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22786

UNIDO Project XP/GLO/01/005

UNIDO Contract N° 2001/282

**“UNIDO Preparatory Activities for
Rio + 10 – World Summit on Sustainable Development”**

Assessing the Uptake of EST

by the Pulp & Paper Industry

in the South of Brazil

- Final Report -

Contractor:



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Porto Alegre, July, 29th 2002

Assessing the Uptake of EST (Environmentally Sound Technologies) by the Pulp & Paper Industry in the South of Brazil

Celso Foelkel
Project leader

Introduction

Worldwide , it is well-known the rapid growth and excellent position, in a competitive basis, of the Brazilian pulp and paper industry. It's even claimed by the Brazilians, that the country has a forest vocation, with the ability to grow planted forests in amazing rates, and to convert the corresponding wood in valuable to the market, but low-cost wood products. The most important of them have been market pulp and paper products. Since the Brazilian pulp and paper segment has gained a very important competitive position, the eyes of the world have been always placed over this business scenario, trying to understand the reasons for that. It's also recognized that this competitive advantage is not only due to tree growth rates, but also to efficient management and corporate responsibility towards the business and to the environment. Most of the Brazilian P&P mills are owned by domestic companies, however there are some controlled by transnational corporations. The success of this business is based on manufacturing costs, product quality, logistics, guarantee of supply the right product at the right time and price, and environmental performance. These features are not only an attribute of the export-oriented companies, but also they are of common demand in the domestic market oriented mills. What have been the main driving forces to this history of business success? What are the forces orientating the strategies to add competitiveness, profitability, productivity and environmentally-friendly attitudes? Why the state-of-the-art technologies have reached Brazil in a so fast rate?

Given these facts of good business performance in an usually polluted industrial activity, this report was made possible by UNIDO to assess information about the segment commitments and to share them with the Society. The research was performed in the South of Brazil, comprising the states of Parana, Santa Catarina, and Rio Grande do Sul. These three states are responsible for the production of 30 % of the Brazilian pulp production and for 40 % of the country paper production. The methodology utilized was based on interviews, readings, own knowledge within the project team, and literature research. Interviews covered pulp and paper mills, environmental regulators, technological centers, business associations, material suppliers and NGOs.

The following main purposes we had in mind to get answers along the investigation:

- ✓ What have been the reasons to guide the pulp and paper segment in the South of Brazil to follow the road of investing in EST- Environmentally Sound Technologies?
- ✓ What sort of EST have been selected by the companies? End-of-pipe techniques or cleaner production and eco-efficiency/pollution prevention?
- ✓ In what speed this implementation is or has happened?
- ✓ What have been the roads to obtain, acquire, develop and transfer these technologies?
- ✓ What level of support the companies have received for doing this? From where?
- ✓ What was the level of technical expertise required for this technological uptake and where this was found??
- ✓ What have been the market and consumers reactions to these implementations?
- ✓ What have been the reactions from stakeholders (clients, suppliers, investors, financing institutions, shareholders, communities, NGOs and environmental regulators)?

- ✓ What have been the impacts of EST in terms of social, environmental and economical performance of the enterprises?
- ✓ What are the expectations in all of these stakeholders in terms of environment, cleaner technologies, and industrial production more environmentally friendly?
- ✓ What could be recommended for further achievements and improvements?

Section 1: Macro-economic issues affecting the sector

Synthesis of the Brazilian economy

Brazil is a country that has now an economy in a process of stabilized growth. A proof of this has been the positive reactions that the economy is given to important world economical crisis, as those in Japan and Tigers, Russia, Indonesia, and more recently, Argentina. Today, it is difficult to predict macro-economical performance in a complex and dynamic global network due to the interactions among the economies. Brazil, because some macro-economical weaknesses, is sensitive to turmoil in economy, but the foundations of the domestic economy are being relatively stable to sustain the growth along the many years of turbulence.

Today, the most difficult task to economists is to combine and to balance three macro-economical factors: inflation rate, currency exchange rate in relation to a strong currency, and interest rates. There are many gurus in economy stating that you are able to control maximum two of this factors, and the remaining will float in a non predictable way. For this reason, the Brazilian industry and the country economy are offset by high interest rates, or currency devaluation, since the inflation rate has been kept under control since 1994. Many times, the currency devaluation reflects political anxieties or clearly investors speculations. In this respect, sometimes a calm scenario is converted to a turmoil from one weak to another thanks to some turbulence elsewhere. This has been the world behavior today, and Latin American countries are being severely hurt by these crisis, since their economies are under consolidation after years of dictatorial regimens, whose benefits are questionable. What is important in the impacts of any financial crisis, whose epicenter may be located in the country or abroad, is that that Brazil has a solid commitment with IMF – International Monetary Fund to implement a consistent macro-economical policy, and the terms and steps are being gradually fulfilled.

The Brazilian GDP – Gross Domestic Product growth in the past 5 years has been positive and varying from 0,2% to 4,2 % yearly, modest level, but not declining. (See Table A, in Annex I). The sectors with better performances are: communications, industry, and agriculture. Brazilian total exports are reaching 55 to 60 billion dollars per year, and imports are close to this value. In comparison to a GDP of 575 billion dollars in the year 2000, exports and imports are roughly 10% of this economic index. This performance is still weak, but the country has great potential to improve it. Up to a certain extent, the protectionism and the trade barriers of the past are still reflecting in the weakness of the global performance of the country. However, this model has being modified substantially in the recent years. Pulp and paper exports are reaching 2.7 billion dollars per year, about 4 to 5% of total exports, showing the importance of the segment. The largest net exporters in Brazil are: Embraer (aircraft), CVRD (mining ores), Petrobras (fossil fuels and gasoline), Volkswagen (cars). However, in the list of the 35 largest Brazilian exporting companies we are able to find Aracruz Celulose and CENIBRA, two market pulp mills.

An important indicator to show the wealth and the health of the economical activity is the value added in the manufacturing industry, also known as MVA. It corresponds to the sum of

outputs less the value of intermediate and raw materials inputs utilized in the industrial production. Brazilian total MVA has grown from 70 billion US\$ in the year 1960 to roughly 155 billion dollars in the year 1999. This is not so spectacular in comparison to the Asian Tigers MVA, but cannot be discarded as non impressive.

In the past 5 years, the country economical performance, including the size of the GDP (see Tables A, B, C and D in Annex I), was very much affected by the exchange rate control. In 1996, the ratio real/dollar was roughly 1:1; in 1998 it reached 1.4: 1. In 1999, with the adoption of the fluctuation regimen for the currency, the rate reached 1.9 : 1, and finally, in mid 2002, it climbed to 2.85:1. This exchange rate policy was very favorable to exports and brought difficulties to imports. The Brazilian products became more competitive, both in the domestic and international markets. For this reason, for the year 2001, the country announced a surplus of 2.6 billion dollars in the trade balance, something completely unique in the recent country history.

Brazilian exports are mainly oriented to European Union (25%), United States(25%), Asia (12%), Mercosul (14%), and ALADI (9%). Main exported goods are: iron ore, coffee, aircrafts, shoes, pulp and paper, soybean raw and derivatives, vehicles and parts, sugar, tobacco, aluminum, orange juice and steel. The main origin for imports are United States, Argentina, Germany, Italy, Japan and France. Main imported products are: vehicles, electronics, aircrafts, oil, chemicals, wheat and pharmaceuticals.

Country population reached in 2000 a number close to 170 million, and the active population is roughly 75 million persons. The country has a continental size (8.5 million square km), and it is a country of contrasts. Central and south regions are well developed, reaching in many standards the first world levels. However, the North and Northeastern are still deserving better opportunities to reduce poverty, illiteracy, famine, and education. On the other hand, these regions have a potential to become leaders in tourism, and this has not been fully understood and explored till now.

The most recent statistics are from the year 2000, showing an average growth rate of the population along the 90's as being 1.6% per year. The states with better wealth, income per capita, literacy, and life quality are: Federal District (DF), Sao Paulo (SP), Rio de Janeiro (RJ), Santa Catarina (SC), Rio Grande do Sul (RS), and Parana (PR).

Brazil is gradually consolidating its image as a stable economy, gaining the fight against inflation, improving the trade balance and sustaining a continuous, although modest, growth.

Synthesis of the Brazilian Southern states economy

The states comprised by the Southern region of Brazil are Parana, Santa Catarina and Rio Grande do Sul, with corresponding populations of 9.6 million, 5.3 million, and 10.2 million inhabitants. The South corresponds to 15% of the Brazilian population. These states have received high level of immigration along the 19th and early 20th century, mainly from Germany, Italy, Poland, Spain, Uruguay, Argentina, Scandinavia, without mentioning the people from Portuguese origin. The best results in Brazil for the UN Human Development Indexes are found in these states, comparably with other regions of the country. Per capita income is related to the better performance of the people as consumers and quality demands. These states also have good education standards, inferior only to Federal District, Rio de Janeiro and Sao Paulo. As a rule, it may be said that these states are very homogeneous in terms of quality of life, educational level and income. They are well ranked comparably with the other Brazilian states. Regarding to wealth generation, Sao Paulo is far the leader in Brazil, but a growth in the Southern states is being noticed along the recent years.

Table 1: Brazilian states - GDP and exports (billion of dollars in the year 2000)

	GDP (year 2000)	Exports
Sao Paulo	216.7	19.79
Rio de Janeiro	64.5	1.84
Minas Gerais	57.7	6.71
Rio Grande do Sul	42.8	5.78
Parana	33.9	4.39
Bahia	26.2	1.94
Santa Catarina	19.6	2.71
Federal District	15.5	-

Source: Revista Amanha- Ranking of Brazilian States
Year XVI, number 172, November 2001

A comparison among the states was also performed based on indexes as such: illiteracy, GDP, per capita income, hospital availability of beds, gasoline consumption, cement consumption, house appliance available at homes, sales of supermarket networks, mortality of infants, life expectance, potential for consumption of goods. All these parameters were converted in a Global Competitiveness Index, and a ranking was found as such:

Table 2: Global Competitiveness Indexes for Brazilian states

States	Global Competitiveness Index (the higher , the better)
Sao Paulo	182.2
Minas Gerais	163.6
Rio de Janeiro	162.6
Parana	157.4
Rio Grande do Sul	157.3
Santa Catarina	150.0
Bahia	131.7

Source: Revista Amanha- Ranking of Brazilian States,
Year XVI, number 172, November 2001

Once more, it is stressed the fact that the Southern states are homogeneous in life quality, and also in their economies. They are ranked among the most competitive in the Brazilian economy. Within the top 500 companies in the South of Brazil, Rio Grande do Sul has 240, Parana has 147, and Santa Catarina has 113. (Source: Revista Amanha, Year 168, number 168, July 2001). In most of cases, the top enterprises are oriented to business as such: food industry, metal-mechanics, electric/electronic, financing, textiles, furniture, and pulp & paper. It is possible to observe an agricultural and forestry orientation in theses states, but in the recent past decades, a strong industrialization based on metal/mechanics and electric/electronics has grown. More sophisticated industrial clusters are been formed, and they are very competitive. Besides industry, the financing and telecommunication sectors are also growing. Companies in the south are also oriented to business as petrochemical, metallurgy, airlines, generation of electricity, food production, banks, and pulp and paper. Pulp and paper is a traditional business in the states of

South Brazil. Some companies had their origin in the local they are installed, and others have migrated from other states (Sao Paulo, for instance), because the abundant availability of wood supply in the region. It's a highlight in this respect the Klabin group, the number one pulp and paper group in Brazil, with several mills located in the Southern states. These mills are mainly integrated and oriented to the production of packaging papers and paperboards, market pulp and tissue papers.

Macro-economical environment and the effects on the pulp and paper industry

The overall appraisal of the Brazilian economy in recent years is widely positive. In regard of certain competitive parameters, the country is being able to consolidate a moderate growth, without lack of stability. The outstanding Brazilian features on the macro-economic environment are being the ability to maintain inflation under control, below 7%; to improve the trade balance (finally positive); to rescue the investor's confidence specially in the pulp and paper sector; and to promote GDP growth (although still at modest rates). The adjustment of the economy, the improvements of the general financing conditions, and a more flexible and real exchange rate policy are bringing back the confidence for better days ahead. More than this, the economy is showing potential for recovering, although suffering to absorb the economical crash of Argentina, the Brazilian largest partner in Mercosul.

The Brazilian economical policy reflects the commitments with the International Monetary Fund, responsible to the very austere management of the country accounts. Fiscal policies have been settled to the needs to guarantee the goals of fiscal surplus. With regard to institutional changes, the Law of Fiscal Responsibility was recently approved. This opens the opportunity to check the fiscal administration of government authorities, in any level. The monetary policy is still disappointing investors, because the still abnormally high interest rates to finance and to borrow money at the financial institutions. Another disappointment is the slow move on the Federal Government side to promote adjustments in the tremendously complex taxation system, something difficult to be understood even by the most qualified lawyers in the matter.

Fortunately, the fluctuating rate regimen applied to the national currency is being highly positive, improving the country competitiveness in the domestic and international markets.

However, Federal Government still has homework to be done: tributary (taxation) and monetary (interest rates) issues are weakening the Brazilian competitiveness, and they must be solved as soon as possible. There are concerns about these trends because the Federal Government moves are expected to slow down, since Mr. Fernando Henrique Cardoso is close to the end of his presidential term. The perspectives of changes in the country economical and social policies due to potential replacements in the federal government are bringing some concerns to the foreign investors, but this is democracy. Changes have to be accepted, understood, and absorbed, if votes switch from one party to another, reflecting the people wishes.

Up to a certain extent, the pulp and paper segment is considered an island of prosperity and happiness in the overall Brazilian economy. There are several reasons for this: a) the exporting orientation of the P&P industry, benefited from the exchange rate; b) the lowest worldwide production costs in dollars, partially due to exchange rate, and mainly due to low wood, energy and chemical costs; c) the highest margin of contribution in the world to market pulp, and some grades of papers. This enables the country to grab significant world market share in the manufacturing of eucalyptus market pulp. Even during the turbulence in some of the frequent but temporary financial crisis, the pulp and paper firms are performing very well in the

stocks markets (Aracruz, Votorantin, Ripasa, Klabin), showing continuous growth in demand and value. However, the segment is not navigating in a sea of flowers. There are several constraints, from which some of the most important are: a) the amount of capital required for further growth and the cost of money in Brazil; b) the old taxation system, very primitive and painful to the manufacturing industry; c) the complicated and bureaucratic logistics, from the forest to the sea port, when exporting.

Industrial regimen and public policy measures affecting the pulp and paper sector

The 90's were very positive years to the deregulation of barriers that traditionally were reducing the Brazilian competitiveness. Former president, Mr. Fernando Collor de Mello, although unpopular due to corruption denouncements, was courageous enough to remove protective barriers that had isolated Brazil for decades. The succeeding presidents, Mr. Itamar Franco and Mr. F. H. Cardoso, have also focused to promote Brazilian competitiveness via trade liberalization, control of inflation, strong privatization program, and management of the exchange rate. The impacts were very positive and the recent years are showing the results. The industry in Brazil is growing at moderate rates (-1.7% to + 6.6% per year), and some industrial segments are running over capacity to supply internal demand for products, and to generate surplus for exports. One of the industrial sector running at full capacity is the pulp and paper.

Although still with a low profile behavior, the industry executives and investors are playing better the political game, something required in any economy. The Brazilian Confederation of Industries (CNI – www.cni.org.br) and the federations of industries in each state are becoming more sensitive to dialogue with governments, politicians, labor unions, media, ordinary public and NGOs. They are also becoming more active in terms of environmental issues via the environmental councils (CNI / COEMA, and industrial federations / CODEMAs).

Due to the austerity and prudence in the fiscal measures and its management by the Federal Government, incentives are been forbidden words in the government policies. When they happen, they have the aim to attract new industries to a certain region, and they are related to infrastructure supply and/or tax exemption for some years. Very few and shy incentives are being placed to the existing manufacturing sector: there are some possibilities for social and cultural programs, for developing R&D projects in connection to some university, and for training and development of human resources.

In the year 2001, the Federal Government launched an important policy to the pulp and paper segment: the “National Policy for Forests”. The goal is to guarantee raw material supply to the wood-based industry (pulp & paper, furniture, charcoal, panels, housing, etc.), based on the increasing of forest plantations. The aim is to grow plantation area from the today 110,000 hectares per year to around 600,000 hectares. The main exigency in this ambitious plan, is that the forests must be implemented in accordance with sustainable forestry management, protecting the bio-diversity, the watersheds, and the ecosystems.

Another incentive to the sector lies in the recently created Forest Fund, in the Science and Technology Ministry (www.mct.gov.br). The goal is to promote technological developments in the forest-based industry, from the forests to the final products. One of the recently announced support of this incentive is the financial aid to a research project involving universities and forest companies, to read the *Eucalyptus* species genome. The expectations with this research is to speed up forest genetics and tree breeding, maintaining the low wood cost, a highly competitive key factor to the industry.

The pulp and paper segment has had the advantage of the establishment of an important machinery manufacturing industry in Brazil during the 70's, due to strong Federal Government support. For this reason, the segment is not dependent on imports of machinery to grow, both to the upgrading of existing mills or to the build up of new greenfield mills. The majority of the machinery is made under technological contracts and agreements by sub-contracting local firms, or in multinational companies with factories in Brazil (Voith, Kvaerner, ABB, etc). It is estimated that over 90% of a new P&P mill may be manufactured in Brazil. The great problem however is the enormous taxation and tariffs on the machinery, that may vary from 43 to 53% (as reported by BNDES, 2001). The Brazilian machinery industry is able to manufacture most of the required equipments to build up from the ground a new greenfield modern pulp or paper mill: digesters, boilers, lime kiln, turbines, generators, compressors, etc. EOP equipments and installations are also fields of good expertise and excellent domestic manufacturing: gas burners, electrostatic precipitators, scrubbers, clarifiers, aerators, wastewater treatments plants, sludge presses, etc.

Brazilian chemical industry is very important, and it has also an important participation on the pulp and paper development. Most of the chemicals utilized in the P&P manufacturing are made in the country, either on mill site, or at the supplier factory. This is the case for oxygen, chlorine dioxide, ozone, caustic soda, alum, kaolin, calcium carbonate, etc. Some few chemicals are imported from abroad, such as antraquinone, talc, titanium dioxide, powerful brighteners for paper, dyes, etc.

One of the great challenges the Brazilian industry has today is to incorporate to the metal mechanic industry, the world of electronics and communication devices. These segments (electrical, micro-electronics, communications) have been stagnated in the Brazilian industry growth, losing significant ground along the 90's. Even the heavy machinery industry, a golden mine in Brazil during the 70's and 80's, is also depressed by the reduction in public investments in the country infrastructure. This mediocre performances are being followed by a significant increasing in the natural resources processing industries (stainless steel, pulp and paper, food industry, soybean, etc.). The high tech or the new economy is still trying to find a door to more powerfully enter the country.

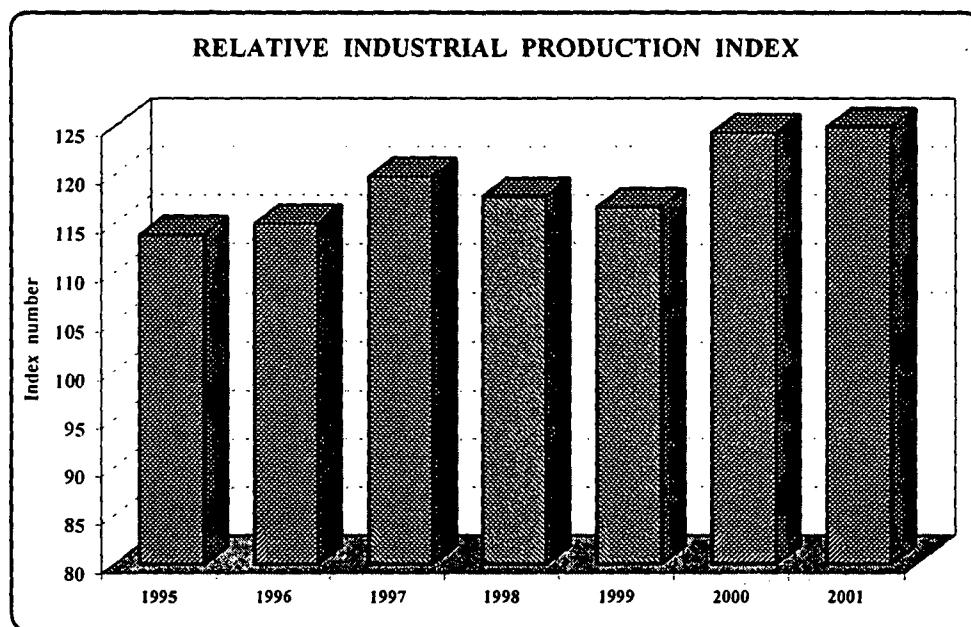
The industrial policies arising from the Ministry of Development, Industry and Commerce (www.mdic.gov.br) are being oriented to raise productivity and reducing wastes, improving overall efficiency in the production chain. In recent years, productivity has dramatically been improved, and new "hidden factories" have been discovered and were able to appear in the production market. Strong quality programs are being promoted and a great enthusiasm is devoted to evaluate constraints, to reduce production costs, to reinforce the operational efficiencies, and to become more competitive. MDID has several programs, together with SEBRAE (www.sebrae.com.br), an entity oriented to develop the skills of management and technology in the small and medium-sized firms. Some of the MDIC and SEBRAE programs, established in partnership with the industry federations, are: competitive forums and sectorial actions to improve competitiveness of selected production chains; program to develop Brazilian design of products; Brazil entrepreneur, a program oriented to develop management performance; bureaucracy-free programs to simplify the procedures to export; quality and productivity forums; industrial inventories for improved information systems; industrial exhibits; utilization of the purchasing power of the governments to develop some specific area of the industry; etc.

There are also other type of incentives to the industrial development, as reduction of local and state taxes and tariffs, utilization of lower cost money available from state funds for modernization and growth; incentives to the exporting-oriented and the job generation centered industries, etc.

The measurements systems to evaluate industrial development may differ from country to country: some appear to be more selective about supporting activities to the industrial framework; other are more specific with respect to companies performances; other are more oriented to industrial sectors; and finally there are measurements to evaluate fitness of the individuals companies to actively participate in the world competitive markets (market share, benchmarks, etc.). Government evaluations give more emphasis on manufacturing, construction, agriculture, services and other productive activities, and they may be found at the MDIC website. The magnitude of the industrial importance in developing world introduced the clear need to a continuous and yearly benchmarking of the industrial development. Several indexes have been developed, but the most accepted now-a-days is the MVA (Manufacturing Value Added), and some variations on the basic index . MVA is important because it shows the aggregation of value, similarly to the EVA to individual firms. Higher it is, more knowledge and technologies are added and incorporated in the manufacturing industry. UNIDO-United Nations Industrial Development Organization (www.unido.org) is a good source of reference information about MVA in different countries. Tables B, C and D in the Annex I provide several information about the Brazilian industrial segments, organized by production growth and by MVA ranking.

Industrial growth may also be interpreted as a component of the GDP, and Table B in the Annex I shows this behavior in Brazil.

Figure 1: Industrial production growth (index number)



Source: www.mdic.gov.br

Trade policies

The positive signs observed in the trade balance in the year 2001 are indications that the country is entering a new global economic era. There are good reasons to project sustainable and long term growth. The intensification of international trade and increased globalization are demanding for improvements in the capacity to compete in the market arenas, both domestic and international. Since protective barriers and closeness have been reduced, new policies are being

requested from industry to safeguard it, and to promote industrial competitiveness. The trend is the increasing demand for fast responses to business environment changes, clear customer focus and the ability to attract investors.

Brazilian companies are limited in their financial flexibility, when compared to the giant multinational enterprises. They are always offset by the low quality and high cost infrastructure available in the country for export: roads, railroads, ports, warehouses, etc. For these reasons, a combination of private and public efforts are required and this has to happen very fast. The competitive scenario claims for cooperative efforts. The insertion of Brazil in the world markets will demand new strategies for facing this dynamic competition. The dynamism is to be placed on cooperation, understanding, customer focus and simplicity. Now-a-days, competitiveness is not achieved only with subsidies to the companies. Certainly, what is being offered in terms of reduction of taxes and tariffs to export goods, in comparison to the abnormally high domestic ones, is a point to add competitive advantage. However, one may understand, that a product cannot export a high tax included in its price, since taxes and tariffs are not part of the product being sold. The government has to understand its role as a provider of a competitive environment and this implies to provide infrastructures, cluster formation policies, clear and simple legislation, high quality education and compatible interest rate levels. The road is difficult and complex, but the target is achievable.

Resource pricing policies: energy, water, and raw materials

Wood is the most valuable raw material to the pulp and paper industry, either as fiber source or as biomass fuel source. Thanks to the very impressive growth rates in the fast-growing plantations, the wood is supplied at no problems to the pulp and paper manufacturers. Most of the companies are close to be self-sufficient in wood supply, because they try to avoid a dependence on the wood market. Recently, in addition to the low wood cost due to the quick growth rates and low implementation expenditures of the forest stand, the wood cost received an additional gain due to the Brazilian currency devaluation. This means that probably today, Brazil is one of the countries in the world displaying one of the best wood prices, as low as US\$ 13 / m³ of solid wood for eucalyptus, and US 16 / m³ to pinewood. Firewood, usually rejects from sawmills, and small diameter top logs and branches, are even less expensive, about US\$ 8 - 9 / m³ of solid wood. This means that the wood price is controlled by the market offer and by the cost of production of the wood in the main forest-based companies. The fact is that, since mills are close to self-sufficiency, they may dictate the wood price, up to certain extent. Since fibrous resources have the price controlled by the market offer/demand, the threats are only related to an eventual shortage in the wood supply. This brings a certain fear to the users, because the low wood cost may incentive alternative utilization to this material.

Energetic use of wood and bark is very much common in the P&P segment. In opposition to a continuous increase on the fuel oil price, thanks to global competition to this product, and the domestic price in Brazil linked to the dollar, the biomass fuel has gained ground in the P&P segment. The calorific value of biomass is much lower than fuel oil: 10,500 kcal/kg for fuel oil; 1,450 kcal/kg for bark (45% moisture); and 2,000 kcal/kg for firewood (45 % moisture). Both biomasses performances depend heavily on moisture content . Moreover, the balance in energy equivalence is very favorable to biomass. This is the reason biomass is an important power source to boilers in this industry. Fuel oil is becoming rather expensive: US\$ 135 / ton of product, against the US\$ 8 - 9 / m³ (US\$ 10.5 / ton of product at 45% moisture content) for firewood. Even considering the differences in boiler efficiency to fuel oil boilers and biomass boilers, the advantage is far in favor of biomass. Also, it is important to mention the fact that most of pulp mills are based on the kraft process, in which a substantial percentage of the energy

comes from the burning of the dissolved wood available in the black liquor to the recovery boiler. Considering firewood, the ratio of power value between fuel oil and biomass is roughly 5 to 6. However, the cost ratio is about the half, favoring firewood (see Table 4).

Another important energetic alternative is mineral coal, available in the Southern states (Parana, Santa Catarina and Rio Grande do Sul). Coal is not rewarded as a "clean fuel", but the power generated from this source is also more inexpensive in relation to fuel oil or natural gas. Mineral coal is also a product based on market demand. Up to know, the participation of coal in the country energetic matrix is small, about 1.0% of all energetics. There are good potential for improvements, since the Government is willing to incentive the generation of electricity via thermo-electrical power stations. Mineral coal in South Brazil has a calorific value of 5,000 kcal/kg; and it has had a substantial improvement in quality in recent years. It's very competitive in price in comparison to fuel oil (coal = US\$ 18 / ton of product ; fuel oil = 135 US\$ / ton of product). Based on calorific power, the coal is more than three times less expensive than fuel oil, it is a Brazilian resource, and has a strong generation of jobs.

Finally, another important source of energy consumed in P&P mills is electricity. In general, the energy is generated at the mill site, by own turbines, powered by the steam coming from boilers burning biomass, coal or fuel oil. There are very few mentions about utilization of natural gas. The cost of purchased electricity is very high (about US\$ 30 / MWh), the double than the cost of the self-generated at the mill site.

Table number 3 shows the contribution of the main components of the Brazilian energy matrix (excluded biomass) and Table 4 provides a performance comparison among the different sources of fuels to power the paper industry.

Table 3: Energy produced in Brazil by type of fuel, except biomass

Fuel	Percentage of energetic matrix
Hydroelectric	52.05
Oil	39.93
Dry Natural Gas	3.76
Geothermal/Solar/Wind	1.64
Coal	1.15
Natural Gas	0.82
Nuclear	0.65
Total	100.00

Table 4 : Cost comparison of fuels based on calorific power and boiler performance

	Calorific value	Cost	Boiler efficiency	Cost ratio to fuel oil
	kcal/kg	US\$ / ton as is	%	
Fuel oil	10,500	135	95	1
Mineral coal	5,000	18	88	3.3
Bark of trees	1,400	3.5	65	3.5
Firewood (chips)	2,000	10.5	78	2.0

Water is another natural resource, available freely till recently. The companies were able to take their needs from the water courses (rivers and lakes). However, the situation is to change, since the water is to become a priced natural resource. There are a lot of negotiations on this subject in the different watersheds committees, and the price of the water will be charged in a two-way manner: the water taken from the water course, and the pollution load added to the same course due to the utilization. There is only a river in Brazil, whose water had the price defined, after a continuous deal with all interested parties. The water collected from the Paraíba do Sul river will be charged at costs from US\$ 0.03 to 0.07 / 1,000 m³. The lower prices are to mills returning a cleaner water than the uptake, and the highest one, to those increasing the COD load. For paper mills using 40 to 60 m³/ton of product, this means the water is to add a new cost of US\$ 1.2 to 4.2 / ton of product. With this new public measure, it is expected a reduction on water consumption by the P&P mills, by new clean technologies being implemented, and better water savings along the process.

Brazilian system for environmental management and regulation

Brazil has an efficient and democratic system for environmental management and a strict and well established environmental legislation. The Ministry of the Environment (www.mma.gov.br) has the responsibility for developing the guidelines for the implementation of the environmental policy, via IBAMA (Brazilian Environment Institute – www.ibama.org.br), the executive arm of the ministry . An inter-ministerial organism (CONAMA – National Council of Environment – www.mma.gov.br/port/conama) has the function to provide general guidelines and resolutions to spread the general concepts within the legal and administrative entities and authorities. Each state has an Environmental Secretary and a regulator and control organism. In Parana, Santa Catarina and Rio Grande do Sul, these organisms are respectively IAP (Environmental Institute of Parana – www.pr.gov.br/iap) , FATMA (Santa Catarina State Foundation for Environment – www.fatma.sc.gov.br) and FEPAM (Rio Grande do Sul State Foundation for Environment – www.fepam.rs.gov.br) . Most of the municipalities have their environmental councils, including citizens, to care about local issues. Another important player is the Public General Attorney (www.mpu.gov.br) an entity of prosecution at disposal of general public to act and to correct deviations in relation to the law, including environmental legislation and environmental crimes.

Some recent initiatives in the Brazilian environmental policies are to manage the watersheds, and to give a price to the consumed water and the discharged wastewater. Other relevant issue is related to the limitations on electricity consumption, due to the scarcity of this source of energy. In Brazil, the main source of electricity is from hydro origin. The limited rainfall in recent years has pressed the government to develop a program with penalties and incentives to reduce the consumption of electricity, with great success.

However, the use of incentives is occasional. The regulators act a lot more with the “compliance to standards” policies. Fines and penalties are the procedures to force the firms in direction to compliance. For this reason, they are very much respected. However, the system is not only adopted as a punishment to the environmental offender, but as a warning. Fines are modest, and the regulators, before apply the penalty, offer the opportunity for corrections. Standards are applied case by case to the different pulp and paper mills, because this segment is considered to be high environmental impact, and each mill has to be considered individually. The country has overall environmental laws, applicable to any environmental impacting activity. They are considered as the minimum requirements in terms of limits. As an extension, states and

municipalities are allowed to strengthen even further these limits, according to the local environmental impacts and needs for protection. Since the policy is to evaluate local impact and to generate the compliance parameters, each pulp and paper mill has its own set of parameters to comply with. The clear orientation to standard compliance led to EOP prioritization in the recent past decades. However, the new environmental scenario, demanding for pollution prevention and cleaner production, associated with the ISO 14001 and FSC label implementations, are being absorbed easily. There are clear signs and examples of firms working towards favorable housekeeping and cleaner production. This has been a natural move, without pressures from the regulators.

Operational licensees are issued every year with the compliance standards to be fulfilled, what allows the regulator to give stricter limits in a year basis. There are very few incentives, such as some light reductions in the BNDES loan interest rates, when the company proves to be implementing social programs to local communities. (BNDES – National Bank for Economical and Social Development – www.bndes.gov.br). There are also some benefits for environmental R&D projects (FINEP - www.finep.gov.br).

As far as the regulators do not suggest technologies, but standards to comply with, the companies are free to make their selections and to follow the roads they believe better. In some cases, the regulators may impose technical restrictions, such as the prohibition of the use of chlorine and/or chlorine dioxide in the bleaching line. However, they do not interfere in the bleaching sequence the company selects, provided it's chlorine and/or chlorine dioxide free. In general, until recent years, the trend was to go to end-of-pipe measures to obtain compliance. This situation is changing very fast in recent times, because mill managers and technical personnel have discovered the fact that they may be able to reduce capital requirements and operational costs via pollution prevention and cleaner production. The CNTL - National Center for Cleaner Production (www.rs.senai.br/cntl) is playing a fundamental role in this awakening.

Industrial environmental awareness and corporate action

As a result to the increased importance of environment in the business scenario, the corporations have reacted very positively. Social and environmental reports are being issued yearly, making freely available to general public the corporation environmental and social commitments and performances. Companies are also organizing themselves in representative NGOs, as the CEBDES – Brazilian Business Council for Sustainable Development (www.cebdes.com) the Brazilian branch of the World Business Council for Sustainable Development (www.wbcsd.ch), or the FBDS- Brazilian Foundation for Sustainable Development (www.fbds.org.br). Pulp and paper companies have proved leadership in both these NGOs.

Environment, quality and occupational health are key issues in business administration, mainly because they provide powerful motivation to employees and communities. There are many companies now certified according to ISO 9000 and ISO 14001. The environmental certification is being a goal not only to export-oriented companies, but as a general management tool to the companies. The Responsible Care environmental management program has also gained prestige with consumers because its adoption by the chemical and pharmaceutical manufacturers (www.abiquim.org.br).

In a wider action, some companies are creating their own NGOs to promote sustainable development, and to invest in social, cultural and environmental programs with or to the communities. In the pulp and paper industry, it is known the example of Suzano, one of the

largest paper corporations in Brazil. They have founded the Ecofuture Institute (www.suzano.com.br).

BRACELPA – the Brazilian Association of Pulp and Paper Manufacturers (www.bracelpa.com.br) placed efforts to promote a national campaign to show the environmental aspects of folding box carton board (www.papelcartao.com.br).

In its wide network, the Brazilian Industrial Confederation (CNI) includes some organizations for R&D and Human Resources developments. One of them is SENAI (National Service for Industrial Training – www.senai.org.br). Under the umbrella of SENAI, several technological centers have been built across the country. For the wood based industry, the most important are: CETCEP- Technological Center for Pulp and Paper (www.senai.cetcep.com.br), CETEMO – Technological Center for Furniture (www.cetemo.com.br) and CNTL – National Center for Cleaner Production (www.rs.senai.br/cntl). CNTL is the leading organization in Brazil promoting cleaner production and eco-efficiency. This action has crossed Brazilian borders, and the center has also programs in Paraguay, Equator, Mozambique, Italy, etc. CNTL was created under the SENAI/CNI system as a proof of the industrial awareness for environmental improvements and sustainability.

Environmental management at the Brazilian pulp and paper sector

The P&P sector in Brazil is being able to revert an image associated with pollution, bad odor, ecological accidents and devastation of natural forests to plant exotic trees. It has not been a single task. The image had severe impacts during the 70's, when new pulp and paper mills and the required plantation areas came to the scene. At that time, pollution control and environmental requirements were far from what they are today. The industry had also little ability to communicate with general public and to the media. The result was, up to a certain extent, a disaster. The industry became linked to pollution generation, bad smell, and plantation of green deserts. Social impacts were also associated to the plantation of forests, given to this activity the responsibility of rural exodus, typical in the Brazilian agriculture from the 70's onwards. The 70's were known as the golden years of the Brazilian economy. Huge investments were made on different kind of industries to justify the so called Brazilian economical miracle: steel, pulp and paper, metallurgy, vehicle manufacturing, shoes, food industry, heavy machinery, etc. Flue gases and smoke were synonymous of development and generation of wealth. There were even the thought that the odor coming from pulp mills could remind the smell of money. Fortunately, these ingenuous feelings were not exclusive of developing countries, such Brazil. Worldwide, the industrial revolution was peaking its model of growth. Pollution generation had increased so much that governments decided to dialogue about environmental issues to find common ground of understanding. Stockholm 1972 was one of the elected forums to strengthen the dialogue about a world of limited resources.

From that time onwards, several well succeeded initiatives appeared in Brazil to help the development of the environmental system available today in the country.

A brief look to the 70's and 80's:

- ✓ Environmental assessment previously to a factory installation.
- ✓ Environmental permits (three levels: previous, implementation and operational).
- ✓ End-of-pipe implemented in many mills to adapt to a legislation growing in restrictions.
- ✓ Compliance with the standards was the sole objective.
- ✓ Treatments were seem as costs, reducing the competitive position in the market.

A brief look to the 90's:

- ✓ Enormous impacts on pulp mill image due to the potential generation of dioxin and other chlorinated organics.
- ✓ Great concern of the communities, including the mill workforce. Employees were worried about their own health, since working with chemicals they had not been informed about.
- ✓ Increasing pressure from NGOs and media, very motivated to the fact that 1992 Rio World Summit Conference had open substantial space to deal with the public about environmental issues.
- ✓ Increasing pressure for developing a forest certification scheme, based on sustainable management of the forests.
- ✓ Better understanding of the sustainable development concept by all actors in the environmental scene.
- ✓ Appearance of the green labels to paper products, becoming a threat to the trade of such products (European Union Green Label, Nordic Swan, German Blue Angel, etc),
- ✓ Voluntary implementation of environmental management systems (EMAS, ISO 14001, Responsible Care, FSC, etc.).
- ✓ Life cycle analysis, with the very comprehensive study sponsored by the World Business Council for Sustainable Development, entitled "Towards a sustainable paper cycle", research elaborated by the IIED - International Institute for Environmental Development (www.iied.org) with data collecting and hearings in Brazil.
- ✓ Diffusion of the new concepts about pollution prevention, cleaner production, eco-efficiency and ZERI emissions.
- ✓ Increasing requirements for corporate social responsibility.
- ✓ Increasing requirements of environmental liability free performance arising from the financial institutions.
- ✓ Increasing requirements from customers to be informed about environmental performance of the pulp and paper suppliers, mainly those from Europe (Germany, Denmark, Holland, Belgium, United Kingdom, France).
- ✓ Launching of the Brazilian Law # 9605/1998 that gives criminal responsibility to those involved or taking decisions about severe environmental impacts.
- ✓ Speed up of the telecommunication system via media and internet: the potential damage to corporate image was accelerated to an unimaginable speed.
- ✓ Green taxation on natural resources consumption and contamination. In the state of Sao Paulo, in the Paraiba do Sul river, the water taken from the river has now a cost and the effluent is also charged based on the contamination with COD (Chemical Oxygen Demand).

The result from all these factors was a revitalization of the environmental management system in the pulp and paper companies. They were gradually pushed to dump to the garbage the low profile attitude of the 70's, mainly due to the sentiment of superiority and also the fear to public exposition. There is no longer ways not to give public explanations. A pro-active attitude regarding community and consumers is now a must. The increased consciousness brought market advantages due to the improved companies image. The ISO 14001 certification of the environmental system is a guarantee to the mill to prove that at least is running in compliance to the law. By the way, the Brazilian environmental legislation system is recognized as one of the most advanced in the world. Thanks to this modification in posture and responsibility towards environment, social issues and occupational health, the image of the pulp and paper industry in Brazil is gradually being revamped. The general public and the NGOs still have reminiscences from the past days. They are acting cautiously, but they are now much more open to discuss based on technical arguments and not only in emotions. Excellent opportunity to dialogue are the public hearings, an exigency linked to the environmental impact assessment of a new project (no matter a new greenfield mill or a substantial modification in an existing mill).

Thanks to the exigencies of the ISO 14001 to practice an open dialogue with the interested parts, the companies are opening the doors to visits, to debates with NGOs, to partnerships, and to talk to the society.

Another great opportunity for an approximation among companies and NGOs was the exigency of discussion forums to adapt the criteria and principles of FSC forest certification to the local Brazilian conditions. The great advantage of FSC – Forest Stewardship Council scheme is the requirement to have at the table of discussions for a common understanding the three legs of the sustainable development: the economic power, represented by business associations; the social NGOs, including consumers' rights associations; and environmental NGOs. The result could not be better: better understanding, improved dialogue and broken barriers.

Environmental impact of the sector

Main sources of contaminants coming from pulp mills are those released to the air (TRS - Total Reduced Sulfur, SO₂, NO_x, CO₂, VOC's, dust); to the water (COD, BOD, SS, Color, AOX), and the solid residues generation.

Air pollution sources are boilers, kilns, digesters, evaporators, burners. Water pollution are in general effluents coming from the wood yard, condensates from the evaporation, bleaching filtrates and spills. Solid residues are a combination of sludges, sawdust and bark, sand & soil, dregs and grits, combustion ashes, miscellaneous garbage, etc.

The efforts to control air emissions are mainly related to the modernization of the recovery boilers and electrostatic precipitators, utilization of stripping/distillation columns and gas burners. Modifications in process parameters or chemicals do also result in good improvements, such as the use of antraquinone replacing totally or partially the sulfidity in alkaline cooking processes.

Since solid residues are been handled, landslide and/or recycled in a sound manner in many mills, reducing substantially their impact and generating by-products (fertilizers, soil pH correctors, etc), the most important impacts to the environment are those to the air (odor and dust) and to the water (color, foam, organic matter, and chlorinated organics).

Air emissions are been forced to be minimum impact, and the control is not only the specifications coming from the regulator, but the acceptance of the pollution level by the surrounding community. The efforts and the requirements to reduce dust in stack gases using electrostatic precipitators and scrubbers have reduced the particles present in the gases to values below 100 or 150 mg/Nm³. TRS, the main cause for odor, has been the main pressure from the communities and NGOs. People are no longer submissive and peaceful to accept the bad odor in their homes and workplaces. The result was a reduction of TRS from over 250g /adton of manufactured product, to about 30 – 60 , in the past 15 years.

Water consumption has also been dramatically reduced in the past decade, although there is a lot of room for further improvements. The most modern market pulp and integrated paper mills in the country are running with 25 - 60 m³ / adton of finished product. Early 90's , the same type of mills were using from 60 to 100 m³/adton. However, there are still many examples in mills of no care and little concern about water utilization.

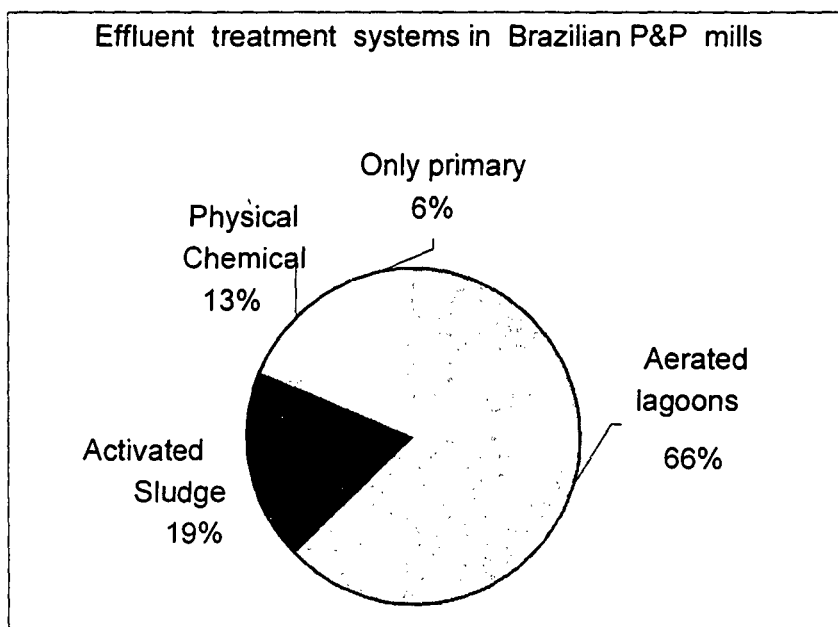
Non-integrated paper mills in general are of two types: a) the smaller are based in wastepaper, and in general they have old machinery with higher environmental impacts (high COD and suspended solids due to fiber and mineral losses); b) the mills based on market pulps are more concerned about housekeeping and preventing losses , but they have also an easier job to keep fiber losses under control. In non-integrated paper mills, the EOP effluent treatment plant is generally simpler : clarifiers, flotation cells, aerated lagoons, chemical flocculation and settling

decanters. All mills have EOP measures to treat effluents. They have to comply with their environmental standards, and in case they do not, they receive penalties and time for adjustments of behavior. The pressures received in the past from the regulators side, including fines and mill shut down during weeks and months, brought to the P&P firms a great respect and the need to work correctly in terms of environment, to preserve the image and the mill running.

The figure number 2 shows the types of secondary treatments being used in Brazil, in a sample of 15 P&P mills across the country.

Figure 2: Types of wastewater treatments in a selection of 15 Brazilian mills

Source: ABTCP, 2002 (preliminary data)



Treated effluents have BOD from 5 to 60 ppm, AOX from 0.1 to 17 ppm, and SS from 7 to 280 ppm. They all comply with the standards applicable to their operation.

In another group of 4 market pulp mills in Brazil, the following range of water contamination, expressed based pulp production, is reported by ABTCP, the Brazilian Technical Association of Pulp and Paper (www.abtcp.com.br).

Table 5 : Hydric losses in treated effluents by a selected sample of 4 Brazilian market pulp mills

Units: kg/ad ton	BOD	COD	SS	AOX
Mill A	2,1	25	1,9	0,3
Mill B	3,5	17	3,6	-
Mill C	0,32	4,2	0,7	0,15
Mill D	2,3	23	6,0	0,13

Source: ABTCP, 2002 (Preliminary data)

Policy instruments

Environmental management and corporate behavior towards environment very seldom is a gift offered by the enterprise or its management. In a competitive capitalistic world, oriented to economical and financial results, managers are squeezed between lack of time and the needs to show a good balance sheet to the shareholders. For these reasons, environmental issues sometimes have to bring fear or pain to be placed in priority positions. There are a series of instruments that may motivate, either by incentives or by pressure, the business management in the direction to a greener business. They may be related to legal regulatory framework, or by fiscal or economical incentives, or better information of the required knowledge to implement the desirable environmental practices, or pressures exerted by interested parties and stakeholders, and finally, by the voluntary action of the corporation.

A table introducing many of these drivers is presented with some comments about the power of motivation for each one.

Table 6: Policy instruments and their effectiveness in Brazil

Policy instrument	Applied	Comments
1. Regulatory		
Discharge standards	YES	National and state laws, with specifications to water, air and solid residues
Industry-specific	YES	Specifications are issued case by case, according to the potential impact of the mill. However, the minimum they are to follow are the standards defined by the national legislation.
General environmental	YES	Based on global warming and international conventions committed by the country
Special permitting conditions	YES	Due to fragile environments.
EIA	YES	All new mills or significant changes in an existing mill demand a study of EIA, and a report to be submitted to the society (RIMA - Environmental Impact Report)
Negotiated compliance	YES	Regulators are often open to negotiate compliance and terms/timing.
Substance/technology bans	YES	Example: chlorine bleaching, PCB's, mercury, asbestos, etc
Criminal prosecution for environmental crimes	YES	It was an important issue created to add respect to environmental from ordinary people to firm chief executive officers. The fear of being accused for a crime has a great impact and it was proved to be very successful.
Public hearings	YES	All project that is to impact the environment may deserve a public hearing to grab information from the stakeholders. The regulator is the entity that decides the convenience or not to organize a public hearing
2. Economic/fiscal		
Reduced taxes, duties and fees	NO	
Grants and duties for Cleaner Technology assessment & implementation	YES	They come from Business Associations and their entities (CEBDES/WBCSD, SEBRAE, SENAI, CNI, Industrial Federations)

	Remove harmful subsidies (e.g. for import of used equipment)	YES	Subsidies are banned words in the Brazilian administration
	Soft and revolving loans for EST investments	NO	
	Facilitate preparation of bankable projects	YES	Banks are very sensitive to formal guarantees, and their environmental demands are strict, in some extent to protect the money they are lending or investing.
	Financial liability	YES	
	Tradable permits	YES	Applied to some sectors, but not to pulp and paper
	Environmental charges	YES	Pocket is very sensitive; charges to raw material consumption and fines are powerful measures.
	Fund R&D for Cleaner Technology	YES	There are specific funds coming from supporting R&D agencies (FINEP, MCT, and state funds) to green projects including CP
3. Information	Disseminate best industry practices	YES	Industrial forums of CP, mainly sponsored by CEBDES/WBCSD, CNTL-National Center for Cleaner Production, Industry Federations.
	Disseminate environmental performance of technology	YES	Technical associations (ABTCP, BRACELPA, etc) and CNTL/SENAI
	Information clearing house and networks	YES	Websites on CP, such as CNTL
	Demonstration projects	YES	Via CNTL
	Product labeling	YES	International labeling systems (European Union, ABNF, hummingbird system, Forest Stewardship Council and CERFLOR to certified wood)
	Cleaner Production in higher education	YES	Only as graduate courses and specialization
	Public recognition and awards	YES	Several awards (given by NGO's and Business associations)
	Training facilities	YES	Business associations, consultants, technological centers, universities

Bencharking-national, sectorial, regional	YES	Trough the environmental committees of ABTCP and BRACELPA
Extension, service and technical assistance systems	YES	Via SENAI, SEBRAE and business associations
4. Transparency and disclosure	NO	There are primitive reports at regulators and BRACELPA, but far from giving a complete inventory release of chemicals by the P&P industry
Corporate reporting	YES	Some companies are providing social and environmental reports to stakeholders in brochures or via internet
Cleaner Technology planning	YES	This is not common practice, because there are mills working with ISO 14001, or SEM, but not including cleaner production planning, only pollution prevention and compliance.
Corporate environmental performance ratings	YES	Only few companies are being rated in international evaluations, but not locally
5. Voluntary programs	YES	Agreements, terms of compliance or commitments are with regulators, NGOs, employees or communities
Negotiated agreements	YES	ISO 14001, Responsible Care, FSC and CERFLOR in forestry
Auditable EMS	YES	Responsible Care and International Chamber of Commerce
Industry codes of practice	YES	For specific environmental solutions, mainly related to the recovery of degraded areas, improvements on biodiversity, supporting social / environmental educational programs.
Other public-private partnerships	YES	

Section 2: The Brazilian Pulp & Paper Segment

Sector description

The pulp and paper segment is one of the most dynamic and with highest sustained growth rates in the Brazilian economy. Up to a certain extent, the success is due to the excellent competitive advantage provided by the amazing growth rates possible to be achieved in plantation forests of *Eucalyptus* and *Pinus* species. However, this advantage would not be enough without a complementation on a safe investment policy, a wise utilization of the resources, an efficient business management, and the utilization of state-of-the-art technologies. The sector is global, it is a double road, pulp and paper products are imported and exported. However, the balance is very favorable to Brazil, since the country is the largest manufacturer and seller of eucalyptus fibers. Exports in 2001 exceeded 2.6 billion dollars. It may be claimed that the segment has a strong contribution to the country development, being important in the generation of wealth, taxes, jobs, foreign currency and promoting social improvements across the country. In a developing country, with a huge population (170 million inhabitants) and people growth rate (somewhat below 1.6% per year), the generation of jobs is an imposition. The pulp and paper segment is a great consumer of labor, both in the mills, forests, logistics and in the paper recycling operations. Although a country relatively poor regarding to GDP per capita (3,400 US\$ / inhabitant), with a corresponding poor garbage, the country has a net recycling rate for paper close to 40%. This rate is over 70 % for packaging boards, one of the highest achieved for such product worldwide. This is only made possible thanks to the organization of thousands of paper pickers, collecting, storing and trading wastepaper in most of the cities, no matter their sizes.

In general overview, the segment is an important player, ranking number 7th in the world for pulp manufacturing and number 12th in papermaking. Unfortunately, apart of the large volumes produced, the per capita consumption is still very low (38.5 kg/inhabitant/year).

Globalization of the segment started in the 70's, with the construction of several large companies oriented to export market pulp. The first of them, Borregard S/A, today Klabin Riocell, was followed by others in a short span of time: Cenibra, Aracruz, Jari, Bahia Sul, Votorantin, etc. With the liberalization of markets along the 90's, the small and medium sized mills also started to play the global game, exporting their products to the most different markets. Advances in technology and management became vital to the mills, and this was achieved by adequate government policies of financing, and corporation management. Quality programs were quickly multiplied, at the same speed for the ISO 9000 certification, and more recently ISO 14001 and forest and wood certification, in accordance to the principles and criteria of FSC- Forest Stewardship Council (www.fsc.org.br). In general, the Brazilian mills are running at the full capacity, to generate surplus for exports. We cannot forget the domestic market growth, since Brazil has an yearly growth in population corresponding to more than 2.5 million inhabitants. This is equivalent to grow close to the Uruguay or New Zealand population, every single year. Besides vegetative population growth, the improvements in life quality that people are obtaining as a result of the stabilization of the economy, may give an anticipation for further domestic growth in paper product consumption. Today's average growth rates for paper is about 5.6% per year. At the moment, many pulp and paper mills are closing doors in developing countries, partly due to technological obsolescence, high production costs, inappropriate scale of production, and environmental pressures to adopt more environmentally sound technologies. Brazil is given its answer with investment plans for growing production, even in the small and medium sized mills. The reasons are simple: except for some paper grades, such newsprint and highly specialty papers, the sector is very competitive, cost-wise and quality-wise. The medium

sized mills have the advantage to supply local markets at competitive costs, and they are able to compete in this competitive arena. According to global trends, the companies are focusing strategies in raising capacities and scale of production, reducing costs, and widening product diversification. The goal is the operational efficiency, reducing wastes and the low quality, and developing new products and services. The segment has always been associated to domestic ownership, but recently the room became open to some new associations with foreign capital, both in terms of acquisitions and participation in the shareholding (International Paper, Norske Skog, JBP-Japanese consortium, etc). This is an indication of foreign eyes in the Brazilian economy, acting not only as capital provider, but operating with their own mills. The main barriers to the faster growth of the sector are the lack and the cost of capital. Since the growth via financing is expensive, the option may be the offer of shares to other investors, in a process of opening the firm capital.

Sector performance in recent years

In 2001, the pulp production peaked 7.4 million tons, a growth of 38.7% in the past 10 years. Paper production reached 7.3 million tons, a 48.6% growth for the same period. Wastepaper consumption was 2.6 million tons, a 41% growth in the past 5 years. It may be said that wastepaper is helping Brazil to keep its important position as market pulp exporter.

Main pulp products produced in 2001 were: bleached short fiber (73%), long fiber (19%), and high yield pulps (6%). Main paper grades were: packaging & wrapping (48%), printing & writing (32%), tissue (8%), and folding box carton board (7%).

Taking a look to the trade balance, the sector exported 2.6 billion dollars and imported 0.859 million, with a positive net result of 1.7 billion dollars. In the past decade, the segment exported over 20 billion dollars. In the same decade, the average growth rate for the industry was 4 to 5%, well above the population growth and the growth of the Brazilian GDP (average 2.6%). Brazil imports are mainly bleached softwood fibers from Chile and Argentina, and newsprint from Canada, USA and South Africa.

Recently, BRACELPA has announced several industry players with intention of growth. The future scene shows an increase of 45% in the production of pulp (from 7.4 to 11.2 million tons) till the year 2005. For paper, the growth is more modest (from 7.3 to 9.1 million tons in the same period). Investment requirements are over 6.5 billion dollars. The new production has the aim to guarantee domestic market consumption growth and to grow exports of market pulps. The business executives demand government policies to reduce taxation and interest rates to the capital, and incentives to the plantation of forests.

However, the world pulp and paper sector is very sensitive to economical crisis and unbalanced offer/supply. After a sequence of difficult years (1996 till 1999) with the international pulp and paper prices very depressed, Brazil had a relief due to 4 main reasons: recovery on prices and consumption rates; mill cost reduction internal programs; consolidation and production policies of the international giants in the manufacturing of P&P; and the new regimen for fluctuating the Brazilian currency. There is a lot of optimism in Brazil, even after the terrorism attack in New York September 2001, reflecting a decrease in the world economy. The industry is celebrating the indicators of overall performance, and the economical recovery in Europe, with the Euro booming. This optimistic scenario in the beginning of the century is warming up the P&P companies in Brazil. The country has 220 manufacturers with roughly 255 industrial units located in 16 states and 180 towns around the country. The industry claims to generate over 100,000 direct job positions.

Pulp and paper segment in the southern states

The more recent consolidated statistics available when writing this report are from the year 2000. At that specific year, total pulp production in the country reached 7.46 million tons. The southern states had produced for the same pulp grades a total of 2.23 million tons, 30% of the country production. The grades are rather different in comparison to the rest of the country: 1.26 million tons of long fibers; 0.51 million tons of short fibers and 0.46 million tons of high yield pulps. The region is the country leader in the production of long fibered chemical pulps (89%), and high yield pulps (91%). These features make the region differentiated and unique to the Brazilian segment.

It is also important to mention that in the year 2000, from the total 7.46 million tons of pulps manufactured in Brazil, about 3 million were exported, being the remaining used domestically to the manufacture of paper. Part of this paper has also been exported (1.1 million tons).

Pulp and paper mills in the south are more integrated, consuming the own production of pulp to manufacture papers. They are integrated in the same site or in the same group. There is only one market pulp mill oriented to export most of the production, and this is Klabin Riocell. This is a situation very unique in comparison to the companies located in Minas Gerais, Espirito Santo, Sao Paulo and Bahia (central and eastern states). In the year 2000, these states exported 2.48 million tons of pulps and 0.67 million tons of paper.

The country has a deficit on long fibers and the Southern states are the leaders on the production of pine pulps. These fibers are well used to manufacture packaging and wrapping papers, newsprint, fluff pulps and specialty papers.

In 2000, the country produced 7.3 million tons of papers, and the south region had produced 2.89 million, about 40% of Brazilian paper production, a very impressive performance. Exports of paper reached 1.1 million tons for Brazil, and 0.42 million tons for the Southern states (about 38%). Tables F and G in Annex I show additional information about production by Brazilian states.

Table 7: Types of papers and relative production in 2000 (production in 1,000 tons)

Type of paper	Brazil	Southern states	Relative percentage
Newsprint	266	266	100
Printing & writing	2092	316	15
Packaging	3347	1876	56
Tissue	597	185	31
Folding boxboard	722	233	32
Specialty papers	163	15	9

Source: BRACELPA, 2001

The largest P&P group in south Brazil is Klabin: Klabin Papeis, Klabin Riocell, Klabin Embalagens, Klabin Kimberly. Klabin group is responsible for manufacturing 20% of the total Brazilian paper production. Also important in the south: International Paper, Inpacel, Rigeza, Trombini, Pisa, Norske Skog, Primo Tedesco, Miguel Forte, Cocelpa, Cambara, Santa Clara, Santa Maria, Iguacu, Ibema, Adami, Novacki, Santher.

Forestry and pulp and paper

All Brazilian pulp and paper production is based on the wood of planted forests. There are about 4.8 million hectares of industrial forests, the majority eucalyptus (2.96 million) and pine (1.85 million). There are statistics showing that the total area of plantations, including the small parcels with farmers and landowners, may reach 6 million hectares. From this total, the pulp and paper industry has the ownership of about 1.5 million hectares (one million eucalyptus and 0.42 million pines). The plantation forests on the ownership of the sector corresponds to 0.18% of the Brazil territorial land. Planted forests are considered natural and renewable resources. They are usually planted in stands, which are combined with native forests stands and agricultural land. This model tries to ensure the required protection to the plantations, to the watersheds, the biodiversity and the ecosystem quality. The conservation area (native forests) on the ownership of the segment reaches 2.5 million hectares. This includes permanently preserved areas and legal reserves. The environmental balance between productive areas and natural reserves, for preservation of ecosystem health, is one of the major concerns of the sector. There are several R&D projects in cooperation with forestry colleges for environmental studies and caring on forestry.

The sector has also to buy wood from third parts, mainly due to the increased use of biomass (firewood), replacing fossil fuels. Total purchases are equivalent to 20% of the total wood consumption. The wood for burning as energy corresponds to 8-10% of the total consumption.

The Southern states have important participation on the plantation, mainly those with pines. They are leaders in Brazil in planting softwoods.

Table 8 : Plantation forests in Brazil (hectares)

State	Pulp and Paper Ownership		Total Plantation (ha)	
	Pines	Eucalyptus	Pines	Eucalyptus
Parana	186,087	43,734	605,130	67,000
Santa Catarina	113,404	8,972	318,120	41,550
Rio Grande do Sul	8,550	52,803	136,800	115,900
Total Southern	308,041	105,509	1,060,050	224,450
Total Brazil	415,346	979,187	1,840,050	2,965,880
%	74.2	10.8	57.6	7.6

Source: SBS , 2001

Despite the success on forestry, the amount of capital for R&D in this activity is not substantial. There are statistics showing 15 million dollars per year. However, many of the research activities are not separated, and they are not seen, because their costs are included as operational costs of planting the stands. The success of the forestry R&D in Brazil are the cooperative programs between companies and universities . The most successful are those organized by IPEF (Institute of Forest Studies and Research – www.ipef.br), Society of Forestry Investigations (www.ufv.br/def/sif), FUPEF (Forestry Research Foundation of Parana - www.floresta.ufpr.br/fupef) and CEPEF (Center for Forestry Research at the Federal University of Santa Maria – www.ufsm.br/dcfl/cepef). Another important source of forestry investigation is CNPF / EMBRAPA (National Center for Forest Research – www.cnpf.embrapa.br) . Several researches are associated to the evaluation of

environmental impacts of forest operations (planting, harvesting, transportation, storage) on soil, watersheds and water quality, erosion, biodiversity, etc. It is also considered important to create minimum impact operations and to develop environmentally sound technologies to the forest area.

Competitiveness advantages & threats to the Brazilian pulp & paper segment

It's clear to all that the Brazilian pulp and paper market is very attractive, both to domestic and international players. Brazil is particularly attractive as source of low cost wood, Eucalyptus and pine plantations. Brazil is also attractive because the huge population and the 5.6% growth per year in paper consumption. The recent devaluation of real currency in 1999 has made the country more competitive, since production costs in a dollar basis have reduced, and exports have converted to be more attractive. Although the international scenario shows great competition, the situation in Brazil is challenging and positive. The sector is still dominated by domestic owners (more than 80% of the ownership is Brazilian). In many cases, the owners are families of the original mill builders. Few companies have shares available to public. However, the financial performance of the majority of domestic companies is good, what allow them to dream with expansions and modernization projects. The main weakness is the lack and the cost of capital. Since this phenomenon also affects government, the taxation system is complex and hungry. Considering the fact that production cash costs are low in a dollar basis for most pulp and paper products, the operational margin is extremely healthy. For most pulpmakers, the EBTIDA (Earnings Before Taxes, Interest, Depreciation and Amortization) is close to 50% of the net pulp price. This would be very good, unless the prejudice on the rate of return caused by other costs: financial, depreciation, logistics, taxation and social costs. For this reason, few companies are able to announce ROI (Return on Investments) over 15%. The WACC (Weighted Average Cost of Capital) required in financial analysis of EVA (Economic Value Added) in Brazil is about 13 - 15%. Investors are very sensitive to the high Latin America risks, associated to the higher capital requirements to build a mill in the country. For these reasons, the excellent margins are offset by the low ROI and the macro-economical risks. As a result, the P&P companies have limited financial flexibility and they have to search the required capital abroad or with the BNDES (Brazilian Bank for Economical and Social Development).

The Brazilian companies are also small in comparison to the global players. The largest pulpmill in Brazil, Aracruz, is far behind the sector giants (Georgia Pacific, International Paper, UPM Kymene, Norske Skog, Mead, Domtar, etc). For these reasons, the Brazilian mills are not able to take advantage of the economy of scale as much as the global players. The Brazilian companies are trying to consolidate, but this move is being very modest. Even alliances and partnerships are not running at the required speed. As far as the majority of companies have the prejudice of economy of scale, the paper machines and digesters are smaller on a global scene. This may be a threat to the future, mainly considering that part of the today competitiveness is due to the weak Brazilian currency.

Till now, the forest productivity has been the milestone to the Brazilian mills. However, photosynthesis is not a privilege only to Brazil. Other countries as Uruguay, Argentina, Australia, Indonesia, Malaysia, Vietnam, South Africa have also great potential to speed up the forest growth. The Brazilian model to use planted forests is very simple: the majority of the forests are owned by the companies. The trees are clear cut to supply the mills. This model is reaching its exhaustion, since other forest-based industry are competing to the same lands and wood. Firewood is also very common in Brazil, both for in-house use or as fuel source in many companies from different sectors. As a result, forest clusters are being recommended and implemented. The advantages are economical and environmental. In a cluster, the overall

efficiency is much higher. A wood residue from an operation may become raw material or firewood to another. The hydric effluent from a firm may become process water to another, and so on.

Among the financial analysts and investors, the main impacts expected for the next 10 years are:

- ✓ Global competition is to become more severe,
- ✓ Gradual transition from commodity products to wider range of products, even within the commodities,
- ✓ Increasing on the paper recycling rates,
- ✓ Threat of the alternatives to paper (electronics, internet, digital printing, etc),
- ✓ Environmental restrictions: they are expected to become stricter and more severe, demanding more capital and increasing investment and operational costs, unless the model of facing environmental problems changes,
- ✓ Changes in industry structure due to consolidation (mergers, acquisitions, alliances),
- ✓ Capital costs: there are no projection for capital costs reductions,
- ✓ Search for simple technologies, less costly and more efficient, not so sophisticated,
- ✓ Genetic modified trees for additional productivity and homogeneity,. There is also the fear of excessive forest domestication may add increased problems with pests and diseases.
- ✓ Pulp and paper commercialization and logistics are to become simpler due to e-commerce, and simplifications in the distribution channels.

Brazil has bet till now in the manufacture of commodity products (market pulp, packaging and printing papers). The main reasons; the simplicity of operations, the economy of scale, world market share in eucalyptus pulp, the efficiency and the low costs associated with. In south of Brazil, the mills are running more integrated, going a little further in the production chain. Many mills in the south are hubs in forest clusters, involving sawmills, panel manufacturers, and believe or not, matches and broom manufacturers. In some respects, the structure of the industry in south Brazil is close to what experts are proposing as ideal in the future. Since lower wood cost is a competitive advantage that may not be sustained in the long-term, the integration in the value addition network is a comment from analysts on competitive strategies. This integration may be domestic or global, via alliances and partnerships with other international players. The integration does not mean that the paper mill is obliged to use the pulp manufactured in its site. Integration may happen between mills of the same corporation, or among global partners.

Another important fact to the Brazilian competitiveness was the substantial reduction on the pulp manufacturing costs from mid 90's to the year 2001. About 45% reduction was achieved due to cost reduction policies, very effective in shortening fixed costs, and the important impact of the Real devaluation (Brazilian currency).

Table 9 : Cost structure for typical pulp plants in 2001 (US\$/ ad ton)

	Bleached short fiber Market pulp	Unbleached long fiber Integrated mill
Wood	50 - 60	90 - 120
Chemicals	25 - 30	10 - 20
Energy	15 - 25	15 - 20
Labor	20 - 30	15 - 25
Other mill costs	35 - 45	20 - 35
Operating costs	140 - 160	175 - 200

Source: adapted from Peruzzi, 2001

Social balance

The overall evaluation of the Brazilian pulp and paper industry in general does not include its positive impact on the social aspects. When one discusses about the industry, the images that usually come first are large industrial plants, machines and forests. However, the industry has a significant social contribution. Let's first consider the total sales of this huge Brazilian segment: about 8 billion dollars, corresponding to 1.4% of the Brazilian GDP. One may infer that 1.4% of the jobs, taxes, commerce, etc. in Brazil are directly or indirectly related to the sector. Although it is not completely clear the total impact of the sector on a social basis, the perception is that it is very significant. According to BRACELPA, in the year 2000, the P&P industry has made a contribution of US\$ 0.8 billion in taxes, provided 100,000 direct jobs, and paid US\$ 0.5 billion in salaries. In Brazil, differently from what can be observed in developed countries, the private companies are requested to play important role in the promotion of social development. In the pulp and paper business segment, this role is outstanding, since many mills and forests are located far from important urban centers. This situation demands from the companies additional investments in social infrastructure (schools, hospital, housing, etc) to improve the well-being of local communities. This is also important to strengthen the concept of sustainable development by including the social dimension in the business.

The figures presented in Table 10 corresponds only to the year 2000, and they do not include substantial investment that have been made in the past decades. This balance corresponds only to 36 members of BRACELPA, totaling 90% of the Brazilian production volume of paper products.

Table 10 : Social investments of the Brazilian P&P industry in the year 2000

	Social investments (US\$ 1,000)	%
Taxes	819,737	42
Salaries, private pension funds, employee participation in the firm results	550,783	29
Social taxes	197,964	10
Medical assistance, health, meals, transportation	97,327	5
Forest plantation	130,491	7
Environmental control & preservation	94,775	3
R&D, education & training	60,904	3
Community action	13,284	1

Source: BRACELPA, 2001

The investments on health and education do not include only actions to the employees, but also campaigns and activities with local communities. Community actions are educational and cultural projects, sanitation, health, environmental education, as well sports and leisure.

The results are shown in the growing participation of local and regional citizens in the internal activities of the companies, and in the companies support to projects that are initiated or coordinated by the communities.

Technological development

Most of the Brazilian pulp mills are based on the kraft manufacturing process. To this process, the best known pulpmaking technologies have been generated along the years. The process is very efficient in chemicals recovery (over 95%), and energy (most of the dissolved wood in the process to individualize the fibers is converted in a black and thick liquid and burnt in a boiler to recover the cooking chemicals and the wood energy). In spite of the possibility to close the pulping chemical cycle, the process has some weakness on the odor generation and in the utilization of substantial volumes of water. For this, the generation of effluents is a continuous problem to the pulpmakers. The most aggressive effluent is the one from the bleaching of pulp. Since chlorine chemicals have been used for decades to bleach kraft pulps, the generation of chlorinated organics became the Achilles'heel of the pulp industry. Among the waste chemicals generated on the bleaching, dioxins and furans are considered the most dangerous. They are classified as POPs (Persistent Organic Pollutants). An enormous fight against chlorine bleaching was decisive along the 90's. The industry developed together with R&D centers and suppliers new ways to bleach pulps, considered to be more environmentally friendly. The rapid development of ECF (Elemental Chlorine Free Bleaching) and TCF (Totally Chlorine Free Bleaching) has boosted in recent years. Today, thanks to huge efforts in a worldwide basis, ECF and ECF-light bleaching sequences are the dominant in the mills. ECF-light sequences are sequences with very little addition of chlorine dioxide, and their effluents are quite alike the ones from TCF bleaching. For doing this, the use of ozone and hydrogen peroxide are essentials. Environmental aspects have been the main driving forces behind these developments, with a strong cooperation of squeezing forces from regulators and NGOs. TCF sequences are still more expensive, but they offer the possibility to better close the water cycle, reducing bleaching effluents close to nil. They allow this because the lower concentration of corrosive chemicals in the wastewaters. However, TCF bleaching acceptance is being limited by the bleaching costs, poorer product quality and higher energy consumption. They are not growing as expected. The new paradigm seems to be the ECF-light sequences, combining the TCF fundamental basis, with a light addition of the powerful bleaching agent, chlorine dioxide.

The minimization of wastewater discharges, air emissions and solid residues require efficient management of the process as a whole. It is inappropriate to imagine, that working only in one step or one fundamental, the gains will be rewarding. Integrated pulp and paper mills have even more challenging tasks, since today the alkaline sizing of modern papers adds calcium to the waters. This ion is poison to the bleaching and to pulp manufacture, because it favors deposits along the process, and bring dirt specks to the product. As a consequence, improving environment is not only a decision to change one technology in a step of the process, but to evaluate the entire producing process. For example, the closing the water concept is very good to reduce wastewater, but the amount of generated solids residues climbs and a new environmental problem will come demanding new solutions. For all these reasons, technological developments are happening all along the production process. A good understanding of these relations by highly skilled technical personnel is essential in the today's technical environment.

In addition to this, a great number of research areas are coming to the scene, including: kraft pulping modifications to increase pulp yield; new bleaching sequences and combinations of pre-treatments of the pulp; novel by-product developments; and new product developments in papermaking. Since papermaking is rapidly changing to faster machines oriented to manufacture a more uniform and high quality paper, rapid technological changes are being expected to the paper machines, paper chemicals, stock preparation and process control. Mills are trying to work with widen line of products, developing niche markets. Others are competing in the commodity

market, but offering higher quality. These changes in product and process are reflecting in rapid developments. In this regard, the suppliers are playing decisive role as technology promoters.

The challenges being placed today are to take the most of the existing available technology, and to develop new ones. The first goal is to maximize the utilization of the existing technologies, to raise productivity and quality, to improve operational efficiency of all machinery, and to minimize wastes. This moment is particularly favorable to the adoption of pollution prevention concepts, cleaner production and eco-efficiency. By the ways, the goals are the same: reducing wastes to reduce costs. Operational efficiency and eco-efficiency, the way they are being seen today, may be considered synonymous.

The adoption of end-of-pipe techniques are also vital. In many cases, the use of a wastewater treatment or a filter to a flue gas are the only viable alternatives. In most of cases, the end-of-pipe treatments are applied to comply with the regulated requirements established by law.

Internal recycling is being the preferred manner to reduce environmental impact. The industry is faster developing measures to recover water, energy, fibers, chemicals, etc. This is a task involving everybody: researchers, operators and managers.

Finally, the odor is being fight but still not defeated. It has been reduced in intensity level by new technologies as: low odor recovery boiler, gas burners and scrubbers, pulping additives, etc. Additional investigation are required on this subject.

Sector specific EST – Environmentally Sound Technologies characterization

The pulp and paper industry is worldwidely recognized as a large volume commodity manufacturing industry, consuming enormous amounts of raw materials. Water, fiber resources and energy use are required in intense dosages. Because of the huge consumption, the industry also regarded as an environmental impacting manufacture. However, in recent years, the industry has placed efforts and also pushed hardly to switch from a position of high impact to a sustainable manufacturing activity, based on renewable resources. Many technological and management initiatives were promoted throughout the world, aiming to rescue a good image and to reduce the pressure from communities about pollution. From mid 80's till now, many technological innovations were implemented, from forests to end customers. The general trend was to save resources and to produce more efficiently, wasting less. At the same time, the mills were saving money and reducing costs, they were working more eco-efficiently. Clean technologies were introduced to give more operational efficiency and savings to the mills. The term "clean technology" is defined as " the manufacturing process or technology that reduce the pollution load or waste generation, the energy use, and the raw material consumption, in comparison to the technology it is replacing". This means that any modification or any technical modification reducing needs of water, energy and raw materials to a given unit of manufactured product, may be defined as a clean technology, as far as it does not include harmful counter-effects.

The key impacts of the pulp and paper industry includes the following:

Water:

Pulp and paper industry is one of the largest consumers of water in the industrial process. Considering an average of 50 m³ of water per ton of manufactured pulp, and 20 m³ for paper, the total water uptake in the Brazilian P&P industry is in the range of 500 – 600 million cubic meters

per year, with corresponding generation of effluent to be treated and discarded back to the rivers, lakes and sea. Reducing water is a primary concern to the industry. Although far from the ideal concept of total closure, the industry is gradually implementing processes modifications to reduce this impact. As a gross figure in Brazil, it may be said that the water use per ton of manufactured paper or pulp has been reduced to half along the past 15 years. On the other side, the pulp production raised from 3.7 million tons in 1985 to 7.4 in 2001; and paper manufacturing from 4.0 to 7.2 in the same period. The impact is close to the same, volumewise speaking. Under an ecologist point of view, this may represent no improvements, but under the view of making more with less (eco-efficiency), the industry proved to be working hard in the homework.

Fiber resources:

The wood coming from *Eucalyptus* and *Pinus* plantations are the most important virgin fibrous raw materials to the Brazilian industry. Wastepaper ranks after, being recovered at a rate of about 40% in Brazil. Thanks to forest tree breeding technologies, the pulp industry is benefiting from the tree growth yields and wood quality to the end products. Today, the same area of land is able to supply the double or the triple of wood in comparison to 30 years ago. The traditional measurements of forest growth (volume/hectare.year) has been replaced by a new index (equivalent tons of manufactured pulp per hectare per year). In 1970 this figure was about 4 ad ton/ha.year in the eucalyptus plantations. Today, is over 10 in average, but cloned superior stands are giving over 15 ad tons/ha.year. This has a fantastic reduction in the needs of geographical area to supply a mill. In pines, the trend was not that impressive, because clonal multiplication of trees is in the initial steps, but results are minimum twice as better in relation to the 70's.

Energy use:

Chemical pulping and subsequently papermaking demands a total of about 4.5 to 6.5 Gcal/ton of product. Energy demands are of two types: steam and electricity. The general rule till mid 80's was the use of fossil fuels to generate both types of power. The Brazilian pulp and paper industry took the challenge to use huge biomass boilers (bark and firewood), and the success was rewarding by savings in money and in clean production. Today, the great majority of pulp and paper mills in Brazil are burning renewable biomass resources to generate energy. The resulting ashes from the boilers play a role as unexpected forest fertilizers. Fuel oil, if consumed as the sole source of fuel, complementing the generation of the recovery boilers burning black liquor from the kraft process, would be used in a specific consumption of about 500 kg/ ton of product. However, when biomass is used, the fuel oil consumption drops to about 70 kg/ton of product (in lime kilns, burners, etc). The electricity is generated from the high pressure superheated steam in turbines located at the mill sites. Use of electricity is also high, about 1 MWh/ton in the chemical pulp and also in the paper mills. Steam demands are in the range 7 to 10 tons of steam per ton of pulp. Certainly, the energy consumption depends very much on how much of the chemical furnish is manufactured on mil site, or bought from outside suppliers.

Table 11 : Natural resources : water, wood and energy consumption for a typical eucalyptus pulp manufacturing plant

	Pulp mill	Paper mill	Unit
Water	25 - 60	15 - 35	m ³ / ton
Wood	3.9 - 4.4	-	m ³ under bark / ton
Virgin fiber	-	0.7 - 0.8	ad/ton/ton
Wastepaper (recycling-based mills)	-	1.35 - 1.45	ton / ton
Energy:			
• Electricity	0.8 - 1.1	0.8 - 1.0	MWh/ ton
• Steam	7 - 10	1.8 - 2.2	ton / ton

Source: interviews

EST categorization:

There are at several types of specific EST technologies to the sector :

- ✓ Cost-effective reducing technologies (CERT): aiming to improve overall efficiency and to reduce costs. These technologies are in most of the cases pollution prevention based. They include measures to better use the wood, to reduce fiber and chemical losses, to reduce energy consumption, to reduce steam losses, to better burn the fuels, to recover waste heat from flue gases, etc. In all cases, the mill manager take benefits of reduced production costs.
- ✓ End-of-pipe technologies (EOP): in general they aim to convert one type of pollution in another one less aggressive, but in general another residue. An wastewater treatment plant may give a sludge as residue, transforming hydric pollution problem in a solid residue problem. An electrostatic precipitator clean the flue gases from particulate matter, but generates an ash to be handled. A gas burner changes one gas to another not so harmful, etc.
- ✓ Internal on site recycling technologies (IORT): in general based on machinery from the former group of technologies. Instead of being used as end-of-pipe, they are oriented to collect a pollution and to send it back to the manufacturing process.
- ✓ Process modification (PM): in many cases, to solve an environmental problem, the production process has to be modified. It is the case of using the kraft/antraquinone or soda/antraquinone pulping process to reduce generation of odor. There are examples in Brazil for doing this: Klabin Riocell (RS) and Nobrecel (SP).
- ✓ Equipment modification (EM): modifications on existing process equipments to run the process more efficiently.
- ✓ Input material change (IMC): when some toxic material is replaced by nontoxic or by a renewable one.

- ✓ Automation and process control (APC): modifications in the procedure to control the process to run it more efficiently, at higher efficiency and at lower waste and emission generating rates.
- ✓ Product modifications or eco-design of products (ED) : modifications of the product characteristics in order to minimize the environmental impacts during its production, use and disposal.

Clean & EST technologies:

A long list of cleaner pulp and paper technologies has been built in recent decades. They have been implemented in all steps of the process, from forests to warehouses.

All sampled firms in our study are adopting several of these more environmentally sound technologies, resulted from the option to replace former more pollutant and wasting procedures to cleaner ones.

- Clean technologies in wood yard: bark removal and utilization as biomass or composted fertilizer; dry debarking in opposition to wet systems; horizontal chippers; low energy conveyors; bark dryers using waste flue gases; utilization of sawdust to byproducts.
- Clean technologies at the pulping process: kraft cooking modifications (extend cooking, low temperature cooking, cold blow, compact cooking, liquor displacement cooking, knots recycling, etc); utilization of antraquinone in cooking and other catalysts for cooking and bleaching; oxygen delignification prior to bleaching; ECF bleaching; TCF bleaching; enzyme bleaching; acid stage previous to bleaching sequence; washing presses; etc
- Clean technologies at the liquor recovery systems: low odor and odor-less recovery boiler technology; black liquor gasification; burning of odorous gases in kiln or boilers; black liquor oxidation; more efficient multiple effect evaporators; fluidized bed boilers; flash dryers for lime kiln drying; tall oil recovery; development of catalysts for combustion; condensates stripping/distillation to remove VOCs and non condensable air emissions; burning of vent gases in captive burners; etc.
- Clean technologies at paper manufacturing: more efficient wet presses; automation; closure of water systems; recovery of fibers and broke; etc.
- Clean technologies at chemical plants: effluent and solid residue-free chlorine dioxide generation; caustic soda generation by the use of membrane cells; etc.
- Clean technologies at waste treatment plants: secondary and tertiary level systems; activated sludge systems; sludge presses; internal recycling; reverse osmosis to clarify waste liquids; anaerobic digestion; composting of organic residues; etc
- General clean technologies: automation and efficient process control; efficient spill control and recovery systems.

There are unanimous agreement that some of the environmental weaknesses of the pulp and paper sector lies today in developing technologies related to:

- ✓ Health effects to humans (employees and surrounding communities),
- ✓ Indoor and workplace pollution,
- ✓ Elimination of odor (sulfur free pulping, etc),
- ✓ Cost-effective alternatives to control TRS (total reduced sulfur), VOCs (volatile organic compounds), POPs (persistent organic pollutants), and HAPs (hazardous air pollutants),
- ✓ Recycling of water and problems related with,
- ✓ Potential uses for solid wastes in a way to eliminate landfills, enhancing value of residuals as products,

- ✓ Recovery of deleterious materials,
- ✓ Low energy demand technologies.

These new technologies have the must to solve environmental problems without impacting product quality and increasing production costs. Pulp and paper products are mostly commodities, the product price is controlled by the offer/demand of the market. Raising prices means to lose competitiveness on the manager viewpoint. Fortunately, there is still a lot of room to reach both targets: reducing pollution and contamination, increasing operational efficiency, and reducing or maintaining costs.

Technological and educational infrastructure

The pulp and paper business is relatively conservative to promote technological changes in process and in machinery. There are good reasons for this: the long term maturity of a new investment, the capital requirement, the need to pay the invested capital, the usage among technical personnel to adopt only proven technologies. Moreover, technical support is frequently required during the decision making period prior to acquisition of the technology, and also during implementation.

Considering all these points, how to explain the quick adoption of EST in Brazil? A simple word may explain this: cooperation. Since environment is a side-area in a mill, it's not seen as a top secret, in opposition to what happens in the paper machine and the converting operations. Certainly, sometimes the technicians may be reluctant to open their figures about air and water emissions, specially when they are not good. However, it is exactly at this time that they are needing and asking for help.

The cooperation pattern was developed under two business associations: ABTCP (Brazilian Technical Association of Pulp and Paper www.abtcp.com.br), and BRACELPA (Brazilian Association of Pulp and Paper Manufacturers www.bracelpa.com.br). Both associations have environmental committees with voluntary participation of members to discuss relevant subjects about environmental performance and upgrading. ABTCP committee is more technical, more related to discussing technologies, equipment, performances, benchmarking, compliance parameters, permits, targets, etc. BRACELPA taskforce is a healthy blend of political, legislation, and benchmarking issues. Both complement each other. In some cases, the member representing the company may act in both committees.

ABTCP provides a broaden range of technical expertise. Environmental issues deserve several forums to exchange knowledge and ideas: seminars, courses, congress, exhibits. They involve the entire process chain, enabling the personal contact among the partners: suppliers, users, universities, technical institutes, consultants. The most attractive product offered by this committee is the Annual Environmental Seminar, that usually takes place in one of the leading mills in the country on environmental performance. The purpose is to exchange data and technological knowledge. Besides the technical paper presentations by universities, plants, suppliers and consultants, several case studies are made available. ABTCP and CNTL – National Center for Cleaner Production are working closer to promote the CP concept to the sector. There are three mills in Rio Grande do Sul working with the implementation of CP programs : Klabin Riocell, Cambara and Tres Portos. ABTCP and CNTL are offering special courses and technical expertise on this concept, with relative success.

BRACELPA committee (known as GT-8) is deeply involved in strategic views of the environment with the focus on the business impact: policies, certifications, eco-labeling, etc. The key words in the BRACELPA group are cooperation and pro-activity. For these reasons, Brazil always have positive participation on international environmental forums, such as those for

discussions about the EU eco-labeling scheme, FSC certification, ISO 14001 set of standards, Kyoto protocol, etc. BRACELPA has continuously participated in three industry forums, where environmental issues are important subjects in the table of discussions: FAO – Food and Agriculture Organization (Advisory Committee on Paper and Wood Products), CICEPLA (Latin American Pulp and Paper Industry Confederation), and IFIR (International Forest Industry Roundtable).

Along the years, a network of different actors was established and it runs smoothly and efficiently. These actors are in general: pulp and paper companies, individual consultants, consulting firms, analytical laboratories, technical institutes (CETCEP, IPT, LACE, CNTL), universities (UFV, USP, UNESP, UFSM, UNICAMP, etc), regulators (CETESB, FEPAM, IAP, FATMA) and suppliers (Meri, Degremont, Kvaerner, Nalco, Buckman, Krofta, etc) It may be said that suppliers are playing important role in this network. Since they are well informed about the main constrains in the industry, they compete to be innovative and to quickly bring solutions to the environmental problems. The network also includes hubs from abroad, mainly the technical associations as TAPPI/ USA (www.tappi.org) and PAPTAC/ Canada (www.paptac.ca)

Curiously, the management of this network is based on trust and good willingness. It is my understanding that CEOs and company managers do not see environment as a knowledge or an intellectual property to be protected, but shared, in opposition to other mill knowledge. Environment has a strong effect on image, not only the company image, but the segment image. Perhaps, to protect the sector, the philosophy is based on an open doors attitude.

Training and education in environment is becoming abundant in Brazil, both at the undergraduate or graduate levels. The M.Sc. and Ph.D. courses are very often taken by professionals of the sector. As consequence, public thesis are made available with interesting researches performed in the mill sites. Training is also provided by the ABTCP seminars, courses and congresses, including courses in cleaner production. There is not a clear integration about the promotion of EST and CP, the events are more or less punctual. A closer cooperation among institutions needs some guidance and a well established national program. National cleaner production programs are available to other areas (furniture manufacturing, chemical industry, etc). To the pulp and paper segment, there are initiatives to the implementation of a national cleaner program under the umbrella of CNTL / SENAI (www.dn.senai.br) and/or SEBRAE (www.sebrae.com.br), with ABTCP (www.abtcp.com.br) as the facilitator sponsor.

As a whole, technological developments in Brazil are driven by technical universities (Federal University of Vicosa, Federal University of Santa Maria, University of Sao Paulo, University of the State of Sao Paulo, University of Campinas), technical institutes (CETCEP and IPT – Technical Institute of Sao Paulo); companies R&D centers (Aracruz, Suzano, Klabin Riocell), mill operation teams and suppliers. The suppliers are used to take advantage of the facilities offered by ABTCP (congress, exhibits, workshops, etc), in a model very similar to other countries. All the important leading pulp and paper suppliers are present in Brazil, both with factories, franchising or sub-contractors. Some examples are: Voith, Kvaerner, Metso, Andritz, Albany, Babcock, Foxboro, Ciba, Degremont, Imerys, Buckman, Solvay, etc.

The process of technological transference in most cases is made without royalties, but included in the product price (*the hidden cost of the technology*). This is also the very typical model in use in a world basis at the pulp and paper segment. The technology buyers (mills) they utilize the competition among the suppliers to get bargains in the prices. However, consolidation is something also happening at the supplier side. Suppliers now are larger and larger, but fewer. There are situations that typically characterize a monopoly. Services from the supplier side are also very good. There are cases where the supplier finance the installation of the machinery and charge it along the years selling the product. There are also cases, when the supplier is

subcontracted to operate a plant he has the expertise. These trends are becoming typical features for all technologies, from heavy machinery to laboratory equipment. This is also common in the EST. There are cases where the pulp/paper wastewater plant is being operated by some chemical supplier, in a close partnership.

Section 3: Methodology and sample profile

Research was based on interviews with selected organizations in south of Brazil, deeply related to the pulp and paper segment: pulp and paper mills, machinery and raw material suppliers, technological centers, business associations, NGOs and environmental regulators.

The interviews were performed in a face-to-face basis, covering the period December 10th, 2001 till April 26th, 2002.

The following pulp and paper firms and important stakeholders have made up the sample:

Pulp and paper firms:

- Ø **Klabin Riocell S/A** (www.riocell.com.br): one of the most interesting cases of environmental change over three decades of improvements. Klabin Riocell is famous for the ability it had to switch the image “from devil to angel”, with aggressive investments on EST and a committed responsibility towards environmental performance.
- Ø **Cambara S/A Produtos Florestais** (www.ufsm.br/dcfl/cepef/cambara): another case of success on dealing with environmental problems. The company faced strong opposition in the past, mainly from regulators and public prosecutors. With a serious program of investments towards technological upgrades and qualification of human resources and management team, the company is now running to reach the vision it wants to have in the future: “*to be recognized as environmentally responsible*”.
- Ø **Santher – Fabrica de Papel Santa Therezinha S/A** (www.santher.com.br): a small paper mill located in Guaiba / RS, originally an integrated pulp and paper mill with great problems with water pollution. The firm had to change technology and to find niche markets to the products to become more efficient and profitable. All these moves had environment as driving force.
- Ø **Klabin Papeis**(www.klabin.com.br): an integrated pulp and paperboard firm, and leader in Brazil in manufacturing packaging boards.
- Ø **Inpacel S/A** (www.inpacel.com.br) : an integrated paper mill, manufacturing LWC – light weighted coated paper, located in the state of Parana
- Ø **Norske Skog Pisa** (www.norske-skog.com) : an integrated high yield and newsprint mill. The company is regarded as one of the first to adopt the cluster concept with surrounding forest-based companies.
- Ø **Iguacu Celulose e Papel S/A** (www.iguacucelulose.com.br): a corporation with mills in the Parana and Santa Catarina states, manufacturing packaging and specialty papers.

The table number 12 presented below provides a summary of the sampled firms, with some important features of them.

Table 12

Name of firm	Product Type	Process	Scale/ Size*	Located	Sales Orient.	Technology Level	Ownership	Envir. practice	Regulatory Compliance	Donor Assistance
Klabin Riocell	Market pulp; P&W papers	Kraft	300,679 ad ton/y of pulp; 42,000 tons of paper	Guaiba RS	Pulp: 70% export; 30% domestic	BAT, with modernizing project concluded in 2002	Private domestic	YES ISO14001 ISO 9000 FSC EOP CP EST	YES	NO
Cambara	Fluff pulp and tissue paper	Sulfite Fourdrinier	25,181 t/y	Cambara do Sul RS	100% domestic	Standard	Private domestic	YES EOP CP EST House Keeping & Quality	YES	NO
Santher	Tissue and industrial papers	Fourdrinier; Wastepaper & market pulp	17,750 t/y	Guaiba RS	25% exports; 75% domestic	Standard	Private domestic	YES House-keeping Quality EOP EST	YES	NO
Klabin Papeis	Kraftliner & Paper Board & Sacks	Kraft Fourdrinier & Converting	354,000 t/y kraftliner & 120,000 t/y sackpaper	Otacio Costa & Correia Pinto SC	80% export kraftliner 100% domestic sack	Standard (kraftliner) & BAT (sacks)	Private domestic	YES EMS ISO 9000 OSHA EOP EST	YES	NO

Inpaccel	LWC coated paper	TMP Fourdrinier Coating	182,200 t/y	Arapoti PR	35% exports 65% domestic	BAT	Private domestic	YES ISO 9000 ISO 14000 EMS EOP EST Pollution Prevention	YES	NO
Norske-Skog	Newsprint	Groundwood	180,000 t/y	Jaguari-aiva PR	94% domestic 06% export	Standard	Private foreign	YES EMS OSHA EOP EST	YES	NO
Iguacu Celulose	Kraft pulp Packaging and industrial papers	Kraft pulp	88,650 ad t/y of pulp for own group	Pirai do Sul PR	100% domestic	Standard	Private domestic	YES ISO 9000 EOP EST House-keeping	YES	NO

All firms in the sample are members of BRACELPA & ABTCP, and also of the local state industrial federation and the pulp and paper manufacturers associations in the corresponding state they are located.

Major stakeholders

Technological Centers:

- Ø **CNTL – National Center for Cleaner Production** (www.rs.senai.br/cntl): the Brazilian center for cleaner production, responsible for implementing cleaner production concepts and training in some of the sampled firms.
- Ø **LACE – Pulp and Effluents Laboratory** (www.etfpel.tche.br): a specialized laboratory associated with a technical college in Pelotas/RS. The lab has facilities to evaluate fibers and pulps, effluents and environmental monitoring and simulations.
- Ø **CEPEF / UFSM- Federal University of Santa Maria** (www.ufsm.br/dcfl/cepef): the university has a graduate program on pulp and paper technology with several efforts on EST, both with air, water and solid residues. The university has also a well-equipped laboratory for ecological impact evaluation in forests.
- Ø **CETCEP – Technological Center for Pulp and Paper** (www.senai.cetcep.com.br): one of the outstanding centers in South Brazil for training and researching pulp and paper issues.
- Ø **CNPF – National Center for Forest Research / Embrapa** (www.cnpf.embrapa.br): a reference center in forestry and forest products utilization in Brazil.

Regulators:

- Ø **FEPAM (RS)** (www.fepam.rs.gov.br): the environmental regulator organization for the state of Rio Grande do Sul.
- Ø **FATMA (SC)** (www.fatma.sc.gov.br): the regulator in the state of Santa Catarina.
- Ø **IAP (PR)** (www.pr.gov.br/iap): the regulator in the state of Parana.
- Ø **IBAMA** (www.ibama.gov.br) the Brazilian Federal entity responsible for the implementation of the country environmental policies, as the executive arm of the Ministry of Environment.
- Ø **General Public Attorney** (www.mp.rs.gov.br): the branch in Rio Grande do Sul from the Brazilian General Public Attorney, a prosecution entity very important to guarantee law compliance, regarding individuals and firms.

Business Associations:

- Ø **BRACELPA – Brazilian Association of Pulp and Paper Manufacturers** (www.bracelpa.com.br): the national association comprising pulp and paper manufacturers and located in the state of Sao Paulo.
- Ø **ABTCP – Brazilian Pulp and Paper Technical Association** (www.abtcp.com.br): the technical association of the industry, located in Sao Paulo.
- Ø **SINPASUL (RS)** (www.sinpasul.com.br): the pulp and paper association of manufacturers in Rio Grande do Sul.
- Ø **SINPACEL (PR)** (www.sinpacel.org.br): the corresponding association of manufacturers in Parana state.

Suppliers:

- Ø **COPELMI (RS)** : a mineral coal miner.
- Ø **KVAERNER Pulping (PR)** (www.kvaerner.com): one of the most important machinery suppliers in the world, with a factory in Parana state.
- Ø **Sulfato Rio Grande (RS)** : the largest manufacturer of alum in south Brazil to be used in clarification of water and effluents.

NGOs:

- Ø **AMA- Friends of Environment / Amigos do Meio ambiente (RS)**: a small, but very active NGO in the same location as Klabin Riocell.
- Ø **Fundacao Gaia (RS)** (www.fgaia.org.br): founded and managed by the most renowned environmentalist in Brazil, Dr. Jose Lutzenberger, former Minister of Environment in the early 90's.
- Ø **AGAPAN (RS)** (www.agirazul.com.br/agapan): the landmark in terms of campaigning against the pulp and paper mills in the state of Rio Grande do Sul.
- Ø **Nucleo Amigos da Terra / Friends of the Earth(RS)** (www.nat.agirazul.com.br): an important NGO in south Brazil. Also responsible for dramatic campaigns in opposition to pulp and paper mills.

The interviews and questionnaires are presented as appendix to this report.

Section 4: Main findings of survey and recommendations

EST and Clean Technologies (CT) adopted by the sampled firms and main benefits

From the previous section, the different list of new EST and CT technologies presented are related to the pulp and paper firms in the sample to roughly evaluate their commitments to the implementation of cleaner procedures.

Table number 13 was built with the purpose to condense the EST adopted technologies, the type, the benefits, and the level of difficulty to the implementation. The results of the table are only indications, since the interviews with firms were not exhausting. When a factor is not applicable to a certain firm, due to be a non-integrated paper mill, or to be exclusively a pulp mill, or a high yield process with integrated paper manufacturing, the letters NA were placed in the table, indicating it is not applicable to this particular case.

Table 13: EST & Clean technologies in the sampled firms

	Klabin Riocell	Cambara	Santher	Klabin Papeis	Inpacel	Norske Skog	Iguacu	Type of EST	Benefits	Level of difficulty to implement
WOOD HANDLING										
Biomass fuel	No	Yes	Yes	???	??	??	???	CERT IORT IMC	Cost CP	Medium
Biomass composting	Yes	Yes	Yes	Yes	??	??	???	IORT	CP	Simple
Low energy conveyors	Yes	Yes	NA	Yes	Yes	Yes	Yes	CERT EM	Cost Energy	Simple
Bark dryers	No	No	NA	???	??	??	???	CERT PM	--	Medium
Utilization of sawdust	No	Yes	NA	Yes	Yes	Yes	Yes	CERT IORT	Cost CP	Simple
PULPING										
Cooking modifications (extended, higher yield, etc)	Yes	Yes	NA	???	NA	NA	???	CERT PM EM	Cost Efficiency	Medium
Antraquinone use	Yes	NA	NA	No	NA	NA	???	CERT PM IMC	Cost Efficiency Yield Odor	Simple
Oxygen delignification	Yes	Yes	NA	NA	NA	NA	NA	CERT PM	Cost Efficiency AOX	Medium
ECF bleaching	Yes	Yes	NA	NA	NA	NA	NA	PM IMC ED	AOX Quality	Medium
TCF bleaching	No	No	NA	NA	Yes	Yes	NA	PM IMC	Process needs	Complex

	Klabin Riocell	Cambara	Santher	Klabin Papeis	Inpacel	Norske Skog	Iguaçu	Type of EST	Benefits	Level of difficulty to implement
PULPING										
Enzyme bleaching	No	No	NA	NA	No	No	NA	PM IMC	--	Medium
Acid stage pre bleaching	Yes	No	NA	NA	NA	NA	NA	PM IMC	Cost Savings	Simple
Washing presses	??	No	NA	??	??	??	??	EM IORT	Cost Efficiency	Medium
RECOVERY OF LIQUOR										
Low odor or odor less recovery boiler technology	Yes	No	NA	???	NA	NA	???	EM	Odor Efficiency	Complex
Black liquor gasification	No	No	NA	???	NA	NA	No	PM	--	Complex
Burning odor gases in lime kiln or boiler	Yes	No	NA	???	NA	NA	???	EOP	Odor	Medium
Black liquor oxidation	Yes	No	NA	???	NA	NA	???	PM	Odor Energy	Medium
Recycle of cooking liquor to lignosulfonates	NA	Yes	NA	NA	NA	NA	NA	IORT PM	Waste use Pollution	Complex
Efficient multiple effect evaporators	Yes	Yes	NA	???	???	???	???	CERT EM	Energy saving	Medium
Fluidized bed boilers	No	No	No	No	No	No	No	PM EM	Cost Efficiency	Complex
Flash dryers to lime kiln	???	No	NA	???	NA	NA	???	PM EM GERT	Energy Efficiency	Medium
Tail oil recovery	No	No	NA	???	NA	NA	???	IORT GERT	Cost	Medium
Catalysts at power boiler combustion	???	???	???	???	???	???	???	CERT PM	Efficiency	Simple
Condensate stripping column	Yes	No	NA	??	NA	NA	???	PM EOP	Odor Pollution	Medium

	Klabin Riocell	Cambara	Santher	Klabin Papeis	Inpacel	Norske Skog	Iguaçu	Type of EST	Benefits	Level of difficulty to implement
RECOVERY OF LIQUOR										
Burning vent gases in captive burner	Yes	No	No	???	???	???	???	EOP	Odor Pollution	Medium
PAPER / SHEET MANUFACTURING										
Modern wet presses	No	No	No	???	???	???	???	CERT EM	Cost Energy Cost	Complex
Closure of water systems	Yes	Yes	Yes	Yes	Yes	Yes	Yes	CERT IORT	Cost Pollution	Medium Complex
Automation / process control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	CERT EM APC	Cost Efficiency	Complex
Recovery of fibers	Yes	Yes	Yes	Yes	Yes	Yes	Yes	CERT IORT	Cost Pollution	Simple
Utilization of recovered fibers / wastepaper	NA	NA	Yes	NA	NA	NA	NA	CERT IORT	Cost	Simple
Broke management	Yes	Yes	Yes	Yes	Yes	Yes	Yes	CERT IORT	Cost Efficiency	Medium
CHEMICAL PLANT										
Effluent free chemical manufacturing	No	No	Yes	???	???	???	???	EOP IORT	Pollution	Complex
Membrane cells to caustic soda making	Yes	NA	NA	???	???	???	???	EM CERT	Pollution	Complex
WASTE TREATMENT										
Effluent treatment plant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	EOP	Compliance	Medium
• Level	tertiary	secondary	secondary	???	???	???	secondary		Compliance	to Complex

	Klabin Riocell	Cambara	Santher	Klabin Papéis	Inpapel	Norske Skog	Iguaçu	Type of EST	Benefits	-level of difficulty to implement
WASTE TREATMENT										
Activated sludge	Yes	Yes	No	??	???	???	???	EOP	Cost Efficiency Compliance	Complex
Sludge presses	Yes	No	No	???	???	???	???	EOP IORT	Cost	Medium
Reverse osmosis	No	No	No	???	???	???	???	PM	???	Complex
Anaerobic digestion	No	No	No	???	???	???	???	EOP EM	???	Complex
Composting of solid residues	Yes	Yes	Yes	Yes	???	???	???	EOP PM EM	Cost CP	Medium
GENERAL CLEAN TECHNOLOGIES										
Automation and process control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	APC CERT EM PM	Cost Efficiency	Medium
Spill recovery system	Yes	Partial	Partial	???	???	???	???	EOP CERT IORT PM	Cost CP Pollution Compliance	Medium

Drivers for EST and technological changes

There is a simple rule in today's business arena: " a company has two options, to modernize or to die". Modernization means to become more competitive and a key competitive factor is production cost. Competitiveness is also related to competition capability, and growth and power in the market. Competitiveness also depends on innovation, on management, on future vision and strategies, on technological upgrading, and action in the markets. For these reasons, competitiveness has been defined as the most important driver for defining technological changes and for implementation of new technologies. Low costs are not only operational costs, but along the entire productive chain. They are the goal of most mill managers. This objective may be reached by improved quality, productivity, new products and markets development, selected market presence, new technologies and qualified human resources. In this regard, the Brazilian export-oriented companies have an important role as promoters and internalization of new technologies. To guarantee presence in competitive markets they have to be at the state-of-the-art technical levels, including using EST technologies. Sales are improved and more smoothly done, when the pulp and paper supplier to the global market is environmentally friendly. For this reason, the exporting-oriented mills have usually an aggressive performance in environmental performance and management. They need also excellent managerial team. Improvements on these subjects started to be noticed when Brazil took an aggressive position in the international pulp markets. The consequence was a scattering of these world-class technological and managerial levels to other companies in the country, even to those integrated and oriented to domestic market. The search for operation efficiency and to benchmark the world class companies is a common task in most Brazilian pulp and paper companies. BRACELPA has an important role on the evaluation of the Brazilian competitive position in the international scenario. However, the case for the small mills is somewhat different. With lack of capital and scale of production, many of them try to survive or to merge. Moreover, pressures over them are more difficult to be absorbed and processed. Nevertheless, there are several examples of small mills that were able to achieve business success, in terms of quality, management, productivity and economical and environmental performance. Two selected cases included in our sample are examples of this: Cambara and Santher/Guaiba.

It's well understood that any pressure to add environmental control systems or new machinery means additional capital investments, at the moment of a decision-making about technology. The first reaction may be some resistance to spend the money, or to evaluate the rate of return based on traditional concepts of investment analysis. Apart from this, very often there is the suspicion about the EST performance and its effects on the overall existing process. The managers' questions frequently are: how to internalize this capital cost? How to revert this capital investment cost to operational and production costs gains? These two question have been little by little answered not only by the pulp and paper firms intelligence, but mainly by the suppliers. Suppliers have discovered along the years how to sell a technology in an environment like the pulp and paper business, relatively conservative to spend money. It was even mentioned during one of the interviews, that suppliers are excitedly expected with their proposals for solving mill problems, including those environmental. The way suppliers found was to develop more efficient technologies, using less resources (water, energy, air, chemicals, steam) and to recycle some of the existing losses (fibers, chemicals, etc). The consequence has been the fact that most of the process technologies are, in a not so hidden manner, cleaner technologies. For this reason, they are sold and adopted even without environmental pressures, and they bring benefits to the natural resources consumption. The closing system concept has been adopted widely by the companies, mills are becoming more efficient, more environmentally friendly. By contrary, costs are not raising because environmental improvements, but reducing.

It's also clear to mill managers that end-of-pipe technologies, although required in some cases, they represent only costs, they do not add economical value or gain. For these reasons, they are gradually being replaced by internal recycling, managerial measures, replacement of raw materials, development of less aggressive products, closing cycle, cleaner production and eco-efficiency, etc.

One of the main drivers to the smooth utilization of these concepts and this changing in attitude were the quality programs implemented in most pulp and paper companies, along the 80's and 90's. Total quality management, quality circles, total productive maintenance, 5 S's, ISO 9000, all brought to the mind of employees the responsibility to kill wastes and residues (and consequently, pollution loads). Companies with good quality programs and excellent house-keeping were easily converted to cleaner production, adopting eco-efficiency more smoothly. Several EST were implemented, although in many cases without knowing the concept of EST or cleaner production: recovery of fiber losses, recovery of wastewaters, reduction on energy and steam consumption, composting sludge to fertilizers, etc.

It's a general feeling that the technological upgrading taken by mills in the sample brought as overall consequences: quality of life, better workplace, motivation to employees, cleaner operation, improved quality, improved environmental and economical performances, reduction on costs, business sustainability. There is a clear understanding that technological uptake is fundamental. Although this fact was so clear, it was found some limitations in the mills for technological information access. Some companies have poor internet utilization, and other little participation in the technical events and technical visits to the "mills across the street". Many technicians do not read technical journals or books, although extensive literature is available in Portuguese.

Another important driving force was defined as the pressure from legislation and from regulators action (government agencies of control and General Public Attorney). There is a fear associated with fines, loss of permits, temporary shut down of the mill, impacts on public image, reduction of shares value in the stocks market, etc. One of the most dreaded pressure is the denouncement to the Public Attorney of any environmental disturbance, because the recent launched law of environmental crimes. This drive, also known as the police action of the governments, had important role in past decades. It was possible to understand from the interviews that the strict legislation of the past has contributed with excellent consequences and benefits to the today's operational and environmental performance. However, it was also stated that the time to "squeeze oranges" is gone. Today, the industry is courageously facing a severe legislation, but based on a better dialogue , and in a proactive pattern with regulators.

The third driving force has been defined as market forces. They were understood with three patterns. The first, the pressures from customers demanding ISO 14001, forest certification, certificates of health effect free products, certifications of no dioxin or furans, etc. This pattern is particularly true to companies exporting products. Even customers in the third world, they are also used to request such type of demands. The second identified market pattern is the possibility the firms have to identify niches of more valuable markets to sell their environmentally friendly products. This is typical to countries as Belgium, Holland, Germany, United Kingdom. The market in this countries is good and buyer, and payments are safe and on time. Finally, the third pattern is the competition among the Brazilian companies that wants to keep an environmentally friendly image at the markets they act. Nobody wants to be worse or the worst. This market effect has a strong pressure on the companies and speed up the process of environmental improvements. Many companies are working hard to show good environmental performances via nice reports and internet, or to gain international recognition awards. Multinational firms with mills in Brazil are very concerned about showing a nice face to the global market. Since they do not want to be seen as companies destroying the environment in the third world, they usually play a very good role in terms of environmental performance.

The fourth driver has been NGOs campaigns and opposition. NGOs are the usual carriers of denouncements to the Public Attorney. Ordinary citizens and customers groups are less important, but also have some role. It is a consensus that NGOs are a lot more qualified, they have better arguments and technical knowledge, and more open to debate. They are more oriented to find ways to promote sustainable development and life quality, new models for economical growth, and to preserve the natural heritage. It was said that they found their room to work where the government shows omission. Questionings are now more related to concepts or models and less to focal events. It was also clear that they want political independence, not willing to be linked to any political party, including the Green Party.

The survey has also proved that the technological infrastructure is relatively weak to develop EST, but fast to learn and to implement. The regulators were not considered drivers for helping technological development because the lack of information and knowledge they have about the sector technologies. They were reported as more concerned with standards and limits. However, the strict limits they impose are strong drivers to the innovation and to the use of EST. It was even said that globalization may have an impact on Brazilian legislation and restriction, since regulators will be able to easily identify new restrictions worldwide to use as new paradigms.

There is a concern expressed by the business associations, that stricter legislation may have negative impact and weaken the country's competitiveness in this segment. The example of American pulp and paper mills after EPA cluster rules shock was mentioned.

It was also a consensus that new environmental pressures are inevitable from all sides. It is a dynamic environment, but there is a lot of fun to play the game, it has also been said.

Recommendations:

Recommendations to the Governments:

- ❖ Implementation of a national program for citizen consciousness (quality, environment, consumers' rights, home management).
- ❖ Improvements on the education in all levels, giving more opportunities to citizens to think globally and to act locally.
- ❖ Improvements on dialoguing with government, pulp and paper companies and politicians.
- ❖ Incentives to the technological innovation and R&D oriented to EST, in partnership with universities and pulp and paper companies.
- ❖ Attack the so called "Brazilian cost": taxation, bureaucracy, excess of laws, infrastructure, etc.
- ❖ Find ways to favor the experience of Brazilian regulators with those from other countries, not only to exchange limits, but to understand the incentives offered to "the better than compliance companies".
- ❖ Improve the regulator agencies with data banks, toxic compounds inventories, laboratories, technical personnel, training, etc.
- ❖ Speed up the decision-making on the regulators side. There are cases when a slow-moving decision to settle permits were enough to bring the investors' intention to move to other places or businesses.
- ❖ Develop better qualification about the pulp and paper technologies to the regulator technical staff.
- ❖ Develop new incentives to environmental performance improvements, using the taxation system.

- ✿ Develop “green financing models”, with lower interest rates. In a country with lack of capital, the companies are reluctant to invest in projects with low or negative rate of return.

Recommendations to the business associations:

- ✿ Improve the political participation, helping to build and to amend legislation.
- ✿ Campaign to ordinary people to bring clear understanding about controversies on environmental subjects: plantations, odor, dioxin and POPs, sustainability, genetic engineering, etc.
- ✿ Improve the technical exchange using ABTCP to promote international partnerships with sister associations in USA, Canada, Sweden, Finland, Chile, etc.
- ✿ The same as before, but with other Brazilian associations, from different industrial segments.
- ✿ Favor the strengthening of the technological network by including other actors and sources of intelligence in the associations forums: regulators, NGOs, suppliers, consultants.
- ✿ Promote cleaner production and eco-efficiency via events, news, conferences, overall country programs, etc.
- ✿ Favor a better approximation between NGOs and pulp and paper companies.
- ✿ Favor environmental technical exchanges using: studies of cases, benchmarks, technical visits to world-class mills, in Brazil or abroad.
- ✿ Promote links between companies, technical centers, and universities, favoring the upgrading of the laboratories, courses, libraries about environmentally sound technologies (EST).
- ✿ Promotion of openness and cooperation on sharing environmental technology knowledge.
- ✿ Help to kill low profile or no profile postures towards environment.

Recommendations to the firms:

- ✿ Participate more actively and proactively in environmental forums, mainly those including the different actors analyzed in this report.
- ✿ Pay more attention to different viewpoints about sustainable development. The economical side may have some difficulties to understand the models offered by social and environmental organizations.
- ✿ Create forums to debate environmental issues, internally and/or externally the fences of the company.
- ✿ Improve the process to obtain and to scatter information about EST.
- ✿ Qualify the employees with additional expertise, organizing internal courses, continuous education, e-learning, etc.
- ✿ Sponsor R&D projects in universities and technological centers, offering scholarships to graduate students working with EST issues.

Recommendations to the technological centers:

- ✿ Market the skills and potential services on EST developments.
- ✿ Improve qualification of technical staff by advanced training on EST.
- ✿ Obtain financial support from pulp and paper companies, business associations or government to upgrade laboratories and facilities.
- ✿ Search partners to develop R&D and student thesis about EST.
- ✿ Develop a project to better understanding of the environmental impacts of the pulp and paper productive chain, and potential utilization of EST.

Recommendations to the regulators:

- ❖ Improve technical qualification on pulp and paper issues.
- ❖ Participate more actively on pulp and paper congresses, exhibits, etc.
- ❖ Search forums for improving knowledge about EST related to the pulp and paper sector.

Recommendations to the NGOs:

- ❖ Develop a basis for improved dialogue with the business and technical associations.
- ❖ Develop trustiness and understanding.

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ANNEX I

Table A: Macro-economical indicators - Brazil

	1997	1998	1999	2000	2001	2002 (projected)
GDP, US\$ billion	804	775	561	600	525	545
GDP / capita	5,043	4,669	3,339	3,529	3,052	3,131
GDP growth, %	3.3	0.2	0.8	4.2	1.5	2.0
Inflation rate, %	4.3	0.7	8.9	6.0	7.7	8.0
Unemployment rate, %	5.7	7.6	7.5	7.1	6.2	6.5
Interest rate (inflation-free), %	18.4	29.0	15.0	10.8	9.0	11.0
Exports, US\$ bill.	53.0	51.1	48.0	55.1	58.2	57.0
Imports, US\$ bill.	59.8	57.7	49.2	55.8	55.6	52.0
Trade balance, US\$ billion	-6.8	-6.6	-1.2	-0.7	2.6	5.0
Currency reserves, US\$ billion	52.2	44.6	36.3	33.0	33.0	35.0
Public deficit (%GDP)	6.1	8.0	9.5	4.6	5.3	4.5
Public debt, US\$ billion	276.4	321	275	288	286	275
Foreign debt, US\$ billion	200	243	237	215	220	225
Exchange rate, R\$/US\$			Jan. 1.21	Jan. 1.85	Jan. 1.95	Jan. 2.34 July 2.85

Source: Pagnoncelli & Associados, 2002

Table B : Manufacturing Value Added – Brazil

	Value	Unit	Year
GDP	775.4	Billion US\$	1998
MVA	137.84	Billion US\$	1990
MVA	152.75	Billion US\$	1995
MVA	151.30	Billion US\$	1998
Share of MVA in GDP	19.5	%	1998
Total exports	47.8	Billion US\$	1999
Manufactured exports	38.0	Billion US\$	1999
Share of manufactured exports in total exports	79.8	%	1999
Total imports	51.6	Billion US\$	1999
Manufactured imports	45.2	Billion US\$	1999
Share of manufactured imports in total imports	87.4	%	1999

Source: www.unido.org

Table C : Manufacturing Value Added (MVA) growth in percentage by industrial segment in selected years.

Total MVA in 1995: 152.75 Billion US\$

	1990	1995
Food products	10.7	12.9
Textiles	5.5	3.5
Wood products, except furniture	0.9	0.7
Paper products	3.3	4.0
Chemicals	19.2	21.0
Iron & steel	11.0	9.9
Machinery, except electrical	8.8	5.8
Machinery, electrical only	8.8	6.8
Transport equipments	8.9	14.6
Other manufacturing products	22.9	20.8

Source: www.unido.org

Table D : Real growth of the industrial activity (%)

	1995	1996	1997	1998	1999	2000	2001
Industry	1,9	1,0	4,2	-1,7	-0,9	6,6	1,5
• Extractive	3,3	9,7	7,3	13,1	8,4	11,8	3,5
• Manufacturing	1,8	0,4	3,9	-2,9	-1,9	6,1	1,2

Source: www.mdic.gov.br

Table E : Performance of the Brazilian pulp and paper segment

	Pulp Production	Paper Production	Wastepaper consumption	Imports	Exports	Balance
	Million tons	Million tons	Million tons	Billion US\$	Billion US\$	Billion US\$
1992	5.36	4.90	n.a	1.47	0.31	1.16
1993	5.55	5.30	n.a	1.51	0.34	1.17
1994	5.91	5.65	n.a	1.79	0.46	1.33
1995	6.01	5.80	1.84	2.70	1.10	1.60
1996	6.34	6.18	2.18	1.93	1.01	0.92
1997	6.48	6.52	2.24	1.99	1.06	0.93
1998	6.82	6.59	2.30	1.98	1.06	0.92
1999	7.34	6.94	2.41	2.14	0.83	1.31
2000	7.60	7.19	2.61	2.54	0.97	1.57
2001	7.43	7.29	2.59	2.57	0.86	1.71

Source: BRACELPA, Preliminary Statistics 2001 (www.bracelpa.org.br)

Table F: Chemical and semi-chemical pulp production in the Brazilian states (year 2000)

	Million a . d. tons	% total Brazilian production	Number of mills
Sao Paulo	2.12	30.5	13
Espirito Santo	1.30	18.7	1
Minas Gerais	0.82	11.8	1
Santa Catarina	0.81	11.6	6
Parana	0.64	9.2	5
Bahia	0.58	8.4	1
Rio Grande do Sul	0.32	4.6	2
Para	0.29	4.2	1

Source: BRACELPA, Relatorio estatistico 2000

Table G: Paper production in the Brazilian states (year 2000)

	Million tons	% total Brazilian production	Number of mills
Sao Paulo	3.26	45.4	48
Parana	1.46	20.4	30
Santa Catarina	1.26	17.6	26
Minas Gerais	0.34	4.7	14
Bahia	0.24	3.4	5
Rio de Janeiro	0.23	3.1	9
Rio Grande do Sul	0.16	2.3	11

Source: BRACELPA, Relatório estatístico 2000

ANNEX II

“Selection of Quotes from the Interviews”

Jose Lutzenberger / Fundacao Gaia

“The companies need simple and inexpensive technological and environmental solutions, but they buy and they demand for expensive and sophisticated ones”

“Stricter environmental regulations are to gradually kill the small and medium sized manufacturer, opening the doors to the global giants to take control of all the markets. It seems to have some orchestration behind the carpets promoting this”

Nei Lima/ ABTCP

“Environments is a road without return or end”

Clair Sanfelici / Santher Guaiba

“Many times in our industry, the today's environmental responsibility was built over a foundation of very strict past requirements”

Wagner Gerber / LACE

“The starting point in any environmental discussion is now eco-efficiency, the rational utilization of resources and a win/win posture”

Alicio Bottin da Silva / SINPASUL

“The pulp and paper industry in the Rio Grande do Sul state has a growth model based on efforts to upgrade technology and to improve technical and managerial skills of the human resources”

Walter Rudi Christmann / Cambara

“There is a giant room for dialogue and better understanding with regulators. However, they need to be better informed about the pulp and paper business and the existing technologies”

Juarez Cruz / AMA

“In case a pulp and paper mill has the purpose to grow capacity to increase its competitiveness, it has to pay the price of the best available technology to avoid additional damage to the environment”

“Mill managers are improving environmental care and performance not because the pressure of the NGOs, but because the fear they have these pressures may happen to hurt the companies image”

Hugo Springer / CNTL

"The growing acquisition power of the Brazilian population is to guide to new consumption patterns, new quality requirements, more reliability and trustiness with the manufacturers. The environment is to play important role on this relation"

"Technological changes are driven by education (government and companies) , legislation (government), market (companies and citizens) and global consciousness (NGOs and communities). However, the main driving force is innovation."

Rosane Monteiro Borges / Klabin Riocell

"Environment does not provide a premium price to products, but it is a guarantee to access better markets and to obtain customer faithfulness"

"ISO 14001 is an obligation to the pulp and paper mills exporting to markets as European Unio: it is the minimum you shall do"

Ernesto Ronchini Lima , BRACELPA

"The squeeze the orange model is close to exhaustion"

"There is always the fear that the snow ball may become an avalanche"

"The today's complains are to be reverted in benefits and proud to the future business survivors"

Francisco Milanez / AGAPAN

"Green conquests are miserable in comparison to what has to be achieved"

"The NGOs are the best CEOs' friends forcing them to be a conscious citizen and not a rude moneymaker"

"Green Party is a buffoonery imported from Europe: all political parties should be green"

Nelson Tadeu Galvao de Oliveira / CETCEP

"Legislation will reflect the wishes of the society, and society is demanding a cleaner world. These pressures are to raise environmental requirements, and also modifications in the society behavior and consumption patterns"

"The real fact is that the large firms are good environmental performers. However, the small mills are very deteriorated in technology and qualification of personnel. The shortage of capital in these small business brings no option: if they have to make a choice, to invest in the environment or in the production, the answer is clearly to the production line"

"It is clear that the regular business man has still to improve his consciousness to invest more in environmental issues"

Mauro Schumacher / CEPEF-UFSM

"In today's world, there is no room for ecology without economy, and vice-versa"

"The search to the easier and cheaper is the dominant culture"

Cesar Weinschenck de Faria / COPELMI

"The more competitive technologies are closely related to more environmentally friendly. More competitive technologies have lower losses, better efficiencies and the result is favorable to environment. Thus, if you search more competitive technologies, you also find EST. More than this: competitive technologies are to improve the workers' quality of life. They bring social justice associated with."

"Without being competitive, there is no way to be environmentally correct"

Vitor Hoeflich / Embrapa Florestas CNPF

"The businessman is now associating the sustainability of the business to the requirements of a society everyday more exigent towards environmental issues"

" Those firms not adopting sustainable development by love, will have to do it by pain"

"The shareholders are demanding nice environmental reports to better sell the firm in the stock markets, to the citizens and to the stakeholders "

"The business associations are not acting with the power they have to promote EST. They are more devoted to protect the institutions in the short term"

"The intermediate managers need to learn how to deal and to propose ideas. They are those who are closer to EST, not the CEO's and the decision makers. Pro-activity is a scarce good in the intermediate managers. We need to break this barrier"

"The firm owner and the CEOs are the ones who elect the intermediate management in the firms. If they are happy with people resistant to changes and to EST, they are also responsible"

"Omission is the most typical characteristics in the human beings. It is a label that applies to most people. For this reason, many firms are not taking advantage of the new technologies they even may know to be available, but they are not running in this direction. Worse than this, they place critics to maintain their convenient positions"

"We have to promote the technological knowledge spreading out, to avoid firms to have limited and restricted understanding of the know how. There is a road to be paved, it is new and it demands hardwork"

"The pulp and paper industry is running out of the R&D game. The reengineering in the firms was responsible for tremendous reductions on the R&D staff in the firms, including those in the sample. The result was a short term vision to most of the firms, and a dependence on the suppliers. Machinery in general give visible rate of returns, but technological developments

have many times hidden results. They will be available for knowledge, only at the end of the R&D journey. The firms should work more cooperatively in these types of projects."

"The Federal and State Governments are doing their jobs, by developing graduate courses, increasing the level of qualification in the human resources. The R&D in universities go to the pre-process or pre-product. It is a function of the firms and business associations to develop the next step."

Ronald Sotschnig / FATMA

"The system has to be simple. If quality is good, there is no need to place efforts to prove the obvious."

Mário Soares / FEPAM

"The utilization of a clean technology does not mean that the firm will be clean."

"The philosophy is to request strict specification in the end of the pipe to the force technological changes."

"The legislation issue in Brazil is not the problem. We have good and state-of-the-art legislation. The problems are compliance and understanding, mainly from the politicians and business men"

"The main obstacle is cultural, related to consciousness. Many of the businessmen believe that money is scarce and pollution control is not a top priority."

"The control system is in a gradual evolution process. To a single problem being solved, others are coming, and the system being improved in a continuous model. New technologies are to come to help solving environmental problems, but other problems will also arise. The environmental concerns are to grow. The future may not be only to grab an environmental permit and that is all. Many other concerns are to come, mainly from the society."

Ivonete Coelho Chaves / IAP Parana

"In the future the self control will be predominant, with regular and frequent auditing by third parties."

Rodney Morgado / IBAMA

"Te pulp and paper sector is potentially high impacting to the environment (air, water, forestry). A good and tight monitoring is required although the good performance of the mills. There is no way to tactfully pollute in this segment".

Jose Eduardo Nardi / Iguacu Celulose

"The new pressure coming in 2002, the charge to the water consumption, is surely going to activate the internal creativeness to reduce water consumption and natural resources.

Benedito Vanderlei Madruga / INPACEL

"We must pay attention to the regulations in Brazil and in other countries to previously prepare the company in the best way to attend the new requirements: this means to act proactively."

Jose Potter/ Sulfato Rio Grande

"The customers options was clearly price, but now is changing to efficiency and performance"

"The today's executive does not want to look behind in his life history and to see his behavior and his acts destroying Nature."

Angelo Augusto Alves / SINPACEL

"The majority of the small mills are owned by traditional families, and they have no experience in the difficult game of international competition. They have also lack of capital to move to more advanced technologies."

Ana Maria Marchesan / General Public Attorney

"The most important objective related to environment is to protect it, being proactive and taking actions before the damage. The role of the Public Attorney is to force the accused to comply with the law, to amend the damage, or to be prosecuted because his environmental crime."

Jorge Don / Kvaerner Pulping

"More strict legislation is the best driver to promote EST. The other driver is to offer more efficient technologies that provide lower cost production. Pulp and papermakers are very sensitive to the money leaving the pockets."

"Now-a-days , the engineering development exceeds by far technological development. The technical advances that are happening today are more related to economy of scale than breakthroughs and new developments."

Thomas Ritter / Norske-Skog Pisa

"Truly speaking, the banks frequently are more interested in protecting their money than the environment."

Kathia Vasconcellos Monteiro / NAT Nucleo Amigos da Terra

"The consumerist model needs to be modified : the lack of commitment of many people who know the prejudices of such existing model is unbelievable."

"The industrial firms prefer to stay in the technological and market safe place, the place they know, and where they feel comfortable to perform. There is a lack of future vision in most of business men"

Hans Jurgen Kleine / Klabin Papeis

"An EST technology by itself has no market, unless it also adds competitiveness to the user"

"When the company aims the environmental certification or in case it has ISO 14001, the main pressure is no longer the one coming from the regulator, but the need to be successful when audited by the third party. The figure of the external auditor starts to play a fundamental role. Also, the need not to receive penalties or fines to keep the certification brings an amazing pressure on top of the firm."

"The pressures are very positive, they have a warning role, the effect of someone showing to us things we may not be seeing"

All of the interviewed persons:

"Environmental and business performances are win/win games"