indian Green building Council, TERI Griha, and Bureau of Energy Efficiency are working towards green construction activities with usage of materials that save energy at all stages. PVC is known to save energy during the entire life cycle. Besides; products like windows, doors, partition, wall paneling false ceiling, and furniture when made in PVC, save natural resource like wood which would help in saving fast depleting forests.

6.7.8 Knowing the fact that the development focus has now shifted to Asia, world renowned window manufacturers have set up their fabrication units in India with future plans for backward integration to profile extrusion. Also special technologies in pipe manufacturing are being introduced in India. Indian processors have shown willingness to adopt new technologies and are keen on development of new products for widening the spectrum of applications of PVC products.

6.7.9 With this kind of demands, it is expected that the PVC consumption in the country shall be close to 30 MMTA by 2016-17.

6.8 ***Polystyrene – GPS /HIPS and EPS***

6.8.1 We have three types of polystyrenes with different application - General purpose Polystyrene (GPPS), High Impact Polystyrene (HIPS) and Expandable Polystyrene (EPS).

6.8.2 General Purpose polystyrene has excellent transparency, processability and its grades are used to cover a wide variety of applications such as disposable containers, cutlery, CD storage cases, co-extrusion to obtain gloss layer, toys, stationery and refrigeration components.

6.8.3 High Impact polystyrenes resins are specifically designed to meet the mechanical properties and productivity requirements of a wide variety of applications both in injection and extrusion / thermoforming processes. Typical applications include Electronics, household appliances, disposable containers, toys and refrigeration components.

6.8.4 Polystyrene foam also known as Expandable Polystyrene is prepared by suspension polymerization of styrene, and then adding foaming agent and white bead-like particles, with relative density of 1.05 are obtained. Thermal conductivity is low. EPS is polystyrene (PS) is a rigid foam honeycomb material with good insulation and vibration absorption, high compressive strength, very light weight and resistance to moisture, its uses include building insulation and sound insulation, sidewall, and within the walls of the Cover, packaging materials and disposable containers.

6.8.5 Polystyrene current capacity is of 472 KT that can swing between GP and HIPS production. There are three producers in India i.e. Supreme PC (272 KT), BASF (100 KT) and LGP (100 KT). Production has been about 305 KT.

6.8.6 Domestic supplies are 275 KT, plus there are imports of (10 KT). The current domestic demand is 285 KT and exports are in the vicinity of 64 KT.

6.8.7 By the end of 12th five year plan we expect the demand to be in the vicinity of 453 KT with a growth rate of 11.9%.

6.8.8 PS end use is mainly into the “Electronics / Appliances” sector, which accounts for almost 60 percent of total demand. This sector is forecast to have growth rate of 8-9% per year. Export of PS destinations have been West Europe, Africa, and the Middle East

6.8.9 One reason why PS demand in the Indian Subcontinent has been below expectations is the competition from other polymers, mainly polypropylene in both packaging and durables, primarily due to cost reasons.

6.8.10 Expandable Polystyrene current capacity is in the vicinity of 168 KT from a level of 109 KT last FY. There are three major producers in India i.e. Supreme, BASF and LGP. M/s Supreme has been expanding by takeover and adding new capacities.

6.8.11 Current supplies from domestic route are 81 KT, plus there are imports of (11 KT). The current domestic demand is 92 KT and exports are in the vicinity of 9 KT.

6.8.12 By the end of 12th five year plan, we expect the same to be in the vicinity of 145 KT with a growth rate of 11.5%.

6.8.13 Future demand growth is expected with strong performance in the packaging sector. India's low-cost labor pool has been touted as one of the causes for manufacturing capabilities moving to India, which has supported the largest polystyrene end use of "Electronics / Appliances." This large PS end use consumes EPS through the packaging sector, making packaging the largest sector for EPS.

6.8.14 The table below summarises list of consumer end products produced from five commodity plastics.

Table 59: Polymers & Corresponding Plastic Products

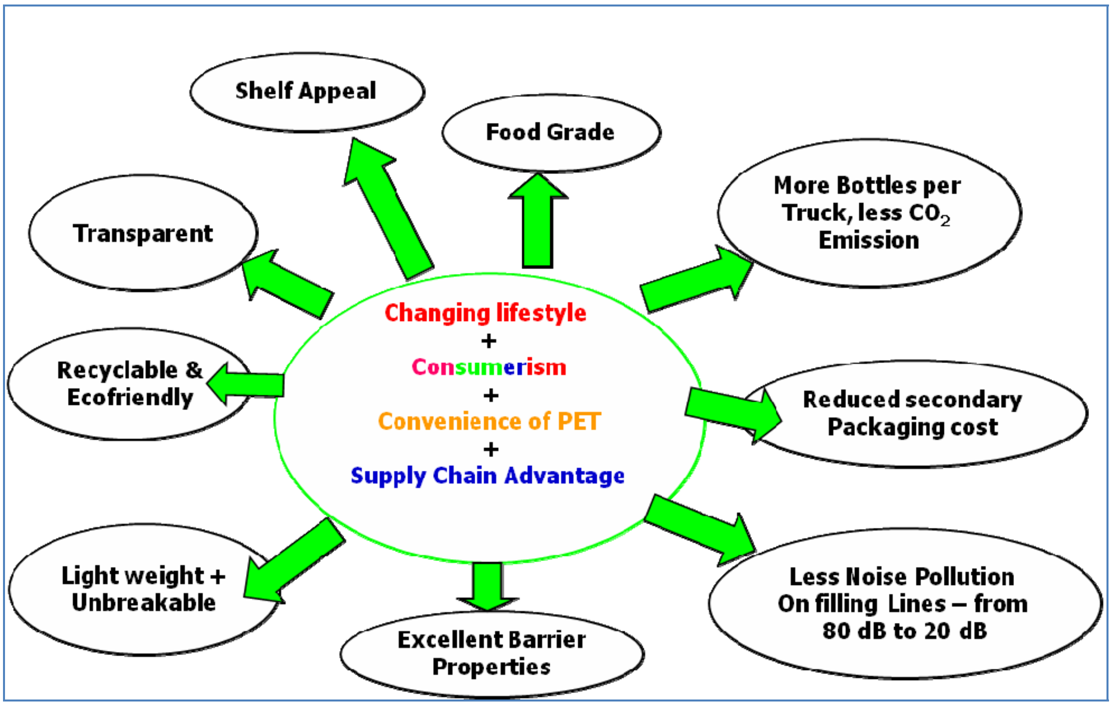
LD/LLDPE	HDPE	PP	PVC	PS
Cast & stretch cling films	Raffia/ Monofilaments	Raffia/FIBC	Irrigation pipes & fittings	Thermocol
Mono/ Multi layer films	Crates	Fish nets	Wire and cables	Foam
Wires & Cables	Multi layer films	Buckets, Tiffin boxes	Floorings/Tiles	Refrigerator trays
Water storage tanks	Water Conveyance pipes	Automobile bumpers	Shower curtains	CD/DVD cases
House wares	Pesticide bottles	BOPP films	Blister films	Structural insulation
Carrier bags	Woven sacks	Washing machine tubs	Profiles & Builders' ware	Bottles
Furniture	Caps & closures	Leno bags	Footwear	Disposable cups/ cutleries
Milk Packaging	Pallets	Fibres & Filaments	IV bottles & blood bags	Smoke detectors
Detergent Packaging	Thin wall moldings	Syringes	Bag liners	Films

6.9 *PET*

6.9.1 Polyethylene Terephthalate (PET) is thermo plastic polyester. PET, the material used for the manufacturing of the plastic beverage bottles is of high strength and high barrier material. Pepsi-cola was the first company to commercially introduce its beverages products in PET.

6.9.2 PET containers when properly manufactured, offer excellent clarity and gloss, toughness and impact resistance, chemical resistance, low gas permeation, good process ability and good dimensional stability.

Figure 56: Why PET?



6.9.3 PET is used for the production of bottles, sheet, strapping and injection moulded products. PET bottles are used for packaging wide range consumer products such as all types of Beverages including alcoholic, Edible Oil, Pharmaceutical formulations, Agro chemicals, Personal and Home Care etc. PET is also used for non-bottle applications such as thin/thick thermoform able sheet, dual-oven able crystallised PET (CPET) containers injection moulded components, fastening straps etc.

6.9.4 Building blocks for PET is granular form Purified Terephthalic acid (PTA) & mono ethylene glycol (MEG) are some of these building blocks used for manufacturing PET It is a condensation polymer made by continuous melt-phase polymerization process (CP) followed by Solid State Polymerization (SSP). In the past, it was manufactured either by DMT or PTA route:

1) DMT Route (Di Methyl Terepthalate) DMT+MEG = PET Polymer
2) PTA Route (Purified Terephthalic acid) PTA+MEG = PET Polymer

6.9.5 DMT is seldom used for PET now a day. It is manufactured using PTA to help achieve better quality .and consistency.

6.9.6 **Injection Moulding of PET** is becoming more prevalent in today's market place. PET can be best injection moulded into parts with wall thickness of up to 4.0 mm.

6.9.7 **The Stretch Blow Moulding** process is used to convert the injection moulded preform which is of amorphous structure to a specific bottle design of bi-axially oriented structure. To achieve the best bottle performance from a preform, it must be stretched by its natural amount both in longitudinal and transverse direction. This means for any desired bottle shape, preform must be specifically designed. The natural amount of stretching which need to be applied to amorphous PET is of the order of 10-12 times, resulting in a thickness reduction of 10 times between preform and bottle blown at 35-40 bar under controlled temperature conditions..

6.9.8 **The concern for Recycled PET (RPET)** is continuously growing in recent times. PET bottles, which form the major market of PET packaging resin (94 %), are the major concern from the point of recycling. More than 90% of PET is consumed in food packaging with drinks / beverages forming almost 80%. Since drinks and beverages are consumed mostly in residential houses, restaurants, stadia, railway stations, airports, entertainment venues and other public places, the importance of organized collection and recycling of post-consumer PET bottles need not be over-emphasized.

6.9.9 The PET bottle is 100% recyclable and most eco-friendly in nature. The need of the hour is proper handling system at all stages. The end-consumers should take care to remove the cap and label from the used PET bottle before disposing it off and also should not throw the empty bottles in a public place. In order to ease the handling at different stages, the PET bottle should be 'flattened' and baled before sending it to the intended area of usage.

6.9.10 Recycled PET is becoming alternative for PET packaging options today and is getting serious consideration by the packaging world. There is a growing awareness among consumers towards their environment obligation in individual capacity and a marked preference thus for recycled content packaging.

6.9.11 **PET Consumption** - Global average PET consumption is 2.13 kg/capita. While consumption in USA, Mexico & Italy is as high as 8.0

kg/ capita, Indonesia, India & Philippines are still in the lowest quadrant with consumption less than < 0.5 kg/ capita.

6.9.12 **Global Demand of virgin PET** has observed a phenomenal growth rate. Demand for 2011-12 is estimated 16.5 MMT at CARG 7.7% over last year. For 2016-17 demand is projected as 23.2 MMT with CARG of 7.1% in next 5 yrs. And further down the line demand is estimated to reach 30 MMT by 2021-22 with CAGR of 6.5%.

6.9.13 **Capacity Growth** - Capacity for 2010-11 exit rate is 19.3 MMT. Projected capacity for FY'11-12: 20.6 MMT; FY'16-17: 29.7 MMT; FY'21-22: 34 MMT. In next 5 years

6.9.14 **INDIAN MARKET**

Consumption

6.9.15 PET consumption in India is growing rapidly. Strong fundamentals for growth lies within robust GDP growth rate, steadily increasing urbanization, improving affluence among middle class population, change in youth life style, boom in organized retail and inorganic consumption growth through non- conversion of non- PET. In 1995, per capita consumption was only 0.01kg vis.a.vis 0.30 kg in 2010.

6.9.16 Predominantly PET consumption in India is driven by Beverages, Health Care, Personal Care, Agro Chemicals, Cooking oil, Confectioneries and Non- bottle segments

Demand

6.9.17 In domestic market, beverages mostly covered Mineral water, Fortified water, flavored water, Sparkling water, Juices, Coke & Pepsi Cola and other alcoholic drinks. Projected consumption of PET in this segment for 2011 is 280 KT and expected to grow by 30%. For FMCG, Pharma & Agrochemical sector, current consumption is 190 KT with a vigorous growth of 25%. In non- bottle segment e.g sheets, straps lamipack, punnets & blisters presently 100KT PET is consumed with a steady growth rate of 25%.

6.9.18 India's domestic demand is growing with CARG 25.5% in last 5 years, increased from 174 KT to 542 KT, and projected as 1319 KT by FY 2016-17 with a CARG of 19%. By 2021-22, domestic consumption is expected to touch 2614KT. It is growing with a multiple of 3.3 to GDP growth rate in last 5 years.

Capacity Growth

6.9.19 In last 5- years, domestic capacities increased from 578 KT to 814 KT with a CARG% of 7%. SAPL & JBF both announced to add 200 KT each by 2012-13. Even if any of one of above capacities will commission by 2013 & RIL capacity of 648 KTA will become fully operational by 2014.

6.9.20 Unless there is further capacity addition, India will be a net importer of PET by 2021-22 with current trend of growth. With so much certainty, domestic PET industry in India is poised for an exponential growth.

6.10 ***Polycarbonate***

6.10.1 Polycarbonate is a high performance engineering resin which demonstrated phenomenal growth during the 1990s averaging close to 20 percent per year largely due to its use in optical media applications - primarily the production of CDs and DVDs. Today, polycarbonate applications have developed extensively into many different areas, which is an important factor for an industry which can no longer rely on growth from optical media for the long term development of the business. This is because optical media applications are increasingly superseded by other technologies, such as mp3 and mp4 files, and higher internet bandwidth allowing the downloading of music and movies.

6.10.2 India is home to Moser Baer, one of the world's leading producers of audio CDs and DVDs. The market for these products is large in India and is expected to grow, given the availability of Bollywood movies on DVD and Blu-ray discs in the domestic market at prices that are competitive with unofficial versions. Moser Baer consumes around 70 percent of the region's demand.

6.10.3 Polycarbonate finds its application in Sheets/film, Automotive (window and non window), optical media, Appliances, Housewares, Electronics/Electrical, medical, ophthalmic, construction, sports, recreational, packaging etc. As blends, it finds usage as auto-body in Europe and USA.

6.10.4 **Supply:** Despite the sizeable domestic demand, there is no domestic production of polycarbonate, so all material for domestic consumption is imported. There are a number of potential Cumene/Phenol projects being contemplated in the country, which have prompted consideration of associated Bisphenol-A (BPA) and polycarbonate capacity. However, analysis suggests the addition of polycarbonate to an integrated Cumene/Phenol project to be a very much bigger step. Currently 130 KT of Polycarbonate is imported into our country.

6.10.5 **Demand:** As the Indian economy continues to develop rapidly, it is clear that polycarbonate demand will increase from its current low base. Currently, the largest end use sector is optical media, which makes up over 45 percent of the region's polycarbonate demand but is in a global long-term decline. The other demand sectors, such as sheet/film, automotive, appliances / house wares and electronics / electrical, will drive future growth.

6.10.6 It is estimated that an average demand growth of 9-10 percent over the forecast period, despite an average contraction in optical media demand of 4-5 percent over the same period. As automotive production increases with both domestic and foreign investment, the Automotive (non-window) market is forecast to grow at an average rate of more than 14 percent over the next five years.

6.10.7 Entire demand is met by imports. By the start of 11th five year plan the country’s requirement was close to 50 KT and currently it is 130 KT of Polycarbonate and expected to be 210 KT by the end of 12 th Five year plan .

6.11 Acrylonitrile Butadiene Styrene (ABS)

6.11.1 ABS resins are well-established, high volume, amorphous engineering thermoplastics, which offer an excellent balance of heat, chemical and impact resistance with superior processing versatility. This product is the largest volume engineering resin and has a relatively mature market with average annual growth rates over the last 20 years of between five and six percent.

6.11.2 It is derived from Acrylonitrile, butadiene, and styrene either as such as graft polymer or SAN on Polybutadiene or as a blend of ABS plus SAN. Composition of the constituent monomers can be varied in order to alter the properties of the final resin. The advantage of ABS is that this material combines the strength and rigidity of Acrylonitrile and styrene polymers with the toughness of the Poly-Butadiene rubber. Resistance and Toughness are the most important mechanical properties of this product.

6.11.3 ABS finds its application in Buildings /Construction , Transportation, Electronics/Electrical , Appliances ,Alloys and other application like medical ,toys and recreational. ABS demand is expected to grow strongly, across all segments given rapid industrialization and growth of the auto sector. One difference between the two polymers (Polycarbonate and ABS) is that there is local ABS capacity. There is likely to be good growth and consumers will benefit from strong competition for the available business.

6.11.4 **Supply:** Current capacity in India is 120 KT. The major producer of ABS in India is INEOS ABS (formerly Lanxess, Bayer) with 80,000 metric tonnes of capacity and Bhansali Polymer with current capacity of 40,000 metric tonnes. The capacity utilization is 75% during current FY.

6.11.5 By 12th five year plan it is expected that Ineos is likely to increase their capacity to 300 KT and Bhansali Polymers to 75 KT. The stated objective is to continuously expand manufacturing capacities in India in order to foster the region's strong market growth.

6.11.6 **Demand:** In spite of a modest contraction from the recession, India is expected to see double-digit growth rates through the forecast period, averaging more than 10 percent per year. The country's market is characterized by high demand in pre-colored ABS and SAN grades, with a focus on consumer and industrial applications. The largest segments in this region are the transportation, appliance and electronics/electrical segments.

6.11.7 The current demand is close to 120 KT, the same is met by 85 KT through domestic players and 35 KT through imports. We export close to 5 KT. The demand is expected to reach around 200 KT by the end of 12th five year with a growth close to 11%.

6.12 ***Styrene Acrylonitrile (SAN)***

6.12.1 Styrene Acrylonitrile (SAN) - Styrene and Acrylonitrile monomers can be copolymerized to form a random, amorphous copolymer that has improved weather ability, stress crack resistance, and barrier properties. The copolymer is called styrene Acrylonitrile or SAN. The SAN copolymer generally contains 70 to 80% styrene and 30 to 20% Acrylonitrile. This combination provides higher strength, rigidity, and chemical resistance than polystyrene, but it is not quite as clear as crystal polystyrene and its appearance tends to yellow more quickly.

6.12.2 SAN has a high clarity with High Heat resistance and good chemical resistance besides good dimensional stability and food contact acceptability.

6.12.3 SAN finds its application in Electrical/Electronic, Automotive, Applications, General Purpose, Containers, Household Goods, Cosmetics and Compounding with ABS, Acrylics, etc.

6.12.4 **Supply:** The processors are the same as that of ABS, though in this case only two monomers are involved and they can manufacture both SAN and ABS. Current capacity in India is 120 KT .The major producer of ABS in India is INEOS ABS (formerly Lanxess, Bayer) with 80,000 metric tonnes of capacity, and Bhansali Polymer with current capacity of 40,000 metric tonnes.

6.12.5 By 12th five year plan it is expected that Ineos is likely to increase their capacity to 200 KT and Bhansali Polymers to 80 KT. The stated objective is to continuously expand manufacturing capacities in India in order to foster the region's strong market growth.

6.12.6 **Demand:** The country's market is characterized by good demand of SAN grades, with a focus on consumer and industrial applications.

6.12.7 The demand during current FY is likely to touch close to 83 KT, from a level of 66 KT during last FY. Imports in the country are close to 5 KT, with no exports. The demand is expected to reach close to 142 MT by the end of 12th five year plan with a growth envisaged close to 11%.

Table 60: Growth of Engineering Plastics

Type of Engineering Plastics	2006-07	2010-11	2016-17 E	Growth
Polycarbonate	50	130	210	15%
ABS	48	120	200	15%
SAN	33	83	142	16%
Polyamide	50	85	168	13%
PBT	20	25	50	10%
Poly Acetal	8	13	26	13%
M-PPO	2	3	6	12%
Others	5	8	16	12%
Total	**216**	**467**	**818**	**14%**

6.13 Synthetic Detergent Intermediates (Surfactants), LAB, EO

6.13.1 Surfactants are products used as detergents, dispersing agents, emulsifiers, wetting agents, foaming or anti-foam agents, and solubilizers. They also constitute the raw material for the formulation of household products such as fabric detergents, shampoos, housecleaning products, as well as industrial auxiliary products for facilitating work in the manufacture of textile, flotation agents for ore, metal working, etc. They are used in other sectors of industry such as food processing, metallurgy, pharmaceuticals and public works.

6.13.2 Linear Alkyl Benzene (LAB) and Ethylene Oxide (EO) are the major synthetic intermediates used in manufacture of detergents and surfactants.

6.13.3 Linear alkyl benzene (LAB), a basic petrochemical intermediate, is used for manufacture detergents. LAB is manufactured from N-parrafins extracted from kerosene & benzene. 0.85 MT N-parrrafins & 0.35 MT Benzene is required to manufacture 1 MT of LAB.

6.13.4 **Capacity:**The industry made a modest beginning in the late 70's, when IPCL commissioned the first LAB plant. Subsequently Reliance Industries Ltd (RIL), Tamil Nadu Petrochemicals Limited (TPL) and Nirma Ltd. set up facilities for manufacture of LAB. Indian Oil

Corporation Ltd (IOC) commissioned a plant of capacity of 120 KTA in August 2004 is the latest entrant. The current installed capacity of LAB in India is 530 KTA as shown in the following table.

Table 61: LAB Capacity in India

(In kt)	Capacity
Reliance	180
TPL	120
Nirma	110
IOC	120
Total	530

Source: CPMA

6.13.5 **Supply and Demand Growth**

Table 62: LAB Demand- Supply Balance in India

(in kt)	2007-08	2008-09	2009-10	2010-11	2011-12
Capacity	530	530	530	530	530
Production	472	423	435	460	454
Imports	56	74	113	130	143
Exports	98	83	95	100	69
Demand*	354	332	425	459	480
Y-O-Y Growth	7%	-6%	28%	8%	5%
CAGR					8%

Source: Industry

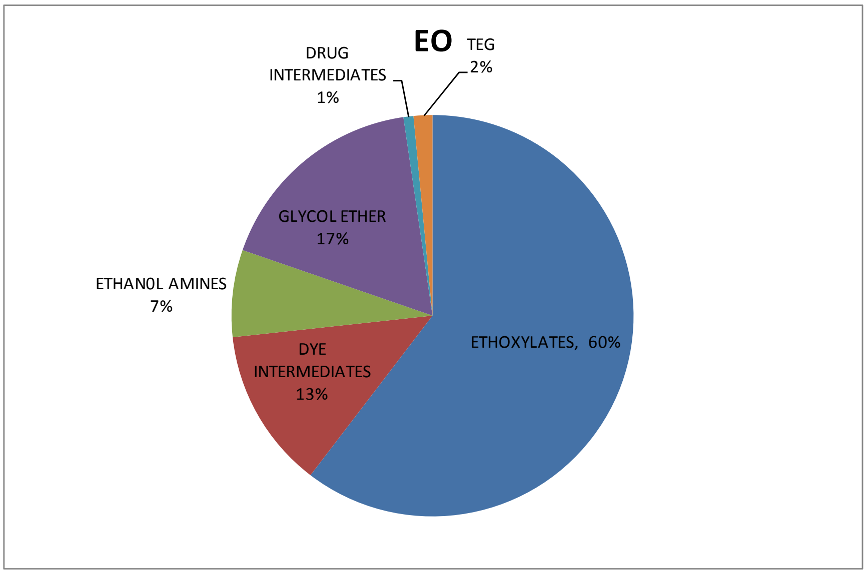
6.13.5.1 The demand for LAB has grown at CAGR of 8% during 2007-08 to 2011-12.

6.13.6 **Ethylene Oxide (EO)**

6.13.6.1 Ethylene oxide (EO) is a versatile intermediate used in the production of Surfactants and other derivatives such as glycol ethers, polyethylene glycol, polyether polyols, Dye Intermediates, Drug

Intermediates and ethanolamines. EO is produced by oxidation of ethylene. In India, cracking of naphtha/ natural gas fractions produces the bulk of ethylene. A small quantity of ethylene is also produced through alcohol route (ethyl alcohol).

Figure 57: EO – 2010-11 Consumption



6.13.7 **Capacity**

6.13.7.1 In India, EO is produced by Reliance Industries Ltd (RIL) and India Glycols Ltd. (IGL). RIL sells the entire EO produced for the Merchant Market while IGL captively consumes all EO produced for Surfactants & Glycol ethers production. The current effective capacity of EO is 209 KTA. Current capacity is more than demand. The capacity listed below refers to Purified EO capacity excluding EO used in production of Glycols.

Table 63: EO Capacity in India (KTA)

Reliance	154
Total	154

Source: CPMA

6.13.8 **Supply and Demand Growth**

6.13.8.1 There has been a steady increase in demand and supply of EO for last few years as table below shows, driven mainly by demand for Ethoxylates, Glycol ether and Dye intermediates. EO is neither imported nor exported because of its hazardous nature. However, import and export of EO derivatives has been steadily growing over the last few years.

Table 64: EO Demand-Supply Balance in India

(in kt)	2007-08	2008-09	2009-10	2010-11	2011-12
Capacity	129	129	145	175	209
Production	102	115	138	147	173
Demand*	102	115	138	147	173
Y-O-Y Growth	8.5%	12.8%	20%	6.5%	17.7%
CAGR					13%

Source: Industry

6.13.8.2 The demand for EO has grown at CAGR of 13% during 2007-08 to 2011-12.

6.14 Synthetic Rubbers (Elastomers)

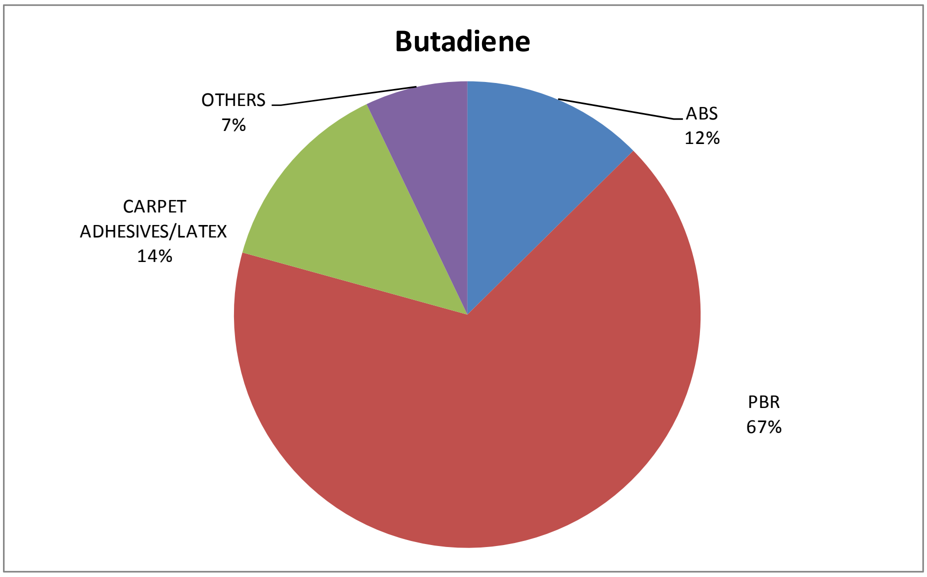
6.14.1 The importance of the Rubber Industry ever since it first appeared and the decisive role that it has played in the development of modern civilization prompted interest in discovering its chemical composition in order to synthesize the produce. Through these research projects, the tyre industry saw the possibility of breaking away from the grip of world's Natural rubber plantation.

6.14.2 During World War-II, Germany first produced Polybutadiene Rubber. Over the last about 60 years there has been tremendous development leading to a large number of synthetic rubbers having diverse physical properties and uses. Synthetic Rubber is broadly classified in two categories viz. General Purpose Rubber (GP) and Special Purpose Synthetic Rubber. GP includes Styrene Butadiene Rubber (SBR), Polybutadiene Rubber (PBR) and Polyisoprene Rubber (IR). Styrene Butadiene Rubber (SBR) is the largest tonnage synthetic rubber. Ethylene-Propylene Rubber (EPM and EDPM), Butyl Rubber (IIR) and Nitrile Rubber (NBR) are some of the other important types of synthetic rubbers.

6.15 1, 3-Butadiene (BD)

6.15.1 Butadiene is colourless easily liquefiable flammable gas used in the production of a wide variety of synthetic rubbers (SBR, BR, and NBR etc.), Acrylonitrile-butadiene-styrene (ABS), polymer resins and few chemical intermediates.

Figure 58: Butadiene – 2010 – 11 Consumption



6.15.2 **Production Process :** In India BD is manufactured from C4 available from Naphtha & Gas Cracking units. There was no import of C4 due to poor economic viability.

6.15.3 **Uses**

6.15.3.1 SBR is used mainly in automobile tyres and also in adhesives, sealants, coatings and rubber articles such as shoe soles.

6.15.3.2 BR is used mainly in tyres and also as an impact modifier of polymers such as high impact polystyrene (HIPS).

6.15.3.3 Nitrile rubbers are used mainly in the manufacture of hoses, gasket seals and fuel lines for the automobile industry as well as in gloves and footwear.

6.15.3.4 Acrylonitrile-butadiene-styrene (ABS) used in business machines, computers, radios, televisions and telephone handsets and also in automobile industry.

6.15.3.5 Styrene-butadiene (SB) copolymer latex is used in paper coatings, carpet back coatings, foam mattresses and adhesives.

6.15.3.6 Other Chemical intermediates manufactured from butadiene are adiponitrile and chloroprene. Adiponitrile is used to make nylon fibres and polymers. Chloroprene is used to make polychloroprene (better known as Neoprene) which has uses such as wet suits, electrical insulation, car fan belts, gaskets, hoses, corrosion-resistant coatings and adhesives.

6.15.4 **Capacity**

6.15.4.1 Following the merger of IPCL into Reliance by 2008, Reliance and Haldia are currently the two butadiene producers in India. However, the number of butadiene producers is likely to grow by 2013 when additional extraction capacity will start up supported by crude C4 supplies from new steam crackers.

6.15.4.2 The current installed capacity of Butadiene in India is 295 KTA as shown in the following table.

Table 65: Butadiene Capacity in India

Manufacturer	Capacity (kt)	Type
Reliance Hazira, Gujarat	140	Naphtha Cracker
Reliance Vadodara, Gujarat	60	Naphtha + 2 Gas Crackers
Haldia, West Bengal	95	Naphtha Cracker
Total	**295**	
Source: Industry		

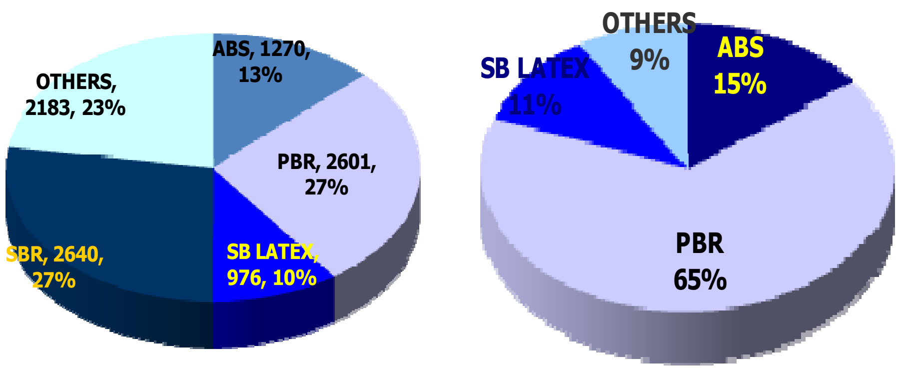
6.15.5 **New Capacity in India**

6.15.5.1 OPAL (a subsidiary of ONGC) is planning a grass roots petrochemical complex at Dahej, Gujarat that includes a 95,000 metric ton Butadiene extraction unit by 2014.

6.15.5.2 Indian oil Corporation Ltd (IOC) is also in process of commissioning 138,000 metric ton Butadiene extraction unit at Panipat Haryana by 2013-14.

6.15.5.3 By 2015 total available BD including new capacities will be sufficient to cater to existing and upcoming downstream projects such as SBR, BR & Polychloroprene rubber.

Figure 59: Share of End-uses in Butadiene Demand



6.15.5.4 Global demand of Butadiene is estimated to be 9.6 MMT. Synthetic elastomers such as PBR and SBR constitute approx 54% of total demand followed by ABS at 13%.

6.15.5.5 The North-East Asian region remain major BD consumer, with demand of 4.3 MMT (44% of global), followed by 22%, and 21% by USA and Europe respectively. Compared to this, Indian demand is merely 124 KTA.

Table 66: Supply Demand of Butadiene in India

(KT)	07-08	08-09	09-10	10-11	11-12
Capacity	275	275	275	295	295
Production	214	214	205	266	266
Imports	4.5	3.8	0.0	4.1	0.0
Exports	133	120	111	147	142
Apparent Demand	112	109	110	121	124
Y- O- Y Growth		1.9%	4.8%	6.4%	6%
CAGR					3%
Source: Industry					

6.15.5.6 Domestic demand in India has grown at a steady pace over the past few years and has reached almost 124 KT in 2010-11.Actual export been 147 KT in 2010-11. Domestic volume is expected to increase to 470 KTA by 2016-17.

6.15.5.7 Butadiene and synthetic rubber demand in the Indian Subcontinent is primarily supported by the rapidly expanding automotive industry. Strong GDP growth forecast to average almost 8% per year will drive an even faster growing automotive market, increasing motor vehicle production from an estimated 2.9 million units in 2010 to about 4.5 million units by 2015.

6.16 SBR, PBR, Nitrile Rubber & Butyl Rubber

6.16.1 **Global Scene**

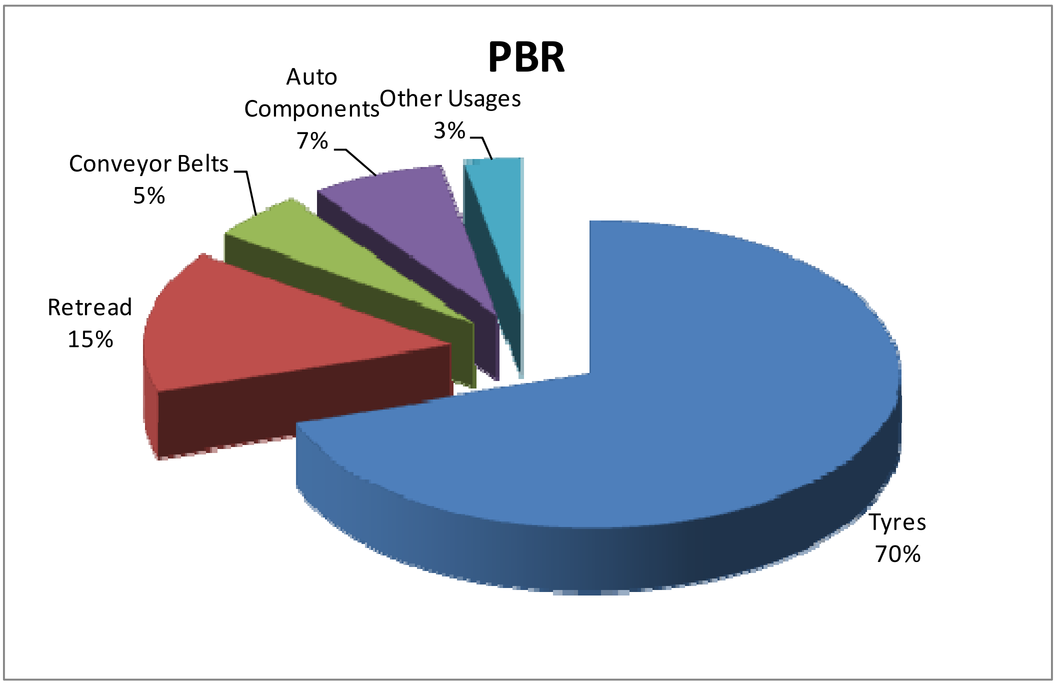
6.16.1.1 Globally, consumption of rubber was 18 MMT in 2000 and 21 MMT in 2005 which increased to 24.3 MT in 2010. Of the total rubber consumption in 2010, the consumption of natural rubber was 10.7MMT and synthetic rubber accounted for the remaining 13.6 MMT. In 2005 consumption of natural rubber and synthetic rubber were 9.2 MMT and 11.8 MMT respectively.

6.16.1.2 The growth in total demand for rubber from 2005 to 2010 was 3.07%, while demand for synthetic rubber and natural rubber during the same period grew by 3.14% and 2.99% respectively.

6.16.2 **Domestic Rubber Sector**

6.16.2.1 India is the 4th largest producer and 2nd largest consumer of natural rubber in the world. Thailand, Indonesia and Malaysia and are other leading producers of natural rubber. The large availability of natural rubber as compared to that of synthetic rubber significantly influences demand for synthetic rubbers in the country. While globally the ratio between NR and SR is 44:56 in India it is 70:30.Given the increasing deficit in Natural rubber supply as compared to demand & technological advancements in tyre industry, the NR: SR ratio has grown from 22% in 2005 to current level of 30%. The trend is expected to continue.

Figure 60: PBR – 2010-11 Consumption



6.16.2.2 The wide variety of rubber products produced for various applications are broadly classified into two categories viz. Tyres and Non-Tyres. Presently India produces practically entire range of automobile tyres. Non-tyres products include Cycle Tyres, Belting, Hoses, Footwear, Moulded Rubber Goods, sports goods and Proofing Fabrics.

6.16.2.3 Table below shows growth in demand for natural and synthetic rubber during 2005-06 to 2010-11. Despite economic slowdown in 2009, the demand for rubber registered the increase of 5.5% from 2005-06 to 2010-11, thanks largely to growth in automotive sector.

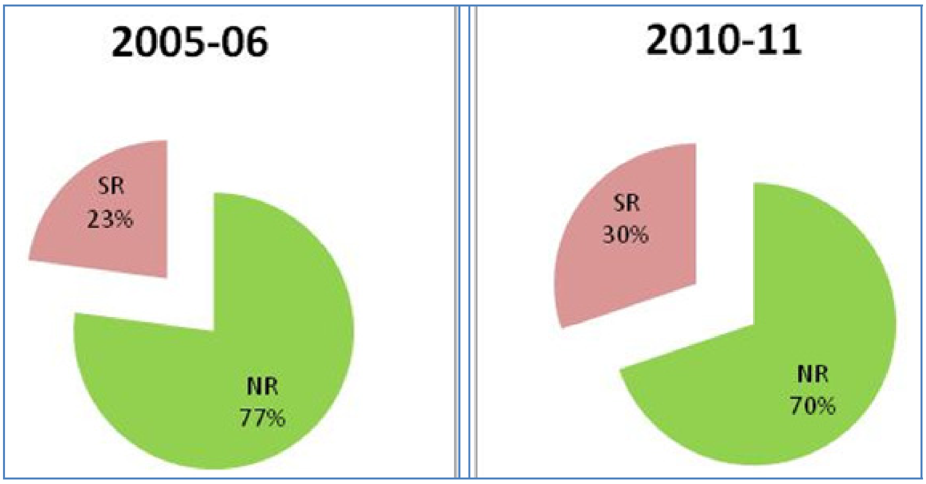
Table 67: Rubber demand in India

(in KTA)	2005-06	2006-07	2007-08	2008-09	2009-10
Natural Rubber	801	820	862	872	931
Synthetic Rubber	238	271	297	293	348
Total Rubber	**1039**	**1091**	**1159**	**1165**	**1278**

Source : Rubber Board

6.16.2.4 As the above table shows, during the period from 2005-06 to 2010-11, demand for synthetic rubber registered a strong growth CAGR of 11.5% in sharp contrast to slow growth of 3.4% for natural rubber. Consequently the share of Synthetic Rubber has increased from 23% in 2005-06 to 30 % in 2010-11 as shown in the figure below.

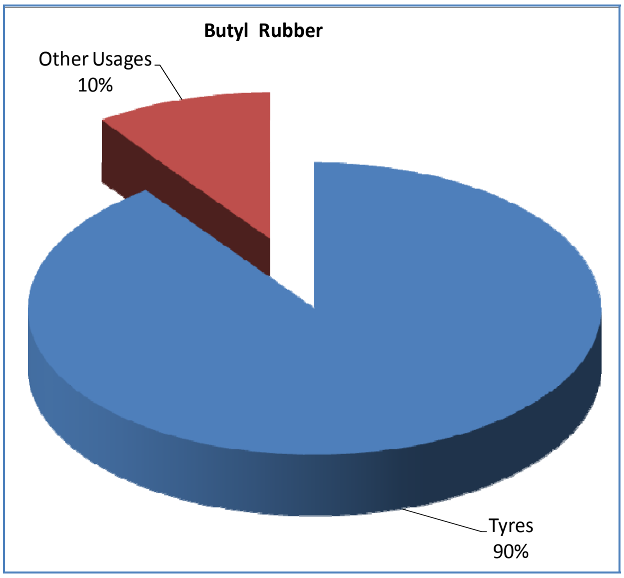
Figure 61: Share of NR & SR in total rubber consumption in India



Source: Rubber Board

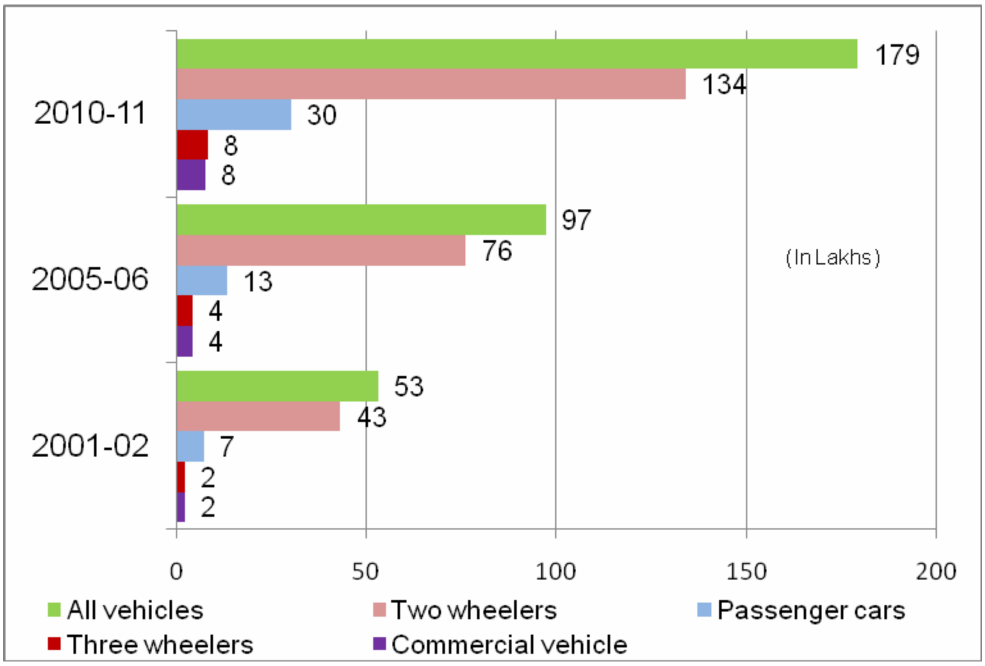
6.16.2.5 As India's per capita consumption of rubber of 1.126 Kg is roughly 32 % i.e. one third of global average, the potential for growth is high. Further, as there are limitations in augmenting availability of natural rubber due to non-availability of acreage in area suitable to NR farming, synthetic rubber would be called upon to play increasingly important role in meeting the rapidly rising domestic demand for rubber.

Figure 62: Butyl Rubber – 2010-11 Consumption



6.16.2.6 Automotive tyres, accounting for about 78% of total rubber demand, continues to grow rapidly, driven by boom in the auto sector. The following chart depicts the rapid growth in automobiles production in India, which has contributed significantly towards rising synthetic rubber demand in the tyre sector.

Figure 63: Automobile Production in India.



Source : SIAM

6.16.2.7 While overall availability of rubber has grown at a rate higher vis-à-vis demand, yet the gap between demand and supply for 2010-11 was about 365 KT. The table below shows the trends in supply of rubber in the country during 2005-06 to 2010-11. As shown in the table, on an average supply of natural rubber has lagged behind compared to the growth in overall rubber supply, which has grown at a CAGR(05-06/10-11) of 1.94% during the period, buoyed by the relatively higher growth in supply of synthetic rubber at CAGR(05-06/10-11) of 2.48% over the same period.

Table 68: Rubber Supply in India

(in KTA)	05-06	06-07	07-08	08-09	09-10	10-11	CAGR %
Natural Rubber	802.6	852.9	825.3	864.5	831.4	880.9	1.88
Synthetic Rubber	97.6	99.5	101.3	96.7	106.7	110.3	2.48
Total Rubber	**900.3**	**952.4**	**926.6**	**961.2**	**938.1**	**991.3**	**1.94**

Source : Rubber Board

Figure 64: SBR – 2010-11 Consumption

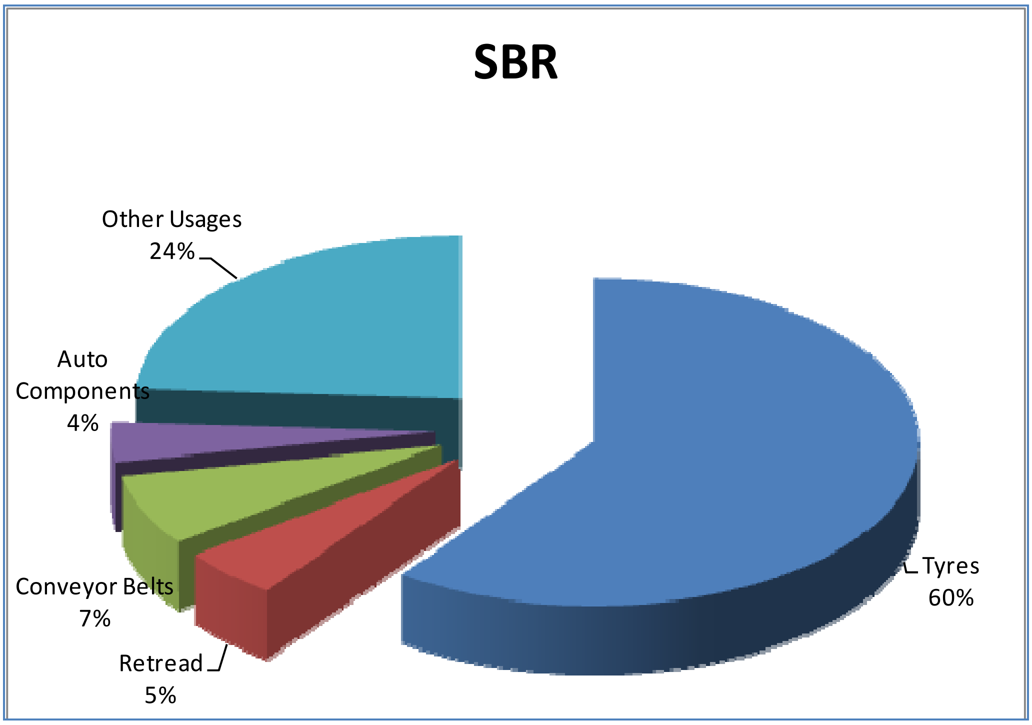
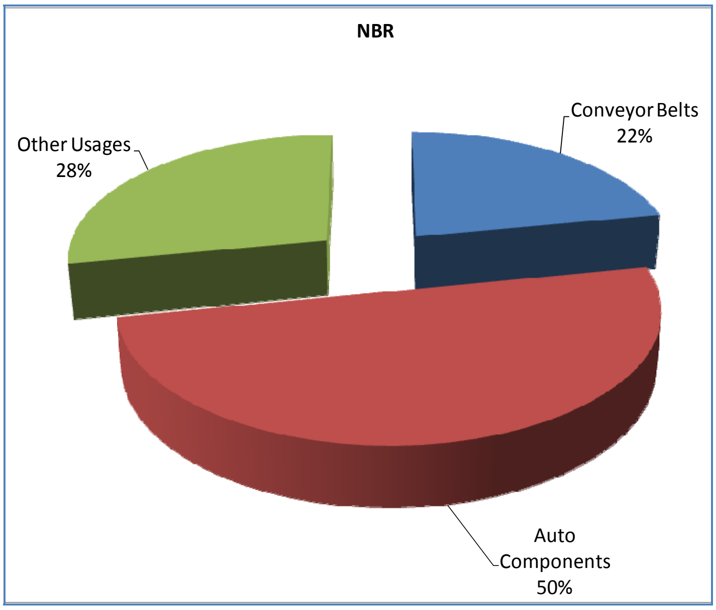


Figure 65: NBR – 2010-11 Consumption



6.16.3 **Synthetic Rubber: Domestic Capacity**

6.16.3.1 As shown in the table below, the current total capacity of synthetic rubber in India is only 124 KTA. Reliance is the sole manufacturer of PBR and account for ~60% of domestic synthetic rubber capacity of 124 KT (2010-11). Synthetics and Chemicals Limited (S&C), which is a major producer of SBR, is under prolonged closure.Unimers India Limited too have idled their 10 KTA EPDM plant since year 2008. Other manufacturers of synthetic rubber in the country mostly operate relatively small plants.

Table 69: Synthetic Rubber Capacity in India

Synthetic Rubber Type	Capacity (KTA)
PBR	74
SBR	20
NBR	20
EPDM	10
TOTAL	124

6.16.4 **Synthetic Rubber: Demand-Supply Balance:** As of date, domestic production of synthetic rubber is meeting only one-fourth of domestic demand, which is 410 KT in 2010.

6.16.4.1 During the period 2005-06 to 2010-11 the demand for synthetic rubber grew at an impressive CAGR of 11.5% while the demand for natural rubber grew at CAGR of 3.4% and overall demand of rubber registered CAGR of 5.5%.Year wise details of capacity, production, import export and demand are given in the following chart.

Figure 66: Synthetic Rubber Demand-Supply Balance – India.

Source: Rubber board

6.16.4.2 Due to rapid growth in demand of synthetic rubber and its limited domestic availability, the imports have been steadily increasing. Import dependency, which was at 55 % in 2005-06, has increased to 73 % in 2010-11.

6.16.4.3 Among synthetic rubbers, PBR and SBR constitute ~72.6% of domestic demand. During the period 2005-06 to 2010-11 the CAGR for PBR and SBR were 12.4 and 16.6 % respectively. Table T04 shows year-wise details of demand-supply balance for PBR, SBR and Butyl rubber.

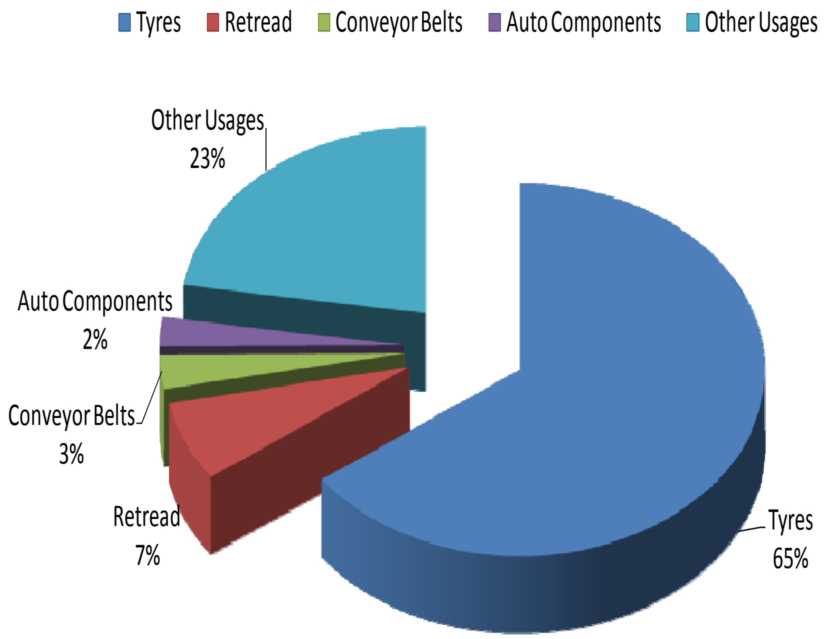
Table 70: Demand-Supply Balance – PBR, SBR & Butyl Rubber

(in KTA)	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
PBR						
Capacity	74	74	74	74	74	74
Production	67	72	74	72	73	76
Import	2	9	12.2	16.5	27.3	47.35
Export	0	0	0.2	0.5	0.6	0.35
Demand	69	80	88	83	104	124
Y-o-Y Growth (%)		15.7	10.4	-6.2	26.3	18.8
CAGR (05-06/10-11)(%)						12.4

SBR						
Capacity	20	20	20	20	20	20
Production	18	12	15	13	18	20
Import	63	94.3	104.3	107	127.5	158
Export	0	8.3	8.3	8	6.5	4
Demand	81	98	111	112	139	174
Y-o-Y Growth (%)		21.4	13.0	0.7	24.3	25.6
CAGR (05-06/10-11)(%)						16.6
Butyl Rubber						
Capacity	0	0	0	0	0	0
Production	0	0	0	0	0	0
Import		51	57	63	70	77
Export	0	0	0	0	0	0
Demand	47	51	57	63	70	77
Y-o-Y Growth (%)	6	8	11.8	10.5	11.1	10.0
CAGR (05-06/10-11)(%)						10.4

Source: Rubber Board/Market research

Figure 67: End use Consumption Pattern of Natural Rubber



6.17 ***Aromatics***

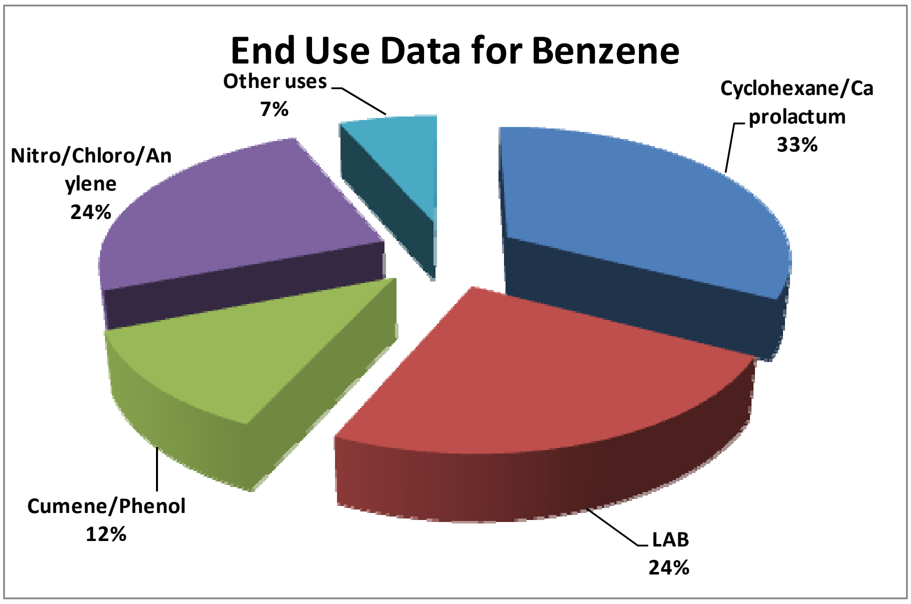
6.17.1 The diverse end-use sectors of Aromatics products range from that of nylon, unsaturated polyester resins, phenolic resins, drugs, dyes, pesticides, polymers, detergents, solvents- inks, paints, others Polyurethanes, Carrier solvent for wide range of chemical specialties, Oil Field Chemicals to Food Acids.

6.17.2 Under the umbrella of 'aromatics', Benzene, Toluene, Mix-Xylene and Ortho-Xylene are the major products.

6.18 Benzene

6.18.1 Benzene is an aromatic hydrocarbon and one of the primary building blocks for the petrochemical industry. It is found naturally in crude oil but it is also commercially produced via synthesis from other petroleum based chemicals.

Figure 68: Benzene – 2010-11 Consumption

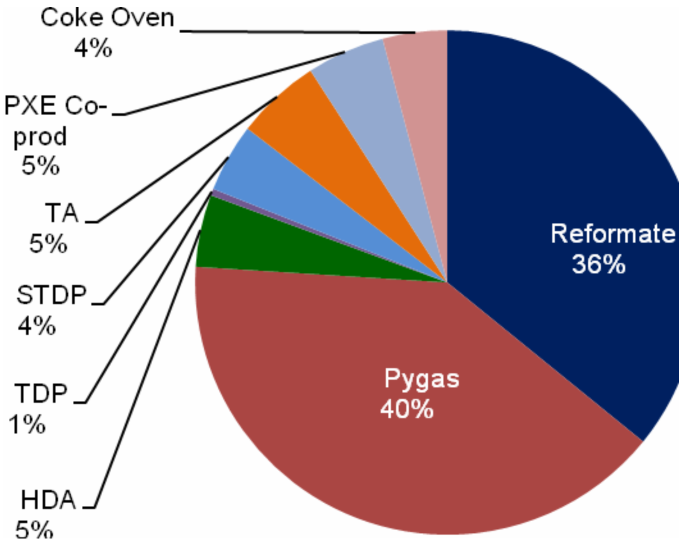


6.18.2 **Production Process**

6.18.2.1 Benzene was originally produced as a byproduct of coke production for the steel industry. However today, benzene is primarily produced as a by-product of refinery and steam cracker operations. There are also a number of other processes - toluene disproportionation (TDP), selective TDP (STDP) etc. - that produce benzene as a co-product. There is only one process, the hydrodealkylation (HDA) process that produces benzene on-purpose.

6.18.2.2 The total global production of benzene for the year 2010 was 41 MMT.

Figure 69: World Benzene Production by Source

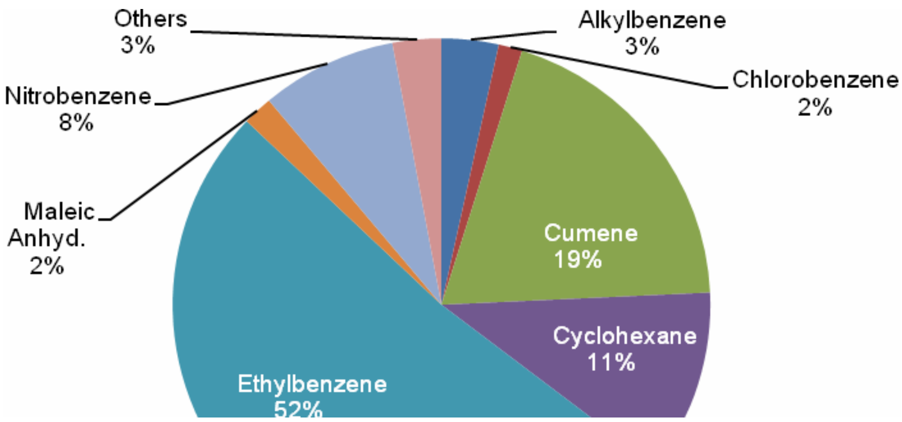


Source: CMAI

6.18.3 **Uses:** Benzene is principally used as a primary building block for the production of Ethyl Benzene/Styrene, Cumene/phenol, cyclohexane/Caprolactum, Chlorobenzene/derivatives LAB and other industrial chemicals.

6.18.3.1 Ethylbenzene/styrene, cumene/phenol and cyclohexane consume over 80 % of global benzene demand and are forecasted to grow at an average annual rate over 3.0 % during the five year forecast period.

Figure 70: Benzene Consumption End use-wise



Source: CMAI

6.18.4 **Benzene Capacity**

6.18.4.1 India has a nameplate Benzene capacity of 1.23 million metric tonnes the break-up of which is tabulated below.

Table 71: Benzene Capacity in India in 2010

Company	Capacity(KT)
RIL	680
IOCL	200
BPCL	80
KRL	85
HPL	125
Steel Plants	60
Total	**1230**

Source: Industry

6.18.4.2 Total benzene production for 2010 was approximately 1.1 million metric tonnes, an increase of 10% from 2009 mainly attributed to increases in local demand and exports.

6.18.4.3 The main source of benzene supply comes from pygas and reformate/toluene transalkylation based production units, each accounting for about 400,000 tonnes and 620,000 tonnes, respectively. There is also a small volume from coke oven benzene.

6.18.5 **New Capacity**

6.18.5.1 Mangalore Refinery, a subsidiary of ONGC, has announced a new aromatics complex in Mangalore. The aromatics complex is expected to produce 920,000 metric tonnes of paraxylene and 275,000 metric tonnes of benzene. Completion is delayed, with start up expected in early 2016-17.

6.18.5.2 OPAL (a subsidiary of ONGC) is planning a grass root petrochemical complex at Dahej, Gujarat that includes a 135,000 metric ton benzene extraction unit, with start up expected in early 2013-14.

6.18.5.3 However no new concrete downstream projects have been unveiled by major players. India will continue to rely heavily on the export market for regional benzene growth.

6.18.5.4 With new capacity expected to come on stream over the forecast period, Operating rates are likely to fall to about 70% by 2014. However, the strong export demand is expected to lift regional operating rates to 77% in 2015.

6.18.6 **Demand**

6.18.6.1 Domestic demand in India has grown at a steady pace over the past few years and is expected to reach almost 600,000 metric tonnes in 2010.

6.18.6.2 Export demand is projected at over 540,000 metric tonnes in 2011-12. Export volume is expected to increase substantially to over 900, 000 metric tonnes in 2016-17.

6.18.6.3 Domestic demand will see a steady growth over the forecast period as volume is expected to reach 935,000 tonnes by 2016-17. The majority of development in domestic demand is expected to be from Cyclohexane, Cumene/Phenol sectors which are expected to see substantial growth through to 2016-17. However, export demand will increase even faster, surpassing domestic demand from 2013. By 2016-17, exports are expected to be more than 70% above the level of domestic demand.

6.18.6.4 Imports are not required as India has excess capacity meeting the needs of its downstreamdomestic demand. Yet some of the quantity is being imported in the last few years.

6.18.6.5 Benzene exports are forecast to continue growing at a high rate over the forecast period. Exports to Southeast Asia are expected to be halted fundamentally due to new large scale capacity coming on line within that region and as a result India has increased and will increase its exports to other regions, including the Middle East, West Europe and North America.

Table 72: Benzene Demand- Supply in India

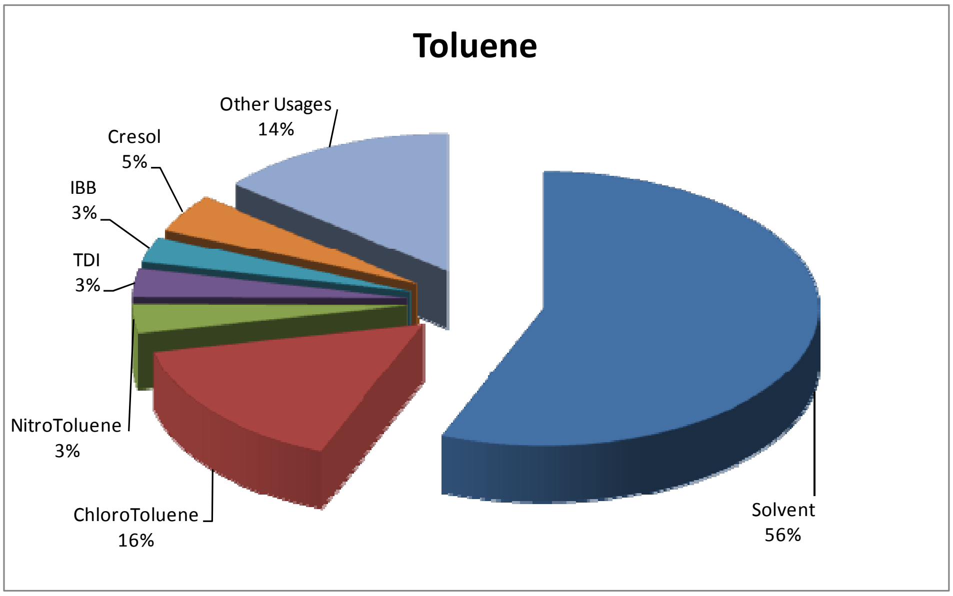
(KT)	07-08	08-09	09-10	10-11	11-12
Production	940	943	945	1018	1135
Imports	13	36	62	72	20
Domestic Sales	523	460	464	514	570
Exports	399	461	434	429	540
Consumption	536	496	526	586	590
Y- O- Y Growth	4.7%	-7.5%	6.0%	11.4%	0.7%
CAGR					2.9%

Source: Industry

6.19 ***Toluene***

6.19.1 Toluene is an aromatic hydrocarbon and it plays an essential role in the petrochemical industry. Many of the products we use in our everyday life stem from this ringed aromatic compound. It is commercially produced via synthesis from petroleum based chemicals.

Figure 71: Toluene – 2010-11 Consumption



6.19.2 **Production Process**

6.19.2.1 The Petrochemical industry's predominant sources of Toluene are refinery reformers and hycarbon steam crackers, which together account for over 98% of the world supply. The process routes are as follows.

6.19.2.2 **Catalytic Reforming** – Conversion of low octane paraffinic naphtha to hydrogen, isoparaffins, naphthenes and aromatics.

6.19.2.3 **Pyrolysis Steam Cracking** – High temperature heating LPG's, condensate, naphtha, diesel or gas oil with steam, in the absence of air to produce olefins and aromatics.

6.19.2.4 **Coal Carbonization** –Benzene, toluene and xylenes are the low purity products recovered in the coal carbonization process in the steel industry.

6.19.2.5 Price dynamics plays a very important role in the Toluene market. Depending on the price advantage, Toluene is either sold to merchant market or converted to benzene or xylenes via different routes;

6.19.2.6 Conversion to benzene via hydrodealkylation, (HDA).

6.19.2.7 Conversion to equal portions of benzene and xylenes via toluene disproportionation (TDP).

6.19.2.8 Selective conversion to benzene and xylene via selective toluene disproportionation, (STDP). Conversion to benzene and xylene via transalkylation with C9 and C10 aromatics.

6.19.3 **Uses:** Toluene is used as major solvent in the petrochemical industry. It is also used in the manufacture of Toluene derivatives such as Toluene Di-Isocynate (TDI), Para-Cresol, Iso Butyl benzene (IBB), Chlorotoluene, Nitrotoluene and Pharmaceuticals

6.19.4 **Capacity:** Reliance is the largest producer of TDI Grade Toluene in India. Only three refineries produce 'On purpose Toluene'. Toluene is also produced as a byproduct via coal carbonization process. This is low purity product mostly used as solvent. India will continue to rely heavily on imports for meetingrising demand.

Table 73: Toluene Imports in to India & Source Countries

(kt)	2009-10	2010-11
Singapore	48	90
Iran	40	45
Korea	40	65
Others	70	50
Total	198	250

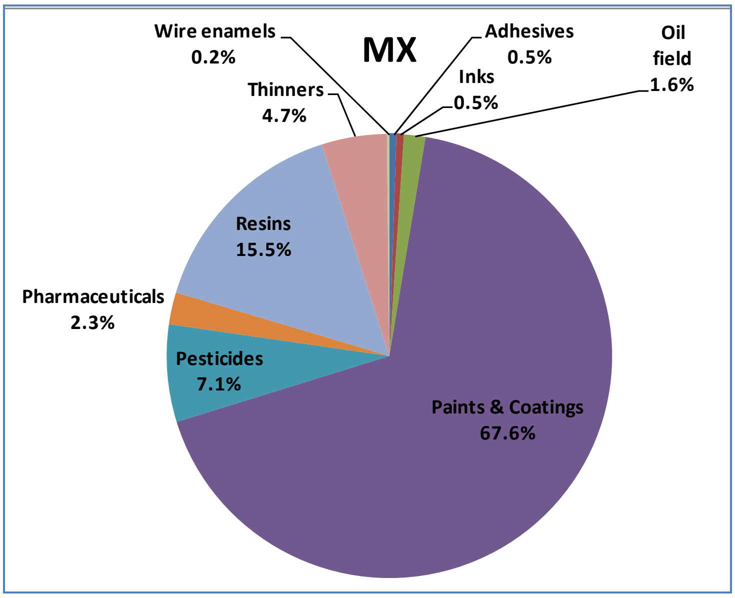
Table 74: Toluene Demand-Supply in India

(kt)	2007-08	2008-09	2009-10	2010-11	2011-12
Production	142	140	140	140	140
Imports	140	145	198	250	300
Exports	1.4	2.7	1.4	0	0
Demand	282	285	338	390	440
Y-O-Y Growth%	3.1%	0.6%	19.2%	15.9%	12.8%
CAGR					9.3%
Source: Industry					

6.20 Mixed Xylenes

6.20.1 Mixed Xylenesare a mixture of three structural isomers of the aromatic hydrocarbon dimethylbenzene, namely ortho, meta and para Xylene. Mix Xylene is a clear, colorless, sweet-smelling liquid that is very flammable. It is commercially produced via synthesis from other petroleum based chemicals.

Figure 72: MX – 2010-11 Consumption



6.20.2 **Production Process**

6.20.2.1 Mixed Xylenesare basic aromatic petrochemicals and are produced through several routes.

6.20.2.2 **Catalytic Reforming**:– Conversion of low octane paraffinic naphtha to hydrogen, isoparaffins, naphthenes and aromatics.

6.20.2.3 **Pyrolysis Steam Cracking**:– High temperature heating LPG's, condensate, naphtha, diesel or gas oil with steam, in the absence of air to produce olefins and aromatics.

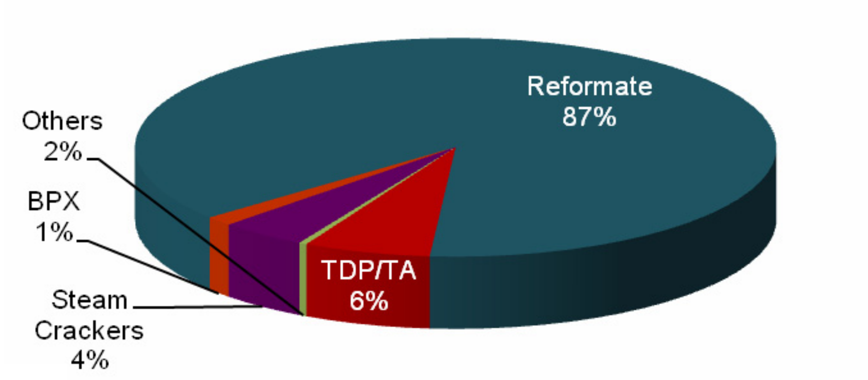
6.20.2.4 **Coal Carbonization:**– High temperature heating of coal in the absence of air to drive off volatile hydrocarbons. The resulting coke is used in steel industry blast furnaces. The volatile hydrocarbons, tar, light oil and gas are recovered as byproducts. BZ, toluene and xylenes are recovered from the light oil.

6.20.2.5 **Cyclar® (dehydrocyclodimerization):–** Catalytic conversion of propane/butane to aromatics.

6.20.2.6 **Toluene disproportionation (TDP):–** Catalytic conversion of toluene to benzene and xylene.

6.20.2.7 **Transalkylation:–** Catalytic conversion of toluene and C9/C10 aromatics to benzene and xylene.

Figure 73: World Mixed Xylene Production by Source



6.20.2.8 The predominant supply sources for xylenes are refinery reformers and toluenedis-proportionation units which together account for over 93% of the world's supply.

6.20.3 **Uses:** Mixed Xylene are used as solvents in paints, printing inks, rubber, and leather industries.

6.20.4 **Capacity in India:** Currently, there are 2 manufacturers, RIL and MRPL in India with a combined production capacity of 90 kT and production in 2010-11 was 72 kT.

Table 75: Mixed Xylenes Capacity in India in 2010-11

Company	Capacity (kt)
RIL	50
MRPL	40
Total	90

6.20.5 **New Capacity:** With no capacity additions in near future there will be only two players in the market to serve the domestic competition.

6.20.6 **Demand**

6.20.6.1 Domestic demand in India has grown at a steady pace over the past few years and is expected to reach almost 108 thousand metric tonnes in 2011-12.

6.20.6.2 Domestic demand will see a steady growth over the forecast period as volume is expected to reach 160 thousand metric tonnes by 2015.

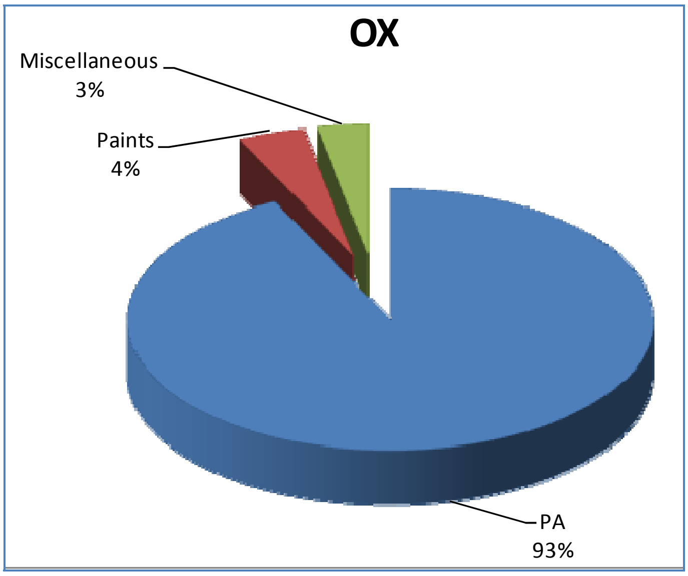
The majority of development in domestic demand is expected to be from Paints and Coatings sectors which are expected to see substantial growth through to 2015.

6.20.6.3 Imports are also expected to increase as there is no capacity addition forecasted to meet the needs of its downstream domestic demand.

6.21 Ortho Xylene

6.21.1 Ortho Xylene (OX) is one of the three isomers of Xylene. It has the second largest demand amongst three isomers. It is a colourless and odourless liquid with a peculiar odour. It reacts explosively with strong oxidants.

Figure 74: OX – 2010-11 Consumption



6.21.2 **Production Process:** It can be produced by catalytic reforming of naphtha as well as from pyrolysis gasoline.

6.21.3 **Uses**

6.21.3.1 Ortho Xylene is used for a variety of applications. A majority (92%) of all the Ortho-Xylene produced globally is used for the manufacture of Phthalic Anhydride (PA). PA is a very versatile intermediate used for organic synthesis with a variety of applications.

6.21.3.2 Unsaturated Polyester Resins (UPRs) are the most widely used thermosetting resin accounting for 66% of the thermosetting resin market. Epoxies account for 23% of the market share while the others account for the remaining 11%.

6.21.3.3 The two major types of UPRs used in the composite industry are Orthophthalic and Isophthalic polyester resin. Orthophthalic is the cheaper standard resin used for many applications while Isophthalic resin is majorly used in the marine construction industry due to its superior water resistance.

6.21.3.4 The major useful characteristics of polyester resins are its corrosion resistance, low weight, modifiable mechanical properties, dimensional stability, low cost, easy processing and handling.

6.21.3.5 The un-reinforced version of the resins are used for making buttonnes, body fillers, coatings, clear casting resin etc. while resins reinforced with fibers are used for construction (doors, pultruded profiles, window, modular buildings), sanitary items (pipes, tanks and ducts), electrical parts (housing, fuse box etc.), automobile parts (hood, deck lid), boat pars (hull, decks etc.). Most of the UPR is used in the construction industry followed by marine, transportation and E&E.

6.21.3.6 Other than the major uses in PA and UPR, Ortho Xylene is also used for the following applications

- Preferred solvent in the aromatics range due to its narrow distillation range, relatively low volatility and high solvency.
- It is also used as a carrier solvent in many pesticide formulations
- Used as a solvent in paints
- The good solvency of Ortho Xylene provides consistent tint development and tint stability in the ink formulations
- It is also used as a solvent in the manufacture of Oil Field Chemicals like pour point depressants due to its relatively high flash point and high solvency
- Manufacture of 3,4 Xylidine used for the manufacture of vitamin B2

6.21.4 Future Potential Opportunity: Polyethylene Naphthalate (PEN)

6.21.4.1 Polyethylene Naphthalate (PEN) is a new generation Polymer with physical properties superior to those of PET. It has a higher dimensional stability and is far more shrinkage resistant as compared to PET (PEN Fiber).

6.21.4.2 It also has higher temperature stability and has good barrier properties which (better than PET) which makes it suitable for bottling beverages susceptible to oxidation, such as beer (Polyethylene naphthalate, 2011) bottle. It is however more expensive as compared to PET at this point of time. It is a high performance polymer whose demand is expected to increase in the future. The major uses of PEN are as follows.

- Bottling Beverages Susceptible to oxidation
- Medium for advanced photo system
- Manufacture of high performance fibres
- Substrate of Some LTO type cartridges
- Substrate for flexible integrated circuits

6.21.4.3 The market for this product is in the Asia-Pacific region. There are also no manufacturers of PEN in India. It will take time before such speciality polyesters find a market in the country, and even more time for someone to setup a manufacturing facility for such polyesters. Therefore, the potential for OX use for this application is very low.

6.21.5 Capacity

6.21.5.1 Reliance is the only Indian manufacturer of Ortho Xylene with installed capacity of 420,000 TPA. Reliance is the largest OX supplier in Asia market.

Table 76: OX Demand- Supply Balance in India

(in KT)	2007-08	2008-09	2009-10	2010-11	2011-12
Capacity	420	420	420	420	420
Production	268	226	357	400	362
Imports	110	87	56	54	50
Exports	160	115	176	184	146
Demand	218	198	238	270	266
Y-O-Y Growth%	17%	-9%	20%	14%	-1%
CAGR					7.3%

Source: Industry

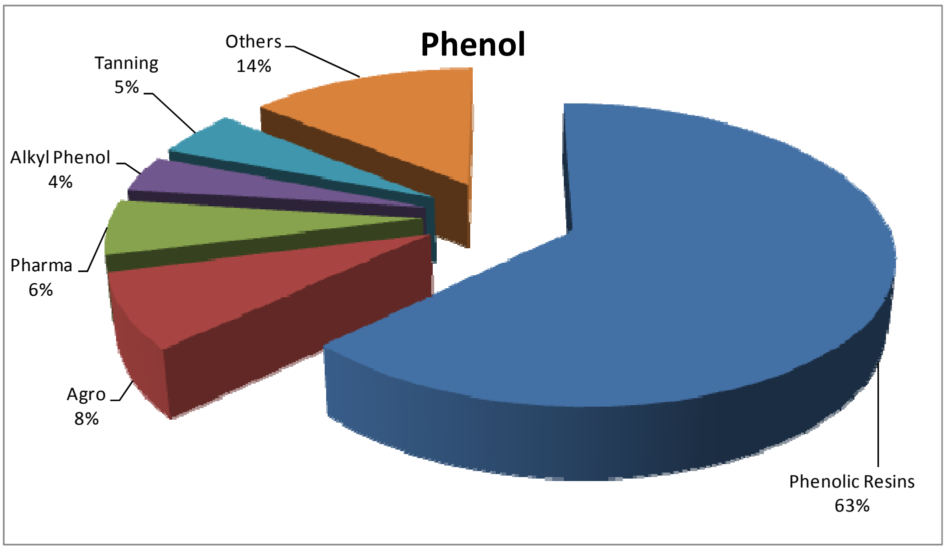
6.21.5.2 The demand for OX has grown at CAGR of 7% in India during 2007-08 to 2010-11.

6.22 Chemical Intermediates - Phenol & Acrylonitrile

6.22.1 **Phenol,** also known as carbolic acid, is an organic compound derived from petrochemical sources. It is a white crystalline solid. Phenol is appreciably soluble in water and slightly acidic in nature. The major uses of phenol is its conversion to plastics or related materials. Condensation with acetone gives bisphenol–A, a key building block for polycarbonates. Condensation with formaldehyde gives phenolic resins. Phenol is also used in the preparation of cosmetics viz.

sunscreen. In clinical medicine, phenol is used in the management of spasticity and refractory cancer pain.

Figure 75: Phenol – 2010-11 Consumption



6.22.2 **Major End-use markets**

6.22.2.1 Major end uses of Phenol are: Bisphenol-A(BPA) Polycarbonate/Liquid Epoxy Resins, PF Resins, Caprolactum,Nylon fibers, resins & films.

Table 77: End Use Analysis of Phenol

End Product	Share in Total Consumption	
(kt)	Global	India
Bisphenol - A	46	62
Phenolic Resins	27	8
Nylon / KA Oil	15	6
Alkyl Phenol	4	4
Others	8	15

Source: Industry

6.22.3 **Capacity**

Table 78: Phenol Capacities in India

Company	Capacity (KTA)
HOC Ltd., Kerala.	40
Schenectady International, Maharashtra	34

6.22.4 **Supply and Demand Growth**

Table 79: Supply Demand of Phenol

In KT	07-08	08-09	09-10	10-11	11-12
Sales	70	70	70	70	70
Demand	168	178	189	200	212
Y-o-Y Growth		6%	6%	5.8%	6%

Source: Industry

6.22.4.1 The requirement of phenol–formaldehyde (PF) resins is about 60% of the Indian phenol demand.

6.22.4.2 Even under stagnant and unreliable domestic supply and difficulties in import of phenol, the demand for phenol in India is growing at 6.5% p.a.

Table 80: Phenol derivatives demand growth projections in India

Sr.No.	Phenol Derivatives	Applications	CAGR,%
1.	Phenol Formaldehyde resin	Automobile components, household electrical and domestic appliances	10
		Laminates and plywood industry	12-14
		Abrasive grinding wheel industry	5-6
		Foundry Industry	10-12
2.	Alkylated derivatives of phenol	Detergents, wetting agents, oil emulsifiers, textiles, lube oil additives, wire enamels, cutting fluid additives and rubber chemicals	8-10
3.	Chloro phenols	Fungicides, fumigants, Intermediates for Insecticides and herbicides	5-6
4.	Dyes	Textile Industry	5-6
5.	Leather Chemicals	Used for tanning and post tanning operations of raw hides and skins	6-7
Expected overall growth rate			6-8

Table 81: Market Share of Phenol Applications

	Growth Rate (%)	Market Share (%)
PF Resin	9	62
Pharma	10	6
Agro Chemicals	8	8
Alkyl Phenols	6	4
Tanning	3	5
Others	6	13
Source: Industry		

6.22.5 **Phenol Market Scenario**

6.22.5.1 Globally about 20% of benzene is used in manufacturing phenol. Global demand for phenol during 2009-10 is 8500 KTA and is growing at CAGR 4%.

6.22.5.2 India's demand for phenol is 212 KTA growing at 4.8% p.a. India imports about 140 KTA of phenol. With domestic phenol capacity stagnant at 74 KTA the import is expected to reach 170 KTA by 2013-14.

6.22.5.3 Contrary to the global trend, Indian phenol demand is not based on BPA and its derivatives PC. Phenolic resins, alkyl phenols and pharma intermediates are the major end uses of phenol in India.

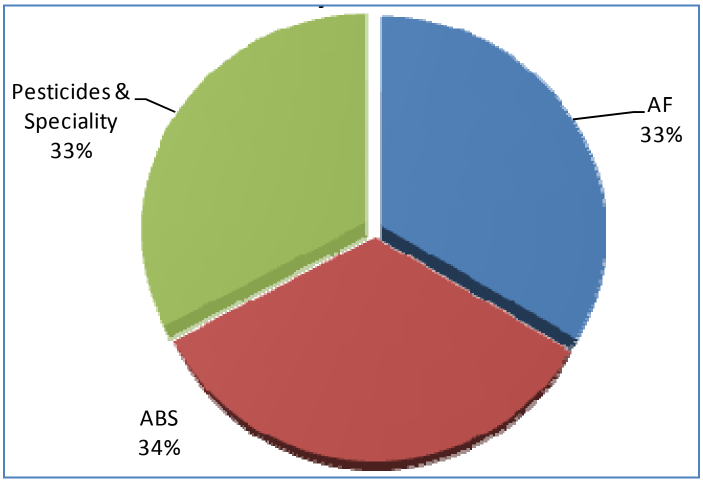
6.22.5.4 By the year 2014 India is likely to have some surplus of Phenol for exports after meeting domestic demand. Exports volume will come down in subsequent years due to the growth in domestic market.

6.23 Acrylonitrile

6.23.1 Acrylonitrile (ACN) is used mainly as a monomer or co-monomer in the production of synthetic fibres, plastics and elastomers. The largest outlet is in the manufacture of acrylic fibres while the main growth sector for ACN is the acrylonitrile-butadiene-styrene (ABS)/styrene-acrylonitrile (SAN) market.

6.23.2 Acrylonitrile is the key ingredient in the acrylic fiber used to make clothing and carpeting; in acrylonitrile-butadiene-styrene (ABS), a durable material used in automobile components, telephone and computer casings, and sports equipment; and in nitrile rubber, which is used in the manufacture of hoses for pumping fuel.

Figure 76: Acrylonitrile – 2010-11 Consumption



6.23.3 **Production Process**

6.23.3.1 Acrylonitrile is manufactured by catalytic Ammoxidation of Propylene. 1.1 MT Propylene & 0.52 MT Ammonia is required to manufacture 1 MT of ACN.

6.23.4 **Capacity**

6.23.4.1 The ACN plant in India was started by Indian Petrochemical Corporations Ltd, Vadodara (Now RIL), way back in 1979 with 24 KT capacity. The plant modifications had been done in 1986 and 2004 to enhance the plant capacity to 40 KT.

6.23.4.2 Currently, Reliance's 40 kT ACN plant is the only unit manufacturing ACN in India.

6.23.5 **Supply and Demand Growth**

Table 82: ACN Demand- Supply Balance in India

(In KT)	2007-08	2008-09	2009-10	2010-11	2011-12
Capacity	40	40	40	40	40
Production	39	30	39	38	40
Imports	81	90	81	85	86
Exports	0	0	3	0	0
Demand	120	120	120	123	126
Y-O-Y Growth	0.0	0.0	0.0	2.5	2.4
CAGR					1%

Source: Industry

6.24 Fibre Intermediates

6.24.1 Paraxylene

6.24.1.1 Xylenes are Benzene ring compounds and are available in 3 Isomers- Ortho, Meta & Para. Paraxylene is the isomer with the largest demand amongst all 3 Isomers. Paraxylene is a clear liquid and is consumed with purity level of 99.7%.

6.24.1.2 Paraxylene is mainly used in the manufacture of PTA (Purified Terephthalic Acid) and DMT (DI-Methyl Terephthalate). The DMT market is shrinking globally. PTA and DMT are inputs for Polyester. Paraxylene is traded globally in bulk in a minimum standard parcel size of 5000 MTs +/- 5%.

6.24.2 PX Global Scenario

6.24.2.1 Globally, PX is produced in almost all regions for manufacture of PTA and there are more than 50 PX producers. The demand for PX has grown from 24 MTPA to about 32 MTPA in the past 5 years and we expect demand to reach about 45 MTPA by 2016, growing at a CAGR OF 6.7 % PA.

6.24.3 PX - Asia

6.24.3.1 In line with Asia's global stature, Asia is a major center of PX trade, production and consumption in the world. Asian PX consumption currently accounts for 78% of the growth global consumption. Asia is the growth region for PX and Asian PX consumption is expected to grow from 25 MTPA currently to about 35.6 MTPA in 2016, growing by a CAGR of 7% pa growth rate faster than the global growth rate.

6.24.4 PX - India

6.24.4.1 India is among the fast growing economics of the world. In India, Reliance is the only producer-exporter of Paraxylene. IOC is producing about 350 KTA of PX entirely for captive consumption for its own PTA unit. RIL and ONGC Mangalore will come up with PX expansions in coming years in line with growing downstream Polyester /PTA demand in India.

6.24.5 Future of PX

6.24.5.1 We expect global & particularly Chinese Polyester industry to grow resulting in consumption growth of PTA & thereby in PX demand.

6.24.5.2 Globally, the polyester market is expected to grow at 3.5 MTPA (6-7% pa) in next 5-10 years. This translates into PX demand growth of

2 MTPA. The Indian Polyester demand is expected to grow at 0.5 MTPA (12% pa). This translates into PX demand growth of 0.3 MTPA

6.24.5.3 In line with growing demand, we expect PX capacity addition in India in 2014 to the extent of 900 KTA of nameplate capacity by ONGC-Mangalore Petrochemical and by 1.5 MTPA by Reliance.

6.24.6 **PTA**

6.24.6.1 DMT or PTA and MEG are the raw materials of polyester. PTA has now emerged as the main raw material with DMT becoming practically extinct globally.

6.24.6.2 The first PTA capacity of 150 KT was installed in India in 1988 and it has grown to 3050 KT by 2006 driven by the demand growth. The current PTA capacity is 3850 KT which projected to grow to 7130 KT by 2014-15.

6.24.6.3 The demand growth has shown a steady consistent growth of 8-10% future growth projections are 12-13% driven by downstream investments.

6.24.6.4 The investment in PTA is done by both domestic private and public sectors companies as well as foreign entities. All the PTA plants in India are of world class technology and size and offer best quality raw material to the domestic industry. IOC has already made investment in the polyester feedstock chain PX-PTA-MEG at Panipat and has further plans in Gujarat. MRPL has planned PX-PTA complex as part of its downstream investment with Mangalore refinery.

6.24.6.5 The domestic availability of raw material has been a unique advantage enjoyed by the domestic polyester industry as against China where import dependence has as high as 64% during the growth phase. The raw material self-sufficiency has provided a boost to the growth of the industry in India and has driven investment plans for future. The total polyester production has grown to 4.35 MMT in FY 10-11 and around 2-3 MMT of new capacities are slated to come up in next few years.

6.24.6.6 Apart from polyester fibre/PET/Film, another segment which is growing strongly is the resin applications in UPR, FRP, Wire-enamels, Paints/powder coating & Specialty Chemicals. PTA is being used in these applications as an alternative to Isopthalic acid and pthalic Anhydride. This segment is growing at a very rapid rate driven by the economic growth.

6.24.6.7 The new PTA expansions planned would take care of the demand growth and replace imports which are currently meeting the growing demand.

6.24.7 **MEG**

6.24.7.1 MEG major use is as a raw material for polyester and it also finds usage as anti freeze and other chemical applications. Reliance is one of the largest manufacturers of Polyester. Nearly 85% of MEG produced by RIL goes for captive polyester production.

6.24.7.2 Globally MEG demand has seen phenomenal growth over the last five decades to reach a level of 22 million tones. Overall global capacity has reached a level of 28 million tonnes out of which nearly 70% is contributed by Top 10 producers. MEG Global demand witnessed a robust growth of 11% in 2010 and is expected to grow at a healthy CAGR of 6% upto 2015 well above the expected global GPD growth.

6.24.7.3 Middle East having an advantage of cheap ethane feedstock is a dominant player in the MEG Industry having built up large capacities of nearly 9 million tones. China has emerged as a main consumption hub having building up large downstream Polyester capacities to the tune of 30 million tones. Year 2010 has witnessed large capacity addition of nearly 3.1 million tones of MEG mainly in Middle East.

6.24.7.4 In 2006-07, MEG industry in India was at 950 KT and was a small player in the global market. In a span of five years the industry has grown to 1300 KT. The growth momentum is expected to continue with industry expected to cross 2 million tonnes mark by 2016-2017.

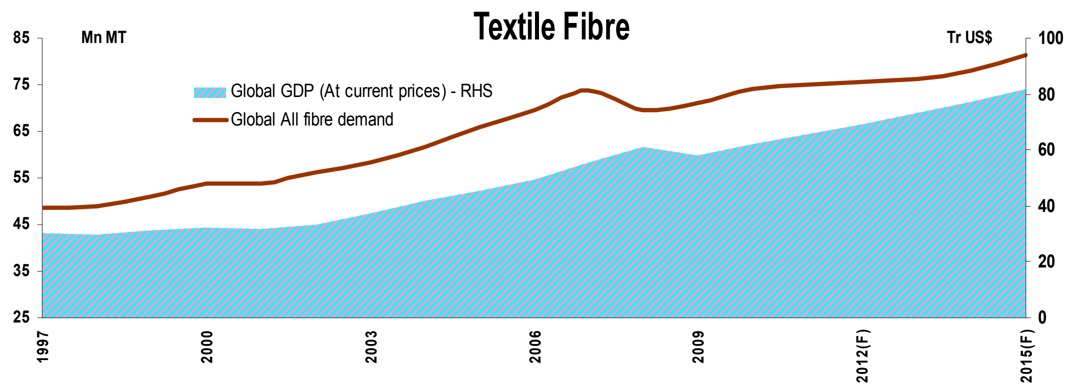
6.24.7.5 Other major producers of MEG are IOCL & India Glycol Ltd in addition to RIL. The Current domestic capacity stands at 1.3 million tonnes in 2011-12, which is lower than current consumption of 1.84 million Tonnes. The domestic shortfall in supply results in an import of MEG mainly from Saudi Arabia, Kuwait and Singapore to the tune of 800 KTA/Annum. The concept of “Green MEG” (MEG made from Agriculture based Alcohol) is slowly catching up in the WEST with many PET bottle manufacturing marketing it as environmentally friendly less carbon footprint products. IGL producing the MEG through alcohol route is able to export its MEG at a premium.

6.24.7.6 In India with a series of new Polyester expansion lined up, MEG will continue to be in shortfall even after commissioning of new MEG plant of 700 KTA in Jamnagar by RIL in 2015-16.

6.25 Synthetic Fibre

6.25.1 Revival in global economy after the recession in 2008 has improved the fundamentals of the global textile and clothing industry. Although recently the global sentiments remain observant, the overall direction points towards a growth. In response the global consumption of textile and apparels has increased, so has overall trade and bodes brighter prospects going forward as the global economy continues to grow driven largely by the emerging economies.

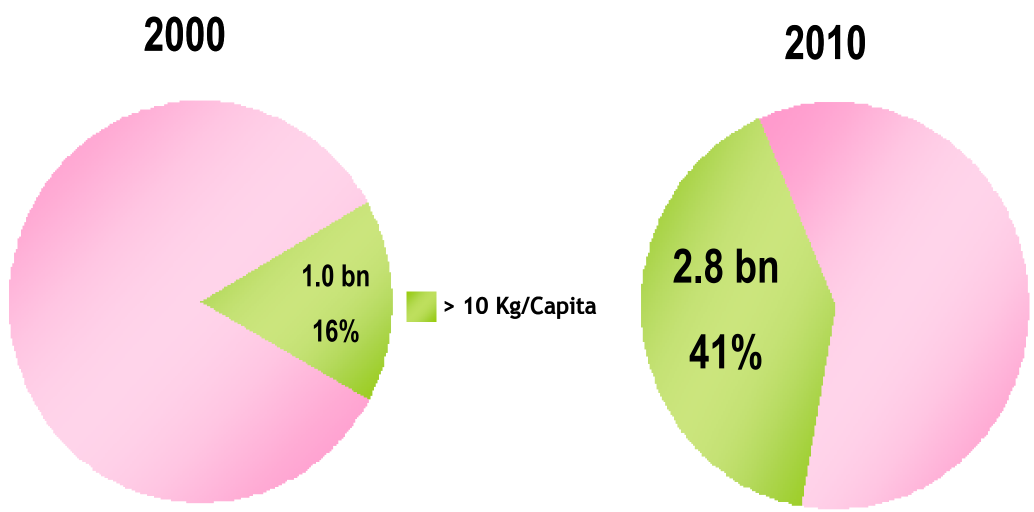
Figure 77: Textile Fibre Demand & Global GDP



Source: PCI, IMF

6.25.2 The global growth has been a combined effect of the growing population in the world and the improving affluence amongst the consumers. Taking note of the consumption pattern, it is note worthy to spot that the segment of global population consuming over 10Kg per year has increased to 41% from mere 16% ten years ago. Here again the economic landscape is changing with the developing countries in Asia, East Europe and Latin America making inroads into the league.

Figure 78: Manmade Fibre Consumption in 2000 & 2010



Source: Private Consultants

6.25.3 This growth has been met by rising consumption of both manmade and natural fibres. The growth rate in the manmade fibre segment has been much faster and has overgrown the consumption volume of the natural fibres. Presently manmade fibres represent 65% of the global consumption.

6.25.4 Keeping pace with the global trends the developing countries too are bracing up and share of manmade fibre in total consumption is fast gaining an increasing share.

Table 83: Per Capita Consumption of Manmade and Cotton Yarn

Year	Kg per Capita		Mkt share (%)
	Cotton	Non-Cotton	Cotton
1960	3.4	1.6	68
1970	3.3	2.6	56
1980	3.2	3.5	48
1990	3.5	3.7	49
2000	3.3	4.9	40
2010	3.3	6.2	35

Source: ICAC

6.25.5 Noteworthy is that the driving base in the rising fibre consumption has been polyester. According to private estimates, it is likely to have the highest growth rate in the coming decade and continue to bear a leading role.

6.25.6 All fibre global demand is growing by around 3-4 million tonnes per annum. Polyester holds better prospects to capture the growth opportunity and is forecasted to account for around 70% of incremental fibre demand globally in the next decade.

6.25.7 On the other hand, cotton faces long-term challenges like land and resource availability, global priority for food security and of course, vagaries of nature. Further, better reliability on availability and lesser price fluctuations would make man made fibres and filaments a natural choice of the industry.

6.25.8 A second noteworthy feature of the textile industry is the structural distribution of the consumers and the producers. At present Asia serves the primary base of production led by China and India. In coming times it is expected that the Asian dominance in global textile traded would continue. A historical perspective reveals that not only textile and clothing, the Asian base has also strengthened in production of raw materials as well. Polyester companies that were largely based in western countries earlier have either closed or have shifted operations to Asia.

6.25.9 The global upswing in the textile industry could also be affirmed from the fact that textile machinery shipments has significantly improved in during 2010 over 2009 in all categories of machines. This puts in place the base for coming growth and ensuing demand for textile and in turn its raw materials. Decade high investments in polyester texturising machines strengthen the acceptability of polyester as an industry choice.

Table 84: Polyester Texturising Machines

	UOM	2008	2009	2010	Y-o-Y
Polyester Texturising Spindles	000 spindles	163	248	518	***109%***
Short Staple Spindles	Mn spindles	8.6	7.2	12.5	***74%***
Open-End Rotors	000 rotors	196	144	450	***211%***
Shuttle-less Looms	000 looms	45	43	107	***146%***
Knitting machines	000 m/cs	41	43	86	***98%***

Source: ITMF

6.26 *Indian Textile Industry*

6.26.1 The Indian textile industry has been growing at a rate of 11% during the last five years, as per private estimates. Maintaining the growth rate, the Indian textile industry is likely to reach a target of $ 220 bn by 2020. At present per capita fibre consumption in India is only 5 Kg vis a vis the global average of 10 Kg per capita.

Table 85: Per Capita Consumption

Per Capita Consumption (Kg)	2000	2010
N America	35	31
W Europe	22	22
China	10	16
E Europe	6	12
L America	7	7
Other Asia	7	7
India	4	5
Africa/M East	3	4

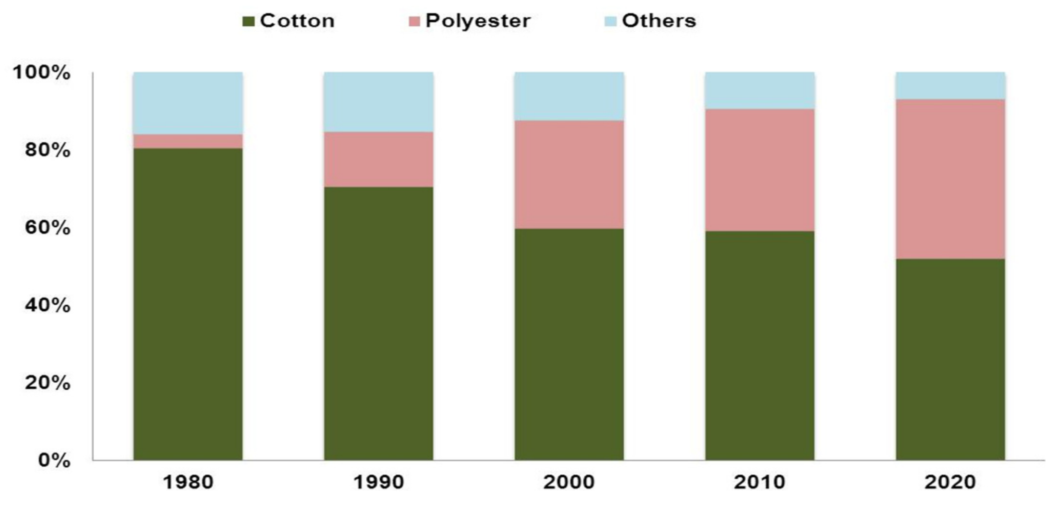
Source: PCI

6.26.2 Export markets have a huge potential to expand from current 4% of global market share to 8% by the end of the current decade. The recent developments in the continent's largest textile exporter, China, open up a huge potential to be captured. Deregulation of currency exchange rate, rising labour and power costs and higher focus on growth of the domestic economy and infrastructure would leave an untapped arena in global trade market, which India should appropriately use to its benefit and create a bigger impression in the global trade map.

6.26.3 The domestic markets too hold big opportunity with the changing habits and consumption patterns. Growth of organized retail, rise in number of urban household population, improving tastes due to urbanization and corporatization would continue to boost the private consumption. In addition to this, the growth of infrastructure and use of textiles for non-apparel uses would also augur to the growth. Gradually man made fibre are finding increasing usage in textile as well as non-textile uses. Polyester has grown significantly amongst the synthetic fibre segment.

6.26.4 In India, the current fibre share is tilted towards cotton. However going forward it should match the global fibre share trend which is dominated by the man made fires and filaments. To harness the upcoming opportunity in the global market and to respond to the rising domestic needs, the industry needs to adopt the fast track riding on growth of manmade fibres. Noteworthy is that polyester has been garnering an increased share progressively and provides for a scalable raw material for affordable and fashionable clothing.

Figure 79: Trend in Fibre Consumption



Source: PCI

6.27 Strategies to achieve domestic growth of the synthetic fibre industry

6.27.1 Desirable support needs to be extended to help investments in the manmade fibre, filament yarn and fabric sector for mordernisation and expansion of plants. There should be an **interest rate subsidy** on the investment in plant and machinery to encourage the growth of the sector.

6.27.2 The consumer should have impartial options to choose what is best suited based on merits. The neutral duty structure would facilitate final consumers to decide the most affordable fibre on based on merit. A **fibre neutral policy** should be adopted to give a fair and level playing ground for all parties. Excise duty regime should be modified to aid the growth of the manmade fibre industry. Currently cotton enjoys zero excise duty and spinning comes under the optional duty structure. Manmade fibre production faces an excise duty of 10%. This discrepancy is a deterrent to the downstream consumption and a rationalisation to bring a level playing ground would be a great support for the manmade fibre sector and the textile industry.

6.27.3 Import duties on manmade fibres are very low at 5%, which is on par with China and other competing countries. Therefore to keep the global competitiveness of the local man made fibre industry, **import duties on these products should be maintained** to sustain the economics of the producers. Further SAD should be retained to maintain the import parity.

6.27.4 Export bears a significant role in the growth of the industry. **Export incentives should be continued** to assist the industry. DEPB has been proposed to be discontinued after September 2011. Under the present global scenario DEPB should be maintained beyond September 2011 to sustain the momentum of exports. In the face of uncertainty of exchange rates and fluctuations in global trade markets; DEPB benefits should be maintained till the global economy stabilizes.

6.27.5 Infrastructural and financial support to set up **captive power plants** would help maintain steady industry operations in order to seize the right opportunity.

6.27.6 An efficient **port and road connectivity** and related ancillaries to improve the turnaround time. Similarly creating a seamless online documentation process will help in reducing transaction costs.

6.27.7 As observed during the early phase of the 2011-12 financial year, environmental awareness is gaining prominence. Many downstream industries had to be stopped due to environmental issues. It is a healthy practice adopted by the Government to boost the image of the Indian textile industry in the global arena. In continuation of the efforts, support to set up **effluent treatment plants** with marine outfall pipelines/network and water recycling facilities with UF/RO facilities should be extended.

6.27.8 The global consumerism trend is moving towards a more environmental conscious era, wherein the recyclability of products is gaining prominence, and the desirability of this feature in fibres and textiles is no less important. Friendly policies should in place to encourage **recycling and usage of more recycled content**.

6.27.9 The man made fibre industry holds versatile and diverse potential for applications in segments other than the apparel application. The **non apparel industry** is still in a nascent stage with research and development needs to boost its growth and application arena across the country. Set up of **new institutes with R&D facilities** and incentivisation of private institutes along with introduction of suitable legislation mandating the use of technical textiles in public infrastructure would be a great helping hand to accelerate the growth of the non-apparel segment. Pilot plants should be set up to serve as model plants.

6.27.10 **Feedstock sufficiency** is very critical to any industry. The country is currently more sufficient than China for its feedstock requirements. But as the industry grows it is envisioned that it would require an investment of about Rs 10,000 crores. The Government should take steps to support the growth of the textile as well as the feedstock industry to build a strong base for the entire industry.

6.28 Technical Textiles

6.28.1 **Introduction**

6.28.1.1 Technical textiles are among the most promising and faster growing areas for the global and the Indian textile industry. In the present world, these are indispensible part of human life and account for over one-quarter of all textile consumption in weight terms. Considering the growing and versatile economic and infrastructural development of India, technical textiles are bound to play a very crucial role in the future ahead. An outstanding feature of the technical textiles industry is the range and diversity of raw materials, processes, products and applications that it encompasses.

6.28.1.2 Technical textiles are defined as comprising all those textile-based products which are used principally for their performance or functional characteristics rather than for their aesthetics. Depending on the product characteristics, functional requirements and end-use applications, these have been grouped into 12 sectors, viz.:

- Agrotech (agriculture, horticulture and forestry)
- Buildtech (building and construction)
- Clothtech (shoes and clothing)
- Geotech (geotextiles, civil engineering)
- Hometech (furniture, upholstery, interior furnishing, household textiles, floor covering)
- Indutech (filtration, cleaning and other industrial uses)

- Medtech (medical, healthcare and hygiene)
- Mobiltech (automobiles, shipping, railways and aerospace)
- Oekotech (environmental protection)
- Packtech (packaging)
- Protech (person and property protection)
- Sporttech (sport and leisure)

6.28.1.3 There are over 150 products classified under Technical Textiles and its coverage in terms of application areas is expanding globally with each passing day on account of technological advancement in raw materials and processes.

6.28.1.4 Unlike India's textiles and garments industry which is export intensive, the Technical Textiles industry is **import intensive**. Many products are imported in order to cater to the domestic demand. The only **products which are exported** in large quantities from India (like fishnets, surgical dressings, and flexible intermediate bulk containers, among others) do not require high levels of R&D and technology. Also, the size of manufacturing units varies to a great extent.

6.28.1.5 Technical textiles in developed countries have matured and hence its growth in these regions is expected to be moderate. Developing economies like China and India are expected to register a robust growth in Technical Textiles on account of heavy infrastructure activities in these regions. Also, as the consumption of disposable Technical Textiles products (like wipes, sanitary napkins, and adult/baby diapers) is directly related to disposable income, an increase in disposable income of a country is expected to drive the demand of these products. India has huge advantage in manufacturing of textiles and garment due to its inherent low cost advantage. Therefore, in niche segments of technical textiles India can gain cost advantage through tie-ups with research institutes for the development of new technologies.

6.28.2 Global Scenario

6.28.2.1 The global market size of Technical Textiles was estimated to be US$ 106.8 billion in 2005 (20 billion kg). As per Baseline survey conducted by IMACS, amongst all the segments of Technical Textiles, Mobiltech, Indutech and Sporttech are the more prominent ones which collectively accounted for 56% of global market size in 2005.

6.28.2.2 Globally, production of segments in the textiles industry has reached a saturation point and its manufacture has become extremely competitive due to shift in production to low cost nations. Hence, these nations have shifted their focus on manufacture of value added products namely Technical Textiles which offer good margins and are technology intensive.

Table 86: Global Market Size of Technical Textiles

Global market size						
	Year					
Segment	2005		2010		CAGR (%)	
	Volume (bn kgs)	Value (US$ mn)	Volume (mn kgs)	Value (US$ mn)	Volume	Value
Mobiltech	2.8	26,861	3	29,282	3	1
Indutech	2.6	16,687	3	21,528	4	5
Sporttech	1.1	16,052	1	19,062	3	3
Buildtech	2.0	7,296	3	9,325	5	5
Hometech	2.5	7,622	3	8,778	3	3
Clothtech	1.4	7,014	2	8,306	3	3
Meditech	1.9	6,670	2	8,238	4	4
Agrotech	1.6	6,568	2	8,079	4	4
Protech	0.2	5,873	0	6,857	4	3
Packtech	3.0	5,329	4	6,630	4	4
Geotech	0.3	927	0.3	1,203	5	5
Oekotech	0.3	1039	0.4	1389	6	5
Total	19.7	106,899	24	127,288	4	3
Source: DRA						

6.28.3 **Indian Scenario**

6.28.3.1 India is the second largest textiles economy in the world after China. However, its contribution to the global technical textiles market is insignificant. As per the latest estimates by Technopak, the current market size (2009) of Technical Textiles in India stands at Rs 49000 crores and it has grown at a CAGR of 10% from Rs 28330 crores in 2005. The estimates for 2010 are Rs. 58100 crores which are expected to increase to Rs103140 crores by 2015 and to Rs. 146000 crores by 2020 at a CAGR of 10 percent. However, the segment wise figures as per baseline survey report outlined below are somewhat non realistic in the sense that these do not cover all technical textile products and many packtech and other commodity products cannot be really classified as technical textiles. Also, the CAGR indicated in these figures needs to be modified depending upon the new capacity creation as well as infrastructural development.

6.28.3.2 In India the rapid growing segments of technical textiles include Agrotech, Meditech, Geotech (including Builtech), Protech, Hometech, Mobiltech and Packtech. The segments of Protech, Meditech and Geotech are expected to grow rapidly if appropriate regulatory measures are provided by the Government as discussed here. Nonwoven and Composite sectors cover many of the above segments of technical textiles and need to be given thrust. **Accordingly, the Government of India has established eight centres of excellence (CoEs) for Agrotech, Medtech, Geotech, Protech, Indutech, Sporttech, Nonwovens and Composites** for the development and promotion of technical textiles.

Table 87: Segmental Market Size of Technical Textiles

Exhibit 7.1.3: Segmental market size (Rs n) Segmental market size (Rs mn)			
Segment	FY02	FY08	CAGR (%)
Agrotech	2,610	5,530	11.3
Buildtech	10,511	21,570	10.8
Clothtech	53,951	69,080	3.6
Geotech	1,100	2,720	13.8
Hometech	7,579	50,250	31.0
Indutech	26,220	32,060	2.9
Meditech	11,933	16,690	4.9
Mobiltech	12,764	31,830	13.9
Oekotech	-	680	-
Packtech	35,877	146,300	22.2
Protech	3,475	13,020	20.8
Sporttech	53,898	28,510	-8.7
Total	219,917	417,560	9.6
Source: ECTT, Baseline Survey on Technical Textiles			

6.28.3.3 The segment wise domestic market for technical textiles as per Technopak report is as follows:

Table 88: Market for technical textiles as per Technopak report (Rs. Crs)

Segment	2005	2009	2010(E)	2015(E)	2020(E)	CAGR %
Packtech	7250	18492	23400	49000	72150	13
Clothtech	6105	7200	7500	9200	10230	3
Hometech	1950	6887	9450	15900	25600	13
Mobiltech	2020	3707	4300	8300	11650	11
Sporttech	3920	2564	2300	2950	3350	3
Buildtech	1500	2432	2700	4990	6800	10
Meditech	1410	1765	1900	2470	2850	4
Protech	670	1623	2000	4070	5850	12
Agrotech	380	627	700	1330	1850	10
Geotech	170	320	380	780	1150	12
Indutech	2900	3315	3400	4050	4400	3
Oekotech	55	68	70	100	120	5
Total	28330	49000	58100	103140	146000	10

6.28.4 **Growth Projections**

6.28.4.1 According to the baseline survey of technical textiles commissioned by the Office of Textiles Commissioner, the technical textiles industry is expected to register a growth of 11% per annum till 2012-13 which now appears unrealistic. Similarly, Technopak report indicates this figure at 10% which is more realistic if appropriate policy and regulatory regime is introduced by the government. Due to non-availability of time-series data on production/ consumption of various technical textile products, it has been difficult to estimate growth projections for various segments of the technical textile sector.

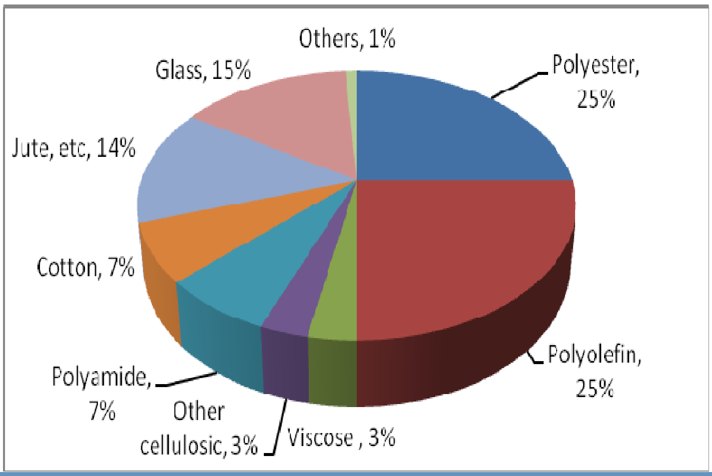
6.28.4.2 However, taking a holistic view of the current scenario, it is expected that the technical textile industry is likely to grow at 6-8% per annum till 2020 without any policy interventions. Therefore, to achieve a CAGR of the order of 10 percent or more and attracting new investments and new capacity creation, the government interventions are required to push their demands in the interest of environment, health and safety of the masses, in the form of regulatory measures, especially in the areas of Geotech, Medtech, Protech, Mobiltech and Oekotech.

6.28.5 **Raw Material for Technical Textiles**

6.28.5.1 Technical Textiles products are manufactured from various fibres depending upon the end usage of the product. All types of fibres – natural (cotton, silk, jute, coir and wool), man-made fibres (viscose, polyester, nylon, acrylic, etc) as well as high performance specialty fibres find usage in Technical Textiles. Man-made fibres (MMFS) find more usage in manufacture of Technical Textiles due to their inherent advantage of having higher strength and versatility as compared to natural fibres.

6.28.5.2 World consumption of fibres in Technical Textiles in 2005 was 22% of the total fibres consumed. Of the total fibres consumed (19.68 mn tonnes), around 80% comprised of MMFs and remaining comprised of natural fibres. Industry experts believe the share of MMFs in total fibre consumption will further increase to 81.3% by 2010. Among various fibres, polyoliefin and polyester collectively accounted for 50% of total fibre consumed in Technical Textiles in 2005 followed by glass (15%) and jute (14%). Specialized fibres like aramid and carbon account for 1% of fibres consumed in Technical Textiles. Natural fibres find application in comparatively less demanding applications like sacks, twine and carpet backing.

Figure 80: Raw Material used in Technical Textiles



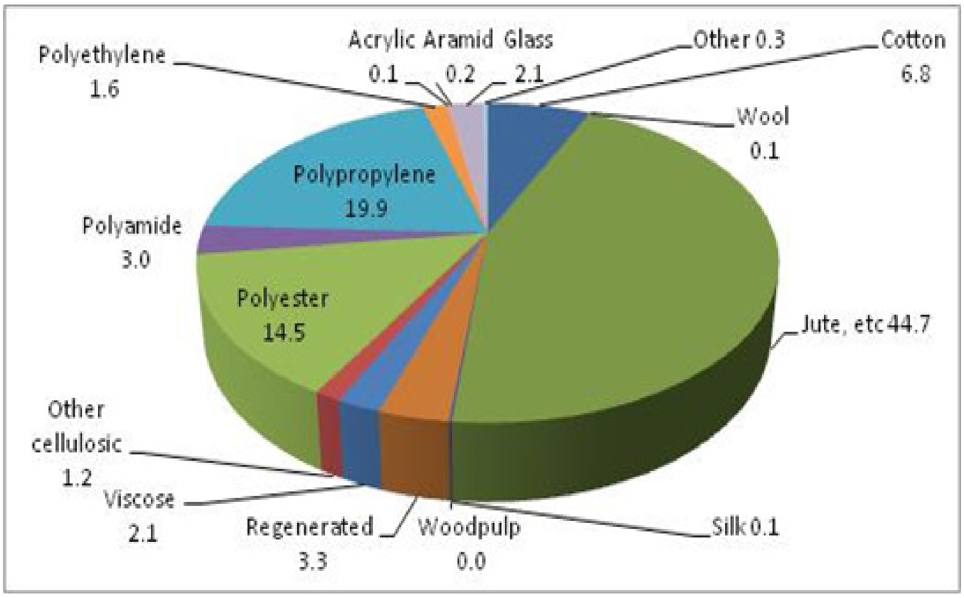
Source: ECTT

6.28.6 **Indian scenario**

6.28.6.1 In India, indigenous production of fibres is limited and majority of specialty fibres are imported to cater to growing demand. Among various fibres, polypropylene and polyester account for 34.4% of total fibre consumption in Technical Textiles. While jute has mostly been replaced by HDPE or Polypropylene all over the world, India still uses jute in manufacturing of packaging products due to mandatory packaging in jute materials Act. Also, other traditional fibres like hemp, sisal and cotton are rapidly getting substituted by synthetic fibres like polyester, polyethylene, nylon, etc due to better performance and functional properties of these fibres.

6.28.6.2 Type of fibres used in the manufacture of Technical Textiles products depend upon the desired properties of the end products. Majority of products of Technical Textiles are manufactured from MMFs (polyester, nylon and polypropylene) and polymers (HDPE, LDPE, and Polypropylene (PP). Some of the speciality fibres used in the manufacture of Technical Textiles include Aramid, UHMPE, Carbon fibre, Nomex, Trevera and glass fibres.

Figure 81: Fibre composition in Technical Textiles



6.29 Strategy to Increase Investment for Production & Consumption of Technical Textiles in India

6.29.1 **Policy Measures**

6.29.1.1 TUF scheme has been very useful in attracting new investments in the area of technical textiles particularly and greater efforts are still required to build indigenous capacity for technical textiles. Accordingly, the interest subsidy under TUF needs to be enhanced to 10 percent and more allocation needs to be given for technical textiles for upgradation and installation of machineries and equipments for technical textiles production in the country. Further, the capital subsidy scheme needs to be continued. Also, all capital equipment for technical textiles machinery to be exempted from import duty.

6.29.1.2 Sales tax incentives for the technical textiles (yarn & downstream fabric) manufacturer need to be provided suitably.

6.29.1.3 The excise duty refund for specialty yarns for technical textiles to be made available for domestic manufacturers or it should be given total excise duty exemption. This will boost indigenous production of technical textiles at affordable prices.

6.29.1.4 The focus product scheme for enhancing exports of technical textiles needs to be enlarged to cover specialty fibres and yarns for technical textiles such as antimicrobial fibres, fire retardant fibres/filaments, micro fibres, recrobulk yarns, antistatic fibres, etc.

6.29.1.5 A price purchase preference of at least 5 percent be given by all govt agencies on local technical textile products to attract investment in this area and increase indigenous competitiveness with imported products

6.29.1.6 These steps are essential to promote the growth of technical textiles in India which has been identified as a focus area by GOI where a growth rate of 11% p.a. has been projected in next 3-5 years. Technical textiles usage in the country is estimated at 4% compared to international norms of 22-25% of textile consumption. The above measures will help the industry in achieving the projected growth targets.

6.29.2 **Regulatory Measures**

Fire Retardant Textiles

1. In view of public safety and property loss as well as high environmental pollution involved in fires, it is very urgent that relevant Indian standards are made mandatory for textiles used in public places/buildings such as hospitals, airports, theaters, shopping complexes, railways, civil aviation, automobiles, defence, etc, upholstery items in automobiles, etc. Legislation for fire retardant textiles is already in force in many of the developed countries of the world and India should be no exception to this.
2. In view of safety of workers, BIS standards on industrial workers' clothing are also required to be made mandatory under the BIS Act.
3. Standards on FR textiles e.g. IS15741: 2007, IS15742:2007, IS15748:2007 and IS15768:2007, could be made mandatory under the BIS Act.
4. Subsequently, standard for resistance to ignition of mattresses, divans and bed bases to be made mandatory after publication.
5. Standards developed by BIS on fire retardant textiles need to be included in National Building Code of India 2005 immediately as a separate chapter.

Geotech & Buildtech

a) A separate comprehensive legislation is required to promote use of geo-synthetics (especially where CBR ratio is less than 3.5) in India in view of environmental protection, pollution prevention, efficient utilization of natural resources, safety of masses involved, increased efficiency, increased productivity, maintenance free construction, large potential for cost reduction of projects, etc. in the following areas:

i) Pavements – new construction and rehabilitation of old paved surfaces
ii) Railways – new tracks, track renewals
iii) Roads - highways, expressways, coastal roads, rural roads, access roads, forest roads, airport runways, taxiways, parking lots and storage yards
iv) Filtration and Drainage applications – road drainage, wall drainage, agricultural & pipe drains, basement drainage, landfill drainage, blanket drains in roads & sports fields, vertical drainage for soil improvement
v) Erosion and Sediment Control – roads, landslides, landscaping, building foundation, footpaths
vi) Reinforced Soil Walls
vii) Landfill and Waste Management
viii) Waterproof Canal/Pond/Reservoir lining
ix) Airport strips and pavement
x) Containment walls
xi) Building & construction activities e.g. fibres for concrete reinforcement

b) In view of large potential for cost savings, environmental protection, safety, economic and social importance of geo-synthetics in the infrastructural development in India and the environmental protection by their use, it is essential that their use is made mandatory in India just like mandatory regulation of fly ash or iodized salt, especially in the following areas:

i) All highways, expressways and coastal roads, reinforcement with geosynthetics must be mandatory when the CBR ratio is less than 5
ii) All coastal roads embankments which are on soft soil foundation, use of geosynthetics must be mandatory.
iii) Most rural roads are rebuilt after a prolonged period of 10 years or more. Such or even higher survivability of rural roads can only be guaranteed by using separation geosynthetics.

Hence it is essential that guidelines of IRC, RDSO need to be modified to include mandatory standards for such usages of geotechs so as to promote production and consumption of geotechs in India. This is more essential in view of the fact that in India almost entire infrastructural work is handled by the government which is supposed to comply with standards in the interest of public safety, environmental protection and large scale savings in public funds.

c) Throughout the world there is a tendency towards projects that are funded with private capital. Almost all developing and many developed economies face a similar situation:

- Rapidly growing demand for infrastructure projects.
- Insufficient public funds to finance projects.

d) The projects are often organized as a BOT (Build Operate Transfer). Since these projects have a responsibility to produce yields for the capital borrowed, cost effectiveness and more innovative designs leading to cost savings could have increased attention. The BOT system may be relevant to developed economies where latest technology is being used for geo-techs. In India, this needs be modified to DBOT (Design Build Operate Transfer) with the idea to give emphasis on the initial design of the project regarding the right use of latest material and technologies like geo-tech in various infrastructural development projects.

e)The use of Geosynthetics need to be promoted by incorporating relevant standards in building byelaws of various State Government and also in the National Building Code of India for adoption by the relevant agencies.

Meditech

a) Amendment required in Rule 124 C Schedule F (II) ‘Standards for surgical dressings’ of the Drugs and Cosmetics Act to cover:

i) All kinds of woven and non-woven surgical dressings made from antimicrobial non allergic polyester and other man-made fibres such as rolled bandages, bandage cloth, absorbent gauzes, crepe bandages, etc.
ii) Feel fresh odourless antimicrobial uniforms fabric for hospital staff
iii) Woven, nonwoven and coated fabrics made from micro filament polyester yarn as well as non-woven single use fabrics made from SMS polyester/polypropylene

Various medtech products made from new generation Man-Made Fibres including polyester include:

i) Woven/nonwoven surgical gowns, drapes, clean air suits and other garments used in surgical and other medical situations
ii) All medical wovens, knits such as bandages and dressings, gauze, slings, etc
iii) Nonwovens for bandages, dressings and other medical end-uses not elsewhere specified
iv) Sterile medical packaging
v) Waterproof coated fabrics for mattresses
vi) Outer fabrics used in sanitary towels, diapers, incontinence pads
vii) Wipes for cleansing skin, face, hands, etc.

The Indian Drugs and Cosmetics Rules presently cover standards of absorbent gauze and bandage cloth made of cotton only [Rule 124-C, Schedule F (II)] while many better antimicrobial man-made fibre products are being used throughout the world to specifically meet the functional requirements of antimicrobial activity (antifungal & antibacterial) (*see* British US and Japanese standards, e.g. EN 1644-1997). The Indian Pharmacopeia also does not cover these latest innovative man-made fibre products as it is obsolete and outdated and covers only use of cotton bandages. There is an urgent need for reviewing these standards as well as other standards on surgical dressings and medtech textiles in the light of the latest developments at national and international levels where much better textile products are useful in providing health and safety to the users. Of all the medtech products, the surgical dressings are used to a large extent involving almost all the sections of our society and, therefore, deserve topmost attention.

6.29.3 Manufacturers of Speciality Fibres for Technical Textiles

6.29.4 List available on website of the O/o Textile Commissioner, Mumbai. This website also includes details on Mini Mission on Technical Textiles as well as capacity information.

6.30 Products with Significant Scale to Justify a World Scale Plant in India

6.30.1 The following chemicals are produced on an industrial scale in the leading economies of the world, but are notable by the absence of global scale efficient plants in India, despite large local demand and consumption.

6.30.2 The unavailability of these products frequently restrains the forward integration of other products and concomitant growth / development of the industry.

6.30.3 It would be useful to take at least the next step in the value chain which in turn would encourage the development of the relatively smaller scale downstream products. The key products along with a synopsis of their production technology are as follows:

6.30.4 **Methanol derivatives**

6.30.4.1 **Acetic Acid ➔ Vinyl Acetate monomer (VAM) ➔Plastics:** The major route to acetic acid is via carbonylation of methanol, which accounts for about 75% of dedicated acetic acid capacity according to SRI. BP and Celanese are the leading practitioners of carbonylation technologies. Other processes include acetaldehyde oxidation, which accounts for about 9% of world capacity, and butane oxidation, accounting for about 7%. These processes are not as efficient as carbonylation, however, and much capacity using the technology has been shut, analysts say. About 40% of acetic acid is obtained as a byproduct of other chemicals, such as polyvinyl alcohol. (Produced by GNFC).

6.30.4.2 **Methyl Methacrylate (MMA) ➔ PMMA (acrylic resins):** More than 80% of MMA worldwide is produced by the esterification of methacrylamide obtained from acetone cyanohydrin. The "Alpha process" developed by Lucite is a novel MMA technology based on carbon dioxide, ethylene, and methanol compared with traditional routes based on acetone and hydrocyanic acid, or isobutylene. (Produced by GSFC)

6.30.5 **Ethylene derivatives**

6.30.5.1 **Styrene ➔ Polystyrene, ABS, SAN (Engineering Polymers), SBR, Unsat. Polyesters (Specialty Materials):** Styrene is produced by reacting benzene with ethylene to form ethyl benzene, which is subsequently dehydrogenated to produce styrene. Styrene is also made as a co-product in the propylene oxide / styrene monomer process.

6.30.5.2 **Ethanolamines ➔Mono, di and tri ethanolamines**

6.30.5.3 **Glycol Ethers ➔ Solvents (for inks, cosmetics, detergents)**

6.30.5.4 **Ethyl Acetate ➔ Solvent:** Ethyl acetate is an ester of Acetic acid and ethanol. The main method to manufacture ethyl acetate involves the esterification of ethanol with acetic acid although some is produced by the catalytic condensation of acetaldehyde with alkoxides. Solutia obtains ethyl acetate as a coproduct in production of polyvinyl alcohol, which the company uses captively in the manufacture of polyvinyl butyral. In the main esterification process, a mixture of acetic acid and ethanol with a small amount of sulphuric acid (catalyst) is preheated and fed to an esterifying column where it is refluxed. (Produced by Jubilant, Somaiya, etc.)

6.30.6 **Propylene derivatives**

6.30.6.1 **Acrylic Acid ➔ Paints, Coatings, Super Absorbent Polymers, Adhesives, Detergents:** Most plants produce acrylic acid via a two-step oxidation process in which propylene is oxidized to make acrylic acid. The process also generates acrolein, which can be further oxidized at high temperatures to form more acrylic acid. BASF has discontinued use of the Reppe process, which synthesizes acrylic acid from acetylene, carbon monoxide, and water over a nickel catalyst. All new capacity will produce acrylic acid through propylene oxidation, although considerable research is ongoing on acrylic acid based on bio-feedstock as well as one-step oxidation of propane / propylene.

6.30.6.2 **Cumene / Phenol / Acetone ➔ Phenolic Resins, Bisphenol A, Polycarbonate polymer, MMA:** About 50% of cumene production uses zeolite catalysts, as producers have switched from older phosphoric acid-based processes. Zeolite technology is not a radical change from the earlier process that alkylates benzene with propylene, but it is more economical than using phosphoric acid. About two-thirds of acetone worldwide is made as a coproduct of phenol during cumene oxidation. Technology licensers include KBR, Mitsui Chemicals, and UOP. (Producers include HOC, SI group)

6.30.6.3 **Acrylonitrile ➔ ABS, SAN, NBR, Acrylic fibers:** Propylene ammoxidation is the main commercial route to Acrylonitrile. Most plants use the BP Sohio process, which converts propylene, ammonia, and air to Acrylonitrile and coproducts including acetonitrile and hydrogen cyanide. BP also manufactures and sells the proprietary catalyst used in the process. Other producers include Asahi Chemical and Solutia.

6.30.6.4 **Propylene Oxide ➔ Propylene Glycol, Polyols ➔ Antifreeze, Polyesters, Polyurethanes**

6.30.6.4.1 Propylene oxide (PO) is made traditionally by chlorohydrin and epoxidation routes but new technologies based on hydrogen peroxide or cumene hydroperoxide have been commercialised. A significant amount of PO capacity is based on the older chlorohydrin process but this route suffers from environmental liabilities and has high capital costs. Propylene and chlorine in the presence of water are reacted to form propylene chlorohydrin, which is further reacted with sodium hydroxide or calcium hydroxide to obtain PO.

6.30.6.4.2 An epoxidation process that had been gaining in popularity due to its superior economics was the propylene oxide/styrene monomer (PO/SM) route. However, it has the potential disadvantage of coproducing 2.25 tonnes of styrene for every tonne of PO. In the PO/SM process, ethyl benzene is first reacted with oxygen to make ethyl benzene hydroperoxide and then with propylene to form PO. The phenylmethylcarbinol co-product is dehydrated to styrene. An alternative epoxidation route uses isobutane which makes a tertiary-butyl alcohol co-product that can be converted to methyl tertiary butyl ether (MTBE).

6.30.6.4.3 New PO technologies without co-products have now been developed. Cumene hydroperoxide is obtained by the oxidation of cumene (made from benzene and propylene) with air. On giving up oxygen to propylene, the cumene hydroperoxide is converted to cumyl alcohol (also referred to as dimethylbenzyl alcohol). The cumyl alcohol can be dehydrated to alphamethyl styrene which in turn can be hydrogenated back to cumene for recycle.

6.30.6.4.4 A number of companies have developed technologies to make PO from propylene and hydrogen peroxide. The greatest attraction of the HPPO process is its apparent simplicity with a relatively straightforward reaction and few by-products.

6.30.6.5 **2-ethyl hexanol (2EH) ➔Plasticizers**

6.30.6.6 **n-butanol ➔ Acrylates, Acetates (Solvents):** Both 2EH and n-butanol (oxo alcohols) are produced by the oxo (hydroformylation) process to produce normal and iso-butyraldehydes from propylene for subsequent conversion to 2-ethylhexanol or to butanols. Normal and iso-butyraldehydes are produced by reacting propylene with synthesis gas (a mixture of carbon monoxide and hydrogen) in the presence of a catalyst. (Produced by Andhra Petro)

6.30.7 **Butene derivatives**

6.30.7.1 **Butadiene, iso-butylene ➔ Elastomers**, **Comonomers for Engineering polymers, higher olefins**. Most butadiene is obtained by extractive distillation from the crude C4 stream from ethylene crackers.

6.30.8 **Benzene derivatives**

6.30.8.1 **Styrene ➔ same as in Ethylene derivatives above**

6.30.8.2 **Cyclohexane ➔ Adipic Acid / Caprolactam ➔ Nylon.** All producers make adipic acid by nitric acid oxidation of KA oil, a cyclohexanone-cyclohexanol mixture obtained from the oxi¬dation of cyclohexane or phenol. Asahi Kasei uses a route proceeding via cyclohexene to con¬vert benzene to cyclohexanol.

6.30.8.3 Cyclohexane or phenol is the primary feedstocks in the production of caprolactam, Tecnon says. Producers such as BASF, Rhodia, and DSM have developed alternative routes, including butadiene conversion. Most plants use the oximation of cyclohexane.

6.30.8.4 **Cumene / Phenol ➔ same as in Propylene derivatives above.**

6.30.9 **Toluene derivatives**

6.30.9.1 **Toluene Diisocyanate (TDI) for urethanes (Beddings, insulation, varnishes, adhesives, sealants, footwear).** The main commercial route for the manufacture of TDI starts with the nitration of toluene using nitric acid to produce Dinitrotoluene followed by catalytic hydrogenation to toluene Diamine. The toluene Diamine is reacted with phosgene to produce TDI. A new development by Bayer involves the Phosgenation being carried out in the gas phase instead of the liquid phase. TDI can be produced directly from Dinitrotoluene by liquid phase Carbonylation with o-dichlorobenzene. This route avoids the use of phosgene and waste recovery problems associated with HCl (Produced by GNFC / Chematur).

6.31 Issues Facing Indian Petrochemical Industry

6.31.1 Investment in petrochemical industry depends on many factors. Some of the important ones are

- Availability of feedstock- in particular gas
- High duty on feedstock – in particular LNG and natural gas
- Low import duty on polymers vis-à-vis most ASEAN countries as well as many developed countries.
- Poor margins due to nil duty differential between feed-stock and products
- Requires large fund to set-up petrochemical complexes.
- Ability to withstand the troughs of low profitability when margins are shrunk. Petrochemical is highly cyclic industry and follows a pattern of 6-8 years between two peaks or troughs.

6.31.2 All the above factors influence decision of putting up fresh investment in petrochemicals. Above points are discussed below in detail.

6.31.3 **Feedstock availability** - The demand projections for 2016-17 and 2021-22 period indicated that approximately 7 million tons ethylene will be required in case all products are to be produced in India. For any company to plan future investment, feedstock tie up is a must. Currently petrochemical feed stocks attract 5 % customs duty. The products namely polymers, synthetic fibre/ yarn intermediates and synthetic fibre/yarn attracts 5 % customs duty. There is no duty differential between feedstock and products manufactured. At times of price volatility domestic manufacturers face squeeze in margin.

6.31.4 **Low import duty on polymers vis-à-vis Other Countries & Nil duty differential between feedstock and end-products.** Import duty on key petrochemicals like polymers in India is one of the lowest in the world as the following table shows. Not only other Asian countries, even developed countries like the US, EU and Japan have a higher duty of 6.5%. Since duty on feed stocks and polymers are at the same level of 5%, there is nil duty differential between them unlike in other countries who maintain a positive duty differential between the two.

Table 89: Cross Country Comparison of Import Tariff

HS Code	Product	India	China	Malaysia	Thailand	Philip-pines	Indonesia	Saudi Arabia	Japan	US	EU
27101190	Naphtha	5%	1%	0%	0%	3%	0%	5%	0%	0%	0%
390110	LDPE	5%	6.5%	30%	5%	15%	15%	12%	6.5%	6.5%	6.5%
390110	LLDPE	5%	6.5%	30%	5%	15%	15%	12%	6.5%	6.5%	6.5%
390120	HDPE	5%	6.5%	30%	5%	15%	15%	12%	6.5%	6.5%	6.5%
390210	PP	5%	6.5%	30%	5%	15%	15%	12%	6.5%	6.5%	6.5%
390410	PVC	5%	6.5%	20%	5%	15%	10%	5%	6.5%	6.5%	6.5%
390311	PS	5%	6.5%	20%	5%	15%	10%	12%	6.5%	6.5%	6.5%
Duty Differential		0%	5.5%	30%/20%	5%	12%	15%/10%	7%	6.5%	6.5%	6.5%

6.31.5 **Large investible Surplus** - In the recent past, IOCL has added a Naphtha Cracker,at the cost of Rs 14,400 Crs. Future investments will depend on the capabilities of companies to invest such large sums.

Table 90: Ethylene Capacity Addition

		Capacity (mmt)			
Company	**Start up**	**Ethylene**	**Propylene**	**PE**	**PP**
OPAL	2014-15	1.1	0.34	0.72	0.34
HMEL	11/12-13/14	1.0	0.49-0.54		0.44
IOCL	2009-10	0.86	0.60	0.64	0.65

6.31.6 In conclusion, capital financing is one aspect in investment in Petrochemicals. Other important aspects are feedstock tie up and ability to withstand the cyclicality. The lack of Capital financing is attributed the rising trend in interest rates, slow down in industrial output, high cost of borrowing. A survey by CII (Northern Region) in September 2011 indicated that around 89 % of the industry respondents of the survey indicated that rising interest rates is mainly responsible for declining investment.

6.31.7 In case of polymers and synthetic fiber currently there is a oversupply, the slow recovery of the global markets especially the Western economies of USA and European Union. Prevailing uncertainty in global economy as well as the volatility in prices of commodities has induced a very cautious buying approach.

7 Petrochemicals R&D in India

7.1 Overview

7.1.1 R&D is the key factor for the growth of the chemical industry and its focus varies across different sectors of the industry. Typically petrochemicals being a basic chemical industry the chief focus will be on optimizing the processes to reduce cost and application development to boost demand. A huge amount of effort is also directed towards energy management since energy is the significant element of conversion cost. In petrochemical sector application R&D is very critical as new applications have to be identified in order to synthesize new and advanced class of polymers. India has been making considerable effort in strengthening its R&D potential. In a recent UNCTAD report India was highlighted as one of the most preferred R&D destinations outside the US. In the last 2-3 yrs has seen a preponderance of companies looking at India as an R&D destination.

7.1.2 In India, in the field of petrochemical sector, the main institutions or companies which are doing continuous, significant amount of R&D are Indian Institute of Petroleum (IIP), National Chemical Laboratory (NCL), Indian Institute of Chemical Technology (IICT), National Institute for Interdisciplinary Science & Technology (NIIST), North East Institute of Science & Technology (NEIST-Jorhat), Reliance Industries Limited (RIL), Oil and Natural Gas Corporation (ONGC), Hindustan Petroleum Corporation Limited (HPCL), Chennai Petroleum Corporation Limited (CPCL), Indian Oil Corporation Limited (IOCL) etc. Of all the above institutions, IIP has contributed a lot to the petrochemical sector in research.

7.2 Central Institute of Plastics Engineering & Technology (CIPET)

7.2.1 Central Institute of Plastics Engineering & Technology (CIPET), Chennai, Tamil Nadu is a premier institution devoted to manpower training and technical services to the plastics and allied industries. CIPET has been accredited with ISO 9001:2000 certification on "Design, development and conduct of specialized training courses in plastics engineering & technology and rendering technical/ consultancy services in design, tooling, plastics processing & testing to the plastics & allied industry".

7.2.2 R&D Projects Undertaken By CIPET in Petrochemical Sector:

Table 91: List of Petrochemicals R&D Projects Undertaken by CIPET

Sl.No.	Title of the Project	Project Objectives
1	Development of Bitumen packaging poly bags in association with CRRI, New Delhi	Application development of appropriate material/blend for producing poly bags for Bitumen packaging
2	Development of mechanically and thermally stable biodegradable plastic composites.	project envisages to develop biodegradable polymer composites prepared from natural fibers and biodegradable plastics matrices
3	Development of High Performance Thermoplastics & Thermosetting Nano-composites	Develop different types of thermoplastics and thermosetting based Nano-composites for High performance applications
4	Development of polyolefin based Nano-composites.	The project envisages developing and characterizing polyolefin based Nano-composites and studying the commercial viability of the developed composites.
5	New curing systems for thermo-plastics toughened, thermo set epoxies.	The project is an Indo-US Joint Initiative to develop silicon based multifunctional epoxies and curing agents to investigate Tg values and other properties with and without thermoplastics modifiers.

7.3 ***National Chemical Laboratory - Pune***

7.3.1 National Chemical Laboratory (NCL), Pune, is a research, development and consulting organization with a focus on chemistry and chemical engineering. It has a successful record of research partnership with industry.

7.3.2 **Objectives**

7.3.2.1 To be a globally recognized and respected R&D organization in the area of chemical sciences and engineering.

7.3.2.2 To become an organization that will contribute significantly towards assisting the Indian chemical and related industries in transforming themselves into globally competitive organizations.

7.3.2.3 To become an organization that will generate opportunities for wealth creation for the nation and, thereby, enhance the quality of life for its people.

7.3.3 Currently, NCL- Pune is working on the following R&D projects in the field of petrochemical sector

7.3.3.1 Modeling & simulation of coal gasification

7.3.3.2 Adsorptive sulfur removal from transportation fuels

7.3.4 Following are some of the works that has been recently published or patented by scientists at NCL in the field of petrochemical sector

7.3.4.1 Highly Efficient Solid Catalysts for Production of Biodiesel and Bio lubricants

7.3.4.2 Conversion of Methane and Methanol into Gasoline

*7.4 **Indian Institute of Chemical Technology***

7.4.1 Indian Institute of Chemical Technology (IICT), Hyderabad is a premier R&D Institute in India. The Institute had its origin as the Central Laboratories for Scientific & Industrial Research (CLSIR), established in 1944 by the then Government of Hyderabad State. Major areas of research at IICT are: Natural Products Chemistry, Agrochemicals, Drugs & Intermediates, Speciality and Fine Chemicals, Fluoro organics, Inorganic & Physical Chemistry (Catalysis & Material Science), Lipid Sciences & Technology, Coal, Gas & Energy, Chemical Engineering and Design & Engineering.

7.4.2 IICT 's basic objectives have always been to carry out research in the chemical sciences leading to innovative processes for a variety of products necessary for human welfare such as food, health and energy and the conduct of R&D work is fully geared to meet the requirements of technology development, transfer and commercialization.

7.4.3 Projects Completed In Petrochemicals Sector

1) Atmospheric Fluid bed gasification to produce fuel gas from coal
2) Moving bed pressure gasification of low-grade coals
3) Coal tar hydrogenation to middle distillates
4) F-T Synthesis to produce liquid fuels from coal
5) Hydro-cracking of tar to paraffins, naphthalene's etc
6) Coal-tar distillation
7) CO2 Removal from Natural Gas (Joint project with EIL/ ONGC)

7.4.4 Current Research Areas in Petrochemical Sector

1) Hydrogen production by Catalytic Reforming of Methanol
2) Chemical Characterization of Coal / Coal-derived products
3) Direct sourcing of value added chemicals from coal

7.5 ***Future R&D Vision of the Indian Petrochemical Industry***

7.5.1 Efficiency improvement in raw material usage, energy efficiency and reuse of recycled materials.

7.5.2 Process operation improvement with efficient management of supply chain.

7.5.3 Environmental impacts and project viability economic should be balanced.

7.5.4 Commitment to long term R & D investment and innovation.

7.5.5 Technology forecasting and identification of emerging technology fusion areas.

7.5.6 Recycling technologies and recycled product development.

7.5.7 Collaborative investment in public private partnership in technology development by Government, Academic Institutions and Industry in a targeted R & D Initiatives which will have long term impact.

7.5.8 Innovative plastic processing technologies, new process technologies for high performance polymers (green processes, etc.).

7.5.9 Thrust on new platforms – bio- nano sciences as enabler for improved polymer advance materials.

7.5.10 R & D Thrust in Capital goods, development of moulds, dyes and tools.

7.5.11 Development of world class R & D Centre for appropriate material / technology. Networking of institutes / R & D institutions for integrated research projects.

7.5.12 Knowledge alliances and networking. Initiative to add value to IPR from know-how/ knowledge.

7.5.13 Generation & management of intellectual property rights, awareness, development, protection and utilization and enforcement programmes.

7.5.14 Creating more product application, design development centers.

7.6 ***Ways & Means of Strengthening R&D***

7.6.1 **Infrastructure Development is very essential for R & D Growth in the country. This includes**

7.6.1.1 Creation of World class R&D centers for improved efficiencies and speed.

7.6.1.2 World-class knowledge centre's with digital access to latest scientific and technical literature and patents.

7.6.1.3 Networking of all research labs/institutes for integrated research.

7.6.2 **Need of highly knowledgeable, skilled and qualified professionals**

7.6.2.1 For promoting higher education. E.g. Ph.D.

7.6.2.2 Retain scientific talent for research.

7.6.2.3 Attract best Indian professionals from abroad for research.

7.6.3 **Basic research**

7.6.3.1 Partnership with Universities/Institutes across boundaries to accelerate development.

7.6.3.2 Commitment to build a synergy between educational institution & Polymer industry

7.6.4 **Applied Research**

7.6.4.1 Trained professionals for technology management.

7.6.4.2 Foster a climate for best innovation processes.

7.6.5 **IPR Policies in conformance with International practices**
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7.6.5.1 Creating a pool of specialized professionals/lawyers with necessary experience and expertise in IPR.

7.6.5.2 Strict enforcement of IPR compliance.

7.6.5.3 Speedy resolution of IPR issues in the legal system.

7.6.6 **Programs to sustain continuous knowledge up gradation**

7.6.6.1 Improve participation in National/International conference.

7.6.6.2 Create online/e-based knowledge up gradation portals.

7.6.6.3 Making re-certification mandatory for practicing professionals.

7.6.7 Collaborative research for leapfrogging technologies

7.6.7.1 Research collaborations with best institutes on frontier technologies.

7.6.7.2 Avoid sequential R&D development. Embrace quantum jumps in technologies to speed up R&D growth.

7.6.7.3 R&D funding as a percentage of GDP to be benchmarked with the global best.

7.7 New Initiatives Undertaken To Achieve R&D Objectives

7.7.1 Petroleum Research and Development Fund

7.7.1.1 The feasibility of setting up a new scheme of Petrochemical Research and Development Fund (PRDF) which would cater to the projects of R&D in Up gradation and modernization of existing technology, waste management, recycling and development of biopolymers and biodegradable polymers is proposed to be evaluated in Public Private Partnership (PPP) Mode

7.7.1.2 This feasibility will take into account the existing initiatives of the Government on Technology Development and Technology Leadership in India and work out mechanism to dovetail with the existing schemes or suggest sector specific new initiatives.

7.7.1.3 Special focus will be given to supporting research and development in new and emerging areas of petrochemicals technology.

7.7.2 Plastic Development Council

7.7.2.1 Plastic development council will be an advisory body with members from industry, academia and the Government. This will work for a sustained development of plastics processing sector including technology and R & D Initiatives.

7.7.3 Petrochemicals Competitiveness Initiatives

7.7.3.1 Dedicated plastic parks will be evaluated to promote cluster approach in the areas of development of plastic applications and plastic recycling.

7.7.3.2 Steps to augment the existing testing centers and promoting new testing centers in PPP Mode to act as certifying agencies for testing plastic products and raw materials to meet international as well as BIS standards.

7.7.4 Setting Up of Centers for Excellence in Polymer Technology

7.7.4.1 Centers of Excellence can be set up in existing educational and research institutions working in the field of polymers viz. National Chemical Laboratory, CSIR, Indian Institute of Chemical Technology, Indian Institutes of Technology, National Institutes of Technology and others established R & D set ups.

7.7.4.2 The initiative will also include setting up of new world class R & D establishments through Public Private Partnership with the following objectives.

7.7.4.3 Thrust on R & D in capital goods for plastic processing dies and mould developments.

7.7.4.4 Recycling process technology, innovative collection, segregation, cleaning and development of recycled products

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7.7.4.5 Product and application developments using engineering polymers/ compounds /blends /alloys.

7.7.4.6 Alternate sources of feedstock for petrochemicals and maximizing hydrocarbon utilization in the value addition chain for feedstock securitization

7.7.5 Developing Bio-Degradable Polymers

7.7.5.1 In view of the growing environmental concerns arising due to the non degradable nature of plastics, particularly carry bags, there is an urgent need to develop biodegradable polymers.

7.7.5.2 Biodegradable polymers have also been identified as one of the core research areas under the New Millennium Initiative Technology Leadership India (NMITLI), in the Ministry of Science and Technology.

7.7.6 Development of Plastics Application in Thrust Areas Identified in National Petrochemical Policy

7.7.6.1 The thrust areas focus on resource conservation. Plastics are light in weight and save energy in the manufacturing and transportation. It also provides cost effective substitutes for the conventional and natural materials.

7.7.6.2 In respect of plasticulture there is a need to establish a linkage between the National Committee on Plasticulture Applications in Horticulture (NCPAH). and the proposed Plastic Development Council (PDC) which may be responsible for overall coordination, monitoring, technology support and quality control in the field of plasticulture.

7.7.7 **Fiscal benefits for the petrochemical sector**

7.7.7.1 Joint initiatives may be worked out by DSIR and the Department of Chemicals & Petrochemicals for developing innovative approaches in industrial R&D to encourage industry to aggressively undertake technology/intellectual property acquisitions.

7.7.7.2 The government has provided a number of fiscal incentives and other support measures for promoting R&D in industry and increased utilization of locally available R&D options for industrial development. These include the following:

7.7.7.3 Writing off of capital expenditure on R&D in the year of incurring the expenditure

7.7.7.4 Weighted tax deduction of 125% for sponsored research programmes in approved national laboratories, Universities functioning under the aegis of the Indian Council of Agricultural Research (ICAR), Indian Council of Medical Research (ICMR), Council of Scientific and Industrial Research (CSIR), Defense Research & Development organization (DRDO), Department of Electronics, Department of Biotechnology, Department of Atomic Energy, Universities and IITs is available to the sponsor. The Head of the concerned National Laboratory or the University or the Indian Institute of Technology can give the requisite approval of the sponsored research programs with effect from 1 October 1996. Prior to this DSIR was the nodal scientific department to administer this incentive.

7.7.7.5 Weighted tax deduction @ 125% (raised to 150% by the Finance Act 2000) on R&D expenditure to companies engaged in the business of bio-technology or in the business of manufacture or production of drugs, pharmaceuticals, electronic equipment, computers, telecommunication equipment, automobile and its components, chemicals, manufacture of aircraft's and helicopters in government approved in-house R&D centers. Expenditure on scientific research in relation to drugs and pharmaceuticals, shall include expenditure incurred on clinical drug trials obtaining approvals from any regulatory authority under any Central, State or Provincial Act and filing an application for a patent under the Patents Act, 1970 (39 of 1970 Income-tax exemption @ 125% to donations made to approved Scientific and Industrial Research Organizations.

7.7.7.6 Accelerated depreciation allowance for investment on plant and machinery made on the basis of indigenous technology.

7.7.7.7 Customs duty exemption to public funded R&D institutions and privately funded scientific and industrial research organizations, both for capital equipment and consumables needed for R&D.

7.7.7.8 Excise duty exemption to public funded R&D institutions and privately funded scientific and industrial research organizations, both for capital, dated 1st March 1997).

7.7.7.9 Excise duty exemption for 3 years on goods designed and developed by a wholly owned Indian company and patented in any two countries out of: India, USA, Japan and any one country of European Union.

7.7.7.10 Exemption from customs duty on imports made for R&D projects funded by Government in industry.

7.7.8 **Thrust Areas of R&D to be focused to sustain and improve the growth of the Indian Petrochemical sector**

7.7.8.1 There is a need to have a thrust on R&D in capital goods for plastic processing and petrochemical industry. A coordinated effort needs to be made for development of such capital goods by supporting the manufacturers of machinery for petrochemical industry and plastic/polymer processing industry. DSIR can actively participate in such development projects.

7.7.8.2 Specific thrust on supporting R&D for development of degradable / biodegradable plastics, promoting scientific and state of art plastics waste recycling technologies

7.7.8.3 The key for the success of India's petrochemical sector also lies in the ability to achieve greater energy efficiency, carbon capture and storage, new feedstock sources - including clean coal and bio feeds - and a new generation of products and production technologies and focused R&D will go a long way towards this direction.

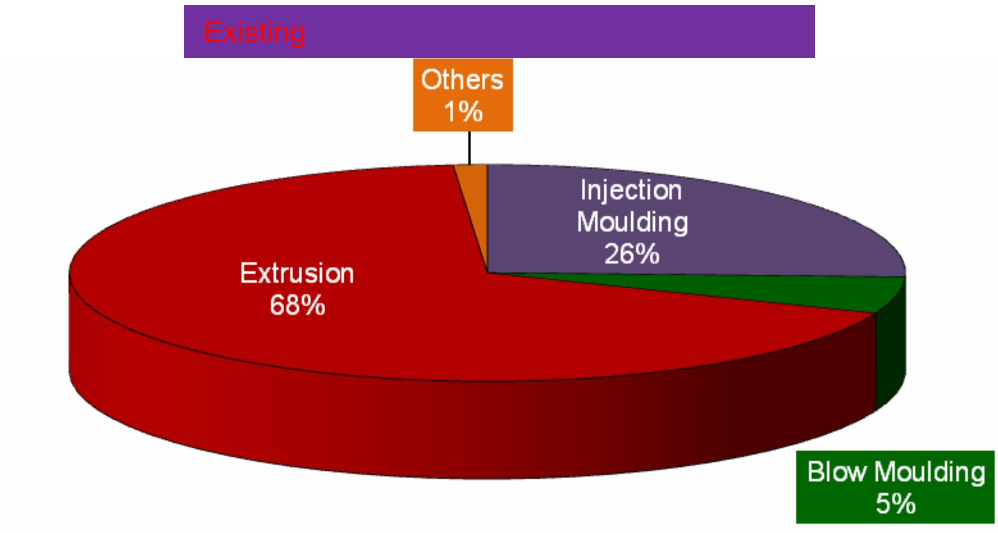
8 Downstream plastic processing industry

8.1 Current Status of the Processing Industry

8.1.1 With around 23,000+ processing units, the domestic downstream industry covering 3 key categories viz. Injection moulding, Blowmoulding and Extrusion that caters to the requirements of a wide array of applications like packaging, automobile, consumer durables, healthcare, agriculture, infrastructure etc.

8.1.2 Virgin polymer consumption during 2010-11 was estimated to be 8.5 MMT, with 68% accounted by Extrusion, 26% by Injection Moulding Sector and the remaining 6% by Blow Moulding & other sectors.

Figure 82: Sector-wise Polymer Consumption 2010-11: 8.5 MMT



8.1.3 As of 2010-11, the number of machines installed in the major processing sectors was 97400. In terms of number of machines, more than 62% was injection molding machines followed by 30% in Extrusion and 8% in Blow Moulding. In terms of Capacity, Extrusion accounts for 67% of total capacity, Injection Moulding 29%, and Blow Moulding 4%.

Table 92: Plastic Processing Industry Status (as on March 2011)

Sector	No. of machines	Installed Capacity (KT)
Injection Molding	61000	6850
Blow Molding	8000	1050
Extrusion	28400	15800
Monolayer Film	8650	1500
Multilayer Film	1125	875
BOPP	30	500
Raffia	1000	1950
PO Pipes	1125	1150
RPVC Pipes	4500	4375
TQPP Film	2765	600
PVC Film & Calendaring	425	310
Nonwoven & Fibre/Filament	170	210
Sheet Lines	735	720
Others	7875	3610
TOTAL	97400	23700

8.1.4 Installed Capacity has more than doubled in the last five years from 11.7 MMT in 05-06 to 23.7 MMT in 10 -11. 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.

8.1.5 Indian plastic processing industry invested around Rs 3000crores in machinery during 2010-11.This is almost 3 times that of investments in 2005-06 which was Rs.1100cr and Rs 800cr in 2000-01.

8.1.6 In the last decade, there has been close to a four fold increase in installed capacity per annum in all the three major sectors, viz., Extrusion, injection & blow moulding as shown in the table below.

Table 93: Downstream Capacity Additions

Segment		2000-01	2005-06	2010-11
Extrusion	Machines Added (Nos.)	1000	1270	1902
	Installed Capacity (KTA)	554	935	1901
	Investment in Machinery (Rs.cr)	187	381	1084
Injection Moulding	Machines Added (Nos.)	1837	3265	5667
	Installed Capacity (KTA)	253	451	1101
	Investment in Machinery (Rs.cr)	607	704	1761
Blow Moulding	Machines Added (Nos.)	263	271	570
	Installed Capacity (KTA)	33	41	131
	Investment in Machinery (Rs.cr)	21	29	92
Total	Machines Added (Nos.)	3100	4806	8139
	Installed Capacity (KTA)	840	1427	3133
	Investment in Machinery (Rs.cr)	815	1114	2937

Table 94: Actual Machinery Addition FY 2010-11

Sector	FY 2010-2011		
	Machines Reqd (No.)	Installed Cap (KT)	Investment Rs in crs
IM	5667	1101	1761
BM	570	131	92
Monolayer Film	422	83	31
Multilayer Film	103	107	57
BOPP Film	2	62	250
Raffia Tape Line	82	267	83
PO Pipes	158	236	88
RPVC Pipe (TS+SS)	418	615	278

Sheet Line	81	100	30
Others	636	431	267
Total Extrusion	1902	1901	1084
Grand Total	8139	3133	2937

8.1.7 The total employment in the downstream sector is ~636,000 more than a third of which is in the injection molding segment. It is estimated that the plastic industry provides employment to around 3.53 million people if the indirect employment generated by the sector is also factored in.

8.1.8 Exports of plastic finished goods have more than doubled in the last 5 years from 1 Bn USD to 2.3 Bn. USD (est.). But fierce competition from countries such as China, Indonesia, Taiwan and other South Asian countries are restricting growth.

Figure 83: Exports of Plastic Products during 2010-11

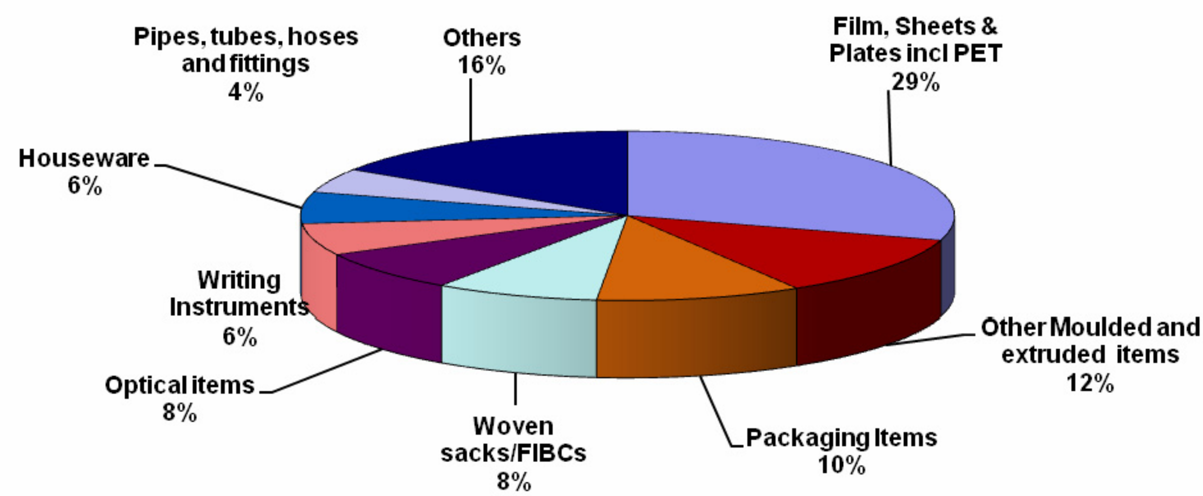


Table 95: Value-added Plastic Products Exports

Export of Finished Plastic Goods						
Year	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11 (est)
Value in(Mn USD)	1078	1177	1812	2029	2104	2323
%Growth(YoY)		9%	54%	12%	4%	10%

8.1.9 Due to technological advances in sectors like FIBC, the overall increase in export has been 115% over last 5 years. With this, India has become a leader in this sector. To revive growth in exports of other sectors, the downstream processing industry needs further investment and FDI to increase value addition and exports

8.1.10 **Capacity addition & Technological Advancements**

8.1.10.1 During the period 2007-2011 capacity in the plastic processing sector has increased at a CARG of 15% as table shows. The average installed capacity per machine during the year 2000 was around 260 MT/annum/machine, which for new machines installed in the year 2010 is estimated at 385 MT/annum/machine reflecting that more higher-output, high-technology machines are being installed.

Table 96: Plastic Processing Industry Projections

	Addition in 2014-15			Addition in 2016-17			Addition in 2021-22		
	Machines (No.)	Inst. Cap. (KT)	Investment (Rs.Cr.)	Machines (No.)	Inst. Cap. (KT)	Investment (Rs. Lakhs)	Machines (No.)	Inst. Cap. (KT)	Investment (Rs. Lakhs)
Injection Moulding	**7350**	**1840**	**2720**	**8375**	**2370**	**3400**	**11000**	**4200**	**5500**
Blow Moulding	**610**	**170**	**110**	**720**	**240**	**145**	**1110**	**560**	**310**
Monolayer Film	700	120	50	800	140	60	700	140	60
Multilayer Film	90	90	75	100	110	90	110	150	120
PPTQ Film	220	50	15	250	60	15	190	50	10
BOPP & Cast PP Film	10	50	340	10	90	560	20	120	630
PVC Films	30	30	60	40	30	60	20	30	70
Sub Total Films	**1050**	**340**	**540**	**1200**	**430**	**785**	**1040**	**490**	**890**
Raffia Tape Line	130	250	165	150	330	220	150	500	300
Box Strapping / Monofilament/Sutli Line	140	30	20	160	40	25	50	10	10
PP Nonwoven & Fibre & Filament	20	30	40	20	30	50	30	110	140
Sub Total Orientation	**290**	**310**	**225**	**330**	**400**	**295**	**230**	**620**	**450**
PO Pipes / Drip lines	100	140	40	110	180	55	250	590	180
PVC Pipes & Profiles	390	470	250	440	610	310	770	1560	785
Sub Total Pipe & Profiles	**490**	**610**	**290**	**550**	**790**	**365**	**1480**	**2150**	**965**
Extr. Coat.	50	40	40	60	50	50	110	120	115
Sheet Lines	70	80	30	70	100	35	280	520	160
Compounding & Palletizing	100	130	45	110	170	60	490	1330	420
Misc & Others	250	80	50	290	100	60	480	230	140
Sub-Total Misc.	**470**	**330**	**165**	**530**	**420**	**205**	**1360**	**2200**	**835**
Sub-Total Extrusion	**2300**	**1590**	**1220**	**2610**	**2040**	**1650**	**4110**	**5460**	**3140**
TOTAL	**10260**	**3600**	**4050**	**11705**	**4650**	**5195**	**16220**	**10220**	**8950**

8.1.10.2 The Indian Plastic processing industry has seen a shift from low ouput/low technology machines to high output, high technology machines. There has been some major technological advancements 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.

8.1.10.3 Some of the highlights of advancements in Indian plastic processing technology are as follows :

Extrusion:

- Multilayer film plant with 9 layer

- 7 layers Multilayer blown film line with PVdC processing
- 3 layer PVC cast film line
- HDPE pipe plant with capacity to manufacture 1600 mm pipe.
- Corrugated pipe >1400 mm PVC pipe – both foam & plain – largest dia. 630 mm
- Drip irrigation plant having capacity of 150 mt/min.
- Slit Tape plant with capacity: 1000 Kg./hr for woven fabric

Injection Moulding:

- Machines having 3800 Ton clamping (max)
- All Electrical Machine1600 Ton (max)

Blow Moulding:

- 6 layer blow moulding machine for fuel tank & specialty products
- 1500 L blow molding machine

Rotomoulding:

- Rotomolding machines to produce tanks of capacity 35KL.

8.1.11 **Status of Machinery Manufacturing**

8.1.11.1 There are about 200 registered machinery manufacturers out of which the top 20 manufacturers account for 80 -85% of the Capacity.

8.1.11.2 Imports of machinery have been increasing in the recent past. Currently, imported machinery accounts for about 40% of overall sales from just 7% in 2000-01. In the Injection moulding machinery sector, out of sales of around 5600 machines, domestic manufacturers are estimated to have 50% share while imports accounts for rest . There are more than 50 global manufacturers from China, Taiwan, Japan, Europe and America who are footprint in Indian plastic machinery market currently.

Table 97: Processing Machinery Imports

Machinery Imports (Nos.)						
Sector	2005-06	06-07	07-08	08-09	09-10	10-11
Injection Moulding	1441	1723	2272	1880	1900	2745
Blow Moulding	23	28	40	58	83	111
Extrusion	129	229	205	297	277	416
Total Imports	1593	1980	2517	2235	2260	3372

Domestic supply	4100	3659	3788	3312	4222	4767
Share of imports	28%	35%	40%	40%	35%	41%

8.1.11.3 All the leading machinery manufactures have expanded their production capacities as well as portfolio range to meet the challenge.

8.1.11.4 Although recent injection moulding machines offer advantages like latest technology with low maintenance cost and energy efficiency, the cost of new machines is still high. Hence, market for imported used Injection Moulding machinery has been steadily growing @ 30% CARG since 2005 as shown in the table below.

Table 98: Imports of Used Imported Injection Moulding Machines (Nos.)

Imports of Used Imported Injection Moulding Machines (Nos.)					
2005-06	06-07	07-08	08-09	09-10	10-11
350	451	508	497	1045	1280

8.1.11.5 The boom in auto sector, renewed investment in consumer goods, houseware sector etc, the economy of scale will force the processing industry to go for higher investment in larger size & energy efficient machines. For example, all electric injection moulding machines are increasingly becoming popular due to their energy efficiency, greater cleanliness, quick start up, better repeatability, and quiet operations. However, cost of these machines is higher by 50 - 200% than conventional hydraulic systems. In spite of the higher costs, the industry has been investing in these machines. Domestic manufacturers have also started supplying All Electric machines in recent year.

8.1.12 **Projections Over Next 5 Years**

8.1.12.1 Consumption of plastics in high growth sectors like Infrastructure, Agriculture, Material Handling & Packaging, Automobiles, White & Brown goods etc is growing at more than 13 % p.a. leading to tremendous opportunities for plastic machinery manufacturers. By the end of the 12th Five year Plan, the demand for plastic processing machinery is projected to increase annually by 10.5% to 10800 machine/ year with installed capacity of 50 MMTA. This demand will also be due to factors such as advances in new technology, high output machines, energy efficiency, replacement of old machines and investment by new entrepreneurs.

8.1.13 **Investment Requirement by 2016-17**

Table 99: Additional Investment by 2016-17, Projection Based on Polymer consumption data

Sector	Machines Required	Installed Capacity	Investment
	(No.)	(KT)	Rs in crs
		2014-15	
IM	4723	680	3060
BM	637	92	184
Extrusion	1728	1323	3346
Grand Total	7089	2094	6590
		2016-17	
IM	5366	773	3476
BM	767	110	220
Extrusion	2057	1562	4028
Grand Total	8191	2445	7724
		2021-22	
IM	7850	1130	5088
BM	1207	174	348
Extrusion	2990	2289	5948
Grand Total	12047	3593	11384

Table 100: Additional Investment by 2016-17, Projection Based on Machinery addition of past 5 years CARG

Sector	Machines Required	Installed Capacity	Investment
	(No.)	(KT)	Rs in crs
		2014-15	
IM	6585	1536	2513
BM	779	217	151
Extrusion	2509	3095	2458
Grand Total	9873	4848	5122
		2016-17	
IM	8210	2196	3627
BM	1049	346	240
Extrusion	2949	4110	3735
Grand Total	12208	6652	7602
		2021-22	
IM	14249	5360	9071
BM	2207	1104	762
Extrusion	4416	8357	10626
Grand Total	20872	14821	20459

8.1.13.1 However, India's technology needs in areas like high production and automatic 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.

9 Recycling of Plastics

9.1 Current Profile of Recycling Industry

9.1.1 According to recent study the following figures for recycling industry in India emerge:

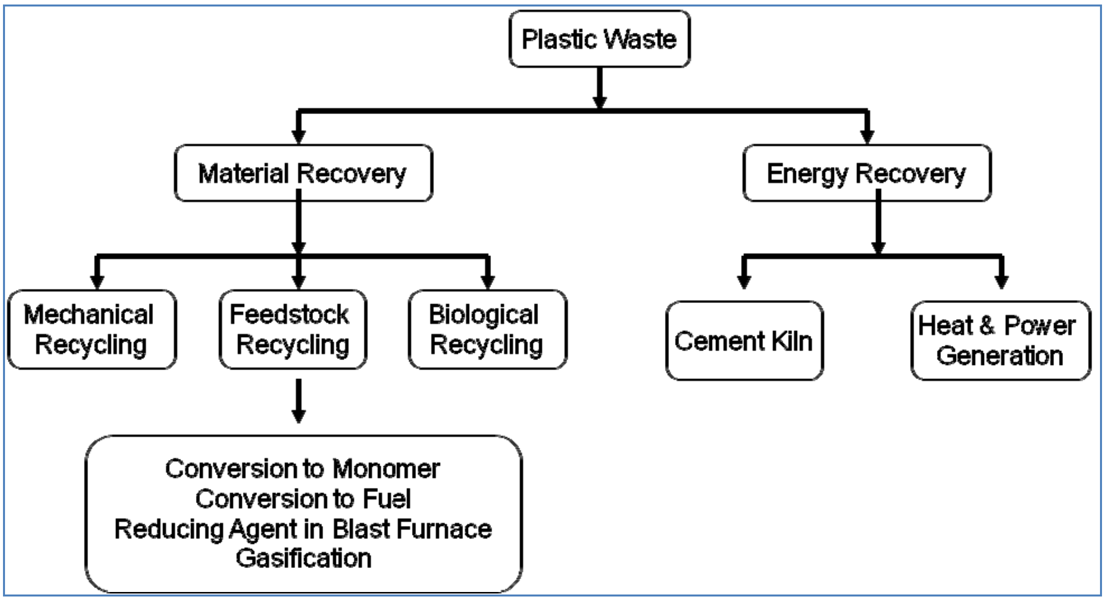
- Numbers of Organised Recycling Units: **3500**
- Numbers of Unorganised Recycling Units: **4000**
- All types of plastics (Thermoplastics) are recycled by the mechanical recycling route.
- Most common types are **PE, PP, PVC, PET, PS, ABS, PMMA.**
- Engineering plastics like **PBT, SAN and Nylon,** etc are also recycled by selected recyclers.
- Manpower directly involved in Plastics Recycling: **around 6,00,000**
- Manpower indirectly involved in Plastics Recycling: **around 10,00,000**
- Quantum of Plastics Recycled per annum: 36,00,000 Tonnes (3.6 Million Tonnes)
- Estimated Investment in Ingenious Plant & Machinery for Recycling Industries (Mostly Tier – I): about Rs. 150.00 Crores.

9.1.2 **Recycling / Recovery options**

9.1.3 The selection of methodologies and processes for the management of plastic wastes available from pre-consumer sources and end of life products may be approached using various strategies, all of which should include a preliminary analysis of the available recovery options.

9.1.4 While determining the methodologies of recovery system, it is required to make a distinction between different recovery options. The Recycling / Recovery options, as specified in the ISO 15270:2008 are as described below:

Figure 84: Plastic Waste Recycling Flow Diagram



9.1.5 **Mechanical Recycling**

9.1.5.1 Mechanical Recycling is adopted to manufacture products for similar or new applications. This is the most preferred and widely used recycling process due to its cost effectiveness and ease of conversion to useful products. The requirement is homogeneous and clean input. When the input is not clean, adequate cleaning is required which involves energy, water and other resources. Moreover, plastics of single-material streams can be recycled to produce better quality output. Same family or group of plastics also can be processed together. For instance polyethylene – HDPE and LLDPE can be mixed together and recycled. For a better output quality, material of similar molecular weight / density should be recycled together. More than about 10% polypropylene, when mixed with polyethylene, may disturb the whole recycling batch.

9.1.6 **Feedstock Recycling**

9.1.6.1 Feedstock Recycling is used to manufacture different products for use in subsequent production processes within or outside the sector.

a) Conversion to monomer
b) Fuel
c) Reducing Agent in Blast furnace for production of iron

9.1.6.2 Conversion to Monomer: PET and PMMA are already converted to their monomers for reusing as the base material for polymerization. At least 30 – 40% of PET waste has been de-polymerized to fresh raw material. This needs State support to augment the collection cost from all over the country.

9.1.6.3 Fuel from Plastics Waste: Waste generated from mixed plastics, co-mingled plastics and plastics materials made out of a combination of different plastic materials are generally difficult for normal recycling and are mostly abandoned in the waste stream as it is and hence creates waste management problem.

9.1.6.4 Success has been achieved in converting such plastics waste in to industrial fuel in an environmental friendly technology in the country (Prof. (Mrs.) Alka Zadgaonkar, Nagpur and TVS – NTI, Chennai). Technologies are available from developed / other countries also. This option has the benefit of using mixture of different types of plastics waste without segregation. Elaborate cleaning / washing is also not required. Industrial Fuel made out of the plastics waste is substitute of fossil fuel. Though commercial production has already started in the country in a small scale, State support and incentive is required for popularizing this technology among the entrepreneurs for its large scale commercial utilization.

9.1.6.5 Reducing Agent in Blast Furnace for Production of Iron: Successful examples are available for use of waste plastics as a reducing agent in the blast furnace for production of iron from its ore. Use of coke in the blast furnace provides only one type of reducing agent – Carbon Monoxide. In contrast, use of plastics waste provides one additional type of reducing agent – Hydrogen. The process also reduces generation of 'ash'. A steel manufacturing facility having production capacity of 3 million tonnes per annum, can consume 600, 000 MTs of plastics waste.

9.1.6.6 Though the technology is already in use in some developed countries, it is yet to be developed and practiced in India. Government support is required for developing such technology indigenously.

9.1.7 **Energy Recovery**

9.1.7.1 The following processes are commonly followed for energy recovery.

a) Co-Processing in Cement Kilns to substitute fossil fuel
b) Incineration for energy recovery / power generation

9.1.7.2 As the recovery option depends on many prevailing circumstances, Life Cycle Analysis (LCA) may be applied to decide, depending on the type and composition of the plastic wastes, which options are environmentally more favourable and sustainable.

9.1.7.3 Co-Processing in Cement Kilns to Substitute Fossil Fuel: One of the most effective methods of recycling of plastics waste for recovery of energy is its use as an alternative fuel in cement kilns. The list below gives a comparison of the calorific values of different plastic materials as compared to coal.

a) Polyethylene : 46 MJ/kg
b) Polypropylene: 44 MJ/kg
c) Polyamide (Nylons): 32 MJ/kg
d) PET: 22 MJ/kg
e) Cellulose Acetate: 16 MJ/kg
f) Coal: 29 MJ/kg

9.1.7.4 The high temperature used in the cement kilns gives a scope for use of even some type of plastics waste contaminated with toxic chemicals like pesticides and some other hazardous materials. No segregation or cleaning is required for such type of disposal. There are about 170 cement kilns in the country, in different zones. Even at the rate of 10 MTD of plastics waste per cement kiln, the total requirement of plastics waste for co-processing could be more than 0.5 million tonnes, a quantity which is more than the abandoned plastics waste in the MSW stream.

9.1.7.5 ICPE has already taken initiatives along with M/s ACC Ltd and in discussion with CPCB, for developing a code of practice. Support and cooperation of State Pollution Control Boards is needed to formalize this mode of plastics waste recycling. Local bodies / Municipality Authorities would then find a scientific solution for disposing of abandoned plastics waste.

9.1.7.6 Use of Plastics Waste in Construction of Asphalt Road: Use of plastics waste in the construction of asphalt road has been demonstrated by at least two to three technologies in the country in the past 3 – 4 years. There is scope of using some types of low-end plastics waste without elaborate cleaning, for improving the property of tar road by replacing bitumen to an extent of about 8 – 12 %. There is a scope of reduction of cost also. Government support is required for formalizing the technology for its adoption all over the country.

9.1.7.7 After using the major part of plastic waste for mechanical recycling and recovery of energy, there would still remain some waste, heavily contaminated with different toxic chemicals or hazardous products. The best way of re-utilizing these wastes is to incinerate them, instead of dumping them on landfills. Incineration helps recovers their calorific values. The choice of incinerators is very important. Modern incineration technology can utilize plastic waste without polluting the environment and in many cases recovering the calorific value out of the waste being incinerated. Whichever form of recycling is chosen, the whole process can succeed only if an efficient solid waste collection mechanism is put in place.

9.2 **Collection & Segregation**

9.2.1 ***Segregation of recyclable waste at source***

9.2.1.1 In all parts of the country, people by and large do salvage re-usable or saleable material from waste, e.g. newspaper, glass bottles, empty tins, plastic bags, old clothes etc., and to that extent such reusable / recyclable waste material are not thrown out for disposal. However, a lot of recyclable dry waste such as waste paper, plastic, broken glass, metal, packaging material etc., is not segregated and is thrown on the streets mixed with domestic / trade /institutional waste.

9.2.1.2 Such waste is picked up to some extent by poor rag picker. At times they empty the dustbins and spread the contents around for effective sorting and collection. By throwing such recyclable material on the streets or into a common dustbin, the quality of recyclable material deteriorates as it gets soiled by wet waste, which often contains contaminated and hazardous wastes.

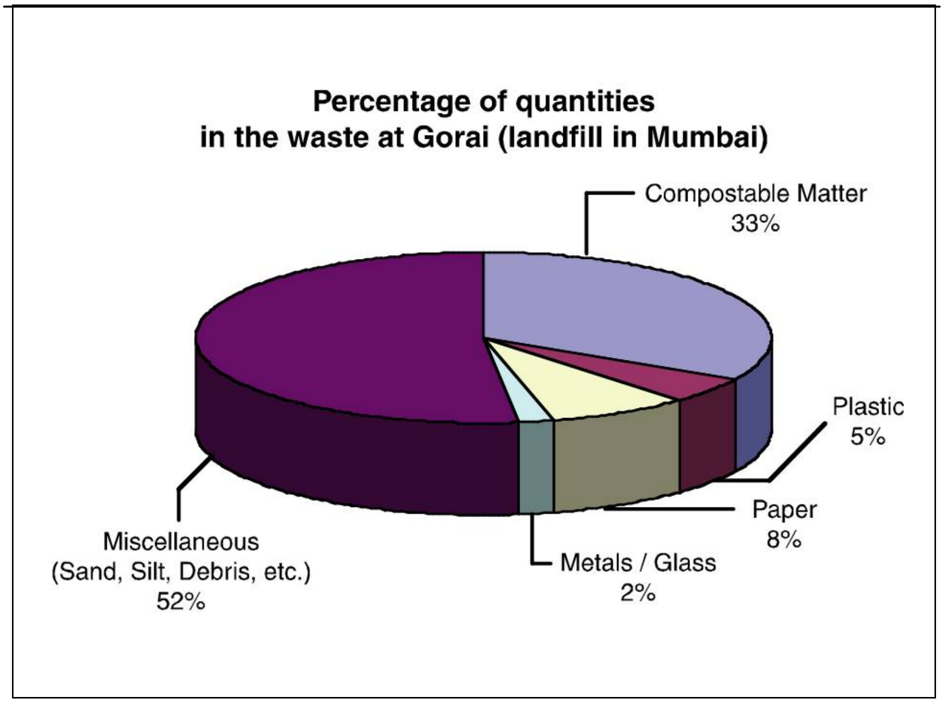
9.2.1.3 Households and establishments, who throw such waste on the streets or in the municipal bins unseggregated, thus not seriously practice segregation of recyclable waste at source. The waste can conveniently be segregated at source for recycling, which is being thrown on the streets in absence of the practice of segregation of waste at source. Part of this waste is picked up by rag-pickers in a soiled condition and sold to middle men at a low price, who in turn pass on the material to the recycling industry at a higher price after cleaning or segregation and the waste that remains uncollected finds its way to the dumping grounds or remain strewn to the sides of the road or fields ultimately finding their ways to the drains, water bodies and to the rivers or the sea.

9.2.2 **Segregation of plastics waste**

9.2.2.1 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. This can be done 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.

9.2.2.2 The preliminary findings of a study conducted by the Central Pollution Control Board (titled as “Assessment and Quantification of Plastic Waste in 60 major cities” indicate that plastic wastes constitute approximately 10-15 % of the municipal and solid waste generated in a city, including a significant proportion of multilayered and metalised pouches. However, after the generation of the plastic waste, the waste pickers collect a considerable quantity of plastic waste for selling to the waste dealers who ultimately resale those to actual recyclers. Ultimately only about 5 to 7% plastics wastes only reach the landfill.

Figure 85: % of quantities in the waste at Gorai

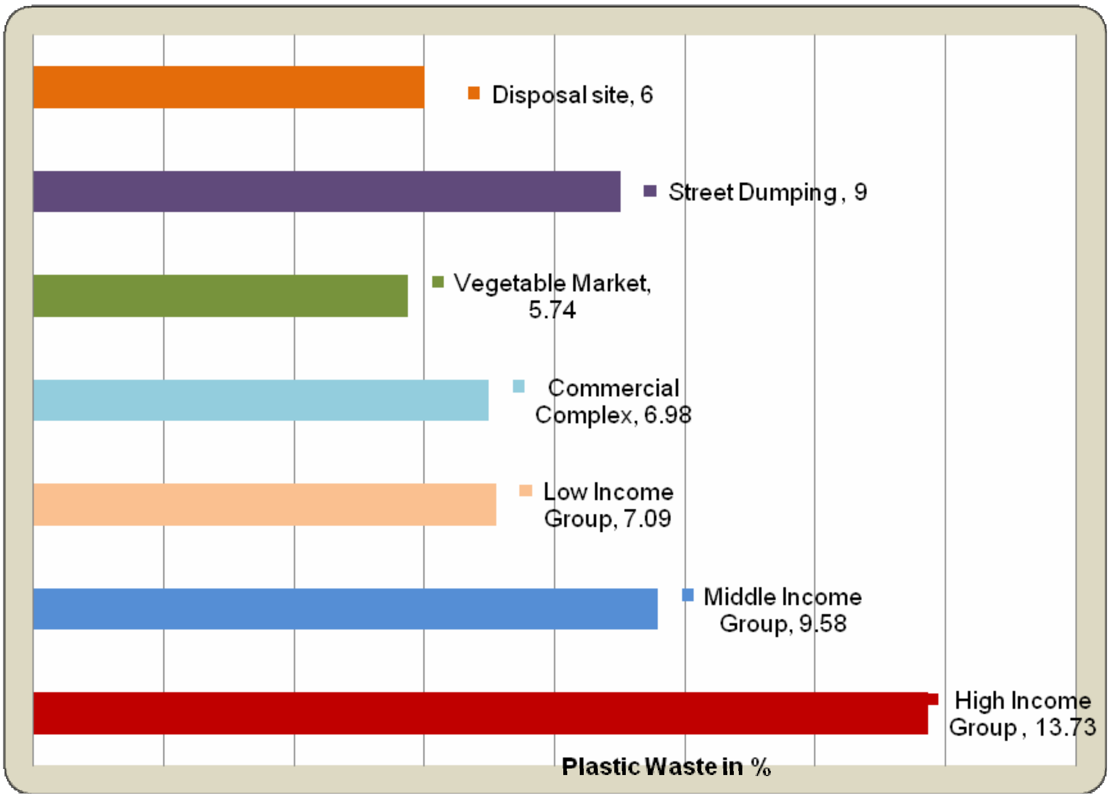


Source: NEERI (National Environmental Engineering & Research Institute, Nagpur, Maharashtra) Report on composition of MSW in Mumbai landfill in 2005

9.2.2.3 The main source of waste in the urban cities are households, offices / institutions, hotels, vegetable markets, public roads /streets, industrial areas, construction sites and hospitals. Because of the lack of segregation at the source, the waste received at the collection point is mixed up with recyclables and valuables like Paper, Packaging Items, Plastic Bottles, Plastic Carry Bags, Packaging Foam, Packaging Foils, Glass Bottles, Metal Items, Clothes , Leather items, Electrical and Electronics Waste, etc. It is important to evaluate the amount of these items present in the waste generated.

9.2.2.4 A study was conducted at Mumbai in 2009 to assess the quantum of plastics waste as a %age of total solid waste in the MSW stream.

Figure 86: Plastic Waste at Different locations



9.2.2.5 The study shows that higher percentage of plastics waste was observed in higher income locality and the lowest was observed at vegetable market and disposal sites. Also on compairing all the types of plastics waste items, ratio of carry bags was found to be the heighest (60-30%). It was also observed that, %age of waste at the source was high. But when it comes to community level, a major portion of the plastics wastes (along with other Dry Waste), mostly the ones which are comparatively clean and more valuable, are segeregated, separated and picked up by ragpickers / waste collectors for selling to the waste dealers. By the time the waste reaches final disposal site (landfill area), quantity of plastics waste reduces further – from a level of about 15% at source of generation to about 5 – 7 % at the disposal site.

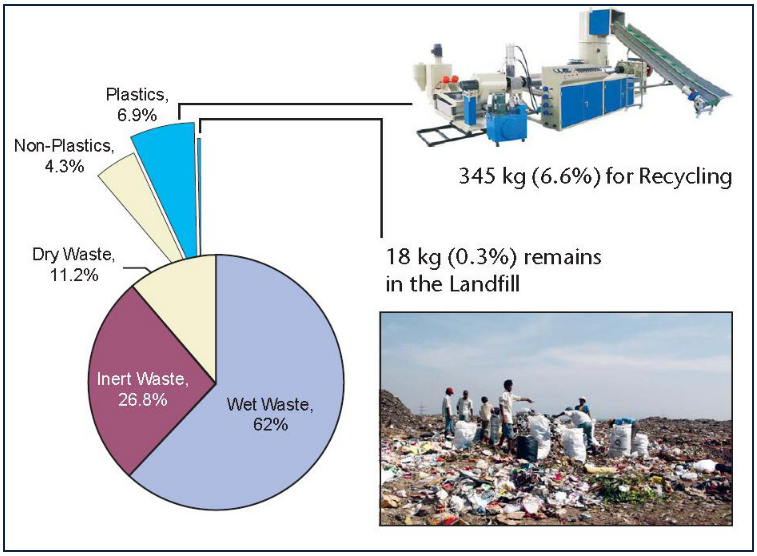
9.2.2.6 Plastics Waste Management and recycling has attained significance in the entire Municipal Solid Waste Management activity.

9.2.2.7 Another detailed study in Deonar Dumping Area in Mumbai revealed that only less than 1% of the dumped plastics waste remain in the Dump yard – rest all is collected by the waste pickers and are sold to the waste dealers at a price around Rs. 2 to Rs. 3 per kg.

Table 101: Details of MSW in one compactor

Details of MSW in One Compactor		
Waste	**Kg**	**%age**
Dry	586	11.2
Inert	1400	26.8
Wet	3238	62.0
Total Waste	5224	
DRY WASTE		
Plastics	363	6.9
Non-Plastics	223	4.3
Plastic Waste Removed from the Landfill		
Total Plastics Waste at Landfill	363	6.9
Picked up & Removed for Recycling	345	6.6
Plastics Waste Remaining in the Landfill	18	0.3

Figure 87: Characterization of Total waste



9.2.2.8 In some parts of the country efforts are on to separate the Dry and Wet waste at the source itself, so that the Dry wastes could be further segregated into different types of wastes and could be sent for recycling, resulting in lower load on landfill, sites.

9.2.2.9 There is an increasing activity among various Local Self Government Councils to treat the wet waste also through vermiculture or similar process, to generate compost, which can be used as fertilizers.

9.2.2.10 **ICPE** along with some NGO's have joined hands with BMC in some Wards of Mumbai to propagate the Proper Solid Waste Management culture among the citizens.

9.2.2.11 Though it is an uphill task, at least in some areas of different wards, (like in 'A' and 'D' Wards) of Mumbai, the results are evident.

The brief description of the work being practiced:

'A'– Ward (Cuff Parade Area):

1. BMC has given a secured area and a shed for segregation of dry waste.
2. BMC has also provided 2 nos. 1-tonner vans with drivers, free of cost, to move in the locality for 8 hours to collect dry wastes from households.
3. BMC has given Identity badges to the rag pickers who have been identified by the NGO's.
4. Some rag pickers accompany the BMC vans and collect dry wastes from doorsteps of the households/society buildings and bring those to the BMC allotted sheds for segregation.
5. The dry wastes are product-wise segregated into: paper, plastics, metal and others. Obviously, within each product, there are different categories e.g. in metal, there would be iron, aluminium foil etc. In plastics, there would be PE, PP films, polystyrene cups, HDPE solid items / caps etc.
6. These segregated dry wastes are stored in the secured sheds for disposal.
7. When sufficient quantity of scrap is accumulated, scrap dealers come to these sheds, weigh the scraps and pay the rag pickers / co-coordinator the cost of the scraps, and collect the dry waste. Generally, this collection takes place once in a week. (In some places, where the sheds are not well secured, rag pickers dispose off their segregated wastes every alternate day, or even daily to the recycles / traders)
8. The wet wastes are collected by separate BMC vans from the household localities – directly to the landfills.

In some societies, local self-government council or the societies themselves are collecting the wet wastes also for composting, resulting into zero garbage concept. However, this is not yet widely practised in general.

Collection bins, hand gloves, aprons, masks, etc have been provided to the rag pickers, and promotional literature have been distributed to the society members. BMC as well as the concerned localities are happy with the activities carried out at ‘A’ and ‘D’ Ward. Activity has now been extended to some other wards also.

Figure 88: Segregation of dry waste

9.3 End-products from Recycled Material

Illustrative list of Non-Critical Items which are made of Recycled Plastics

1. Fiber fills for pillows/mattresses/sleeping bags

2. Carpets
3. Floor/door mats
4. Lumbers for making Benches, Pallets and Fence etc.
5. Lube oil bottles
6. Box Strapping and other secondary packaging items
7. Drainage and Agricultural Pipes
8. Dust Bins/Pans
9. Trash/Garbage Bags
10. Refuse Containers
11. Wheel barrows used in SWM
12. Moulded Luggage - Briefcase
13. Non food containers for household and industrial chemicals such as bleach, detergent, oils **(non-edible)** etc.
14. Signs and Traffic barrier cones
15. Flower pots
16. Horticultural supplies – Planters, trays, nursery bags
17. Household Multi-utility Items not meant for food-contact applications
18. Storage Bags
19. Drip Irrigation pipes
20. Garden Pipes
21. Buckets/Mugs for wash-rooms
22. Jackets, T-shirts, Upholstery and apparels
23. Tool handles
24. Footwear
25. Mirror Frame
26. Soap Container
27. Garden furniture
28. Recreational Equipment
29. Structural Applications – Non-critical
30. Conduits for Cables
31. Floor Coverings
32. Stationery products: rulers, staplers, Video/CD boxes
33. Coat hangers
34. Photo frames
35. Office supplies – File folders, binder covers, presentation folders etc
36. Car mats
37. Tarpaulin
38. Barsati Films
39. Niwar Patti
40. Sutli
41. Camping equipment
42. Clamshell packaging for Polaroid cameras

43. Automotive parts where appearance and strength are not important
44. Computer applications
45. Instrument Panel top-covers/retainers
46. Lawn/Garden Components
47. Roofing shingles
48. Plastic broom / scoop and the like.

9.3.1 Performance Analysis of Products Made from Recycled Plastics

9.3.1.1 The performance of the products made out of recycled plastics depends mainly on the quality of the waste collected and on the manufacturing process. It is obvious that the properties of the products made of recycled plastics would be different than that obtained from the virgin plastics raw material. It is in this context that the application areas for recycled plastics products are in non-critical sectors. In practice, some amount of virgin plastics is blended with the waste plastics during recycling process to enhance the quality of end product. The blending ratio may vary from 10 % to even 50 % depending on the market segment targeted. However as per current National Rule, recycled Plastics products are not permitted to be used in contact with food items.

Table 102: Applications of Recycled Material

Waste Type	Source of Waste	Application of Recycled Waste
PET	Soft drink and mineral water bottles	Multi-layer soft drink bottles, carpet fibres, fleecy jackets
HDPE	Milk crates, bottles for shampoo and cleaners milk and cream bottles	Waste bins, detergent bottles, crates, agricultural pipes, kerbside recycling crates. Plastic lumber, Plant pots, Traffic cones, Toys, Outdoor furniture
Rigid PVC	Clear cordial and juice bottles, plumbing pipes and fittings	Detergent bottles, tiles, plumbing pipe fittings.
PP	Drinking straws, ice-cream containers hinged lunch boxes	Composite bins, crates
PS	Yoghurt containers, plastic cutlery	Coat hangers, office accessories rulers, video/CD boxes

9.3.1.2 In practice, some amount of virgin plastics is blended with the waste plastics during recycling process to enhance the quality of end product. The blending ratio may vary from 10 % to even 50 % depending on the market segment targeted. However as per current National Rule, recycled Plastics products are not permitted to be used in contact with food items.

9.4 Life-cycle Analysis

9.4.1 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 all parameters plastics create lesser foot print on earth.

9.4.2 All these benefits are available when plastics waste is recycled. Reduction of environmental load during the manufacturing stage of basic plastics raw material is added benefit – a phenomenon which is true for any type of recycling though. However recycling of plastics saves more energy compared to recycling of paper or glass. For example Plastics and Paper both can be recycled. However, it takes 91% less energy to recycle a kilogram of plastic than a kilogram of paper.

9.4.3 When compared to 30% recycled fiber paper bags, polyethylene grocery bags use energy in terms of fuels for manufacturing, less oil, and less potable water. In addition, polyethylene plastic grocery bags emit fewer global warming gases, less acid rain emissions, and less solid wastes. The same trend exists when comparing the typical polyethylene grocery bag to grocery bags made with compostable plastic resins—traditional plastic grocery bags use less energy in terms of fuels for manufacturing, less oil, and less potable water, and emit fewer global warming gases, less acid rain emissions, and less solid wastes.

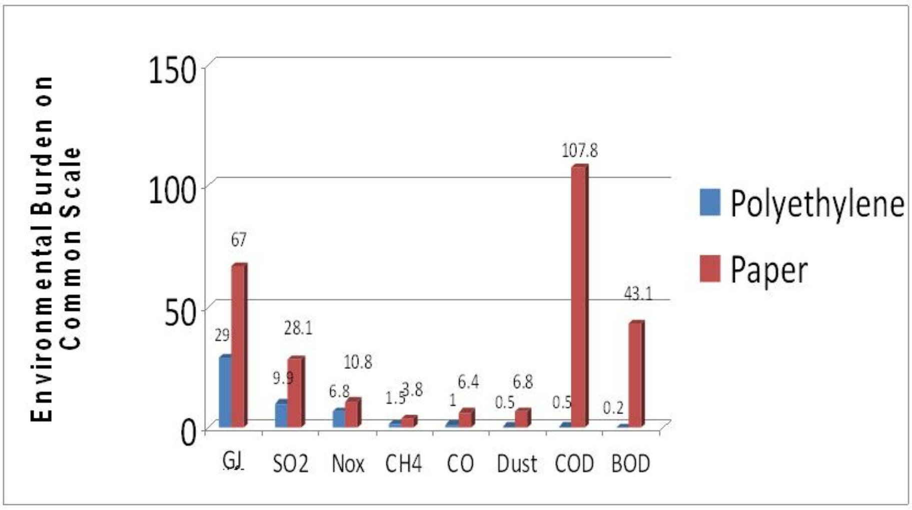
Table 103: Recycling of Plastic Wastes

	Paper (30% recycled Fibre)	Compostable Plastics	Polyethylene
Total Energy Usage (MJ)	2622	2070	763
Fossil Fuel Usage (Kg)	23.2	41.5	14.9
Municipal Solid Waste (Kg)	33.9	19.2	7.0
Green House Gas Emission (CO2 Equivalent Tonnes)	0.08	0.18	0.04
Fresh Water Usage (Gallons)	1004	1017	58

Source: Boustead LCA Report

9.4.4 Comparison of the environment burden due alternatives to plastics have been briefed in the following tables:

Figure 89: Comparison of the environment burden



(Fabbri A, Scott G and Gilead D)

Figure 90: Environmental burden-1

Environmental Burden in kg	Jute Bag	Plastic Bag
Air Pollution		
CO	54.3	0.6
CO2	6610.2*	760*
SOx	134.8	5.2
Nox	68.1*	4.8*
CH4	39.5	3.2
HCL	5.3	0
Dust	67.6	1.4
Water Pollution		
Suspended Solids	352.3	0.2
Chlorides	4535.5	0.1

(LCA study by IIT – Delhi)

Figure 91: Environmental Burden-2

Emission	Gm/km	Excess Emission for jute Bags	Plastic Bags
CO2	781*	11107.3*	Taken as Basis
CO	4.5	64.0	Taken as Basis
HC	1.1	15.6	Taken as Basis
NOx	8*	113.8*	Taken as Basis
Particulates	0.36	5.1	Taken as Basis
Total Regulated Tailpipe Emission	13.96	198.5	Taken as Basis

(LCA study by IIT – Delhi)

9.4.5 In the year 2005, plastics packaging alone saved the earth from a burden of 220 Million Tonnes CO_2e Green House Gases (McKinsey Report). The contribution of the total plastics applications is more than double. Considering recycling of plastics is 30 - 40% on global average, the total GHG saving due to recycling of plastics may safely be estimated more than another 100 Million Tonnes CO_2e.

9.4.6 Brief of McKinsey report on GHG saving by plastics in packaging applications:

Figure 92: Comparing segments -1

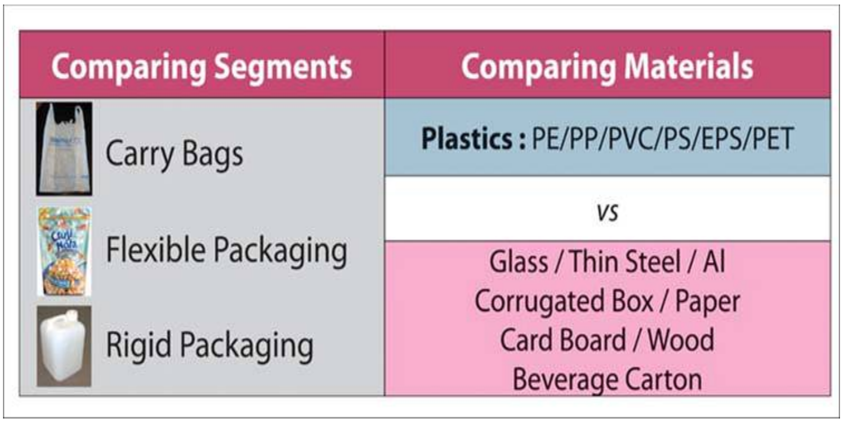
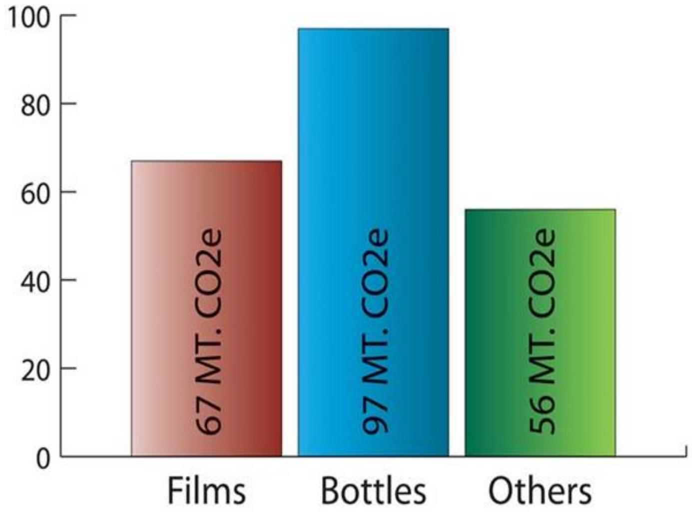


Figure 93: Comparing Segments -2



*9.5 **State Legislations on Plastics Use & Its Impact***

9.5.1 Use of plastics for various applications are governed by individual sectors or specific applications like – food, pharmaceuticals, drinking water, electrical or telecommunication cables, automobiles, pipes – agricultural or building application etc.

9.5.2 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.

9.5.3 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.

9.5.4 Some State Governments have further modified these rules by increasing the minimum thickness. While some State Governments have completely banned use of plastics carry bags. There are proposals by some State Governments / Local Bodies to ban the one-time use plastic items like cups, plates etc.

9.5.5 Real impact of such legislations is wide. It is true that very thin plastic carry bags, though technically and environmentally not objectionable materials create waste management problem as the users discard them indiscriminately. As the infrastructure for waste collection system is not adequate and also as the waste pickers do not get adequate economic return for collecting this type of waste, these thin plastics carry bags remain discarded in the road side and fields. Multi layered plastics pouches / sachets and thermocol (expanded polystyrene) are very essential packaging materials, which save energy and conserve the life of the packed products. However due to lack of proper collection and recycling infrastructure, Government tries to restrict the very use of such forms of plastics. This would burden the environment and cause health and safety deficiencies in the society at large.

9.5.6 The real solution lies in the segregation of dry and wet solid waste at the source, creation of efficient solid waste management infrastructure coupled with establishment of recycling centres as plastics can be recycled to produce articles of non-critical applications for mass use augmenting the concept of resource management.

9.6 Practices in Advanced Countries & China

9.6.1 In most of the developed countries, Plastics Waste Management is a part of the comprehensive "Packaging Waste Management" rules.

9.6.2 The differing national measures concerning the management of packaging and packaging waste are harmonized in order, on the one hand, to prevent any impact thereof on the environment or to reduce such impact, thus providing a high level of environmental protection, and, on the other hand, to ensure the functioning of the internal market and to avoid obstacles to trade and distortion and restriction of competition within the Community;

9.6.3 It is considered that the best means of preventing the creation of packaging waste is to reduce the overall volume of packaging.

9.6.4 The rules aim to improve the total environmental performance and lifecycle management of consumer packaging and paper by pursuing the following specific environmentally focused performance goals:

1. Packaging is optimised to integrate considerations about resource efficiency, maximum resource re-utilisation, product protection, safety and hygiene.

2. Efficient resource recovery systems for consumer packaging and paper.

3. Consumers able to make informed decisions about consumption, use and disposal of packaging of products.

4. Supply chain members and other signatories able to demonstrate how their actions contribute to goals (1) – (3) above.

5. All signatories demonstrate continuous improvement in their management of packaging through their individual Action Plans and Annual Reports.

9.6.5 In order to measure the achievement of each of the goals identified, specific overarching targets have been established in the following areas:

1. Increase in the amount of packaging recycled
2. Increased recycling rate for 'non-recyclable' packaging1
3. No increase in the amount of packaging disposed of to landfill.
4. Key Performance Indicators (KPI's) have also been established for the Covenant.
5. Both the targets and KPIs are clearly described.

The overall success of the System is measured by the extent to which it meets these overarching targets and environmental goals.

9.6.6 To assist the System's capacity to deliver on these goals and targets, the Covenant has been broadened to include:

a) A requirement for specific actions and quantifiable targets in relation to key performance indicators in Covenant Signatory Action Plans.

b) The expansion of recovery systems and re-use of consumer packaging and paper to include material generated away from home and in workplaces — commercial, industrial and government premises — as well as in the home.

c) An increased focus on the provision of information and education to:
   - improve the environmental performance of packaging systems
   - assist the packaging supply chain and consumers to make informed choices about packaging and products

- assist the packaging supply chain and users to make responsible choices, including design, purchasing, recycling, reuse and disposal.
- An improvement in the efficiency of good practice recovery and waste management systems, defined as the:
    - recovery and re-use of consumer packaging and related materials from kerbside
    - collections, including drop-off systems
    - recovery of consumer packaging at public places, workplace/commercial premises and industrial premises
    - recovery of consumer packaging, distribution packaging and related materials throughout the packaging supply chain
    - reduction of litter and the impacts of littering of consumer packaging
    - Use of suitable alternatives to lightweight, single-use plastic bags.

THE OBJECTIVE AND SCOPE OF THE COVENANT

The objective of the Covenant is to reduce environmental degradation arising from the disposal of used consumer packaging and conserve resources through:

- Better product design
- Increased reduction, re-use and recycling of used packaging materials
- Reduced use of non-recyclable materials
- Reduced amount of used packaging materials going to landfill
- Reduced incidence of packaging being littered.

This objective will also be achieved through:

- A framework based on the principle of shared responsibility for the effective lifecycle management of consumer packaging and paper products including their recovery and utilisation by all stakeholders.

- A collaborative approach to ensure that the management of consumer packaging and paper throughout its lifecycle and the implementation of collection systems including kerbside recycling schemes, produces real and sustainable environmental benefits in a cost effective manner.

- A forum for regular consultation and discussion of issues and problems affecting the recovery, utilisation and disposal of consumer packaging and paper, including costs.

  The arrangement applies to the lifecycle management of consumer packaging and consumer paper with the exclusion of paper that is used to publish newspapers or magazines. This sector is being addressed through a parallel industry and government national industry waste reduction agreement.

9.7 Need for Public Awareness on Recycling in India

9.7.1 **Role of CIPET & Industry**

9.7.1.1 As done during the XI Plan, CIPET can organize seminars/workshops at different cities with the support of administrative Ministry during XII Plan. CIPET has successfully organized the Technical Workshops at Kolkata, Delhi, Murthal, Bangalore, Guwahati, Madurai & BhOPal. During XII Plan, with the funding support from Administrative Ministry, CIPET with the support and in association with ICPE, PIF, AIPMA, etc can organize many more such Seminars/Workshops at different parts of the country.

9.7.1.2 Grass root level education is of paramount importance to have a focused clear vision of addressing the key issues in Plastics Waste Management such as, collection, segregation, awareness of code of practices, safe handling of plastics waste & disposal. This can be addressed effectively through organizing campaign at school levels through presentations, interactive sessions, placards, posters and information booklets in local languages, etc highlighting the usefulness of plastics and effective and efficient plastic waste management solutions.

9.7.1.3 With the necessary funding support of Dept of Chemicals & Petrochemicals, CIPET can organize awareness campaign at school levels during the XII Plan covering around 50 schools per year throughout India. The services of ICPE, the Nodal organization in Plastics Waste Management in India can also be roped in.

9.7.1.4 In order to create public awareness on plastics recycling and to dispel the incorrect perception of the general public, advertisement campaigns can be telecast in the television, railway stations and bus stands at 20 selected cities to start with and the coverage can be expanded subsequently to cover the entire country.

9.7.1.5 CIPET has published a booklet on “Plastics - the Hidden Facts” and released during the technical seminar on plastic waste management held at Madurai. With this experience CIPET can prepare similar booklets in the selected regional languages which will be helpful in educating the general public, NGO’s, and those who are concerned about Plastics Waste management.

9.7.2 **Participation of Stakeholders**

9.7.2.1 As adopted successfully in many developed countries, the participation and active involvement of 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.

9.7.2.2 Key components of an effective action plan need to include the following.

- Bin Culture
- Source segregation of waste
- Transportation of Plastics Waste to reclamation site
- Offering incentive scheme.

9.7.3 **Setting up of Plastic Waste Management Centres**

9.7.3.1 CIPET with the support of Dept. of Chemicals & Petrochemicals, Govt. of India has successfully implemented a PWMC project at Guwahati – Assam with a project outlay of Rs. 7.90 crores. Further, CIPET is involved in establishing a PWMC centre at Delhi which is under progress. Plastic recycling centre can be a part of Plastic Park which is under active implementation by the Administrative Ministry.; Plastics Waste Management centres can be established by CIPET at all existing centres and new centres planned/proposed by CIPET during 12th Plan.

9.7.4 **Suggestions for Development of Recycling Industry in India**

9.7.5 The following recommendations, if implemented will go a long way to develop the recycling sector in the country.

9.7.5.1 Taking a advantage of location and expertise of CIPET in Plastics Waste Management, Pilot Demonstration Plants on Plastics Waste Management and recycling can be established at all CIPET Centres.

9.7.5.2 With the funding support of DCPC, GOI, in association with leading plastic associations, ICPE, CIPET can organise

Conferences/Technical Seminars, Campaign at School level on Plastics Recycling and Waste Management at different parts of the country.

9.7.5.3 Plastic recycling centres can also be established as a part of the Plastic Park which is under active consideration by the Administrative Ministry.

9.7.5.4 Growth and sustainability of the plastics recycling industries calls for adoption of latest sophisticated Plastics recycling technologies which in turn necessitates the need to visit periodically the develop countries in order to understand the technologies and evaluate/study the feasibility of adopting such technologies with respect to Indian Context. The team can comprise high level delegation from the Administrative Ministry, CIPET and leading Plastics Industries/Associations.

9.7.5.5 A focused scheme can be developed for promoting best practices in plastic waste management in India.

10 Growth Drivers in the 11th & 12th Plan – Key end use sectors

10.1 Review

10.1.1 Before the performance of 11th plan is reviewed and 12th plan demand forecasts are estimated, it is necessary to review the key end use sectors which are driving the growth. Petrochemical growth is driven by GDP growth, improvement in disposable income, aspirations of young India, urbanization, etc. These megatrends get translated to increase demand for healthcare, packaging, white goods, automobiles, agri produce, retail, etc. Some of the key demand drivers are discussed below.

10.2 Packaging –Touching our Lives every day!

10.2.1 Packaging provides first point of contact by which a company presents its products to consumers & keeps the product protected and quality preserved, maximizing shelf life with design innovations.

10.2.2 Packaging is the 3rd largest industry in the world after Food, Energy & Petrochemicals. It is only industry that has growth rate higher than GDP in almost all countries. In developing countries like India it is growing at almost twice the GDP rate. The packaging industry in India is valued over Rs 300 Bn and is growing at almost 15%-16% p.a. Plastics, Metals, Papers, Glass are the basic materials used in Packaging. Plastics contribute more than 30% of which two third is flexible packaging and one third is rigid (injection / blow moulded containers).

10.2.3 India is one of the most rapidly expanding flexible packaging industries in the world besides China, Russia, Eastern Europe and South America. Asian countries are witnessing excellent growth in consumer packaging. The market for rigid containers has shifted substantially to flexibles due to lower cost and convenience of single use unit pack.

10.2.4 Flexible packaging with a total market size of 1.5 MMT worth 15000 Crs growing @ more than 17% pa (consists of multilayer PE films, monolayer PE films , CPP, BOPP , TQPP films, PET films), is used to pack a variety of products today viz. milk, water, edible oil, snack foods, confectioneries, frozen foods, commodities, dry fruits, detergents, seeds, pesticides, automotive parts, fabrics, textiles, pharma products, food grains, gutkha, etc

10.2.5 Market Drivers – increase in consumption of packaged goods due to lifestyle changes and, shift from rigid to convenient packaging, growth in the processed foods industry, growth of non food sectors.

10.2.6 Plastic pouches are the only option to deliver fresh milk to millions of households, delivering the nutritious dairy products in most economical, hygienic, safe and environment friendly packages.

10.2.7 30 to 40% of Fruits and Vegetables is lost annually due to poor post harvest techniques. Packaging materials play an important role in preventing losses at the farm and during the distribution chain.

10.2.8 India consumes over 6000 million litres of bottled water every year. Plastic ensures quality packaged drinking water.

10.2.9 Plastic Films -only means of getting fresh bread available to masses.

10.2.10 Delivers cement, fertilizers, detergents and seeds to millions

10.2.11 Best Packaging Medium, lowest tare weight of all packaging. Reduced raw material consumption by 300%+

10.2.12 Low volume of waste generation. Solid waste reduced by 160% over all other packaging

10.2.13 Simple conversion process. Reduced energy demand by 110% over other competing packaging materials

10.2.14 Reduced cost of packaging. Competing packaging materials costlier by 200%.

10.2.15 Milk production in India has come a long way over the years from 17 MMT (1951) to 112 MMT in 2010 with per capita consumption of 265g/day. The Indian dairy industry presently contributes about 15 % to the total milk production of the world and stands at a mammoth size of US$ 70 billion1. Given the highest milch bovine population of 115 million in the world, India exhibits tremendous potential to further strengthen its position in the world dairy market.

10.2.16 The laurels of this numerouno position emanates from a huge base of around 11 million farmers organised into about 1 lakh Village Dairy Cooperative Societies. The Indian dairy market is currently growing at an annual growth rate of 7% at current prices.

10.2.17 The operation flood program promoted and implemented by the National Dairy Development Board (NDDB) has been instrumental in bringing about a white revolution in India. Changing lifestyle, feeding habits and urban culture has somewhat effected the transition of the

Indian dairy Industry into a more of a demand driven, highly diversified and exciting business proposition.

10.2.18 Presently only 18% of the marketed milk is represented by packaged and branded pasteurized milk. The appropriate packaging of dairy products is of utmost importance not only to preserve nutritive value and saving of wastage, but also to improve the marketability to achieve better returns.

10.2.19 Milk in its various forms gives ample challenging opportunities to the packaging manufactures from the field of glass, metal, paper, plastics etc. to innovate and introduce packaging solutions. The challenge to the packaging fraternity is to deliver the nutritious dairy products to the consumer in most economical, hygienic, safe and environmentally friendly packages. Plastics have been the most preferred material serving all criterias, whether its pouches, flavoured milk bottles, injection moulded containers for yogurt, etc. Total Polymer consumption in dairy sector is close to 73 KT.

10.2.20 **Issues & Challenges**

10.2.20.1 Despite being the world's largest milk producer, India's share in the world dairy trade is almost negligible. However, India is a net exporter of dairy products, milk powders, baby foods, butter and other fats, casein, milk and cream, cheese, and whey products.

10.2.20.2 Demand supply gap has become imminent in the dairy industry because of the dynamic demographic pattern, changing food consumption habits and the rapid urbanization of rural India. This requires an inclusive growth of the dairy sector along with the rapidly growing Indian economy.

10.2.20.3 The dairy industry in India has its base in the small holders and marginal farmers. The Operation Flood program might have brought in a plethora of changes in the dairy sector but there is still much to be reformed. This is because about 82% of the dairy industry is unorganized and the raw milk market is still dominated by the local milkman/dhudaiyas and halwai in India. This leads to a complex supply chain that is compounded by a lack of proper cold chain facilities and logistics. The return of investment for the farmers who are a major stake-holder in the industry is on the downside and value percolation to the base of the chain has been minimal.

10.2.20.4 A thorough analysis of the existing Govt. schemes for the dairy sector shows that the Govt. patronage to cooperative societies and small farmers has been fostering growth in the sector to some extent but still there are gaps in terms of maximizing the value involved in the entire chain. There has been a dearth of incentives for the private corporate houses and conglomerates to venture into the dairy sector.

Though the Government has been promoting some large scale private investments in the food processing sector through the Mega Food Parks and Cold Chain Infrastructure schemes, there has been not much progress in the dairy processing sector.

10.2.20.5 In India, the average milk yield per animal on a daily basis is 6.5 kg for crossbred dairy cows which is quite less in comparison to the yield of exotic varieties in temperate countries. This huge gap in the production standards presents for the need for an intervention to boost the overall yield and productivity parameters. It is hence important that the private sector investments get accelerated in this very important space.

10.2.21 **Indian FMCG Sector**

10.2.21.1 The Indian FMCG sector, with a market size of US$ 30 billion, constitutes 2%of India‘s GDP and is expected to grow at more than 10% pa. A well-established distribution network spread across six million retail outlets (including two million in 5,160 towns and four million in 627,000 villages), low penetration levels, low operating costs and competition between the organized and unorganized segments are key characteristics of this sector.

10.2.21.2 Organised retail has created new channels for FMCG players through diverse retail formats such as departmental stores, hypermarkets, supermarkets and specialty stores. With organized retailing emerging in a major way across the country, the revenues of FMCG companies are expected to surge.

10.2.22 **Rural market —the new growth frontier**

10.2.22.1 Rural India accounts for close to one-third of the total consumption pie. Robust consumption in the rural economy is a key driver of India‘s sustained growth. The penetration of companies into rural north India increased from 9.5%in 2000 to 46%in 2008, due to companies selling their products in small packets or plastic sachets.

The under Rs. 5/- transaction challenge

Breakfast : Nestle Redimix: Rs. 3/-, Parle G: Rs. 2/-
Clothes : Ariel, Surf Excel : Rs. 3/-
Bath: Lux : Rs. 5/-, Clinic Plus Satchet: Rs. 2.5/-
Grooming : Fair & Lovely: Rs. 5/-, Parachute coconut oil: Rs. 1/-,
Lifebuoy family talc : Rs. 2/-
Lunch: Maggi : Rs. 5/-
Snack: Perk/Dairy Milk: Rs. 5/-,

FMCG companies are devising exclusive rural marketing strategies to tap the rural consumer base.

ITC‘s e-Choupal

DCM Shriram's —HariyaliKisaan||

10.2.23 **Indian Retail Industry**

10.2.23.1 Traditional retailing continues to be the backbone of the Indian retail industry, with traditional/unorganised retailing contributing to over 95%of total retail revenues. The quintessential mom-and-pop retailing outlets or the corner store formats constitute a major part of Indian retail store formats. Over 12 million small and medium retail outlets exist in India, the highest in any country. More than 80 % of these are run as small family businesses. Prevalence of traditional retailing is highly pronounced in small towns and cities with primary presence of neighborhood "kirana" stores, push-cart vendors, "melas"and "mandis".

10.2.23.2 Modern/Organised retailing is growing at an aggressive pace in urban India, fuelled by bourgeoning economic activity. In 2010, the Indian retail market size was US$ 353 billion and is projected to grow at 11.5%per annum to reach US$ 543.2 billion by 2014. The current share of organised retail is estimated to be 4 to 5%and is expected to increase by 14 to 18%by 2015. A large number of domestic and international players are setting up base and expanding their business with newer organized retail formats and intense competition driving innovation in formats.

10.2.23.3 Retail sector in India is primarily categorised by the type of products retailed, as opposed to the different retail formats in operation. The Food and Beverages vertical accounts for the largest share of revenues at 74%of the total retail market. This category has the highest consumer demand across all income levels and various retail formats. The Indian consumer behavior of preferring proximity to retail formats is highly pronounced in this sector, with food, grocery and allied products largely sourced from the local stores or push-cart vendors.

10.2.23.4 The emergence of organized sector retail chain stores and a rise in competition is likely to be a catalyst for bringing about much needed reform in the agriculture-related supply chain. The large players in the retail sector and fast moving consumer goods are also influencing the government to liberalize the regulations, which hitherto have constricted the operational environment.

10.2.24 **Importance of Packaging in Retail**

10.2.24.1 Packaging provides the most important first point of contact by which a company presents its products to consumers.

10.2.24.2 It is the most important means of product differentiation.

10.2.24.3 It is the only communicator with the consumer at the all-important point of purchase.

10.2.24.4 Innovation in packaging designs and colours is taking place as brands jostle for shelf appeal and space.

10.2.24.5 Modern customer today is looking more for convenience, quality, and hygiene. Current innovative food packaging systems ensure better protection of foods as well as efficient quality preservation and enhanced safety.

10.3 Plastics in Bulk Packaging (Cement, Fertiliser, Sugar etc)

10.3.1 Bulk commodities have traditionally been packed in either Jute or paper sacks. The sacks for bulk packaging are required to be strong, light and easy to handle and safe from the point of hygiene. In addition to above attributes, sacks for bulk packaging must be environment-friendly & energy-efficient.

10.3.2 Due to its superior functional & technical properties, plastic woven sacks have replaced traditional sacks in bulk packaging of a wide range of products like fertilizers, cement, chemicals & foodstuffs etc.

Figure 94: Food grains packed in woven sacks in India as well as abroad

10.3.3 Current Status: Indian plastic woven sack industry has an estimated capacity of over 1700 MTA with consumption of 1170 KT polymers in 2010-11 with turnover of ~ Rs. 12000 Cr. The industry is 2nd largest in the world with all major developed countries relying on Indian processors for the bulk packaging sourcing be it in the form of small woven bags or technical FIBC bags, lumber covers etc. The industry has tremendous opportunity as a key export / foreign ex-change earner.

10.3.4 Suitability & Accreditation: Woven sacks have been proven as a superior packaging for bulk handling of commodities & foodstuffs from various studies conducted by reputed Government as well as private testing & research centers like IGSMRI, IARI, CPRI, NRCOG, NSI, ITRC, IIP, NHRDF, Delhi Test House to name a few. In fact International Standard ISO 23560 also confers woven sacks as suitable for packaging, storage & transportation of foodstuffs such as cereals. However, use of woven Sacks for packaging of food grains and sugar in India has been thwarted by the continuation of JPMA, which makes use of Jute bags mandatory for packaging of the 2 commodities mentioned above. However due to acute shortages in jute bags during FY 2009-10, woven sack industry supplied 35 KT bags on war footing to help procured food grains from rotting & their performance also were satisfactory.

10.3.5 Standing Advisory committee has repeatedly recommended usage of plastic woven sacks by dilution of JPMA due to cost advantages, supply shortages of jute bags, suitability & ability of woven bag manufacturers to provide the bags on JIT.

10.3.6 Even corporate end users of foodstuffs like sugar demand woven sacks packaging instead of jute bags due to issues like fiber contamination which is backed by various sugar mills associations.

10.3.7 Table: compares energy requirement for plastic sacks for bulk packaging of 1 MMT commodity with the same for Jute and paper sacks. As shown in the table, the volume of material required for Jute and paper sacks are 6 times and 3 times that of PWS respectively. Net energy consumption, which is 180000 GJ for PWS, is much more for Jute sacks (333000 GJ) or paper sacks (638000 GJ).

Table 104: Comparison of Plastic Sacks with Jute & Paper

Note: Figures are for packaging 1 MMT commodity transported over 100 km

Comparison of PWS, Jute Sacks & Paper Sacks for Bulk Packaging of 1 MMT Commodity

	Unit	Plastic Woven Sacks	Jute Sacks	Paper Sacks
Production of Sacks				
Material Required	MT	2310	12290	
Energy Required for Raw Materials Production	000 GJ	178.3	153.6	720
	000 GJ	48.5	179.4	57.6
	000 GJ	226.8	333	669.6
Energy Required for Manufacturing Sacks Total Energy Requirement	No.	111368	112477	111873
Transportation of Sacks				
Total No. of Truck loads Required Additional	No.		1109	505
Truck Loads Required Over PWS	litres		36355	16570
Additional Fuel Required Over PWS	GJ		2035.9	927.9
Additional Energy Required Over PWS				
			333	638
Net Energy Consumption Including Production, Transportation, Incineration & Recycling	000 GJ	180		

Note:Figures are for packaging 1 MMT commodity transported over 100 Km
Source: LCA, IIT Delhi

New Horizons: Leno bags for Fruits & Vegetables:

10.3.8 Leno bags produced by the same set of customers has recently caught the attention of farming society as well as cold storages as most suitable, hygienic & cost effective packaging. They offer freshness, breathability of F & V offering higher shelf life & reduced wastage of F & V. Over all they are cost effective over jute bags by ~ 60%. Today the leno bags usage has grown from mere 0.5 MnT to 10.0 MnT fruits & vegetables packaging in last 5 years registering a growth of 82 CAGR. This has resulted reduced cost of packaging, easier & regular availability of packaging material at farm level reducing wastage & offering hygiene.

Figure 95: FIBC / Jumbo Bags offering latest packaging practices

10.3.9 Jumbo bags or FIBC, is the art of packaging commodities ranging from 500 Kg to 2000 Kg in a single bag weighing just 900g to 3.3 Kg of packaging material! This offers latest packaging techniques allowing material savings, lower carbon footprints! Worldwide in developed counties FIBC are the standard practice due to their bulk handling, cost effectiveness & automation. India is the 3rd largest exporters of FIBC in the world supplying to EU & USA. This industry has potential to change the packaging scenario in India too offering efficiency & reducing packaging waste. India is poised to become world's biggest exporters of FIBC in next 5 years.

Figure 96: Leno bags for reduced farm wastage & hygienic, cost effective packaging

10.3.10 **Outlook for Bulk Packaging:**

10.3.10.1 The sector is poised to grow at 9% CAGR in next 5 years too. Polymer consumption is expected to be 1962 KTA by 2016-17 with industry turnover of ~ Rs. 20000 Cr. India is also expected to become global leader in FIBC exports & small bag exports by 2016-17 & earn significant foreign exchange. Since this sector is highly manpower intensive for it will continue to offer huge employment in a large scale.

10.4 Plastics in Agriculture

10.4.1 Agriculture is the mainstay of any developing economy. India supports nearly 16% of the world population with only 2.4% land resource & 4% of water resources with 2/3 of our population directly or indirectly dependant on Agriculture. This sector is contributing nearly 17% of GDP consuming almost 80% of available water.

10.4.2 The major challenges this sector is encountering today are:

10.4.2.1 Shrinking of cultivable land for cultivation.

10.4.2.2 Low productivity, 40-60% of world average with no major mind set change to newer techniques.

10.4.2.3 Only 40% of the total land area is irrigated with conventional irrigation.

10.4.2.4 Considerable pre and post harvest losses due to poor infrastructural facilities.

10.4.2.5 Water logging & soil salinity leading to land becoming uncultivable.

10.4.2.6 Drastic reduction in per capita land holding across the country& lack of awareness.

10.4.2.7 Depleting water table & drastic reduction in quality and quantum of water availability.

10.4.2.8 Lower realization in farm income & unorganized in-efficient marketing network.

10.4.3 Out of the total geographical area of 329 mha nearly 140 mha is sown area with 61 mha is being irrigated under different forms & only 5 mha is under micro irrigation in the country. The growth of agriculture & allied sector is still a critical factor in the overall performance of our economy. These accounted for 14.2% of GDP according to the advance estimates of Central Statistics Office (CSO).

10.4.4 The need of the hour is to enhance agricultural productivity towards meeting the food security for the ever increasing population through optimal us of available agricultural land, water and agri-inputs by adopting improved cultivation practices and Plasticulture applications. With immense scope for the same to achieve the projected 4% AGR of agriculture sector.

10.5 Protected Cover Cultivation & other Plasticulture Applications

10.5.1 Plasticulture applications such as poly-houses, Shad-net House, Plastic Tunnel, Protection nets, mulching etc provide favorable micro climate for crops and optimizes yield. Surface cover cultivation (Plastics mulch) & plastic film for lining of water harvesting structures and farm ponds, canal etc is also an effective tool for conserving soil moisture by arresting evaporation, seepage losses etc thereby reducing the demand of water for irrigating crop and also reduction in weed growth which saves nutrient loss, provides cleaner crop resulting in significant increase in crop yield as well as savings of labour cost involved in Intercultural operations. The protected structures enable to cultivate off – season crops irrespective of the vagaries of the climatic conditions, thereby ensuring supply of agricultural/horticultural produce round the year with improved quality which in turn provides food security in the country apart from higher returns.

Figure 97: Canal Lining

10.5.2 Farm pond /reservoir lining films, technical textile products such as shade-nets, geo-synthetic films etc provide the required atmospheric conditions for optimum plant growth. Packaging helps in reduction of post harvest losses and enhancement of shelf life of the produce.

10.5.3 The proposed area coverage for different **Plasticulture** applications other than Micro Irrigation for the 12th plan period is as under**.**

Table 105: The proposed area coverage for different Plasticulture applications

Year	Proposed Area for Adoption (ha)					
	Green House	Shadenet House	Plastic Tunnel	Protection Nets	Plastic Mulch	Pond Lining
2012-13	1232	3025	1050	2880	5760	3000
2013-14	1416	3781	1260	3168	6912	3450
2014-15	1629	4727	1512	3485	8294	3600
2015-16	1954	5908	1890	4008	9953	4320
2016-17	2345	7385	2363	4609	11944	5184
Total	**8576**	**24826**	**8075**	**18149**	**42864**	**19554**

10.5.4 It is estimated that 298.7 KT of polymer would be required for these Plasticulture applications as detailed below.

Table 106: Plastics Requirement for Plasticulture application

Year	Plastic Requirement (KT)						Total
	Green House	Shadenet House	Plastic Tunnel	Protection Nets	Plastic Mulch	Pond Lining	

2012-13	5.5	6.1	1.1	2.9	0.9	27.3	43.7
2013-14	6.4	7.6	1.3	3.2	1.0	31.4	50.8
2014-15	7.3	9.5	1.5	3.5	1.2	32.7	55.8
2015-16	8.8	11.8	1.9	4.0	1.5	39.3	67.3
2016-17	10.6	14.8	2.4	4.6	1.8	47.1	81.2
Total	38.6	49.7	8.1	18.1	6.4	177.8	298.7

10.5.5 Accordingly the total polymer requirement for Plasticulture & Water Management for the 12th plan period would be 1835.9 KT as under:

- Water Management (Drip & Sprinkler Irrigation) 1537.2 KT
- Protected Cover & Other Plasticulture Applications 298.7 KT
- **Total** **1835.9 KT**

10.6 *Plastics in Healthcare*

10.6.1 With advent of modern medical science the life expectancy of the people has increased. Take an example of India, in just 50 years the average life expectancy has increased from 40 years to 64 years according to World Bank data. Also the global population is expected to touch 8Bn by 2030. As result of these factors, there is an increased pressure on healthcare needs. On material front, plastics have emerged as the most suitable material for various healthcare needs, may it be syringes, drug packaging, artificial implants or medical equipment, to name a few.

10.7 *Why plastics in Healthcare?*

10.7.1 Plastics offer numerous advantages over conventional materials.

- Cost effective
- Light weight
- Inert, non toxic, bio-compatible
- Ease of Disposability, recycle-ability
- Design and forming flexibility
- Ease of Sterilisation
- Can be made transparent

10.7.2 Globally, 1.8Mn MT of plastics are consumed in Healthcare products, with 75% share of Polyolefins and PVC. Global demand of plastics in Devices and Pharma packaging is growing by 7%.

10.7.3 Plastics usage in Healthcare sector can be classified into three categories

10.7.3.1 Medical Devices: A medical device is a product which is used for medical purposes in patients, in diagnosis, therapy or surgery. If applied to the body, the effect of the medical device is primarily physical in contrast to pharmaceutical drugs, which exert a biochemical effect.

10.7.3.2 Medical devices include a wide range of products varying in complexity and application. Examples include tongue depressors, medical thermometers, blood sugar meters, total artificial hearts, fibrin scaffolds, stents and X-ray machines

10.7.3.3 Global medical device industry is expected to reach US $ 150 billion in 2012 from today's US $ 200 billion, growing at 12%. USA totals 45-47% of the world's consumption.

10.7.3.4 Implant is an exciting treatment alternative that allows us to treat an edentulous space or a missing tooth with an almost equivalent restoration in terms of function, strength, and aesthetic.

10.7.3.5 The global dental implants market is expected to grow from $2.9 billion in 2009 to $4 billion in 2014 at a CAGR of 6.04%. According to the global authority on medical technology market intelligence, global spinal implant market, including the US, Europe, and Asia Pacific, was valued at over $5 billion in 2008 and will grow to more than $7.5 billion in 2013.

10.7.3.6 Medical disposable (also called disposable product) is a product designed for low cost and short-term convenience, intended for single use only rather than medium to long-term durability.

10.7.3.7 Worldwide, the medical disposable market demand for plastic is expected to reach more than US$~billion by 2011, with a combined annual growth rate for injection moulded products ranging from 4.0-5.5% between 2006 and 2011. The European Union (EU) market is the second largest market for medical devices and disposables. It has a market share of 30% which is only second to US which has a share of 45% of the total world market.

10.7.3.8 In India the healthcare sector was $38 Billion in 2008. This is expected to grow at 15% CAGR to reach $77 Bn by 2013. The sector spending contributes 8% of the GDP and employees ~10Mn people. Plastics offer tremendous scope for growth in Healthcare sector. Some of the examples are listed below.

Table 107: Indian Plastics consumption for various healthcare products

	Consumption in 2010-11	Projected Consumption for 2014-15
Syringes	33000 MT	58000 MT
IV Fluid Bottles	15000 MT	26000 MT
Blood Bags	60000 MT	105000 MT

Application areas of plastics in Healthcare

a. Medical Equipments
b. Syringes, Blood Bags and other disposable items
c. Artificial organs, joints
d. Implants
e. Non Woven medical disposables
f. Pharmaceuticals packaging
g. Controlled release drugs

10.7.3.9 To sum up, plastics help in enriching human life in number of ways, be it healthcare or other needs. It is inevitable that the growth of healthcare industry and plastics for healthcare will take place synergistically.

10.8 Automotive Sector

10.8.1 Automobile Industry in India has witnessed spectacular growth in recent years and expected to grow at the rate of 13% in next couple of years. Indian automotive market size is currently $55Bn contributing about 5% of the GDP.

10.8.2 The Indian Automotive Industry is one of the fastest growing Industries in the world and expected to become 4th largest globally by 2015. The production of all categories of vehicles has grown at a CAGR of 15% over last 5 years. India is emerging as one of the fastest growing Passenger car market and 2nd largest Two Wheeler manufacturer in the world.

10.8.3 Government released Automotive Mission Plan 2006-16 to give road map to Indian Automobile Industry.

- Increase turnover to $145Bn from $55Bn
- Increase export to $35Bn from 4.1Bn
- Auto component industry is expected to touch $40-45Bn from $18Bn
- Provide employment to additional 25Mn people
- Contribute10% of country's GDP and 30-35% of the Industry

10.8.4 Currently Automotive Industry employs 2 lakh persons in vehicle manufacturing and 2.5lakhs in component manufacturing and 100 lakhs at different levels of value chain. The expected growth in investment and output of India’s Automotive sector in next 5years will further create employment opportunities in the country by way of both direct and indirect employment in Automotive sector.

10.8.5 Automakers are working towards increased use of lightweight materials to reduce cost and save weight for fuel economy. Hence, Plastics plays important role and increasingly becoming the resin of choice for many automotive applications. Globally, Plastic penetration in a car is max. 160 kg with an average penetration of 120kgs translating into 9MMTA plastic consumption that is expected to grow to 14 MMTA by 2016. Polypropylene accounts for 46% of total plastics in a global car. On a average PP penetration in a global car is 56kgs and total PP consumption is 4.0MMT

10.8.6 On Indian front, average Plastics penetration in a car is 70kgs with Plastics consumption to the tune of 320 KTA which is expected to grow to 3 times in next 5 years. In an Indian car, Polypropylene accounts for 50% of total plastics and on a average Polypropylene car comes to 35gs with Plastics consumption of 160KTA

10.8.7 China has a relatively low vehicle density with 27 vehicles per 1,000 people in 2010, but the population in China is over 1.3 billion people. And India has a similarly low vehicle density to China, but with a population of almost 1.2 billion people.

Figure 98: Vehicle Density

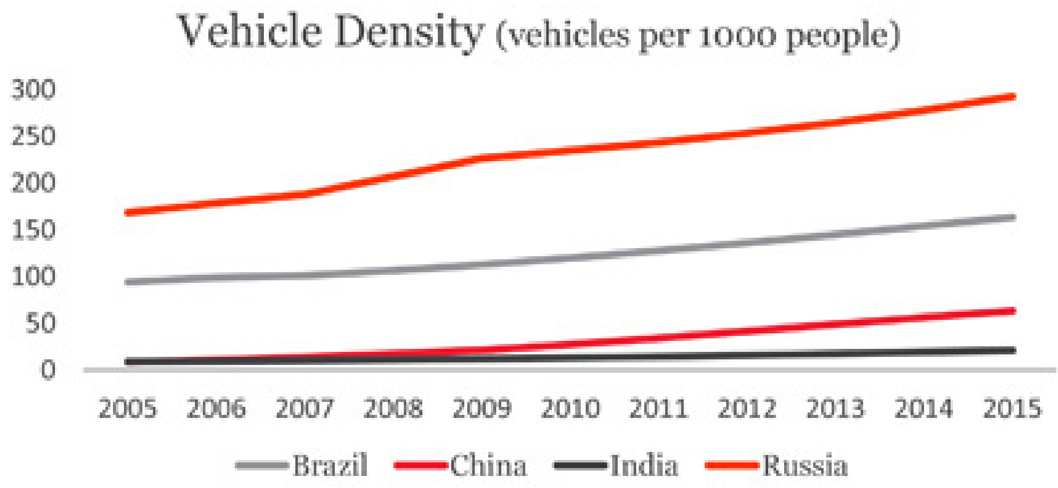


Table 108: Vehicle Production Data in million

Segment	2005-06	2010-11	2014-15 (Exp)
PV	1.3	2.9	5.5
2 Wheeler	7.6	13.2	20
3 Wheeler	0.4	0.8	1.1
CVs	0.4	0.7	1.2
Total Automotive	**10**	**18**	**28**

10.9 Appliance Sector

10.9.1 The Appliances industry is growing with a CAGR of 15% in last 5 years and expected to grow with same pace in coming years too. The current market size of Appliance Industry is pegged at $45 billion. The Appliance Industry has been witnessing significant growth in recent years due to rapid economic growth, rising disposable incomes, availability of easy finance scheme, increasing consumer awareness, increased local manufacturing and expanding distribution networks.

10.9.2 The rural market is growing faster than the urban markets as penetration level in rural area is much lower. The CTV segment is expected to the largest contributing segment to the overall growth of the industry.

10.9.3 Foreign interest continues to grow in large appliances. Huge investments are being made by Korean & Japanese giants creating premium image for its products in Indian market. The market share of MNCs in White goods segment is 65%.

10.9.4 The major categories in the market are household appliances such as Refrigerator, Washing Machine, Air Conditioner, CTVs, Water Purifier, and Microwave Oven etc.

Figure 99: White goods manufacturing distribution

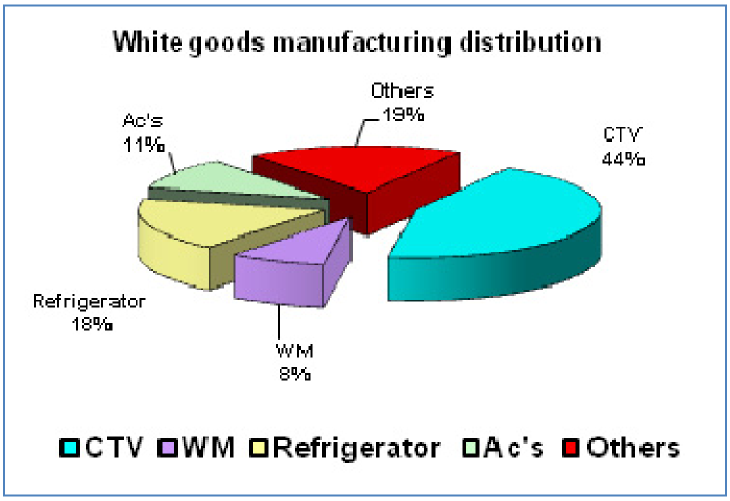


Table 109: Appliances Production Data in million

Segment	2005	2010	2015(Exp)
Refrigerator	4.1	7.3	8.8
W/M	1.7	3.8	4.8
AC	1.5	2.1	2.7
CTV	10.3	18.0	19.8
H20 Purifier	1.0	2.3	5.7

10.9.5 Plastic finds extensive use in various home appliances. The PP content in Washing machine (S.Auto), Refrigerator, Air conditioner and Colour TV is 14kgs, 9kgs, 6kgs & 5kgs respectively.

Table 110: Use of plastic in Various Home Appliances

Appliances	Total Plastics (Kg)
Refrigerator	
Frost Free	10.0
Washing Machines	
• *Semi Automatic*	*14.0*
• *Fully Automatic*	*9.0*
• *Washers*	*4.0*
Air Conditioners	
• *Window AC*	*6.0*
• *Split AC*	*5.0*
Colour TV	6.0
Water Purifier	5.0

10.9.6 Indian Washing machines market is on a high growth trajectory with an overall growth of 38% to 3.8Mn in 2010 over 2009. The semi-automatic segment is estimated at 2.5Mn units and fully automatic segment is 1.3Mn units. Though the share of fully automatic machines is much lower, in 2010 it saw an astronomical growth of 53% over last year. Now a day, in semi automatic machines, metallic body is replaced by Polypropylene. Therefore an average semi automatic washing machine has average plastics penetration of around 14kgs.

10.9.7 The Indian refrigerator market witnessed high growth with estimated sales of 7.3 million units in 2010. This was a tremendous 24% growth over the previous year. The demand for refrigerators is continuously escalating due to the low penetration level in the country and the increase in demand from the rural and semi urban areas. This is supported by the hot extended summers. Frost free Refrigerators have gained immense popularity over traditional 2-door refrigerators. French door, Side-by-side door and bottom freezer models are becoming popular. Innovative features in modern Refrigerators like freeze and cook box, beauty and care box, base stand with drawer for vegetables, 3-door refrigerator for odour free storage of frozen food & fresh food has helped in increasing usage of plastics.

10.9.8 The Indian market is upbeat on water purifiers. Currently, there are 5-6 Mn homes owning water purifiers out of a total of 220 million households nationwide. The potential is enormous and is expected to grow with rate of 20% for the next couple of years.

10.9.9 Manufacturing water purifiers catering to all levels of income has also enabled an expansion in market size. The water purifier industry may be divided into three basic segments according to the various purification technologies utilized within each category, reverse osmosis, ultra violet, and offline. In 2009-10, the RO-based purifiers were considered to be the premium products with sales of 50 Mn units. The UV based purifier has market of 83Mn units. However, offline water purifiers with a price range of Rs 500 to Rs.3200 which has gained immense popularity lately had sales of 1.8 Mn units in 2010.

10.9.10 The Indian air conditioner industry is on a high growth trajectory with an overall volume growth rate of 20–25% per annum to 3.88Mn in 2010. This growth rate is expected to be maintained in 2011 too.

10.9.11 The Indian Colour TV market stands at 18 million sets in 2010 registering a decline of 4.6% over last year. The LCD television market in India in 2010 is estimated at 3 million sets. It doubled itself from 1.5 million sets in 2009.

11 Performance of the Petrochemicals during 11th Five Year Plan

11.1 Demand & Consumption

11.1.1 **Building Blocks**

11.1.1.1 Building block i.e. Ethylene, Propylene, Styrene and Butadiene demand is based on the downstream projects being set up. During the 11th plan period, the demand for olefins was up my a million MTA from 5.3 MMT to 6.4 MMT. Partial debottlenecking by GAIL and HPL, start up of IOCL plants and propylene extraction by RIL increased building blocks production during the 11th plan period.

Table 111: Demand of Building Blocks in 11th Plan

BUILDING BLOCKS		11th Plan Period Performance						11th Plan Growth	
ALL Fig in KTs		Demand						CARG	
	Actual	Actual	Actual	Actual	Actual	Projected Growth	Est	Projected Growth	Achieved
Product	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2011-12	06-07 to 11-12	06-07 to 11-12
	10th Plan	11th Plan	11th Plan	11th Plan	11th Plan	11th Plan	11th Plan	11th Plan	12th Plan
Butadiene	108	112	109	110	121	124	124	2.8%	2.8%
Ethylene	2700	2825	2657	2555	3055	3785	3785	7.0%	7.0%
Propylene	2124	2158	2200	2819	3150	3700	3700	11.7%	11.7%
Styrene	406	414	396	453	470	496	496	4.1%	4.1%
Total	**5337**	**5508**	**5362**	**5937**	**6796**	**8104**	**8105**	**8.7%**	**8.7%**
Yearly Growth		**3%**	**-3%**	**11%**	**14%**		**19%**		

11.1.2 **Commodity Polymers**

11.1.2.1 Commodity polymers consumption at the end of 10th plan period i.e. 2006-07 was 4.8 MMTs. During 11th Plan projections were made at two levels. Level-I, high growth in case suggestions of Sub group are implemented and Level-II moderate growth. Level II projections were more realistic at overall growth of app 10% while Level I was at 20% CARG.

11.1.2.2 11th plan started off with 15% growth in consumption in 2007-08. In 2008-09, witnessed global slowdown triggered by subprime crisis in US and bursting of the property bubble. Indian economy was also effected in 2008-09 and commodity polymers consumption growth dropped to 4% which was rebounded in subsequent years. Overall consumption growth achieved in 11th plan period was 11.6% for commodity polymers.

Table 112: Demand of Commodity Plastics in 11th Plan

COMM PLASTICS		11th Plan Period Performance			11th Plan Growth		
All Fig in KTs		Demand			CARG		
	Actual	Projected Hi Growth	Projected Mod Gr	Est	Projected Hi Growth	Projected Mod Gr	Achieved
Product	2006-07	2011-12	2011-12	2011-12	06-07 to 11-12	06-07 to 11-12	06-07 to 11-12
	10th Plan	11th Plan	11th Plan	11th Plan	11th Plan	11th Plan	12th Plan
LDPE	253	344	285	405	6.3%	2.4%	9.9%
LLDPE	631	4367	2579	1198	21.9%	9.7%	13.7%
HDPE	990			1657			10.9%
PP	1530	4627	2634	2993	24.8%	11.5%	14.4%
PVC	1219	2772	2031	1925	17.9%	10.8%	9.6%
PS+EPS	246	481	351	377	14.4%	7.4%	8.9%
Total	**4869**	**12591**	**7880**	**8555**	**20.9%**	**10.1%**	**11.9%**

11.1.2.3 The factors contributing to consumption growth in India were higher disposable household income resulting in greater demand for product and services, boom in automotive sector, emergence of retail sector, growth in infrastructure. These sectors gave a boost to consumption of commodity polymers in Injection molding, Consumer packaging and bulk packaging of cement etc.

11.1.3 **Synthetic Rubbers**

11.1.3.1 Demand for Synthetic Rubber which finds major application in automobile tyres was 269 KTs at the end of 10th plan period. Consumption was estimated to grow at 10.4% during 11th plan period. Synthetic Rubber demand also stagnated during 2008-09. However there was a very healthy rebound in consumption in subsequent two years. 11th plan period ended with a growth of 11.4% in consumption.

Table 113: Demand of Synthetic Rubbers in 11th Plan

SYN RUBBERS		11th Plan Period Performance			11th Plan Growth	
All Figs in KTs		Demand			CARG	
	Actual	Projected Growth	Est		Projected Growth	Achieved
Product	2006-07	2011-12	2011-12		06-07 to 11-12	06-07 to 11-12
	10th Plan	11th Plan	11th Plan		11th Plan	12th Plan
PBR	80	132	131		10.6%	10.4%
SBR	98	165	186		11.0%	13.6%
NBR	24	31	31		5.3%	5.3%
Butyl	51	87	87		11.3%	11.3%
EPDM	16	27	27		10.9%	11.0%
Total	**269**	**442**	**462**		**10.4%**	**11.4%**
Nat Rubber	**820**	**948**	**982**		**2.9%**	**3.7%**

11.1.4 **Surfactants**

11.1.4.1 Though detergent consumption may not have got impacted significantly by global slowdown, raw materials for detergents i.e. LAB and EO inventory fluctuated at the manufacturer's level resulting in low consumption in 2008-09 which was made up in 2009-10. Overall surfactants demand grew by 8.8% during 11th plan period vs projection of 8.2%.

Table 114: Demand of Surfactants in 11th Plan

SURFACTANTS		11th Plan Period Performance		11th Plan Growth	
All Figs in KTs		Demand		CARG	
	Actual	Projected Growth	Est	Projected Growth	Achieved
Product	2006-07	2011-12	2011-12	06-07 to 11-12	06-07 to 11-12
	10th Plan	11th Plan	11th Plan	11th Plan	12th Plan
LAB	331	490	483	8.1%	7.8%
EO	94	141	165	8.4%	11.9%
Total	**425**	**631**	**648**	**8.2%**	**8.8%**

11.1.5 **Solvents and intermediates**

11.1.5.1 Aromatic solvents and intermediates demand grew@ of 5% in 11th plan period.

Table 115: Demand of Solvents & Intermediate in 11th Plan

SOLVENTS & INT		11th Plan Period Performance		11th Plan Growth	
All Figs in KTs		Demand		CARG	
	Actual	Projected Growth	Est	Projected Growth	Achieved
Product	2006-07	2011-12	2011-12	06-07 to 11-12	06-07 to 11-12
	10th Plan	11th Plan	11th Plan	11th Plan	12th Plan
Benzene	512	595	595	3.1%	3.1%
Toluene	282	440	440	9.3%	9.3%
Mixed Xylenes	43	110	110	20.7%	20.7%
Ortho Xylenes	246	266	266	1.5%	1.5%
Phenol	168	212	212	4.8%	4.8%
ACN	120	125	125	0.8%	0.8%
Total	**1371**	**1748**	**1748**	**5.0%**	**5.0%**

11.1.6 **Fibre intermediates**

11.1.6.1 Fibre intermediates have already attained a large base of 5.5 MMTA and achieved a healthy growth rate of 9% during 11th plan period. Fibre intermediates growth in domestic demand is expected to move in tune with demand for synthetic fibres. During the 11th plan period we saw government refineries extending their operations to enter into manufacturing of fibre intermediates.

Table 116: Demand of Fibre Intermediate in 11th Plan

Fibre Intermediates		11th Plan Period Performance	11th Plan Growth	
ALL Figs in KTs		Demand	CARG	
	Actual	Est	Projected Growth	Achieved
Product	2006-07	2011-12	06-07 to 11-12	06-07 to 11-12
	10th Plan	11th Plan	11th Plan	12th Plan
PX	1641	2306	7.0%	7.0%
PTA	2946	4350	8.1%	8.1%
MEG	967	1836	13.7%	13.7%
PET	174	542	25.5%	25.5%
Total	**5728**	**9034**	**9.5%**	**9.5%**
Yearly Growth		**13%**		

11.1.7 **Synthetic Fibres**

11.1.7.1 Among the synthetic fibres, polyester fibre and yarn were the drivers of growth. The plan period witnessed new players entering the segment. They were predominantly into textiles / texturising earlier. The entry into raw material manufacturing helped them to improve their presence in the value chain.

Table 117: Demand of Synthetic Fibres in 11th Plan

Synthetic Fibres		**11th Plan Period Performance**		**11th Plan Growth**	
ALL Figs in KTs		**Demand**		**CARG**	
	Actual	Projected Growth	Est	Projected Growth	Achieved
Product	**2006-07**	2011-12	2011-12	06-07 to 11-12	06-07 to 11-12
	10th Plan	11th Plan	11th Plan	11th Plan	12th Plan
PSF	792	1214	1100	8.9%	6.8%
PFY	1271	1973	2100	9.2%	10.6%
NFY	32	48	56	8.4%	11.8%
NIY	98	115	113	3.3%	2.9%
PIY	0	40	36	-	-
Total	**2193**	**3390**	**3405**	**9.1%**	**9.2%**
Yearly Growth			**10%**		

11.2 Capacity

11.2.1 Capacity addition is a step function whereas demand growth is linear. A cracker and downstream projects are planned together rather than setting up a plant for a single product. The margins in the industry are cyclical and typically follow a 6-8 year period of troughs and peaks. New capacities are normally deferred in case an impending trough is predicted. Sometimes, individual plants are debottlenecked to enhance production. Feedstock availability for a long term and competitive pricing of feedstock are other factors which influences decision on capacity creation. Lastly, investment required in petrochemical complexes is huge and very few corporate house or Government undertakings venture for new petrochemicals complexes.

11.2.2 **Building Blocks**

11.2.2.1 A total of 3.3 MMTA capacities were built for building blocks during the 11th plan period. (Actual production normally improves gradually) These additions, as mentioned earlier were by RIL, GAIL, HPL and IOCL by way of new plants, or debottlenecking.

Table 118: Building Blocks capacity creation during 11th Plan

Building Blocks		**11th Plan Capacity Creation**	**11th Plan Growth**		
All Fig in KTs			Capacity	Capacity	Demand
Product	**Actual**	Actual	Addition	CARG	CARG
	2006-07	2011-12	06-07 to 11-12	06-07 to 11-12	06-07 to 11-12
	10th Plan	11th Plan	11th Plan	11th Plan	11th Plan
Butadiene	275	295	20	1.4%	2.8%
Ethylene	2510	3867	1357	9.0%	7.0%
Propylene	2208	4117	1909	13.3%	11.7%
Styrene	0	0	0	0.0%	4.1%
Total	**4993**	**8279**	**3286**	**10.6%**	**8.7%**

11.2.3 **Commodity polymers**

11.2.3.1 Commodity polymers grew at 11.9% CARG during 11th plan whereas capacity creation grew by 10.8%. No capacity increase for LDPE and PS during this period. GAIL debottlenecked LLDPE/HDPE capacity by 100 KTs and IOCL started its LLDPE/HDPE plant. HPL increased capacity by 150 KTs. In case of PP, all the four producers added capacities and it kept pace with demand growth. In case of PVC, Chemplast substantially enhanced capacity from 30 KTs to 250 KTs.

Table 119: Commodity Plastics capacity creation during 11th Plan

POLYMERS		**11th Plan Capacity Creation**	**11th Plan Growth**		
All Fig in KTs			Capacity	Capacity	Demand
Product	**Actual**	Actual	Addition	CARG	CARG
	2006-07	2011-12	06-07 to 11-12	06-07 to 11-12	06-07 to 11-12
	10th Plan	11th Plan	11th Plan	11th Plan	11th Plan
LDPE	205	205	0	0.0%	9.9%
LLDPE	597	1198	601	14.9%	13.7%
HDPE	1177	1825	648	9.2%	10.9%
PP	1985	4140	2155	15.8%	14.4%
PVC	1110	1330	220	3.7%	9.6%
PS	499	640	141	5.1%	8.9%
Total	**5573**	**9338**	**3765**	**10.9%**	**11.9%**

11.2.4 **Synthetic Rubbers**

11.2.4.1 Though synthetic rubber demand grew by 11.4 % during 11th plan period, there was no capacity addition.

Table 120: Synthetic Rubber capacity creation during 11th Plan

SYN RUBBERS		11th Plan Capacity	11th Plan Growth		
All Fig in KTs			Capacity	Capacity	Demand
Product	Actual	Actual	Addition	CARG	CARG
	2006-07	2011-12	06-07 to 11-12	06-07 to 11-12	06-07 to 11-12
	10th Plan	11th Plan	11th Plan	11th Plan	11th Plan
PBR	74	74	0	0.0%	10.4%
SBR	20	20	0	0.0%	13.6%
NBR	20	20	0	0.0%	5.3%
Butyl	0	0	0	0.0%	11.3%
EPDM	10	10	0	0.0%	11.0%
Total	**124**	**124**	**0**	**0.0%**	**11.4%**
Nat Rubber	**853**	**862**	**9**	**0.2%**	**3.7%**

11.2.5 **Surfactants**

11.2.5.1 In case of surfactants, both RIL and India glycol enhanced their EO capacities but LAB capacity remained same.

Table 121: Surfactants capacity creation during 11th Plan

SURFACTANTS		Capacity	11th Plan Growth		
All Fig in KTs			Capacity	Capacity	Demand
Product	Actual	Actual	Addition	CARG	CARG
	2006-07	2011-12	06-07 to 11-12	06-07 to 11-12	06-07 to 11-12
	10th Plan	11th Plan	11th Plan	11th Plan	11th Plan
LAB	530	530	0	0.0%	7.8%
EO	125	209	84	10.8%	11.9%
Total	**655**	**739**	**84**	**2.4%**	**8.8%**

11.2.6 **Solvents and Intermediates**

11.2.6.1 Benzene capacity was increased by both IOCL and HPCL. MX capacity increase was by MRPL. Though overall demand increase for this group of products was 5% during 11th plan period, Capacity increase was marginal.

Table 122: Solvents & Intermediates capacity creation during 11th Plan

SOLVENTS & INT		Capacity	11th Plan Growth		
All Fig in KTs			Capacity	Capacity	Demand
Product	Actual	Actual	Addition	CARG	CARG
	2006-07	2011-12	06-07 to 11-12	06-07 to 11-12	06-07 to 11-12
	10th Plan	11th Plan	11th Plan	11th Plan	11th Plan
Benzene	1050	1235	185	3.3%	3.1%
Toluene	270	270	0	0.0%	9.3%
Mixed Xylenes	70	90	20	5.2%	20.7%
Ortho Xylenes	420	420	0	0.0%	1.5%
Phenol	74	74	0	0.0%	4.8%
ACN	40	40	0	0.0%	0.8%
Total	**1924**	**2129**	**205**	**2.0%**	**5.0%**

11.2.7 **Fibre Intermediates**

11.2.7.1 FID demand growth was at 8.9% whereas capacity growth was at 4.3%. 1.4 MMTA capacity was added.

Table 123: Fibre Intermediates capacity creation during 11th Plan

Fibre Intermediates		11th Plan Capacity Creation	11th Plan Growth		
All Fig in KTs			Capacity	Capacity	Demand
Product	Actual	Actual	Addition	CARG	CARG
	2006-07	2011-12	06-07 to 11-12	06-07 to 11-12	06-07 to 11-12
	10th Plan	11th Plan	11th Plan	11th Plan	11th Plan
PX	2174	2477	303	2.6%	7.0%
PTA	3050	3850	800	4.8%	8.1%
MEG	950	1300	350	6.5%	13.7%
PET	578	814	236	7.1%	25.5%
Total	**6752**	**8441**	**1689**	**4.6%**	**9.5%**

11.2.8 **Synthetic Fibres**

11.2.8.1 In case of synthetic fibres, capacity addition was mainly in PFY of 1.1 MMTA in 11th plan period.

Table 124: Synthetic Fibres capacity creation during 11th Plan

Synthetic Fibres		11th Plan Capacity Creation	11th Plan Growth		
All Fig in KTs			Capacity	Capacity	Demand
Product	Actual	Actual	Addition	CARG	CARG
	2006-07	2011-12	06-07 to 11-12	06-07 to 11-12	06-07 to 11-12
	10th Plan	11th Plan	11th Plan	11th Plan	11th Plan
PSF	1158	1400	242	3.9%	6.8%
PFY	1924	3000	1076	9.3%	10.6%
NFY	32	32	0	0.0%	11.8%
NIY	60	74	0	-	2.9%
PIY	0	21	21	-	-
Total	**3174**	**4527**	**1353**	**7.4%**	**9.2%**

12 Projections & Milestones for 12th Plan (Medium Term) & 13th Plan (Long term)

12.1 Outlook for the 12th Plan Period

12.1.1 11th plan started off with 15% growth in consumption in 2007-08. In 2008-09, witnessed global slowdown triggered by subprime crisis in US and bursting of the property bubble. Indian economy was also effected in 2008-09 and commodity polymers consumption growth dropped to 4% which rebounded in subsequent years.

12.1.2 Commodity polymers grew at 11.9% CARG during 11th plan whereas capacity creation grew by 10.8%.

12.1.3 Fortunately for India, the recovery after global recession was quite fast as the industry was dependant on domestic consumption and enjoyed good demand.

12.1.4 Commodity polymers are enjoying above GDP growth and are expected to remain so in 12th plan period also. Demand is likely to touch 14 MMT from 8.5 MMT at the end of 11th plan period. All polymers are expected to grow at app 10% CARG during the 12th plan period.

12.1.5 12th plan period will have substantial increase in capacities of LDPE, LLDPE, HDPE and small increase in capacities of PP and PVC. Polystyrene capacity will remain same. Overall capacity growth of 6.8% CARG will be lower than demand growth of app 10%.

12.2 Demand & Consumption

12.2.1 Building Blocks

12.2.1.1 Building block demand is based on projected downstream capacities for polymers/ synthetic rubber etc. During 12th plan period new capacities are being planned and requirement of building blocks will go up from 6.4 MMT to 13.5 MMT. IOCL and OPAL are adding butadiene capacities. RIL, ESSAR and OPAL are adding ethylene and propylene. Requirement of styrene will be met through imports only in 12th plan also as no new capacities are planned.

Table 125: 12th Plan projections for Building Blocks

BUILDING BLOCKS			12th Plan Period Projection					12th Plan Growth		13th Plan Proj	
ALL Fig in KTs			Demand					CARG		Demand	CARG
	End of 10th Plan	End of 11th Plan	Projected	Projected	Projected	Projected	Projected	Achieveed 11th Plan	Projected1 2th Plan	13th Plan	13th Plan
Product	**2006-07**	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	06-07 to 11-12	11-12 to 16-17	21-22	16-17 to 21-22
	10th Plan	11th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan	11th Plan	12th Plan	13th Plan	13th Plan
Butadiene	108	124	149	246	407	413	470	2.8%	30.5%	570	3.9%
Ethylene	2700	3785	3845	3970	5255	6505	6805	7.0%	12.4%	7092	0.8%
Propylene	2124	3700	4000	4300	4550	4710	4823	11.7%	5.4%	4900	0.3%
Styrene	406	496	523	551	582	614	647	4.1%	5.5%	846	5.5%
Total	**5337**	**8105**	**8517**	**9067**	**10793**	**12241**	**12746**	**8.7%**	**9.5%**	**13407**	**1.0%**
Yearly Growth			**5%**	**6%**	**19%**	**13%**	**4%**				

12.2.2 **Commodity Polymers**

12.2.2.1 Commodity polymers are enjoying above GDP growth rates and are expected to remain so in 12th plan period also. Demand is likely to touch 14 MMT from 8.5 MMT at the end of 11th plan period. All polymers are expected to grow at app 10% CARG during the 12th plan period.

Table 126: 12th Plan projections for Commodity Plastics

COMMODITY PLASTICS			12th Plan Period Projection					12th Plan Growth		13th Plan Proj	
All Fig in KTs			Demand					CARG		Demand	CARG
	End of 10th Plan	End of 11th Plan	Projected	Projected	Projected	Projected	Projected	Achieveed 11th Plan	Projected 12th Plan	13th Plan	13th Plan
Product	**2006-07**	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	06-07 to 11-12	11-12 to 16-17	21-22	16-17 to 21-22
	10th Plan	11th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan	11th Plan	12th Plan	13th Plan	13th Plan
LDPE	253	405	438	474	511	552	597	9.9%	8.1%	880	8.1%
LLDPE	631	1198	1319	1478	1655	1854	2076	13.7%	11.6%	3660	12.0%
HDPE	990	1657	1822	1987	2165	2360	2573	10.9%	9.2%	3960	9.0%
PP	1423	2993	3275	3698	4105	4564	5015	16.0%	10.9%	8085	10.0%
PVC	1219	1925	2118	2330	2563	2820	3102	9.6%	10.0%	4560	8.0%
PS	246	377	430	479	533	598	638	8.9%	11.1%	935	7.9%
Total	**4762**	**8555**	**9402**	**10445**	**11532**	**12748**	**14001**	**12.4%**	**10.4%**	**22080**	**9.5%**
Yearly Growth			**10%**	**11%**	**10%**	**11%**	**10%**				

12.2.3 **Synthetic Rubbers**

12.2.3.1 Synthetic rubbers are estimated to grow at 6-8% growth rates. Although current demand growth is strong, however still concerns on long term sustenance of global growth remains, which could have potential impact on growth in India. At the same time if global economy maintains it's pace, it is likely that prices of commodities will be much more stronger with potential impact on Indian economy. Synthetic Rubber estimates are on the basis of projections made by IRSG (International Rubber Study Group)/ IISRP.

Table 127: 12th Plan projections for Synthetic Rubber

SYNTHETIC RUBBERS			12th Plan Period Projection					12th Plan Growth		13th Plan Proj	
ALL FIG IN KTs			Demand					CARG		Demand	CARG
	End of 10th Plan	End of 11th Plan	Projected	Projected	Projected	Projected	Projected	Achieveed 11th Plan	Projected 12th Plan	13th Plan	13th Plan
Product	**2006-07**	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	06-07 to 11-12	11-12 to 16-17	21-22	16-17 to 21-22
	10th Plan	11th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan	11th Plan	12th Plan	13th Plan	13th Plan
PBR	80	131	141	153	167	178	193	10.4%	8.1%	283	8.0%
SBR	98	186	198	215	230	251	275	13.6%	8.2%	407	8.2%
NBR	24	31	35	38	40	44	47	5.3%	8.7%	71	8.7%
Butyl	51	87	93	100	106	114.7	127	11.3%	7.9%	184	7.6%
EPDM	16	27	33	41	51	63	79	11.0%	24.0%	120	8.7%
Total	**269**	**462**	**500**	**547**	**594**	**650**	**721**	**11.4%**	**9.3%**	**1065**	**8.1%**
Yearly Growth			**8%**	**9%**	**8%**	**10%**	**11%**				
Natural Rubber	**820**	**982**	**1019**	**1056**	**1095**	**1135**	**1177**	**3.7%**	**3.7%**		

12.2.4 **Surfactants**

12.2.4.1 Surfactants normally have a slow and steady demand growth and are expected to grow at app 6% during the 12th plan period.

Table 128: 12th Plan projections for Surfactants

SURFACTANTS	12th Plan Period Projection							12th Plan Growth		13th Plan Proj	
ALL FIG IN KTs			Demand					CARG		Demand	CARG
	End of 10th Plan	End of 11th Plan	Projected	Projected	Projected	Projected	Projected	Achieveed 11th Plan	Projected1 2th Plan	13th Plan	13th Plan
Product	2006-07	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	06-07 to 11-12	11-12 to 16-17	21-22	16-17 to 21-22
	10th Plan	11th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan	11th Plan	12th Plan	13th Plan	13th Plan
LAB	331	483	506	534	564	595	627	7.8%	5.4%	772	4.2%
EO	94	165	190	202	213	226	241	11.9%	7.9%	320	5.8%
Total	**425**	**648**	**696**	**736**	**777**	**821**	**868**	**8.8%**	**6.0%**	**1092**	**4.7%**
Yearly Growth			**7%**	**6%**	**6%**	**6%**	**6%**				

12.2.5 **Solvents and Intermediates**

12.2.5.1 Solvents and intermediated are normally one component in an end product and normally not converted to various end products. This group of products is estimated to grow at 8.4 % during 12th plan period.

Table 129: 12th Plan projections for Solvent and Intermediates

Solvents and Intermediates	12th Plan Period Projection							12th Plan Growth		13th Plan Proj	
ALL FIG IN KTs			Demand					CARG		Demand	CARG
	End of 10th Plan	End of 11th Plan	Projected	Projected	Projected	Projected	Projected	Achieveed 11th Plan	Projected1 2th Plan	13th Plan	13th Plan
Product	2006-07	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	06-07 to 11-12	11-12 to 16-17	21-22	16-17 to 21-22
	10th Plan	11th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan	11th Plan	12th Plan	13th Plan	13th Plan
Benzene	512	595	590	730	870	930	935	3.1%	9.5%	954	0.4%
Toluene	282	440	477	520	570	610	650	9.3%	8.1%	800	4.2%
Mixed Xylenes	43	110	119	133	147	164	181	20.7%	10.5%	385	16.3%
Ortho Xylenes	246	266	279	301	325	351	379	1.5%	7.4%	479	4.8%
Phenol	168	212	225	239	254	271	288	4.8%	6.3%	430	8.3%
ACN	120	125	142	151	160	170	180.5	0.8%	7.6%	196	1.7%
Total	**1371**	**1748**	**1832**	**2074**	**2326**	**2496**	**2614**	**5.0%**	**8.4%**	**3244**	**4.4%**
Yearly Growth			**5%**	**13%**	**12%**	**7%**	**5%**				

12.2.6 **Fibre Intermediates**

12.2.6.1 FID products are expected to have healthy consumption growth during 12th plan as synthetic fibre industry has already shifted from west to east. App 13% pa consumption growth is estimated. Unlike China, India is more self reliant on raw material for fibre intermediates. This helps the industry to improve reliability in global supplies.

Table 130: 12th Plan projections for Fibre Intermediates

Fibre Intermediates			12th Plan Period Projection					12th Plan Growth		13th Plan Proj	
ALL FIG IN KTs			Demand					CARG		Demand	CARG
	End of 10th Plan	End of 11th Plan	Projected	Projected	Projected	Projected	Projected	Achieveed 11th Plan	Projected 12th Plan	13th Plan	13th Plan
Product	**2006-07**	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	06-07 to 11-12	11-12 to 16-17	21-22	16-17 to 21-22
	10th Plan	11th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan	11th Plan	12th Plan	13th Plan	13th Plan
PX	1641	2306	2468	2920	4576	4576	4576	7.0%	14.7%	4576	0.0%
PTA	2946	4350	5048	6123	6647	7436	7992	8.1%	12.9%	11743	8.0%
MEG	967	1836	2056	2303	2579	2888	3024	13.7%	10.5%	4443	8.0%
PET	174	542	657	791	945	1121	1319	25.5%	19.5%	2614	14.7%
Total	**5728**	**9034**	**10229**	**12136**	**14747**	**16021**	**16911**	**9.5%**	**13.4%**	**20762**	**4.2%**
Yearly Growth			**13%**	**19%**	**22%**	**9%**	**6%**				

12.2.7 **Synthetic Fibres**

12.2.7.1 Synthetic fibres domestic consumption is estimated to grow at 9.5%. With restriction on availability of land for growing natural fibres, global textile industry is now dependent on synthetic fibres to cater to the growing demand. Added to the demand from textile industry, technical textiles are also growing faster than traditional textiles. These technical textiles depend on physical properties like tensile strength for its growth. Synthetic fibres are the only material which can provide raw material to this industry.

Table 131: 12th Plan projections for Synthetic Fibres

Synthetic Fibres			12th Plan Period Projection					12th Plan Growth		13th Plan Proj	
ALL FIG IN KTs			Demand					CARG		Demand	CARG
	End of 10th Plan	End of 11th Plan	Projected	Projected	Projected	Projected	Projected	Achieveed 11th Plan	Projected1 2th Plan	13th Plan	13th Plan
Product	2006-07	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	06-07 to 11-12	11-12 to 16-17	21-22	16-17 to 21-22
	10th Plan	11th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan	11th Plan	12th Plan	13th Plan	13th Plan
PSF	792	1100	1188	1283	1386	1497	1600	6.8%	7.8%	2250	7.1%
PFY	1271	2100	2380	2660	2940	3220	3500	10.6%	10.8%	5250	8.4%
NFY	32	56	59	63	65	69	71	11.8%	4.9%	110	9.2%
NIY	98	113	112	110	115	120	125	2.9%	2.0%	150	3.7%
PIY	0	36	41	47	53	61	68	-	13.6%	102	8.4%
Total	**2193**	**3405**	**3780**	**4163**	**4559**	**4967**	**5364**	**9.2%**	**9.5%**	**7862**	**7.9%**
Yearly Growth			**11%**	**10%**	**10%**	**9%**	**8%**				

12.3 ***Capacity***

12.3.1 **Building Blocks**

12.3.1.1 During 12th plan period, Butadiene capacity is being added by IOCL and OPAL. Crackers are being planned by RIL, ESSAR and OPAL. All these will lead to addition to app 4.1 MMTA of building blocks during 12th plan. The current capacity of 8.5 MMTA has been built over a period of last 40 years in India.

Table 132: 12th Plan capacity addition for Building Blocks

Building Blocks	**12th Plan Capacity Creation**						**12th Plan Growth**		
All Fig in KTs							Capacity	Capacity	Demand
Product	**Actual**	Actual	Actual	Actual	Actual	Actual	Addition	CARG	CARG
	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	11-12 to 16-17	11-12 to 16-17	11-12 to 16-17
	11th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan
Butadiene	295	295	295	528	528	528	233	12.3%	30.5%
Ethylene	3867	3867	4587	5687	7087	7087	3220	12.9%	12.4%
Propylene	4382	4382	4477	4817	4987	4987	605	2.6%	5.4%
Styrene	0	0	0	0	0	0	0	-	5.5%
Total	**8544**	**8544**	**9359**	**11032**	**12602**	**12602**	**4058**	**8.1%**	**9.5%**

12.3.2 **Commodity Polymers**

12.3.2.1 12th plan period will have substantial increase in capacities of LDPE/LLDPE and HDPE and small increase in capacities of PP and PVC. PS capacity will remain same. Overall capacity growth of 6.8% CARG will be lower than demand growth of app 10%.

Table 133: 12th Plan capacity addition for Commodity Plastics

Comm Plastics		12th Plan Capacity Creation					12th Plan Growth		
All Fig in KTs							Capacity	Capacity	Demand
Product	**Actual**	Actual	Actual	Actual	Actual	Actual	Addition	CARG	CARG
	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	11-12 to 16-17	11-12 to 16-17	11-12 to 16-17
	11th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan
LDPE	205	205	205	205	605	605	400	24.2%	8.1%
LLDPE	835	835	1110	1410	1960	1960	1125	18.6%	11.6%
HDPE	1825	1925	2370	3090	3090	3090	1265	11.1%	9.2%
PP	4140	4495	4555	4555	4715	4715	575	2.6%	10.9%
PVC	1330	1440	1590	1635	1635	1635	305	4.2%	10.0%
PS	640	640	640	652	666	666	26	0.8%	11.1%
Total	**8975**	**9540**	**10470**	**11547**	**12671**	**12671**	**3696**	**7.1%**	**10.4%**

12.3.3 **Synthetic Rubbers**

12.3.3.1 Synthetic rubber capacities in India have remained almost stagnant for quite some time. Substantial addition in synthetic rubber capacities are being planned during 12th plan period. From mere 124 KTA, Synthetic Rubber capacity will increase to 684 KTA by end of 12th plan period. Butyl Rubber, (a closely guarded manufacturing technology) will be produced for the first time in India. PBR and SBR capacities will also see substantial increase.

Table 134: 12th Plan capacity addition for Synthetic Rubbers

SYN RUBBERS	12th Plan Capacity Creation						12th Plan Growth		
All Fig in KTs							Capacity	Capacity	Demand
Product	Actual	Actual	Actual	Actual	Actual	Actual	Addition	CARG	CARG
	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	11-12 to 16-17	11-12 to 16-17	11-12 to 16-17
	11th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan
PBR	74	74	94	114	114	164	90	17.3%	8.1%
SBR	20	20	155	290	370	370	350	79.2%	8.2%
NBR	20	20	20	40	40	40	20	14.9%	8.7%
Butyl	0	0	25	75	100	100	100	-	7.9%
EPDM	10	10	10	90	90	90	80	55.2%	24.0%
Total	**124**	**124**	**304**	**609**	**714**	**764**	**640**	**43.9%**	**9.3%**
Nat Rubber	**889**	**925**	**971**	**1027**	**1086**	**1162**	**273**	**5.5%**	**3.7%**

12.3.4 **Surfactants**

12.3.4.1 Surfactant capacities will be marginally increased for EO during 12th Plan period.

12.3.5 **Solvents and Intermediates**

12.3.5.1 Benzene capacity only is going up substantially during 12th plan period. These capacity increases are coming at RIL, MRPL and OPAL. In addition, RIL also has planned a phenol plant.

Table 135: 12th Plan capacity addition for Solvents and Intermediates

Solvents & Interm	12th Plan Capacity Creation						12th Plan Growth		
All Fig in KTs							Capacity	Capacity	Demand
Product	Actual	Actual	Actual	Actual	Actual	Actual	Addition	CARG	CARG
	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	11-12 to 16-17	11-12 to 16-17	11-12 to 16-17
	11th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan
Benzene	1235	1235	1435	1635	1835	2110	875	11.3%	9.5%
Toluene	270	270	270	270	270	270	0	0.0%	8.1%
Mixed Xylenes	90	90	90	90	90	90	0	0.0%	10.5%
Ortho Xylenes	420	420	420	420	420	420	0	0.0%	7.4%
Phenol	74	74	74	294	374	374	300	38.3%	6.3%
ACN	40	40	40	40	40	40	0	0.0%	7.6%
Total	**2129**	**2129**	**2329**	**2749**	**3029**	**3304**	**1175**	**9.2%**	**8.4%**

12.3.6 **Fibre Intermediates**

12.3.6.1 FID capacities will be almost doubled from 8 MMTA to 15.3 MMTA during 12th plan period. This growth is accompanied by growth in the downstream polyester industry as well. China will continue to be dependent on imported fibre intermediates during this period.

Table 136: 12th Plan capacity addition for Fibre Intermediates

Fibre Intermediates	12th Plan Capacity Creation						12th Plan Growth		
All Fig in KTs							Capacity	Capacity	Demand
Product	Actual	Actual	Actual	Actual	Actual	Actual	Addition	CARG	CARG
	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	11-12 to 16-17	11-12 to 16-17	11-12 to 16-17
	11th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan
PX	2477	2501	2944	5201	5201	5201	2723	16.0%	14.7%
PTA	3850	3850	4990	7130	7130	7130	3280	13.1%	12.9%
MEG	1836	2056	2303	2579	2888	3024	1188	10.5%	10.5%
PET	814	1612	1662	1662	1662	2310	1496	23.2%	19.5%
Total	**8977**	**10018**	**11899**	**16572**	**16881**	**17664**	**8687**	**14.5%**	**13.4%**

12.3.7 **Synthetic Fibres**

12.3.7.1 In case of synthetic fibres, Polyester Filament Yarn will see 2.9 MMTA capacity additions during 12th plan. With strong downstream expansion happening in textile industry, expansion in synthetic fibre and yarn will improve reliability of supplies.

Table 137: 12th Plan capacity addition for Synthetic Fibres

Synthetic Fibres		12th Plan Capacity Creation					12th Plan Growth		
All Fig in KTs							Capacity	Capacity	Demand
Product	Actual	Actual	Actual	Actual	Actual	Actual	Addition	CARG	CARG
	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	11-12 to 16-17	11-12 to 16-17	11-12 to 16-17
	11th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan	12th Plan
PSF	1400	1530	1650	1750	1880	2000	600	7.4%	7.8%
PFY	3000	4021	4440	4663	4973	5216	2216	11.7%	10.8%
NFY	32	32	32	32	32	32	0	0.0%	4.9%
NIY	74	74	74	74	74	74	0	-	2.0%
PIY	21	21	21	65	65	68	47	-	13.6%
Total	**4527**	**5678**	**6217**	**6584**	**7024**	**7390**	**2863**	**10.3%**	**9.5%**

12.3.8 **Demand supply summary**

12.3.8.1 Overall demand supply summary for major products is given in the table below. Shortfall of PVC will grow during 12th plan period and surplus of Benzene will increase. Other products where capacity will fall short of demand are PP, Toluene and ACN. HDPE will be in surplus. Most other products will be balanced to marginal short/excess.

Table 138: Demand Supply Summary

All Fig in KTs		Consumption		Consumption Growth		Capacity		Gap	
		Actual	Projected	During	During	Actual	Projected	Actual	Projected
Group	Product	2011-12	2016-17	2006/07-11/12	2011/12- 16/17	2011-12	2016-17	2011-12	2016-17
		11th Plan	12th Plan	11th Plan	12th Plan	11th Plan	12th Plan	12th Plan	12th Plan
Building Blocks	Butadiene	124	470	2.8%	30.5%	295	528	171	58
	Ethylene	3785	6805	7.0%	12.4%	3867	7087	82	**282**
	Propylene	3700	4823	11.7%	5.4%	4117.355	4987.355	417	164
	Styrene	496	647	4.1%	5.5%	0	0	-496	**-647**
	Total	**8105**	**12746**	**8.7%**	**9.5%**	**8279**	**12602**	**175**	**-143**
Comm Plastics	LDPE	405	597	9.9%	8.1%	205	605	-200	8
	LLDPE	1198	2076	13.7%	11.6%	835	1960	-363	-116
	HDPE	1657	2573	10.9%	9.2%	1825	3090	168	**517**
	PP	2993	5015	14.4%	10.9%	4140	4715	1147	**-300**
	PVC	1925	3102	9.6%	10.0%	1330	1635	-595	**-1467**
	PS	377	638	8.9%	11.1%	640	666	263	28
	Total	**8555**	**14001**	**11.9%**	**10.4%**	**8975**	**12671**	**420**	**-1330**
Syn Rubbers	PBR	131	193	10.4%	8.1%	74	164	-57	-29
	SBR	186	275	13.6%	8.2%	20	370	-166	95
	NBR	31	47	5.3%	8.7%	20	40	-11	-7
	Butyl	87	127	11.3%	7.9%	0	100	-87	-27
	EPDM	27	79	11.0%	24.0%	10	90	-17	11
	Total	**462**	**721**	**11.4%**	**9.3%**	**124**	**764**	**-338**	**43**
Surfactants	LAB	483	627	7.8%	5.4%	530	530	47	-97
	EO	165	241	11.9%	7.9%	209	254	44	13
	Total	**648**	**868**	**8.8%**	**6.0%**	**739**	**784**	**91**	**-84**
Solvents and Int	Benzene	595	935	3.1%	9.5%	1235	2110	640	**1175**
	Toluene	440	650	9.3%	8.1%	270	270	-170	**-380**
	Mixed Xylenes	88	130	15.5%	8.0%	90	90	2	-40
	Ortho Xylenes	266	379	1.5%	7.4%	420	420	154	41
	Phenol	212	288	4.8%	6.3%	74	374	-138	86
	ACN	125	181	0.8%	7.6%	40	40	-85	**-141**
	Total	**1726**	**2563**	**4.7%**	**8.2%**	**2129**	**3304**	**403**	**742**
Fibre Intermediates	PX	2306	4576	7.0%	14.7%	2477	5201	171	**624**
	PTA	4350	7992	8.1%	12.9%	3850	7130	-500	**-862**
	MEG	1836	3024	13.7%	10.5%	1300	3024	-536	**0**
	PET	542	1319	25.5%	19.5%	814	2310	272	**991**
	Total	**9034**	**16911**	**9.5%**	**13.4%**	**8441**	**17664**	**-592**	**753**
Synthetic Fibres	PSF	1100	1600	6.8%	7.8%	1400	2000	300	**400**
	PFY	2100	3500	10.6%	10.8%	3000	5216	900	**1716**
	NFY	56	71	11.8%	4.9%	32	32	-24	-39
	NIY	113	125	2.9%	2.0%	74	74	-39	**-51**
	PIY	36	68	-	13.6%	21	68	-15	0
	Total	**3405**	**5364**	**9.2%**	**9.5%**	**4527**	**7390**	**1122**	**2026**

12.4 Outlook on Petrochemical Prices

12.4.1 The price forecast for intermediates and polymers for Asia region has been taken from global consultant CMAI.

Table 139: Fibre & Rubber Intermediate Price Forecast ($/Mt)

Product	Acrylonitrile	Butadiene	Caprolactum	MEG Fiber Grade	Phenol	Phthalic Anhydride
Market	NE Asia	NE Asia	NE Asia	Asia	NE Asia	NE Asia
Type	Spot	Contract	Spot	Contract	Spot Avg	Spot
INCO Term	CFR China	CIF Taiwan	CFR Far East	CFR Asia/Pacific	CFR NE Asia	FOB NE Asia
2012	2,302	2,412	3,183	1,348	1,575	1,413
2013	2,226	3,186	3,190	1,360	1,948	1,593
2014	2,278	3,109	2,990	1,451	1,726	1,626
2015	2,350	3,012	2,950	1,494	1,672	1,540

Table 140: Olefins Price Forecast ($/Mt)

Product	Ethylene	Propylene	Styrene	EDC	VCM
Market	SE Asia	SE Asia	NE Asia	NE Asia	NE Asia
Type	Spot, Avg.	Spot, Avg.	Avg Acquisition Cost	Spot, Avg	Spot
INCO Term	CFR SE Asia	CFR SE Asia	CFR NE Asia	CFR NE Asia	CFR China
2012	1,255	1,491	1,437	452	903
2013	1,333	1,411	1,578	612	962
2014	1,436	1,521	1,615	691	1,053
2015	1,549	1,609	1,703	828	1,201

Table 141: Aromatics Price Forecast ($/Mt)

Product	Benzene	Toluene	Mixed Xylenes	Orthoxylene	Paraxylene
Market	SE Asia	NE Asia	NE Asia	NE Asia	NE Asia
Type	Spot, Avg.	Spot	Spot	Spot	Spot
INCO Term	CFR SE Asia	FOB S. Korea	FOB S. Korea	C&F NE Asia	C&F Taiwan
2012	1,109	1,105	1,212	1,353	1,603
2013	1,221	1,132	1,176	1,494	1,648
2014	1,219	1,154	1,212	1,523	1,571
2015	1,262	1,150	1,235	1,435	1,462

Table 142: Polymer Price Forecast ($/Mt)

Product	LDPE GP Film	LLDPE Butene	HDPE BM	PP HP	PS GP	PVC Susp
Market	SE Asia	SE Asia	SE Asia	SE Asia	NE Asia	NE Asia
Type	Spot/Export	Spot/Export	Spot/Export	Spot Export	Spot	Spot
INCO Term	CFR SE Asia	FOB Singapore	CFR SE Asia	CFR SE Asia	CFR Hong Kong	CFR NE Asia
2012	1,549	1,379	1,393	1,518	1,568	1,073
2013	1,792	1,608	1,620	1,683	1,721	1,142
2014	1,936	1,746	1,758	1,825	1,772	1,240
2015	2,033	1,859	1,872	1,912	1,862	1,394

Table 143: Polyester & Feedstock Price Forecast ($/Mt)

Product	PX	PTA	MEG	PSF	Bottle Grade PET
Market	C&F Taiwan	C&F NE Asia	CFR NE Asia	FOB NE Asia	FOB NE Asia
2011	1,581	1,306	1,205	1,843	1,686
2012	1,603	1,244	1,256	1,750	1,663
2013	1,648	1,238	1,310	1,866	1,703
2014	1,571	1,197	1,402	1,866	1,712
2015	1,462	1,155	1,445	1,823	1,767

13 12th Plan Period Growth Enablers

13.1 PCPIR – Implementation & Forward Path

13.1.1 Govt. constituted a high-level Task Force to explore ways to facilitate investments in petroleum, chemicals & petrochemicals sector. Based on the Task Force's recommendations, Govt. announced Policy on Petroleum, Chemicals & Petrochemicals Investment Regions (PCPIR) in 2007. Specifically delineated investment region with an area of around 250 sq km for the establishment of manufacturing facilities in petroleum, chemical & petrochemicals with world-class services and infrastructure.

13.1.2 Six states submitted proposals for developing PCPIR. Union Cabinet approved 3 PCPIRs in March 2009 at Dahej in Gujarat, Haldia in West Bengal and Visakhapatnam in Andhra Pradesh.

13.1.3 In the second phase, Orissa & Karnataka also showed interest. Karnataka backed out for the time being. Initial plans drawn up for the

4 approved PCPIRs with statutory & regulatory compliance requirements have been being worked out.

13.2 Summary of PCPIR

1. Bharuch, Gujarat

– Area: 453 sq km
– Spread over Vagra & Bharuch in South Gujarat
– Processing area: 186 sq km
– Total Investment: Rs 50,000 crs
– Committed Investment: Rs 22,930 crs
– Cost of infrastructure development: Rs 7750 crs
– Estimated direct employment generation: 1.9 lakh
– Total employment generation: 8 lakh

Anchor Project: OPal

– ONGC Petro Additions Ltd (OPal), JV promoted by ONGC, Gujarat State Petroleum Corporation (GSPC) and GAIL
– Located within Dahej SEZ
– Dahej SEZ Ltd to develop all infrastructures in the Petrochemical SEZ within GPCPIR
– OPal setting up world scale dual feed petrochemical cracker complex with investments of Rs. 12,440 crs
– Will produce 1.1 MMTPA Ethylene, expected to commence production in Dec 2012
– 1.9 MMTPA petrochemical products
    - LLDPE/HDPE - 1100 kt
    - PP - 340 kt
    - Butadiene - 95 kt
    - Benzene - 130 kt
    - Carbon Black - 70 kt
– Construction of ONGC's C2/C3 extraction plant at Dahej already under way

Existing Facilities

– Close to Dahej & Vilayat Industrial Estates of GIDC
– GSPL gas grid passes through GPCPIR
– Handles more than 13 MMSCMD of gas
– Also close to Gujarat Gas network
– 220 KV Power Substation existing at Dahej
– LNG Petronet Jetty with 5 MMTPA capacities soon to be operational
– 8 MGD water supply from Narmada River
– 8 MGD existing, 25 MGD under construction
– Additional 35 MGD planned by GIDC
– 90 MLD effluent conveying system of GIDC
– 3 operational airports in the vicinity of GPCPIR
– Surat, Ahmedabad, Vadodara
– Connected to NH-8 via State Highway 6 from Dahej to Bharuch

- NH-8 Vadodara Surat Section completed National Expressway No. 1 from Ahmedabad to Vadodara
- Connected to Delhi-Mumbai Western Rail Route
- Dedicated Freight Corridor JNPT-Dadri by Indian Railways

Proposed Infrastructure development

- **Road Connectivity** - 6 laning of Dahej-Bharuch linking road
- Link road connecting coastal route to National Highway & Expressway
- Coastal road along River Narmada
- 55 km Link route from NH8 to GPCPIR
- 42 kms state highway within GPCPIR
- **Port Connectivity**
- 40 MMTPA additional berthing facility
- 100,000 TEU feeder container terminal Jetties
- GCPTCL 1.8 MMTPA liquid chemical jetty
- Birla Copper 4.5 MMTPA solid cargo jetty
- 3.5 MMTPA IPCL jetty (liquid fuel)
- **Utilities**
- 2000 MW uninterrupted power supply
- Augment existing water supply
- By 60 MGD initially thereafter by additional 550 MGD
- 50 MGD effluent treatment plant
- Plans for full-fledged Airport exclusively for PCPIR in future

2. Haldia, West Bengal

- Area: 250.19 sq km
- Covering 200.83 sq.kms in Haldia mainland and 49.36 sq.kms in the Purba Medinipur
- Processing area: 108.42 sq km
- Total Investment: Rs 93,180 crs
- Committed Investment: Rs 48,180 crs
- Cost of infrastructure development: ~Rs 18,031 crs
- Estimated direct employment generation: 4 lakhs
- Total employment generation: 10 lakhs

Anchor Projects

- **IOC**

• Haldia Refinery
• Expanded from 6 MMTPA to 7.5 MMTPA
• New hydro cracker unit
• Investments of Rs 3,000 crs
• Paradip-Haldia oil pipeline – already in operation
• 330 km pipeline to carry 10 MMT of crude oil, servicing IOC's Haldia Refinery
• 15 MMTPA integrated grassroots refinery cum Petrochemicals Complex
• Based on IOC's MoU with Govt. of West Bengal in 2006
• Yet to be decided whether part of WBPCPIR

- Feasibility study yet to be initiated
- Project to go ahead only with appropriate international partner

– **CALS Refinery (Spice Energy)**

- To relocate 2 refineries of 5 MMT each to Haldia in the first phase of WBPCPIR
- Bayer oil refinery in Ingolstadt, Germany
- Petro Canada refinery in Oakville, Ontario, Canada
- Investment involved is Rs 5,500 crs
- BP expected to enter strategic agreement for 5 million ton crude oil supply

Existing Facilities

– Project developer PCR Chemicals Pvt. Ltd
– JV between WBIDC & New Kolkata International Development (NKID) JV of Salim Group, Indonesia and Prasoon Mukherjee Group
– Haldia Port - 3rd largest cargo handling port in India
– Handles ~18 MMT POL cargo annually
– Dock system with 12 berths, 3 oil jetties and barge jetties
– IOC's Paradip-Haldia oil pipeline already operational
– 330 km pipeline to carry 10 MMT of crude oil
– Presence of large chemical & petrochemical players
– Mitsubishi Chemicals Corporation, HPL, Tata Chemicals, Exide, etc
– Serviced by South Eastern Railways
– Well connected by National Highway network
– NH2, NH6, NH 34, NH 35 and NH 117
– Large water front in Nayachar Island
– A natural buffer zone for PCPIR

Proposed Infrastructural Development

– Government of India has approved Rs 2108 cr for investment in physical infrastructure
– MoA signed in Oct 2009 for port, road & submarine cable landing station
– Rs 15,923 crs investment in infrastructure development by developer PCR Chem
– Through PPP mode
– Infrastructure to be developed
– 2000 MW power plant & water supply network
– Utility Park to be set up with a 3X660 MW Super Critical Thermal Power Plant
– Work regarding Phase I (2X660 MW) is to commence from February 2011
– 22 marine berths in Nayachar Island
– Internal road connectivity
– Centralized logistics
– Miscellaneous facilities
– Waste management systems
– Irrigation & storm water drainage

- Fire protection systems
- Comprehensive multi-utility services
- Connectivity between Haldia mainland &Nayachar Island
- Air strip on island

3. Vishakhapatnam , AP

- Area: 603.58 sq km
- Covering Visakhapatnam and East Godavari districts (Vishakhapatnam-Kakinada-Rajahmundry region)
- Processing area: 270 sq km
- Total Investment: Rs 3,43,000 crs
- Committed Investment: Rs 1,74,654 crs
- Cost of infrastructure development: ~Rs 19,031 crs
- 5 existing SEZs within PCPIR
- Estimated direct employment generation: 5.25 lakhs
- Total employment generation: 12 lakhs

Anchor Projects: HPCL & GMR Led Consortium

- Expansion of existing Visakh Refinery
- First phase increasing capacity from 7.5 MMTPA to 9.24 MMTPA completed
- 2nd phase capacity expansion to 15 MMTPA with Rs 10,000 crs investment planned
- Greenfield 15 MMTPA Refinery cum Petrochemicals Complex at Visakhapatnam
- Consortium comprising of HPCL, Total SA, Saudi Aramco, Gail & OIL
- Investment of Rs 32,000 crs
- Includes Aromatic complex & Naphtha cracker to produce 1 MMTPA olefins & aromatics
- Pre-feasibility study completed & configuration finalized Kakinada Refinery & Petrochemicals Pvt. Ltd.
- Greenfield 15 MMTPA Refinery cum Petrochemicals Complex
- Investment of Rs 31,000 crs within Kakinada SEZ
- Consortium comprising of GMR & Kakinada Sea Ports Ltd.
- Initially ONGC was the key stakeholder
- GMR Group acquired ONGC's stake in June 2008
- Tecno-Economic feasibility study by PFC Energy in progress

Existing Facilities

- 2 Airports at Visakhapatnam
- New Terminal building with night-landing facilities soon to enable operation of international flights
- Rajamundry expansion of runway in progress
- New terminal building - by mid 2010
- 3 Operational Ports
- Visakhapatnam Port

- Modern deep draft (14.9 m) container terminal with 24 berths and exclusive jetties for crude & POL
- 60,000 MT LPG cavern by HPCL
- India's largest cargo handling port (65 MMT), to increase to 80 MMT by 2012
- Gangavaram Port developed through PPP format by AP Govt. & Gangavaram Port Ltd.
- To be India's deepest port with 21 m draft
- Phase 1 completed – 5 berths & 35 MMTPA cargo capacity
- On completion will have 29 berths + SRM & capable of handling 200 MMTPA cargo
- Kakinada Deep Water Port
- Commissioned in Feb 08 with 4 berths
- Handled 14 MMT cargo in 08-09
- Road Connectivity- connected to the Golden Quadrilateral/National Highway 5, 12 kms from PCPIR site
- State Highway 97 connects with Vizag city, National Highway 214
- Industrial Parks & SEZs connected through 4-lane access road to NH-5
- Rail Connectivity
- Chennai - Howrah Trunk Railway line runs close to PCPIR
- POWER: 14,086 MW Installed capacity
- Adding another 10,000 MW in next 3 years
- Close to NTPC's 1000 MW power station
- Being expanded by another 1000 MW
- Water Supply
- Industrial Water Supply Project (776 MLD) from River Godavari commissioned
- Project with investment of Rs 525 crs completed
- Environment Management Systems
- Two CETP's (22MLD & 4.5 MLD) with marine outfall facility already commissioned

Proposed Infrastructure Development

- Road Network – Outlay Rs 4381 crs
- Up gradation of existing roads
- National Highways from 4 to 6 lanes
- State Highways from 2 to 4 lanes
- Construction of new roads
- 138 km PCPIR Expressway from Gangavaram Port to Kakinada Port
- Airports Outlay Rs 2620 crs
- International airport at Visakhapatnam
- Captive airport & air cargo terminal dedicated to PCPIR
- Up gradation of existing Visakhapatnam & Rajamundry airports
- Ports Outlay Rs 3600 crs
- Proposed dedicated port for PCPIR at Kona
- Cargo handling capacity – 27 MMTPA
- Proposed port at Mutyalammapalem
- Dedicated liquid cargo facility
- SPM for HPCL by Gangavaram Port

– Miscellaneous external infrastructure Outlay Rs 7420 crs
– Logistics Hubs, Water Supply, Power, Waste Management, etc

4. Kendrapara & Jagatsinghpur, Orissa

– Area: 284.15 sq km
– Covering Kendrapara and Jagatsinghpur
– Total Investment: Rs 277,734 crs
– Committed Investment: Rs 29,777 crs
– Infrastructure Investment: Rs 13,634 crs
– GOI Support: 716 crs on account of VGF funding for one port and three road related projects
– State Government: 1,796 crs
– Private participation: 11,122 crs
– Estimated direct employment generation: 2.27 Lakh
– Estimated indirect employment generation: 4.21 Lakh
– Total employment generation: 6.48 Lakh

Anchor Projects: Indian Oil Corporation Ltd (IOCL)

- MMTPA grassroot refinery at Paradeep in the first phase at a cost of 29,777 crore
- Refinery will have Crude and vacuum Distillation Unit, a Hydrocracking Unit, a Delayed Coker Unit and other secondary processing facilities
- It will also have an Integrated Gassification Combined Cycle Plant for production of steam, power and hydrogen from petroleum coke for captive use in the refinery
- A petrochemical complex will be set up at a later date depending on the market conditions
- IOCL, Deepak Fertilizers - Greenfield ammonium nitrate plant and Coal to Liquid Project of TATA Steel and M/s SASOL

Current Status

– Proposal was approved by the CCEA in Dec'10
– Memorandum of Agreement to be signed with the State Government shortly.

13.3 PCPIR – Current Status

13.3.1 The matter of review of implementation of PCPIRs and the pace of investments etc in the PCPIRs has engaged the attention of the Department for a while now. It is acknowledged by State Governments, by this Department and the Industrial community that the pace of growth of PCPIRs has been below expectation.

13.3.2 Our assessment is that this is mainly on account of the Anchor Tenants that have "put on hold" their investment decisions as a result of which the necessary boost to investments in the region have not come through. The Anchor Tenants, in most cases, have assured that they are not withdrawing but are only postponing their investments.

13.3.3 The State Governments, as implementing entities have a slight different perception. Apart from the Anchor Tenants, they also cite the inadequate financial i.e budgetary support from Government of India for creation of infrastructure in the PCPIRs, which was projected as the other driver of growth in these regions

13.4 Approach to Sustainable Growth (SHE)

13.4.1 Chemicals and Petrochemical Industry is viewed as major polluting industry. Strict pollution control norms are set and at times most entrepreneurs / corporate house/ PSU etc are termed defaulters for adhering to such norms.

13.4.2 While the contribution made by the industry in making available products that are critical inputs to agriculture, healthcare, construction, FMCG and consumer durable industry, its importance is often overshadowed by its negative perception. There are compelling rationale to support the growth of the industry. However the growth should be sustainable.

13.4.3 There is a strong need to have a code of conduct by which growth of the industry is not hampered and environment is protected.

13.4.4 In the above backdrop, certain directional measures are suggested which can be developed into an implementable programmes.

13.4.5 Industrial discharge in one major source for pollution of rivers and ultimately marine life. Aim is to cut the industrial discharges to zero which are reaching water bodies.

13.4.5.1 **Zero discharge Industrial Units:** Instead of having norms for discharge and checking pollutions to water sources, certain type of industries beyond a size to be permitted only if they can ensure zero discharge. The effluent is either recycled or used for horticulture.

13.4.5.2 **Centralised Effluent Treatment:** In case of medium and small industries which can't afford or not capable of having effluent treatment should direct industrial waste to some centralized channels. These centralized effluent treatment plants should be the responsibility of state administration. Industrial waste should not be allowed to go to the sewers or rivers and must go to certain separate channels. The inflow in these channels to be monitored for quantity as well quality of discharge by industrial units. The industrial units to be charged an amount per KL of discharge depending on quantum of pollutants in the discharge. Highly polluted discharge industries to be charged more and less polluting industry to be charged less. The financial model of the central effluent treatment authority to be financed from such collections only. The idea is that the polluting industry pays and the one which pollutes more, pays more.

13.4.5.3 **Social Forestry:** The water from these centralized effluent treatment plants also should not be allowed to go to rivers and get mixed with the fresh water resources. The treated water is to be used for growing timber or flowers. i.e. agricultural output not for human consumption. This will increase the green cover of the country as well as reduce the risk of any industrial contaminant getting into the food chain either through vegetables or through fisheries.

13.4.5.4 **Rain Water Harvesting:** Large industrial projects have substantial areas for their plants and other services. Such sites receive lot of rain water which goes to the drains or flows out of the plant sites. Conserving this water should be made mandatory. This water should either be stored or used within the plant or should be used to recharge ground water table. Moreover wastelands available around the plant sites to be converted to green belts. Green belt development is already in practice around the sites of many large projects.

13.5 Improve Value Addition

13.5.1 **Markets**

  - *Promote use of plastic in untapped areas domestically*
  - *Proactively focus on exports as a business strategy rather than the current mindset of focusing only on the domestic market*
- Costs
  - *Reduce the burden of Plastic cost on the end use industry*
- Scale / Technology Markets
  - *Increase scale of operations*
  - *Adopt new technology to be in sync with global trends*

13.5.2 **Focus Area:**

- Consolidate and enhance Capacity - Explore options of creating Plastic SEZs / clusters around polymer manufacturing facilities
- Upgrade facilities and improve productivity - Need for technology Up gradation Fund.
- Promote utilization of critical plastic applications which saves energy / cost etc. –
  - Mandate the use of geo-synthetics for road construction
  - Promote use of plastics in pipe & profile applications

- Promote sale of products for self-consumption in packaged form.

- Reduce excise duty on Polymers and Plastics to make it more competitive & thereby;
  - Cut costs of processed foods
  - Boost demand for processed foods
  - Cut costs on plasticulture applications
  - Decrease farmer's upfront investment in plasticulture applications

13.5.3 **Need of the hour**

13.5.3.1 **Formation of Industrial Clusters / Plastic Parks.**

- *The benefits `of industrial clusters are more important for SMEs than for large firms. Possible benefits of Industrial clusters being;*
- *Enterprise can easily learn from other enterprises (Information spillovers)*
- *They can easily transact intermediate goods and service with each other (Division of labor)*
- *They can easily find workers with desired skills (and such workers can easily find jobs) (Formation of market for special skills)*
- *Industrial clusters can attract customers & material suppliers*
- *Since SMEs are dominant in labor-intensive industries, the promotion of cluster-based industrial development is often equal to the promotion of labor-intensive industries.*

13.5.3.2 **Technology Council & Technology Development Fund**

13.5.3.2.1 Technology Development Fund (TDF) scheme is required to be set up for directs assistance to industries. TDF would encourage industrial units to modernize their production facilities in the future and adopt improved and updated technology so as to strengthen their domestic & export capabilities and competitiveness.

13.5.3.2.2 Assistance under the scheme could be made available for meeting the expenditure on purchase of new/additional capital equipment, acquisition of latest technical know-how, upgradation of process technology and products with thrust on quality improvement, improvement in packaging and cost of TQM and acquisition of ISO-9000 series certification.

13.5.3.3 **Training of Human Resources**

13.5.3.3.1 Plastic processing being relatively less complex and more labor intensive, offers substantial employment opportunities for both semi-skilled as well as unskilled manpower thus bringing socio-economic benefits to India.

13.5.3.3.2 The industry requires skilled manpower in managerial, operational and maintenance areas. There are requirements for specialized manpower with polymer technology background and with mechanical and electrical engineering skills. While the level of specialization is not very high, manpower with polymer science and engineering background are essential in these units.

13.5.3.3.3 In addition, training of manpower for supervisory & operator's role is also essential to the industry, which needs to be provided both classroom as well as on-site.

13.5.3.3.4 There is a need to provide for various educational and training opportunities for the workers which will help them move up the ladder.

13.5.3.4 **The thrust area of training centres can be as under**

13.5.3.4.1 Manpower development through specialized technical training programmes which are specifically designed to represent the needs of various disciplines of today's Plastics industrie*s.*

13.5.3.4.2 Up gradation of skill and technical know-how of the executives of the Plastics industries through short duration skill cum technology up gradation programs.

13.5.3.4.3 Conducting Entrepreneurship Development Programmes (EDPs) exclusively for "Setting up a Plastics Industry" and provide Technical Assistance to the potential entrepreneurs in establishing their industries from the "concept to commissioning stage".

13.5.3.4.4 CIPET / ITI / IIP etc. with existing facilities can act as the nodes & model for development of training centres.

13.5.3.5 **Formation of Technical Centres in each State**

13.5.3.5.1 Funding & supporting formation of new technical centres & existing centres thereby providing help in development & absorption of Advanced Technology.

The centres to provide;

13.5.3.5.2 Facilities for the testing of Plastics materials and products as per the national and international standards for the quality control requirements of the industries.

13.5.3.5.3 Characterisation and assessment of Plastics materials, product evaluation, formulation of testing standards for Plastics products.

13.5.3.5.4 Carry out as well support Research & Development related to polymers, additives & plastic processing.

13.5.3.5.5 Offering technical services for the design and development of moulds and dies

13.5.4 **India's Trade Agreements**

13.5.4.1 **Overview**

13.5.5 As geographical boundaries of countries continue to rapidly fade away under the aegis of the WTO, countries around the globe are striving to forge new trade relations and deepen economic cooperation among their preferred trade partners. Regional Trade Agreements (RTAs) among countries or group of countries have emerged as the most frequently used instrument for international economic integration among countries and country groupings.

13.5.6 Trade agreements can be bilateral or plurilateral—that is, the agreement is between two nations or group of countries. For the majority of countries global trade is synchronized by unilateral barriers of several types, including tariffs, non tariff barriers, and outright restrictions.

13.5.7 Many of the Asian countries have made significant improvements in terms of loosening trade regimes and reducing tariffs since the beginning of 1990s. The governments and the private sector identify that sturdy exports are grave for overall economic growth and poverty diminution, and export-led growth has become a chief shove in each country.

13.5.8 Trade agreements are one of the approaches to diminish these barriers, thus opening all parties to the remuneration of increased trade. In most contemporary economies the possible alliances of interested groups are numerous, and the variety of possible unilateral barriers is enormous. Further, several trade barriers are created for other, non economic grounds, such as national security or the aspiration to preserve or protect local culture from foreign manipulations.

13.5.9 Till the early 1990s, India was a relatively closed economy with high average tariffs, quantitative restrictions on imports and there were stringent restrictions on foreign investment. However, with the initiation of the economic reforms process in the country, India also embarked upon liberalizing the external sector by lowering tariffs, eliminating import quotas and restrictions on foreign investments.

13.5.10 As part of the opening up of the economy and globalization, India undertook major trade reforms which resulted in rapid trade growth. India's trade to GDP ratio has increased from 15% to 35% of GDP between 1990 and 2010, and trade has emerged as a key contributor to India's economic growth.

13.5.11 With globalization and India's integration with the global economy, the country's trade landscape underwent fundamental changes. Average non-agricultural tariffs have fallen to the level of ~10%, quantitative restrictions on imports and other non-tariff barriers have been eliminated, and foreign investments norms have been relaxed for a number of sectors.

13.5.12 India is now aggressively pushing for a more liberal global trade regime, especially in services. It has assumed a leadership role among developing nations in global trade negotiations, and continues to play a critical part in the Doha negotiations which at present seems to be at a standstill.

13.5.12.1 **India's Trade Agreements**

13.5.12.1.1 India has recently signed trade agreements with its neighbors and is seeking new ones with the East Asian countries and the United States. Its regional and bilateral trade agreements - or variants of them - are at different stages of development:

13.5.12.1.2 India views Regional Trading Arrangements (RTA's) as constructive blocks towards the overall purpose of trade liberalization. Consequently, it is participating in a number of RTA's which include Free Trade Agreements (FTA's); Preferential Trade Agreements (PTA's); Comprehensive Economic Cooperation Agreements (CECA's); etc. These agreements are pierced into either bilaterally or in a regional grouping. Status of India's key trade agreements i.e. FTAs, PTAs, CECAs, etc are given below.

Table 144: India's Trade Agreements in Operation

Agreement	Partner Country	Date of Coming in to Effect	Status	Remark
India-Sri Lanka FTA	Sri Lanka	1-Mar-00	Except 429 items in negative list India's duty reduction commitment completed	India's first FTA, signed in Dec '98;

India-Thailand FTA	Thailand	1-Sep-04	Framework agreement - 2003; Duty eliminated only on 82 items under the Early Harvest Scheme	Implementation of FTA delayed; To adopt the same rules of origin as those of the India-ASEAN FTA
India-Singapore CECA	Singapore	1-Aug-05	Came into effect from 1.8.05, 4 categories, ID on polymers reduced from 5% to 3.35%	Duty on PE, PP scheduled to be nil by Dec 2015
SAFTA	Nepal, Bangladesh, Bhutan, Pakistan, Sri Lanka, Maldives	1-Sep-06	Framework agreement - Jan 04; in effect from Sept 06. India unilaterally reduced its negative list from 744 items to 500 items on 3.3.08	Tariff to be reduced to 0-5% in 5 years starting the 3rd year after the FTA takes effect;
India-MERCOSUR PTA	Uruguay, Paraguay, Argentina, Brazil	1-Jun-09	Framework Agreement - June '03; PTA signed in Jan '04, India & MERCOSUR have submitted additional wish lists	Addl wish lists exchanged: India (3111 tariff lines) MERCOSUR (1289 tariff lines)
India-Chile PTA	Chile	11-Sep-07	Framework Agreement signed in Jan '05 20%-50% Margin of preference negotiated.	Meeting for expansion & deepening of India-Chile PTA was held in Santiago on 28-29 Jan 2010 in which both sides exchanged additional wish lists
Asia Pacific Trade Agreement	India, China, South Korea, Lao PDR, Bangladesh, Sri Lanka	31-Jan-76	Formerly known as Bangkok Agreement, renamed in Nov ’05; 3rd round of tariff concessions implemented in Sept ‘06	Tariff preference made uniform for all member countries
India-ASEAN FTA	Indonesia, Malaysia, Philippines, Singapore, Thailand. Brunei, Myanmar, Cambodia, Laos, and Vietnam	1-Jan-10	Framework Agreement - Oct '03; Negotiations concluded & FTA operationalized on 1.1.2010 for India and Malaysia, Singapore, Thailand. After ratification by remaining ASEAN members in 2011, FTA fully operationalized	Key petrochemical products included in Phased Tariff Reduction/Elimination by 2018/2015 Lists. Negotiations in Trade in Services and Investment are underway

			in Aug '11	
India-Korea CEPA	South Korea	1-Jan-10	Negotiations concluded & CEPA operationalized on 1.1.2010	Key items are in Exclusion / Phased Tariff reduction Lists.
India-Japan CEPA	Japan	1-Aug-11	CEPA operationalized	Key items are in Exclusion / Phased Tariff reduction Lists. Likely to come into effect by end 2010
India-Malaysia CEPA	Malaysia	1-Jul-11	CEPA operationalized	Key petrochemical products included in list where tariff to be retained at 5% till 2019

13.5.12.1.3 In addition to the trade agreements, tabulated above, negotiations were on for the following trade agreements and some progress was made between the negotiating sides but in between several factors including the global economic slowdown has temporarily stalled the negotiations (except the agreement with the EU where negotiations continued without any break). Negotiations under these agreements are likely to be resumed shortly.

Table 145: Agreements under Negotiation

Agreement	Partner Country	Status	Remark
India-EU Trade & Investment Agreement	EU 27 members	8 rounds of negotiations have been alternately held at Brussels and New Delhi respectively, the 8th Round was held during January 25-29, 2010.	The 2 sides trying to conclude negotiations by 2011
India-GCC FTA	Bahrain, UAE, Saudi Arabia, Oman, Qatar & Kuwait	Framework Agreement - Aug '04, rounds completed, negative list yet to be finalized	3rd round delayed, new date yet to be notified
BIMSTEC	Bangladesh, India, Sri Lanka, Thailand, Myanmar	Framework agreement signed in Feb 03.	Negative lists of member countries circulated. Date yet to be announced for resumption of negotiations

13.5.12.1.4 Several other trade agreements are in the pipeline as India continues to pursue its agenda of enhancing trade and economic cooperation with its key partners.

13.5.12.1.5 Negotiations to begin shortly

1. India-Australia

2. India-New Zealand
3. India-Canada
4. India-Indonesia
5. India-Mexico

13.5.12.1.6 Joint Study Group report submitted & Govt. examining RTA feasibility

1. India-Turkey
2. India-Russia
3. India-China
4. India-Israel

13.5.13 Joint Study Group examining preferential trade potential

1. India-Iran
2. India-Brazil-South Africa
3. India-Egypt

13.5.14 Feasibility of an FTA being explored

13.5.15 19-nation Common Market for Eastern and Southern Africa (COMESA).

13.6 Impact of Trade Agreements on the Petrochemical Industry

13.6.1 The primary goals of a regional free trade agreement are to stimulate domestic economic growth through enhancing the market access of a nation's exports to other countries; attracting increased foreign direct investment (and the modern technology that comes with it); stimulating increased productivity and competitiveness in domestic as well as foreign markets; and to deepen economic integration with preferred trading partners.

13.6.2 The ultimate impact of an FTA on Indian industry in general and the petrochemical industry in particular is influenced by a wide and diverse array of factors. Each FTA in itself is unique and hence their impact on the industry will vary from agreement to agreement. However, irrespective of the partner country, the 2 broad issues involved is assessment of the impact of any RTA/FTA are improved market access to the domestic market of the partner country which can boost India's exports and the likelihood of imports coming from the partner country through preferential route to India's domestic market.

13.6.3 While some of India's RTAs like SAFTA, India-MERCOSUR PTA, India-Chile PTA, etc have significant potential to provide a fillip to India's petrochemicals exports, certain other RTAs can be potential threats to the domestic petrochemical industry. FTAs like those with ASEAN, GCC, Thailand, Japan, Singapore, etc can have an adverse impact on the Indian petrochemical manufacturers by flooding the market with cheap imports. Some of India's partner countries like Singapore and GCC are major international trade hubs with easy access to ports and act as transit a point, which increases the potential threat of preferential imports disrupting the Indian market with the added risk of rerouting of merchandise from other countries who are not party to the RTA.

13.6.4 Petrochemical industry in several of India's RTA partner countries like ASEAN and GCC have come up on the back of huge incentives/ benefits/ concessions provided by their respective governments, which give them cost advantage vis-à-vis Indian manufacturers. India needs to take a cautious approach to trade agreements keeping in view the higher transaction costs in the country and needs to evaluate each RTA on a case-by-case basis to safeguard the domestic industry's interest, especially for sectors like petrochemicals which are extremely capital-intensive.

13.6.5 To ensure that the primary objective of FTAs i.e. increasing trade, is met, it is important that India enters in to negotiations only with those countries and groups where there is complimentarity between the two sides.

13.6.6 In order to address the issue of trade diversion and abuse of preferential benefits, it is imperative that the rules of origin for the FTAs are stringent with dual criteria of both changes in tariff classification as well as minimum local content.

14 **Policy Submissions**

14.1 Policy Actions for Sustained Industry Growth

14.1.1 Petrochemicals is a major segment of manufacturing industry and plays a pivotal role in packaging, agriculture, building and construction, infrastructure, healthcare, communications and other critical sectors supporting welfare of the common man. Plastics, Synthetic Fiber, Synthetic Rubber and other petrochemicals being highly energy-efficient bring multiple benefits to users like superior performance, lower costs, reusability, durability, etc in addition to benefiting the economy at large through resource conservation, minimizing wastage, offering affordable healthcare and meeting daily necessities.

14.1.2 On account of its superiority, compared to traditional materials like wood, paper, metals, etc. plastics became one of the fastest growing industries in the 1990s registering 2-3 times the rate of GDP growth.

14.1.3 Similarly, synthetic fiber and synthetic rubber compliment and supplement cotton and natural rubber in almost all applications, conserving resources and at the same time enhancing end-product performance.

14.1.4 Petrochemicals are major contributor to the exchequer and the polymer industry annually contributes over Rs 7000 crores by way of taxes and duties. Hence, stagnating demand in the sector would have adverse impact not only on employment but also on contribution to the exchequer.

14.1.5 Taking cognizance of the huge potential, Government of India had identified the petrochemical industry as one of the key driver to GDP growth. National Policy on Petrochemicals released by the Government ("Policy Resolution for Petrochemicals" published in Gazette on April 30, 2007) recognizes the necessity of sustained growth in this sector.

14.1.6 However, **realization of the growth potential is possible only with a supportive policy regime and a facilitative business environment**. A facilitative fiscal regime would revive industry growth, attract investments and promote petrochemical usage, which in turn, would bring in multiple cascading benefits, tangible and intangible, to the national economy.

14.1.7 It is also ironical that India is a net exporter of Naphtha, the basic feedstock, and at the same time importing petrochemical products, thereby discouraging value addition between Naphtha and the derivatives within the country.

14.1.8 The key issues in the petrochemical industry are detailed below along with suggestions for enhanced standard of living for the common man by driving industry growth through facilitative policy initiatives.

14.2 *Fiscal Initiatives*

14.2.1 **National level VAT / GST on primary inputs and products with common policy on Input Tax Credit.**

Table 146: VAT rates on Polymers, by state

State	VAT %	State	VAT %
Chhatisgarh	5.00%	Orissa	4.00%
Gujarat	5.00%	Sikkim	4.00%
Madhya Pradesh	5.00%	Tripura	4.00%
Rajasthan	5.00%	West Bengal	4.00%
Dadra, Nagarhaveli	4.00%	Chandigarh	5.00%
Daman & Diu	4.00%	Delhi	5.00%
Goa	5.00%	Haryana	4.20%
Maharashtra	5.00%	Himachal Pradesh	5.00%
Silvassa	4.00%	Jammu & Kashmir	5.00%
Arunachal Pradesh	4.00%	Punjab	8.80%
Assam	5.00%	Uttar Pradesh	5.00%
Bihar	5.00%	Uttaranchal	4.50%
Jharkhand	5.00%	Andaman & Nicobar	
Manipur	4.00%	Andhra Pradesh	4.00%
Meghalaya	4.00%	Karnataka	5.00%
Mizoram	4.00%	Kerala	4.04%
Nagaland	4.00%	Pondicherry	4.00%

14.2.2 **Background**

14.2.2.1 India has one of the highest indirect tax burdens as compared to many developing and developed countries.

14.2.2.2 The continuation of Indirect Tax reforms to bring in uniformity in tax rates across India and also to put a check on cascading effects of existing Central and State VAT system.

14.2.2.3 The design of the system is also expected to provide a boost to exports, by minimizing the export of taxes and to provide a competitive edge for Indian companies in the international market.

14.2.2.4 The implementation date has been rolled back several times.

14.2.2.5 An Empowered Group of State Finance Ministers has been established to develop and implement this new improved tax structure in India.

14.2.3 **Submission**

14.2.3.1 Establish a single national level VAT / GST on plastics and articles of plastics at a uniform 4% across states.

Table 147: Tax rates on commodity Polymers (PE, PP & PVC) in India

No.	Tax	Current Rate	Proposed Rate
1	VAT (State dependent)	4 - 8.8%	4%
2	CST (against C form)	2 %	-
3	Excise	10%	-
4	Customs Duty	5%	5%

14.2.3.2 Key petrochemical inputs such as Naphtha should also fall under a national level VAT/GST regime at a uniform 4% across states, with complete input tax credit.

14.2.3.3 Natural Gas – a key petrochemical feedstock – to be included in the list of "Declared Goods" under CST Act and be taxed at a uniform 4% rate across the country. In the event of abolition of CST, a maximum VAT of 4% may be fixed for natural gas. (Sales Tax currently varies significantly from state to state).

14.2.3.4 GST should be finalized expeditiously and implemented before the 12th, Five Year Plan period.

14.2.4 **Benefits**

14.2.4.1 Develop a Common Market for enhanced Inter-state commerce with reduced tax-arbitrage inefficiencies.

14.2.4.2 Reduce inflation on mass consumption products such as low cost footwear, products for public health, agriculture applications, low cost housing components, etc.

14.2.4.3 Boost exports with a competitive edge in the International markets and remove fiscal and regulatory elements that contribute to higher transaction costs to Indian manufacturers.

14.2.4.4 Drive manufacturing growth with stable tax regime to reduce project risks and enhance viability.

14.2.4.5 Level playing field with substitute materials such as wood, which are outside the VAT net.

14.2.4.6 Widening the tax base equitably with administration at minimum cost and complexity.

14.2.4.7 Retain chain value addition within Indian economy, providing the backbone to enhanced employment opportunity, development of SME sector as well as enhanced economic activity, resulting in growth as well as improved revenue collection.

Table 148: Taxation Rates in key Countries in the World

No	Country	VAT	GST	Excise	Duties	Other Taxes
1	ALGERIA	7, 17%			3-40%	Luxury: 20-110%
2	AUSTRALIA		10%		0-17.5%	
3	**AUSTRIA**	**20%**			**3.5-15% (avg. 3.5%)**	
4	BELARUS	20%			20-40%	
5	**BELGIUM**	**12, 21%**			**3.5-15% (avg. 3.5%)**	
6	BULGARIA	7, 20%			5-40%	
7	CANADA		5%		0-20%	
8	CHILE	19%			6-16.5%	Luxury: 50-85%
9	CHINA	17%			0-35%	Consumption: 5-10%
10	CROATIA	10, 23%			0-18%	
11	CYPRUS	15%			0-30%	
12	**CZECH REPUBLIC**	**10, 20%**			**0-20% (avg.)**	
13	DENMARK	25%			5-14%	
14	ESTONIA	20%			Avg. duty rate 5%	
15	FINLAND	23%			0-35%	
16	FRANCE	5.5, 19.6%			5-17%	
17	GERMANY	7, 19%			5-17%	
18	GREECE	9, 23%			5-7%	
19	HONG KONG					
20	**HUNGARY**	**25%**			**0-60% (8% avg.)**	**Luxury: 10-35%**
21	ICELAND	7.5%, 25%			0-30% (avg. 3.6%)	
22	**INDIA**	**12.50%**		**8-24%**	**0-40%**	**Educational CESS: 3%**
23	**IRELAND**	**21%**			**5-20% (avg. 3.5%)**	
24	ISRAEL	16.50%			0.8-80%	Purchase: 5-90%
25	**ITALY**	**10, 20%**			**5-20% (avg. 3.5%)**	
26	JAPAN					Consumption: 5%
27	**LEBANON**	**10%**			**0-70% (avg. 15%)**	
28	LIECHTENSTEIN	7.60%				
29	LUXEMBOURG	3, 15%			5-14%	
30	**MALAYSIA**		**5-10%**		**0-300% (avg. 8.1%)**	
31	MEXICO	10-16%				
32	MONGOLIA	13%			5%	
33	**MONTENEGRO**	**7, 18%**			**5% (avg.)**	
34	**MOROCCO**	**10, 20%**			**2.5-200% (avg. 10%)**	
35	**NETHERLANDS**	**6, 19%**			**5-20% (avg. 3.5%)**	
36	NEW ZEALAND		12.50%		0-15%	
37	NORWAY	12-25%			0-8%	
38	PAKISTAN		17%		0-30%	

39	**POLAND**	**7, 23%**			**0-15% (avg. 4.2%)**	
40	**PORTUGAL**	**23%**			**0-15% (avg. 4.2%)**	
41	**ROMANIA**	**24%**			**0-30% (avg. 11.7%)**	
42	**RUSSIA**	**18%,10%**		**20-570%**	**5-20% (avg. 14%)**	
43	**SERBIA**	**18%**		**5-70%**	**0-30% (avg. 9.4%)**	
44	SINGAPORE		7%		0-1 %	
45	**SOUTH AFRICA**	**14%**		**5-10%**	**0-40% (avg. 20%)**	
46	**SOUTH KOREA**	**10%**			**7.9% (avg.)**	**Luxury / Electric goods: 15-100%**
47	**SPAIN**	**18%**			**0-20% (avg. 4.2%)**	
48	SRI LANKA	12%			5-35%,	
49	**SWEDEN**	**25%**			**2-14% (avg. 4.2%)**	
50	**SWITZERLAND**	**8%, 2.4%**			**3.2% (avg.)**	**Environmental Tax 3% (Co2 Emissions)**
51	**TAIWAN**	**5%**			**2-60% (avg. 8.2%)**	
52	THAILAND	7%			0-45%	Luxury: 25-80%
53	**TURKEY**	**18%**			**0-20% (avg. 5%)**	**7-40% (some luxury items & motor vehicles)**
54	UAE				4-5%	
55	**UKRAINE**	**17%**		**0-300%**	**0-20 (avg. 16%)**	
56	**UNITED KINGDOM**	**20%**			**0-15% (avg. 4.2%)**	

Source: United States Council for International Business **(corrected India VAT stated @ 13.5%?)** and others

14.2.5 **Progressive customs duty policy - Background**

14.2.5.1 While the internal taxes are relatively high, India has very low import duty on polymers and key petrochemicals at a rate of 5%, lower than most SEA countries (India: 5%, Malaysia: 20-30%, Thailand: 5%, Philippines: 15%, Indonesia: 20%, China: 6.5-8.4%), affecting the competitive viability of the domestic investment.

14.2.5.2 This duality in fiscal structure has resulted in a high cost economy that discourages local investment.

14.2.5.3 Further, Indian import duty structure provides for NIL incremental tariff protection between key petrochemical inputs (Naphtha, LNG, Propane) and their end products (building blocks such as Ethylene, Propylene, Benzene, Butadiene) as well as major petrochemical products such as Polymers.

14.2.5.4 With preferential duty for countries that have signed FTA with India, the tariff protection is even negative for many products like polymers.

14.2.5.5 High growth countries like China also maintain a 5.5% duty differential between Naphtha and Polymers.

14.2.5.6 While import tariff on products has been reduced to 5%, capital goods attract duty of up to 10%, affecting the industry adversely.

14.2.6 **Submission**

14.2.6.1 Import duty for all petrochemical feedstock and products should be recalibrated providing adequate incentive to attract investment in this sector. The Government has taken a partial step in this direction by reducing the import duty on naphtha which, unfortunately, has company specific applicability and not for the sector as a whole.

14.2.6.2 Maintain differentials in basic customs duty across value chain, by grouping petrochemicals into four categories, viz. Feed-stocks, Intermediates, Primary Petrochemicals and Semi-Specialty / Value Added Petrochemicals with cascading Import duties of 0%, 2%, 5% and 10%.

Table 149: Proposed duty structure

Category	Sample Products	Existing duty	Proposed duty
Feed-stocks	Naphtha, LPG, Gas	0 - 5% (company dependent)	0%
Intermediates	Ethylene, Propylene, Benzene	5%	2 %
Primary Petrochemicals	Polymers & most bulk Chemicals	5%	5%
Semi-specialty / Value Added Petrochemicals	Elastomers, Secondary derivatives (e.g. organic acids, alcohols, esters), LAB, etc.	7.5%	10%

14.2.6.3 In order to partially offset the disadvantage of the domestic petrochemical industry, import tariff on capital goods ought to be eliminated

14.2.7 **Benefits**

14.2.7.1 Encourage development and integration into higher value added products further down the chain.

14.2.7.2 Drive investment growth with elimination of import tariff on capital goods.

14.2.7.3 Leverage the available Scientific and Engineering skills and develop an industry ecosystem for global competitiveness.

14.2.8 **Incentives for Sustainable development – Submission:** Introduce special fiscal policy initiatives to encourage and support use of renewable feedstock, adoption of green processes and build energy efficient housing.

14.2.9 **Benefits**

14.2.9.1 Reduce dependence on high cost petroleum oil imports.

14.2.9.2 Moderate the inflationary pressures with independence from increasingly expensive oil as the only source of petrochemicals feedstock.

14.2.9.3 Utilization of marginal, arid, barren land for production of bio feedstock (e.g. - Jatropha), with enhanced diversification for non-food producing land farmers and employment opportunities for unskilled workers in cultivating and collection of second generation (non-food chain) feedstock.

14.2.9.4 Leverage the available Scientific and Engineering skills and participate in the new international technology developments in Industrial Biotechnology.

*14.3 **Non-fiscal Initiatives***

14.3.1 **Infrastructure – Background**

14.3.1.1 Infrastructure has long been recognized as a critical enabler in enhancing competitiveness of industry in being able to produce and distribute goods both for the domestic market and for exports.

14.3.1.2 As a result of the under-developed trade and logistics infrastructure, the logistics cost of the Indian economy is over 13%of GDP, compared to less than 10%of GDP in almost the entire Western Europe and North America.

14.3.1.3 Towards this the 11th five year plan envisaged considerable investment.

14.3.1.4 Although significant progress has been made, much needs to be done, along the lines recognized by the Planning Commission.

14.3.2 **Submission:** Institute outcome based measurable targets for infrastructure development, after establishing benchmarks, e.g.

14.3.2.1.1 Road transport: (Safety, Security, Speed, Reliability)

- Road surface quality
- Average daily distance covered by trucks
- Pilferage losses (%)
- Number of checks en-route / day
- Highway accident rate
- Fleet maintenance costs, (Rs/truck/year)
- other

14.3.2.1.2 Ports

- Ship turnaround time
- Frequency of services
- Document processing time
- Transit times to and within port
- Port congestion leading to incidence of demurrage.
- Maintain water front to allow higher capacity marine vessels to ply and navigate in Indian waters.

14.3.2.1.3 Railways

- Improve efficiencies for reduced cost of transportation.
- Higher average speeds.
- Evaluate option for bulk transport of chemicals & plastics.

14.3.2.1.4 Power generation / distribution

- Create fiscal and regulatory framework that facilitates investment in captive, private and public power generation.

- Remove bottlenecks in the operation of power exchange grid.

14.3.3 **Benefits**

14.3.3.1 Meet customer requirements for delivery of high value and time-sensitive products in both domestic and export markets, while simultaneously reducing the cost of logistics.

14.3.3.2 Bulk rail transport of chemicals and plastics is safer and more energy efficient than road transport and also reduces highway congestion and can reduce shipping times.

14.3.3.3 Standardization (BIS) of articles of mass consumption

14.3.4 **Background**

14.3.4.1 A significant lack of standardization involving petrochemical products and their end-products in the country has created technical barriers to trade and to establish economies of scale.

14.3.4.2 For product standards the benefits may be broadly summarized under the headings cost reduction (design, production, transaction, working capital), increased competition amongst suppliers, quality assurance, supplier reliability and product interchange-ability.

14.3.4.3 As per DIN (European standards): Standards generate economic benefits which have been estimated at 17 billion Euros a year for Germany alone. Standards promote worldwide trade, encouraging rationalization, quality assurance and environmental protection, as well as improving security and communication. Standards have a greater effect on economic growth than patents or licences.

14.3.4.4 Standardization is a strategic instrument for economic success. By becoming involved in standards work, businesses can gain a competitive lead through timely access to information and knowledge. They can use this to their own advantage, reducing the risks and costs involved in R & D as well as greatly reducing transaction costs. Standards play a major deregulatory role, relieving the state of the responsibility for developing detailed technical specifications. By referring to standards, legislation is more flexible in adapting to technical advances.

14.3.5 **Submission:** Establish a consensus driven system of standardization of common goods, (e.g. door / window sizes, carry bags of >40 micron thickness, etc.).

14.3.6 Overhaul the process of setting up new standards or updating existing standards so as to cut down on time and resources currently expended in this area.

14.3.7 **Benefits**

14.3.7.1 Lower cost of producing goods, with efficient economies of scale in large scale production, distribution and working capital.

14.3.7.2 Drive growth of a "Common Market" within India with the same standards applicable throughout the country.

14.3.8 **Enhance Export competitiveness by Branding and Promoting "Made in India" of manufactured products – Background**

14.3.8.1 India enjoys an excellent reputation for technical skills globally, built on the technical prowess of the Diaspora and IT services leadership.

14.3.8.2 Leveraging this reputation by formulating a focused program on quality and workmanship of manufactured goods would be a strategic differentiator vis-à-vis the perceived quality of goods exported by China.

14.3.8.3 Recent developments such as the Nano car which gained extensive international acclamation also provide an opportunity for the branding of goods from India.

14.3.8.4 **Submission** - Program (a' la' "Incredible India") to promote image of manufactured goods from India as high quality, value-for-money products.

14.3.9 **Benefits**

14.3.9.1 Build on the professional image of India from IT services to promote / market Indian manufactured goods.

14.3.9.2 Prime the national economy and drive growth with export earnings.

14.3.9.3 Enhanced employment prospects for semi-skilled / skilled / professional manpower.

14.3.9.4 Effectively compete with other Asian export oriented economies.

14.3.10 **Jute Packaging Material Act (JPMA)**

14.3.11 **Background**

14.3.11.1 **The Jute Packaging Material Act (JPMA)** was enacted in 1987 as a temporary measure to provide some relief to the ailing jute industry.

The Act made jute packaging mandatory for food grains, sugar, cement & fertilizers. However, even after 24 years, the Act continues to remain in existence even though cement & fertilizers have been taken out of its ambit.

14.3.11.2 Currently, 100% of sugar & food grains produced in India are mandated to be packed in jute sacks despite the existence of more versatile and cost-effective solution e.g. plastic woven sacks.

14.3.11.3 The existing 100% reservations in favour of jute for packaging of food grains and sugar is strangulating demand for synthetic sacks and denying producers of food grains and sugar the choice of a cheaper and better packaging material. The sugar industry (70% corporate buyers), through their associations, has demanded flexibility in use of packaging material to pack sugar, such as in plastic woven sacks in place of jute due to fiber contamination in their products.

14.3.11.4 Several field trials conducted in various parts of the country, some which had been carried out along with Government agencies like the FCI, had clearly established the superiority of synthetic sacks compared to Jute sacks. The continuation of the Act continues to strangulate demand for plastic sacks despite the fact that Jute availability in India has virtually stagnated.

14.3.11.5 Historically, synthetic sack industry was dependent on import of synthetic raw materials viz. HDPE & PP due to insufficient domestic supplies. However, with new capacity build-up by IPCL, RIL, GAIL and subsequently by Haldia Petrochemicals, domestic supplies eased significantly during the past few years.

14.3.11.6 Besides, various plastic raw materials are also allowed to be imported freely.

14.3.11.7 With installed capacity of 1700 kt distributed among 900 small, medium and large units, the Rs.12,000 crore Indian synthetic sack industries consumes around 1170 kt of polymers annually and provides employment to around 5.5 lakh persons.

14.3.11.8 In the interest of the national economy it is imperative that JPMA is abolished which would bring significant benefits to consumers.

14.3.11.9 The JPMA also restricts free competition amongst various alternatives of bulk packaging and is also in-consistent with the recently enacted Competition Law.

14.3.11.10 Acreage available for Jute cultivation can be gainfully utilized for growing alternative crops like food grains (rice, wheat), oil-seed and other cash crops, thereby increasing food security without compromising the basic requirement of efficient packaging, storage and transportation of food grains.

14.3.12 **Submission - Phase out JPMA in the interest of the national economy**.

14.3.13 **Benefits**

14.3.13.1 Versatile and cost-effective packaging options for the sugar and food-grain industry, which are currently mandated to pack in jute sacks, frequently constrained by availability.

14.3.13.2 Reduce overall packaging and storage cost of food-grains, thereby benefiting the consumer.

14.3.13.3 The 900 small, medium and large units of the Rs 12,000 cr synthetic sack industry provide employment to 5.5 lakh persons, with potential to grow further.

14.3.13.4 Encourage the Jute industry for value addition and focus on superior products.

14.3.14 **Edible Oil Packaging**

14.3.15 **Background**

14.3.15.1 Significant quantities of edible oil continue to be sold in loose form primarily to the poor sections of society. The loose oil thus sold is subjected to adulteration primarily during distribution, which can be avoided by the packaging in plastic pouches, cans or bottles, which have become increasingly prevalent due to their convenience and low cost.

14.3.15.2 To eliminate adulteration of oil, the Edible Oil Packaging (Regulation) Order, 1998 was passed which required the edible oil to be sold as packaged goods.

14.3.15.3 However, flouting this regulation, edible oils continue to be sold in loose form with possibility of adulteration; due to the lack of proper enforcement of this regulation at the state level.

14.3.16 **Submission:** Ensure strict and effective enforcement of the “Edible Oil Packaging (Regulation) Order, 1998 by all state governments.

14.3.17 **Benefits:** Reduced scope of adulteration of edible oil.

14.3.17.1 Eliminate public health hazards like dropsy, caused by adulterated edible oil, with loose oil sales especially affecting the poorer sections of society.

14.3.18 **Aseptic Food packaging (milk)**

14.3.19 **Background**

14.3.19.1 Milk production in India has come a long way over the years from 17 MMT (1951) to 112 MMT in 2010 with per capita consumption of 265g/day. The Indian dairy industry presently contributes about 15 % to the total milk production of the world and stands at a mammoth size of US$ 70 billion.

14.3.19.2 Presently only 18% of the marketed milk is represented by packaged and branded pasteurized milk. The appropriate packaging of dairy products is of utmost importance not only to preserve nutritive value and saving of wastage, but also to improve the marketability to achieve better returns. Over the years especially in urban areas plastic pouches have replaced glass bottles which were earlier used for milk packaging.

14.3.19.3 Despite being the world's largest milk producer, India's share in the world dairy trade is almost negligible. However, India is a net exporter of dairy products, milk powders, baby foods, butter and other fats, casein, milk and cream, cheese, and whey products.

14.3.19.4 The dairy industry in India has its base in the small holders and marginal farmers. The Operation Flood program might have brought in a plethora of changes in the dairy sector but there is still much to be reformed. This is because about 82% of the dairy industry is unorganized. This leads to a complex supply chain that is compounded by a lack of proper cold chain facilities and logistics.

14.3.20 **Submission:** Develop a technical option for aseptic plastic packaging to allow the packaging of pasteurized milk without the requirement of a cold chain, minimizing the capital investment required to preserve the quality and freshness of milk.

14.3.21 **Benefits**

14.3.21.1 Plastic pouches are the best option to deliver fresh milk to millions of households.

14.3.21.2 Reduced raw material consumption with the lowest tare weight of all packaging.

14.3.21.3 Inclusive growth of the dairy sector with the small holders and marginal farmers by reducing waste and value addition to the consumer.

14.3.22 **Resource-conserving Initiatives & Necessary Legislation**

14.3.23 **Background:** Plastics can play a vital role in conservation of water, energy and forests. To take advantage of this opportunity, the promotion and requirement of plastics as replacement of traditional materials would result in substantial conservation of resources.

14.3.24 **Submission**

14.3.24.1 Encourage / legislate the use of drip irrigation pipes for effective delivery of water to the plants and minimize the loss of water in horticulture.

14.3.24.2 Encourage the use of recycled plastic profiles and components as a substitute of forest resources such as wood in certain furniture and construction applications.

14.3.24.3 Encourage the use of plastic packaging in key applications, e.g. milk packaging.

14.3.24.4 Encourage the use of plastic components in housing to reduce energy requirements

14.3.25 **Benefits**

14.3.25.1 Gain agricultural productivity while saving resources such as water, fertilizers and crop chemicals by the use of drip irrigation.

14.3.25.2 Prevent de-forestation while converting recycled plastics into high value furniture, thus saving forest resources.

14.3.25.3 Low weight plastic packaging reduces the energy requirements in the production of packaging materials as well as in the transportation sector.

14.3.25.4 Use of plastic doors and windows can result in 30-50% savings in terms of heating / cooling load.

14.3.26 **Agriculture productivity**

14.3.27 **Background:** Micro-irrigation has played an important role in enhancing the effectiveness of water usage in the agriculture / horticulture sector.

14.3.28 Similar enhancements in productivity / yields can be achieved by the use of plastic films for mulching and "protected cover" cultivation.

14.3.29 **Submission:** Promote and provide incentives for the use of mulch films and other "protected cover" cultivation in the field for enhancing agriculture & horticulture productivity and yields.

14.3.30 **Benefits:** Gain agricultural productivity while saving resources such as water, fertilizers and crop chemicals by the use of mulch films and protected cover cultivation.

14.3.31 **Treat Captive Power Plants at par with Utility Power Plants**

14.3.32 **Background**

14.3.32.1 Primary petrochemical production facilities are energy intensive and need the support of high quality and adequate / reliable power supply.

14.3.32.2 Many industries, especially in the continuous process industries have to necessarily put up a captive power plant due to non availability of power, poor quality and reliability of the grid and high tariff as a result of cross subsidization.

14.3.32.3 GoI also provides encouragement towards this investment by providing additional fiscal incentives (which are one time in nature), with a view to reduce the burden on state and central electricity producers and distribution system.

14.3.32.4 The high level of duties and taxes on the sale of surplus power as well as numerous restrictions on the operations (e.g. high charges for back-up/stand-by power from the grid, lack of wheeling capacity) of captive power plants make this non-core activity a drag on many companies.

14.3.33 **Submission:** Treat captive power plants at par with utility power plants in all aspects and provide priority allocation of Natural Gas to this segment.

14.3.34 Include "natural gas" utilized by captive power plants in the list of "Declared Goods" under CST Act and be taxed at a uniform 4% rate across the country. In the event of abolition of CST, a maximum VAT of 4% to be fixed for natural gas (Sales Tax currently varies significantly from state to state).

14.3.35 **Benefits:** Support higher uptimes and capacity utilization of productive assets by augmenting the structural availability of power.

14.3.36 **Background:** Despite the policy being in existence for many years, the cluster concept has not been as accepted as desired.

14.3.37 The Government has recently conducted a review to re-evaluate the status and revisit incentives to attract participation.

14.3.38 **Submission:** Benchmark similar clusters in China, Singapore, Taiwan and other areas which have successfully built such facilities over the years to serve as a blue-print on policy actions.

14.3.39 **Benefits:** Provide the infrastructure for symbiotic growth of complementary upstream and downstream sectors of the petrochemicals industry.

14.3.40 **Singapore model of industrialization and Government support to Petchem Industry.**

14.3.41 **Background:** The small city of Singapore, despite a miniscule market, has established a thriving petrochemicals industry on Jurong Island, setup as an exclusive manufacturing zone with significant support from the government of Singapore, in terms of infrastructure development (reclamation, logistics, etc.), tax incentives, manpower training and other support.

14.3.42 **Submission:** Build on a blue-print of incentives emulating the Singapore government experience, a leader in establishing public-private partnerships to maintain leadership in per capita GDP position in the region.

14.3.43 **Benefits:** Enhance the growth prospects of petrochemicals, a significant foundation industry which can help support the up-liftment of a significant portion of the countries populace by improving their quality of life.

14.3.44 Increase foreign exchange earnings accrued by augmenting exports of value-added goods.

14.3.45 **Land for Industry**

14.3.46 **Background:** Being a primarily agrarian society a bulk of the land in India is used for agricultural purposes, most of which is fragmented in size over the generations.

14.3.46.1 As industrialization progresses, there is an increasing need for the land to be made available for development purposes, setting up a conflict between the various purposes. With the requirement of contiguous land of significant size for developing projects with economies of scale, the issue of land acquisition needs to be resolved in a mutually satisfactory manner for all stakeholders.

14.3.47 **Submission:** A policy by states for land acquisition which would allow for the development of industries to proceed expeditiously in a mutually agreeable manner between landowners and project developers.

14.3.48 **Benefits:** Faster implementation of projects for the development and growth of industry.

14.3.49 **Environment & Sustainability**

14.3.50 **Background**

14.3.50.1 Chemical industry has poor image of being a polluter and plastic use is erroneously perceived as harmful to environment.

14.3.50.2 Contribution of petrochemicals and plastics to all the critical sectors of the economy is inadequately appreciated and understood by other stake holders.

14.3.50.3 There are widespread myths about the negative aspects often fuelled by unscientific perception.

14.3.51 **Submission**

14.3.51.1 Support communication programme of the industry.

14.3.51.2 Help set-up recycling demonstration unit for plastics.

14.3.52 **Benefits:** Correct the negative perception about petrochemical products

14.4 Strategies to achieve domestic growth of the synthetic fibre industry

14.4.1 Desirable support needs to be extended to help investments in the manmade fibre, filament yarn and fabric sector for mordernisation and expansion of plants. There should be an **interest rate subsidy** on the investment in plant and machinery to encourage the growth of the sector.

14.4.2 The consumer should have impartial options to choose what is best suited based on merits. The neutral duty structure would facilitate final consumers to decide the most affordable fibre on based on merit. A **fibre neutral policy** should be adopted to give a fair and level playing ground for all parties. Excise duty regime should be modified to aid the growth of the manmade fibre industry. Currently cotton enjoys zero excise duty and spinning comes under the optional duty structure. Manmade fibre production faces an excise duty of 10%. This discrepancy is a deterrent to the downstream consumption and a rationalisation to bring a level playing ground would be a great support for the manmade fibre sector and the textile industry.

14.4.3 Import duties on manmade fibres are very low at 5%, which is on par with China and other competing countries. Therefore to keep the global competitiveness of the local man made fibre industry, **import duties on these products should be maintained** to sustain the economics of the producers. Further SAD should be retained to maintain the import parity.

14.4.4 Export bears a significant role in the growth of the industry. **Export incentives should be continued** to assist the industry. DEPB has been proposed to be discontinued after September 2011. Under the present global scenario DEPB should be maintained beyond September 2011 to sustain the momentum of exports. In the face of uncertainty of exchange rates and fluctuations in global trade markets; DEPB benefits should be maintained till the global economy stabilizes.

14.4.5 Infrastructural and financial support to set up **captive power plants** would help maintain steady industry operations in order to seize the right opportunity.

14.4.6 An efficient **port and road connectivity** and related ancillaries to improve the turnaround time. Similarly creating a seamless online documentation process will help in reducing transaction costs.

14.4.7 As observed during the early phase of the 2011-12 financial year, environmental awareness is gaining prominence. Many downstream industries had to be stopped due to environmental issues. It is a healthy practice adopted by the Govt to boost the image of the Indian textile industry in the global arena. In continuation of the efforts, support to set up **effluent treatment plants** with marine outfall pipelines/network and water recycling facilities with UF/RO facilities should be extended.

14.4.8 The global consumerism trend is moving towards a more environmental conscious era, wherein the recyclability of products is gaining prominence, and the desirability of this feature in fibres and textiles is no less important. Friendly policies should in place to encourage **recycling and usage of more recycled content**.

14.4.9 The man made fibre industry holds versatile and diverse potential for applications in segments other than the apparel application. The **non apparel industry** is still in a nascent stage with research and development needs to boost its growth and application arena across the country. Set up of **new institutes with R&D facilities** and incentivisation of private institutes along with introduction of suitable legislation mandating the use of technical textiles in public infrastructure would be a great helping hand to accelerate the growth of the non-apparel segment. Pilot plants should be set up to serve as model plants.

14.4.10 **Feedstock sufficiency** is very critical to any industry. The country is currently more sufficient than China for its feedstock requirements. But as the industry grows it is envisioned that it would require an investment of about Rs 10,000 crores. The Government should take steps to support the growth of the textile as well as the feedstock industry to build a strong base for the entire industry.