



Plastics Recycling in India

10 Sep 2020

Magesh Nandagopal

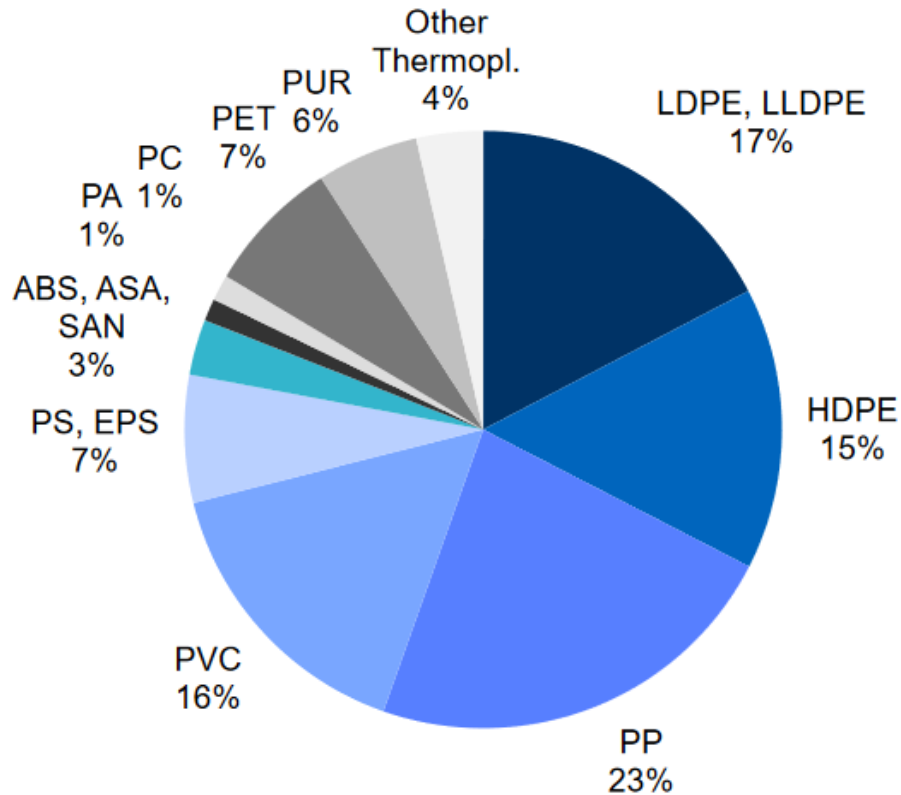
Principal Scientist, NCL Innovations, CSIR-National Chemical Laboratory

The short story

- Plastics (demand: 331 mt) – Integral part of our lives
- Packaging biggest application
- Packaging waste:
 - High volumes
 - Shortest in-use life; fastest to grave
 - Most visible litter
- Response:
 - “Right” materials (choose)
 - Reduce; Redesign
 - Recover (manage wastes actively)
 - Reuse
 - Recycle (physical, chemical)



World Plastics Demand - 2015



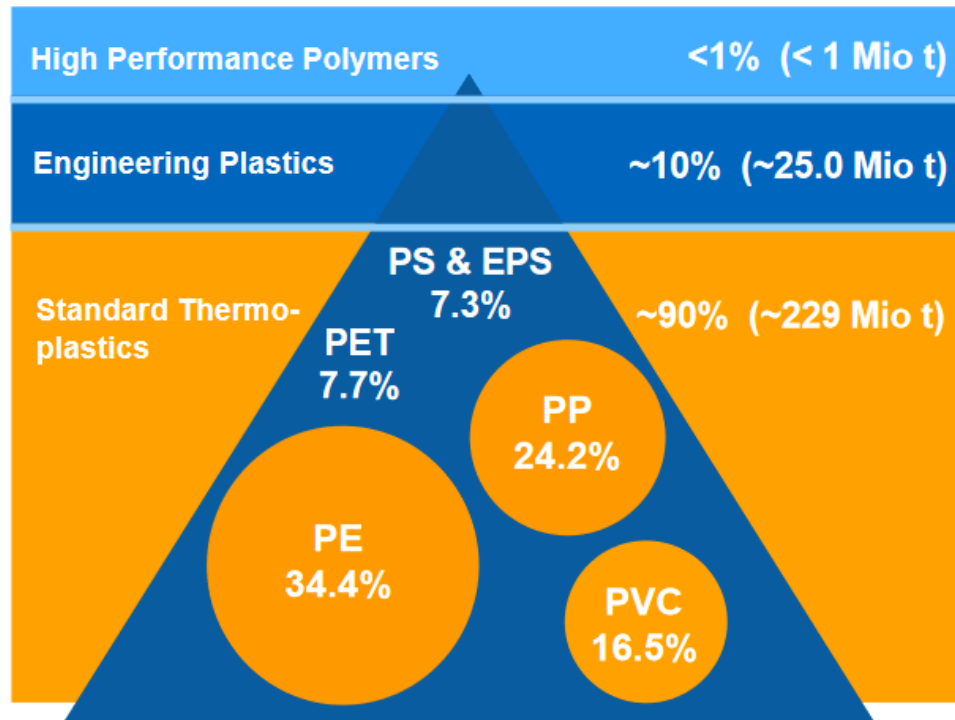
Polyolefins account for more than 55% of the plastics demand, followed by PVC

2015
269 Mio. t*

*w/o Other Plastics (includes Thermosets, Elastomers, Adhesives, Coatings and Sealants and PP-Fibers. Not included PET, PA and Polyacryl Fibers) = ~ 53 Mio. t

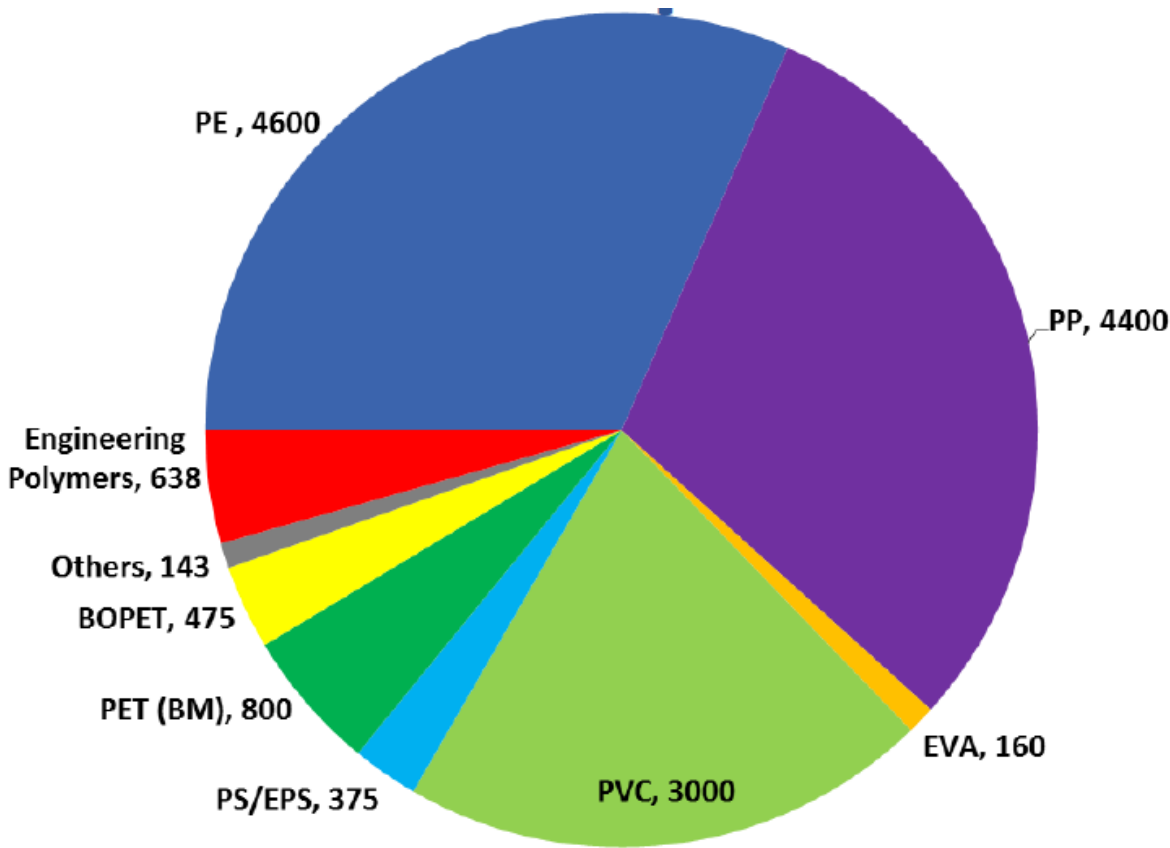
World Thermoplastics Market Share - 2015

Triangle of Thermoplastics Classified by Market Share



- **Standard Plastics** are the basics materials.
- **Polyolefins** are the largest product group.
Polyethylene: 34%
Polypropylene: 24%
- **Engineering Plastics** are a small but valuable part of the market.
- **High Performance Polymers** are specialized for very demanding applications.

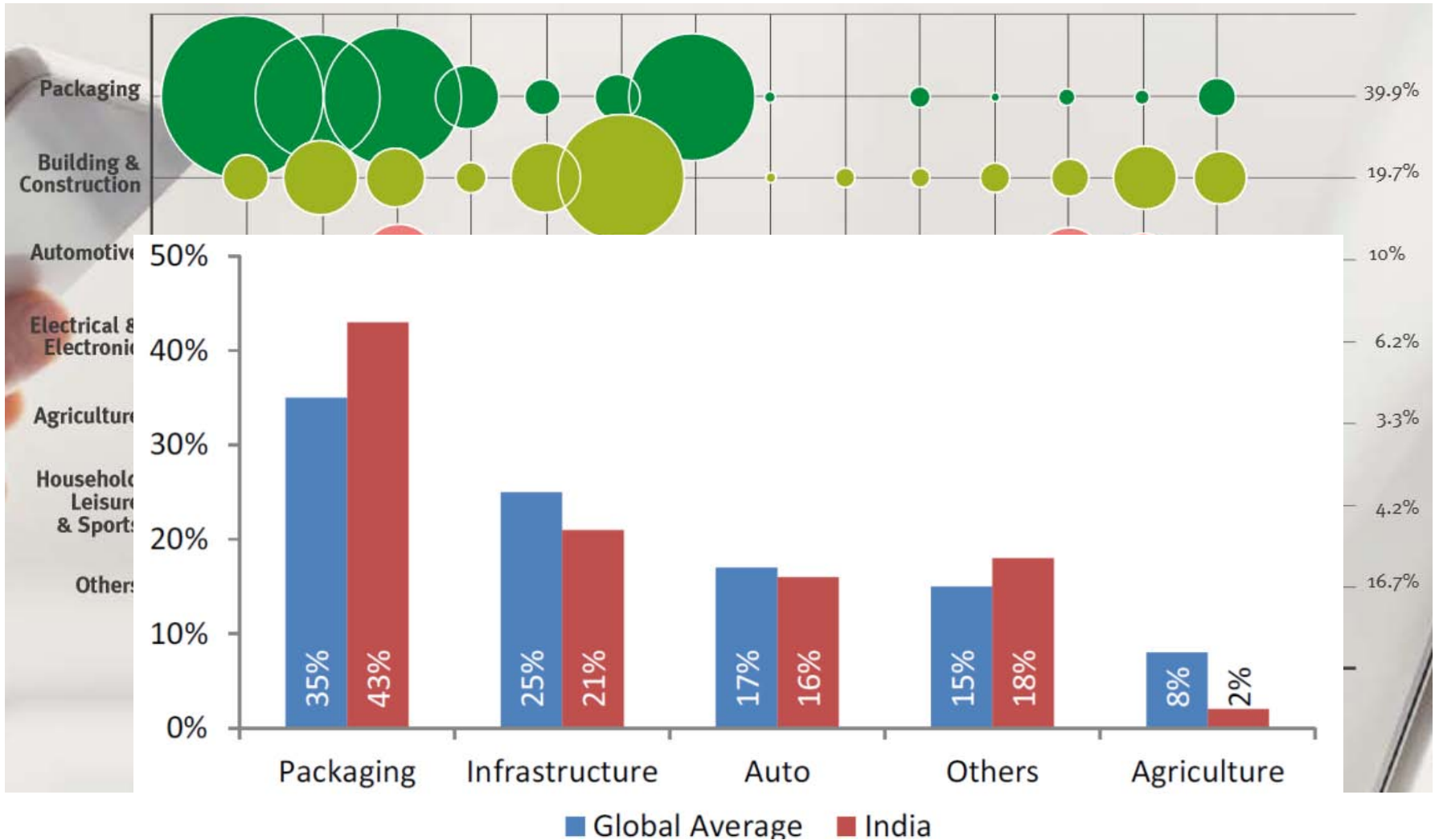
India Thermoplastics Consumption – 2016-17



Polyolefins account for
~62% of thermoplastics
PE: 32%
PP: 30%

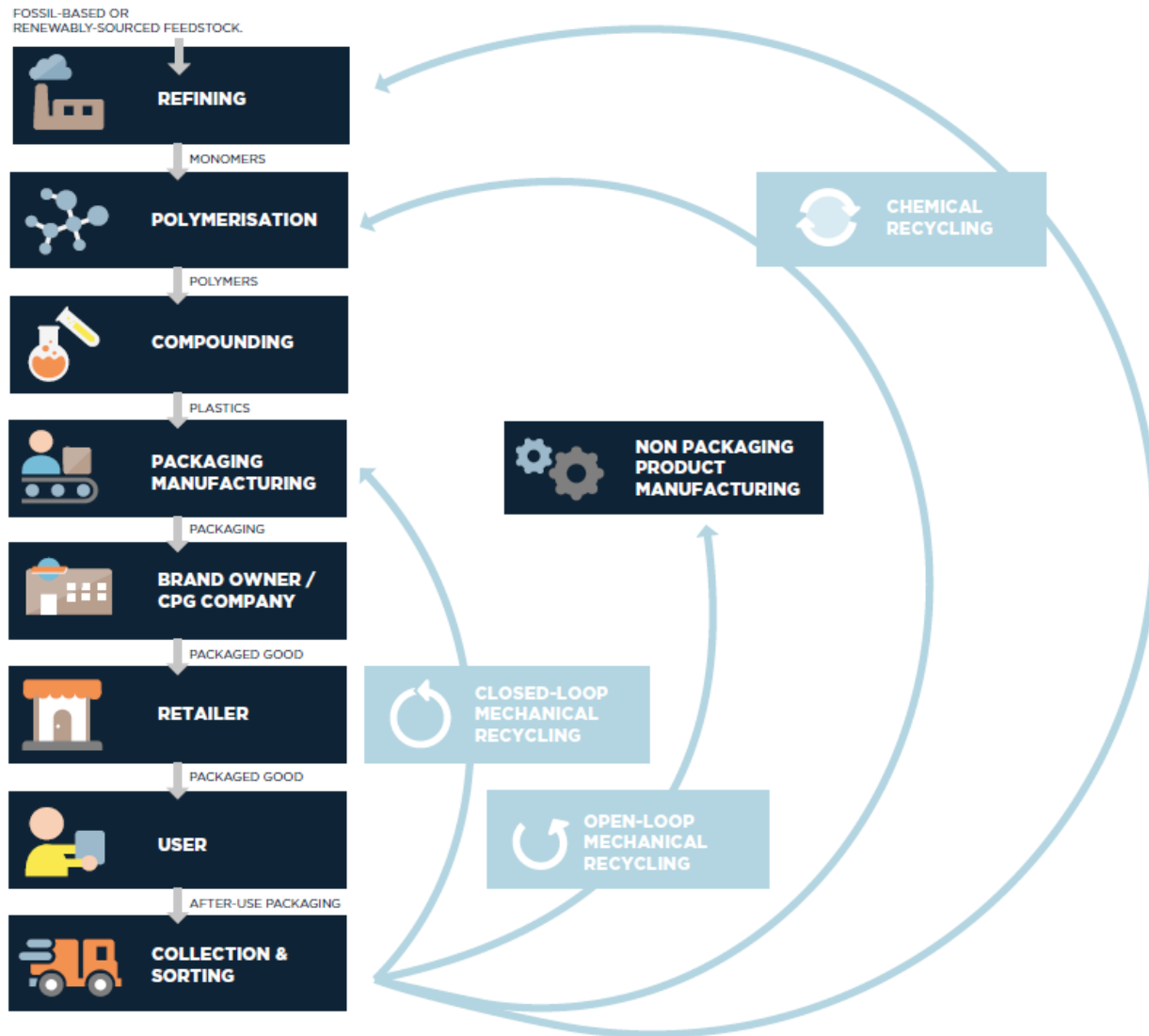
Consumption : 14550 KT (2016/17)

Plastics Utilization by Application (2015)

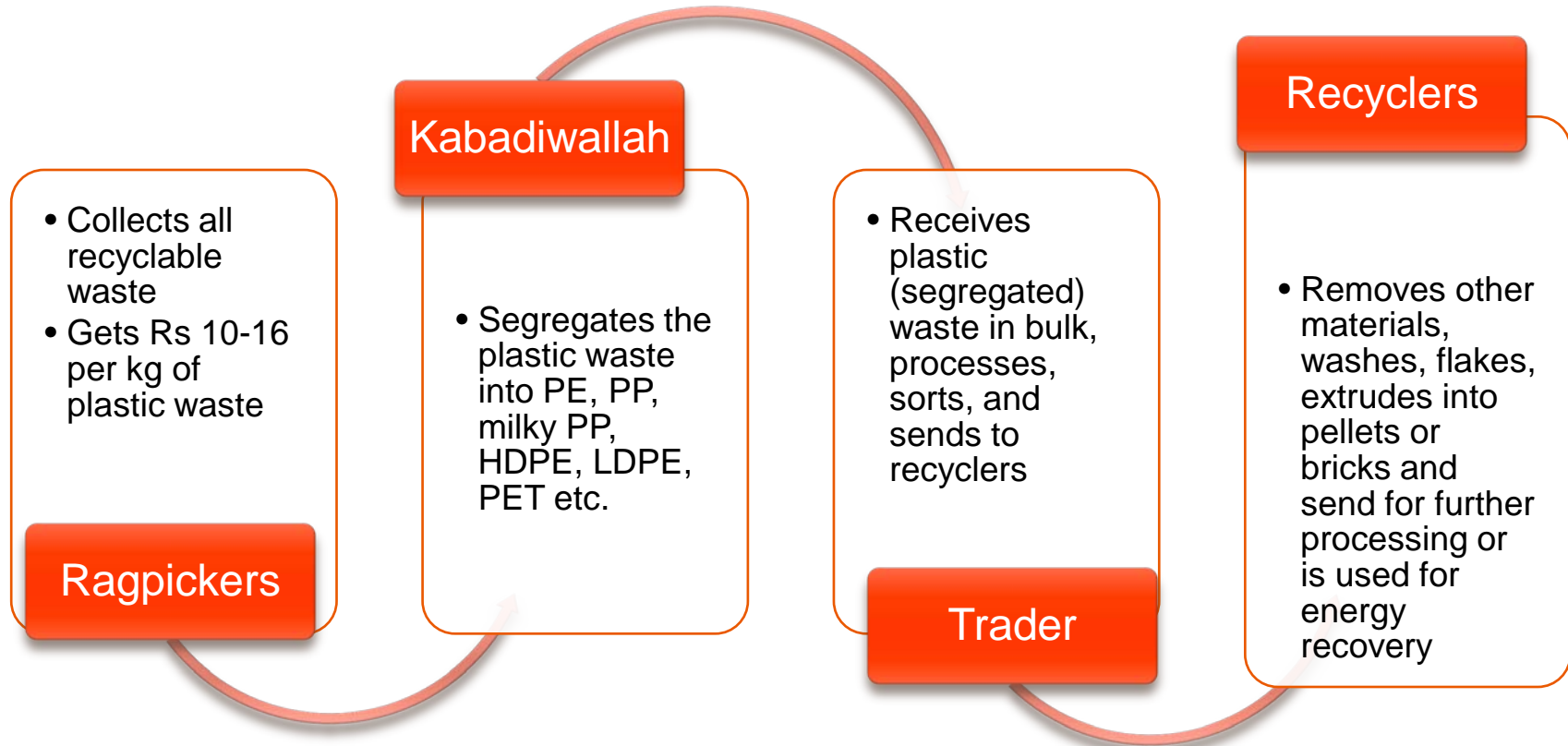


Source: FICCI report on Potential of Plastic Industry in Northern India, April 2017, HDFC Bank Investment Advisory Group; Plastics Europe Facts 2017

Overview of Recycling Types



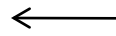
Postconsumer Plastic Waste – The path to recycling in India



Recycling of Polyolefin in the unorganized sector in India



Recycling of Polyolefins in the unorganized sector in India



PET Recycling in India

Color Bottles (Trading)



Bought at 25 Rs/kg
Sold at 30-31 Rs/kg
Margin of Rs 1



Bought at 25 Rs/kg
Sold at 29 Rs/kg
Margin of Rs 1 or less
5-15% of bottles received
are green (comes in
mixed)



Bought at 7-14 Rs/kg
Sold at 18-22 Rs/kg
Good Margin
2% of bottles received
are amber/red (comes in
mixed)

* Prices vary; Data collected in June-July 2016

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At the trader's...



Sorting



What they look for

- ❑ Aluminum caps, rings
- ❑ By color
- ❑ Recycled, virgin PET bottles
- ❑ PVC labels
- ❑ Other plastic bottles





Baling

- ❑ Costs ~ Rs 3.25 lakhs
- ❑ Can handle 25-30 tons per month
- ❑ Requires 10 laborers for sorting, operating, packing etc.
- ❑ [sorting happens during daytime; baling happens at other times]
- ❑ Typically, only baling machine per location; if they have more than one it is in different locations







At the recyclers...





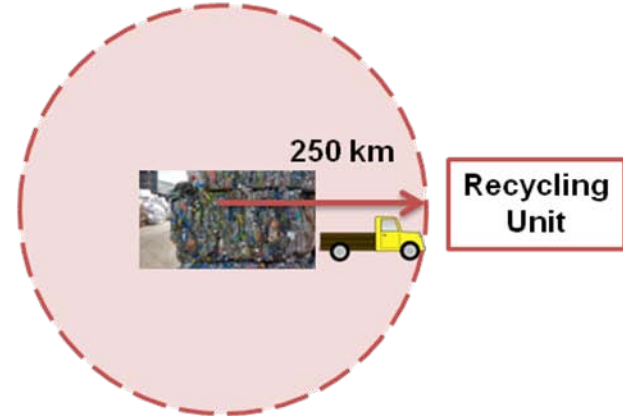


The Economics of Transportation

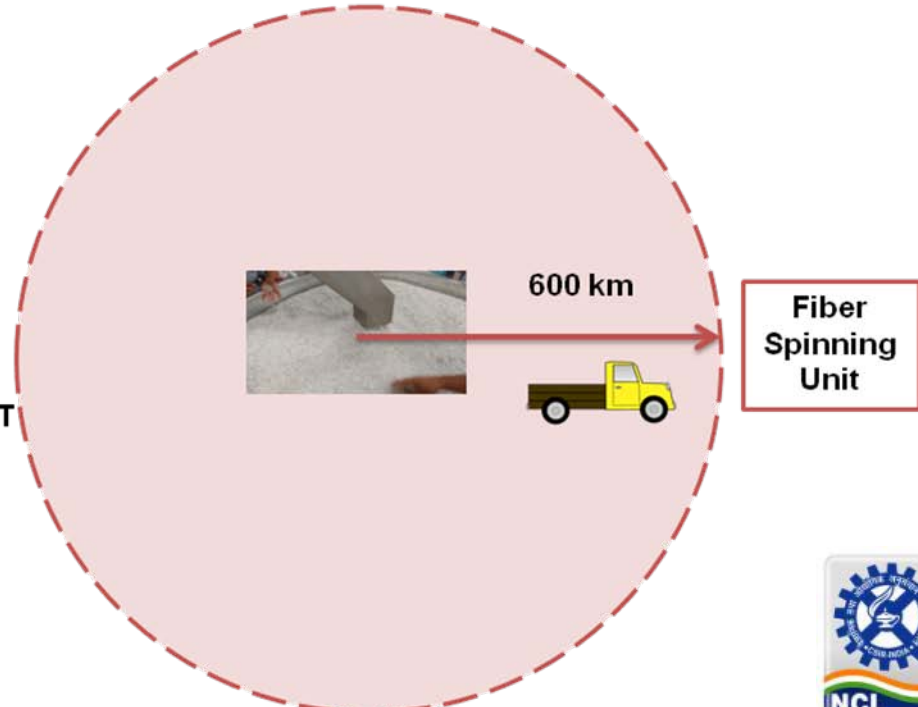
Used PET bottles



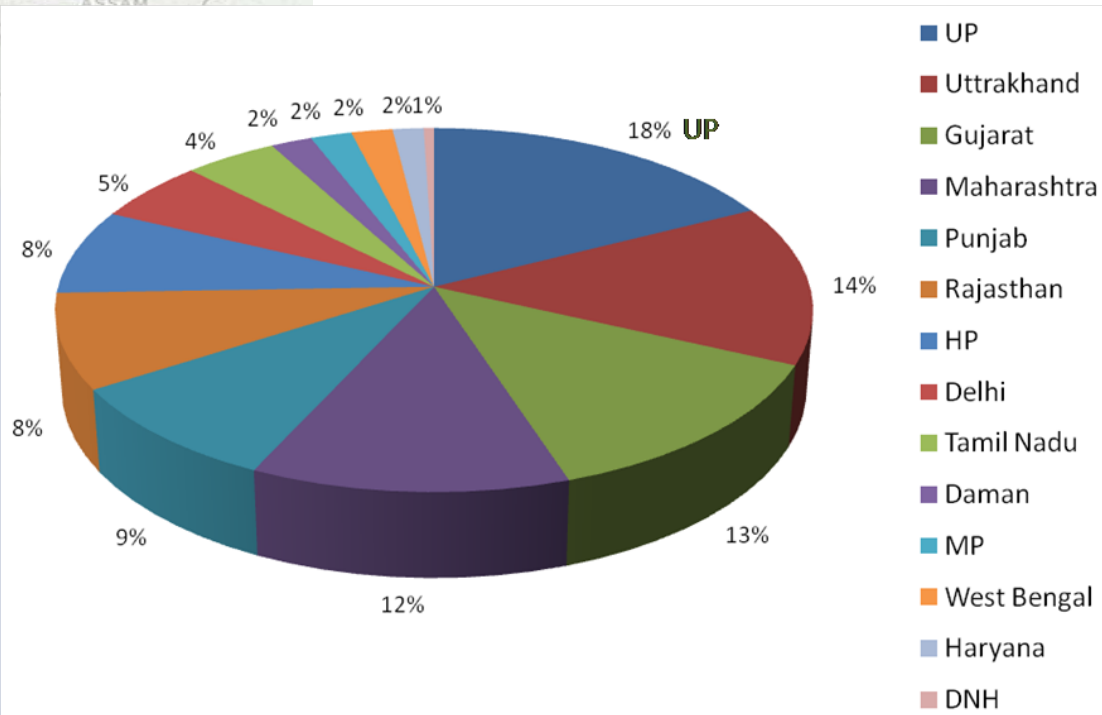
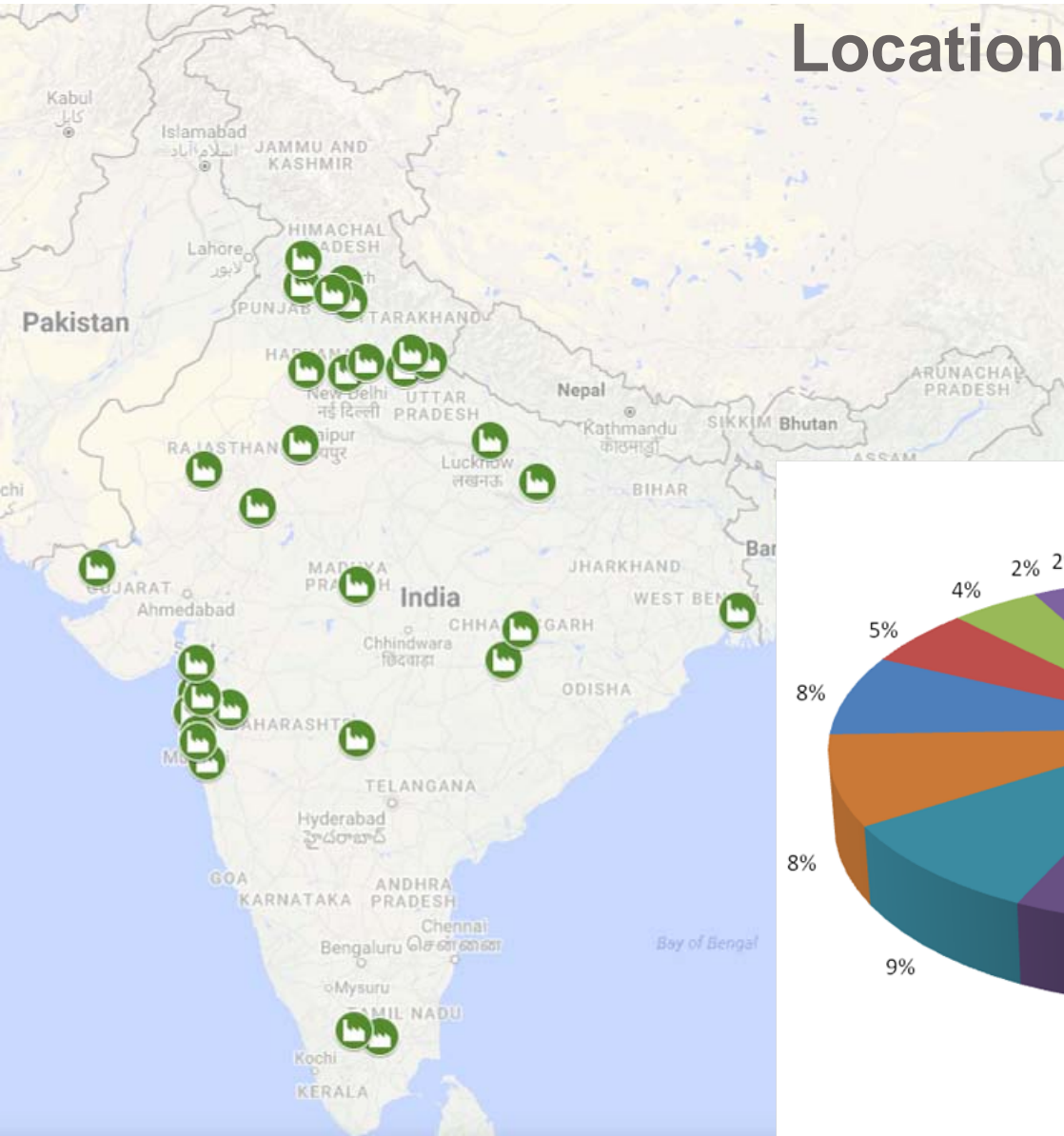
PET bottles, crushed, bundled



Washed flakes (from used PET bottles)



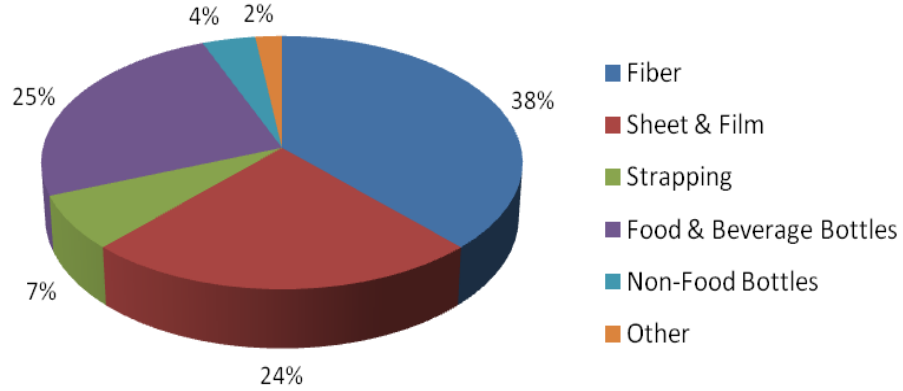
Location of Units using r-PET





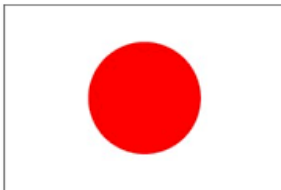
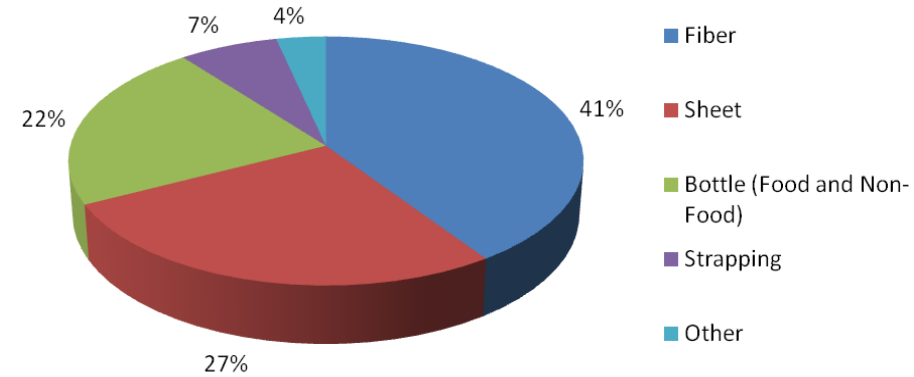
Collection Rate (2014)

31%



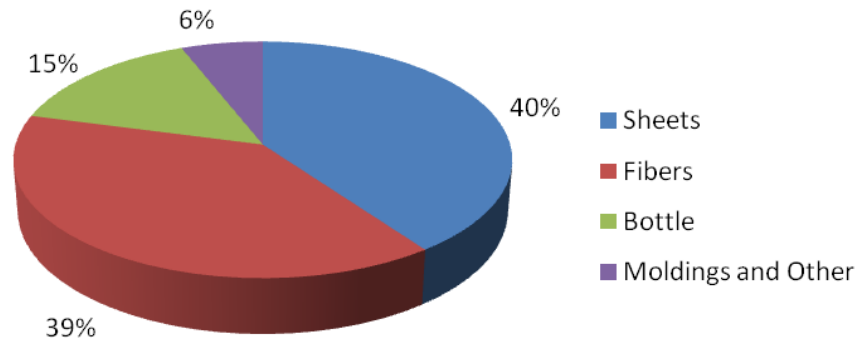
Collection Rate (2015)

59%



Collection Rate (2014)

93%



PET Recycling in India

Manufacturers using r-PET

40 Manufacturers

46 Locations

800 kTPA Total Capacity

60-70% of PET consumed in India is recycled through the organized sector

Rs 3000-4000 Crore
- the annual turnover generated by PET recycling operations in India (in the organized sector)



The jerseys worn by the Indian cricket team during the 2015 World Cup



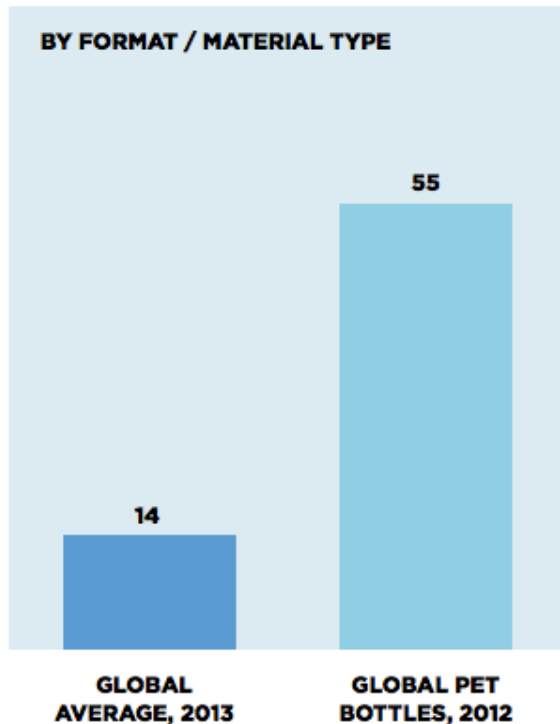
Pillows and soft toys are filled using polyester fibrefill – made from recycled PET



Blankets introduced by Emirates recently – made from 100% recycled PET

Learnings from the PET recycling experience

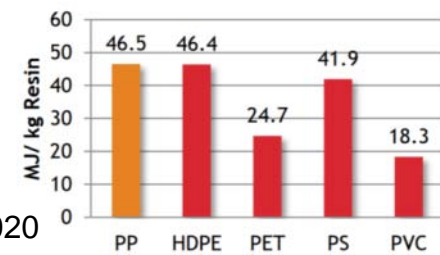
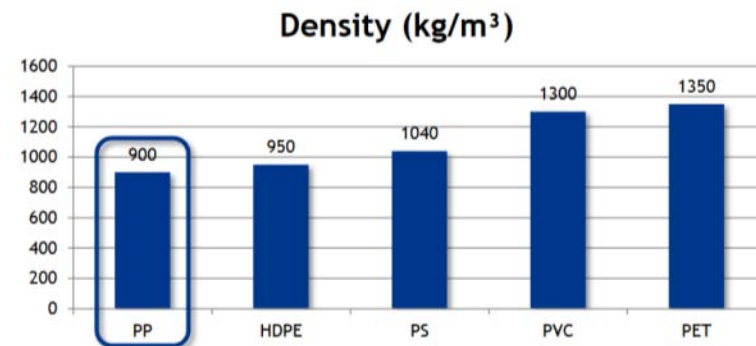
PLASTIC PACKAGING COLLECTED-FOR-RECYCLING RATE, %



- The most recycled plastic worldwide
- Rigid plastic, large items
- Clearly identifiable
- Sufficient volumes in the solid waste stream
- Not too many other layers or materials
- Heightened properties (even after one down-cycle, still has lot of value)
- High value end products (fibers, straps, bottles)

60-70% of Rs 3000-4000 Crore
PET consumed in India is recycled through the organized sector - the annual turnover generated by PET recycling operations in India (in the organized sector)

Source: The New Plastics Economy, Report by Ellen MacArthur Foundation, 2016; Milliken; Study conducted by NCL, 2016-17



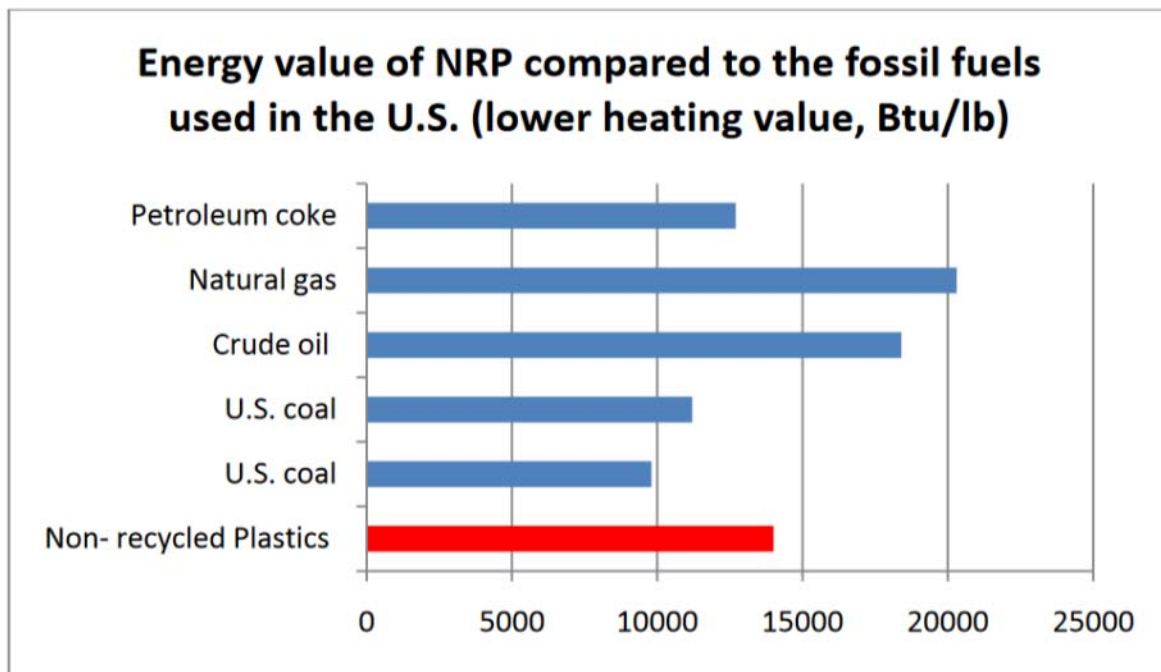
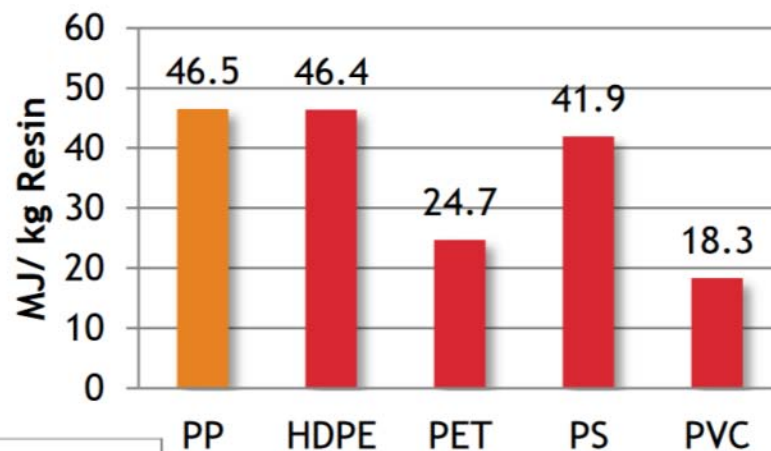
Plastic waste management (PWM) rules, 2016 , India

- ❑ 2011 rules applied only to municipal areas; 2016 rules apply to every waste generator, local body, Gram Panchayat, manufacturer, Importers, and producer
- ❑ Extended Producer Responsibility: Earlier, EPR was the discretion of local bodies. Now, the producers and brand owners are responsible for collecting waste generated from their products.
- ❑ Recycling of plastic shall conform to the Indian Standard: IS 14534:1998 Guidelines for the recovery and recycling of plastic waste



**Ministry of Environment,
Forest and Climate Change**
Government of India

Energy Recovery from non-recycled plastics



Source: Cradle to Gate Life Cycle Inventory report, prepared for ACC by Franklin Associates, 07/10; Milliken EEC Study of non-recycled plastics-August 2011, Columbia University

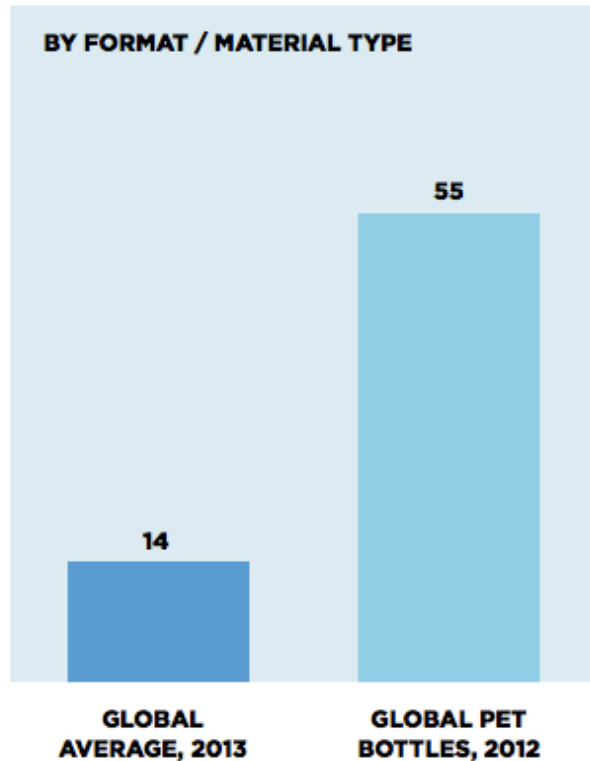
Multilayer Materials – Difficulty in Recycling

15–20 μm	<i>Coextruded OPP film, made up of:</i>	
1–2 μm	Co- or terpolymer PP	Low temperature sealing to inside layer
12–17 μm	Homopolymer PP	Strength and heat resistance
1–2 μm	Co- or terpolymer PP	Surface to be printed
	Ink	Visible from the outside through the clear OPP film, which moreover protects the ink from abrasion
1.5–2.5 g/m^2	Adhesive	Bonding, usually 100% solids for economic reasons
40–100 nm	Aluminium metallisation	Light and moisture barrier and some degree of gas barrier. Note that this thin layer is protected from mechanical damage by being sandwiched between the two OPPs
15–20 μm	<i>Coextruded OPP film, made up of:</i>	
1–2 μm	Co- or terpolymer	Surface for aluminium deposition
12–17 μm	Homopolymer PP	Strength and heat resistance
1–2 μm	Co- or terpolymer	Low temperature sealing to itself and outside layer



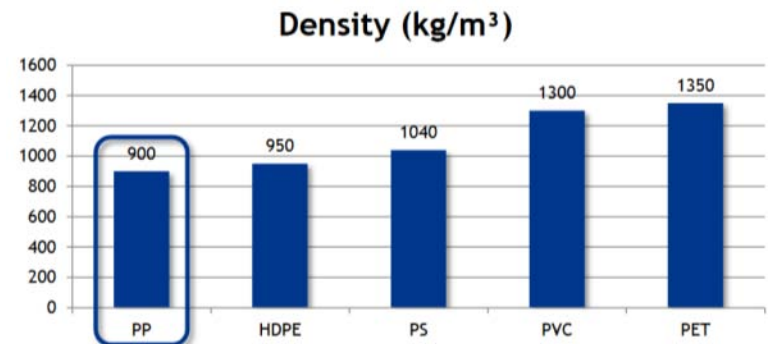
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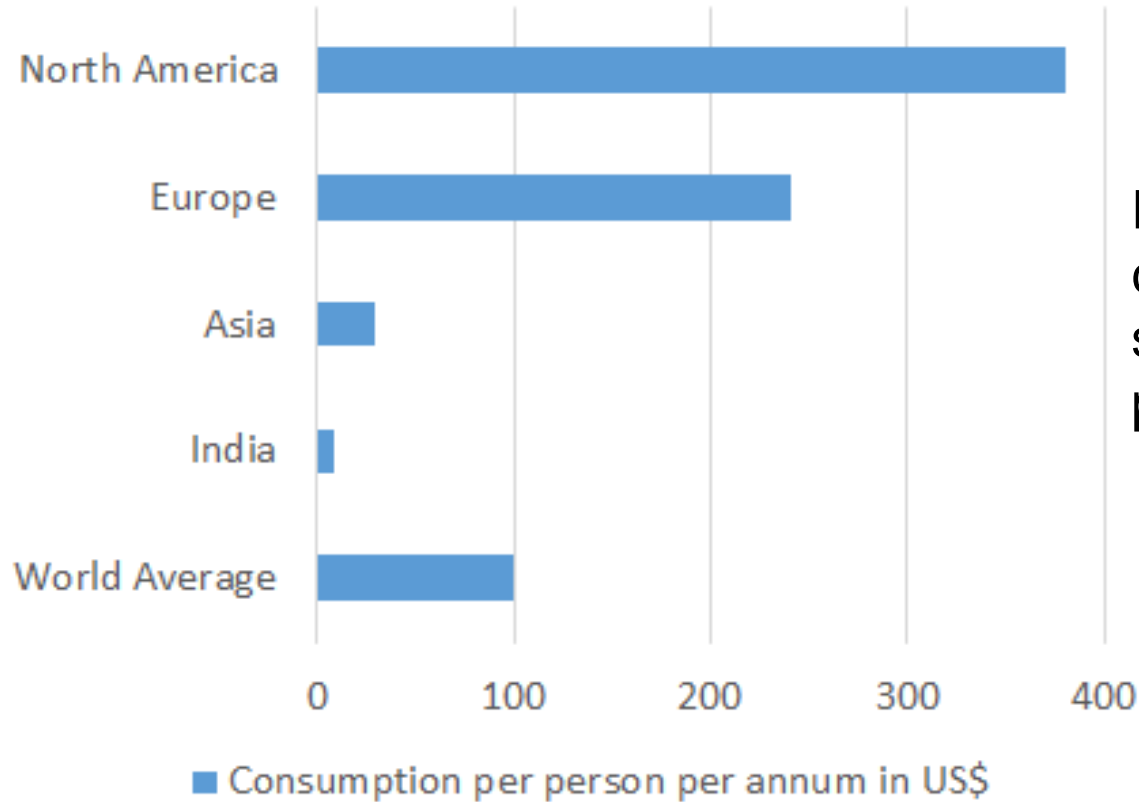


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Per Capita Consumption of Packaging



Plastics, packaging consumption is known to scale with purchasing power of families.

Conclusion

- ❑ **Collection**
 - ❑ Size of the item
 - ❑ Density
 - ❑ Mixed material
 - ❑ Volumes
- ❑ **Sorting**
 - ❑ Manual
 - ❑ Semi-automatic
 - ❑ Automatic (tracers, near-IR)
- ❑ **Recycling**
 - ❑ Presence of other materials, impurities
 - ❑ Drop in material properties

Thank you

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