PAPER THROUGH TIME

Tracking the Industry's Progress

FOREWORD

The idea of the Green Rating Project was born in the mid-1990s when the Founder-Director of Centre for Science and Environment (CSE), Anil Agarwal, first read about the work of a US based non-government organization, Centre for Environment Protection (CEP). CEP, as an independent assessor of environmental performance of companies, was pushing businesses to become responsible voluntarily. With India having just entered the era of industrialization, the idea of a Green Rating of its industrial sectors to safeguard the interests of the environment took root. The neutral, rigorous and transparent nature of the rating along with the public disclosure of its findings made the CSE's Green Rating Project one of a kind in the country. Since its inception in 1997, the Green Rating Project has rated 5 major industrial sectors: Pulp and Paper (1999 and 2004), Automobile (2001), Chlor-Alkali (2002), Cement (2005) and Iron and Steel (2012).

The Pulp and Paper Industry was the very first sector to be rated under the Green Rating Project of the Centre for Science and Environment in 1999. Today, the Indian pulp and paper industry has come a long way from where it was then. Being the first sector to go through the rigorous Green Rating exercise, companies were slow to participate voluntarily. It took nearly a year of perseverance for all of the companies to come forward and be a part of the project. When CSE decided to take up the sector for the second time in 2004, there was a marked difference in the attitude of the companies. This time 90% of the sample voluntarily participated.

With almost a decade gone by since the last ratings, CSE has decided to take stock of the Pulp and Paper Sector yet again; this time with a little less apprehension and a little more hope than the last. The third time around, the response from the industry was phenomenal: a single phone call was all that was required for 90 per cent participation. The intention of the current survey of the pulp and paper industry was not to rate individual companies[1]. The idea was to provide an indicative picture of the industry's overall environmental performance. Of all the companies that responded, a study of 12 integrated wood based plants has been considered. This study tells us how an industrial sector has progressed, or not, in terms of environmental performance post-liberalization in the early 1990s. There are major learnings from this exercise and we hope that these will be internalized by the industry and the government for charting a sustainable future for the industry.

[1] For the sake of convenience, in various instances in this document the three studies done by CSE have been titled GRP 1, GRP 2 and GRP 3. This does not mean the survey done this time, for the period between 2012-2013, is a rating exercise.

The sample

The twelve integrated mills account for 21 per cent of the total production of the industry and are spread over 10 states. The oldest mill is BILT-Shree Gopal which was established in 1936, and the newest is BILT-Sewa. All the mills had participated in the previous Green Ratings of the pulp and paper industry carried out in 1999 and 2004. The mills in the sample use wood as a major proportion of their raw material. Large wood based integrated mills were found to be the most resource intensive and polluting during the previous rating. Therefore the performance of the mills over time in our sample serves as an indicator to showcase, not only their individual progress, but of the industry as a whole.

Distribution of sample mills

The sample mills

Name of Mill	Location	Year of Establishment
BILT- Shree Gopal Unit (BILT-SGU)	Yamunanagar, Haryana	1936
BILT - Ballarpur	Ballarshah,Maharashtra	1953
BILT- Sewa	Gaganpur, Orissa	1991
Tamil Nadu Papers Ltd.(TNPL)	Karur, Tamil Nadu	1984
JK Paper Ltd- Central Pulp Mills (JKP-CPM)	Tappi, Gujarat	1966
ITC Ltd- Bhadrachalam Unit (ITC Ltd.)	Bhadrachalam, Andhra Pradesh	1979
Seshasayee Paper	Erode, Tamil Nadu	1960
Orient Paper	Shahdil, Madhya Pradesh	1965
Star Papers	Saharanpur, Uttar Pradesh	1938
Century Pulp and Paper	Nainital, Uttarakhand	1984
West Coast Paper Mills (WCPM)	Dandeli, Karnataka	1955
JKP- Rayagada	Rayagada, Orissa	1962

CAPACITY

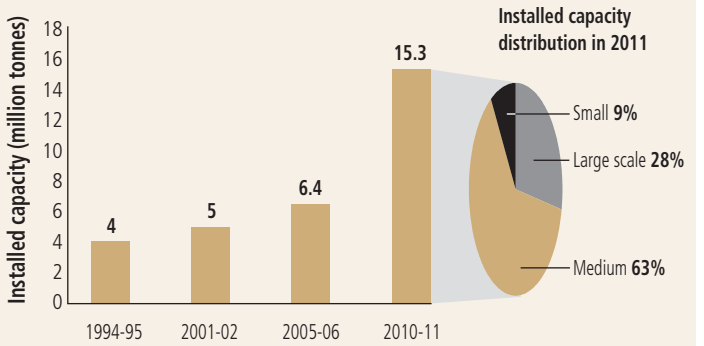
Paper industry: The growth trajectory

From just 17 mills in 1951 with a capacity of 0.14 million tonnes, the industry has grown to 825 mills with a capacity of 15.3 million tonnes. In a span of last two decades the industry has grown by almost 4 times. The number of mills has increased from 330 in 1991 to 825 in 2012. The total installed capacity of the industry has grown at a compounded annual growth rate (CAGR) of 6 per cent over the past decade. Average capacity of the Indian mills has increased from 14,200 tonnes per annum to 22,100 tonnes per annum between 2001 and 2011.

Considering mills with capacity greater than 100,000 tonnes per annum (TPA) as large scale, between 10,000 to 100,000 TPA as medium scale, and below 10,000 TPA as small scale, the distribution in terms of number and capacity is detailed in the table below. The 32 large scale mills are only 5% of the total number of mills in the Indian paper industry, however, they contribute to 28% of the installed capacity. Medium scale mills contribute 63 percent of the total installed capacity while the large number of small scale mills contributes to only 9 per cent of the industry's capacity.

While the paper industry comprises a number of small scale mills, relatively large mills continue to contribute to a sizable share of total production. In 2012, around 88 mills in the industry with capacities higher than 50,000 TPA contributed to 53 per cent of the industry's installed capacity. With an increase in demand in the last five years, large scale mills have reported capacity utilizations as high as 80 per cent and above. Assuming a conservative 75 per cent capacity utilization, these 88 mills contribute to around 60 per cent of the total production in the country. This characteristic has been long standing- in 2000 mills with capacities higher than 50,000 TPA produced nearly 59 per cent of the India's total pulp and paper production.

Increase in installed capacity

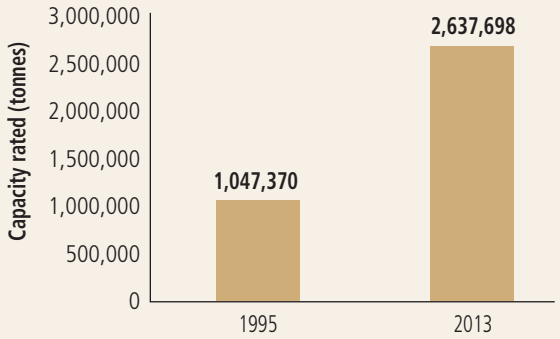


Year	Small scale (<10,000 TPA)	Medium scale (10,000-100,000 TPA)	Large scale (>100,000 TPA)	Average capacity (Tonnes/Annum)
2001	393 (66.1%)	190 (32%)	11 (1.9%)	14,200
2011	314 (45%)	344 (50%)	32 (5%)	22,100

Installed capacity of sample mills

The growth trajectory of the mills in the sample has been on the same lines as the rest of the paper and pulp industry. The combined capacity of the mills has increased at a CAGR of 5.3 percent since 1995. Since 1999, ITC Ltd has remained the largest integrated paper manufacturing plant in the country. From 1995 onwards, they have grown at an average rate of 12 per cent and today have a capacity of 4.7 lakh tonnes. Most of the other plants have also registered increase in capacities in line with the overall growth rate of the industry. Orient Paper is the only plant that has not increased its capacity.

Installed capacity



Installed capacity in samples mills (Tonnes)

	BILT- SGU	BILT - Ballarpur	BILT- Sewa	TNPL	JKP - CPM	ITC Ltd	Seshasayee Paper	Orient Paper	Star	Century	WCPM	JKP -Rayagada	Total Installed Capacity (Tonnes)
1995	70,000	105,000	30,000	180,000	47,000	62,500	60,000	85,000	46,200	151,920	119,750	90,000	1,047,370
2013	85,068	299,500	72,000	400,000	139,000	470,000	187,000	85,000	75,000	265,130	320,000	240,000	2,637,698
% increase	**22**	**185**	**140**	**122**	**196**	**652**	**212**	**0**	**62**	**75**	**167**	**167**	**152**
CAGR	**1.1**	**6.0**	**5.0**	**4.5**	**6.2**	**11.9**	**6.5**	**0.0**	**2.7**	**3.1**	**5.6**	**5.6**	**5.3**

PRODUCTION AND CONSUMPTION

Production trends

The per capita consumption in India continues to be low by global standards. In 1995, the consumption stood at 3 kg and by 2003 it was just 5 kg. Today it stands at 9.3 kg compared to other Asian countries such as Indonesia (at 22 kg) and China (at 42kg).

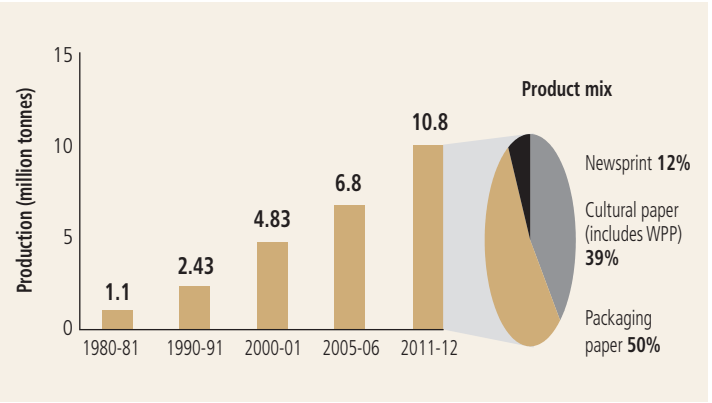
Production growth has lagged the increase in demand for paper, necessitating reliance to an extent on imports, specifically in the newsprint segment. Around 2.5 million tonnes of paper and paperboard, amounting to 19 per cent of total consumption, were imported in 2011-12.

In 2012, India produced 2.6 per cent of the 394 million tonnes of paper produced in the world. From 2.43 million tonnes in 1991, the Indian Pulp and Paper Industry's production has increased to 10.8 million tonnes in 2012 – a CAGR of 7.4 per cent.

In terms of product mix, the percentages of writing printing paper (WPP) and packaging paper have been more or less constant in the last decade. The share of WPP was 37 per cent in 2002 and increased to 39 per cent in 2012. Packaging paper contributed to 46 per cent of the total paper manufactured in 2002 and has now increased to 50 per cent in 2012. Newsprints' share on the other hand has decreased, from 16 per cent in 2002 to 12 per cent in 2012.

In 2012, India produced 4.2 million tonnes of WPP/coated uncoated paper, 5.4 million tonnes of packaging paper and 1.3 million tonnes of newsprint paper. The increase in consumption of WPP and paperboard, at a CAGR of 7.1 per cent in the last five years, meant most of thel production of the industry went to meet the demand. With WPP and paperboard production falling slightly short of demand, around 10 per cent was imported. The demand for newsprint has been increasing at an average of 6 per cent per annum in the last five years according to Indian Newsprint Manufacturers Association. Historically, a large share of the newsprint demand in the country has been met by imports. In 2000, 47 per cent of the total consumption of newsprint was met by imports. Today, of the total consumption of 2.7 million tonnes, around 50 per cent is met by imports.

Production growth in the industry

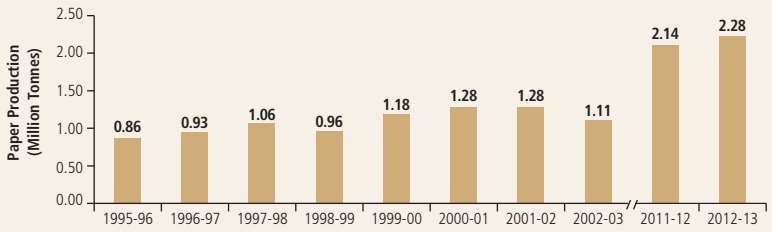


Production trends in sample mills

The combined production of the integrated mills in our sample has increased at a CAGR of 5.6 percent since 1995. The production increased at a sharper rate in the most recent decade (2003-2013), with the period registering a CAGR of 7.7 per cent.

ITC Ltd has the highest rate of increase in production at a CAGR of 10 per cent. From an average 0.86 lakh tonnes of pulp and paper between 1995-1998, the mill's production increased almost 4 times, to 4.9 lakh tonnes of paper in 2013. TNPL, JKP-CPM and WCPM have also recorded an increase in production at a CAGR of more than 7 per cent since 1995. BILT-SGU and Orient Papers, the two mills with little or no capacity enhancement, are also the only ones that have recorded a declining production trend.

Pulp and paper production in sample mills



Product mix in sample mills (%)

	GRP 1	GRP 2	GRP 3
Writing and printing	65	69	70
Packaging Paper and Paper Board	22	18	24
Industrial Paper	2	2	2
Newsprint	4	4	0.03
Specialty Papers	3	0.28	1
Market pulp	4	6	2
Others	1	1	1

Product mix in sample mills

The sample mills continue to manufacture predominantly writing and printing paper followed by packaging and paper boards. The first rating showed that of the total production, writing and printing paper accounted for 65 percent while packaging and paper board accounted for 22 percent. The share has remained more or less the same: in 2012-13, 70 per cent of the total production was writing and printing paper while 24 per cent was packaging paper and paper board.

About 4 per cent of the product mix manufactured during 1995-98 was newsprint, produced by only TNPL. With TNPL moving towards manufacturing writing and printing paper, only 0.03 per cent of the product mix in the sample was newsprint.

Production in sample mills

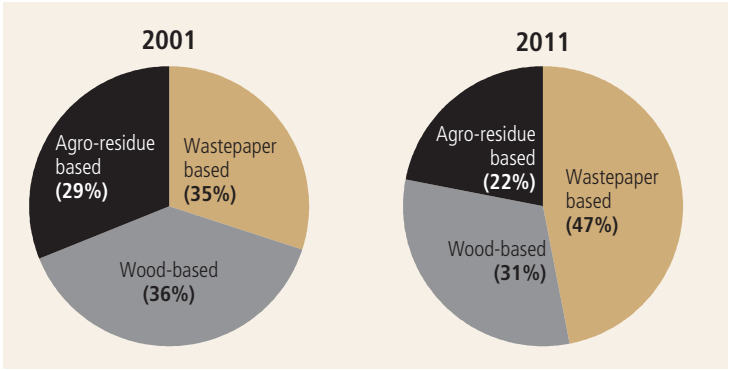
Production Trends	BILT- SGU	BILT- Ballarpur	BILT- Sewa	TNPL	JK Paper-CPM	ITC Ltd	Seshasayee Paper	Orient Paper	Star	Century	WCPM	JKP-Rayagada	Total Production (tonnes)
1995-96	91299	99,541	20,331	101,161	40,653	89,057	58,737	68,380	52,957	74,747	88,255	79,578	861,617
1996-97	85355	100,714	21,272	153,460	41,688	86,041	58,552	64,020	52,590	104,815	94,107	75,069	932,637
1997-98	85,250	153,561	26,590	170,618	41,322	84,148	58,898	65,783	53,395	131,392	111,375	82,616	1,059,324
1998-99	67,387	93,225	36,121	162,869	43,618	127,948	56,277	59,461	53,269	95,296	109,645	57,778	963,569
1999-00	72,273	130,778	41,546	165,456	46,608	172,872	57,190	67,459	58,547	147,932	105,770	97,578	1,164,432
2000-01	72,041	133,702	45,728	177,445	45,481	193,468	78,334	70,546	60,039	145,155	112,997	131,692	1,268,133
2001-02	75,598	135,721	43,994	172,114	50,397	197,812	96,976	66,741	60,196	144,399	113,075	111,438	1,270,890
2011-12	77,647	236,683	67,065	323,286	140,912	466,385	132,079	61,626	53,620	162,851	294,360	131,151	2,147,665
2012-13	78,114	239,411	65,100	352,398	149,712	495,055	139,017	59,972	60,784	216,918	304,910	128,206	2,289,596
% increase	**-14**	**141**	**220**	**248**	**268**	**456**	**153**	**-12**	**13**	**190**	**245**	**61**	**166**
CAGR	**-0.9**	**5.0**	**6.7**	**7.2**	**7.5**	**10.0**	**5.3**	**-0.7**	**0.7**	**6.1**	**7.1**	**2.7**	**5.6**

Raw material consumption

In 2001, raw material usage in the Indian pulp and paper mills was more or less equally distributed with production from waste paper based mills at 35 per cent, from agro-residue based mills at 29 per cent and from wood based mills at 36 per cent. The share of wood in the total raw material mix has been steadily declining in the Indian industry since the 1970s. From 84 per cent in 1970, its share came down to 36 per cent in 2001 and was 31 per cent in 2011.

Production from wastepaper, on the other hand, has jumped from 7 per cent in 1970 to 47 per cent in 2011. The contribution from waste paper based mills, especially small and medium has increased on the whole driving an increase in the share of waste paper in the raw material mix by nearly 12 per cent in the last decade. In early 2000s, it looked like wastepaper would become the favorite raw material given that the industry was predicting a "wood drought" around the corner.This did not prove to be true.

The percentage of pulp and paper from wood based mills did not reduce drastically and continues to stand at a substantial 31 per cent. In 2001, the industry produced around 1.7 million tonnes of pulp and paper from 3.4 million tonnes of wood and bamboo. In 2011, 3.3 million tonnes of product was manufactured from approximately 6.5 million tonnes of wood, a bulk of which was by the large scale integrated mills. Clearly the two-fold increase in consumption of wood had been possible as these mills had opted to take the farm forestry route. This move is bringing the industry closer to a sustainable model of wood sourcing.



Raw material distribution in sample mills

Forest based raw materials, wood and bamboo, have continued to rule the roost in sample mills over the last 18 years. Of the two, bamboo's share has dropped on the whole from 30 per cent during the first rating to a mere 5 per cent today. This has lead to a number of companies dramatically increasing the proportion of wood in their raw material mix. Companies such as ITC Ltd. which used significant amount of recyclables are now reliant predominantly on wood. (See ITC's Farm Forestry). ITC Ltd. has increased its wood consumption by almost 6 times in the last 18 years. Similarly mills such as TNPL, WCPM and Seshasayee Papers have also increased their wood consumption substantially (See Box).

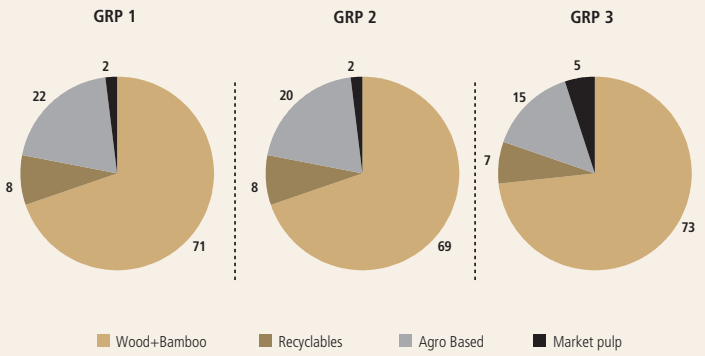
Since the mills have steadily increased production, there has been a substantial increase in consumption of wood. On the whole these mills, which consumed around 17.4 lakh tonnes of wood in 1995, increased their consumption to 32.6 lakh tonnes in 2012. While there was talk of shortage 10 years ago, the companies have found a way around the wood crunch by investing in farm forestry.

TNPL: Wood contributed to 10 per cent (0.5 lakh tonnes) of the total raw material consumed in 1995. This proportion increased to an average of 19 percent (1.7 lakh tonnes) for the period 1998-2002. In 2011-12, hardwood consumption constituted of 42 per cent (3.1 lakh tonnes) of the total raw materials used by the mill.

Seshasayee Paper: An average of 50 per cent of the mill's raw material (0.9 lakh tonnes) was forest based during 1998-2002. In 2011-12, 83 per cent (2.3 lakh tonnes) of the raw material was wood.

WCPM: Wood has been responsible for more than 90 percent of the raw material requirement of the mill since 1995. With a capacity increase of nearly 170 per cent and wood contributing to 95 per cent of the total fiber furnish, the overall wood consumption has also increased proportionally. From around 2.7 lakh tonnes of wood in 1995, the mill consumption has more than doubled to 6.7 lakh tonnes of wood in 2012.

Share of forest based raw materials remain the highest in sample mills



Wood and bamboo sourced in sample mills (tonnes)

Production Trends	BILT- SGU*	BILT- Ballarpur	BILT- Sewa	TNPL	JK Paper- CPM	ITC Ltd	Seshasayee Paper	Orient Paper*	Star	Century	WCPM	JKP- Rayagada	Total (tonnes)
1995-96	190,500	234,000	71,079	48,754	84,875	111,296	72,617	200,422	NA	269,310	266,159	189,880	1,738,892
1996-97	166,754	235,462	85,952	61,218	103,884	139,047	85,913	172,619	NA	123,270	276,485	171,564	1,622,169
1997-98	155,222	227,200	106,225	55,390	110,971	111,462	71,904	168,081	148,817	157,361	283,672	178,832	1,775,137
1998-99	81,891	190,571	76,746	51,880	84,275	147,976	78,054	126,474	73,385	117,772	196,908	134,285	1,393,394
1999-00	103,144	256,552	100,667	58,798	102,046	156,822	78,443	173,081	102,962	202,568	160,010	226,944	1,740,257
2000-01	116,921	255,091	105,682	62,546	108,003	150,190	90,265	180,330	91,491	163,048	205,081	251,184	1,813,556
2001-02	130,231	256,551	98,363	69,358	110,384	177,261	102,429	163,156	100,553	235,142	215,630	251,821	1,967,592
2011-12	61,244	285,323	136,786	313,229	119,743	732,690	232,822	155,572	58,660	231,145	672,168	270,368	3,269,750
% Change	**-68**	**22**	**92**	**542**	**41**	**558**	**221**	**-22**	**-61**	**-14**	**153**	**42**	**88**
CAGR	**-6.5**	**1.2**	**3.9**	**11.6**	**2.0**	**11.7**	**7.1**	**-1.5**	**-6.0**	**-0.9**	**5.6**	**2.1**	**3.8**

Note: **BILT-SGU and Orient have increased the use of veneer waste (from a large number of plywood industries in the plant's vicinity) in its raw material.*

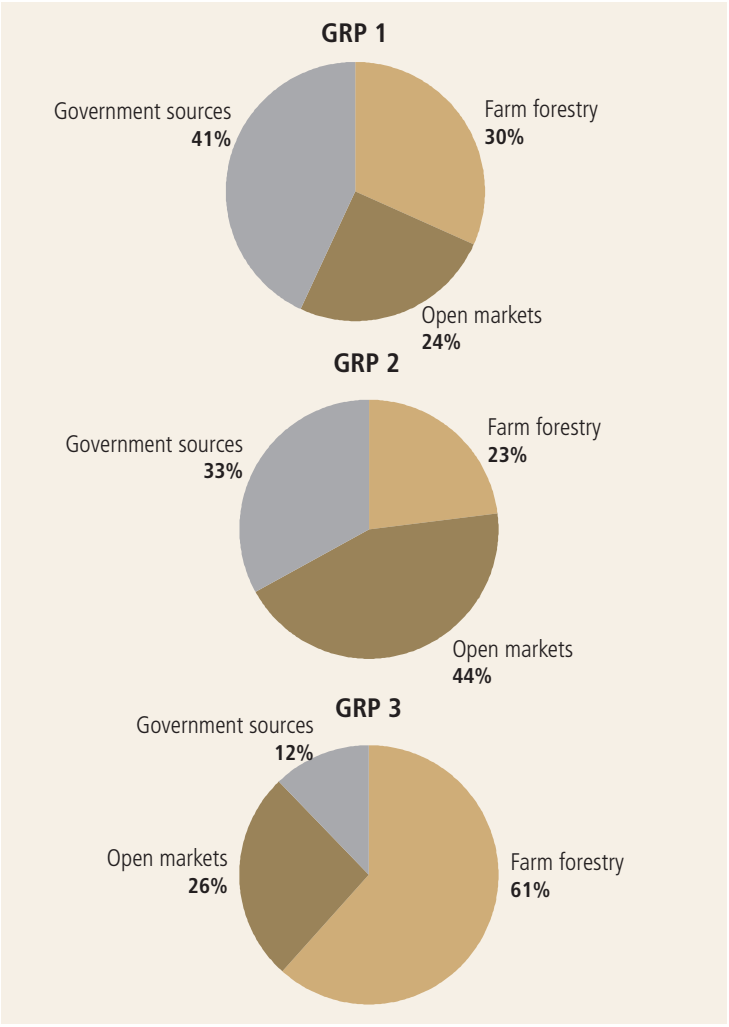
Wood and bamboo: Sourcing pattern

Till the late 1970s, the government heavily supported the paper industry's increasing wood needs by offering raw materials at extremely low rates from state owned forests. The resultant indiscriminate felling led to large scale deforestation. The growing environmental and social concerns over the loss of forests saw the beginning of India's first social forestry program. The program also introduced the concept of farm forestry in the country. In the 1980's, reduced pulp import duty led to a collapse of the farm forestry experiment. In addition, cheap pulp wood from state forests further led to a crash in the open market price of wood. However, a combination of factors – pressure from environmentalists, restriction on farming in forest land by the government and increasing fear of an impending raw material crunch by the industry – changed the fiber sourcing patterns in the country.

During the first rating, up to 40 per cent of the wood procured by the mills in the sample was from government sources. Mills like BILT – Ballarpur, TNPL, and JKP-CPM procured almost 100 per cent of their wood from various government sources while JKP – Rayagada, Century and Star Papers sourced between 30 to 70 per cent. Today, the mills source an average of 59 per cent of wood from farm forestry. ITC Ltd uses farm forestry for more than 95 per cent of its wood requirements. Others like Star, JKP-Rayagada, Westcoast Papers and BILT-Ballarpur source more than 80 per cent of their wood through farm forestry. While TNPL sourced up to 49 per cent from farm forestry in 2011-12, they continue to procure up to 50 per cent from government plantations.

On the whole, government forests contribute to only 13 per cent of the total share of wood and bamboo sourced. Open market has a share of 26 per cent in 2013, a drop from the 47 per cent in 2004. While this appears high in terms of percentages, the actual reduction in terms of quantity is far less. The mills sourced around 9 lakh tonnes of wood from the open market in 2002 and in 2012 the quantity was 8.3 lakh tonnes. The open market source has remained more or less constant, volume-wise. This coupled with reduction in contribution from government forests shows that farm forestry has expanded to almost single handedly cater to the increase in wood demand.

Sustainable sourcing: The industry's shift towards farm forestry



ITC'S FARM FORESTRY

A major portion of the ITC Ltd.'s raw material used to be wastepaper until 2004. Despite having the oldest farm forestry program, ITC had not yet embraced it due to unreliability. Today, however, ITC's Bhadrachalam unit relies predominantly on wood and sources more than 95 per cent of it from its farm forestry initiatives.

ITC Ltd. has remained the largest paper plant in the country in the last 15 years. Its capacity has increased at a rate of 12.6 percent per annum – from 0.6 lakh tonnes in 1995 to 4.9 lakh tonnes in 2013. On becoming a predominantly wood based unit, its wood consumption has risen by almost 6 times – from 1.1 lakh tonnes in 1995-96 to 6.4 lakh tonnes in 2013. ITC's farm forestry initiatives, which began in 1989, further expanded to meet its increased consumption.

From 1992 to 2013, the company has promoted plantations over an area of 1,57,743 hectares and has distributed 712 million saplings in partnership with 78,076 farmers. The plantations are predominantly in Andhra Pradesh (AP) and spread over all 23 districts of the state. Additionally they have plantations in Tamil Nadu, Maharashtra, Chattisgarh, Orissa, Kerala, UP, MP, Maharastra, Punjab and Haryana. While bipartite agreements with farmers are no longer the norm, the company offers it to those who ask for it in order to obtain loans from banks. As a result, though the farmers who have been initiated under the program are free to sell the wood in the open market, ITC Ltd has been able to ensure a reliable supply by putting in place a number of extension services. Procurement of wood from plantations outside of Khamman district in AP, where the mill is located, is done through contractors. A network of 25 depots has been set up to reduce transportation hassles in these cases. Further the company has also set up a transparent system which ensures that the farmers are paid on delivery either at the company weigh bridge in Bhadrachalam or at the depots. In 2013, the mill paid Rs.4935 per tonne of wood procured. The combination all of their extension services coupled with competitive rates has enabled ITC – Bhadrachalam unit to sustainably as well as reliably source their raw material.

PROCESS TECHNOLOGY AND CONSUMPTION

Pulping

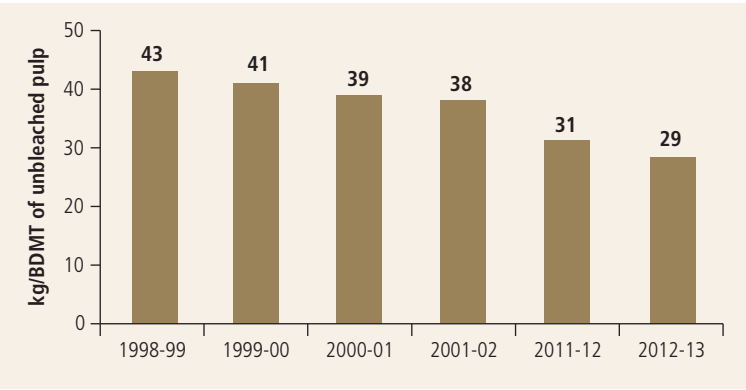
Pulping is carried out to extract cellulose- the fibrous content of the raw material used in paper making- from other components such as lignin, resins and hemi-cellulose. The most commonly used pulping technique and the most effective one is the chemical or Kraft cooking process. In the mills in our sample, chemical consumption in the pulping process was quite high, at an average 45 kg of caustic soda equivalent per BDMT of unbleached pulp, during the period 1998-2002. The global best practice during the same time period was only 12 kg/BDMT of unbleached pulp. This time around the average specific chemical consumption has reduced to 29 kg per BDMT of unbleached pulp- a long way from the global best practices.

Specific Lime Consumption:

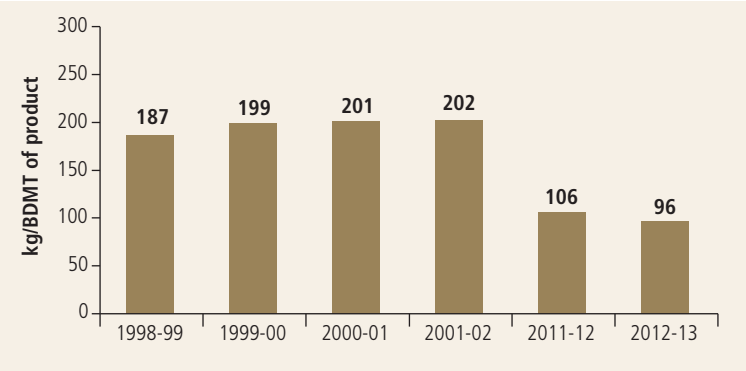
Caustizing is a process where the primary pulping chemical (sodium carbonate) is converted into active cooking chemical sodium hydroxide (NaOH) on reacting with calcium oxide or lime. This reaction generates lime mud, i.e. calcium carbonate. The lime mud can be burnt to regenerate calcium oxide, a process normally carried out in lime kilns. In theory, 100% of lime used in paper mills is recoverable.

During the first and second rating of the sector lime kilns were uncommon features. By the second rating, only 4 of the 12 mills had installed lime kilns to recover lime. Huge volumes of lime mud were dumped by the mills and consequently the specific consumption of lime was extremely high – at an average of 200 kg /BDMT of product. In 2012, every mill had installed a lime kiln leading to overall reduction in consumption of lime. However, the mills continue to consume unacceptably high levels of lime despite the presence of lime kilns. In 2012-13, the consumption of lime in the sector was an average 96 kg/BDMT of product while the global best practice stands at around 5 kg/BDMT.

Specific pulping chemical consumption as equivalent NaOH in sample mills



Specific lime consumption in sample mills



Specific pulping chemical consumption – as equivalent NaOH (kg/BDMT of unbleached pulp)

	BILT- SGU	BILT - Ballarpur	BILT- Sewa	TNPL8	JKP - CPM	ITC Ltd	Seshasayee Paper*	Orient Paper	Star	Century*	WCPM	JKP - Rayagada	Weighted Average
1998-99	44	45	42	38	35	30	48	62	33	31	57	59	43
1999-00	38	39	58	39	47	29	47	45	31	37	42	60	41
2000-01	35	35	52	38	42	28	64	50	28	38	46	57	39
2001-02	31	35	43	29	42	27	55	51	32	38	41	58	38
2011-12	31	35	40	24	27	30	20	85	53	33	22	35	31
2012-13	27	39	28	20	28	21	22	89	59	26	26	38	29
% Change	**-39**	**-12**	**-33**	**-47**	**-21**	**-30**	**-54**	**44**	**77**	**-17**	**-55**	**-36**	**-33**
CAGR	**-3.2**	**-0.9**	**-2.7**	**-4.2**	**-1.6**	**-2.4**	**-5.0**	**2.5**	**3.9**	**-1.2**	**-5.1**	**-2.9**	**-2.6**

Note: **.The pulping chemical consumption pertains only to Kraft wood pulping so that data is comparable across all 12 paper mills. TNPL, Seshasayee and Century use both wood and baggase as raw materials*

Specific lime consumption (kg/BDMT of product)

	BILT- SGU	BILT - Ballarpur	BILT- Sewa	TNPL	JKP - CPM	ITC Ltd	Seshasayee Paper	Orient Paper	Star	Century	WCPM	JKP -Rayagada	Weighted Average
1998-99	307	239	265	92	255	290	260	235	54	NA	92	395	187
1999-00	314	230	237	106	274	294	267	213	44	63	98	345	197
2000-01	317	226	248	111	273	282	257	203	45	57	91	343	196
2001-02	303	229	236	131	284	286	229.	210	45	67	74	350	200
2011-12	123	94	71	125	153	110	87	175	42	66	18	286	106
2012-13	120	73	80	127	105	112	98	146	36	63	19	223	96
%change	**-61**	**-69**	**-70**	**37**	**-59**	**-61**	**-62**	**-38**	**-33**	**1**	**-80**	**-44**	**-48**
CAGR	**-6.1**	**-7.6**	**-7.7**	**2.1**	**-5.7**	**-6.1**	**-6.3**	**-3.1**	**-2.6**	**0.1**	**-10.1**	**-3.7**	**-4.3**

Pulping Technology: The pollution load of a paper mill is dependent on its pulping process and the technology used. The previous rating found the industry's pulping technology to be out-dated at least by a decade. The current survey indicates that the industry appears to have, to an extent, caught up. This time, we looked at two key technology changes in the pulping section: ***Extended/Modified Cooking and Oxygen Delignification.***

During pulping the raw material is cooked in a sodium based alkaline solution such that its lignin content -denoted by the kappa number- is reduced. The cooked pulp has residual lignin which has to be removed in order to make the finished paper bright. Bleaching is carried out to remove this residual lignin. Higher kappa number after cooking translates to higher chemical consumption during the bleaching phase. This further leads to increased pollution load. Extending or modifying the cooking can substantially lower the kappa number. Similarly, oxygen delignification- carried out after the cooking of pulp- is yet another process that reduces the kappa number. Here oxygen works selectively on the lignin, breaking it down resulting in further reduction in the kappa number.

Technology up-gradation: While there were no mills with extended or modified cooking technologies during the first rating, the second rating saw one mill – JK Paper, Rayagada – with the state of the art RDH (Rapid Displacement Heating) cooking process in the country and 3 mills that had implemented oxygen delignification. Today, more than 70 percent of the unbleached pulp production from the mills in our sample is through extended or modified cooking. Additionally 8 out of 12 mills have adopted oxygen delignification.

Conventional vs. modified cooking

	BILT- SGU	BILT- Ballarpur	BILT- Sewa	TNPL	JKP - CPM	ITC Ltd	Seshasayee Paper	Orient Paper	Star	Century	WCPM	JKP -Rayagada	Percentage
Capacity of digesters with conventional cooking (TPD)	180	360	175	750*			100*	240	210	412.50			
- % of total cooking capacity	100	100	100	68.8			20.0	100	100	100.00			30
Capacity of digesters with modified cooking (TPD)				340	150	1000	450				725	313.2	
- % of total cooking capacity				31.2	100	100	82.0				100	100	70

Note: **In the case of mills like TNPL and Seshasayee, agro-waste like baggase in their raw material is cooked in continuous digesters without modification. Given that the conventional cooking time is around 15-20 minutes only, extending or modifying the cooking process is not relevant.*

Bleaching

Bleaching is carried out to make the paper bright by removing leftover lignin components in the pulp after cooking. This section of the mill contributes the most to overall pollution load. By 2001, paper mills in the developed world had already phased out the most common bleaching chemical, chlorine, due to the environmental hazards it poses. (The carcinogenic organochlorides discharged during bleaching with chlorine do not degrade and enter the food chain easily.) In Indian paper mills, however, until 2001 chlorine still remained the favoured bleaching chemical as it was effective and cheap. With no environmental standards or facilities to check the presence of organochlorides in effluents, there was no control over the industry's bleaching process. Inefficient use of chlorine further exacerbated the situation, leading to high specific consumption of the chemical. Today Indian paper units have begun to slowly move towards Elemental Chlorine Free (ECF) bleaching, which uses chlorine dioxide as primary bleaching chemical, however, elemental chlorine has not been phased out completely. On the other hand European mills have moved further ahead to Total Chlorine Free (TCF) bleaching (which uses ozone, oxygen or peracetic acid and peroxide) to completely eliminate any trace of organochloride halides from effluents discharged. In addition, TCF reduces water consumption in the bleaching plant, which is responsible for roughly half the total water consumed in the entire mill, by 50 percent

Most of the mills in the sample have replaced chlorine partially with chlorine dioxide. Consequently, a small consolation is that the specific consumption of chlorine has dropped. While none of the mills had ECF technology at the time of the first rating, one mill had adopted it by the second rating. Today, 4 of the 12 plants have moved over to Elemental Chlorine Free Bleaching with ITC Ltd. being the first plant to make the change in 2004. It is also the only plant that uses ozone in its bleaching sequence thus reducing the chlorine dioxide consumption. Star Paper is the only mill that continues to use elemental chlorine in its entire production line.

Two ways to it: The move to ECF

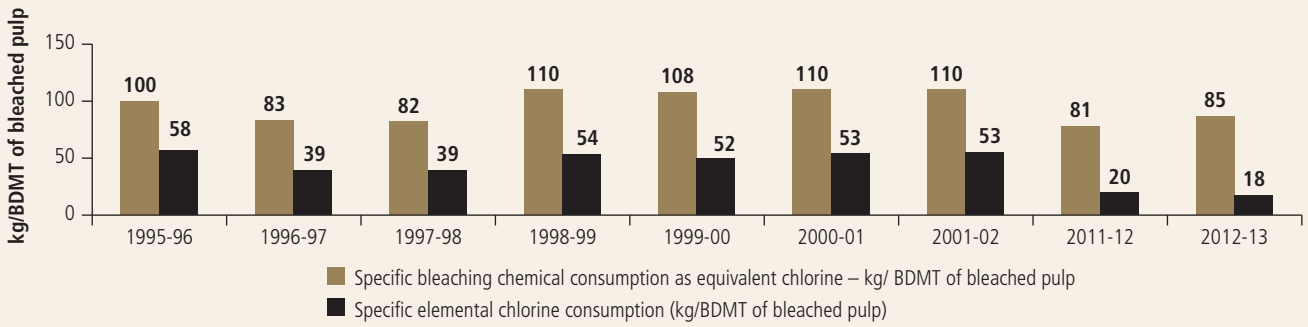
Chlorine Dioxide has replaced chlorine in four of the biggest paper manufacturing facilities in the country. The four companies have opted for different types of chlorine dioxide manufacturing technologies and each, they claim, has its benefits. ITC Ltd and Seshasayee Papers use a non-integrated process which uses methanol to reduce sodium chlorate ($NaClO_3$) to chlorine dioxide at high levels of acidity (trademarked by ClO_2 manufacturers as ERCO R8© and EKA SVP-Lite™). The process produces a double salt, sodium sesquisulphate, $Na_3H(SO_4)_2$ as a by-product. This by-product is recovered by the units and is added as make-up sodium sulphate along with black liquor in the digesters. This process is less capital intensive and also consumes less energy. However this benefit is offset as the recurring costs are high. The raw materials sodium chlorate, hydrochloric acid and methanol are all purchased. Sodium chlorate is particularly expensive with one tonne costing around Rs. 50,000.

TNPL and WCPM on the other hand use integrated chlorine dioxide production plants. Here the plant produces the two intermediate products: sodium chlorate ($NaClO_3$) and hydrochloric acid (HCL). Sodium Chlorate is produced by electrolytic method where current is passed through a brine solution. The hydrogen gas produced as a by-product is in turn used for producing HCL. The chlorine requirement here however has to be is met by adding chlorine gas separately. Chlorine dioxide is then produced by combining the strong chlorate and hydrochloric acid. The by-products produced are weak chlorine gas, which is used as make up in the HCL section and Sodium Chloride (NaCl-Salt), which is used to make the brine solution for the $NaCLO_3$ sections. This process is more capital intensive and also more energy intensive as it manufactures the intermediate products as well.

The weighted average consumption of elemental chlorine for the sample had declined appreciably to 18 Kg/BDMT of bleached pulp in 2012-13 from 58 Kg/BDMT of bleached pulp in 1995- 96. However, the average reduction is the result of a shift to ECF bleaching by four mills. Elemental chlorine consumption by the rest of the eight mills remains indefensibly high.

On the whole the total bleaching chemical consumption in the sample mills has reduced by only 20 per cent since 1995: from 100 kg/BDMT of bleached pulp to 85 kg/BDMT of bleached pulp. This, too, is a dismal performance given that best achievable bleaching chemical consumption is a one fourth of this level.

Bleaching chemical consumption



Change in the bleaching sequences

	BILT- Yamuna Nagar	BILT - Ballarpur*	BILT- Sewa	TNPL	JK P -CPM	ITC	Seshayee Paper	Orient Paper	Star	Century	West Coast Paper	JKP Rayagada
GRP 1	CEP HH	CDE-O-HH-D	CEH	CEH	C-EP-H-H	C-D-E-O-H-H-D	CE/P HH	C-E-H-D	C-E-H-H	Wood: C/D-E/P-HH-D Baggase C/D- Eo- D RGP C-E-H-H-D	CE/P HH	CD-EoP-D
GRP 2	CD-EoP-D-D	C/D- EoP- H-H- D	C-EP-H-H-D	Wood : C-EP-H-H Baggase: C-EP-H	CD-EoP-D	DO-EoP-D1	Wood: C-EP-H-H Baggase: C-EP-H	C-EP-H-D	C-EP-HH	Wood : C-E-H-H-D Baggase: C/D-Eo-D RGP C-E--H-H-D-S	C-EP-H-H	CD-EoP--D
GRP 3	CD-EoP-D1-D2	CD- EoP- H & D	CD-EOP-H-D	Wood DHT-EoP-D1 Baggase D0-EoP-D1	CD-EoP-D	DO-Ze-D1-P	Wood: O-D0-EoP-D1 Baggase: D0-EoP-D1	CD-EoP-H-D	C-EoP-H1 H2	Kraft: CD-EP-H-D RGP: C-EoP-H-D1-D2-SO2	Dhot EoP DnD	CD-EoP-D

Note: ** BILT Ballarpur has changed its sequence to ECF in 2013-14*

Specific elemental chlorine consumption (kg/BDMT of bleached pulp)

	BILT- SGU	BILT - Ballarpur	BILT- Sewa	TNPL*	JKP - CPM	ITC Ltd	Seshasayee Paper*	Orient Paper	Star	Century*	WCPM	JKP -Rayagada	Weighted Average
1995-96	33	55	98	36	68	46		67	74	71			58
1996-97	39	52	85	33	64	40	132	67	74	63	56	96	39
1997-98	41	56	95	35	62	37		67	70	51			39
1998-99	69	62	73	43	66	40	50	73	109	48	37	45	54
1999-00	70	55	58	43	71	50	42	60	95	51	41	34	52
2000-01	61	49	57	69	66	47	43	66	95	41	41	32	53
2001-02	52	49	54	72	65	49	54	64	108	34	39	33	53
2011-12	52	42	54	0	56	0	0	42	88	26	0	38	20
2012-13	50	45	47	0	48	0	0	54	89	25	0	45	19
% change	**54**	**-19**	**-52**	**-100**	**-29**	**-100**	**-100**	**-19**	**21**	**-65**	**-100**	**-53**	**-69**
CAGR	**2.4**	**-1.1**	**-4.0**	**-100**	**-1.9**	**-100**	**-100**	**-1.2**	**1.1**	**-5.7**	**-100**	**-4.2**	**-6.4**

Specific bleaching chemical consumption as equivalent chlorine – kg/ BDMT of bleached pulp

	BILT- SGU	BILT - Ballarpur	BILT- Sewa	TNPL*	JKP - CPM	ITC Ltd	Seshasayee Paper*	Orient Paper	Star	Century*	WCPM	JKP -Rayagada	Weighted Average
1995-96	145	131	116	73	129	93		148	82	134	NA		100
1996-97	151	129	106	72	121	79	132	146	87	127	NA	128	83
1997-98	132	135	117	75	118	76		147	80	104	NA		82
1998-99	117	131	152	88	120	98	86	134	203	119	81	73	110
1999-00	111	118	122	90	133	107	85	114	184	130	84	61	108
2000-01	113	106	112	126	124	114	63	123	184	114	87	59	110
2001-02	104	104	103	131	122	117	68	139	210	112	87	64	110
2011-12	107	87	127	85	116	56	84	97	119	71	68	93	81
2012-13	103	99	127	83	120	59	88	131	114	61	78	110	85
% change	**-29**	**-25**	**9**	**14**	**-7**	**-36**	**-33**	**-12**	**38**	**-54**	**-4**	**-14**	**-20**
CAGR	**-1.9**	**-1.6**	**0.5**	**0.7**	**-0.4**	**-2.5**	**-2.2**	**-0.7**	**1.8**	**-4.2**	**-0.3**	**-0.9**	**-1.2**

Note: ** The bleaching chemical consumption and the elemental consumption pertain only to Kraft wood pulping so that data is comparable across all mills. TNPL, Seshasayee and Century use and baggase wood and baggase as raw materials.*

RESOURCE EFFICIENCY

Energy efficiency

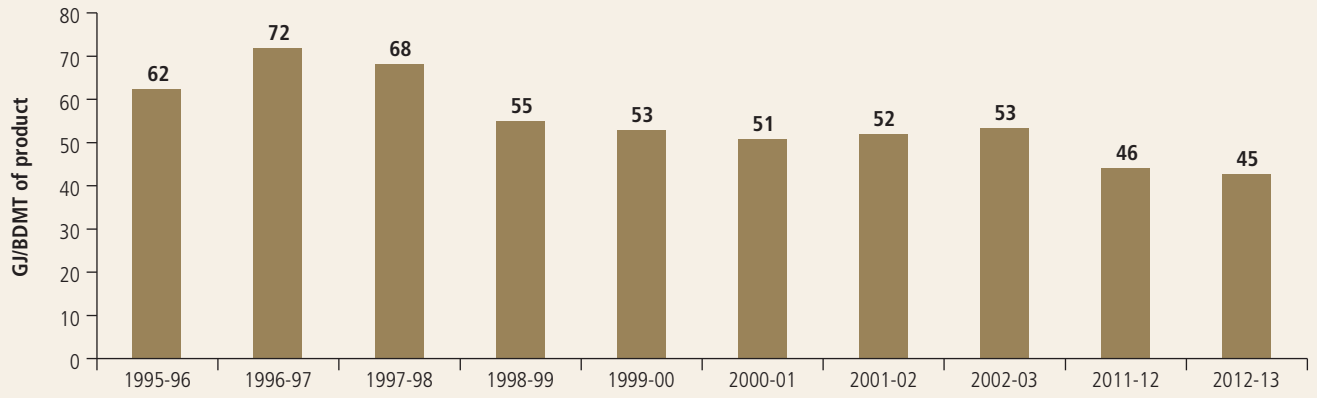
The pulp and paper industry is extremely energy intensive, with energy costs accounting for nearly 25 per cent of the paper manufacturing costs. On the other hand, a pulp mill can be 100 per cent self-sufficient in terms of heat energy by utilizing the internally generated biomass. In fact, pulp mills in Sweden send the surplus heat to their district heating networks. However, in order to be reliant predominantly on the biomass generated, the energy consumption levels of the mill's processes should be low.

The energy consumption in the sample mills has shown a decreasing trend but the rate of improvement has been inadequate. In 2012-13, the specific primary energy consumption has reduced to 45 GJ/BDMT of product, at a CAGR of -1.8 per cent, dropping from 62 GJ/BDMT of product in 1995. TNPL and ITC Ltd. have reduced their energy consumption the most. From an average specific energy consumption of 107 GJ/BDMT of product during the years 1995-98, TNPL has reduced its energy consumption to 45 GJ/BDMT of paper produced in 2012-13. However, an increasing proportion of it comes from fossil fuels, thereby offsetting the benefits of reduced energy consumption. Similarly ITC Ltd. has reduced its energy consumption from an average of 74 GJ/BDMT of product during 1995-98 to 31 GJ/BDMT of product in 2012-13. JKP-Rayagada and Orient Paper are the only mills that seem to have increased energy consumption. It may be noted here that factors such as change in product mix and capacity utilization may have played a part in the energy consumption trends.

Though benchmarking energy consumption is difficult given the variations in terms of raw material mix, processes, reporting methods, final product etc, we estimate that the industry continues to underperform when compared to mills globally. International Papers for example, consumes secondary energy of 10 GJ per tonne of paper produced. The sustainability report by Confederation of European Paper Mills pegs the average secondary energy consumption of European mills at 13 GJ/tonne of product. This would roughly translate to specific primary energy of 22 GJ/tonne of product – half the average energy consumption of the sample mills. Even taking the boiler and turbine efficiencies into consideration, the mills in our sample are far from global standards.

The Indian pulp and paper industry's main source of energy continues to be coal, which contributes to more than 50 percent of the total energy consumed, a state of affairs that has seen no change in the last 18 years.

Specific energy consumption in sample mills



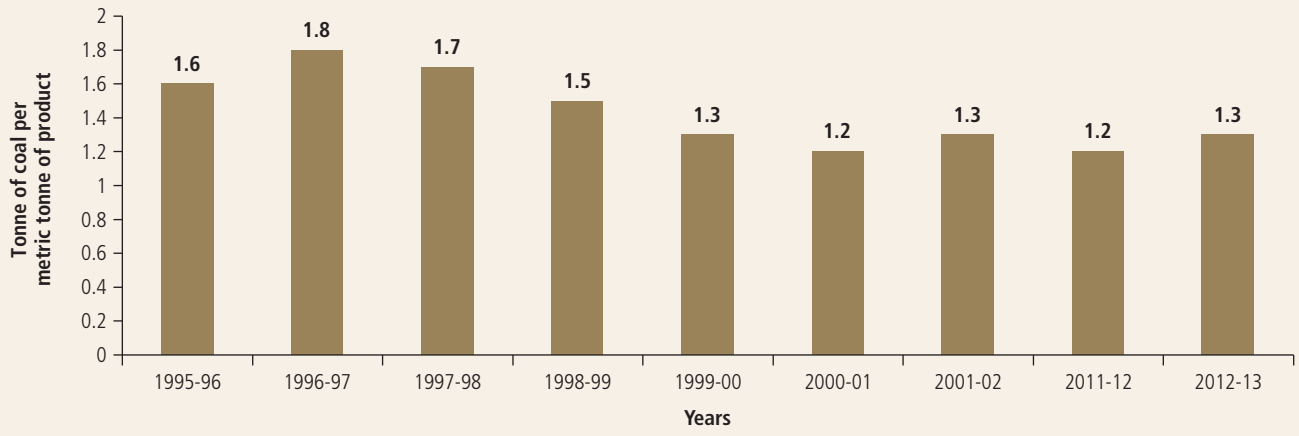
Specific energy consumption (GJ/BDMT of product)

	BILT-SGU	BILT-Ballarpur	BILT- Sewa	TNPL	JKP- CPM	ITC Ltd	Seshasayee Paper	Orient Paper	Star	Century	WCPM	JKP-Rayagada	Weighted average
1995-96	79	67	79	99	54	65	67	NA	53	74	53	44	62
1996-97	65	65	85	127	49	67	69	81	NA	75	55	53	72
1997-98	60	59	83	96	47	90	69	86	NA	66	58	66	68
1998-99	75	59	68	35	52	43	87	83	56	52	44	68	55
1999-00	74	56	63	40	50	37	85	77	54	47	45	60	53
2000-01	72	53	67	42	53	34	70	76	51	50	45	55	50
2001-02	69	51	70	52	45	37	61	80	50	48	42	54	52
2002-03	69	53	71	67	48	39	48	79	45	52	NA	51	53
2011-12	63	44	62	48	35	32	53	86	54	48	46	50	46
2012-13	58	42	61	45	34	31	51	91	45	55	45	49	45
CAGR	**-1.7**	**-2.5**	**-1.4**	**-4.3**	**-2.5**	**-4.1**	**-1.5**	**0.7**	**-0.9**	**-1.6**	**-0.9**	**0.6**	**-1.8**

Specific coal consumption (MT of coal/BDMT of product)

	BILT- SGU	BILT - Ballarpur	BILT- Sewa	TNPL	JKP- CPM	ITC Ltd	Seshasayee Paper	Orient Paper	Star	Century	WCPM	JKP -Rayagada	Weighted average
1995-96	2.3	2.8	2.7	1.0	1.6	1.7	2.6		1.2	2.2	1.5	1.3	1.7
1996-97	2.2	2.8	2.7	1.5	1.7	1.8	2.7	2.4	1.3	1.9	1.5	1.6	1.9
1997-98	2.2	1.7	2.7	1.2	1.5	2.4	2.7	2.8	0.0	1.5	1.3	2.1	1.7
1998-99	2.6	2.1	2.2	0.9	1.5	1.7	0.4	2.9	0.9	1.4	1.0	2.5	1.6
1999-00	1.8	2.0	2.1	1.2	1.5	1.4	0.8	2.7	0.7	1.3	1.0	2.0	1.5
2000-01	1.7	1.8	2.5	1.3	1.7	1.2	0.6	2.7	0.6	1.4	1.0	1.4	1.5
2001-02	1.7	1.7	2.7	1.5	1.3	1.2	0.5	2.9	0.6	1.5	0.8	1.7	1.4
2011-12	2.3	1.8	1.8	1.2	1.1	1.0	1.4	3.0	0.8	1.4	1.0	1.6	1.3
2012-13	2.1	1.7	1.8	1.1	1.0	1.0	1.3	3.5	0.5	1.6	1.0	1.6	1.3

Specific coal consumption in sample mills



Percentage of energy from coal (%)

	BILT- SGU	BILT- Ballarpur	BILT- Sewa	TNPL	JKP- CPM	ITC Ltd	Seshasayee Paper	Orient Paper	Star	Century	WCPM	JKP -Rayagada	Weighted average
1995-96	71	75	63	17	55	71	75	NA	49	57	55	62	56
1996-97	84	75	59	22	63	71	76	NA	NA	50	53	67	49
1997-98	86	73	60	23	61	75	76	52	NA	45	53	73	55
1998-99	77	64	50	56	54	71	13	67	41	53	46	63	56
1999-00	76	65	56	61	54	72	27	67	35	53	44	58	58
2000-01	75	63	58	62	58	74	24	68	33	55	45	54	57
2001-02	74	61	56	65	51	76	21	68	32	59	37	53	57
2011-12	65	70	57	51	66	44	52	62	29	59	47	59	54
2012-13	61	70	60	51	68	46	51	67	24	57	49	57	55

Self Sufficiency Index: The self-sufficiency index is a measure of the sustainability of the energy sourcing practices in a paper mill. It takes into account the percentage of energy used by the mill from renewable energy, internally generated bio mass and other bio fuels. With the considerable dependency on fossil fuels, the sustainability index of the mills has not improved.

Self sufficiency index (%)

	BILT- SGU	BILT - Ballarpur	BILT- Sewa	TNPL	JKP - CPM	ITC Ltd	Seshasayee Paper	Orient Paper	Star	Century	WCPM	JKP - Rayagada	Weighted Average
1998-99	22	35	39	38	42	26	46	33	45	46	36	34	36
1999-00	23	35	37	36	44	26	49	33	49	46	36	38	36
2000-01	25	37	34	34	41	25	45	31	49	44	37	41	35
2001-02	26	39	33	32	48	23	45	31	49	39	44	44	36
2011-12	34	26	37	43	33	53	43	36	54	37	46	41	42
2012-13	34	27	34	44	32	52	44	32	64	39	46	43	42

Water consumption

Integrated wood based paper mills were known to be water guzzlers in the past. However by the second rating of the industry there was clearly a decreasing trend in their water consumption. With rising water scarcity, mills have adopted various water conservation measures bringing the water consumption levels down substantially. The mills in the sample have reduced their specific water use by a CAGR of 7 per cent since 1995. This is a 73 per cent reduction from its, admittedly, high water consumption figures in 1995. In terms of total quantum of water consumed, the mills are using 30 per cent lesser water today to produce 170 percent more pulp and paper. Though the reduction in consumption is impressive, there is immense scope for further lowering it. Considering that the average fresh water consumption of European mills is at 35 cubic meter of water per tonne of product, Indian mills still have a long way to go.

A number of mills like JKP-CPM and Rayagada, ITC Ltd., TNPL and BILT – Ballarpur have substantially reduced their water consumption. Given that manufacturing of writing and printing paper is more water intensive and water scarcity is a huge threat to the mills, TNPL and BILT – Ballarpur's initiatives towards reducing water consumption is commendable. Water has never been a commodity that can be exploited indefinitely. Reduction in water use is unavoidable as a number of units are located in severe water stressed areas resulting in increased conflicts with local communities (See Box). Though the sector as a whole has shown marked improvement, the units that continue to consume higher levels have to ensure better performance before they are forced to do so. Most plants only seem to take steps on a war-footing basis, when shortage hits their production. The need of the hour for paper mills across the country is to take steps towards water conservation -immediately and proactively.

Water water everywhere?

From consuming more than 200 m^3 of water per tonne of paper produced, Tamil Nadu Newsprint and Paper Ltd. is has reduced its consumption by 70 per cent, at 58 m^3 of water, owing to large scale water conservation measures implemented by them.

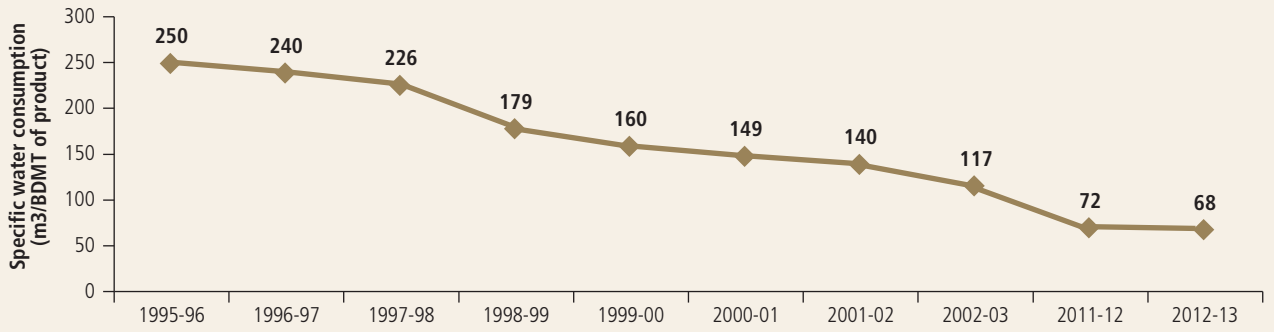
TNPL, situated in Karur, Tamil Nadu, is completely dependent on the water from the Cauvery River. With the failure of the south-west monsoons in 2012-13 the area faced severe water scarcity. The summer of 2013 saw wide spread agitation in nearly 25 villages around TNPL's units demanding reduced water consumption by the paper mill and diversion of this water from the river to the villages. Despite TNPL's paper production being hit by the crisis, the mill had to relent to the villager's demands that it halves its water consumption.

During this period, the mill implemented a slew of water conservation initiatives. The management constituted a team to identify possible areas of water conservation for both short and long term and to implement and conduct regular overviews of these initiatives.

The replacement of fresh water with a) clear water for dilution of fillers in a paper machine b) cooling water in a recovery boiler's spout cooling system c) pump seal water in chlorine dioxide plants and d) pump seal water in causticizer and limekiln and reusing of clarified paper machine effluent in raw material preparation are a few initiatives which helped reduced their water intake. The extensive reuse of water, for example, recirculation of hydraulic cooling water within the ECF plant, return of ID, FD cooling water, feed pump cooling water and lime kiln support roller bearing cooling water to water treatment plant have also been carried out to effectively run the plant with the water available.

In the two most severe months of draught in 2013 (May-June), the unit implemented extremely stringent water saving measures such that the specific water consumption dropped as low as 34 m^3. The mill asserts that such measures however cannot be implemented all year round. TNPL however has been able to reduce the specific water consumption to 48 m^3 per tonne of paper post June 2013 while it recorded a consumption of 58m^3 per tonne of paper produced in 2012-13.

Specific water consumption in sample mills



Specific water consumption (m^3/BDMT of product)

	BILT- SGU	BILT - Ballarpur	BILT- Sewa	TNPL	JKP - CPM	ITC Ltd	Seshasayee Paper	Orient Paper	Star	Century	WCPM	JKP - Rayagada	Weighted Average
1995-96	396	205	220	216	151	283	221	275	242	219	327	147	250
1996-97	414	162	204	231	198	285	219	258	222	179	298	148	240
1997-98	433	153	202	193	244	334	201	251	212	150	288	118	226
1998-99	276	165	175	121	197	140	208	226	194	150	246	169	179
1999-00	247	166	162	117	194	106	202	175	180	134	231	136	158
2000-01	223	146	129	100	193	98	169	177	172	134	267	109	148
2001-02	182	132	134	104	178	97	128	194	175	122	244	110	139
2002-03	188	137	137	113	143	82	97	167	144	130	NA	93	117
2011-12	126	58	110	65	45	46	79	101	129	85	98	59	72
2012-13	127	59	105	58	42	42	74	135	109	77	91	58	68
% change	**-68**	**-74**	**-52**	**-73**	**-72**	**-85**	**-67**	**-51**	**-55**	**-65**	**-72**	**-60**	**-73**
CAGR	**-6.1**	**-7.2**	**-4.0**	**-7.0**	**-6.9**	**-10.0**	**-5.9**	**-3.9**	**-4.3**	**-5.6**	**-6.9**	**-5.0**	**-7.0**

POLLUTION

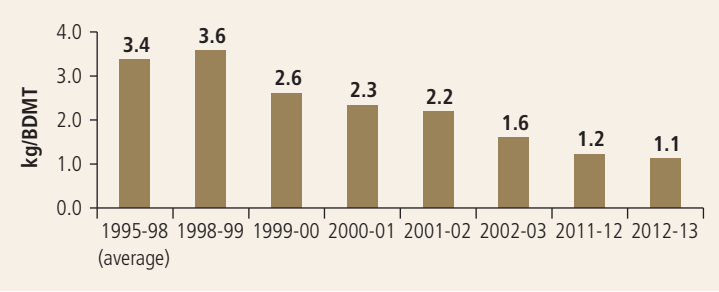
Waste water

Waste water discharge: Reduced water consumption, as has been detailed in the previous section, has brought about reduction in quantum of waste water discharged. Secondly, with increased water recycling measures, mills have also proportionately reduced the waste water discharged into the environment. All mills have reduced their waste water discharge by at least 50 per cent, at a CAGR of -7.4 per cent, since 1995. TNPL discharges the lowest amount of specific waste water (at an average 28 m^3 / tonne of paper) into the environment. The mill also discharges lowest quantum of water as percentage of specific water consumed (at 45 percent) given the extensive recycling and reusing measures it has employed.

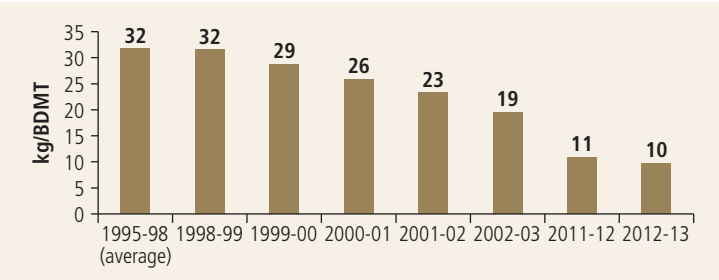
Waste water pollution load: The sample mills have implemented a number of process changes in the bleaching and pulping sections specifically. These changes have led to reduction in the pollution load in the effluent discharged. The data disclosed by the mills appear to have wide variations and the reasons have not been explored in detail. (For example, the effluent quality is also a function of the effluent treatment plant in place.) Overall pollution load has dropped substantially with BOD and COD reducing by 69 per cent and TSS by 75 per cent since 1995. Also, despite a few inexplicable variations, there has been a substantial reduction in AOX levels. A reduction in pollution loads- especially AOX levels- is seen in mills which have adopted ECF bleaching. The pollution loads disclosed from all the mills are well within standards prescribed by the Central Pollution Control Board. However in comparison with international standards they fall short. The Indian mills average BOD levels were 1.2 kg/BDMT of product and the COD levels stood at 11 kg/BDMT of product. The European mills on the other hand reported an average BOD of 0.89 kg/ tonne of product and COD of 6.26 kg/tonne of product.

Waste water characteristics

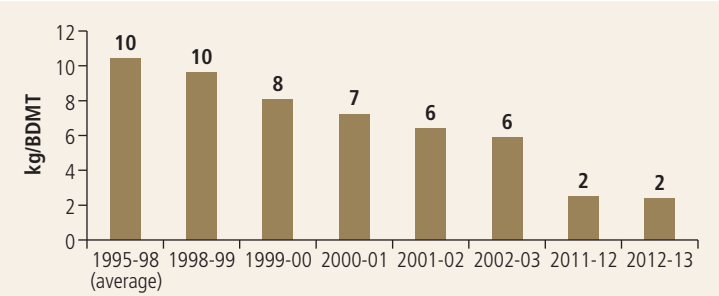
Specific BOD



Specific COD



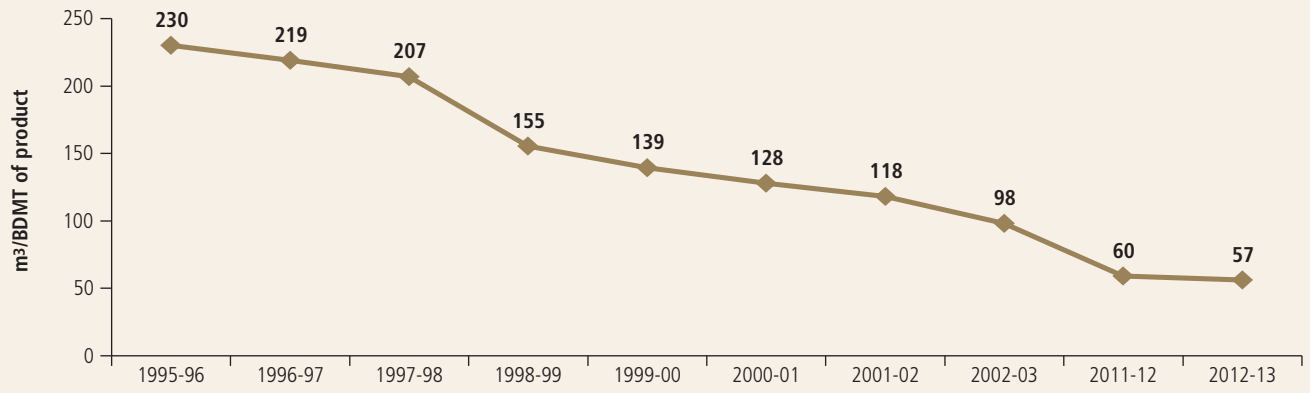
Specific TSS



Specific waste water discharge in sample mills

	BILT- SGU	BILT - Ballarpur	BILT- Sewa	TNPL	JKP - CPM	ITC Ltd	Seshasayee Paper	Orient Paper	Star	Century	WCPM	JKP - Rayagada	Weighted Average
1995-96	357	227	198	194	136	255	199	247	218	203	294	133	230
1996-97	372	180	184	208	178	257	197	232	200	170	268	133	219
1997-98	389	169	182	174	219	300	181	226	191	143	259	107	207
1998-99	264	157	157	104	193	113	191	158	181	135	198	141	156
1999-00	224	158	146	98	190	87	182	138	168	121	190	101	138
2000-01	202	132	116	86	185	82	159	133	161	121	199	91	127
2001-02	165	119	121	79	168	81	115	140	162	110	189	86	117
2002-03	171	123	110	74	137	73	94	104	134	117	NA	79	98
2011-12	113	52	93	30	41	44	71	88	114	63	96	53	60
2012-13	109	52	90	28	38	41	67	115	97	58	87	52	57
% change	**-69**	**-75**	**-55**	**-86**	**-72**	**-84**	**-66**	**-54**	**-55**	**-71**	**-70**	**-61**	**-75**
CAGR	**-6.4**	**-7.4**	**-4.3**	**-10.2**	**-6.8**	**-9.7**	**-5.9**	**-4.2**	**-4.4**	**-6.7**	**-6.5**	**-5.1**	**-7.4**

Specific waste water discharge



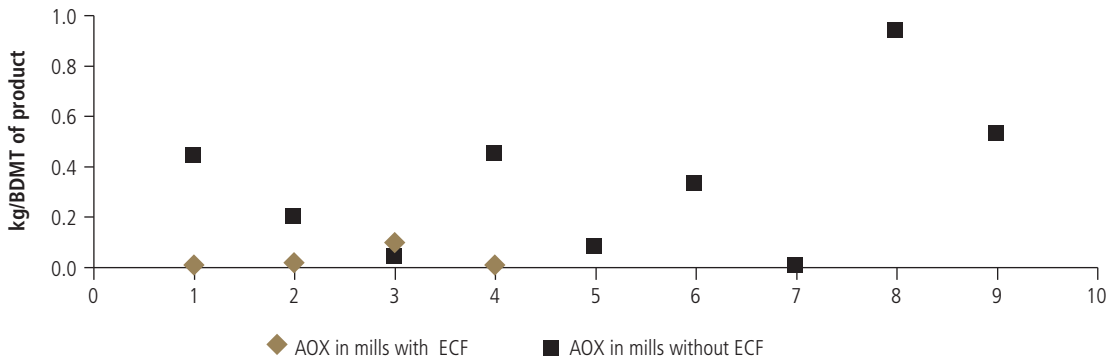
Elemental Chlorine Free bleaching and pollution loads

Adsorbable Organic Halides or AOX are formed during the bleaching phase in the paper manufacturing process. The bleaching process generates organochlorides (measured as AOX) which do not degrade easily, tend to bio-accumulate and are proven to be carcinogenic. Eliminating elemental chlorine from the bleaching cycle is the primary solution to eliminating AOX. Oxygen delignification (ODL) also reduces the lignin content of the pulp which translates into reduction in chlorine required to remove it. This consequently reduces the AOX levels in the final effluent.

Of the 12 mills, 4 use Elemental Chlorine Free Bleaching while 9 have installed oxygen delignification. While all the mills indicated that their AOX levels are below the permitted 1 kg/BDMT of paper, those which have ECF bleaching reported lower levels. The lowest values have been reported by TNPL, Seshasayee Papers and ITC which not only have ECF bleaching but ODL as well. BILT-Sewa, which does not have ODL and partially uses chlorine in its bleaching sequence, has reported highest AOX levels at 0.95 kg/BDMT of paper.

However, despite AOX being the most toxic of the pollutants in the effluent stream, its reporting and monitoring remains poor. Mills which employ elemental chlorine and consume large volumes of the same report inexplicably low values. ODL can explain lower levels of AOX reported in a few cases but in instances where no measures seem evident there appears to be irregularities in either measurements or reporting. This appears to highlight a deficiency in the systems set up to ensure regular monitoring and proper reporting of the deadliest of the pollutants from a paper mill.

AOX levels in sample mills

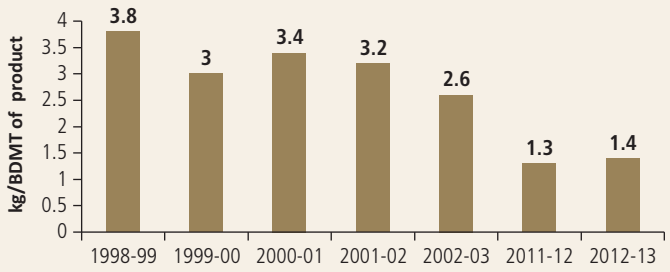


Air emissions

Clearly discernable foul odour is a characteristic quality of air emissions in a pulp and paper mill, more so in the kraft pulping process where emissions of sulphur content are high. Power boilers and lime kiln are the main emitters of the oxides of sulphur and nitrogen, collectively grouped as SOx and NOx. In the absence of norms for both these parameters, the monitoring and reporting of the same was irregular and consequently, unreliable during the previous ratings. Today, there are still no norms for SOx and NOx emissions and the reliability remains questionable. However, based on the available data, the average specific SO_2 emissions in the sample mills stand at 1.94 kg/ BDMT of product and the NOx levels at 0.32 kg/BDMT of product. SPM has been reported at 1.4 kg/BDMT of product- a reduction by 63 percent from the levels reported in 1999.

The pulp and paper industry's substantial use of carbon neutral biomass as fuel reflects significantly in its carbon dioxide emission profile. With reducing energy consumption and a slight increase in share of biomass in the fuel mix, the GHG emissions of a paper mills has dropped by 23 per cent, from 3.4 tonnes /BDMT of product to 2.6 tonnes/BDMT of product. On the other hand, in 2012 European mills report an average 0.24 tonnes/BDMT of product produced- nearly 10 times lesser than their Indian counterparts.

Specific Particulate Matter



Specific GHG emissions in sample mills (tonnes/BDMT of product)

	BILT- Yamuna Nagar	BILT - Ballarpur	BILT- Sewa	TNPL	JKP-CPM	ITC Ltd	Seshayee Paper	Orient Paper	Star	Century Pulp & Paper	West Coast Paper	JKP Rayagada	Weighted Average
1998-99	5.4	3.6	3.9	2.4	3.0	3.0	4.0	5.2	3.6	2.7	2.7	4.5	3.4
1999-00	5.3	3.4	3.8	2.7	2.8	2.5	4.5	4.8	2.8	2.5	2.7	3.7	3.3
2000-01	5.0	3.1	3.8	2.9	2.9	2.4	3.9	4.9	2.6	2.7	2.8	3.2	3.1
2001-02	4.7	2.9	3.9	3.4	2.2	2.7	3.6	5.2	2.5	2.9	2.3	3.0	3.2
2011-12	4.2	3.2	4.0	2.7	2.4	1.6	3.1	5.6	3.0	3.0	2.5	2.9	2.7
2012-13	4.0	3.0	4.2	2.5	2.5	1.5	2.8	6.1	2.0	3.3	2.5	2.8	2.6
% change	**-26**	**-17**	**8**	**3**	**-18**	**-50**	**-30**	**18**	**-45**	**23**	**-10**	**-37**	**-23**
CAGR	**-2.0**	**-1.2**	**0.5**	**0.2**	**-1.3**	**-4.5**	**-2.4**	**1.1**	**-4.0**	**1.4**	**-0.7**	**-3.1**	**-1.7**

Conclusion

The two Green Ratings of the pulp and paper industry carried out in 1998 and 2004 and the survey carried out in 2013 helps to benchmark the performance of the industry over the years. The previous rating showed that in many aspects the industry was behind the global standards by at least a decade. Since the last rating, the industry has shown consistent improvement across several parameters. However, the Indian mills are yet to catch up with the developed world.

The first and second ratings highlighted a number of important indicators that exhibited improving trends: water management, raw material sourcing, environment management and cleaner technologies in the bleaching and pulping sections being the key ones. The current survey of the integrated plants in our sample shows commendable improvements in all of the above mentioned indicators and has added a few more to this list.

The most heartening indicator is the further improvement in raw material sourcing. On an average, the mills in our sample were sourcing between 24 per cent to 30 per cent of wood from farmers during the first and second ratings. The sample is now sourcing 59 per cent of its wood from farmers and 26 per cent from open markets. The share of wood from government plantations has reduced substantially and captive plantations are all but non-existent.

On the energy front, the consumption levels still remain drastically higher than the global standards. Given that several pulp mills around the globe are now energy "surplus", the energy consumption of the integrated mills in our sample at 45 GJ/annum has immense scope for reduction. The higher levels of consumption also result in greater dependence on fossil fuels. With coal contributing to more than 50 per cent of the fuel used, the mills self sufficiency index- the percentage contribution of biofuels – remains low.

As we found in our second rating, the decreasing trend in water consumption has continued. Better water management and recycling practices reflect in the reduction in water usage in the Indian mills. From an average 226 m^3 of water consumed for every tonne of paper made in 1998, the usage dropped to an average 140 m^3 of water in 2002. In 2013, the average specific water consumption of the sample mills stood at 68 m^3. While this indicates a 73 per cent reduction in consumption from 1995 levels, we note that this is still a long way from the standards in the developed world. Adoption of clean technologies like TCF by the European mills has brought their water usage levels down to 35 m^3 per tonne of product produced. Furthermore, water closure has already been realized to a large extent in a number of mills across the world, a clear indicator of how far the Indian mills still need to go.

Similarly, improvements in the bleaching section are noticeable but chlorine is yet to be completely phased out in the Indian pulp and paper industry. As mentioned previously in the report, mills across the world have completely phased out both chlorine and chlorine dioxide as primary bleaching chemical and are now moving towards TCF bleaching. In contrast, elemental chlorine use in several mills in our sample remains inordinately high.

Chemical recovery measures have been implemented in every single plant greatly reducing their overall chemical consumption. Lime consumption, however, remains inexplicably high at an average 96 kg/BDMT of unbleached pulp. This is despite all the mills in the sample having lime kilns.

In balance, we believe, there is an increased environmental consciousness in the industry. The industry has taken some encouraging steps with positive results in raw material sourcing. It has shown considerable improvement in water usage but still has some ground to cover. Energy efficiency is steadily improving, albeit at a less than desirable rate. It is in chemical consumption, specifically chlorine use, where the industry has fallen below our expectations. While some companies in our sample have done away with elemental chlorine, TCF bleaching remains a distant goal. Finally, we are encouraged by the industry's willingness to come forward with data, which indicates their confidence in their work on the sustainability front. It is also a reminder that being a responsible business is inextricably linked to voluntary public disclosure.