



# Resource Efficiency and Circular Economy in the paper and steel sector

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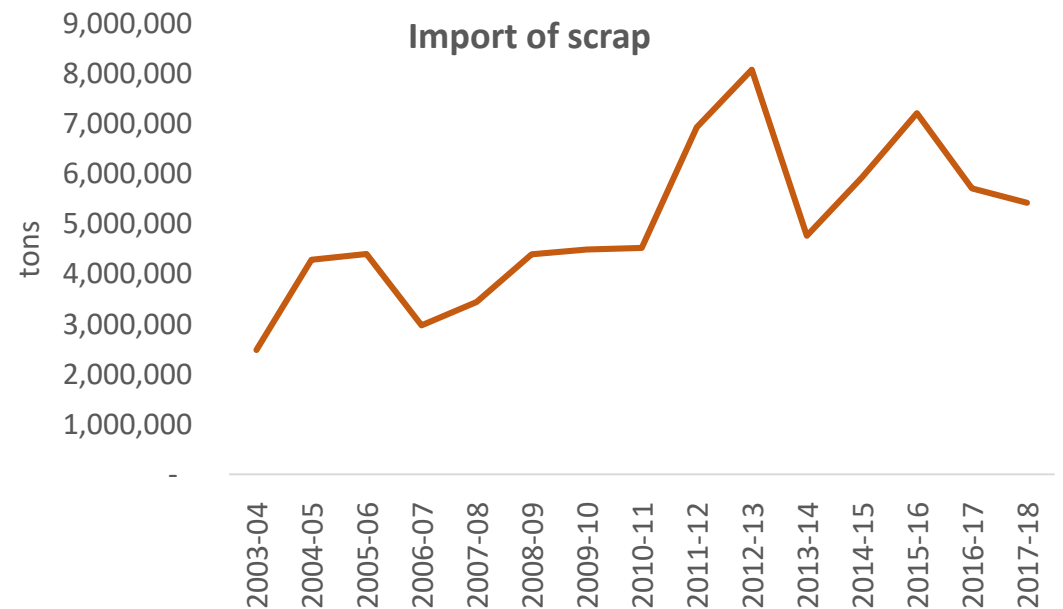
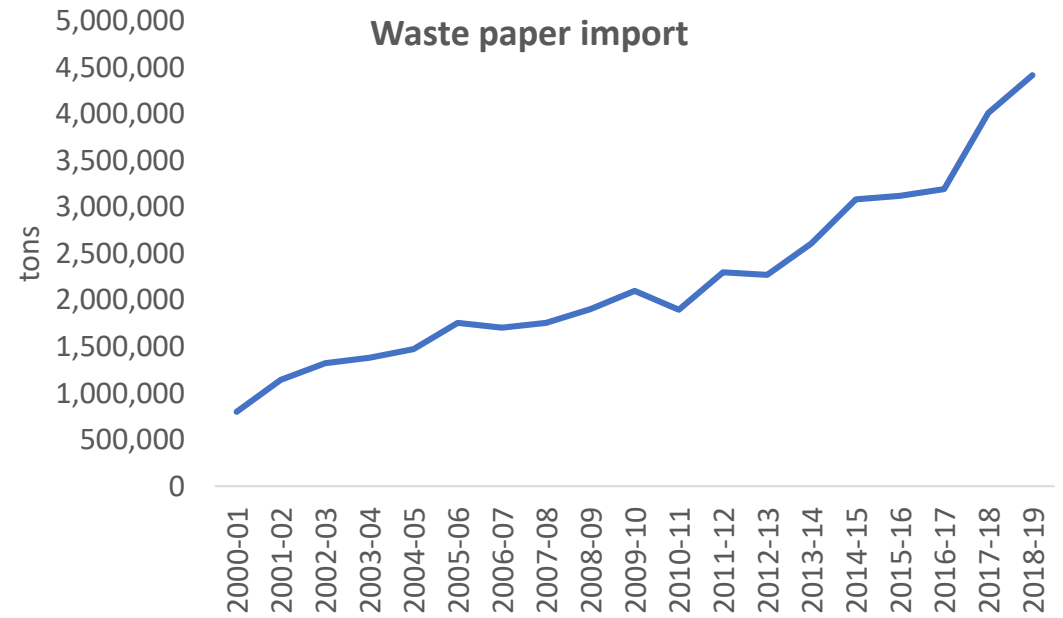
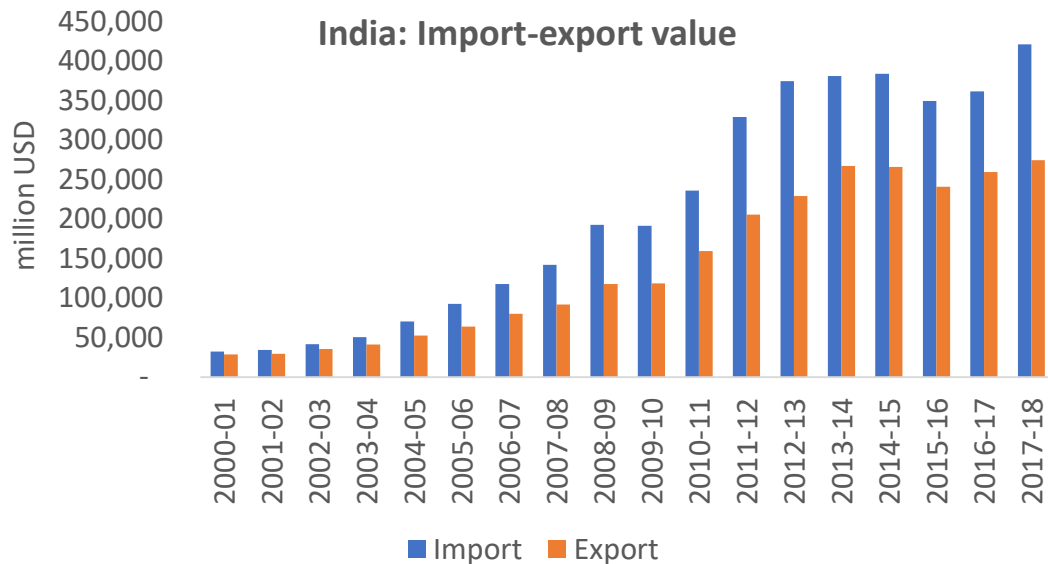
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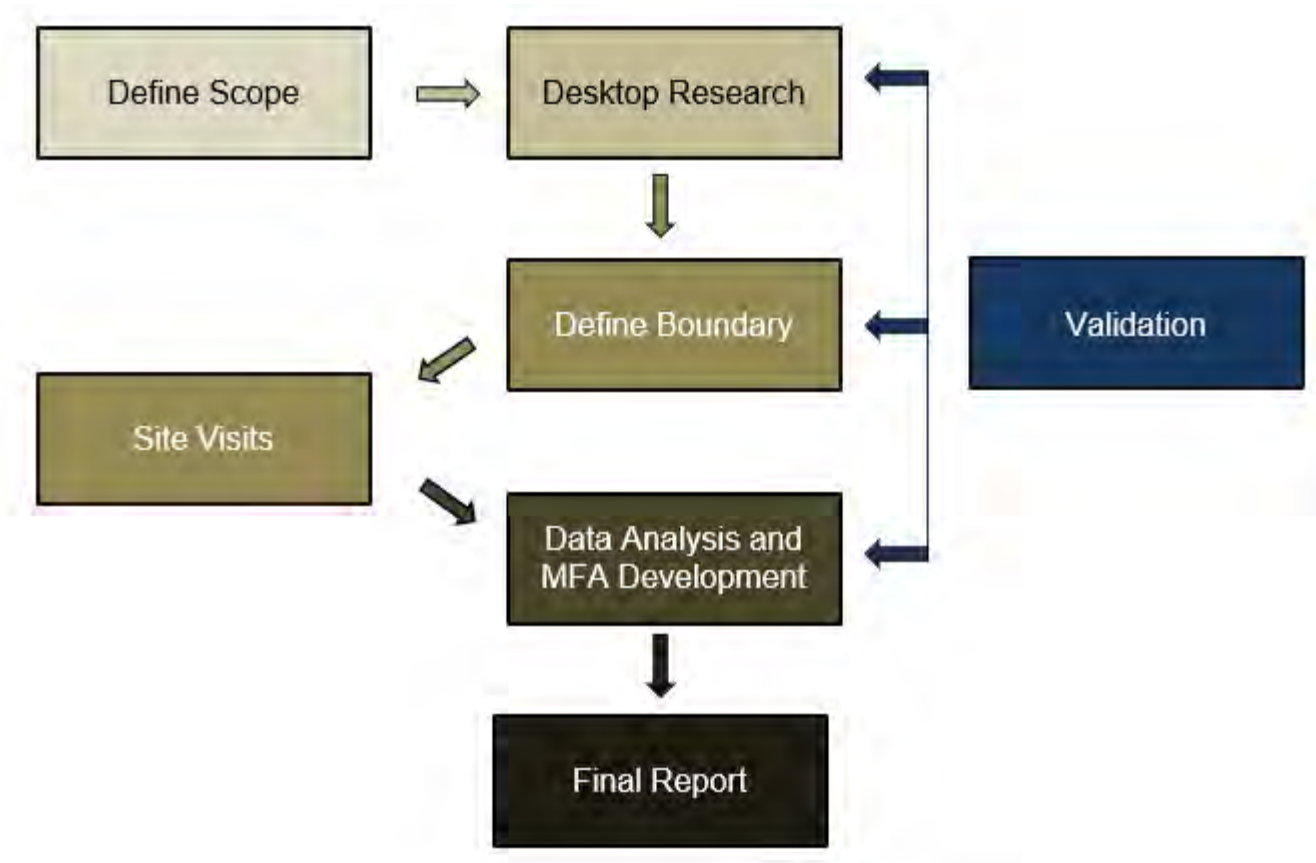
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# Introduction

- Trade imbalance
- Large imports of raw material
- Resource scarcity related to domestic issues



# Methodology



- Consultative approach
- Validation at each step

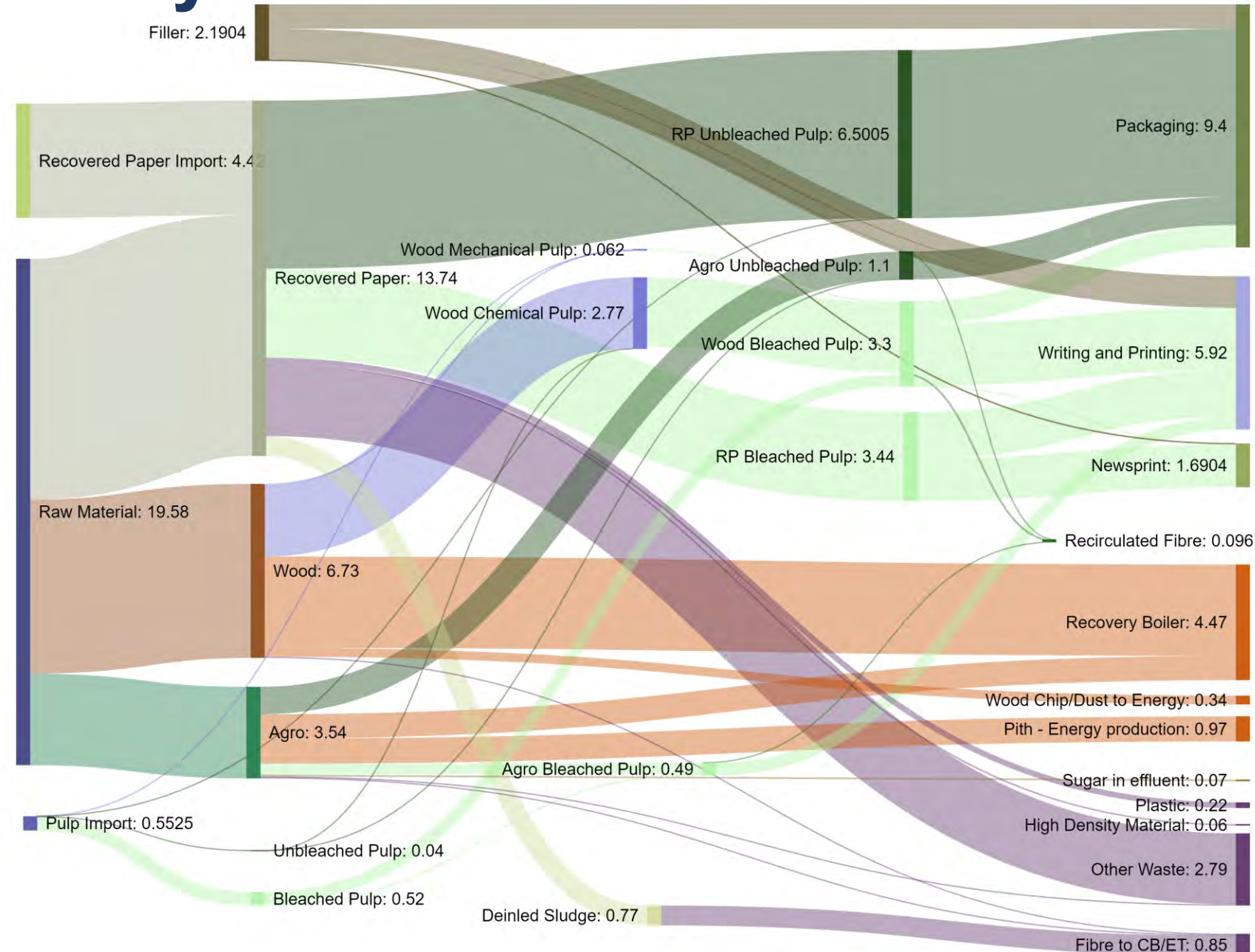
# Data

- Challenges
  - Reliable data unavailable (esp. paper)
  - Diversity in scale of manufacturing:
    - Recovered paper plants
    - EAF and IF steel production plants
- Sampling strategy
  - Maximize coverage in terms of production capacity
    - Site visits
    - Telephonic conversations
    - Interactions with sector specific industry associations



# Material Flow Analysis: Paper

- Fiber source: recovered paper, agro residue, wood
- Final product: packaging, newsprint and writing/printing

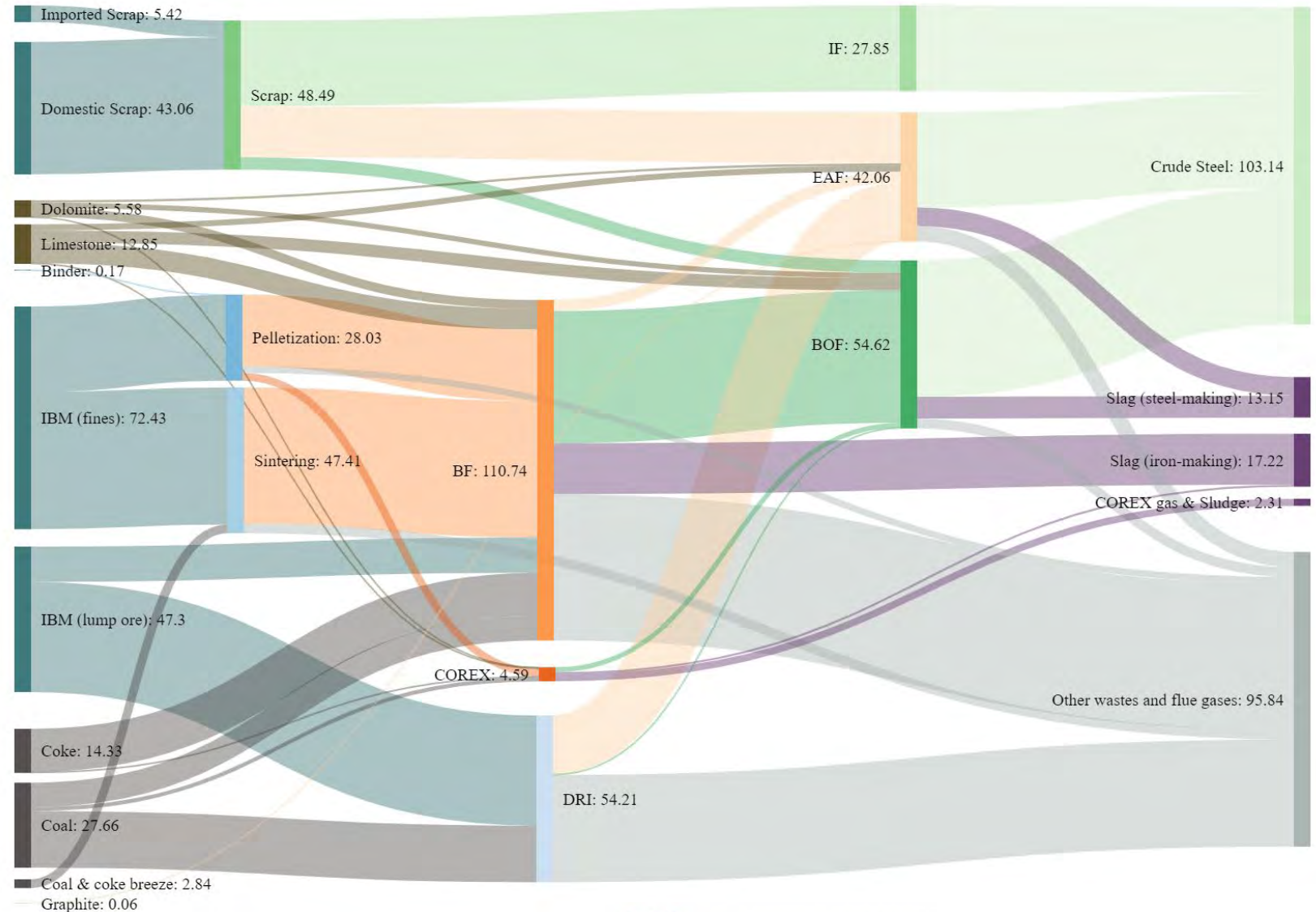


# National level estimates – resource consumption

Category	Aspect	Unit	Range (in million tons)
Fibre source	Wood	million tons	6.7
	Agriculture residue	million tons	3 to 4.3
	Recovered paper	million tons	13.7 (4.42 imported)
Bleaching	Chlorine dioxide	kilo tons	44 to 101
	Hydrogen peroxide	kilo tons	86 to 187
	Oxygen	kilo tons	14 to 17
	Caustic soda	kilo tons	32 to 66
	Hydro sulphite	kilo tons	14 to 28
	Hydro bi-sulphite	kilo tons	86 to 103
	Chlorine	kilo tons	17 to 18
	Hydrated lime	kilo tons	9 to 10
Chemicals consumed in recovery	Sulfidity chemicals (NaOH + Na <sub>2</sub> S)	kilo tons	132 to 234
	Lime	kilo tons	337 to 693
Paper Machine	Calcium Carbonate (filler)	kilo tons	1,736
	AKD (sizing agent)	kilo tons	176
	OBA (Optical Brightening Agent)	kilo tons	82
	Starch (surface and cationic for strengthening)	kilo tons	315
	Dry strength resin (DSR) (strengthening)	kilo tons	7
	Other	kilo tons	10

# Material Flow Analysis: Steel

- Iron bearing material: scrap, ore fines, ore lumps
- Process routes:
  - blast furnace-basic oxygen furnace;
  - COREX-BOF;
  - electric arc furnace;
  - induction furnace



# National level estimates – resource consumption

Process	Material	Range (in million tons)		
Induction Furnace	Scrap	27.85		
Electric Arc Furnace	Scrap	16.59		
	DRI	19.11		
	Pig iron	3.59		
	Limestone	1.23	to	2.69
	Dolomite	0.21	to	1.29
	Graphite	0.33	to	0.096
Basic Oxygen Furnace	Hot metal (from BF)	43		
	Hot metal (from COREX)	1.6		
	Scrap	4.05		
	DRI	0.25		
	Limestone	3.73	to	4.26
	Dolomite	1.33	to	2.13
Blast Furnace	Pellets	15.84	to	30.89
	Sinters	37.22	to	51.48
	Lump ore	11.09	to	11.88
	Coke	11.74	to	16.31
	Coal	7.55	to	8.39
	Limestone	5.59	to	7.69
	Dolomite	2.33	to	3.49
COREX	Iron ore (pellets)	2.48	to	2.56
	Coal	1.27	to	1.32
	Coke	0.29	to	0.34
	Limestone	0.24	to	0.29
	Dolomite	0.16	to	0.22
DRI	Iron ore (lumps)	34.85	to	36.79
	Coal	17.43	to	19.36
Pelletization	IBM (fines)	19.42	to	36.55
	Binder	0.10	to	0.25
Sintering	IBM (fines)	37.22	to	51.99
	Coal & coke mix	2.16	to	3.60



# Recommendations – paper sector

- For government
  - Import controls
  - Enabling policy to encourage industrial symbiosis between paper and cement sector
    - lime sludge from agro-based paper mills
    - deinked sludge from recovered paper based mills
- For business
  - Examine the use of leachate generated from storage of agro residues
  - Invest in R&D for material re-use
    - deinked sludge to regenerate filler material

# Recommendations – steel sector

- For government
  - Import controls
  - Encourage/promote H-DRI technology
- For business
  - Explore utility sharing (mines and production units)

# Thank you

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