No.

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF ECONOMY, THE REPUBLIC OF LITHUANIA

REPORT
FOR
THE STUDY
ON
THE DEVELOPMENT OF PULP AND PAPER INDUSTRY
IN
THE REPUBLIC OF LITHUANIA

NOVEMBER 2000

UNICO INTERNATIONAL CORPORATION

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PREFACE

In response to a request from the Government of the Republic of Lithuania, the Government of Japan decided to conduct The Study on The Development of Pulp and Paper Industry in The Republic of Lithuania and the study was implemented by the Japan International Cooperation Agency (JICA).

JICA sent a study team, led by Mr. Masaaki Shiraishi of UNICO International Corp. to the Republic of Lithuania three times from February 2000 to October 2000.

The team held discussion with the officials of the Government of the Republic of Lithuania, and conducted related field surveys. After returning to home countries, the team conducted further studies and compiled the final results in this report.

I hope this report will contribute to the promotion of the pulp and paper industries in the republic of Lithuania and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Lithuania for their close cooperation throughout the study.

November 2000

Kunihiko Saito
President
Japan International Cooperation Agency

ACKNOWLEDGEMENT

This study report compiles the results of research and study conducted for the proposed pulp mill project, which was carried out between February and October 2000, including three field surveys. The final report consists of the main text, the executive summary and the Investment Guide (in English). The Investment Guide is designed to provide information on the pulp mill project for potential foreign investors.

The main text consists of 12 chapters, covering the analysis of the pulp and paper markets, raw materials, candidate mill sites, environmental assessment, mill design, construction and operation plans, estimation of required capital investment and financing plan, project's financial analysis and evaluation, investment environment study and the current state of the existing paper product industries.

The study team consists of consultants representing UNICO International Corporation and other consulting firms of Japan, and consulting engineers of Sweden's Jaakko Pöyry Consulting AB, led by Mr. Masaaki Shiraishi of UNICO. The Lithuanian counterpart is the Industrial Strategy Bureau of the Ministry of Economy and a steering committee was established to confer upon important agenda, organized by representatives of the Ministry of Economy, the Ministry of Environment and the LDA and chaired by Mr. Osavaldas Čiuksys, Vice Minister of the Ministry of Economy. In addition, a working group organized by staff of related ministries was appointed to lead collaborative efforts in the actual research and study process.

The study was conducted smoothly and completed as scheduled in cooperation of members of the counterpart ministries, other government organizations, local governments, environmental groups (NGOs), offices of international organizations in Lithuania, private enterprises and other entities, groups and individuals.

We are pleased to confirm that the study has found the feasibility of the pulp mill project in Lithuania. To bring the project requiring a large amount of investment into reality, however, much efforts will be required by the Lithuanian government, particularly its Task Force Team that is mandated to attract investors to the project. We sincerely hope that this report will help potential investors who are interested in this project to make their decision.

Finally, we would like to express our gratitude to those who have been taking part in or providing guidance and assistance for this study, including many members of the government ministries and organizations in various countries.

MEASUREMENT UNITS AND PREFIXES

The SI (International System of Units) is used as basic system for measurement units (base units and derived units) and for prefixes. Certain non SI-units are used because of their practical importance and common use. Non SI-units are shown in *italic*.

1. Measurement units

Symbol	Unit	Physical quantity	Note
a	*annum, year*	*time*	
A	ampere	electric current	
C	coulomb	electric quantity, electric charge	A· s
^{0}C	degree Celcius	temperature (t)	t (^{0}C) = T (K) – 273.15
cd	candela	luminous intensity	
d	*day*	*time*	*24 h*
g	gram	mass	
h	*hour*	*time*	*3600 s*
ha	*hectare*	*area*	*10 000 m^2*
Hz	hertz	frequency	
J	joule	energy, quantity of heat	N· m
K	kelvin	temperature (T)	thermodynamic temperature
kg	kilogram	mass	
L	*litre*	*volume*	*1 dm^3*
m	metre	length	
m^2	square metre	area	
m^3	cubic metre	volume	See note 1)
mb	*millibar*	*pressure*	*100 Pa, meteorology only*
m/s	metre per second	speed, velocity	
m/s^2	metre per second squared	acceleration	
min	*minute*	*time*	*60 s*
mol	mole	amount of substance, chemical substance	
N	newton	force	
Pa	pascal	pressure	N/m^2
rad	radian	plane angle	
s	second	time	
t	*tonne*	*mass*	*1000 kg, used with prefixes kilo and mega only*
V	volt	electric potential	W/A
W	watt	power	J/s
Wh	*watthour*	*energy*	

Notes: 1) For wood raw material the following units are used

m^3 sob	Volume of round wood measured as solid volume over (on, with) bark (cubic metre solid volume over bark).
m^3 sub	Volume of round wood measured as solid volume under (without) bark (cubic metre solid volume under bark).
m^3 st	Volume of round wood measured in stack/pile including volume of intermediate air
m^3 l	Volume of chips measured in pile including volume of intermediate air (cubic metre loose volume)

2) If not specifically specified m^3 and m^3 s denotes m^3 sub.

2. Prefixes

Prefix	Name	Factor	
p	pico	10^{-12}	
n	nano	10^{-9}	
µ	micro	10^{-6}	
m	milli	10^{-3}	
c	*centi*	10^{-2}	Not strictly SI-units but may be used in conjunction with the metre.
d	*deci*	10^{-1}	Not strictly SI-units but may be used in conjunction with the metre.
k	kilo	10^{3}	
M	mega	10^{6}	
G	giga	10^{9}	
T	tera	10^{12}	
P	peta	10^{15}	
E	exa	10^{18}	

3. ABBREVIATIONS AND ACRONYMS

3-1. Common abbreviations

AAC	Annual allowable cut - maximum allowable wood harvest	
AD, ADt	Air dry, air dry ton(s).	For pulp 1 000 kg at 10% moisture content
AOX	Absorbable organic halogens, a standard method for analysis of halogenated organic compounds	
BAT	Best available technology	
BCTMP	Bleached CTMP	
BD, BDt	Bone dry, bone dry ton(s).	1 000 kg of bone dry e.g. wood or - more seldom - pulp
BHKP	Bleached hardwood kraft pulp	
BHSP	Bleached hardwood sulphite pulp	
BKP	Bleached kraft pulp	

bl	Bleached	
BOD_x	Biochemical oxygen demand in (x) days	
BSKP	Bleached softwood kraft pulp	
BSSP	Bleached softwood sulphite pulp	
C&F	Cost and freight	
Cf., cf.	Compare	
CIF	Cost, insurance and freight	
CMP	Chemi-mechanical pulp	
COD	Chemical oxygen demand	
CO_2	Carbon dioxide	
CTMP	Chemi-thermomechanical pulp	
DIP	Deinked pulp	
DS, ds	Dry solids	
ECF	Elemental chlorine-free	Cl_2 is not used
e.g.	for example	
EIA	Environmental Impact Assessment	
EMAS	Eco Management and Audit Scheme	
ESP	Electrostatic precipitator	
excl.	excluding, exclusive	
FB	Fibreboard	
FOB	Free on board	
GDP	Gross domestic product	
GNP	Gross national product	
HP	High pressure	
HW, hw	Hardwood	Deciduous tree species
i.e.	that is	
incl.	including, inclusive	
IPPC	Integrated pollution prevention and control directive	From EU
LP	Low pressure	
LPG	Liquefied petroleum gas	
MAI	Mean annual increment	
MDF	Medium density fibreboard	
MP	Medium pressure	
NBSKP	Northern bleached softwood kraft pulp	
Norscan	North American and Scandinavian market pulp suppliers	
NO_x	Nitrogen oxides (NO, NO2)	

ob	Over bark	
OD, ODt	Oven dry, oven dry ton(s)	
OSB	Oriented strand board - a type of reconstituted wood panel	
PB	Particle board	
pH	Measure of acidity/alkalinity of a solution	
PPI	Pulp & Paper International - trade magazine	
ppm	Parts per million	
RCF	Recycled fibre	
ROE	Return on equity	
ROI	Return on investment	
SCMP	Semi-chemical mechanical pulp	
SO_2	Sulphur dioxide	
sob	Solid over bark	e.g. m^3 sob, solid volume of wood measured over (on) bark in cubic metre
spp	Species (plural)	
SS	Suspended solids	
sub	Solid under bark	e.g. m^3 sub, solid volume of wood measured under (without) bark in cubic metre
SW, sw	Softwood	Coniferous species
SWOT	Strengths, weaknesses, options, threats.	
TCF	Totally chlorine-free	
TEF	Totally effluent-free	
TMP	Thermo-mechanical pulp	
TOC	Total organic carbon	
TOX	Total organic halogens	
TSS	Total suspended solids	
ub	under bark	
UKP	Unbleached kraft pulp	
unbl	Unbleached	
VAT	Value added tax	

3-2. Organisations

CEPI	Confédération Européenne de l'industrie des pâtes, papiers et cartons.	
CIS	Commonwealth of Independent States (former USSR excl. Baltic countries)	
EBRD	European Bank for Reconstruction and	

	Development	
EU	European Union	
FAO	Food and agriculture organisation of the United Nations	
FSC	Forest stewardship Council	
IFC	International Finance Corporation	
ISO	International Organisation for Standardisation	
ITTO	International Tropical Timber Organisation	
JICA	Japan International Co-operation Agency	
LDA	Lithuanian Development Agency	
MEC	Lithuanian Centre of Forest Economics	
NGO	Non-government organisation	
OECD	Organisation for economic co-operation and development	
WB	World Bank	
WWF	World wild fund for nature	

3-3. Currencies

DEM	German mark	
EEK	Estonian kronor	
EUR	European euro	
FIM	Finnish mark	
JPY	Japanese yen	
LAT	Latvian …..	
LTL	Lithuanian litas	
SEK	Swedish kronor	
USD	United States dollars	

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Chapter 1　BACKGROUND OF THE PROJECT

Chapter 1 BACKGROUND OF THE PROJECT

1.1 Republic of Lithuania: Country and People

(1) Geography

The Republic of Lithuania is located in the southeast coast of the Baltic Sea, bounded by Lativia on the north, Belarus on the east, and Poland and Kaliningrad (detached territory of Russia) on the south. It has land area of 65300 square km and is situated at a western edge of the East European plain. Its terrain is generally flat and the highest elevation is 293m above the sea level. It is endowed with natural resources, especially water resources; 772 rivers and as many as 2800 lakes of varying sizes account for 1.5% of total land area. Also, forests cover 30.5% (1994400 ha) and cultivatable land 60.2% (3928100 ha). An area along the Baltic Sea, extending 90km, contains resort areas, wildlife sanctuaries, and ports and harbors. The country is generally under a climate intermediate between maritime and continental, with the inland areas being under a stronger influence of the continental climate. The mean daily temperature is –4.9℃ in January and 17.2℃ in July.

(2) History

The Balt, ancestor of Lithuanian, settled in the southern part of the Baltic Sea in around 2000 B.C. The name “Lithuania” was first appeared in an ancient manuscript dated 1004 B.C. In the early 13th century, Grand Duke Mindaugus founded the dukedom of Lithuania and grew to a great duchy extending from the Baltic Sea to the Black Sea in the early 14th century. In the late 14th century, it joined to the kingdom of Poland in a union by marriage. Poland gradually dominated, and in 1568, Lithuania became a subject state of Poland under the Lublin union. In 1795, with the third division of Poland, Lithuania was annexed by Russia. In 1918, it declared independence at the end of the First World War and the Republic of Lithuania was formed.

In 1940, the Lithuanian parliament decided to join the Soviet Union under the pressure of the Soviet military force. The country was then occupied by Nazi Germany between 1941 and 1944 and came under the Soviet Union after the Second World War. In 1988, the Lithuanian independence movement “Sajudis” was created with the emergence of perestroika in the Soviet Union and quickly spread throughout the country. In March 1990, “Sajudis” won an election of the Supreme Council, which later declared the restoration of Lithuaninan independence. After the Soviet’s military sanctions (the Vilnius incident), its independence was recognized by many countries in August 1991, followed by UN admittance in September. In February 1993, Algirdas Brazauskas was elected to the first president through general elections. In August, the withdrawal of the Soviet forces was completed.

(3) Population and language

Lithuania has 3700800 population as of January 1999. Its capital, Vilnius, has population of 578000, Kaunas 414000, and Klaipeda 203000. People residing urban areas account for 68% of total population. The population density is 56.7 per square km. Esnic composition is Lithuanian 80%, Russian 9.4%, Polish 7%, and others 3.6% (e.g., Belorussian, Ukranian and Latvian). The official language is Lithuanian, which originated in Sanskrit and belongs to the Baltic language group, the Indo-European stock.

(4) Currency

The unit of currency is Litas (LTL) which is currently pegged to the U.S. dollar at a fixed exchange of rate of USD1 = 4 LTL. However, the Currency Board intends to abolish the current system as soon as government finance becomes stable and plans to introduce an Euro/U.S. dollar-pegged system in 2001, eventually a float rate system.

1.2 Political and Social Conditions

(1) Administrative unit

The country is divided into 10 administrative units (districts or counties), each of which is managed by a governor who is appointed by the cabinet. Municipalities consist of 12 cities and 44 regions, each of which has a local administrative body and a local assembly organized by elected representatives (three-year term).

(2) Education

The basic education system in Lithuania consists of four-year elementary schools, four-year primary schools and four-year gymnasium (secondary schools), totaling twelve years. Compulsory education covers up to 16 years old. There are 2327 elementary and primary schools throughout the country, with total enrollment of approximately 540000.(1996/97).

In addition, there are 106 vocational training schools (2-4 years), and more than 300 adult educational institutions (both formal and informal), and advanced educational institutions (including seven universities and six academies), which participate in the EC's TEMPUS program.

(3) Transportation infrastructure

Lithuania is strategically located in a transportation hub connecting the EU countries and Eastern Europe. The north-south corridor consists of inland transportation routes connecting Scandinavia and Central Europe, while the east-west routes link Europe and the CIS countries.

The country has an ice free port of Klaipeda which handles 20% (16 million tons annually) of cargoes loaded and unloaded at all the ports on the eastern part of the Baltic region. It has extended rail networks with total length of 1997km. In 1993, they were linked with the Polish rail system at Sestokai. Also, they have good access to Russia, Belarus, Ukraine, Estonia and Germany. The country also boasts well-developed road networks, more than 90% of which are paved, higher than the European average. Inland access extends to all directions, including Germany and Eastern Europe via Poland, the Baltic

States, and Russia via Belarus. It also has airports, and natural gas and oil pipelines.

(4) Communication

The country has reliable postal service as well as courier services including DHL, Federal Express, TNT and UPS. Telephone service has expanded rapidly in recent years, and optic fiber cables are widely installed to allow extensive digital communication. Also, the cellular phone market is exploding as joint ventures with foreign telecoms (Denmark and Belgium) and Motorola are emerging. Also the Internet connectivity and e-mail service are expanding.

(5) Work force and unemployment rate

The unemployment rate in Lithuania has recently been on the rise, as the working population remains flat. Yearly changes in unemployment rate are shown below.

1995	6.22%
1996	6.98%
1997	5.89%
1998	6.42%
1999	8.4%
2000	11.1%

Note: The figure in 2000 is as of may (Economic and Social Development in Lithuania).

Table 1.2.1 Labor Force and Employment

(Unit : Person)

	1995	1996	1997	1998	1999
Labor Force	1752600	1783500	1773700	1769800	1804800
Employed	1643600	1659000	1669200	1656100	1660800
	93.78%	93.02%	94.11%	93.58%	92.02%
Public Sector	600000	584600	538500	526800	518100
	34.23%	32.78%	30.36%	29.77%	28.71%
Private Sector	1043600	1074400	1130700	1129300	1142700
	59.55%	60.24%	63.75%	63.81%	63.31%
Unemployed	109000	124500	104500	113700	148700
	6.22%	6.98%	5.89%	6.42%	8.24%

Source : Labor Market and Employment B324 1999 Statistics Lithuania

The number of employees in the public sector has been declining year after year, probably due to the effects of administrative reforms, falling below 30%. On the other hand, employment in the private sector remains almost unchanged. Stagnated employment, together with growth of the potential work force, causes the gradual rise in unemployment rate. Breakdown of the working population by sector reveals a more detailed picture, as shown below (third quarter of 1999) (see Table 1.2.2):

Agriculture/forestry	339000	20.41%
Manufacturing	284100	17.11%
Commerce/repair	234400	14.11%
Education	160900	9.69%
Construction	115900	6.98%

Table 1.2.2 Employment Population by Economic Activity (3rd Quarter of 1999)

Economic Sector	Public Sector		Private Sector		Total	
	Person	%	Person	%	Person	%
Agriculture, Hunting and Forestry	15400	2.97%	323600	28.32%	339000	20.41%
Fisning	100	0.02%	1400	0.12%	1500	0.09%
Mining and Quarrying	400	0.08%	2700	0.24%	3100	0.19%
Manufacturing	25200	4.86%	258900	22.66%	284100	17.11%
Electricity, Gas and Water Supply	37400	7.22%	300	0.03%	37700	2.27%
Construction	5300	1.02%	110600	9.68%	115900	6.98%
Trade and Repair of Cars & Household Goods	4000	0.77%	230400	20.16%	234400	14.11%
Hotels and Restaurants	1500	0.29%	27700	2.42%	29200	1.76%
Transport and Storage	36300	7.01%	49200	4.31%	85500	5.15%
Communication	8100	1.56%	11500	1.01%	19600	1.18%
Financial Intermediation	8900	1.72%	7500	0.66%	16400	0.99%
Real Estate and Renting Business	24500	4.73%	30400	2.66%	54900	3.31%
Public Administration and Defence	71100	13.72%	0	0.00%	71100	4.28%
Education	149900	28.93%	11000	0.96%	160900	9.69%
Health and Social Work	94400	18.22%	15200	1.33%	109600	6.60%
Other Community, Scial & Personal Service	35600	6.87%	58800	5.15%	94400	5.68%
Private household Service	0	0.00%	3500	0.31%	3500	0.21%
TOTAL	518100	100.00%	1142700	100.00%	1660800	100.00%

Source : Labor Market and Employment B324 1999 Statistics Lithuania

Notably, sectors which production stagnates in recent years are major employers in the job market, explaining the increase in unemployment rate.

Jobless people are equally divided between male and female. On the other hand, the jobless rate appears to be inversely proportional to the level of education, except for female with higher education that shows a higher unemployment rate. The unemployment rate for male with vocational training is higher than that for female with the same educational background.

Educational level	Overall composition	Male	Female
Higher Education	5.2%	38.3%	61.7%
Special Secondary	17.0%	37.6%	62.4%
Vocational	40.7%	58.7%	41.3%
Unskilled	37.1%	49.1%	50.9%

Thus, a fundamental approach to the easing of unemployment is to promote the manufacturing sector, particularly labor-intensive, light industries (dominated by small- and medium-sized enterprises) requiring less skills, which are expected to create a large number of jobs.

1.3 Outline of the Lithuanian Economy

1.3.1 Baltic States and Central/Eastern Europe

Economies in the Baltic States and the CEFTA countries dropped sharply in their rapid transition to a market economy until 1994. They turned upward in 1995 and 1996, with resumption of GDP growth. In 1997 and 1998, however, the currency crisis in Russia hit them hard again and most countries suffered stagnation of GDP growth in the two consecutive years. In particular, Czech and Romania recorded negative growth in 1998. In fact, these upheavals are viewed as a general phenomenon in the former Soviet Union and Central and Easter Europe that are still struggling to cast off their old economic structure molded under the centrally planned, uncompetitive market system.

Nevertheless, these economies have successfully suppressed hyperinflation that broke out in the initial stage of transition and inflation rates are generally stabilized at one-digit levels. On the other hand, unemployment rates in the countries remain unchanged or increase slight at relatively high levels. For instance, Poland and Slovakia registered the double-digit rates in 1997 and 1998.

Government finance is chronically in deficit in most countries (except for Latvia), which is further increasing. Similarly, most countries are suffering from the persistent deficit on current account, which is much larger than the budget deficit.

1.3.2 Lithuanian Economy

(1) Domestic production

As shown in the chart, Lithuania's GDP showed violent ups and downs on a quarterly basis (between 1997 and the first quarter of 1999). When equalized over the period, the economy remained flat, no signs of upward trend. In particular, GDP recorded negative growth of 10.7% (in rear term) in 1993 due to the economic turmoil triggered by the energy crisis at the end of 1992 (when energy supply from Russia became unstable). It dropped to a level one half that in 1989. Then, as the country made a strategic shift from the previous dependence on the sluggish domestic market and the former Soviet markets to the participation in the West European market (as aided by the free trade agreement with a number of countries), the economy showed solid signs of recovery, which has been clearly felt after 1995. In 1997 and 1998, however, the Russian currency crisis hit the economy hard in 1998 and 1999 and the economic growth rate turned into negative again. This indicates that the Lithuanian economy is still heavily dependent on Russia.

GDP Growth Rate

1991	- 5.7 %
1992	- 21.3 %
1993	- 16.2 %
1994	- 9.8 %
1995	3.3 %
1996	4.7 %
1997	7.3 %
1998	5.1 %
1999	- 4.1 %

Source : Statistical Yearbook of Lithuania 1998,
Economic and Social Development in Lithuania 5/2000

Looking at the sectoral share of GDP, agriculture and industry are on the declining trend, while commerce and service expand rapidly. Note that, according to the country's classification of economic activities, the industrial sector includes, in addition to the manufacturing industry, mining, electricity, gas, water supply, wood production, and fishery. The energy sector, such as petroleum refining, power generation and transmission, hot water supply, and gas supply, account for approximately 30% of industrial output.

(2) Currency and inflation

The Lithuanian government inaugurated its own currency, Litas, in June 1993, and introduced a floating system. However, as inflation did not subside, the government pegged the local currency to the U.S. dollar in April 1994 under the Litas Stabilization Law (USD1 = 4 Litas). As a result, the inflation rate dropped from 1163% in 1992 to 35.6% in 1995, 13.1% in 1996, 8.4% in 1997, 2.4% in 1998, and 0.3% in 1999. At the same time, however, the pegging to the U.S. dollar adversely affects the country's export competitiveness (as the U.S. dollar is strong against the Euro). It is important to watch the country's currency and foreign exchange policies carefully, including anticipated reforms of the Currency Board system.

The consumer price index is relatively stabilized at 174.0 in 1996, 189.4 in 1997, 199.1 in 1998, and 187.9 in 1999 (1994 = 100).

(3) Government finance

The government budget is continuously in deficit. Tax revenues account for 95-96% of total revenues. VAT represents more than 50%, social insurance 25-30%, and income tax 12-17%. The income tax increases its share recently. Social welfare accounts for 30-38% of total expenditures and medical 10-14%.

Government finance

(Unit: Million Litas)

	Revenues	Expenditures	Deficit
1995	5758.0	6196.8	- 438.8
1996	6720.2	7510.2	- 790.0
1997	8237.5	8612.4	- 374.9
1998	9377.8	9915.6	- 537.8
1999	8983.6	9108.7	- 125.1

(Source : Economic and Social Development in Lithuania 5/2000B111)

(4) Current and trade accounts

Both the current and trade accounts have been in chronic deficit, which is financed by the surplus on the capital account. In particular, steady expansion of foreign direct investment contributes greatly to the overall balance-of-payment surplus, while a deficit on the trade account is increasing (See Table 1.3.1.).

Table1.3.1 Balance of Payments

Items of Accounts	1995 10^3 USD	1996 10^3 USD	1997 10^3 USD
Trade of Goods			
Exports (FOB)	2706.1	3413.2	4192.4
Imports (FOB)	-3404.0	-4309.3	-5339.9
Balance	-697.9	-896.1	-1147.5
Trade of Service			
Exports	485.2	797.5	1031.8
Imports	-498.1	-676.7	-897.4
Balance	-12.9	120.8	134.4
Other Income & Payments			
Received	50.9	52.0	80.4
Paid	-63.7	-143.0	-278.8
Balance	-12.8	-91.0	-198.4
Balance of Goods, Services & Income	-723.6	-866.3	-1211.5
Current Transfers Received	112.3	149.4	237.0
Current Transfers Paid	-3.0	-5.6	-7.0
Current Balance	-614.3	-722.5	-981.5
Capital Account			
Capital Account (net)	-39.0	5.5	4.1
Direct Investment Abroad	-1.0	-0.1	-27.0
Direct Investment from Abroad	72.6	152.4	354.5
Portfolio Investment Assets	-10.5	-26.9	7.7
Portfolio Investment Liabilities	26.6	89.6	180.5
Other Investment Assets	-36.1	-170.4	-219.3
Other Investment Liabilities	482.8	601.0	709.1
Net Errors and Omissions	287.2	66.7	195.9
Ocerall Balance	168.3	-4.7	224.0

Source : The Europa World Yearbook 1999 V0l. II

(5) External trade

Lithuania has signed bilateral free trade agreements with 24 countries (EU, EFTA and CEFTA countries, Ukraine, and the Baltic States), of which the agreements with 17 countries have been effectuated. The country abolished tariff on textile products from and to the EU countries.

In 1998, Lithuania exported 14842.4 million Litas (USD3710.6 million) of goods and imported 23174.3 million Litas (USD5793.6 million) , with a deficit of 8331.9 million Litas (USD5793.6 million). In 1999, the trade deficit totaled 7323 million Litas (USD1831 million).

Major export items are petroleum products, mineral products (including electricity), textile and apparel products, machinery and equipment, and chemicals. Major import items are mining products including petroleum and natural gas, machinery and equipment, chemicals, and transportation equipment.

Major trade partners are still Russia and other countries in the former Soviet Union, Central and East European countries (including Belarus, Ukraine, Latvia and Poland), although their share has been declining year after year (see Table 1.3.2). As shown in Table 1.3.2, Germany is the largest trade partner among the EU countries with dominant shares in both exports and imports – a notable trend commonly seen among the Baltic States and Central and East European countries. Other trade partners in the EU include Finland, Denmark, Sweden and Italy for exports, and the Netherlands, the U.K., Sweden and Denmark for imports.

Table 1.3.2 Major Countries for Foreign Trade

(Unit : %)

Country	1993		1994		1995		1996		1997	
	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import
Russia	33.1	53.7	28.2	39.3	20.4	31.2	24.0	25.9	24.5	24.3
Germany	6.8	9.7	11.5	13.8	14.4	14.3	12.8	15.8	11.4	18.7
Belorussia	7.4	3.3	6.5	3.8	10.8	3.6	10.2	2.4	10.3	2.4
Ukraine	11.2	6.2	6.1	5.0	7.5	3.7	7.7	3.3	8.8	1.9
Latvia	7.3	1.5	8.4	2.7	7.1	3.3	9.2	3.3	8.6	3.4
Pland	7.0	2.2	5.0	4.0	3.9	4.2	3.2	5.1	2.3	5.8
Denmark		2.4		2.6		3.5		3.8		4.3
Unite Kingdom	1.6	0.9	2.3	1.4	3.1	3.1	2.8	3.9	3.2	3.3
Nederland	2.8		5.2		4.9		3.3		2.8	
Others	22.8	20.1	26.8	27.4	27.9	33.1	26.8	36.5	28.1	35.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source : Wood Industry of Lithuania -Overview (1999)

1.4 Industry

1.4.1 Industry and Industrial policy

The industrial sector in Lithuania has undergone the hardships during the economic turmoil, and many enterprises in a wide range of industries went bankrupt. It is still in the process of rehabilitating itself. Many enterprises are restructuring themselves under the government support. The government is implementing industrial policy aiming at full-scale industrial development, which goes beyond the traditional recovery efforts to regain the previous production levels (during the Soviet era), accompanied by export expansion. This policy emphasizes the support for relatively small, light industries that exist in great number. SMEs account for a sizable portion of the economy (6% of GDP in 1996). The government has designated the following three areas as the means to expand industrial output by SMEs:

a. Environmental betterment and development of technology that produces less environmental loads
b. Development of wood products and the fostering of the sawmills industry
c. Development of agriculture-related technology

This policy appears to represent the strategic focus to promote sustainable industrial development with technological advancement by taking advantage of low-cost, highly skilled work force and leveraging domestic reusable resources.

Major industrial sectors in Lithuania include agriculture and forestry, wood processing, food processing, chemical, machinery, electrical and electronics, energy and construction materials. Industrial output (including agriculture, forestry and fishery) accounts for around 40% of GDP and employment share reaches 41%. Breakdown of domestic production and value added by sector is shown in Table 1.4.1, 1.4.2.

Sector	Production(98) (one million LT)	Share	Value added
Agriculture/forestry	4305	12.8%	12.6%
Industry	8206	24.4%	24.1%
(Manufacturing/mining)	7083	21.1%	20.8%
(Energy/utilities)	1123	3.3%	3.3%
Construction	2484	7.4%	7.3%
Commerce/service	5760	17.1%	16.9%
Others	12880	38.3%	39.1%
Total	33635	100.0%	100.0%

1.4.2 Investment

In 1999, public investment dropped sharply due to the decline in government revenue to reflect the Russian currency crisis in 1997/98. On the other hand, private investment shows firm growth, except for major loans from foreign banks in 1998. Overall, investment's share in GDP dropped from 20.1% in 1995 to 14.3% in 1996, 12.6% in 1997, 10.8% in 1998 and 5.6% in 1999.

Breakdown of investment by sector in the past three years is shown below.

Breakdown of Investment

	1997	1998	1999
Total investment(10^6Litas)	5488.3	6442.7	5376.7
Industry	19.7%	16.4%	17.9%
Agriculture/forestry	2.6%	2.4%	2.0%
Utilities	9.4%	10.7%	11.2%
Construction	1.5%	2.6%	2.5%
Commerce	3.9%	7.3%	7.5%
Transportation	21.8%	23.1%	19.8%
Communication	9.9%	8.9%	10.7%
Housing construction	9.2%	7.4%	8.4%
Education	1.5%	2.0%	2.4%
Public health/medical	2.0%	2.9%	2.6%
Hygiene	2.1%	2.4%	1.6%
Others	16.2%	13.8%	13.2%

Table 1.4.1 Production of Industrial Sub-Sectors

	Economic Activity	1993		1994		1995		1996		1997		Growth Rate	Potential Indicator	
		10^3 Litas	%	10^3 Litas	%	10^3 Litas	%	10^3 Litas	%	10^3 Litas	%	%		Index
10.00	Extraction and Agglomeration of Peat	25479	0.2%	39271	0.3%	37049	0.2%	51425	0.2%	46597	0.2%	16.29%	3.2%	0.2%
11.00	Extraction of Crude Oil	47011	0.4%	35878	0.3%	63777	0.4%	105822	0.5%	134215	0.6%	29.99%	17.2%	1.1%
14.00	Quarrying of Stone, Clay and Sand	25547	0.2%	45843	0.3%	45302	0.3%	68885	0.3%	92737	0.4%	38.03%	15.0%	1.0%
15.00	Manufacture of Food and Beverages	3387794	25.4%	3460633	25.1%	4781421	26.8%	6059443	27.4%	5785070	24.7%	14.31%	352.9%	23.2%
16.00	Manufacture of Tobacco Products	48081	0.4%	133162	1.0%	220467	1.2%	340257	1.5%	-	-	91.99%	141.3%	9.3%
17.00	Manufacture of Textiles	823143	6.2%	849655	6.2%	1068095	6.0%	1233222	5.6%	1311867	5.6%	12.36%	69.1%	4.5%
18.00	Manufacture of Apparels & Fur Dyeing	341022	2.6%	394140	2.9%	680717	3.8%	972219	4.4%	1377711	5.9%	41.77%	245.3%	16.1%
19.00	Manufacture of Leather & Leather Products	162972	1.2%	175122	1.3%	194790	1.1%	278377	1.3%	360663	1.5%	21.97%	33.8%	2.2%
20.00	Manufacture of Wood & Wood Products	302995	2.3%	441707	3.2%	630334	3.5%	592317	2.7%	902354	3.8%	31.37%	120.6%	7.9%
21.00	Manufacture of Pulp, Paper & Paperboard	88272	0.7%	143210	1.0%	251512	1.4%	241697	1.1%	287691	1.2%	34.36%	42.1%	2.8%
22.00	Publishing, Printing, Recorded Media	48642	0.4%	145114	1.1%	214747	1.2%	365997	1.7%	460078	2.0%	75.37%	147.8%	9.7%
23.00	Manufacture of Refined Petroleum Products	2541628	19.1%	2084191	15.1%	2014014	11.3%	2823010	12.7%	3488135	14.9%	8.24%	122.4%	8.1%
24.00	Manufacture of Chemicals & Chemical Products	386499	2.9%	543463	3.9%	1066200	6.0%	1315312	5.9%	1221945	5.2%	33.34%	173.6%	11.4%
25.00	Manufacture of Rubber & Plastic Products	28362	0.2%	50732	0.4%	95598	0.5%	178736	0.8%	249560	1.1%	72.23%	76.8%	5.1%
26.00	Manufacture of Non-metallic Mineral Products	396912	3.0%	488343	3.5%	601290	3.4%	644501	2.9%	639855	2.7%	12.68%	34.6%	2.3%
27.00	Manufacture of Basic Metals	39800	0.3%	43525	0.3%	58123	0.3%	68725	0.3%	67909	0.3%	14.29%	4.1%	0.3%
28.00	Manufacture of Fabricated Metal Products	114424	0.9%	134390	1.0%	244390	1.4%	247953	1.1%	301027	1.3%	27.36%	35.1%	2.3%
29.00	Manufacture of Machinery and Equipment	530932	4.0%	533499	3.9%	620315	3.5%	567320	2.6%	572993	2.4%	1.92%	4.7%	0.3%
30.00	Manufacture of Office Machinery and Compon't	13795	0.1%	15539	0.1%	17240	0.1%	22433	0.1%	9022	0.0%	-10.07%	-0.4%	0.0%
31.00	Manufacture of Electric Machinery & Apparatus	143845	1.1%	115031	0.8%	181448	1.0%	346193	1.6%	454080	1.9%	33.29%	64.4%	4.2%
32.00	Manufacture of Radio, TV & Communication Eq.	487988	3.7%	351884	2.6%	482733	2.7%	516132	2.3%	505993	2.2%	0.91%	2.0%	0.1%
33.00	Manufacture of Medical, Precision & Optical Instruments	91901	0.7%	119961	0.9%	76455	0.4%	112112	0.5%	147697	0.6%	12.59%	7.9%	0.5%
34.00	Manufacture of Motor Vehicles	34926	0.3%	21310	0.2%	24635	0.1%	43899	0.2%	41131	0.2%	4.17%	0.7%	0.0%
35.00	Manufacture of Other Transport Equiopment	143994	1.1%	272389	2.0%	248360	1.4%	298765	1.3%	336515	1.4%	23.64%	33.9%	2.2%
36.00	Manufacture of Furniture & n.e.c.	283118	2.1%	270209	2.0%	336492	1.9%	439454	2.0%	510817	2.2%	15.90%	34.6%	2.3%
37.00	Recycling of Metal Waste and Scrap	19764	0.1%	47689	0.3%	114421	0.6%	43239	0.2%	49414	0.2%	25.75%	5.4%	0.4%
40.10	Electric Power Generation & Distribution	1213173	9.1%	1267000	9.2%	1728369	9.7%	2238773	10.1%	2119232	9.0%	14.96%	135.2%	8.9%
40.20	Gas Production and Distribution	896901	6.7%	636825	4.6%	718679	4.0%	738653	3.3%	682378	2.9%	-6.61%	-19.2%	-1.3%
40.30	Steam & Hot-water Production & Distribution	591367	4.4%	698000	5.1%	777913	4.4%	945821	4.3%	1055513	4.5%	15.59%	70.1%	4.6%
41.00	Waste Water Gathering, Treatment & Distribution	63783	0.5%	216000	1.6%	276237	1.5%	246932	1.1%	252740	1.1%	41.09%	44.3%	2.9%
	TOTAL	13324070	100.0%	13773715	100.0%	17871123	100.0%	22147624	100.0%	23464939	100.0%	15.20%	1519.8%	100.0%

Source : Statistical Yearbook of Lithuania 1998

Table 1.4.2 Industrial Sub-Sectors and Share of Production (1998)

No.	Industrial Subsector	Share (%)	No.	Industrial Subsector	Share (%)
1	Manufacture of food products and beverages	29.1	11	Manufacture of electrical machinery and apparatus	2.2
2	Manufacture of refined petroleum products	19.9	12	Publishing, printing and reproduction of recorded media	2.1
3	Manufacture of wearing apparel, dressing and dying of fur	7.2	13	Manufacture of other transport equipment	1.9
4	Manufacture of chemical and chemical products	7.1	14	Manufacture of fabricated metal products, except machinery and equipment	1.5
5	Manufacture of textiles	7.0	15	Manufacture of pulp, paper and paper products	1.4
6	Manufacture of other non-metallic mineral products	3.2	16	Manufacture of leather and leather products	1.3
7	Manufacture of wood and wood products (except furnitues)	3.0	17	Manufacture of rebber and plastic products	1.1
8	Manufacture of machinery and equipment	2.8	18	Extraction of petroleum	0.7
9	Manufacture of radio, television and communincation equipment and apparatus	2.8	19	Manufacture of medical, precision and optical instruments	0.7
10	Manufacture of furniture manufacturing of n.e.c.	2.3	20	Quarrying of stone, clay and sand	0.5

1.5 Manufacturing Industry

(1) Major industries and production activities

Table 1.4.1 shows production, GDP share and annual average growth rate of the industrial sector between 1993 and 1997. The current state of major industries in the manufacturing sector is summarized as follows.

a. The food processing industry still shows steady growth and maintains the largest share.
b. The petroleum refining industry, although the second largest, has a number of uncertainties compared to the food processing industry, such as a high percentage of product exports, unreliable crude oil sources, and price volatility in the international commodity market.
c. The non-metallic product sector including petroleum and natural gas maintains a stable share of 3%.
d. In the textile and apparel sector, the downstream segment grows strongly, as opposed to the stagnated upstream segment (textile), and is becoming a prospective sector for the country that has a major advantage in low-cost and highly skilled work force.
e. The wood products sector maintains its firm position, although growth appears to slow down.
f. The pulp and paper industry remains unchanged, although lacking stability.
g. The furniture subsector has a high prospect for future growth.
h. Among other light industries, tobacco, printing and publishing, and rubber and plastics processing are showing healthy growth, while the leather industry is in the stable status.
i. Among the machinery and electrical/electronics industries, metalworking and electrical equipment subsectors grow steadily, while the metal, machinery and electronics subsectors are sluggish, although they are expected to play an important role.
j. The medical equipment, automotive and other transportation equipment, and office equipment subsectors remain stable with slow growth.

(2) Employment and labor productivity

Employment by the industrial sector (mining, manufacturing and energy) accounts for 20% of the total. Within the sector, the manufacturing sector accounts for 17.1% (284100 employees), the second largest next to agriculture among all economic sectors.

Industrial subsectors are ranked according to the number of employees, as follows. Light industries are major employers in the country's industrial sector.

Subsector	Employment	No. of establishments	No. of employees per establishment
① Food processing	46714	434	107.6
② Textile	24822	118	210.4
③ Sewing	24281	231	105.1
④ Machinery	16027	104	154.1
⑤ Wood products	14408	452	31.9
⑥ Non-metal	11745	15	106.4
⑦ Furniture	11265	174	64.7
⑧ Electronics/ household appliance	9292	31	299.8
⑨ Chemical	7624	59	129.2
⑩ Other transportation equipment	6575	41	160.4

Labor productivity per employee in 1998 is shown in Table 1.5.2. Top ten subsectors among 25 subsectors are listed below.

Subsector	Labor productivity (thousand Litas/employee)
① Oil exploration and drilling	276.20
② Chemical	163.84
③ Metal recycling	99.48
④ Food processing	98.59
⑤ Electrical machinery	90.85
⑥ Sand and quarry mining	81.95
⑦ Rubber and plastics	79.03
⑧ Transportation equipment	67.68
⑨ Printing and publishing	58.87
⑩ Electronic equipment	57.92
⑬ Pulp and paper	57.01
⑲ Furniture	42.39
⑳ Sawmill and wood processing	37.56

(3) Export ratio

To reflect the fact that the domestic market is fairly small and purchase power remains stagnated, most industrial subsectors (except for publishing and printing, sand and quarry mining, and utilities) export large portions of their products. In fact, 10 out of 25 subsectors record the export ratio exceeding 70%, and 16 more than 50%. The average export ratio of 25 subsectors (not including utilities) is 52.4%. This clearly indicates that most industries in the country are inherently required to obtain competitiveness in export markets if they are to survive in the increasingly open marketplace. This means, the government should preferably pursue industrial policy to foster specific industries that can maintain competitiveness in the open market, rather than industrial promotion through protection.

1.6 Forestry

1.6.1 World Forestry and Forestry Product Supply and Demand

(1) World forestry trend

The general environment surrounding the world forestry and forest-related industries is becoming complex as debates over their environmental, economic, social and cultural roles are heating including academic aspects. Efforts are being made to develop standards for sustainable forest management under the philosophy that forests should perform vital and continuous functions of supplying important products, helping environmental conservation, and providing social benefits. At the same time, an emphasis is made on management of forests as an ecological system having diverse economic and environmental benefits, demanding stronger protection of the forest environment and its biological diversity. The emphasis on environmental aspects of forest has initiated various efforts to promote the effective use of wood products, including recycling, and to incorporate environmental consideration into international trade, such as the ISO certification requirements, the addition of specific tree species to the protection list of the Washington Convention. At the same time, it is important to address the needs of people who depend on forest resources and consider their interest as part of the issues related to allocation of forest resources and their social and cultural benefits. Thus, the government must address its forest development policy by coordinating conflicting interests of diverse groups who have different incentives and concern.

(2) World forest area

Throughout the world, forests have been steadily disappearing, although its rate has gradually slowed down. Major factors for forest loss include the conversion of forest to farmland due to pressure on increased food production, extensive infrastructure development accompanying economic development programs, and growth of demand for forest products driven by economic development. As they are primarily caused by population growth and economic development in developing countries, the declining trend is expected to continue in the years to come.

According to the SOFO report, world forests disappeared at a rate of 11.3 million ha per year between 1990 and 1995, totaling 56.3 million ha which is equivalent to 1.6% of the world forest area (3454 million ha in 1995). The annual average rate of decline is 0.3%. During the period, an average 13.7 million ha of natural forest disappeared. This means that it was partly compensated for by an increase in artificial forest (2.4 million ha), mainly in industrialized countries.

Thus, the recent trend is that natural forests continue to disappear, although at a declining rate due to controlled cutting, while artificial forests increase steadily. Nevertheless, natural forests decrease at a much faster pace than the increase in artificial forest, resulting in the continued disappearance of natural forest and a further decrease in total forest area. As a result, debates will continue between the opposition to environmental destruction due to harvesting of natural forest and the desire of developing countries to use the forest industry as a source of economic growth.

1.6.2 Forest Industry in Lithuania

(1) Forest and forest area

Forest land areas in Lithuania account for 30% of the national land area and are classified as follows. For land use classification purposes, they are divided into forested areas and non-forest areas.

Non-forested areas include clear cut areas, dead islands, blanks, seedling nurseries, nurseries, seed orchards, and firebreaks.

Forested areas are divided into four forest protection groups as follows:

Group 1 Strict reserves forests
Group 2 Special purpose forests – ecosystem preserving and recreational
Group 3 Protective forests
Group 4 Commercial forests

These four forest groups are subject to the following restrictions on cutting:

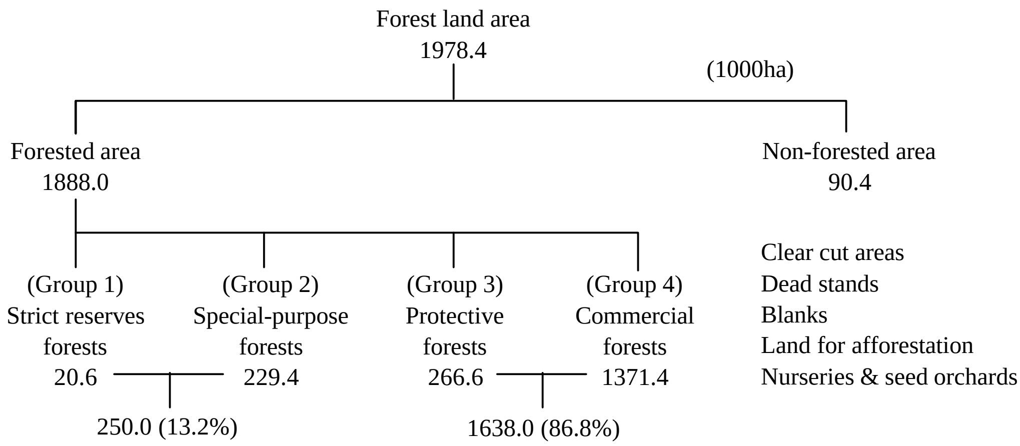
Group 1 Cutting is prohibited
Group 2 Thinning is permitted, but final cutting is prohibited

Group 3 Thinning is permitted, and final cutting is conditionally permitted (depending on the cut area and method)

Group 4 No restriction

Among the four groups, Group 3 and 4 forests are covered in this report as exploitable forests.

Figure 1.6.1 Forecast Classification and Area in Lithuania



Source: Lithuanian Forest Statistics 1998

(2) Forest types, wood species, and ownership patterns

Forests in Lithuania are dominated by mixed forests of coniferous and broadleaf species. As shown in the table below, they are classified into nine forest types, of which three types (pine, spruce and birch) hold an 80% share. Thus these species are widely seen in the country. On the other hand, alder forests account for only 12%, including black and grey. This suggests flat topography with poor drainage.

Before independence from the Soviet Union, all forests in the country were state owned, although they were managed by different ministries and agencies. After independence, ownership of all forests was transferred to State Forest Enterprises under the Ministry of Forestry. Then, it was decided to return forests that were nationalized in 1941 to their previous owners or heirs, and their returning is underway. As of January 1, 2000, the total forest area that was returned to private ownership reached 373900 ha, accounting for 41% of the total area to be returned (908200 ha). However, the actual pace of returning is said to be behind the original schedule.

Note that harvest activities are prohibited in forests that are to be returned to private ownership.

State forests are managed by 42 State Forest Enterprises and 4 national parks, under the supervision of the Department of Forests and Protected Areas, the Ministry of Environment.

State Forest Enterprises also supervise and provide guidance for privately-owned forests by assigning at least one private forest consultant to each forest, who provides extension service for privatized forests in the areas of forest management and logging approval.

As shown in Table 1.6.1, state forests are characterized by a much higher percentage of coniferous species than private forests, which, on the other hand, are dominated by birch and grey alder.

Table 1.6.1 Forest Areas by Species and Ownership

(1000 ha)

Forest type	State forests		Private and reserve for privatization		Total forests	
		%		%		%
Pine	408.7	41.7	293.4	32.3	702.1	37.2
Spruce	256.8	26.2	185.1	20.4	441.9	23.4
Birch	173.2	17.7	202.0	22.2	375.2	19.9
Aspen	27.6	2.8	24.8	2.7	52.4	2.8
Black alder	57.7	5.9	50.8	5.6	108.5	5.7
Grey alder	11.1	1.1	100.2	11.0	111.3	5.9
Oak	14.7	1.5	18.9	2.1	33.6	1.8
Ash	26.5	2.7	24.3	2.7	50.8	2.7
Other	3.5	0.4	8.7	1.0	12.2	0.6
Total	979.8	100.0	908.2	100.0	1888.0	100.0
%	51.9		48.1		100.0	

Forest type is named according to the dominating tree species based on standing volume

Souce:Lithuanian Forest Statistics 1998

Table 1.6.2 shows breakdown of forest areas by forest type and group. Of 1880000 ha of forested area, exploitable forests (Groups 3 and 4) account for 87%, or 1638000 ha.

Table 1.6.2 Forest Areas by Forest Type and Group

(1000 ha)

Forest type	Forest group		Sub total		Forest group		Sub total		Total	
	1	2		%	3	4		%		%
Pine	13.0	115.4	128.4	51.4	124.7	448.9	573.6	35.0	702.0	37.2
Spruce	2.2	38.3	40.5	16.2	43.6	357.9	401.5	24.5	442.0	23.4
Birch	2.8	29.5	32.3	12.9	41.6	301.3	342.9	20.9	375.2	19.9
Aspen	0.2	3.0	3.2	1.3	4.8	44.4	49.2	3.0	52.4	2.8
Black alder	1.7	9.8	11.5	4.6	17.7	79.3	97.0	5.9	108.5	5.7
Grey alder	0.1	15.2	15.3	6.1	21.4	74.6	96.0	5.9	111.3	5.9
Oak	0.4	8.5	8.9	3.6	4.8	19.9	24.7	1.5	33.6	1.8
Ash	0.1	4.7	4.8	1.9	5.1	40.9	46.0	2.8	50.8	2.7
Other	0.1	5.0	5.1	2.0	2.9	4.2	7.1	0.4	12.2	0.6
Total	20.6	229.4	250.0	100.0	266.6	1371.4	1638.0	100.0	1888.0	100.0
%			13.2				86.8		100.0	

Souce:Lithuanian Forest Statistics 1998

Table 1.6.3 shows growing stock volume by forest type and species

Table1.6.3 Growing Stock Volume by Forest Type and Species

(1000 m^3)

Forest type	Total volume	Pine	Spruce	Other	Birch	Aspen	Bl.alder	G.alder	Oak	Ash	Other	Total volume
Pine	144653	122978	12690	18	7870	342	201	196	270	10	78	144653
%	100.0	85.0	8.8	0.0	5.4	0.2	0.1	0.1	0.2	0.0	0.1	41.6
Spruce	84922	4953	58347	23	10891	4027	2045	1623	1651	868	494	84922
%	100.0	5.8	68.7	0.0	12.8	4.7	2.4	1.9	1.9	1.0	0.6	24.4
Birch	60825	1631	7641	2	37900	5627	3763	2252	551	1103	355	60825
%	100.0	2.7	12.6	0.0	62.3	9.3	6.2	3.7	0.9	1.8	0.6	17.5
Aspen	11215	38	1535		1760	6319	240	372	304	469	178	11215
%	100.0	0.3	13.7	0.0	15.7	56.3	2.1	3.3	2.7	4.2	1.6	3.2
Black alder	19780	116	1394		3492	391	13397	452	40	406	92	19780
%	100.0	0.6	7.0	0.0	17.7	2.0	67.7	2.3	0.2	2.1	0.5	5.7
Grey alder	10775	47	314		1039	370	260	8176	113	224	232	10775
%	100.0	0.4	2.9	0.0	9.6	3.4	2.4	75.9	1.0	2.1	2.2	3.1
Oak	6026	89	741	1	523	553	57	155	3152	313	442	6026
%	100.0	1.5	12.3	0.0	8.7	9.2	0.9	2.6	52.3	5.2	7.3	1.7
Ash	7635	5	441		798	847	276	415	370	4265	218	7635
%	100.0	0.1	5.8	0.0	10.5	11.1	3.6	5.4	4.8	55.9	2.9	2.2
Other	1734	163	83	772	98	94	21	83	115	68	937	1734
%	100.0	9.4	4.8	4.2	5.7	5.4	1.2	4.8	6.6	3.9	54.0	0.5
Total	347565	130020	83186	116	64371	18570	20260	13724	6566	7726	3026	347565
%	100.0	37.4	23.9	0.0	18.5	5.4	5.8	4.0	1.9	2.2	0.9	100.0

Source: Lithuanian Forest Statistics 1998

The breakdown of forest area and growing stock volume by species is shown below. Differences between percentage shares of forest area and growing stock volume are relatively large for birch, aspen and grey alder.

	Percentage share of Forest are	Percentage share of Growing stock volume	Difference
Pine	37.2	37.4	+0.2
Spruce	23.4	23.9	+0.5
Birch	19.9	18.5	-1.4
Aspen	2.8	5.4	+2.6
Black alder	5.7	5.8	+0.1
Grey alder	5.9	4.0	-1.9
Oak	1.8	1.9	+0.1
Ash	2.7	2.2	-0.5
Others	0.6	0.9	+0.3
Total	100.0	100.0	

(3) Forested area, growing stock and growth increment by forest type and age class

Figures 1.6.2, 1.6.3, and 1.6.4 show forested areas of pine, spruce and birch species by age group, respectively. Pine and birch forests are characterized by relatively small percentages of young and mature stands. On the other hand, spruce forests are dominated by young stand, while mature stand accounts for relatively large portions.

Figure 1.6.2 Pine Forest Type

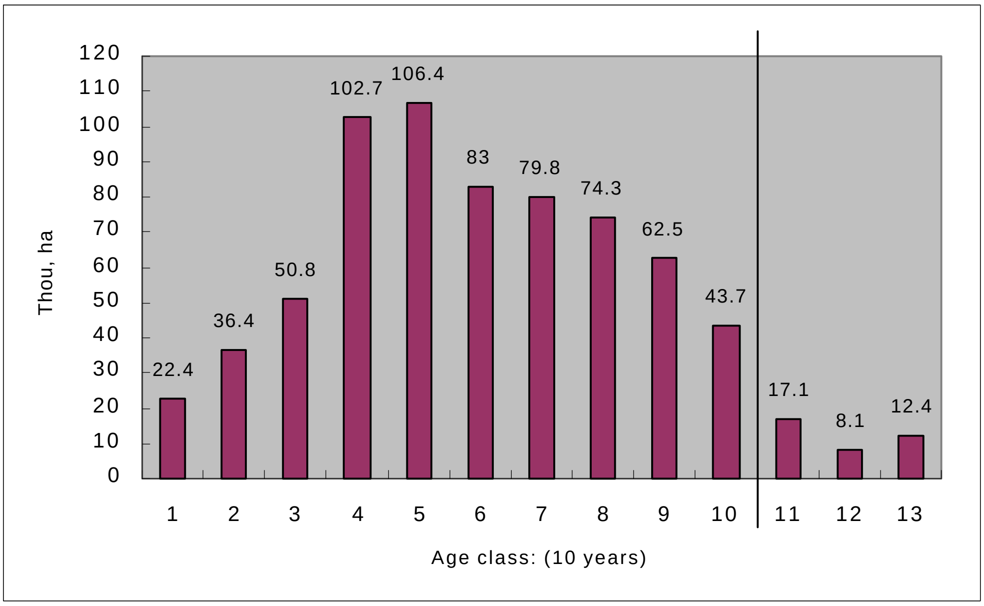


Figure 1.6.3 Spruce Forest Type

Figure 1.6.4 Birch Forest Type

Tables 1.6.4 shows forest area by forest type and age class, Table 1.6.5 growing stock volume by forest type and age class, and Table 1.6.6 stock volume per ha by forest type and age class.

Table 1.6.6 shows the growing stock volume per ha as calculated from data in Tables 1.6.4 and 1.6.5. The stock volume per ha of all the forests reaches 184m^3, which ranks middle among forest-rich countries in Europe.

Figure 1.6.5 shows growing stock volumes of pine, spruce and birch forests that dominate forest resources in Lithuania. According to the data, the stock volume in pine forests remains mostly unchanged for age class 11 or higher forests, and their growth appear to stagnate. Similarly, age class 8 or higher spruce forests seem to lose the stock volume slightly. For age class 9 or higher birch forests, a clear decline in stock volume is observed.

Table 1.6.4 Forest Area by Forest Type and Age Class

(ha)

Forest type	Age class (10 Years)													
	1	2	3	4	5	6	7	8	9	10	11	12	13	計
Pine	22422	36388	50843	102672	106364	82962	79795	74309	62504	43697	17144	8034	12407	699541
%	3.2	5.2	7.3	14.7	15.2	11.9	11.4	10.6	8.9	6.2	2.5	1.1	1.8	100.0
Spruce	67680	54941	33958	30780	36321	54541	62680	53597	26689	11569	5027	2390	1743	441916
%	15.3	12.4	7.7	7.0	8.2	12.3	14.2	12.1	6.0	2.6	1.1	0.5	0.4	100.0
Birch	11140	22051	42125	72070	95480	72002	35177	18388	5848	805	110	13		375209
%	3.0	5.9	11.2	19.2	25.4	19.2	9.4	4.9	1.6	0.2	0.0	0.0	0.0	100.0
Aspen	3615	2705	4978	9975	12728	10454	5145	2175	507	76				52358
%	6.9	5.2	9.5	19.1	24.3	20.0	9.8	4.2	1.0	0.1	0.0	0.0	0.0	100.0
Black alder	6664	10888	14318	17517	17320	19406	12572	6266	2541	785	136	49		108462
%	6.1	10.0	13.2	16.2	16.0	17.9	11.6	5.8	2.3	0.7	0.1	0.0	0.0	100.0
Grey alder	9242	34102	38860	22442	5629	955	93							111323
%	8.3	30.6	34.9	20.2	5.1	0.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Oak	399	395	1170	3098	3814	4020	3451	3147	2471	1906	1404	1546	6758	33579
%	1.2	1.2	3.5	9.2	11.4	12.0	10.3	9.4	7.4	5.7	4.2	4.6	20.1	100.0
Ash	2885	4900	5482	7845	8798	7513	5161	3877	2037	1050	568	327	300	50743
%	5.7	9.7	10.8	15.5	17.3	14.8	10.2	7.6	4.0	2.1	1.1	0.6	0.6	100.0
Other	435	1067	2024	3268	2500	1638	1053	591	386	1479	250	86	66	14843
%	2.9	7.2	13.6	22.0	16.8	11.0	7.1	4.0	2.6	10.0	1.7	0.6	0.4	100.0
Total	124482	167437	193758	269667	288954	253491	205127	162350	102983	61367	24639	12445	21274	1887974
%	6.6	8.9	10.3	14.3	15.3	13.4	10.9	8.6	5.5	3.3	1.3	0.7	1.1	100.0

Source: LITHUANIAN FOREST STATISTICS 1998

Table 1.6.5 Growing Stock Volume by Forest Type and Age Class

(1000 m^3)

Forest type	Age class (10 Years)													
	1	2	3	4	5	6	7	8	9	10	11	12	13	計
Pine	46.1	1704.1	5572.3	17297.5	21258.1	18922.8	19765.0	19547.0	17242.2	12457.5	4955.4	2305.5	3580.1	144653.6
%	0.0	1.2	3.9	12.0	14.7	13.1	13.7	13.5	11.9	8.6	3.4	1.6	2.5	100.0
Spruce	230.3	2273.0	3965.5	6155.7	9056.7	15184.3	18390.9	15900.9	7829.4	3356.8	1416.4	673.9	488.2	84922.0
%	0.3	2.7	4.7	7.2	10.7	17.9	21.7	18.7	9.2	4.0	1.7	0.8	0.6	100.0
Birch	175.1	960.4	3833.1	10158.2	16933.1	14726.2	7974.4	4470.6	1395.2	173.1	23.7	1.8		60824.9
%	0.3	1.6	6.3	16.7	27.8	24.2	13.1	7.3	2.3	0.3	0.0	0.0		100.0
Aspen	95.9	191.0	634.4	1947.2	3112.7	2902.4	1510.4	650.9	146.2	24.2				11215.3
%	0.9	1.7	5.7	17.4	27.8	25.9	13.5	5.8	1.3	0.2				100.0
Black alder	108.9	616.3	1519.8	2842.9	3612.9	4859.4	3461.7	1762.3	728.0	217.4	36.3	13.6		19779.5
%	0.6	3.1	7.7	14.4	18.3	24.6	17.5	8.9	3.7	1.1	0.2	0.1		100.0
Grey alder	316.8	2505.0	4165.8	2830.2	794.1	147.8	15.0							10774.7
%	2.9	23.2	38.7	26.3	7.4	1.4	0.1							100.0
Oak	1.1	15.0	86.9	366.3	546.8	672.6	623.0	575.0	458.7	379.1	305.2	347.6	1648.4	6025.7
%	0.0	0.2	1.4	6.1	9.1	11.2	10.3	9.5	7.6	6.3	5.1	5.8	27.4	100.0
Ash	42.9	230.3	510.2	1049.9	1481.7	1439.6	1072.8	831.7	442.0	239.2	135.2	82.7	77.1	7635.3
%	0.6	3.0	6.7	13.8	19.4	18.9	14.1	10.9	5.8	3.1	1.8	1.1	1.0	100.0
Other	3.4	45.3	178.8	391.9	347.3	263.2	196.9	108.6	59.4	92.3	21.4	8.5	17.0	1734.0
%	0.2	2.6	10.3	22.6	20.0	15.2	11.4	6.3	3.4	5.3	1.2	0.5	1.0	100.0
Total	1020.5	8540.4	20466.8	43039.8	57143.4	59118.3	53010.1	43847.0	28301.1	16939.6	6893.6	3433.6	5810.8	347565.0
%	0.3	2.5	5.9	12.4	16.4	17.0	15.3	12.6	8.1	4.9	2.0	1.0	1.7	100.0

Source: LITHUANIAN FOREST STATISTICS 1998

Table 1.6.6 Growing Stock Volume per ha. By Forest Type and Age Class

(m^3/ha)

Forest type	Age class (10 Years) 1	2	3	4	5	6	7	8	9	10	11	12	13	計	FCA
Pine	2	47	110	168	200	228	248	263	276	285	289	287	289	207	101
Spruce	3	41	117	200	249	278	293	297	293	290	282	282	280	192	71
Birch	16	44	91	141	177	205	227	243	239	215	215	138		162	61
Aspen	27	71	127	195	245	278	294	299	288	318				214	41
Black alder	16	57	106	162	209	250	275	281	287	277	267	278		182	61
Grey alder	34	73	107	126	141	155	161							97	31
Oak	3	38	74	118	143	167	181	183	186	199	217	225	244	179	121
Ash	15	47	93	134	168	192	208	215	217	228	238	253	257	150	101
Other	8	42	88	120	139	161	187	184	154	62	86	99	258	117	
Total	8	51	106	160	198	233	258	270	275	276	280	276	273	184	

FCA : Final Cutting Age (Years)
Souce : Lithuanian Forest Statistics 1998

Table 1.6.7 Estimated Mean Annual Increment

(m^3/ha,year)

Forest type	Forest Age (years) 5	15	25	35	45	55	65	75	85	95	105	115	125		FCA
Pine	0.4	3.1	4.4	4.8	4.4	4.1	3.8	3.5	3.2	3.0	2.8	2.5	2.3		101
Spruce	0.7	2.8	4.7	5.7	5.5	5.1	4.5	4.0	3.5	3.1	2.7	2.5	2.2		71
Birch	3.1	2.9	3.6	4.0	3.9	3.7	3.5	3.2	2.8	2.3	2.1	1.2			61
Aspen	5.3	4.7	5.1	5.6	5.4	5.0	4.5	4.0	3.4	3.4					41
Black alder	3.3	3.8	4.2	4.6	4.6	4.6	4.2	3.7	3.4	2.9	2.5	2.4			61
Grey alder	6.9	4.9	4.3	3.6	3.1	2.8	2.5								31
Oak	0.6	2.5	3.0	3.4	3.2	3.0	2.8	2.4	2.2	2.1	2.1	2.0	2.0		121
Ash	3.0	3.1	3.7	3.8	3.7	3.5	3.2	2.9	2.6	2.4	2.3	2.2	2.1		101
Other	1.6	2.8	3.5	3.4	3.1	2.9	2.9	2.5	1.8	0.7	0.8	0.9	2.1		
Total	1.6	3.4	4.2	4.6	4.4	4.2	4.0	3.6	3.2	2.9	2.7	2.4	2.2		

FCA : Final Cutting Age (Years)

Figure 1.6.5 Volume per ha. By Age Class & Forest Type

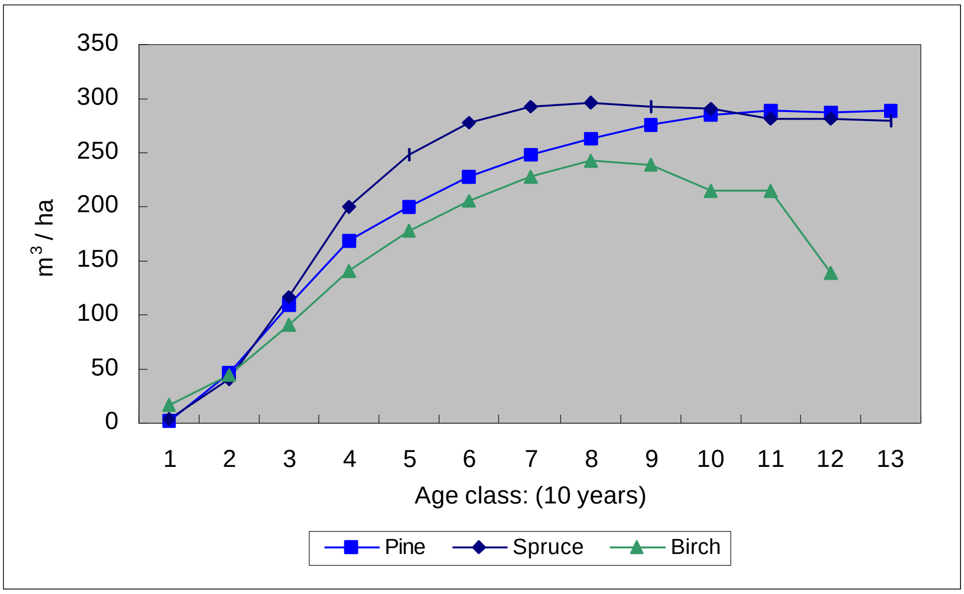


Figure 1.6.6 Estimated Mean Annual Increment

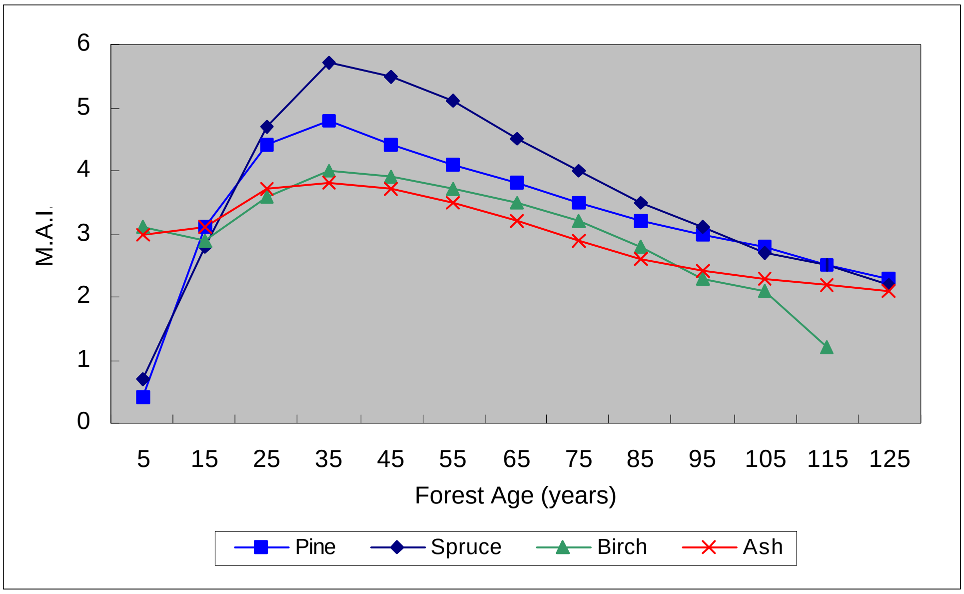


Table 1.6.7 shows the annual average increment, which is estimated from the stock volume per ha by forest type and age class in Table 1.6.6. (Note that the stock volume per ha for each age class is calculated as the stock volume for forest age of (age class x 10 years – 5 years).

Figure 1.6.6 plots some data in Table 1.6.7. According to the chart, the final cutting age generally agrees with the forest age at which the annual average increment reaches its peak for some species, namely aspen, black, alder and grey alder.

For other species, the final cutting age is much later than with the forest age at which the annual average increment reaches its peak. As determination of the final cutting age is largely affected by the productive diameter class, it tends to be longer than the peak forest age. Judging from the fact that 1 million m^3 of fuelwood are used annually, it is speculated that the grey alder forest is used as the short rotation forest.

Table 1.6.8 shows forest area by forest type and maturity and Table 1.6.9 growing stock volume by forest type and maturity.

Comparing the percentage share of mature forest area in Table 1.6.7 and the standard ratio of mature forest area (when the forest area assumed to be same for every age class), both pine and spruce trees have a relatively small percentage of mature forest, while broad-leaved forests, excepting ash, have a larger percentage of mature forest than the standard ratio, while young stand is much smaller in percentage share.

Table 1.6.8 Forest Area by Type and Maturity

(1000 ha)

Forest type	groupe of maturity					
	young stand	middle-aged	premature	mature	Total	Standard % of mature
Pine	213.1	343.6	107.6	37.8	702.1	
%	30.4	48.9	15.3	5.4	100.0	17
Spruce	187.4	90.8	116.3	47.4	441.9	
%	42.4	20.5	26.3	10.7	100.0	20
Birch	33.2	209.7	72.0	60.3	375.2	
%	8.8	55.9	19.2	16.1	100.0	14
Aspen	6.4	5.0	10.0	31.0	52.4	
%	12.2	9.5	19.1	59.2	100.0	20
Black alder	17.6	49.2	19.4	22.3	108.5	
%	16.2	45.3	17.9	20.6	100.0	14
Grey alder	9.3	34.1	38.9	29.0	111.3	
%	8.4	30.6	35.0	26.1	100.0	25
Oak	5.1	18.8	2.9	6.8	33.6	
%	15.2	56.0	8.6	20.2	100.0	14
Ash	21.1	25.4	3.1	1.2	50.8	
%	41.5	50.0	6.1	2.4	100.0	17
Other	2.3	5.3	1.9	2.7	12.2	
%	18.9	43.4	15.6	22.1	100.0	
Total	495.5	781.9	372.1	238.5	1888.0	
%	26.2	41.4	19.7	12.6	100.0	

Standard % of mature : when areas of all classes are equal.
Souce : Lithuanian Forest Statistics 1998

Classification by maturity in the above table can be translated to classification by cutting age as shown below.

Forest type	groupe of maturity			
	young stand	middle-aged	premature	mature
Pine,Ash	1-40	41-80	81-100	101...
Spruce	1-40	41-60	61-80	81...
Birch,B.alder	1-20	21-50	51-60	61...
Aspen	1-20	21-30	31-40	41...
G.alder	1-10	11-20	21-30	31...
Oak	1-40	41-100	101-120	121...

Table 1.6.9 Stock Volume by Forest Type and Maturity

(1000 m^3)

Forest type	groupe of maturity				
	young stand	middle-aged	premature	mature	Total
Pine	24677	79510	29765	10852	144804
%	17.0	54.9	20.6	7.5	100.0
Spruce	12624	24241	34292	13765	84922
%	14.9	28.5	40.4	16.2	100.0
Birch	1135	30924	14726	14039	60824
%	1.9	50.8	24.2	23.1	100.0
Aspen	287	634	1947	8347	11215
%	2.6	5.7	17.4	74.4	100.0
Black alder	725	7976	4859	6219	19779
%	3.7	40.3	24.6	31.4	100.0
Grey alder	317	2505	4166	3787	10775
%	2.9	23.2	38.7	35.1	100.0
Oak	469	3255	653	1648	6025
%	7.8	54.0	10.8	27.4	100.0
Ash	1833	4826	681	295	7635
%	24.0	63.2	8.9	3.9	100.0
Other	200	683	287	415	1585
%	12.6	43.1	18.1	26.2	100.0
Total	42267	154554	91376	59367	347564
%	12.2	44.5	26.3	17.1	100.0

Souce : Lithuanian Forest Statistics 1998

Table 1.6.10 shows stock volume per ha by forest type and maturity. Compared to the stock volume of 184m^3/ha for all forests, that for mature forest is 249m^3/ha.

Table 1.6.10 Stock Volume Per Hectare by Forest Type and Maturity

(m^3/ha)

Forest type	groupe of maturity				
	young stand	middle-aged	premature	mature	Total
Pine	116	231	277	287	206
Spruce	67	267	295	290	192
Birch	34	147	205	233	162
Aspen	45	127	195	269	214
Black alder	41	162	250	279	182
Grey alder	34	73	107	131	97
Oak	92	173	225	242	179
Ash	87	190	220	246	150
Other	87	129	151	154	130
Total	85	198	246	249	184

Souce : Lithuanian Forest Statistics 1998

(4) Historical trends in Lithuania forest resources

Figure 1.6.7 shows cutting trends and dynamics of forests in Lithuania, on the basis of Lithuanian Forest Statistics 1998 and Lithuanian Forestry and Timber Industry Development Programme Resolution (27.9.1994). Notably, vigorous cutting at a rate of 6 million m^3 per year over three decades, starting in 1921, seriously reduced forest resources in the country.

Statistical data show that the average stock volume per ha was $76m^3$ in 1948. This figure is applied to pine forests in Figure 1.6.5 of this report, it is equivalent to the stock volume for 25 years old (the current stock volume of $184m^3$/ha for around 45 years old). Together with the low percentage (5%) of mature forest, most mature forests seem to have been cut in the late 1940s or the early 1950s.

Then, great efforts have presumably been made to restore forest resources through restrained cutting and reforestation over five decades. As the stock volume has recovered to a significant level to warrant sustainable growth, further growth is expected in the future, although there are some problems to be overcome.

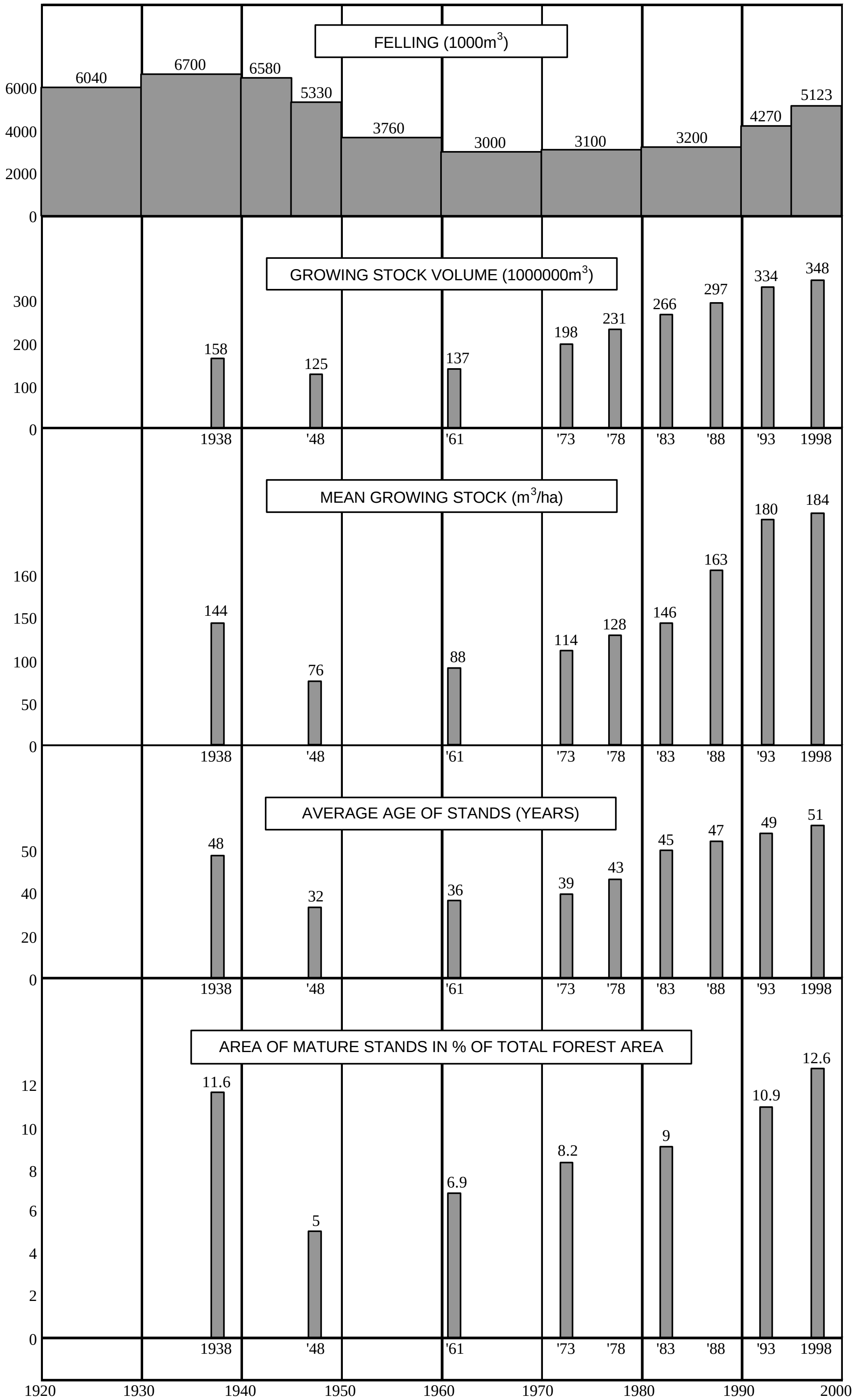
Figure 1.6.7 shows the annual removal rates since 1938, which depict excess cutting in the early years.

($1000m^3$)

Year	Stock volume	Annual cut	Removal rate (%)
1938	158000	6700	4.24
1948	125000	5330	4.26
1961	137000	3000	2.19
1973	198000	3100	1.57
1983	266000	3200	1.20
1993	334000	4270	1.28
1998	348000	5123	1.47
	348000	(6200)	1.78

Thus, the annual removal rate exceeded 4% of the stock volume, compared to the annual allowable cut of 6.2 million m^3 that is equivalent to 1.78% of the recent stock volume.

Figure 1.6.7 Forest Resource Trends in Lithuania



(5) Cutting trends

Table 1.6.11 shows cutting trends between 1997 and 1999 and Table 1.6.12 detailed data in 1999.

Cutting is primarily carried out by State Forest Enterprises which manage state forests. At present, the annual cut reaches 5 million m^3, of which that of privately-owned forests exceeded 1 million m^3 in 1999 for the first time. As the ratio of state forests to private forests will become 52:48 when all the nationalized forests are returned to private ownership, the cut in private forests is expected to grow rapidly in the near future.

Data in Table 1.6.11 can be summarized as follows.

	Percentage share of state-owned forests	Private forests	Total
1997	82.6%	17.4%	100%
1998	83.7	16.3	100
1999	79.3	20.7	100
	Final cutting	Thinning	Total
1997	47.7%	52.3%	100%
1998	52.6	47.4	100
1999	58.5	41.5	100

Notably, the cutting volume for thinning and sanitation cutting purposes account for more than 40% of total. From the 1999 data in Table 1.6.12, it is revealed that selective sanitation cutting represents a majority of thinning and sanitation cutting. This reflects the fact that extensive cutting was carried out to remove wind-fallen trees and insect damaged trees, which mainly occurred in spruce forests in 1993.

Table 1.6.11 Removal in 1997-1999

(1000 m^3)

1999	Area	Cutting in State Forest						Allowed to cut in Private Forest		Total	
		Sub-Total		Cut by Forest Enterprise		Cut by Other Logging Co.					
	ha	removal	commercial	removal	commercial	removal	commercial	area	removal	removal	%
Ⅰ.Final cutting,Total	11880.0	2248.0	1643.2	2212.3	1639.8	35.7	3.4	7098.0	632.7	2880.7	58.5
Ⅱ.Thinning & Sanitation cutting,Total	156667.0	1602.8	774.1	1085.3	727.5	517.5	46.6	29978.0	304.8	1907.6	38.7
Ⅲ.Other Intermediate cutting,Total	2917.0	51.9	27.2	36.1	25.1	15.8	2.1	3417.0	84.1	136.0	2.8
Ⅳ.Total	171464.0	3902.7	2444.5	3333.7	2392.4	569.0	52.1	40493.0	1021.6	4924.3	100.0
%		79.3(100.0)		(85.4)		(14.6)			20.7	100.0	

1998	Area	Cutting in State Forest						Allowed to cut in Private Forest		Total	
		Sub-Total		Cut by Forest Enterprise		Cut by Other Logging Co.					
	ha	removal	commercial	removal	commercial	removal	commercial	area	removal	removal	%
Ⅰ.Final cutting,Total	11117.0	2137.3	1554.4	2129.5	1551.7	7.8	2.7	3958.0	430.5	2567.8	52.6
Ⅱ.Thinning & Sanitation cutting,Total	183755.0	1875.8	899.8	1247.1	805.5	628.7	94.3	34684.0	307.1	1554.2	31.8
Ⅲ.Other Intermediate cutting,Total	3372.0	73.5	42.9	55.6	38.4	17.9	4.5	3088.0	55.9	129.4	2.7
Ⅳ.Total	198244.0	4086.6	2497.1	3432.2	2395.6	654.4	101.5	41730.0	793.5	4880.1	100.0
%		83.7(100.0)		(84.0)		(16.0)			16.3		

1997	Area	Cutting in State Forest						Allowed to cut in Private Forest		Total	
		Sub-Total		Cut by Forest Enterprise		Cut by Other Logging Co.					
	ha	removal	commercial	removal	commercial	removal	commercial	area	removal	removal	%
Ⅰ.Final cutting,Total	11925.0	2118.1	1527.9	2108.1	1525.2	10.0	2.7	2385.0	337.7	2455.8	47.7
Ⅱ.Thinning & Sanitation cutting,Total	197935.0	2024.3	1046.8	1405.4	922.3	618.9	124.5	63184.0	492.6	1898.0	36.9
Ⅲ.Other Intermediate cutting,Total	3745.0	109.1	77.0	98.8	74.6	10.3	2.4	2567.0	67.3	176.4	3.4
Ⅳ.Total	213605.0	4251.5	2651.7	3612.3	2522.1	639.2	129.6	68136.0	897.6	5149.1	100.0
%		82.6(100.0)		(85.0)		(15.0)			17.4	100.0	

removal : including fuelwood, commercial : without fuelwood

Souce : Department of Forests & Protected Areas

Table 1.6.12 Details of Removal in 1999

(1000 m^3)

1999	Area	Cutting in State Forest						Allowed to cut in Private Forest		Total	
		Sub-Total		Cut by Forest Enterprise		Cut by Other Logging Co.					
	ha	removal	commercial	removal	commercial	removal	commercial	area	removal	removal	%
Ⅰ.Final cutting,Total	11880.0	2248.0	1643.2	2212.3	1639.8	35.7	3.4	7098.0	632.7	2880.7	58.5
Ⅱ.Thinning & Sanitation cutting,Total	156667.0	1602.8	774.1	1085.3	727.5	517.5	46.6	29978.0	304.8	1907.6	38.7
Ⅲ.Other Intermediate cutting,Total	2917.0	51.9	27.2	36.1	25.1	15.8	2.1	3417.0	84.1	136.0	2.8
Ⅳ.Total	171464.0	3902.7	2444.5	3333.7	2392.4	569.0	52.1	40486.0	1021.6	4924.3	100.0

Details of Ⅰ.Final cutting,Total

Spruce	3546.0	566.9	429.9	562.9	429.1	4.0	0.8	3735.0	297.4	864.3	30.0
Pine & Others	1770.0	379.8	338.3	378.9	338.1	0.9	0.2	1607.0	117.0	496.8	17.2
① Coniferous,Total	5316.0	946.7	768.2	941.8	767.2	4.9	1.0	5342.0	414.4	1361.1	47.2
Oak	145.0	23.7	14.1	23.5	14.1	0.2	0.0	66.0	9.2	32.9	1.1
Ash & Others	79.0	14.2	7.7	14.0	7.7	0.2	0.0	141.0	11.2	25.4	0.9
② Hardbroadleaves,Total	224.0	37.9	21.8	37.5	21.8	0.4	0.0	207.0	20.4	58.3	2.0
Birch	3379.0	649.4	478.2	643.5	477.9	5.9	0.3	852.0	102.8	752.2	26.1
Black alder	1151.0	268.3	184.4	266.9	184.4	1.4	0.0	188.0	34.5	302.8	10.5
Aspen & Others	1810.0	345.7	190.6	322.6	188.5	23.1	2.1	509.0	60.6	406.3	14.1
③ Softbroadleaves,Total	6340.0	1263.4	853.2	1233.0	850.8	30.4	2.4	1549.0	197.9	1461.3	50.7
Ⅰ.Final cutting,Total (①+②+③)	11880.0	2248.0	1643.2	2212.3	1639.8	35.7	3.4	7098.0	632.7	2880.7	100.0

Details of Ⅱ.Thinning & Sanitation cutting,Total

① Pre-commercial thinning	13357.0	25.0	5.2	14.3	5.1	10.7	0.1	109.0	1.8	26.8	1.4
② Commercial thinning	7108.0	279.0	174.9	257.1	171.3	21.9	3.6	1057.0	31.8	310.8	16.3
③ Thinning	8826.0	498.8	340.7	487.8	338.5	11.0	2.2	2879.0	96.1	594.9	31.2
④ Selection-sanitation cutting	127376.0	800.0	253.3	326.1	212.6	473.9	40.7	25933.0	175.1	975.1	51.1
Ⅱ.Thinning & Sanitation cutting,Total (①+②+③+④)	156667.0	1602.8	774.1	1085.3	727.5	517.5	46.6	29978.0	304.8	1907.6	100.0

Of Final cutting,Total

Clear final cutting	9637.0	2043.8	1498.0	2014.3	1495.0	29.5	3.0	2429.0	503.1	2546.9	88.4
Clear sanitary cutting	148.0	17.8	12.9	17.4	12.8	0.4	0.1	135.0	15.5	33.3	1.2

figures in column % show percentage to Final cutting,Total

Of Other Intermediate cutting,Total

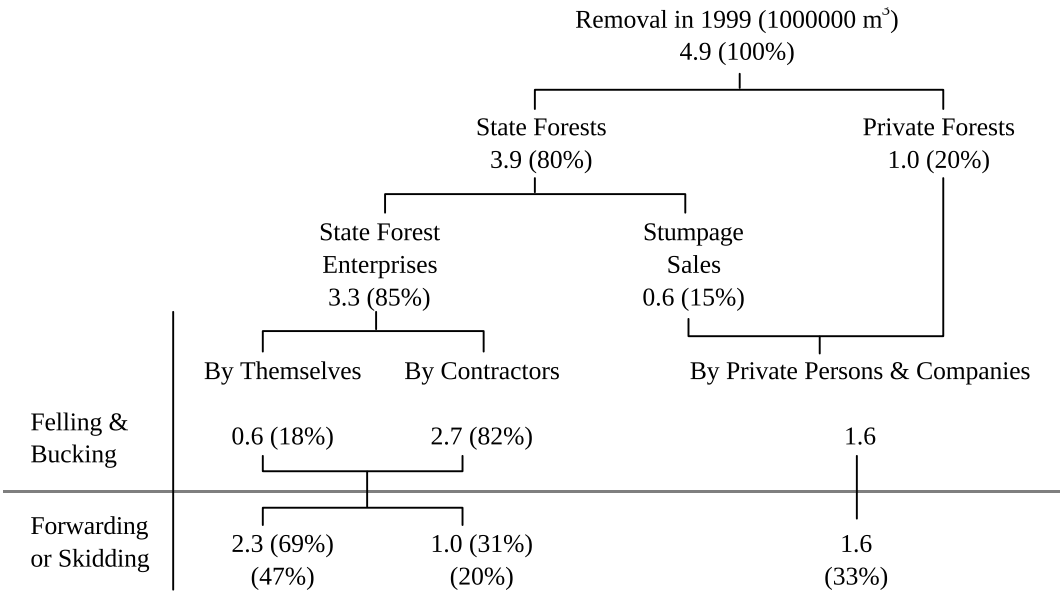
Clear sanitary cutting	65.0	7.4	5.1	6.8	4.9	0.6	0.2	16	2.2	9.6

Souce : Department of Forests & Protected Areas

(6) Logging operation

Figure 1.6.8 illustrates a general flow of logging operations in 1999. Notably, even in state forests that accounted for 80% of the annual cut in 1999, 82% of felling and bucking operations and 30% of yarding to forest roads were commissioned to private contractors. On the national average, direct operation by State Forest Enterprises account for 47% of total logging operation. As state forests are returned to private ownership and harvesting of private forests increases, private loggers will grow in number and skills will improve.

Figure 1.6.8 General Flow of Logging Operations (1999)



Source: Center of Forest Economics

Table 1.6.13 shows yearly changes in stumpage sales volume in state forests. The figure grew 50% in 1993 due to a large number of wind-fallen trees. Loggers who have logged these trees must have improved their skills, which should be utilized in the future.

Table 1.6.13 Yearly Changes in Stumpage Sales Volume from State Forests

(1000000 m^3)

	Total Removal in State Forest	of which Stumpage Sales	%
1991	3.32	0.72	21.7
1992	3.34	0.77	23.1
1993	4.61	2.33	50.5
1994	4.00	1.47	36.8
1995	5.28	1.62	30.7
1996	4.77	0.91	19.1
1997	4.25	0.64	15.1
1998	4.09	0.66	16.1
1999	3.90	0.57	14.6

Souce : Center of Forest Economics

Table 1.6.14 shows the changes in transportation and handling methods used by State forest Enterprises. Clearly, they have been using the whole stem method less and less – the traditional method used in the Soviet Union to haul whole logs to a stockyard (mostly near a rail station) by a skidder or a truck. The method's percentage share declined to 7% in 1999. Among short wood methods, called the Scandinavian method, skidding using a horse or farm tractor has also been on the decline, increasingly replaced with the forwarding method using a forwarder or a wagon vehicle with a grapple crane hauled by a farm tractor.

Table 1.6.14 Logging Operations by State Forest Enterprises

(1000 m^3)

Year	Skidding and Forwarding										
	Total	Whole stem method		Skidding by Horses		Skidding by Tractors		Forwarding by Forwarders		Shortwood method Sub-total	
			%		%		%		%		%
1997	3425	562	16.4	152	4.4	1228	35.9	1482	43.3	2862	83.6
1998	3281	436	13.3	107	3.3	937	28.6	1801	54.9	2845	86.7
1999	3239	228	7.0	59	1.8	1004	31.0	1948	60.1	3011	93.0

Souce : Department of Forests & Protected Areas

Table 1.6.15 shows an operation record of forwarders in 1999. This is the operation record of 56 forwarders (2 models) out of 76 owned by State Forest Enterprises throughout the country. Each forwarder was operated for 216 days per year on average and handled 23000 m^3 by working for 12 – 13 hours per day and based on 1.7 shifts. (106m^3/day/unit, 61m^3/shift/unit)

This is a highly efficient operation, although work was mainly performed over flat terrain, but the forwarder is very expensive, reportedly over EUR200000 per unit.

Table 1.6.15 Operation Record of Forwarders（1999）

Name of Machines	No. of Machines	Worked Days		Worked Shifts		Forwarded Volumes			
		all M.	per M.	all M.	per Day	all M.	per M.	per Day,M	per Shift,M
		days	days	shifts	shifts	1000m^3	1000m^3	m^3	m^3
Timberjack	33	7842	237.6	12959	1.7	734.9	22.3	93.7	56.7
Valmet	32	6196	193.6	11474	1.9	748.9	23.4	120.9	65.3
Total	65	14038	216.0	24433	1.7	1483.8	22.8	105.7	60.7

M : Machine(s)
Souce : Department of Forests & Protected Areas

Table 1.6.16 shows an operation record of wagon forwarders equipped with grapple cranes, which are hauled by farm tractors. Compared to forwarders that are specially designed for forestry operation, it is advantageous to use the less costly farm tractor.

Although the handling capacity per shift/unit is less than one half that of the forwarder, the farm tractor is far cheaper, reportedly around EUR73000. Also, small-scale harvesting in private forests is expected to increase in the near future, logging operation using the wagon will likely become pervasive.

Table 1.6.16 Working Record of Wagon Forwarders with Grapple Cranes

Name of Machines	No. of Machines	Worked Days		Worked Shifts		Forwarded Volumes			
		all M.	per M.	all M.	per Day	all M.	per M.	per Day,M	per Shift,M
		days	days	shifts	shifts	1000m^3	1000m^3	m^3	m^3
Patu	27	3911	144.9	4114	1.1	124.1	4.6	31.7	30.2
Weimer	15	2617	174.5	2789	1.1	77.4	5.2	29.6	27.8
RDM	9	1539	171.0	1972	1.3	45.0	5.0	29.2	22.8
Nokka	9	1524	169.3	1574	1.0	46.8	5.2	30.7	29.7
PV-8	4	571	142.8	765	1.3	14.2	3.6	24.9	18.6
Sveteka	1	169	169.0	169	1.0	6.3	6.3	37.3	37.3
Krona	1	194	194.0	194	1.0	8.2	8.2	42.3	42.3
Total	66	10525	159.5	11577	1.1	322.0	4.9	30.6	27.8

M : Machine(s)
Souce : Department of Forests & Protected Areas

Table 1.6.17 shows the average logging operation prices contracted by State Forest Enterprises to subcontractors.

The contract price for a combination of felling, cutting and yarding operations is lower than that of each operation because high levels of work efficiency can be maintained due to clear cutting as well as work in pipe forests.

Clearly, the ability to maintain this cost advantage will hold the key to further growth of forestry in Lithuania.

Table 1.6.17 Average Contract Price for Logging Operations

(LTL/m^3,(USD/m^3))

Year	Average Contract Price			
	Felling & Bucking	Forwarding	Total	Felling & Forwarding
1997	12.8(3.2)	11.8(3.0)	24.6(6.2)	22.0(5.5)
1998	13.2(3.3)	12.8(3.2)	26.0(6.5)	22.1(5.5)
1999	12.9(3.2)	14.0(3.5)	26.9(6.7)	23.0(5.8)

Source: Department of Forests and Protected Areas

(7) Domestic wood consumption

Table 1.6.18 estimates wood consumption in Lithuania from the cutting volume in the country and log exports and imports.

Table 1.6.19 shows industrial log consumption in the above table estimated from production statistics of wood products and log supply by State Enterprises.

As reliable statistical data are difficult to obtain, industrial log consumption in the country is assumed to be 3 million m^3 annually and fuelwood consumption 1 million m^3.

Table 1.6.18 Domestic Wood Consumption Trends

($1000m^3$sub)

	1997	1998	1999
Removals	5150	4880	4920
Log Import	100	86	79
Log Export	764	786	937
Apparent Consumption	4486	4180	4062
industrial log	3336	3010	2892
fuelwood	1150	1170	1170

Souce : Center of Forest Economics NAUJIENOS No.1 (12)

Table 1.6.19 Industrial Log Consumption Trends

	Unit	Production			Estmated Consump.($1000m^3$sub)		
		1997	1998	1999	1997	1998	1999
Sawn-timber	$1000m^3$	1250	1150	1150	2800	2500	2500
Plywood	$1000m^3$	29.5	35.7	31.5	100	100	100
Particleboard	$1000m^3$	169.8	159.1	100.3	300	200	100
Fibreboard	$1000000m^2$	19.0	20.0	12.2	200	200	100
					3400	3000	2800

Souce: Center of Forest Economics

(8) Annual increment and annual allowable cut (1999 – 2008)

First of all, the annual increment of all forests in Lithuania is estimated at 11.6 million m^3 sob (forested area of 1,888,000 ha x $6.14m^3$/ha), whereas the present annual allowable cut amounts to 5 million m^3 sob). This is explained as shown in the table below (Lietuvos Misku Istekliai Noudojimo Perspektyvos by A. Kuliesis)

(million m^3)

National mean annual growth	11.6
Decrease due to natural dead	-1.1
Portions belonging to Groups I and II (15%)	-1.7
Net – Groups III and IV	8.8
Saleable portions (83%)	7.3
Unable to cut due to immaturity	-1.1
Net – allowable cut	6.2

The annual allowable cut currently announced is as follows.

Potential Use of timber Resources

YEAR	FORECASTED CUTTING VOLUME (Million m^3)
1999-2008	6.2
2009-2018	6.7
2019-2028	7.1

(9) Truck and rail transportation costs

The truck transportation cost incurred by Nemensines State Forest Enterprise is reported as follows:
Loading and unloading costs: 5LT/m^3
Transportation charge per km: 2.4LT/km, truck load of 20-22m^3
Thus, assuming that a 20m^3 load is transported for a distance of 100km:
2.4×100km＋5×20＝340LTL／20m^3 17LTL／m^3

Rail transport (350km from Nemencines to Kleipeda Port)
Lading cost: 7-8LT/m^3
Freight charge per car: 1000LT – 50m^3 load per ca = 20LT/m^3
Total: 27-28LT/m^3

The transportation cost for chips from a private sawmill is estimated as follows:
Transportation charge per km: 1.7LT/km – truck load of 21m^3 (solid cubic metre)

(10) Reforestation cost

According to Nemencines State Forest Enterprise, the reforestation cost including soil (land) preparation to plant 7000 – 10000 nursery trees is 900 – 1400LT/ha, or USD225 – 350/ha.

As the cutting rotation in Lithuania is relatively long, it is important for the industry to reduce the reforestation cost.

1.7 Forestry and Wood products

1.7.1 Worldwide Wood product Supply and Demand Situation

(1) Wood product demand

According to the 1994 FAO statistics, fuelwood accounted for 56% of wood product demand in the world, and industrial use 44%. In industrialized countries, fuelwood demand represented 15% and industrial consumption 85%. In contrast, the former accounted for 81% and the latter 19% in developing countries. Generally speaking, industrial demand is roughly proportional to population and income, while fuelwood demand decrease with income growth.

Table 1.7.1 World Wood Product Consumption

(Unit：100万m^3)

Category	1970	1980	1994	1995
Roundwood				
World	2463	3499	3358	4056
Industrialized countries	1258	1559	1318	—
Developing countries	1206	1947	2122	—
Fuelwood				
World	1185	1780	1891	1923
Industrialized countries	187	234	191	—
Developing countries	998	1546	1700	—
Industrial				
World	1278	1718	1891	2133
Industrialized countries	1070	1318	1051	—
Developing countries	208	401	417	—

Overall, industrial demand in industrialized countries will remain flat or grow slightly, whereas that in developing countries will grow rapidly to reflect high growth rates of both economy and population. Meanwhile, fuelwood demand in developing countries will decline gradually. As a result, worldwide wood product demand will grow largely due to brisk demand in developing countries, led by Asia. The FAO predicts that world log demand will reach 5 billion m^3 in 2010.

(2) Trade structure for wood products

In terms of overall trade structure, both exports and imports of wood products are controlled by industrialized countries. The bulk of wood product trade takes place among Europe, North America and Asia. Notably, Asian countries which are currently major exporters of wood products are losing export capacities due to fast-growing economies accompanied by rapid growth of domestic demand. And some of them may turn into importers. It should also be noted that only 20-30% of wood products produced worldwide are traded in the international market, and remaining 70-80% in the domestic markets.

Table 1.7.2 Regional Breakdown of Exports/Imports of Wood Products (1994)

Region	Export	Import
Europe	43%	45%
North America	32%	17%
Asia	13%	31%
(3 regions)	(88%)	(93%)
Latin America	4%	3%
Africa	2%	2%
Oceania	3%	2%
Former Soviet Union	3%	0%

Table 1.7.3 Worldwide Production and Exports of Wood products

Wood products	1970		1994	
	Production	Export	Production	Export
				(Million m^3)
Industrial logs	1278	93.6	1467	113.4 (7.7%)
Sawmill products	415	57.4	413	107.6 (26.1%)
Plywood	70	9.7	127	38.2 (30.1%)
Pulp	103	16.9	172	31.6 (18.4%)
Paper/paperboard	126	23.4	269	72.7 (27.0%)

(3) Regional supply and demand balance

According to the FAO forecast, the present supply and demand balance will basically be maintained at least until 2010 without a significant supply shortage or long-term price hikes. In the meantime, consumption will shift to paper, paperboard and panel products, so that industrial log production will shift to smaller diameter products.

In any case, the world supply and demand structure will primarily consist of North America, Asia and Europe. Regions that serve as uncertain factors on the supply side are Russia and the Pacific Rim countries, including South America, which have high potential to grow as major sources of artificial forest wood. Supply and demand outlooks in the three regions are described as follows.

1) North America

In the U.S., coniferous tree may become short supply between 2000 and 2010, but as plantations in South and Northwest will grow to tradable volume by 2010, long-term availability will not likely become a problem. The supply shortage up to 2010 will be compensated for by the use of surplus broadleaf tree or imports.

In Canada where coniferous tree is mainly consumed and its forest resources are mainly natural (primary) forests, supply is expected to decline in response to the growing environmental concern. On the other hand, broad-leaved forests have sufficient stock to meet requirements, so long as the market accept hardwood.

Exports of softwood logs from North America to the Pacific Rim market (Asia) are limited to those harvested from privately owned secondary forests, because the U.S. government bans their exports from public forests in West, and provincial governments in Canada impose similar restriction.

2) Europe

According to the ETTS forecast, log production in European forests is expected to grow gradually, whereas wood product demand will grow constantly. As a result, prices will likely rise, although the long-term price trend will be relatively stable. Supply and demand forecast up to 2020 indicates that demand for sawmill products, plywood, pulp and paper will grow at 20% - 80% annually. On the other hand, the annual removal will remain 70% of the net growing stock (slightly more than one half the total supply volume) and net imports of wood products from other regions (excluding logs) will increase 55 – 80 million m^3, especially in the form of paper and pulp as well as logs.

3) Asia

While Asia expands production at the fastest pace, it will continue to face supply shortage, which is most acute in the world. The shortage will occur for plywood and veneer at the beginning of the 21st century, and pulp and paper shortages will become serious. For many wood products, consumption in Asia reaches the same or higher level than that in Europe, and demand growth exceeds supply in most products. The shortage is expected to be covered by imports from the former Soviet Union, Oceania and Americas (North and South Americas), together with harvest from plantations in Asia. Notably, the recent closedown of a large number of small paper mills in China suggests the country intends to reduce the cost burdens related to environmental protection by increasingly relying on imports. This means that paper and pulp imports by China will grow rapidly, also driven by the country's economic growth.

(4) Wood product market trends

1) Sawmill products

According to the FAO's 1997 statistics, world sawmill product demand ranged between 430 – 400 million m^3 annually. Softwood accounted for 70% and hardwood 30%. Softwood imports are dominated by the U.S., followed by Japan, the U.K., Italy and Germany. For hardwood, the large importer is China, followed by Japan, Italy, Thailand and the U.S.

The FAO's forecast based on the past data between 1983 and 1997 indicates that world demand will grow at an annual 1.7% after 1998. This means an annual average increase of 2.68 million m^3 up to 2020. Regionally, demand in North America will increase by 2-3%, while West Europe will remain unchanged and increase slightly and Asian demand will grow at around 1% as China's rapid growth will more than compensate for contracted demand in Japan. Demand in Latin America will continue to level off.

2) Plywood

World plywood demand ranges between 50 and 55 million m^3, 37% of which are imported. The major exporter is Indonesia (41%), followed by Malaysia (18%). These two countries account for a combined share of nearly 60%. The largest importer is Japan, followed by China, the U.S., Germany and South Korea. Four countries in Asia, Japan, China, South Korea and Singapore, account for a combined share of 54% to total imports. The U.S. is the largest plywood consuming country in terms of consumption per 1000 population ($39m^3$), followed by Europe ($9m^3$), Asia ($7m^3$) and South America ($5m^3$).

In both Indonesia and Malaysia, timber for veneer production are harvested from natural forests in Borneo. Recently, however, logging camps are moving into remote areas to make logging operations increasingly uneconomical and cause steady reduction of log supply. As a result, smaller diameter logs will be used for veneer production, leading to the rise in production cost and increased competition with OSB and other substitutive products.

In overall consideration of the above factors, the bulk of plywood currently traded in the world market is harvested from natural forests in tropical areas. However, the production cost rises gradually due to increasingly unfavorable harvesting conditions, while smaller logs are increasingly used. As a result, smaller diameter wood will become a principal material for plywood in the near future. According to other information sources, the plywood industry in the U.S. is using roundwood of 30cm or small diameters, and OSB is receiving attention as a promising alternative.

The long-term demand forecast indicates that demand in China will maintain high growth rates of 3-4% annually and become the largest consuming country in 2010, compared to the U.S. which was the largest consumer in 1997 but will decline thereafter. Overall, total demand will expand from 52.8 million m^3 in 1997 to 66.1 million m^3 in 2010 and 77.2 million m^3 in 2020, with an annual average growth rate of 1.06 million m^3.

3) Particleboard

World particleboard demand amounts to around 70 million m^3, of which 15.8 million m^3 (22.5%) are procured through imports. Major importing countries are the U.S., Germany, the U.K., Japan and Italy (in that order). Imports by North American and European countries account for more than 80% of world total imports. Major exporting countries are also in these regions, namely Canada, Benelux, Germany, France and Austria. European exports accounts for slightly over 93% of the world total.

In fact, North American and European countries dominate world particle board production, consumption and trade by controlling 80% or more share. World demand grew at a healthy 8.2% between 1993 and 1997. Among regions, the U.S. and Asia were fast growing, 19.4% and 13% respectively.

4) Fiberboard

Worldwide fiberboard demand totaled 23360000 m^3 in 1997. Of total, insulation boards accounted for 24%, hardboards 31%, and MDF 45%. The three segments grew 0%, 1.92% and 8.3% during the past four years, indicating rapid growth of the largest segment, MDF.

A. Insulation board

Regionally, demand declined in North and Central Americas, Europe and the Pacific region during the four-year period, compared to some surges in South America, Asia and Africa. In particular, demand in Europe dropped by 37% and North and Central Americas by 23%. South America experienced 96% growth and Asia 84%.

The largest importer is China, followed by the U.S., Germany, the U.K. and Italy. Demand in China grew nearly six fold (480%) between 1993 and 1997. The U.S. recorded modest growth of 11.2% and Germany 15%. The U.K. registered negative growth of 18%.

The largest exporting country is Canada, followed by Poland, Italy, the U.S., and France. During the four-year period, only the U.S. exports decreased by 41%, while Canada boosted 48%, Poland 430%, Italy 160% and France 71%.

World demand, however, did not increase at all during the four-year period. Production fell 7.2% probably because the industry anticipated sluggish demand. Insulation boards account for the smallest percentage of fiberboard (20% in 1997) and their future prospect is not very bright.

B. MDF

MDF is the most widely used fiberboard product. It is mainly produced in Europe (34%), Asia (28) and North and Central Americas (25%). Demand grew at an annual average rate of 17% between 1995 and 1997, and accounted for 47% of total fiberboard consumption (1997). One fourth of MDF products is traded in the export market, which is dominated by Europe (53% of total volume), followed by Asia (16%) and the Pacific States (11%). Europe is also the major importing region (47%) and Asia (35). The two regions hold a combined share of 82%.

Japan and China are major importers, accounting for 29%, followed by the U.K., the U.S., Spain and Germany. Major exporting countries include Malaysia (590000 tons; 13.4%), Italy, France, New Zealand, Canada, and Chile (340000 tons; 7.7%).

Overall, Europe has become the major exporter by boosting exports, whereas Asia is the largest net exporter despite the fact that production expands rapidly. In North and Central Americas, production and demand are mostly in balance.

World demand, although forecast is not totally reliable due to inadequate MDF trade statistics (1995 – 1997), is expected to grow at an annual 8.2% between 1997 and 2020, with 4.2% between 2010 and 2020. Among major consuming regions and countries, South Asia, China and Latin America will grow faster than 10% between 1997 and 2010. The U.S. and Japan will grow at 8% while Europe will slow down to 2.6%.

C. Hardboard

As in the case of insulation board, hardboard is overwhelmed by MDF and its growth rate hovers at 3-4%. North and Central Americas and Europe are major importers (particularly Germany and the U.K.), while North and

Central Americas (including Canada), Germany and Brazil are major exporting regions.

5) Others

Production of OSB grows rapidly in North America as it is increasingly used as one of the most popular structural panels, together with wafer board. In 1993, OSB accounted for 28% of structural panel demand in the U.S. market, compared to a mere 1% in 19980, and replaced the bulk of plywood made from softwood. OSB is mostly used for housing and its production is expected grow further. Also it can substitute for plywood, production is expected to increase in order to meet demand in export markets such as North America. In North America, OSB can be made from low-valued, smaller diameter trees of diverse specifies, both softwood and hardwood. Together with cost structure (wood raw material accounts for 35-40% of total variable cost and labor slightly over 20%), OSB may become a strategic product for production in Lithuania which has cost advantages in these two areas.

In addition, other products such as finger joint and LVL will be increasingly supplied according to the domestic and export market needs.

1.7.2 Wood Product Industries in Lithuania

(1) Major subsectors

Wood product industries in Lithuania are classified into the following six subsectors:

a. Sawmill and wood processing
b. Wood fiber, paper and paperboard
c. Paper and paperboard processing
d. Printing
e. Publishing
f. Furniture

As discussed in 1.6.1, the country has rich forest resources that have high potential to grow to wood product industries. In this connection, however, it is important to examine competition for raw materials between the large pulp and paper project and the existing wood product industries. To address this potential conflict, the current state of three core sectors in a., b. and f. is examined below. Note that other sectors - paper and paperboard, printing and publishing – are not as not important as the large pulp market, although they form a sizable domestic market. Thus no study is made on these sectors. Production and employment of these core subsectors are summarized as follows.

Classification No. (NACE Rev. 1)	Product category	Production (97) (106 LTL)	Employment (Persons)
20.00	Lumber and wood products	902	14408
21.00	Pulp, paper and allied products	288	3854
22.00	Printing, publishing, media products	460	6411
36.00	Furniture	510	11265

(2) Production record

Production record of the three subsectors is shown in Table 1.7.4. Their production levels in 1997 are far below those in 1992 (immediately after independence); the sawmill industry 57.3%, pulp and paper 35.9%, and furniture 42.9%. The wood product industry as a whole represented only 7% of total output by mining and manufacturing industries. Thus, the industry plays a far less significant role than expected from rich forest resources.

Table 1.7.4 Production of Wood Industry in Lithuania

Industrial Sub-sector	1993		1994		1995		1996		1997	
	(1000 litas)	(%)	(1000 litas)	(%)	(1000 litas)	(%)	(1000 litas)	(%)	(1000 litas)	(%)
Timber & Timber Products										
Production	302995	2.87	441707	4.03	630334	4.39	592317	3.25	NA	
Production Index	60.1		48.2		48.2		54.5		57.3	
Pulp, Pper, Paperboard & their Products										
Production	88272	0.84	143210	1.31	251512	1.75	241697	1.33	NA	
Production Index	32.3		35.9		41.3		38.7		35.9	
Furniture Industry										
Production	283118	2.68	270209	2.47	336492	2.34	439454	2.41	NA	
Production Index	88.0		53.4		43.5		39.8		42.9	
All Industries										
Production	110558846	100	10955890	100	14369925	100	18221095	100	NA	
Production Index	65.3		45.9		46.3		47.9		50.3	

Note: Prouction Index: 1992=100

Source: Statistical Yearbook of Lithuania 1998

There are 452 establishments in the sawmill industry, 19 in the pulp and paper industry, and 174 in the furniture industry. Note that they are mostly small in size, excepting those in the pulp and paper industry. For instance, in the sawmill industry, top thirty manufacturers accounted for 36% of sales and 27% of employment in 1998 (Table 1.7.5).

Table 1.7.5 Activities of Wood Industry Enterprises

	Unit	1996	1997	1998
Sales				
Total Wood Industry	Mill. Litas	1231	1601	1950
30 Biggest Firms	Mill. Litas	532.3	636.5	697.6
Share	%	43.2	39.8	35.8
Employee				
Total Wood Industry	Person	34776	38917	37560
30 Biggest Firms	Person	11852	11382	10156
Share	%	34.0	29.2	27.0
Productivity				
(Annual Sales per Employee)				
Total Wood Industry	1000 Lit.	40.0	41.1	51.9
Wood Processing Industry	1000 Lit.	32.4	38.4	51.1
Paper Industry	1000 Lit.	52.2	66.7	68.0
Furniture Industry	1000 Lit.	32.3	37.6	48.1
Biggest Enterprise	1000 Lit.	44.4	59.0	68.3

Source : Lithuanian Forest-Based Industry, PHARE Project under EC (2000)

(3) Markets

Production share, domestic sales and export ratio of the sawmill, papermaking and furniture industries are shown in Table 1.7.6. The sawmill industry has been exporting an increasing percentage of their products, 68.6% in 1997. On the other hand, the pulp and furniture industries export 46-47% of total products, which remain unchanged in recent years. The high export ratio of the sawmill industry suggests that the industry makes products of standard specifications which have a competitive edge in the export market. The export values of major products are shown in Table 1.7.7.

Table 1.7.6 Sales Structure of Wood Industry

Sector/Sub-sector	Year	Share (%)	Domestic Sales (%)	Export Sales (%)
Total Industry	1993	100.0	46.0	54.0
	1994	100.0	53.7	46.3
	1995	100.0	57.5	42.5
	1996	100.0	50.6	49.4
	1997	100.0	46.7	53.3
Wood Industry	1993	1.2	78.5	21.5
	1994	1.5	64.0	36.0
	1995	1.7	50.5	49.5
	1996	2.8	39.4	60.6
	1997	2.2	31.2	68.8
Paper Industry	1993	1.1	47.8	52.2
	1994	1.5	53.8	46.1
	1995	1.9	60.3	39.7
	1996	1.4	50.0	50.0
	1997	1.4	53.8	46.2
Furniture Industry	1993	2.5	51.6	48.4
	1994	2.3	53.0	47.0
	1995	1.9	54.5	45.5
	1996	2.4	53.5	46.8
	1997	2.0	53.9	46.1

Source : Wood Industry in Lithuania - Overview (1999)

Table 1.7.7 Export Shares of Wood Industry

Sub-sector	1995		1996		1997	
	10^6 USD	%	10^6 USD	%	10^6 USD	%
Logs	53.5	30.1	23.1	11.7	21.9	11.2
Sawn Timber	84.2	47.4	120.3	60.8	105.8	55.3
Plywood	6.9	3.9	8.9	4.5	6.0	3.0
Particle Board	4.4	2.5	9.4	4.8	16.8	8.6
Fiber Board	10.3	5.8	11.0	5.6	10.1	5.2
Other Products	18.5	10.4	25.2	12.6	32.7	16.7
Total	177.8	100.1	197.9	100.0	193.3	100.0

Source : Wood Industry in Lithuania - Overview (1999)

(4) Labor productivity and fixed assets

Labor productivity and assets of the sawmill, papermaking and furniture industries are shown in Table 1.7.8. Labor productivities of the three subsectors are lower than the national average for the mining and manufacturing industries (79150 Litas).

(5) Production of major products

Production trends in major sawmill products in Lithuania, Latvia, Sweden and Finland are shown in Table 1.7.9.

Production record of sawmill products, wood boards, paper and paperboard, match and furniture by major manufacturers in Lithuania is presented in Table 1.7.10~12.

Table 1.7.8 Productivity by Industrial Subsectors (1998)

NACE No.	Economic Subsector	Production		Change in Fixed Assets during 1998			
		per Worker (Litas/Worker)	per Worker/Hr. (Litas /Hour)	Beginning of '98 1000 Litas	Investment in '98 1000 Litas	Depreciated in '98 1000 Litas	End of '98 1000 Litas
C+D	**Mining, Quarrying & Mfg.**	**79.15**	**47.39**	11773778	2083112	800388	13048423
10	Peat Extraction	33.49	19.26	67019	11306	1859	76466
11	Crude Oil Extraction	276.20	152.37	142226	23373	2222	163377
14	Quarrying of Stone, Clay, Sand	81.95	44.80	118129	23538	2790	138877
15	Food and Beverages Production	98.59	56.99	2608241	675408	199029	3084621
16	Tobcco Production	-	-	-	-	-	-
17	Textile Manufacturing	49.59	30.89	1207738	96511	73240	1230793
18	Apparel Manufacturing	50.96	31.94	253312	70018	8958	314381
19	Leather Products Manufacturing	34.62	22.19	143734	21584	10120	155198
20	**Wood & Wood Products Mfg.**	**37.56**	**23.14**	506833	80037	43657	543213
20.1	**Sawing & Sawmill Products**	**35.85**	**22.61**	107027	25234	6090	126171
20.2	**Wood Panel & Board Production**	**52.95**	**31.62**	139802	14373	25437	128738
20.3	**Joinery Products Manufacturing**	**30.10**	**18.47**	123982	25530	7640	141872
20.4	**Wooden Container Production**	**51.12**	**31.49**	116794	9013	2534	123273
20.5	**Other Wood Products**	**22.60**	**13.88**	19228	5887	1956	23159
21	**Pulp, Paper and Paperboard**	**57.01**	**33.04**	262399	29248	17297	271559
22	Printing and Publishing	58.87	31.27	317090	63719	32756	343663
23	Petroleum Refining	-	-	1084089	174240	12890	1245439
24	Chemical Products	163.84	96.57	1214952	148284	49861	1313375
25	Rubber and Plastics products	79.03	45.51	123250	30883	2809	150632
26	Non-metallic Mineral Products	55.37	31.87	784843	288285	178193	894935
27	Basic Metal Products	41.47	23.84	82576	3678	1557	84697
28	Metal Fabrication	46.12	26.66	254743	40723	22916	272550
29	Machinery and Equipment	30.12	20.26	820172	32502	23734	828940
30	Office Machinery and Computors	15.68	9.60	35209	2716	3316	34609
31	Electrical Machinery	90.85	55.53	169458	43598	24839	188217
32	Electronics Machinery	57.92	36.93	453777	49585	24524	478838
33	Medical Equipment & Opticals	55.63	30.81	227695	19525	6605	240615
34	Motor Vehicles	30.52	27.88	53764	1561	4951	50374
35	Other Transport Equipment	67.68	37.39	361117	47398	20117	388398
36	**Furniture Manufacturing**	**42.39**	**24.55**	292472	72434	10490	354416
37	Waste Metal Recycling	99.48	54.07	43215	791	288	43718

Source : Statistics Lithuania 1998 (A400)

Table 1.7.9 Production Import Export Consumption of Sawnwood in Four Countries

(Unit: 1000 cubic meter)

		LITHUANIA					LATVIA					FINLAND					SWEDEN				
	PRODUCT	1993	1994	1995	1996	1997	1993	1994	1995	1996	1997	1993	1994	1995	1996	1997	1993	1994	1995	1996	1997
	Exchange Rate	0.232	0.251	0.250	0.250	0.250	1.506	1.788	1.897	1.816	1.722	######	######	1.308	1.270	1.134	######	######	1.308	1.270	1.134
1	**Sawnwood(C)**																				
	Production	627	700	865	1350	1160	401	750	950	1510	2550	8305	9700	9400	9300	10600	12538	13616	14737	14170	15419
	Import	0	13	19	26	120	2	4	6	2	21	109	153	129	91	176	98	134	155	99	108
	Export	92	273	728	1046	849	254	700	1292	1268	2030	6188	7158	7343	7009	7509	10040	10423	10301	11632	10900
	Consumption	535	44	155	330	431	150	54	-336	244	541	2226	2695	2186	2382	3267	2596	3327	4591	2637	4627
	(Unit Expt Value $/m3)	84.49	104.26	106.54	101.53	109.26	122.32	93.40	99.99	149.14	149.11	174.10	214.65	237.08	208.32	220.41	182.61	226.60	249.26	216.04	229.99
2	**Sawnwood(NC)**																				
	Production	72	60	75	100	90	45	200	350	104	150	70	48	80	70	70	200	200	200	200	200
	Import	0	4	5	8	14	0	1	1	1	4	49	62	52	58	66	76	114	139	115	116
	Export	7	16	39	52	115	20	124	195	164	140	32	49	34	27	26	27	43	38	17	20
	Consumption	65	48	41	56	-11	25	77	156	-59	14	87	61	98	101	110	249	271	308	298	296
	(Unit Expt Value $/m3)	177.71	230.94	149.97	167.48	131.33	141.80	261.85	262.28	186.19	192.86	330.00	355.82	465.53	513.33	517.19	366.41	238.37	188.47	570.29	440.85
3	**Wood-Based Panels**																				
	Production	159	155	156	197	267	187	238	236	281	310	1224	1369	1444	1668	1784	817	833	979	931	930
	Import	1	26	38	45	56	1	6	9	6	11	78	80	99	93	132	370	444	566	521	603
	Export	44	87	105	152	210	74	154	162	226	251	842	969	1021	1156	1199	250	305	365	423	385
	Consumption	116	94	90	91	113	114	91	84	61	70	460	480	522	605	717	936	972	1180	1029	1148
	(Unit Expt Value $/m3)	179.16	202.66	223.67	210.75	170.47	248.91	238.14	276.69	356.32	359.63	524.74	568.89	655.58	551.30	528.89	274.96	298.30	345.11	321.59	357.90
4	**Plywood**																				
	Production	15	15	15	21	30	58	63	73	103	120	621	700	778	869	987	73	85	108	119	113
	Import	1	10	4	6	4	0	1	3	0	1	16	18	22	21	23	98	126	112	135	184
	Export	10	20	19	22	19	41	46	54	92	100	542	626	667	795	861	38	49	63	112	95
	Consumption	6	5	n.a.	6	15	17	19	22	11	21	1	1	1	1	1	133	162	157	142	202
	(Unit Expt Value $/m3)	372.30	392.95	362.63	404.73	299.68	356.59	482.50	486.24	488.54	490.00	686.19	730.00	821.69	665.71	617.94	422.63	449.63	627.94	379.55	444.38
5	**Particle Board**																				
	Production	90	75	70	110	168	101	148	130	143	150	439	477	475	605	603	597	609	632	577	612
	Import	0	12	30	32	42	0	2	5	5	8	13	10	22	13	35	158	186	293	263	287
	Export	16	30	36	72	137	22	92	85	107	120	195	200	224	238	196	128	140	133	147	157
	Consumption	74	57	64	71	73	80	58	50	41	38	257	287	273	380	442	627	655	792	693	742
	(Unit Expt Value $/m3)	67.56	85.30	123.08	130.67	123.01	77.91	96.53	96.09	186.92	183.33	158.69	196.62	263.23	220.84	228.28	178.66	200.88	297.75	258.75	304.80
6	**Hardboard**																				
	Production	-	-	50	45	48	-	-	21	23	27	-	-	74	74	74	-	-	107	106	116
	Import	-	-	1	1	2	-	-	0	0	0	-	-	11	8	10	-	-	41	35	40
	Export	-	-	44	40	37	-	-	18	22	23	-	-	62	56	57	-	-	41	38	27
	Consumption	-	-	7	6	13	-	-	3	1	4	-	-	23	26	27	-	-	107	103	129
	(Unit Expt Value $/m3)	-	-	200.80	225.95	213.11	-	-	144.44	262.45	260.87	-	-	384.11	371.16	350.88	-	-	390.46	402.29	417.54
7	**MDF**																				
	Production	0	0	1	1	1			2					6	6	6			505	490	490
	Import			0	1	1								27	27	34			74	48	47
	Export													4	4	4			4	10	23
	Consumption			2	2	2			2					29	29	36			442	467	612
	(Unit Expt Value $/m3)													476.75	466.00	433.00			280.75	313.20	267.91
8	**Insulation Board**																				
	Production	15	17	15	20	20						38	37	37	40	40	67	55	116	116	76
	Import	0	0	0	2	2						19	11	8	16	17	12	12	12	10	16
	Export	4	2	3	16	14						1	3	3	3	4	48	56	112	104	71
	Consumption	11	15	12	6	8						56	45	42	53	53	31	11	16	22	21
	(Unit Expt Value $/m3)	165.00	224.50	390.33	109.63	143.00						n.a.	n.a.	n.a.	n.a.	n.a.	107.06	106.46	130.40	152.03	160.65

Source : FAO Yearbook Forest Products 1997

Table 1.7.10 Sales of Wood Products by Major Manufacturers

	Name of Manufacturer	Sales Amount		Nos. of Employees	
		1996	1997	1996	1997
		10^6 USD	10^6 USD	Person	Person
1	Klaipedos Mediena	16.4	21.6	1103	1424
2	Grigiskes	18.9	18.6	1512	1364
3	Medienos Plausas	10.1	10.5	534	454
4	Narbutas and Ko	5.9	9.5	245	264
5	Giriu Bisonas	4.7	9.2	207	245
6	Klaipedos Baldai	7.4	7.6	400	439
7	Ochoco Lumber	2.3	7.3	69	89
8	Lietuvos Tara	7.0	7.0	713	554
9	Silutes Baldai	5.6	5.7	770	611
10	Kauno Baldai	5.3	5.2	697	611
11	Silunga	5.4	4.9	279	260
12	Klaipedos Kartonas	5.2	4.7	697	611
13	Voke-III	2.6	4.3		211
14	Staliu Gaminiai	4.4	3.8		326
15	Pajurio Mediena	2.3	3.5	205	204
16	Libra Gruppe		3.2		234
17	Vilniaus Baldu Kombinatas	2.6	2.8	416	344
18	Freda	2.4	2.8	253	259
19	Panevezio Baldai	3.5	2.7	371	280
20	Venta	2.8	2.3	491	455
21	Karige	1.5	2.3	205	238
22	Skraja	2.5	2.2	340	229
23	Siguldos Baldai		2.1		91
24	Vilniaus Mediena	1.7	2.1	113	112
25	Timbex Arima	1.2	1.9	96	122
26	Baldai Jums	1.3	1.9	151	182
27	Sakuona	1.7	1.8	190	302
28	Ukmerges Baldai	2.3	1.7	352	267
29	Azuolas	1.5	1.7	200	115
30	Taurages Tauras	1.6	1.6	213	172

Source : Wood Industry in Lithuania - Overview (1999)

Table 1.7.11 Production of Wood Panels by Major Producers

Manufacturers	Unit	1990	1994	1995	1996	1997
Particle Board						
Klaipedos Mediena	1000 m^3	61.9	72.2	68.5	68.3	84.4
Giriu Bizonas	1001 m^3	129.0	2.7	1.2	42.0	83.5
Total		190.9	74.9	69.7	110.3	167.9
Fiber Board						
Girgiskes	Mill m^2	14.8	14.0	13.6	14.7	15.4
Medienos Plausas	Mill m^3	1.1	1.7	1.5	2.3	2.1
Total		15.9	15.7	15.1	17.0	17.5

Table 1.7.12 Furniture Production by Major 20 Producers

Company Name	Production		Number of Employees	
	1996 10^3 USD	1997 10^3 USD	1996 Person	1997 Person
Narbutas and Ko	5.9	9.5	245	264
Klaipedos Baldai	7.4	7.6	400	439
Silutes Baldai	5.6	5.7	770	611
Kauno Baldai	5.3	5.2	697	611
Voke III	2.6	4.3	n.a.	211
Vilniaus Baldu Kombinatas	2.6	2.8	416	344
Freda	2.4	2.8	258	259
Panevezio Baldai	3.5	2.7	371	280
Venta	2.8	2.3	491	455
Karige	1.5	2.3	205	238

Source : Wood Industry in Lithuania -Overview (1999)

Chapter 2　PULP AND PAPER MARKET

Chapter 2 PULP AND PAPER MARKET

2.1 Domestic Market

(1) Trend of Domestic Market

Pulp and paper production in Lithuania turned upward from 1950, as shown in the Table 2.1.1, and maintained an annual production level of 200 thousand tons until 1991 just before the independence, after it reached the level in the second half of 1970. On the basis of the performance of 1989, Lithuania exported 36% of production to the former Soviet Union and COMECON countries, which means they served as one of the supply bases of uulp and paper in the region.

Production	255000 tons
Consumption	162000 tons
Export	93000 tons

Following the collapse of the Soviet Union, however, the economy and industry of Lithuania was severely damaged due to the deterioration of the economic environment, which is summarized as follows:

a. Slump of economic activity and reduction of consumption caused by the collapse of the former -Soviet economic region and confusion thereof.
b. Collapse of the banking system, turmoil in the foreign exchange system following to the issuance of new currencies by the newly born independent countries, which resulted in the batter economy. in those area.
c. Deterioration of trade activities due to various barriers imposed on export and import by the newly born independent countries.
d. Economic turmoil and financial difficulty in Russia, the largest trade partner of Lithuania, which adversely affected the country’ s balances of payment due to the advance payment requirement for imports from Russia and frequent payment delay for exports from Lithuania.

Under these circumstances, the National economies of Lithuania experienced severe recession, thus consumption decreased and their pulp and paper industries were in severe slump.

Table 2.1.1 Production of Pulp and Paper in Lithuania (1950~1992)

(Unit: 1000t)

Product	1950	1960	1970	1980	1990	1991	1992
Mechanical Pulp	7.5	17.2	23.9	47	38	37.5	20.1
Sulfite Pulp	18.5	30.9	38.2	47	40	32.8	19.8
PULP	**26**	**48.1**	**62.1**	**94**	**78**	**70.3**	**39.9**
Paper	19.5	48.1	102.1	107.9	100.7	101.2	34.9
Board	11.3	35.3	50.3	127.5	116.9	113.3	49.5
Paper and Paper Board	**30.8**	**83.4**	**152.4**	**235.4**	**217.6**	**214.5**	**84.4**

Source: FSDP-MAIN Page 19 Ministry of Industry and Trade Statistic

In 1992, the dramatic changes in the economy and society caused production and consumption of pulp and paper products to plummet, and the industry underwent hard time. While consumption gradually recovered with the subsequent political stability, production failed to show a significant comeback and the growing consumption being satisfied by increased imports, as seen in Table 2.1.2.

Table 2.1.2 Pulp and Paper Production, Export, Import and Consumption (1997~1999)

(Pulp Paper Board) (Unit:1000t)

		Wood Pulp	Waste Pulp	Paper	Board
1997	Production	1.7	24.8	15.2	9.5
	Import	11.4	0.6	76.1	4.1
	Export	11.1	0	25.4	1.6
	Consumption	2.0	25.4	65.9	12.0
1998	Production	1.3	24.3	26.0	11.3
	Import	15.1	0.8	77.1	3.8
	Export	13.0	0	19.6	1.5
	Consumption	3.4	25.1	83.5	13.6
1999	Production	0	36.1	33.8	3.0
	Import	5.9	0.1	67.7	3.8
	Export	3.9	0.1	10.8	1.3
	Consumption	2.0	36.0	90.7	5.5

Source: Ministry of Economy Statistic Data

“ Detail list as per Appendix 1”

(2) Present supply and demand situation

The main products during 1997 ~ 1999 are Jute liner, corrugating medium and tissue paper, all of which were made from wastepaper. The pulpwood pulp production facilities were shut down as can be seen in the description of domestic mills mentioned below.

a. Grigeskes

Founded in 1926, the millproduced 400 tons of fiberboard and tissue paper per month respectively, by using the domestic pulpwood and wood tip for the fiberboard, and the domestic wastepaper and imported wood pulp for the tissue paper. It also produced groundwood pulp..

b. AB Klaipedos Kartonas

Founded in 1898, the millproduced 900 tons of corrugating liner and 3000 tons of medium paper per annum by using mainly the domestic wastepaper. The sulphite pulp plant which was built in 1930 was closed in1994.

c. AB Nahjieji Verkiai

The oldest paper mill, founded in 1860, is currently manufacturing sanitary and household paper like tissue, toilet rolls etc.

d. Medienos Plausas

The mill produces such paper wares as corrugated board, fiberboard and pulp mold. The main product is corrugated board, which accounts for 80% of total production, with monthly production reaching 50 million m^2.

e. Kaunas Paper

Founded in 1932 as an only one printing factory in Lithuania. The mill has an off-coater machine and is capable of producing coated paper. However, it now mainly produces secondary products like notebook, using the domestic waste paper and imported pulpwood pulp from Kaliningrades.

f. Pabrade Cardboard Factory

Founded in 1929, the mill started production of paperboard in 1945, and is currently making book cover using dissolved wastepaper. The production in 1997 was 1690 tons.

The domestic mills which had previously produced more than 250000 tons of pulp and paper per year now produce less than 40000 tons only using the facilities that become obsolete. Under these circumstances, it may be difficult to expect further expansion without the fundamental rehabilitation of production facilities. In the meantime, therefore, it seems to be a logical choice for the mills to continue production using mainly wastepaper and to rely on import for such paper as printing and writing, demand of which is expected to grow steadily.

2.2 Neighboring Markets

(1) Latvia

1) Pulp and paper mills

Before independence, the country had four pulp and paper mills which met domestic demand.

a. Sloka Pulp and Paper

The largest mill in the country produced more than 90000 tons of unbleached sulphite , recycled fiber and groundwood pulp, and 100000 tons of paper and paperboard per year between 1983 and 1987 After 1993, however, the mill was forced to decrease production due to skyrocketed energy costs and was finally closed down in 1996.

b. Ligatne Paper

The oldest paper mill in Latovia commenced operation in 1815. The mill produced 15000 tons of paper products per year by four small paper machines. Production declined after the country' s independence, and now limit to production of small lot operation such as cigarette paper.

c. Jaunciem Paper

The mill produced 16000 tons of paper products per year using two machines. The No.2 machine was suspended in 1992, and the No. 1 machine also discontinued operation in 1993. At present, only one processing line to produce paper sack and facsimile roll is in operation.

d. Jugla Paper

An only state-owned paper mill in the country. Its operation was assigned to Jugla Papers Co. on a rental basis. The mill has two machines to produce 16000 tons of paper altogether and other two machines to produce 8000 tons of paperboard annually. Although the machines are slow and inefficient in energy consumption, they are well maintained and operated in good condition, capable of producing 25000 tons of paper and paperboard annually The mill employs 440 workers.

2) Present position of supply and demand

Production, import and export in the recent three years

(Unit: 1000t)

		Paper & Paperboard	Pulp
Production	1997	16.0	0
	1998	25.0	0
	1999(Est.)	30.0	0
Import	1997	85.0	0.5
	1998	90.0	0.5
	1999 (Est.)	95.0	2.0
Export	1997	10.0	0
	1998	12.0	0
	1999(Est.)	15.0	0

Production, import and export by grade in 1997

(Unit: 1000t)

	Production	Import	Export
Newsprint	3.0	12.5	2.0
Non-coat	1.0	6.7 woodfree	0
“		2.0 mechanical	0
Coat		16.8 woodfree	0
“		2.0 mechanical	0
Waste-fluting	1.0	5.6	0
Corrugated Board	10.0	8.0	4.5
Wrapping	1.0	6.0	0.5
Kraft Liner	0	10.5	0
Tissue	0	5.4	0
Others	0	9.5	3.0
NBKP	0	0.3	0
UKP	0	0.2	0
Total	(16.0)	(85.5)	(10.0)

3) Latvia Pulp Project

On March l, 2000, the Ministry of Agriculture and Forestry entered into a basic agreement with Metsaliitto of Finland and Sodra of Sweden to establish **Baltic Pulp**, a company to prepare for construction of a pulp mill in Latovia. According to Dr. Arnis Treimanis, Technical Director of Pulp Mill Project Group, whom the study team interviewed, the project was originally studied in 1995, when feasibility study was conducted by JAAKKO POYRY under the financial assistance by SIDA (Swedish Development Cooperation Agency). Metsaliitto and Sodra conducted field surveys by themselves during 1998 and 1999, based on which it was decided to establish the joint venture. The project plan will be finalized by December 31, 2002. If the final plan is approved by the parties concerned, construction of 600000-ton kraft pulp mill will start. The major concern for the project is to secure wood supply of 3 million m^3 which are required to produce 600000 tons of kraft pulp annually. At this moment, however, the government has guaranteed supply of s 1.2 to 1.4 million m^3. In addition, the private sector so far promised to supply one million m^3 , but without guarantee. As for the location of the proposed plant, Dr.Treimanis mentioned that Livani will be the No.1 site to be selected. And if so, as the area is close to forest resources of Lithuania, he personally thinks, if any good plan can be worked out for the mutual benefit.

(2) Estonia

1) Present supply and demand situation

At present, three enterprises are engaged in production of pulp, paper and paperboard products after the turmoil in the early 1990. The mills produced 48000 tons of unbleached softwood kraft pulp and 50000 tons of kraft paper and household paper products in1998. The study team visited " Horizon Pulp and Paper Co." the largest mill , in cooperation with the Ministry of Economy and obtained the following information.

The company was originally established as Kehra Paper in 1938, which produced kraft paper for the agricultural use to supply to the entire Soviet Union until 1990. The company terminated the operation due to the economic disorder triggered by the country' s independence and the collapse of the former Soviet Union. In 1995, the mill' s facilities and equipment were bought by Tolaram Group, an Indian owned Singapore-based textile trading company, through the introduction of the Ministry of Economy. The mill was reopened in 1996 and run steadily thereafter as follows.

Product types: Sack Kraft Paper(integrated production from UKP)
Tissue Paper (waste pulp)

	1996	1997	1998	1999	2000(p)	2001(p)	2002(p)
Production (t)	19486	34350	42525	45000	47433	56100	61050
Export (1000 USD)	8200	16820	21450	22960	-	-	-

Note: 1USD =14.5EEK
(p) = plan

Export Area (in 1999)	USA/Europe	Asia	Africa	Others
	47%	29%	5%	19%

2) Forest resources and utilization

Forest area : 2 million ha..
Maximum annual removal : 7.81 m^3
Net annual increment of exploitable forest : 10 million m^3 (60% softwood, 40% hardwood)
Actual removal (1998) : 6.1 million m^3
Export of roundwood : 3.8 million m^3 (Pulpwood 2.7 million m^3)
Destination (1997) : Sweden (56%), Finland (22%), Norway (12%), Others (10%)

3) Pulp mill project

The study team interviewed officials of the Ministry of Economy and felt that the government is eager to invigorate the national economy by building and operating a pulp mill in cooperation with a foreign capital and engineering.
In the special incentive package which the government prepared to attract foreign investors, it was mentioned as follows:

“ It will be feasible but probably not the best solution to meet the whole demand of the pulp mill by exploiting Estonian sources because the proposed pulp mill will be located in the the area where no pulpwood consuming industries are located closely
Demand for pulpwood in the neighbor countries is small. At the moment competition for pulpwood is low especially in Russia and Belarus due to the lack of processing industry. Also, part of the existing export flow from these regions to the Scandinavian countries and limited amounts to other countries via

the Russian ports might favor an Estonian pulp mill due to shorter transport distances.

Substantial volumes of pulpwood are harvested annually in the neighboring areas of Estonia. The bulk of the annual pulpwood harvested in the neighboring area can be imported to Estonia. Some of the Scandinavian pulpwood imports are already now being transported through the Estonian territory and it could be re-routed to secure the wood supply of the planned pulp mill.

The neighboring regions (Leningrad, Novgorod and Pskov Oblasts, Belarus, Latvia and Lithuania) produce 6.5 million m^3 of coniferous pulpwood and 3.3 million m^3 of deciduous pulpwood. Within the next five years the annual pulpwood yield is expected to grow by 2.4 million m^3 in softwood and 3.2 million m^3 in hardwood.

There is a huge potential of wood raw material, and for economic reasons, there is strong public pressure to utilize forest resources within the wood procurement region of the proposed Estonian pulp mill."

(3) Poland

Production, Import, Export, Consumption

(Unit:1000t)

		Production		Import		Export		Consumption	
		1997	1998	1997	1998	1997	1998	1997	1998
Newsprint		80	92	26	18	45	36	61	74
Coated	Woodfree	0	0	172	197	4	5	168	192
"	Mechanial	0	0	69	80	0	0	69	80
Uncoated	Woodfree	386	410	59	49	230	198	215	261
"	Mechanial	84	91	126	154	7	10	203	235
Sanitary &	Household	160	150	24	30	40	50	144	130
Other Paper		8	7	10	11	6	7	12	11
Corrugated Board		497	510	168	171	143	153	522	528
Wrapping paper		238	263	10	12	105	110	143	165
Other boards		187	188	90	90	35	36	242	242
Paper&Board Total		1640	1711	754	812	615	605	1779	1918
Pulp	BKP	341	350	152	154	59	47	434	457
	UKP	319	353	6	7	1	0	324	360
	BSP	0	0	20	10	0	0	20	10
	USP	0	0	1	0	0	0	1	0
	SCP	78	71	0	0	0	0	78	71
	Mechanical	102	103	5	6	0	0	107	109
	DP	43	43	5	5	32	26	16	22
Pulp Total		883	920	189	182	92	73	980	1029
(Market Pulp)		120	120	189	182	92	73		

Source P.P.I.

Re: According to supplemental information of P.P.I., Frantschach Swiecie, the sole manufacturer of DP pulp in Poland, terminated production in February 1999 by closing down the 43000-ton mill.

Krapkowice decided to shut down a 35000-ton UKP production in April 2000.

The major reason for closedown of the two mills is loss of competitiveness..

Foreign investment trends

Foreign direct investment has been rapidly growing since 1994 as follows:

(Million USDUSD valued at the year end)

1994 : 4300

1995 : 6800

1996 : 12000

1997 : 20600
1998 : 30800

Major investing countries at the end of 1998
(Million USDUSD)

Germany	:	5100
USA	:	4900
France	:	2400
Italy	:	2000

Foreign investment in the polish pulp and paper industry (as of the end of 1999)
(Million USA)

Investor	Country	Amount	Type of Industry (Name of Mill)	
International Paper	USA	465	Pulp and Paper	(Kwidzyn SA / Klucze SA)
Framondi NV	Austria	175	-ditto-	(Frantsch Swiecie SA)
Intercelulosa AB	Sweden	108	-ditto-	(Intercell SA)
Trebruk AB	Sweden	72	-ditto-	(Kostrzyn SA)
Kappa Packaging	Netherlands	45	Packaging paper	

In addition, foreign investment has been made for about 20 local mills.

Summary of the interview with the Polish Pulp and Paper Research Institute
(Mr. Piotr Stanislawczyk, Director)
The country ranks the seventh in land area in Europe (313683 km^2) and the sixth in population (38.7 million). The economy has been growing steadfastly since 1992 as follows.
GDP growth rates; 1993 (103.8%) 1994 (105.2%) 1995 (107%) 1996 (106%) 1997 (106.9%) 1998 (104.8%)

The country' s paper consumption is 50 kg per capita, which is extremely small among the industrialized countries in West Europe. Concurrentlywith the growth of GDP, consumption of paper has been increasing year after year to require further expansion of production facilities. For this reason, the government and the private sectors concerned are looking for foreign investment, but don' t proceed as expected. Instead, imports increase to meet the growing demand.

2.3 World Market

(1) General market trends

In 1998, production and consumption of pulp, paper and board decreased in Asia and North America as the financial crisis occurred in Thailand and Indonesia in the third quarter of 1997 and the economic recession of East Asia, i.e. Japan and South Korea. On the other hand, Europe experienced firm growth. Production exceeded 82 million tons of paper and board, an increase of 3.1% over 1997, that represents an all time record.

From the second quarter of 1999, the market condition improved to real growth all over the world. In particular, paper and board production in the major producing countries and regions at the end of 1999 grew as followsUSA (2.2%), Canada (8%), Europe (3.0%), Japan (2.5%)

The figures for the first quarter of 2000 continued to show positive growth. Many countries expect the " millennium effect" which hopefully boost demand in both the graphics sector with an increase in publishing worldwide and the packaging sector with increased consumption of packaged goods.

(2) Production Trend

Wood pulp Production in the World (1985 - 1999)

(Unit:1000 t)

Region	1985	1990	1995	1998	1999	1999/1998 (%)
CEPI	28870	31682	33967	37986	38201	0.6
Russia	9834	10081	4863	3993	4750	19.0
USA	48296	56397	59909	58376	57074	-2.2
Canada	20040	22839	25442	23642	25387	7.4
China	8796	13325	24571	18211	16425	-9.8
Japan	9040	11151	10980	10838	10911	0.7
Indonesia	221	786	2022	3430	3800	10.8
Brazil	3648	4364	5845	6720	7204	7.2
Chile	836	804	2113	2210	2434	10.1
South Africa	788	1564	1547	1845	2118	14.8
Australia	898	1047	1010	949	872	-8.1
Others	10501	11850	11134	8421	9952	18.1
WORLD TOTAL	141768	165890	183403	176621	179128	1.4

Source: CEPI ANNUAL STATISTICS 1999

Paper and Paperboard production in the World (1997 - 1999)

(Unit:1000 t)

Region	1985	1990	1995	1998	1999	1999/1998 (%)
CEPI	48638	61486	73330	82789	85241	3.0
Russia	10031	10718	4070	3664	4467	21.9
USA	60959	71965	81000	75812	77480	2.2
Canada	14448	16466	18705	18724	20208	7.9
China	11197	17328	24000	32053	29608	-7.6
Japan	20469	28088	29663	29886	30631	2.5
Indonesia	500	1438	3429	5487	6977	27.2
Brazil	4022	4844	5856	6524	6889	6.4
Chile	385	462	557	642	796	24.0
South Africa	1489	1904	1871	2047	2041	-0.3
Australia	1546	2011	2297	2542	2540	-0.1
Others	19257	23412	32302	33388	48831	16.3
WORLD TOTAL	192941	240122	277080	293558	315709	7.5

Source: CEPI ANNUAL STATISTICS 1999

Production Increase/Decrease of Paper & Paperboard (1998:1999)

(Unit: %)

	CEPI	AF&PA	CPPA	Japan Paper Association
Newsprint	3.1	−0.9	7.3	0.9
Uncoat Mechnical	- 1.6	−3.8	17.2	−5.4
Uncoat Woodfree	2.3	1.7	5.6	1.5
Coat	4.8	2.5	1.3	8.4
Sanitary & Household	4.9	n.a.	5.9	2.5
Wrappings	2.0	n.a.	−3.5	−2.3
Boards	2.6	2.6	6.4	1.7
TOTAL	3.0	2.2	8.0	2.5

Source: CEPI Annual Statistics 1999

CEPI : Confederation of European Paper Industries

AF&PA : American Forest and Paper Association

CPPA : Canadian Pulp and Paper Association

JPPA : Japan Pulp and Paper Association

Source: Attached sheet No.7: Newsprint/Printing & Writing Paper Production by Region from 1990 to 1999

Attached sheet No.8: Paper and Pulp---Production, Import, Export and Apparent Consumption of Major Countries (97/98)

(3) Sales Price Trend

Market pulp prices (NBSKP:Northern Bleached Softwood Pulp) which reached a bottom at USD360 per ton (C&F) at the fourth quarter of 1985 turned up ward continuously to the level of USD830 at the second quarter of 1989 and maintained till the second quarter of 1990. As it is shown in the Appendix9, it started to fall to the level of USD500 in September 1991 and recovered to USD600 in June 1992, and again started to fall from December 1992 to hit below USD400 in September 1993.

The cause for such abrupt fluctuation of prices might be explained on the basis of the statistic data issued by CPPA(Canadian Pulp and Paper Association), the largest manufacture of market pulp in the world, as per Reference Tables 1998.

1. World production capacity (152 million tons/1985 increased to 189 million tons/1998)
2. World production (132 million tons/1985 increased to 159 million tons/1997) Please refer to the Appendix 2
3. Production of sulphate pulp (108 million tons/1997=68%) Appendix 3
4. Out of total production, integrated pulp (that is produced for use as raw material in production of paper at the same mill) occupies a larger portion, and a portion of so called " market pulp" is about 23 million tons on the basis of 1998 performance. Appendix 6
5. Production capacity of market pulp (27 million tons/1985 increased to 41 milliontons/1998) which means excess capacity, though it may include some obsolete and un-economical machines. Appendix 5
6. The overall production capacity is 189 million tons against the actual production of 159 million tons in 1997, which means excess capacity even in the integrated pulp sector too. Appendix 2 (It also includes inefficient machines too)
7. Under such constitution of excess production capacity, when an accumulation of inventory in the world market exceeds over a certain level, the market price starts to fall due to the lack of new orders, and the mills are forced to curtail production.

In addition to the inadequate operation, profitability is affected by the collapse in market pulp prices and the resultant softening of paper prices. When a level of inventory is adjusted below normal line, the operating rate and price tends to recover.

However, sooner or later good profitability attracts full operation and investment in new machines which can lead to another period of overcapacity. That is why paper and board is called as a cyclical business. The above trend might be seen from the Appendix 10, " Chemical market pulp operating rates by quarter" and " Inventories by month" . Reached the historical high at Northern BSKP USD1000 and BHKP USD865 in October 1995, market pulp prices continued to fall in three consecutive years (1996 ~ 1998) down to a USD400 level. The prices turned upward in second quarter of 1999 as a result of the vigorous curtailment of operations and closure of several mills by mainly the North American producers. The price of BSKP is said to be around USD720 at the third quarter of 2000.

In addition to the unstable situation of the pulp market, the paper and paperboard industries continued to suffer from overcapacity which pushed prices down, in some cases dramatically, eroding company profitability. International Paper, the No.1 company in the field of paper manufacturing in USA, suffered a net loss of 80 million USD in 1997 partly because of economical confusion in east Asia. In Japan, Oji paper , the largest maker in Japan, also suffered a net loss of 30 million USD in the accounting year ending March 1998 due to severe deterioration of almost all grades of paper prices.
In the Pulp and Paper Statistics 1999, the Japan Paper Association explained the situation as follows;

【The Pulp and Paper Industry —supply and demand imbalance, deteriorated profitability due to price erosion —Back in 1997, paper and paperboard production and shipment reached record highs despite the slowdown of the economy. As the economy began to turn downward in 1998, and more definitely toward the end of the year, the paper market also started to show clear sings of decline. In the face of stagnant domestic demand, both production and shipment dropped sharply with the inventory increasing higher than the normal level. The oversupply market, deflationary climate and pressure from users made the market prices push down through out the year and this price erosion became the primary factor to worsen the corporate profitability.】

From the second quarter of 1999, the prices began to turn upward following the recovery of the pulp market, improvement of supply and demand balance

due to picking up of demand in the fields of printing paper and container board with most probably the millennium effects.
This favorable situation is now deemed to last long as very little new production capacity is expected within the next few years among the major pulp and paper producing countries.

(4) Demand Forecast

Mr. John Dillon, Chairman and Chief Executive Officer of International Paper mentioned in the opening article of 1999 Annual Report as follows;

【Market fundamentals are extremely promising. Demand for our products is strong, the supply is well balanced with demand within our industry, and importantly very little new production capacity is expected within the next few years. The U.S economy remains healthy, Asia continues to recover and Europe is rebounding strongly.】

Finnish Forest Industries Federation mentioned in their book " Key to the Finnish Forest Industry 1998" as follows:

【Long range forecast indicate continuing growth in world demand for forest products. Consumption of paper and paperboard is expected to increase at an average annual rate of **2.5 per cent up to the year 2010.** The average annual rate of growth in European consumption is forecast to be below 2 per cent in the same period. The strongest growth will be in consumption of printing and writing papers.】

Demand for paper and paperboard in major countries is moving as follows;
In North American countries, it turned upward month by month after hit the bottom in the fourth quarter of 1998, and keeps it's trend on.
In European countries under CEPI, the figures for the first quarter of 2000 confirm that the latter part of last year's upswing in output has been more than maintained into the new year with an 8% increase in total paper production over the first quarter of 1999. Especially, demand for coated woodfree expanded largely.
In Japan shipments in 1999 rose 2.5 percent for the domestic market, which was greater than the overall economic growth. The direct cuuses for the increase in shipments and production were the increase in advertising expenditures in

anticipation of the economic recovery as well as the increase in sales of information and communication equipment, which posted the record high. Printing paper and ultra light weight coated paper were benefited most, the shipment of which increased over 9 % while total paper shipment increased 3.2% than the previous year.
As for South Korea, after the severe recession in 1998, the economy recovered drastically during 1999 with the results that the shipments rose 18.8% for the domestic market and 6.5% for the export, thus brought production up by 14.5% than the previous year.
In Taiwan, although a tempo of recovery is sluggish due to a major earthquake, shipments rose 5.3% for the domestic market and production increased 3% than the previous year.

Market pulp supply in international trade became tight in the middle of 1999, chiefly because the recovery of paper and paperboard demand and production in such major markets as Asia, Europe and North America. It is also considered partly because the decrease of supply caused by shutdown of uneconomical mills in the North America due to strict environmental protection regulation and persistent price deterioration, and the withdrawal of Indonesia from pulp exports following the completion of Pulp and Paper Integration.
Under these circumstances, market pulp prices prices in the international market turned upwards as mentioned in the Appendix 9 and the inventories being decreased rapidly.

The consensus view, therefore, appears to be brighter expecting further expansion of demand in paper and paperboard, and recovery of profitability as a whole.

For reference: see Appendix 11 Forecast of Pulp, Paper and Board Production Capacity Expansion by FAO, Appendix 12 Production of Paper and Board in West Europe and in Other Main Countries (1990 – 1999)

2.4 Market Trend of European Major Countries

(1) General Market Ttrend (CEPI countries as a whole)

The variation of market situation after 1995 in the European Paper Industries were as follows.

1995: Strong booking which led to an increase in paper and board production of almost 7% in the first half of the year, evaporated during the summer, forcing many machines to stop so that production collapsed by almost 10% in the 4th.quarter, giving only a marginal increase of 1.2% in output for the year as a whole. The price of market pulp jumped up to USD1000 (Northern BSKP).

1996: The low activity seen in the second half of 1995 continued into 1996 resulting in a sharp decline in production until the end of June and a strong recovery during the summer months, continuation until the end of the year, giving a slight decrease of yearly production by 0.7%. The price of market pulp turned down abruptly to USD520 in April.

1997: The industry returned to a consistently strong performance in 1997. Paper and Board production in 1997 reached a new record level of 80.3 million tons. Trade was particularly active, with both exports and imports (including Intra CEPI trade) showing strong increase of 13.8% and 12.3% respectively over 1996. Production of pulp for papermaking was also increased by 9.2% and the apparent consumption rose by 8.3%. The price of market pulp moved up and down in the line of USD600 and finally settled at USD580 at the end of the year.

1998: Following a successful end to the previous year, the industry began 1998 on a high note with record first quarter pulp and paper production figures The momentum carried through to half year a total year-on-year increase running at over 5%. Unfortunately this rosy picture was blighted somewhat during the latter months of the year. Nevertheless, by the end of 1998 the member countries of CEPI had produced over 82 million tons of paper and board, an increase of 3.1% over 1997. The price of market pulp turned down again to the level of USD460 at the end of the year, in spite of production curtailment by the mills, but due to slow down of the economies in Asia and supply and demand unbalance remained in the North America.

1999: Began with the trend of dull movements at the latter parts of the previous year, the fall was arrested during the spring months and completely reversed by the end of the year.

In 1999, the industry produced 85.2 million tons of paper and board, an increase of 3.0% over 1998 as follows, and this represents on all time record level of output.

	1999 (1000t)	1998 (1000t)	Change (%)
Newsprint	10434	10116	3.1
Uncoated mechanical	5723	5816	-1.6
Coated mechanical	7996	8071	-0.9
Uncoated woodfree	9471	9257	2.3
Coated woodfree	9402	8529	10.2
Sanitary & Household	5033	4796	4.9
Case materials	19320	18620	3.8
Folding boxboards	6993	6926	1.0
Wrappings	3518	3448	2.0
Others for package	3639	3643	-0.1
Others	3712	3567	4.1
TOTAL	85241	82789	3.0

Wood pulp for papermaking production increased marginally over 1998 (+0.6%) to 38.2 million tons. As with paper and board, this figure represents a record level of output. The majority of pulp imports from outside the CEPI (7.2 million tons) came from North America (61%) and a further 26% from Latin America.

The price of market pulp turned upwards from the second quarter and settled at USD600 at the end of the year.

Source: CEPI Annual Report from 1995 to 1999

(2) West European and Scandinavian Markets

① Paper and Paperboard Production（1999）

(Unit: million tons)

Germany	16.7 (20%)
Finland	**12.9 (16%)**
Sweden	**10.1 (12%)**

France	9.6 (12%)
Italy	8.6 (10%)
U.K.	6.6 (8%)
Spain	4.4 (5%)
Austria	4.1 (5%)
Netherlands	3.3 (4%)
Norway	2.2 (3%)
Others	4.6 (6%)
Total Production:	**83 (100%)**

② Wood pulp Production （1999）

(Unit: million tons)

Finland	**11.6 (32%)**
Sweden	**10.7 (30%)**
France	2.6 (7%)
Norway	2.3 (7%)
Germany	1.9 (5%)
Portugal	1.8 (5%)
Spain	1.7 (5%)
Austria	1.5 (4%)
Others	1.7 (5%)
Total Production:	**35.8 (100%)**

Source: CEPI

③ Paper and Paperboard Capacity in Western Europe by OWNERSHIP (1999)

(Unit: million tons)

Finish Companies	**27**
Swedish “	**13**
Norwegian “	4
Other European “	41
Non-European “	7

Source: Finish Forest Industries Federation, FAO

Total Capacity	**92**

④ Location of Paper and Paperboard Capacity owned by **FINNISH Companies (2000)**

(Unit: million tons)

in Finland	14.3 (46%)
in Germany	5.2 (17%)
in Sweden	3.8 (12%)
in North America	2.6 (8%)
in France	1.6 (5%)
in U.K.	1.2 (4%)
in Other Europe	1.4 (5%)
in Other Countries	0.7 (2%)
Total Capacity	**30.5**

Source: Finish Forest Industires Federation

⑤ Wood pulp Production by CEPI countries, Finland and Sweden

(Unit:1000 t.)

	1990	1995	1996	1997	1998	1999
CEPI Total	32540	34263	32680	35886	36512	36749
Finland	8886	10088	9692	11088	11355	11579
Sweden	9913	10186	9847	10496	10548	10695
% of Finland	27.3	29.4	29.7	31.1	31.1	31.5
% of Sweden	30.5	29.7	30.1	29.2	28.9	29.1

The above data indicate that Finland and Sweden have strong influence in the world pulp and paper industries as investors as well as supply sources of raw materials and products.

(3) Notes on major producing countries

① Finland

a. Position of Forest Industry in the Export Sector (1999)

Total value 232.6 billion FIM (100%)

1 Forest industry (29%)
2 Electronics and electric industry (28%)
3 Basic metal industry and engineering (25%)
4 Chemical industry (10%)
5 Textile and clothing industry (2%)

Other (6%)

b. Current State of Forest Industry in Finland 1999

PRODUCT	Production	Exports	No. of Plants
Paper industry (mill tons)	10.3	9.4	28
Paperboard industry (mill tons)	2.6	2.2	14
Pulp industry (mill.tons)	11.6	1.9	43
Market pulp	2	1.8	14
Sawmilling industry (mill.m^3)	11.7	8.4	170
Plywood industry (1000 m^3)	1076	939	16
Particle board industry (1000 m^3)	439	183	3
Fibre board industry (1000 m^3)	96	62	2

c. Domestic and Overseas Production Capacities

PRODUCT	in Finland	Abroad	Total
Paper and Board (mill.tons)	14.1	13.4	27.5
Pulp (mill.tons)	13.5	6.8	20.3

As seen above, the forest industry is the largest and most important industrial sector in the country and is moving toward consolidation through merger and acquisition between major manufacturers, including Swedish ones (as seen in the Stora-Enso deal), in an attempt to align themselves with the integration of Europe, as seen in the establishment of the EU, and growing competition in the international market as a result of the increasingly globalized economy. At present, the industry in Finland is dominated by the following three groups.

	Turnover in 1999 (billion FIM)	
Stora Enso Oy	63.2	(36.7%)
UPM-Kymmene Oy	49.1	(28.5%)
Metsaliitto	33.9	(19.7%)
	Total Turnover 172	(in Finland 100)
		(in abroad 72)

Overseas, they have acquired 22 paper manufacturers in West Europe, 3 in North America, 1 in Latin America, and 1 in Asia (as of 1998).

The aggressive moves apparently are aiming for industrial restructuring to end a vicious cycle of excess capital investment and oversupply which has traditionally been prevailing in the industry, similar to aggressive M&A

activities of North American companies, such International Paper and Weyehaeuser.

d. Product sales and distribution channels

Before joining the EU, the country promoted exports through two cooperatives, FINCELL and FINPAP, which were dissolved in 1995 when the country obtained the EU membership. Since then, individual paper manufacturers have been managing their own sales organizations by establishing local sales companies in major markets for direct sales to major customers, in addition to the use of local sales agents and distributors.

e. General view of the pulp project in Lithuania

Finnish paper makers believe that the world pulp production capacity is on the oversupply side, including North and South Americas and seem to oppose a new mill project in the short- and medium-terms. At the same time, they have strong interest in forest resources in the Baltic region due to geographical proximity and expect that the need for new capacity will arise as standards of living in the Middle East and Africa rise with increasing political stability. On the other hand, they are pessimistic about political stability and economic recovery in Russia and the CIS countries and are thus reluctant to investment in the region. Finally, they show general interest in the Chinese market because of political and economic stability.

Reference： Attached Sheet No.13 Finish Pulp,Paper and Paperboard Production from 1989 to 1998

Production and Delivery of Market Wood pulp from 1995 to 1998

Attached Sheet No.14 Delivery of Market Pulp per Country

② Sweden

a Position of Forest Industry in the Export Sector (1999)

Total Value : 701 billion SEK

1 Electronic goods and computers (22%)
2 Other engineering products (21.5%)
3 Forest industry products (13.4%)
4 Motor vehicles, automotive partsautomoative parts (12.4%)
5 Other chemical products (5.7%)

6 Pharmaceutical products (4.7%)
7 Iron and steel (4.6%)
Others (15.7%)

b. Pulp and Paper Production in Sweden

Production Capacity

Paper and Board (Mill. tons)	10.9
Pulp	11.4

c. Production of Paper and Paperboard Production Trends

(Unit: 1000t)

	1996	1997	1998	1999
Newsprint	2283	2411	2478	2508
Printing and writing				
Mechanical paper	752	915	1012	1042
Woodfree coated	527	569	541	556
Woodfree uncoated	892	975	992	1019
Tissue paper	297	292	299	294
Corrugated Material				
Kraftliner	1506	1516	1475	1563
Others	404	454	435	477
Paperboard for Packaging	1456	1531	1565	1484
Wrapping paper				
Sack paper	501	536	541	573
Others	379	410	413	430
Other paper and paperboard	22	147	128	125
TOTAL	9019	9756	9879	10071

d. Pulp Production Trends

(Unit: 1000 t)

	1997	1998	1999	(For the market) 1997	1998	1999
Mechanical	2959	3026	3029	321	322	356
SCMP	266	236	257	0	0	0
Sulphite	720	688	656	292	294	311
BSKP	3382	3360	3428	2241	2240	2293
BHKP	1189	1223	1303	442	459	529
UKP	1982	2016	2020	113	96	58
TOTAL	10498	10549	10693	3409	3411	3547

Source: Swedish Forest Industries Federation

e. Restructuring efforts of the Swedish pulp and paper industry and capital spending

   In 1998, STORA in Sweden and ENSO in Finland agreed on the mega-merger deal (the new company will be headquartered in Helsinki, Finland). Then in 1999, two Swedish companies, MODO and SCA, agreed to merge their woodfree paper production and sales departments to form a joint venture. The deal gave birth to the third largest woodfree paper manufacturer in Europe (USD2.2 billion in annual sales and 6000 employees), next to STORA/ENSO and UPM/KYMMENE. The new company’ s production division will reportedly be controlled by SCA and the sales division by MODO. As for capital spending by Swedish pulp and paper companies, it peaked out in 1996 and has been gradually on the decline. In 1999, capital expenditures totaled 6.4 billion SEK, all of which were spent for maintenance and refurbishment of existing facilities and equipment, while new mill construction including any plan was not seen.

d. Product sales and distribution channels

   Swedish companies have their own sales companies in major markets for direct sales to major customers, and local agents and distributors in other countries. For instance, SODRA, the largest maker, has subsidies in the U.K., Germany, France, the Netherlands and Norway, and use Northern Pulp Company in Spain and the Netherlands. Paperboard makers, such as AssiDoman and Korsnas have corrugated board, sheet or sack plants in major market to build up integrated production systems from pulp, paper to processing. They also have sales offices in major markets including the U.K., Germany and France for extensive marketing activities including final products.

e. General view of the Lithuanian pulp project

   As they have already committed to the Latvian project, they show no interest in the Lithuanian project.

③ Germany

Paper, Paperboard, Pulp Production and Trade Statistics

a. Paper and Paperboard (Unit: 1000t)

	Production			Import		Export	
	1997	1998	1999	1997	1998	1997	1998
Newsprint	1618	1630	1644	1286	1316	641	561
Printing & Writing							
Uncoat Woodfree	1480	1371	1376	955	1097	783	799
" Mechanical	1449	1531	1398	896	886	605	595
Coat Woodfree	1620	1651	1993	732	870	1537	1541
" Mechanical	1657	1899	1972	925	863	1185	1196
Sanitary & Household	890	931	954	126	111	108	107
Corrugated sheet	3442	3475	3590	1469	1511	1459	1374
Other packaging	2665	2667	2589	1332	1219	1177	1121
Other paper & board	1109	1155	1170	137	120	166	154
TOTAL	15930	16310	16686	7858	7993	7661	7448

b. Wood pulp

	Production			Import		Export	
	1997	1998	1999	1997	1998	1997	1998
KP	0	0	0	3510	3529	158	135
SP	738	759	706	170	156	218	194
SCP	0	0	0	96	99	5	3
Mechanical	1220	1191	1192	54	37	12	8
Other Pulp	0	0	0	12	16	12	4
TOTAL	1958	1950	1898	3842	3836	404	342
(Market Pulp)	242	225	n.a.	3842	3836	404	342

Source: P.P.I., CEPI

Germany is the largest producer and the largest market in Europe, active in both export and imports, mainly within the region. The country attracts foreign investors who seek to establish production bases. In particular, Finnish pulp and paper manufacturers own more than 30% of production capacities in Germany (17 million tons).

In 1998, paper and paperboard production in Germany grew 2.4% on an annual basis, despite a slowdown in the second half. It also recorded a 2.3% increase in 1999, based on CEPI’ s preliminary figures. In particular, woodfree coated paper showed notable growth.

<Industrial restructuring and capital spending>

Previously, Germany did not have kraft pulp production facilities and totally depended upon imports. Last year, Mercer International converted a 160,000-ton sulphite pulp mill in Rosenthal to a bleached software kraft pulp (BSKP) production facility with design capacity of 280000 tons by investing USD348 million. The renovated mill started commercial operation as the first market kraft pulp production base in the country. Mercer initially planned to sell the mill to the Metsaliitto MetsaSerla Group in Finland. After the failed negotiation, the company decided on renovation. In addition, it reportedly has a plan to install a batch digester and boost production capacity to 550000 tons per year, although the Pulp and Paper Industry Association (VDP) holds a negative view and expects that the Rosenthal mill will eventually be sold to the Metsa Group.

c. General view of the Lithuanian pulp project

The VDP is negative about investment in the new BSKP mill project with financial burdens and management commitment, although it has general interest in the Lithuanian project. As Germany has close relations with Scandinavian countries, it is watchful for the moves in the region, particularly Finland.

④ France

Paper, Paperboard, Pulp Production and Trade Statistics

a. Paper and Board (Unit: 1000 t)

Production	1988	1995	1996	1997	1998	1999
Newspring	374	890	783	909	922	1098
Printing and Writing	2486	3186	3141	3351	3102	3252
Sanitary and Household	298	488	508	535	514	535
Case Materials	1867	2641	2724	2912	3193	3196
Wrappings	466	414	389	428	418	387
Carton Board	606	741	730	733	737	809
Other Paper and Board	217	256	256	276	275	326
TOTAL	6313	8616	8531	9144	9161	9603
(Production Capacity)	6550	9620	9805	9960	10140	n.a.
Import	3737	4655	4772	5507	5808	n.a.
Export	1965	3639	3921	4322	4287	n.a.
Apparent Consumption	8085	9633	9382	10330	10682	n.a.
Per capita (kg)	144.4	165.4	160.4	175	175.4	n.a.

b. Pulp

Production	2191	2819	2516	2831	2677	2592
Import	1744	1872	1944	2060	2052	n.a
Export	407	417	362	510	515	n.a
Number of Mills						
Integrated	16	15	14	14	14	n.a.
Market Pulp	5	5	6	6	6	4

Source: COPACEL (Confedertion de l'industrie Francaise des Papiers, Cartons et celluloses)

The French economy started to recover in 1997. In 1998, GDP showed the highest growth rate of 3.2% in the EU (2.8% on average) and the economy is considered to be strongest in West Europe. Paper and paperboard production also reflected the favorable economic condition and registered the highest growth rate of 7.2% in 1997. In 1998, it kept moderate growth of 0.2% in 1998 and soared 4.8% in 1999 (preliminary figures). On the other hand, pulp (NBSK) prices for papermaking dropped from USD610 in the fourth quarter of 1997, to USD520 in the first quarter of 1998 and USD460 in the yearend. In 1999, however, inventory levels declined worldwide, and together with increased paper production, to bring the price upward in the second quarter.

c. General view on the Lithuanian pulp project

In France, there are four market pulp manufacturers, and two are partly owned by Scandinavian companies. Naturally, they show cautious and cold reactions to a new mill project by reflecting their parents' view to look for market stability.

On the other hand, the Lithuanian project receives attention, with some expectation, from non-integrated mills which do not have their own pulp production facilities and manufacture paper and paperboard products by purchasing market pulp, as well as importers and distributors, because they feel alerted by the growing wave of industrial consolidation, led by M&A activities involving large paper companies in North America and Scandinavia, accompanied by increased integration from raw material to papermaking, and expansion of direct sales channels.

On June 22, the study team met Mr. Freville, honorary president (former president) of the AAPPT (Agent Association of Pulp and Paper Traders) and received various materials (presentation of John Claes). It is recommended to contact him from time to time to collect relevant information.

⑤ The U.K.

Paper, Paperboard, Pulp Production and Trade Statistics

a. Production of Paper and Paperboard (Unit: 1000 t)

	1991	1992	1993	1994	1995	1996	1997	1998	1999
Newsprint	671.8	699.8	741.3	769.2	873.3	975.7	1030.3	1045.5	1070.5
Printing and Writing	1478.1	1568.6	1587.9	1732.3	1733.8	1729.8	1752.2	1742.4	1745
Sanitary and Household	455.4	473.1	543.6	557.5	566.9	596.1	638.5	634.5	718.3
Corrugated case Mat.	1364.4	1381.1	1368.8	1559.5	1667.9	1690.6	1754	1760.2	1812.9
Packaging Papers	89.4	92	151.3	158.7	147.4	149.8	155.1	159.8	140.6
Packaging Boards	652.2	669.9	689.6	707.7	718.5	686.2	708.2	670.4	573
Other Paper & Board	239.8	243.6	318.9	358.2	385.1	396.5	441.4	463.8	514.7
TOTAL	**4951**	**5128**	**5401**	**5843**	**6093**	**6225**	**6480**	**6477**	**6575**

In 1998, production declined slightly due to a slowdown in the second half. It declined 2% in the first quarter of 1999, but showed a strong recovery in the second quarter. On an annualized basis, it grew 1.5% and went over 6.5 million tons for the first time in history. Product-wise, coated printing and writing paper exceeded the uncoated one, and mechanical paper outperformed woodfree. Production of packaging paper (wrapping paper grade) and packaging board (grey board) declined due to the mill shutdowns between the second half of 1998 and the first half of 1999.

Industry Structure

1999 Capacity of Paper and Board	Number of Mills	% of Total Capacity	
0 - 10000	22	102761	(1.5%)
10001 - 25000	21	365055	(5.2%)
25001 - 50000	18	634395	(9.1%)
50001 - 100000	17	1286558	(18.5%)
100001- 200000	11	1673502	(24.1%)
200001- 300000	6	1460268	(21.0%)
300001- 750000	3	1431080	(20.6%)
TOTAL	98	6953619	(100%)

a. Paper and Board (Unit: 1000t)

IMPORT	1991	1992	1993	1994	1995	1996	1997	1998	1999
Newsprint	1327.5	1315.6	1353.4	1705.8	1508.1	1450.5	1530.8	1645.6	1720.2
Printing and Writing	2056.2	2271.9	2558.7	2803	2806.5	2836.3	3201.4	3209.3	3399.1
Sanitary & Household	128.6	168.7	207.3	202.6	241.5	233.9	258.7	295.2	253.4
Corrugated Case Mat.	927.6	951.7	943.1	939.3	893.6	961.1	1007.4	970.3	913.7
Packaging Paper	345.8	335.4	371.5	346.7	324.9	308.5	353.3	327.1	302.8
Packaging Board	746	821.3	811.7	667.5	684.3	704.5	749.5	770.5	776.3
Other Paper and Board	83.5	94	89	94.9	90.2	89.6	86.3	178.1	155.8
TOTAL	**5615**	**5959**	**6335**	**6760**	**6549**	**6584**	**7187**	**7396**	**7521**

EXPORT									
Newsprint	148.6	155.3	152.4	166.2	148.5	187	221	183.6	198.6
Printing and Writing	573.8	668.7	430.1	506.2	503	503.8	534.8	494.1	483
Sanitary & Household	25.2	29.9	26.5	24.2	17.3	14.8	20	19	24.8
Corrugated Case Mat.	231.2	227.2	152.2	181	131.8	156.7	176.4	182.5	199.4
Packaging Paper	66.6	72.4	34	37	33.5	37.9	43.8	40.9	46.3
Packaging Board	270.8	287.5	168.5	188.6	183.3	169	208.7	210.2	167.2
Other Paper and Board	72.5	78.1	139	166.5	192.7	204.1	234.4	259	313.7
TOTAL	**1389**	**1519**	**1103**	**1270**	**1210**	**1273**	**1439**	**1389**	**1433**

Source: The Paper Federation of Great Britain
"Reference Statistics 2000

b. Wool Pulp Import Trends for Papermaking by Country of Origin

(Unit: ADt)

Country of Origin	1996	1997	1998	1999
Austria	1253	2832	1822	311
Belgium				5090
Belgium/Lux.	3293	1928	71	
Denmark	39	419	775	2
Finland	182482	193934	173529	126822
France	7841	17976	16507	10330
Germany	11996	16063	4511	8597
Greece	9	1		
Irish	1417	841	239	145
Italy	3631	931	272	189
Netherlands	0	677	1476	259
Portugal	89539	70276	90262	104781
Spain	77703	70838	61530	64458
Sweden	144678	159580	166480	165391
Norway	49225	35864	31592	36416
Switzerland	714	410	690	478
Czech Republic	2185	1807	1904	2475
Estonia	6902	2428	3931	
Latvia				435
Lithuania				21
Russia	21189	27721	22959	24876
Morocco	3172	6349	2350	
South Africa	21202	21356	25213	23927
Swaziland			18	
Tunisia	40		25	
Canada	265778	279214	281951	272004
USA	296613	310743	270382	243032
Argentina	3752	6962	1004	1938
Bahamas	1200	5778		467
Brazil	201752	252049	233673	246840
Chile	121396	104265	88449	58795
Ecuador				3747
China		193		35
Hong Kong			3	
Indonesia	438	4701	22794	18257
Japan				21
Thailand	3104	48	508	2700
Australia			29	537
New Zealand				0
Others	1242	2995	509	347
TOTAL	1523785	1599179	1505458	1423723

c. Wood Pulp Import Trends for Papermaking by Grade (1999) (Excluding EU Countries)

(Unit: ADt)

Grade	USA	Canada	Brazil	Chile	Indonesia	Norway	Russia	S.Africa	Others
TMP	0	33594	0	0	0	963	0	0	0
Mechanical	6	179	20	0	0	2359	19	0	0
Semi-chemical	59	5798	0	0	0	826	0	0	0
UKP	0	5979	39	692	0	0	3083	369	0
BSKP	69372	166972	7806	31005	0	24985	7126	23558	0
BHKP	173171	42227	238975	27099	18257	3	14647	0	470
Sulphite	425	17255	0	0	0	7280	0	0	9
TOTAL	243033	272004	246840	58796	18257	36416	24875	23927	479

Source: The Paper Federation of Great Britain

The country produced around 500000 tons of pulp (mechanical and semi-mechanical pulp) up to 1998. Then, three mills were closed down in 1999 and additional three mills will terminate operation in 2000, reducing total capacity by 180000 tons.

d. General view on the Lithuanian pulp project

For the U.K. pulp and paper industry which reduces pulp production and increases imports, overseas production seems to be out of concern. During the visit, the study team only obtained general data on the industry.

⑥ Italy

Production, Import, Export and Apparent Consumption

a. Paper and Paperboard

(Unit: 1000 t)

year	Production	Import	Export	APP. Consumption
1990	6180	2617	1188	7609
1991	6388	2712	1273	7827
1992	6638	3173	1348	8463
1993	6715	3143	1626	8232
1994	7287	3587	1749	9125
1995	7371	3521	1889	9003
1996	7487	3325	2013	8799
1997	8031	3857	2253	9635
1998	8253	3934	2250	9937
1999	8568	4173	2436	10305

b. Wood Pulp

(Unit: 1000 t)

year	Production	Import	Export	APP. Consumption
1990	596.4	2049.8	69.9	2576
1991	509.4	2309.1	59.5	2759
1992	442.1	2451.1	12.4	2881
1993	424.5	2477.2	34.2	2867
1994	460.9	2666	26.7	3100
1995	490.5	2714.2	17.8	3187
1996	447.2	2784.9	18.4	3214
1997	467.6	3030.2	11.9	3486
1998	462.5	3075.7	12.9	3525
1999	444.2	3008.2	15.4	3547

Source:ASSOCARTA 2000

Production grew strongly in the first half of 1998 and declined slightly in the latter half. On an annual basis, it recorded the highest growth rate 10.0%, well over the previous boom of 7.3% in 1997, and reached 8250000 tons. After some slowdown, production showed a firm recovery since the second half of 1999 and registered a all time of 8560000 tons, a 3.8% increase over 1998.

Italy is the fifth largest paper producer in Europe and consumes more than 10 million tons annually. On the other hand, it produces less than 500000 tons of pulp. In particular it entirely depends on imports for kraft pulp supply and is the second largest importer next to Germany, amounting to 2.5 million tons annually. (The country imports a total of over 3 million tons annually after 1997.)

Reference： Attached Sheet No. 15 Wood pulp Production, Trade and Apparent Consumption of Europe (Major Countries)

Attached Sheet No.16 Pulp Import to CEPI countries

c. General view on the Lithuanian pulp project

The industry, which entirely imports pulp, appears to have concern about the industrial restructuring, as seen in aggressive M&A activities of large pulp and paper makers in North America and Scandinavia, and closedowns of unprofitable market pulp mills in North America, which may unfavorably increase market control of the supplier side. And they showed strong interest in mill projects planned in the Baltic region. The following is an excerpt of a report made by ASSOCARTA which studied the Baltic states in last March.

“ This report on the potential of the paper pulp market in the Baltic states has been prepared as part of the strategic imports Project of the Foreign Trade institute (I.C.E.) for 1998.

The documentation and information on which the report itself is based was gathered during a research mission undertaken in March 1999 financed by the ICE with the technical backing of the Helsinki office and the institute’ s local operatives. It is important to note that the report is in effect a follow-up to similar projects undertaken in previous years into the wood pulp markets in Chile, Indonesia, South Africa, Argentina and Brazil always under the same Strategic Import Project. (Intermediate sentences omitted)

The legitimate interest of the Baltic States governments in utilizing their natural resources at local level to create new economic development opportunity has lead Estonia, Latovia and Lithuania to launch important projects for the installation of large scale paper pulp facilities (5-600000 tons/year). These projects, envisaging Western Europe as the principle market outlet for the potential production, are of significant interest to the Italian paper industry which, after Germany, is the main consumer within the European market. As mentioned above, the effective possibility of obtaining the immense financial resources necessary to undertake the projects as envisaged is still to be verified. Moreover, it is considered that the eventual realization of one of the projects would inevitably have the effect of impeding the development of the other two, at least over the medium term.

However, despite the significant number of unknown quantities in financial terms, all the projects have indubitably solid foundations from a basic economic point of view, and so it would be opportune that Italian operators follow developments with some attention.

Finally, as regards the paper industry, since the closure and drastic restructuring of the obsolete facilities operating during the Soviet era, the three Baltic States have been looking for potential partners to develop joint ventures.

Particular interest has been shown by local operators **in the tissue paper sector**, for which considerable growth in internal demand is forecast in the short term as a result of the increasing per-capita income level of the population of the entire Baltic region.

(Note that Italy is the largest producer of sanitary paper in Europe and Italian manufacturers are aggressively acquiring companies in the U.K. and France.)

ASSOCARTA plans to send a research mission to the Baltic states in October 2000. It is recommended that the Lithuanian government keep close communication with it.

2.5 Consolidation of Pulp and Paper Industries in Industrialized Countries through M&A Activities

The pulp and paper industry has been traditionally undergoing cyclical ups and downs with significant price fluctuation, which is caused by aggresive capital spending and capacity expansion. For instance, the Alex Brown Research Institute under a German bank reports the following four cases:

1989-1991	12 newsprint paper making machines were installed in the U.S. and Canada to create concern about oversupply, and prices fell to the lowest level in the fifteen years.
1994 - 1996	Container board production capacity increased rapidly in the U.S. and corrugating medium prices plummeted from USD525 to USD200/ton.
1995 - 1999	Pulp production capacity in Southeast showed a rapid increase and prices leveled off since 1996.
1998 - 2002	Sanitary paper making machines are installed at an accelerated pace to create price pressure.

The industry is now seeing the wave of mega-merger deals in recent years.
（See Attached Sheet No. 20 " Restructuring through merger and acquisition" ）

Unlike the M&A boom in the 1980s, which was characterized by money game-oriented TOB, the recent M&A activities have two distinctive objectives:

1. To establish strategic alliance between dominant companies: A primary example is International Paper' s merger of Union Camp (ranked 8th in the U.S. and 17th in the world in 1998) in 1999 to rationalize capital investment by avoiding duplication of efforts.
2. To integrate production facilities and jettison unprofitable facilities: A typical example is the merger of Stone Container with Smerfit, which resulted in closedown of the 1.6 million ton container board capacity, followed by acquisition of St. Laurent Paper to add.

Most pulp and paper companies in North America have been afflicted with low returns form sluggish market conditions and reduced margins due to deteriorated cost competitiveness. They are now looking for sustainable growth through industrial restructuring that leads to increased competitiveness and rationalization of capital projects.

In Europe, global M&A initiatives are rampant, led by STORA/ENSO – a paper giant formed by STORA in Sweden and ENSO in Finland – which acquired Consolidated of the U.S. and became the second largest company in the 1998 world ranking, followed by UPM-Kymmen.

Most European makers have been launching extensive rationalization/cost reduction efforts since the early 1990s, which have helped them to establish sound financial base. After 1998, they have been restraining capital investment within depreciation expenses. Today, European companies account for approximately 30% of world pulp and paper capacity and have significant market clouts. They are now moving toward further consolidation and sustainable growth of the industry through aggressive merger and acquisition.

Mr. Dillon, chairman of International Paper, made the following statement in the company's 1999 Annual Report:
"Traditionally, we favored capital projects that would yield increased production capacity. **No more.** Today, we are investing discretionary capital in ways to meet market needs."

<References>

1 Pulp, Paper and Paperboard-Production, Trade and Apparent Consumption of LITHUANIA
2 World wood pulp statistics(Production Capacity and Production by Region)
3 ー" ー(Production Capacity and Production by Grade)
4 North America and Scandinavian "Wood Pulp statistics" (Production Capacity and Production by Grade)
5 World Wood Pulp Statistics (Market Pulp Production Capacity by Region & Grade)
6 North America and Scandinavia "Wood Pulp Shipments by Grade, Destination and Chemical Market Pulp Shipment by Destination"
7 Newsprint and Printing & Writing Production Statistics
8 Paper and Pulp-Production, Import, Export and Appar. Consumption of Major Countries

9 Northern Bleached Softwood Kraft Pulp (NBSK) Prices
10 North America and Scandinavia (Chemical Market Pulp Operating Rates by Quarter)
11 Forecast of Production Capacity Expansion by FAO
12 Production of Paper and Paperboard in West Europe and in other Main Countries
13 Finnish Pulp, Paper and Paperboard Production from 1989 to 1998
14 Finland " Delivery of Market Pulp per Country
15 Production of Wood pulp for Paper Making in Europe(Major Markets only)
16 Pulp Import to CEPI Countries
17 Pulp Import to Italy
18 Paper-Pulp Enterprises Rank 50
19 Pulp and Paper Performance of Major Enterprises in the World
20 Restructuring through merger and acquisition in the World Paper Industries

References attached：

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The Finish Forest Industries Federation " Fact and Figures 1998"
The Swedish Forest Industries " Fact and Figures 1999"
The Reference Statistics of the Paper Federation of Great Britain
COPACEL Rapport Annual 1998 (French Version)
VDP Papier 2000 (Germany Version)
IL Settore Delle Paste per Carta nei Paesi Baltici (Italian Version)
Presentation of John Claes, Paris June 22nd, 2000 年

Attached Sheet No.1

Unit: 1000 t.

Pulp, Paper and Paperboard -Production, Trade and Apparent Consumption

ITEM	PRODUCTION			IMPORT			EXPORT			APPARENT CONSUMPTION		
	1997	1998	1999	1997	1998	1999	1997	1998	1999	1997	1998	1999
Newsprint	0	0	0	17.4	20	19	1.2	2.2	0.8	16.2	17.8	18.2
Woodfree Uncoated	0.2	0.7	1	10.4	9.6	8.5	4.3	3.8	2.4	6.3	6.5	7.1
Coated	0	0	0	6	5.6	6.2	0.7	0.7	0.3	5.3	4.9	5.9
Mechanical Uncoated	0	0	0	2.1	1.2	1.87	0.1	0.05	0.02	2	1.15	1.85
Coated	0	0	0	2.7	5.8	5.9	0.1	0.1	0.06	2.6	5.7	5.84
Corrugating sheet												
Virgin fibre liner	0	0	0	14.6	12.1	8.7	8.3	5.5	3.7	6.3	6.6	5
Waste based liner	2.6	7	16	0.2	0.4	0.3	4.2	3.2	1.38	-1.4	4.2	14.92
Virgin fibre fluting	0	0	0	3.3	0.4	0.71	1.9	0	0	1.4	0.4	0.71
Waste based fluting	2	4.4	7.8	0	0	0	0	0	0	2	4.4	7.8
Other wrapping paper	2.3	2.4	0.9	0.2	0.5	0.3	0.04	0.08	0.24	2.46	2.82	0.96
Tissue & Towelling	7.9	11.5	8	0.1	0.3	0.23	0.6	0.4	0.8	7.4	11.4	7.43
Other paper	0.2	0	0.1	19.1	21.2	16	4	3.6	1.13	15.3	17.6	14.97
Other board	9.5	11.3	3	4.1	3.8	3.8	1.6	1.5	1.26	12	13.6	5.54
TOTAL	24.7	37.3	36.8	80.2	80.9	71.51	27.04	21.13	12.09	77.86	97.07	96.22
PULP												
Bleached sulphate	0	0	0	2.7	0.5	0.376	1.7	0	0	1	0.5	0.376
Unbleached sulphate	0	0	0	0.1	0.1	0.167	0	0	0	0.1	0.1	0.167
Bleached sulphite	0	0	0	6.8	13	4.7	4.6	10.6	3.8	2.2	2.4	0.9
Unbleched sulphite	0	0	0	0.5	1.4	0.014	0.2	1.2	0	0.3	0.2	0.014
Mechanical	1.7	1.3	0	0.02	0.01	0.04	3.3	0.6	0.08	-1.58	0.71	-0.04
Other woodpulp	0	0	0	1.3	0.1	0.6	1.3	0.6	0.002	0	-0.5	0.598
Wastepaper pulp	24.8	24.3	36.1	0.6	0.8	0.05	0	0	0.14	25.4	25.1	36.01
TOTAL	26.5	25.6	36.1	12.02	15.91	5.947	11.1	13	4.022	27.42	28.51	38.025

Source: Lithuanian Ministry of Economy

Attached Sheet No. 2

WORLD WOOD PULP STATISTICS

【Production Capacity by Region】 Unit:1000ｔ

Year	Canada	USA	Nordic	W.Europe	E.Europe	Latin Am	Japan	Asia	Africa	Oceania		**Total**
1985	23157	52763	21180	10966	17181	6427	12014	3770	2167	2681		152306
1986	23784	53785	21555	11460	17165	6528	12299	4120	2306	2718		155720
1987	24015	55056	21545	11788	17193	6708	12253	4456	2334	2473		157821
1988	24744	56522	22745	12121	15407	7033	12858	3930	2391	2702		160453
1989	25455	57661	22880	12760	14185	7578	13157	3812	2437	2694		162619
1990	26278	58513	23695	13831	14476	8051	13495	3967	2487	2683		167476
1991	27238	59841	23707	13332	14845	8483	15082	4374	2517	2779		172198
1992	27065	61000	23056	14082	14998	9512	15126	5375	2587	2758		175559
1993	26243	60622	24680	14000	14926	9977	15276	6129	2650	2649		177152
1994	26661	61009	23844	12557	14024	10240	14814	5867	2611	2810		174437
1995	27551	61686	25707	13501	14806	10379	14615	8096	2598	2766		181705
1996	27908	61735	25880	13615	13369	10700	14724	8179	2681	2769		181560
1997	28005	63808	26733	12869	12383	11363	15029	10890	2366	2838		186284
1998	28291	63172	27260	13000	12468	11822	15532	12896	2381	2837		189659
1999	28136										As a % of	
	【Pulp Production by Region】										Capacity	
1985	20242	48058	19076	10386	12804	5877	9279	3418	1622	2054	<87.2>	132816
1986	21556	50576	19278	10754	13518	6114	9240	3616	1642	2020	<88.8>	138314
1987	22865	52836	20388	11102	14351	6215	9733	3783	1628	2072	<91.9>	144973
1988	23535	54246	21275	11655	14633	6541	10415	3919	1749	2205	<93.6>	150173
1989	23422	54955	21646	11910	14584	6570	10987	3831	1847	2305	<93.5>	152057
1990	22605	56026	20968	11870	13771	6519	11328	4530	2297	2261	<90.9>	152175
1991	23096	56490	20457	12255	11527	7166	11729	4652	2306	2387	<88.3>	152065
1992	22653	58029	20125	11484	10542	8361	11200	4755	2340	2268	<86.4>	151757
1993	22896	57070	21460	10570	5788	9609	10582	5485	2639	2338	<83.8>	148437
1994	24649	58509	22813	10885	6215	8920	10564	5748	1976	2350	<87.5>	152629
1995	25402	59682	22759	11395	7414	9396	11120	7453	2422	2418	<88.7>	159461
1996	24352	58291	21793	11056	6107	9852	11061	8520	2422	2328	<85.8>	155782
1997	24970	59360	23873	11561	6087	9697	11360	8026	2209	2234	<85.6>	159377
1998	23558	57941	24324	12188	n.a.	n.a.	10829	n.a.	n.a.	n.a.		n.a.
1999							10910					

Source: CPPA Reference Tables 1998
CEPI Annual Report 1999
JPPA " " 2000

				Attached Sheet No. 3				
WORLD WOOD PULP STATISTICS							(Unit:1000t.	
	【Production Capacity by GRADE】							
Year	BSKP	BHKP	UKP	Sulphite	High Yield	Others	**Total**	
1985	29746	25346	38341	11312	36665	10896	**152306**	
1986	30752	26510	38415	11203	37742	11098	**155720**	
1987	30821	27685	38635	11052	38790	10838	**157821**	
1988	31897	28568	39278	9975	40741	9994	**160453**	
1989	32625	30415	39313	10340	41793	8133	**162619**	
1990	32849	32369	39453	10799	43722	8284	**167476**	
1991	33996	34807	38922	9758	43688	11027	**172198**	
1992	34962	37303	39402	9001	43872	11019	**175559**	
1993	35795	38656	39109	8237	44341	11014	**177152**	
1994	34769	39689	38925	7912	43752	9390	**174437**	
1995	35169	41960	39024	7752	45991	9809	**179705**	
1996	36430	42753	39502	7756	45733	9386	**181560**	
1997	36964	46389	40545	7518	46480	8388	**186284**	(revised)
1998	37248	48914	40431	7430	46999	8637	**189659**	
1999								As a % of
	【Total Pulp Production by GRADE】							Capacity
1985	25684	21885	34973	10274	29955	10045	**132816**	<87.2>
1986	27954	24098	35405	9093	31237	10527	**138314**	<88.8>
1987	29056	26100	36567	10306	32447	10497	**144973**	<91.9>
1988	30102	26960	37160	10637	34364	10950	**150173**	<93.6>
1989	30530	28461	37220	10306	35143	10397	**152057**	<93.5>
1990	30714	30266	35153	9098	36417	10527	**152175**	<90.9>
1991	31373	32121	34708	8161	35868	9834	**152065**	<88.3>
1992	30670	32724	34658	8111	35818	9776	**151757**	<86.4>
1993	31816	34270	32203	6615	34380	9153	**148437**	<83.8>
1994	32747	37398	32945	6225	34445	8869	**152629**	<87.5>
1995	33994	39985	34461	6476	37224	7321	**159461**	<88.7>
1996	33003	40498	32915	6062	35360	7944	**155782**	<85.8>
1997	33885	41415	33334	6066	36762	7915	**159377**	<85.6>
1998	34099	42528	33270	5889	34141	n.a.	**n.a.**	
1999								
			Source:	CPPA Reference Tables 1998				

				Attached Sheet No. 4				
North America and Nordic "Wood Pulp Statistics"								
	【Productio n Capaity】						**Total**	(Unit:1000t.)
Year	BSKP	BHKP	UKP	Sulphite	HighYield	SCMP		
1985	24868	13573	24396	4781	22630	5439	**Total**	
1986	25373	14398	24469	4665	23332	5392	**97629**	
1987	25916	15168	24549	4525	23890	5506	**99554**	
1988	26503	16184	24961	4327	25015	5613	**102603**	
1989	26721	17114	25135	4367	25700	5566	**104603**	
1990	27146	17650	25468	4254	27221	5655	**107394**	
1991	28031	18429	25552	4000	27966	5616	**109594**	
1992	28630	19411	25559	3621	27580	5609	**110410**	
1993	28643	20422	25101	3343	27860	5517	**110886**	
1994	28455	21253	25258	3129	27896	5348	**111339**	
1995	29073	21650	25288	3159	28724	5396	**113290**	
1996	30192	21860	25348	3079	29039	5253	**114771**	
1997	30720	22741	26428	2813	28283	5773	**116758**	
1998	31258	23054	26320	2630	30478	4698	**118438**	
1999								As a % of
	【Production】							Capacity
1985	22816	13230	22244	4119	19888	4653	**86950**	<90.9>
1986	23556	14598	23067	3977	20766	4888	**90852**	<93.1>
1987	24832	15490	24167	4102	21883	5017	**95491**	<95.9>
1988	25360	16374	24296	4137	23083	5165	**98415**	<95.9>
1989	25563	17002	24108	4034	23476	5140	**99323**	<95.0>
1990	25235	16610	24311	3882	23858	5114	**99010**	<92.2>
1991	25295	17246	24099	3469	23615	5016	**98740**	<90.1>
1992	27066	18159	24251	3096	23042	5047	**100661**	<91.2>
1993	26850	19178	23701	3037	23715	4886	**101367**	<91.4>
1994	27899	21026	24263	3039	24347	4916	**105490**	<94.7>
1995	28676	21258	24530	3077	25477	4773	**107791**	<95.1>
1996	28144	20996	23634	2750	24138	4634	**104296**	<90.9>
1997	27236	20234	22993	2614	25230	5015	**103332**	<88.5>
1998	29575	21290	23170	2245	24159	4948	**105387**	<89.0>
1999								
		Source: CPPA Reference Tables 1998						

Attached Sheet No. 5

WORLD WOOD PULP STATISTICS

【Market Pulp Production Capacity by Region】 Unit:1000t.

Year	Canada	USA	Nordic	W. Europe	E. Europe	Latin Ame.	Japan	Asia	Africa	Oceanea		**Total**
1985	7505	5615	6110	3270	n.a.	2395	880	480	435	635		**27325**
1986	7740	6065	6295	3560	n.a.	2410	820	475	430	655		**28450**
1987	7935	6180	6255	3680	n.a.	2465	795	480	450	685		**28925**
1988	8135	6775	6040	3890	n.a.	2555	765	520	450	680		**29810**
1989	8535	6895	6060	3985	n.a.	2785	765	655	450	670		**30800**
1990	8565	7285	6325	4005	n.a.	2715	755	790	455	695		**31590**
1990	9170	7885	6130	4040	n.a.	3285	775	860	455	725		**33325**
1992	9655	8420	6325	3855	n.a.	4180	790	815	515	625		**35180**
1993	9500	8575	6190	3650	n.a.	4240	730	960	570	695		**35110**
1994	10150	8350	5990	3970	n.a.	4430	740	1115	575	700		**36020**
1995	11020	8790	5955	4100	n.a.	4595	790	1960	630	665		**38505**
1996	11400	8435	6445	4160	n.a.	5060	820	2045	685	705		**39755**
1997	11550	8485	6540	4280	n.a.	5185	815	2755	680	750		**41040**
1998	11535	8500	6540	4210	n.a.	5615	805	2855	630	820		**41510**
1999												

【Market Pulp Production Capacity by Grade】 Unit:1000t.

Year	BSKP	BHKP	UKP	Sulphite	High Yield		**Total**
1985	13030	8565	1805	2090	1835		**27325**
1986	13675	8860	1830	2120	1965		**28450**
1987	13675	9410	1760	2045	2035		**28925**
1988	14045	9925	1735	1940	2165		**29810**
1989	14300	10345	1660	1910	2585		**30800**
1990	15010	10575	1600	1855	2550		**31590**
1991	15535	11470	1665	1790	2865		**33325**
1992	16520	12465	1590	1580	3025		**35180**
1993	16920	12525	1550	1500	2615		**35110**
1994	16940	13170	1575	1675	2670		**36030**
1995	17620	14340	1635	1725	3185		**38505**
1996	18205	14650	1795	1730	3375		**39755**
1997	18375	15680	1925	1745	3315		**41040**
1998	18590	16185	1925	1590	3220		**41510**
1999							

Source: CPPA Reference Tables 1998

Attached Sheet No. 6

North America and Nordic "Wood Pulp Statistics"

【Market Pulp Shipments by Grade】 (Unit:1000t.)

Year	BSKP	BHKP	UKP	Sulphite	High Yield	SCMP	Total
1985	10551	3818	642	1094	1223	32	**17360**
1986	11418	4347	563	1079	1281	35	**18723**
1987	12062	4673	600	1126	1355	31	**19847**
1988	12148	4915	629	1030	1572	37	**20331**
1989	11898	5004	469	883	1707	33	**19994**
1990	10956	4717	522	914	1753	33	**18895**
1991	11597	4952	506	902	1668	33	**19658**
1992	12347	5340	432	851	1692	33	**20695**
1993	12748	5633	462	737	1706	33	**21319**
1994	13635	6091	492	787	2066	33	**23104**
1995	13362	5921	437	751	2200	33	**22704**
1996	13614	5744	538	675	2047	33	**22651**
1997	14617	5879	571	658	2147	33	**23905**
1998	14606	5290	460	487	2170	33	**23046**
1999							

【Market Pulp Shipments by Destination】

Year	Canada	USA	W.Europe	Nordic	E.Europe	Latin Ame.	Japan	Asia & Africa	Oceania	Total
1985	934	4569	6659	1090	119	520	1532	1832	106	**17361**
1986	982	4941	7056	1214	173	592	1823	1785	157	**18723**
1987	1079	5065	7231	1249	207	708	1969	2138	200	**19846**
1988	1077	5259	7520	1200	222	568	2199	2112	173	**20330**
1989	1000	5019	7725	1170	240	410	2433	1835	162	**19994**
1990	913	4709	7407	1139	212	535	1891	1949	140	**18895**
1991	868	4459	8033	941	148	541	1949	2596	121	**19656**
1992	870	4540	8615	958	138	595	2053	2799	129	**20697**
1993	924	5029	8124	992	125	785	2200	3019	124	**21322**
1994	972	5458	8706	1144	128	828	2573	3188	106	**23103**
1995	1033	5490	8479	1155	137	795	2511	3007	96	**22703**
1996	955	5124	8322	1027	167	797	2360	3792	107	**22651**
1997	998	5871	8729	1140	158	962	2340	3636	70	**23904**
1998	999	5918	8552	1177	195	850	2101	3169	84	**23045**
1999										

【Chemical Market Pulp Shipments by Destination】

1985	840	4461	6094	951	114	480	1354	1705	106	**16105**
1986	881	4831	6503	1066	162	559	1618	1635	152	**17407**
1987	959	4953	6686	1095	190	670	1754	1956	198	**18461**
1988	952	5122	6916	995	205	516	1941	1907	168	**18722**
1989	935	4791	7022	989	219	360	2110	1669	159	**18254**
1990	828	4502	6684	947	192	466	1586	1765	139	**17109**
1991	748	4276	7306	773	125	464	1720	2426	119	**17957**
1992	834	4304	7882	776	113	537	1841	2556	128	**18971**
1993	888	4805	7409	838	102	723	1964	2729	123	**19581**
1994	913	5237	7829	958	105	750	2284	2826	103	**21005**
1995	941	5260	7554	943	109	751	2236	2580	96	**20470**
1996	906	4862	7561	865	147	763	2091	3270	107	**20572**
1997	931	5596	7973	996	139	881	2063	3077	68	**21724**
1998	922	5672	7783	1004	173	800	1817	2594	78	**20843**
1999										

Source: CPPA Reference Table 1998

Attached Sheet No. 7

【Newsprint Production Statistics】 Unit : 1000m/ t

A. Total Newsprint Production by Region

Year	W.Europe	N.Europe	E.Europe	Canada	U.S.A.	L.America	Japan	Asia	Africa	Oceania		W.Total
1990	3913	4694	2087	9068	5997	1023	3479	1627	420	670		32978
1991	3946	4324	1838	8855	6206	1023	3516	1655	405	702		32470
1992	3992	4315	1246	8753	6425	882	3253	1867	387	738		31858
1993	4221	4710	1282	9136	6412	798	2917	2219	401	734		32830
1994	4434	4833	1368	9299	6335	805	2972	2511	390	738		33685
1995	5006	4441	1793	9226	6352	932	3098	2786	392	755		34781
1996	4876	4522	1587	9025	6304	945	3132	3268	392	720		34771
1997	5272	4730	1556	9204	6545	965	3192	3844	392	700		36400
1998	5129	4875	n.a.	8581	6575	n.a.	3265	n.a.	n.a.	n.a.		n.a.
1999	5461	4868	n.a.	n.a.	6518	n.a.	3295	n.a.	n.a.	n.a.		n.a.

【Printing and Writing Paper Statistics】

B. World (Region)

Year	W.Europe	N.Europe	E.Europe	Canada	U.S.A.	L.America	Japan	Asia	Africa	Oceania		W.Total
1990	16108	6794	2351	3600	18910	2446	9251	8006	615	444		68525
1991	16577	6940	2015	3688	18669	2567	9730	8439	592	425		69642
1992	16871	7157	1425	3742	19866	2685	9610	9237	536	321		71450
1993	17079	7942	1287	4194	20348	2875	9516	6932	629	314		71116
1994	19031	8800	1101	4429	21793	3076	9805	8880	600	362		77877
1995	19096	9250	1339	4882	21701	3026	10565	10050	502	378		80789
1996	18917	8855	1452	4689	21225	3096	10811	11189	501	365		81100
1997	20702	10571	n.a.	4962	24387	n.a.	11112	n.a.	n.a.	n.a.		n.a.
1998	20526	11123	n.a.	5154	24180	n.a.	10903	n.a.	n.a.	n.a.		n.a.
1999	21181	11377	n.a.	n.a.	n.a.	n.a.	11348	n.a.	n.a.	n.a.		n.a.

Source: PI Production Statistics 4th quarter 1999 and JPA2000

Attached Sheet No. 8

Paper and Pulp - Production, Import, Export and Apparent Consumption of Major Countries (1997/198)

							(1000ｔ)	(ｋｍ	<10000>
Country	Product		Year	Production	Import	Export	Consumption	Area	Population
Finland	Newsprint		1997	1470	39	1211	298	304600	515
	"		1998	1483	37	1199	312		
	Printing	Coat	1997	3826	28	3613	241	per Capita	320.5kg
	& Writin	”	1998	4357	22	4125	254		
	"	Uncoat	1997	3295	27	3182	140		
	"	”	1998	3343	30	3235	138		
	Other		1997	3558	214	2791	981		
	Paper & Boar		1998	3520	203	2784	939		
	BKP		1997	5957	20	1635	4342		
	”		1998	6065	30	1531	4564		
Sweden	Newsprint		1997	2412	38	2040	410	410000	885
	”		1998	2478	44	2071	451		
	Printing	Coat	1997	1003	83	854	232	per Capita	267.4kg
	& Writir	”	1998	1010	95	814	291		
	”	Uncoat	1997	1455	73	1131	397		
	”	”	1998	1535	79	1287	327		
	Sanitary		1997	292	31	163	160		
	& Household		1998	299	25	185	139		
	Other		1997	4594	281	3690	1185		
	Paper & Board		1998	4557	279	3677	1159		
	BKP		1997	4570	172	2239	2503		
	"		1998	4583	192	2278	2497		
Norway	Newsprint		1997	882	46	835	93	323895	440
	"		1998	914	41	907	48		
	Printing	Coat	1997	4	116	13	107	per Capita	175.9kg
	& Writing	"	1998	13	127	14	126		
	"	Uncoat	1997	798	85	652	231		
	"	"	1998	805	98	631	272		
	Sanitary		1997	27	57	19	65		
	& Household		1998	28	59	17	70		
	Other		1997	498	215	450	263		
	Paper & Board		1998	500	n.a.	n.a.	n.a.		
	BKP		1997	341	92	219	214		
	"		1998	358	80	238	200		
Germany	Newsprint		1997	1618	1286	641	2263	357030	8207
	"		1998	1630	1316	561	2385		
	Printing	Coat	1997	3277	1657	2722	2212	per Capita	205.4kg
	& Writing		1998	3550	1733	2737	2546		
	"	Uncoat	1997	2929	1851	1388	3524		
	"		1998	2902	1983	1394	3491		
	Sanitary		1997	890	126	108	908		
	& Household		1998	931	111	107	935		
	Other		1997	7216	2938	2802	7352		
	Paper & Board		1998	7297	2850	2649	7498		
	BKP		1987	0	3510	158	3352		
	"		1988	0	3529	135	3394		

France	Newsprint		1997	909	493	605	797	551500	6090
	"		1998	923	460	578	805		
	Printing	Coat	1997	1759	1622	1238	2143	per Capita	175.4kg
	& Writin	"	1998	1606	1820	1164	2262		
	"	Uncoat	1997	1592	1146	716	2022		
	"	"	1998	1495	1252	694	2053		
	Sanitary		1997	397	251	291	357		
	& Household		1998	386	268	276	378		
	Other		1997	4350	2035	1608	4777		
	Paper & Board		1998	4623	2028	1673	4978		
	BKP		1997	1087	1854	272	2669		
	"		1998	1056	1854	264	2646		
Italy	Newsprint		1997	180	461	8	633	301308	5760
	"		1998	190	458	5	643		
	Printing	Coat	1997	1890	780	837	1833	per Capita	172.2kg
	& Writin	"	1998	1916	863	825	1954		
	"	Uncoat	1997	860	654	133	1381		
	"	"	1998	863	661	125	1399		
	Sanitary		1997	1026	52	437	641		
	& Household		1998	1102	58	468	692		
	Other		1997	4076	1892	831	5137		
	Paper & Board		1998	4174	1875	818	5231		
	Chemical		1997	83	2873	6	2950		
	Pulp		1998	79	2932	9	3002		
U.K.	Newsprint		1997	1030	1531	211	2350	245050	6110
	"		1998	1043	1646	192	2497		
	Printing	Coat	1997	636	1640	230	2046	per Capita	204.2kg
	& Writin	"	1998	661	1765	237	2189		
	"	Uncoat	1997	878	1322	246	1954		
	"	"	1998	862	1409	227	2044		
	Sanitary		1997	639	259	32	866		
	& Household		1998	635	299	4	930		
	Other		1997	3032	2196	646	4582		
	Paper & Board		1998	3031	2090	704	4417		
	BKP		1997	0	1432	3	1429		
	"		1998	0	1416	15	1401		
Spain	Newsprint		1997	143	396	49	490	504780	3985
	"		1998	192	412	38	566		
	Printing		1997	900	1208	494	1614	per Capita	152.4kg
	& Writing		1998	884	1368	518	1734		
	Sanitary		1997	328	108	61	375		
	& Household		1998	393	101	68	426		
	Other		1997	2596	1110	587	3119		
	Paper & Board		1998	2726	1215	597	3344		
	BKP		1997	1224	471	717	978		
	"		1998	1287	475	702	1060		

Russia	Newsprint		1997	1194	1	822	373	17075400	14810
	"		1998	1394	2	1016	380		
	Printing		1997	447	81	183	345	per Capita	13.2kg
	& Writing		1998	470	75	241	304		
	Sanitary		1997	93	3	0	96		
	& Household		1998	115	2	0	117		
	Other		1997	1581	89	442	1228		
	Paper & Board		1998	1561	85	493	1153		
	BKP		1997	1178	21	681	518		
	"		1998	1205	18	746	477		
USA	Newsprint		1997	6545	6503	967	12081	9372614	27031
	"		1998	6503	6521	781	12243		
	Printing	Coat	1997	8450	1521	639	9332	per Capita	336.5kg
	& Writin	"	1998	8287	1866	639	9514		
	"	Uncoat	1997	14292	3245	795	16742		
	"	"	1998	14494	3497	704	17287		
	Sanitary		1997	5832	170	86	5916		
	& Household		1998	5990	160	90	6060		
	Other		1997	49688	1914	7373	44229		
	Paper & Board		1998	49181	2095	6772	44504		
	Chemical Pulp		1997	50292	5310	5483	50119		
	"		1998	49078	5065	4734	49409		
Canada	Newsprint		1997	9208	17	8247	978	9976136	3068
	"		1998	8581	39	7362	1258		
	Printing	Coat	1997	1142	430	866	706	per Capita	238.1kg
	& Writin	"	1998	1230	481	944	767		
	"	Uncoat	1997	3820	432	3103	1149		
	"	"	1998	3924	494	3161	1257		
	Sanitary		1997	617	109	80	646		
	& Household		1998	624	104	103	625		
	Other		1997	4182	1192	2188	3186		
	Paper & Board		1998	4365	1252	2215	3402		
	BKP		1997	10967	184	8118	3033		
	"		1998	10849	196	8075	2970		
Japan	Newsprint		1997	3192	628	29	3791	377800	12650
	"		1998	3265	620	90	3795		
	Printing	Coat	1997	5722	387	512	5597	per Capita	236.8kg
	& Writin	"	1998	5749	285	570	5464		
	"	Uncoat	1997	5390	included in coat		5390		
	"	"	1998	5154	"		5154		
	Sanitary		1997	1715	0	0	1715		
	& Household		1998	1659	0	0	1659		
	Other		1997	14995	309	422	14882		
	Paper & Board		1998	14059	265	446	13878		
	BKP		1997	7852	2572	59	10365		
	"		1998	7606	2393	37	9962		

China	Newsprint		1997	730	453	3	1180	9596961	125510
	"		1998	740	236	0	976		
	Printing	Coat	1997	142	828	22	948	per Capita	n.a.
	& Writin	"	1998	132	1428	20	1540		
	"	Uncoat	1997	5100	240	29	5311		
	"	"	1998	5152	349	25	5476		
	Sanitry		1997	2280	20	55	2245		
	& Household		1998	2310	29	0	2339		
	Chemical Pulp		1997	1385	865	0	2250		
	"		1998	1310	1863	n.a.	3173		
Korea	Newsprint		1997	1592	14	279	1327	99222	4610
	"		1998	1700	0	808	892		
	"		1999	1718	n.a.	n.a.	n.a.	per Capita	113.7kg
	Printing	Coat	1997	1169	56	599	626		
	& Writin	"	1998	1118	17	802	333		
	"	"	1999	1302	n.a.	823	n.a.		
	"	Uncoat	1997	836	56	67	825		
	"	"	1998	630	7	63	574		
	"	"	1999	784	n.a.	24	n.a.		
	Sanitary		1997	332	0	4	328		
	& Household		1998	272	0	4	268		
	"		1999	291	n.a.	17	n.a.		
	BKP		1997	394	1505	0	1899		
	"		1998	249	1408	0	1657		
Taiwan	Newsprint		1997	63	432	0	495	35788	2180
	"		1998	84	407	0	491		
	"		1999	79	n.a.	0	n.a.	per Capita	221.9kg
	Printing	Coat	1997	322	65	53	334		
	& Writin	"	1998	323	65	64	324		
	"	"	1999	341	n.a.	77	n.a.		
	"	Uncoat	1997	417	128	36	509		
	"	"	1998	402	112	37	477		
	"	"	1999	399	n.a.	31	n.a.		
	Sanitary		1997	267	27	29	265		
	& Household		1998	262	26	32	256		
	"		1999	278	n.a.	35	n.a.		
	BKP		1997	346	602	3	945		
	"		1998	339	531	1	869		
			Source: P.P.I.,CEPI, AF&PA, CPPA, JPPA						

Attached Sheet No. 9

Northern Bleached Softwood Kraft MARKET PULP(NBSK) PRICES-Monthly Figures in USD per ton

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1990	830	830	830	830	830	830	800	800	800	800	800	760
1991	720	700	700	650	580	580	560	540	500	500	520	520
1992	540	540	580	580	580	600	600	600	600	600	600	500
1993	450	450	400	400	400	400	400	400	390	390	390	390
1994	440	440	460	510	510	510	510	630	630	700	700	700
1995	750	750	820	825	825	925	925	925	925	1000	1000	925
1996	825	650	550	520	520	520	520	550	550	560	560	560
1997	560	520	510	510	540	560	580	580	610	610	600	580
1998	560	540	500	530	550	550	550	520	480	460	460	460
1999	460	460	460	480	500	520	520	520	560	560	600	600
2000	630	630	630	670	670	700	720					

Source: 1990-1992 By research of JPPA, dtd. Nov.26, 1998
1993-2000/Mar. " P.P.I. Processed by Assocarta(Italian Assn.)
2000/Apr.-July " Mitsui & Co.

Attached Sheet No. 10

North America and Nordic "Wood Pulp Statistics"

【Chemical Market Pulp Operating Rates by Quarter】 <%>

Year	Q-1	Q-2	Q-3	Q-4	Total
1985	92.6	85.2	86.8	89	88.4
1986	88.5	88.2	92.7	94	90.9
1987	96.2	95.8	99.5	97.1	97.2
1988	100.6	92.6	98.9	95.8	97
1989	99.8	95.7	96.8	90.5	95.7
1990	92	85.6	84.1	84.9	86.6
1991	89.9	84.5	81.6	87.1	85.7
1992	93.3	87	89.3	88.4	89.5
1993	89.6	85.7	85	85.5	86.5
1994	93.2	92.8	92.1	92.5	92.6
1995	96.6	93.1	97.9	87.7	93.8
1996	83.5	83.7	91.9	89.1	87.2
1997	93.6	90.5	91.1	88.4	90.9
1998	85.9	86.6	85.7	86.7	86.2
1999					

【Chemical Market Pulp Inventories by Month】 Unit:1000t.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1985	1788	1836	1790	1643	1466	1478	1504	1528	1384	1504	1562	1326
1986	1330	1306	1131	1024	1080	943	1014	1030	894	890	1018	847
1987	1000	1022	867	907	925	801	955	1053	854	870	897	676
1988	915	900	797	815	767	671	798	844	772	798	852	675
1989	890	897	764	804	841	786	943	1033	992	1068	1182	1026
1990	1418	1470	1388	1402	1448	1400	1702	1656	1485	1464	1450	1353
1991	1487	1596	1578	1554	1575	1612	1643	1741	1467	1440	1378	1237
1992	1400	1403	1250	1269	1295	1125	1286	1509	1563	1637	1840	1847
1993	2045	2115	1974	1888	1810	1848	1956	2070	1933	1751	1603	1412
1994	1501	1536	1425	1325	1252	1265	1284	1267	1111	1162	1205	1053
1995	1160	1177	1187	1199	1136	1020	1249	1266	1284	1584	1856	1993
1996	2332	2595	2574	2126	1827	1527	1720	1766	1736	1756	1930	1926
1997	2066	2138	1984	1752	1645	1575	1696	1778	1621	1582	1764	1769
1998	1931	1836	1532	1473	1434	1521	1836	1523	1759	1662	1650	1593
1999												

Attached Sheet No.11

WOODPULP, PAPER and PAPER BOARD

Forecast of Production Capacity Expansion by FAO

Unit:1000 t.

Region	Paper and Paper Board						Woodpulp for Paper Making				
	Production Capacity			Annual Change			Production Capacity			Annual Change	
	1992	1997	2002	＜92-96＞	＜97-02＞		1992	1997	2002	＜92-96＞	＜97-02＞
World Total	283121	324905	349796	2.8	1.5		174642	186322	198324	1.3	1.3
Canada	18799	20401	21699	1.6	1.2		27065	28005	28479	0.7	0.3
USA	81449	93104	96630	2.7	0.7		60550	61809	62586	0.4	0.3
North/West Europe	74743	87636	98208	3.2	2.3		37035	40507	43046	1.8	1.2
Japan	33071	33271	34898	0.1	1.0		15126	15029	15901	-0.1	1.1
East Europe,exUSSI	16623	12400	13124	-5.7	1.1		14145	12383	12773	-2.6	0.6
Deveoped Countries (Others)	5344	6155	6691	2.9	1.7		4249	4548	5020	1.4	2.0
Asia	37152	53703	58314	7.6	1.7		5788	11458	14220	14.6	4.4
(China)	19793	23355	24755	3.4	1.2		2184	3135	3320	7.5	1.2
(Korea)	6008	10289	11242	11.4	1.8		480	836	836	11.7	0.0
(Indonesia)	3309	7242	7242	17.0	0.0		939	4312	6032	35.6	6.9
(Thailand)	1574	3283	4548	15.8	6.7		0	518	518		0.0
(Others)	6468	9534	10527				2185	2657	3514		
Others	15940	18235	20232	2.7	2.1		10684	12583	16299	3.3	5.3

Attached Sheet No. 12

Production of Paper and Paper Board in West Europe and in Other Main Countrie (1990～1999)

Unit: 1000 t.

COUNTRY	1990	%	1991	%	1992	%	1993	%	1994	%	1995	%	1996	%	1997	%	1998	%	1999	%
									69476											
E.U.	59137	100	59984	101.4	62182	105.1	63928	108.1		117.5	70179	118.7	69822	118.1	75736	128.1	77547	131.1	79811	135.0
Germany	11873	100	12132	102.2	12942	109.0	13034	109.8	14457	121.8	14827	124.9	14733	124.1	15930	134.2	16311	137.4	16686	140.5
Finland	8965	100	8760	97.7	9130	101.8	9966	111.2	10879	121.3	10841	120.9	10349	115.4	12148	135.5	12702	141.7	12947	144.4
Sweden	8427	100	8349	99.1	8378	99.4	8779	104.2	9284	110.2	9170	108.8	9019	107.0	9759	115.8	9879	117.2	10077	119.6
France	7049	100	7319	103.8	7695	109.2	7975	113.1	8682	123.2	8616	122.2	8529	121.0	9144	129.7	9164	130.0	9603	136.2
Italy	6180	100	6389	103.4	6639	107.4	6716	108.7	7287	117.9	7371	119.3	7488	121.2	8031	130.0	8254	133.6	8568	138.6
U.K.	4825	100	4951	102.6	5128	106.3	5402	112.0	5843	121.1	6090	126.2	6222	129.0	6478	134.3	6477	134.2	6568	136.1
Spain	3446	100	3426	99.4	3449	100.1	3351	97.2	3501	101.6	3684	106.9	3770	109.4	3968	115.1	4197	121.8	4435	128.7
Austia	2932	100	3090	105.4	3252	110.9	3301	112.6	3603	122.9	3599	122.7	3653	124.6	3817	130.2	4010	136.8	4142	141.3
Netherlands	2742	100	2862	104.4	2835	103.4	2857	104.2	3010	109.8	2967	108.2	2987	108.9	3159	115.2	3180	116.0	3252	118.6
Belgium	1201	100	1126	93.8	1139	94.8	1027	85.5	1247	103.8	1313	109.3	1328	110.6	1500	124.9	1538	128.1	1664	138.6
Portugal	780	100	866	111.0	958	122.8	876	112.3	949	121.7	977	125.3	1025	131.4	1078	138.2	1132	145.1	1164	149.2
Greece	347	100	323	93.1	307	88.5	320	92.2	380	109.5	387	111.5	354	102.0	347	100.0	322	92.8	322	92.8
Denmark	335	100	356	106.3	294	87.8	287	85.7	314	93.7	301	89.9	323	96.4	335	100.0	345	103.0	347	103.6
Ireland	35	100	35	100.0	36	102.9	37	105.7	40	114.3	36	102.9	42	120.0	42	120.0	36	102.9	36	102.9
West Europe Others	3115	100	3043	97.7	2988	95.9	3294	105.7	3574	114.7	3697	118.7	3513	112.8	3789	121.6	3838	123.2	3971	127.5
Norway	1820	100	1784	98.0	1684	92.5	1965	108.0	2147	118.0	2262	124.3	2094	115.1	2209	121.4	2259	124.1	2240	123.1
Switzerland	1295	100	1259	97.2	1304	100.7	1329	102.6	1427	110.2	1435	110.8	1419	109.6	1580	122.0	1579	121.9	1731	133.7
North America	87929	100	88679	100.9	91841	104.4	94606	107.6	98991	112.6	100559	114.4	100408	114.2	105189	119.6	104623	119.0	107908	122.7
U.S.A.	71463	100	72120	100.9	75243	105.3	77072	107.8	80683	112.9	81845	114.5	81989	114.7	86223	120.7	85899	120.2	87682	122.7
Canada	16456	100	16559	100.6	16598	100.8	17534	106.5	18308	111.2	18714	113.7	18419	111.9	18966	115.2	18724	113.7	20226	122.8
Japan	28088	100	29053	103.4	28322	100.8	27762	98.8	28527	101.6	29663	105.6	30013	106.9	31015	110.4	29888	106.4	30631	109.1

Source: CEPI, FAO, AF&PA, CPPA, JPPA, ASSOCARTA

For Reference	1997	1998	1999
Korea	8369	7750	8875
Taiwan	4507	4223	4349

Source: JPPA

Attached Sheet No. 13

Finnish Pulp, Paper and Paperboard Production from 1989 to 1998

Unit:1000 t.

Products	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Chemical Pulp	5543	5159	4897	4914	5465	5844	5782	5736	6620	6718
Sulphate	5224	4870	4682	4914	5465	5844	5782	5736	6620	6718
Sulphite	318	289	215	0	0	0	0	0	0	0
Mechanical Pulp	3203	3293	3157	3156	3401	3631	4306	3957	4469	4637
Semi-chemical Pulp	373	434	432	458	472	487	0	0	0	0
TOTAL PULP	**9119**	**8886**	**8486**	**8528**	**9339**	**9962**	**10088**	**9693**	**11089**	**11355**
Paper	6780	7078	6851	7075	7834	8546	8595	8023	9543	10116
Paperboard	1973	1889	1926	2078	2156	2363	2346	2419	2606	2586
TOTAL PAPER	**8753**	**8966**	**8777**	**9153**	**9990**	**10909**	**10941**	**10442**	**12149**	**12703**

	Production of Market Chemical Woodpulp in Finland (フィンランド市販化学パルプ生産統計資料)						Delivery of Market Woodpulp per Quality 品質別市販パルプ納入統計資料)				
	1995	1996	1997	1998	Unit: tons		1995	1996	1997	1998	Unit: tons
Bleached Sulphate	1431352	1615287	1791293	1729835			1380648	1604195	1808480	1730578	
(Softwood)	789145	895870	1014570	968926			755983	881743	1028768	967868	
(Hardwood)	642207	719417	776723	760909			624665	722452	779712	762710	
Unbleached Sulphate	43531	38209	35184	25430			39071	37693	32170	29806	
Total	1474883	1653496	1826477	1756265			1419719	1641868	1840650	1780384	

Attached Sheet No. 14

FINLAND — Delivery of MARKET PULP per Country (Source: Finnish Forest Ind. Federation)

Unit: tons

	1995	1996	1997	1998
Austria	12663	27809	20322	17330
Belgium	26352	25243	26337	18755
Finland	207284	159358	204765	191045
France	136080	152453	153110	107794
Germany	567994	625918	679113	687879
Ireland	816	1587	2329	2701
Italy	49266	66733	87989	105514
Netherlands	37586	59757	42052	37216
Portugal	35329	50104	63037	48017
Spain	5478	19803	11082	12417
Denmark	145	198	22	10
Greece	3205	3827	2104	1035
Sweden	32099	34407	61205	63081
United Kingdom	180989	245230	248402	235587
Norway	7334	622	0	54
Switzerland	41063	38573	78219	72807
Western Europe	1343683	1511622	1680088	1603240
Bulgaria	608	1000	738	300
Croatia	18	0	0	0
Czech Republic	795	1556	3583	5023
Hungary	3316	2053	5	2325
Malta	100	425	667	131
Poland	302	3593	1761	6851
Russia	2181	5587	5555	7064
Slovakia	366	472	628	968
Slovenia	1279	3747	4753	9809
Turkey	885	8865	1032	6010
Ukraine	18	689	596	98
Yugoslavia	0	28	139	63
Others	92	105	25	0
Eastern Europe	9960	28120	19482	38642
U.S.A.	3427	3918	4307	4828
Others	31	14	105	48
America	3458	3932		4876
Algeria	0	0	0	989
Egypt	1158	0	70	0
Morocco	100	124	2085	53
South Africa	60	90	120	121
Tunisia	891	1560	2086	2222
Others	1060	1258	1047	1280
Africa	3269	3032	5408	4665
China	5098	20215	18319	25284
Inida	1926	3250	5929	3508
Indonesia	11976	4777	16650	17101
Iran	868	3078	4970	2960
Israle	13664	18925	26354	26069
Japan	19688	23114	27855	14684
Lebanon	1943	2585	8159	6041
Malesia	315	1091	663	478
Philipines	498	795	2410	316
South Korea	0	10553	7710	3942
Syria	300	1	1251	988
Taiwan	1314	1076	2353	6730
Thailand	0	1911	5928	570
Vietnam	1352	1381	2150	1623
Others	387	2410	519	665
Asia	59329	95162	131220	110959
Other Countries	20	20	40	0
GRAND TOTAL	1419719	1641888	1840650	1762382

						Attached Sheet No. 15							
		PRODUCTION OF WOODPULP FOR PAPER MAKING IN EUROPE (MAJOR MARKETS ONLY)											
Country	1990	1995	1997	1998	1990=100	Market Pulp Only			NUMBER OF MILLS BY VOLUME				
					1998	1998	1998	1998					
	(Unit: 1000 t.)				(%)	Production	Domestic	Total	Less than	10001-	50000-	100001-	Over
							Delivery	Delivery	10000 t/y	50000 t/y	100000t/y	250000t/y	250000t/y
Austria	1459	1466	1475	1491	102	310	81	284	2	2	1	7	1
Belgium	477	443	406	380	80	146	72	204	0	0	1	2	0
Finland	8886	10088	11088	11354	128	1756	191	1760	2	5	6	12	20
France	2205	2817	2829	2674	121	669	428	667	3	3	1	8	4
Germany	2338	1950	1957	1949	83	0	0	0	3	6	7	9	0
Italy	591	455	467	462	78	0	0	0	1	6	4	2	0
Netherlands	189	148	137	129	68	0	0	0	0	1	0	1	0
Norway	2275	2485	2337	2420	106	286	45	283	0	4	4	3	4
Portugal	1449	1616	1703	1708	118	1068	77	1039	0	0	1	3	3
Spain	1519	1576	1560	1608	106	982	287	982	3	2	3	5	2
Sweden	9913	10186	10496	10541	106	2794	441	2786	0	6	8	12	20
U.K.	595	638	623	583	98	0	0	0	0	0	2	1	1
(Reference Data)													
Canada	22605	25402	24850	23556	104	9739	839	9881	Source:	CEPI: Confederation of European Paper Ind.			
					1997	1997				AF&PA. American Forest & Paper Assn.			
U.S.A.	56025	59679	59358	n.a.	106	8545	n.a.	n.a.		CPPA: Canadian Pulp & Paper Assn.			
Japan	11140	10978	11365	10833	97	1224	1222	0		JPA: Japan Paper Assn.			
Latin America	6426	9293	n.a.	n.a.									

Attached Sheet No. 16

Wood Pulp Import Statistics

<1998>

Unit: 1000 t.

D. Pulp Import to CEPI Countries

TO / FROM	Austria	Belgium	Denmark	Finland	France	Germany	Italy	Netherlands	Portugal	Spain	Sweden	U. K.	**Total EU**	Czech Rep	Norway	Switzerland	**Total CEPI**
Austria		3	n.a.	0	9	46	137	5	0	1	0	2	203	4		10	217
Belgium	2		n.a.	0	47	12	45	268	0	0	1	0	375	0		7	381
Denmark	0	0		3	1	3	9	2	0	0	1	1	19	0		2	21
Finland	18	46	n.a.		107	670	94		45	14	53	174	1220	12	1	73	1306
France	5	16	n.a.	1		71	147	80	1	93	0	17	431	0		18	448
Germany	27	16	n.a.	3	19		149	656	0	4	12	5	891	10		6	907
Ireland	0	0	n.a.	0		0	0	3	0	0	0	0	3	0		0	3
Italy	1	0	n.a.	0	1	2			0	1	0	0	5	0		0	5
Netherlands	0	9	n.a.	0	3	4	6		2	0	0	2	26	0		1	26
Portugal	54	9	n.a.	8	101	219	48	310		117	69	90	1025	4	9	33	1071
Spain	49	6	n.a.	7	62	138	140	40	9		12	62	524	1	3	37	565
Sweden	177	58	n.a.	9	312	726	251	273	14	45		167	2032	13	102	47	2194
United Kingdom	0	0	n.a.	0	3	1	1	80	0	2	0		87	0		0	88
Total EU	333	163	n.a.	30	664	1892	1027	1717	71	277	148	518	**6841**	45	115	232	**7233**
Czech Republic	18	3	n.a.	0	28	39	36		0	0	5	2	130			9	139
Norway	11	7	n.a.	6	94	98	36	50	0	1	51	32	386	0		11	397
Slovak Republic	2	4	n.a.		2	8	0		0	0	0		16			0	16
Switzerland	3	4	n.a.	0	8	17	69	15	0	5	0	1	121	1			122
Total SEPI	367	181	n.a.	36	796	2054	1168	1782	71	284	204	552	**7494**	45	115	252	**7907**
Other West Europe	0	0	n.a.	0	0		0		0	0	0	0	0	0		0	0
Total West Europe	367	181	n.a.	36	796	2054	1168	1782	71	284	204	552	**7494**	46	115	252	**7907**
Eastern Europe	9	19	n.a.	5	21	100	117		0	15	0	27	314	93		1	407
U.S.A.	29	52	n.a.	2	364	295	663	270	1	99	17	270	2062	5		27	2095
Canada	46	96	n.a.	8	380	870	664	87	11	83	10	282	2538	1		69	2608
Brazil	39	37	n.a.	0	222	209	136	44	0	6	3	233	929	0		35	964
Other Latin America	12	24	n.a.	2	123	118	182		12	56	2	90	620	0		36	656
Japan	0	)19	n.a.	0		0	0		0	0	0		19	0		0	19
Other Asia	10	)	n.a.	0	17	35	128		2	19	4	23	238	0		10	249
Africa	87	)	n.a.	0	36	9	41		0	3	0	28	203	0		0	203
Oceania	0		n.a.	0	0	1	0		0	0	0		1	0		0	2
Others	0		n.a.	0	80		0		0		0	1	81	5	8	0	94
TOTAL	599	426	n.a.	53	2040	3691	3099	2183	96	565	240	1506	**14498**	151	123	432	**15203**

Source: Confedertion of European Paper Industries-Trade Statistics 1998(CEPI)

				Attached Sheet No.17						
				IMPORT OF WOODPULP TO ITALY						
										(Unit: 1000 t)
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
WORLD Total	2049.8	2309.1	2451.1	2477.2	2666	2714.2	2784.9	3030.2	3075.7	3118.2
(From)										
Germany	18.8	32.1	38.3	34.5	59.7	73.3	82.2	114.4	128.7	118.9
France	128.1	143.8	158.7	118.2	131.2	117.5	93.8	145.4	146.9	147.7
Netherlands	0.1	0.1	0.7	1.1	1.3	13.6	21.5	9.5	5.8	10.2
Belgium/Lux.	17	12	12.1	1.1	18.2	26.4	48.6	59.8	44.6	35.8
U.K.	0.6	0.6	0.6	0.6	0.9	0.9	0.3	0.6	1	0.7
Ireland	0	0	0	0	0	0	0	0	0	0
Denmark	32	27.7	20.3	16.5	28.5	30.2	25.6	33.7	8.4	0
Greece	0	0	0	0	0	0	0	0	0	0
Portugal	61.3	59.4	49.9	58.2	64.5	62.6	59.4	42.7	48.1	51.5
Spain	95	87.3	94.1	78	107.4	108.3	112.7	129.8	138.6	145.3
Sweden	214.2	307.8	292.1	306	292.3	234.7	200	220.2	251.5	290.8
Finland	111.2	96.9	99.1	91.3	86.6	51	67.4	91.8	94	145.4
Austria	108	76.2	93.2	111.4	108	111.2	128.7	159.2	136.9	137.8
Norway	32.7	23.9	25.5	35.2	46.2	27.1	25.3	18.4	35.7	30.1
Switzerland	26.5	34.6	35	30.7	34.7	33.2	39.4	74.2	68.9	76
EAST EUROPE	257.5	139.4	174.7	298.1	<261.4>	<321.7>	<250.6>	<197.3>	<153.2>	<134.2>
Russia	n.a	n.a	n.a	n.a	162.1	217.5	135.9	79.6	41.9	20.7
Czech Rep.	n.a	n.a	n.a	n.a	22	18	22.4	31.2	35.6	35
Bulgaria	n.a	n.a	n.a	n.a	21.9	14.9	16.9	18.7	16.9	15.8
Slovenia	n.a	n.a	n.a	n.a	12.5	18.3	15.3	34.9	25.4	26
Croatia	n.a	n.a	n.a	n.a	22	20.5	25	25.9	32	31.6
U.S.A.	426.3	623.5	643.4	497.2	516.3	534.7	601.6	650.6	662.7	579.4
Canada	409	480.2	502.8	532.6	626.7	646.6	617.4	696.2	664.1	699.7
LATIN AMERICA										
Brazil	42.1	82.6	84.4	108.1	109.3	84.9	110.7	103.3	135.8	173.4
Chile	10.1	21	57.3	92.4	102.3	120.6	162.7	176.5	180.5	188.7
Others	20.9	7.1	9.9	6.6	8.4	10	6.9	4.8	1.6	0.2
ASIA	1.4	0.2	0.2	0.1	<3.1>	<63.7>	<87.4>	<54.4>	<127.8>	<101.6>
Indonesia	n.a	n.a	n.a	n.a	0.1	48.9	78.3	53.1	114.1	71.8
Thailand	n.a	n.a	n.a	n.a	2.8	14.7	8.8	1.1	13.1	28.9
Others	n.a	n.a	n.a	n.a	0.2	0.1	0.3	0.2	0.6	0.9
AFRICA										
Marocco	16	14.9	17.9	17.3	23.7	13.5	21.3	21.1	19.1	26.6
South Africa	14.3	30.1	32.8	38.6	33.1	27.1	19.3	26.1	18	20.2
Others	3.1	4.8	4.5	3.1	2.2	2.4	1.8	0.2	3.8	4
Austria/Ocea.	3.6	2.9	3.6	0.3	0	0	0.3	0	0	0
Others				Source: ASSOCARTA(Italian Pulp and Paper Association)						

			Attached Sheet No. 18		Source: P.P.I.
PAPER・PULP ENTERPRISES RANK 50 (1998)					
RANK		SALES	1998/1997	NAME of COMPANY	COUNTRY
1998	1997	million USD	%		
1	1	15310	-3.4	International Paper	USA
2	3	8949	5.8	Stora Enso	Finland, Sweden
3	4	8545	2.4	Kimberly Clark	USA
4	2	7911	-9.6	Oji Seisi	Japan
5	5	7789	8.9	UPM Kymmene	Finland
6	6	7301	0.6	Fort James	USA
7	9	5797	10	Svensca Cellulosa	Sweden
8	7	5675	-12.8	Nippon Seisi	Japan
9	8	5652	2.4	Georgia Pacific	USA
10	10	5270	-2.6	Arjo Wiggins Appleton	U.K.
11	11	4879	0.6	Stone Container	USA
12	12	4640	-3.3	Champion International	USA
13	13	4300	-6.7	Weyerhaeuser	USA
14	14	4117	12.3	Jefferson Smurfit Group	Ireland
15	18	3996	41.7	Sappi	South Africa
16	15	3919	9.2	Metsa Serla	Finland
17	17	3484	2.4	Union Camp	USA
18	19	3310	1.7	Mead	USA
19	16	3007	-1.7	Amcor	Australia
20	20	2653	-18.1	Jefferson Smurfit Corp.	USA
21	22	2556	-3.8	Westvaco	USA
22	25	2515	15.8	Assi Doman	Sweden
23	26	2446	9.3	Willamette Industries Inc	USA
24	31	2385	19.5	Asia Pulp and Paper	Singapor
25	24	2294	2.8	Daio Seisi	Japan
26	23	2141	18.6	Sonoco Products	USA
27	28	2138	3.5	Modo	Sweden
28	27	2133	4	Abitibi Consolidated	Canada
29	21	2065	-16.4	Daishowa Seisi	Japan
30	30	2018	-2.2	Temple Inland	USA
31	35	1983	23.8	Consolidated Papers	USA
32	43	1847	36.8	Bowater	USA
33	33	1793	3.7	Haindl	Germany
34	34	1752	9.2	Boise Cascade	USA
35	40	1700	13.3	Tenneco Packaging	USA
36	32	1679	-2.9	Rengo	Japan
37	39	1654	18.1	Cascades	Canada
38	38	1649	16.8	Norske Skog Industria	Norway
39	36	1640	5.7	Cartiere Burgo	Italy
40	41	1587	7.7	Kappa Packaging	Netherlands
41	29	1548	-9.5	Fletcher Challenge	New Zealand
42	42	1436	3.1	Franchati	Austria
43	46	1342	19.1	Domtar	Canada
44	37	1325	-6.9	Mitsubishi Seisi	Japan
45	50	1293	16.6	Rock Tenn	USA
46	47	1265	8	Myllykoski	Finland
47	63	1217	47.4	Donohue	Canada
48	49	1136	-0.3	Riverwood International	USA
49	52	1045	-3.1	Potlatch Corp	USA
50	56	1005	8	Maria Mellhow	Austria

Attached Sheet No. 19

Pulp and Paper: Performance of Major Enterprises in the World(1998)

RANK		Name of Company	P/P Sales	Profit		% of P/P	Total Asset	Production (1000 t.)		Number of
Region	World		million USD	mill.USD	%	in Total Sale	million USD	Market Pulp	Paper&Board	Employee
		【U.S.A.】								
1	1	International Paper	15310	308	1.6	78	26356	1365	10900	80000
2	3	Kimbery Clark	8545	1165	9.5	70	11510	n.a.	3500	55000
3	6	Fort James	7301	500	6.9	100	7792	200	4700	28000
4	9	Georgia Pacific	5652	289	2.2	42	12700	1811	6685	45000
5	11	Stone Container	4879	Δ785	-	100	8793	708	5695	23000
6	12	Champion Int.	4640	75	1.3	82	8839	0	4236	21100
7	13	Weyerhaeuser	4300	294	2.7	40	12800	2120	5010	35032
8	17	Union Camp	3484	43	1	77	5176	n.a.	3225	18300
9	18	Mead	3310	162	4.3	88	5142	255	1729	14100
10	20	Jeferson Smurfit	2653	Δ158	-	89	2838	0	3301	15000
		【CANADA】								
1	28	Abitibi Consolidated	2133	Δ10	-	95	4607	60	3110	13300
2	37	Cascades	1654	30	1.8	97	1675	230	2531	11805
3	43	Domtar	1342	49	3.2	85	2716	308	1555	8000
4	47	Donohue	1217	154	10	79	2330	415	2020	8000
5	57	MacMillan Bloedel	921	28	1	33	2253	0	1664	10000
		【Europe,Africa,Asia】								
1	2	Stora Enso(Finland)	8949	170	1.8	96	13761	1964	11758	40679
2	5	UPM Kymmene(Finland)	7789	1145	12.3	84	12738	0	7499	32351
3	7	Svenska Cell(Sweden)	5797	425	5.5	75	9858	0	4921	32082
4	10	Arjo Wiggins Appl(U.K.)	5270	244	4.6	100	4801	n.a.	1920	18938
5	14	Jefferson Smu.(Ireland)	4117	199	4.8	100	6098	0	4222	25430
6	15	Sappi (South Africa)	3996	180	4.4	97	6791	745	4106	23620
7	16	Metsa Serla(Finland)	3919	184	4.7	100	5297	n.a.	3446	14611
8	19	Amcor (Australia)	3007	31	0.8	79	4519	2	1251	22900
9	22	Assi Doman(Sweden)	2515	89	3	83	4256	283	1829	17543
10	24	Asia Pulp&Paper(Singa)	2385	142	6	100	15583	888	2913	72000
		【Japan】								
1	4	Oji Seisi	7911	Δ34	-	86	13422	63	6767	13563
2	8	Nippon Seisi	5675	8.2	0.1	82	8824	171	4335	13132
3	25	Daio Seisi	2294	138	6	100	3348	43	1706	2964
4	29	Daishowa Seisi	2065	221	9.3	87	4289	23	2530	3614
5	36	Rengo	1679	11	0.6	96	2370	0	874	3451

Source: P.P.I., Japan Paper Association

Pulp and Paper, Performance of Major Enterprises of Northcan(1999)

		P/P Sales	1999÷1998	Profit	1999÷1998
(U.S.A.)					
million USD	(30 Companies)TTL	130552	7.5%	5973	59.3%
International Paper		24573	2.5%	551	59.7%
Georgia Pacific		17790	34.5%	716	6.5 times
Kimbery Clark		13007	5.8%	1668	49.7%
Weyerhaeuser		12262	13.9%	681	2.0 times
Smurfit Stones		7151	2.1 times	169	Red to Black
(Canada)					
million Canadian Doller	(15 Companies)TTL	24845	16.2%	875	3.0 times
Abitibi Consolidated		4039	20.9%	Δ65	-
Domtar		3083	31.3%	163	2.2 times
(Northern Europe)					
million Euro					
Stora Enso		10636	1.4%	1151	3.4 times
UPM-Kymmene		8261	Δ1.2%	1398	Δ2.7%
Metsa Serla		4236	20.2%	330	2.2%
AssiDoman		2867	13.2%	Δ82	Red
million Krone					
SCA		64896	5.9%	5521	6.8%

Source: P.P.W., Japan Paper Association

Attached Sheet No. 20

Restructuring through Merger and Acquisition in the World Paper Industries (Since 1999)

USA	International Paper	Acquired Union Camp at $6.6 billion
	Weyerhaeuser	Acquired MacMillan Bloedel of Canada at $2.45 billion and the second largest corrugated cardboard manufacturer in the world.
	Georgia Pacific	Acquired Unisource Worldwide at $850 million.
	Kimberly Clark	Acquired Attisholz AG, a tissue manufacturer in Switzerland and became the largest bathroom tissue manufacturer in Europe.
	Smurfit・Stone Container	Sold share of Abitibi Consolidate, slashed corrugated cardboard/market pulp capacities in the U.S., and sold a newsprint mill. Planing to acquire St.Lawrent Paper Board at $1.4 billion in 2000.
Canada	Abitibi Consolidated	Plans to acquire Donohue at 7.1 billion Canadian Dollars in2000.becoming the giant newsprint manufacturer controlling 16% of the world market.
	Tembec	Acquired a NBKP mill of Crestbrookand a BCTMP mill of Donohue. In 2000, the company plans to acquire a NBKP mill of Fort James, jointly with Kruger
	Canfor	Acquired Northwood at635 million Canadian Dollar and became the largest market pulp maker in Canada.
Finland	Stora・Enso	Acquired Consolidated (31st in world ranking) at 4.9 billion Euro in 2000 and became the second largest in the world.
Sweden	Svenska Cellulosa	Merged with Modo’s woodfree paperdivision to establish Modo Paper and became the third largest in Europe.

Source: Pulp & Paper Week, JPA” Pulp & Paper No.616”

Attached Sheet No. 21

GRADE DEFINITIONS

The definitions below are intended to give a broad guide to the major grades specified in
the report.

PULP

The report shows figures for total pulp production, i.e. both integrated pulp and market pulp. Integrated pulp is pulp that is produced for use as row material in production of paper at the same mill, or for shipment by a producing mill to other mills, which it owns, controls or with which is affiliated within the same country. Market pulp is pulp that
is sold in open competition with that of other producers. All pulp exported exported from the producing country is considered to be market pulp.

MECHANICAL PULPS

Stone Groundwood pulp produced by grinding wood into relatively short fibres. This pulp is used mainly in newsprint and wood-containing papers, like LWC and SC papers.

Thermo-mechanical (TMP) pulp produced in a thermomechanical process where wood particles are softened by steam before entering a pressurized refiner. TMP has mainly the same end uses as Stone Groundwood.

Variants of the abkove two processes produce pressurized stone groundwood pulp and refiner mechanical pulp.

SEMI-CHEMICAL PULPS

Semi-chemical pulp produced in a two-stage process which involves partial digestion with chemicals, followed by mechanical treatment in a disc refiner. This pulp is mainly used in production of fluting medium for corrugated board.

Chemi-thermomechanical(CTMP) pulp produced in a similar way to TMP, but the wood particles are chemically treated before entering the fefiner. This pulp has properties suited to tissue manufacture. Some CTMP pulp is used in printing and writing grade. CTMP pulp is classified under semi-chemical pulps in the Harmonised System of the Customs co-operation council. In FAO, as well as other industry, such chemi-thermo-mechanical pulps are grouped with mechanical pulp.

CHEMICAL PULPS

Sulphite pulp produced by cooking wood chips in a pressure vessel in the presence of bisulphite liquor. End-uses range from newsprint, printing and writing papers, tissue and sanitary papers. Sulphite can be either bleached or unbleached.

Sulphate (or Kraft) pulp produced by cooking wood chips in pressure vessel in the presence of a sodium hydroxide (soda) liquor. The pulp may be unbleached or bleached End uses are widespread, with bleached pulp particularly used for graphic papers, tissue and carton boards. Unbleached pulp is commonly used in liner for corrugated board, wrappings, sack and bag papers, envelopes and other unbleached speciality papers.

DISSOLVING PULPS

Pulp which is highly refined, bleached sulphite or sulphate pulp with a high content of alpha (pure cellulose) fibre. Its normal end-uses are the production of rayon, acetate. cellophane. explosives etc. It is also used in speciality papermaking.

Chapter 3　RAW MATERIALS

Chapter 3 RAW MATERIALS

3.1 Potential Supply Sources and Major Issues

(1) Supply sources

In Lithuania, there are three types of pulpwood supply sources, as shown below.

* The following five species that are currently exported as pulpwood logs
  Spruce
  Pine
  Birch
  Aspen
  Alder
* Fuelwood
  Most fuelwood logs can also be used as pulpwood logs for BKP production in terms of diameter and length, unless species are not limited.
* Wood wastes from sawmills
  Chips that can be generated from sawmill wastes are discussed in the next section. Potential supply sources of domestic pulpwood logs (currently exported) and fuelwood logs are examined below.

1) Export pulpwood materials

As shown in Table 1.6.18 “Domestic Wood Consumption Trends,” logs exports from the country in recent years range between 760000 and 940000 m^3, most of which are reportedly pulpwood logs. Log sales by State Forest Enterprises – major suppliers of export logs – including export volume by market are summarized below.

Table 3.1.1 Roundwood Export & State Forest Enterprises' Pulpwood Sales

($1000m^3$)

	1996	1997	1998	1999
Log Export	952	764	786	936
S.F.E..' Sales	769	703	662	707

Souce: Center of Forest Economics
S.F.E. : State Forest Enterprises

Exports to Russia are reportedly shipped to three pulp mills in Kaliningrad and those to Latvia appear to be sent to Sweden.

Table 3.1.2 Main Export Countries

(1000m^3)

	1996	1997	1998	1999
Sweden	257	373	387	505
Poland	73	26	90	205
Russia	443	273	209	147
Latvia	28	36	85	47
Total	801	708	771	904

Souce: Center of Forest Economics

Table 3.1.3 State Forest Enterprises' Pulpwood Sales by Species

(1000m^3)

	1996	1997	1998	1999
Spruce P.	536	317	202	209
Pine P.	47	76	91	105
Birch P.	150	245	318	364
Aspen P.	34	54	49	28
Alder P.	2	11	2	1
Total	769	703	662	707

P. : Pulpwood   Souce: Center of Forest Economics

The major specifies for export is shifting from spruce to birch, while demand for aspen and alder is relatively small.

2) Fuelwood logs

Fuelwood production and consumption in the country is estimated at around 1 million m^3 per year. As pointed out earlier, fuelwood logs are basically same as pulpwood logs, except for species, and in fact they are used as “technological wood” to produce particleboards and fireboards. As the proposed 500,000 ton pulp mill require 2.5 million m^3 of pulpwood logs, a variety of logs need to be collected, not only pulpwood logs that are currently exported, but logs of diameter and length that are not suitable for sawmill production or other industrial uses, including fuelwood logs. The possible shortage of fuelwood due to conversion is discussed in the next section on sawmill wastes.

3) Wood supply outlook

The study team received wood supply forecast data from the Forest Inventory and Management Institute, national research organization on forest resources and accounting. The report, entitled the "Report on Structure of Roundwood Supply for the Next Two Decades (2000 – 2020) from the Commercial Forests in Lithuania," forecasts the annual average wood supply volume for the periods between 2000 and 2010 and between 2011 and 2020 by State Forest Enterprise, and 18 species (Scotch pine, Pinus Banks, mountain pine, Norway spruce, larch, oak, ash, maple, horn beam, elm, birch, black alder, aspen, gray alder, lime polar, goat willow, and willow).

The report also presents supply forecast by type of lumber and fuelwood. Lumber is classified into five types by diameter class (top diameter over bark), namely Large (d>=25.1), Medium I (25.0>d>=17.1), Medium II (17.1>=d>=13.6), Medium Total, and Small (13.5>=d>=5.6). Same estimation is made for state-owned forests.

The institute is currently compiling supply forecast for the next three decades, including Forest Group 2, logging residues and branches, and has presented its outline to the study team. In short, it contains the annual average supply forecast for the three periods between 2000 and 2010, between 2011 and 2020, and between 2021 and 2030 for the following categories:

- Total, state-owned forests and private forests
- Species (pine, spruce, oak, ash, birch, black alder, aspen, gray alder, others, and total)
- Harvest category (final cutting, thinning, sanitary, and total)
- Lumber, fuelwood, logging residue and branch
- Lumber's diameter class (see above)

The institute is currently compiling detailed data for publication in November 2000. Key data are shown in Table 3.1.4 "Wood Supply Outline (2001 – 2030)."

The proposed pulp mill is assumed to operate at 80% of capacity in the first year (2007), 95% in the second year (2008) and 100% in the third year and afterwards. Based on these operating rates, wood demand trends in the initial years are expected as follows.

	2007	2008	2009 and afterwards
Wood demand for domestic industry	3000	3000	3000
Demand by the new pulp mill	1960	2328	2450
Total	4960	5328	5450

As pulpwood log supply is expected to be very tight between 2008 and 2010, the wood material procurement plan should be established on the basis of fuelwood conversion. Supply and demand will be balanced in 2011 and afterwards.

4) Major issues related to wood material supply

For forestry in Lithuania, there are two major issues to be solved to meet the anticipated demand for 2.5 million m^3 of pulpwood logs by the new pump mill.

First of all, the country exports 1 million m^3 of pulpwood logs annually. Based on the annual allowable cut, forest resources in the country are not capable of meeting the new demand by the proposed pulp mill, while continuing the present level of exports. Clearly, it is imperative divert currently exported logs to the new mill operation.

Secondly, the bulk of forests in the country are now private owned, and the average forest area per owner is very small, 3 ha on the average. This means procurement needs to be made from a large number of forest owners (private forests are expected to represent 48% of the total in the near future). Efforts should be made to procure logs from small owners in an efficient manner by keeping good relationships with them.

Table3.1.4 Outline of Roundwood Supply

(2001---2010) (1000m^3)

	Large d>25	Medium Ⅰ 17<d<=25	Medium Ⅱ 13.5<d<=17	Medium Total	Small 13.5<d<=5.6	Log Total	Fuel wood	Grand Total
State Forests								
Softwood	730.2	409.2	332.0	741.2	341.8	1813.2	187.1	2000.3
Hardwood	430.5	266.1	396.7	662.8	262.3	1355.6	453.8	1809.4
Total	1160.7	675.3	728.7	1404.0	604.1	3168.8	640.9	3809.7
Private Forests								
Softwood	248.4	210.3	219.2	429.5	266.0	914.7	186.4	1130.3
Hardwood	263.4	182.2	448.3	630.5	279.5	1358.3	414.0	1587.4
Total	511.8	392.5	667.5	1060.0	545.5	2273.0	600.4	2717.7
Grand Total								
Softwood	978.6	619.5	551.2	1170.7	607.8	2727.9	373.5	3130.6
Hardwood	693.9	448.3	845.0	1293.3	541.8	2713.9	867.8	3396.8
Total	1672.5	1067.8	1396.2	2464.0	1149.6	5441.8	1241.3	6527.4
Total of P.R.	1759.1	991.8	998.1	2150.1	921.4	4830.6	975.7	5806.3
Difference	-86.6	76.0	398.1	313.9	228.2	611.2	265.6	721.1

P.R.: Previous Report : Report on structure of roundwood supply for the next two decade (2000-2020) from the commercial forests in Lithuania

(2011---2020)

	Large d>25	Medium Ⅰ 17<d<=25	Medium Ⅱ 13.5<d<=17	Medium Total	Small 13.5<d<=5.6	Log Total	Fuel wood	Grand Total
State Forests								
Softwood	744.5	405.4	331.4	736.8	532.5	2013.8	208.5	2222.3
Hardwood	348.5	218.3	353.3	571.6	316.7	1236.8	439.9	1676.7
Total	1093.0	623.7	684.7	1308.4	849.2	3250.6	648.4	3899.0
Private Forests								
Softwood	533.9	334.6	287.6	622.2	400.9	1557.0	202.0	1759.0
Hardwood	278.2	191.5	459.7	651.2	344.4	1273.8	455.6	1729.4
Total	812.1	526.1	747.3	1273.4	745.3	2830.8	657.6	3488.4
Grand Total								
Softwood	1278.4	740.0	619.0	1359.0	933.4	3570.8	410.5	3981.3
Hardwood	626.7	409.8	813.0	1222.8	661.1	2510.6	895.5	3406.1
Total	1905.1	1149.8	1432.0	2581.8	1594.5	6081.4	1306.0	7387.4
Total of P.R.	1909.1	1050.5	980.0	2195.3	1305.1	5409.5	888.9	6298.4
Difference	-4.0	99.3	452.0	386.5	289.4	671.9	417.1	1089.0

P.R.: Previous Report

(2021---2030)

	Large d>25	Medium Ⅰ 17<d<=25	Medium Ⅱ 13.5<d<=17	Medium Total	Small 13.5<d<=5.6	Log Total	Fuel wood	Grand Total
State Forests								
Softwood	775.4	430.6	368.1	798.7	676.4	2250.5	234.5	2485.0
Hardwood	322.3	195.6	333.1	528.7	313.0	1164.0	410.3	1574.3
Total	1097.7	626.2	701.2	1327.4	989.4	3414.5	644.8	4059.3
Private Forests								
Softwood	724.9	409.8	341.0	750.8	515.7	1991.4	219.8	2211.2
Hardwood	284.0	179.8	442.1	621.9	363.6	1269.5	447.1	1716.6
Total	1008.9	589.6	783.1	1372.7	879.3	3260.9	666.9	3927.8
Grand Total								
Softwood	1500.3	840.4	709.1	1549.5	1192.1	4241.9	454.3	4696.2
Hardwood	606.3	375.4	775.2	1150.6	676.6	2433.5	857.4	3290.9
Total	2106.6	1215.8	1484.3	2700.1	1868.7	6675.4	1311.7	7987.1

Souce: Forest Inventory and Management Institute

(2) Proposals to secure wood supply sources

1) Export pulpwood logs

At present, pulpwood logs produced in Lithuania are exported via Klaipeda Port, Pagegia or Kybartai station (destined to Kaliningrad), Sestokai station (Poland), and Sarkiai or Mazeikiai station (Latvia).

To intercept these flows and divert them to the proposed pulp mill, it is proposed to establish pulpwood log collection points (referred to as “district offices”) at the following four stations:

1. Plunge station: To collect logs that are currently shipped to Klaipeda.
2. Taurage: To collect logs that are currently shipped to Pagegiai
3. Kazlu Ruda: To collect logs that are currently shipped to Kybartai and Sestokai
4. Siauliai: To divert logs that are currently shipped to Sarkiai and Mazeikiai

These four district offices will perform the following functions:

1. Negotiation with State Forest Enterprises on log purchase, contract administration, acceptance, and transportation to the mill
2. Negotiation with private forest owners on log purchase, contract administration, delivery management, and transportation to the mill
3. Operation and management of log storage yards (referred to as “terminals,” each having land area of 2 –3ha and used to store pulpwood logs purchased by district offices and load them to rail freight cars.
4. Inspection and acceptance of pulpwood logs

2) Small lot procurement from private forest owners

As State Forest Enterprises have expertise and experience in handling logs and own handling and transportation facilities and equipment (including rail stations), district offices should ask them to transport purchased logs by rail or truck to the mill site.

On the other hand, procurement from private forest owners will likely be made in small lot (e.g., a small truck load). It is therefore proposed to establish the following district offices at key railway stations, which will be responsible for procurement service:

1. Kupiskis

2. Utena
3. Jonava
4. Vilnius
5. Varena

Together with the four district offices proposed above, the nine district offices will be established to ensure sufficient geographical coverage (see Figure3.1.1)

3) Use of fuelwood logs

It is already discussed in the previous section.

4) Acceptance of logs by weight

It is proposed to accept log delivery on the basis of weight, which is particularly suitable for small logs.

5) Imports of pulpwood logs

At present, Lithuania exports 1 million m^3 of pulpwood logs annually. Exporters handling the trade (closely associated with foreign pulp companies) will not likely give up their business easily to the new pulp mill as they have large stakes in facilities and goodwill. If they intend to continue exports in competition with the paper mill, supply will become very tight up to 2010 and pulpwood log prices will inevitably rise sharply. If this occurs, imports from Belarus and Latvia are recommended as a temporary measure. In this connection, it is important to secure import channels in advance.

Figure 3.1.1 Distribution of 9 District Office and Collection Zones

3.2 Sawmill Wood Wastes and Chips

(1) Supply potential and major issues

1) The number and size of sawmills

Table 3.2.1 presents the number of sawmills by purchase volume from State Forest Enterprises.

Table 3.2.1 The Number of Sawmills by Log Volume Purchased from State Forest Enterprises (1999)

	(A) Percentage of volume purchased from S.F.E..(%)	(B) Volume purchased from S.F.E.. ($1000m^3$)	(C) Nummber of mills	(D) Average volume purchased from S.F.E. ($1000m^3$)
Plywood & boardmills ①	16	291.0	4	72.8
Log volume purchased from S.F.E.. by sawmills				
>10000m3	33	599.7	27	22.2
5000-10000m3	14	254.5	39	6.5
1000-5000m3	25	454.4	199	2.3
100-1000m3	12	218.1	556	0.4
Total	100	1817.7	825	2.2
'Total except ①	84	1526.7	821	1.9

Log volume purchased from S.F.E. by sawmills	(E) Percentage of volume purchased from P.F..(%)	(F) Volume purchased from P.F. ($1000m^3$)	(G) Total volume (S.F.E+P.F.) ($1000m^3$)	(H) Average total volume (S.F.E+P.F.) ($1000m^3$)
>10000m3	39	382.2	981.9	36.4
5000-10000m3	17	162.2	416.7	10.7
1000-5000m3	30	289.6	744.0	3.7
100-1000m3	14	139.0	357.1	0.6
Total	100	973.0	2499.7	3.0

S.F.E..: State Forest Enterprises, P.F.: Private Forests,
Source: Calculated by using Center of Forest Economics' data

Compared to the estimated consumption of sawmill logs (2.5 million m^3) in Table 1.6.19 “Industrial Wood Consumption Trends,” 1526700 m^3 accounts for 61%. Generally, sawmills obtain 80% of their log requirements from State Forest Enterprises. As seen in Figure 1.6.8 “Flow of Logging Operations (1999),” 1.6.2(6) “Logging Operations,” private logging operations account for 33% of the total, reaching 1.6 million m^3, so that it is reasonable to contribute that they contribute 39% of the total deficit in sawmill logs, 973000 m^3 (equivalent to 61% of 1.6 million m^3).

There are no statistical data available to show movement of logs harvested in private forests to sawmills. In any case, assuming that the same percentage of logs from private forests as state-owned forests is purchased by sawmills, 66 large sawmills (purchasing more than 5000m^3 of logs from state-owned forests) seem to account for an anomalously high share. For instance, 27 sawmills which purchase more than 1000m^3 of logs from state-owned forests (see Table 3.2.1) produce an average 16700 m^3 (36400 m^3 x estimated yield of 46%), which far exceeds the average sawmill production of 11700m^3 in Table 3.2.2.

Table 3.2.2 Sawmills' Production Volume

(1000m^3)

No	Name	Place	1998	1999	Remarks
1	Pajurio mediena	Klaipeda	16.4	32.7	exporting chips without barks
2	G.Kaminsko jm.	Prienai	18.0	21.0	selling chips without barks to boardmill
3	Birzuuredija	Birzai	16.6	19.0	
4	Timbex Arima	Radviliskis	15.0	14.7	
5	Baltic Wood	Mazeikiai	10.4	14.0	exporting chips without barks
6	Silunga	Alytus	3.9	13.4	
7	Ukmerges uredija	Ukmerge	8.9	9.7	
8	Jonavos uredija	Jonava	8.4	9.3	
9	Vilniaus mediena	Vilnius	8.1	8.4	
10	Taurages uredija	Taurage	9.0	8.2	
11	S.Bagdono jm.	Siauliai	8.0	10.0	
12	Klijuota mediena	Kaunas	10.0	10.0	
13	Dubravos uredija	Kaunas	6.8	7.8	
14	Egle	Kazlu Ruda		7.7	
15	Nemencines uredija	Vilnius	10.1	7.3	
16	Oslo Wood	Vilnius	6.8	6.9	
17	Jurbarko uredija	Jurbarkas	6.7	6.8	
18	Kaisiadoriu uredija	Kaisiadorys	9.9	6.8	
19	Juodeliai	Marijampole	6.0	8.0	
	Total		179.0	221.7	
	Average		9.9	11.7	

Source: Center of Forest Economics

Aside from some questionable items, Table 3.2.1 present the first target group of 27 large sawmills which are considered to be potential sources of debarked chips (in fact, 3 produce debarked chips), among 821 sawmills in the country. Some of them produce chips with barks and sell them to customers.

A logical option is to contract with these sawmills to supply chips with barks to the new mill, while assisting them in making wood wastes into fuelwood products by providing financial and technical assistance. The arrangement should be done during the mill construction period.

2) Current state of waste chip production

While there are more than 800 sawmills of varying size throughout the country, only three facilities produce barked chips by installing debarking and chipping facilities (Nos.1, 2 and 5 in Table 3.2.2). Some sawmills have chipping facilities and produce chips with barks. In fact, sawmills under State Forest Enterprises reported chip sales of 45300m^3 (sales price 25 LTL) in 1999.

3) Productive use of wood wastes generated from sawmills

For sawmills which do not have chipping facilities, disposal of wood wastes (barks, cutting wastage and sawmills wastes) is a serious problem. Some sawmills are occupied by wood wastes generated over years. Thus, purchase of waste chips by the new pulp mill must be a good news for many saw mills. It will provide incentive for sawmills to invest in debarking and chipping facilities.

Some sawmills produce stick fuels from cutting wastage and barks which are crushed into power and heat treated. Fuelwood products are an important raw material for forestry, and if such fuels can be widely used to replace fuelwood products, it is highly desirable from the viewpoint of promoting the effective use of natural resources.

<u>Reference data</u>

Annual sawmill log consumption	2500000m^3
Amount of barks generated (12%)	300000m^3
Amount of cutting wastage generated (25%)	625000m^3
Amount of chips generated (25%)	625000m^3
Amount of sawmill products generated (50%)	1250000m^3

(2) Preliminary proposal for wood material sourcing

1) To establish a collection system for 2.5 million m^3 of pulpwood logs.

2) After the mill operation has started, to contract with sawmills near the pulp mill, which are specialized in processing softwood, to supply waste chips to the mill. Waste chips can be a stable supply source so long as the sawmill continues to operate, and there is no risk for the pulp mill to secure logs to produce chips.

If the arrangement works well, the contract can serve as a model case to be followed by other sawmills.

3) Also, a large quantity of softwood chips serves as another advantage. In fact, the establishment of the waste chip collection system should be given of highest priority after the pulpwood log collection system in 1) is established.

4) Once the purchase of waste chips increases, the relationship with sawmills grows to encourage the establishment of the mutually beneficial relationship.

3.3 Material Procurement Planning Framework

(1) Wood material procurement plan

To meet pulpwood requirements of 2.5 million m^3 (accounting for 40% of the annual allowable cut), procurement should be made from forest resources throughout the country. The procurement process starts from the establishment of key collection points. The nine district offices should be established as proposed in 3.1 (2) 1) and 2) and their service areas should be delineated.

1) Delineation of service areas of the nine district offices

Service areas of the nine district offices were delineated with reference of jurisdictions of State Forest Enterprises and on the basis of distance data measured on the map. The results are shown in Table 3.3.1 and Figure 3.1.1.

2) Procurement of pulpwood logs from state-owned forests

State Forest Enterprises will become major pulpwood suppliers for the new mill. In fact, it is impossible to procure 2.5 million m^3 of logs without their cooperation. They have expertise and experience in mass production, sales and transportation of wood and own related facilities and equipment. It is therefore desirable to have them transport purchased logs by rail or truck to the mill site. As they are expected to supply more than one half of pulpwood requirements for the mill, their cooperation will be helpful, particularly during the initial period of mill operation. Note that payment should be made within 40 days after delivery of pulpwood logs (to be shorted to 30 days).

Table 3.3.1 Territory Allotment to 9 District Offices

(%)

No.	No.	District Office / State Forest E.	Plunge	Siauliai	Kupiskis	Utena	Vilnius	Varena	Kazlu Ruda	Taurage	Jonava	Total
1	3	Birzu			100							100
2	41	Veisieju						20	80			100
3	5	Ignalinos				100						100
4	9	Kaisiadoriu									100	100
5	10	Kauno									100	100
6	13	Kedainiu									100	100
7	21	Panevezio			40						60	100
8	23	Prienu							40		60	100
9	24	Radviliskio		100								100
10	25	Raseiniu								100		100
11	33	Taurages								100		100
12	36	Traku					50	25			25	100
13	30	Siauliu		100								100
14	31	Silutes	50							50		100
15	8	Jurbarko								100		100
16	1	Alytaus						70	30			100
17	4	Druskininku						100				100
18	45	Dzukijos NP						100				100
19	39	Valkininku					40	60				100
20	19	Nemencines					100					100
21	29	Salcininku					100					100
22	17	Marijampoles							100			100
23	28	Sakiu							100			100
24	22	Plunges	100									100
25	26	Rietavo	60							40		100
26	18	Mazeikiu	70	30								100
27	34	Telsiu	100									100
28	20	Pakruojo		100								100
29	7	Joniskio		100								100
30	35	Tytuvenu		70						30		100
31	38	Utenos				70	15				15	100
32	2	Anyksciu			30	30					40	100
33	43	Zarasu				100						100
34	15	Kupiskio			100							100
35	6	Jonavos									100	100
36	11	Dubravos							10		90	100
37	12	Kazlu Rudos							100			100
38	16	Kursenu		100								100
39	27	Rokiskio			50	50						100
40	32	Svencioneliut				100						100
41	37	Ukmerges									100	100
42	40	Varenos						100				100
43	14	Kretingos	100									100
44	42	Vilniaus					80				20	100
45	44	Aukstaitijos NP				100						100
47	47	Zemaitijos NP	100									100
48	48	Traku INP										0

	Plunge	Siauliai	Kupiskis	Utena	Vilnius	Varena	Kazlu Ruda	Taurage	Jonava
Distance from Gaiziunai (km)									
(by Rayway)*1	223	123	201	216	90	133	72	215	7
(by Road)	224	135	146	109	124	163	85	168	7
Distance from Alytus (km)									
(by Rayway)*1	398	298	376	383	257	286	103	390	182
(by Road)	275	229	240	220	100	45	107	219	125
Distance from Vievis (km)									
(by Rayway)*1	271	171	249	168	42	85	98	263	55
(by Road)	247	218	212	192	38	119	108	191	90

*1: From Mr.Liljeblad's Data (Source: Ministry of Transport and Communications)

3) Small-lot purchase from private forest owners

As discussed earlier, pulpwood logs from private forests need to be purchased from a large number of forest owners, each in relatively small quantities (although the use of brokers may be considered). Thus an elaborate collection system should be planned and established to ensure efficient collection and transportation of purchased logs.

Basically, purchased logs should be transported by each district office to specific collection points for temporary storage, from which they are transported by truck or rail on a dairy basis.

Each district office should perform the following functions, together with required facilities:

① Terminal's storage capacity: 30000 at maximum (land area of 3ha)

② Terminal facilities and equipment to load, unload and handle logs to trucks or rail freight cars (including large log loader)

③ Inspection and acceptance capabilities at terminals (availability of inspector)

④ Contract administration and payment capabilities (Exporters currently purchasing logs make payment within a few days after delivery.)

4) Quantity of pulpwood logs to be handled by each direct office

The report, entitled the "Report on Structure of Roundwood Supply for the Next Two Decades (2000 – 2020) from the Commercial Forests in Lithuania," published by the Forest Inventory and Management Institute (not including Forest Group 2), forecasts the annual average cut for each of two periods (2000-2010 and 2011-2020) for each State Enterprise, state-owned forests or private forests, species, lumber or fuelwood (for lumber, by diameter class).

For the annual average cut by lumber and species during the 2011 – 2020 period, a total of the figures for Small (13.5>=d>=5.6; top diameter over bark, em), Medium II (17.1>=d>=13.6) were added to those for Medium Total (oak, ash, maple, horn beam, elm, gray alder, willow, each quantity is small) to obtain the total value for each district office, as shown in Table 3.3.2.

Table 3.3.2 Estimated Pulpwood Procurement by District Offices (2011--2020)

(1000m³)

District Offices	Softwood Total	Pine	Spruce	Others	Hardwood Total	Birch	Aspen	Alder	Others	Grand Total	%
Plunge	177.6	31.9	145.6	0.2	139.9	58.0	14.5	48.30	19.00	317.5	12.9
Siauliai	127.3	14.4	112.8	0.1	161.9	61.6	23.2	45.9	31.2	289.1	11.8
Kupiskis	77.7	21.5	56.1	0.10	130.4	51.1	13.5	48.8	17.0	208.1	8.5
Utena	176.6	94.0	82.4	0.2	128.9	59.0	10.2	53.1	6.6	305.5	12.4
Vilunius	185.0	110.7	73.5	0.7	66.5	33.7	5.6	21.5	5.6	251.4	10.2
Varena	192.7	159.8	30.0	2.8	40.8	20.9	2.9	10.1	7.0	233.4	9.5
Kazlu Ruda	117.7	57.0	60.1	0.5	78.8	29.0	7.1	28.5	14.2	196.4	8.0
Taurage	148.3	37.5	110.8	0.1	114.9	45.0	13.4	40.3	16.2	263.2	10.7
Jonava	177.6	67.5	110.1	0.1	215.2	82.7	28.3	61.6	42.7	392.8	16.0
Total	1380.3	594.1	781.4	4.8	1077.1	440.9	118.6	358.0	159.6	2457.36	100.0
%	56.2				43.8					100.0	

(2) Log transportation costs

The supplier (seller) will bear transportation costs up to the district office terminal, and the pulp mill (buyer) will bear the unloading cost (truck or rail freight car) at the terminal.

If the State Forest Enterprise or the large supplier transports logs directly from the logging site to the mill, not via the direct office terminal, the purchase price will be determined by adding the transportation cost (truck or rail) from the district office and the mill and the loading cost at the terminal.

Table 3.3.3 shows distances between the district offices and the candidate mill sites, as indicated in lower columns of Table 3.3.1 "Service Areas of District Offices."

Table 3-3.3 Transportation Disances between District Offices and Proposed Mill Sites

District Office	Plunge	Siauliai	Kupiskis	Utena	Vilnius	Varena	Kazlu Ruda	Taurage	Jonava
Distance from Gaiziunai(km)									
(by Rayway)*1	223	123	201	216	90	133	72	215	7
(by Road)	224	135	146	109	124	163	85	168	7
Distance from Alytus(km)									
(by Rayway)*1	398	298	376	383	257	286	103	390	182
(by Road)	275	229	240	220	100	45	107	219	125
Distance from Vievis(km)									
(by Rayway)*1	271	171	249	168	42	85	98	263	55
(by Road)	247	218	212	192	38	119	108	191	90

*1: From Mr.Liljeblad's Data (Source: Ministry of Transport and Communications)

1) Comparison of truck and rail transportation costs between the district offices and the candidate mill sites

In the case of rail transport, the per-ton transportation cost varies between 40-ton and 70-ton freight cars. The unit transportation cost for the 70-ton freight car is approximately 65% of that for the 40-ton car.

Comparison of truck and rail transportation costs between the district offices and the candidate mill sites is made on the basis of the following data.

① In the case of rail transport, the unit transportation cost (freight charge for the 40-ton car was applied as it is not certain if the 70-ton car is always available) was calculated on the basis of distances between the candidate sites and key stations, which were estimated from data furnished by the Ministry of Transport and Communications, and the loading cost is estimated at 4LTL/ton.

② In the case of truck transport, the transportation cost is assumed to be 2.4LTL/km on the basis of data obtained from the Nemencines and Ukmerges State Enterprises, and the loading cost is estimated at 3LTL/ton.

③ 1 ton = 1sub from Table 3.3.4 "Wood Weight by Species."

④ In "Rail/Truck" column in Table 3.3.5 "Comparison of Truck and Rail Transportation Costs Between the Direct Offices and the Candidate Sites," "R" is specified if rail transport has cost advantage and "T" for truck.

Note that rail transport does not always shows cost advantage at a longer distance as it may take a significantly different route from truck transport.

Table 3.3.4 Wood Weight by Species

(kg /m^3)

Species	Green Wood	Half Dried Wood
Pine	863.0	600.0
Spruce	794.0	550.0
Birch	878.0	710.0
Aspen	762.0	530.0
Black alder	827.0	590.0
Grey alder	800.0	520.0
Oak	1020.0	800.0
Ash	924.0	780.0
Maple	960.0	750.0
Horn beam	988.0	790.0
Elm	950.0	740.0
Lime	792.0	580.0

Source: Depertment of Forests and Protected Areas

Table 3.3.5 Transportation Cost Comparison between by Railway Wagon and by Truck from District Offices to Proposed Mill Sites

District Office State F. E.	Plunge	Siauliai	Kupiskis	Utena	Vilnius	Varena	Kazlu Ruda	Taurage	Jonava
Distance from Gaiziunai									
(by Rayway) km	223	123	201	216	90	133	72	215	
LTL/t *1	22	18	22	22	10	18	11	22	
Loading cost LTL/t	4	4	4	4	4	4	4	4	
Total	26	22	26	26	14	22	15	26	
(by Road) km	224	135	146	109	124	163	85	168	
@ LTL/km	0.109	0.109	0.109	0.109	0.109	0.109	0.109	0.109	
LTL/t	24	15	16	12	14	18	9	18	
Loading cost LTL/t	3	3	3	3	3	3	3	3	
Total	27	18	19	15	17	21	12	21	
Rail or Truck	R	T	T	T	R	T	T	T	T
Distance from Alytus									
(by Rayway) km	398	298	376	383	257	286	103	390	182
LTL/t *1	22	18	22	22	17	18	11	22	14
Loading cost LTL/t	4	4	4	4	4	4	4	4	4
Total	26	22	26	26	21	22	15	26	18
(by Road) km	275	229	240	220	100	45	107	219	125
@ LTL/km	0.109	0.109	0.109	0.109	0.109	0.109	0.109	0.109	0.109
LTL/t	30	25	26	24	11	5	12	24	14
Loading cost LTL/t	3	3	3	3	3	3	3	3	3
Total	33	28	29	27	14	8	15	27	17
Rail or Truck	R	R	R	R	T	T	T	R	T
Distance from Vievis									
(by Rayway) km	271	171	249	168	42	85	98	263	55
LTL/t *1	18	14	16	13	8	10	10	17	9
Loading cost LTL/t	4	4	4	4	4	4	4	4	4
Total	22	18	20	17	12	14	14	21	13
(by Road) km	247	218	212	192	38	119	108	191	90
@ LTL/km	0.109	0.109	0.109	0.109	0.109	0.109	0.109	0.109	0.109
LTL/t	27	24	23	21	4	13	12	21	10
Loading cost LTL/t	3	3	3	3	3	3	3	3	3
Total	30	27	26	24	7	16	15	24	13
Rail or Truck	R	R	R	R	T	R	R	R	R&T

*1: From Mr.L'iljeblad's Data (Souce: Ministry of Transpot & Communications

2) Comparison of the candidate sites based on transportation cost

Transportation costs for the candidate sites were estimated on the basis of pulpwood volume procured by each district office (Table 3.3.2) and the unit transportation cost, truck or rail, selected from Table 3.3.5. The results are summarized in Table 3.3.6 indicating that Gaiziunai (Jonava City) is the best location from the standpoint of pulpwood transportation cost.

Table 3.3.6 Transportation Costs for the Candidate Sites

District Offices	Volume (1000m^3)	To Gaizunai R. or T.	To Gaizunai LTL /m^3	To Gaizunai (1000 LTL)	To Alytus R. or T.	To Alytus LTL /m^3	To Alytus (1000 LTL)	To Vievis R. or T.	To Vievis LTL /m^3	To Vievis (1000 LTL)
Plunge	317.46	R	26	8253.96	R	26	8253.96	R	22	6984.12
Siauliai	289.14	T	18	5204.52	R	22	6361.08	R	18	5204.52
Kupiskis	208.06	T	19	3953.14	R	26	5409.56	R	20	4161.20
Utena	305.46	T	15	4581.90	R	26	7941.96	R	17	5192.82
Vilunius	251.41	R	14	3519.74	T	14	3519.74	T	7	1759.87
Varena	233.41	T	21	4901.61	T	8	1867.28	R	14	3267.74
Kazlu Ruda	196.40	T	12	2356.80	T	15	2946.00	R	14	2749.60
Taurage	263.20	T	21	5527.20	R	26	6843.20	R	21	5527.20
Jonava	392.82	T		0.00	T	17	6677.94	R&T	13	5106.66
Total	2457.36		15.59	38298.87		20.27	49820.72		16.26	39953.73
Index				100			130.0840469			104.3209108

(3) Purchase prices

1) Market price trends and statistical adjustment

Market prices of pulpwood logs in Lithuania are indicated as FOB Klaipeda or at the border (with Kaliningrad, Poland and Latvia) as they are currently exported in entire quantity. The unloading cost is borne by the buyer (exporter), and so is the transportation cost after the boarder in the case of land transport.

Price trends by species in Table 3.3.7 are based on sales prices of State Forest Enterprises (Free Klaipeda Harbour & Lithuanian Borders) from July 1993 to May 2000. These are illustrated in Figure 3.3.1 in the form of a linear regression equation obtained by the method of least squares for each species. Table 3.3.8 compares the theoretical price in May 2000 estimated from the regression analysis and the actual market price. The former was calculated because of significant fluctuation of pulpwood log prices which makes the current price deviate largely from the past trend and renders it unsuitable for the basis of financial analysis.

Table 3.3.7 Dynamics of Pulpwood Prices by Species

(LTL/m^3)

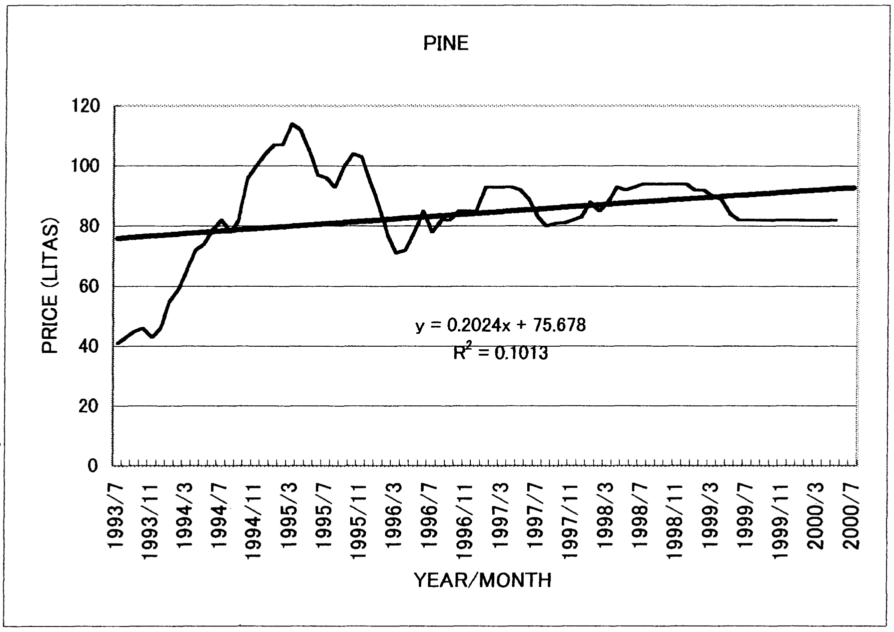
Year	Month	Pine	Spruce	Birch	Aspen	Alder
1993	7	41	36	49		
	8	43	41	51		
	9	45	44	54	38	
	10	46	41	57	32	
	11	43	40	52	24	
	12	46	44	52	31	
1994	1	55	46	55	26	
	2	59	56	59	33	
	3	65	57	66	32	
	4	72	63	72	38	
	5	74	64	75	36	
	6	79	75	81	44	
	7	82	76	83	50	
	8	78	76	83	48	
	9	82	75	84	46	
	10	96	87	96	51	47
	11	100	90	103	57	46
	12	104	94	109	61	53
1995	1	107	102	117	70	56
	2	107	105	116	74	53
	3	114	107	116	73	55
	4	112	104	119	65	56
	5	105	103	123	69	57
	6	97	101	125	68	53
	7	96	98	126	73	55
	8	93	100	126	72	55
	9	100	92	127	72	58
	10	104	86	127	72	45
	11	103	82	119	64	45
	12	95	81	98	56	45
1996	1	87	73	95	53	45
	2	77	67	83	49	
	3	71	66	84	45	
	4	72	62	76	40	
	5	78	59	67	40	
	6	85	53	77	40	
	7	78	55	79	40	
	8	82	56	79	41	42
	9	82	58	82	47	40
	10	85	63	87	46	42
	11	85	66	88	48	42
	12	85	69	89	50	42

(LTL/m^3)

Year	Month	Pine	Spruce	Birch	Aspen	Alder
1997	1	93	72	95	56	45
	2	93	78	96	57	45
	3	93	77	96	56	45
	4	93	77	98	57	45
	5	92	79	98	56	45
	6	89	82	96	57	46
	7	83	73	95	54	45
	8	80	73	92	54	45
	9	81	75	92	51	45
	10	81	74	93	53	45
	11	82	76	97	53	45
	12	83	79	98	51	45
1998	1	88	87	105	58	45
	2	85	86	106	59	45
	3	88	86	107	55	45
	4	93	87	112	57	45
	5	92	88	112	58	45
	6	93	88	112	59	45
	7	94	87	113	57	45
	8	94	91	112	57	45
	9	94	92	113	58	45
	10	94	92	111	56	45
	11	94	91	106	59	
	12	94	92	106	58	
1999	1	92	92	104	54	
	2	92	92	103	50	
	3	90	91	100	58	
	4	89	91	94	54	
	5	84	84	84	52	
	6	82	82	81	55	
	7	82	80	82	49	
	8	82	78	82	56	
	9	82	79	82	56	
	10	82	80	81	48	
	11	82	82	81	51	40
	12	82	81	80	57	40
2000	1	82	89	82	50	
	2	82	89	82	48	
	3	82	90	82	49	
	4	82	88	82	49	
	5	82	83	82	50	

Souce: Center of Forest Economics

Figure 3.3.1 Dynamics of Pulpwood Prices by Species (1)



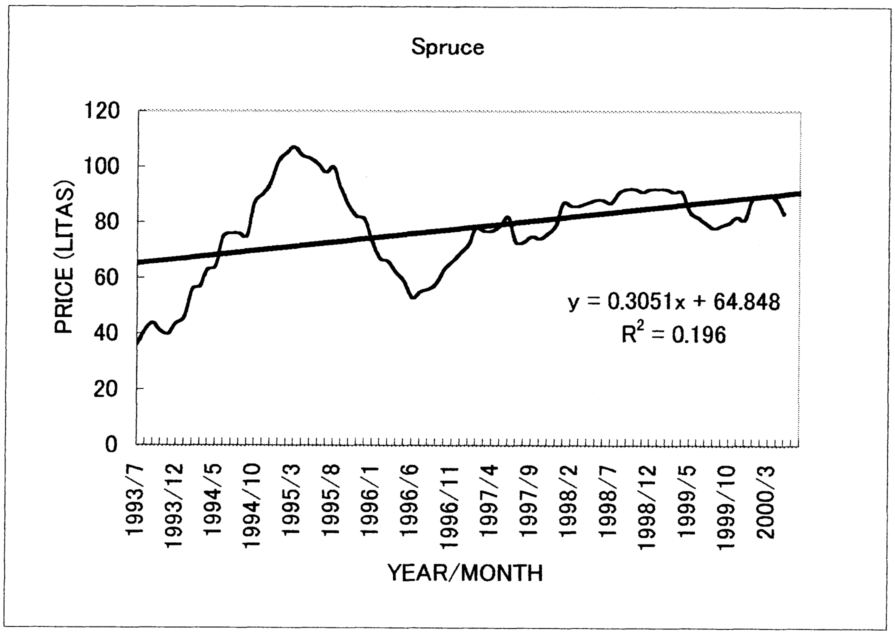
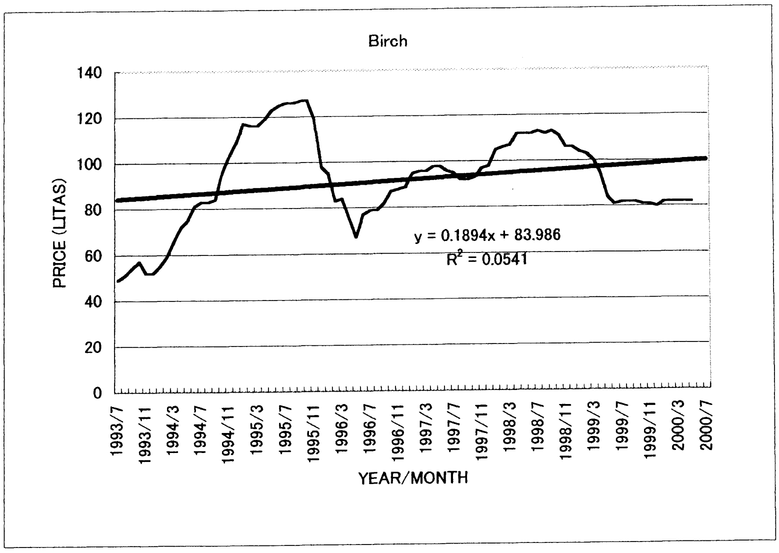
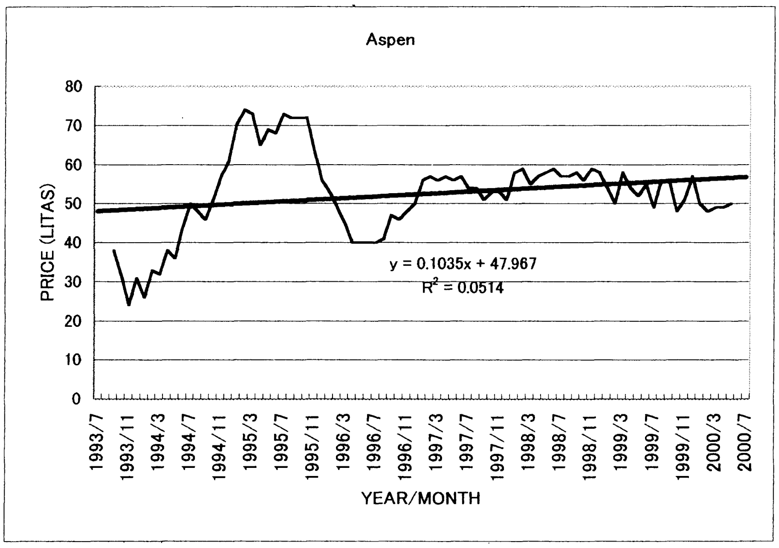


Figure 3.3.1 Dynamics of Pulpwood Prices by Species (2)





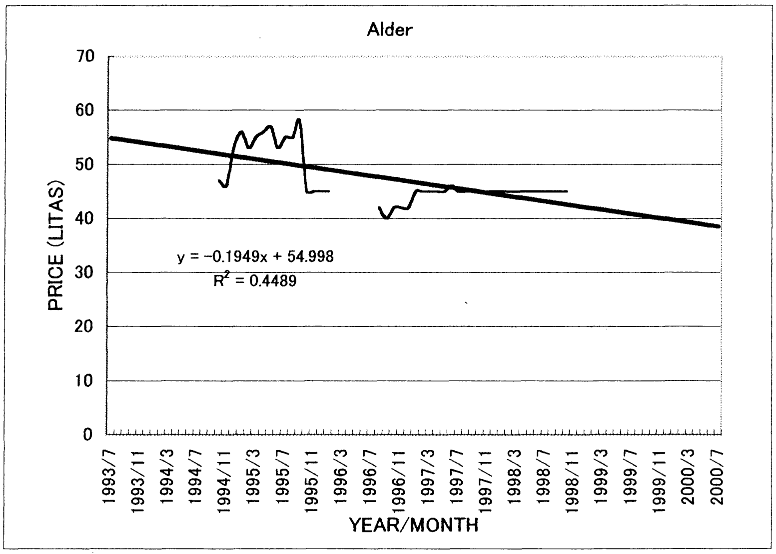


Table 3.3.8 Pulpwood Price Comparison between Actual and Calculated Ones in May 2000

(LTL/m^3)

	Actual Price (A) in May, 2000	Calculated Price (B)	(B)/(A)*100
Pine	82	92.48	113
Spruce	83	90.17	109
Birch	82	99.71	122
Aspen	50	56.56	113
Alder		38.82	

2) Estimation of purchase prices

As discussed in 3.1 (2) 1), the following four district offices (Plunge, Taurage, Kazulu Ruda, and Siauliai) will be established to intercept and divert pulpwood logs for exports to the proposed mill.

Obviously, purchase prices by the pulp mill must be at least same as current export prices. At lower price levels, the district offices will not be able to compete with exporters. Thus, the purchase price by the four district offices is assumed to be the current export price.

Similarly, purchase prices by other five district offices (Kapiskis, Utena, Jonava, Vilnius, Varena) are assumed to be same as export prices, and these prices are based on FAF, i.e., export prices less the transportation cost between the district office and the mill site, which are assumed to be the purchase price at terminal by the five district offices. As a result, the purchase price will vary among the district offices.

This price setting is at least equivalent to or better than the current prices offered by exporters to suppliers, depending upon the logging location, and therefore constitutes the minimum purchase condition required to compete with export demand.

3) Estimation of mill prices

Basic assumptions

① Quantity of pulpwood logs to be procured by each of the nine district offices is obtained from Table 3.3.2.

② The transportation cost for each office uses the lowest cost (Gaiziunai) among those listed in Table 3.3.8.

③ The pulpwood log price for each office is based on the price data in Table 3.3.8 (comparing the theoretical and actual prices in May 2000) and is determined according to the principles discussed in 3.3 (3) 2).

④ The cost related to the district office's terminal and its operation is assumed to be 5.6LTL/ton (including the unloading (truck) and loading (rail) costs, lining and administration costs), based on the data in Sweden (12SEK/ton = USUSD1.4/ton). Then, the loading cost (4LTL for rail and 3LTL for truck) is added to assume a risk of cost increase related to the new terminal construction.

The results of the above estimation are summarized in Tables 3.3.9 through 3.3.17. In addition, Table 3.3.18 "Mill Prices for the Candidate Sites" compares the mill prices for Gaiziunai and other two candidate sites.

Chapter 4　MILL SITE

Chapter 4 MILL SITE

4.1 Introduction

The Lithuanian Forest Sector Master Plan, prepared 1992-1993 during the first phases of the Lithuanian Forest Sector Development Programme (FSDP), recommended that further studies should be carried out concerning the feasibility of a new green-field kraft pulp mill in Lithuania with a possible production start before end of year 2005. The Lithuanian Government and concerned ministries and institutions supported the proposal and some minor studies were conducted during the end of the 90's. The present study has encompassed a more detailed analysis of possible investment alternatives, including more detailed discussions and screening of potential mill sites for the mill.

Already during the course of the Master Plan Project some potential areas for a new kraft pulp mill were tentatively discussed. However, at that stage no field surveys, nor any technical/financial analyses, were carried out, and no specific sites identified. The suggestions of potential areas for a new mill were based on rough judgements and tentative information about wood supply, infrastructure conditions, possible access to fresh water and potential waste water recipients, etc. No environmental restrictions were included at that stage.

The regions and mill site areas, tentatively identified in the Master Plan Project, have been used as a basis for this study. However, the list of potential sites has been revised and new alternatives added in order to broaden the geographical coverage.

Below, in Section 4.2, the methodology applied in the process for screening out suitable and most favourable mill sites is briefly described. The potential areas investigated, are presented in Section 4.3. Additional information on concerned counties and specific sites are presented in Annexes 4-1 and 4-2 respectively (see end of Chapter 4). In Section 4.4 below, the findings from this screening and evaluation of potential sites are presented. The most favourable sites selected and suggested for further analyses are presented in Section 4.5.

Specific consideration in the site selection process has been taken to environmental restrictions and the possible actions available to mitigate negative effects of a mill establishment. These issues are discussed below but are discussed more in detail in Chapter 5 – “Environmental Aspects”.

It should be noticed that the word "site" is used in this report in a somewhat broader sense. It is thus not the intention to exactly point out and decide upon the borders of the different sites, but to limit the area, where a possible mill could be located, to a level allowing for relevant and reliable technical analyses and economic calculations on a pre-feasibility level.

It should further be noticed that, although the primary goal of present study is to analyse the potential for a Lithuanian pulp mill, a possible paper mill to be built at a later point of time is also, when relevant, considered in the analyses and site selection process.

4.2 Site selection method

4.2.1 Screening procedure

A stepwise approach has been applied in the evaluation and screening of potential mill sites. In the first step a list of potential areas – districts (rajonas) and sub-districts - was prepared where a mill site possibly could be located. This list was primarily based on the preliminary recommendations from the Lithuanian Forest Sector Master Plan Project. The list was complemented with new areas, identified during the preparation and the initial work of this study, and which were considered of great interest as potential places for location of a pulp mill.

In a second step, representatives of the Consultant's team visited all proposed counties and districts. In cooperation with local authorities and experts, more specific areas or possible mill sites were identified. These identified and locally suggested sites made up the first "Long List" of potential sites for the pulp mill. After some complements during the course of the study the "Long List" of mill sites finally encompassed 20 sites. See further Section 4.3 below.

During the first field survey, the site area, infrastructure conditions, water supply and possible recipient of treated wastewater, etc., was reviewed for each site on the "Long List". Meetings were held in all places with local politicians on county (apskritis), district (rajona) and sub-district levels, as well as with environmental specialists and relevant technical experts.

The information obtained from the field visits and data received from local sources were thereafter further analysed and complemented with information and viewpoints from Ministries, state institutes, NGOs and private enterprises, etc. Information was gathered for example about water flow in rivers, identified as possible sources of raw water for the mill and as recipients of treated wastewater, about local environmental restrictions, including possibly protected rivers (species of fishes), and about infrastructure conditions of relevance for the study. Aspects considered in the survey and analysis of potential sites are listed and further discussed below.

Based on the findings from the initial field surveys and analyses of potential sites, a "Short List" of most promising mill sites was prepared and presented in the Interim Report of the study. This first screening of sites was tentative and the Short List was later complemented with a few new interesting alternatives.

In the next phase of the site screening process, a number of additional visits were paid to the sites on the Short List and complementary discussions organised with local authorities, NGOs, and representatives of local organisations and enterprises. Visits were also paid to some new sites identified and included in the survey. Successively the Short List was reduced to finally end up in a "List of most favourable sites".

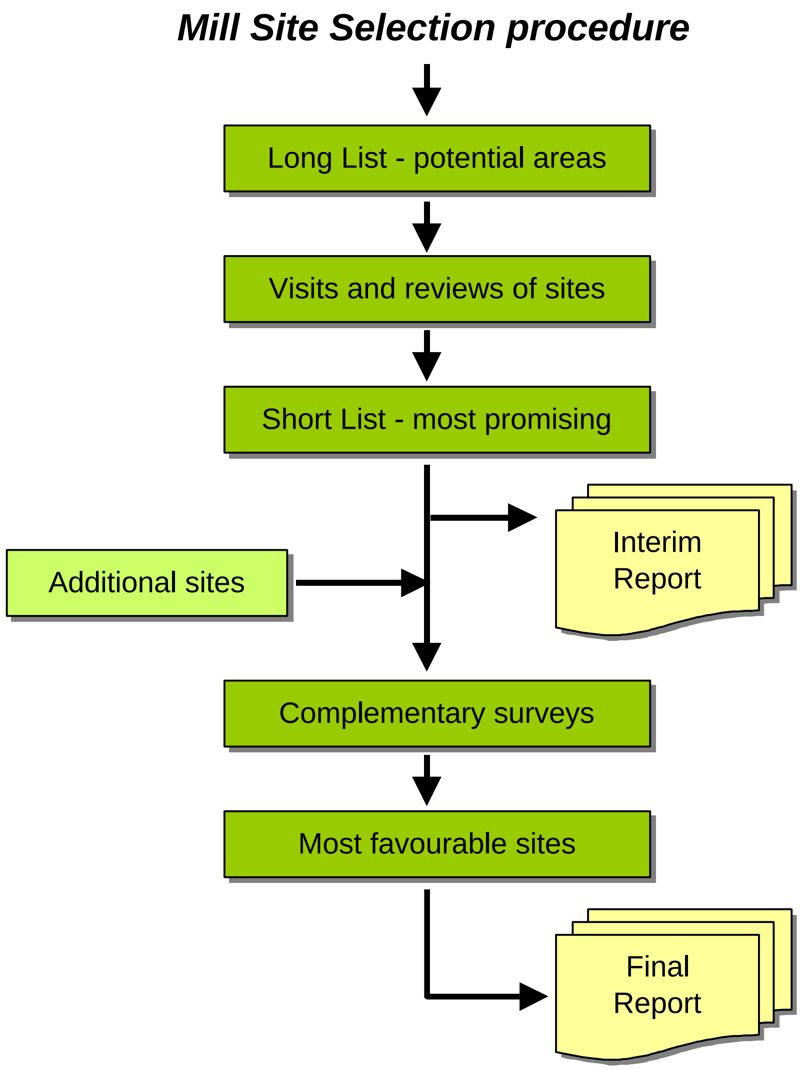
Before the final selection of most favourable sites a series of seminars were given to a broad public in the districts and cities concerned. The seminars focused the environmental aspects of a new pulp mill. The feed back from the seminars have been integrated to the final screening of most favourable sites.

During the whole process, close contacts have been maintained with relevant central authorities, especially the Ministry of Economics and the Ministry of Environment, including the Department for Forestry and Protected Areas. Contacts - for information exchange and for gathering relevant data for the study - have also been taken with a number of other Ministries, state agencies, institutions as well as branch associations and individual enterprises in the private sector. Especially can be mentioned Ministry of Transports; the state railway and energy companies; road transport associations; harbour authorities and shipping agencies; the geological, hydrological and meterological institutes; the Forest Inventory and Planning Institute in Kaunas; etc. just to mention a few.

It should be noticed that no geological survey has been carried out at this stage, nor has any organized contacts been taken with concerned landowners. Some contacts and information exchange with landowners have nevertheless taken place and made up an important input to the site screening process, however, principally only on an ad hoc basis.

It has been the intention to identify and suggest only two sites as the most favourable. However, present list includes three alternative sites. At this stage of the project these three finally selected sites are considered of more or less equal interest. They should all be subject for further more detailed analyses, especially as concerns their environmental and financial advantages and disadvantages, before they are rejected or finally selected.

Figure 4.2.1 Site Screening Procedure Layout



(1) Issues considered in screening procedure

For each potential site identified a valuation of various factors of relevance to the location of the mill have been carried out. Following factors have been specifically considered in the site screening process.

Supply of Wood Raw Material
- supply of domestic pulp wood (round wood)
- supply of chips from domestic sawmills
- possibilities for import of wood raw material

Water Supply and Recipient of Treated Wastewater
- supply of process water
- supply of potable water
- recipient of treated wastewater

Energy Supply and Solid Handling
- nearness to power lines
- nearness to gas pipelines
- nearness to local district heating system
- nearness to solid waste deposit

Transport Infrastructure
- transports of wood raw material
- transports of end products (pulp)
- transports of other necessities and goods
- main roads and site access roads - road transports
- railway system - railway transports
- harbour and harbour facilities - sea transports

Mill Site Characteristics
- available area and expansion opportunities
- topography and geological conditions
- ownership status

Specific Environmental Issues
- impact on water flow due to use of fresh water
- impact of discharged treated wastewater
- effects of emissions to the air
- handling of solid waste
- traffic, noise, smell and other disturbances in nearby residential areas
- sensitive surrounding areas

Other Aspects

- access to research, development and educational resources
- availability of skilled labour
- housing/accommodation conditions
- political and local support
- social aspects

Above factors and the principles for including possible unconditional requirements or desirable considerations in the site screening procedure, are further discussed below. Some factors have been given a higher priority than other, for example environmental restrictions, possible source of process water, possible recipient of treated wastewater, wood supply and infrastructure conditions.

The relevant legislative and environmental restrictions to be considered are also elaborated in Chapter 5 – “Environmental Aspects”.

4.2.2 Supply of wood raw material

The basis for the pre-feasibility study has been that the calculated demand for wood raw material for the mill should be fully supplied from domestic sources – round wood pulpwood and sawmill chips. Opportunities for future import of wood raw material should be considered as a positive factor but not primarily be included in the supply basis for the mill.

(1) Supply of domestic pulpwood (round wood)

The Forest Inventory and Management Planning Institute in Kaunas has carried out new up-to-date calculations on future potential sustainable cut. Present forest management system and harvesting regulations have been adopted in the calculations. The results of the calculations are presented in Chapter 3 "Raw Material" above. They clearly show that there are possibilities to fully supply the pulp mill with domestic wood.

However, although the calculations on future potential cut can be considered as conservative, the whole country principally must be included in the wood supply area for the mill. Forest resources are scattered and distributed over the whole country with less densely forested regions in the west and more densely forested areas, especially conifers, in the east. Central Lithuania has a higher share of mixed forests. Both conifers and broadleaved species will be used as raw material for the mill.

To minimise wood transport costs, sites located to the centre point of the forest resources are more favourable compared to sites in the outskirts of the country. The centre point of the wood supply area is tentatively judged to lay in a sector east or north of Kaunas.

Competition for the domestic wood raw material can mainly be expected from Nordic countries – export through Klaipeda harbour or via Latvia – or from a possible future new Latvian pulp mill. Also Russian pulp mills in the Kaliningrad area have during the last decade been major importers of Lithuanian round wood. However, the paying capacity of these mills is limited and can be expected to be further reduced, unless new investments are made in the mills.

Export to Nordic countries, primarily Sweden is today mainly made through the Klaipeda harbour. The cost competitive advantage for a Lithuanian pulp mill can roughly be compared to the harbour and sea transport costs from Klaipeda to harbour in the importing country. The farther east a new Lithuanian pulp mill will be located, the less competitive will it be in the western parts of Lithuania, compared to foreign wood buyers.

The greatest competition from Latvia can be expected in northern and north-eastern Lithuania while Polish buyers will be more interested in wood from the southern regions. It can be noticed that the Latvian pulp mill project is planning for an import of close to 1 million m^3 sub/a of which a marginal quantity or some 10% is expected to come from Lithuania. This implies that locations farther north (to meet Latvian competition) or farther south (to meet competition from Poland and Kaliningrad) would be more advantageous, thus contrary to each other.

On the basis of above, a mill location in the central of Lithuania is judged most advantageous considering wood supply, wood transportation costs and competitiveness towards other potential major wood buyers.

(2) Supply of chips from domestic sawmills

Part of the wood raw material for the mill is expected to come from domestic sawmills. Presently, however, only three sawmills in Lithuania are equipped with debarking devices allowing them to produce pulp chips of required quality. Currently chips are sold from these sawmills mainly to Swedish buyers – pulp mills. These sawmills are

- Pajurio Mediena Klaipeda
- Kaminskas sawmill in Prienai
- Baltic Wood in Maeikiai

Generally speaking the sawmill industry in Lithuania is still rather undeveloped. The average capacity and production level is low and larger strategic investments are still rather rare. Principally there is no new modern sawmill in Lithuania and a comprehensive restructuring and modernisation of the sector is required for the industry to stay competitive and profitable.

It can be expected that a number of larger sawmills will be built within the next years to come following the development in Estonia and Latvia. It can also be expected that new large sawmills besides one or two in Klaipeda will be inland located close to the forest areas. Thus the centre point for the supply of sawmill chips can be expected to be close to the centre point for the round wood supply, and the preferable location of the new pulp mill is - also from this point of view - in the central parts of Lithuania.

Once a pulp mill is decided to be built and the site is known, this will most probably influence locations and investments in the sawmill sector, as sales of pulp chips is an important source of income to the sawmills.

(3) Possibilities for import of wood raw material

Although this study is basically assuming that the new mill will be supplied with wood raw material from domestic sources, import of wood may become a reality once the mill is built and in operation. Thus, favourable conditions for future wood import, is considered an advantage in the mill site evaluation.

Russia and Belarus provide the best opportunities for import of pulpwood to Lithuania. Possibly also minor quantities can be imported from Latvia and

Poland, however, competition is expected to be harder and prices higher in these countries.

Imported wood from Russia and Belarus may be delivered by truck from areas nearby the Lithuanian border supporting a location of a new pulp mill to the eastern parts of Lithuania, in areas where efficient road transports are possible. However, train is considered to be the main transport mean for imported wood. Thus good railway connections to the mill site are required, preferably in combination with a location of the mill to eastern parts of Lithuania.

4.2.3 Water supply and recipient of treated wastewater

(1) Supply of process water

The demand for fresh water for the process and for cooling purposes of the planned mill is calculated at 1.0 - 1.2 m^3/s. A large part of the consumed water is used only as cooling water, which is not polluted. This water is discharged from the process as clean water, but with a temperature rise. A fraction of this heated, clean water will be used as process water for the pulp mill, while the remaining fraction will be discharged directly as a clean effluent.
Consequently, the capacity of the raw water source, being a river in the normal case, must be related to the approximate mill water consumption of maximum 1.2 m^3/s. The environmental impact of this size of water consumption is further discussed below.

This total water consumption is based on a relatively low consumption of process water for the pulp mill, 30 m^3 per ton of pulp. This water consumption is regarded as BAT (Best Available Technique). Theoretically, it may be possible to reduce the water consumption further by applying more advanced closed cycle technology in the mill, methods which, however, are not fully established today.

Principally all fresh water taken in to the mill is discharged back after the process, either as clean, but heated cooling water, or as partly polluted water from the pulping process. Thus when one and the same river will serve both as source of fresh water to the mill and as recipient of the discharged waste water, the total water flow in the river is only marginally influenced down streams the water outlet. This is the general situation for all potential sites considered, except those in western Lithuania for which wastewater is assumed to be discharged directly through pipeline to the Baltic Sea.

For this reason, the supply of fresh water is not considered a major issue for the inland locations, as the river's capacity as recipient of treated wastewater will make up the main restriction. For sites discharging wastewater directly to the Baltic Sea, the minimum flow in the fresh water source should not be below 5 to 10 times the calculated water consumption in order to avoid severe damages down streams. For environmentally sensitive rivers even this may be a too generous condition.

(2) Supply of potable water

Access to drinking water from the community system would be advantageous. However, the lack of municipal potable water at the site is not considered a serious disadvantage. Lithuanian ground water reserves are substantial and drilling of new ground water wells for the mill’s need is considered fully realistic and may even be economically favourable compared to using municipal water. Principally, today all drinking water in Lithuania, with very few exceptions, is taken from the ground water and with enough capacity and good water quality.
Drinking water/potable water will be needed from the very first beginning of the construction of the mill.

(3) Recipient of treated wastewater

The discharge of wastewater will include a polluted fraction of about 0.5 m^3/s (after effluent treatment) corresponding to the process water consumption of 30 m^3 per tonne of pulp. In addition 0.5 - 0.7 m^3/s of clean, but heated water (temperature up to about 45 ^oC) will be discharged. The polluted effluent will be efficiently treated by biological treatment, but still have a certain content of, e.g., organic matter and nutrients. Therefore it is important that the recipient for the effluent, if this is a river, has a large water flow, in order to minimise the impact on the river's water quality.

There are no exact limits set up for the minimum water flow required. This varies by the local conditions and the sensitivity of the recipient river. However, a flow of minimum 30 to 50 times the discharge of partly polluted water is judged to result in sufficient dilution and acceptable low impact to the water quality.

4.2.4 Energy supply and solid waste handling

(1) Nearness to power transmission lines

Nearness to high voltage transmission lines is favourable both for the supply of necessary power to the mill and for delivering possible surplus generated in the mill. The latter is an economic and technical question but also an administrative and organisational matter to be solved with responsible energy company.
For the initial screening of mill sites nearness to a 110 kV power line connection point is considered necessary. This is further justified when considering a possible second stage including building of a paper mill.

(2) External fuel supply – nearness to gas pipelines

A modern pulp mill is practically self-supporting on fuel assuming that all wood residues are used as fuel in a power boiler in addition to the recovery boiler. However, some external fuel may occasionally be needed. This can preferably be natural gas with lower environmental impact than fuel oil. Nearness to a gas pipeline of sufficient capacity is thus a favourable factor to a potential mill site.

(3) Local nearby district heating system

As said above, a modern pulp mill is in principle self-sufficient in fuel. There may even be good prospects for delivery of heat to a nearby district heating system. This is not considered a factor of major importance in the site selection but nearness to a district heating system may add profitability to the project.

(4) Solid waste deposit

As a result of the pulp production also various types of wastes will be produced. These waste products are generally less hazardous to the environment but must be taken care of and deposited under controlled conditions or otherwise processed and eliminated. Typical types of waste products are bark, sludge from wastewater treatment, ash, etc.

It is the intention that the planned pulp mill shall have its own solid waste deposit area. In case a municipality deposit is located close to the mill site, with capacity to take care of the industrial waste, this deposit may be considered instead.

As mentioned above bark, other wood wastes and sludge as far as possible will be used internally for fuel.

4.2.5 Transport infrastructure

(1) Transports of wood raw material

A pulp mill of the size now proposed with a capacity of 500 000 ADt per year will consume some 2.4 Mm^3sub of wood annually, corresponding to 7100 m^3sub per 24 hours or some 8000 m^3sob/d.
The bulk of the wood raw material will be made up of domestic round wood and chips from sawmills. Wood and chips will to a great extent be delivered to the mill by trucks. At long distances, railway transport is expected to be competitive. The main part of possibly imported wood, is assumed to be delivered by train, but trucks can also be considered from nearby areas in for example Belarus.

(2) Transports of end products (pulp)

The mill will tentatively produce some 500 000 ADt per year of market pulp. If, in a possible later stage, a paper mill be built and integrated to the pulp mill, corresponding amounts of paper and paper products will be produced and transported from the mill. The most realistic markets for both the pulp and possible future paper products are the Central and West European countries – Germany, Benelux, UK, Italy etc.

There are principally two main alternatives for transport of finished products from the mill to the markets

- by truck or railway to Klaipeda, by boat to Central / West European harbour, and then once again by truck or railway to the final destination,
- by truck/railway from the mill directly via Poland to final destination in Central/Western Europe.

If the first option is chosen a location close to Klaipeda is most favourable from the pulp delivery point of view. However, no sites have been possible to find in or quite adjacent to the harbour area. For all sites a shorter or longer transport by truck or train to the harbour has to be considered, including necessary storing facilities at the harbour. The shorter land transport to the harbour the better. It is judged, however, that possible advantage of short land transport for the pulp will be outbalanced by the disadvantage of longer wood transports.

For the second option – road or railway transport directly to European buyer – a location in the centre or south region of Lithuania is most favourable. Presently direct transport by train is not possible as the Lithuanian and central European railway systems have different width of the gauge. Reloading in Šeštokai in southern Lithuania is required. There are, however, plans to build a new line of European standard from the Polish border to Kaunas. See further below, "Railway system – railway transports".

A mill location in central Lithuania, with good railway connection and good access to the main road net, is judged most favourable. This will allow for optimal flexibility as concerns pulp deliveries and be the most cost-efficient alternative considering transport costs for both pulp and wood raw material.

(3) Transports of other necessities and goods

The production of pulp requires, in addition to the wood raw material, also other necessities such as chemicals, fuels, etc. The quantities of these necessities are in total terms substantial, but small compared to the volumes of wood consumed. Generally, the flow of these necessities to the mill has a marginal or very low impact on the location of the mill.
Nevertheless, these transport flows must be considered and carefully planned for, as they may be classified as hazardous transports and may cause severe damages to ground or environment, or make up a risk for nearby residents, in case of a traffic accident.

Good infrastructure with proper main roads and good access roads to the mill site, as well as good railway connections, which do not demand that these transports pass through densely populated residential areas, are favourable. When using railway transports it is generally not possible to avoid populated areas as most railway lines pass directly through cities and villages.
Transports of solid waste produced will be short distance transports and do principally not influence the site selection.

(4) Main roads and site access roads – Road transports

For all sites specific access roads to the mill site have to be built and included in the investments for the project. The construction cost per km of these roads are judged rather equal for all sites as far as bridges or specific intersections not have to be included. The length required to reach public roads will vary somewhat.

More important is the standard of nearby main public roads. Preferably there shall also be good public roads going in all directions of relevance for road transports of wood and possibly also pulp and other necessities. Investments and improvements in the public road net is not included in the investment for this project but must be the responsibility of Lithuanian Government and authorities. Major improvement in the public road net is a long term undertaking. Thus poor public roads to the mill site is considered a severe disadvantage.

According to present Lithuanian road and traffic legislation the maximum gross vehicle weight (GVW) is 40 tonnes, allowing for a load of some 25 tonnes per vehicle. This is comparable to many EU countries but much lower than the allowed GVW and load capacity in for example Sweden (60 tonnes max GVW) and Finland. The low allowed load for trucks increases the competitiveness of railway transports.

(5) Railway system – Railway transports

The Lithuanian Railway Company – Lietuvos Gele□inkeliai (LG) – is presently the only railway company operating in Lithuania. LG is fully state owned with responsibility for both infrastructure and transport services. There are plans to split the company in a number of smaller companies of which some simultaneously would be sold out and privatised. According to present plans, separate companies will be established for infrastructure facilities, goods freight, passenger traffic, maintenance and service of rolling equipment, etc.
Infrastructure and fixed facilities will remain the responsibility of the state through the Ministry of Transport. Restructuring may be finished in the end of year 2000 or beginning next year, at the earliest.

For the main part of the Lithuanian railway net the gauge is 1520 mm, which is the standard gauge in the CEECs and somewhat wider than the standard gauge

(1435 mm) used in, for example, Poland and most West European countries. Currently only some 22 km of railway from the Polish border to Šeštokai has the west-European standard. Thus reloading or change of axles of railway wagons has to take place before entering the border to Poland. A similar reloading station is located on the Polish side of the border.

According to Lithuanian railway authorities there are presently plans to build - in a first step - a new railway line from Šeštokai to Kaunas with Central/West European standard, thus eliminating the need for reloading at the border. The investment plans also includes upgrading of the line from Šeštokai to the Polish border. In a possible second step the railway will be extended through Kaunas to Jonava and northwards forming the start of a Baltic railway corridor. A mill location along this new line would be favourable if railway transports to the European markets are considered.

(6) Harbour and harbour facilities – Sea transports

Klaipeda harbour is the only harbour in Lithuania at the Baltic Sea. It has capacity to handle also the pulp from a possible new mill and it should be possible to find a suitable area for necessary storing buildings for the pulp if desirable.
As mentioned above there is however not enough place for a pulp mill in the harbour area, nor in any adjacent site.

4.2.6 Mill site characteristics

(1) Available area and expansion opportunities

It is estimated that a minimum area of 130 ha is required for the pulp mill including areas for roads, wood storing and solid waste deposit, etc. However, considering also a possible future paper mill, the area demanded at this stage is set to 150 ha at a minimum. The possibilities to further expand the site (up to 200 ha) is considered an advantage which for example would allow for a future sawmill adjacent to the pulp mill.

(2) Topography and geological conditions

Flat land is preferred, although slightly rolling may sometimes be positive from drainage point of view. Good geological conditions are important to keep investments for access roads, railway connections and other construction works at an acceptable level.

The topography at the sites has been generally reviewed at the field visits for each site, more detailed for the sites screened out for the Short List. No geo-technical investigations have been carried out at this stage but geo-technical conditions are roughly judged based on optical review of surface, topography, etc., combined with preliminary information from local representatives and other local projects.

(3) Ownership status

Ownership status is normally an important factor to consider. However, it is judged that in this case the ownership, whether state or privately owned land, will not make up a major problem. As support for the project is required from both Government and local administration, it can be assumed that conditions for acquisition of land for the mill will be similar for all potential sites. Private owners, in most cases, are also supposed to be happy to get a chance to sell their land. The price of the land may differ depending on location in the country, nearness to cities or other competition for the land.

The right for foreign investors to acquire or lease industrial land in Lithuania is not discussed here but should be seriously analysed as to the effect it may have for the realisation of the project. According to present legislation foreigners have the right to buy industrial land. However, it seems as if the bureaucracy is still rather heavy, causing unnecessary problems and delays in the process.

4.2.7 Specific environmental issues

Consideration to environmental impacts of a new pulp and paper mill have been given highest possible priority in the site selection. Pulp and paper mills used to be heavy polluters of the environment and still are in some countries, where the industry has not yet been modernised, applying today's best available technique (BAT). Applying BAT in modern bleached kraft pulp mills means significantly reduced atmospheric and water emissions, as compared to older mills. The discussion below and in Chapter 5 is limited to the kraft pulping only. In case a paper mill will be added, it would still be the kraft pulp mill that would contribute to the main part of the environmental impact.

The impacts caused by atmospheric emissions and water emissions from modern bleached kraft mills are the two types of impacts that are most significant. They are also those, which are specific for this type of industry and are therefore specifically discussed below. A general discussion about these emissions is given in Chapter 5. Other types of impacts are for instance solid waste generation and noise, which are of a more general nature.

The environmental aspects, which have been considered in the site selection are the following:

- Use of fresh water and possible down streams problems due to changes in water flow, specifically during periods of low natural flow.
- Waste water discharges to recipient and risks for down streams problems caused by pollutants from the mill.
- Emissions to air and possible problems related to air quality or smell in nearby residential areas
- Solid waste production and possible problems related to handling, processing or deposit at land fills
- Traffic, noise and other disturbances in nearby residential areas
- Risks for disturbances in nearby sensitive (protected) areas

It should be noticed that consideration to these factors has been possible only at a limited extent during this study of the project. All these aspects must be further considered in the Environmental Impact Assessment (EIA), which has to be performed in a later stage of the project. Certain requirements regarding air quality, noise level and water quality in the river (in case of wastewater discharge to a river) have to be complied with in designing and operating the mill. These data will be part of the Environmental Permit for the mill. Calculations of such data have not been carried out in this study.

(1) Impact on water flow due to use of fresh water

The use of fresh water from rivers (or lakes) influences the water flow and the biotopes for fishes and other animals and plants living in or along the river. To limit these effects the use of fresh water must not exceed a certain percentage of the minimum flow of the river. In case the same river is used as recipient for the polluted water from the mill, the total water flow will be only marginally affected. In this case the river as recipient of wastewater is considered to be the limiting factor.

In case wastewater is discharged to another river or lake than the one used for fresh water, or to the Baltic Sea, the percentage of fresh water taken out will be important. Great environmental problems can be foreseen if the source river is not big enough compared to the volume taken out for the mill. These problems may concern the wildlife as well as tourism and leisure time activities.
As mentioned above the demand for fresh water for the mill is calculated to be maximum about 1.2 m^3/s. The demand also depends on the temperature of the river from where the water is taken. As a significant fraction of the water is used for cooling purposes, the highest demand is in the summer, when also the water level in rivers and lakes normally is at the minimum level.

(2) Impact of discharged treated wastewater

Most of the discussed possible mill sites, except a few in Klaipeda and Kretinga Districts, are located inland, and thus the recipient for the wastewater must be a river (or a lake). The impact of the mill wastewater to the river water quality is directly depending on the river water flow. Consequently, the decisive factor here is the river water flow, a higher flow being more advantageous than a lower. All rivers show large annual variations as regards the flow. The lowest flow rates must be considered here. Also the classification of the river must be considered. A lower class, meaning a cleaner river, implies a river being less suitable as a wastewater recipient.

Some potential mill sites are identified in the Klaipeda and Kretinga area, in which case the wastewater could possibly be discharged, by a long-distance pipe, directly to the Baltic Sea. This option would probably be the most advantageous, from the point of view of water pollution.

As mentioned above, the water pollution from modern kraft pulp mills has been considerably reduced, compared to older mills. This means that also a relatively small river could be acceptable as a recipient in the normal situation. However, it is also necessary to consider the risk of temporarily increased water emissions, in connection with disturbances in the mill. In such cases the risk of negative influence on the river water quality is, of course, larger for a smaller river.

Therefore, our opinion is that a mill location at a low-flow, relatively clean river should be avoided.

This factor is parallel to the question of water supply for the mill - a higher river water flow being generally more advantageous than a lower flow, both from the water supply and the wastewater discharge point of view.

(3) Effects of emissions to the air

The Environmental Permit for the mill, according to the present legislation, will include a number of air quality parameters, e.g. the concentrations of sulphur dioxide and nitrogen oxides, which must not be exceeded outside the sanitary zone. This zone is usually defined as an area surrounding the industry at a distance of 1 km from the fence. For a pulp mill of this type and size we would, however, recommend a minimum distance from the mill to nearby main residential areas, which exceeds this 1 km limit. A distance of 4-5 km would be recommended, although 2-3 km could be accepted. The main reason is the risk of odour load from the mill. The odour load is normally of low significance at modern mills, although temporarily increased loads could occur in connection with disturbances.

Consequently, the main factor to be considered here is the distance from the mill to main residential areas. Also the dominating wind direction is of importance, a mill location in the wind direction “downstream” the city being preferential.

(4) Handling of solid waste

Concerning the solid waste generation, and the possible problems related to handling, processing or deposit at landfills, we regard the significance of these problems as relatively similar in comparing the different sites, and thus not decisive at this stage of the site selection process.

(5) Traffic, noise and other disturbances in nearby residential areas

Concerning the noise from the mill, the distance from the mill to main residential areas is a decisive factor. Noise, vibrations and air pollution caused by traffic are disturbing factors, the magnitude of which depends upon the position of main roads to the mill relative to residential areas. As the traffic load to and from the mill will be rather high, main roads remote from residential areas are more advantageous.

(6) Sensitive surrounding areas

Lithuania is rich in protected areas, sensitive rivers and creeks, etc. which must be protected, as well as areas of special interest for tourism and leisure time activities. Depending on type of protected or valuable area, a larger or smaller buffer zone has to be considered.

The surroundings of protected and otherwise sensitive or valuable areas have as far as possible been avoided when identifying possible mill sites. However, it has not been possible to fully avoid this and the possible impact to these areas of a new pulp mill must be further investigated and assessed in later Environmental Impact Assessment.

4.2.8 Other aspects

(1) Access to research, development and educational resources

Kaunas can be considered the centre in Lithuania as concerns research, development and education related to the forestry and forest industry sector. To Kaunas city is located Kaunas University of Technology with departments for pulp and paper industry and for wood mechanical industry. To Kaunas is further located the Agriculture Academy with the Forestry Faculty, Kaunas Technological College, Kaunas Centre for Training of Building Workers and the Forest Inventory and Planning Institute.

In Girionys, some 10-15 km southeast of Kaunas, are located the Forestry Research Institute and Kaunas Forestry College.

Cooperation with these institutions and use of their services are facilitated the closer to Kaunas the mill will be established.

(2) Availability of skilled labour

A modern pulp mill of the size discussed for Lithuania requires some 600 to 800 people for the operation of the mill. People needed for local workshops, transportation etc. is not included in those figures. In general a mill creates indirect employment of 3-5 times that of the mill operation itself, which means that some 2000 – 4000 persons will benefit through employment directly or indirectly from the mill. Staff and labour for the forestry operations are not included and will be required in addition. However, as forestry operations are ongoing already today only a limited number of new employment opportunities will be created in the forestry sector.

It should be noticed that a high percentage of the labour in the mill must have a comparably high education and skill as today's pulp and paper mills are technically advanced and economically sensitive to disturbances in the operations.

Thus high unemployment in an area is not enough to secure the supply of skilled labour for the mill. A potential area for location of the mill must be attractive for labour and for their families. Nearness to relevant research and educational institutions is also an advantage.

(3) Accommodation/housing conditions

The number of labour assumed to be employed at the mill, including also indirectly employed people, will require facilities for accommodation and housing. A municipal of reasonable size within reasonable transport distance is required.

Already during the construction and erection phases of the mill the demand for accommodations will be substantial. Thousands of workers will be engaged during this period, to a great extent also foreign experts and labour, thus demanding for a large number of temporary accommodation opportunities (hotels, private houses, etc.)

(4) Political and local support

Any project of the size now discussed will require the support from the Government and the Parliament. However, the local support is as important as the national support. Thus backing up from local politicians and the local administration, as well as acceptance for the project from the public, are essential factors to be considered in the site selection process. No foreign investor is assumed to enter a project of this magnitude and high economical risks in case there is a potential risk for disturbances during the construction period of the mill or later on when production has started. Such lack of support and risks for disturbances may be based on real facts or may be of emotional character related to large foreign investments or to the forest industry, which used to be a major polluter of air and water. In these later cases a massive, impartial awareness campaign founded on facts may improve the situation.

Consideration to the local support and acceptance of the project has only partly been possible at this stage of the study but will be a major issue at later stages.

(5) Social consideration

Social effects, positive or negative, related to a new pulp mill are difficult to integrate in the site selection process and impossible to quantify. Nevertheless, consideration to social aspects should be a part of the process and impacts as far as possible identified and analyzed. For negative effects a mitigation plan shall be elaborated.

Positive social impacts of a new pulp mill are considered comparably neutral as to the different potential mill sites, although there are some differences. This concerns for example new employment, general economic growth in the region and related growth of the social sector in form of possible new schools, better public service, improved communication services, etc.

Negative social effects of a new pulp mill may vary largely but is generally of a minor magnitude for the society, although not for the individuals affected. This type of negative impact may be related to expropriation of land and necessity for families to move from their homes. These types of social effects should be avoided as far as possible but it is assumed that they can be handled in a dignified manner and people hit properly compensated.

The social impact of a new pulp mill has only marginally been possible to include in the site selection process.

4.3 Initially identified site alternatives – "Long List of Candidate Sites"

The following areas and sites have been identified as potential places for location of a new pulp mill. They are listed without priority in alphabetical order of county and district. In several districts more than one site have been identified and surveyed. They are denominated 1, 2 etc. but are also given a simpler short name.

Table 4.3.1 List of Potential Mill Sites – Long List

Site No	County/ Apskritis	District (Rajona)	No	Location	Short name
1	Alytus	Alytus	1	North Alytus city and industrial area, between road 130 and river Nemunas	Alytus North
2			2	South Alytus city, at river Nemunas north side on former military area	Alytus South
3	Alytus	Var na	1	East Matuizos village	Matuizos
4			2	Northwest of railway and river Merkis crossing in Pamerkiai village	Pamerkiai
5	Kaunas	Jonava	1	North industrial area, northeast Jonava city	Jonava North
6			2	Southeast Jonava city, west Rukla municipality	Jonava Rukla
7	Kaunas	K dainiai	1	Industrial area east of Kėdainiai city	K dainiai
8	Klaip da	Klaip da	1	Southwest of L bartai village	L bartai
9			2	South-southwest of waste deposit plant at Dumpai village	Dumpai
10			3	West of Mickai village, between railway and Klaipedos Kanalas	Mickai
11	Klaip da	Kretinga	1	East of T bausiai village	T bausiai
12			2	West of Darb nai municipality, west of artificial lake	Darb nai
13	Klaip da	Šilut	1	South of Pag giai municipality and railway station	Pag giai South
14			2	North of Pag giai municipality, north of railway	Pag giai North
15	Utena	Ignalina	1	Area around Ci□iunai village	Ci□iunai
16			2	North of Janionys village	Janionys
17			3	East of Visaginas town, at nuclear power plant	Visaginas
18	Vilnius	Šven iony s	1	Southwest of Pabrad and Karka□iške municipalities, east of railway	Pabrad
19	Vilnius	Traikai	1	North of Vievis municipality	Vievis
20			2	Grigišk s Paper and Hardboard Plant	Grigišk s

Totally 20 potential sites are listed above. During the initial reviews and field surveys a number of additional sites have been discussed but rejected at an early stage and not further analysed.

Each site alternative is briefly presented below. Profiles of counties and potential mill sites are further presented in Annex 4-1 and 4-2 respectively.

Figure 4.3.1 Map of Potential Mill Sites

(1) Alytus North – Alytus District, Alytus County

The proposed area for the site – presently primarily agriculture land – is located north of the City of Alytus. The site is located close to the major industrial area, including among others the Silunga Sawmill. Good infrastructure, near to main public roads, although transports from south and east have to pass around the city to reach the site. A new bridge over nearby river Nemunas is planned to be built. River Nemunas is also the possible source for process water and the recipient for treated wastewater. Railway and electric power transmission grid to the area. Close to one district heating plant in Alytus city and close to the city's new wastewater treatment plant.

(2) Alytus South – Alytus District, Alytus County

The potential area for the site is located south of the city of Alytus at the former military area along river Nemunas' north side, upstream city centre. No power supply and no railway connection to the area. Railway connection probably difficult to build due to environmental restrictions in nearby botanical reserve. Good road connections. River Nemunas makes up the possible source for process water as well as recipient for wastewater.

(3) Matuizos – Varena District, Alytus County

Proposed site is located close to the old brick factory in the village Matuizos. The railway from Vilnius southwards to Belarus passes through village. Power line to village. Poor access road to Varena and to main road A4 from Vilnius, some 10-15 km southwest of site. Process water to be taken from river Merkys some 5 km north or west of site. River Merkis also makes up the only possible recipient of wastewater. *(Area not visited during site field survey).*

(4) Pamerkiai – Varena District, Alytus County

The proposed site is located in the typical small, old countryside village of Pamerkiai with a few hundreds of inhabitants, at the intersection of river Merkys and the railway from Vilnius southwards to Belarus. The site, presently agriculture land, is located in a mixed agriculture and forest landscape. Nearest main public road is road A4 from Vilnius, some 4 km north of the site. Low standard, gravelled road to the site. Nearest power supply connection point can be found some 4-5 km south of the site in village Matuizos. River Merkis makes up the only possible source for process water as well as the only recipient for wastewater.

(5) Jonava North – Jonava District, Kaunas County

The proposed site is located northeast of Jonava City in a flat mainly forested area with scattered agriculture land. The site is neighbouring an existing industrial area, including among others the sawmill of Jonava State Forest Enterprise and the district heating plant (0.5-1 km away). Distance to residential areas rather short or about 1-2 km. Distance to nearby river Neris - to be used as process water source and waste water recipient – is about 1-1.5 km. Railway through Jonava City. Close to electricity grid and to good public main roads in most directions.

(6) Jonava Rukla – Jonava District, Kaunas County

The site is located opposite river Neris from Jonava city centre, neighbouring the industrial area of Achema chemical and fertiliser industry, and west of the municipality of Rukla, former military area. Generally good infrastructure with nearby main public roads, power supply and railway connection close to the area. The proposed site is slightly hilly. Distance to Rukla residential area is rather short or about 2 km and to river Neris for process water 1.5-2 km and for discharging treated wastewater some 4-5 km downstream Jonava city.

(7) K dainiai – K dainiai District, Kaunas County

A possible site for a pulp mill is proposed east of the town of Kedainiai in an existing industrial area – chemical and fertilizer industries, etc. The site is made up of flat grassland, somewhat swampy, but underneath ground is said to be good for heavy buildings (no ground survey carried out). Railway and electric power available in the area. Good roads. The area is bordering the new road Via Baltica now under construction. Limited supply of process water from river Obelis or river Nev is, which also makes up the only possible recipient for wastewater.

(8) L bartai – Klaip da District, Klaipeda County

Flat area with extensively used grassland and agriculture land, east of Klaipeda City, southwest of the small village of L bartai. Some 10 km to nearest main residential areas in Klaipeda or Gargzdai. Medium/low standard access roads to the site and some 3-4 km distance to the main public road from Klaipeda to Šilute. About 4 km to railway and about 10 km to harbour area. The site is neighbouring the cemetery of Klaipeda and also close to the wastewater treatment plant in Dumpai. Limited possibilities for supply of process water from river Minija some 2 km away. Possible waste water discharge through pipeline directly to the Baltic Sea.

(9) Dumpai – Klaip da District, Klaip da County

The site is located near the village Dumpai, close to and south of the wastewater treatment plant and solid waste deposit. The site area is bordering the main road from Klaip da to Šilute. The railway is passing close to the area but opposite the main road. Conditions for process supply and wastewater recipient are similar as for L bartai above.

(10) Mickai - Klaip da District, Klaip da County

The site is located west of the small village Mickai, between the railway and the artificial channel Klaip das Kanalas. The site area is bordering the main road and the railway from Klaip da to Šilute. The area is slightly hilly. Conditions for process water supply and wastewater recipient are similar as for Lebartai above.

(11) T bausiai – Kretinga District, Klaip da County

Proposed area is mainly made up of agriculture land, some 2-3 km east of the main road Klaip da – Kretinga – Darbenai, nearby the village T bausiai. Process water from river Akmena and nearby artificial lake/dam. Treated wastewater to be discharged through pipeline directly to the Baltic Sea some 14 – 15 km away. Railway line 3-4 km away. Good road connection southwards to Klaipeda and eastwards to Plunge etc.

(12) Darb nai - Kretinga District, Klaip da County

The proposed site is located some 4 – 5 km west of Darb nai municipality and west of adjacent artificial lake/dam, which would serve as the source for process water. Treated wastewater to be discharged directly through pipeline to the Baltic Sea some 6 – 7 km westwards. Poor access road to site (4-5 km) from main road Klaip da – Kretinga – Darb nai. Railway connection possible in Darb nai with further connections to Latvia in north and the Lihuanian railway system in south.

(13) Pag giai South – Šilute District, Klaip da County

The site is located 1-2 km south of Pag giai residential area. The proposed site is made up of a slightly hilly area close to river Nemunas at the border to Kaliningrad, about 1 km to river. Land area between the proposed site and river

Nemunas normally flooded once or twice a year. Nemunas makes up the possible source for process water and the possible recipient of wastewater. Opposite the river on the Kaliningrad side, is the Russian pulp mill Celulose Combinatas Sovetsk Tilze, which is a heavy polluter of the river. The site is located close to the railway station in Pag giai and close to main roads of rather good standard, going in three directions to Klaip da, Taurage and Jurbarkas respectively.

(14) Pag giai North – Šilute District, Klaip da County

A second area for the pulp mill site in Pag giai is proposed in the former military area – mainly flat, wooded land - north of the main road to Klaip da and north of Pag giai residential area, 1 - 2 km. Distance to railway about 1 km, or less. Other conditions similar to above site.

(15) Ciziunai – Ignalina District, Utena County

East of lake Dysnai in rolling agriculture landscape. Medium standard road passing the area, no railway (min. 10 km away). Process water to be taken from lake Dysnai, which also must be used as recipient for treated wastewater. Lake Dysnai is Lithuania's 2nd largest lake with an area of 2.4 ha, however, rather shallow. Outflow through lake Dysnykstis and river Dysnai eastwards through Belarus to Latvia and river Daugava.

(16) Janionys – Ignalina District, Utena County

Main alternative site proposed in the district, some 20 – 30 km northeast of Ignalina city. Located at a small lake and river Dysna with limited supply of fresh water. River Dysna flows southwards to Belarus and thereafter to river Daugava through Latvia to the Baltic Sea. Flat, extensively used agriculture land. Distance to main road (medium standard) some 2 km, no railway (8 – 10 km away).

(17) Visaginas – Ignalina District, Utena County

The proposed site is located between the City of Visaginas and lake Drukši , bordering the area of the Ignalina nuclear plant. The area is an heavily exploited industrial area. Process water to be supplied from the lake - 3.6 ha, 32 m deep – which also makes up the potential recipient for wastewater. Water temperature in lake (said to vary between 15 and 35 ^{o}C) is strongly influenced by cooling water from nuclear plant. Locally good infrastructure – access roads, railway, power supply. High standard main road going south to Ignalina city.

(18) Pabrade – Šven ionys District, Vilnius County

A possible area for a pulp mill site has been proposed southwest of the village Karkeiške and some 5 – 8 km south of Pabrade. The site area is bordering the railway and is also close to river Zeimena. The main road from Vilnius to Ignalina is passing opposite both the railway and the river from the site. Limited supply of process water from the river, which is also environmentally sensitive and partly protected. Possible recipient of wastewater is river Neris some 4-6 km southwards.

(19) Vievis –Trakai District, Vilnius County

The proposed area for the site is located north of Vievis municipality, between railway and river Neris. Flat, mainly agriculture area. Good infrastructure with main road A1 from Vilnius to Klaipeda passing south the area as well as the railway. Good conditions for power supply from nearby Elektrenai power plant.

(20) Grigišk s – Trakai District, Vilnius County

The site of AB Grigiškes Paper and Board Industry. The site is located in the residential area in the center of the town of Grigiškes, some 20 km west of Vilnius. The site is located between and along the main road from Vilnius to Klaipeda and the river Neris downstreams Vilnius. The area is an industrial area including AB Grigiškes' tissue and hardboard factories and belonging energy production plant and facilities for handling and storing of wood and finished products. Good infrastructure including main road, railway connection and power supply. Limited area available for a possible pulp mill.

4.4 Site screening – "Short List of Potential Sites"

Based on the field surveys carried out, complemented with desk analyses of gathered information and on discussions with relevant experts, the "long list" of candidate sites was reduced to a "short list" of most promising mill sites.

The prepared "short list", initially presented in the Interim Report of the study, included the following sites

- Alytus North, Alytus District
- Jonava North, Jonava District
- Jonava Rukla, Jonava District
- L bartai, Klaipeda District
- Dumpai, Klaipeda District

The potential sites Vievis, Mickai, Tubausiai and Darbenai were added to the "long list" after that the tentatively "short list" had been prepared. Surveys and analyses of these sites resulted in that site Vievis was also included in the "short list".
It should be noticed that some sites from Klaipeda District are on the "short list" although the fresh water supply is considered not enough for these sites. The conditions for these sites, as well as other alternatives close to the Baltic Sea coast - Mickai, Tubausiai and Darbenai - are commented separately below.

The Tables below indicate the results of the initial valuation of each of the factors considered. Principally (+++) means that the conditions for the site for that specific aspect is very favourable or have very small negative impact, (++) means that the conditions are good but not perfect and (+) that the conditions are acceptable without any specific advantages. (0) means that the conditions for the factor considered are not acceptable or it can be expected that a realization of a pulp mill project will result in serious negative effects.

Table 4.4.1 Site Screening – Valuation of Factors Considered

Short name	Supply of wood raw material			Water supply and recipient of treated wastewater		
	Supply of domestic wood	Supply of sawmill chips	Import of wood	Supply of process water	Supply of potable water	Recipient of wastewater
Alytus North	++	++	+	+++	++	+++
Alytus South	++	++	+	+++	++	++
Matuizos	+	+	+++	+	++	0
Pamerkiai	+	+	+++	+	++	0
Jonava North	+++	+++	++	+++	++	++
Jonava Rukla	+++	+++	++	+++	++	+++
K dainiai	++	++	+	+	++	0
L bartai	+	+	0	0[1]	++	0[2]
Dumpai	+	+	0	0[1]	++	0[2]
Mickai	+	+	0	0[1]	++	0[2]
T bausiai	+	+	0	0[1]	++	+[2]
Darbenai	+	+	0	0[1]	++	+++[2]
Pag giai South	+	+	0	+++	++	+++
Pag giai North	+	+	0	+++	++	+++
Ci□iunai	+	+	++	+++	++	0
Janionys	+	+	++	+++	++	0
Visaginas	+	+	++	+++	++	+
Pabrad	+	+	+++	+	++	+
Vievis	+++	+++	+++	+++	++	+++
Grigišk s	++	++	+++	+++	++	+++

[1] Supply of fresh water from rivers is considered not enough. However, possibilities to improve water supply through ground water wells and in some cases by artificial reservoirs (dams) have been discussed.

[2] Discharge of wastewater to the Baltic Sea is considered but judged not possible for L bartai, Dumpai and Mickai sites due to Kursin Marios and Neringa National Park which have to be passed. For T bausiai and Darbenai long pipes to the Baltic Sea are assumed.

Short name	Energy supply and solid waste handling				Transport infrastructure			
	Nearness to power lines	Nearness to gas pipelines	Nearness to district heating system	Solid waste deposit	Transports of wood raw material	Transports of end products (pulp)	Main roads and access roads	Coonection to railway
Alytus North	+++	+++	++	+	++	+++	+++	++
Alytus South	+	..	++	+	+	+	++	0
Matuizos	+++	..	0	+	++	+	0	+++
Pamerkiai	+	..	0	+	++	+	+	+++
Jonava North	+++	+++	+++	++	+++	+++	+++	++
Jonava Rukla	+++	+++	+	+++	+++	+++	+++	+++
K dainiai	++	++	..	+	++	+++	+++	++
L bartai	..	..	0	+++	+	+++	++	+
Dumpai	..	..	0	+++	+	+++	+++	+
Mickai	..	..	0	+++	+	+++	+++	+++
T bausiai	..	..	0	+	+	++	++	+
Darb nai	+	..	0	+	+	++	++	++
Pag giai South	..	..	0	+	+	++	++	+++
Pag giai North	..	..	0	+	+	++	++	+++
Ciziunai	+	..	0	+	+	+	+	0
Janionys	+	..	0	+	+	+	0	0
Visaginas	+++	..	+	+	+	+	++	++
Pabrad	+	++	0	+	++	+	+	++
Vievis	++	++	+	++	+++	++	+++	++
Grigišk s	+++	..	+++	+	+++	++	+++	+++

Short name	Mill site characteristics				Specific environmental issues				Other aspects	
	Avail-able area	Topo-graphy and geology	Owner-ship status	Sensitive surroun-dings (environ-mentally)	Use of fresh water	Waste water discharge	Emis-sions to air	Traffic, noise etc	Availabi-lity of skilled labour	Housing/ accommo-dation
Alytus North	+++	++	++	+	+++	++	++	+	++	++
Alytus South	+	++	+++	+	+++	+	+	+	++	++
Matuizos	+++	++	..	++	+	0	++	+++	0	0
Pamerkiai	+++	++	++	++	+	0	++	+++	0	0
Jonava North	+	++	++	++	+++	+	++	+	+++	++
Jonava Rukla	+++	++	+++	++	+++	++	++	+++	+++	++
K dainiai	+++	++	..	++	+	0	..	+	++	++
L bartai	+++	++	+	+	0	0[1]	+	+	++	+
Dumpai	+++	++	+	++	0	0[1]	++	++	++	+
Mickai	+++	++	+	+	0	0[1]	++	++	++	+
T bausiai	+++	++	..	++	+	++	++	++	0	0
Darb nai	+++	++	++	++	+	++	++	+++	0	0
Pag giai South	+++	++	..	++	+++	++	++	++	0	0
Pag giai North	+++	++	..	++	+++	++	++	++	0	0
Ciziunai	+++	++	..	++	+++	0	++	+++	0	0
Janionys	+++	++	+++	++	++	0	++	+++	0	0
Visaginas	+++	++	..	++	+++	+	++	++	++	+
Pabrad	+++	++	..	++	+	+	++	++ +	0	0
Vievis	+++	++	++	+	+++	++	++	++	+++	++
Grigišk s	+	++	+++	++	+++	++	0	+	+++	++

[1] Please refer to notes on previous page.

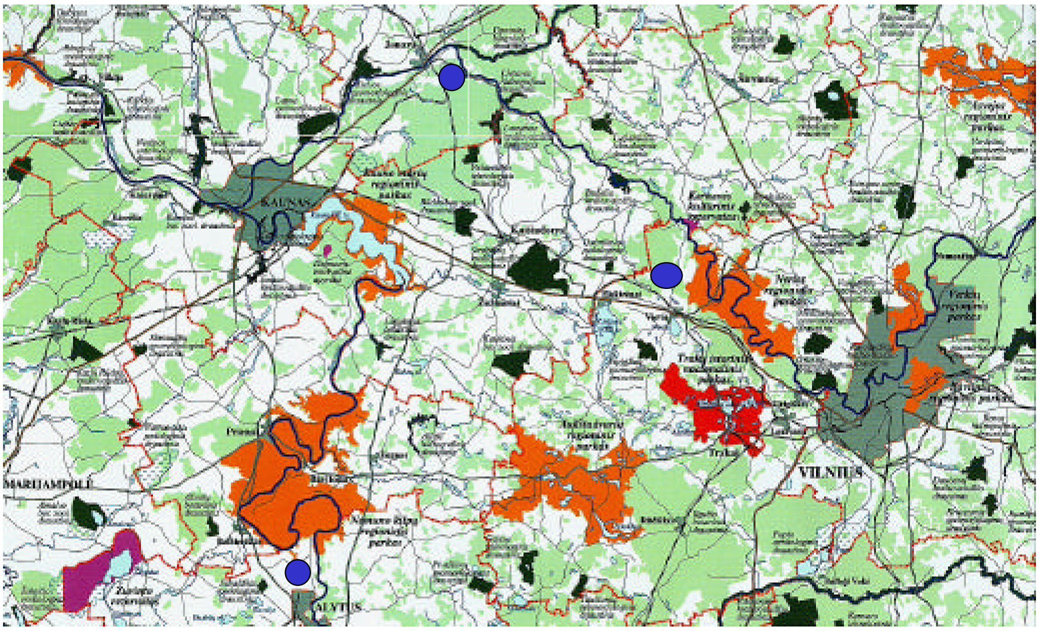
4.5 Recommendation – "List of Most Favourable Sites"

(1) Most favourable sites

The final list of potential mill sites, selected and recommended as the most favourable ones, includes three sites

- Alytus North
- Jonava Rukla
- Vievis

Figure 4.5.1 The Most Favourable Potential Mill Sites



These site alternatives are recommended for further consideration and analyses in next step of the Lithuanian pulp mill project.

All these sites are located at large rivers, large enough to serve as both source of fresh process water and recipient of treated waste water, namely river Nemunas for Alytus North and river Neris for the other site alternatives. These rivers are the two main rivers in Lithuania. River Neris is joining river Nemunas in the centre of Kaunas city, from where Nemunas flows westwards along the Russian/Kaliningrad border to Kurši Marios to finally reach the Baltic Sea at the harbour of Klaipeda.

The sites are located to areas with generally good infrastructure. Distances to main public road of good standard, railway, power transmission line and gas pipeline are generally short, minimising investments outside the site borders. There are international airports in both Kaunas and Vilnius within 1 to 1 ½ hour travelling by car from each site.

Conditions as concern access to potable water, solid waste deposit and possibilities to connect to local district heating system vary between the site alternatives. These issues are, however, generally judged to be possible to solve without any major problems.

All sites are further favourably located in the central regions of the wood supply area, except for Alytus North, which location to the south is somewhat less advantageous in this respect in comparison to the others. This involves longer transport distances and higher wood transport costs for the Alytus alternative. For wood import by train or truck, Vievis is somewhat more favourably located than Jonava Rukla, while Alytus North has the disadvantage of substantially longer railway transports to reach the site.

Conditions for export and delivery of pulp to main clients – tentatively assumed to be located in Central or Western Europe – vary somewhat between the sites and whether sea transport via Klaipeda is considered or direct land transport to client via Poland by truck and train. Distances from Alytus North are somewhat shorter when land transport is considered but slightly longer if sea transport via Klaipeda will be applied. The conditions for Jonava Rukla and Vievis are principally equal to each other whichever delivery method is applied. The possible future Baltic Corridor (railway) passing Jonava and connecting Lithuania with the European standard railway system, would be a great advantage to the Jonava Rukla alternative. However, this will not be realised within a near future. The Via Baltica highway through the Baltic states and Poland will be an advantage to all alternatives. The Lithuanian part is now under construction.

All three places can offer nearness to medium sized municipalities – Alytus, Jonava and Elektr nai respectively. Alytus and Jonava are considered more

attractive and can offer more services and variation to its residents. Jonava and Vievis are also reasonably close located to Kaunas and Vilnius respectively.
Possibilities to attract and employ skilled workers are tentatively considered quite comparable for the three sites, possibly with a small advantage for Jonava.

The distance to Kaunas, the centre for research and education in the forestry and forest industry sector, is reasonably short from all three sites and should not make up any obstacle for cooperation with the institutions in Kaunas. The same can be assumed for authorities, institutions and enterprises in Vilnius.
The expected environmental impact of a pulp mill is judged to be on an acceptable low level with no major differences between the three site alternatives (see comment on Regional Parks below). However, for better information and knowledge of the environmental impact of the project and necessary mitigation actions, a comprehensive Environmental Impact Assessment (EIA) must be carried through. The EIA must consider not only present pulp mill project but also other existing and possible future polluters in the area. An EIA is also required according to Lithuanian legislation.

It is expected that Best Available Technique (BAT) is applied in the mill and the pulping process, including modern technique to clean process water and to control smell and emissions to the air. Nevertheless, there will be discharges of wastewater and emissions to the air. The impact to river Nemunas and river Neris should be comparable for the three sites, river Neris having a somewhat lower average flow until the junction with Nemunas in Kaunas. Concern has been raised for negative impact on one drinking water source (ground water wells) close to river Neris at Kaunas. The issue has to be further studied.

The impact and disturbances to nearby residential areas by emissions to the air, heavy traffic and noise, is judged roughly equivalent for the sites considered. All sites are located to the favourable side of main residential areas considering direction of dominating winds. For all three sites there are smaller villages and scattered individual dwelling-houses within a distance of 1-2 km. Leisure time areas are located within a few km from the sites in Alytus (along bank of river Nemunas) and at Vievis (north of small lake).

An EIA must especially assess the impact to the Regional Parks at Alytus and Vievis respectively (effluents to rivers, emissions to air, impact on leisure time activities, etc.). These Regional Parks are primarily established to protect green areas close to the rivers. For both Alytus North and Vievis, the most favourable alternative from a technical point of view, seems to be to pass the area of the Regional Parks with pipelines for fresh water (Vievis) and for wastewater (Vievis and Alytus North). The legal possibilities for this are not known at present nor the actual impact to the parks. For both sites, alternatives for the pipelines can be found, however, implying longer distances.

The social impact to the surroundings of all three sites will be positive, except for a smaller group of people directly concerned by the mill construction and possibly later nearby disturbances from the production. No great differences in this respect are foreseen for the recommended sites.

No major differences in the local support for the project have been noticed. So far local politicians and other representatives have shown a positive attitude towards the project, promising their full support. Information to NGOs and the public has been given on each place in the form of a seminar/workshop. However, this should not be considered as enough and further activities are required to fulfil the local population's legitimate demands for information and opportunities to express their opinions.

(2) Comments to site alternatives close to the Baltic Sea

The "long list" and "short list" of potential mill sites included a number of sites located in Klaipeda County, Districts of Klaipeda and Kretinga respectively. All these alternatives are considered less favourable from a wood supply and wood transport point of view. Their possible advantage as concerns export and transports of the pulp to European buyers does not compensate for this. No site is located directly at the coast with possibilities for own quay and shipping to Europe of pulp. All sites require truck or railway transports to Klaipeda harbour.

None of these sites are located at a river large enough to serve as source for fresh water. For this reason the possibility to use ground water also as mill process water – exclusively or as a complement to other sources - has been discussed. The idea is not unrealistic but can at this stage not be verified. Special geological and ground water supply studies have be carried out to estimate the available quantities. Lithuania has vaste sources of good quality ground water and principally all municipal water is currently supplied from ground water.

The sites in Klaipeda and Kretinga Districts have primarily been identified in order to find one alternative from where discharges of treated wastewater can be discharged directly through pipeline to the Baltic Sea. From this point of view, Darbenai seems to offer the best conditions. A pipeline of some 7 km to the coast and some additional km to the Baltic Sea will be required. Darb nai is also located at an artificial lake, which can serve partly or fully as a source of fresh water.

The alternative sites in Klaipeda District – Lebertai, Dumpai and Mickai – are all judged to face too large environmental problems. Pipelines for wastewater have to pass the Kursiu Marios and the Neringa National Park to reach the Baltic Sea. A site location in western Lithuania discharging wastewater directly to the Baltic Sea is presently not recommended.

Annex 4-1

Selected Counties (Apskritis) - Profiles in Brief

Alytus County (Region) – Alytus Apskritis – in brief

Alytus County is the southernmost county of Lithuania. It is bordering to Poland in the west and to Belarus in south and east. In northwest, north and northeast Alytus county borders the counties of Marijampoles, Kaunas and Vilnius respectively.

The total land area amounts to 542 500 ha of which

37.5 %	agricultural land
45.6 %	forest land
4.5 %	lakes, rivers, etc.
2.1 %	residential areas
2.3 %	infrastructure and industry
8.0 %	others

Alytus county encompasses three districts (rajonas)

- Alytus district
- Lazdijai district
- Varena district

and two municipal administrative units

- Alytus City
- Druskininkai

The population of the county amounts to 203 000 inhabitants of which

- 61% in urban areas
- 39% in rural areas

Alytus makes up the main city within the county with approximately 77 000 inhabitants. County administration resides in Alytus City. Other main municipalities are Druskininkai, Lazdijai and Varena.

Main agriculture areas are found in the western and northern parts of the county, while eastern and southern parts mainly are forested. It is the most densely forested county in Lithuania. Major industries are found in the textile, chemical, food, construction and machine manufacturing sectors. Largest industries are located to Alytus such as AB Snaiges (household refrigerator manufacturer), AB Alita (bubbling wine distillery), AB

Alytus Tekstiles (cotton textile and thread producer) and AB Dainava (Sewing factory). Alytus hard board mill is currently shut down. Silunga sawmill in Alytus city, earlier part of Alytus Housebuilding Combinate, used to be the largest sawmill in Lithuania but is today running only at a very low capacity level. Other small sawmills, furniture industries, carpentries etc. can be found in the county.

The school and education system is well built up. No universities or high schools/colleges are located to the county.

The main road net is generally good with mainly 2-lane, paved roads with an ordinary width of 8 to 10 m.

The railway from Vilnius to Belarus is passing through the eastern part of the county through the town of Varena. There is also a railway, ending in Alytus city, connecting westwards in Šeštokai to the railway from Kaunas to Poland. A railway terminal is located to Šeštokai connecting the Lithuanian railway system with the western European standard railway system.

The county is rich of small lakes and rivers, especially in the western and northern areas. River Nemunas, Lithuania's largest river flows northwards from Belarus through the county. River Merkis coming from northeast and passing through Varena, joins river Nemunas at Druskininkai.

The county includes the Dzekija National Park and a number of nature reserves, regional parks and state reserves.

Kaunas County (Region) –Kauno Apskritis – in brief

Kaunas County is located in the centre of Lithuania. It is bordering to Alytus county in south, Marijampoles and Taurages in west, Šiauliai and Panaveys in north, and to Vilnius county in east. It is the only county in Lithuania not bordering any foreign country.
The total area amounts to 817 000 ha

Kaunas county encompasses six districts (rajonas)

- Jonava district
- Kaunas district
- Kedainiai district
- Kaišiadorys district
- Prienai district
- Raseiniai district

and two municipal administrative units

- Kaunas City
- Birstonas City

The population of the county amounts to some 760 000 inhabitants
Kaunas makes up the main city with approximately 415 000 inhabitants which makes Kaunas the second largest city in Lithuania. County administration resides in Kaunas City. Other main municipalities are Kedainiai, Jonava, Prienai and Raseiniai.

Kaunas county can be characterised as a mixed agriculture and industrial area. Kaunas is the main industrial city, well known for its fabrics and clothes manufacturing industry. This has also been the main type of industry in Raseiniai. Jonava and Kedainiai are mainly known for their chemical and fertiliser production plants. Kaunas Paper Mill in the city of Kaunas is still operating but currently on a very low level and future development opportunities are discouraging. Several smaller sawmills, furniture industries and other mechanical wood industries are found in the county.

The school and education system is well built up with a number of university units, colleges and other high education institutions. Especially can be mentioned Kaunas Technological University with departments for mechanical wood processing and for pulp and paper production, Vytautas Magnus University, Agriculture Academy (with Forestry

Faculty) and Kaunas Forestry College. Kaunas makes up the centre in Lithuania as concerns research, development and education related to forestry and forest industry.

Kaunas county has a strategic location in the middle of Lithuania with very good infrastructure. The main highway from Belarus and Vilnius, through Kaunas, crosses the county on its way to Klaipeda. Other main public roads, crossing the county in most directions, are generally of good standard with mainly 2-lane, paved roads with an ordinary width of 8 to 10 (12) m.

The county is crossed by a number of main roads, including

- A1 from Belarus (Minsk) and Vilnius to Klaipeda
- A5 from Kaunas to Marijampoles and further south to Poland
- A6 from Kaunas to Jonava, Ukmerges, Utena to Daugavpils in Latvia
- A8 through Kedainiai and northwards to Panaveys

Other main roads run westwards to Jurbarkas and further along river Nemunas to Klaipeda, and southwards to Alytus.

Via Baltica planned to connect Helsinki with Berlin crosses the county from north to south on its way to Poland, and passes the cities of Kedainiai and Kaunas. Major construction work is currently ongoing within the county in order to finalise the Lithuanian link of the road.

Main railways run in most directions from Kaunas – northwards through Jonava and Kedainiai, eastwards through Kaišiadorys, and southwards to Poland. Kaunas makes up one of the most important railway hubs in Lithuania. A new railway line of West European standard is planned to be built from Kaunas to the Polish border. Kaunas International Airport is located a few km northeast of the city along the main road to Jonava.

Kauno Marios at Kaunas city, one of Lithuania's major lakes, is an artificial lake. River Nemunas, coming from Alytus in the south, flows through Kauno Marios and passes Kanuas city on its way eastwards to the Baltic Sea. River Neris, the second largest river in Lithuania, comes from Vilnius and joins river Nemunas in Kaunas city. Other important rivers are Nevezis flowing southwards through Kedainiai city to river Nemunas, Dubysa passing Raseiniai district on its way south to Nemunas, and Šventoji joining river Neris in Jonava city.

The county includes no national park but three regional parks along river Nemunas, river Dubysa and Kauno Marios, and a number of other nature reserves and state reserves.

Klaipeda County (region) – Klaipeda Apskritis – in brief

Klaipeda County is the westernmost county of Lithuania. It is bordering the Baltic Sea and has a total coastline of about 100 km. It borders Russia/ Kaliningrad in the south and Latvia in the north. To the east Klaipeda county borders the counties of Telšiai and Taurages.

The total area is 574 600 ha of which

56.4 %	agricultural land
23.0 %	forest land
9.6 %.	lakes, rivers, etc
2.7 %	urban areas
8.2 %	others

Klaipeda county encompasses four districts (rajonas)

- Klaipeda district
- Kretinga district
- Šiluté district
- Skoudas district

and three municipal administrative units

- Klaipeda city
- Neringa municipality
- Palanga city

The population amounts to 416 000 inhabitants. Klaipeda City makes up the main municipality with over 200 000 inhabitants. Other important municipalities are Šilute, Kretinga and Palanga. The county administration resides in Klaipeda city.

Klaipeda county is a typical agricultural region, whereas major industries can also be found, primarily in Klaipeda City. The nearness to the Baltic Sea and the long coastline – made up of a continuous sand beach between the Kaliningrad and the Latvian borders, except for the harbour area in the City of Klaipeda – makes Klaipeda county to the most important region in Lithuania for recreation and tourism. Besides companies built up and based on the activities in the harbour (shipping, ship building, ship repair and maintenance, fishing, etc.) can be mentioned Philip Morris and Siemens in Klaipeda and Fast Food in Gargzdai all established during the 90ies. Klaipeda Cardboard Mill is still running but at a very low production level. The sulphite pulp and the groundwood pulp production is closed since beginning of the 90ies. The possibilities for development are limited due to the mill's location close to major residential areas and present technical and financial status of the company. Other important wood based industries are the particleboard mill, the veneer plant and some sawmills, all located to Klaipeda city.

The school and education system is well built up with University in Klaipeda and lower education institutions.

The infrastructure is well built up with main roads, railways, harbour and international airport. The main highway A1 from Vilnius and Kaunas ends up in Klaipeda. Other main public roads of good standard run soutwards to Šilute and further eastwards to Jurbarkas and Kaunas, and from Klaipeda northwards to Kretinga, Palanga and Latvia.
Railways are coming from north, east and south to Klaipeda city. The harbour of Klaipeda also includes a railway ferry terminal with connection to Germany.
The harbour in Klaipeda City, the only harbour at the Baltic Sea in Lithuania, is of utmost importance to the city and the whole country. An offshore oil terminal for loading of oil to and from the refinery in Mazeikiai, has recently also been built at Butinge close to the Latvian border.

Palanga international airport, some 30 km north of Klaipeda, has direct connection to Germany (Hamburg, Frankfurt), Denmark (Billund), Sweden (Kristianstad), Norway (Solo) and Russia (Moscow, St Petersburg).

Klaipeda county is short of rivers and lakes except for river Nemunas flowing along the border to Russia/Kaliningrad into Kursiu Marios and the Baltic Sea. Rivers like river Dane and river Minija are comparatively small and environmentally sensitive.

Klaipeda county encompasses several environmentally sensitive and protected areas like

- Neringa National Park
- Nemunas Delta Regional Park
- Pajerio Regional Park
- Salantu Regional Park

as well as a number of other protected areas, e.g. the river Minija.

Utena County (region) – Utena Apskritis – in brief

Utena county in the eastern part of Lithuania borders the counties of Panav □ in the north and Vilnius in the south. Utena county is also bordering Latvia in northeast and Belarus in east.

The total area amounts to 720 000 ha

Utena county encompasses five districts (rajonas)

- Anykšeiai district
- Ignalina district
- Moletai district
- Utena district
- Zarasai district

The population of the county amounts to some 202 000 inhabitants
Utena city makes up the main city in the county with approximately 36 000 inhabitants. County administration resides in Utena city. Other main municipalities are Anykšeiai, Ignalina, Visaginas, Moletai and Zarasai.

Utena county can be characterised as a rural agriculture area with primarily only light and small to medium size industries, except the nuclear power plant in Ignalia district, close to Visaginas town.

The school and education system is rather well built up on lower education levels but with no university units, colleges or other high education institutions.

There are two important main roads crossing the county - the A6 from Kaunas, Ukmerges to Utena and eastwards to Daugavpils in Latvia and further east, and the south-north road between Utena and Vilnius. Other main public roads, crossing the county in most directions, are generally of lower standard with mainly 2-lane, paved roads with an ordinary width of 8 to 10 m.

The railway passing Ignalina and Visaginis connects the eastern parts of the county to Latvia in north (and further east/northwards) and to Vilnius in the south. The railway to Utena city ends in the city and connects in the south to the railway to Vilnius.

The county is rich in, generally shallow, lakes and small rivers and creeks. There is no major river passing the county. The outflows of the major lakes Dysnai and Dr kši go to Belarus and further on to river Daugava in Latvia before joining the Baltic Sea in Riga.

The county encompasses Aukštaitijos National Park, and a number of other regional parks, nature reserves and state reserves.

Vilnius County (Region) – Vilnius Apskritis – in brief

Vilnius County, located in eastern Lithuania, borders Belarus in south and east. In north it borders the counties of Utena and Panav □ys, and in west the counties of Kaunas and Alytus.

The total area of Vilnius county amounts to 965 000 ha of which

- 49 % agricultural land

Vilnius county encompasses seven administrative districts (rajonas)

- Elektr nai district
- Šal ininkai district
- Širvintos district
- Šven ionys district
- Trakai district
- Ukmerges district
- Vilnius district

and one municipal administrative unit

- Vilnius City

The population of the county amounts to 894 000 inhabitants of which

- 79.5 % in urban areas
- 20.5 % in rural areas

Vilnius makes up the main city and the capital of Lithuania. Vilnius with approximately 415 000 inhabitants is the largest city in Lithuania. County administration resides in Vilnius City as well as the Government and Parliament (Seimas) of Lithuania. Other important municipalities in the county are for example Ukmerges, Elektr nai, Trakai, Lentvaris, Šal ininkai and Šven ionys.

Vilnius county is dominated by the Capital Vilnius which can be characterised as a mixed governmental, industrial and education city. Areas outside of Vilnius are typical rural agriculture areas. Presently foodstuff processing industries are the most important type of industries together with clothes manufacturing, wood based industries, beverage and chemical production as well as other types of light industry and construction work. AB

Grigiskes, located some 20 km west of Vilnius in the town of Grigiskes, produces tissue and hardboard as their main products. The company is principally the only pulp and paper industry in Lithuania that has managed to develop and reached profitable increasing production. Other wood based industries are Pabrade Paper Mill and Naujuju Verkiu Paper Mill, both with very low production, as well as a number of small sawmills and furniture industries of varying size.

The school and education system is well built up with a number of university units, colleges and other high education institutions. Especially can be mentioned Vilnius University and Vilnius Technical University.

The infrastructure of Vilnius county is well built up especially in the central and western districts. The eastern districts, both in south and north, are typical rural districts with poorer public road net. The main highway from Belarus crosses the county on its way to Kaunas and Klaipeda. Also the main road to northwest towards Ukmerges and Panav ys is of highway standard. Other main public roads, crossing the county in most directions, are generally of good standard with mainly 2-lane, paved roads with an ordinary width of 8 to 10 (12) m.

Vilnius city is an important railway hub and railways run in most directions from the city – westwards to Kaunas and Klaipeda, to southeast through Varena to Belarus, south- and eastwards to Belarus, and to northeast through Pabrade and Ignalina to Daugavpils in Latvia.

Vilnius international airport is located a few km south of the city.

River Neris, the second largest river in Lithuania, flows through Vilnius city westwards and joins river Nemunas in Kaunas city. Other rivers are mainly small, like river eimena passing Pabrad s, and generally environmentally sensitive. The county is rich of lakes, normally shallow.

The county encompasses Trakai National Park, Neris Regional Park between Vilnius and Elektr nai and a number of other nature reserves and state reserves.

Annex 4-2

Potential Mill Sites - Profiles in Brief

Note 1 All distances presented are rough estimates as the definite borders of the mill site are not decided. Distances refer to distance outside mill site to connect to roads, railways, power lines, process water source and wastewater recipient, etc.

Note 2 Figures are more accurate for those sites finally selected as the most favourable sites (Alytus North, Jonava Rukla and Vievis).

Note 3 Environmental restrictions are only occasionally commented, but are discussed in more detail in Chapter 5.

Proposed mill site: Alytus North

County (Apskritis)	Alytus
District (Rajona)	Alytus
Location of site	North Alytus city (6-9 km) and north industrial area (2-4 km), between road 130 and river Nemunas
Site characteristics	Slightly rolling agriculture land, with a few dwelling-houses scattered in the area. Potentially available area exceeds 200 ha with possibilities to further expand.
Land ownership	Mainly private land – 90 % - a few (5-6) rather large farms (30-60ha each).
Surroundings	To the east and north flows river Nemunas, the largest river in Lithuania. North of the proposed mill site the River Nemunas Regional Park is situated encompassing the banks and nearby areas of river Nemunas. To the west is mainly agriculture land and the main road from Alytus to Kaunas. Urban areas in south (Alytus city), about 5 km to main residential areas in city, scattered dwelling-houses especially to the east towards Nemunas west bank.
Process water supply	River Nemunas east of site at 2-3 km distance, south border of regional park. Steep banks at river Nemunas, difference of 50-60 m to site level. The textile industry has its own water intake from Nemunas with over capacity and is selling treated water (filtered) to nearby industries
Potable water supply	Municipal
Waste water treatment	Own plant on site initially assumed. Alytus new municipal waste water treatment plant close to the area, 3-4 km. The plant – located between the industrial area and river Nemunas north of the city - has been built in cooperation with Denmark Waste water from textile plant returned to community system
Wastewater recipient	River Nemunas north of site within regional park, approx. 3 km. Alternatively south of (upstreams) regional park, 2-3 km.
Power supply	110 kV and 330 kV power lines close to site, 1 km
Access to natural gas	Gas pipeline – high, medium and low pressure – between road and river
Roads	Main road 130 Alytus – Kaunas passes a few km to the west of the site. River Nemunas makes up an obstacle for traffic coming from south or east. However, a new bridge planned over the river and further passing through industrial area connecting to main road 130 – forming part of a new "ring way" - will improve wood transport conditions to the mill site.
Railway connection	Railway connection available in adjacent industrial area, 2-3 km
Solid waste deposit	Probably own deposit to be prepared
Local district heating system	District heating plant situated in industrial area.
Others	Sawmill (Silunga) and other wood based industries (wooden houses, windows, doors, etc.) situated in nearby industrial area. The hardboard factory has been shut down. It is planned to be dismantled and sold. Mineral wool factory dismantled. No cultural heritages known. Growing important leisure time area along Nemunas banks, although presently said to be only marginally utilised
Special notes	Pipeline for treated effluent water has to cross part of the regional park on the south bank of river Nemunas if discharging to the north is considered. Discharging to the east, south of the regional park, will influence the raw water intake that has to be moved further south (upstreams) to avoid effluent water in the fresh raw water .

Proposed mill site: Alytus South

County (Apskritis)	Alytus
District (Rajona)	Alytus
Location of site	South to southeast of Alytus city at river Nemunas north bank on former military area, between the river and road 128 running from Alytus eastwards to Vilnius.
Site characteristics	Flat, open, presently unused land. Former military area. Potentially available area about 1x1.5 km (150 ha) or less, with limited possibilities to expand.
Land ownership	State owned.
Surroundings	The proposed site is surrounded by river Nemunas to the south and east, a botanical nature reserve area to the west and further west and north by the city of Alytus. About 2 km to nearest main residential area and another 2 km to the centre of the city. Opposite side of river Nemunas mainly forested areas.
Process water supply	River Nemunas, 0.5 km
Potable water supply	Municipality
Waste water treatment	Own plant on site initially assumed.
Wastewater recipient	River Nemunas, north of site, upstreams the city, 0.5-1.0 km
Power supply	In city
Access to natural gas	
Roads	Road 128 passing the site in west-east direction.
Railway connection	Nearest railway line in the city, 7-8 km away, with limited possibilities to build a new line to the mill (passing the nature reserve)
Solid waste deposit	Probably own deposit to be prepared
Local district heating system	District heating system in city
Others	
Special notes	

Proposed mill site: Matuizos

County (Apskritis)	Alytus
District (Rajona)	Var na
Location of site	East of Matuizos village, close to the old brick factory
Site characteristics	
Land ownership	
Surroundings	Typical forest area with some scattered agriculture land. Nearest village Matuizos and some 10 km away the small town of Varena. Varena is the largest district in Lithuania by area – 2400 km2 – but the least densely populated. Total population amounts to 36 000 of which 10 500 in the town of Varena. About 65 % of the land is forested – mainly by pine.
Process water supply	River Merkis
Potable water supply	
Waste water treatment	Own plant on site initially assumed.
Wastewater recipient	River Merkis
Power supply	110 kV power line to village Matuizos
Access to natural gas	
Roads	Rather poor road to Varena. Nearest main road is road A4 from Vilnius some 15 km from site
Railway connection	Railway Vilnius – Belarus passes village Matuizos
Solid waste deposit	No, own deposit has to be prepared
Local district heating system	No
Others	River Merkis is considered to be a clean river with 22 different species of fish. Downstreams Pamerkiai there is a Geological Reserve Area. Further down streams, Merkis is passing Dzukijos National Park, before reaching river Nemunas in the municipality of Merkine.
Special notes	Site not visited, information through local authority representatives.

Proposed mill site: Pamerkiai

County (Apskritis)	Alytus
District (Rajona)	Var na
Location of site	Northwest of railway and river Merkis intersection in Pamerkiai village
Site characteristics	Flat agriculture and forest land on the north side of river Merkis and west of the railway line. Minimum 150 ha possible to find with possibilities for further expansions (forest land)
Land ownership	Mixed. Agriculture land private, forest land mainly state owned.
Surroundings	The small village of Pamerkiai and Varena town. Pamerkiai is a typical old poor countryside village with an estimated population of some 100 – 200 persons. People mainly living from agriculture business. Varena is the largest district in Lithuania by area – 2400 km2 – but the least densely populated. Total population amounts to 36 000 of which 10 500 in the town of Varena. About 65 % of the land is forested – mainly by pine.
Process water supply	River Merkis
Potable water supply	Own ground water well
Waste water treatment	Own plant on site initially assumed.
Wastewater recipient	River Merkis
Power supply	110 kV power line in Matuizos some 4 km southwards.
Access to natural gas	
Roads	Poor access road to mill site, gravelled, from main road A4 from Vilnius to Belarus, Distance to road A4 some 4-5 km
Railway connection	Railway Vilnius – Belarus passing along mill site
Solid waste deposit	No, own deposit has to be prepared
Local district heating system	No
Others	River Merkis is considered to be a clean river with 22 different species of fish. Downstreams Pamerkiai there is a Geological Reserve Area. Further down streams, Merkis is passing Dzukijos National Park, before reaching river Nemunas in the municipality of Merkine. Dominating wind from southwest
Special notes	

Proposed mill site: Jonava North

County (Apskritis)	Kaunas
District (Rajona)	Jonava
Location of site	North of industrial area, northeast of Jonava city
Site characteristics	Flat, mainly forested land (pine, average age some 50 years) with a few small farms. Available area less than 150 ha (120 ha) with no possibilities to expand. Area surrounded by roads and high voltage power lines. Geological conditions are good, mainly sandy soils, ground water level unknown but drainage is considered no problem. Risk for pollution through ground water judged very low. Analyses were made around Achema some years ago with no specific risks noticed.
Land ownership	30 % private, 6 farms with rather poor small scale farming activities, remaining area state owned (State Forest Fund)
Surroundings	Industrial area to southwest between mill site and Jonava residential areas. About 1.5-2 km to nearest main residential areas. To the south power lines, main road from Ukmerge to Jonava and river Neris. To the north and east primarily agriculture land with scattered villages and dwelling-houses. Main municipalities Jonava city, 35 000 inhabitants, and Kaunas some 30 km southwest, 400 000 inhabitants. Main industry is Achema AB producing nitrogen fertilisers, urea, ammonia, and others. Private company.
Process water supply	River Neris, 1-1.5 km
Potable water supply	Municipal or own ground water well.
Waste water treatment	Own plant on site initially assumed. Municipal waste water treatment plant close to river Neris in southern part of town. Pumping station close to railway station in central Jonova, capacity of pumping 20 000 m3/day, present use about 5-6 000 m^3
Wastewater recipient	River Neris. Discharge of wastewater up streams the town might cause problems as concerns permits, pumping to existing pump station judged less realistic.
Power supply	330 and 110 kV power lines adjacent to mill site. 1 km to transformer station of 330/110 kV
Access to natural gas	Gas pipeline available at district heating plant, 0.5-1 km
Roads	Short access road, 1 km required, to reach main road A6 to Kaunas in southwest and Ukmerge in northeast.
Railway connection	In Jonava city, railroad connection to industrial area, 1 km away
Solid waste deposit	Municipal deposit south of river Neris, about 5 km, alternatively own deposit
Local district heating system	District heating plant in industrial area, 0.5-1 km
Others	Jonava State Forest Enterprise's sawmill situated opposite road to mill site. Dominating winds are coming from southwest. No cultural heritages known.
Special notes	To discharge treated effluent water down streams the city is judged difficult

Proposed mill site: Jonava Rukla

County (Apskritis)	Kaunas
District (Rajona)	Jonava
Location of site	Southeast of Jonava city, west of Rukla municipality, between railway and road 143
Site characteristics	Slightly hilly landscape with mainly sandy soils, but also parts of more swampy character judged not to cause any drainage problems. Area mainly covered by forest or bushes. Available area exceeds 200 ha with possibilities to further expansion
Land ownership	State owned land, partly former military area. Marginal parts privately owned.
Surroundings	To the west mixed agriculture and forest land with some villages and scattered dwelling-houses, to the north the industrial area of Achema chemical plant (fertiliser producer) and further west on opposite side of river Neris the residential areas of Jonava. To the east mainly forest land, river Neris and the municipality of Rukla.In south mainly forest land and former military area (partly still in use). Main municipalities are Jonava city, 35 000 inhabitants, and Kaunas some 30 km southwest, 400 000 inhabitants. Main industry is Achema AB producing nitrogen fertilisers, urea, ammonia, and others. Private company.
Process water supply	River Neris upstreams Jonava, east of mill site, 1.5-2 km
Potable water supply	Municipal ground water field in Rukla or own ground water well
Waste water treatment	Own plant on site initially assumed. Waste water treatment plant in Rukla only used to a small share of its capacity. Treated water discharged to Neris.
Wastewater recipient	River Neris down streams Jonava centre, 4-5 km
Power supply	110 kV (2 km) and 330 kV (1 km) power lines available
Access to natural gas	High pressure and low pressure gas pipelines along border of site
Roads	Access roads to be improved 3-4 km. good connection to main road A6 Kaunas-Jonava-Ukmerge etc. Two-lane road to southeast to Elektrenai and main road A1Vilnius-Kaunas-Klaipeda
Railway connection	West of mill site, Gai□i nai railway station (presently unused) with good conditions for parking railway wagons and for train movements, 1 km. Connection to Achema railway line judged to be too steep.
Solid waste deposit	Municipal deposit, 1.5-2.5 km
Local district heating system	Possibilities to connect to district heating system in Rukla.
Others	Dominating winds are coming from southwest. Rukla facilities were built for military purposes and the area used to be intensively used by the military, presently used to some extent for Lithuanian military and housing of illegally arrived immigrants (waiting to be returned to their country of origin) No cultural heritages known.
Special notes	

Proposed mill site: K dainiai

County (Apskritis)	Kaunas
District (Rajona)	K dainiai
Location of site	Eastern part of industrial area east of K dainiai city
Site characteristics	Flat grassland, somewhat swampy, but underneath ground is said to be good for heavy buildings (no ground survey carried out).
Land ownership	
Surroundings	Proposed site situated in existing industrial area. Surroundings mainly agriculture land with scattered forest areas and scattered dwelling-houses and small villages. K dainiai is a typical industrial town with large bio-chemical industry – e.g. AB Kedainu Bio-Chemija – producing additives for animal, furforal, etc. Grain storage, sugar factory and others. Only minor wood working industries in the area
Process water supply	River Obelis or river Nev □is, limited supply
Potable water supply	Municipal
Waste water treatment	Own plant on site initially assumed.
Wastewater recipient	River Nev □is
Power supply	110 kV power line, a few km
Access to natural gas	
Roads	Good road connections in most directions. The area is bordering the new road Via Baltica now under construction
Railway connection	Main railway Vilnius-Klaipeda, roughly 2-3 km away
Solid waste deposit	
Local district heating system	
Others	
Special notes	

Proposed mill site: L bartai

County (Apskritis)	Klaip da
District (Rajona)	Klaip da
Location of site	East of Klaip da City, southwest of the small village of Lebartai.
Site characteristics	Flat area with extensively used grassland and agriculture land
Land ownership	Mainly private or in process to be privatised. Presently some 20-30 owners
Surroundings	Typical agriculture area with scattered villages and individual dwelling-houses. Some 10 km to nearest main residential areas in Klaip da or Gargzdai. The site is neighbouring the cemetery of Klaip da and also close to the wastewater treatment plant in Dumpai.
Process water supply	River Minija, 2 km away, limited supply. Protected area. Ground water wells (?) Process water from Kurši Marios not considered as salt water is penetrating Kurši Marios about 30 days per year up to a line of roughly 1/3 of Lithuanian part of lagoon.
Potable water supply	Own ground water wells
Waste water treatment	Own plant on site initially assumed. New waste water treatment plant, start-up in 1999, with full mechanical and biological treatment at Dumpai. Cleaned water pumped and discharged in Kurši Marios. The area also includes handling/storing facilities for hazardous waste, as well as a new solid waste deposit.
Wastewater recipient	Pipeline directly to the Baltic Sea. Pipeline has to pass Kurši Marios as well as Neringa National Park, which probably is not acceptable. The possibility to discharge waste water into the harbour area has been discussed, together with the waste water from the municipality plant, but is presently not further considered.
Power supply	
Access to natural gas	
Roads	Medium/low standard access roads to the site and some 3-4 km distance to the main public road from Klaip da to Šilut .
Railway connection	Railway Klaipeda-Silute, 4 km
Solid waste deposit	Nearby municipal deposit in Dumpai or own deposit
Local district heating system	No
Others	Dominating wind from seaside/west. River Minja protected for biological/ecological reasons. River considered as cleaner than river Dana from Kretinga. Salmon and trouts can be found in Minja, although not very common.
Special notes	

Proposed mill site: Dumpai

County (Apskritis)	Klaip da
District (Rajona)	Klaip da
Location of site	South to southeast of waste deposit plant at Dumpai.
Site characteristics	Flat, presently unused grassland
Land ownership	Mainly private or in process to be privatised. Presently some 30-40 owners
Surroundings	Typical agriculture area with scattered villages and individual dwelling-houses. Some 10 km to nearest main residential areas in Klaip da or Gargzdai. The site is neighbouring the wastewater treatment plant and solid waste deposit in Dumpai.
Process water supply	River Minija, 2 km away, limited supply. Ground water wells (?) Process water from Kurši Marios not considered as salt water is penetrating Kurši Marios about 30 days per year up to a line of roughly 1/3 of Lithuanian part of lagoon.
Potable water supply	Own ground water well
Waste water treatment	Own plant on site initially assumed. New waste water treatment plant, start-up in 1999, with full mechanical and biological treatment at Dumpai. Cleaned water pumped and discharged in Kurši Marios. The area also includes handling/storing facilities for hazardous waste, as well as a new solid waste deposit.
Wastewater recipient	Pipeline directly to the Baltic Sea Pipeline has to pass Kurši Marios as well as Neringa National Park, which probably is not acceptable. The possibility to discharge waste water into the harbour area has been discussed, together with the waste water from the municipality plant, but is presently not further considered.
Power supply	
Access to natural gas	
Roads	The site area is bordering the main road from Klaip da to Šilut
Railway connection	The railway Klaipeda-Silute is passing close to the area but opposite the main road.
Solid waste deposit	Nearby municipal deposit in Dumpai or own deposit
Local district heating system	No
Others	Dominating wind from seaside/west. River Minja protected for biological/ecological reasons. River considered as cleaner than river Dana from Kretinga. Salmon and trouts can be found in Minja, although not very common.
Special notes	

Proposed mill site: Mickai

County (Apskritis)	Klaip da
District (Rajona)	Klaip da
Location of site	West of Mickai village, between railway and the artificial channel Klaipedos Kanalas.
Site characteristics	Slightly rolling presently unused grassland
Land ownership	Mainly private or in process to be privatised. Presently some 30-40 owners
Surroundings	Typical agriculture areas to the east with scattered villages and individual dwelling-houses. Some 8 km to nearest main residential areas in Klaip da.
Process water supply	River Minija, 2 km away, limited supply. Ground water wells (?) Process water from Kurši Marios not considered as salt water is penetrating Kurši Marios about 30 days per year up to a line of roughly 1/3 of Lithuanian part of lagoon.
Potable water supply	Own ground water well
Waste water treatment	Own plant on site initially assumed. New waste water treatment plant, start-up in 1999, with full mechanical and biological treatment at Dumpai. Cleaned water pumped and discharged in Kurši Marios. The area also includes handling/storing facilities for hazardous waste, as well as a new solid waste deposit.
Wastewater recipient	Pipeline directly to the Baltic Sea. Pipeline has to pass Kurši Marios as well as Neringa National Park, which probably is not acceptable. The possibility to discharge waste water into the harbour area has been discussed, together with the waste water from the municipality plant, but is presently not further considered.
Power supply	
Access to natural gas	
Roads	The site area is bordering the main road from Klaip da to Šilut
Railway connection	The railway Klaipeda-Silute is passing along the proposed site.
Solid waste deposit	Nearby municipal deposit in Dumpai or own deposit
Local district heating system	No
Others	Dominating wind from seaside/west. River Minja protected for biological/ecological reasons. River considered as cleaner than river Dana from Kretinga. Salmon and trouts can be found in Minja, although not very common. Probably to close to Klaipeda Channel (water reservoir for Klaipeda). It is also located within the "Coastal Zone" which should be generally protected.
Special notes	

Proposed mill site: T bausiai

County (Apskritis)	Klaip da
District (Rajona)	Kretinga
Location of site	East of T bausiai village some 8 km northeast of Kretinga, east of river Akmene
Site characteristics	Flat to slightly rolling agriculture area
Land ownership	
Surroundings	Mixed agriculture and forest area with scattered small villages and individual dwelling-houses. Nearest main residential area in Kretinga, 8 km.
Process water supply	River Akmena and artificial lake/dam nearby mill site. Area and volume of lake unknown
Potable water supply	Own ground water well
Waste water treatment	Own plant on site initially assumed.
Wastewater recipient	Discharged through pipeline directly to the Baltic Sea some 14 – 15 km away
Power supply	
Access to natural gas	
Roads	2-3 km rather poor gravel access road to the main road Klaipeda – Kretinga – Darbenai. Rather poor 2-lane paved road to Kretinga. Good road connection southwards to Klaipeda and eastwards to Plunge etc.
Railway connection	Railway line from Klaipeda to Kretinga and further on to Latvia 3-4 km away
Solid waste deposit	Own deposit to be prepared. Kretinga own solid waste deposit overfilled and a new one is planned
Local district heating system	No
Others	
Special notes	

Proposed mill site: Darb nai

County (Apskritis)	Klaip da
District (Rajona)	Kretinga
Location of site	West of Darb nai municipality, 4-5 km, and west of neighbouring artificial lake/dam
Site characteristics	Flat, presently extensively used agriculture land. Totally some 400 ha of which only some 200 ha are used. Sandy soils, about 1 m to clay, lowland area where drainage may become a problem.
Land ownership	Privately owned
Surroundings	Mixed agriculture and forest area with scattered small villages and individual dwelling-houses. Nearest main residential area in Darb nai municipality, 4-5 km, 1500 inhabitants.
Process water supply	Artificial lake/dam in river Darba. Supply ? The lake is up to 20 m deep, estimated avarge 7-8 m, and has a total area of 110 ha.
Potable water supply	Own ground water well
Waste water treatment	Own plant on site initially assumed.
Wastewater recipient	Discharged through pipeline directly to the Baltic Sea some 7 km away
Power supply	110 kV power lines in Darb nai, 4-5 km
Access to natural gas	
Roads	Poor access road to site (4-5 km) - partly gravelled, partly paved - from main road Klaipeda – Kretinga – Darb nai. Rather poor 2-lane paved road to Kretinga
Railway connection	Railway connection possible in Darb nai, 3-4 km, with further connections to Latvia in north and the Lihuanian railway system to the south
Solid waste deposit	Own deposit to be prepared.
Local district heating system	No
Others	Distance to Palanga International Airport 12-15 km.
Special notes	

Proposed mill site: Pag giai South

County (Apskritis)	Klaip da
District (Rajona)	Šilut
Location of site	South of Pag giai municipality, 1-2 km, and railway station, close to river Nemunas at the border to Kaliningrad, about 1 km to river.
Site characteristics	Slightly hilly area
Land ownership	
Surroundings	Mixed agriculture and forest land with scattered small villages and individual dwelling-houses. Areas south and west of side down to river Nemunas typical lowland areas commonly flooded.
Process water supply	River Nemunas
Potable water supply	Own ground water well
Waste water treatment	Own plant on site initially assumed.
Wastewater recipient	River Nemunas
Power supply	
Access to natural gas	
Roads	The main road through the town - from Klaipeda to Kaunas – is of rather good standard, paved some 8 – 10m in width. There is also a road of similar standard going northeast to Taurage and main road A1. Bridge over Nemunas to Kaliningrad in Panemune.
Railway connection	Close to the railway station in Pag giai and railway line from Klaipeda, Jurbarkas and Kaliningrad
Solid waste deposit	Own deposit to be prepared
Local district heating system	No
Others	
Special notes	Land area between the proposed site and river Nemunas normally flooded once or twice a year. Opposite the river on the Kaliningrad side, is the Russian pulp mill Celulose Combinatas Sovetsk Tilze, which is a heavy polluter of the river.

Proposed mill site: Pag giai North

County (Apskritis)	Klaip da
District (Rajona)	Šilut
Location of site	North of Pag giai municipality, 1-2 km, and north of main road to Klaipeda and railway, former military area
Site characteristics	Mainly flat, wooded land
Land ownership	
Surroundings	Mixed agriculture and forest land with scattered small villages and individual dwelling-houses. Areas south and west of side, down to river Nemunas typical lowland areas commonly flooded.
Process water supply	River Nemunas
Potable water supply	Own ground water well
Waste water treatment	Own plant on site initially assumed.
Wastewater recipient	River Nemunas
Power supply	
Access to natural gas	
Roads	The main road through the town - from Klaipeda to Kaunas – is of rather good standard, paved some 8 – 10m in width. There is also a road of similar standard going northeast to Taurage and main road A1. Bridge over Nemunas to Kaliningrad in Panemune.
Railway connection	Close to railway Klaipeda – Taurage and Kaliningrad, 1-2 km.
Solid waste deposit	Own deposit to be prepared
Local district heating system	No
Others	
Special notes	Opposite the river on the Kaliningrad side, is the Russian pulp mill Celulose Combinatas Sovetsk Tilze, which is a heavy polluter of the river.

Proposed mill site: i□iunai

County (Apskritis)	Utena
District (Rajona)	Ignalina
Location of site	Area around i□iunai village, east of lake Dysnai.
Site characteristics	Slightly rolling agriculture landscape
Land ownership	
Surroundings	Bordering lake Dysnai in west. Mainly agriculture land in other directions in the neighbourhood mixed with small forest areas, farther away more forested land. Sparsely populated area with scattered small villages and individual dwelling-houses.
Process water supply	Lake Dysnai
Potable water supply	Own ground water well
Waste water treatment	Own plant on site initially assumed.
Wastewater recipient	Lake Dysnai
Power supply	North of lake Dysnai, 7-8 km
Access to natural gas	
Roads	Medium standard road passing the area
Railway connection	No railway, minimum 8-10 km away
Solid waste deposit	Own deposit to be prepared
Local district heating system	No
Others	
Special notes	Lake Dysnai is Lithuania's 2nd largest lake with an area of 2.4 ha, however, rather shallow. Outflow through lake Dysnykstis and river Dysnai eastwards through Belarus to Latvia and river Daugava

Proposed mill site: Janionys

County (Apskritis)	Utena
District (Rajona)	Ignalina
Location of site	North of Janionys village, some 20 – 30 km northeast of Ignalina city.
Site characteristics	Flat, extensively used agriculture land
Land ownership	Privately owned (one owner)
Surroundings	Mainly agriculture land mixed with forest areas. Sparsely populated with small villages and few individual dwelling-houses
Process water supply	Small lake and river Dysna
Potable water supply	Own ground water well
Waste water treatment	Own plant on site initially assumed.
Wastewater recipient	River Dysna
Power supply	West of lake Dysnai, 6-8 km
Access to natural gas	
Roads	Poor access road, 2 km, to medium standard public road
Railway connection	No, railway line 7-9 km away
Solid waste deposit	Own deposit to be prepared
Local district heating system	No
Others	
Special notes	River Dysna flows southwards to Belarus and thereafter to river Daugava through Latvia to the Baltic Sea.

Proposed mill site: Visaginas

County (Apskritis)	Utena
District (Rajona)	Ignalina
Location of site	East of Visaginas town, between the city of Visaginas and lake Dr kši , bordering the area of the Ignalina nuclear plant
Site characteristics	
Land ownership	
Surroundings	The area around the nuclear plant is an heavily exploited industrial area. Area bordering in east to Belarus. Mainly sparsely populated forest land with scattered agriculture land. Nearest main residential area is Visaginas with some 30 000 inhabitants. Only small wood working industries in the district, some 20 sawmills, furniture factories etc. Dairy in Ignalina.
Process water supply	Lake Dr kši
Potable water supply	Municipal
Waste water treatment	Own plant on site initially assumed.
Wastewater recipient	Lake Dr kši
Power supply	Yes, 110 and 330 kV power lines
Access to natural gas	
Roads	High standard main road going south to Ignalina city
Railway connection	Yes
Solid waste deposit	Own deposit to be prepared
Local district heating system	Possibly in Visaginas
Others	
Special notes	Lake Dr kši - 3.6 ha, 32 m deep. Water temperature in lake (varying between 15 and 35 ^{o}C) is strongly influenced by cooling water from nuclear plant.

Proposed mill site: Pabrad

County (Apskritis)	Vilnius
District (Rajona)	Šven ionys
Location of site	Southwest of Pabrad , 5-8 km, and close to Karka□iške municipalities, east of railway railway
Site characteristics	
Land ownership	
Surroundings	Mainly flat forest land with cattered agriculture areas. Pabrade is a small town with about 7000 inhabitants, of which 70 % Polish and 15 % Lithuanian origin. Pabrade Paper Industry and a British medical company are the main industries in the town. There is also a Centre for Illegal Immigrants (transfer centre) in the town.
Process water supply	River eimena, limited supply. Protected river.
Potable water supply	Own ground water well
Waste water treatment	Own plant on site initially assumed. Pabrade has its own waste water treatment plant, mech. + biol. treatment, new.
Wastewater recipient	River eimena or possibly river Neris, 4-6 km southwards
Power supply	
Access to natural gas	Natural gas for heating available - gas pipeline through village
Roads	Main road from Vilnius to Ignalina is passing, however, opposite both the railway and the river from the site
Railway connection	Bordering the railway to Vilnius from Latvia (Russia)
Solid waste deposit	Own deposit to be prepared
Local district heating system	No
Others	eimena used to be the cleanest river in Lithuania and is today protected upstream river Neris. Presently the paper mill is using only recycled paper. Water is taken from river Dubinga/Spengla (?) and the artificial pond upstream the mill. Water supply said to be relatively constant – upstream dam at lake Arinas. Drinking water is taken from groundwater.
Special notes	

Proposed mill site: Vievis

County (Apskritis)	Vilnius
District (Rajona)	Trakai
Location of site	North of Vievis municipality, north of main road A1 and railway
Site characteristics	Flat grassland/agriculture land without any buildings or farms except one pig farm.
Land ownership	Private
Surroundings	To the north mixed agriculture and forest land, to the south primarily agriculture land and the municipality of Vievis with some 6000 inhabitants. In southwest Elektr nai town with 16500 inhabitants. Pig farm and some food stuff industries within a few km distance
Process water supply	River Neris east (5 km) or north (6 km) of site
Potable water supply	Own ground water wells
Waste water treatment	Own plant on site initially assumed. Waste water treatment plant in Alseninkai with biological treatment serving Elektrenai and Vievis. Planned for a capacity of 40 000 m3/d but built only to half capacity, 20 000 m3/d. Actual usage/flow at present about half of present capacity. Treated water discharged through 2-3 km long pipe – self flowing – to small creek Alosa. Discharged water makes up more than 50 % of water flow in Alosa. Alosa flows into Neris.
Wastewater recipient	River Neris east (5-6 km) or north (6-7 km) of site
Power supply	110 kV power line, 3 km
Access to natural gas	High pressure gas pipeline along main road Vilnius – Kaunas
Roads	Good infrastructure with main road A1 from Vilnius to Klaipeda passing south the area
Railway connection	Railway Vilnius Klaipeda, 2.5-3.5 km
Solid waste deposit	Possibly municipal, alternatively own deposit
Local district heating system	Possibilities to connect in Vievis. District heating in Vievis is supplied from different small facilities using mainly heavy oil. Also electricity is used and some plants can use gas.
Others	Dominating winds are from south-west. Power production in Elektr nai power station from heavy oil and natural gas. The power plant is a major polluter, only one unit of 8 has some type of filter for flue gas cleaning. Public concern for additional polluter to the area is great.
Special notes	Pipelines for process water and for treated effluent water have to pass Neris Regional Park when pipelines to the east are considered. The northern alternative will avoid the regional park. For a site location somewhat westwards, may possibly also the lake at Elektrenai municipality be considered as a potential fresh water source with discharging of effluent water northwards of the site to river Neris (downstreams regional park), total distance for fresh and effluent water approx. 15-16 km.

Proposed mill site: Grigišk s

County (Apskritis)	Vilnius
District (Rajona)	Trakai
Location of site	AB Grigišk s Paper and Hardboard Plant. The site is located in the residential area in the center of the town of Grigišk s, some 20 km west of Vilnius. The site is located between and along the main road from Vilnius to Klaipeda and the river Neris downstreams Vilnius.
Site characteristics	The area is an industrial area including AB Grigišk s' tissue and hardboard factories and belonging energy production plant and facilities for handling and storing of wood and finished products. Available area limited, less than 150 ha. No further expansion possibilities.
Land ownership	Privately owned industrial site
Surroundings	Residential areas of Grigišk s town. North of town and river Neris mainly forest land, south of town mixed agriculture and forest land
Process water supply	River Neris
Potable water supply	Municipal, or possibly own ground water well
Waste water treatment	Own plant on site initially assumed.
Wastewater recipient	River Neris
Power supply	110 kV power line on site
Access to natural gas	
Roads	Bordering main road A1 from Vilnius to Klaipeda
Railway connection	Railway line on the site
Solid waste deposit	Own deposit to be prepared
Local district heating system	Yes, in town
Others	
Special notes	

Chapter 5　ENVIRONMENTAL ASPECTS

Chapter 5 ENVIRONMENTAL ASPECTS

5.1 General

Lithuania has adopted the principles of sustainable development. Accordingly, a new Lithuanian Environmental Strategy was formulated in 1996. This is one basis for the preparation and successive amendment of the environmental legislation.

The environmental legislation in Lithuania, including laws and ordinances, covers the following areas, which are relevant for the implementation and operation of a new pulp and paper mill:

* Environmental impact assessments
* Water quality
* Air quality
* Solid waste handling
* Noise
* Environmental monitoring
* Protected areas
* Taxes on Pollution and Natural resources

Relevant issues of this legislation are summarized in the following section 5.2. The information has been collected basically through contacts with officials at the Ministry of the Environment, in charge of the different areas.

As Lithuania is a member candidate of the European Union, the environmental legislation will gradually be adapted to the corresponding EU legislation. This adaptation work is now going on in several areas.

The IPPC Directive of the EU (Integrated Pollution Prevention and Control) shall be in force in Lithuania from 2003-01-01.

The new kraft pulp mill is proposed to be built and operated, utilising the latest proven technology for minimising impact on the environment, also designated as Best Available Technique (BAT). The anticipated emissions to water and atmosphere will correspond to low levels, comparable with the most modern pulp mills that are in operation today.

5.2 Environmental Legislation in Lithuania

5.2.1 Environmental impact assessments – Environmental decisions

The following law governs the implementation of Environmental Impact Assessments in Lithuania:

* Law on Environmental Impact Assessments of the Republic of Lithuania, adopted on April 18, 2000

In addition there are the following Ministerial Orders:

* Methodological Guidelines on Screening
* Regulations on preparation of the Environmental Impact Assessment Program and Report
* The Order on Informing the public and Participation of the public in the EIA Process

Object of the EIA is any proposed economic activity, which might have significant effects on the environment, by virtue of its nature, size or proposed location. Such activities are specified in two lists:

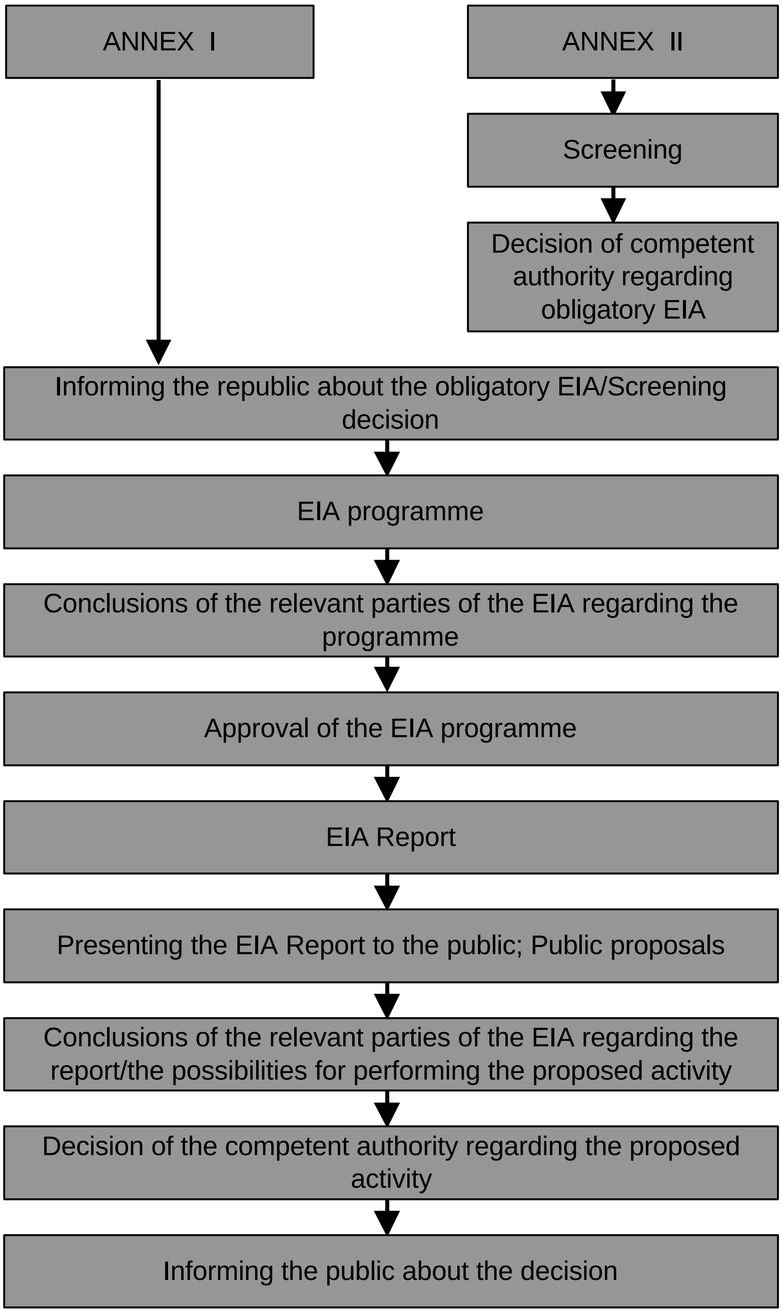
1) List of Types of Economic Activities that shall be subject to the Environmental Impact Assessment (Annex I)
2) List of Types of Economic Activities that shall be subject to the Screening for Obligatory Environmental Impact Assessment (Annex II)

The List under 1) above includes i.a. “Wood processing industry / Production of cellulose, paper and card-board”, which means that for this industry the EIA is obligatory, and no screening is required.

The new EIA legislation is based on the new EU Directive 97/11/EC. The new law implies a simplified process, compared to the old law.

The EIA process, according to the new law, is schematically shown in Figure 5.2.1.

Figure 5.2.1 EIA process in Lithuania.



Some important issues of the EIA process are (note: the screening is not required for a pulp and paper industry):

* The proponent (i.e. the investor of the project) applies first to the Municipal Administration (environmental division), in the district (municipality or city) where the project shall be implemented, concerning the Screening for EIA

* The Screening is handled by the Ministry of Environment (MoE) or the Regional Environmental Protection department
* Information to the public about an obligatory EIA (acc. to Annex I) or Screening decision (acc. to Annex II)
* In case of obligatory EIA, or if the Screening results in a requirement for an EIA, the next step is the preparation of a Programme for the EIA, made by the proponent
* The MoE approves the Programme, after hearing of the other Relevant parties (the "Relevant parties" in the EIA process are the Ministry of Health Protection and the Ministry of Interior Affairs/Fire Protection Department)
* The proponent performs the EIA and submits to the MoE.
* The MoE or the Regional Department of the MoE (i.e. one of the "Competent Authorities") makes a quality control of the EIA, and then takes the decision.

The proponent shall then submit an application for implementing the project, together with the decision of the MoE, to the County Administration. This Administration gives the final permit for the project, which is based on the EIA.

Concerning the application of EU regulations - emission standards etc. - in the setting of permit standards, Lithuania will basically follow these. In those cases the Lithuanian regulation may be stricter than the corresponding EU regulation, the Lithuanian regulation will be applied.

5.2.2 Water quality

(1) Water quality standards

A new system for classification of surface waters and water quality standards, based on EU Directives, is in the process of being prepared. This should be finished by 2002.

(2) Classification of rivers

According to an existing, old Regulation the water quality in a river, suitable for fishing, must fulfil certain requirements. This means that limit values for 24 different parameters must not be exceeded (MPC = maximum permissible concentrations). Some of the 24 MPC values are given in Table 5.2.1. The legal implication of this is not fully clear – basically it can be regarded as a kind of recommendation.

Table 5.2.1 Maximum permissible concentrations (for DO minimum conc.) in river waters, suitable for fishing

Parameter	MPC
Dissolved oxygen (DO)	$\geq$ 6 mg/l
BOD_7	2.3 mg O_2/l
Ammonium-nitrogen	0.39 mg N/l
Nitrite-nitrogen	0.02 mg N/l
Total nitrogen	2 mg N/l
Phosphate-P	0.08 mgP/l
Chloride	300 mg/l
Sulphate	100 mg/l
Total P	0.2 mgP/l
Mineral oil	0.05 mg/l
Anionic surfactants	0.1 mg/l
Phenols	0.001 mg/l

In addition there are limits for calcium, magnesium, sodium, potassium, and eight heavy metals.

All rivers in Lithuania, about 47 separate rivers, are classified according to the water quality. It shall be stressed, however, that this is an unofficial classification, without any legal implication. The basic meaning is informative. The six Classes are from "Very clean" to "Very high polluted". The following parameters are considered, and for each Class each parameter must comply with a certain interval: BOD_7, Inorganic Nitrogen, Phosphate-phosphorus (PO_4-P) and Bacteria (coli). As examples the data for three classes are given in Table 5.2.2.

Obviously, the actual Class of any river may depend on the parameter to be considered.

Table 5.2.2 Classification of river waters

Parameter	Quality classes		
	I	IV	VI
	Very clean	Average polluted	Very highly polluted
BOD_7 mg/l	< 2.3	5.9 – 9.2	> 20.7
Inorganic nitrogen mg N/l	< 0.3	2.6 – 7.5	> 15.0
Phosphate mg P/l	< 0.03	0.13 – 0.29	> 0.50
Bacteria, coli no:s/l	$\leq$ 1000	$\leq$ 1 000 000	> 10^7

(3) Regulations for wastewater discharge

The permits for wastewater discharges are primarily based on absolute discharges of pollutants (e.g. as kg/d), while concentrations are basically used for control purpose (see also section 5.2.2 (4)). Existing regulations, so far, only specify limit values as concentrations.
A Regulation is in force, No. 127 of 24 July 1997, concerning

* Wastewater quality for discharge to receiving waters, i.e. surface waters
  This is obviously formulated with respect to municipal (urban) wastewater and its treatment. It is not clear to what extend this Regulation is applied for industries, with wastewater differing in character from urban wastewater. However, there is no special regulation applicable particularly for industrial wastewaters. So it must be assumed that this regulation can be applied also for industries, discharging wastewater directly to a recipient.
  This Regulation includes limit values in the form of concentrations.
  A switch to EU standards is underway. The EU standards shall be in effect by 2002, and fully implemented by 2015. Relevant EU directives:
* Proposal for a Water Framework Directive
* Council Directive 91/271/EEC of 21 May 1991 concerning urban wastewater treatment.

This mentioned Regulation for wastewater quality requires treatment to certain limit values before discharge to receiving waters; see Table 5.2.3. The “size of treatment plant” refers to wastewater flow and/or person equivalents (p.e.), i.e. the number of people connected to the plant, or the corresponding amount of BOD or other pollutant. (1 p.e. is defined as 70 g of BOD_7/d, or 70 g of suspended solids/d, or 12 g of N/d, or 2.7 g of P/d.)
The BOD and COD values in Table 5.2.3, at least for the larger plant sizes, require, according to our conclusion, that urban wastewater must be treated by a normal type, normal efficiency biological treatment plant.

Table 5.2.3 Permitted pollution levels in treated wastewater, discharged to surface waters.

Pollutants	Size of treatment plant	Permitted max. concentrations Average annual mg/l	Max. momentary mg/l
BOD_7	< 5 m^3 / d 5 m^3 / d, 5 000 p.e. 5 000 – 10 000 p.e. > 10 000 p.e.	30 25 20 15	50 40 30 25
COD	< 10 000 p.e. > 10 000 p.e.	100 75	150 120
Total phosphorus, as P	> 10 000 p.e.	1.5	2.5
Total nitrogen, as N	10 000 – 100 000 p.e. > 100 000 p.e.	20 15	35 25
Settleable solids	< 100 000 p.e. > 100 000 p.e.	30 25	45 35

In addition there are general limit values for 22 other parameters, in wastewater discharged to surface waters. Some of these are the following:

Chloride	500 mg/l
Active chlorine	0.6 mg/l
Sulphide	0.5 mg/l
Sulphate	300 mg/l
Anionic surfactants	1.5 mg/l
Nonionic surfactants	2.0 mg/l
Mineral oil	1.0 mg/l
Phenols	0.2 mg/l

There are also limit values for 12 metals, e.g. cadmium, chromium, copper, mercury and manganese.

(4) Environmental permits – Limit setting with respect to water quality

Environmental permits, as mentioned above, are set based on absolute discharged amounts , e.g. as kg per 24 h or per month. It can be noted that this is a requirement for the application of the environmental tax system, see section 5.2.8. The permit will always be based on the EIA, which is required for each new project.

The principle in the limit setting is that the required quality of the discharged wastewater shall be based on the required quality of the river water. A certain river flow value must be assumed for the calculation. Here is normally chosen the lowest value, which occurs with 95 % probability, i.e. with maximum 20 years interval. The minimum 30 days' average has usually been chosen here, but at present this is not clear – it might be possible instead to choose the 95 % minimum annual average.

Many rivers are controlled by dams, to give "environmental water flows". The above calculations shall be based on such flows.

The system described above may be changed when the adaptation to EU regulations has been finalised.

(5) Raw water withdrawal from rivers or groundwater

Rivers

Withdrawal of water from a river will require a permit (included in the environmental permit) that will specify the maximum withdrawal. The question of how much water that may be withdrawn cannot be exactly answered at this stage. However, withdrawal of e.g. 10 % of the 95 % probability minimum value would probably not be a problem.

Groundwater

No definite rules are used for groundwater abstraction permits. Permits are given by the Lithuanian Geology Service. However, it is not very common to use groundwater for industrial purpose; there must be very good reasons for this. Special drills for industrial purpose are usually not applied.

5.2.3 Air quality

(1) New Law on Air protection

A new Law was taken November 1999:

* Law on Environmental Air Protection

This Law reflects definitions etc from EU Regulations and Directives.

Some important items of this Law:

1. List of Priorities:
   1) Increased efficiency of the energy consumption
   2) Reduced pollution from vehicles
   3) Implementation of BAT

2. Air Quality Management

shall be based on the assessment of air quality, according to the EU Council Directive 96/62/EC, Directive on Ambient Air Quality Assessment and Management, 27 Sept 1996.

The new Law will be completed with a number of special Decrees and Acts, which are now being developed within a project funded by the World Bank (WB).

Provisions must be taken to convert EU regulations to Lithuanian terms until 2002. This is a requirement for starting the membership negotiations with the EU.

Regulations and permitting will particularly include a number of environmental limits, according to a list of parameters set up by the EU. This reflects the requirements of the Law to

* Protect the environment
* Protect the health of humans.

The EU list of parameters includes the following:
SO_2, NO_2 , Particles (= Dust) , Fine particles/Soot , Ozone , Benzene , Carbon monoxide , PAH , Lead , Cadmium , Arsenic , Nickel , Mercury.
Some of these are significant for pulp mills, i.e. SO_2, NO_2 , Particles , Fine particles/Soot and Carbon monoxide.
New standards will be defined and applied after the WB project is finalized.

(2) Existing regulations

Maximum permissible concentrations
An existing regulation on maximum permissible concentrations of air emissions is the following:

* Maximum Permissible Concentrations of Emissions by Stationary Combustion Sources, LAND 12-98 (1998-04-30)
  LAND = Lithuanian Environmental Normative Document

This regulation is based on EU Directive 88/609 EEC. Separate MPC's are given for gaseous, liquid and solid fuels, and for existing and new sources. The data for solid fuels, new sources are given in Table 5.2.4.

Table 5.2.4 Maximum permissible concentrations of emissions by stationary combustion sources. Solid fuels. New sources.

Thermal capacity MW	Maximum permissible concentration, mg/Nm^3				Standard O_2 conc. %
	SO_2	NO_x	CO	Particulates	
1 – 20	2 000	650	1000	400	6 %
> 20 – 50	2 000	650	1000	300	6 %
> 50 – 100	2 000	650	700	200	6 %
> 100 – 500	2000 – 400 (even decrease)	400	500	100	6 %
> 500	400	400	300	50	6 %

Sulphur content of fuel oil

According to a special Law, only liquid fuels, which conform to the quality fixed by the Ministries of Economy, Environment and Transportation, may be used in Lithuania. At present the sulphur content must not exceed 2.5 % w/w. This shall be changed to 1 %, which is ratified so far by the Ministry of Economy, but not by the other Ministries.

Hygienic limit values

Regulations are in force concerning hygienic limit values (maximum permissible concentrations, MPC) for ambient air quality. These include a very large number of parameters. Some of those, with relevance to the pulp and paper industry, are given in Table 5.2.5. For most of the parameters two values are given, a short-term limit based on 1/2-hour average, and a long-term value based on 24-hours average.

These hygienic MPC values are at present used in the permitting, e.g. for a new industry. But, of course, only those parameters relevant for the type of industry are considered. The way the MPC values are used in permitting is described in section 5.2.2 (3).

Table 5.2.5 Hygienic maximum permissible concentrations in ambient air

Parameter	MPC ½-h values, mg/m^3	MPC 24-h values, mg/m^3
Particles, inorganic (dust)	0.5	0.15
Dust of Limestone, $CaCO_3$	0.5 (prel.)	-
Dust of Calcium oxide, CaO	0.3 (prel.)	-
Dust of Sodium sulphate, $NaSO_4$	0.5	0.05
Sulphur dioxide SO_2	0.5	0.05
Carbon monoxide CO	5	3
Nitrogen dioxide NO_2	0.085	0.04
Nitrogen monoxide NO	0.4	0.06
Hydrogen sulphide H_2S	0.008	-
Methyl mercaptan	0.000009	-
Dimethyl sulphide	0.08	-
Hydrocarbons C_1–C_{10} as C	5	1.5

Generally in Lithuania the largest concerns are for the acidifying gases, i.e. sulphur dioxide and nitrogen oxides. But the acidifying gases are to a large part "imported" from the West, e.g. Poland and Germany. It is estimated that 70 – 80 % of the air pollution of this type in Lithuania originates from other countries. The sulphite pulp mill in Klaipeda, which is now closed, caused big environmental problems, i.a. because of the emissions of sulphur dioxide.

There is a regular monitoring of certain of these parameters, particularly SO_2 , NO_x and Dust, in 14 places in Lithuania, in totally 23 stations. These include 10 major cities and industrial areas, as well as 4 stations for background data, with little anthropogenic influence. The results are published annually. Data from 1998 for the cities Jonava, Kedainiai, Klaipeda and Vilnius show, for instance, the following.

* SO_2 : the concentrations were far below the MPC values (approx. 10 % of the MPC values)
* NO_x : the 24-hour averages were below the MPC value (approx. 50 %), while the ½-hour averages were exceeded by approx. 10-50 %, and by 300 % in Vilnius.
* Dust: the 24-hour averages were below the MPC value (approx. 30 – 60 % below), while the ½-hour averages were below the MPC in Klaipeda but exceeded the MPC by approx. 30 – 100 % in Jonava, Kedainiai and Vilnius.

(3) Environmental permits – Limit setting with respect to air quality

The limit setting with respect to air quality is based on the emissions of certain pollutants and the calculated quality of air. This is further described below.

Regarding the permit for a new pulp mill the greatest concern will be on sulphur dioxide and nitrogen oxides. This means e.g. that the use of low sulphur oil will be a requirement. This will not be a problem for the proposed new pulp mill, as only natural gas will be used fossil fuel.

The procedure in the permit setting includes the following steps:

1) Define/calculate emissions from the source (e.g. the industry)
2) Use a dispersion model to calculate concentrations in ambient air
3) Compare with hygienic MPC (today), or with other values (future)
4) If calculated values higher than MPC etc.- further measures must be taken.

New standards will be applied after the WB project is finalised.

There are no specific requirements valid for the pulp and paper industry. However, it was mentioned in a discussion with the Ministry of the Environment, that for a new pulp mill “BAT (best available technique) must be used”, “i.e. the latest know-how and the cleanest technology, not the cheapest”, and that EU regulations must be followed.

As regards the permitting for a new pulp mill (or any industry), it cannot be specified at present, which of the parameters of Table 5.2.5, or of the EU list, that would be included in the permit. Whichever parameters be chosen, the principle is that the MPC values must not be exceeded outside the so-called sanitary zone (but may be exceeded inside the zone). This zone surrounds the industry at a distance from the fence, which is usually 1 km (may be 0.5 km in some cases).

The concentrations of the different pollutants in the ambient air, at various distances from the industry, can be calculated based on the emissions (in absolute amounts, e.g. tons per 24 h), and utilizing a dispersion calculation model. In Lithuania is presently used the AIRVIRO model. This model was developed by the Swedish Meteorological and Hydrological Institute, and is available for use by the Ministry of Environment. It takes into account several parameters that influence the pollutant concentrations, such as the different meteorological data.

Based on these calculations, the maximum permissible emissions can be chosen, with the aim that the MPC values shall not be exceeded outside the sanitary zone.

5.2.4 Solid waste handling

Legislation that controls waste handling include

* Environmental Protection Law of the Republic of Lithuania (1992, No 5-75; 1996, No 57-1325; 1997, No 65-1540)
* Waste Management Law of the Republic of Lithuania (1998, No 61-1726)
* Implementation Law of Waste Management Law of the Republic of Lithuania (1998, No 61-1729)

Other relevant documents are

* Draft National Waste Management Strategy and Action Programme: Resolution No 593, 1999-05-17
* Waste Management Regulations: Decree No 217, 1999-07-14

A “Regulation on landfill of waste” is being prepared.

The mentioned regulations are adapted to corresponding regulations of the European Union.

The Waste Management Law of 1998 will be changed this year.

Waste Management Plans are now being prepared, according to the following timetable:

* National Strategy Waste Management Plan: 2001-12-31
* Counties Waste Management Plans: 2002-06-30
* Municipal Waste Management Plans: 2002-12-31

As regards the pulp and paper industry there are no special regulations in force. The general legislation has to be applied. Concerning a new pulp mill, it can be assumed that requirements concerning the waste handling will be included in the Environmental Permit. Taking into account a realistic time schedule for this project, the above mentioned Waste Management Plans, as well as the “Regulation on landfill of waste” will most likely be in force, when the detail plans for the pulp mill project will be worked out.

5.2.5 Noise

Questions concerning noise regulations are handled by the Ministry of Environment, Housing and Technical Regulations Department. The following information is based on contacts with this Department.

Noise issues are handled also by

* The Centre of State Public Health
* The Hygiene Institute

At present only an old Soviet regulation is in force: Maximum 55 dB(A) at the border of residential areas. This applies at industries as well as at roads.

Adaptation to EU regulations is planned. An EU document underway, to be applied when it comes into force, is the following, which is now available as a draft proposal, presented to the European Parliament:

* Directive on the approximation of the laws of the Member States related to the noise emissions by equipment used outdoors.

A preliminary document is COM (1998) 46 final – 98/0029 (COD) 18/2 98.

In Lithuania there is at present a new council being formed, for handling the question of reducing noise levels in cities, “Commission for protection against noise”. Participants are i.a. the Hygiene Institute, the Technical University Health Office and the Ministry of the Environment.

As an international example can be mentioned the following recommended noise limitations, presently applied in Sweden for “new industries”. It is most likely that future regulations in Lithuania will apply these or stricter limits.

Table 5.2.6 Swedish recommendations regarding noise, expressed as the largest equivalent noise level outside inhabited buildings. New industries.

Time of the day	Largest equivalent noise level
Day-time – weekdays 07.00 – 18.00	50 dB(A)
Evening-time and holidays 18.00 – 22.00	45 dB(A)
Night-time 22.00 – 07.00	40 dB(A)
Momentary noise in night-time may not exceed 55 dB(A). If the noise includes often recurrent sounds and/or audible tones, the equivalent noise level shall be decreased by 5 dB(A).	

5.2.6 Environmental monitoring

* Law on Environmental Monitoring Nr VIII – 529, 1997

  This Law specifies required monitoring concerning Air, Water etc on three levels:

- National
- Municipal
- Company

The Joint Research Center of the Ministry of Environment is the authority responsible for monitoring.

Article 12 regulates “Monitoring by legal entities”, as follows (in brief):

1) Legal entities shall conduct monitoring of pollution sources and their impact to the environment by notifying and providing information to the governing and self-management institutions of the state.

2) The Ministry of Environment shall set up a list of legal entities and “natural persons” subject to the conducting of monitoring.
3) According to the procedures, set up by the Ministry of Environment, legal entities shall hand over their environmental monitoring data to the Environment Monitoring Data Fund. Correspondingly, the data on forests and soils are to be handed over to the Ministry of Agriculture and Forestry and the Lithuanian Geology Service, according to the procedures set up by the latter.

5.2.7 Protected areas

* Law on Protected Areas of the Republic of Lithuania,

No 1-301, 9 November 1993

This Law will not be discussed in detail here. We will only comment one item of the law, which is related to restrictions in constructing plants etc. in protected areas. The reason is that, in the case of the sites in Alytus and Elektrenai/Vievis, pipes for fresh water and wastewater to and from the Mill may have to be drawn across State Regional Parks. The activities in this type of parks are regulated in the Law. (The Mill sites would, however, not encroach the Parks.)

This Law’s Article 25 “Determination of activities in state parks” points out i.a. that

“In state parks it is prohibited to…..lay down transit communication lines..…“

In case water and wastewater pipelines would be defined as transit communication lines, this formulation might be an obstacle to these sites. The relevant authority must take the decision in this matter.

5.2.8 Environmental taxes

The Ministry of Environment, Environmental Strategies Department, handles questions on environmental taxes. This department also handles questions on

* Investments for environmental protection measures – questions concerning grants and loans
* Cooperation issues in environmental protection – i.e. cooperation between i.a. the construction sector, territorial planning, forestry
* Integration with the EU – environmental issues
* Institutional building
* Management of programmes for environmental protection

This section describes the tax system. The integration with EU is summarized in section 5.2.9.

(1) Environmental taxes - General

This system is referred to as the economical instruments for environmental protection. Legally the system is established by the following laws:

* Law on Charges for Environmental Pollution, Nr VIII-1183, of May 13, 1999.
* Law about Charges for the Use of Natural Resources

These two laws will be applied for a pulp and paper mill as follows:

1. Taxes shall be paid based on the emissions of certain pollutants
2. A tax shall be paid based on the consumption of water from a natural source, for instance a river

These taxes are deducted from the gross revenue when computing a taxable profit.

For a pulp and paper mill, using a river as the water source, the pollution tax will be significantly higher than the natural resources tax.

(2) Pollution taxes – Stationary sources

General

For an industry, for example a pulp and paper mill, the system will work as follows:

* there will be set limit values for the emissions of certain pollutants; these are given in the Environmental Permit
* if the emissions are below these limits, a normal charge or tax is paid for each emission, in proportion to the amount of the emission (e.g. as tons per year)
* if the emission of any pollutant is above the limit, a penalty charge is paid, for the part that is above the limit.

The limits are set individually for each enterprise or industry.

The taxes are paid for water and atmospheric emissions, from stationary sources. Also for atmospheric emissions from mobile sources (vehicles) taxes are paid, based on the fuel consumption. This refers to vehicles that are used commercially, i.e. for production purposes or for passenger transports.

If an enterprise is taking measures for reducing an emission below the limit, it has a 3 years' respite to do this, and does not have to pay the penalty charge during this time. This requires that the measures aim at reducing the emission to a value less than 90 % of the limit.

As mentioned above, adaptation of the Lithuanian environmental legislation to the corresponding EU legislation is presently going on. It cannot be exactly specified at present to what extent this will influence the pollution tax regulations. So far, it must be assumed that the present taxation system shall be used also in the future.

However, the EU adaptation will include the introduction of certain charges with relation to the generation of waste, i.e. for

* packaging (glass, paper, plastics etc.)
* luminescent lamps
* accumulators for vehicles
* oil filters for cars

Tax rates and penalties for stationary sources

The taxation system is regulated according to the Law on Charges for Environmental Pollution.

The normal taxes are calculated by the use of a set of factors, the tax rates. The calculation is done by multiplying as follows:

Tax (e.g. Lt/a) = Emission (e.g. t/a) $*$ Tax rate

The penalty taxes are calculated by further multiplying the above Tax by tax rate coefficients. The penalty tax is calculated and paid for that part of the emission which exceeds the emission limit.

The normal tax rates and the tax rate coefficients are given in the following Tables 5.2.7 and 5.2.8 for water pollutants and Tables 5.2.9 and 5.2.10 for air pollutants. As is clear from the tables, the tax rates are raised each year.

It shall be pointed out that only parameters that are relevant for the industry or enterprise in question, and that are regulated in the Environmental permit, are considered for the tax calculation.

As shown in the tables, only BOD - not COD - is used as the water pollution parameter for organic matter. There are at present no plans for adding or switching to COD. Also in the Environmental permits only BOD is included. COD may be used by operators or in monitoring systems.

However, COD is used as a regulatory parameter in the Regulation for wastewater discharge, see section 5.2.2. There is a trend in the EU, as well as in other parts of the world, to switch to COD as the main parameter for characterizing organic matter in wastewater. It can be expected that this will be the case also in Lithuania in the future.

The “Pollutant groups” according to the tables are specified in a separate regulation:

* Taxable Pollutants According to Groups. Regulation Nr 53, January 18, 2000 including two parts: I. Pollutants to water, soil and deeper soil (42 chemical elements and compounds), and II. Pollutants to Atmosphere (abt. 280 chemical elements and compounds).

Table 5.2.7 Tax rates for normal taxes. Water pollutants. Stationary sources.

	Tax rates Lt/ton Year			
Pollutants	2001	2002	2003	2004
BOD_7	573	649	714	765
Total nitrogen	435	435	550	600
Total phosphorus	1480	1480	2000	3000
Suspended solids	210	248	281	309
Sulphate SO_4^{2-}	2	2	2	2
Chloride Cl^-	9	9	9	9
Pollutant groups				
I	8700460	8700460	8700460	8700460
II	792710	792710	792710	792710
III	129250	129250	129250	129250
IV	29290	29290	29290	29290
V	2871	2871	2871	2871

Table 5.2.8 Tax rate coefficients for penalty taxes. Water pollutants.

Pollutants	Coefficients
BOD_7	10
Total nitrogen	5
Total phosphorus	10
Suspended solids	1.5
Sulphate SO_4^{2-}	1.5
Chloride Cl^-	1.5
Pollutant groups	
I	100
II	50
III	10
IV	5
V	2

Table 5.2.9 Tax rates for normal taxes. Air pollutants. Stationary sources.

	Tax rates Lt/ton Year			
Pollutants	2001	2002	2003	2004
SO_2	225	268	288	311
NO_x	386	405	479	587
Vanadium pentoxide	11485	11485	11485	11485
Dust, organic + inorganic 1)	184	184	184	184
Pollutant groups				
I	1210	1210	1210	1210
II	570	570	570	570
III	74	74	74	74
IV	13	13	13	13

1) Excluding particles from burning solid, liquid or gaseous fuels, and asbestos particles.

Table 5.2.10 Tax rate coefficients for penalty taxes. Air pollutants.

Pollutants	Coefficients
SO_2	1.5
NO_x	1.5
Vanadium pentoxide	300
Dust, organic + inorganic	1.5
Pollutant groups	
I	300
II	50
III	30
IV	1.5

The pollutant groups of Tables 5.2.9 and 5.2.10 include for instance the following components, of relevance to a kraft pulp mill:

Group I Mercaptan

Group II Particles from burning solid, liquid or gaseous fuels

Group III Sodium sulphate

Group IV Carbon monoxide, calcium carbonate, calcium oxide.

(3) Pollution taxes - Mobile sources

The pollution taxes for mobile sources (vehicles) are specified in the same Regulation Nr 53, of January 18, 2000. The tax is here calculated based on the consumption of fuel. Different types of vehicles are specified: automobiles etc., ships, railways and airplanes, and different types of fuels: gasoline, diesel oil, heavy oil (with different sulphur contents) and gas (from liquid oil and natural gas). Only two examples shall be mentioned:

* Automobiles etc., with gasoline as fuel. The tax is 18 Lt/ton fuel in 2001 and 24 Lt/ton in 2004.
* Ships, with diesel oil as fuel. The tax is 31 Lt/ton in 2001 and 45 Lt/ton in 2004.

(4) Natural resources taxes

An enterprise, e.g. a pulp and paper mill, is subject to taxation for the use of state-owned natural resources (state-owned land, continental shelf, fossil fuels etc.) for commercial purposes. In this case the law is applicable only for the use of water from rivers.

The tax is calculated as follows:

Tax (e.g. Lt/a) = Water consump. (e.g. m^3/a) $*$ 0.005 Lt/m^3 $*$ Index factor

The Index factor is changed by time, depending on the inflation. During the first half of 2000 the Index factor was:

1 quarter	1.255
2 quarter	1.278

5.2.9 EU Adaptation

There is a national planning in force for integration to the European Union. As far as concerns the environment, the Environmental Strategies Department presently handles the following issues:

* Improvement of the laws, to fulfill EU requirements
* Institutional building, to fulfill EU requirements
* Improvements concerning the following issues, to fulfill EU standards:

1) Municipal wastewater treatment
2) Reduced atmospheric emissions from boilers
3) Waste handling

The planning, concerning these issues, shall be finished until 2003. The required measures concerning 1) – 3) above shall be finished until 2015. Estimated investments amount to 1 billion Euro, which is supposed to be partly covered (50 %) by ISPO funds and structural funds.

5.2.10 Relevant Government Offices

The Government office, responsible for the preparation and formulation of the Environmental Legislation, is the

* Ministry of the Environment

Some of the units of this Ministry, which have been consulted during this Study, are:

* Territorial planning department – Environmental Impact Assessment Division
* Environmental Strategy Department
* Environmental Technologies Division
* Environmental Quality Department – Air Division
* Environmental Quality Department – Water Division
* Joint Research Center (responsible for monitoring)
* Forest and Protected Areas Department

On the Regional (County – Apskritis) level, there are Regional Environmental Departments, which are subdivisions of the Ministry of Environment.

The following two Ministries have the role of “Relevant parties” in the EIA process:

* Ministry of Health Protection
* Ministry of Interior Affairs – Fire Protection Department

The following authority is responsible for ground water issues:

* Lithuanian Geology Service

5.3 Applicable Environmental Standards for the Project

5.3.1 Environmental Standards in Lithuania

There are no regulations or standards in the Lithuanian environmental legislation, particularly valid for the pulp and paper industry. Concerning water and air emissions, as well as noise, it must be assumed that all those different standards that are summarised above, and that are relevant, will be applied also for a new pulp mill. However, as described above, part of the legislation is presently under revision, for adapting to the European Union legislation. Therefore it can not yet be exactly specified which standards that will be applied for this project. Also, the environmental permit will be set individually for each new plant, so there are some degrees of freedom for the authorities in setting the emission limits.

Environmental permits for the pulp and paper industry in the European Union will, from the near future and on, be set according to the IPPC system, which is described below. Lithuania will also follow this system.

5.3.2 Helsinki Convention

Here shall also be mentioned the Helsinki Convention, i.e. the Convention on the Protection of the Marine Environment of the Baltic Sea Area, 1974. As a state situated at the Baltic Sea, Lithuania has agreed to follow this Convention. The Convention stipulates that the Contracting parties “shall take all appropriate measures

- to control and minimise land-based pollution of the marine environment of the Baltic Sea Area
- to control and strictly limit pollution by noxious substances and nutrients”

The work for fulfilling the intentions of the Convention is managed by HELCOM, i.e. the “Baltic Marine Environment Protection Commission” or Helsinki Commission. HELCOM has formulated recommendations for parts of the pulp and paper industry, i.a. kraft pulp mills (1996). These include definitions of Best Available Techniques (similar to the EU definitions, see below) as well as recommended emission limit values for water and atmospheric emissions. For instance, the HELCOM recommendations for bleached kraft specify max 15 kg COD/ADt to water (mills starting operation after 1 January 1997) and max 1 kg sulphur/ADt to atmosphere (after 1 January, 2000). We assume that the EU recommendations will be followed in Lithuania in the future. Also, emission limits formulated on the basis of the EU recommendations can be expected to become stricter than the HELCOM recommendations. For these reasons, the HELCOM recommendations will not be further discussed here.

5.3.3 European Union regulatory requirements

(1) General

Lithuania is a membership candidate for the European Union. Planning is underway for adaptation to EU directives, regulations, standards etc., also in environmental matters. This is a requirement for starting the membership negotiations. However, membership can probably not be a reality until within 5 – 10 years. In any case, we regard it as most relevant to summarise some of the planning, which is going on within the EU, concerning the pulp and paper industry and the environment.

No "environmental regulations" are in force in the EU, on the central level, regarding particularly the pulp and paper industry. What is in force is the IPPC Directive (Integrated Pollution Prevention and Control Directive) and a Reference Document on "Best Available Techniques in the Pulp and Paper Industry". These documents shall serve as a base for each state in the Union, in establishing their own regulations, emission limits etc. They are briefly commented in the following sections.

(2) IPPC Directive

The complete title of this document is: COUNCIL DIRECTIVE 96/61/EC of 25 September 1996 Concerning Integrated Pollution Prevention and Control.

The Directive aims at contributing to a high level of protection of the environment as a whole and a sustainable production, by adopting an integrated approach of industrial pollution. The Directive was to be translated into national law in each Member State by October 1999, being applicable to new plants at that date, and to existing plants by 2007.

The Directive is applicable to several industrial activities, including in practice 98 % of the industry within the EU. The list of industries includes e.g.:

"6.1. Industrial plants for the production of

(a) Pulp from timber or other fibrous materials

(b) Paper and board with a production capacity exceeding 20 tonnes per day"

The Directive has adopted the principle of subsidiarity in the setting of emission limits. This means that ELVs – emission limit values – shall be defined at local level, by local authorities, taking into account the local environmental and industrial conditions. So no special “EU limit values” will be established.
The term “integrated” has been interpreted as threefold, e.g. by CEPI (Confederation of European Paper Industries, paper given by Ms A. Carpentier, Environmental director, at the Finnish Paper Engineers’ Association Annual Meeting, Helsinki, March 31, 2000):

1. The Directive is part of an overall environmental framework
2. “Multi-media approach”: a request to consider all polluting sources and receiving media in an integrated way.
3. Requirement for a cost/benefit assessment for the selection of BAT (Best Available Techniques). The choice of BAT must ensure a fair balance between the resources to be spent on pollution abatement and the proven and realistic advantages for the environment of such measures, while not overseeing technical aspects.

The Directive requests from local authorities to adopt ELVs (emission limit values) in the individual permits on the basis of BAT (Best Available Techniques), as defined by the Directive. The Directive also requires that no technique should be prescribed, and that the technical conditions on the site, its geographical situation and the local environmental conditions should be taken into account when setting ELVs.
The BAT concept is defined in detail as follows.

BAT – *Best Available Techniques*: “the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for emission limit values designed to prevent, and where that is not practicable, generally to reduce emissions and the impact on the environment as a whole.”
Techniques “shall include both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned”.
Available techniques “shall mean those developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced inside the Member State in question, as long as they are reasonably accessible to the operator”

Best “shall mean the most effective in achieving a high general level of protection of the environment as a whole”.

The development of the BAT concept for the pulp and paper industry is summarised in the next section.

(3) BAT Reference Document (BREF) – Pulp and paper industry

The full title of this so-called BREF document is:

* Reference Document on Best Available Techniques in the Pulp and Paper Industry. July 2000.

The BREF is an official publication of the European Communities. It was produced by the IPPC Bureau (Seville, Spain) according to the IPPC Directive, article 16, which requires the European Commission to organise “an exchange of information between Member states and industry”. This means i.a. that the industry has had an active role in producing this document, through CEPI (Confederation of European Paper Industries). (The document is available on the Internet via the website http://eippcb.jrc.es.)

The BREF defines BAT – best available techniques – for the pulp and paper industry sector wise, and states expected or experienced emission levels when BAT is applied. It shall be pointed out that the BREF document does not give “required emission limit values to be applied within the EU”, or something like that. It rather reflects present day knowledge and experience from the industry, basically in Europe. The BREF document is intended to be used as a reference and background for the national environmental authorities in setting their emission limit vales. These should, in each state and each separate case, be based on local conditions, concerning technical, economical and environmental issues.

Below are given, for reference purpose, “General BAT for all processes” as well as “BAT for Kraft pulp processing”, according to the BREF document. The other processes, of which BAT is defined in the BREF, are “Sulphite pulping”, “Mechanical pulping and chemi-mechanical pulping”, “Recycled fibre processing” and “Papermaking and related processes”.

In the Tables 5.3.1 and 5.3.2 are given the expected levels of water emissions and atmospheric emissions, when BAT is applied.

<u>General BAT for all processes</u>

* Training, education and motivation of staff and operators
* Process control optimisation

* Sufficient maintenance, to maintain a high efficiency of the technical units and the abatement techniques
* Environmental management system (EMS), which clearly defines the responsibilities for environmentally relevant aspects.

Water emissions

Kraft pulp mills – Best available techniques for reducing emissions to water

* Dry debarking of wood
* Increased delignification ahead of the bleach plant by extended or modified cooking and additional oxygen stages
* Brown stock: Highly efficient washing and closed cycle screening
* Elemental chlorine free (ECF) bleaching with low AOX or Totally chlorine free (TCF) bleaching
* Recycling of some, mainly alkaline process water from the bleach plant
* Effective spill monitoring, containment and recovery system
* Stripping and reuse of condensates from the evaporation plant
* Sufficient capacity of black liquor evaporation plant and the recovery boiler to cope with the additional liquor and dry solids load
* Collection and reuse of clean cooling waters
* Buffer tanks for storage of occasional discharge of cooking and recovery liquors and dirty condensates, to prevent upsets in external effluent treatment
* Primary (mechanical) and biological effluent treatment

Table 5.3.1 Water emissions with BAT. Kraft pulp mills.
(EU BREF Document.)

	Flow m^3/ADt	COD Kg/ADt	BOD kg/ADt	TSS kg/ADt	AOX Kg/ADt	Total N kg/ADt	Total P Kg/ADt
Bleached Pulp	30 – 50	8 – 23	0.3 – 1.5	0.6 – 1.5	< 0.25	0.1– 0.25	0.01-0.03
Unbleached Pulp	15 – 25	5 – 10	0.2 – 0.7	0.3 – 1.0	-	0.1 – 0.2	0.005-0.02

"m^3/ADt" and "kg/ADt" mean "per air dry ton of produced pulp".

These emission levels, referring to pulping only, are stated to be associated with the use of "a suitable combination" of the mentioned BAT techniques. They are to be regarded as annual averages. The water flow is polluted water, assuming that cooling water and other clean waters are discharged separately. In integrated mills the emissions from papermaking have to be added.

Atmospheric emissions

Kraft pulp mills – Best available techniques for reducing emissions to air

* Collection and incineration of concentrated malodorous gases and control of the resulting SO_2 emission
* Diluted malodorous gases from various sources are also collected and incinerated and the resulting SO_2 is controlled
* TRS (total reduced sulphur) emission of the recovery boiler is mitigated by efficient combustion control and CO (carbon monoxide) measurement
* TRS emission of the lime kiln is mitigated by controlling the excess oxygen, by using low-S fuel, and by controlling the residual soluble sodium in the lime mud fed to the kiln
* The SO_2 emission from the recovery boiler (RB) is controlled by firing high dry solids conc. black liquor in the RB and/or by using a flue gas scrubber
* Control of NO_x emission from the RB (i.e. by ensuring proper mixing and division of air in the boiler), lime kiln and from auxiliary boilers by controlling the firing conditions, and also by appropriate design
* SO_2 emissions from auxiliary boilers are reduced by using bark, gas, low sulphur oil and coal, or controlling S emissions with a scrubber
* Flue gases from recovery boilers, auxiliary boilers (for bio fuels and/or fossil fuels) and lime kilns are cleaned with electrostatic precipitators (ESP) to mitigate dust emissions.

Table 5.3.2 Atmospheric emissions with BAT. Kraft pulp mills. (EU BREF Document.)

	Dust kg/ADt	SO_2 (as S) kg/ADt	NO_x ($NO+NO_2$ as NO_2) kg/ADt	TRS (as S) kg/ADt
Bleached and Unbleached Pulp	0.2 – 0.5	0.2 – 0.4	1.0 – 1.5	0.1 – 0.2

These emission levels are process emissions, stated to be associated with the use of “a combination” of the mentioned BAT techniques. They are to be regarded as annual averages and are valid at standard conditions. Emissions from auxiliary boilers, e.g. due to the production of steam used for drying of pulp and/or paper, are not included (these are also given in the BREF). The values refer to the contribution of pulping only. In integrated mills the emissions from steam boilers or power plants, required for the energy needed for the papermaking, have to be added.

Solid wastes

The BREF document points out the following important items concerning the minimisation and handling of solid wastes:

* Minimisation the generation of solid wastes and recover, recycle and reuse these materials as far as possible
* Separate collection of waste fraction at source and, if necessary, intermediate storage of residuals/waste to make possible an appropriate handling of remaining waste products
* Incinerating all non-hazardous organic material (bark, wood waste, effluent sludge etc.) in an auxiliary boiler, specially designed for burning of moist, low calorific value fuels (as e.g. fluidised bed boilers)
* External utilisation of residuals/waste as substitutes in forestry, agriculture or other industries, if possible.

Energy consumption

The BREF document gives an extensive list of energy saving measures, according to the following main groups:

* Measures for a high heat recovery and a low heat consumption
* Measures for low consumption of electric power
* Measures for high generation of electric power

The document further states that energy efficient kraft pulp and paper mills consume heat and power approximately as follows:

* Non-integrated kraft pulp mills: 10 - 14 GJ/ADt process heat and 0.6 - 0.8 MWh/ADt of power
* Integrated bleached kraft pulp and paper mills: 14 - 20 GJ/ADt process heat and 1.2 – 1.5 MWh/ADt of power

5.3.4 Expected permitting for a new pulp mill

A new pulp mill project in Lithuania must be designed to ensure the principles of sustainability, concerning the forestry as well as the industrial components. It can be concluded that the Lithuanian authorities, in formulating the Environmental Permit and setting the emission limit values (ELV’s) for a new pulp mill, will take into account the relevant EU Directives – for instance the

IPPC Directive and the corresponding BAT Reference Document – that are in force at that time. In addition, local technical, economical and environmental conditions will be taken into account.

There will also be applied a tax system for the discharge of water and air pollutants, and for the use of surface (river) water.

Details concerning the requirements and ELV's cannot be anticipated at this stage. The scope of the Permit will, however, most likely contain at least the following items:

* Maximum withdrawal of fresh water from the water source
* Requirements for the arrangement of wastewater discharge
* Limits for water emissions, given as absolute amounts, e.g. tons per day, tons per month etc.
* Requirements for the water quality in the receiving water, if a river, after the wastewater discharge
* Limits for atmospheric emissions, given as absolute amounts, e.g. tons per day, tons per month etc., and possibly also as concentrations
* Requirements for the air quality outside a sanitary zone of the mill
* Limit values for noise
* Requirements for the handling of solid waste, particularly for the design, load and operation of a landfill

5.4 Proposed Technical Measures for Environmental Improvement

5.4.1 General

The kraft pulp mill causes water emissions by effluent from the pulping and bleaching processes, air pollution by exhaust gases from the recovery boiler, the lime kiln and the bark furnace, and offensive odour produced by sulphur compounds contained in the effluent and in exhaust gases (hydrogen sulphide, methyl mercaptan, methyl sulphides, i.e. the TRS, total reduced sulphur). In addition the mill generates certain amounts of solid wastes, hazardous wastes, and noise. Further comments about the environmental impacts are given in section 5.5.

The following measures are proposed to control the different types of pollution. Further details are given in Chapter 6.

5.4.2 Water Pollution Control

(1) Dry debarking of wood

Dry debarking means that very little water is consumed. Water is added only for washing the logs and in winter for de-icing the incoming logs. There is an extensive recycling of water in the process, so the effluent and the water pollution will be very low.

(2) Extended/Modified cooking and Oxygen delignification

The latest technology in the cooking will be used, which means a high degree of delignification without affecting the pulp quality and the yield. Further delignification will be done by a two-stage oxygen delignification, from which the waste water is recycled to the recovery system. These processes will also include modern, efficient equipment for pulp washing and screening, which means low water consumption and highly efficient recycling of spent liquors to the recovery system.

This process technology means the lowest possible lignin content in the pulp before the bleaching. Kappa numbers would typically be about 20 (softwood pulp) and 15 (hardwood pulp) after the cooking, and about 8-12 (softwood) and 8-10 (hardwood) after the oxygen stage.

(3) ECF and TCF bleaching

The low content of lignin in the pulp before bleaching, as mentioned above, will consequently give a low consumption of bleach chemicals and a low pollution (e.g. measured as COD) from the bleaching. By using the ECF bleaching or the TCF bleaching, based on the chemicals ozone, peroxide, oxygen and, in the case of ECF, small amounts of chlorine dioxide, very low (ECF) or zero (TCF) emissions of chlorinated organic material will be obtained in the effluent. The present knowledge and experience shows that ECF and TCF effluents are low in terms of toxicity to water-living organisms (compared to the older bleaching technology) and close to being equal in this respect. This refers to the acute (lethal) as well as the so-called sublethal toxic effects.
Note: Chlorinated organic material is usually measured as AOX, "adsorbable organic halogen".

The main concept will be ECF bleaching, mainly for market reasons. The plant will be designed in such a way, that also TCF bleaching will be possible.

(4) Recycling of bleach plant effluent

The technology of bleach plant effluent recycling, aiming at the "total effluent free mill" (TEF), is today not yet fully developed and not commercially available, although R&D work is going on, e.g. in Scandinavia. We consider for this mill, however, a limited recycling of alkaline bleach effluents, aiming at a rather low but realistic effluent flow and water emission from the bleach plant.

(5) Stripping and reuse of condensates

This measure refers to digester (cooking) and evaporation condensates, which are partly contaminated with COD-material (mainly turpentine and methanol) and reduced, odorous sulphur compounds (TRS compounds). The more contaminated condensates will be treated in a decanter for turpentine removal and a stripping column (a type of distillation unit, heated with steam), for removal of the turpentine, the methanol and the TRS compounds. The turpentine and methanol, as well as the TRS, will be collected and incinerated. This is part of the odour control system. The treated condensate from the stripper, as well as the cleaner condensates, will be partly reused, for instance for pulp washing and in the causticizing plant, thereby reducing the total water consumption. Residual condensates will be sent to the effluent treatment.

(6) Collection and recycling of spillages

This refers primarily to *black* liquor spillages, coming from the cooking and evaporation areas as a result of accidental and temporary upsets in the process. Liquor spillages will add to the BOD and COD emission and may disturb the biological effluent treatment. Two principles are applied: First, process equipment is designed to avoid spillages as far as possible. Secondly, any spills occurring, particularly those more heavily concentrated, are detected, collected, stored and then recycled into the mill's chemical recovery system (evaporation and recovery boiler) for final incineration of the organic contaminants. Installed equipment includes a number of pump pits, a collection and storage tank, a piping system and a control system. In addition the evaporation plant and the recovery boiler will be given sufficient capacity for this additional input.
A similar system will be installed for the collection of *white* liquor spillages, from the causticizing department etc., and recycling these spills to the causticizing.

(7) Separation and recycling of clean waters

Clean waters refer to waters, which are used in the mill without being polluted. These waters should be discharged separately in order not to load the effluent treatment plant. This requires separate piping and sewers for the clean waters, in order to separate them from the polluted effluent. The main part of the clean waters is cooling waters, used e.g. in the evaporation and the power plants. In this case it is also assumed that a main part of the used and heated cooling waters will be used as fresh water supply to the pulp mill. This procedure will substantially reduce the total water consumption in the mill.

Another flow of clean waters is the storm waters (rain waters). These will be collected in separate canals and also discharged separately, i.e. not be allowed to load the effluent treatment plant.

(8) Effluent treatment

Effluent treatment – i.e. the purification of polluted wastewaters – will be accomplished in a primary – secondary treatment plant. This will include basically the following steps:

* Primary clarification, for the removal of fibres and other suspended matter.

* Pretreatment by equalisation, cooling, neutralisation (pH control) and nutrient addition.
* Biological (secondary) treatment in a low-loaded activated sludge plant, for the removal of organic matter, e.g. measured as BOD and COD
* Sludge handling, i.e. dewatering of the mixed fibre (primary) sludge and excess biological (secondary) sludge, to reach a high solids content suitable for a subsequent incineration.

The sludge will be incinerated together with bark in the power boiler.

5.4.3 Air pollution control

(1) Dust control

Dust emissions (particles) from the recovery boiler, the lime kiln and the power boiler will be reduced by treating the flue gases by electrostatic precipitators (ESP's).

(2) Reduced sulphur emissions

<u>Reduced SO_2 emission from recovery boiler</u>

The emission of sulphur dioxide (SO_2) from the recovery boiler will be reduced by concentrating the black liquor to a high dry solids content in the evaporation plant. The aim is to reach about 75 % dry solids before the recovery boiler.
In addition there will be installed an SO_2 scrubber, to treat the flue gases from the boiler for further SO_2 removal.

<u>Reduced TRS emission from recovery boiler</u>

Total reduced sulphur (TRS) emission from the recovery boiler will be minimised by applying an efficient process control for the boiler.

<u>Reduced sulphur emission from lime kiln</u>

SO_2 and TRS emissions from the lime kiln will be minimised by an efficient wash of the lime mud, ahead of the kiln, and by using natural gas (sulphur free) as the fuel for the kiln.

(3) Odour control

Odour control includes the collection and incineration of malodorous gases, i.e. the TRS gases (total reduced sulphur) from several positions in the pulp mill. These are also called the NCG, non-condensable gases. These gases occur as:

* Concentrated (strong) gases, in a relatively small gas (air) volume. The strong gases contain about 90 % of the total TRS. They originate from certain positions in the cooking and evaporation plants.

* Diluted (weak) gases, in a much larger gas (air) volume. The weak gases contain about 10 % of the total TRS. The weak gases originate from several other positions in the cooking, washing and evaporation plants and from the sewer system.

The first step is to collect the strong gases in a piping system and blow them to an incineration plant, for oxidation of the TRS compounds to SO_2. This incineration can be done in the recovery boiler or the lime kiln, but it is here suggested to use a separate incinerator, equipped with a steam boiler. In this case the formed SO_2 will be removed in a separate scrubber.

This measure is one of the most important for reducing the odour load from the kraft mill, and it is normal practice at modern mills.

Even more efficient odour removal can be obtained by collecting and incinerating also the weak gases. It is suggested for this project to collect also the weak gases, in order to minimize the odour load as far as possible. These gases would be incinerated in the recovery boiler.

(4) NO_x control

The formation of nitrogen oxides (NO_x) in the recovery boiler, the lime kiln and the bark furnace will be reduced by applying certain process designs and appropriate process control.

5.4.4 Solid waste handling

Different types of process specific wastes, non-hazardous, are generated, basically the following:

* Bark (mainly organic)
* Other wood wastes (organic)
* Ashes from the power boiler (mainly inorganic, or mineral)
* Green liquor dregs from the causticizing plant (inorganic, or mineral)
* Lime slaker grits from the causticizing plant (inorganic, or mineral)
* Sludge from the effluent treatment (organic)

In addition various non process specific wastes are generated:

* Scrap metals, glass etc. – partly recyclable
* Hazardous wastes, e.g. spill oil, chemicals, luminescent lamp tubes etc.
* General garbage (similar to domestic waste)

The principles for handling these wastes will be as follows:

Incineration of bark and other organics

Bark, other wood wastes, and sludge from the effluent treatment ("biofuels") will be incinerated in the power boiler, for destruction and for the generation of heat and steam.

Recycling of certain wastes

Recyclable wastes are e.g. scrap metal, glass, paper. Such wastes will be separately collected, and supplied, as far as possible, to external operators, that are specialised in the recycling of such materials.

Landfill of certain wastes

Wastes that have to be landfilled, assuming present technology, are mainly the inorganic wastes, i.e. the green liquor dregs, the lime slaker grits and the ashes. This may include also smaller amouts of bark that are contaminated with sand, gravel etc., which makes the incineration difficult.

The particular landfill area to be used is not specified. There are two basic options:

* Use a near-by municipal landfill area, if available at a suitable distance and if the capacity is sufficient
* Install the mill's own landfill area

Whichever option is chosen, we can assume that the Lithuanian "Regulation on landfill of waste", now being prepared, will have to be followed.

Primarily it is assumed that a municipal waste disposal area can be used. Such landfill areas are, or will probably be, available at a suitable distance from all the discussed sites. The capacities and other conditions for disposing the mill's wastes have, however, not been studied so far.

If the mill's own landfill area has to be arranged, certain precautions must be taken. These include i.a. the following.

* Potential sites for the landfill must be examined with regard to ground water, ground material (permeability, depth), topographic conditions and surroundings.
* The landfill must be located and designed so there is no risk of contamination of ground water. Bottom lining to prevent this may be required.
* The deposited waste must be distributed and compressed in a manner, such that air pockets, which might lead to fires or other danger for landfill staff, are avoided.
* The waste should be covered continuously with a suitable material in order to minimise drainage and leachate formation due to rainfall.
* The leachate, which should be only a small volume if the covering is done properly, should be drained out and collected in such a way that monitoring is easily performed
* If the leachate contains larger quantities of impurities, it should be treated, for instance in the mill's effluent treatment plant

<u>Hazardous wastes</u>

Hazardous wastes shall be separately collected and supplied to external operators that are specialised in the handling of such materials.

<u>General garbage</u>

General garbage, similar to domestic municipal wastes, is also generated at the pulp mill. Those fractions of this waste, which cannot be recycled, shall be landfilled at a nearby municipal landfill disposal area.

Two options for further waste handling, which may be applied in the future, shall be mentioned here. The application of these will require that present R&D activities and practical experiences in different countries will appear to be successful:

* Composting of sludge from the effluent treatment, possibly together with some bark, for the production of a soil product
* Spreading of biofuel ashes in forests, for the purpose of recycling of a material which has fertilizing properties.

5.4.5 Noise Control

Important sources of noise in the mill area are:

* The wood handling area – loading and unloading of logs, operation of the debarking plant
* Transportation of chips
* Fans, cyclones and other types of stationary equipment
* Transports on the mill site

Also transports to and from the mill site are an important source of noise in the surroundings.

The actual noise levels substantially depend on the equipment selected, the location (with reference to the topography and the screening potential), installation techniques, the degree of insulation of particularly noisy equipment, the mill layout and the building materials used. All these items, must be considered in the efforts for reducing the total noise level from the mill.

5.5 Estimated Pollution Loads

5.5.1 General

This section specifies estimated water emissions, atmospheric emissions and solid waste generation. The data are based on the assumption that Best Available Techniques will be applied. As regards the water and atmospheric emissions, these will depend on several factors, such as the process types, the choice and design of process equipment and pollution abatement equipment, the level of process control and the process and operation conditions. All these issues cannot be specified in detail in a pre-feasibility study, and therefore the emission levels must be regarded as estimations, but still typical for a modern mill, applying BAT.

The estimated emission levels are such that have been achieved in practice at modern mills. They are fairly low, but not necessarily the very lowest, which have ever been reached. These estimated emissions are also at such levels, that we judge would be accepted by the Lithuanian authorities in a future situation.

Further and closer estimations of the emissions must be elaborated in a future EIA.

The estimated emission data are based on the production data, on experienced specific emissions, i.e. emission values per ton of pulp, and – concerning water emissions – on experienced removal rates in the effluent treatment.

The production data are assumed as follows:

	Total BKP	Softwood BKP	Hardwood BKP
Operations days, d/a	340	188	152
Annual prod., ADt/a	500000	254256	245743
Daily prod., ADt/d	1471	1350	1620

5.5.2 Water emissions

(1) Process effluent

The estimated water emissions are given in Table 5.5.1. This refers to the process water which is being polluted by use in the pulping processes and then treated in the effluent treatment plant before discharge. There will also be a clean effluent – section 5.5.2 (2).

Table 5.5.1 Water emissions – from Mill and after Effluent treatment, to Recipient. (Monthly averages)

	Water m^3/d	TSS t/d	COD t/d	BOD_7 t/d	Phosph. kg P/d	Nitrogen t N/d	AOX *) t/d
From Mill to Effluent treatment	44 000	10	49	17.5	ca 60	ca 0.3	ca 0.5
From Effluent treatment to Recipient	44 000	2	16	0.8	30	0.25	0.22
To Recipient Specific data	30 m^3/ADt	1.4 kg/ADt	11 kg/ADt	0.6 kg/ADt	20 g/ADt	0.17 kg/ADt	0.15 kg/ADt

*) AOX emission only during ECF pulp production.

The estimated emissions after the effluent treatment are based on experiences from similar effluents and processes. The efficiencies in the biological treatment are assumed to be, i.a., the following:

COD	65 – 70 %
BOD	95 %
Phosphorus	ca 50 %
AOX	50 – 60 %

Concerning Nitrogen, only a slight removal can be expected, in the range of 10 – 20 %.

Another important parameter, of which no figures are given here, is the toxicity to water-living organisms, for instance fish. This matter is further discussed in section 5.6. In brief, the effluent from this mill, utilising the most modern process technology and efficient biological treatment, is expected to give no acute (lethal) toxicity to fish.

(2) Total water consumption and effluent discharge

The total water consumption, i.e. the flow of water with has to be withdrawn from the water source (the river), will be approximately 1.0 – 1.2 m^3/s. Of this amount about 0.5 m^3/s will be used as process water, which will end up as the effluent according to section 5.5.2 (1). The remaining part will be used in the mill without being polluted, mainly as cooling water. This part of the consumed water will be discharged directly to the recipient as clean water, but with an increased temperature, approximately 40 – 50 ^oC.

In order to save water, i.e. to reduce the withdrawal of water from the river, it is suggested to use part of the spent and heated cooling water as process water supply to the pulp mill.

In summary the following approximate effluent flows will be obtained:

	m^3/s	m^3/d
Treated effluent, from Effluent treatment plant	0.5	44 000
Cooling water and other clean waters	0.5-0.7	42 – 60 000
Total	**1.0-1.2**	**86 – 104 000**

5.5.3 Atmospheric emissions

The estimated atmospheric emissions are given in Table 5.5.2.

Table 5.5.2 Atmospheric emissions

		t/d	t/a	kg/ADt
Dust		0.6	200	0.4
Sulphur dioxide	as SO_2	0.9	306	0.6
	as S	0.45	153	0.3
TRS	as S	0.15	51	0.1
Total sulphur,	as S	0.6	204	0.4
NO_x	as NO_2	1.75	600	1.2

In addition we have estimated the total emission of carbon monoxide, CO, to approximately 0.5 kg CO/ADt, or 750 kg CO/d. (The basis for this estimation is very limited, compared to the other parameters.)

CO is not included among those parameters, of which the EU has specified expected BAT emissions. CO, however, is included in the present Lithuanian legislation, i.e. in the list of MPC's of stationary combustion sources (Table 5.2.4), the list of hygienic MPC's (Table 5.2.5) and the legislation on pollution taxes.

The estimated emissions can be compared with the MPC's of Table 5.2.4. The corresponding regulation is in force, but it is not clear to what extent it is applicable to the kraft pulp mill. Anyhow the main atmospheric polluters in the mill – i.e. the recovery boiler, the lime kiln and the bark furnace – must all be regarded as "combustion sources".

Based on calculated and estimated flue gas flows from these units, the expected concentrations in the flue gases have been estimated to reach approximately the following levels:

Dust 15 – 50 mg/Nm^3
SO_2 60 – 80 mg/Nm^3
NO_x 100 – 300 mg/Nm^3
CO appr. 50 mg/Nm^3.
These concentrations are significantly lower than the MPC values.

5.5.4 Solid waste generation

The largest fraction of the solid wastes is the bark, from the debarking of the wood raw material, including also some wood wastes. This amount will be substantially reduced by incineration. Sludge from the effluent treatment will be incinerated together with the bark. The residue from the incineration, the ashes, will be landfilled.
The estimated amounts of these mentioned wastes, together with the other wastes which must be landfilled, are summarised in Table 5.5.3. The given data are estimations, which shall be regarded as typical data for a modern kraft mill, utilising BAT.

Table 5.5.3 Solid wastes to incineration and landfill, as dry solids. Estimations.

Type of waste	Specific generation of solid wastes kg DS/Adt	Total generation of solid wastes	
		t DS/d	t DS/a
To Incineration			
Bark and wood wastes	253	372	126 500
Sludge	11	16	5 500
Total to Incineration	264	388	132 000
To Landfill			
Ashes from incineration	6	9	3 050
Green liquor sludge	15	22	7 500
Lime grit and sludge	5	7.5	2 550
Bark wastes	5	7.5	2 550
Others	4	6	2 050
Total to Landfill	35	52	ca 18 000

The solid wastes, to be disposed on landfill, are not dry in practice. The dry solids content may be in the range of 50 – 60 %, as an average. Assuming 60 % DS content, the total amount of solid wastes to landfill would be about 30 000 tons/annum. Expressed as volume, the figure would be approximately the same, i.e. about 30 000 m^3 / annum.

The other types of wastes, i.e. recyclable wastes, hazardous wastes and general garbage, represent much smaller amounts and volumes, compared to the above. The specific generation of these types of waste can vary extensively, and therefore it is not meaningful to give any estimated figures here.

5.5.5 Environmental taxes

We have estimated the expected environmental taxes. The emissions etc. used for this estimation are the following:

Water pollutants	BOD_7	0.8 t/d	
	Total N	0.25 t/d	
	Total P	30 kg/d	
	TSS	2 t/d	
	Sulphate	9 t/d	
	Chloride	4 t/d	
Air pollutants	SO_2	0.9 t/d	
	NO_x	1.8 t/d	
	Dust	0.08 t/d	from Lime kiln
	Dust	0.44 t/d	from Rec boiler, and Power boiler
H_2S	0.15 t/d		
CO	0.75 t/d		
Fuel consumption	Gasoline	35 t/a	
	Diesel	180 t/a	
Water consumption	River water	1.2 m^3/s	

Note: Sulphate and Chloride (estimated values) are included in this calculation, according to the Law, although these compounds are normally not regarded as "pollutants".

The total environmental tax was estimated to the level of 1.4 MLt/year.

5.6 Environmental Impacts

5.6.1 General – Modern kraft pulp mills

(1) Water emissions

Through the recent development of the pulp bleaching processes and the pollution control methods, the industry has reached a considerable reduction of the impacts, which are caused by the mill effluents. This refers to the main types of impacts, typical for pulp mill effluents, i.e. caused by the emissions of suspended solids (fibres, etc.), oxygen consuming substances and toxic substances.

Suspended solids are normally at such low levels that problems with solids deposits outside the mills would not be found.

Emissions of readily oxygen consuming substances, measured as BOD (biochemical oxygen demand), are also very low, provided that an efficient biological treatment is installed. This means that the traditional problem of oxygen deficit in the recipient water, in the vicinity of the discharge point, is virtually eliminated, as regards modern mills.

Toxic effects include lethal toxicity (mortality) to water living organisms, as well as other so-called sub-lethal effects (for instance the reproducibility of fish).

Substantial reductions of the toxic effects have been reached by three different ways:

- the general reduction of organic substances emissions, through changes and improvements in the pulping systems
- the change of the bleaching processes towards the non-chlorine and non-chlorine compounds processes, i.e. ECF and TCF bleaching (elemental chlorine free and total chlorine free)
- the introduction of efficient biological effluent treatment

These results have been extensively demonstrated, both through laboratory tests and through larger long-term tests in model ecosystems. Toxic effects caused by effluents from modern mills with ECF bleaching and AOX levels below 1.5 kg per ton of pulp are generally very low, and show no variations related to the AOX level. This indicates that the chlorinated organics in these effluents do not contribute significantly to the toxicity. This means also that the remaining minor toxic effects are virtually the same for ECF and TCF bleach effluents.

The emissions of nutrients, i.e. nitrogen and phosphorus compounds, have not been reduced at the same degree as the other types of pollutants, mentioned above. These emissions may still contribute to the eutrophication effects in areas, where either nitrogen or phosphorus is a controlling factor for the algal growth. However, in many areas, for instance the Baltic, the contribution of the pulp industry to the eutrophication would be small, as other nitrogen and phosphorus sources are much larger, such as municipal effluents and agriculture.

(2) Atmospheric emissions

The main types of atmospheric environmental impacts of modern kraft mills are caused by the emissions of particles, sulphur containing substances, and nitrogen oxides (NO_x). Of these the sulphur containing substances are the most important.

Particles emissions are generally of less significance at modern mills, due to efficient abatement technology. Problems, mainly aesthetic in nature, can occur in the near vicinity of the mill, in cases of disturbances in the mill, due to the precipitation of particles.

The impact from the sulphur containing substances can be divided in two categories, odour and acidification. The odorous, or foul smelling, gases are hydrogen sulphide, organic sulphides and methyl mercaptan. At older kraft mills these could cause heavy odour loads, also at larger distances, due to the very low odour threshold of these compounds, particularly the mercaptan. The low concentrations causing the odour, do not, however, give any health hazard.

At modern mills, an efficient reduction of the atmospheric emissions has been achieved by internal process measures, as well as flue gas treatment. This refers also to the odour problems, which have been substantially reduced. These may have significance only in the near vicinity of the mill, and at larger distances only in connection with temporary disturbances.

Acidification is caused by the emissions of sulphur dioxide (SO_2) and nitrogen oxides (NO_x). This is not a local effect, instead the SO_2 and NO_x emissions from the pulp mill adds to the total emissions from all other sources of these gases, in the region, in the country as a whole and in neighbouring countries.

To give an idea of the significance of the pulp industry's contributions to these emissions, the following 1994 data for Sweden can be mentioned. Sweden has an important pulp industry. Still this industry contributed only by about 16% of the total SO_2 emissions and about 7 % (including transports) of the total NO_x

emissions. The figures can be compared to the emissions from traffic, which contributed by 28 % of the SO_2 emissions and 62 % of the NO_x emissions.

5.6.2 Environmental impacts from the new pulp mill

(1) General – Aspects on forestry

This section covers only those impacts, which are caused by the Mill itself and its operation, particularly the water and atmospheric emissions. Impacts on the forests and their flora and fauna, caused by forestry operations, and impacts from the transportation of wood and other raw material, as well as transports of pulp, were not covered in this study.

It can be expected that the forestry business will increase in Lithuania, independently of whether a new pulp mill is built or not, to a level corresponding to the sustainable annual allowable cut. This development will probably be speeded up in case a pulp mill is built.

An increased forestry activity may cause severe impact to the forests and the nature, unless mitigation actions are considered in logging operations, technical development, reforestation etc. There are no reasons to believe, or any indications, that a new pulp mill will influence the development and the environmental impacts in a more negative way, than the option that a mill is not being built. However, the forestry operations and the wood transports must be considered in the future EIA and be seriously analysed as to their environmental impacts.

(2) Water emissions

We discuss here primarily the inland sites, i.e. the impacts on rivers Neris and Nemunas, as these sites are presently regarded as the more interesting ones. As regards the possible coastal sites, in the Kretinga district, some brief comments are also given.

<u>Inland sites</u>

We refer here to the discussed sites in Elektrenai/Vievis, Jonava and Alytus. We have compared the expected emissions with the transports of pollutants by the rivers, as follows. The latter are based on the available statistical data for the rivers Neris and Nemunas. These include, i.a., flow data and contents of COD, BOD, nitrogen, phosphorus and suspended solids. The results are given as mill emissions in percentages of the transport of the same pollutants by the rivers, near the mill sites, Table 5.6.1. For river Neris, the comparisons have to be done at two different locations, as the river flow and quality changes along the river.

Table 5.6.1 Water emissions from the Mill, related to the transports by the river. River data from 1998 (av.) and 1999 (av. and monthly variation).

		Neris downstream Vilnius	Neris downstream Jonava	Nemunas downstream Alytus
COD %	-99	av. 10 (4 – 18)	av. 5 (2 – 12)	av. 2 (0.9 – 4)
	-98	av. 6	av. 2.6	av. 2.3
BOD_7 %	-99	av. 2.3 (1 – 4)	av. 1.8 (0.8 – 4.4)	av. 0.6 (0.4 – 1.4)
	-98	av. 1.6	av. 1.5	av. 0.5
Tot N %	-99	av. 1.6 (0.7 – 3)	av. 1 (0.4 – 2.5)	av. 0.6 (0.2 – 1.7)
	-98	av. 1.2	av. 0.5	av. 0.7
Tot P %	-99	av. 2.8 (1.2 – 5)	av. 2 (0.8 – 4.5)	av. 0.9 (0.5 – 2)
	-98	av. 2	av. 1.3	av. 0.9
TSS %	-99	av. 2.5 (1 – 4.5)	av. 1.5	av. 0.4
	-98	av. 2.4	av. 0.6	av. 0.5

Typical flow data of the rivers are given in Table 5.6.2.

Table 5.6.2 Flow data of rivers Neris and Nemunas.

	Neris downstream Vilnius	Neris downstream Jonava	Nemunas downstream Alytus
Flow m^3/s			
annual av.	109	220	255
monthly av. variation	50 – 200	90 – 400	131 – 483
daily av. variation	-	80 – 590	98 – 572

The percentage figures of Table 5.6.1 can also be interpreted as the approximate increase of the concentration of each pollutant in the river water, caused by the Mill effluent, at the point of discharge. The monthly variations of 1999 reflect the fact that the river flows and pollutant transports have an annual variation, with highest values in spring and lowest values in summer – autumn.

In the case of river Neris, the flows and pollutant transports were relatively low during 1999, thus giving an indication of the worst situation.

The levels of dilution of the effluent in the rivers are approximately as follows, as average and monthly variation (based on the polluted effluent only):

Neris downstream Vilnius	av. 200 (100 – 400)
Neris downstream Jonava	av. 400 (200 – 800)
Nemunas downstream Alytus	av. 500 (250 – 1000)

The contribution from the Mill to the total pollution transport by the rivers can be regarded in general as small. At least in the cases of Neris downstream Jonava and Nemunas downstream Alytus, the emissions from the Mill are not likely to give any significant impact on the situation in the rivers. This refers to normal and undisturbed operation in the Mill. A future EIA will have to consider, for instance, the risks of temporary raised emissions, due to disturbances in the Mill, and their impact on the rivers.

As regards the site at Alytus, river Nemunas is the recipient, and it gives the highest dilution of the effluent, considering the three sites. However, in the Alytus case also the lake just upstream Kaunas (Kauno marios) will be affected. This particular problem will require a special consideration.

Coastal site

This refers to the two discussed sites in the Kretinga district, Klaipeda County, i.e. Darbenai and Tubausiai. These sites are located about 7 and 10 km from the coastal line. One problem with these sites is the shortage of fresh water for the Mill, which is discussed in section 4.2.3.

The effluent would have to be pumped through a pipeline of approximately 10 - 15 km length. The pipeline would discharge into the Baltic Sea at some kilometres from the coastal line, with an arrangement for a high grade of dilution of the effluent, in order to minimise the impacts on the coastal area and the sea water. The pipe would need significant costs for the installation and also for the operation. This arrangement would, however, represent the particular advantage of this site: The risk of contaminating the river waters by the mill effluent would be eliminated. The higher immediate dilution of the effluent, which is possible in the Baltic, means that this can be regarded as a less sensitive recipient, compared to the rivers.

Actual impacts that could be expected in the Baltic cannot be specified at this stage. This will be a question of the EIA, if this site option is to be considered. However, it is assumed that the pipe length and the dilution can be chosen in such a way as to virtually eliminate any impact from the effluent on the water quality near the coastal line.

Inland/Coastal location – Natural purification - Conclusion

When discussing the inland and coastal locations, it should be pointed out that river Neris discharges into river Nemunas, downstream Kaunas, and Nemunas into the Kursiu Lagoon and further into the Baltic. So the effluent finally ends up in the Baltic, irrespective of the Mill site. In the inland cases the effluent undergoes some “natural purification” in the rivers and the lagoon. This means a virtually complete removal of the BOD, probably a significant removal of suspended solids, and only slight or negligible removals of nitrogen and phosphorus. COD will also be removed only slightly, as most of the COD after an efficient biological treatment is non-, or only slowly, biodegradable.

The BOD removal, and some COD removal, will occur through biological degradation under the consumption of oxygen. Due to the low BOD content of the effluent this will influence the dissolved oxygen (DO) in the rivers at a very low rate. The DO contents in these rivers are normally on a high level, corresponding to the saturation 85 – 120 % (Neris) and 70 – 115 % (Nemunas). In the coastal case these purification processes will occur in the sea water.

The most serious risk of influencing the recipient water quality is connected to the risk of upsets in the Mill, which can lead to temporary discharges of effluents with raised pollutant concentrations. This problem will, however, be efficiently counteracted by the installation of various safety systems, spill collection volumes etc. However, the risk of obtaining serious impacts from incidents of this kind is lower with the coastal location.

In summary, our opinion is that the coastal location in general is a better option than the inland location, from the point of view of water pollution.

(3) Atmospheric emissions

It is not possible at this stage to estimate the air quality in the surroundings of the Mill, resulting from the expected atmospheric emissions. This will have to be done within the later EIA. We have instead summarised the total emissions of the main pollutants, and compared them with the same emissions in the actual cities/districts, according to available statistical data (“Natural resources and environmental protection 1998”. Statistics Lithuania, A501. Vilnius 2000). Also data from the chemical industry ACHEMA, the largest industry in Jonava city, is included (data provided by Jonava District).

The Trakai district is included, as the Vievis site was previously located in this district. Now, 2000, Elektrenai has formed a new district of its own, where Visevis is located.

Table 5.6.3 Atmospheric emissions from the Mill.
Total emissions in the districts and in Lithuania 1998.

Atmosph. pollutants	Mill emission	Alytus City and district total	Jonava district total	Jonava ACHEMA industry	Trakai district total	Kretinga district total	Lithuania Total	
		Stationary sources					Stationary sources	Mobile sources
	tons/a							
Dust	200	149	276	1	609	111	7 300	2 300
SO_2	306	1 209	506	72	20 611	40	74 500	1 200
NO_x	600	169	520	450	1 858	52	14 800	37 500
CO	255	361	6 088	6 700	1 415	312	25 900	318 900

The data in the table give an indication of the estimated Mill emissions in relation to present emissions from other sources. The emissions are locally significant, compared to the present emissions in the actual districts, but are in some cases higher, in some cases lower. The relatively high emissions in the Trakai district most likely originate from the power plant in Elektrenai.

The local effects of these emissions, in terms of air quality outside the sanitary zone, will have to be studied in the later EIA.

The most obvious local effect will be the odour, caused by the TRS compounds (total reduced sulphur). This odour can be perceived as unpleasant, even when the TRS concentrations are very low. However, in this case, as in other modern kraft pulp mills, the most modern and efficient systems for reducing the TRS emissions will be applied. This means that the odour will be very low, although not really unnoticeable. During normal operation some odour will most likely be noticed within the Mill area and in the near vicinity. At larger distance, i.e. a few km, no odour will be noticed. Operation problems, which may occur from time to time, will temporarily increase the odour level also at larger distances, which may give rise to complaints. However, this situation will not give any health problems.

Local effects in residential areas, incl. odour, will be limited, due to the fact that main wind directions are around south-west. In the main site options the Mill location will be north (Alytus, Vievis) or south-east (Jonava) of the main residential areas.

The emissions from the Mill are very low in relation to the total Lithuanian emissions. The percentages are as follows, based on the emissions from stationary sources and from all sources (total = stationary + mobile sources):

	Stationary	Total
Dust	2.7 %	2.1 %
SO_2	0.4 %	0.4 %
NO_x	4 %	1.2 %
CO	1 %	0.1 %

(4) Solid waste landfill

This discussion refers to both the options, i.e. the Mill’s own landfill or a nearby municipal landfill. The most significant impact of the solid waste handling will be the appearance of the landfill area, i.e. mainly an esthetical impact. Other impacts could be:

* Odour from the landfill itself
* Drain water and leachate originating from the landfill, causing odour, as well as contamination of ground waters and surface waters
* Noise, caused by the transports of the wastes and by the handling of the wastes on the landfill

In order to minimize these impacts, particular care must be taken when choosing the location of and designing the landfill. See also section 5.4.4.

5.6.2 Environmental Impact Assessment

It shall be noted that a detailed Environmental Impact Assessment has not been carried out within the scope of the pre-feasibility study. This has to be done at a later stage of the project, according to the legislation, which is summarised in section 5.2.1.

An EIA will have to cover several issues, which were not covered in this study, i.a. the following:

- If the estimated water emissions will cause acceptable or unacceptable changes in the river water quality, based on the required water quality data, which have possibly been established at that point of time.
- To what extent the aquatic life in the rivers may possibly be affected
- The sensitivity of the rivers in terms of usage for recreation, fishing etc.

- The risks of temporary raised emissions, due to disturbances in the Mill, and their impact on the rivers
- If the estimated air emissions will cause acceptable or unacceptable changes in the ambient air quality, based on the required air quality data, which have possibly been established at that point of time.
- The risk of odour in residential areas
- The impact of transports (raw materials, products and chemicals, externally, as well as internal transports in the mill area)
- The impacts on forests and biodiversity

Chapter 6 PULP MILL DESIGN

Chapter 6 PULP MILL DESIGN

6.1 Products and Specifications

6.1.1 Selection of pulp products and reasons

(1) Objective and nature of the study

1) To assist existing operators and investors in expanding and developing business; or
2) To attract new operators and investors.

In the former case, there are sufficient data and criteria available to determine viability of the contemplated applications (and needs) of major products and their markets (future prospects). Past experience, knowledge and know-how are used as the basis of analyzing the study results and data, leading to a final plan. On the other hand, the latter case should rely on statistical data and neutral evaluation criteria that are applied to all study items to be considered. In this case, it is important to evaluate study results and data obtained under a variety of conditions from broad perspectives, rather than specific cases, in the planning process. In particular, the present study is designed to develop a plan to build a large pulp mill that has international competitiveness, while not competing with existing paper and paperboard manufacturers in the country, which are on the decline. Thus, the study should address the issues facing the local industry so that the new mill will not be caught in the same problem.

(2) Major considerations in selection of market pulp products

Pulp and paper products are closely related to each other, and their selection in the production plan involves a delicate balancing act similar to design of a new coin (pulp products on one face and paper products on the other). Major considerations required in selection of market pulp products are summarized as follows:

1) Application: The most critical factor
2) Market: Europe (export market)
3) Raw materials: softwood and hardwood that are already planted

4) Competitors: Nordic Countries' and North American pulp manufacturers for softwood; and South European and South American pulp manufacturers for hardwood
5) Cost competitiveness: Found in raw material and labor, while the average level for other factors
6) Technology competitiveness: Average level
7) Production process: Latest and field-proven process
8) Production equipment: Field-proven equipment that is reliable in operation and maintenance
9) Construction cost: Not significant difference in mill construction cost so far as market pulp products are made
10) Timing of construction: It is desirable to make the new mill come on stream when the market turns upwards and before it reaches its peak, although the cyclic nature of the pulp market makes timely construction difficult.

Preliminary evaluation of the above items from 1) through 10) in comparison to potential competitors indicates that promising pulp products for the project are very limited. In fact, BSKP and BHKP are considered as primary candidates.

(3) Reasons for selection of BSKP and BHKP

a. Europe is the world largest importer of pulp products. In 1999, it imported nearly 14 million ADt of pulp.
b. As European countries exported a combined total of 9.7 million ADt in the same year, the region's net imports amounted to 4.3 million ADt. Note that some countries import woods in and outside of Europe and produce pulp products for exports.
c. BSKP and BHKP are most widely used market pulp products, which demand is expected to grow steadily in Europe.
d. If the country intends to foster the pulp and paper industry as a strategic sector that utilizes the country's rich forest resources, the best strategy is to produce BSKP and BHKP at large pulp mills in the country, thereby to use logs currently exported to European countries as a raw material for pulp production and export pulp products to neighboring countries in Europe.

e. Meanwhile, reconstruction of the existing paper and paperboard companies must wait until the national economy recovers and consumption grows to create an opportunity for production of paper products using locally supplied pulp.

Table 6.1.1 compares BSKP, BHKP and other pulps.

Table 6.1.1 Major Factors Considered in Selection of Pulp Products

Description		BSKP	BHKP	YKP	UKP	TMP
Grade / Production ADt/y		＞5000000	＞500000	350000	350000	180000
① Application	1) Printing and writing paper	○	◎			
	2) Office paper	○	◎			
	3) Coated base paper	○	◎			
	4) Household and sanitary paper	○	◎			
	5) Newsprint and magazine			◎		◎
	6) Package, box and container	◎	◎	◎	◎	
	7) Board (liner)				◎	
② Market	1) Area	Entire Europe	Entire Europe	Entire Europe	Entire Europe	Entire Europe
	2) Customer	Paper company	Paper company	Newsprint maker	Board maker	Newsprint maker
	3) Sales volume	Large	Large	Small	Medium	Medium
③ Raw materials	1) Wood	N	L	N	N	N&L
	2) Chemicals	Self-made/purchase	Self-made/purchase	Self-made/purchase	Self-made/purchase	Purchase
	3) Fuel	Natural gas	Natural gas	Natural gas	Natural gas	
	4) Electricity	Internal generation	Internal generation	Internal generation	Internal generation	Purchase
④ Competitors		Nordic countries, North America	Southern Europe, South America	Nordic countries, North America	Nordic countries, North America	Latvia, Nordic countries
⑤ Cost competitiveness		High	High	Relatively low	Poor	Poor
⑥ Technology competitiveness		High	High	High	High	High
⑦ Production process		Very complex	Very complex	Complex	Slightly complex	Simple
⑧ Production line		Continuous one train	Continuous one train	Continuous one train	Continuous one train	Continuous multi train
⑨ Construction cost		High	High	High	High	Low
⑩ Construction period (months)		24～36	24～36	24～36	24～36	16～20

YKP : (=Yellow Kraft Pulp = semi-bleached Kraft Pulp)

6.1.2 Product specifications

As the proposed products are assumed to be sold to the general market at the present, product specifications are established to serve wide applications, as follows:

- Type	: ECF (or TCF) BSKP and BHKP
- Grade	: Paper grade
- Market	: Mainly Europe
- Brightness	: 80 ° - 90 ° ISO
- Moisture content	: 10% (air dry (AD))
- Product type	: Sheet pulp

6.2 Production Capacity

6.2.1 Design Capacity

Based on the results of the field survey, design capacity of the BKP mill is established as follows.

Table 6.2.1 Production Capacity and Operation Plan

	Unit	BSKP	BHKP	Total or average
a. Operating days	d/a	188	152	340*
b. Production capacity ratio		1.00*	1.20*	
c. Daily average production	ADt/d	1350	1620	1471
d. Annual production	ADt/a	254257	245743	500000*

Note: 1. The figures marked by * mark are established as design standards for the project.

2. The operating days of the BSKP mill (188 days) are estimated from consumption of softwood and hardwood in Table 6.2.2 “Log Supply Conditions and Consumption.”
3. The daily average production at the BSKP mill (1350ADt/d) is calculated as follows:
   500000 / (188 x 1 + 152 x 1.2) = 1350

6.2.2 Log Supply Plan and Consumption

Based on the results of the field survey and the data furnished by the Forest Bureau, log supply to the BKP mil is assumed to be composed of softwood 55% and hardwood 45% (on a debarked lumber basis).

Table 6.2.2 Log Supply Conditions and Consumption

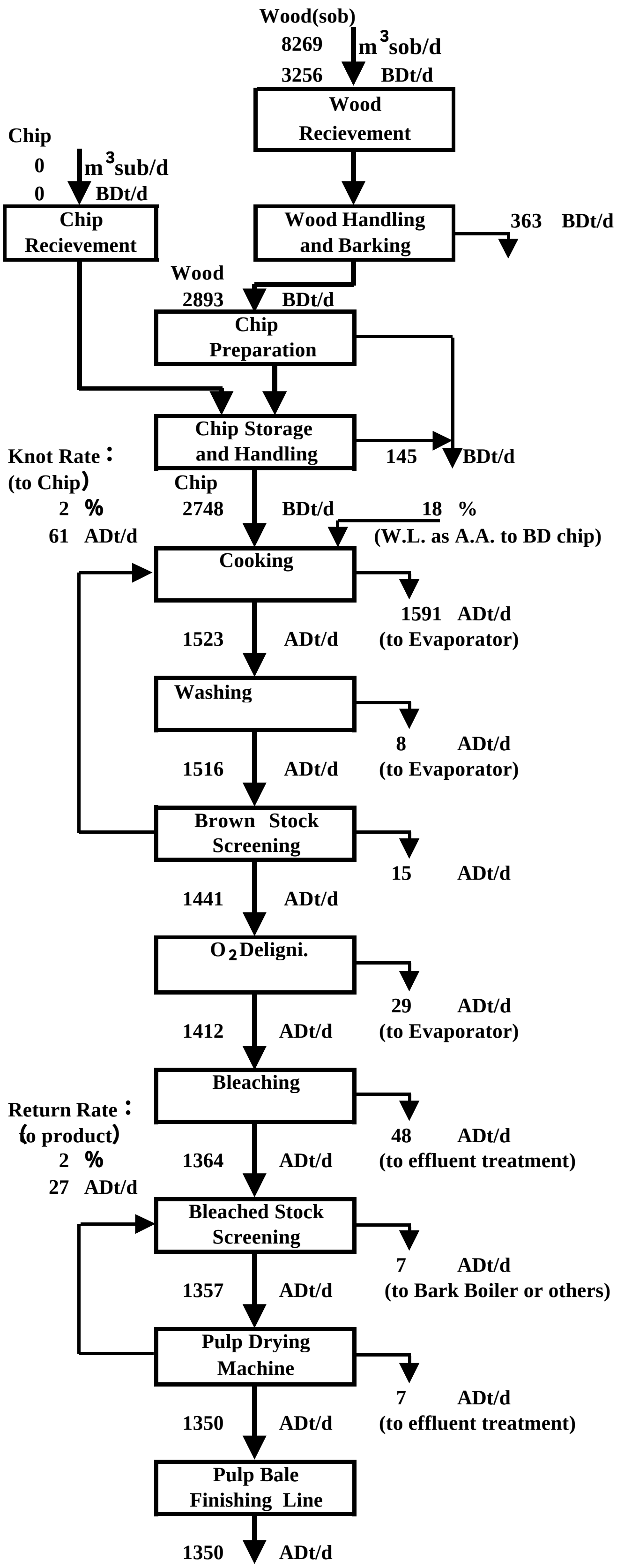
	Unit	BSKP	BHKP	Total or average
a. Species		Spruce & pine	Birch, etc.	
b. Log weight/unit volume	kg/ m^3 sub	405*	427 *	
c. Unit volume	m^3 sub /ADt	5.30**	4.48**	4.90**
d. Composition	%	55.0*	45.0*	100
e. Annual log consumption	m^3 sub /a	1346939	1102041	2450000

Note: 1. The figures marked by * are established as design standards for the project.
2. The figures marked by ** are estimated from those marked by*.
See Annex 1 "Lithuania Pulp Mill" for detail.
3. The annual log consumption (2450000 sub m^3/a) is calculated as follows:
500000 /(55/(5.30 x 100) + 45/(4.48 x 100))= 2450000

Figure 6.2.1 shows the "pulp flow" during BSKP operation, Figure 6.2.2 during BHKP operation, and Figure 6.2.3 during the BSKP/BHKP operation in equal proportions.

Note that the operating condition in Figure 6.2.3 is a hypothetical situation for convenience of presentation and calculation.

Figure 6.2.1 Pulp Flow - during BSKP operation



Daily Ave.Pulp Production	1350	ADt/d
Wood density(ave.)	405	kg/m^3
Bark density(assumed)	325	kg/m^3
Ave. unit wood consum.	5	m^3/ADt
Daily wood consumption	7152	m^3sub/d
Chip Rate	0	%
Baek and Fine Recovery Efficie	92	% BDt
Wood to bark and fine	20	% m3

Wood Handlig and Barking Yield (wood m3 sob to sub)	87	%

Generation of Bark and Fines BDt/d			
	Bark	Fines	Total
Chip from wood	363	145	507
Chip from outside	0	0	0
Total	363	145	507
to Bark Boiler	332	133	465

Woodto Chip Hand. Yield	95.0	%
Chip toChip Handlig Yield	99.0	%

Cooking Yield: (to chip fed to digester)	47.9	%

Washing recovery: (to Blow Pulp)	0.5	%

Reject Rate： (to washed pulp)	1.0	%

O_2 Deligni. Shrinkage： (to screened pulp)	2.0	%

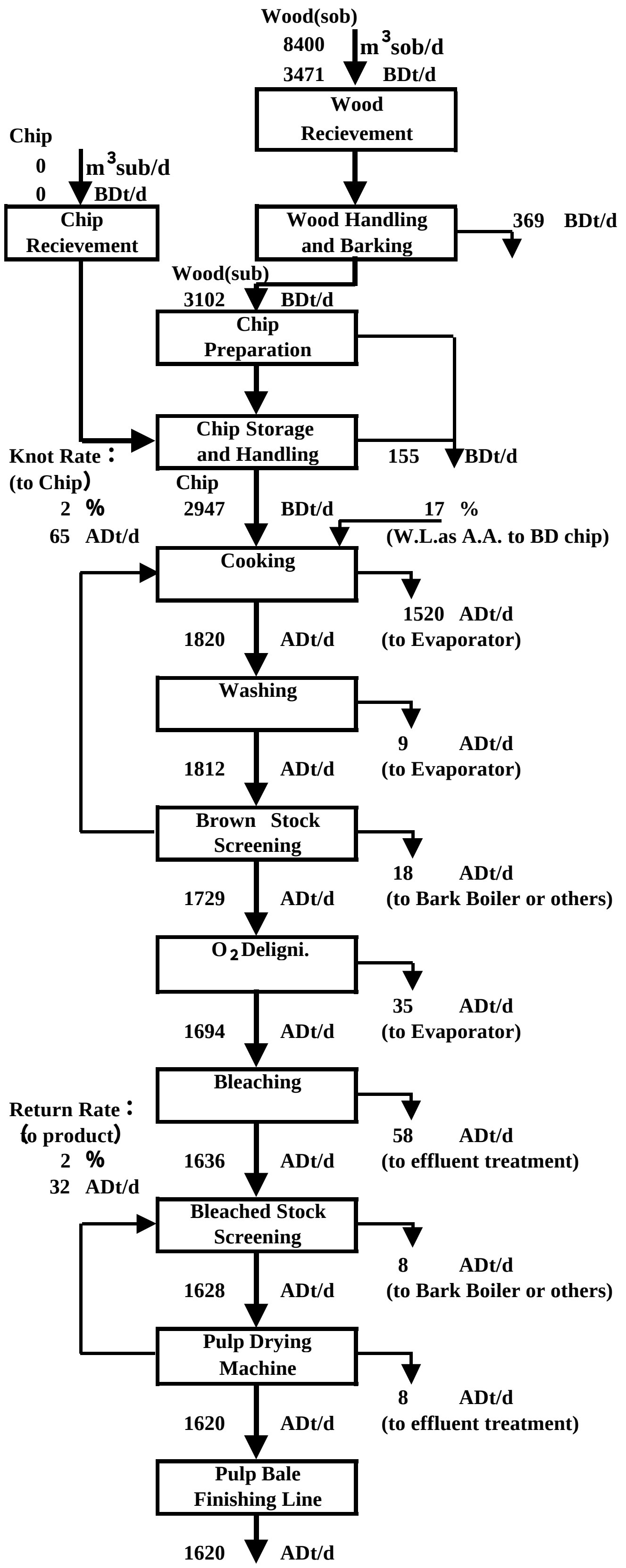
Bleaching Shrinkage： (to unbleached pulp)	3.4	%

BKP Screening Loss： (to bleached pulp)	0.5	%

Pulp M/C Losses： (to screened pulp)	0.5	%

Total Yield： (to sub wood)	42.0	%

Figure 6.2.2 Pulp Flow - during BHKP operation



Daily Ave.Pulp Production	1620	ADt/d
Wood density(ave.)	427	kg/m^3
Bark density(assumed)	325	kg/m^3
Ave. unit wood consum.	4	m^3/ADt
Daily wood consumption	7266	m^3sub/d
Chip Rate	0	%
Recovery Efficiency	90	% BDt
Wood to bark and fine	20	% m3

Wood Handlig and Barking Yield (wood m3 sob to sub) 87 %

Generation of Bark and Fines BDt/d			
	Bark	Fines	Total
Chip from wood	369	155	524
Chip from outside	0	0	0
Total	369	155	524
to Bark Boiler	332	140	472

Wood toChip Hand. Yield 95.0 %
Chip toChip Handlig Yield 99.0 %

Cooking Yield: 53.6 %
(to chip fed to digester)

Washing recovery: 0.5 %
(to Blow Pulp)

Reject Rate : 1.0 %
(to washed pulp)

O_2 Deligni. Shrinkage : 2.0 %
(to screened pulp)

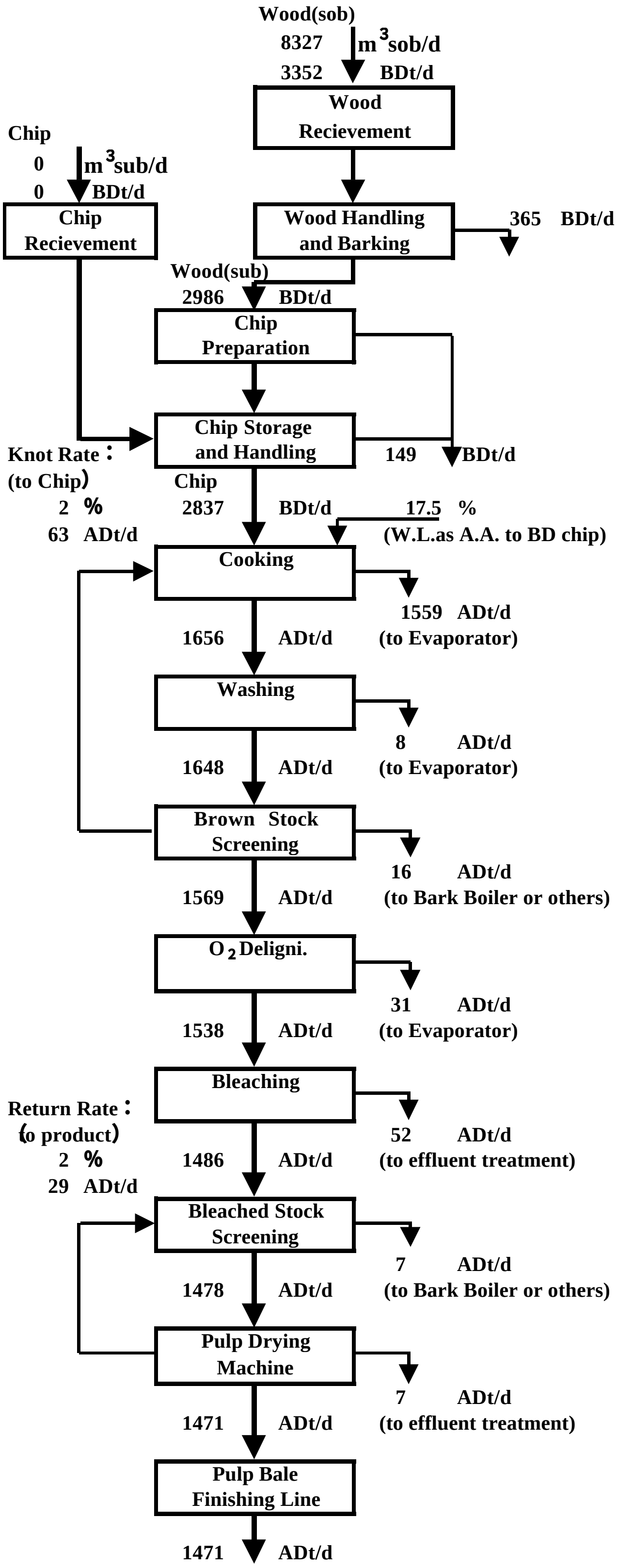
Bleaching Shrinkage : 3.4 %
(to unbleached pulp)

BKP Screening Loss : 0.5 %
(to bleached pulp)

Pulp M/C Losses : 0.5 %
(to screened pulp)

Total Yield : 47.0 %
(to sub wood)

Figure 6.2.3 Pulp Flow - during BSKP & BHKP operation in equal proportions



Daily Ave.Pulp Production	1471	ADt/d
Wood density(ave.)	415	kg/m^3
Bark density(assumed)	325	kg/m^3
Ave. unit wood consum.	5	m^3/ADt
Daily wood consumption	7203	m^{3}sub/d
Chip Rate	0	%
Recovery Efficiency	91	% BDt
Wood to bark and fine	20	% m3

Wood Handlig and Barking Yield (wood m3 sob to sub) 87 %

Generation of Bark and Fines BDt/d			
	Bark	Fines	Total
Chip from wood	365	149	515
Chip from outside	0	0	0
Total	365	149	515
to Bark Boiler	332	136	468

Wood toChip Hand. Yield 95.0 %
Chip toChip Handlig Yield 99.0 %

Cooking Yield: (to chip fed to digester) 50.5 %

Washing recovery: (to Blow Pulp) 0.5 %

Reject Rate： (to washed pulp) 1.0 %

O_2 Deligni. Shrinkage： (to screened pulp) 2.0 %

Bleaching Shrinkage： (to unbleached pulp) 3.4 %

BKP Screening Loss： (to bleached pulp) 0.5 %

Pulp M/C Losses： (to screened pulp) 0.5 %

Total Yield： (to sub wood) 44.3 %

6.2.3 Selection of Production Capacity

Production capacity of the green field pulp mill should be selected in consideration of the following factors.

(1) General trend in capacity increase

The capacity trend since the 1950s is well reflected in the installed capacity trend of the Kamyr continuous digesters, the mainstream equipment for production of BKP, the most popular market pulp. In the 1970s, the 500 – 1000 ADt/d range was the largest capacity level, and then 1500 – 2000ADt/d mills were constructed between the late 1980s and the early 1990s.

From the late 1990s to the present, 1800 – 2000ADt/d mills were constructed or announced, as well as 1500ADt/d mills.

Up to the early 1990s, the largest single line KP plant, with continuous digester, both for softwood and hardwood, were build in North America, South America and Asia/Oceania, but not in Europe. Then, some were built in Nordic Countries during the late 1990s, although they do not produce market pulp.

To this date, the largest single line BSKP capacity, with continuous digester, is 483000 ADt/a. The largest single line BHKP capacity is 542000 ADt/.

Note that the above single line BKP capacities were calculated from UKP daily design capacities of existing mills, as announced, multiplied by the yield of BKP (bleached KP) vs. UKP (unbleached KP), 94%, the overall operating efficiency of 90%, and annual operating days of 340.

See Table 6.2.3 “Installed Base of Kamyr Continuous Cooking Process by Year of Installation” for detail.

Table 6.2.3 Installed Base of Kamyr Continuous Cooking Process by Year of Installation

2000-08-15

	North America (Ahlstrom *3)			Europe (Kvaerner *2)			Aisa, Oceania (Kvaerner *2)			Latin America (Kvaerner *2)			Africa (Ahlstrom *3)			Total		
	SW	HW	Total	SW	HW	Total	SW	HW	Total	SW	HW	Total	SW	HW	Total	SW	HW	Total
1950-1959																		
Design capacity UKP ＡDt/d *1	1300	0	1300	1900	125	2025	465	390	855	0	0	0	0	0	0	3665	515	4180
Installed base (unit)	6.0	0.0	6.0	17.0	3.0	20.0	4.0	4.0	8.0	0.0	0.0	0.0	0.0	0.0	0.0	27.0	7.0	34.0
Average capacity UKP Adt/d/unit	217		217	112	42	101	116	98	107							136	74	123
Max. capacity UKP Adt/d/unit	350			200	60		150	180								350	180	
1960-1969																		
Design capacity UKP ＡDt/d *1	36705	4088	40793	13230	1915	15145	2020	1472	3492	490	100	590	550	0	550	52995	7575	60570
Installed base (unit)	78.0	7.0	85.0	37.0	9.0	46.0	11.0	9.0	20.0	1.0	1.0	2.0	2.0	0.0	2.0	129.0	26.0	155.0
Average capacity UKP Adt/d/unit	471	584	480	358	213	329	184	164	175	490	100	295	275		275	411	291	391
Max. capacity UKP Adt/d/unit	900	1,080		820	500		420	420		490	100		300			900	1,080	
1970-1979																		
Design capacity UKP ＡDt/d *1	13700	4818	18518	21615	1960	23575	4550	3652	8202	378	3418	3796	1450	270	1720	41693	14118	55810
Installed base (unit)	22.0	8.0	30.0	37.5	5.5	43.0	11.5	8.5	20.0	1.5	4.5	6.0	3.0	1.0	4.0	77.0	26.0	103.0
Average capacity UKP Adt/d/unit	623	602	617	576	356	548	396	430	410	252	760	633	483	270	430	541	543	542
Max. capacity UKP Adt/d/unit	1275	950		1000	860		660	640		255	1350		835	270		1275	1350	
1980-1989																		
Design capacity UKP ＡDt/d *1	17663	6593	24256	8500	4792	13292	4735	4252	8987	900	1063	1963	782	0	782	32580	16700	49280
Installed base (unit)	20.0	10.0	30.0	11.5	8.5	20.0	9.5	8.5	18.0	1.5	1.5	3.0	1.0	0.0	1.0	43.5	28.5	72.0
Average capacity UKP Adt/d/unit	883	659	809	739	564	665	498	500	499	600	709	654	782		782	749	586	684
Max. capacity UKP Adt/d/unit	1325	1410		1100	1060		800	750		800	1000		782			1325	1410	
1990-1998																		
Design capacity UKP ＡDt/d *1	13851	11647	25498	4309	3712	8021	3403	12534	15937	3028	6147	9175	750	534	1284	25340	34574	59914
Installed base (unit)	10.5	10.5	21.0	5.0	5.0	10.0	6.5	12.5	19.0	3.0	4.0	7.0	1.0	1.0	2.0	26.0	33.0	59.0
Average capacity UKP Adt/d/unit	1319	1109	1214	862	742	802	523	1003	839	1009	1537	1311	750	534	642	975	1048	1015
Max. capacity UKP Adt/d/unit	1680	1820		1300	1200		1390	1750		1210	1885		750	534		1680	1885	
1950-1998																		
Design capacity UKP ＡDt/d *1	83219	27145	110364	49554	12504	62058	15173	22300	37473	4796	10728	15524	3532	804	4336	156272	73481	229753
Installed base (unit)	136.5	35.5	172.0	108.0	31.0	139.0	42.5	42.5	85.0	7.0	11.0	18.0	7.0	2.0	9.0	302.5	120.5	423.0
Average capacity UKP Adt/d/unit	610	765	642	459	403	446	357	525	441	685	975	862	505	402	482	517	610	543
Max. capacity UKP Adt/d/unit	1680	1820		1300	1200		1390	1750		1210	1885		835	543		1680	1885	

Sources: Contract delivery record furnished by Kvaemer and Sumitomo Heavy Industries/Ahlstrom (as of 1999)

*1 The digester's nominal capacity is indicated in volume of production of unbleached pulp, which is 10-12% larger than output of bleached pulp due to loss in the bleaching and screening processes.

*2 Kamyr was established in 1920 by KMW of Sweden (pulp and paper machine manufacturer) and Myren of Norway (machinery manufacturer), and joined by Ahlstrom of Finland (leading pulp and paper manufacturer/plant manufacturer) in 1934. The company has long known in Japan as a leading pulp and paper machine manufacturer in Scandinavia. It started research and development on the continuous digester, using a pilot plant, in 1938, which was commercialized in 1949. The first unit came on stream in 1950. After the decades of dominance in the industry, Kamyr was divided into Pulping Division of Kvaermer of Norway and Ahlstrom of Finland in 1990, which are currently competitors.

*3 Kamyr Inc., under Sweden Kamyr, primarily operated in North America (excluding Mexico) and Africa. As a result of division of the parent company in 1990, the company became a subsidy of Ahlstrom and has been competing with Kvaerner's Pulping Division. In 1999, the two companies announced consolidation of their pulp and paper plant divisions into a new company in order to rationalize their operations in response to the persistent recession in the pulp and paper industry. However, they failed to obtain the approval of the European Commission and they are now pursuing separate strategies. Reportedly, the merger proposal was opposed by Valmet, a leading pulp and paper manufacturer in Finland (which acquired Sunds, a Swedish pulp and paper machine manufacturer), although details are not known.

The above data partly explain the present assumption that “the annual production of 500000 ADt (daily production of 1500AD) BKP mill is the breakeven point for economic viability.” The higher capacity is clearly favorable as fixed costs such as depreciation and labor decrease in relative terms. In particular, for a market pulp maker located in an area of rich wood resources, which is designed to export products to major areas of consumption, the capacity must be large enough to reduce the fixed cost per ADt, thereby to compensate for the large capital requirement and the high transportation cost for long haul to the market.

It should be noted, however, that the annual capacity of 500000 ADt is not the minimum requirement for all the market BKP mill projects. The feasibility seems to be evaluated rather in rather overall consideration of log supply capacity and price, product market environment (supply and demand, price forecast), locational conditions including the environment, and the funding environment (availability of equity capital, loan capacity, interest rate).

Based on the above analysis, the contemplated 500000 ADt/a BKP mill producing BSKP and BHKP is considered to be the largest scale and seems to be a very attractive project.

(2) Application: Sales or captive consumption

In the case of market BKP production, a strong tendency exists to maximize capacity in order to minimize construction costs, maintenance costs and labor and other costs per production unit (ton). This is a logical choice for the BKP production process that is a complex, capital-intensive process consisting of a large number of equipment and needs to be operated on a continuous basis while keeping material, chemical and energy balances among interrelated processes, including pulp production, chemical recovery, power and pollution control. As a result, the construction cost for the BKP process is much higher than that for other production processes of the pulp and paper industry. As the project plans to sell all of pulp produced at the mill, production capacity should be set at the maximum allowable level in terms of raw material availability, thereby to maximize cost competitiveness of products.

(3) Wood supply source

1) Northern forest

Northern forest has a relatively long growing period, with some variation between natural forest and plantation and between coniferous and broad-leaved trees. Thus, the supply source must be selected in forest areas where trees can be harvested and exploited when the proposed mill has been constructed.

Two forest regions meet this requirement, North America and Europe (including Russia) (forest areas grown since the 1960s). In 1998, North America (U.S. and Canada) accounted for 46.0% of world pulp production of 183 10^6ADt. In the region, there were a number of large KP mills that accounted for 48.0% of world UKP production capacity as of 230 10^3ADt/d (using the Kamyr continuous process) up to 1999. The large production base is located close to a huge market and wide natural forest as a source of raw material supply.

Europe also accounts for a major share (23.5%) of world pulp production and 27.0% of world UKP production capacity. Within Europe, Nordic countries although having abundant forest resources, are presently net importer of logs, for economic reasons.

Forest in Lithuania belongs to northern forest and accounts for more than 30% of the country's land area (6500 10^3ha). Furthermore, its stock is gradually increasing. Thus, the mill capacity plan needs to take into account this factor.

2) Southern forest

With some variation between natural forest and plantation and between coniferous and broad-leaved trees, southern forest has a relatively short growing period. As a result, forest areas that can be converted to afforested areas will be included as a potential source of wood supply, in addition to forest areas where trees can be harvested and exploited when the proposed mill is constructed. Two regions meet this requirement: South America (forest grown since the 1970s) and Indonesia (forest grown since the 1990s). The former accounted for 5.8% of world pulp production in 1998 and 6.7% of world UKP production capacity. On the other hand, the latter represented

2.4% and 2.6%, respectively. Table 6.2.4 summarizes pulp production capacity, production volume and forest area by region.

Table 6.2.4 Installed Capacity of Kymyr Continuous Cooking Process (up to 1999), Pulp Production (1998) and Forest Area (1997) by Region

Region / Major features	North America	Europe	Asia/ Oceania	South America	Africa	Total
Installed process						
Design capacity UKP ADt/d	110364	62058	37473	15524	4336	229753
Percentage share %	48.0	27.0	16.3	6.8	1.9	100.0
Number of units installed	172	139	85	18	9	423
Percentage share %	40.7	32.9	20.1	4.3	2.1	100.0
Average capacity UKP ADt/day/unit	642	446	441	862	482	543
Percentage share %	118.1	82.2	81.2	158.8	88.7	100.0
Maximum design capacity UKP ADt/day/unit	1820	1300	1750	1885	482	1885
Pulp production (Total) 10^3AD/ty	83043	42301	41917	10472	2576	180309
Percentage share %	46.1	23.5	23.2	5.8	1.4	100.0
Forest area 10^6ha (*1)	456	962	565	950	520	3454
Percentage share %	13.2	27.8	16.3	27.5	15.1	100.0

Sources *1: State of The World's Forest 1997

3) BSKP

BSKP, made from softwood, is primarily produced in the northern hemisphere where coniferous forests are widely distributed. Major exporters of market BSKP are Canada, the U.S., Sweden, Norway, Finland, and Russia.

In Canada and the U.S., BSKP is mainly made from waste softwood of sawmills, although there are huge coniferous forest resources compared to other countries, they are required to exploit forest resources on a sustainable basis for the interest of ensuring global environmental protection. In Nordic Countries, BSKP is mainly made from round softwood, furthermore sustainable development of forest industries had been established already, but the cost of softwood for BSKP has a tendency to increase gradually. As a result in general, they are keen to secure stable supply of BSKP materials.

This is evidenced in the fact that leading pulp and paper manufactures in North America and Nordic countries are investing in coniferous tree plantation projects in Chile and Uruguay. Thus, it is a very rational choice for Lithuania to produce BSKP by using softwood available locally on a sustainable basis too mentioned above, so long as the project can fulfill various conditions (a. economy, b. environment and c. technology).

4) BHKP

BHKP, made from hardwood, is widely produced all over the world because of global distribution of broad-leaved trees. Among a variety of species available, eucalyptus is increasingly planted and used for pulp production because of various advantages: fast growing under the temperate climate; excellent pulping characteristics; and suitability for production of various types of paper.

In Lithuania, both coniferous and broad-leaved forests are growing. The annual growing volume of both forests reach to the level that exceeds the rate of consumption for sawmill and firewood purposes.

Among broad-leaved, birch is most widely produced, followed by alder and aspen. Birch is exported to Nordic countries at a rate of a few hundred thousand m^3 per year and is widely recognized as the good BHKP material.

The mean annual increment (MAI) of these species is less than one fifth of that of eucalyptus in South America, but the log price of the BHKP material is governed by a number of factors, including geography, infrastructure and labor cost. Thus, hardwood materials in Lithuania can competed with those available in South America if sufficient forest resources are made available.

5) Log supply to the proposed pulp mill

The results of the two field surveys indicate that the available log stock, which can be most effectively and economically exploited, is estimated at around 2.5 million m^3 sub/year (debarked). Of total, softwood accounts for 55% and hardwood 45%. This supply capacity matches the proposed BKP capacity of 500000 ADt/y.

Based on the above supply capacity, the softwood price for BSKP production was set at USD26.63/m^3 sub or USD141.07/ADt, and the hardwood price for BHKP production at USD20.36/m^3 sub or USD91.32/ADt. These prices are very attractive and are considered as one of the major economic advantages for the project, in addition to merit of scale of the proposed BKP mill.

(4) Market, Supply and Demand, and Price Fluctuation

1) Distance from the mill site to the market and transportation requirements

If the mill is located within a relatively short distance from the market, transportation cost saving allows it to compete with a larger mill that is remotely located, so long as such cost saving exceeds an increased construction cost per unit of production (ton) for the smaller mill.

2) Supply and Demand, and Price Fluctuation

Market pulp is an internationally traded commodity which price fluctuates greatly due to the changes in supply and demand situation. In this study, the BSKP price is assumed to be at USD640/ADt and the BHKP price at USD615/ADt by taking into account the prices in the second quarter of 2000 and transportation costs to the European market.

As a larger capacity is more sensitive to the decline in pulp prices, the proposed mill should be designed to ensure a high level of efficiency to minimize the production cost.

(5) Allowance for future production increase and capacity expansion

The scale of production should be considered by taking into account possible production increase and capacity expansion in the future. This must be clearly addressed before a mill site is acquired, and careful consideration should be given to industrial water supply and discharge facilities, service pipes and cables, access to main roads and other non-process facilities and equipment, as to whether a future expansion plan can be accommodated

6.2.4 Result of Capacity Selection

In consideration of the factors discussed in 6.2.3, conceptual design of the proposed mill was developed under the assumption that the mill capacity is 500000 ADt/a. In the process, technical study and research was conducted in due consideration of the fact that a green field BKP mill project will have significant impacts, both environmentally and economically, on investors and

stakeholders in the area around the mill site. The results of economic and environmental surveys are reported in separate chapters. In particular, full environmental consideration is given to the conceptual design, because: ① the BKP mill is generally considered as a major source of environmental impacts; ② Lithuania has no modern BKP mill and has not produced chemical pulp for nearly 10 years; and ③ EU environmental standards are expected to be applied in due course (Lithuania has applied EU membership and times for full membership about 2004. Realistically, however, the process will most certainly require a longer time.) .

As a result, the study team proposes a project to build and operate a market pulp mill which can take advantages of various comparative advantages of the country and which is widely and feasibly located in an area where raw wood materials are available in abundant. Major reasons for the capacity selection, together with other considerations are summarized as follows:

a. At present, the BKP mills, with a single line capacity as of 500000 ADt/a, will be one of the largest single line in the world.
b. Market pulp production needs to be cost competitive and a larger capacity offers a significant advantage due to a relatively small percentage of fixed cost.
c. The field survey to assess log supply capacity indicates that a total of 2.5 million m^3/year is feasible. The supply volume matches the total capacity of 500000 tons as well as the BSKP and BHKP production capacities.
d. To reduce the influence of price fluctuation in the highly volatile pulp market, it is desirable to build a mill with low production costs.
e. Site and other conditions, including the possibility of future expansion, should be considered in the mill site selection process.
f. Other conditions required to obtain public acceptance, considering social and environmental impacts, should be examined.

6.3 Selection and Description of the Production Process

6.3.1 Process Selection

The production process was selected in consideration to the following factors:

(1) The ability to make high quality pulp;

(2) Excellent unit consumption of logs, chemicals and energies;

(3) The adaptability to pollution control measures; and

(4) Incorporation of excellent and field proven technology.

6.3.2 Description of Main Production Processes

(1) Dry debarking

The drum barker is designed to remove barks by utilizing friction of logs in a large, rotating drum. In this case, as in other modern mill, dry debarking process will be used.

The dry debarking process consumes water only for log washing and de-icing purposes. As water can be easily recycled, the effluent is much less (0.5 – 2.5 m^3/ton pulp) and thus less water pollutants are discharged, compared to the older debarking process. Also, bark has less moisture content to improve energy efficiency of the bark boiler.

In consideration of the above advantages, the project will use the dry debarking process.

(2) Continuous digester

There are two types of digesters available, continuous and batch. The batch type has recently been the objective of an subject to an important development and has various advantages over the continuous type. However, the continuous type is widely used at large pulp mills.

In consideration of the field proven record of operation, the project will use the continuous digester.

A continuous digester of larger size uses a two-vessel liquid phase structure where the cooking liquor impregnation stage is separated from the cooking stage and the indirect heating method is used. As high pressure impregnation is carried out in an independent stage separated from the digester, chips are well impregnated, making them suitable also for cooking of softwood which requires a longer time for impregnation than hardwood. As for indirect heating, the digester is filled with the cooking liquor, which is heated by a feeding and circulating line between the two vessels to allow uniform heat transfer throughout the digester and produce high quality pulp.

Recently, new continuous cooking methods are used, including MCC (modified continuous cooking), EMCC (extended modified continuous cooking) and ITC (iso-thermal cooking). These methods are designed to ensure uniform cooking so as to perform delignification by minimizing the yield loss. As a result, reduction of bleaching chemicals and effluent loads as well as good pulp quality can be achieved. The project will use the ITC method that has most recently been developed. The method performs delignification throughout the digester, so that the cooking temperature is lower than other methods and delignification does not increase steam consumption or affect the yield, while ensuring pulp strength.

(3) Oxygen delignification

Oxygen delignification is performed to remove lignin left after the cooking process, without affecting the strength characteristics of the pulp. It is carried out under the alkali condition and uses the oxidization power of oxygen. The effluent from the process is recycled to the black liquor recovery system.

As a result, if caustic soda (NaOH) is newly added to the process as alkali, the amount of sodium recovered from the effluent increases to change the sodium balance. It is usually avoided by adding oxidized white liquor instead of caustic soda. Also, magnesium sulfate (MgSO4) is added to keep pulp strength.

Oxygen delignification is performed in either one or two stages. Naturally, the two- stage process achieves a higher degree of delignification. As an increased level of oxygen delignification helps to reduce the consumption of bleaching chemicals, together with reduced water emission, the project will employ the two-stage process.

(4) Bleaching sequence

The proposed mill will use the ECF (elemental chlorine free) bleaching process and minimizes the use of ClO_2 (chlorine dioxide) as a bleaching agent, by using ozone. (The reason is stated later.) At the same time, as the TCF (totally chlorine free) process is used in various countries including Germany, design consideration will be given to TCF adaptability.

1) Reason for selection of the ECF bleaching sequence

a. Bleaching cost

Comparison of bleaching costs with or without ozone, as appeared in various reports and source materials, reveals that the cost is lower when ozone is used, for both the ECF and TCF processes. It should be noted that cost figures shown in the source materials vary significantly as different unit prices of chemicals were used for cost calculation. In particular, unit prices of on-site chemicals (i.e., ozone and ClO_2) vary greatly as some include capital (equipment) costs and others do not. Therefore, direct comparison of cost figures in different reports should be avoided.

After cost advantage of ozone is identified, further cost comparison is made to analyze the use of ozone and its cost impacts. There are many cases of comparing the ECF costs with or without ozone. On the other hand, there are few cases of comparing the ECF and TCF costs when ozone is used, including relative comparison by Metsa Botnia (Table 6.3.1). According to the table, the TCF cost is approximately 30% higher than the ECF cost (110/85=1.3; and 100/75=1.3). Furthermore, in both processes, the cost for hardwood is approximately 10% lower than that for softwood.

Table 6.3.1 Relative Comparison of Bleaching Costs by Metsa Botnia

	Softwood	Hardwood
ECF with ClO_2	100	95
ECF with O_3 & ClO_2	85	75
TCF with H_2O_2	185	165
TCF with O_3 & H_2O_2	110	100

Sources : Results presented from Metsa Botnia at the 1995 Non Chlorine Bleaching Conference

Then, comparison is made for the costs with and without ozone. The ECF cost is 15% - 20% lower when ozone is used (85/100=0.85; 75/95=0.79), and the TCF cost is 40% lower (110/185=0.59; and 100/165=0.61).

Table 6.3.2 is an essential extract from a table comparing the ECF and TCF costs, obtained from VALMET, containing sequence and cost data only. In this table, ozone is denoted as Z, and the top two items represent the ECF and TCF costs when ozone is used. In this example, the TCF cost is 10% higher than the ECF cost. Also, the ECF cost with ozone is lower than that without ozone, and the TCF cost without ozone (TCF-P; P stands for peroxide) is significantly higher than that with ozone.

Table 6.3.2 Comparison of Bleaching Costs by Sequence

	Sequence	Cost（USD/ADt）
ECF-Z	（QZ）（EO）DnD	22.4
TCF-Z	（OP）（ZQ）（PO）	24.7
TCF-P	（OP）Q（PO）	42.4
ECF-light	（OP）（DQ）（PO）	24.3～25.7

Sources：VALMET

In conclusion, the costs for both ECF and TCF decrease when ozone is used. Comparing the ECF and TCF costs when ozone is used, the latter is 10-30% higher than the former.

b. Pulp quality

Chlorine and ClO2, particularly the latter, have high selectivity in removing lignin contained in wood, and they have been indispensable for obtaining BKP with high brightness and strength. The TCF pulp is bleached without using chlorine or ClO2, and instead oxygen, hydrogen peroxide or zone is used. However, oxygen and ozone are much less selective about lignin to limit the amount of use, while hydrogen peroxide shows a relatively low delignification effect. As a result, it is difficult to attain high brightness for the TCF pulp.

Recently, the TCF process has been improved to attain a high level of brightness equivalent to commercial products (90% ISO) through reduction of bleaching loads or the improvement of the bleaching method. To reduce bleaching load, delignification needs to be intensified by lowering the kappa number through cooking. However, if cooking is continued to a low kappa number, hemicellulose in wood is removed with lignin because the cooking process is not as lignin selective as the bleaching process, leading to loss of pulp yield. This makes the TCF process less favorable.

Also, the excessive use of ozone is said to damage fibers and may adversely affect pulp strength. Thus, the TCF process is less advantageous from the viewpoint of pulp quality (brightness and strength).

c. Environmental impacts

As for the COD and BOD emission levels contained in the effluent from the bleaching process, there is little difference between the ECF and TCF processes. As for AOX (adsorbable organic halogens), the emission level from the ECF process is significantly low (<0.3 kg/ADt).

As for recovery of the bleaching effluent, the TCF process is considered to be advantageous because of its operating principle. However, as the process uses a large amount of hydrogen peroxide (H2O2), metal elements affecting its effect (e.g., manganese, iron and copper) must be removed from process water. This can be accomplished by intensive chelating treatment or acid wash of pulp, but the chelating agents in use, DTPA and EDPA, are only slowly biodegradable under normal conditions, but are not regarded as particularly harmful substances.

In summary, there are, from the environmental point of view, no obvious reason to select TCF in stead of ECF.

d. Future outlook

The Nordic Countries is the largest producer of the ECF and TCF pulp, but the majority of makers now prefer the ECF pulp, because the TCF pulp is more costly despite the little difference in environmental impact. Users in Germany previously purchased the TCF pulp at premium prices, which mostly disappeared due to the price decline caused by a supply glut occurred in the second half of 1995. This is perhaps one of the reasons why the TCF pulp has lost popularity.

Many industry sources believe that the weak position of the TCF pulp will not change at least in the next ten years. Nevertheless, as some countries, such as Germany, still use the TCF pulp, the process needs to be designed with adaptability to the TCF process.

2) Bleaching sequence selected

Table 6.3.3 shows the ECF bleaching sequence (with ozone) to be employed at the proposed mill.

Table 6.3.3 ECF Bleaching Sequence Selected for the Project

Species	Bleaching sequence
Softwood	OO（QZ）（PO）DD
Hardwood	OO（QZ）（EO）**D**

Note: This bleaching sequence is characterized as the ECF process that minimizes the cost of ClO2 or H2O2 by adding ozone.

3) Switching from ECF to TCF

If switching to the TCF process is required, various types of sequences are available. For instance, if the capital cost is to be minimized, the TCF-1 sequence (shown below) is desirable. On the other hand, the TCF-2 sequence may be preferable for reduction of hydrogen peroxide or improvement of pulp quality (brightness or strength).

Possible TCF bleaching sequences
TCF-1: OO(QZQ)(PO)P
TCF-2: OOQ (OP)(OZ)(PO)

(5) Use of commercial sodium chlorate (chlorate)

Chlorine dioxide (ClO2) used as a bleaching agent needs to be made on site, and sodium chlorate (NaClO3) (generally referred to as “chlorate), an essential agent for the production process may be commercially purchased or made on site by installing an electrolytic plant using salt. This choice depends on whether or not chlorate is available at a reasonable price, and in the later case, on-site production is selected in many cases.

The project will use commercial chlorate for the following reasons.

1) As discussed in the section on bleaching sequence, the project will consume a relatively small amount of ClO2 compared to the mill size (7.2 tons/day), due to the use of the ECF process with ozone. As a result, a relatively small amount of chlorate (11.9 tons/day) will be used.
2) Chlorate can easily be purchased (imported).
3) At present, the ECF process is considered to be suitable for the project. However, possible switching to the TCF process should be considered. As the TCF process does not use chlorate at all, the installation of the electrolytic plant will be wasted if switching occurs. Thus, it is desirable to use the commercial product in the initial stage, and if switching becomes inevitable, the final choice should be made by taking into account cost and other factors.

6.3.3 Pulp Drying

(1) Pulp Dryer and finishing line

The bleached pulp is dewatered in the pulp machine, then dried in the pulp dryer, cut in sheet form in the cutter-layboy, pressed, wrapped, labeled, and unitized in the bale handling processes.

Bleached pulp is drawn from bleached high-density storage with consistency control to the machine chest. The pulp stock in the machine chest is pumped through a consistency control to suction of the primary fan pump. The primary fan pump dilutes the pulp stock for screening and cleaning through a pressure screens and multi-stage centrifugal cleaner system. The cleaner accept pulp is sent to a pressurized pulp machine head box at 1.0 – 1.5% consistency.
Pulp sheet of approximately 630 – 810 g/m^2 is formed in the wire part.
The sheet is press de-watered to dryness of approximately 50% through a three-stage press section.

Three methods are available to dry pulp; air-borne dryer, flash dryer, and cylinder dryer. From point of view of quality of dried pulp, heat economy, and the space requirement, an air-borne dryer with low-pressure steam as heat source should be chosen.

The pressed sheet enters an air-borne dryer and is dried to dryness of 90% (moisture 10%). The dried pulp sheet is cut to size in cutter-layboy.
A pulp sheet sample should be taken every half an hour for quality test and inspection.

The heat of dryer exhaust air is recovered, as hot air (for dryer air supply) and hot water, by means of air-air heat exchanger and water heater.

The piles of pulp sheet are pressed through a hydraulic bale press, wrapped with wrapping sheet, which is made of the same pulp, printed of logo, identifications and specifications, wired, and then unitized to 6- or 8-bale high units. After the bale press, the finishing line will be split to two lines in order to handle the planned production capacity.

All these processes of pressing, wrapping, printing, wiring, and unitizing will be performed automatically by means of PLC (programmable logic controller)

(2) Warehouse

8-high unitized pulp bales will be stored in the warehouse until shipment.

6.3.4 Description of Recovery and Power Processes

(1) Black liquor evaporator

The weak black liquor delivered from digester–brownstock area is stored in the weak black liquor storage tanks. The solids concentration in the weak black liquor is expected to be approximately 15%.
The weak black liquor is concentrated by a sextuple effect steam driven evaporator and a concentrator to a concentration sufficiently high, typically to 75% solids, to sustain efficient and stable combustion in the chemical recovery boiler.

In the multi-effect evaporator, when softwood black liquor is evaporated, soap will precipitate at black liquor concentration of approximately 25%. A soap-skimming vessel will be required at this point.

The steam condensate is returned to the boiler house. The final effect evaporator vapour is condensed with cooling water. Most of the warm cooling water return will be used in the pulping process as warm water. The surplus portion of the warm water is returned to the river.

The condensate from the evaporated black liquor is segregated into two portions, highly contaminated, and lightly contaminated condensates. The highly contaminated portion will be steam stripped of its volatile contaminants, i.e. predominately methanol and reduced forms of sulphur. The strip cleaned condensate and lightly contaminated condensate will be recycled to the pulping and causticizing processes as process water. The stripper overhead vapour will be, after condensing out water, oxidized in an incinerator. The resulting sulphur dioxide in the incinerator flue gas will be scrubbed in a scrubber using dilute caustic soda solution and recycled back to the cooking process.

(2) Recovery Boiler

The strong black liquor from the black liquor evaporator/concentrator is burned in the chemical recovery boiler. The function of recovery boiler is to reduce various sulphur compounds in the black liquor to sodium sulphide, one of the essential ingredients for wood cooking, in the furnace bed with in-sufficient oxygen and high temperature. The remaining inorganic matter in the black liquor is converted to sodium carbonate.

The sodium sulphide, sodium carbonate, together with various impurities, exit recovery boiler as a molten mixture of inorganic salts, called smelt, at about 900 °C. The smelt is dissolved in recycled wash water from causticizer called “weak wash” and turned to cooking liquor(white liquor) through a series of chemical reaction in causticizer plant and recycled back to digester.
Burning of the organic portion of black liquor generates sufficient heat to sustain combustion in the recovery boiler and generates steam at high pressure without supplemental fuel.

The recovery boiler flue gas is cleaned of its solid particles(dust) through an electro-static precipitator, and scrubbed with dilute caustic soda solution to scrub-off any remaining sulphur compound gases. The scrubber effluent is recycled into cooking liquor loop.

The precipitator catch, mainly sodium sulphate particles, is returned to the recovery boiler furnace together with catch from the ash bunker. The scrubber effluent is recycled back to the cooking liquor cycle. The scrubbed and cleaned recovery boiler flue gas is discharged to atmosphere.

The recovery boiler is equipped with natural gas burning facilities. The natural gas burners will be used only for boiler warming-up at start-ups, and in case of abnormal operations.

The recovery boiler will have to be equipped with soot blower system using steam, in order to blow-clean the accumulation of salt cake fine particles on the boiler tubes

(3) Power boiler

The residue from wood de-barking and wood chip screening processes are, combined with other organic debris from the pulping process, pulp screen rejects and sludge from the effluent treatment, burned in the power boiler to generate steam.

The flue gas from the power boiler is cleaned of its solid particles through an electro-static precipitator before discharged to atmosphere. The ash from the power boiler is carried away for landfill.

The power boiler is equipped with natural gas burning facilities. The natural gas burners will be used mainly for mill start-up time to produce sufficient steam to generate power by the turbo-generator system. Also natural gas can be used in case when shortages of steam occur in the pulping process.

(4) Steam

Figure 6.3.1 attached shows the schematic flow of steam in the pulp mill. In this study, high-pressure steam specification is selected as 11 MPa pressure and 515°C temperature. These figures are rather high in comparison to conventional Kraft pulp mill. The reason of selecting higher pressure –temperature for the steam is to generate as much power as possible and;

To run power intensive ozone generator and generate ozone as one of the bleaching chemicals.

To assure energy self-sufficiency of the pulp mill particularly after the nuclear power plant de-commission, when the increase of utility power cost is expected.

- Boiler technology is available.

(5) Turbo-generator

High-pressure steam generated in the chemical recovery boiler and power boiler is expanded in a steam turbine. The steam turbine generates electric power through a close-coupled power generator. The steam turbine discharges steam in two different pressures, one medium-pressure (1200 kPa), and another low-pressure (300 kPa) steam.

The medium- and low-pressure steam is, after temperature adjustment by de-super heaters, sent to pulping processes. The medium-pressure steam is used mostly in digester where a high cooking temperature of 170 °C is required and, in small quantity, in steam ejector services. The low-pressure steam is used for pulp dryer, black liquor evaporator, and other miscellaneous heat consumers.

The electric power generated in the generator is parallel connected with the utility power, as explained later, and serves as electric power source for the pulp mill.

(6) Utility power substation and power distribution

The appropriate voltage level of utility power connection for the relatively small amount of power is 10kV. The utility power transformer, switchgear and metering station will be installed at the mill fence (territory line). The utility and self-generated power will be paralleled and distributed throughout the mill. The voltage levels in the mill will be 13.8kV (at generator), 6kV, 500V, and 220V. Motors equal to, or larger than 150kW should be run by 6kV.

(7) Stand-by power generator

As explained in 6.5.3 (3) “Power balance in pulp mill” section below, a parallel run of self-generated and utility power is necessary at all time although the pulp mill will be basically power self-sufficient.

The reliability of utility power is high in Lithuania. In case of mill turbo-generator trip, the proposed capacity of power contract is sufficient to keep the essential and hazardous equipment running. To best judgment of the writer, stand-by power generator is not necessary.

(8) Emergency power generator

An emergency diesel power generator of a few hundred kVA should be installed in the mill to use in case of total power outage. The diesel fuel should be drawn from the diesel fuel storage tank for the on-site vehicles.

(9) Air compressor center

Compressed air used for various power sources (mainly in pulp dryer) and for automatic process controls is generated in the air compressor center by oil-free air compressors.
The air will be dried through a desiccant type air dryer to a dew point of minus 40 °C and distributed throughout the mill in two pipeline systems, one for pneumatic power, and another for process controls.

(10) Process Control System

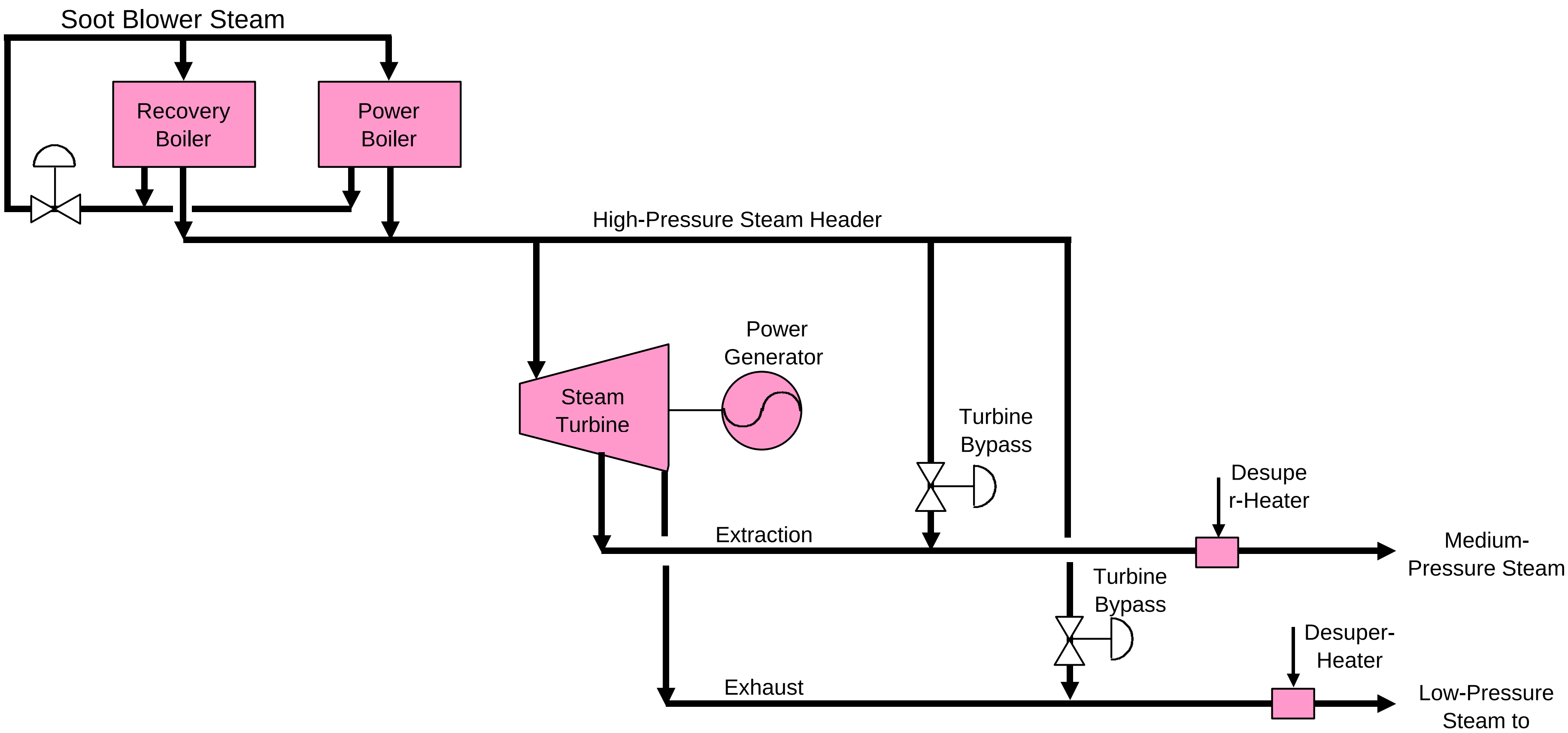
A DCS (distributed control system) network will control the mill processes. The DCS system will communicate with the mill-wide information system, and PLC (programmable logic controller) systems through communication links.
Two main control rooms, one in pulping area, and another in power area, will be provided with sufficient number of operator interface terminals. Other smaller control centers will be located in dryer wet part, chemical preparation area, and in wood handling area, and in effluent treatment area.
Entire DCS system will be tied to a common data highway so that any control station can monitor any part of the mill.
For security of the operation, appropriate redundancies, including UPS (un-interruptible power supply), should be built-in in the system.

(11) Mill-wide Information system

Mill-wide information system will obtain process raw data from DCS system and monitor, compute, and display mill management data. Also the systems function includes;
- Material in/out monitoring and documentations
- Wood, chemicals, fuel, power

- Purchase order and production schedule controls
- Maintenance scheduling and spare parts controls
- Warehouse control
- Woodyard control
- Intermediate storage control
- Bale handling and identifications.
- Effluent and emission monitoring

FIgure 6.3.1 Pulp Mill Steam Flow Schematic



6.3.5 Common Service Systems

(1) Process water

1) Mill water intake and treatment

Figure 6.3.2 is the outline diagram of water flow through the pulp mill.

Three mill water intake pumps are assumed. Each pump has capacity of half of the mill water requirement. In normal operation, two pumps are run with the third one being stand-by.

The river system in Lithuania appears to have rather high hardness (150 to 200 mg/L as CaCO3). The mill water should be softened to less than 100 mg/L (as CaCO3) hardness by one of the chemical softening processes such as cold lime softening process. In the cold lime softening process, the calcium causing hardness (mainly in form of water soluble calcium bicarbonate) is precipitated in form of calcium carbonate and calcium sulphate, using quick lime and sulphuric acid. The small amount of lime for this purpose can be diverted from the limekiln and sulphuric acid from the chlorine dioxide generation plant.

The suspended solids in water, both coming from the water source and from the softening process, are precipitated in the mill water clarifier and filtered-out through a system of sand-filters. To accelerate the precipitation, coagulation reagents, polymer, alum, caustic soda etc. will be used here as required.

Necessity of further treatment processes for metal ions or silica should be determined after the mill-site and water source selections are finalized and detailed analysis of the water becomes available.

Clarified and filtered water is stored in the mill water reservoir. Sand filter backwash water and the clarifier under-flow sludge are returned to the river.

The mill water reservoir is the source of mill process water, cooling water, and fire fighting water. The mill water and cooling water pump suctions will be installed higher than the fire fighting water pump suction so that a certain amount of water is always reserved for fire fighting.

The mill water pumps supply mill water, and the cooling water pumps supply cooling water.

2) Boiler feed water treatment

Mill water is used as source of boiler feed water.

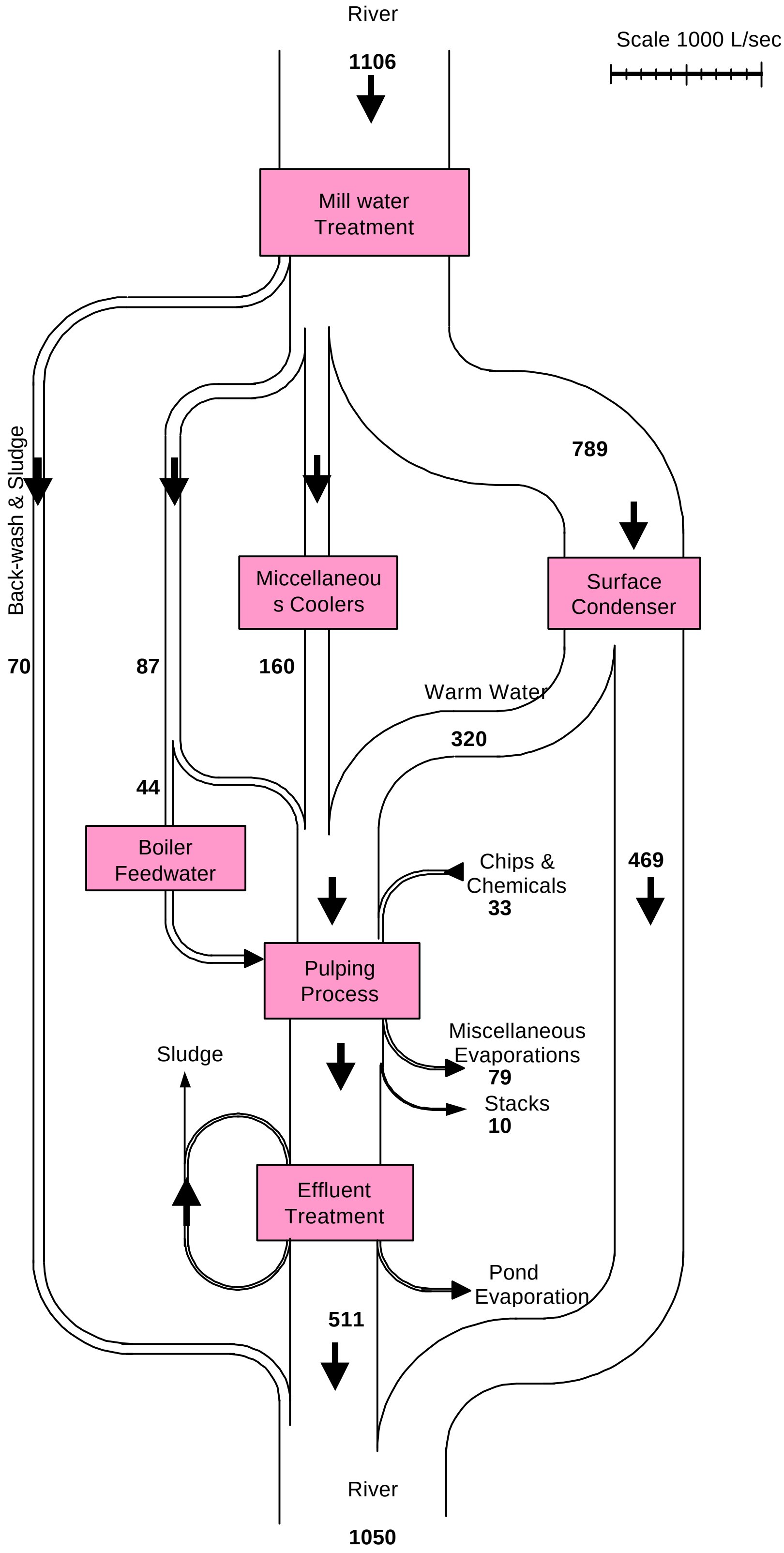
Boiler feed water should be treated by anion and cation exchange resin beds. The recovered condensate from the pulping process should also be polished by ion exchange beds. The ion exchange beds are regenerated using caustic soda and hydrochloric acid.

The boiler feed water is further treated by oxygen scavenger, and other treatment chemicals as required.

3) Potable water

Potable water will be taken from municipal water supply.

Figure 6.3.2   Pulp Mill Water Flow Diagram



(2) Effluent Treatment Facilities

1) Process description

The proposed effluent treatment plant is shown by a simplified flow sheet in Figure 6.4.2. The process is basically a biological treatment plant, based on low-loaded activated sludge, and with appropriate pre-treatment stages.

- Primary clarification, for the removal of fibres and other suspended solids, is carried out in a circular settling basin.
- Equalization pond, for equalizing variations in the effluent flow and composition.
- Spill pond, for the temporary collection of liquor spills and other highly contaminated effluents, and the subsequent bleeding into the treatment plant.
- Pretreatment by cooling in a cooling tower. This is required, as the effluent is expected to hold a temperature above 40 ^{o}C, which is not suitable for the biological process.
- Pretreatment by neutralization (pH control). The effluent is expected to be below the optimal pH range of 6.5 – 8, and pH control with lime is anticipated.
- Pretreatment by nutrient dosage. The content of phosphorus and nitrogen compounds in the effluent is expected to be not sufficient for the biological process. Chemicals like phosphoric acid (for P) and urea (for N) will have to be added.
- Biological (secondary) treatment in a low-loaded activated sludge plant. The main units of this plant are the Aeration Basin, incl. a selector basin (for improving sludge quality), and the Secondary Clarifiers for sludge removal. The removed biological sludge (biosludge) will be mainly recycled to the aeration, to keep a high sludge concentration in the plant.
- Sludge handling, i.e. dewatering of the mixed fibre (primary) sludge and excess biological (secondary) sludge, to reach a high solids content, suitable for a subsequent incineration.

The sludge dewatering will include a separate pre-thickener for excess biosludge, a sludge mix tank for the fibre/biosludge and dewatering equipment in the form of a belt filter press (optionally: a screw press). The press will be integrated with a pre-dewatering stage for the mixed sludge.

6.4 Outline of Mill Facilities and Equipment

In this section, major facilities and equipment of the proposed pulp mill are summarized in the order of: (1) major production facilities and equipment; (2) major utilities; (3) effluent treatment system; and (4) other auxiliary facilities and equipment. Then, all the facilities and equipment are shown in (5) general flow sheet.

Note that general profiles of mill facilities and equipment shown here are based on major features, capacities, unit consumption, efficiency and other parameters of production processes described in Chapter 6. Section 3. Proposed production capacities and operation plan are shown in Table 6.4.1

Table 6.4.1 Production Capacities and Operation Plan

	Unit	BSKP	BHKP	Total,(Av.)
Operation of the mill	d/a	188	152	340
Production rate		1.00	1.20	—
Daily average production	ADt/d	1350	1620	(1471)
Annual production	ADt/a	254257	245743	500000

(same to Table 6.2.1)

These data also form the basis of estimating the mill construction and pulp production costs.

Yet, the facility and equipment data shown here are preliminary in nature, as determined under various assumptions made by the study team and relevant local conditions obtained through the field surveys. For a formal mill construction project, if decided, feasibility study should therefore be carried out, followed by preliminary design to reflect detailed analysis of updated data and information. The data and information presented in this study can be used as a vital guide at the project implementation stage.

6.4.1 Major Production Facilities and Equipment

(1) Wood handling facilities

- To remove barks and contaminants from logs, which would affect pulp quality, in order to produce chips of uniform size for the subsequent pulping process.
- The mill is designed to process logs, both hardwood and softwood, their receiving, storage, debarking, chipping and handling systems.
- Anti-freeze measures are required for the winter.
- Barks and wood wastes generated from the process will be burned in the bark boiler.
- Wood supply conditions and consumption are summarized in Table 6.4.2.

Table 6.4.2 Wood Supply Conditions and Consumption

	Unit	BSKP	BHKP	Total,(Av.)
Wood species		Spruce, etc	Birch, etc	
Wood density	Kg/ m^3 sub	405	427	(415)
Unit wood consumption	m^3 sub /ADt	5.30	4.48	(4.90)
Wood supply ratio	%	55.0	45.0	100.0
Daily wood consumption	m^3 sub /d	7152	7266	(7203)
Annual wood consumption	m^3 sub /a	1346939	1102041	2448980

(same to Table 6.2.2)

1) Wood receiving

- * Truck scale (40 tons) : 2 sets
- * Grapple truck : 4 sets

2) Wood storage yard

- * Storage capacity : 30 days
- * Area (34000m^2 x 5) : 1700000 m^2

3) Debarking and chipping

In the Nordic Countries, logs are de-iced before debarking during the winter. The same practice will be followed in this project.

System configuration

- * Drum barker : 2 sets
- * Chipper (310 sub m^3/h/set) : 2 sets

* Chip storageyard
  Storage capacity : 5 days
  Area ($5000m^2$ x 4) : 20000 m^2
* Chip screen system : 1 set

(2) Pulping and Bleaching

1) Cooking facilities: one line

a. In the cooking process, wood chips received from the wood handling process are mixed with the cooking liquor and are sent to the digester for pulping.
b. Wood chips, after the preheating and deairing process, are impregnated and cooked.
c. The white liquor, used for cooking, is primarily composed of caustic soda (NaOH) and sodium sulphide (Na2S).
d. Selection of the continuous digester was discussed in 6.3.2 (2).
e. Specifications of the digester
   * Type: Continuous digester, 2 vessel liquid phase type,
   * Cooking system : ITC (Iso-thermal cooking)
   * Nominal design capacity : USKP 1625 ADt/d, UHKP 1950 ADt/d
   * Digester dimensions : 9.2mϕx60mH (Approx.2500m^3)

2) Washing system: one line

a. A mixture of pulp and the black liquor (the effluent from the cooking process, containing organic matters such as lignin as well as inorganic compounds) discharged from the digester is washed and separated. The washed pulp is sent to the UKP screening process, while the black liquor is sent to the evaporator through the weak black liquor tank).
b. System configuration
   * Pressure diffuser washer : 1 set
   * High density tower : 3000m^3 x 1 set

3) UKP screening system: one line

a. Knots and contaminants contained in the pulp after the washing process are separated and removed.
b. System configuration

* Knot separation system : 3 sets
  (Knotter, knot washer and sand separator)
* UKP screening system : 3 sets
  1 – 3 stage pressure screen
  Reject refiner
* UKP washer : 1 set

4) Oxygen delignification system: one line

   a. As discussed in 6.3.2 (3), oxygen delignification will be carried out in two stages. Two treatment methods are available, medium consistency system (10-15%) and high consistency system (25-30%). The former is employed for the project on account of lower capital cost and better reactivity.
   b. System configuration
      * Two-stage O2 reactor : 1 set
        5mφ x 31.9mH (507m^3) x 2
      * Two-stage washing : 1 set
        9.2mφ diffuser + wash press (1.5mφ x 6mL)

5) Bleaching system: one line

   a. As the unbleached pulp still contains lignin and other colored materials after the cooking and oxygen delignification processes, bleaching is required to obtain pulp of high brightness. The kraft pulp process usually uses a multistage bleaching system that adds various chemicals in several stages, because high quality pulp (in terms of brightness and/or strength) can be obtained at low cost.
   b. The bleaching sequence is the ECF process using ozone. The background for selection is discussed in 6.3.2 (4).
   c. Kappa numbers at the entrance to the bleaching process (or at the exit from the oxygen delignification process) are targeted at 12 for BSKP and 1 for BHKP.
      Note): The kappa number is one measure of the degree of cooking and a smaller number means a higher level of delignification.
   d. The target brightness is 89% ISO.
   e. The medium consistency system (around 10%) is used.
   f. System configuration

* Multistage bleaching system (mixer, bleaching tower, washer): 1set
* BKP high density tower
  For BSKP : 3000 m^3
  For BHKP : 3000 m^3

(3) Pulp drying

1) BKP screening system: one line

a. The system is designed to remove contaminants in the bleached pulp and consists of pressure screens, cleaners to remove heavy weight contaminants and light weight contaminants.

b. System configuration

* Pressure screen : 3 sets
* Heavy weight contaminant cleaner: 3 sets
* Light weight contaminant cleaner : 3 sets

2) Pulp Dryer: one line

* Speed : 250 m/min as design, 171 m/min operation
* Trim width : 9600 mm
* Basis weight range : 850 g/m^2 normal
* Sheet moisture
  At dryer entrance: 50%
  At dryer outlet : 10%
* Wire part : Fourdrinier type
* Press part : Three-press
* Dryer type : Steam heated air-borne dryer
  Including sheet cooler section.
* Cutter-Layboy
  Sheet size : 690 x 820 mm, 14 cut
* Auxiliary
  Dryer exhaust heat recovery system.
  Vacuum system.

3) Hydraulic bale press

* Quantity : Two
* Capacity : 1700 ton

4) Finishing line

* Quantity : Two lines
* Function : Bale wrapping
  Bale tying
  Bale printing
  8-unit unitizing

(4) Chemical Preparation System

1) Causticizing facilities: one line

a. When the black liquor is burned in the recovery boiler, lignin and other organic components contained in the liquor contribute to steam generation, whereas inorganic components generate smelt (mainly composed of caustic soda and sodium sulphide).

b. In the causticizing process, the smelt is dissolved in the weak liquor (supernatant liquor obtained from cleaning of dregs) to form the green liquor, form which dregs are separated and removed. Then, sodium carbonate (Na2CO3) contained in the remaining green liquor reacts with lime milk (Ca(OH)2) generated from calcined lime (CaO) to produce caustic soda(NaOH). As a result, the white liquor primarily composed of caustic soda and sodium sulphide(Na2S) is obtained and used as a cooking chemical.

c. Separation of dregs from the green liquor and removal of lime mud from the white liquor are performed by clarifiers. For treatment of the white liquor, a disc type clarifier is used to prevent loss of the chemicals.
The green liquor dregs are handled as a solids waste, and send to landfil.
The lime mud is burned in the lime kiln(see below).

d. System configuration

* Green liquor clarifier : 1 set
* Dregs filter : 1 set
  Precoat type, 4.5mφ x 80mL (112m^2)
* White liquor clarifer
  Disc type, 6500m^3 (white liquor)
* Lime mud washer : 1 set
  32.2mφ x 10.0mH (4,140m^3)
* Sludge filter : 1 set

Precoat type, 4.5mφ x 8.0mL

2) Lime kiln facilities:one line

a. The lime kiln burnes the lime mud (mainly composed of CaCO3) separated from the white liquor clarifier.

b. Natural gas (no sulphur content) is used as the fuel for the lime kiln (at a rate of 70600m^3/day) in order to minimize the emission of SO2 gas. Also, an electrostatic precipitator is used to remove particulate contained in the flue gas from the kiln.

c. System configuration

   * Lime kiln : 1 set
     Long rotary kiln, 3.6mφ x 106mL, 510 CaOt/d
   * Natural gas firing equipment: 1 set
   * Lime mud feeding equipment: 1 set
   * Electrostatic precipitator : 1 set

3) Bleaching chemical preparation facilities

a. The bleaching chemicals are roughly divided into purchased chemicals and on-site generation chemicals, which type, application and average consumption (t/d) are listed in Table 6.4.3.

b. According to the table, sulfuric acid (H2SO4) accounts for major portions of the purchased chemicals. It is used in the bleaching process as well as for generation of ClO2.

c. Caustic soda (NaOH) is used in the bleaching process and for SO2 scrubbing of the emission from the recovery boiler. Consumption for the latter purpose (0.5t/d) is not included in the table.

d. Among on-site generation chemicals, about a half of oxygen consumption is primarily used for generation of ozone.

e. ClO2 is generated by the R8 method that does not generate chlorine as a by-product.

f. Chemicals used for ClO2 generation (R8 method) are sodium chlorate (NaClO3), sulfuric acid, methanol (CH3OH) and salt (NaCl).

g. General description of bleaching chemical preparation facilities and equipment

   * For each of the purchased chemicals, receiving and charging facilities are provided.

* For the on-site generation chemicals, the following equipment is provided:

① Oxygen and ozone: Chemical generation and charging

② ClO_2: Generation and charging system (R8 method)

③ Oxidized white liquor (OWL): Oxidization and charging system

Table 6.4.3 List of Bleaching Chemicals

	Chemical	Use of chemicals	Av.Consumption (t /d as 100%)
Purchased chemicals	NaOH	Bleaching	17.0
	H2O2	ditto	2.2
	H2SO4	ditto ,ClO2 generation	44.7
	DTPA	Bleaching	1.5
	MgSO4	ditto	3.0
	NaClO3	ClO2 generation	11.9
	NaCl	ditto	0.2
	CH3OH	ditto	1.1
On site generation chemicals	Oxygen	O2 delignification , Ozone generation	53.7
	Ozone	Bleaching	10.3
	ClO2	ditto	7.2
	OWL(Oxidized white liquor)	O2 delignification	25.7

6.4.2 Major Utilities

(1) Recovery and Power

1) Black liquor evaporator/concentrator

Quantity : One

Evaporator type : Sextuple effect, steam driven, falling-film type evaporator.

Concentrator type : Forced circulation crystallizer concentrator

Evaporative capacity : 15,400 t/d H_2O

Input black liquor : 15% solids, 60 °C

Output black liquor : 75% solids

Steam supply : 300 kPa(g), 150 °C

2) Recovery Boiler

Quantity : One

Type : Tomlinson type.

Capacity : 3,100 t/d solids

Steam condition		: 11 MPa(g), 515 °C
Auxiliary fuel		: Natural gas
Auxiliaries		: Feed water deaerator
		(3)-Motor driven feed water pumps
		Electro-static precipitator
		Flue gas SO_2 scrubber
		Economizer
		Flue gas-air heater
		Steam air heater
		Soot blower

3) Power boiler

Quantity	: One
Steam generating capacity	
Wood waste only	: 80 t/h
With auxiliary fuel	: 110 t/h
Steam condition	: 11 MPa(g), 515 °C
Auxiliaries	: Feed water deaerator
	(3)-Motor driven feed water pumps
	Electro-static precipitator
	Economizer
	Flue gas air heater
	Soot blower

4) Steam turbine

Quantity	: One
Type	: Extraction-back pressure turbine
Capacity	: 60 MW
Inlet steam	: 11 MPa(g), 515 °C
Extraction steam	: 1200 kPa(g)
Exhaust steam	: 300 kPa(g)

5) Power generator

Quantity	: One
Capacity	: 70 MVA
Coupling	: Direct coupled to steam turbine

Voltage : 13.8 kV
Cycle : 50 Hz

6) Emergency diesel power generator

Quantity : One
Capacity : 200 kVA

(2) Water intake and water treatment facilities

Water intake and water treatment facilities are designed based on the water consumption of proposed BKP mill as of 1.1 m^3/sec(=65m^3/ADt), shown in the “ Figure 6.3.2 Pulp Mill Water Diagram ” .

1) Raw water intake

a. Intake weir or bank: 1unit
b. Intake pump: Flow rate – 0.72m^3/sec x head 50m x motor capacity 475kW x 3 units (one standby unit)
c. Pipeline: Inner diameter 1000mm x 1500mL (flow rate – 2m/sec)

2) Water treatment plant

a. Grid chamber: 10m (W) x 80m(L) x 5.5m(D) x 2 units
b. Mixing tank: 6m(W) x 6m(L) x 4.5m(D) x 2 units
c. Coagulation tank: 22m(W) x 15m(L) x 4.0m(D) x 2 units
d. Settlement tank: 22m(W) x 56m(L) x 5.0m(D) x 2 units (2 sludge scrapers/unit)
e. Chemical charger: 1 set
f. Rapid sand filtration system: 8m(W) x 25m(L) x 5.0m(D) x 2 units

3) Mill water supply system

a. Water tank: 30m(W) x 60m(L) x 4.0m(D) x 1 unit
b. Pump: Flow rate – 0.72m^3/sec x head 35m x motor capacity 320kW x 3 units (one standby unit)
c. Piping: One set

Simplified data of raw water condition and consumption in this country are shown in Annex6.2, Table 1"Water Quality of Selected Rivers in Lithuania" and Table 2 "Water Consumption in Lithuania "

6.4.3 Effluent Treatment Plant design

A summary of basic design data is given below.

(1) Design data

1) Effluent flow	a1. calculated	44000 m^3/d
	a2. calculated	1850 m^3/h
	b1. design	50000 m^3/d
	b2. design	2100 m^3/h
2) COD	a. calculated	49 t/d
	a. design	54 t/d
3) BOD	a. calculated	17.5 t/d
	b. design	20 t/d

(2) Primary clarifier: One

1) Surface load, design	0.8 m^3/m^2, h
2) Area	2600 m^2
3) Clarifier, diam.	58 m

(3) Neutralization basin: One

1) Retention time, design	10 min
2) Volume	350 m^3

(4) Equalization basin: One

1) Earthen pond, sloping walls	
2) Retention time, design	12 h
3) Volume	25000 m^3
4) Dim. D * W * L	4 * 66 * 110 m e.g.

(5) Spill pond: One

1) 12 h Earthen pond, sloping walls

2) Volume 25 000 m^3
3) Dim. D * W * L 4 * 66 * 110 m e.g.

(6) Activated sludge plant: One

1) Aeration basin
   a. Concrete basin
   b. Volume, total 42000 m^3
   c. Retention time 20 h
   d. COD load 1.3 kg/m^3, d
   e. BOD load 0.48 kg/m^3, d
   f. Dim. D * W * L 8 * 60 * 90 m e.g.
2) Selector basin
   Part of the Aeration basin
   a. Volume 3500 m^3
   b. Retention time design 1.7 h
3) Aeration
   a. Oxygenation capacity approx 1700 kg O2/h
   (at standard conditions)

(7) Secondary clarifiers: Two

   a. Surface load, design 0.6 m^3/m^2, h
   b. Area Total 3500 m^2
   c. Clarifiers, diam 48 m

(8) Sludge dewatering: One

1) Design data
   a. Sludge amounts, calc.
   * Fibre 9.5 t DS/d
   * Biological 6.5 t DS/d
   * Total 16 t DS/d
   * Sludge amounts, design
   * Fibre 16 t DS/d
   * Biological 8 t DS/d
   * Total 24 t DS/d
2) Sludge thickener
   a. for Biological sludge, diam. 20 m

b. concrete basin one (1) unit

3) Sludge tank

a. for mixed sludge, volume 300 m^3

b. concrete basin one (1) unit

4) Sludge dewatering

a. capacity 1200 kg DS/h

b. belt press or screw press with pre-dewatering unit :one (1)unit

6.4.4 Auxiliary Facilities and Equipment

(1) Auxiliary facilities

1) Administration building: 2000m^2, one storey, with a standard set of equipment and fixture
2) Laboratory: 300m^2, two storeys, with a standard set of equipment and fixture
3) Maintenance workshop; 1200m^2, one storey, with a standard set of equipment and fixture
4) Warehouse: 1200m^2, one storey, with a standard set of equipment and fixture
5) Canteen: 2400m^2, one storey, with a standard set of equipment and fixture
6) Training facility: 1250m^2, one storey, with a standard set of equipment and fixture
7) Clinic: 750m^2, one storey, with a standard set of equipment and fixture
8) Others:

(2) Auxiliary equipment

1) General: As required
2) Fire prevention/fighting: As required
3) Roads: Access road (1000m) and site roads
4) Rail track: Industrial track (2000m) connected to the primary line, and yard tracks
5) Fences and outlying structures: 5000m plus gates and other structures as required
6) Piping support: As required
7) Underground piping:

a. Water intake pipeline between the intake reservoir and the water treatment plant at the mill (1500m)
b. Effluent discharge line between the effluent treatment plant and the discharge point (2500m)
c. Piping within the mill site: As required

8) Exterior lighting: As required
9) Telephone and telecommunication systems: As required
10) Lightning conductor and grounding system: As required
11) Power transmission and receiving systems: a branch line from the power company's 110kV line, transformation to 13.8kV, a substation within the mill site, and switch gears and other receiving equipment: Cost sharing will be negotiated separately
12) Natural gas receiving system: 25 million m^3 per year from the gas company: As required (Cost sharing will be negotiated separately)

6.4.5 Process Flow Diagrams

(1) General flow

Figure 6.4.1 shows a block diagram showing the general configuration and process flow at the BKP mill, including major production processes, power and utilities systems, water intake and treatment plant and effluent treatment plant.

(2) Process flow sheet

The major equipment of the BKP mill and principal interconnections of them are shown in " Figure 6.4.2 General Flow Sheet " .

As there are generally several options for the process flow and equipment, the flow sheet shown here is considered to be an example.

Because technological innovation and development is underway in all areas of the process flow, the flow sheet will be subject to various changes in details at the stage of project implementation. Nevertheless, the general process flow for the proposed BKP mill as a whole will likely be maintained.

(3) Evaporator flow diagram

Figure 6.4.3 shows the general process flow of the black liquor concentration system, which works under a relatively simple operating principle but is fairly large in scale. The process flow is shown here for two purposes: (a) to present the process flow of this section, which is only roughly shown in the general flow sheet; and (b) to shed a spot light on a major water consuming area where the bulk of cooling water is used to condense steam evaporated in the final stage.

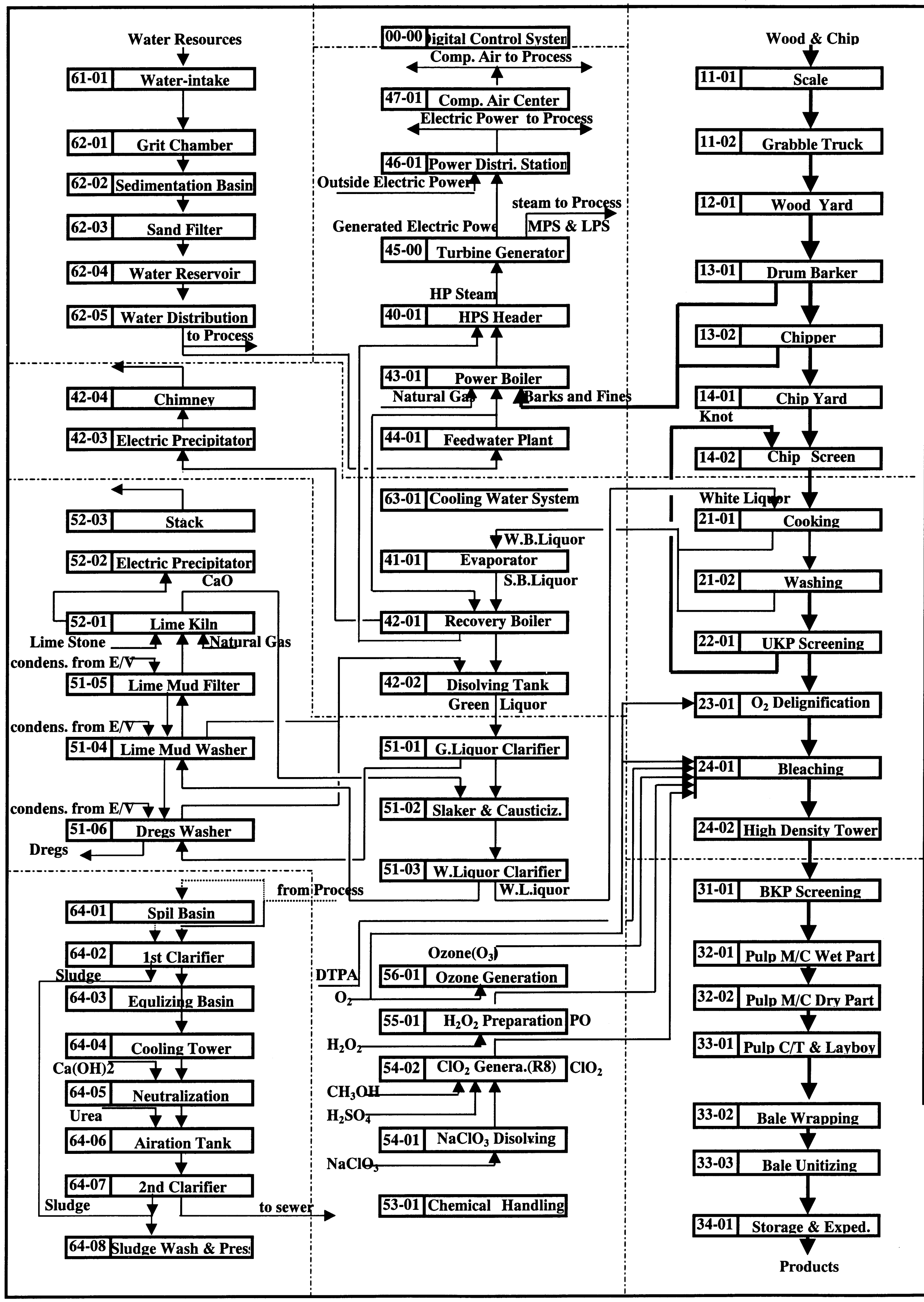
(4) Water balance within the pulp mill

Figure 6.4.4 shows the water balance within the entire pulp mill. This represents a detailed view of "the pulping process" that is shown as part of the mill water flow diagram in Figure 6.3.2, which explains importance of water at the BKP mill and water balance.

Note that the amount of process effluent discharge is estimated at 27 – 30m^3/ADt. These figures are feasible and have to be targeted at a stage of the engineering of proposed BKP mill.

As the increase in process water consumption leads to the increases in production and effluent treatment costs, and may give increased pollution loads, proper control measures should be considered in the process and equipment selection process, followed by their design.

Generally, the increased recycling of effluent from the pulp bleaching－leading to a closed cycle process – would result in the accumulation of foreign matters within the closed system and require additional costs to control or clean them. Thus, the development of the closed cycle should be progressed by addressing these problems step by step.



Pulp Mill (BSKP 1350ADt/d～HBKP 1620ADt/average 1471ADt/d)

Process & Chemical

Eq. No.	eff.	BSKP	BHKP	unit	qty.	Capa.	unit
00-00							
00-00							
00-00							
11-00		8269	8400	m^3 sob/d			
11-01					2	30～40	t
11-02					4	300	m3/h/set
12-01		30	30	days	5	20000	m2
13-01	70	10218	10379	m^3sub/d	2	319	m3/h
13-02	70	10218	10379	m^3sub/d	2	319	m3/h
14-01		5	5	days	4	10000	m2
14-02	70	9707	9860	m^3sub/d	1	404	m3/h
21-01	90	1625	1950	ADt/d	1	2500	m3
21-02	90	1618	1942	ADt/d	1	2015	ADt/d
					1	3000	m3
	90	1600	2103	ADt/d	3	600	ADt/d
22-01					3	750	ADt/d
					1		
23-01	90	1568	1881	ADt/d	2	950	ADt/d
					1		
24-01	90	1514	1819	ADt/d	1	950	ADt/d
24-02	80	1696	2034	ADt/d	1	3000	ADt
31-01	90	1507	1808	ADt/d	3	750	ADt/d
					1		ADt/d
32-01	80	1688	2025	ADt/d	1	10000	mm
					1	10300	mm
					1	2000	ADt/d
32-02	80	1688	2025	ADt/d	1	2000	ADt/d
33-01	80	1688	2025	ADt/d	1		
33-02	80	1688	2025	ADt/d	2	240	Bales/h
33-03	80	1688	2025	ADt/d	2	40	Unit/h
34-01	100	1350	1620	ADt/d	1	10000	m2

Recovery, Power & Utilities

Eq. No.	eff.	BSKP	BHKP	unit	qty.	Capa.	unit
40-01							
41-01	80	14978	14655	H2O t/d	1	15000	H2O t/d
42-01	80	2808	2748	DSt/d	1	3100	DSt/d
						445	steam t/h
42-02							
42-03							
42-04							
43-01	50	800	800	bark t/d	1	110	t/h
44-01	80				1	130	H2O t/h
45-00	90	50.3	60.4	MW			
45-01	Turbine(extrac. & back press.)				1	60.0	MW
45-02	Generator(13.8kV,50Hz)				1	70.0	MVA
46-01		6kV,500Vand 220V			1	80.0	MVA
46-01		Outside electric power(110k			1	5.0	MVA
47-01	50				4		
50-00							
51-01	80	Surface load: 0.5m/h			1	7826	GL m3/d
51-02	80		6652	CGLm3/d	3	176	m3
51-03	80	6267	6495	WL m3/d	1	6495	WL m3/d
51-04	80	874	906	CaCO3 t/d		906	CaCO3 t/d
51-05	80	874	906	CaCO3 t/d		906	CaCO3 t/d
51-06	80	10	10	Dregs t/d	1	10	Dregs t/d
52-01	80	874	906	CaCO3 t/d	1	906	CaCO3 t/d
	80	490	507	CaO t/d	1	507	CaO t/d
52-02							
52-03							
53-01							
54-01	80						
54-02	80	6.4	12.3		1	12	ClO2
55-01	80	5.1	6.1		1	6	H2O2 t/d
56-01	80	11.8	14.2		1	14	O3 t/d
61-01	80	0.72m3/sec×50mh×475kW			3	43	m3/min
62-01		Rt:2h			1	4000	m3
62-02		Rt:4h			1		
62-03		Surface load: 70md			1	704	m2
62-04		Rt:4h			1	3600	m3
62-05	80	0.72m3/sec×50mh×475kW			3	43	m3/min
63-01							
64-01		Rt:12h			1	25000	m3
64-02		Surface load: 0.8m/h			1	2600	m2
64-03		Rt:12h			1	25000	m3
64-04		max. Temp. :30℃			1		
64-05		Rt:10min			1	350	m2
64-06		Rt:20h			1	45500	m3
64-07		Surface load: 0.6m/h			2	1800	m2
64-08		Thickener,tank and press			1	1200	kg DS/h

Figure 6.4.1 Flow Sheet

Lithuania Pulp Mill

(BKP 500000 ADt/a)

Scale: non　　Date: 2000-08-15

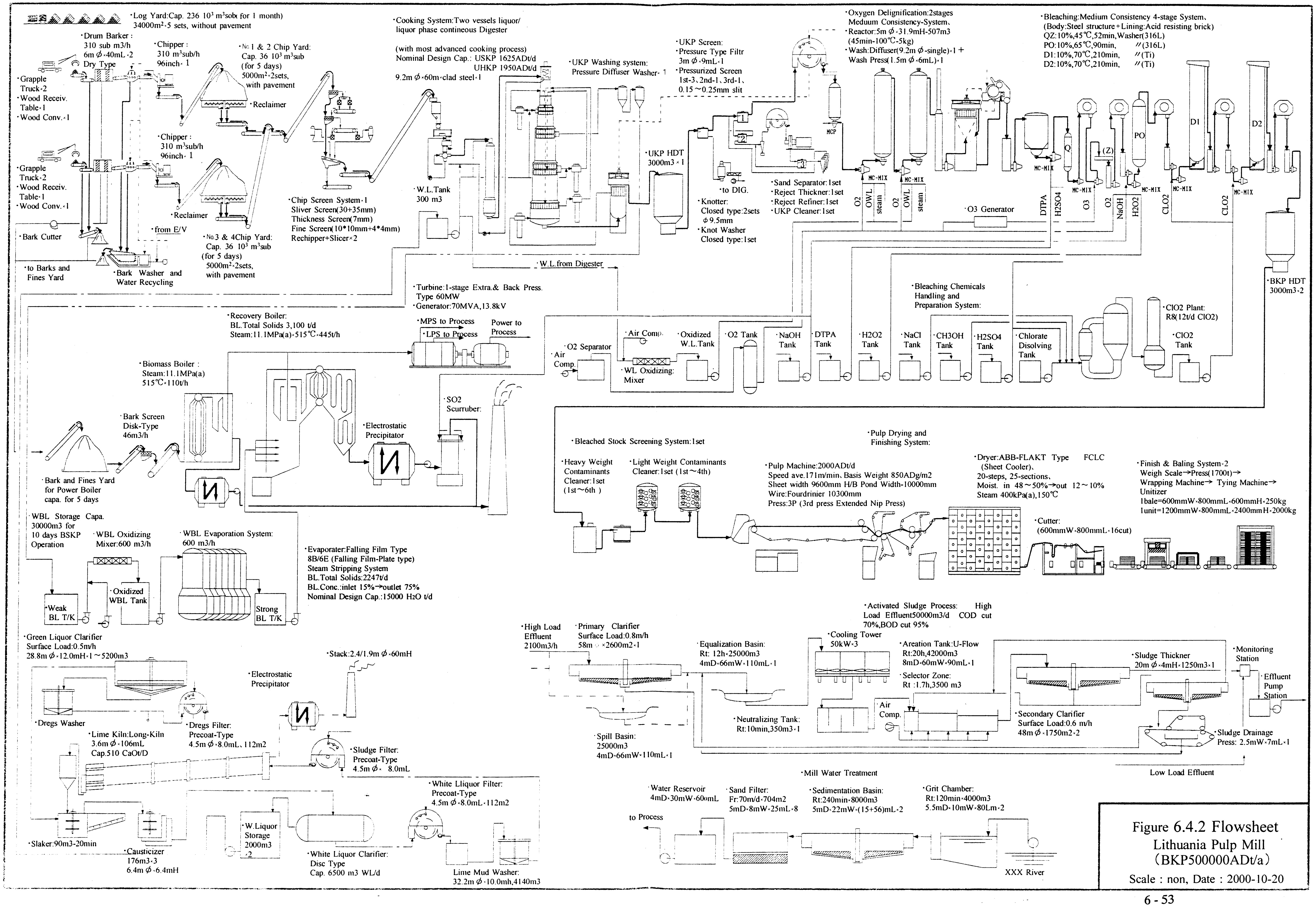
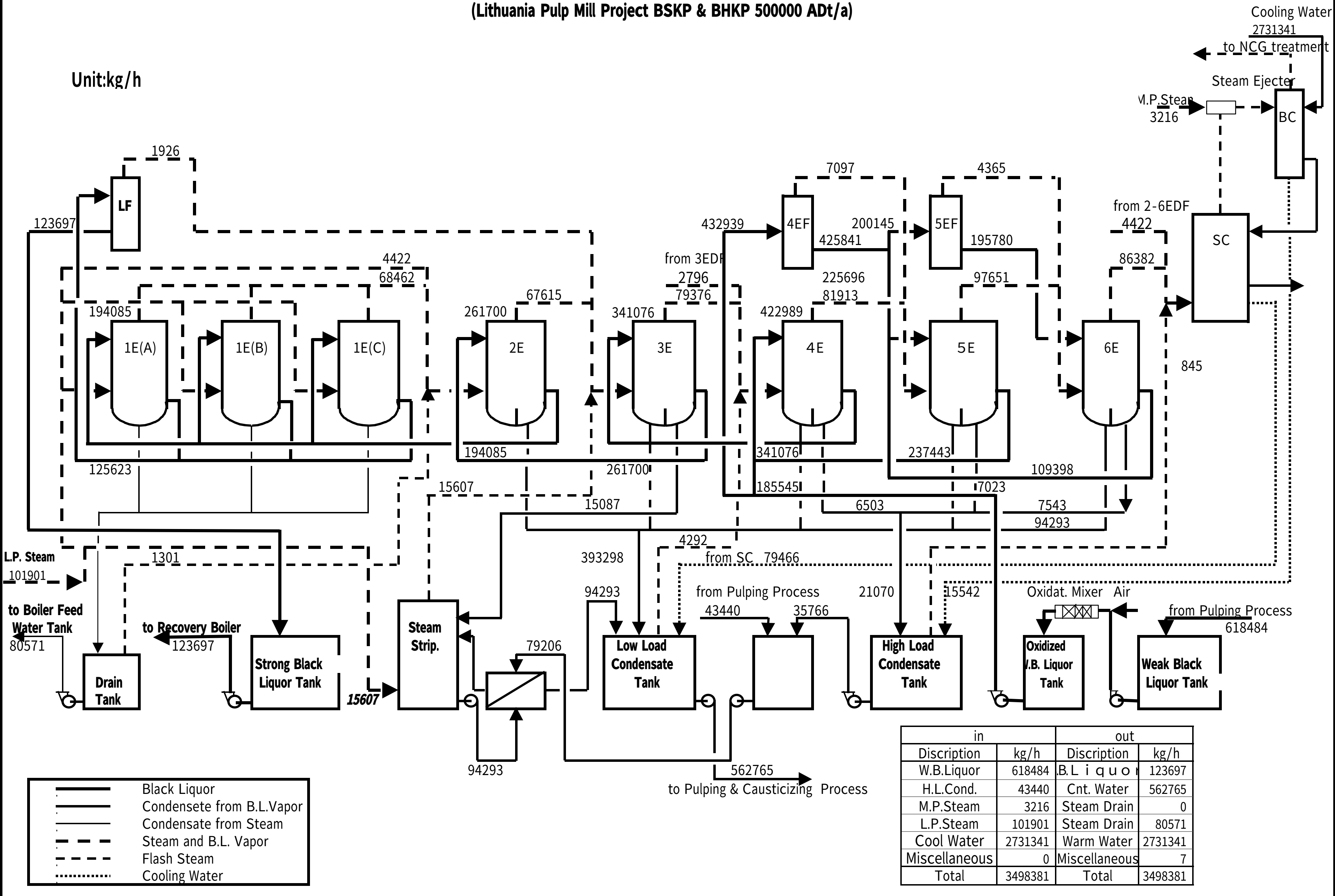


Figure 6.4.2 Flowsheet
Lithuania Pulp Mill
(BKP500000ADt/a)
Scale : non, Date : 2000-10-20

Figure 6.4.3 Evaoporator flow diagram

(Lithuania Pulp Mill Project BSKP & BHKP 500000 ADt/a)

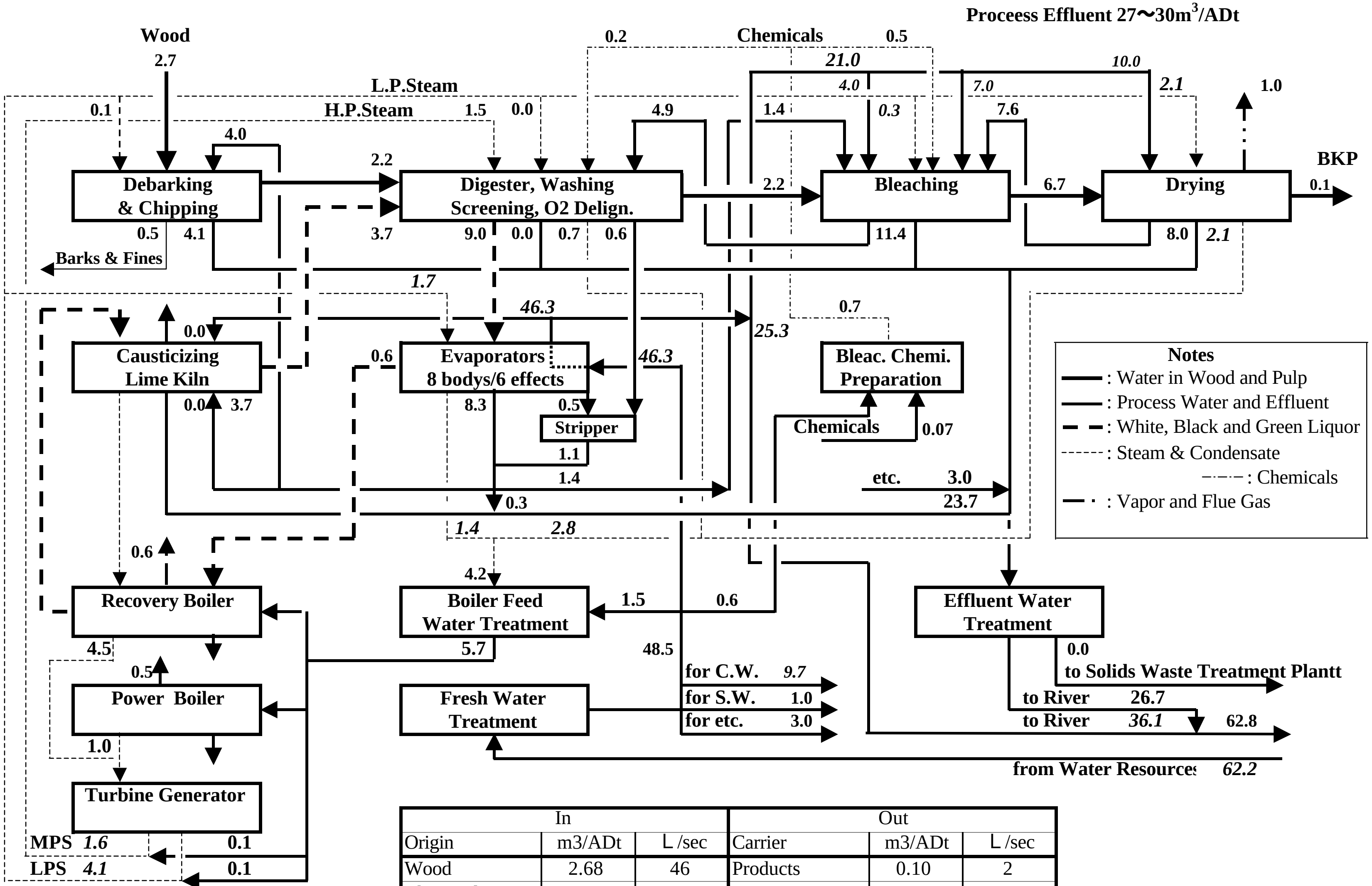


in		out	
Discription	kg/h	Discription	kg/h
W.B.Liquor	618484	B.L i q u o r	123697
H.L.Cond.	43440	Cnt. Water	562765
M.P.Steam	3216	Steam Drain	0
L.P.Steam	101901	Steam Drain	80571
Cool Water	2731341	Warm Water	2731341
Miscellaneous	0	Miscellaneous	7
Total	3498381	Total	3498381

Figure 6.4.4 Water balance within the pulp mill

Unit：[m3/ADt]

(with ECF : ZQ-PO-D-D Sequence)



In			Out		
Origin	m3/ADt	L/sec	Carrier	m3/ADt	L/sec
Wood	2.68	46	Products	0.10	2
Chemical	0.07	1	Evaporation	1.00	17
Mill Water	62.21	1059	Flue Gas	1.08	18
		0	Effluewnt(clean)	36.07	614
		0	Effluewnt(cont.)	26.70	455
Total	64.95	1106	Total	64.95	1106

m3/ADt vs L/sec conversion coefficient=1471/24/3600*1000= 17.03

6.5 Unit Consumption

6.5.1 Unit Consumption of Materials and Sub-Materials

(1) Pulpwood logs

Table 6.5.1 shows unit consumption and cost of pulpwood logs.

Table 6.5.1 Unit Consumption and Cost of Pulpwood Logs

	Unit price (USD/sub m^3)	Unit consumption (sub m^3/ADt)	Unit cost (USD/ADt)
BSKP	26.63	5.30	141.07
BHKP	20.36	4.48	91.32

The unit consumption value of 5.30 for BSKP is based on the 55:45 consumption ratio of spruce and pine, and 4.48 for BHKP is obtained from the ratio of Alder 36%, Aspen 18% and Birch 46%.

The unit cost of BSKP, estimated from the unit price of pulpwood logs and the above unit consumption data, is USD141.07/ADt, and that of BHKP USD91.32/ADt. Thus, the log cost for BSKP is approximately 50% higher than that for BHKP.

(2) Chemicals

Table 6.5.2 shows unit consumption and cost of chemicals. From this table, the following findings are made.

a. The cost for bleaching chemicals including oxygen delignification is USD20.22/ADt for BSKP and USD15.48/ADt for BHKP. Thus, the former is 30% higher than the latter.
b. The total cost for chemicals, including calcined lime for the lime kiln, caustic soda for the SO2 scrubber, and chemicals for effluent treatment, USD21.96/ADt for BSKP and USD17.22/ADt for BHKP.
c. Sodium sulphide (Na2SO3) generated as a result of SO2 recovery from the scrubber is used as a supplemental chemical for sodium and sulphur.

Table 6.5.2　Unit Consumption and Cost of Chemicals

	Unit price (USD/t)	BSKP		BHKP	
		Unit consumption (kg/ADt)	Unit cost (USD/ADt)	Unit consumption (kg/ADt)	Unit cost (kg/ADt)
(Blea.Chem.)					
NaOH	280	15	4.20	8	2.24
Oxygen	80	20	1.60	18	1.44
H2O2	1000	3	3.00	0	0
H2SO4	90	25	2.25	25	2.25
DTPA	1580	1	1.58	1	1.58
Ozone	200	7	1.40	7	1.40
OWL	40	15	0.60	20	0.80
MgSO4	500	4	2.00	0	0
Sub total			16.63		9.71
(Act.Cl)					
NaClO3	475	6.3	2.99	10.1	4.80
NaCl	95	0.1	0.01	0.2	0.02
H2SO4	90	4.2	0.38	6.7	0.60
CH3OH	350	0.6	0.21	1.0	0.35
Sub total			3.59		5.77
Total			20.22		15.48
(Lime kiln)					
CaO	50	5.5	0.28	5.5	0.28
(SO2 scrubber)					
NaOH	280	0.34	0.10	0.34	0.10
Total(chemical)			20.60		15.86
Water Treatment			1.00		1.00
Effluent Treatment					
Urea	170	0.61	0.10	0.61	0.10
H3PO	320	0.08	0.03	0.08	0.03
CaO	50	2.38	0.12	2.38	0.12
Polyelectrolyte	3780	0.03	0.11	0.03	0.11
			0.36		0.36
Grand total			21.96		17.22

(3)　Fuel for the lime kiln

Natural gas (no sulfur content) is used as the fuel for the lime kiln. Table 6.5.3 shows unit consumption and cost of natural gas.

Table 6.5.3　Unit Consumption and Cost of the Fuel for the Lime Kiln

	Unit price (USD/m^3)	Unit consumption (m^3/ADt)	Unit cost (USD/ADt)
Natural gas	0.086	48	4.13

(4) Product packaging materials and other proportional costs

The costs for packaging materials, including steel wire and wire cloth for the pulp machine, are summarized in Table 6.5.4. The total cost is assumed to be USD2.50/ADt.

Table 6.5.4 Unit Consumption and Cost of Packaging Materials

	Unit price (USD/kg)	Unit consumption (kg/ADt)	Unit cost (USD/ADt)
Steel wire(2.18mm)	0.82	1.94	1.59
Wire cloth			0.90
Others			0.01
Total			2.50

6.5.2 Supply Methods and Conditions for Materials and Sub-materials

(1) Logs

1) Supply method

Pulpwood logs are cut into specific length in a logging area, with barks and are transported by trucks and rail freight cars to the mill site directly or via an intermediate wood yard. In the case of truck transport, logs are measured on a truck scale at the service gate of the mill. Logs carried by rail are transferred to road vehicles on the yard track. They are delivered to mill wood yards according to specifies and unloaded by grabble tracks for storage.

2) Supply conditions

The pulp production process produces BSKP using softwood (spruce and pine) and BHKP using hardwood (Birch, Alder and Aspen) in an alternate cycle. The log supply plan should therefore be established in line with the alternative production schedule, allowing direct delivery of logs to the conveyor system.

(2) Chemicals

1) Supply method

Most chemicals used by the pulp mill are transported by trucks or railways (plus maritime transport) from foreign countries and are delivered to receiving and storage facilities within the mill site.

2) Supply conditions

General conditions are as follows.

a. Solid matters, such as chlorate ($NaClO_3$), magnesium sulfate ($MgSO_4$) and chelate (DTPA) are packaged according to specifications and are loaded to containers (10 – 20 tons) for transportation and delivery.
b. Liquids such as sulfuric acid (H_2SO_4), caustic soda (NaOH), hydrogen peroxide (H_2O_2) and methanol (CH_3OH) are transported by trucks or rail.
c. Gases, if necessary, are delivered in special cylinders or tank cars.

6.5.3 Required Utilities and Unit Consumption

(1) Heat requirement of pulp mill

The departmental unit consumption of heat in the pulp mill is shown in Figure 6.5.1.

The proposed pulp mill is basically heat self-sufficient as will be explained in the next section. The only use of fossil fuel in the pulp mill will be at the lime kiln, which requires temperature of over 800 °C, and at recovery and power boilers as start-up and auxiliary fuel only.

(2) Cost of fuel

The choice of fossil fuel is natural gas from the cost, equipment, and environmental point of view. The natural gas will be taken from the adjacent pipeline. The gas distribution company (Lithuanian Gas) will install the necessary pipeline extension to the mill site, metering station, and, if necessary, pressure reducing station(s) at their cost. The cost of natural gas, at the time this report is written, is 343 Litas (USD85.8) /1000m^3. This price does not include 18% VAT. One m^3 of gas contains 8000kCal (33500MJ) of heat value in low-heat-value unit.

Assuming the number and duration of major and minor shut-downs of the pulp mill, the natural gas consumption and the cost to produce one AD ton of pulp, not including consumption in the lime kiln, is as follows;

Peak consumption; 35000 m^3/h
Annual consumption; 1245000 m^3/a

Cost of natural gas;	Softwood cooking	Hardwood cooking
	USD 0.23/ADt	USD 0.19/ADt

(3) Power requirement of pulp mill

The departmental unit consumption of electric power in the pulp mill is shown in Figure 6.5.2.

The proposed pulp mill is basically power self-sufficient as will be explained in the next section. However, the mill has to be connected to the utility power grid at all time because of the following reasons.

1) The pulp mill of the design as proposed here has no capability to adjust its power generating capacity. The electric power is a byproduct of steam, which is produced exactly as the pulping processes demand. Moment by moment balance of the generated and consumed power varies continuously. The utility connection will absorb this unbalance; one time the power may flow from the grid to the mill, another time it may flow from mill to grid.

2) To start-up the pulp mill from a total shutdown, the minimum electric power has to be taken from the grid until one of the boilers is put in operation and the self-generated electric power becomes available. This amount is estimated to be approximately 2.5MW and duration several hours.

3) In case of self-generating turbo-generator trip, the utility power will be used to run temporarily the essential, and hazardous drives, such as boiler fans and feed water pumps, until the turbo-generator operation is resumed, or a safe shut-down state is achieved

(4) Cost of electric power

The entire electric power demand of Lithuania is met by 80% of one of the two 1,300 kVA nuclear power stations at Ignalina. However, the nuclear power plant is scheduled to be de-commissioned in near future. The electric power cost and other situations such as power buy-back policy will certainly change after the nuclear plant shutdown. However, it is impossible to predict the changes and their magnitudes at present. The production cost calculation in this report is based on present power cost.

The power line voltages in Lithuania are 330kV, 110kV, 35kV, and 10kV, 6kV in which 35kV and 6kV lines are being phased out and no new installation is built.

There are three choices of electric power tariff. Assuming that the utility connection is10kV

1)	Fixed charge	: 0.178 Litas/kWh
2)	Variable charge	: Charge varies by the day of week and time of day
	<u>Mon – Fri</u>	
	08:00 – 11:00	: 0.253 Litas/kWh
	18:00 – 20:00	: 0.253 Litas/kWh
	23:00 – 07:00	: 0.123 Litas/kWh
	Rest of the day	: 0.157 Litas/kWh
	<u>Sat – Sun</u>	
	All day	: 0.123 Litas/kWh
3)	Demand charge	
	Monthly installed capacity charge	: 21100 Litas/MW
	Energy charge	: 0.123 Litas/kWh

The above figures do not include VAT
Due to the nature of the utility power consumption as explained above, that is, although, little power is drawn from the grid most of the time, a sizable capacity connection has to be maintained at all time, it is inconceivable to obtain a power contract with the utility company in any form other than "Demand charge".

As explained above, the power may flow from mill to grid or grid to mill in normal operation. In most developed countries, the power sent-back from the user to the utility company is paid by the utility company as one of the measures to promote co-generation and independent power producing businesses. However, in Lithuania, where there is over-capacity in generating power, the utility company will have little interest to buy-back power from the users. There is presently no power buy-back policy in Lithuania and it is

unlikely to have a contract with the utility company with this "power buy-back" term.
The buy-back power price is assumed zero in this report.

The estimate of power cost to produce one AD ton of pulp is as follows;

Contract capacity	: 5.0 MW
Estimated ours in a year to use full capacity	: 27 hours
Average power draw from utility	: 0.15 MW
(Using "Demand Charge" rate as above)	
Softwood pulp production	: USD0.78/ADt
Hardwood pulp production	: USD0.65/ADt

6.5.4 Energy Consumption and Balance

A Kraft pulp mill can generate its own energy needs, heat and electric power.

(1) Steam and power generation in pulp mill

One ton of wood will produce approximately 400kg (zero moisture) of bleached pulp. The remaining wood turns into de-barking waste, fine wood chips (rejects from chip screens), and black liquor (non-cellulose portion of wood dissolved in water together with in-organic chemicals used for cooking), and a small portion into the effluent stream. All of them except the effluent stream are usable and will be used as fuel in the pulp mill.

The function and operation of chemical recovery boiler, Power boiler, and steam turbine are explained in the section 6.3.4 "Description of Recovery and Power Processes". The generated medium- and low-pressure steam and electric power will all be used in the pulp mill.

(2) Heat balance of pulp mill

Table 6.5.5 and Figure 6.5.1 attached show heat balance in the pulp mill estimated to best of the knowledge of the writer for hardwood cooking and softwood cooking.

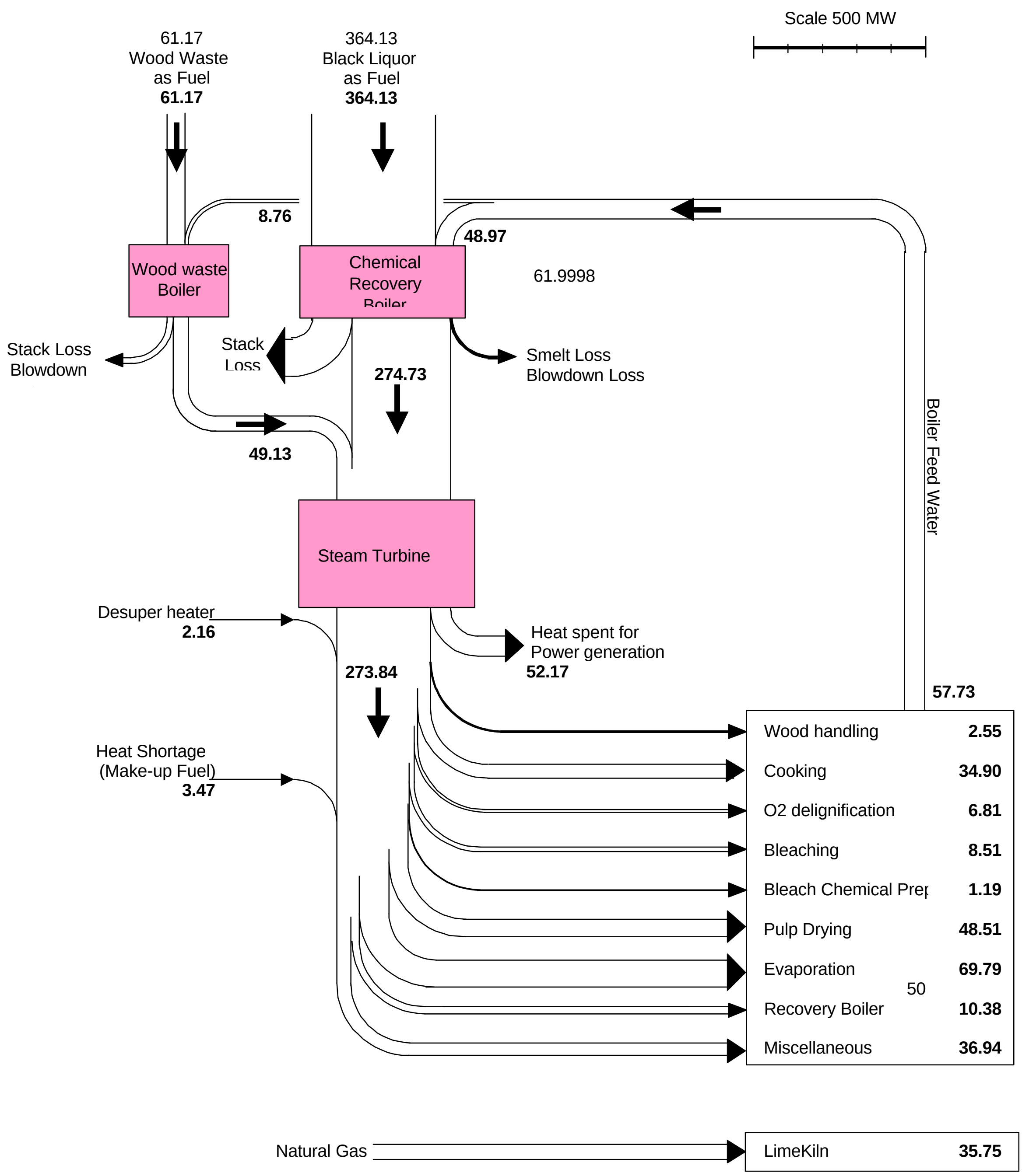
Table 6.5.5 Pulp Mill Heat(Steam) Balance

	Unit consump	Softwood	Hardwood	Average	Remarks
Area	MJ/ADt	MW	MW	MW	
Wood handling	150	2.34	2.81	2.55	
Cooking	2050	32.03	38.44	34.9	
Washing & Screening	0	0	0	0	
O2 delignification	400	6.25	7.5	6.81	
Bleaching	500	7.81	9.38	8.51	
Bleach Chemical Prep.	70	1.09	1.31	1.19	
Bleach Stock Screening	0	0	0	0	
Pulp Drying	2850	44.53	53.44	48.51	
Evaporation	4100	64.06	76.88	69.79	
Recovery Boiler	610	9.53	11.44	10.38	
Power Boiler	0	0	0	0	
Causticizing	0	0	0	0	
Lime Kiln	0	0	0	0	
Miscellaneous	2170	33.91	40.69	36.94	
Total Consumption	12900	201.55	241.89	219.58	
Self generated		246.99	226.71	237.92	
Overall Heat balance		45.44	-15.18	18.34	

Hardwood species produce more pulp from a given amount of wood than softwood species. This means that hardwood produces less black liquor, therefore less steam and less power, than softwood. Storing the black liquor in large storage tanks should equalize this unbalance. More black liquor is burned than produced by drawing down the stored black liquor when hardwood is being cooked, and less black liquor is burned than produced storing the excess liquor in the storage tanks when softwood is being cooked.

The pulp mill is basically heat self-sufficient. The excess heat as steam should be condensed in a blow-down condenser. The condensate from the condenser will be returned to the boiler and the hot water produced can be conveniently used in the pulping process as hot water.

Figure 6.5.1 Pulp Mill Heat (Steam) Flow Diagram



Enthalpy Base Zero degC Liquid Water

(3) Power balance of pulp mill

Table 6.5.6 and Figure 6.5.2 attached show the power balance in the pulp mill estimated to best of the knowledge of the writer for hardwood cooking and softwood cooking.

Table 6.5.6 Pulp Mill Power Balance

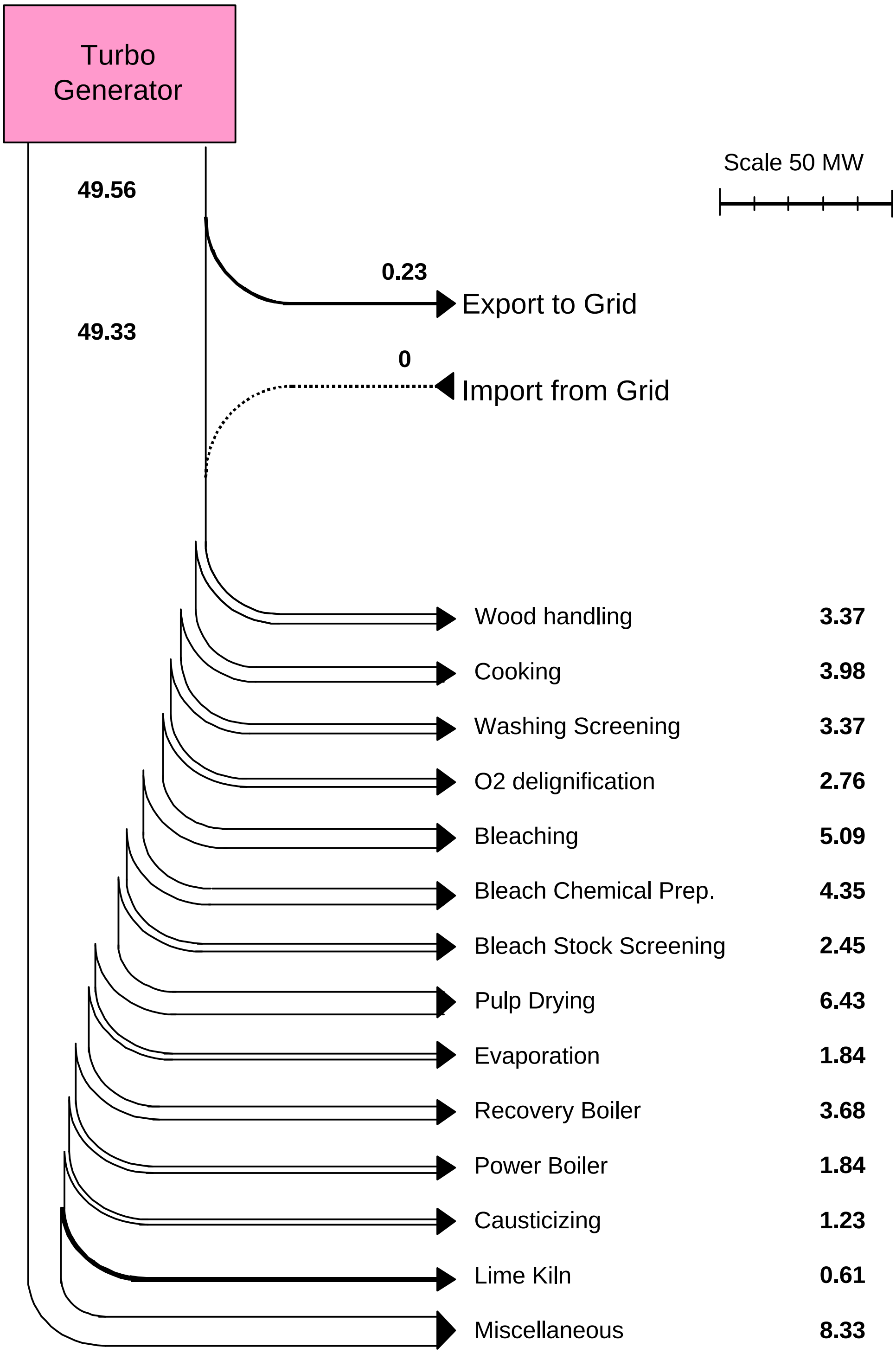
	Unit consump	Softwood	Hardwood	Average	Remarks
Area	kWH/ADt	MW	MW	MW	
Wood handling	55	3.09	3.71	3.37	
Cooking	65	3.66	4.39	3.98	
Washing Screening	55	3.09	3.71	3.37	
O2 delignification	45	2.53	3.04	2.76	
Bleaching	83	4.67	5.60	5.09	
Bleach Chemical Prep.	71	3.99	4.79	4.35	1*
Bleach stock Screening	40	2.25	2.70	2.45	
Pulp Drying	105	5.91	7.09	6.43	
Evaporation	30	1.69	2.03	1.84	
Recovery Boiler	60	3.38	4.05	3.68	
Power Boiler	30	1.69	2.03	1.84	
Causticizing	20	1.13	1.35	1.23	
Lime Kiln	10	0.56	0.68	0.61	
Miscellaneous	136	7.65	9.18	8.33	
Total Consumption	805	45.28	54.34	49.33	
Self generated		55.51	50.95	53.47	
Overall Powert balance		10.23	-3.39	4.14	

Note 1*：Ozone generator included

The difference of power balance between softwood and hardwood cooking should be equalized by the operation mentioned in “Heat balance of pulp mill” section.

The pulp mill is basically power self-sufficient. However, a connection to utility power grid has to be maintained at all time as explained in the section 6.5.3 “Required Utilities and Unit Consumption” c. “Power Requirement of Pulp Mill”

Figure 6.5.2 Power Flow Diagram



6.6 Mill Layout

As a final mill site has not been decided, a general layout was made for a hypothetical 150ha flat land of 1500m x 1000m.
Needless to say, it is imperative to examine the site before the final decision as to suitability for mill construction and operation, together with potential problems, by using detailed topographic and survey maps as well as soil data including bearing capacity.

(1) Important considerations to mill layout

1) Good access to outside roads and facilities

a. Road and rail connections to allow efficient transportation and delivery of raw materials and sub-materials
b. Efficient shipment and transportation of products
c. Efficient connections to the water intake and effluent discharge points

2) Efficient flow of goods between processes

In addition to transportation infrastructure, including roads and rail, efficient flow of goods between processes within the mill site is critical for the 500000 ADt/a BKP mill that handles and consumes large amount s of materials and produces nearly 2000 tons of products. The well-designed and operated material handling, storage and transportation system serves as the basis of smooth production and quality control, while helping to reduce operating costs by minimizing loss of materials and energy.

3) Minimization of environmental impacts to the surrounding habitants

The impacts of emission of smell, dust, vibration and noise are highly affected with the distance and/or dominant wind direction from the origins of emission to the resident area, therefore the potential origins, even if in the mill site, should be located to minimize the impacts considering those factors.

4) Future expandability (including possibility of the paper mill)

(2) Conceptual mill layout

See Figure 6.6.1 “Mill Layout.”

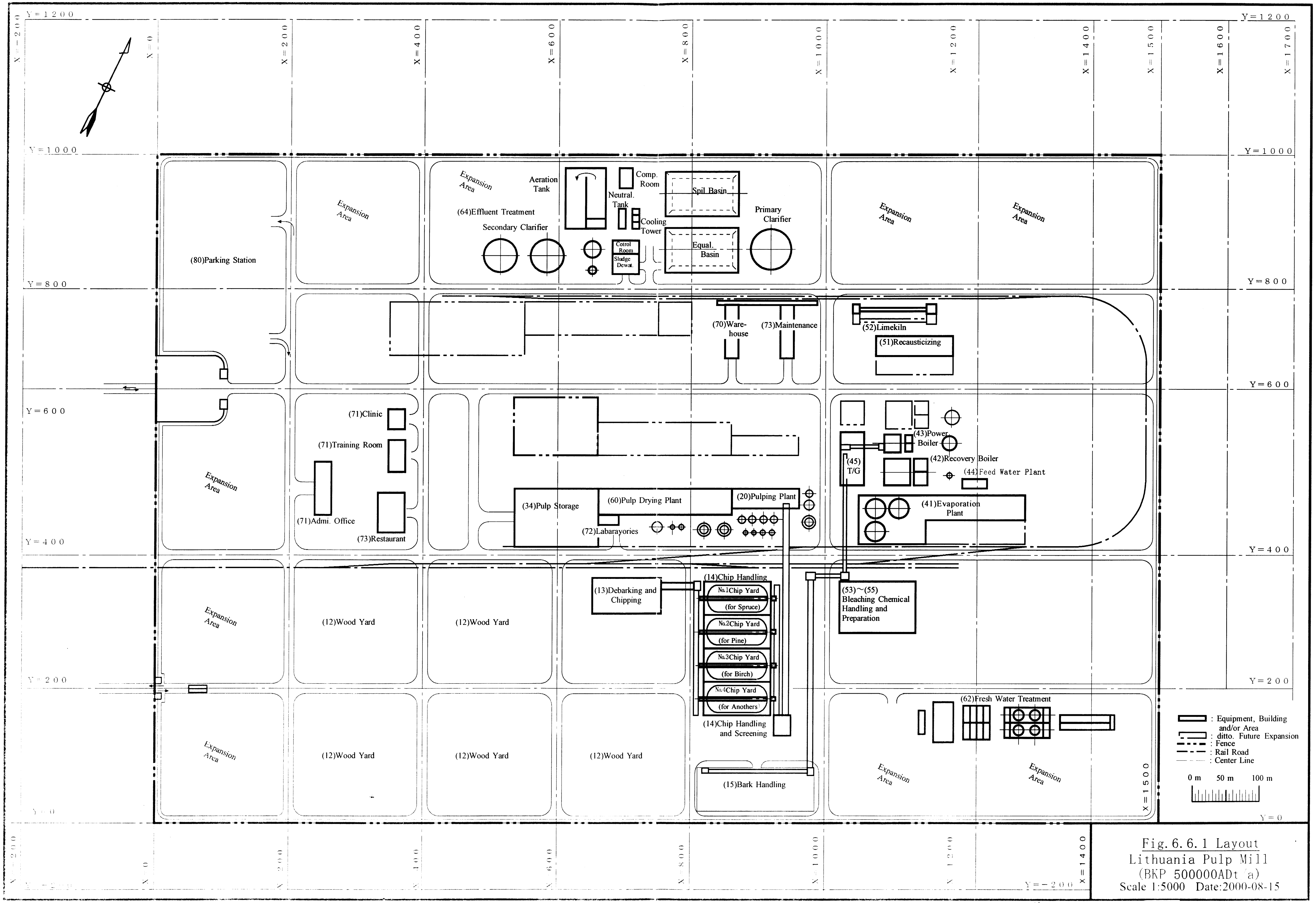


Fig. 6.6.1 Layout
Lithuania Pulp Mill
(BKP 500000ADt/a)
Scale 1:5000 Date:2000-08-15

Annex 6.1 Lithuania Pulp Mill

(Yield wood(sub) to pulp BSKP 42.0%, BHKP 47.0%)

1. Design Base

1) Product

(1) Product : Bleached sulphate pulp (BKP)
(2) Grade : Paper Grade
(3) Market : Export mainly to Europa
(4) Brightness : 89～90 % ISO
(5) Moisture : 10 %
(6) Type of Product : Sheet Pulp

2) Production Capacity

(1) The annual production capacity of Lithuania Pulp Mill was specified as BKP 500000 ADt/a considering both the wood supply capabilities of Lithuania and the cost competitiveness of products in the international BKP market.

(2) Production capacity rate of pulping process and equipment for BSKP and BHKP are assumed as 1.0 vs 1.2 as shown in Table 1 for the time being.

Table 1 Production Capacity and Operation Plan

	unit	BSKP	BHKP	Total or Av.
a.Operation plan	d/a	188	152	340
b.Production rate		1.00	1.20	
c.Daily average production	ADt/d	1350	1620	1471
d.Annual production	ADt/a	254257	245743	500000

3) Pulp Wood

(1) Domestic wood resources of Lithuania will be utilized as the raw material i.e. pulp wood for the mill. According to the results of our second field survey in Lithuania the composition of pulp wood supply were assumed as 55% for soft wood and as 45% for hard wood at m3 sub volume in average during the from 2007 to 2020.

(2) If we don't change the annual production capacity of the mill specified as BKP 500000 ADt/a, the fluctuation of composition of pulp wood supply in future will not invite significant influence in the mill operation technicalwise.

Process and Equipment of Pulp Mill will be designed to use both soft wood and hard wood as raw material as shown in Table 2.

Table 2 Wood Supply Condition

	unit	BSKP	BHKP	Total or Av.
a. Wood species		Spruce, etc.	Birch, etc.	
b. Wood density	kg/ m^3sub	405	427	415
c. Unit wood consumption	m^3sub/ADt	5.30	4.48	4.90
d. Wood supply ratio	%	55.0	45.0	100
e. Annual wood consum.	m^3sub/a	1346939	1102041	2448980

2. Design Premise

1) Production Efficiency of Process & Equipment

The production efficiency of process and equipment for each major area are specified separately and for Pulping Area from cooking to bleached pulp screening are assumed as 90 %.

i.e. Daily average production =Nominal dayly design production capacity×90/100

2) Cooking Chemicals－White Liquor

Table 3 Cooking Chemical (White Liquor)

		BSKP	BHKP	
Active alkali to BD chip	%	18.0	17.0	as Na2O based on BD chip fed to digester
Sulphidity	%	30	30	

3) Pulp Yield to Wood without bark (sub)

(1) The barking losses was specified as 13.5% to the volume of raw wood withbark(m3 sob) i.e. the barking yield is 86.5% to the volume of raw wood withbark(m3 sob)
(2) The chip handling losses were specified as 5% to raw wood without bark(m3 sub) i.e. the chip handling yield is 95% to raw wood without bark(m3 sub).
(chip handling =chipping, chip piling, reclaming, screening and conveying)
(3) The final pulping yield were specified to be for BSKP 42% and for 47% both to BD weight of wood without bark (sub)
(4) The losses of each process from washin to drying were specified as shown Table 4.
(5) The losses and yield of cooking process were estimated based on those prmises from (2) to (4) mentioned above at our convenience for design.

Table 4 Yield of pulping process 1/2

	BSKP						HBKP					
	Process		Accu.	Material flow			Process		Accu.	Material flow		
	losses	yield	yield	Unit	Daily balance				yield	Unit	Daily balance	
Process	%	%	%	kg/ADt	BDt/d		%	%	%	kg/ADt	BDt/d	
1 Raw Wood with bark		100	116	2477	3345			100	116	2214	3587	
2 Barking	13.5	86.5	100	2143	2893	452	13.5	86.5	100	1915	3102	484
3 Chip screen & handling	5.0	95.0	95.0	2036	2748	145	5.0	95.0	95.0	1819	2947	155
4 Cooking	52.1	47.9	45.5	975	1316	1432	46.4	53.6	50.9	975	1579	1368
5 Washing	0.5	99.5	45.3	970	1310	7	0.5	99.5	50.7	970	1571	8
6 UKP Screening	1.0	99.0	44.8	960	1296	13	1.0	99.0	50.1	960	1556	16
7 O２ Delignification	2.0	98.0	43.9	941	1271	26	2.0	98.0	49.1	941	1525	31
8 Bleaching	3.4	96.6	42.4	909	1227	43	3.4	96.6	47.5	909	1473	52
9 BKP Screening	0.5	99.5	42.2	905	1221	6	0.5	99.5	47.2	905	1465	7
10 Drying(=Final products)	0.5	99.5	42.0	900	1215	6	0.5	99.5	47.0	900	1458	7

Table 4 Yield of pulping process 2/2

	BSKP and BHKP					
	Process		Accu.	Material flow		
	losses	yield	yield	Unit	Daily balance	
Process	%	%	%	kg/ADt	BDt/d	
1 Raw Wood with bark		100	116	2348	3452	
2 Barker	13.5	86.5	100	2031	2986	466
3 Chip screen & handling	5.0	95.0	95.0	1929	2837	149
4 Cooking	49.5	50.5	48.0	975	1434	1403
5 Washing	0.5	99.5	47.8	970	1426	7
6 UKP Screening	1.0	99.0	47.3	960	1412	14
7 O２ Delignification	2.0	98.0	46.3	941	1384	28
8 Bleaching	3.4	96.6	44.8	909	1337	47
9 BKP Screening	0.5	99.5	44.5	905	1330	7
10 Drying(=Final products)	0.5	99.5	44.3	900	1324	7

4) Wood Density & Unit Wood Consumption

(1) We didn't performe any laboratory pulping test to confirm the pulpabilities of Lithuanian several wood species suppused to use as raw materials and to assure the propaty of products made of them, but applied data and informations offered by menbuer of our study team and counter partnerns of Lithuania as the premise of mill design.

(2) Therefore the potential invester of this project will need to performe some procedure to confirm those more directly at least, eventhough we aer expecting that there would not appear big discrepancies between the conclusions derived from results of new test and the conclusions in our report.

Table 5 Wood Density & Unit Wood Consumption

Wood		BSKP(55%)			BHKP(45%)			Average		
Species	Density kg/m^3 sub	ratio %	yield %	m^3-sub/t	ratio %	yield %	m^3-sub/t	ratio %	yield %	m^3-sub/t
1. Spruce,stemwood	400	55.0	42.0	5.36						
2. Spruce,branches	600	0.0	42.0	3.57						
3. Pine	410	45.0	42.0	5.23						
Soft Wood Ave.	405	100	42.0	5.30						
4. Alder	360				36.0	47.0	5.32			
5. Aspen	400				18.0	47.0	4.79			
6. Birch	490				46.0	47.0	3.91			
7 .Oak	600				0.0	47.0	3.19			
8. M Balsam Poplar	400				0.0	47.0	4.79			
Hard Wood Ave	427				100	47.0	4.48			
1. Spruce,stemwood	400							30.3	42.0	5.36
2. Spruce,branches	600							0.0	42.0	3.57
3. Pine	410							24.8	42.0	5.23
4. Alder	360							16.2	47.0	5.32
5. Aspen	400							8.1	47.0	4.79
6. Birch	490							20.7	47.0	3.91
7 .Oak	600							0.0	47.0	3.19
8. Mixed Species Balsa	400							0.0	47.0	4.79
SW & HW Total Ave.	415							100	44.3	4.90

5) Dry Solids of Black Liquor

(1) The figure of total organic DSt/d was calculated based on the losses pulping process including cooking, washing and O_2 Delignification

(2) The figure of total inorganic DSt/d was calculated based on the cooking chemical substances.

Table 6 Dry Solids of Black Liquor

	unit	BSKP	BHKP	SB & HB Ave.
a. Total Organic	DSt/d	1465	1407	1439
b. Total Inorganic	DSt/d	783	793	787
c. Total Solids	DSt/d	2248	2200	2226

Annex 6.2 Information of River Water in Lithuania

1. The water consumption of proposed BKP mill

As the BKP mill requires a large amount of fresh water, it is important to secure a reliable source of raw water and a recipient of effluent to be discharged.
In fact, they constitute the most fundamental requirements to be considered in the mill site selection.

The water unit consumption of proposed BKP mill is 65m^3/ADt, 27-30m^3/ADt of which is used as process water and residual 35-38m^3/ADt of which is used for another purposes such as cooling water, sealing water, boiler feed water and etc., in the mill.

The process water as of 27-30 m^3/ADt is sent to effuluent treatment plant before diccharge to the recipient, and the as of residual 35-38m^3/ADt is sent directly to the same.

The total anuual water consumption comes to 32 millions m^3/a (=1.1 m^3/sec x 3,600 x 24 x 340), and this figure is a fairly large amount but it is expected to be acceptable considering with the flow volume of rivers closeto any of the three candidate sites.

General water consumption data in the country are shown in “Table 1 Water Consumption in Lithuania ” .
At present, industrial water consumption in the country amounts to 58 millions m^3/a.

Table 1 Water Consumption in Lithuania by Type of Use (1998)

Unit: thousand m^3/year

	Industrial	Household	Power generation	Agriculture	Fish farming	Others	Total	Surface water	Ground water
Alytus	2740	4216	924	137	13801	187	22004	15762	6243
Kauno	18407	23216	1991394	779	20211	409	2054415	2028808	25608
Klaipedos	10393	19447	1767	0	2467	243	34317	11432	22885
Mrijampoles	1805	7174	51	45	4990	41	14106	5945	8161
Panvezio	5445	10232	753	278	3500	276	20483	6362	14122
Siauliu	1916	3273	626	368	6918	62	18163	7704	10459
Taurages	184	3145	67	73	0	46	3515	52	3463
Telsiu	5760	4064	2094	188	1100	0	13206	7165	6041
Utenos	2250	9198	2782482	66	10723	28	2804747	2793235	11513
Vilinius	9393	36173	4848	326	29338	7	80085	39546	40539
合 計	58293	120139	4785007	2259	93047	1297	5065042	4916009	149033

Sources 2. ：Natural resources and environmental protection A501/Lithuania Statistics Department 1998. Water use by Utenos (power company) is cooling water for its nuclear power plant.

2. The quality of river water

The quality of mill water is a very important issue for the proposed BKP mill.
The quality of river(s) water which are flowing closed to the candidate sites areshown in Table 2 “Water quality of Selected Rivers in Lithuania”. Generally, the water of those rivers are characterized by high levels of total hardness requiring a slihgt additional water treatment costs.

Table 2 Water Quality of Selected Rivers in Lithuania

Unit : mg/l

	Tappi Stand. for BKP Production	Neris							Nemunas			
		downstream of Vilnius			upstream of Yonava		downstream of Yonava		downstream of Alytus		upstream oｆ Rusnes	
		Left bank	Center	Right bank	Left bank	Right bank	Left bank	Right bank	Left bank	Right bank	Center	Right bank
Temperature												
Minmum °C		0.4	0.4	0.4	0.3	0.3	0.5	1.0	0.1	0.0	10	0.3
Maximum		22.6	22.3	22.6	25	25	25	25.0	25.6	25.4	22.1	22.1
Average		9.6	9.6	9.6	9.3	9.7	9.3	10.1	10.7	10.7	16.1	14.5
Turbidity(as SiO2)	25											
Transparency												
Minmum cm		6.0	6.0	6.0	4.0	5.0	5.0	1.0	11.0	12.0	10.0	11.0
Maximum		20.0	20.0	22.0	25.0	24.0	25.0	25.0	22.0	22.0	20.0	20.0
Average		13.0	13.0	14.0	13.0	14.0	15.0	10.1	17.0	17.0	16.0	17.0
Oduor		non	non	non	middle	middle	middle	middle	non	non	non	non
Color (platinum unit)	5°	yellow	yellow	yellow	yellow	yellow	yellow	yellow	yellow	yellow	yellow	yellow
pH	-											
Minmum		7.95	8.04	8.00	7.80	7.80	7.80	7.8	7.4	7	8.1	8.0
Maximum		8.86	8.86	8.76	8.80	8.60	8.50	8.4	9	9	9.0	9.0
Average		8.45	8.46	8.44	8.15	8.17	8.13	8.14	8.24	8.25	8.5	8.5
Hardness (as CaCO3)	100	180	175	180	225	210	205	230	200	205	210	215
Minmum mg ekv/l		2.6	2.2	2.3	3.8	3.9	3.8	4.4	3.8	4.0	3.8	4.3
Maximum		4.7	4.7	4.7	5.6	4.9	4.5	5.0	4.2	4.2	4.5	4.3
Average		3.6	3.5	3.6	4.5	4.2	4.1	4.6	4.0	4.1	4.2	4.3
Silica Solubility as SiO2	20											
Minmum mg/l		4.2	4.2	4.2	1.3	1.3	1.4	1.8	5	4.7	1.0	1.0
Maximum		5.6	5.5	5.5	4.0	4.0	4.0	4.0	5.2	5.1	4.0	4.0
Average		5.0	4.8	4.9	2.7	2.4	2.5	2.7	5.1	4.9	2.6	2.6
Ferric contents (as Fe)	0.1											
Minmum mg/l		0.20	0.10	0.10	0.16	0.15	0.01	0.15	0.29	0.23	0.01	0.10
Maximum		0.50	0.50	0.50	0.48	0.36	0.66	0.31	0.42	0.4	0.30	0.30
Average		0.36	0.30	0.32	0.30	0.27	0.34	0.26	0.36	0.33	0.13	0.20
Manganese(as Mn)	0.05											
Minmum mg/l		1.2	1.2	1.2	12.0	12.0	7.8	9.7	11.0	13.0	9.7	12.0
Maximum		30.0	22.0	22.0	22.0	24.0	15.0	21.0	15.0	16.0	17.0	17.0
Average		13.6	7.3	10.8	16.5	18.5	10.1	16.9	13.0	14.2	13.9	15.3