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

## SUMMARY

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# 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 ⓡiuksys, 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 | Conféderation 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

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## 1.1 General Profiles of the Republic of Lithuania

(1) The Republic of Lithuania is located in the southeastern coast of the Baltic Sea and borders Latvia, Belarus, Poland, and Kaliningrad (detached territory of Russia). It has land area of 65300 square kilometers and is generally flat. Forest accounts for 30.5% of total land (1.884400ha) and farmland 60.2% (3928100ha).

(2) It has population of approximately 3700800 (as of January 1999). Vilnius, the capital city, has the largest population of 578000, followed by Kaunas 414000 and Klaipeda 203000. The population density is 56.7 persons per square kilometer. Esnic composition is 80% Lithuanian, 9.4% Russian, 7% Polish, and 3.6% others. The official language is Lithuanian.

(3) 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. The government 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) 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) Lithuania is strategically located in a transportation hub connecting the EU countries and Eastern Europe. It 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. It also boasts well-developed road networks, more than 90% of which are paved, higher than the European average. It also has airports, and natural gas and oil pipelines.

(3) The country has reliable postal service as well as courier service. 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, with the Internet connectivity and e-mail service.

(4) Meanwhile, the unemployment rate has been on the rise due to a slowdown in growth of employment and rose to 11.1% in 2000. Recession in major employers, agriculture and manufacturing, is a major cause. The effective employment policy should focus on promotion of the manufacturing sector, particularly labor-intensive light industries (mainly consisting of small- and medium-sized enterprises).

## 1.3 Economic Conditions

### 1.3.1 Economies of the Baltic States and the CEFTA Countries

(1) The Baltic States and the CEFTA countries experienced rapid and continuous, economic declines until 1994 as a result of abrupt transition from the centrally planned economy system to a market economy. They turned upward in 1995 and 1996, with positive GDP growth rates. Then, most of countries recorded negative growth of GDP in 1997 and 1998 due to the currency crisis in Russia.

(2) At the initial stage of transition to a market economy, these countries underwent hyperinflation but managed to keep it in check. The current inflation rate is mostly maintained at one-digit levels. On the other hand, the unemployment rate remains unchanged or rise slightly to reflect economic stagnation that is generally observed in the region. In particular, Poland and Slovakia experience over 10% jobless rates (as of 1997 and 1998).

(3) Government finance is mostly in deficit, which increases steadily. Similarly, most countries report chronic deficits in current account, which have reached at significant levels.

### 1.3.2 Lithuanian Economy

(1) GDP

The country's GDP has been remaining flat on the average and shows no signs of significant growth. In particular, it faced a major setback in 1993 when it showed negative growth of 10.7% in real term due to the energy crisis at the end of 1992 triggered by unstable energy supply from Russia. As a result, GDP fell to a level almost one half that in 1989. Then, as the country moved out of dependency on the sluggish domestic economy and the former Soviet markets and strategically expanded into Western Europe by leveraging the free trade agreement with the West European countries, GDP turned into growth 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.

Recent GDP Trends

| | 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 Developmet in Lithuania 5/2000

Sectoral breakdown of GDP indicates that the service sector, led by commerce, shows rapid growth while agriculture and industry are on the decline. It should be noted, however, that the industrial sector in the country includes mining, electricity, gas, water, wood production and fishery, in addition to manufacturing. Notably, the energy-related sector such as petroleum refining, power generation and transmission, hot water supply and gas supply accounts for approximately 30% of industrial output.

(2) Currency and inflation

The Lithuanian government introduced its own currency (Litas) in June 1993 and linked it to the U.S. dollar at a fixed rate of USD1 = 4 Litas in 1994 in an attempt to control inflation. As a result, the inflation rate subsided from 35.6% in 1995, to 1.31% in 1996, 8.4% in 1997, 2.4% in 1998 and 0.3% in 1999. At the same time, however, the pegging to the strong U.S. dollar adversely affects the country's export competitiveness. The government is expected to make policy changes to cope with the situation, including reforms of the Currency Board.

(3) Government finance

The government budget is constantly in deficit. Tax revenues account for 95-96% of government revenues and VAT represents more than 50%.

Government Revenues and Expenditures in Recent Years

| | 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 |

(4) Current account and merchandize trade balances

Both the current account and merchandize trade balances are mostly in deficit, which are financed by capital account surpluses. In particular, recent growth of foreign direct investment contributes greatly to a surplus in overall balance.

(5) External trade

Against, the country's trade balance is constantly in deficit. Major export items include petroleum products, electricity, textile and apparel, machinery, and chemicals, while import items are mineral products, including crude oil and natural gas, machinery, chemicals and transportation equipment.

Major trade partners are still Russia and the former Soviet countries as well as Central and Eastern Europe, although their share has been falling year after year. Among the EU countries, Germany dominates both exports and imports.

## 1.4 Industry

### 1.4.1 Industry and Industrial Policy

The government's industrial policy is not limited to reconstruction and rehabilitation of production capacities to the levels during the former Soviet era. It has been pursuing more dynamic industrial development and expansion of export markets. The current industrial policy emphasizes support for light industries of small scale and sets forth the following targets as part of national efforts to expand production:

a. Restoration of the environment and development of technology with less environmental burdens;
b. Fostering of wood products and the sawmill industry; and
c. Development of agriculture-related technology.

The industrial policy appears to aim at promoting sustainable industrial growth, particularly the fostering of industries making high value added products, by utilizing highly skilled and low-cost labor force and recyclable resources available in the country.

Major industries in the country include agriculture, forestry, wood processing, food processing, chemical, machinery, electrical and electronics, energy and construction materials. The agriculture and manufacturing sectors account for approximately 40% of GDP and employ 41% of total work force. Output and value added by major sectors are summarized as follows.

| Sector | Output (1998) (Million Litas) | Share (%) | Value added (%) |
|---|---|---|---|
| Agriculture and forestry | 4305 | 12.8 | 12.6 |
| Industry | 8206 | 24.4 | 24.1 |
| (Manufacturing/mining) | 7083 | 21.1 | 20.8 |
| (Energy and 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

While public investment has been on the decline in the recent years, private investment shows steady growth. 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.

## 1.5 Manufacturing Industry

(1) Major industries and production activities

From the analysis of industrial production between 1993 and 1997, the changes in GDP share, and annual growth rates, the current status of the industrial 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 (sewing and finishing) 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 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% (284,100 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 |

Top ten subsectors (among 25 subsectors) in terms of labor productivity per employee in 1998 is shown 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 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 market environment. 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 initiates 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 system.

(2) World forest area

Throughout the world, forests have been steadily disappearing, although its rate has gradually slowed down due to the concerted conservation efforts. As population growth and economic development in developing countries are consuming major portions of forest resources, 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, which represents 0.3% of the world forest area. 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.

### 1.6.2 Forestry in Lithuania

(1) Exploitable forests available to wood production amount to 1638000 ha, 83% of the national forest area of 1978400 ha (30% of the total land area).

(2) Major species are pine, spruce and birch, which account for a combined share of 80% of the total exploitable forest area. State forests represent 52%. Of forests to be privatized (908000 ha), 374000 ha (41) have been converted and procedures are underway for the remaining area.

(3) The forest stage varies greatly. In pine and birch forests, young and mature stands represent relatively small portions, while spruce forests are dominated by young stand. The growing stock per ha of all forests is 184$m^3$, and that of mature forests 249$m^3$/ha.

(4) From 1920 to around 1950, vigorous cutting continued at a rate of 5 million to 6.7 million $m^3$ annually and resulted in a significant decline in forest productivity. Then, between 1950 and 1990, controlled cutting at a rate of 3 million $m^3$ caused a strong recovery of productivity. Today, forest resources are expected to grow on a continuous basis.

(5) The annual removal rate in the recent three years is around 5 million $m^3$. In 1999, the total cutting volume in privately owned forests reached 1 million $m^3$ for the first time. As privatization of forest progresses, the cutting volume will increase steadily. In 1999, final cutting accounted for 60% of the total cutting volume, while thinning and sanitary cutting the remaining 40%

(6) In 1999, 47% of cutting work in state forests were carried out by State Forest Enterprises, and remaining 53% by private operators. The cutting method is being shifted from the whole stem method that was adopted in the Soviet Union to the short wood method that uses chain saws and forwarders. The cutting cost is very small and is expected to keep it as a major competitive advantage.

(7) Annual consumption of industrial logs in the country is 3 million $m^3$, and consumption of fuelwood 1 million $m^3$, totaling 4 million $m^3$ annually.

(8) The annual growth increment is estimated at 11.6 million $m^3$, while the annual allowable cut is 6.2 million $m^3$.

## 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, firewood accounted for 56% of wood product demand in the world, and industrial use 44%. In industrialized countries, firewood 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 firewood demand decrease with income growth.

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, firewood 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 1.7.3 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 and 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. 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, although long-term availability will not likely become a problem.

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.

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 harvests 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 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. 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.

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.

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 and replaced the bulk of plywood made from softwood. OSB is mostly used for housing and its production is expected grow further. 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

While rich forest resources in the country have high potential to develop wood product industries, it is important to examine competition for raw materials between the large pulp and paper project and the existing wood product industries, particularly three subsectors mentioned above, sawmill and wood processing, wood fiber, paper and paperboard, and furniture. General profiles of these subsectors are as follows.

| Classification No. (NACE Rev.1) | | Production (1997) (106 LTL) | Employment (Person) |
|---|---|---|---|
| 20.00 | Lumber and wood products | 902 | 14408 |
| 21.00 | Pulp, paper, paperboard and products | 288 | 3854 |
| 22.00 | Printing, publishing and media products | 460 | 6411 |
| 36.00 | Furniture | 510 | 11265 |

(2) Production record

According to the production record of the three subsectors, their production levels in 1997 were 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.

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.

(3) Export market

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.

(4) Labor productivity and fixed assets

Labor productivities of the three subsectors are lower than the national average for the mining and manufacturing industries (79150 Litas).

(5) Comparison with Latvia

Based on the FAO data, Latvia's sawmill production and exports are twice those in Lithuania when their major sawmill products are compared (1997). Also, export prices of sawmill products are higher than those in Lithuania, while there is little difference in panel production and exports. The reasons for such differences are unknown.

# Chapter 2 PULP AND PAPER MARKET

# Chapter 2 PULP AND PAPER MARKET

## 2.1 Domestic Market

The production of Pulp and Paper in Lithuania turned upward from 1950. and developed to produce over 200 thousands tone at the latter parts of 1970.
In 1989, just before the independence, the production reached to 255000 tons and exported 93000 tons of products to the former Soviet Union and COMECON countries.

In process of the collapse of Soviet Union and the attainment of Lithuanian independence during the early parts of 1990. the domestic economy met a severe recession due to political and economical confusion. A shrinkage of consumption forced the paper industries to reduce production after 1991.

While consumption gradually recovered with the subsequent political stability, production is kept at a lower level producing Jute liner**,** Corrugated medium, Tissue paper etc. using mainly the local waste paper and a small amount of import pulp. The production in 1999 amounted to only 33800 tons.

As the facilities are becoming obsolete year by year, it may not be able to expect a significant improve in production without fundamental restructuring. In the meantime, therefore**,** it may not but to continue the present type of production using mainly wastepaper and to rely on import of such paper as printing and writing , demand of which is expected to grow.

## 2.2 Neighboring Markets

(1) Latvia

The production of pulp and paper products was forced to decrease to a great extent owing to political and economical confusion during the early parts of 1990th.when the independence was attained following the collapse of Soviet Union.

The production level at present is kept only around 25000 ~ 30000 tons per year against 130000 tons made before the independence.. The production facilities are of old fashioned type during the time of Soviet Union, which need fundamental renovation but no actual step taken so far.

In March 1st. 2000, the Ministry of Agriculture and Forestry entered into a basic agreement with Metsaliitto of Finland and Sodra of Sweden to establish a J/V Co. named Baltic Pulp to prepare for construction of a pulp mill in Latvia It was reported that the Co. will make all necessary study and arrangements by the end of 2002 and if every thing okay, will start and complete construction of a Kraft Pulp plant of 600000 tons capacity per year by 2005. An arrangement of sufficient quantity of pulpwood seems to remain as a major problem to be solved by the Government. The study team tried to collect more information and proposed an interview to Sodra but failed due no time.

(2) Estonia

At present, three enterprises are engaged in production of pulp, paper and board after the turmoil in the early 1990th. The mills produced 48000 tons of UKP, 50000 tons of Kraft and household paper in 1998.

Horizon Pulp and Paper, the largest mill run by a Singapore based trading firm with Indian capital “Tolaram Group”, re-started operation on 1996 by having taken over the old facilities and equipments of “Kehra Paber” who ceased operation to produce Kraft Paper for agriculture on 1993 due to the collapse of Soviet Union. With additional investments, the production of Kraft and Household paper now exceeded 45000 tons a year and amount of export jumped up beyond 20 million USD in the performance in 1999, being now regarded as one of the excellent enterprises in Estonia According to the management, they owe a lot for the cooperation of the Ministry of Economy

who intermediated the taken over transaction from the beginning and efficient handling of necessary application, documentation etc.
They appreciated a fair and good relationship with the Government.
This case may be regarded as one of the useful examples for restructuring the Lithuanian paper mills.

(3) Poland

The country has the seventh in land area in Europe (313683 $km^2$) and the sixth in population (38.7 million). According to an observation given by Japanese firm, Poland has made a rapid advancement in industrialization during the 1990.
With a substantial domestic consumption supported by a fairly large population, the country attracted the incoming of foreign investments during the decade, to reach 30.8 billion USD at the end of 1998. Germany is the largest investor as of 5.1 billion USD, then, USA 4.9 billion, France 2.4 billion, Italy 2.0 billion and so on.

They consumed 1.92 million tons of paper and l.02 million tons of pulp during 1998, against the local production of 1.71 million tons of paper and 0.92 million tons of pulp, which means a gap of supply and consumption being met by import from foreign countries. The Government and the private sector concerned are seeking further incoming of foreign investments to reinforce the local production facilities, but it seems not an easy task so far.

## 2.3 World Market

North America, West Europe including Scandinavia and Asia is considered as three major markets of the world in regard to the production and consumption of pulp, paper and paperboard.
In 1998, the two markets, Asia and North America, depressed because of the financial crisis took place in Thailand and Indonesia at the 3rd. quarter of 1997 and the serious recession in East Asian Countries, i.e. Japan and Korea etc.
On the other hand, it increased in Europe having production of over 82 million tons of paper and paperboard, an increase of 3.1% over 1997,that represents on all time record level of output. The production of pulp increased by 0.6%.
The imbalance between pulp supply and demand escalated from the decline in Asian demand due to the recession had a strong impact on pulp prices in 1998, in all over the world, which resulted to push down paper prices too.
Under such situation, the company's profitability deteriorated in Asia and North America during 1998. In Europe, although paper prices showed a downward trend most of the year, the average price level remained slightly above that of 1997. With relatively high operating rates and moderate cost increases, the companies in most of the countries in Europe were able to keep their profitability on the same level as in 1997, according to the report as per the CEPI annual report 1998.

In 1999 from the 2nd. quarter and on, the market tendency changed to a positive real growth in all over the world and this upswing are more than maintained into the year of 2000.

Looking ahead, the Finnish Forest Industries Federation mentioned in their book "Key to the Finnish Forest Industry " that 「consumption of paper and paperboard is expected to increase at an average annual rate of 2.5% up to the year 2010. The strongest growth will be in consumption of printing and writing papers」

As for the price tendency, since a very little new production capacity is expected within the next few years and the constitution of excessive competition is also expected to be rectified by on-going international integration and restructuring movements., it is viewed that a drastic fluctuation of prices happened in the past may not repeat or at least will become lesser.

In North America after hit the bottom in the 4th. quarter of 1998, the demand turned upward and changed to increasing trend throughout the following years.

In West Europe after 1996 when the production decreased by 0.7%, the production and consumption keeps upward every year that represent on all time record level.

Especially, the demand of Coated Woodfree expanded largely.

In Japan, the shipments bounded since the middle of 1999 with a 2.3 % increase in the first half of the year and 4.4 % in the rest of the year. As a result, the production increased 2.5% exceeding 30 million tons in 1999. Printing paper and ultra light weight coated paper most enjoyed the benefits and the shipment of these two items increased over 9%. Paperboard shipments increased 2.3%. supported by a stable growth of processed foods and the improved industrial output combined with a special demand related to Y2K at the end of the year. The production increased 1.5%.

As a general tendency in the industrialized countries, the shipment of coated paper good for color printing to the printers and publishers are mostly increasing following the improvement of printing technology and enlargement of OA In Japan, coated magazine paper with light weight coated is enlarging it's share to the printing industry.

## 2.4 European Markets

The decade of the 1990th. made increases of over 38% in paper and paperboard production and over 36% in consumption within the CEPI region. In case of pulp, it was over 20% in both production and consumption. That means, in paper and paperboard, the average yearly increase was a little over 3.5%, and in pulp it was about 2%. The performances in the other important markets over the same period are as follows.

(Unit: %)

| | North America | Asia | (Japan) | CEPI | World |
|---|---|---|---|---|---|
| Paper and Board | | | | | |
| Production | 10.5 | 61.9 | 9.05 | 38.6 | 31.5 |
| Consumption | 23.0 | 60.8 | 7.2 | 36.3 | 30.9 |
| Pulp Production | 4.1 | 28.4 | Δ 2.2 | 20.6 | 8.0 |
| Consumption | 3.4 | 41.0 | Δ 0.08 | 21.2 | 8.4 |

Among the industrial region, it is clear that Europe made the best performance in the decade of the 1990th and increased their importance in the field of pulp and paper industry in the world. (Source: CEPI Annual Statistics 1999)

In the production of paper and paper board in 1999, Germany produced 16742 thousand tons (19.6%), Finland 12948 thousand tone (15.2%) and Sweden 10071 thousand tons (11.8%). All of the three countries combined occupied over 46% of the total production of CEPI. In the production of pulp during the same period, Finland produced 11888 thousand tons (31.1%) and Sweden 10693 thousand tone (28%). The share of two countries combined reached close to 60%. All these factors show how important the presence of these two Scandinavian countries in the field of pulp and paper industry in Europe as well as in the World. (Source: CEPI Annual Statistics 1999)

According to the latest data published by the Finish Forest Industries Federation on June 2000, the total paper and paperboard capacity owned by Finish Companies reaches to 30.5 million tons, out of which 14.3 million tons are in Sweden and the rest in foreign countries as follows.

| | |
|---|---|
| In Germany | 5.2 million tons |
| Sweden | 3.8 “ |
| North America | 2.6 “ |

| | | |
|---|---|---|
| France | 1.6 | " |
| U.K. | 1.2 | " |
| Other Europe | 1.4 | " |
| Others | 0.7 | " |

It is noteworthy that 1/3 of total production capacity in Germany is under control of Finish Capital, and Finish pulp and paper mills are, at present, more or less consolidated into the following three groups through M&A.

【Total Turnover in 1999 = 100】

| | |
|---|---|
| Stora Enso | 36.7% |
| UPM Kymmene | 28.5% |
| Metsaliitto | 19.7% |

Comments and Feeling toward Lithuanian Pulp Project

During the short visits covering north and west European countries, the study team obtained following impression mainly thru interview with the local association in charge of Pulp and Paper Industries.

**Finland and Sweden:**

In short and middle term, their interest toward Baltic area seems to limit as a supply source of wood material, but in longer term. seems to regard as one of the supply source of pulp to cover Middle East and/or African market.

Germany, UK and France:

Basically, they seem not to have an interest toward pulp project in abroad.

**Italy:**

On the basis of the latest statistic data, Italy consumed more than 10 million tons and produced 8.5 million of paper and paperboard in 1999. They import 100% of Sulphate pulp as they don't have any local production, and so they imported 2.5 million tons in 1999. The active movements on the side of supply countries for integration and restructuring by means of M&A even across the boarder made them feel uneasy, since they afraid such reinforcement of supply side position may create excess control over the market pulp business in future.

In the interview with ASSOCARTA, they mentioned that they have investigated the markets of Latin America, South Africa and Indonesia, and also visited Baltic region last year. They intend to send a mission again to Baltic region some time October this year, for which we expect the Government of Lithuania to keep close contact with the said Association as one of the prospective partners of the projected pulp plant.

# Chapter 3 RAW MATERIALS

# Chapter 3 RAW MATERIALS

(1) Major pulpwood supply sources are pulpwood logs (exported) and fuelwood logs. Present production levels are 1 million $m^3$ for both pulpwood and fuelwood logs. Export pulpwood logs are limited to five species (pine, spruce, birch, aspen and alder), while fuelwood logs can also be used for pulp production purposes, unless specific species are preferred.

(2) The proposed pulp mill is assumed to operate at 80% of capacity in the first year (2007), 95% in 2008 and 100% in 2009 and afterwards. Comparing these operating rates with the supply plan and forecast made by the Forest Inventory and Management Institute, pulpwood log supply is expected to be very tight in the 2000s, and the wood material procurement plan should be established on the basis of fuelwood conversion. Supply and demand will be balanced in 2011 and afterwards.

($1000m^3$)

| wood demand trends | 2007 | 2008 | 2009～ |
|---|---|---|---|
| Wood demand for domestic industry | 3000 | 3000 | 3000 |
| Demand by the new pulp mill | 1960 | 2328 | 2450 |
| Total | 4960 | 5328 | 5450 |

| supply plan trends | 2001～2010 | 2001～2010 | 2001～2010 | 2011～2020 |
|---|---|---|---|---|
| Pulp wood | 5441.8 | 5441.8 | 5441.8 | 6081.4 |
| Fuelwood | 1241.3 | 1241.3 | 1241.3 | 1306 |
| Total | 6683.1 | 6683.1 | 6683.1 | 7387.4 |

(3) For forestry in Lithuania, there are two major issues to be solved to meet the anticipated demand by the new pump mill: (1) the country exports 1 million $m^3$ of pulpwood logs annually; and (2) private forests, which will soon account for nearly one half the total forest area in the country, are divided into small ownerships.

(4) It is imperative to divert currently exported pulpwood logs (1 million $m^3$) to the new mill by establishing 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 collect logs that are currently shipped to Sarkiai and Mazeikiai

The district offices should be accompanied by terminal facilities that are equipped for unloading (from trucks), loading (to rail freight cars) and temporary storage.

(5) On the other hand, pulpwood logs produced from private forests will have to be purchased from a large number of owners, each representing a fairly small lot. To receive and transport these small-lot supplies efficiently, five district offices (Kupiskis, Utena, Jonava, Vilnius and Varena) will be established, and together with the four district offices, will serve as collection points. (See the map of Figure 3.1 showing geographical distribution of the district offices.)

(6) State-owned forecasts are managed by State Forest Enterprises, which carry out logging operations and produce the average 30,000$m^3$ of pulpwood logs. As they have expertise, experience and resources for logging and marketing operations, it is desirable to purchase pulpwood logs from them under the condition that they will transport and deliver logs to the mill site at the mill price including the transportation cost. This will reduce workloads for the pulp mill significantly.

(7) 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. Some sawmills have chipping facilities and produce chips with barks, but it is doubtful if the bulk of sawmills invest in debarking and chipping facilities in response to commercial operation of the new pulp mill. So far as fuelwood logs can be used for pulp production, it is recommended to meet initial demand by procuring logs (pulpwood and fuelwood) and to ensure stable supply. Once the reliable procurement system is established, a supply source can be added by contracting with sawmills which are specialized in processing softwood to supply waste chips to the mill. Waste chips are advantageous because they are mostly softwood and become a stable supply source without the need to secure raw materials.


Figure 3.1 Distribution of 9 District Office and Collection Zones

(8) Each district office will procure pulpwood logs from state-owned and private forests in its service area. The quantity of logs to be procured by each office is estimated as follows.

(1000m3)

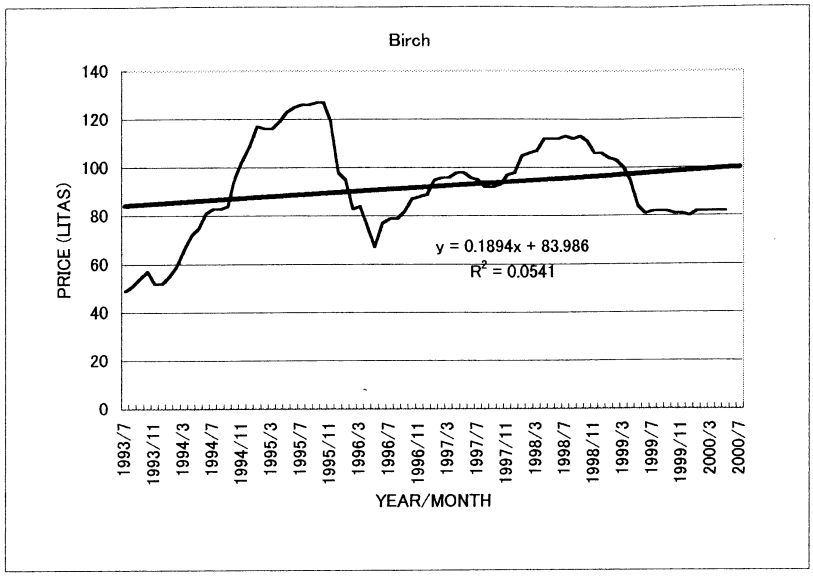
| District Offices | Softwood Total | Hardwood Total | Grand Total | % |
|---|---|---|---|---|
| Plunge | 177.61 | 139.85 | 317.46 | 12.9 |
| Siauliai | 127.26 | 161.88 | 289.14 | 11.8 |
| Kupiskis | 77.67 | 130.39 | 208.06 | 8.5 |
| Utena | 176.59 | 128.87 | 305.46 | 12.4 |
| Vilunius | 184.95 | 66.46 | 251.41 | 10.2 |
| Varena | 192.66 | 40.75 | 233.41 | 9.5 |
| Kazlu Ruda | 117.65 | 78.75 | 196.40 | 8.0 |
| Taurage | 148.33 | 114.87 | 263.20 | 10.7 |
| Jonava | 177.59 | 215.23 | 392.82 | 16.0 |
| Total | 1380.31 | 1077.05 | 2457.36 | 100.0 |
| % | 56.2 | 43.8 | 100.0 | |

(9) 17. Pulpwood log prices have been fluctuating greatly in the past, as shown in the example of birch pulpwood price trends (FOB at Klaipeda Port). In this study, the theoretical price 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.

(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 | |

Dynamics of Pulpwood Prices by Species




(10) To meet large demand by the new mill (2.5 million $m^3$), 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 (Plunge, Taurage, Kazlu Ruda and Siauliai) 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. 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.

(11) Following the above procedures, mill prices are estimated on the basis of the theoretical price as follows.

Mill Site : Gaiziumai (jonava)

| | SOFTWOOD | | HARDWOOD | | TOTAL | |
|---|---|---|---|---|---|---|
| District Offices | V( $m^3$ ) | C&F at Mill @ LTL/$m^3$ | V( $m^3$ ) | C&F at Mill @ LTL/$m^3$ | V( $m^3$ ) | C&F at Mill @ LTL/$m^3$ |
| Plunge | 177.61 | 122.17 | 139.85 | 97.52 | 317.46 | 111.31 |
| Siauliai | 127.26 | 114.02 | 161.88 | 88.13 | 289.14 | 99.53 |
| Kupiskis | 77.67 | 99.40 | 130.39 | 73.13 | 208.06 | 82.93 |
| Utena | 176.59 | 99.99 | 128.87 | 76.70 | 305.46 | 90.16 |
| Vilunius | 184.94 | 101.11 | 66.44 | 80.79 | 251.38 | 95.74 |
| Varena | 192.65 | 100.54 | 40.74 | 76.31 | 233.39 | 96.31 |
| Kazlu Ruda | 117.65 | 108.84 | 78.75 | 80.42 | 196.40 | 97.45 |
| Taurage | 148.33 | 117.35 | 114.87 | 91.31 | 263.20 | 105.98 |
| Jonava | 177.58 | 96.64 | 215.21 | 70.14 | 392.79 | 82.12 |
| Total | 1380.28 | 106.52 | 1077.00 | 81.45 | 2457.28 | 95.53 |
| % | 56.17 | | 43.83 | | 100.00 | |
| @USD/$m^3$ | | 26.63 | | 20.36 | | 23.88 |

Mill Site : Alytus

| | SOFTWOOD | | HARDWOOD | | TOTAL | |
|---|---|---|---|---|---|---|
| | V( $m^3$ ) | C&F at Mill @ LTL/$m^3$ | V( $m^3$ ) | C&F at Mill @ LTL/$m^3$ | V( $m^3$ ) | C&F at Mill @ LTL/$m^3$ |
| Total | 1380.28 | 109.86 | 1077.00 | 87.86 | 2457.28 | 100.22 |
| @USD/$m^3$ | | 27.47 | | 21.97 | | 25.05 |

Mill Site : Vievis (Electrenai)

| | SOFTWOOD | | HARDWOOD | | TOTAL | |
|---|---|---|---|---|---|---|
| | V( $m^3$ ) | C&F at Mill @ LTL/$m^3$ | V( $m^3$ ) | C&F at Mill @ LTL/$m^3$ | V( $m^3$ ) | C&F at Mill @ LTL/$m^3$ |
| Total | 1380.28 | 106.25 | 1077.00 | 83.33 | 2457.28 | 96.21 |
| @USD/$m^3$ | | 26.56 | | 20.83 | | 24.05 |

# Chapter 4 MILL SITE

# Chapter 4 MILL SITE

## 4.1 Site Screening Procedure

A broad review of potential mill sites has been carried out in order to identify a few alternatives with best possible conditions for establishing a new green field kraft pulp mill.

A stepwise approach has been applied in the evaluation and screening of potential mill sites. In the first step a number of potential areas – districts (rajonas) and sub-districts – were identified. In a second step, representatives of the Consultant's team visited all proposed counties and districts. In cooperation with local authorities and experts a number of 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.

A field survey encompassing site area, infrastructure conditions, water supply and possible recipient of treated wastewater, etc. was carried out 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.

Based on the findings from these initial field surveys and analyses of potential sites, a "Short List" of most promising mill sites was prepared.
Additional visits were thereafter paid to the sites on the Short List and complementary discussions organised with local authorities, NGOs, and representatives of local organisations and enterprises. 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.

It should be noticed that no geological survey has been carried out. Neither has any organised contacts been taken with concerned landowners.

## 4.2 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 selection 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 Waste 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

## 4.3 Long List of Candidate Sites

Totally 20 different potential sites were initially identified, surveyed and analysed from above aspects, and finally evaluated and compared to each other. These sites represented a broad range of places with a wide geographical coverage from Visaginas in northeast, Varena in southeast to Klaipeda region in west. The following districts (rajonas) were covered – Alytus, Elektrenai, Ignalina, Jonava, Kedainiai, Klaipeda, Kretinga, Šilute, Šveneionys, Trakai and Varena. Each site is briefly presented in the Main Report - Chapter 4 and Annex 4-2.

## 4.4 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 potential mill sites.
The prepared "short list" included the following sites

- Alytus North Alytus District
- Jonava North Jonava District
- Jonava Rukla Jonava District

- Vievis Trakai District

In addition a number of sites located in Klaipeda and Kretinga Districts were included – Lebartai, Dumpai, Mickai and Darbenai.

Figure 4.1 Map of Lithuania showing locations of potential mill sites


## 4.5 Recommendation – List of Most Favourable Sites

The final list of potential mill sites, selected and recommended as the most favourable ones, includes three sites (figures refer to map above - see Figure 4.1).

(1) Alytus North, located north of the city of Alytus
(6) Jonava Rukla, located east of the city of Jonava
(19) Vievis, located north of the municipality of Vievis

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 effluent water, namely river Nemunas for Alytus North and river Neris for the other site alternatives.

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.

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, 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, whose 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

The possible future Baltic Corridor 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 (under construction) through the Baltic states and Poland will be an advantage to all alternatives.

All three places can offer nearness to medium sized municipalities – Alytus, Jonava and Elektrenai 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 equivalent 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. 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 control smell and emissions to the air. Nevertheless, there will be discharges of effluent water 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.

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.).

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.

A site location in western Lithuania is presently not recommended. Alternative site locations in areas close to the coast have been investigated but not found compatible to the inland sites, although discharging wastewater directly to the Baltic Sea might be environmentally more advantageous. No site is available directly at the coast or Klaipeda harbour with conditions for own quays at the industry. This in combination with shortage of fresh process and cooling water, exclude the western mill site alternatives.

# Chapter 5 ENVIRONMENTAL ASPECTS

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## Environmental Aspects

This part of the study summarises the environmental aspects of a new pulp mill, including legislation, environmental technology, estimated emissions and environmental impacts.
The study did not cover all those aspects and details that must be included in a complete Environmental Impact Assessment (EIA). For instance, the forestry aspects were not covered. The EIA will have to be performed at a later stage of the project, according to the Lithuanian law on Environmental Impact Assessments of Proposed Economic Activities (April 2000).

(1) Legislation – Adaptation to the EU

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 present environmental legislation in Lithuania covers several areas, such as Environmental impact assessments, Water quality, Air quality, Environmental taxes, Environmental Monitoring etc. There are no regulations etc. particularly covering the pulp and paper industry. Lithuania is applying for membership in the European Union, which means that the legislation, including the environmental legislation, is presently being adapted to EU legislation.
The development of the environmental legislation in the European Union will be based on the European Council's IPPC Directive (Integrated Pollution Prevention and Control), issued in 1996 and adapted as a law by the member countries in 1999. As required in this Directive, the Council has recently issued a document, concerning the pulp and paper industry (Reference Document on Best Available Techniques in the Pulp and Paper Industry. July 2000). This document defines and specifies Best Available Techniques (BAT) for minimising impact on the environment, as well as emissions that can be expected when BAT is applied.

The Reference Document does *not*, however, specify emission limit values (ELV). Such values shall be set locally within each country, utilising the

Document as a reference and background, and taking into account local technical, economical and environmental conditions.

(2) Expected requirements for a new pulp mill

We expect that a new pulp mill project in Lithuania will have to be designed to ensure the principles of sustainability, concerning the forestry as well as the industrial components. The Environmental Permit, to be issued by the Lithuanian authorities, will be based on the EU environmental legislation, adapted to Lithuanian conditions. This means for instance application of the IPPC Directive, as well as requirements to utilise Best Available Techniques (BAT) for the production of bleached kraft pulp.

(3) Environmental technology

The environmental technology, which is proposed to be used in the new kraft pulp mill, is summarised below.

The mill will be designed with modern technology, in several respects utilising BAT. This refers to the production units as well as treatment plants for wastewater (effluent) and flue gases. The pulp production will be based on softwood and hardwood. The pulping process will be based on extended cooking in a continuous digester, followed by delignification with oxygen. The bleaching will be done primarily by an ECF process (elemental chlorine free) utilising the chemicals ozone, peroxide, oxygen, caustic soda and a minimum amount of chlorine dioxide. There will also be a possibility to switch to TCF bleaching, utilising the chemicals ozone, peroxide and oxygen, i.e. a totally chlorine free process. The distribution between ECF and TCF will primarily be based on market factors. From the environmental impact point of view, the general opinion today is that these two processes are basically equal, based on the properties of the wastewater.

Other process measures that will be used for minimising *water emissions* are, for instance, dry debarking, efficient pulp washing and closed screening, partial closure of the bleach plant, collection and recycling of liquor spills, and condensate treatment by stripping.

The mill effluent will be treated in a mechanical – biological plant, utilising the low-loaded activated sludge process as the biological stage. The biological treatment is expected to give about 95 % or higher removal of BOD and about 65 – 70 % removal of COD.

Above measures will minimise the water emissions in terms of suspended solids (TSS) and organic matter (measured as BOD and COD). The emission of chlorinated organic matter (measured as AOX) will be on a very low level during ECF bleaching, and zero during TCF bleaching. Also the effluent's toxicity to water-living organisms, e.g. fish, will be very low.

The main measures for minimising *atmospheric emissions* will be:

- improved evaporation for increased dry solids content of the black liquor, ahead of the recovery boiler – for the reduced sulphur emissions
- optimised operation conditions in the recovery boiler and the lime kiln – for the reduced emission of sulphur compounds and nitrogen oxides ($NO_x$)
- treatment of the flue gases from the recovery boiler in a scrubber – for the removal of sulphur dioxide ($SO_2$)
- collection and incineration of malodorous gases, both concentrated and diluted gases – for odour removal
- treatment of flue gases from the recovery boiler, the lime kiln and the power boiler in electrostatic precipitators (ESP) – for dust removal

The resulting emissions to water and atmosphere are expected to be on low levels, comparable with the situation at the most modern pulp mills that are in operation today. The estimated emissions are summarised below.

(4) Water emissions

Estimated water emissions to the recipient are shown in the following table.

Estimated water emissions

| Parameter | Specific emissions per AD ton of pulp | Total daily emissions |
|---|---|---|
| Effluent flow | about 30 $m^3$/t | 44 000 $m^3$/d |
| TSS (susp. solids) | 1.4 kg/t | 2 t/d |
| $BOD_7$ | 0.6 kg/t | 0.8 t/d |
| COD | 11 kg/t | 16 t/d |
| Nitrogen | 0.17 kg N/t | 0.25 t N/d |
| Phosphorus | 20 g P/t | 30 kg P/d |
| AOX *) | 0.15 kg/t | 0.22 t/d |

*) during ECF bleaching

In addition to the effluent, specified in the table, there will be a discharge of clean effluent (mainly cooling waters), approximately 40 – 60 000 $m^3$/d.

The impact of the effluent to the recipient, at the three inland site options, has been estimated, in terms of changes in the river water quality. Estimated increased contents of the different pollutants, in average, are shown in the following table. The data refer to the river water qualities of 1998-99.

Impact to rivers – Increased pollutant contents

| | Vievis site – River Neris | Jonava site – River Neris | Alytus site – River Nemunas |
|---|---|---|---|
| COD | 6 – 10 % | 2.6 – 5 % | 2 – 2.3 % |
| $BOD_7$ | 1.6 – 2.3 % | 1.5 – 1.8 % | 0.5 – 0.6 % |
| Tot N | 1.2 – 1.6 % | 0.5 – 1 % | 0.6 – 0.7 % |
| Tot P | 2 – 2.8 % | 1.3 – 2 % | 0.9 % |
| TSS | 2.4 – 2.5 % | 0.6 – 1.5 % | 0.4 – 0.5 % |

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 the Jonava and Alytus sites, the emissions from the Mill are not likely to give any significant impact on the situation in the rivers.

Concerning the discussed coastal sites, in the Kretinga district, the effluent should be discharged directly to the Baltic Sea, by a pipe-line of totally about 10-15 km length, ending some kilometers outside the coastal line.

The water emissions from the Mill will be very low, as the most modern technology will be used. Still we regard the coastal location as a better solution than the inland locations, from the water pollution point of view. However, the coastal location is not recommended for other reasons, according to Chapter 4.

(5) Atmospheric emissions

Estimated atmospheric emissions are shown in the following table.

Atmospheric emissions

| | Specific emissions per AD ton of pulp | Total daily emissions | Total annual emissions |
|---|---|---|---|
| Dust | 0.4 kg/t | 0.6 t/d | 204 t/a |
| Sulphur dioxide | | | |
| as $SO_2$ | 0.6 kg/t | 0.9 t/d | 306 t/a |
| as S | 0.3 kg/t | 0.45 t/d | 153 t/a |
| TRS *) as S | 0.1 kg/t | 0.15 t/d | 51 t/a |
| Total sulphur, as S | 0.4 kg/t | 0.6 t/d | 204 t/a |
| $NO_x$ as $NO_2$ | 1.2 kg/t | 1.75 t/d | 600 t/a |

*)TRS = total reduced sulphur compounds

These emissions are locally significant, compared to the present emissions in the actual districts. They are in some cases higher, in some cases lower. The local effects of these emissions, in terms of air quality outside the mill area, will have to be studied in the later EIA.

The emissions from the Mill are very low in relation to the total Lithuanian emissions. The percentages are as follows, based on the 1998 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 % |

The most obvious effect of the atmospheric emissions will be the odour load, typical for kraft mills, caused by the reduced sulphur compounds (TRS, i.e. hydrogen sulphide, methyl sulphides and methyl mercaptan). However in this mill, as in other modern mills, the odour load will be reduced to a very low level. Odour will normally be observed only in the near vicinity of the mill, and at larger distances only in connection with temporary disturbances.

(6) Solid wastes

Solid wastes for disposal will be reduced primarily by sorting and recycling wastes as far as possible, and by incinerating in the mills's power boiler most of the organic type wastes, which cannot be recycled. The latter includes mainly the bark and the sludge from the effluent treatment. The wastes to be disposed on landfill, primarily inorganic (mineral) matter such as ash from the power boiler and solid residues from chemical regeneration in the pulp mill, will amount to approximately:

- 18 000 t dry solids per year or 30 000 $m^3$ per year.

A nearby municipal landfill will be used, if sufficient capacity is available, otherwise a new own landfill will have to be opened. This issue has not been studied so far.

General garbage, non-recyclable, will be disposed in a nearby municipal landfill.

Hazardous wastes will be generated in small amounts, such as spill oils, laboratory chemicals, batteries and luminescent lamp tubes. We assume that these wastes shall be collected, and that they can be handled by external firms, specialised in such operations.

(7) Noise

The pulp mill itself, as well as the transports to and from the mill, generate significant levels of noise. We assumed that the choice of mill equipment, the installation and isolation of noisy equipment etc., as well as the arrangements for the transports to and from the mill, will be made in such a way that the authorities' requirements for noise minimisation and/or maximum noise levels can be complied with.

# Chapter 6 PULP MILL DESIGN

# Chapter 6 PULP MILL DESIGN

## 6.1 Products and Specifications

### 6.1.1 Selection of Pulp Products

(1) Objective of the study

The present study has the primary objective to induce full-scale feasibility study by potential investors (manufacturers) in the project contemplated herein and is designed to serve as a preliminary study for investors who have interest in the project and are willing to perform their own feasibility studies.

(2) Factors to be considered in selection of market pulp products

The following factors need to be take into account when market pulp products suitable for the project are selected: (1) application; (2) market; (3) raw materials (softwood or hardwood); (4) competitors (for BSKP; pulp makers in Scandinavia and North America and for BHKP; makers in South Europe, Asia and South America); (5) cost competitiveness (the country appears to be at the average level, except for labor and pulpwood log); (6) competitiveness in production technology; (7) production process; (8) production facilities and equipment; (9) construction cost (not much difference expected in the case of a market pulp mill); and (10) timing of mill construction (to be completed in a upward business cycle).

Preliminary evaluation of the above ten factors at this time indicates that market pulp products which have potential in commercial success are fairly limited, particularly BSKP and BHKP.

(3) Rationale for selection of BSKP and BHKP

Europe is the largest importer of pulp products in the world. In 1998, the region's net imports amounted to 4.3 million ADt. Within the region, however, there are pulp exporting countries which import pulpwood logs from countries in and out of Europe for production. BSKP and BHKP are the most popular market pulp products and their demand is expected to grow steadily in Europe.

### 6.1.2 Product Specifications

As the project plans to sell its pulp products to the general market, the following specifications are established to meet the diverse market needs:

Type: ECF/BSKP and BHKP

Grade: Paper

Market: Primarily Europe

Brightness: 89 ° - 90 ° ISO

Moisture content: 10% (air dry: AD)

Product type: Sheet pulp

## 6.2 Production Capacity

### 6.2.1 Design Production Capacity

Based on the results of the field surveys, the proposed BKP mill's production capacity is set at 500000 tons per year, with breakdown of 1350ADt/d for BSKP and 1620ADt for BHKP, and operating days of 188 and 152 days respectively.

### 6.2.2 Pulpwood Supply Plan and Consumption Forecast

Based on the results of the field survey, the BKP mill will consume 1.35 million $m^3$ sub/year (debarked log basis) of softwood and 1.1 million $m^3$ sub/year of hardwood in order to produce 500000 tons of pulp per year, under the assumption that softwood and hardwood will be used by a 55:45 ratio. (Unit consumptions of softwood and hardwood are assumed to be 5.30$m^3$ sub/ADt and 4.48$m^3$ sub/ADt respectively, and annual log consumption 2.450 million $m^3$ sub/year.) Figure 6.2.1 shows the material flow in the pulp mill under alternate production of BSKP and BHKP in roughly equal proportions.

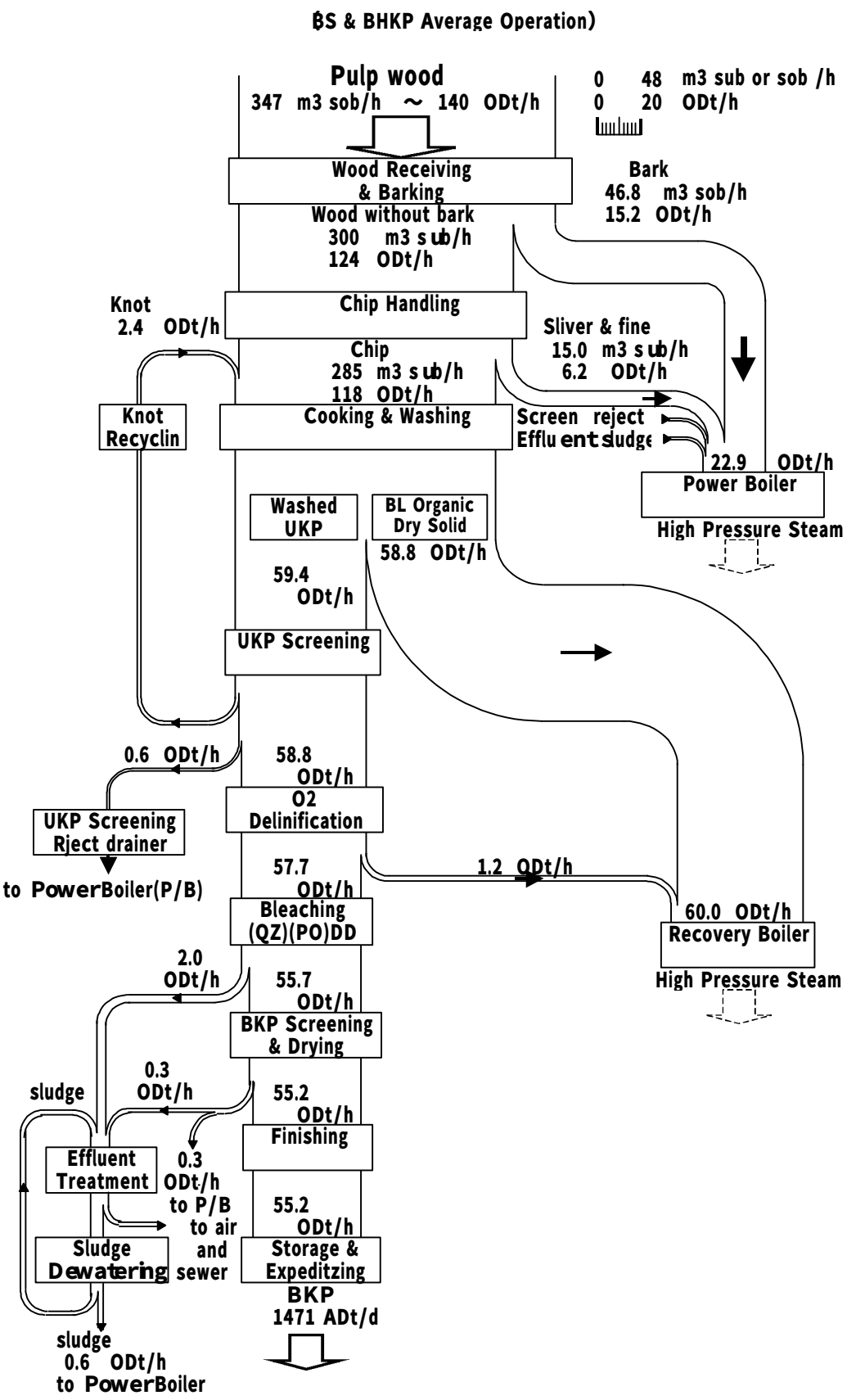
### 6.2.3 Major Factors to be Considered in Determination of Production Capacity

The proposed pulp mill's production capacity is determined by taking into account the following factors.

(1) General trend in capacity increase

Looking at the increase in installed capacity of the Kamyr continuous digester – the most widely used cooking process for production of BKP, the typical market pulp product – since the 1950s, the largest capacity is 483000 ADt/year for BSKP and 542000 ADt/year, with the average of 280000 ADt/year and 301000 ADt/year in the 1990s, respectively.

Figure 6.2.1 Material Flow of the Proposed Pulp Mill



(2) Product use: sales or captive consumption

The second factor for determination of production capacity is whether the product is sold to the market or consumed for internal use. As for market BKP, a prevailing trend is to maximize the capacity as far as the market and the availability of raw materials permit, thereby to minimize construction , repair and labor costs per unit of production (ton). On the other hand, the pulp mills for captive consumption have much smaller capacity.

(3) Pulpwood supply source

The BKP mill capacity is affected by the size of a pulpwood supply source or a distance from the source, with some variation between northern forests with a relatively long growing period and southern forests with a short growth period.

(4) The distance between the mill and the market as well as conditions of transport affects selection of production capacity. Generally, the mill with good transport access to the market and a small production capacity (thus a higher construction cost per ton) has a competitive advantage over a larger mill located in a long distance to the market.

(5) Future capacity expansion plan

Production capacity should be determined in consideration of future expansion possibilities. The future expansion policy should be established at the land acquisition stage and should be linked to non-process facility planning, including industrial water, effluent treatment, industrial track and connection to main roads.

### 6.2.4 Result of Production Capacity Selection

In consideration of the factors identified and discussed in 6.2.3, the preliminary design of the proposed 500000 ADt/year mill was carried out. In the process, study was made to address major economic and environmental impacts on participants in the BKP project and related parties in local communities where the new mill will be operated.

## 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

Compared to the conventional wet debarking process, 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 $m^3$/pulp ton) and thus less water pollutants are discharged compared to wet debarking. Also, the bark has less moisture content which improves the energy efficiency of the bark boiler.

(2) Continuous digester

There are two types of digesters available, continuous and batch. The continuous type is widely used at large pulp mills. Recently, new continuous cooking methods, such as ITC (iso-thermal cooking), are used. These methods are designed to ensure uniform cooking so as to perform delignification by minimizing the yield loss, thereby to achieve reduction of bleaching chemicals and effluent loads as well as good pulp quality.

(3) Oxygen delignification

Oxygen delignification is performed to remove lignin left after the cooking process. It is carried out under the alkali condition by using oxidization power of oxygen. The effluent from the process is recycled to the black liquor recovery system. The two- stage process achieves a higher degree of delignification, which reduces the consumption of bleaching chemicals, together with reduced water emissions.

(4) Bleaching sequence

The proposed mill will use the ECF (elemental chlorine free) bleaching process which minimizes the use of ClO2, as a bleaching agent containing chlorine compounds by using ozone. The plant will be designed for a possible change to TCF bleaching (totally chlorine free), if required for market reasons.

1) Reason for selection of the ECF bleaching sequence

Two ECF bleaching sequences, "OO (QZ) (PO) DD" for softwood and "OO (QZ) (EO) D" for hardwood, were selected in consideration of: (a) bleaching cost; (b) pulp quality; (c) environmental impacts; and (d) future prospect.

a. Bleaching cost

With the use of ozone, the ECF cost is 15-20% lower and the TCF process 40% lower. For the ozone-based process, the TCF cost is approximately 30% higher than the ECF cost. Furthermore, in both processes, the cost for hardwood is approximately 10% lower than that for softwood. See following.

Comparison of Bleaching Costs by Sequence

| | Sequence | Cost (USD/ADt) |
|---|---|---|
| ECF-Z | (QZ) (EO) Dn**D** | 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

b. Pulp quality

In the TCF process that does not use ClO2 and other chlorine-based chemicals, the excessive use of ozone is said to damage fibers and may adversely affect pulp 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 (absorbable organic halogens), the emission level from the ECF process is significantly low (<0.3 kg/ADt). There are, with present day knowledge, no reasons, from the environmental point of view, to select TCF instead of ECF.

d. Future outlook

As discussed above, the ECF process is expected to meet requirements and many industry sources believe that the advantageous position of the ECF will not change at least in the next ten years.

2) Bleaching sequence selected

The low-cost ECF bleaching sequences using ozone and minimizing the use of ClO2 and H2O2, namely "OO (QZ) (PO) DD" for softwood and "OO (QZ) (EO) D" for hardwood, will be employed for the proposed mill.

### 6.3.3 Pulp Drying Process

(1) Pulp dryer and finishing process

1) Pre-machine screens: Following the pressure screen, there are cleaners for heavy and light matters. The pulp accepted by the screens for light matters (concentration of 1.0 – 1.5%) is sent to the pressure machine head box.
2) Wet part: The pulp is dehydrated in the wire part to form a pulp sheet of 600 – 900g/$m^2$ (moisture content of 10%), which is then pressed in the press part and sent to the dry part.
3) Dryer part: There are three methods for drying pulp, air-borne dryer, flash dryer and cylinder dryer. From the point of view of quality of dried pie, heat economy and space requirements, the air-borne dryer using low pressure steam is used.
4) Finishing and packaging part: The pressed sheet dried to dryness of 90% (moisture content of 10%) is cut to size in a cutter-layboy and piled. A pulp sheet sample is taken every thirty minutes for quality testing and inspection. The piles of pulp sheets are carried by cushion conveyors to two packaging lines. They are pressed through a hydraulic bale press, wrapped with packaging sheets made by the same type of pulp, and printed of log, manufacturing number and specifications, and wired. Then they are unitized to 6-8 bale high units for shipment and transportation. All these processes of pressing, packaging, wiring and unitizing are automatically performed under the control of a programmable logic controller (PLC).

(2) Warehouse

Unitized pulps consisting of 6 – 8 bales are stored in a product warehouse near industrial tracks until being shipped.

### 6.3.4 Recovery and Power Processes

(1) Black liquor evaporator

The black liquor delivered from the digester-washing area is stored in weak black liquor storage tanks at the solid concentration of approximately 15%. Then the weak black liquor is concentrated by a sextuple effect steam driven evaporator and a concentrator to a sufficiently high level of concentration, 75% solids, to sustain efficient and stable combustion in the chemical recovery boiler. The highly contaminated condensate from the evaporated black liquor is steam stripped of its volatile contaminants, namely methanol and reduced forms of sulphur. The overhead vapour from the stripper is condensed to water and the non-condensable gases are oxidized in an incinerator. Sulphur dioxide in the incinerator flue gas is removed in a scrubber using a diluted caustic soda solution and is reused in other processes.

(2) Recovery boiler

The recovery boiler is designed 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 insufficient oxygen and high temperature. Inorganic matters remained in the black liquor after the process is converted to sodium carbonate. Organic matters are burned to generate sufficient heat to sustain combustion in the recovery boiler as well as to generate high pressure steam without using a supplemental fuel.

The flue gas from the recovery boiler is cleaned through an electro-static precipitator to remove suspended solid particles and is scrubbed with a diluted caustic soda solution to capture remaining sulphur compound gases. The scrubber effluent is recycled into a cooling liquor loop.

The precipitator catch, mainly sodium sulphate particles, is returned to the recovery boiler furnace together with the catch from the ash bunker. The

effluent from the scrubber is reused in the cooking liquor cycle. The scrubbed and cleaned recovery boiler flue gas is released to the atmosphere.

The recovery boiler is equipped with natural gas burners, which are used only for warming up the boiler at startup and in the case of abnormal operation.

(3) Power boiler

Wastes generated from the wood debarking and chip screening processes are combined with other organic wastes such as pulp screen rejects and sludge from the effluent treatment plant and are burned in the power boiler to generate steam. The power boiler is equipped with natural gas burners that are primarily used to generate steam required for the turbine generator or supplement steam shortage occurred in the pulping process.

(4) Steam

To maximum electricity generation, this study selected high pressure/high temperature specifications (11MPa and 515℃). These figures are rather high in comparison to those of the conventional kraft pulp mills, but recovery boiler technology to achieve these conditions is available.

(5) Turbine generator

The steam turbine discharges steam at two different pressures, medium pressure (1200kPa) and low pressure (300kPa). The medium-pressure steam is mostly used in the digester where a high cooking temperature (170℃) is required, with small quantity to be used in the steam ejector. The low pressure steam is used by the pulp dryer, the black liquor evaporator and other heat consumers. Electricity generated by the turbine generator is parallel connected with the grid power and serves as a primary power source for the pulp mill.

(6) Utility power substation and power distribution

The appropriate voltage level of utility power connection for a relatively small amount of electricity is 10kV. The utility power and the self-generated power sources are parallel connected to supply electricity throughout the mill at three

voltages, 13.8kV (at generator), 6kV, 500V and 220V. Motors equal to or larger than 150kW should be run at 6kV.

(7) Standby power generator

While the pulp mill is basically self-sufficient in power supply, a parallel run of self-generated and utility power sources is required all the time. As reliability of utility power supply is high in Lithuania, no standby power generation is required.

(8) Emergency power generator

An emergency diesel power generator of a few hundred kVA is installed in the mill.

(9) Air compressor center

Compressed air used for various power sources (mainly in the pulp dryer) and for automatic process controls is generated by oil-free air compressor at the air compressor center and is distributed throughout the mill.

(10) Process control system

A distributed control system (DCS) network controls the mill's processes. It is interconnected with mill-wide information system and the PLC (programmable logic controller) via communication links. Two main control rooms, one in the pulping area and another in the power area, are provided with fully equipped operator interface terminals. In addition, smaller control centers are provided in the wood handling area, the dryer area, the chemical preparation area and the effluent treatment area.

(11) Mill-wide information system

The mill-wide information system collects process raw data from the DCS, and monitor, compute and display the mill operation data and information.

### 6.3.5 Common Service Systems

(1) Process water

1) Water intake and treatment

Figure 6.3.1 shows a general water flow diagram in the pulp mill. As river water in Lithuania has fairly high levels of hardness (150 to 200mg/L as CaCO3), it must be softened to less than 10mg/L (as CaCO3) by the chemical softening process using cold lime or other chemicals, before use in the mill process.

The need for further water treatment to control content of metal iron and silica should be determined after final selection of the mill site and the water source to make water quality data available for detailed analysis. Sand filter backwash water and the clarifier under-flow sludge are returned to the river.

2) Boiler feed water treatment

Boiler feed water is supplied from mill water. It should be treated by anion and cation exchange resin beds. The condensate recovered from the pulping process should also be polished through ion exchange beds, which are generated using caustic soda and hydrochloric acid. Boiler feed water is further treated by oxygen scavenger and other chemicals as required.

3) Potable water

Potable water is supplied from municipal water service.

(2) Effluent treatment

The proposed effluent treatment plant is shown in a simplified flow sheet in Figure 6.3.1. It is essentially a biological treatment plant using low-load activated sludge after an appropriate pretreatment process.

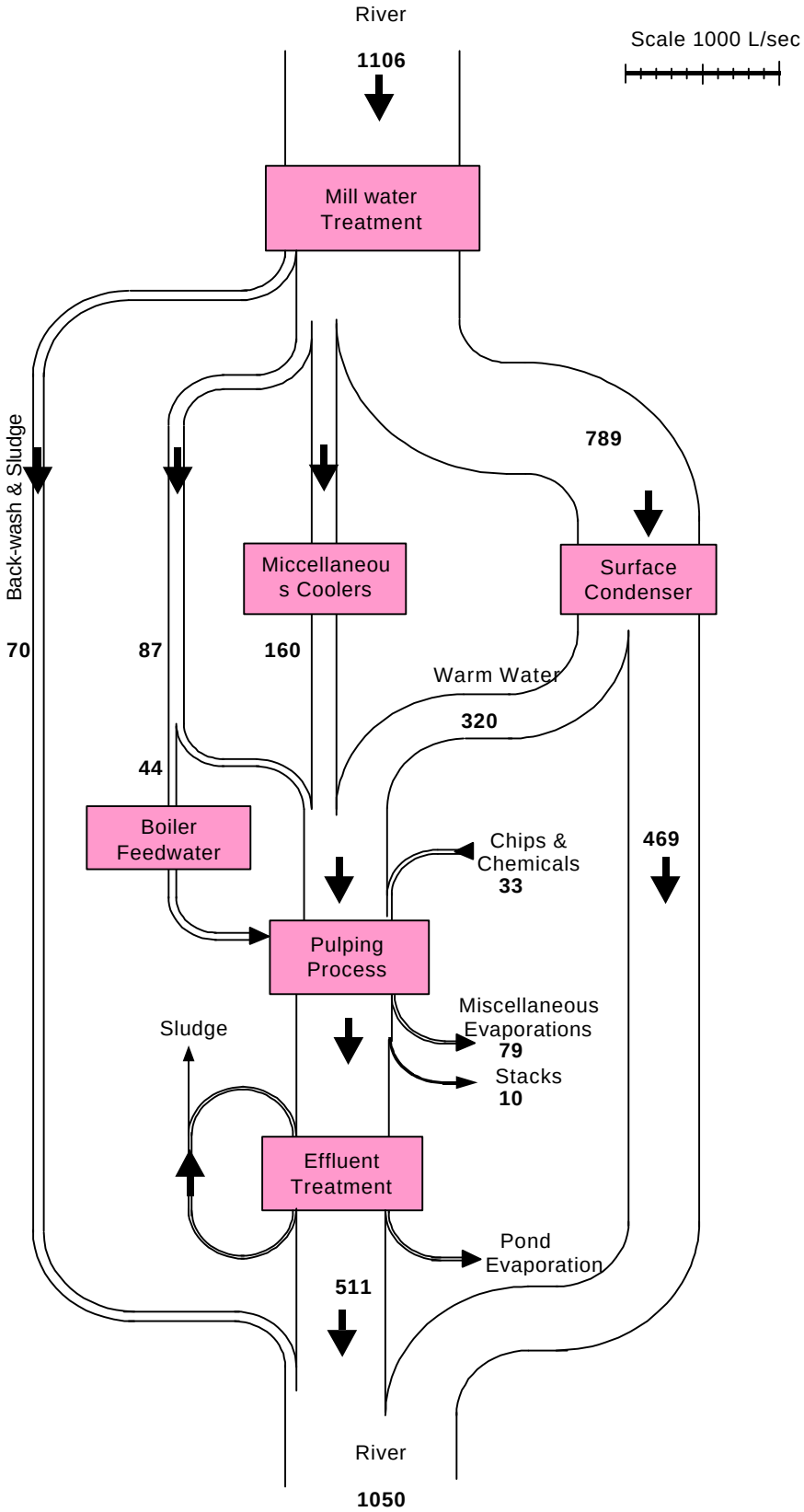
1) The pretreatment process consists of: (a) a primary clarification stage to remove fibers and other suspended solids; (b) an equalization pond to control the flow rate and the variation of ingredients; (c) an effluent cooling tower; (d) a neutralization system; and (e) addition of nutrients (phosphorus and nitrogenous compounds).

2) The secondary, biological treatment process is based on low-load activated sludge and consists of: (f) a selector tank (to improve sludge characteristics); (g) an aeration basin; and (h) a secondary clarifiers tank to remove sludge. The biological sludge is mainly returned to the aeration tank to keep the sludge in the process at a high level of concentration.

3) The sludge dewatering process is designed for a mixture of the fiber (primary) sludge and the surplus biological (secondary) sludge, to produce high solid content suitable for the subsequent combustion process. It is made up of a preliminary concentration (thickning) process for the surplus biological sludge, a tank for mixing the fiber sludge and the biological sludge, and a dewatering system of belt filter press type.

4) In addition, a spill storage pond is installed to temporarily collect spills from the process and highly contaminated effluents before being sent to the effluent treatment process.

Figure 6.3.1 Water Flow in the Pulp Mill



## 6.4 Outline of Mill Facilities and Equipment

### 6.4.1 Major Production Facilities and Equipment

(1) Wood handling facilities : 1 line

1) Wood storage yard (34000$m^2$x5) : 170000$m^2$
   Storage capacity : 30 days
2) Chip storage yard (5000$m^2$x **4** ) : 20000$m^2$
   Storage capacity : 5 days
3) Drum barker and chipper : 2 sets
4) Chip screening and transportation system : 1 set

(2) Pulping and chemical preparation facilities : 1 line

Nominal Design Capacity : BSKP - 1500ADt/d
: BHKP - 1800ADt/d

1) Continuous cooking facilities : 1 line
2) Pressure diffuser washer : 1 set
   High density tower for UKP (3000$m^3$) : 1 set
3) UKP screening system : 1 line
4) Oxygen delignification system : 1 line
   Two stage O2 reactor : 1 set
   Two stage diffuser + wash press : 1 set
5) Bleaching system : 1 line
   Multistage bleaching system (mixer, bleaching tower, washer, etc.): 1 set
   BKP high density tower for BSKP (3000$m^3$): 1 set
   For BHKP (3000$m^3$) : 1 set
6) Causticizing facilities : 1 line
   White liquor production capacity : 6500$m^3$/d
7) Lime kiln facilities : 1 line
   Lime burning capacity : 507CaOt/d
8) Bleaching chemicals preparation facilities : 1 line
   Purchased chemical receiving and injection system: 1 set
   Oxygen and ozone production and injection system: 1 set
   ClO2 production (R8 method) and injection system: 1 set
   Oxidized white liquor (OWL) production and injection system: 1 set

(3) Pulp drying facilities : 1 line

Nominal design capacity for BKP : 2000ADt/d

1) BKP screening system : 1 line
   Pressure screen : 1 set
   Heavy weight contaminant cleaner : 1 set
   Light weight contaminant cleaner : 1 set
2) Pulp dryer
   Design speed : 250m/min
   Average operation rate : 171m/min
   Trim width : 9600mm
   Normal basis weight range : 850g/$m^2$
   Dryer type : Steam heated air-borne dryer
   Cutter lalboy : 600mm x 800mm, 16 cuts

3) Packaging facilities : 2 lines
   Hydraulic bale press (1700 tons) : 2 sets

### 6.4.2 Major Utilities

(1) Recovery and power

1) Black liquor evaporator/concentrator : 1 line
   Evaporator type : Sextuple effect, thin-film drop type
   Evaporative capacity : 15400t/dH2O
   Input black liquor : 15%solids,60°C
   Output black liquor : 75% solids
2) Chemical Recovery Boiler : 1 set
   Type : Tomlinson type
   Capacity : 3100DSt/d
   Steam condition : 11MPa(g),515°C
   Auxiliary fuel : Natural gas
3) Power boiler) : 1 set
   Steam generating capacity
      Wood waste only : 80t/h
      With auxiliary fuel : 110t/h
      Steam condition : 11MPa(g), 515°C

4) Steam turbine : **1** set
Type : Extraction-back pressure turbine
Capacity : 60MW
Steam condition
Inlet steam : 11MPa(g),515°C
Extraction steam : 1200kPa(g)
Exhaust steam : 300kPa(g)
5) Power generator : **1** set
Capacity : 70MVA
Coupling : Direct coupled to steam turbine
Voltage : 13.8kV
Cycle : 50Hz
6) Emergency diesel power generator : 1set
Capacity : 200kVA

(2) Water supply facilities : 1 set

Capacity : 1200L/sec
1) Raw water intake facilities : 1 set
2) Water treatment plant : 1 set
3) Mill water supply facilities : 1 set

### 6.4.3 Effluent Treatment Plant: 1 line

(1) Design data

Effluent flow : 44000$m^3$/d
COD 54t/d:
BOD 20t/d:

(2) Pretreatment

Primary clarifier, surface load : 0.8$m^3/m^2$/h
D58$m^2$600$m^2$ : 1 set
Neutralization basin350$m^3$ : 1set
Cooling tower : 1set
Equalization basin25000$m^3$ : 1set

(3) Active sludge plant

| | |
|---|---|
| Selector basin 3500$m^3$ | : 1set |
| Aeration basin 4200$m^3$ | : 1set |
| Secondary clarifiers, surface load 0.6$m^3/m^2/h$ | |
| D48m 3500$m^2$/set | : 2sets |
| Aeration 1700KgO2/h | : 1set |

(4) Sludge dewatering :1set

Design sludge production
Fiber 16DSt/d:
Active sludge 8DSt/d:
Total 24DSt/d:

| | |
|---|---|
| Sludge thickener D20m | : 1set |
| Sludge tank 300$m^3$/set | : 1set |
| Sludge dewatering capacity | : 1200/kg DS/h |

(5) Spill pond 25000$m^3$ : 1set

### 6.4.4 Other Auxiliary Facilities and Equipment

(1) Auxiliary facilities

Administration and other buildings: Total floor area of 8400$m^2$

(2) Outlying facilities and structures

Roads (access road 1000m and site roads), railroad (industrial track from primary line (2000m) and yard facilities), fence (5000m) and other outlying structures

### 6.4.5 Flow Sheet

Figure 6.4.1 shows a general process flow of the proposed mill.

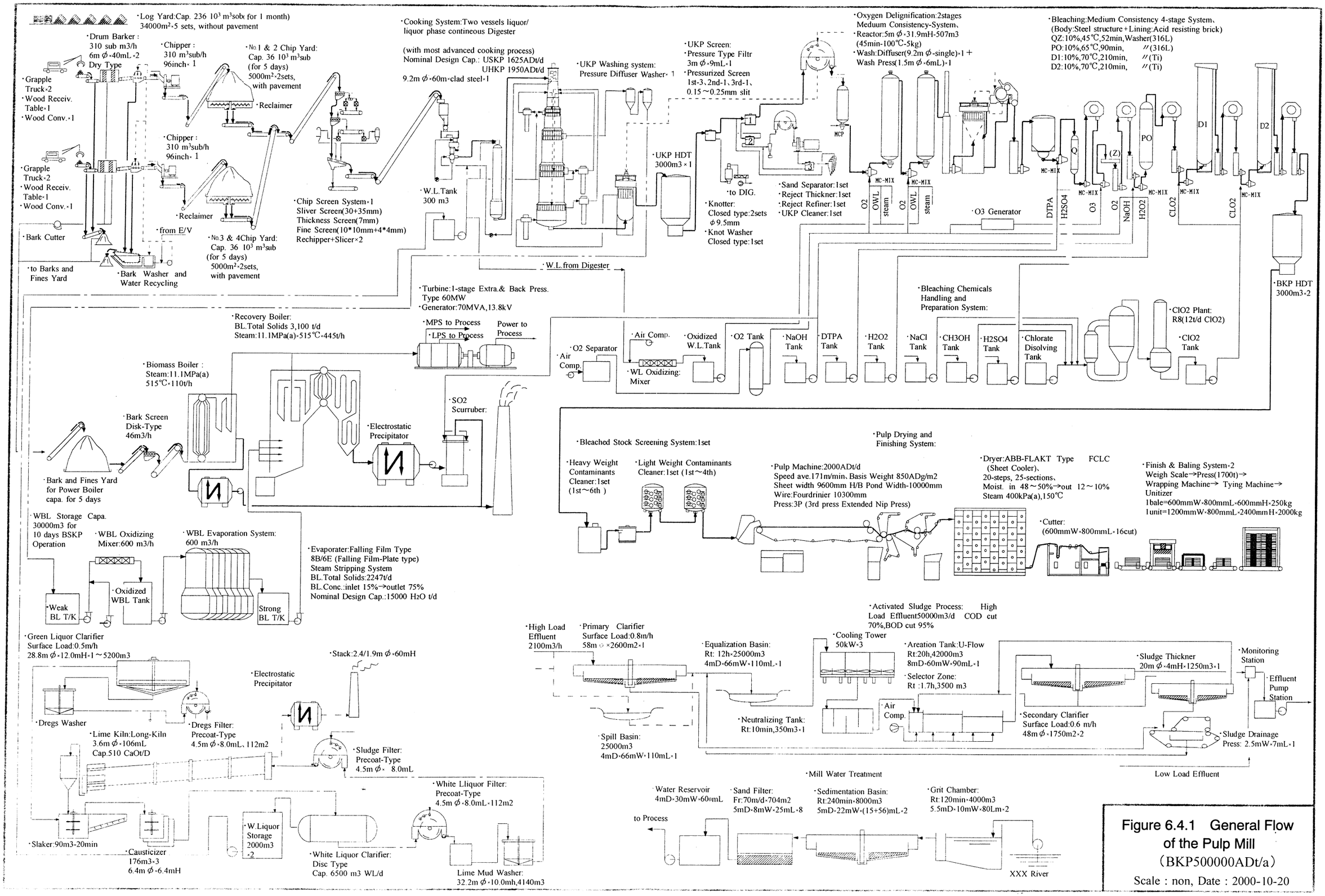



**Figure 6.4.1 General Flow of the Pulp Mill**
(BKP500000ADt/a)
Scale : non, Date : 2000-10-20

## 6.5 Unit Consumption

### 6.5.1 Unit Consumption of Materials and Sub-Materials

(1) Pulpwood logs

Based on pulpwood log costs of USD26.63/sub $m^3$ for softwood and USD20.36/sub $m^3$ for hardwood, and unit wood consumption of 5.30 sub $m^3$/ADt for BSKP and 4.48 sub $m^3$/ADt for BHKP, the unit pulpwood cost is USD141.07/ADt for BSKP and USD91.32/ADt for BHKP.

(2) Chemicals

The cost for bleaching chemicals is USD20.22/ADt for BSKP and USD15.48/ADt for BHKP. The total cost for chemicals is USD21.96/ADt for BSKP and USD17.22/ADt for BHKP.

(3) Fuel for the lime kiln

Assuming that natural gas price is USD0.086/$m^3$ and unit fuel consumption 48$m^3$/AD5, the unit fuel cost is USD4.13/ADt..

(4) Product packaging materials and other proportional costs

The cost for packaging materials, including steel wire, is USD1.59/ADt, and the cost for wire cloth for the pulp machine and other proportional costs amount to USD0.91/ADt, totaling USD2.50/ADt.

### 6.5.2 Supply Methods and Conditions for Materials and Sub-materials

(1) Pulpwood

1) Supply method: Pulpwood logs are cut into specific length (with barks) in a logging and are transported by trucks and rail freight cars to the mill site directly or via an intermediate wood yard. They are delivered to mill wood yards according to specifies and unloaded by grabble tracks for storage.
2) Supply conditions: As BSKP and BHKP are produced alternately in a specific 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: Commercial terms are not fixed.

### 6.5.3 Required Utilities and Unit Consumption

(1) Heat requirement for the pulp mill

The departmental unit heat consumptions in the proposed mill are shown in Figure 6.5.1, which is based on the EU publication "Draft Best Available Technology, section2, "The Kraft (Sulphate) Pulping Processing," with some modifications to suit the requirements specified to the proposed mill.

(2) Fuel cost

Natural gas is used from the cost, equipment and environmental points of view. The natural price when this report is prepared is 343 Litas (USD85.8)/1000$m^3$, which does not include the 18% VAT. The low calorific value of natural gas per $m^3$ is 8000kCal (33500MJ).

(3) Power requirements for the pulp mill

The departmental unit electricity consumptions in the proposed mill are shown in Figure 6.5.1, which is based on the EU publication "Draft Best Available Technology, section 2, "The Kraft (Sulphate) Pulping Processing," with some modifications to suit the requirements specified to the proposed mill. Note that the mill has to be connected to the power grid all the time for the following reasons:

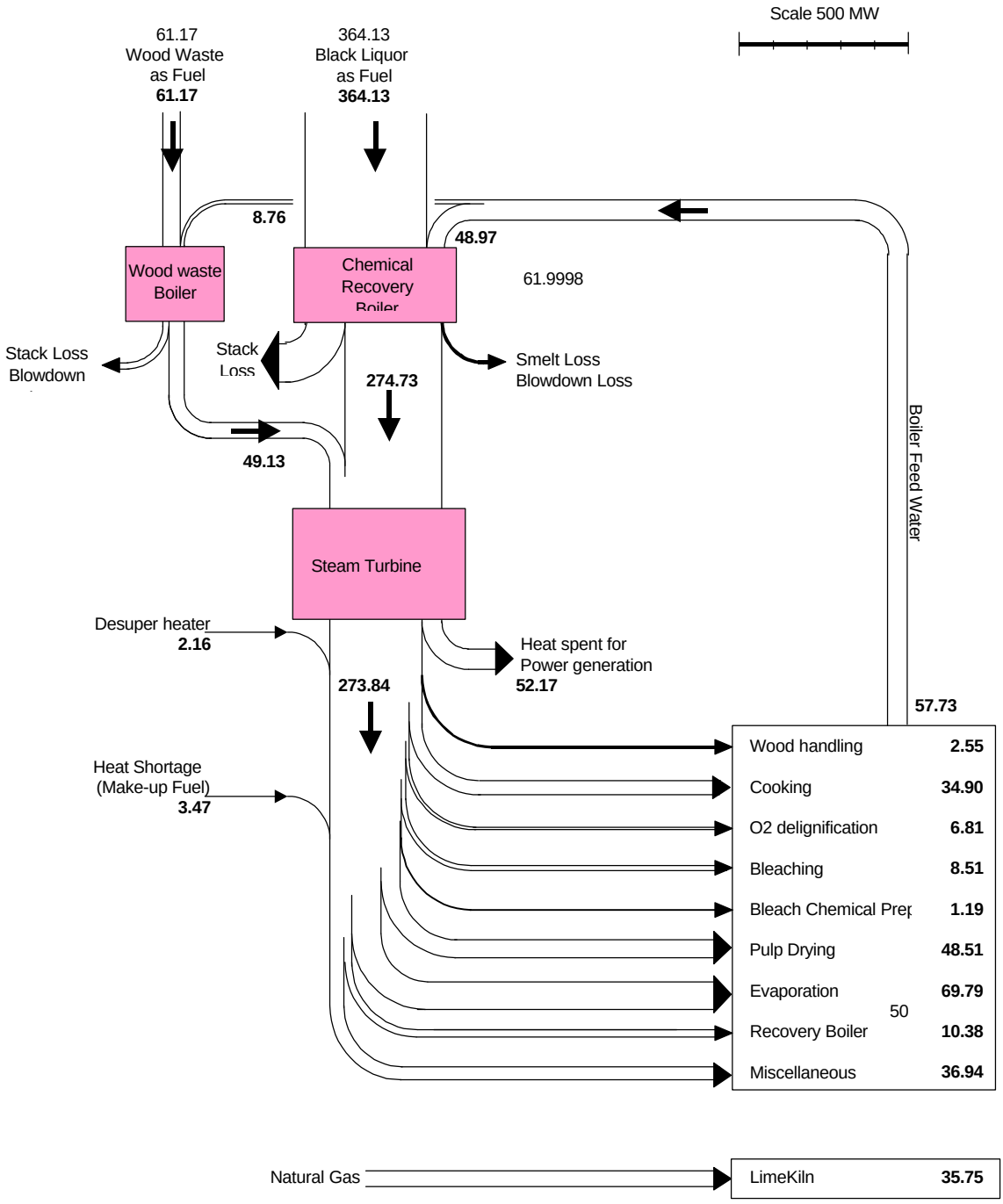
1) The proposed pulp mill design does not include the ability to adjust its power generating capacity.
2) Electric power to start up the mill from a total shutdown needs to be obtained from the grid.
3) Utility power is required to run essential equipment and potentially hazardous devices, such as boiler fans and feed water pumps, in the case of the trip of the mill's turbine generator.

(4) Electricity cost

At present, three are three types of electric power tariff: (1) fixed charge; (2) variable charge; and (3) demand charge.

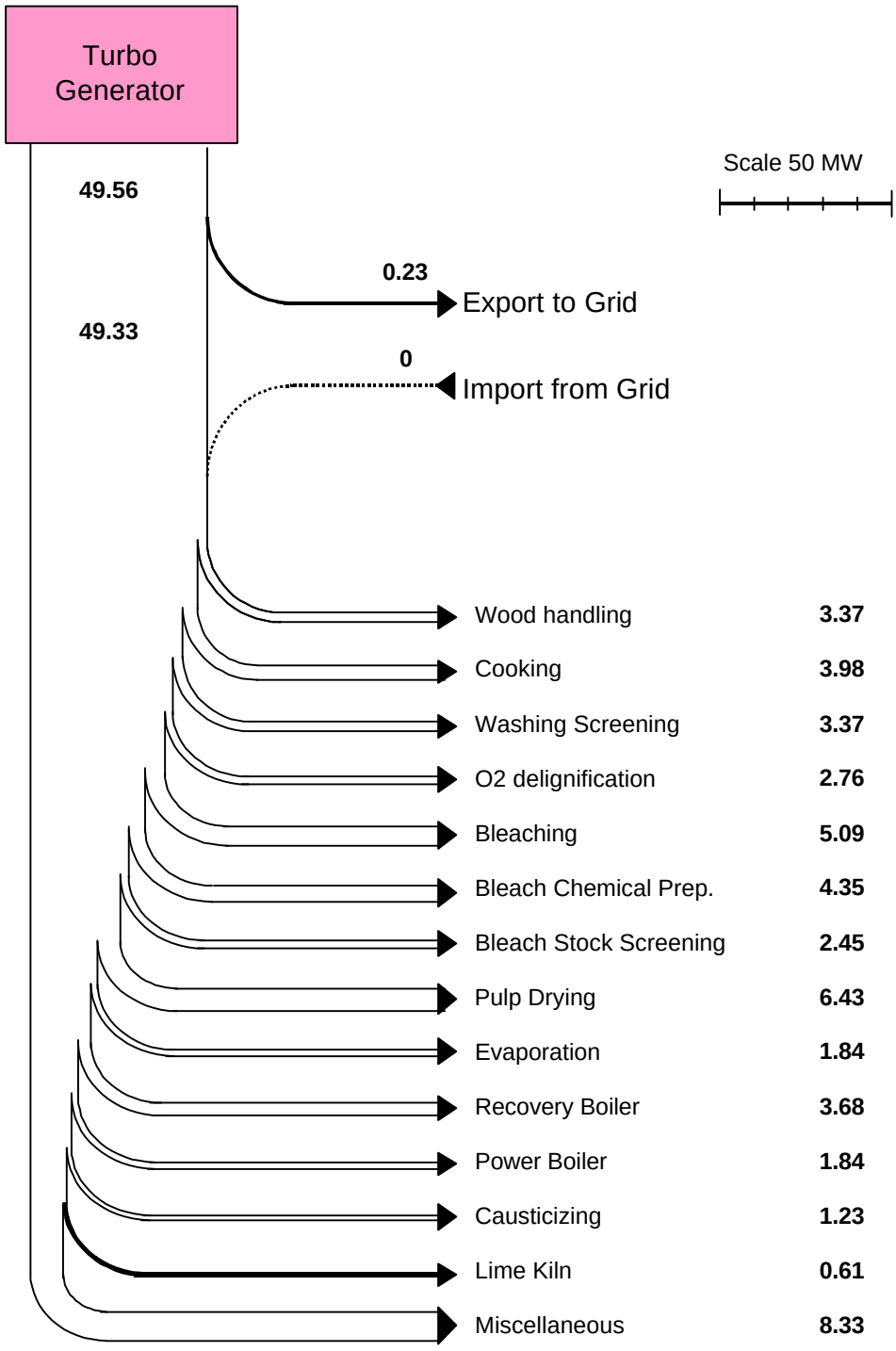
Assuming the contract capacity of 5.0MW, estimated hours of use per year of 27 hours, and the average power draw from the grid of 0.15kW, the electricity cost under the demand charge is USD0.78/ADt for BSKP and USD0.65/ADt for BHKP.

Figure 6.5.1 Stream Flow in the Pulp Mill




**Enthalpy Base Zero degC Liquid Water**

Fig.6.5.2 Electricity Flow in the Pulp Mill



### 6.5.4 Energy Consumption and Balance of the Proposed Pulp Mill

(1) Steam and power generation

The proposed mill will consume one ton of wood to produce approximately 400kg (zero moisture) of bleached pulp. The pulping process generates unused portions of pulpwood logs, which are usable as fuel in the pulp mill, except for small portions that are discharged into the effluent stream. In cooking softwood, the proposed mill is designed to produce black liquor which amount is larger than that the boiler can burn and the surplus amount is stored in a storage tank. On the other hand, the hardwood cooking process results in a deficit in black liquor consumption, which is compensated for by using the black liquor stored in the tank. This consumption pattern requires a large black liquor tank. As for energy balance, the mill is basically self-sufficient in energy, heat and electricity in normal operation, but supplement energy supply is required under some circumstances in the course of BHKP production.

(2) Heat balance

The unit heat consumption of the entire pulp mill, excepting the lime kiln, is estimated at 12900MJ/ADt. The average heat consumption for BSKP and BHKP production is estimated at 219.6MW. On the other hand, black liquor and other wastes are expected to generate the average heat of 216.1MW, as shown in Figure 6.5.1, resulting in a heat deficit of 3.5MW. The actual heat balance should be carefully planned at the design stage.

(3) Power balance

The unit electricity consumption of the entire pulp mill is estimated at 805MW. The average electricity consumption for BSKP and BHKP production is estimated at 49.3MW. On the other hand, black liquor and other wastes are expected to generate high pressure steam and the average electricity of 49.6MW, as shown in Figures 6.5.1 and 6.5.2, resulting in a surplus of 0.3MW. As the surplus is very small, the actual power balance should be carefully planned at the design stage. In particular, the difference in power balance between hardwood and softwood cooking processes can be equalized by the operating mode discussed in (1) “steam and power generation,” while the connection to the power grid is required all the time.

## 6.6 Mill Layout Plan

As a final mill site has not been decided, a general layout was made for a hypothetical 150ha flat land of 1500m x 1000m.

(1) Important considerations to mill layout

1) Good access to outside roads and facilities
2) Efficient flow of goods between processes
3) Minimization of environmental impacts of pollutants other than process effluent
4) Future expandability

(2) Conceptual mill layout

The conceptual mill layout is shown in Figure 6.6.1.

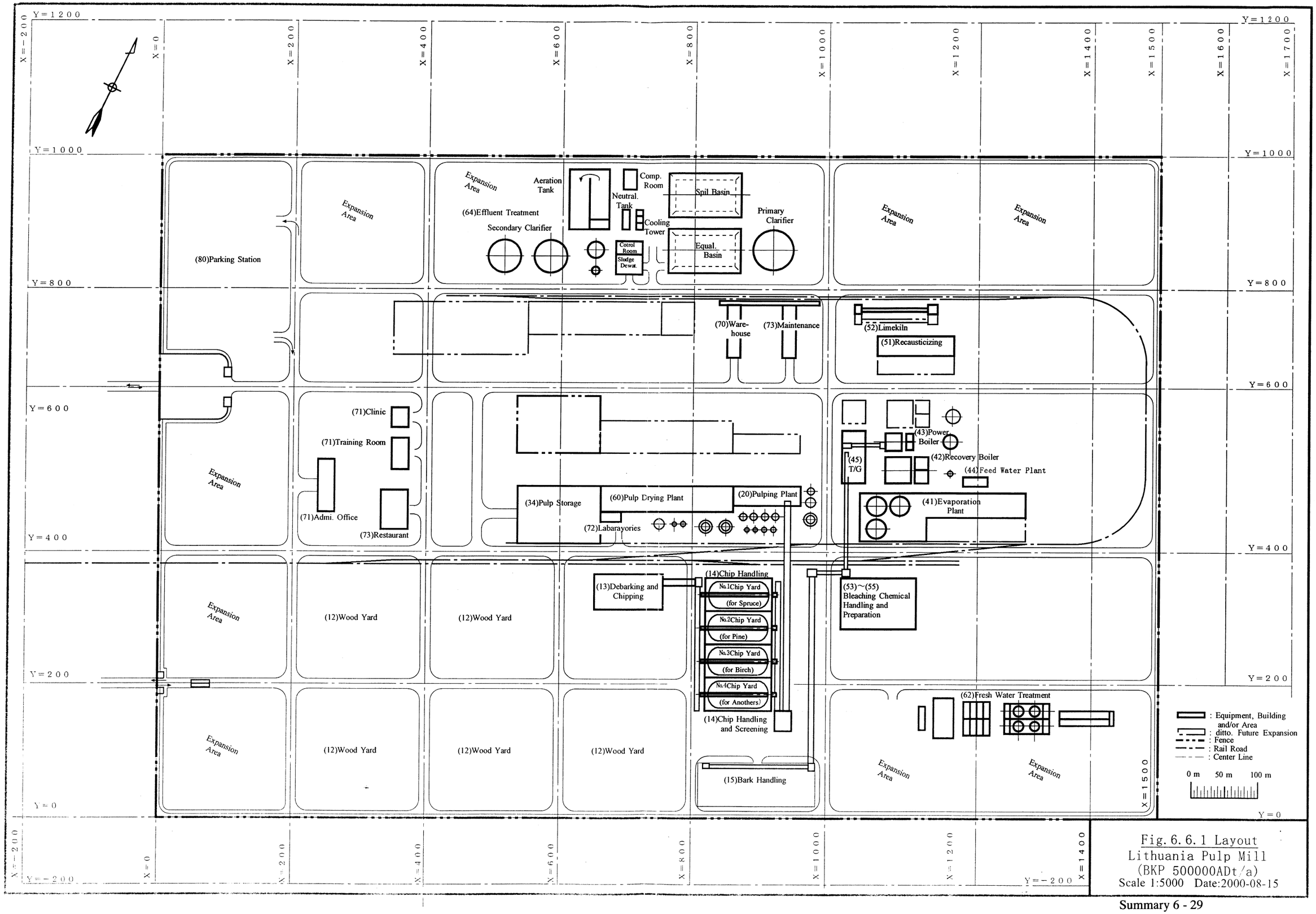



Fig. 6. 6. 1 Layout
Lithuania Pulp Mill
(BKP 500000ADt/a)
Scale 1:5000 Date:2000-08-15

# Chapter 7 MILL CONSTRUCTION PLAN

# Chapter 7 MILL CONSTRUCTION PLAN

## 7.1 Construction Planning Framework

The planning framework for the mill construction project is summarized as follows.

(1) Pre-investment activities and cost allocation

The project will go through the preparation and implementation process, including feasibility study, investment decision and the establishment of the operating company, which incur various costs and expenses by the implementation body (investors). This study assumes that these costs incurred prior to registration of the operating company are not included in the required investment. Only costs incurred thereafter will be capitalized.

(2) Construction project team

The operating company will start as a construction project team and will expand its organization with the progress of construction work. The organization will be become ready for mill operation and management in the final stage of construction. Workers will be hired according to the organization schedule.

(3) Construction management

Construction work will be managed by an experienced project management consultant (PMC), which will be responsible for basic design and engineering, procurement and supervision of construction work under a contract with the operating company, which will form a project team to supervise the PMC's work.

(4) Unit test run and commissioning

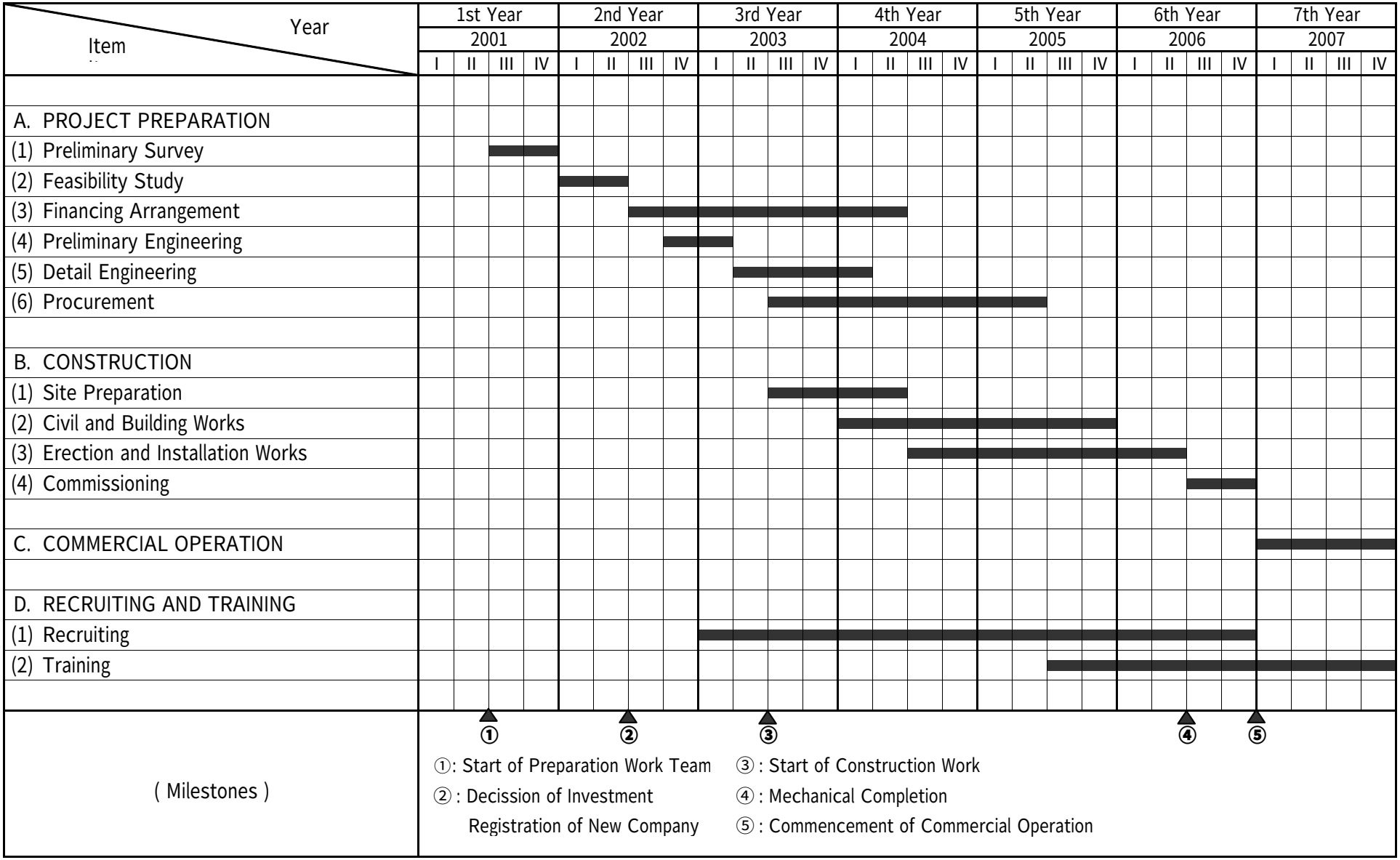
The PMC will be responsible to manage and supervise test runs of key components, equipment and systems designed, supplied and/or installed by contractors to verify their performance in compliance with specific requirements. Then, commissioning will be carried out by the operating

company (a team of operators and instructors) under assistance of engineers of the PMC and unit suppliers.

## 7.2 Construction Schedule

Construction of the pulp mill will take 66 months after the start of pre-feasibility study. The mill will start commercial operating in the 66$^{th}$ month. The preliminary schedule is shown in Figure 7.1.

Figure 7.1 Construction Schedule



# Chapter 8 TOTAL REQUIRED INVESTMENT AND FINANCIAL PLAN

# Chapter 8 TOTAL REQUIRED INVESTMENT AND FINANCIAL PLAN

## 8.1 Total Investment

(1) Basic assumptions

The total required investment is estimated on the basis of the following assumptions:

a. The project cost including mill construction is estimated in fixed prices as of the second quarter of 2000.
b. The total amount of investment in mill construction includes a 500000-ton BKP mill and its auxiliary facilities and equipment.
c. All the costs and prices are quoted in the U.S. dollar. Conversion from other currencies to the U.S. dollar was made at the applicable foreign exchange rates as of April 2000.

(2) Total investment

1) Land acquisition and preparation

a. Land acquisition cost: USD300000 (200ha)
b. Site preparation cost: USD26083000

2) Mill construction cost

USD601984000

Breakdown of Mill Construction Cost

(Unit: USD 1000)

| Item | Foreign Portion | Local Portion | Total |
|---|---|---|---|
| 1. Civil and Building Woks | 102374 | 11375 | 113749 |
| 2. Machinery and Equipment | 278398 | 8495 | 286893 |
| 3. Piping Work | 27737 | 1632 | 29369 |
| 4. Electrical Equipment | 29988 | 1489 | 31477 |
| 5. Process Control | 18811 | 785 | 19596 |
| 6. Painting and Insulation | 5435 | 1034 | 6469 |
| 7. Ventilation Work | 11243 | 1249 | 12492 |
| 8. Temporary Facilities and Services | 15400 | 6600 | 22000 |
| 9. Engineering | 35340 | 2660 | 38000 |
| 10. Project Management *) | 27000 | 3000 | 30000 |
| 11. Cost outside the Mill Fence | 9551 | 2388 | 11939 |
| Total | 561277 | 40707 | 601984 |

Note: Project management will include construction management, field supervision and contract administration.

3) Pre-operation costs and expenses

USD11939000, including salaries and wages, general administration, training, assistance and guidance for operators, trial runs.

4) Physical contingencies

7% of the total project cost (sum of 1) - 3) above), covering unforeseeable costs incurred by design change, deviation from original estimates, and other unexpected events.

5) Initial working capital

It should be estimated by assuming cash requirements, inventory requirements for raw materials and products, the difference between accounts receivable and payable, and other relevant parameters.

6) Taxes

Imported equipment and materials used for the project will be exempted from import tariff, while the 18% VAT is assumed for locally procured equipment and materials.

7) Interest during construction

It is assumed that 70% of the project cost will be financed by debt, with the long-term loan rate of 10%.

8) Total investment

（Unit：USD 1000）

| Items | Foreign Portion | Local Portion | Total |
|---|---|---|---|
| a. Land Acquisition Cost | 0 | 300 | 300 |
| b. Site Preparation Cost | 23475 | 2608 | 26083 |
| c. Plant Construction Cost | 561277 | 40707 | 601984 |
| d. Spare Parts | 9798 | 515 | 10313 |
| e. Pre-operating Expenses | 9750 | 5250 | 15000 |
| f. Physical Contingency | 41334 | 4591 | 45925 |
| g. Value Added Tax (18%) | | 9715 | 9715 |
| Base Project Cost (BC) | 645634 | 63686 | 709320 |
| h. Initial Working Capital | 0 | 27420 | 27420 |
| i. Interest During Construction | 118935 | | 118935 |
| Total | 764569 | 91106 | 855675 |

Note: Spare parts required for two-year operation are included.

## 8.2 Financial Plan

1) Equity capital ratio: 30%

2) Long-term loan: 70%

Grace period: 3.5 years (construction period)
Repayment schedule: 10 years (20 equal semi-annual installments)
Interest rate: 10% per annum

# Chapter 9 OPERATION PLAN

# Chapter 9 OPERATION PALN

## 9.1 Organization and Workforce

The organization of the company operating the mill and its manpower plan are summarized in Figure 9.1. The preliminary employment schedule in the project period is as follows:

| | |
|---|---|
| First year (2003) | : 7 |
| Second year | : 83 |
| Third year | : 277 |
| Fourth year | : 505 |
| Fifth year | : 612 (including 12 instructors for plant operation) |
| Sixth year and afterward | : 599 (regular workforce) |

## 9.2 Production Plan

(1) Operation method

| | |
|---|---|
| a. Work shift | : 3-shift, 4 crew |
| b. Annual operating days | : 340 |
| c. Shutdown due to scheduled maintenance | : 20 |
| d. BSKP production days | : 188 |
| e. BHKP production days | : 152 |
| f. Switching cycle | : 10 days for BSKP<br>8 days for BHKP |

(2) Operating rate

Operating rates are assumed as follows. The mill will be operated at full capacity in the third year on.

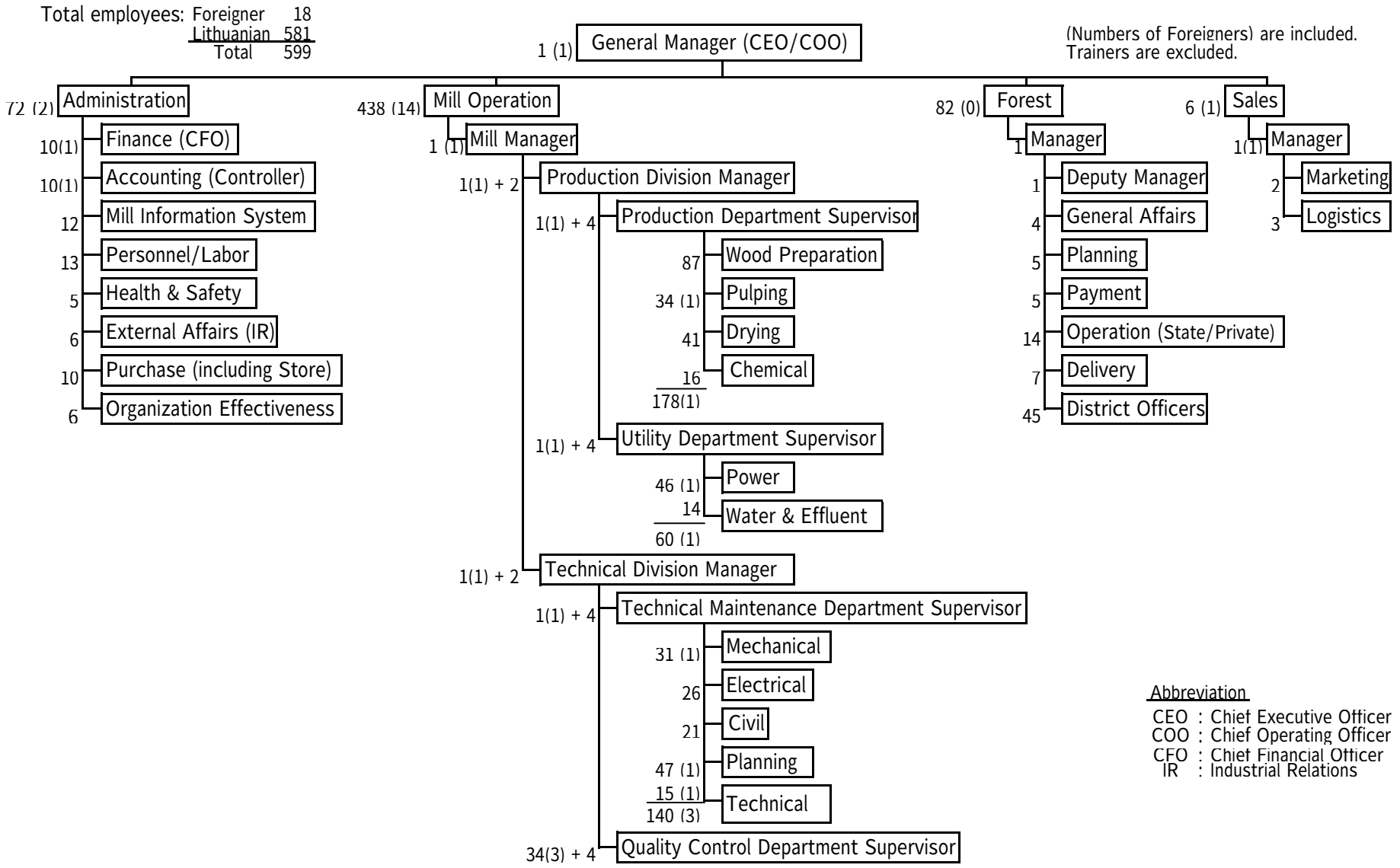
| | |
|---|---|
| Initial year | : 80% |
| Second year | : 95% |
| Third year | : 100% |

(3) Production plan

Daily production capacities are assumed to be 1350ADt for BSKP and 1620ADt for BHKP. The production plan in the first three years is as follows:

| | BSKP | BHKP | Total |
|---|---|---|---|
| First year | 203040 | 196992 | 400032 |
| Second year | 241110 | 233928 | 475038 |
| Third year and afterwards | 253800 | 246240 | 500040 |

Figure 9.1.1 Company Organization and Manning table ( in Full Operation)



# Chapter 10 FINANCIAL ANALYSIS

# Chapter 10 FINANCIAL ANALYSIS

## 10.1 Major Assumptions

Basic assumptions for financial analysis are as follows:

a. All prices and costs are indicated in the U.S. dollar and are fixed as of the second quarter of 2000, and no escalation is assumed.
b. The project life is 15 years after the start of commercial operation.
c. The surplus should be distributed by the 20% dividend, which started in the third year, depending on actual cash flow. The surplus after the dividend will be retained throughout the project period.

## 10.2 Sales Plan

(1) Sales volume

The sales volume is assumed to be the annual production volume less inventory equivalent to 0.5 months of production.

(2) Sales prices

Sales prices of BSKP and BHKP are assumed to be their average market prices in the second quarter of 2000, less transportation cost from the mill site to Europe.

BSKP : USD640/ADt
BHKP : USD615/ADt

## 10.3 Operating Costs

(1) Variable costs

Variable costs in full capacity operation are estimated as follows.

| | | |
|---|---|---|
| a. | Pulpwood | : USD58309000 |
| b. | Chemicals and packaging materials | : USD10640000 |
| c. | Utilities and energy | : USD3280000 |
| | Total | : USD72229000 |

(2) Fixed costs

Fixed costs are estimated as follows.

a. Labor : USD6078000
b. Maintenance : USD8575000
c. Taxes and insurance premium : USD4038000
d. Operating guidance (2 years) : USD802000
e. Depreciation of tangible assets
   Depreciation method : Straight line
   Service life : Equipment 10 years
      Utilities/off-site facilities : 10 years
      Buildings : 20 years
   Salvage value : 0
f. Depreciation of intangible assets (deferred charges)
   Depreciation method : Straight line
   Service life : 5years
   Salvage value : 0
g. Sales expenses : 1% of sales.

(3) Corporate income tax

In Lithuania, the corporate income tax rate is 24% on income before tax. For the project, the following tax incentives are assumed to be granted:

a. 5 years after the start of commercial operation: Income tax exempted
b. 6 – 10 years: 50% reduction

## 10.4 Results of Financial Analysis

Based on the above assumptions and conditions, financial statements were made over the entire project life and financial analysis was performed to determine the project's profitability and soundness. The results are summarized as follows.

(1) Profitability

1) Financial internal rate of return (FIRR)

a. FIRR on total investment
   Before tax : 19.02%
   After tax : 18.19%

b. FIRR on equity capital

Before tax : 24.71%

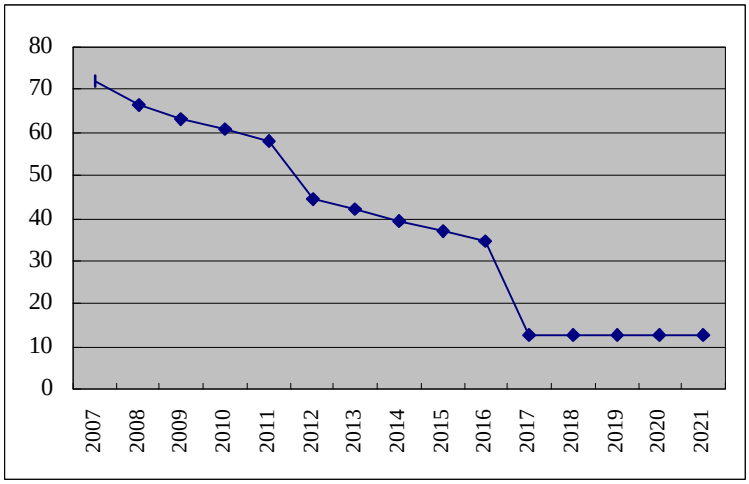
After tax : 23.50%

2) Profit Break-even point

For the purpose of this financial analysis, the profit break-even point for the project is measured by the capital utilization rate, as follows.

Capacity Utilization Rate

| Year | B.E.P. | Planned |
|---|---|---|
| 2007 | 72.0% | 80% |
| 2008 | 66.4% | 95% |
| 2009 | 63.3% | 100% |
| 2010 | 60.6% | 100% |
| 2011 | 58.1% | 100% |
| 2012 | 44.4% | 100% |
| 2013 | 41.9% | 100% |
| 2014 | 39.4% | 100% |
| 2015 | 37.0% | 100% |
| 2016 | 34.5% | 100% |
| 2017~ | 12.4% | 100% |




3) Sensitivity analysis

The changes in the FIRRs due to variations of major cost items and price factors (construction cost, pulpwood price, labor cost, produce price, and capacity utilization rate) are simulated and summarized in Table 10.1 and Figure 10.1 (FIRROI, FIRROE).

# Table 10.1 Sensitivity Analysis

| Case | | | UNIT | Modified Figure | | FIRR Bfr Tax (%) | FIRR Aft Tax (%) | FIRROE(Aft.Tx) (%) | SENSITIVITY INDICATOR | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | FIRR-B-T | FIRR-A-T | FIRROE |
| **Base Case** | | | | | | **19.02** | **18.19** | **23.50** | Change in IRR per one percent of Deviation | | |
| **Capital Requirement** | | | 1000US$ | | | | | | | | |
| | + | 20% | | 1026810 | | 16.27 | 15.44 | 18.40 | -0.14 | -0.14 | -0.26 |
| | + | 10% | | 941243 | | 17.56 | 16.73 | 20.80 | -0.15 | -0.15 | -0.27 |
| **Base Case** | | **0%** | | **855675** | | **19.02** | **18.19** | **23.50** | 0 | 0 | 0 |
| | - | 10% | | 770108 | | 20.7 | 19.87 | 26.59 | 0.17 | 0.17 | 0.31 |
| | - | 20% | | 684540 | | 22.66 | 21.84 | 30.14 | 0.18 | 0.18 | 0.33 |
| | | | | | | | | | | | |
| **Pulpwood Price** | | | US$/m3ub | Soft Wood | Hard Wood | | | | | | |
| | + | 20% | | 31.96 | 24.43 | 18.11 | 17.27 | 21.77 | -0.05 | -0.05 | -0.09 |
| | + | 10% | | 29.29 | 22.40 | 18.57 | 17.73 | 22.64 | -0.04 | -0.05 | -0.09 |
| **Base Case** | | **0%** | | **24.58** | **18.45** | **19.02** | **18.19** | **23.50** | 0 | 0 | 0 |
| | - | 10% | | 23.97 | 18.32 | 19.47 | 18.64 | 24.35 | 0.04 | 0.04 | 0.09 |
| | - | 20% | | 21.3 | 16.29 | 19.91 | 19.08 | 25.91 | 0.04 | 0.04 | 0.12 |
| | | | | | | | | | | | |
| **Labor Cost** | | | 1000US$ | | | | | | | | |
| | + | 50% | | 6078 | | 18.78 | 17.95 | 23.05 | -0.00 | -0.00 | -0.01 |
| | + | 30% | | 5268 | | 18.88 | 18.04 | 23.23 | -0.00 | -0.01 | -0.01 |
| | + | 10% | | 4457 | | 18.97 | 18.14 | 23.41 | -0.01 | -0.01 | -0.01 |
| **Base Case** | | **0%** | | **4052** | | **19.02** | **18.19** | **23.50** | 0 | 0 | 0 |
| | | | | | | | | | | | |
| **Operational Rate** | | | % | | | | | | | | |
| | - | 50% | | 40-47.5-50% | | 8.33 | 7.72 | 4.19 | -0.21 | -0.21 | -0.39 |
| | - | 30% | | 56-66.5-70% | | 13.23 | 12.42 | 12.75 | -0.19 | -0.19 | -0.36 |
| | - | 10% | | 72-85.5-90% | | 17.25 | 16.42 | 20.21 | -0.18 | -0.18 | -0.33 |
| **Base Case** | | **0%** | | **80-95-100%** | | **19.02** | **18.19** | **23.50** | 0 | 0 | 0 |
| | | | | | | | | | | | |
| **Product Price** | | | US$/MT | BSKP | BHKP | | | | | | |
| | - | 50% | | 320.00 | 307.50 | 3.50 | 3.50 | -2.47 | -0.31 | -0.29 | -0.52 |
| | - | 30% | | 448.00 | 430.50 | 11.04 | 10.29 | 8.85 | -0.27 | -0.26 | -0.49 |
| | - | 10% | | 576.00 | 553.50 | 16.63 | 15.80 | 19.05 | -0.24 | -0.24 | -0.45 |
| **Base Case** | | **0%** | | **640.00** | **615.00** | **19.02** | **18.19** | **23.50** | 0 | 0 | 0 |
| | + | 10% | | 704.00 | 676.50 | 21.22 | 20.39 | 27.59 | 0.22 | 0.22 | 0.41 |
| | + | 30% | | 832.00 | 799.50 | 25.17 | 24.37 | 34.83 | 0.21 | 0.21 | 0.38 |
| | + | 50% | | 960.00 | 922.50 | 28.67 | 27.91 | 41.10 | 0.19 | 0.19 | 0.35 |

Figure 10.1 Sensitivity Analysis (FIRROI)

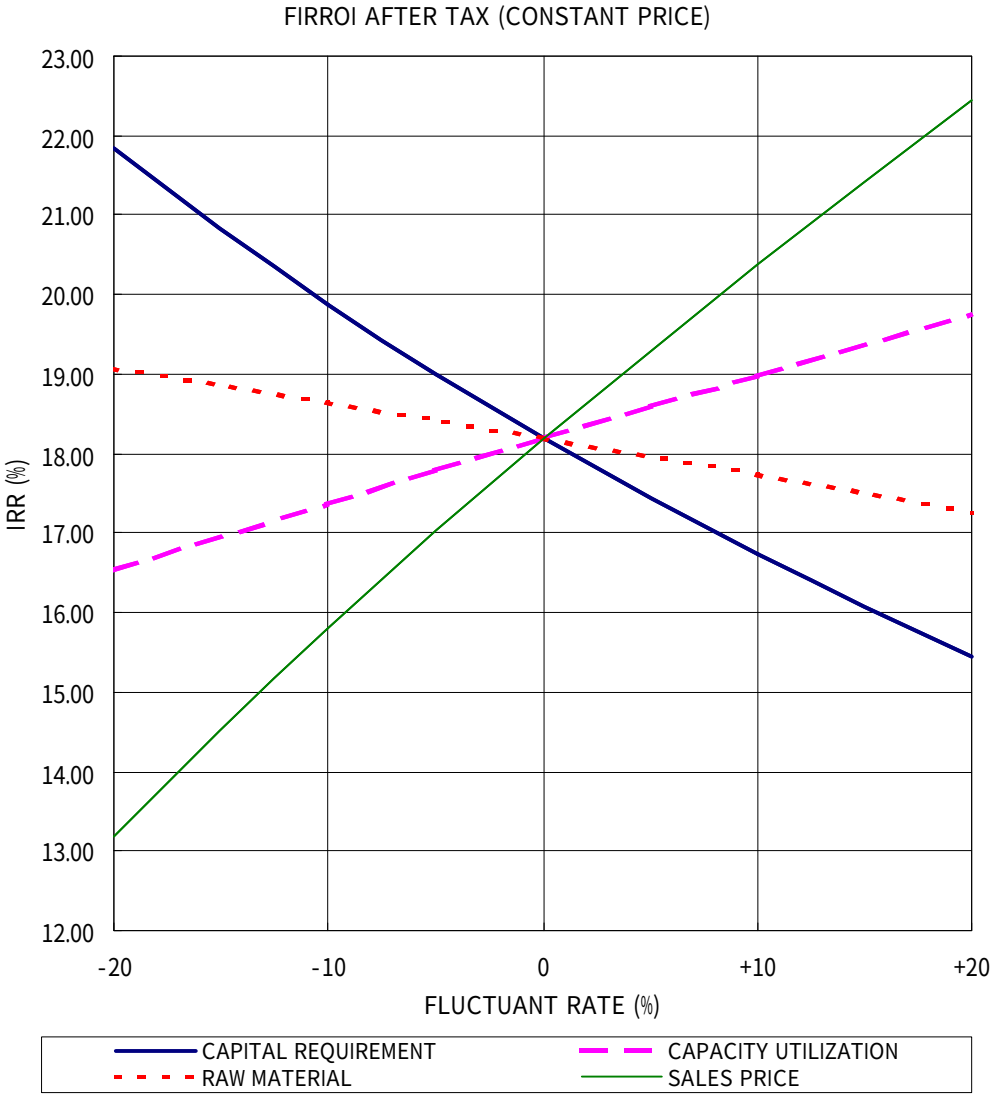
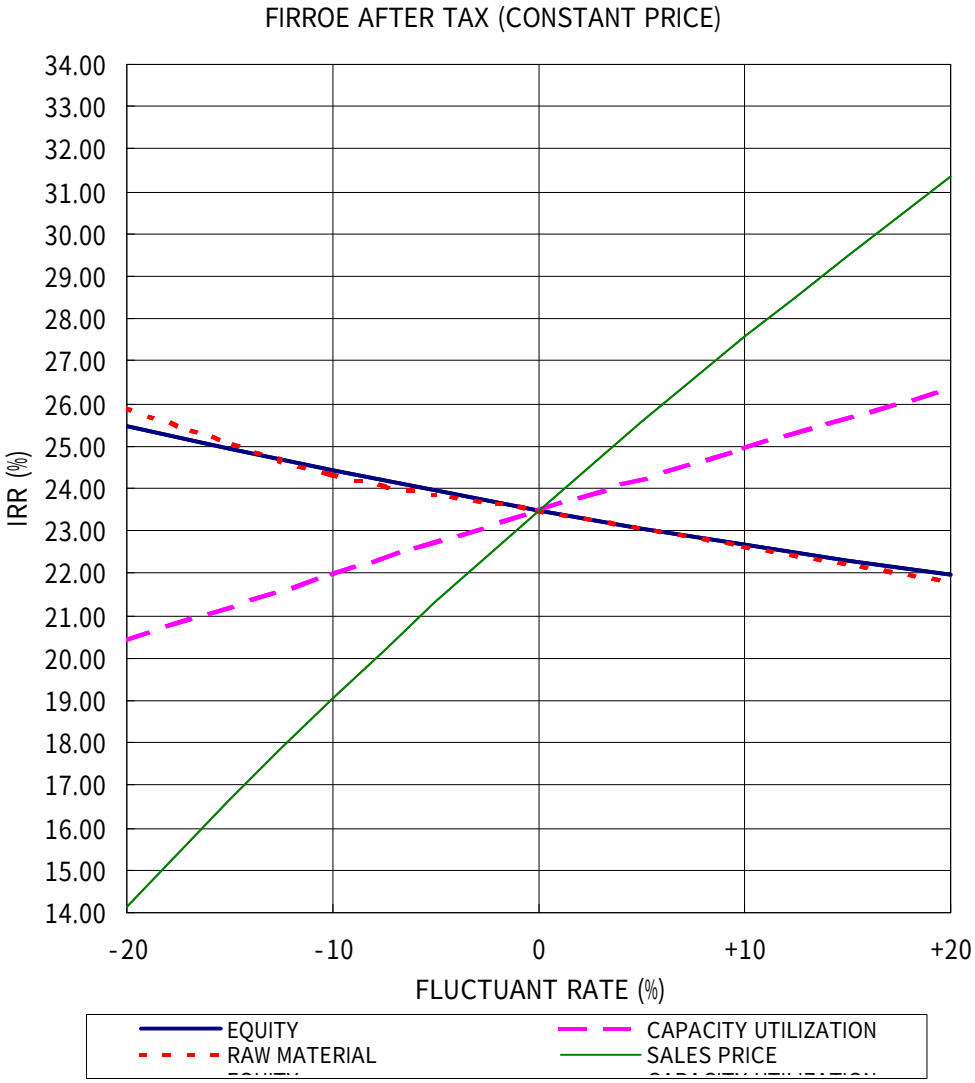


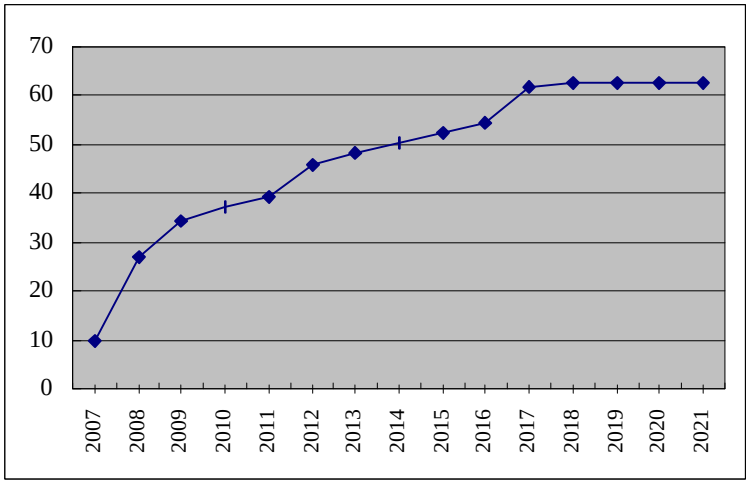
Figure 10.1 Sensitivity Analysis (FIRROE)



4) Profit rate on equity capital

The Profit rate on equity capital over the project life are as follows.

| Year | Profit to Shared Capital |
|---|---|
| 2007 | 9.8% |
| 2008 | 26.9% |
| 2009 | 34.5% |
| 2010 | 37.1% |
| 2012 | 45.7% |
| 2014 | 50.2% |
| 2016 | 54.3% |
| 2018 | 62.6% |
| 2020 | 62.6% |

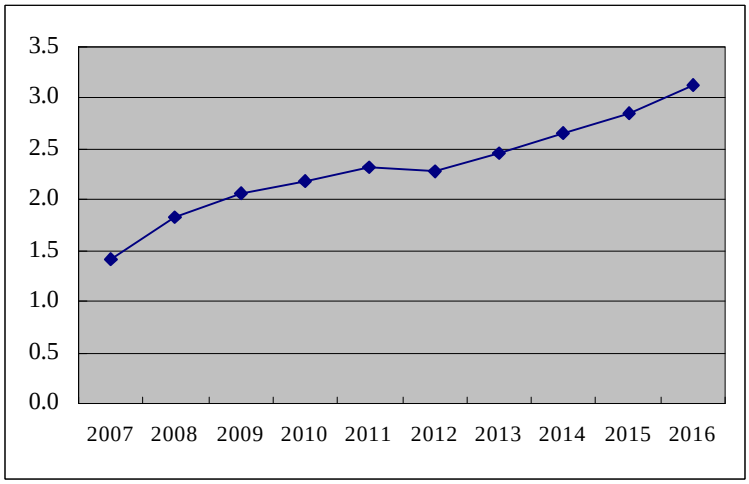



(2) Analysis of financial stability

1) Debt service coverage ratio (DSCR)

The DSCR to measure the project's ability to repay debt is estimated as follows.

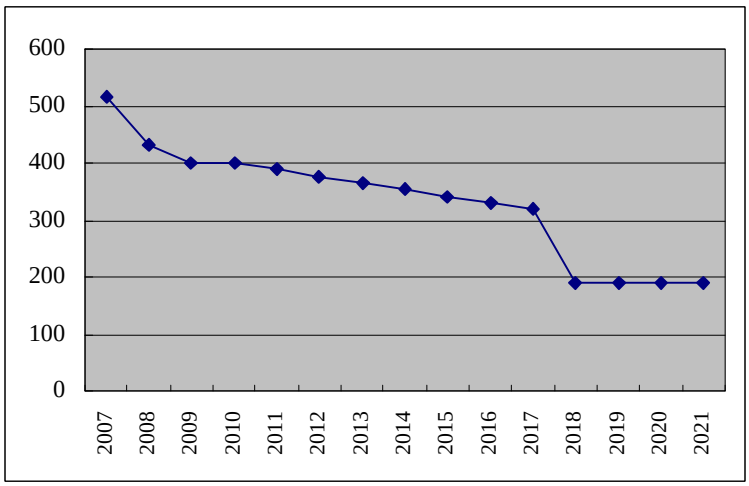
| Year | DSCR |
|---|---|
| 2007 | 1.42 |
| 2008 | 1.83 |
| 2009 | 2.06 |
| 2010 | 2.19 |
| 2011 | 2.33 |



2) Cash Break-even point measured by product price

The marginal produce price corresponding to the cash break-even point in each year is shown below.

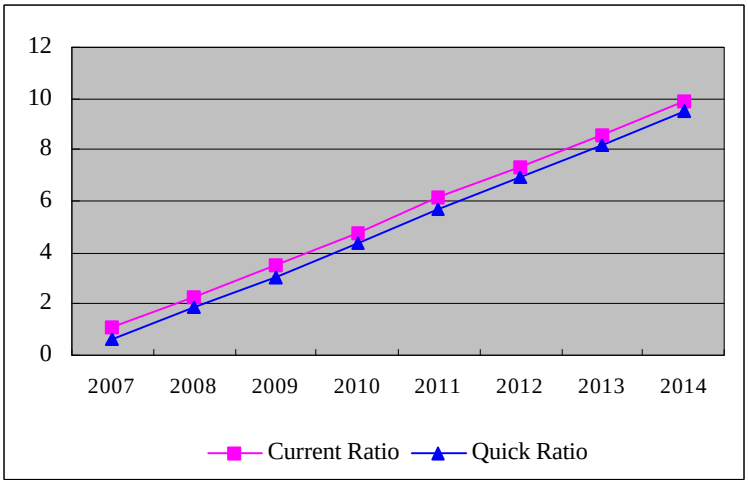
| Year | Product Price BEP (USD /T) |
|---|---|
| 2007 | 516.50 |
| 2008 | 431.00 |
| 2009 | 401.60 |
| 2010 | 388.80 |
| 2011 | 376.80 |
| 2012 | 365.60 |
| 2013 | 353.60 |
| 2014 | 341.60 |




3) Liquidity ratio

Liquidity ratios (current and quick) to measure soundness of repayment capacity and cash flow are as follows.

| Year | Current Ratio | Quick Ratio |
|---|---|---|
| 2007 | 1.08 | 0.65 |
| 2008 | 2.28 | 1.84 |
| 2009 | 3.50 | 3.06 |
| 2010 | 4.79 | 4.34 |
| 2011 | 6.12 | 5.68 |
| 2012 | 7.33 | 6.90 |
| 2013 | 8.60 | 8.18 |
| 2014 | 9.93 | 9.51 |



## 10.5 Conclusion

In conclusion, the project is financially feasible and its financial base is expected to be sound over the project life, for the following reasons.

(1) Profitability

a. The project shows good profitability for the base case analysis and is therefore financially feasible.
b. The FIRROI, which serves as the indicator of dividend propensity to shared capital, indicates that the project will be able to distribute the 20% dividend from the second year.
c. The break-even point measured by the operating rate is 72.0% in the first year, below the planned operating rate, to indicate sound profitability.
d. The result of sensitivity analysis indicates that the project's profitability is most sensitive to the produce price. Market prices have increased over the average price in the second quarter of 2000 and are expected to rise for the time being.

   The capacity utilization rate is the second important sensitivity factor. Again, BKP demand grows steadily and is expected to work favorable for the capacity utilization rate, which is thus not likely to fall for market reasons.

   Similarly, the rise in construction cost is not conceivable because pulp mill investment levels off worldwide and paper machine manufacturers do not have enough backlogs.

(2) Financial stability

a. The debt service coverage ratio (DSCR) to measure the project's loan repayment capability is fairly high at 1.42 in the first year and will increase to 1.83, 2.06 and 2.19 in the subsequent years, indicating that the project will be able to pay back its debt quickly.
b. The cash flow prediction negates the need for short-term loans. This study sets a conservative assumption that the 20% dividend will start in the third year. With the dividend, the surplus will grow steadily to improve the project's financial base. The marginal product price to represent the project's break-even point is USD516.5/ton in the first year, which will fall below USD400 in the third year and thereafter. Compared to the current

world market prices and future projections, the project will be able to operate far above the break-even point.

c. The liquidity ratio will increase year after year despite the 20% dividend that is assumed to start in the third year.

# Chapter 11 INVESTMENT PROMOTION STUDY

# Chapter 11 INVESTMENT PROMOTION STUDY

(1) Institutional Framework and current status related to foreign direct investment

The Government of Lithuania strongly feels the need for foreign direct investment as an essential vehicle for stabilization and development of the country's economy and has been making efforts to improve the investment climate to attract foreign investment. Essentially, it strives to gain confidence of foreign investors by building or modernizing the institutions and systems to be compatible with those in the EU, while providing the environment for foreign firms to conduct business activities freely in more or less the same way as Lithuanian firms. The Lithuania Development Agency has been established as a major vehicle for these efforts and provides support for foreign firms in their feasibility analysis, market research and information service. Nevertheless, the government feels the need for stepping up the efforts to attract foreign investment. In particular, administrative procedures, such as business registration, tax-related registration, land acquisition, and construction permit, need to be streamlined to ensure efficient service for foreign investors.

In the report made by the FIAS, the World Bank and the IFC in 1999, improvements are recommended for the following areas:

1. Improvement of inefficient corporate registration procedures at local government level;
2. Improvement of unfair intellectual property rights registration fees for foreign corporations;
3. Improvement of complicated and unfair land acquisition procedures;
4. Simplification of inefficient land registration procedures;
5. Simplification of undue and duplicated construction permit procedures;
6. Abolition of a complicated licensing system and unfairly imposed license fees for foreign corporations;
7. Simplification of tax examination that exerts heavy burdens on subject companies;
8. Abolition of burdensome recording requirements for every transaction and ownership transfer, for taxation purposes;
9. Further streamlining of customs clearance procedures;
10. Streamlining of employee hiring and dismissal procedures initiated by companies; and

11. Establishment of clear inspection guidelines to control corruption related to official inspection, together with simplification of inspection procedures and reinforcement of anti-corruption measures.

(2) Foreign direct investment in the Baltic States

Foreign direct investment in the Baltic States has been growing steadily. In particular, direct investment in Lithuania, which was slow at the beginning, is picking up, particularly driven by privatization of Lithuania Telecom. Direct investment in the Baltic States mainly comes from Scandinavia, the EU and the U.S. As for Estonia, Sweden accounts for 41% of total investment and Finland 32%. The two countries represent a combined share of 73%, clearly differentiated from investment patterns in Lithuania and Latvia. Investment from Asia is small but on the rise, including Singapore that is ranked tenth among major investors in Latvia and Estonia. Investment from Japan is very small but general interest in the Baltic States is expected to increase as embassies were established in Japan and the extended EU attracts attention of Japanese businesses.

Foreign Direct Investment in the Baltic States (Aggregate Total)

(USD million)

| | Lithuania | Latvia | Estonia |
|---|---|---|---|
| 1995 | 352 | 615 | 1173 |
| 1996 | 700 | 944 | 1324 |
| 1997 | 1041 | 1291 | 1590 |
| 1998 | 1975 | 1501 | 2163 |
| 1999 | 2413 | 1876 | 2467 |

(Source) Government data and publications

(3) Strengths (comparative advantages) and weaknesses (disadvantages) of the Baltic States

Strengths ( advantages) and weaknesses (disadvantages) of the Baltic States, based on the results of the interview surveys to foreign firms operating in the region, are summarized as follows:

Compared to Lithuania, foreign firms point out three advantages unique to Latvia, “free market,” “availability of competent engineers” and “government’s quick response.” Although the limited number of samples prohibit

generalization, these responses clearly indicate that the market economy in the country has reached at a fairly advanced stage.

In Estonia, some respondents cite "government's quick response" as the country's strength. It is evidenced from a positive attitude of an officer of the Ministry of Economy, who accompanied the study team and asked the respondents to see if they had any problems and requested a written report to the government, if any, while promising quick response and action. Compared to Lithuania, much less respondents complain about slow or inefficient administrative service.

Evaluation by Foreign Firms on the Baltic States

| | Lithuania | Latvia | Estonia |
|---|---|---|---|
| Strengths | Highly skilled, abundant, low-cost labor force<br>Well-developed transportation networks<br>Strategic location bridging the EU and the CIS<br>Low production costs, including living costs<br>Social stability (politics and relations with Russia)<br>A small number of labor disputes<br>Abundant raw materials<br>Excellent universities and college | - Availability of low-cost and highly skilled labor force and competent engineers<br>- Strategic geographical location bridging the CIS and the EU<br>- Free market<br>- Presence of a large number of R&D organizations<br>- Well-developed transportation network<br>- Government's quick response<br>- Future growth potential | - Availability of low-cost and highly skilled labor force and competent engineers<br>- Efficient government service<br>- Strategic geographical location bridging the CIS and the EU<br>- Absence of corporate income tax<br>- Ease of procurement of raw materials<br>- Stable currency |
| Weaknesses | Slow, inefficient government service and complicated procedures<br>Frequent changes in public administration systems and regulations without instruction or advice<br>Complicated procedures related to foreign investment<br>Poor financial service (but improving )<br>Inefficient agricultural sector<br>Poor education and public health systems in rural area<br>Relatively high economic dependency on Russia<br>Small market | - Shortage of human resources<br>- Poor financial service for SMEs<br>- Public image about backwardness compared to Latvia<br>- Lack of tax incentives for investment projects<br>- Inefficient bureaucratic service at local government level<br>- Relatively high dependency on the Russian economy<br>- Frequent changes in government programs and systems with lack of communication by government<br>- Small market | - Low standards of living in rural regions<br>- Shortages of middle management and engineering staff<br>- High financial cost<br>- Shortage of vocational training facilities<br>- Rise in electricity charge |

(Source) Interview surveys

(4) SWOT (Strength/Weakness/Opportunity/Threat) Analysis of Lithuania

1) Strengths and their implications on the project

① Geographical advantage

- Strategic location bridging the EU and the CIS

(Implications on the project)

As the proposed project will not likely target the CIS as its key market, good access to the EU market should be emphasized and demonstrated visually in promotional materials.

② Labor force

- Highly skilled, low-cost and abundant labor supply
- Few labor disputes
- High levels of university education

(Implications on the project)

These advantages appear to exist in the three countries with little difference. Instead, labor advantages over industrialized countries should be appealed to foreign firms.

③ Infrastructure

- Well-developed transportation networks (particularly roads)

(Implications on the project)

Good access from the project site to raw material sources, the EU and Klaipeda Port should be visually presented using a map illustrating the networks.

④ Cost factor

- Low operation and living costs

(Implications on the project)

These advantages appear to exist in the three countries with little difference. Instead, cost advantages over industrialized countries should be appealed to foreign firms.

⑤ Social stability

- Racial harmony, political stability and good relations with Russia

(Implications on the project)

Social stability should be emphasized as a major achievement accomplished after independence.

⑥ Abundant raw materials

(Implications on the project)

As the proposed project requires sufficient supply of wood and water, it is imperative to provide the best conditions for wood supply compared to competing projects.

2) Weaknesses

① Government service

- The interview surveys revealed that foreign firms complained about slow and inefficient government services, complicated procedures, frequent changes in service systems without instruction or advice, and complicated administrative procedures related to foreign investment and its approval.
- The World Bank's report also pointed out many problems related to public service, including poor levels of field service.
- These indicate that field organizations and their service quality have still to be improved.

(Implications on the project)

For many countries, attraction of foreign firms and their investment is one of the most important industrial policies. To promote the country effectively to potential investors, it is recommended to provide integrated service for foreign firms through a designated organization, as seen in "One Stop Service" provided by South Korea. In particular, for a project which involves two or more ministries and covers several administrative units, it is imperative to establish a primary contact at the central government level.

In particular, it is important to provide consistent communication and response to the issues related to land acquisition, procurement of wood materials, and environmental protection including wastewater treatment and discharge.

② Institutional reform

- It is pointed out that the reforms in the Baltic States have progressed at a slower pace than expected.

(Implications on the project)

The proposed project will likely be affected by problems related to day-to-day government service, rather than those related to policymaking and implementation. It is therefore important to secure the government's firm commitment to the support for the project.

③ Business service

- Difficulties in domestic financing and various business-related services, and poor education and public health systems in rural regions

(Implications on the project)

Major issues related to financial service should be addressed in the financial planning stage for the proposed project. Also, the project plan should cover critical business services, such as maintenance and security.

④ Industrial economy

- Some respondents pointed out a relatively high economic dependency on Russia and the small domestic market.

(Implications on the project)

While these factors are not directly related to the proposed project, transformation of industrial structure is critical for overall economic growth.

⑤ Financial policy

- There are some concerns about the devaluation of Litas in the near future, but economic experts in Lithuania rule out the possibility in consideration of the sufficiently high level of foreign currency reserves and good management by the currency board.

(Implications on the project)

As the foreign exchange situation is considered to work against price competitiveness in the EU market, it will also directly affect the proposed project. The currency will be pegged to the Euro in 2001.

3) Opportunities

The proposed project should capitalize on the following opportunities:

① Upturns of the pulp market

② Move toward consolidation and alliance among multinationals

③ Expansion of the EU and long-term growth prospects

④ The subsided Russian currency crisis

(Implications on the project)

These changes in the business environment affect all the Baltic States, Central and Eastern Europe, and the CIS, and it is important to respond to them quickly and in a timely manner.

4) Threats

Major threats to the proposed project in the implementation stage are summarized as follows:

① Intensified competition with other Baltic States, Central and East European countries which also attempt to attract foreign direct investment through aggressive promotion.

② Supposed instability of the foreign exchange system (although compensated for by favorable conditions, such as effectiveness of the currency board, the change to the Euro-pegged system in 2001, and the improved current account balance)

③ Rise in environmental concern and reactionary, excessive regulatory control

④ Possible difficulty in stable procurement of wood materials under a market economy involving some volatility

(Implications on the project)

As for the first threat, the more effective and aggressive promotion is required to compete with other countries. The second threat has to be dealt with by the government within the framework of financial policy. The third threat must be mitigated by introducing latest technology and demonstrating its small environmental impacts. Finally, the fourth threat should be addressed by securing the government's commitment to the project and stable supply of wood materials.

(5) Questionnaire Survey of Potential Investors: Result and Analysis

Before the proposed mill plan was decided, the study team conducted a questionnaire survey of around 300 paper and pulp companies to ask about their interest in this project and find out the key successful factors for the project. The survey was conducted by sending a simplified form of questionnaire (questions shown below) to senior managers.

The questionnaire was designed jointly with the Lithuania Development Agency (LDA) and sent under the name of the LDA's manager in charge of investment by facsimile or e-mail.

Key question items:

① General interest in Lithuania as a place of investment;

② A future outlook for pulp and paper demand as industrial materials;

③ A need for new pulp mill construction to meet future requirements for raw materials;
④ A need for new pulp mill construction to produce market pulp and paper in the future;
⑤ Major factors for making mill construction decision; and
⑥ Interest in obtaining a report on this project.

To this date, seven companies responded. Their nationalities are two Italian, one Swedish, one Finnish, one German, one Austrian and one Spanish.

Their responses are summarized as follows.

- Six respondents expressed general interest in Lithuania as a place of investment.
- Five expect growing pulp and paper demand in the future.
- Three feel the need for mill construction to secure raw materials.
- Three feel the need for mill construction to manufacture commercial pulp and paper products.
- Four wish to obtain the project report.

Respondents (although a limited number so far) show generally strong interest in Lithuania and pulp and paper business. Together with the results of the supply and demand survey, the project is expected to attract attention in Europe.

Major factors considered in deciding mill construction are summarized as follows.

- Four companies cited: ① availability of wood resources; ② low operating cost; and ③ transportation network.
- Three cited: ① the country's stability; and ② currency stability.
- Two cited availability of water resources and effluent treatment service.
- One cited low wage.

No respondent cited geographical proximity to the market and tax incentives.

According to leading pulp and paper trading companies in Japan, availability of wood resources is of primary importance for any pulp mill projects; it is the prerequisite to investment decision. Also, tax incentives are considered to

play a crucial role in attracting investment, as evidenced from the results of the interview surveys of foreign firms operating in Lithuania.

Result of questionnaire survey

| Item | Italy (1) | Italy (2) | Sweden (1) | Finland (2) | Austria (1) | Spain (1) | Germany (1) | Total |
|---|---|---|---|---|---|---|---|---|
| General interest in Lithuania as a place of investment | Yes | Yes | Yes | Yes | Yes | None | Yes | Yes (6) |
| Future outlook for pulp and paper demand | Very good | Good | Good | Good | Good | Not good | N/A | Good (5) |
| Need for a new mill to secure raw materials | Yes | Yes | Yes | None | None | None | N/A | Yes (3) |
| Need for a new mill to manufacture commercial products | Yes (strongly felt) | None | Yes | Yes (distant future) | None | None | N/A | Yes (3) |
| Interest in a report on this project | Yes | Yes | Yes | None | Yes | N/A | N/A | Yes (4) |
| Key factors for mill construction | | | | | | | | |
| Availability of wood resources | Yes | | Yes | Yes | | Yes | | 4 |
| Availability of water resources/effluent treatment service | | Yes | | | Yes | | | 2 |
| Low wage | | Yes | | | | | | 1 |
| Low operating cost | Yes | | | Yes | Yes | Yes | | 4 |
| Transportation network | Yes | Yes | | Yes | Yes | | | 4 |
| Proximity to the market | | | | | | | | None |
| The country's stability | | | Yes | Yes | | Yes | | 3 |
| Currency stability | | | Yes | | Yes | Yes | | 3 |
| Tax incentives | | | | | | | | None |

Sources) Questionnaire survey

(6) Major Characteristics of Pulp and Paper Making Business and Foreign Investment Promotion Measures

1) Characteristic 1: Resource-intensive industry with a strong need for proximity to the source of raw materials

Pulp and paper making operations consume large amounts of wood and water resources, which availability holds therefore the key to success of the business.

Latvian and Estonian governments have announced to guarantee wood supply up to 40-50% of requirements for respective projects.

The supply guarantee by the Latvian government may be made in the form of purchase agreement with the government, but it creates fluctuation of price and supply volume due to the country's ongoing transition to a market economy. Instead, a more stable supply mechanism is being considered; the government makes equity participation in the project by contributing state forests as assets of the pulp and paper company. This arrangement will eliminate the land acquisition and wood purchase costs on the company side, while providing stable returns to the Latvian government in the form of dividend as it gives up revenues from land and lumber sales. As the arrangement means that the government will participate in a joint venture with foreign corporations, it must understand and adapt itself to modern corporate management. Note that the joint venture by the private enterprise and the government is doomed to failure if the government tries to manage the company as a government organization.

On the other hand, Estonia is trying to attract investment by proposing six candidate sites and offering the government's supply guarantee of 40% or 1.1 million $m^3$, a long-term contract (10 – 20 years) and price negotiation based on the market price. Also the government suggests that it is ready to negotiate tariff exemption or reduction on imported equipment, and a broad range of support including land acquisition, infrastructure development, employee education and training, and financial assistance.

In Lithuania, foreign firms are not allowed to acquire farmland, which must be leased on a long-term basis. Foreign firms often express complaints about administrative procedures related to land acquisition or leasing. It is now important to make progress in institutional reforms related to land acquisition and registration, which seem to be scheduled to complete by 2003.

An alternative approach is the forest management contract that is adopted for a pulp mill project of Mitsubishi Corporation in Alberta, Canada. The 20-year foreign management contract allows the paper mill to harvest and use wood resources in return for specific prices and requires the company to maintain and manage the forest. According to a leading pulp and paper trading company in Japan, the pulp and paper project requires a large amount of initial investment and thus the government's supply guarantee is one of the basic requirements for investment decision.

Thus, one of the key success factors for this project is to offer the supply guarantee and a transparent price negotiation system based on the market price, which are more attractive than those offered by Latvia and Estonia.

2) Characteristic 2: Capital-intensive operation requiring incentives to ensure a higher rate of return on investment

The pulp and paper mill sometimes requires large-scale capital investment close to 100 billion yen. It must create scale of economies because technology is matured and products are not high value added.

Massive capital investment entails a relatively long period for startup of commercial operation, which increase fixed costs, and initial costs serve as a determinant factor for project viability. Investment incentives therefore play an important role in reducing initial costs and improving financial viability of the project. In fact, foreign firms who responded to the interview surveys highly valued tax incentives valid until April 1, 1997. The incentives were replaced with the "Strategic Investor" certification program which provides incentives on a negotiation basis. For the proposed project, it is important to offer the old incentives or tax incentives applied to the FEZ.

Comparing the present tax incentives for Lithuania's FEZ and those for Latvia's SEZ reveals that the two programs offer similar tax incentives including the corporate income tax, except for the 10-year carryover of operating loss. While the proposed project is limited in site selection and is unlikely to select the FEZ, its large size requires tax incentives equivalent to those available in the FEZ. In this conjunction, additional or accelerated depreciation introduced in Latvia also work to improve the project cash flow and is an effective means to increase viability of the capital-intensive business like paper and pulp.

Also, the joint venture business model introduced in Latvia seems to be eligible for serious consideration.

| Tax Incentives for FEZ in Lithuania | Tax Incentives for SEZ in Latvia |
|---|---|
| For investment exceeding $1 million, the corporate income tax is exempted for the initial five years and 50% reduction is applied for the subsequent ten years.<br>For investment less than $1 million, 80% reduction of the corporate income tax is applied for the first five years, followed by 50% reduction in the additional five years, plus exemption of VAT, customs duties, road tax, real estate tax and/or withholding tax. | Refunding of land and property taxes (80-100%), accelerated depreciation up to 100%, carryover of operating loss over 10 years, refunding of corporate income tax up to 80%, refunding of withholding tax up to 80%, exemption of withholding tax, and/or exemption of customs duties. |

3) Characteristic 3: Unstable, matured industry requiring quick response to market conditions

While the pump market is on the way to recovery, the previous upward cycles accompanied the booming mill construction that led to the price decline and market downturns. Recently, large pulp mill projects have been announced in Estonia and Latvia. The project in Latvia is in the stage of feasibility study, which will be carried out by a company established in this April by the Latvian government and Finnish and Swedish companies. The study will be completed by the end of 2002. If the project progresses smoothly, it will affect the proposed project because the two firms participating in the Latvian project are market pulp manufacturers. Time is of essence for the Lithuanian project. As it is desirable to include the above incentives in the prospectus for the project, in addition to the project outline, the government is expected to establish its integrated policy for investment promotion.

4) Characteristic 4: Significant environmental impact requiring cooperation of local communities

As the pulp and paper industry creates the risks of producing water and/or air pollution, close cooperation of local communities is essential in addition to the use of latest pollution control technology. In fact, such cooperation is an integral part of the project and requires extensive preparation. And good communication with local residents and organizations plays a vital role in achieving the goal by exchanging opinions and keeping each other informed.

5) Other

The proposed project must offer more attractive conditions than those of the Estonian and Latvian projects.. To achieve the goal, however, it is recommended to emphasize price advantages compared to the EU and wood resource reserves, which is more effective than advertising price differentiation, the government's supply guarantee and other advantages compared to Estonia and Latvia.

(7) Need for Policies and Programs Focusing on Foreign Investment

1) Major issues related to attraction of foreign investors to the proposed project

From the results of the field surveys conducted so far, including interview surveys, important findings are summarized as follows.

In light of the recovery of the world pulp market and increased global procurement and production, the project will likely attract attention of pulp and paper companies. In fact, the questionnaire survey of a limited number of companies indicates that several companies are considering construction of a new mill and wish to obtain a final report on this project.
(Four companies requested the report and three of them feel the need for new mill construction.)

Foreign firms operating in Lithuania seem to manage relatively well by weathering the Russian financial crisis. However, they point out a number of problems related to government service, including: ① slow and insufficient service; ② lack of timely and useful information and advice; and ③ unnecessary inspection and check. These problems are also raised by the World Bank and other international organizations. As mentioned earlier, the FIAS, the World Bank and the IFC compiled the report entitled " Lithuania - Study of Administrative Barriers to Investment" in 1999, and the Lithuanian government established the Supervisory Commission for Preparation of Strategic Plan on Improvement of Business Environment that consisted of 12 groups. The commission has started discussion on the ways to improve the investment environment, but it may not be able to produce meaningful results as it is represented by various industries and organizations that have conflict of interest. On the other hand, few complaints are heard about government service in Estonia. In Latvia, similar surveys were conducted in 1998 and

follow-up surveys in 2000. As a result, improvements in many areas have been confirmed.

Today, most countries are constantly evaluated by various organizations for their investment climate and business environment. In many ratings, Lithuania is placed behind Estonia and Latvia. Nevertheless, the results of the interview and other surveys do not indicate significant differences among the three countries, except for quality of government service. On the other hand, Lithuania is widely recognized for its slow pace of change, which is reflected in ongoing reforms of public service. As many countries are fiercely competing for foreign investment, especially direct investment involving construction of new factories, administrative and other reforms should be promoted vigorously as the means to create the country's edges in the global competition.

2) Need for commitment by the political leader and the government

To ensure successful implementation of the proposed project, intensive and continued commitments by the prime minister and the government are essential as a major impetus.

A large project such as this involves a large number of stakeholders who negotiate to reflect their own interest in proceeding with the project.Stakeholders in this project include the Ministry of Economy, the Ministry of Environment, the Ministry of Social Welfare and Labor, the Ministry of Agriculture, the LDA, local governments and private enterprises who show interest. The negotiation process will be inevitably complex and thus will require strong commitment and support of the prime minister and the executive office. Without it, the project will soon reach a stalemate in the present government organization.

Also, continuous commitment by the leadership is essential in keeping the vigor of the stakeholders and potential investors because it takes considerable time for foreign investors to make investment decision after carrying out feasibility study. The commitment, as announced by the government, creates a sense of security for potential investors to make commitment on their side.

The strong commitment should be the prerequisite to implementation of the subsequent program.

3) Wood supply guarantee in competitive condition

Foreign firms are expected to consider availability of raw materials as the primary factor for investment decision, which is far more important than other factors. This should be assured by the government's supply guarantee.

In fact, the Latvian and Estonian governments are considering the supply guarantee to cover 30% - 50% of log requirements for their pulp mill projects.

The Lithuanian government is expected to offer the supply guarantee that can compete with those offered for the competing projects. The State Forest Agency should offer a long-term supply contract (10 – 20 years) for a foreign pulp company, under an annual or semi-annual price negotiation system based on the market price.

4) Competitive advantages for mill construction and operation

The results of the interview surveys of foreign operators and the questionnaire survey of potential investors indicate that good transportation networks and low operating costs are important factors for selection of a pulp mill site. The government is required to be flexible and innovative in meeting these requirements. In addition, tax incentives are an important factor for investment decision. While respondents to the questionnaire survey did not cite tax incentives as a determinant factor, the interview surveys reveal that some foreign firms operating in the country highly value the old taxation system (before 1997) that accompanied attractive tax incentives. As tax incentives have the most tangible effect on the return on investment, the Lithuanian government should offer tax incentives equivalent to or better than those applied to the competing pulp projects in Latvia and Estonia. As pointed out earlier, the Estonian government reduced the corporate income tax rate to zero in 2000, in an attempt to provide a simple, comprehensive package of investment incentives for foreign firms.

5) Establishment of a task force team under the strong leadership

Various reports and analyses suggest difficulty in ensuring efficient and collaborative management of a public program or project that involves multiple government organizations in Lithuania , which still work under the old bureaucratic system. The reforms of public service by the Lithuanian government seem to be far from producing the definite results.

Fortunately, however, the government has gained some experiences in bringing foreign investment to the country. In fact, it can boast the cases of Siemens and Peninox as great success stories. These projects were once stalemated in the course of negotiation. Prime Minister Paskas appointed Mr. G. Rainys, vice minister of the Ministry of Economy, to the project leaders. He was given of full power and authority to use all the government functions for implementation of the projects. He successfully demonstrated a strong leadership in rescuing the projects from the deadlock. While this approach is still effective, some modification is required to reflect the changes in the bureaucratic organization since then. It is therefore recommended to appoint a task force team that is led by an executive officer with strong leadership and several experts assigned from related ministries and agencies.

The membership should be less than 10 in order to ensure quick decision and action, while all members should be fluent in English.

An example of the team organization is shown below:

Task force team by stages

| | | Promotion stage | FS stage by companies | Construction stage | Operation stage |
|---|---|---|---|---|---|
| Project leader | Vice minister of the Ministry of Economy | ◎ | ◎ | ◎ | △ |
| Coordinator | Staff of the Ministry of Economy | ◎ | ◎ | ◎ | △ |
| Marketing/investor relations | Staff of the LDA | ◎ | ◎ | ◎ | △ |
| Forestry resource/wood supply | Staff of the Forestry Bureau | △ | ◎ | ◎ | ○ |
| Environment | Staff of the Ministry of Environment | △ | ◎ | ◎ | ○ |
| Local community/relations | Staff of the Ministry of Agriculture and local governments | △ | ◎ | ◎ | ○ |

Reference) ◎:very important, ○: important, △: participation necessary
Source) JICA study team

6) Establishment of the "one-stop shop" system and expansion of the LDA

According to the results of the interview surveys of foreign firms operating in the Baltic States, those operating in Lithuania are dissatisfied with inefficient and slow government response and action, particularly the lack of information input related to the ongoing institutional reforms and their impacts, and the lack of timely or appropriate advice.

In contrast, these complaints were not heard from foreign firms operating in Latvia and Estonia. While the interview surveys do not necessarily reveal all impediments or barriers to foreign investment, they at least confirm the similar reports of the World Bank, the EBRD and other international organizations.

As foreign firms establish local subsidies, acquire land, build factories and other facilities and operate them, they have to contact and negotiate with a number of government offices and other organizations. Clearly, the present bureaucratic system is perceived as a major barrier to foreign investment, and an effective solution is to create or appoint an organization which serves as a single contact point for foreign firms to provide integrated service. Foreign

firms can ask questions to and obtain answers from the organization, ranging from project inception to the start of operation.

Typically, such "one stop shop" system provides: (1) information on the legal framework, systems, policies and programs related to foreign investment and its promotion; (2) information on investment opportunities; (3) regional information including special zones or areas designated for investment promotion; (4) support for administrative and other procedures related to investment; and (5) support for specific issues related to investment (e.g., finance, labor, taxation). As these functions are primarily possessed by the LDA, the "one stop shop" service organization will likely be based on the LDA with some additional functions as required.

In Latvia, the corporate registration office will merge with the tax registration office in 2001 and the new organization will move to the building that accommodates the Latvia Development Agency. The new office will also contain offices of lawyers and business consultants, and information desks of international organizations. It will still fall short of "one stop shop" service but will be fairly convenience for foreign firms.

7) Transparency of the project and its process to the public

This project will require a large amount of money, with the initial investment amounting to approximately $900 million and the annual operating cost of $150 million, and will employ around 600 people. As the project is expected to create considerable economic interest for the entire country and the area where the project takes place, it is important to implement it in a fair manner by securing transparency of the entire process from inception to planning, implementation and management. In particular, transparency must be maintained for various negotiations that often become a spawning ground for unfair practice, corruption and anti-competitive act.

8) Effective response to companies who have expressed interest

As promotional materials are distributed, there will be companies which will express interest in the project. While appropriate information should be provided to such inquiries, it is not desirable to evaluate these companies by rating them in order of preference at an early stage; it does not serve the best

interest of the project of such large size. They should be evaluated in overall consideration of numerous factors, including the intent and policy related to the project, as well as reputation and credibility.

If more than two companies express interest, the request for proposal may be issued to selected company groups to compete for the best proposal. On the other hand, additional promotion may be required if only a few or no candidates appear. In this case, efforts should be expanded to focused promotion for selected countries and companies in cooperation of Lithuanian embassies.

# Chapter 12 CURRENT STATE OF THE PAPERMAKING INDUSTRY IN LITHUANIA AND MAJOR ISSUES

# Chapter 12 CURRENT STATE OF THE PAPERMAKING INDUSTRY IN LITHUANIA AND MAJOR ISSUES

## 12.1 Current State and Major Issues

(1) Supply and demand situation

Between 1990 and 1998, domestic demand for paper and paperboard products recorded negative growth of 5.46% on an annual average. As a result, demand in 1998 is around two-thirds the 1990 level. On the supply side, the country exports pulpwood to Scandinavian countries and does not produce pulp locally. Local paper and paperboard production mostly uses wastepaper and the bulk of products (58.8%) is exported. Domestic demand is mostly met by imports, which accounted for 83% of domestic consumption in 1998. Production, exports and imports in 1998 are summarized as follows:

| | |
|---|---|
| Paper and paperboard production | 37300 tons |
| Export | 27040 |
| Import | 80200 |
| Nominal consumption | 77860 |
| Consumption per capita | 20.59kg |

The paper and paperboard industries in Lithuania seem to have problems typically seen among countries in transition from a centrally planned to a market economy, including loss of traditional markets, shortage of raw materials, inefficient management and production systems, aging and obsolete production equipment, and technological backwardness. They are facing the very difficult situation.

(2) Current state of paper and paperboard manufacturers

The study team visited four paper and papermaking manufacturers during the field survey, and general findings are summarized as follows:

1) Production equipment

a. The manufacturers visited do not have pulp making equipment or maintain it in working condition.

b. The waste paper treatment process consists of a dissolving pulper and a dust remover.
c. All the machines are old and obsolete, except for the Inverform board that was installed at AB Klaipedos Kartonas in 1973.
d. Only Grigiskes installs both a boiler and a turbine generator, but it does not operate the generator and purchases electricity from outside.
e. Maintenance personnel is assigned on a full-time basis, although all the mills have not been operated on a continuous basis during the recent few years.

2) Pollution control

a. Effluent is only treated through a settling tank and a clarifier to remove suspended matters before being sent to a treatment plant operated by the local government, partly because none of the mills manufacture pulp.
b. Air pollution is not a problem because none of the mills uses a recovery boiler, a lime kiln or an auxiliary boiler burning fossil fuel.

3) Raw material supply sources

a. Waste paper

Waste paper is a primary raw material for production of paperboard and decorative paper, which are principal products of the papermaking industry in Lithuania. However, unstable demand has caused a supply glut and low prices, which have prevent waste paper collection business from becoming viable, deteriorating quality of waste paper traded in the country significantly. In particular, high-grade waste paper is essential in production of decorative paper and is currently imported. To reinvigorate the waste paper supplier base as a sustainable business, efforts should be made to raise public awareness of quality of local paper and paper product, which would provide incentive for local manufacturers to use high grade waste paper for new product development.

b. Imported raw materials

Pulp imports totaled 16 tons in 1998 and 6 tons in 1999. In the future, local manufacturers are expected to boost pulp imports for new product development.

(3) Major issues facing paper and paperboard manufacturers in Lithuania, and possible improvement measures

Major issues and possible improvement measures are summarized as follows.

1) Issue 1: Too many manufacturers

At present, the industry produces 100 – 120 tons of paper products per day. The fact that the four mills produce such small amounts using 7-8 machines simply does not make any economic sense (unable to achieve continuous operation at near capacity). The current market can only support the level of production that can be made by a single mill. In consideration of collection of raw materials and shipments of products, it is recommended to consolidate and rationalize the production system with the final goal of reducing the number of companies to one or two.

2) Issue 2: Unbalanced product mix

The current product line is dominated by products made from waste paper, while other paper products are mostly imported. The industry should develop new products by studying the market needs and adapt its production system to new opportunities.

3) Issue 3: Weak waste paper recycling system

Efforts should be made to improve product yield and quality by improving efficiency and effectiveness of the waste paper recycling system in the following areas:

a. Improvement of waste paper quality through the reinforcement of the current waste paper collection system as a resource recycling mechanism, and increase in waste paper supply through the upgrading of the system to recover waste paper from general wastes;
b. Building of a supply and demand control mechanism under participation of waste paper suppliers and customers;
c. Improvement of the waste paper storage and dissolution processes;
d. Introduction of a classification and deinking system for waste paper pulp; and
e. Upgrading of papermaking technology using waste paper pulp.

4) Issue 4: Low capacity utilization rate

Existing production equipment is uneconomically operated at very low utilization rates. Meanwhile, large amounts of paper products are imported and will likely grow further. The industry should develop products that are suitable for the existing production equipment so as to bring idling production lines back to operation and raise the operating rate of paper machines.

5) Issue 5: Deterioration of industrial skills and morale

Loss of markets, significant production cutbacks, and persistent low operating rates cause deterioration of production skills and morale. If the situation continues, the paper and paperboard industry will lose its ground for future recovery and growth. The following actions should be taken to halt and possible reverse the declining trend:

a. Inception of industry-wide initiatives to maintain and upgrade production skills and morale;
b. Organization of project teams to conduct joint research and study on selected issues that are of common interest to paper and paperboard companies;
c. Need for the Lithuanian government to provide support and assistance for in the areas of finance, human resources, and institutions; and
d. Promotion of joint efforts among the Baltic States.

## 12.2 Current State of Waste Paper Collection and Recycling and Major Issues

(1) General

a. World trends related to waste disposal and management

Increased production of consumer goods and diversification of raw materials have made waste management a major public concern. Safety management and disposal of wastes must be ensured by regulatory control and legislation. At the same time, growing pressure on waste disposal capacity and technological limitation are encouraging volume reduction of general wastes and their reuse.

As for waste paper that accounts for the highest percentage of total waste in terms of volume and weight, more and more countries are enacting current

legislation to require the recycling of paper containers and packaging paper. Furthermore, the recycling system is being expanded to promote reuse of components and materials for household appliances and automobiles, and to the move to prevent manufactured products from being disposed as general wastes.

b. Relationship between international standards and domestic legislation

While international treaties are signed to address the global environmental issues, industrialized countries take lead in building institutions to deal with problems related to wastes and their management as local issues. As for recycling of wastes, the idea of fair burden sharing in society is increasingly institutionalized to urge manufacturers and sellers to assume their share of responsibility for proper disposal of products they make and distribute.

Germany leads the move by enacting the "Recycling Economy Waste Act" of 1994. Packaging materials are effectively recycled through a nationwide collection and recycling system established and operated by the DSD, an organization established under contribution of manufacturers ad distributors of related products. The system accomplishes efficient collection and recycling of all types of packaging materials, including paper, plastics, tin plates, aluminum and glass bottles. Meanwhile, the EU issued a directive in 1994 to require member nations to enact legislation on collection and recycling of packaging materials by 2001.

c. Administrative measures and cooperation by the private sector

Waste management is now one of the most important policy issues for industrialized countries. Germany, facing the shortage of disposal sites and restriction on disposal in other countries under the Basel Convention, was required to dispose wastes within its own territory and reduce disposable wastes as far as possible. France attempts to control and reduce wastes by encouraging the manufacturing and distribution industries to commit themselves to reduction and collection of wastes, and reuse of recycled materials and energy conversion, while educating the general public about effective reduction and disposal of wastes. The ADEME was established as a government organization and is spearheading activities to promote energy saving, resource conservation, reduction of wastes, collection and reuse, and pollution control measures.

Recycling becomes an essential condition for volume reduction of wastes. To ensure effective recycling of resources from general wastes, quality of recycled products must be maintained through effective segregation, which governs economy of recycling. To maximize economic efficiency of the recycling system, cooperation by general citizens is essential in promoting segregation at source. From this standpoint, the government needs to provide the general public with information related to proper waste management and encourage grass-roots involvement in the recycling process, while providing information and guidance for business enterprises in order to gain their understanding on taxation to cover the recycling cost.

d. Present and future of recycling technologies

Recycling technologies are essentially divided into five segments, namely, reduction (including compression, crushing, and dissolving), refinement (disassembly, segregation and sorting), reuse (cleaning, repairing), recycling (reconversion to resources) and reconversion to energy. In the future, these technologies will evolve to a new area of industrial production.

(2) Current state of waste disposal in Lithuania and major issues

a. Current state and major issues

* Legislation

Lithuania has the basic law on waste management, which is based on the law in Denmark. It contains a standard set of provisions, including definitions of terms related to waste disposal and management and regulatory standards. However, it does not represent the firm commitment of the nation to waste reduction and resource reuse. Also the law authorizes the central government to provide financial assistance for local government in implementing related programs, but no specific budget has been allocated for the purpose.

* Public administration and organization

In the current organization of the central government, a number of ministries and agencies are responsible for waste management and assume their own roles and authorities, but they do not function properly to achieve effective regulatory control due to the lack of operational organizations and institutions. Municipalities are directly responsible for waste management

service and strive to fulfill their duties, but they fail to provide necessary support and guidance for field organizations. They often blame the shortage of fund but appear to lack the willingness to solve problems by using limited resources to a maximum extent.

* Waste disposal operation and regeneration technology

Waste disposal is limited to landfilling, and no efforts are made for volume reduction, including technological development.

b. Collection and reuse of waste paper: current state of major issues

* Generation sources

Waste paper is currently collected through three channels; collection by specialized operators, collection of separated waste components in the waste collection system, and recovery from mixed wastes. The first channel works fairly well. On the other hand, little segregation is made at source because of the lack of public awareness. The third channel is virtually informal in nature as the bulk of waste paper is recovered by scavengers at disposal sites, and active involvement of the central and local governments is required.

* Current state of waste paper collection

The waste paper collection industry in Lithuania consists of small operators. With no intermediate distribution system, they collect and bring waste paper directly to paper mills. Previously, they formed a cooperative but increased competition drove many out of business and the cooperative became inactive. The lack of the viable waste paper recycling business partly comes from the weak base of domestic papermaking industries which should otherwise form the other end of the supply chain.

* Reuse of waste paper

Low market prices and other factors cause quality of waste paper to deteriorate. Meanwhile, more and more countries are reducing production of paperboard for containers using low-grade waste paper, and quality improvement becomes an important challenge for the waste paper recycling business to be viable in the long run.

(3) Recommendations for improvement

a. Waste management in general

* Legislation

It is desirable for the government to express its determination to reduce wastes through promotion of resource regeneration in national policy or statutory law. In particular, it declares promotion of resource generation as part of the country's responsibility and obligation to environmental protection as a member of the international community. At the same time, it asks people to understand the importance of resource regeneration and waste reduction.

* Public administration and organization

The central government should establish coordinating body of cross-disciplinary nature to have the accurate understanding of the current status of waste management service performed by municipalities, and provide adequate advice and guidance. Municipalities are expected to provide necessary information for the central government, including accurate statistical data, while they should be ready to utilize the government's support and guidance. For private operators, they should provide information related to waste management and resource regeneration, including latest technology and know-how, in the form of education and training. And the effective collaboration system should be established through good communication.

* Technology related to waste disposal

Today, a variety of waste disposal methods are adopted to make work at disposal facilities much more complex than before. Modern waste disposal facilities must be equipped with a wide range of processes, including selection and processing. As new waste disposal techniques are urgently demanded worldwide, the Lithuanian government should conduct research and study on the latest technology trends.

* Technology related to reuse

In Lithuania which does not have major industries consuming large amounts of resources, it is not feasible to recycle most reusable resources within the country in an economically viable way. As a result, recycled

materials need to be exported to countries which have the ability to process them for industrial production. Clearly, this is not an attractive option. Instead, Lithuania should develop regeneration technology that utilizes its comparative advantages and develop economically feasible products (and semi-finished products) through concerted efforts of universities, research organizations and industries.

* Others

Waste reduction and resource recycling measures can produce the maximum results when they are properly carried out at the source where wastes are generated. Yet, the government and municipalities have not raised public awareness and obtained cooperation of people in the recycling process, and they should step up the efforts in the areas of public campaign and education.

b. Collection of waste paper

* Government action

Most industrialized countries provide financial assistance for the recycling of waste paper from general wastes on account of its waste reduction effect. Although Lithuania has legislation to provide such assistance, it is not backed by government budget for various reasons. Nevertheless, public financial assistance is justifiable so far as the fostering of a cost-effective recycling system operated by the private sector can reduce the public cost for waste disposal. It is acceptable to the general public even if public assistance directly benefits private collection service operators, community organizations, schools or cooperatives, provided that its cost effectiveness is demonstrated by disclosing the government budget on waste management.

* Collection system and organization

The waste paper collection systems operated by private enterprises in Lithuania are considered to be equivalent to those in industrialized countries in terms of efficiency and effectiveness. Now, the industry should shift its focus to high grade waste paper that is generated from business establishments, retailers and office buildings. As for households, efforts should be made to encourage volunteer activities under participation of citizens to collect and sort high-grade paper in a cost effective way, while

securing their commitment as stakeholders to sustainable operation of the supply chain to paper manufacturers.

* Technology related to waste collection

Today, a variety of machinery and equipment is developed by incorporating latest technologies, but they can show their advantages when waste paper is recycled in a certain volume (500 tons/month). Improvements required for the current recycling system from technical aspects include the provision of stockyards and warehouses to keep waste paper clean, and the system to bundle waste paper for ease of stockpiling. In particular, a press to compress and make one-ton packages is effective in preventing the collapse of packaged paper, minimizing storage space, reducing transportation costs, and streamlining quality and inventory control.

* Sales

Most waste paper collected in Lithuania is corrugated cardboard and the mix, which are trade as lowest-grade paper. High-grade waste paper represents some portions but is priced at the level 20% higher than that of corrugated cardboard. While it is difficult to sell high-grade waste paper in the market dominated by cardboard demand, there is an opportunity for suppliers to gain market power through various efforts. They should also improve export quality and ship their products to the international market at favorable prices.

c. Reuse of waste paper

* Reuse of waste paper

Both suppliers and buyers do not have much concern about quality control of waste paper. For the papermaking industry, it is strategically imperative to control product quality, which starts from quality control of raw materials. They should set clear quality standards under agreement with suppliers and inspect product quality upon delivery to check presence of foreign matters. Products accepted by manufacturers should be sorted according to grade and order of delivery and kept in separate places with identification of suppliers. This should help improve the development of mutual confidence between the manufacturer and the supplier.

To promote reuse of waste paper, quality improvement is critical in ensuring the increased use of waste paper and the improvement of quality of

paper products. Also, to effectively use waste paper that will increasingly become mixed quality, development of diverse products that meet the market needs will become a workable solution. Thus, well-planned development efforts including the gathering and analysis of market information are recommended.

* Marketing strategy

Most materials industries can no longer expect long-term prosperity as their products have become ubiquitous commodities. Nevertheless, there are some paper makers that have successfully developed profitable products that appeal to new markets. Their strategy is applicable to Lithuania with a small domestic market, and development of specialty products (small lot and wide varieties) targeting niche markets seems to be effective. Such products should be developed jointly by manufacturers and users (e.g., printing companies) by conducting detailed surveys to identify the changing needs and taste.

* Commercialization

In consideration of the current state of the paper industry, product development creates heavy burdens in terms of capital requirements and technical capabilities. To spread such burdens and risks, manufacturers and users (or other related industries) are expected to work together in development efforts, including product, market and technology.