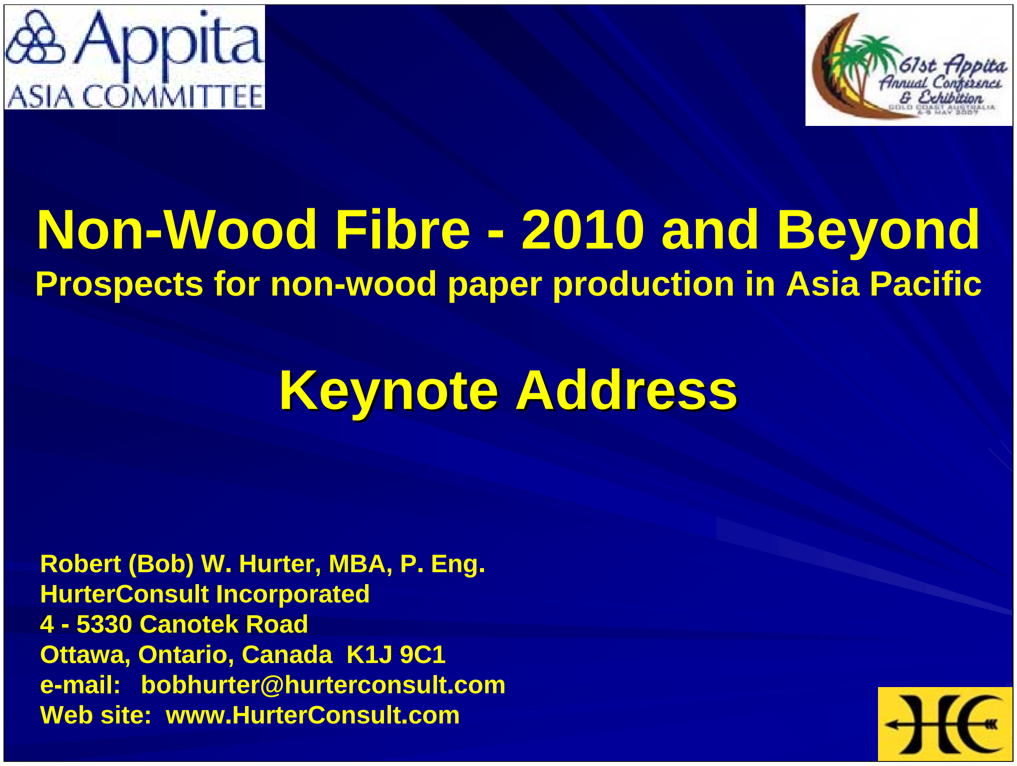
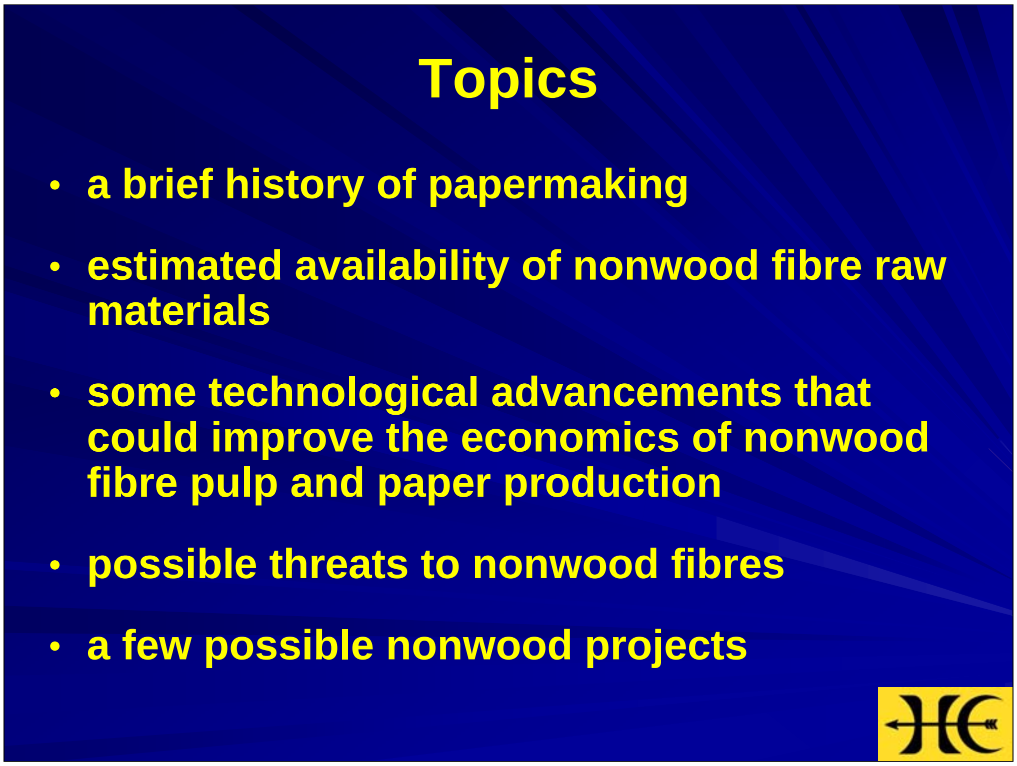


I am honoured to have been asked to present the keynote address at this symposium: Nonwood Fibre - 2010 and Beyond - Prospects for non-wood paper production in Asia Pacific.

Today, you are going to hear from a range of international speakers who will be presenting on the economics, markets, supply chain and business issues relating to a variety of nonwood fibres.

I hope that my presentation provides a good basis for these presentations.

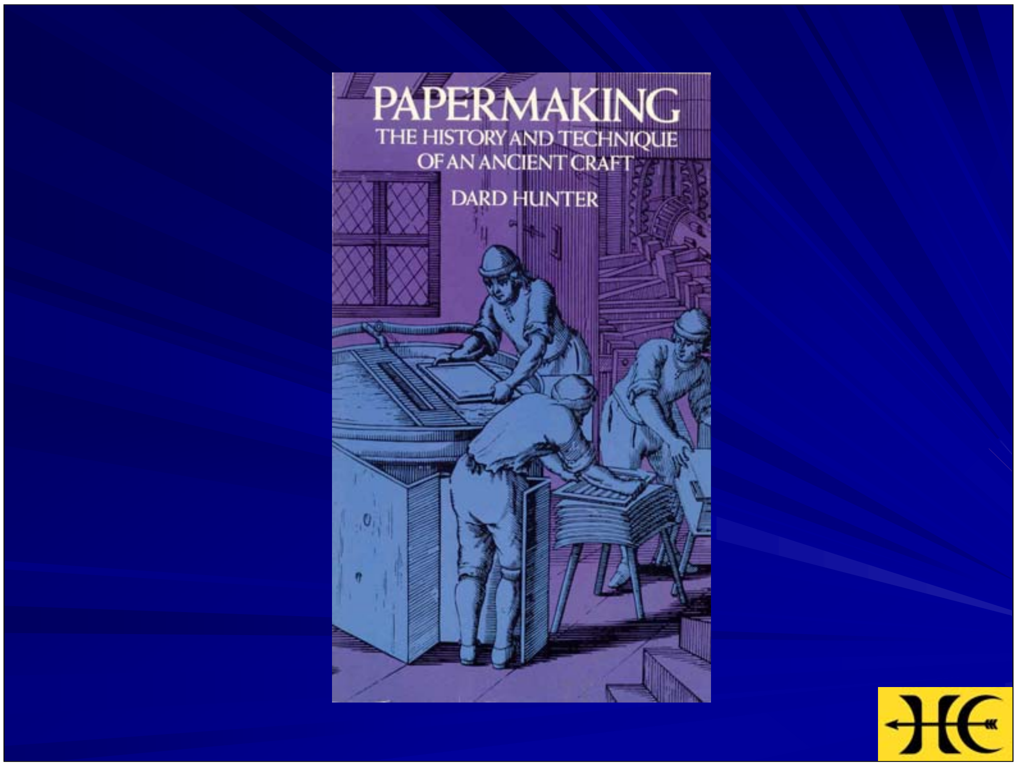


In my presentation, I will start with a brief history of papermaking, as without knowing the history, it is impossible to suggest a direction for the future.

Then I will address the estimated availability of nonwood fibre raw materials.

Next, although I was asked to make a non-technical presentation, I will touch on some technological advancements that could improve the economics of nonwood fibre pulp and paper production.

I will then look at possible threats to nonwood fibres for papermaking and I will finish by suggesting a few possible nonwood projects that could be developed in Asia Pacific.



Papermaking has a rich and varied history. If you have not already read Dard Hunter's "Papermaking: The history and technique of an ancient craft" I highly recommend it.

The following draws from the second edition of this book published in 1947 as well as some more recent developments that have helped to shape the pulp and paper industry into what it is today.

Papyrus from Ani's Book of the Dead

The word "paper" is derived from the Egyptian word "papyrus", although paper was not invented by the Egyptians. Papyrus is not a true paper. It is a sheet of laminated slices of papyrus reed. True paper is made from vegetable fibres in random orientation and is analogous to felt made from animal hair.

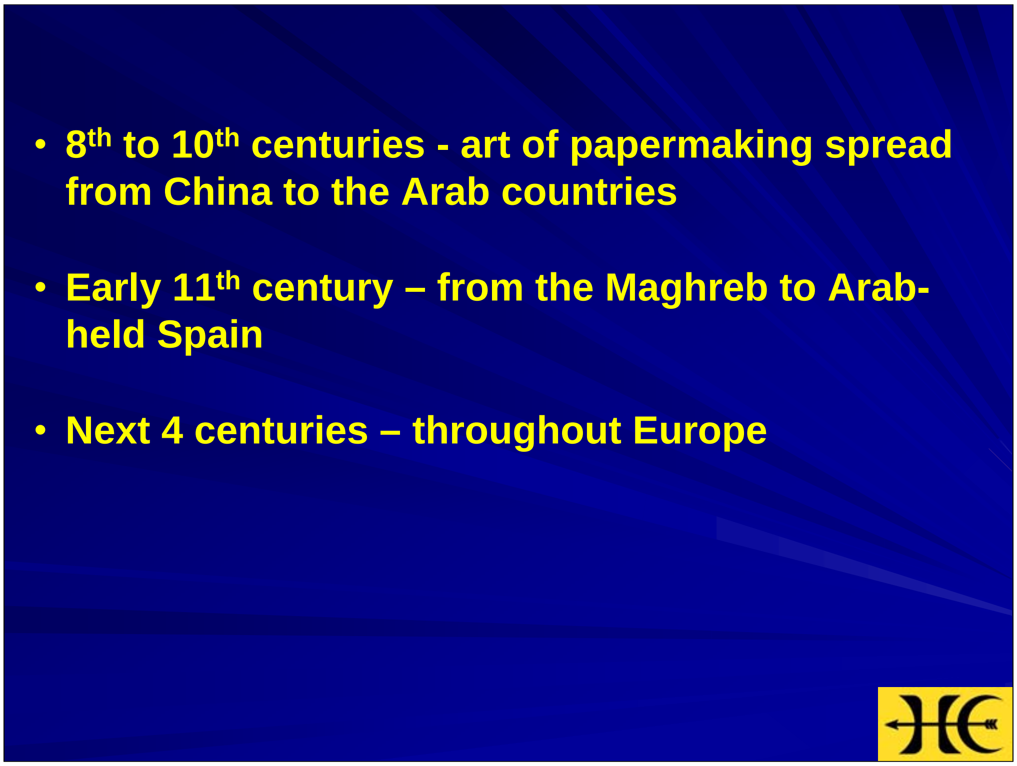
- **True paper was developed in China**
- **First true papers made from vegetable fibres credited to Ts'ai Lun in 105 A.D.**
- **No authentic portrait of Ts'ai Lun exists**
- **For the next 1800 years nonwood fibres were the primary source of raw materials for pulp and paper**

True paper was developed in China, and perhaps the concept was derived from felt made from animal hair. There is evidence that the Chinese were producing paper-like substances from silk fibres macerated in stone mortars as early as the second century B.C.

Historically, the first true papers made from vegetable fibres are credited to Ts'ai Lun in 105 A.D.

There are no known authentic portraits of Ts'ai Lun. This kakemono was produced by a Japanese artist in memory of Seibei Mochizuki who established papermaking in Japan in 1572. It is of interest as it also depicts Ts'ai Lun in the centre and Dokyo, the Korean monk who introduced paper into Japan on the left as well as Mochizuki.

For the next 1800 years nonwood fibres were the primary source of raw materials for pulp and paper



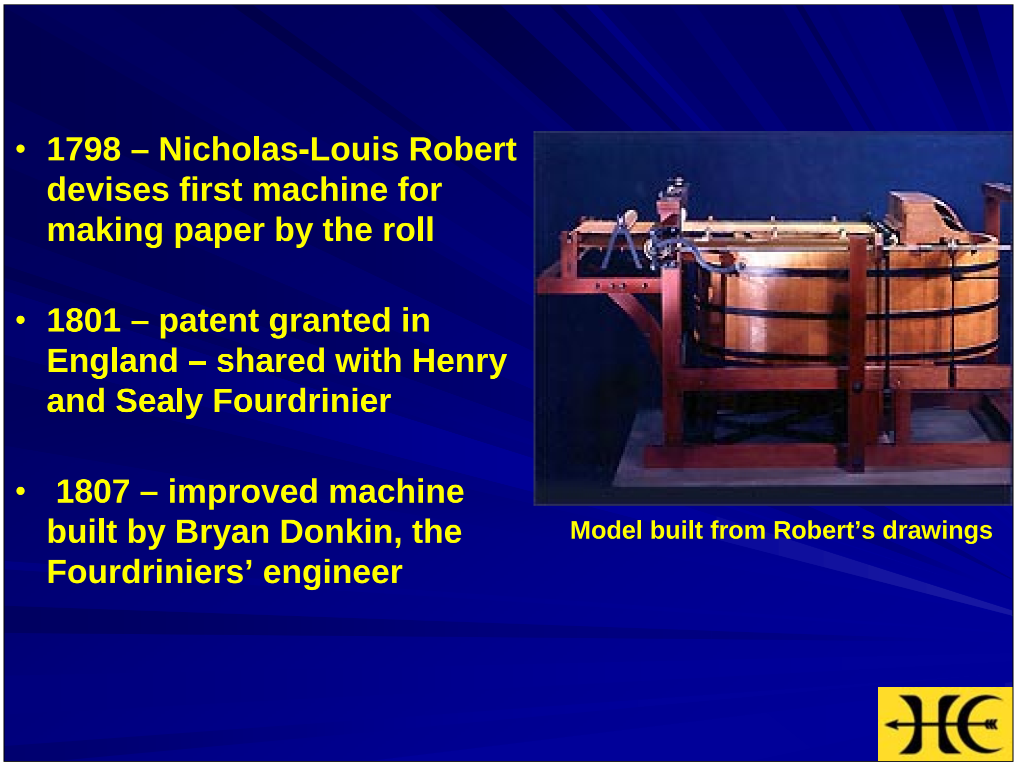
The art of papermaking spread from China through the Arab countries in the 8th to 10th centuries, then over the Maghreb to Arab-held Spain in the early 11th century and throughout the rest of Europe in the next four centuries.

Although, rags, hemp, straw, small diameter bamboo and other vegetable fibres were used by Chinese papermakers at a very early date; Arab and European papermakers used cotton and linen rags as their basic raw materials.

By the mid 18th century around the beginning of the first Industrial Revolution (1760 - 1830), paper mills in Europe were having difficulties acquiring sufficient cotton and linen rags to meet the growing demand for paper, and several investigators studied alternative sources of vegetable fibre for papermaking.

A wide variety of potential raw materials was studied, and samples of paper were prepared from various raw materials. The most promising raw materials were straw and wood.

By the latter part of the 18th century, some straw pulp was being produced by soaking straw with milk of lime or potash in lined pits for a week or more at ambient temperatures, followed by disintegration in Hollander beaters or stamping mills. This early straw pulping process, which is essentially the maceration process used for rags, was followed by cooking at atmospheric pressure and, later, by cooking in pressurized vessels.

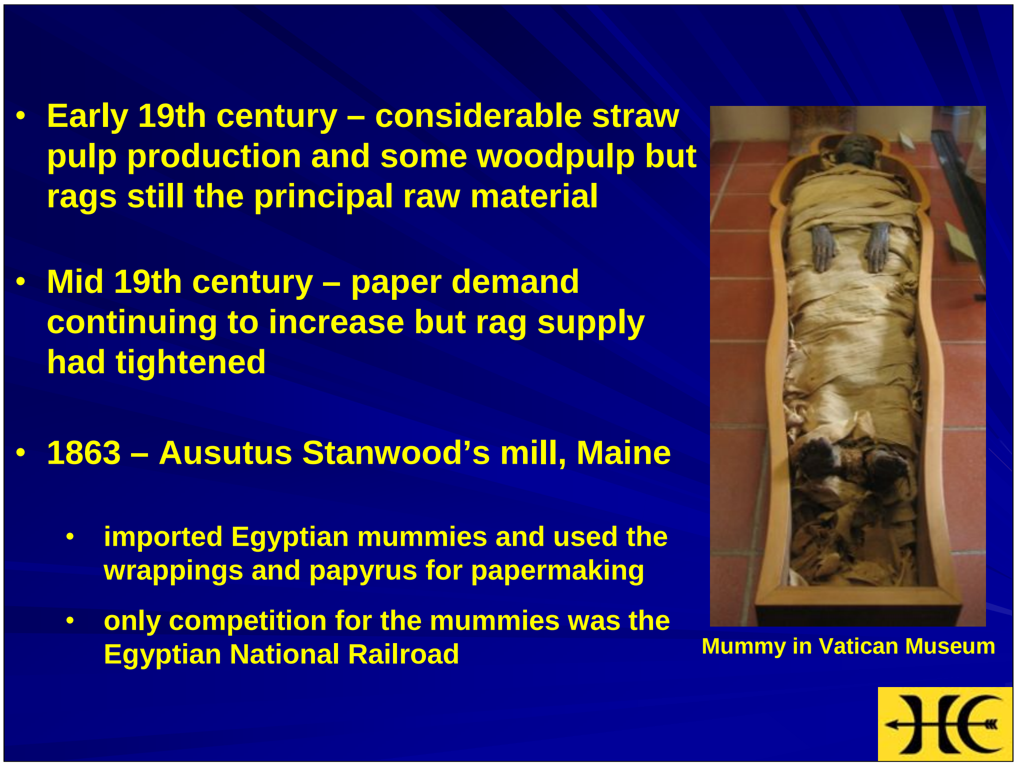


In 1798, Nicholas-Louis Robert, an employee of the French publishing company of Leger Didot, devised his first machine for making paper. But, the quality of the paper was inferior to handmade paper, and the machine was far from perfect.

In 1801, Robert and his brother-in-law John Gamble patented the machine in England. They divided the patent rights with their financial backers, Henry and Sealy Fourdrinier.

The Fourdriniers' engineer, Bryan Donkin, built an improved machine. The "fourdrinier," as it was soon known, made high-quality paper and by 1807, with further improvements, it was put on the market.

The Fourdrinier brothers went bankrupt in 1810, but Donkin continued to manufacture the machine. In 1827, the first two fourdrinier-style paper machines were set up in the United States.



There was considerable straw pulp production during the first part of the 19th century and some woodpulp production, but rags remained the principal raw material.

By the mid 19th century, demand for paper continued to increase but the rag supply had tightened and papermakers were having difficulty meeting demand.

Possibly the most incredible incident in the quest for alternative fibre resources in the 19th century was the use of mummy wrappings.

In 1863, Augustus Stanwood began operating a mill in Gardiner, Maine. During the Civil War when the shortage of rag threatened his operations, he imported several shiploads of mummies and threw the woven wrapping and papyrus filling into the beaters. The result was a coarse brown paper used by grocers, butchers and other merchants. The only competition he had for the mummies came from the Egyptian National Railroad which used the well wrapped, compact mummies as their sole source of fuel for a decade!!

- **1875 to 1900 – straw pulp production becomes substantial in Europe and North America**
  - **straw became the major source of pulp**
  - **used in a variety of papers**
  - **straws primarily used – wheat, rye, rice – same as today**
- **1800 to 1900 – concurrent development of wood pulping**
  - **1867 – Tilghman invents sulphite process**
  - **1884 – Dahl invents Kraft process**
- **1900's - Woodpulp production increases rapidly and wood soon becomes the main raw material for the paper industry**

It was only after the middle of the 19th century, and especially during the last quarter of the century, that straw pulp production became substantial in Europe and America. Straw became the major source of pulp and was used for the production of a wide variety of papers. Even newsprint was produced in the 1880's from a mixture of straw pulp and rag stock.

The straws used for papermaking were and still are primarily wheat, rye and rice straw.

At the same time, mechanical and chemical wood pulping was becoming more efficient. In 1867, Benjamin Tilghman invented the sulphite process which gave birth to various large cooking vessels that eventually evolved into modern-day batch pulp digesters. Shortly after, in 1884, Carl Dahl invented the sulphate or kraft process in Germany.

Woodpulp production rapidly surpassed straw pulp production, and wood became the main source of raw material for the paper industry. In the last decades of the 19th century, the recovery of the pulping chemicals from the soda and, later, the kraft process was carried out.

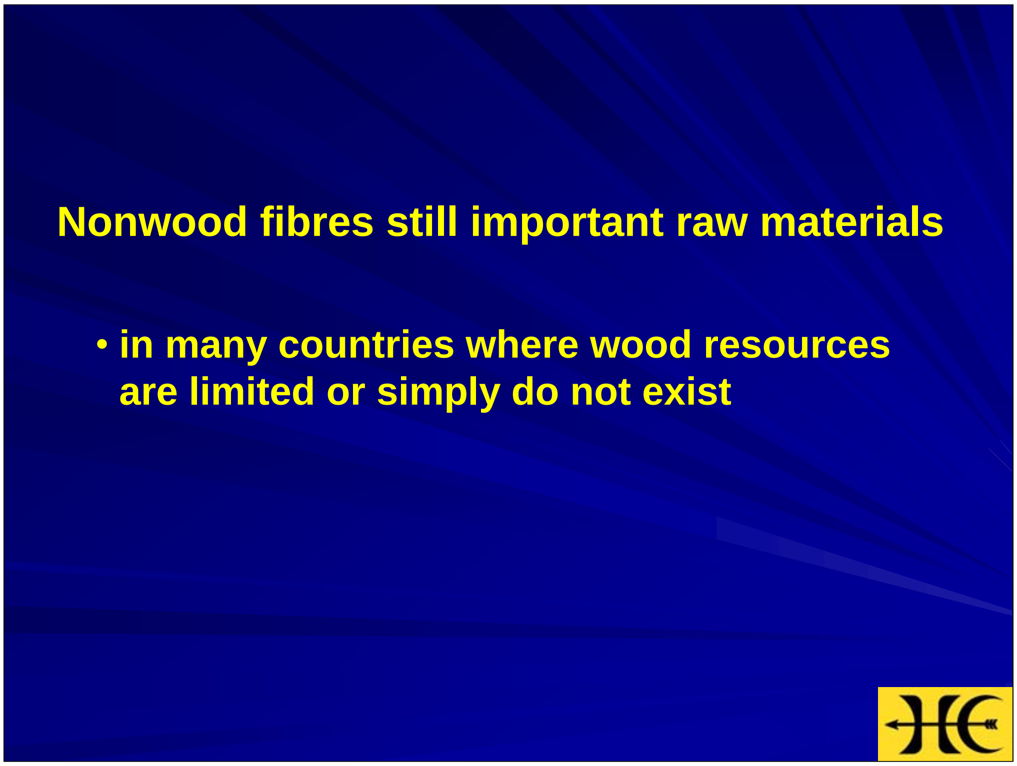
- **1930’s – still quite a few straw pulp mills in Europe**
- **1950’s - most straw pulp mills in the West closed**
- **1950’s – introduction of the Kamyr continuous digester for wood**
- **Today**
  - **wood is the dominant fiber raw for pulp and paper production with over 90% of global pulping capacity**
  - **single line woodpulp mills of 2,000 mt/day are more or less standard and the largest line located in China is 3,000 mt/day**

In the first decade of the 20th century and up to the beginning of the Second World War, woodpulp production increased rapidly while the proportion of the total pulp production produced from straw declined steadily. However, there were many straw pulp mills in operation; and the production of straw pulp remained substantial in the 1920's. As late as the 1930's, there were still quite a few straw pulp mills in Europe.

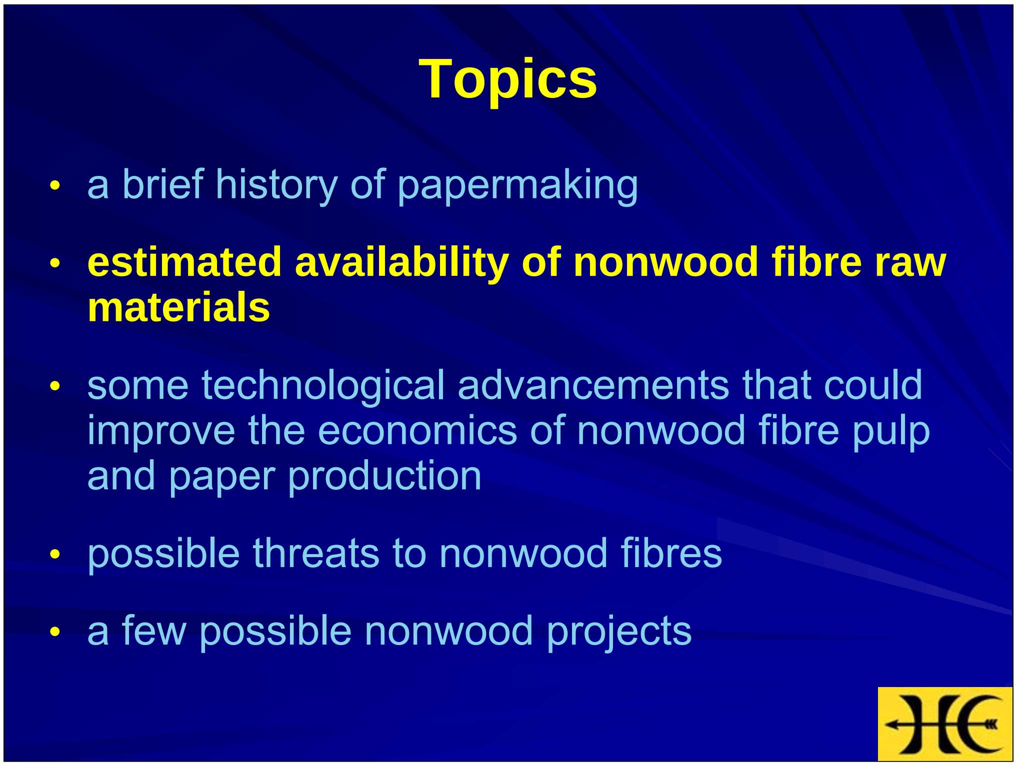
However, within a decade after the end of the Second World War, most straw pulp mills in the West shut down; woodpulp production continued to increase rapidly, and straw pulp production declined to a small fraction of the world's total pulp production.

Development of the Kamyr digester in the 1950’s further increased the dominance of wood as the fibre raw material of choice as they allowed for even larger single line mills to be built.

Today, wood is the dominant fiber raw for pulp and paper with over 90% of the world’s pulping capacity. Single line woodpulp mills of 2,000 mt/day are more or less standard and the largest line located in China is 3,000 mt/day.



Today, nonwood fibre raw materials continue to be important fibre raw materials in many countries where wood resources are limited or simply do not exist such as China, India, Egypt, Pakistan and Cuba.



My next topic is the estimated availability of nonwood fibre raw materials.

Cereal Straws

	BDMT / year
Barley	195,000,000
Oat	55,000,000
Rice	360,000,000
Rye	40,000,000
Wheat	600,000,000
Total	1,250,000,000

Wheat Straw

Globally, about 1.25 billion bone dry metric tons of cereal straws are produced annually of which wheat straw accounts for about half.

Pith containing Nonwoods

	BDMT
Sugarcane bagasse	102,000,000
Corn stalks	750,000,000
Grain & sweet sorghum stalks	252,000,000
Total	1,104,000,000

Sugarcane

Pith containing nonwoods such as sugarcane bagasse, corn stalks and sorghum stalks account for about another billion tons of which corn stalks amount to 750 million tons annually.

But, bagasse is the one most commonly used for pulp and paper. The reason likely is that the bagasse is available at the sugar mill making it relatively easy to use.

Bast Fibre Plants (whole stalk)

	BDMT
Textile flax, hemp, jute, kenaf, etc.	14,000,000
Oilseed flax straw	2,000,000
Cotton stalks	68,000,000
Total whole stalk	84,000,000
Bast fibre only	21,000,000

Kenaf

Bast fibre plants have two types of fibre, a short fibre woody core and a long bast fibre.

They amount to about 84 million tons annually of which the bast fibre is about 21 million tons.

Typically, bast fibres are used in specialty papermaking applications.

Bamboo, Reeds & Grasses

	BDMT
Bamboo	30,000,000
Grass seed straw	3,000,000
Papyrus	5,000,000
Reeds	30,000,000
Sabai grass	200,000
Total	68,200,000

Reeds

Bamboo reeds and grasses account for another 68 million tons annually of which bamboo and reeds account for the bulk of this group.

Bamboo and giant reeds can be chipped like wood and can be cooked in woodpulping equipment which gives them a distinct advantage over other nonwoods.

Cotton

	BDMT
Staple fibre	18,300,000
1st & 2nd cut linters	2,700,000
Total	21,000,000

Cotton

Cotton staple fibre and linters amount to 21 million tons annually.

Unlike the past cotton fibres today are normally used in specialty papermaking applications.

Leaf Fibre Plants

	BDMT
Sisal, henequen, maguay	500,000
Abaca (Manila hemp)	100,000
Total	600,000

Sisal

Leaf fibre raw materials amount to only about 600,000 tons/year but they are used in high end specialty papermaking applications.

All Selected Nonwoods

	BDMT
Cereal straws	1,250,000,000
Pith containing nonwoods	1,104,000,000
Bast fibre plants	84,000,000
Bamboo, reeds & grasses	68,000,000
Cotton	21,000,000
Leaf fibre plants	600,000
TOTAL	2,527,800,000

Most of the nonwood fibre raw materials available are cereal straws and pith containing nonwoods, both of which produce short fibre pulps similar in characteristics to hardwood pulps.

However, other nonwoods such as hemp, flax and kenaf bast fibres, cotton staple and linters and the leaf fibres have characteristics often superior to softwood.

The potential of using various combinations of nonwoods in papermaking is endless.

Of the total 2.5 billion tons produced annually, roughly one third or about 840 million bone dry metric tons is available in Asia.

Other Nonwoods

- **Other nonwood fibres also can be available for pulping**
- **Malaysia – the world's largest producer of palm oil**

	BDMT / year
Oil palm empty fruit bunches (EFB)	5.5 – 6.5 million
EFB fibre	3.5 - 4.1 million
Bleached pulp (40% yield)	1.4 – 1.6 million

Oil Palm EFB

The foregoing only provides data for selected nonwood fibre raw materials. Other nonwoods also are available for pulping but have not been included as they are not yet being used in any large quantities.

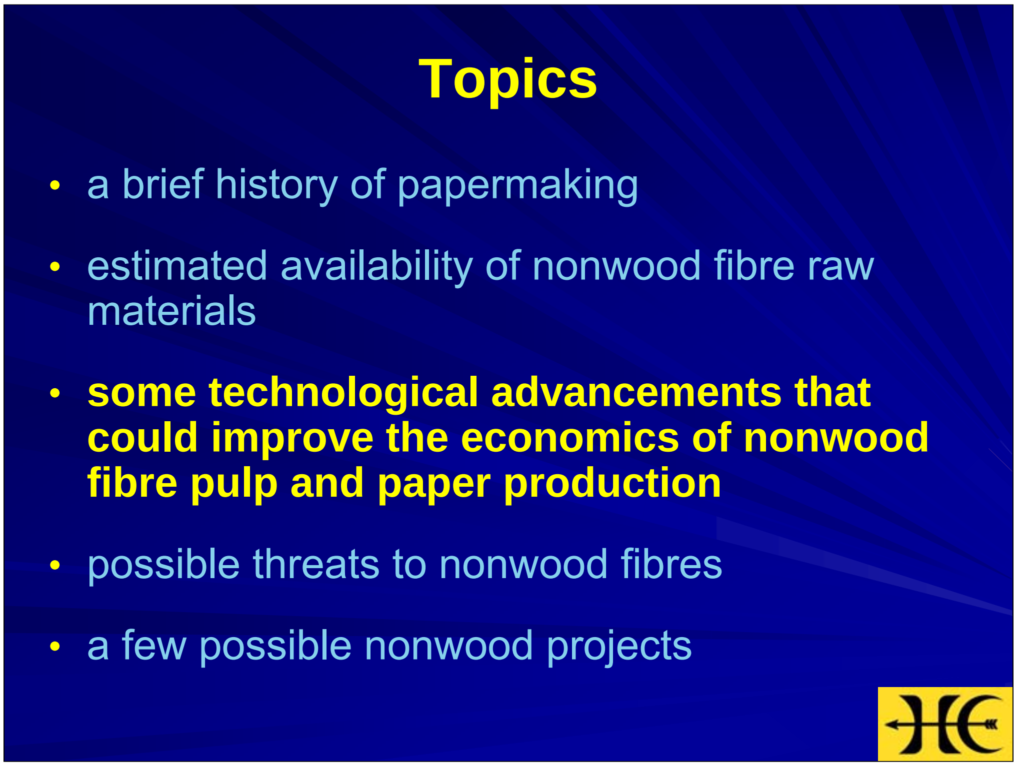
For example, Malaysia is the largest producer of palm oil in the world with about half of its cultivable land in oil palms.

Depending on the information source, the amount of oil palm empty fruit bunches (EFB) generated appears to be between 5.5 to 6.5 million BDMT annually.

Fibre strands that can be extracted from the EFB and used as a resource for pulp and paper amount to about 3.5 to 4.1 million BDMT annually.

Assuming a bleached pulp yield of 40%, this amount of fibre would produce about 1.5 million BDMT of short fibre pulp annually.

This is a huge resource that for the most part has yet to be used in the pulp and paper industry. One Malaysian company, TSH Resources, is planning on building the first EFB-based pulp and paper mill with a capacity of about 30,000 metric tons per year.



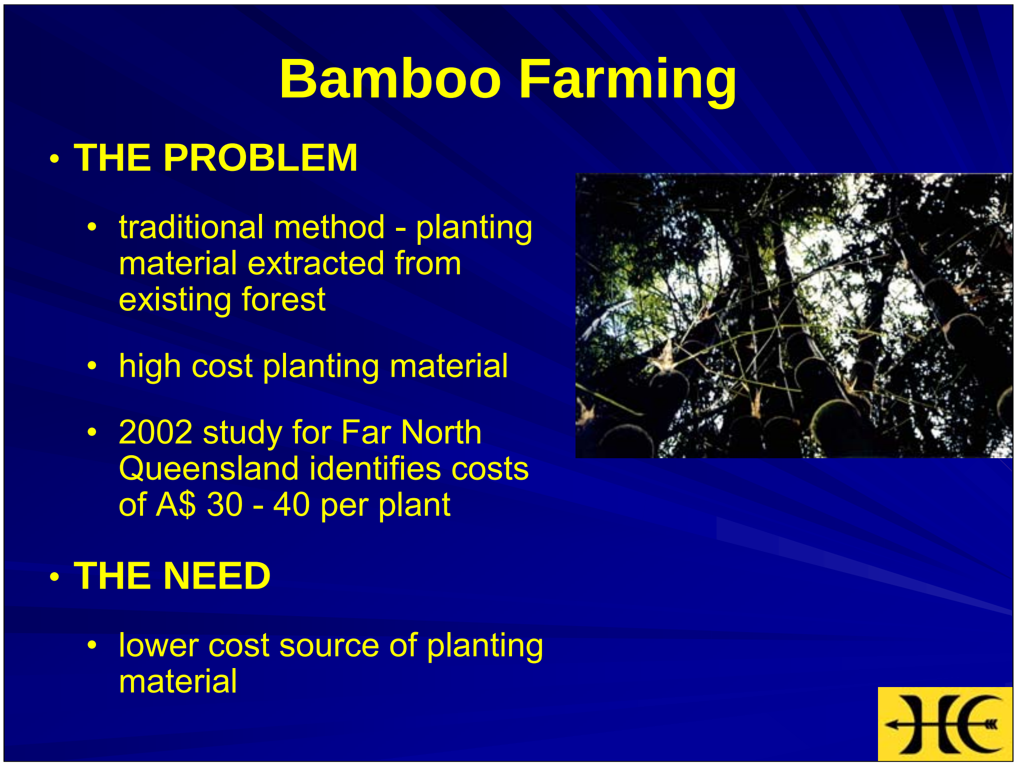
When I was asked to present the keynote address, I was asked to keep my presentation non-technical.

However, nonwoods account for less than 20 million tons per year of global pulping capacity or only about 6% of the world's pulp production despite the huge amount of raw material available, and one needs to ask why nonwoods are not playing a more important role in the global pulp and paper industry.

In my opinion, the economics of nonwood projects versus wood-based projects is a key limiting factor in the use of nonwoods for pulp and papermaking and this is very relevant especially with respect to scale-up, energy usage and chemical recovery.

There a few technological advancements that I believe could significantly improve the economics of nonwood fibre pulp and paper production.

In the next part of my presentation, I want to briefly share with you some of my thoughts.



Historically, the problem with establishing bamboo farms or plantations for commercial use was the method used to establish the farm.

Typically it involved extracting planting material from an existing bamboo forest, shipping it to the new location and then replanting it. This can be extremely expensive and may make the venture uneconomical.

In a December 2002 study "Preliminary Assessment of Product & Market Opportunities for the Bamboo Industry in Far North Queensland" prepared for the Bio-Industry Cluster of Far North Queensland, the authors identified the cost of planting material at Australian $30 - 40 per plant as being the major hurdle to overcome.

The need is a lower cost source of planting material.

A possible solution is offered by WestWind Technology who have patented mass propagation technology under a controlled laboratory setting for bamboo and giant reeds such as Adundo donax.

Using their technology, WestWind can establish bamboo farms on a turnkey basis with guaranteed biomass coverage of 90% at the first harvest for about US$ 5000 per hectare.

If you only want planting material, then WestWind can provide it for about US$ 1000 per hectare.

Whole Stalk Bast Fibre Plant CTMP

- **THE PROBLEM**
  - traditional kenaf chipping followed by cleaning and live bottom bins may result in non-uniform flow to refiners
  - increases difficulty of producing uniform quality pulp
- **THE NEED**
  - method to prepare the raw material in a manner that provides uniform raw material sent to the refiners

A couple of years ago, I was engaged by Andritz who had a problem with producing CTMP from a whole stalk bast fibre plant.

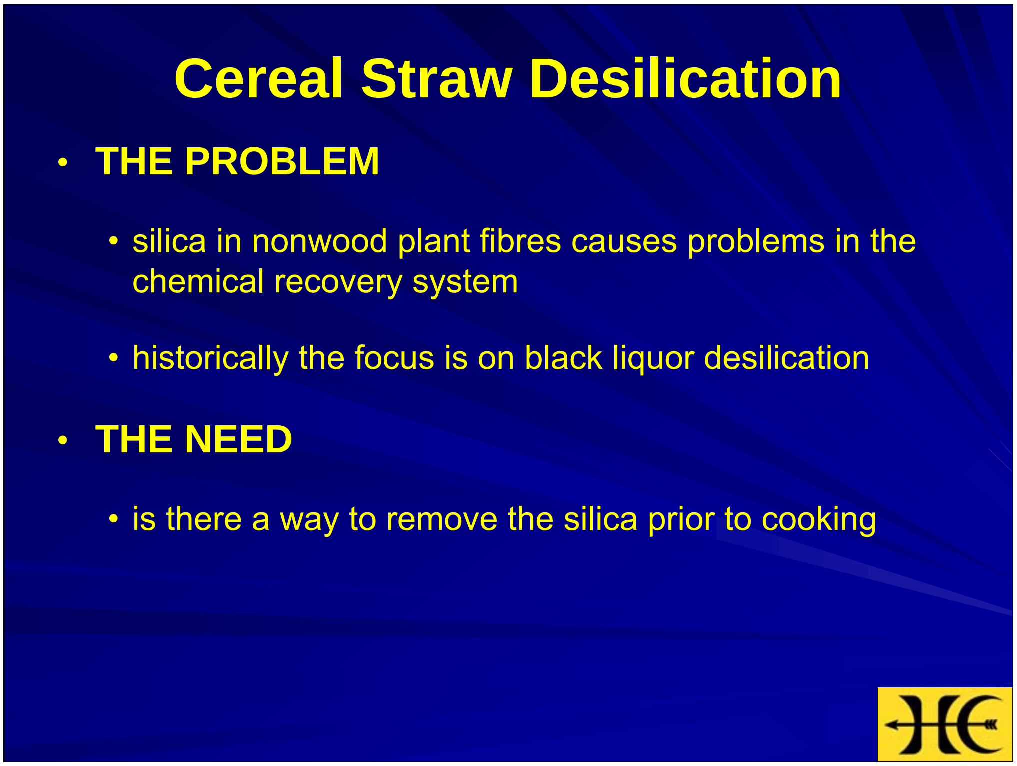
The problem was that using traditional chipping followed by cleaning and live bottom bins could result in a non-uniform flow of raw material to the refiners. This could occur if the "chips" broke up during processing and you could get differing mixes of core and bast fibre fed to the refiners. In this event, refiner control and the resultant quality would suffer.

The need identified was to establish a method to prepare the raw material in a manner that provides a uniform raw material sent to the refiners

My recommendation was to try a method that had not been used previously using a Tornado Pulper from Bolton Emerson Americas, Inc.

The Tornado has been around for many years and has been used to process many very difficult feed stocks. It includes a rotor and stator with cutting elements that is side mounted on a tank. All material entering the tank exits through the rotor/stator which chops the material into a pumpable and uniform slurry.

Andritz subsequently tested the Tornado for this application with positive results and has included it in a 100,000 mt/year kenaf APMP market pulp mill currently under construction in Vietnam.



As you all know, the silica content of many nonwood plant fibre raw materials causes many problems in conventional black liquor chemical recovery systems. Historically, the focus has been centred around desilication of the black liquor prior to evaporation.

Some innovative researchers at the Alberta Research Council in Canada asked the question “is there a way to remove the silica prior to pulping” which would eliminate the problems in conventional chemical recovery.

Cereal Straw Desilication

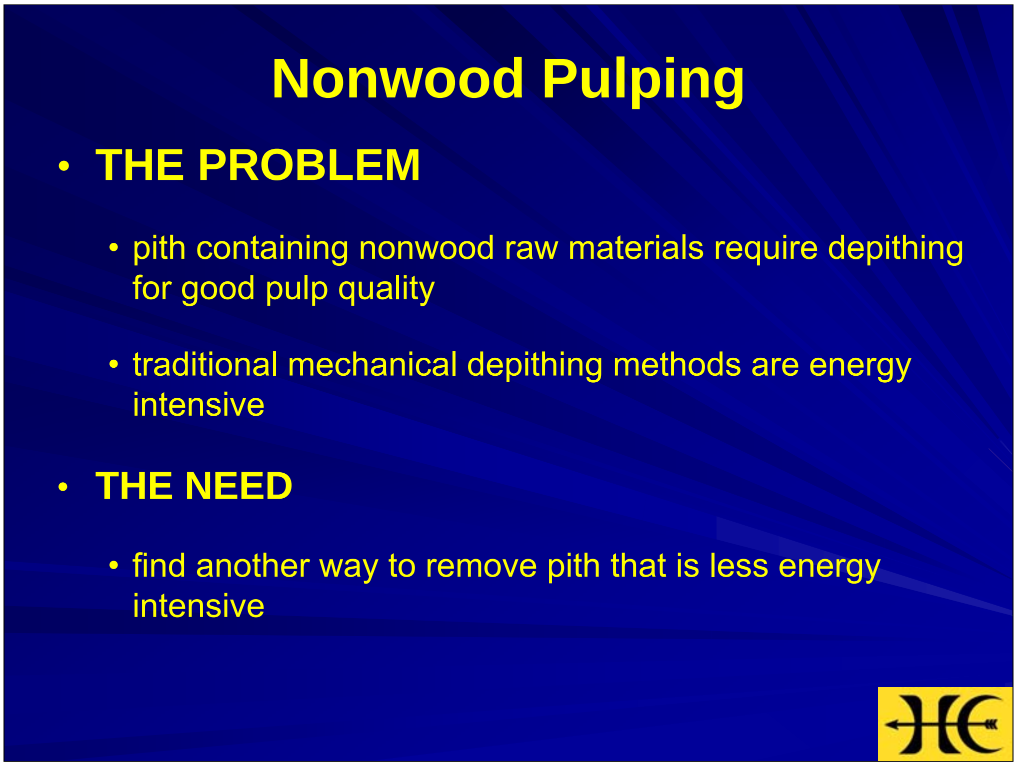
- **A SOLUTION**
  - Alberta Research Council (ARC), Edmonton, Alberta, Canada www.arc.ab.ca – Wade Chute
  - Tornado pulper → junk cyclone → disk refiner → screening
  - mechanical only - up to 60% silica removal
  - can add a small alkali dose < 0.5% NaOH or equivalent
  - adding alkali - up to 80% silica removal
  - ARC has filed for a patent

Wade Chute of the Alberta Research Council has been working with various cereal straws to remove the silica from the raw material prior to chemical pulping.

He uses a Tornado pulper followed by a junk cyclone and then disk refiners to open up the straw structure and release the silica which is then removed when the slurry is screened. The filtrate is filtered to remove the silica and other material and then returned to the Tornado.

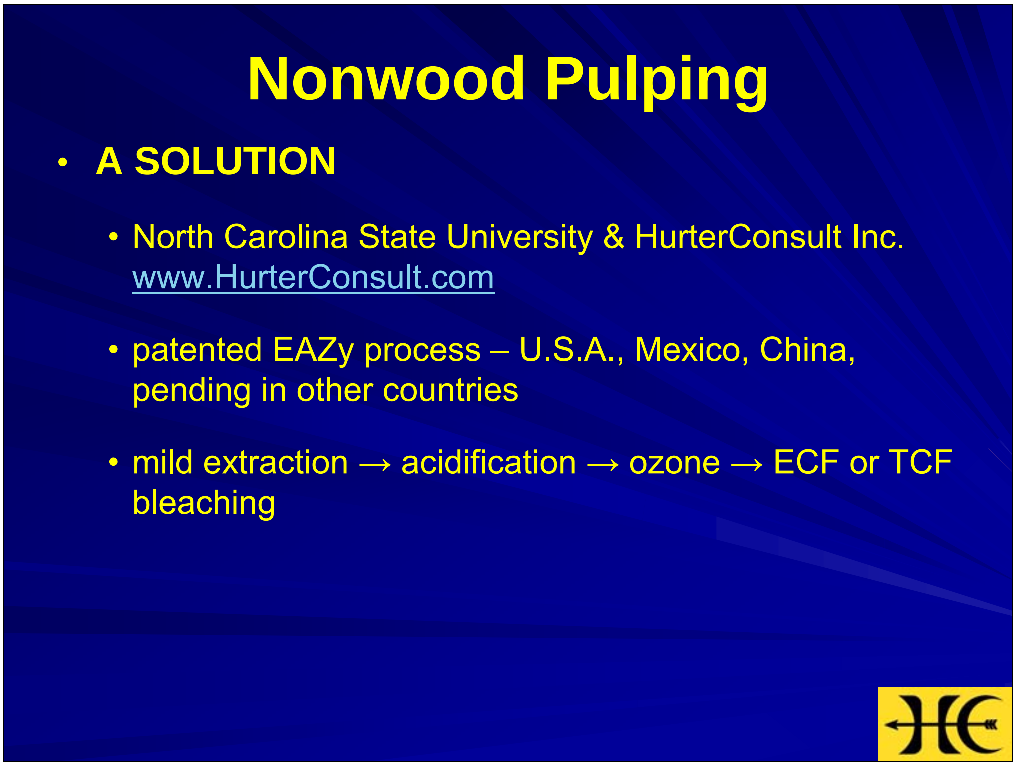
Using mechanical means only, the silica removal rate is up to 60%. Adding a small dose of alkali (less than 0.5% NaOH or equivalent) increases the silica removal rate up to 80%.

ARC has filed for a patent on the process.



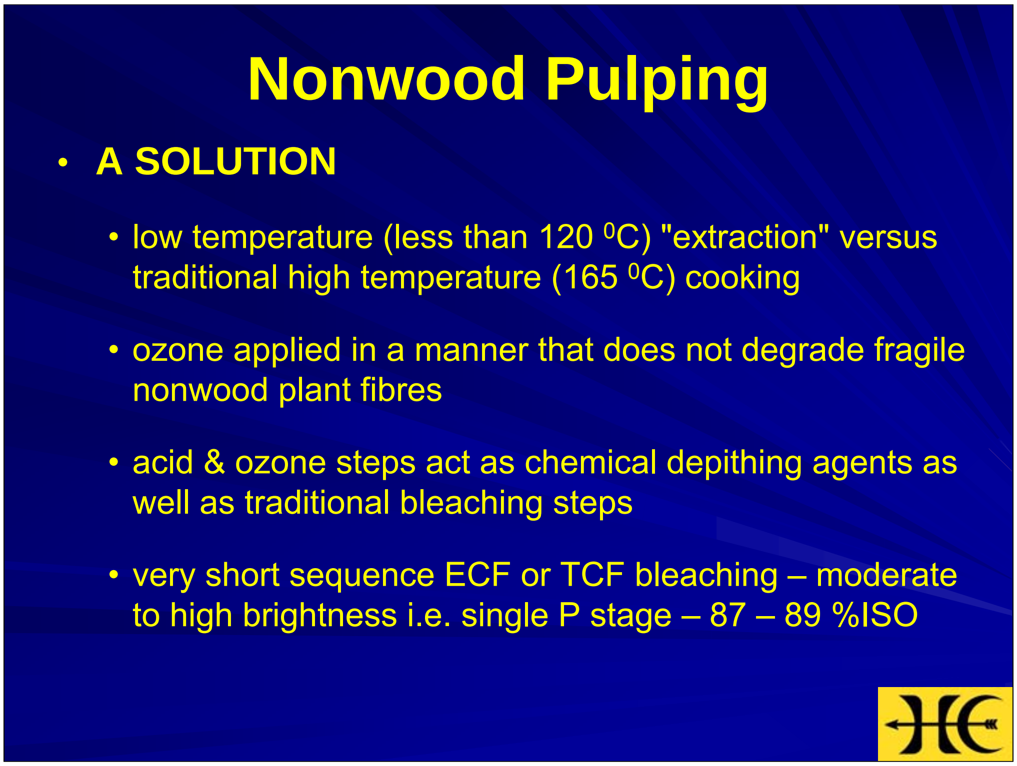
The next problem relates to the pulping of pith containing nonwoods such as bagasse and corn stalks. For good pulp quality the pith needs to be removed. Traditionally this is done using mechanical depithers which are energy intensive.

The need was to find another way to remove the pith that is less energy intensive.



A possible solution is offered by North Caroline State University and HurterConsult in their patented EAZy process.

The process consists of a mild extraction step followed by acidification, ozone treatment and then either ECF or TCF bleaching..

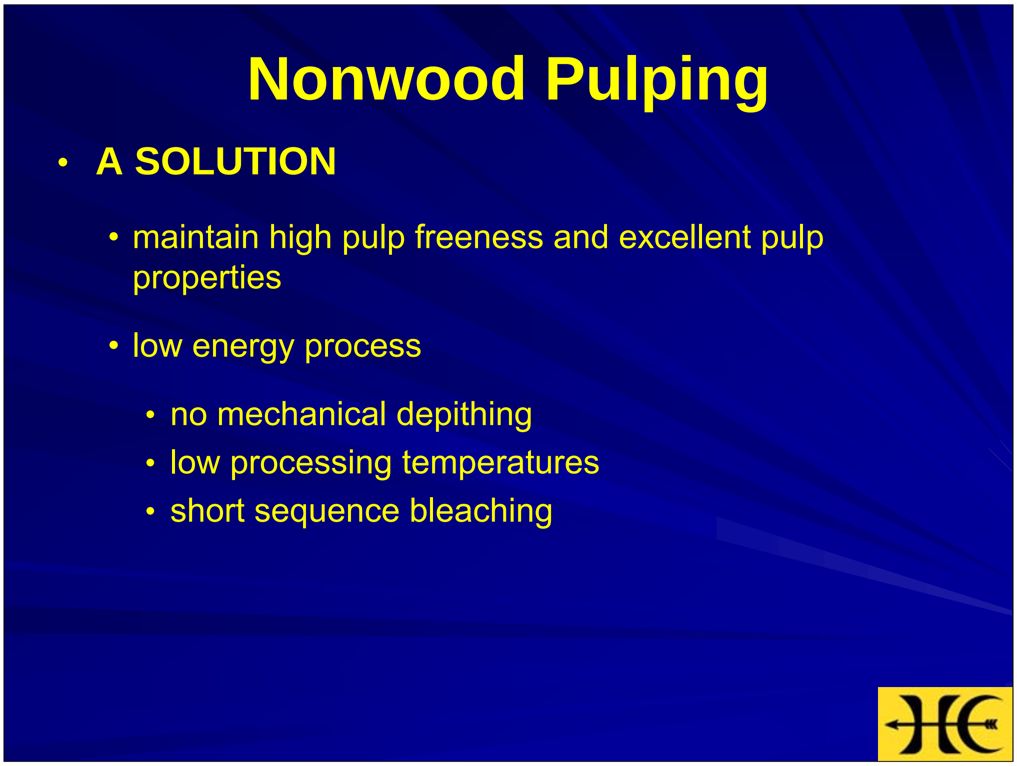


A low temperature "extraction" step is used instead of traditional high temperature cooking resulting in lower energy consumption

Ozone is applied in a manner that does not degrade fragile nonwood plant fibers

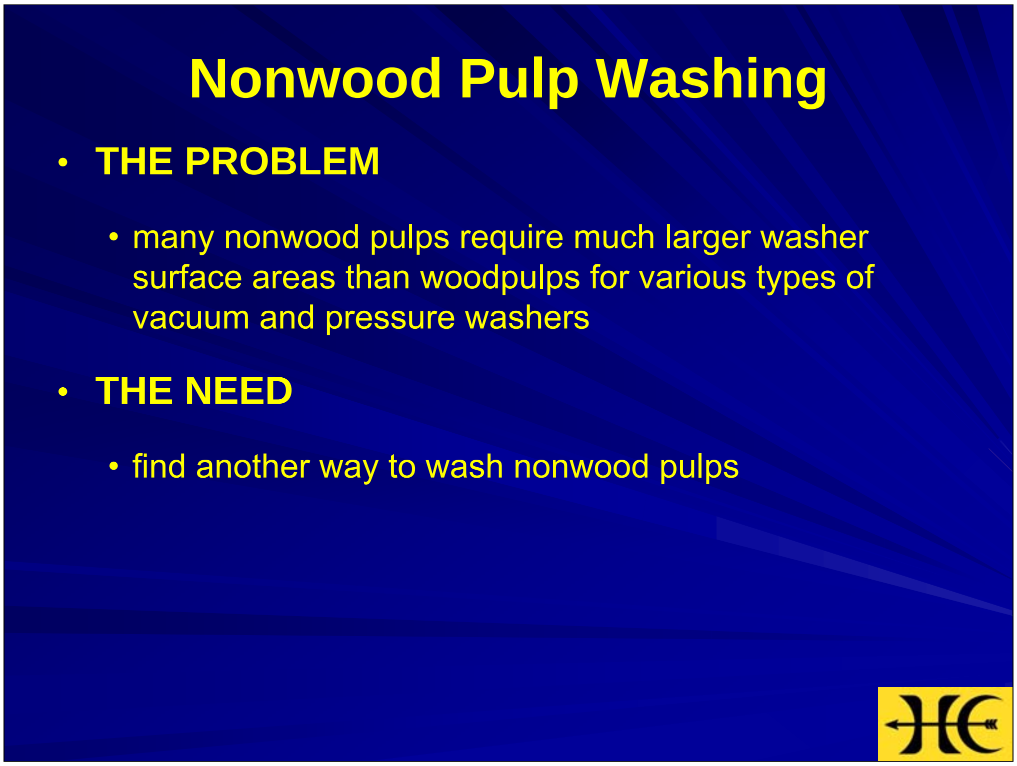
The acid and ozone steps act as chemical depithing agents as well as traditional bleaching steps

Very short ECF or TCF bleaching sequences provide moderate to high brightness – for example a single pressurized peroxide stage can achieve 87 – 89 %ISO brightness.



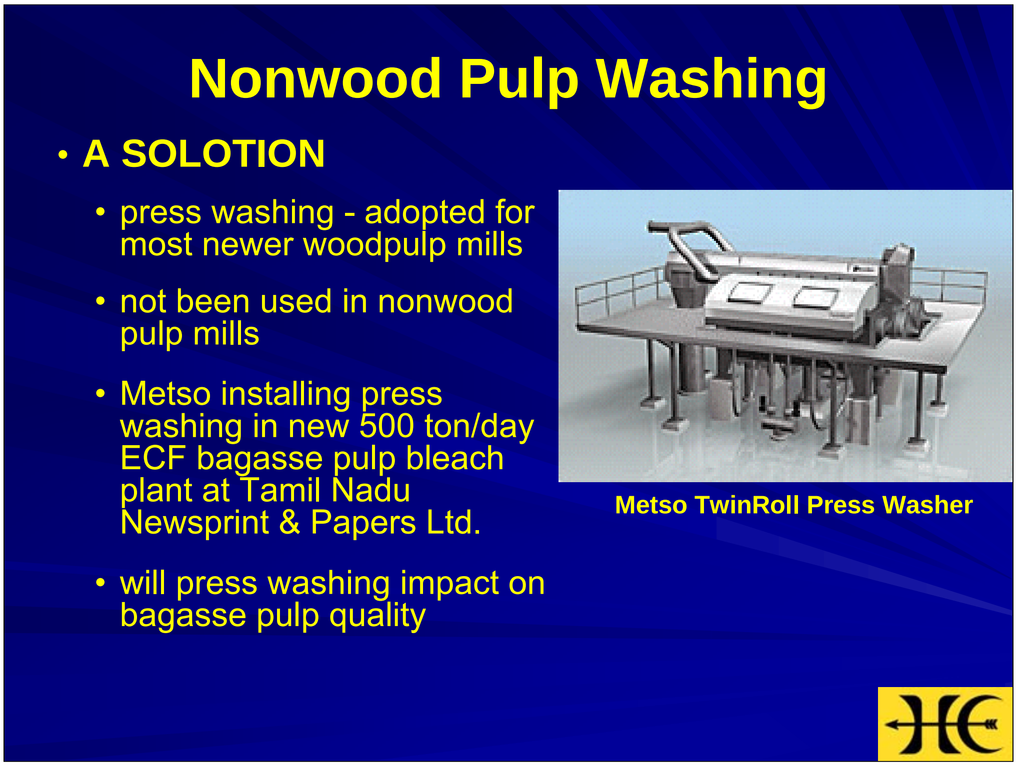
The process maintains high pulp freeness – in excess of 400 CSF and excellent pulp properties.

Overall, the process is a low energy process as there is no mechanical depithing, process temperatures are low – below 120 C – and a short bleaching sequence can be used.



Many nonwood pulps require much larger washer surface areas than woodpulps for various types of vacuum and pressure washers. This has been one of the limiting factors on the scale-up of nonwood fibre pulp mills.

The question is: "Is there another way to wash nonwood pulps without damaging the fibre."



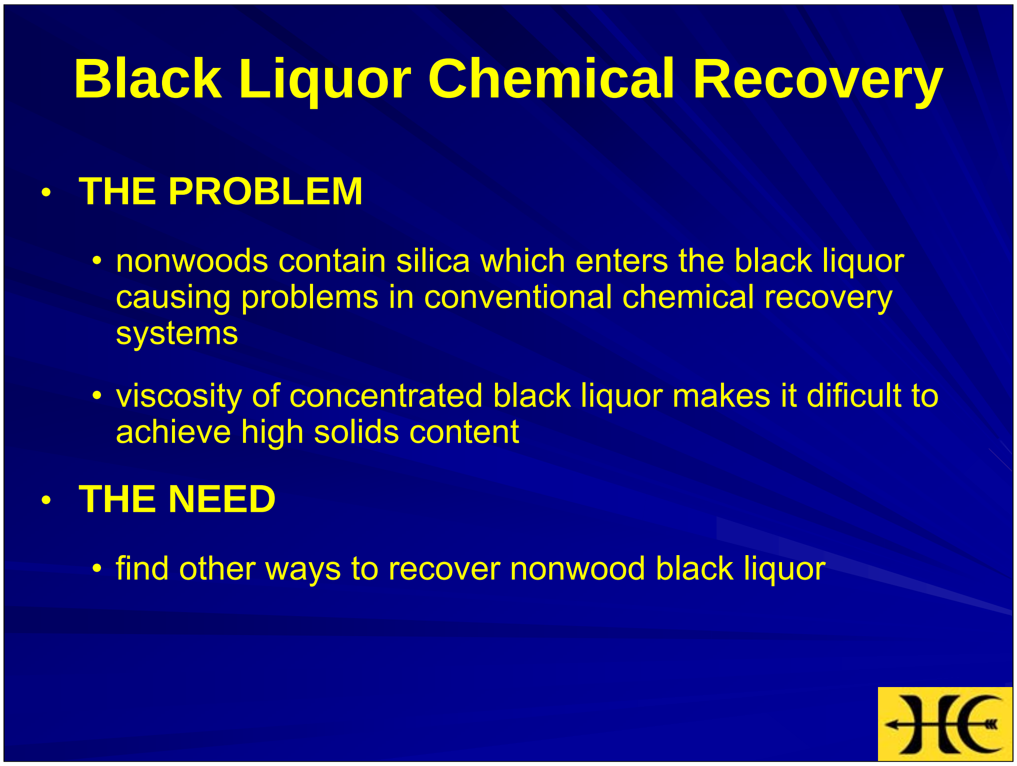
Press washing has been used in the woodpulp industry for many years and twin roll press washers are installed in virtually all of the newer woodpulp mills.

However, they have not been used in nonwood pulp mills.

Metso is currently installing a new 500 ton/day ECF bleach plant for bagasse at Tamil Nadu Newsprint & Papers Ltd. in India and it includes press washers.

It will be interesting to see if the press washers work as effectively on bagasse as they do on woodpulp and whether there is any impact on pulp quality be it positive or negative.

If press washing works well on bagasse, it may allow for the scale-up of nonwood pulp mills beyond what is currently available today.

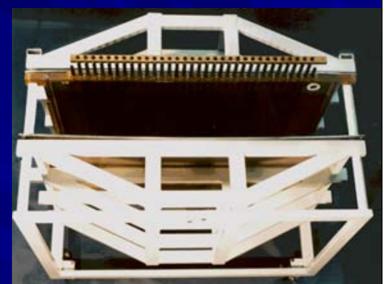


Silica in nonwood fibres enters the black liquor and causes many problems in conventional chemical recovery systems. Also, nonwood black liquors have viscosity problems that make it difficult to achieve high solids content.

The need has been identified for many years to find other ways to recover chemicals from nonwood black liquor.

Black Liquor Chemical Recovery

- **A SOLUTION #1**
  - Electrosep Inc., Oregon, U.S.A (www.electrosepinc.com)
  - nonfouling electrolytic membrane technology
  - caustic recovered directly as NaOH
  - lignin separated by the membrane
  - hemicellulose goes through the membrane and can be fermented
  - may be ideal for smaller mills
  - 1st commercial installation on wheat straw in India - 2007



One possible solution is offered by Electrosep's nonfouling electrolytic membrane technology. I believe that it has huge possibilities for handling black liquor from nonwood pulp mills, especially smaller to medium sized mills that cannot afford conventional chemical recovery.

The caustic is recovered directly as caustic at the electrode. The pH drops as caustic is removed causing the lignin to precipitate, and it is removed by the membrane. The hemicellulose passes through the membrane and can be fermented into alcohols.

This technology eliminates the evaporators, recovery boiler, recausticizing system and lime kiln in a conventional chemical recovery system which would be a significant reduction in capital investment.

The first commercial installation is scheduled for start-up in 2007 at a wheat straw pulp mill in India.

Black Liquor Chemical Recovery

- **A SOLUTION #2**
  - ThermoChem Recovery International Inc., Baltimore, U.S.A (www.tri-inc.net)
  - low temperature gasification (steam reforming)
  - commercial success - NORAMPAC, Trenton, Ontario, Canada – over 18,000 hours
  - energy positive at 60% black liquor solids
  - may allow for switch to higher yield sulphite cooking

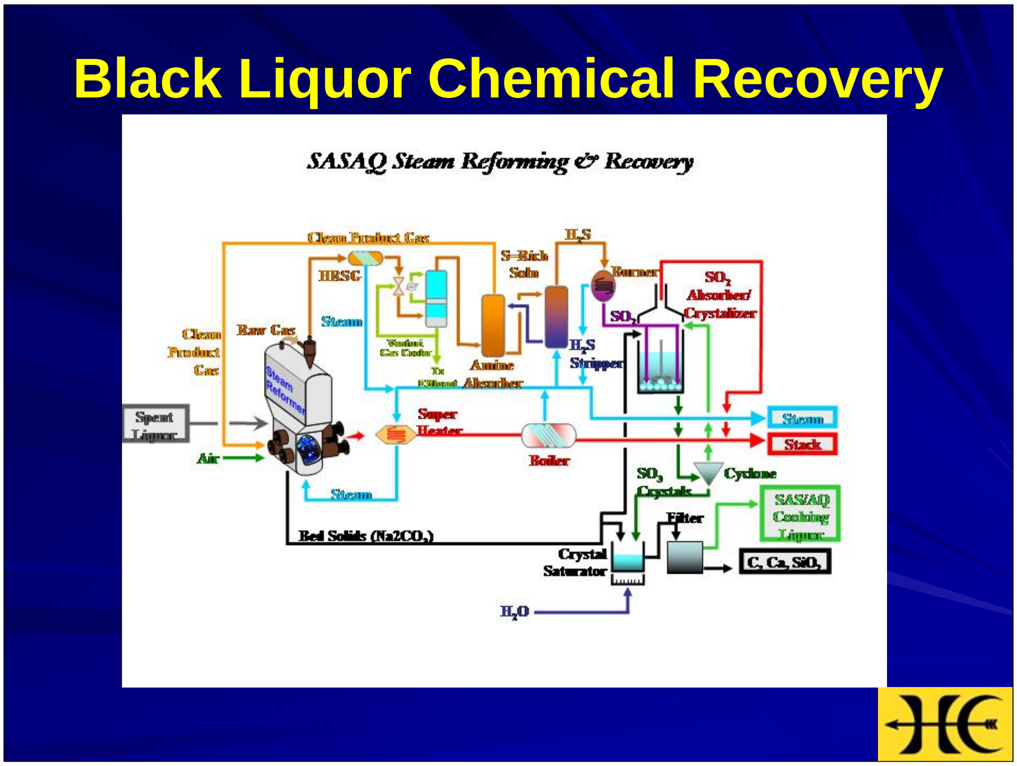
TRI Pulse Combustor

Another possible solution is ThermoChem Recovery's low temperature gasifier or steam reformer.

They have a successful commercial operation at NORAMPAC in Trenton, Ontario, Canada which has operated for over 18,000 hours.

Of interest to nonwoods that have difficulties achieving high black liquor solids due to viscosity issues is that the technology is net energy positive at about 60% solids. Also, the gasifier can handle silica which is discharged along with other non-process elements.

Another possibility that has yet to be tried commercially is that it may allow for easier recovery of sulphite liquors.



Using semi-alkaline sulphite AQ cooking would provide higher yields as well as brighter unbleached pulp that requires less bleaching chemicals – both factors that would decrease nonwood pulp production costs.

This slide provides a schematic of TRI's steam reformer gasifier for semi-alkaline sulphite black liquor including a system for stripping the sulphur from the syngas and reintroducing it to the cooking liquor. It has been tested in the pilot plant and works well.

The system was proposed for the conversion of a soda-based bagasse mill but the mill has deferred any capital investments at this time.

I believe that TRI's technology for both soda and sulphite based nonwood pulp mills offers good potential for medium to large sized pulp mills.

In summary, nonwood pulping needs new technologies to become more economical

The foregoing illustrates a few newer technologies that can improve the economics of nonwood pulp production.

My next topic is possible threats to nonwood fibres for pulp and papermaking.

In my opinion, there is only one serious threat to nonwood fibre raw materials for pulp and papermaking and it can be summed up in one word - “Bio-Mania”. By bio-mania, I mean the huge and growing interest in generating electricity and producing fuels from bio-mass be it wood or nonwoods.

The U.S. government right up the President’s office has made a commitment to increase biofuel production to reduce dependency on imported oil. As a result tens of millions of dollars if not hundreds of millions are being committed to research and commercial operations not only for grain ethanol but also for bio-mass to fuel conversion.

In Germany, incentives offered to bio-mass to bio-fuel and bio-electricity producers are driving up wood costs which has alarmed the pulp and paper industry.

While bio-mania may not have reached the Asia Pacific region as yet, in my opinion, it’s only a matter of time.

Let’s take a look at just a few possible projects based on bio-mass to fuel conversion to get an idea of how they could impact on the availability of nonwood fibre raw materials for pulp and papermaking.

Corn Stalk Pulp & Paper Mill

- 200,000 mt/year fine paper
- 100,000 bdmt/y corn stalk pulp line
- gasification biorefinery

- 300,000 mt/y corn stalks for pulping
- 680,000 mt/y corn stalks for biorefinery

- biorefinery
  - all steam & power for complex
  - 819,000 barrels/y F-T liquid biofuel fuel
  - adds US$150 million to project (total US$ 650 million)
  - increases ROE from 18% to 26%

Corn

I have been working on a 200,000 mt/y fine paper project for the U.S.A. that includes a 100,000 bdmt/y corn stalks pulping line based on the low energy EAZy process mentioned earlier. Last year we looked at adding a gasification-based biorefinery to the project using corn stalks to feed the biorefinery.

The key points are:

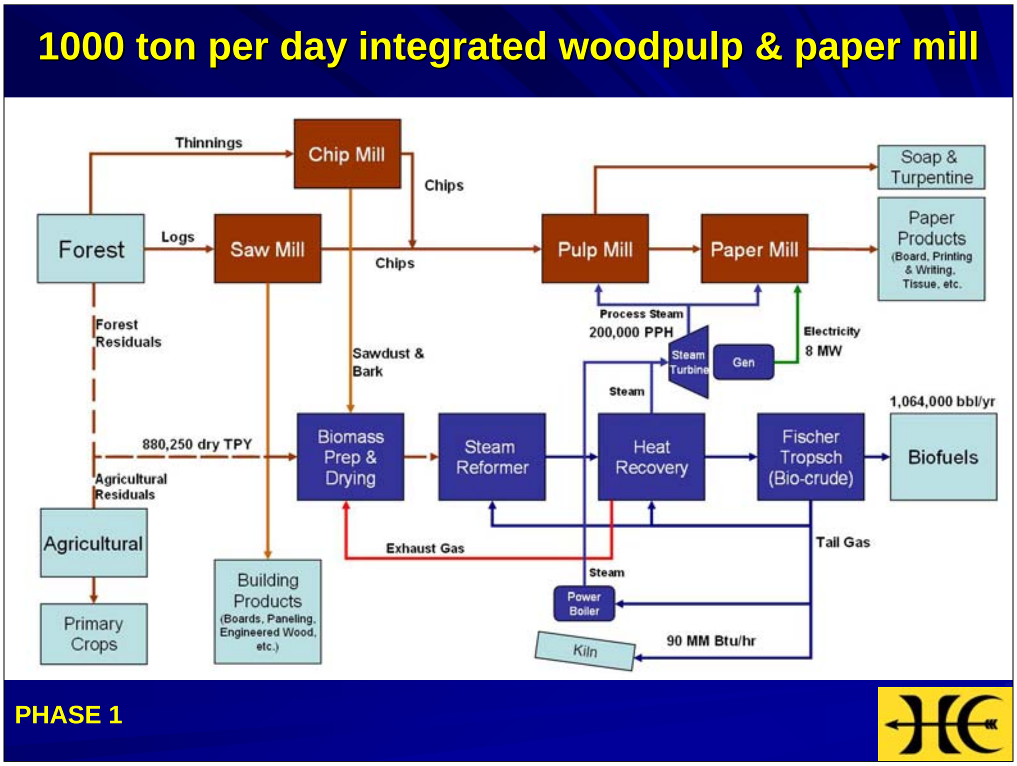
•The pulping line would require about 300,000 mt/y of corn stalks but the biorefinery would add a further 680,000 mt/y making the demand for the mill in the order of 1 million mt/y

•The biorefinery would add US$ 150 million to the project bringing the total to about US$650 million

•The biorefinery would produce all of the steam and power for the complex as well as 819,000 barrels/y of F-T liquid biofuel

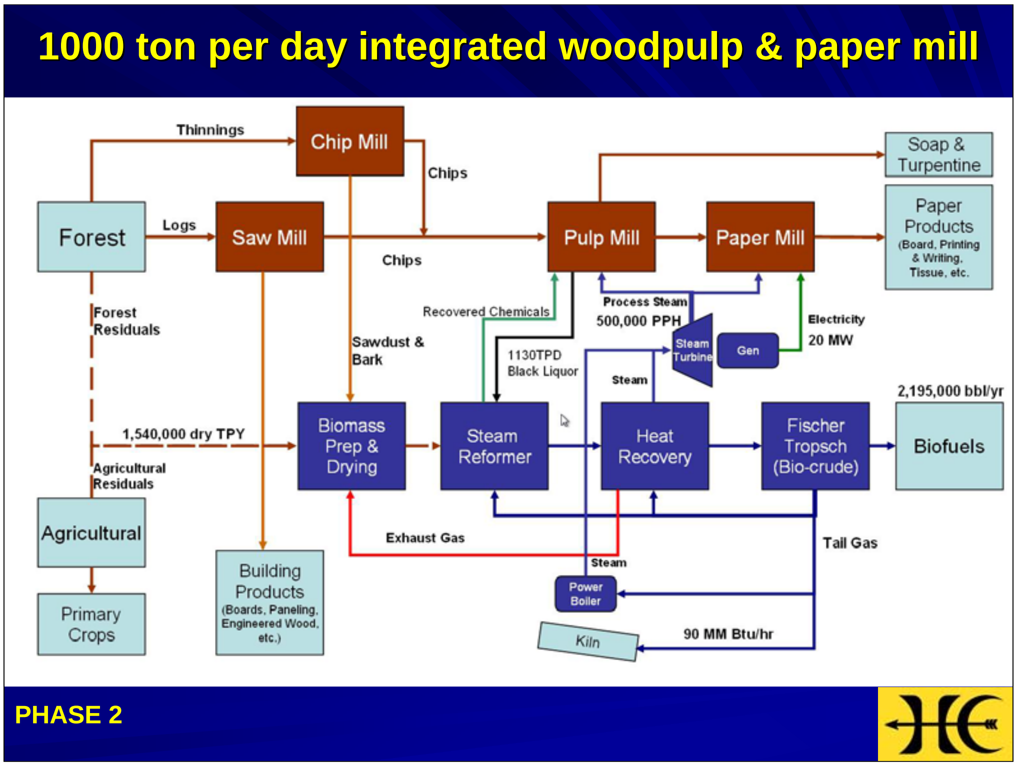
•At current oil prices, the added fuel production increased the estimated project ROE from about 18% up to 26%.

So, including a biorefinery in the project is a double edged sword – it can significantly increase the demand for biomass but on the other hand it improves the project economics as well as the perception that the project is "green".



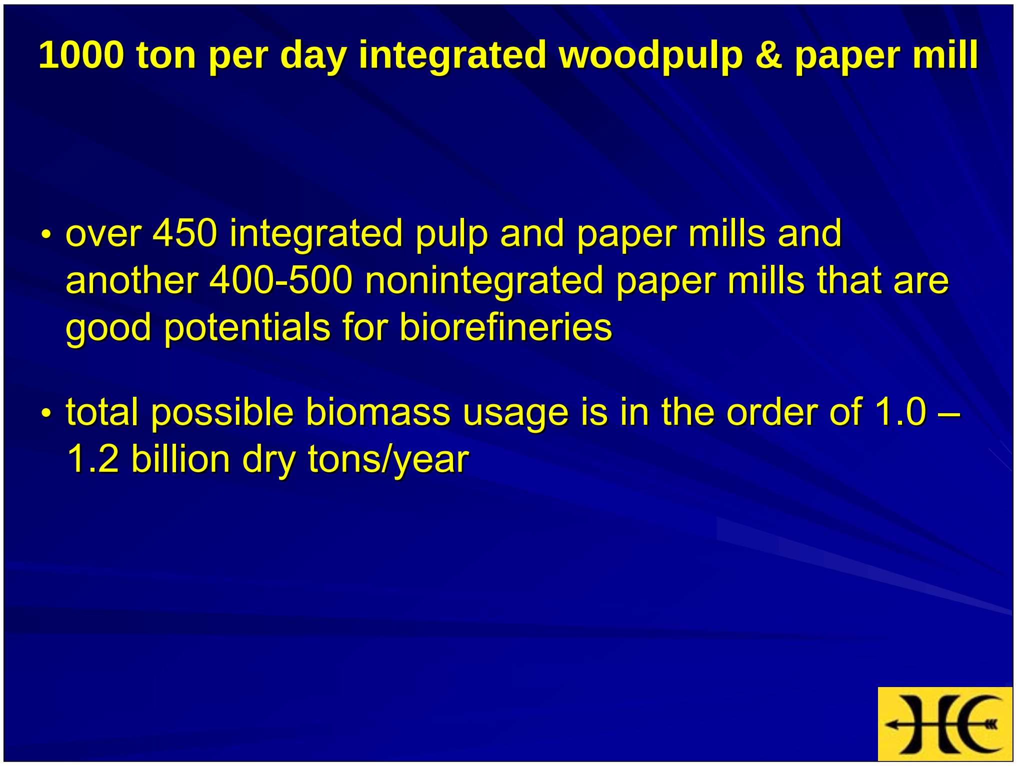
Eric Connor of ThermoChem Recovery International has a very interesting article on biorefineries in the March/April 2007 issue of PaperAge. The basis of the article is the impact of adding a biorefinery to a 1000 ton per day integrated woodpulp and paper mill.

In Phase 1, a biomass to energy gasifier (steam reformer) is added to provide "green" steam and power for the mill. It would consume about 880,000 dry tons per year of biomass and provide part of the steam and power requirements of the mill. The balance comes from the existing conventional chemical recovery boiler. In addition, the biorefinery would produce a little over 1 million barrels per year of F-T biofuel.

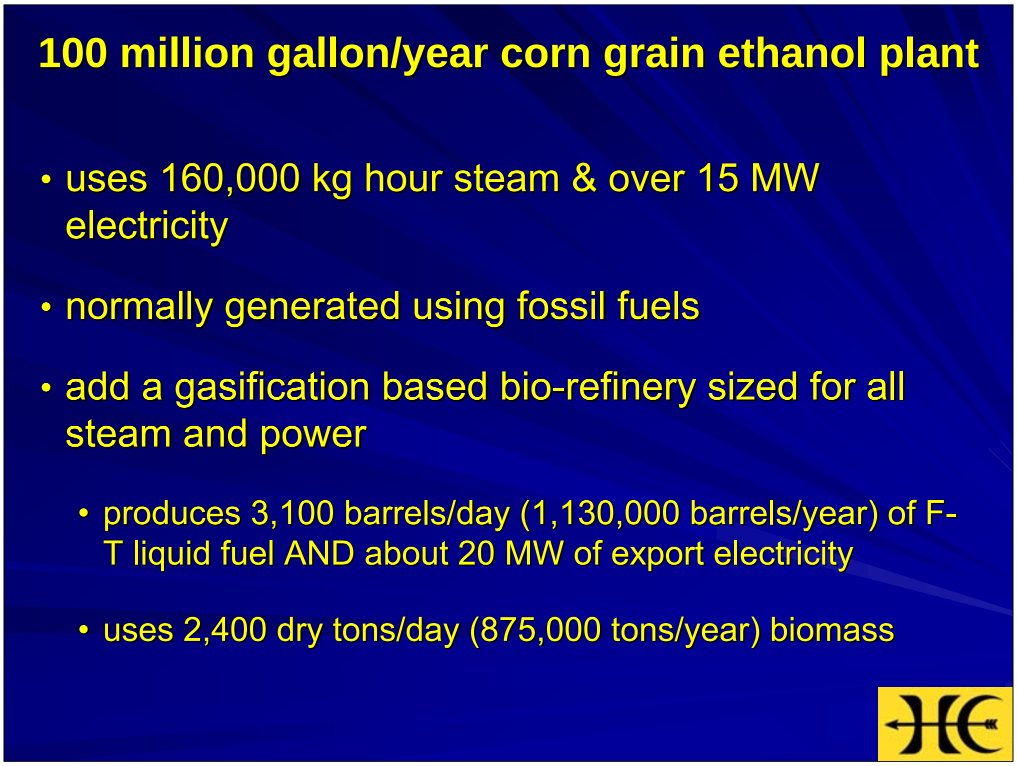


In Phase 2, the conventional recovery boiler is retired and the gasifier (steam reformer) capacity is increased to provide all of the steam and power requirements of the mill. Now, the biorefinery is consuming about 1,540,000 dry tons per year of biomass and producing about 2,195,000 barrels per year of F-T biofuel.

As you can see the biomass potentially comes from forest residuals as well as agricultural residuals.



TRI estimates that there are over 450 integrated pulp and paper mills and another 400-500 nonintegrated paper mills that are good potentials for biorefineries. I estimate that if all of these mills added biorefineries, they could consume between 1.10 – 1.2 billion dry/year of biomass.



Another example is a 100 million gallon per year corn grain ethanol manufacturing plant which requires about 160,000 kilograms per hour of steam and over 15 MW of electricity to ferment corn to distilled, denatured ethanol.

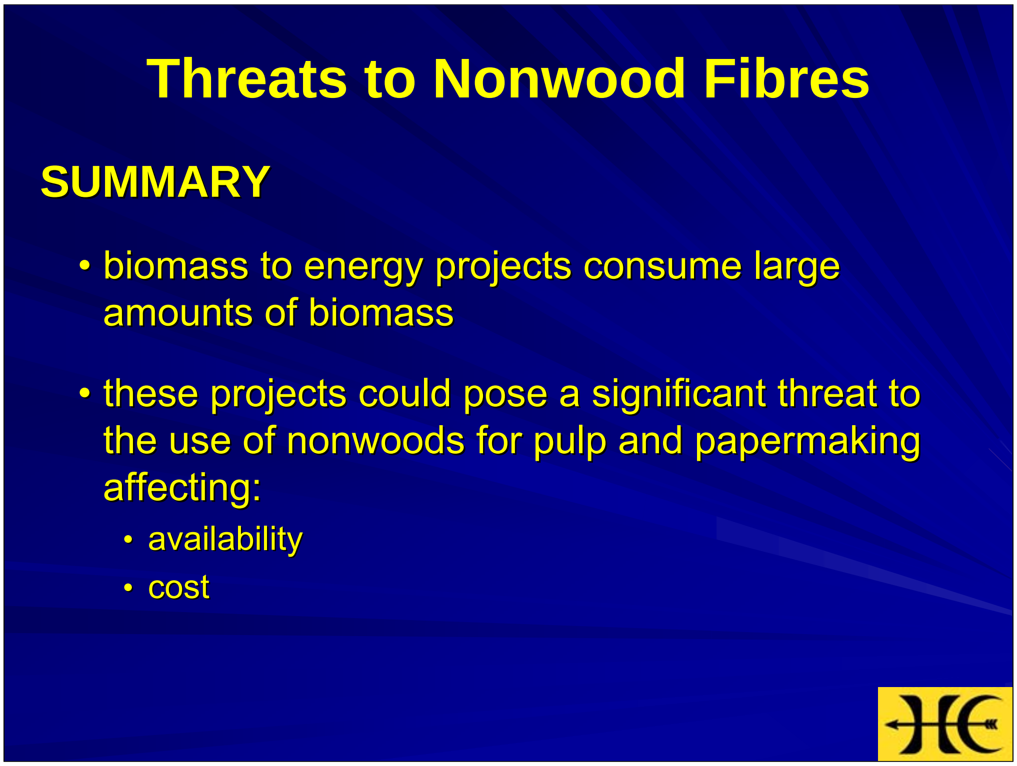
Siting a gasifier-based biorefinery at the ethanol plant and sizing it to match the steam and power needs of the complex would result in a biorefinery using about 2,400 dry tons per day of corn stover and producing about 3,100 barrels per day of F-T biofuels as well as about 20 MW of export electricity..

The ethanol plant would become a true carbon neutral producer of biofuels.

Iogen Corporation in Ottawa, Canada has been developing the enzymatic hydrolysis of cellulose to produce fermentable sugars for many years.

They are currently operating a pilot plant based on their technology which is producing fuel grade ethanol from wheat straw.

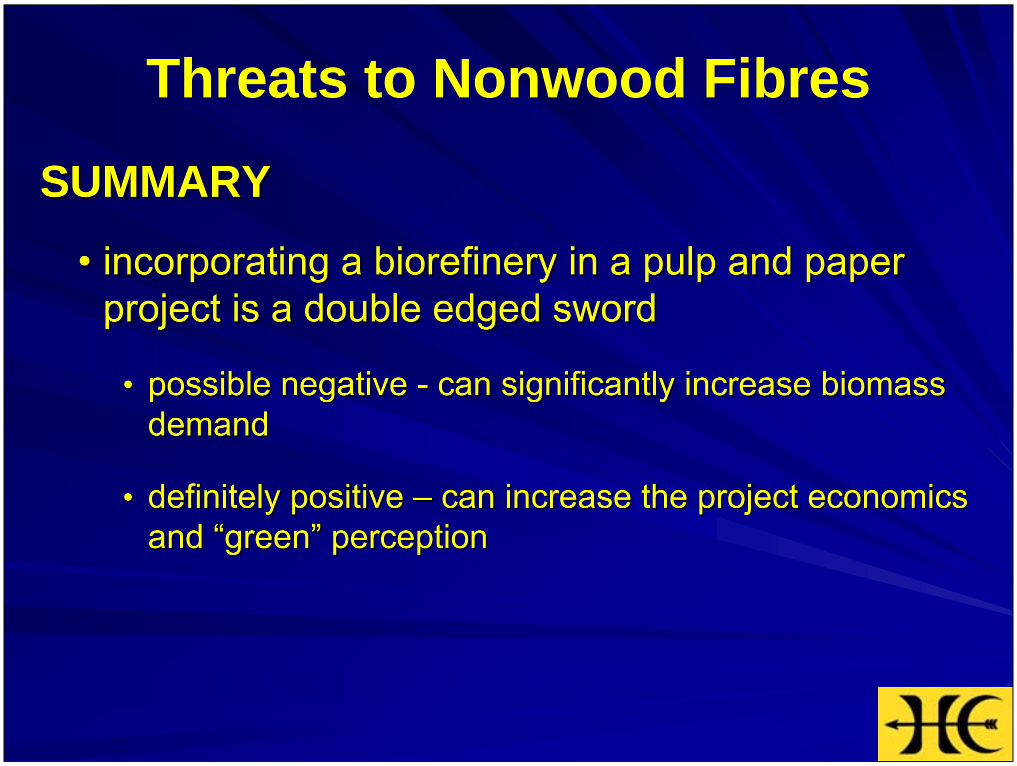
Plans are in the works for several commercial plants that are based on using 750,000 mt/year wheat straw feedstock



Biomass to energy projects have the potential to be very, very large consumers of biomass.

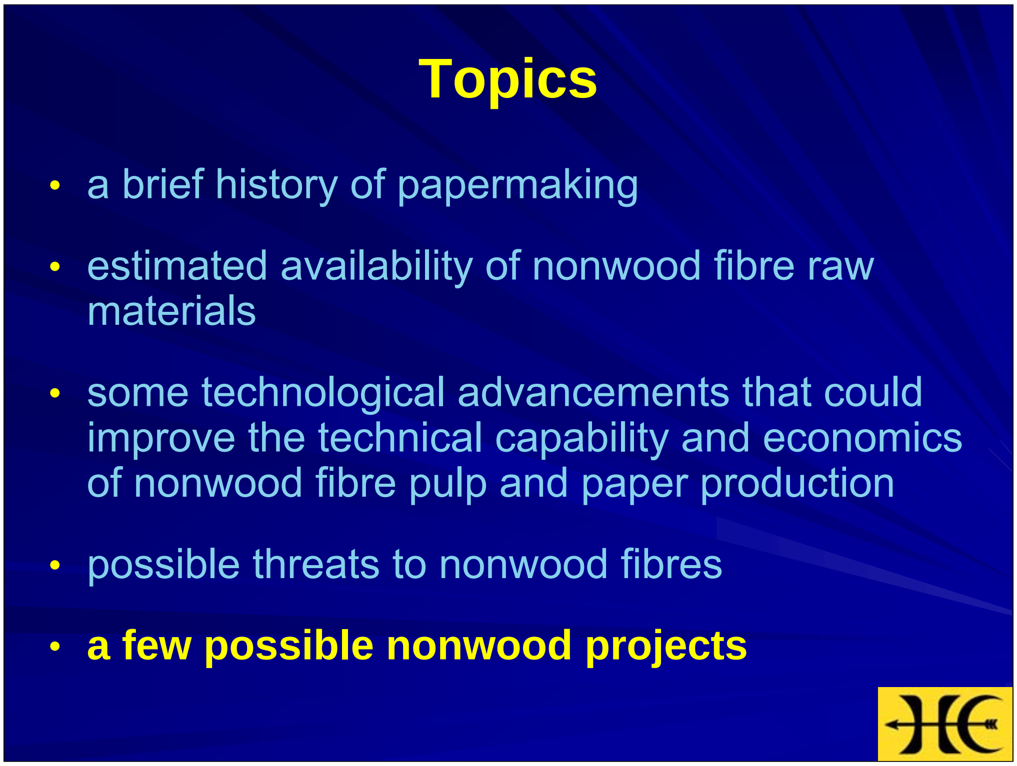
This could pose a significant threat to the use of nonwood fibre raw materials for pulp and papermaking as biorefineries could affect the availability and costs of the nonwoods for pulp and papermaking.

As mentioned earlier, in Germany, incentives offered to bio-mass to bio-fuel and bio-electricity producers are driving up wood costs which has alarmed the pulp and paper industry. It is conceivable that the same could happen to nonwoods.



Using biomass to produce energy and liquid fuels in a biorefinery and including one in a pulp and paper project is a double edged sword – it can significantly increase the demand for biomass but on the other hand it improves the project economics as well as the perception that the project is “green”.

Since it became legal to grow industrial hemp in Australia, I have been approached regarding two projects in West Australia – one for pulp and paper and the other for energy. Which will be more successful it yet to be determined.



Next, I want to suggest a few possible nonwood fibre projects that could be built in Asia in the next decade. I have selected some larger projects but smaller ones could be developed if for example some of the technologies that I mentioned earlier are adopted.

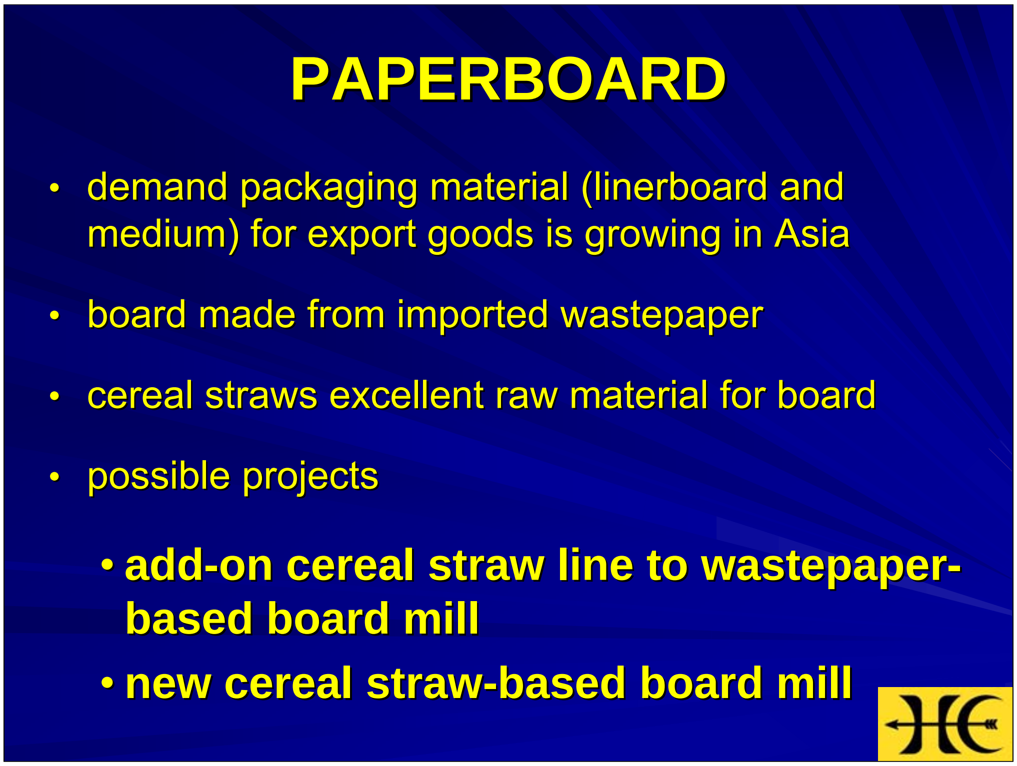
The away-from-home (AFH) tissue and toweling market is the fastest growing paper market in the world.

Economic development in China and India is creating a huge demand in the AFH market. Companies such as SCA are positioning themselves to supply this growing market. In March 2007, SCA announced that it is purchasing 20% of the Chinese tissue company Vinda. With a market share of approximately 4%, Vinda is one of the four largest tissue players in China.

Various nonwoods such as bagasse, straw and bamboo can be used to produce good quality tissue and toweling.

Since tissue and toweling are bulky and do not lend themselves to long distance transportation, my first possible project would be a 40,000 – 60,000 mt/y nonwood-based tissue/toweling mill for the AFH market.

I believe that several of these types of projects could be built in various countries in Asia Pacific.

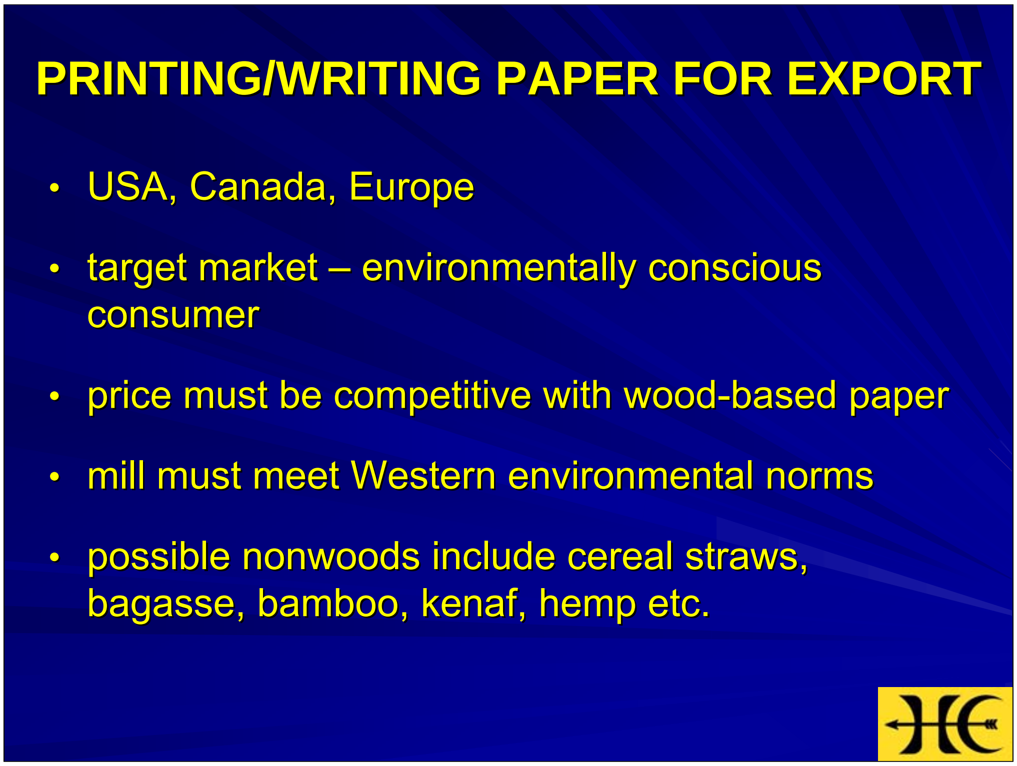


The demand for linerboard and medium for packaging material is growing in Asia as exports to the West increase. Much of the board is currently made from wastepaper imported from the West, primarily the U.S.A.

Cereal straws are an excellent raw material for board production.

My second possible project would be either a cereal straw pulping line as an add-on to an existing wastepaper-based board mill or a new board mill based primarily on cereal straw.

A board mill in Washington State recently installed an add-on cereal straw pulping line, and it is working effectively as well as reducing the furnish costs.



Nonwood fibre printing and writing papers could have good market opportunities in the USA, Canada and Europe if directed towards the “environmentally conscious” market. Of course, the price of the paper would need to be competitive with wood-based papers already in the market – in other words, forget about getting any significant premium for the nonwood paper if you want to achieve high market penetration.

For this market, any project must be built to Western environmental standards, and the fibre raw material must come from a sustainable resource. For example, bamboo from a natural forest likely would not be acceptable.

Possible nonwood fibre raw materials include a wide range such as cereal straws, bagasse, bamboo, kenaf, hemp etc.

Many Western corporations have established paper purchasing practices that include environmental issues. As such, the grade structure for the project likely should include grades such as financial and commercial opaques for annual reports as these papers command higher prices than copy paper as well as having less volatile markets.

My third project would be a nonwood-based printing/writing mill geared for the export market. I believe that the mill capacity should be in the 200,000 mt/year range or more, but local conditions may allow for smaller projects.

Given the potential size of the market, I expect that several similar projects could be built in Asia Pacific.

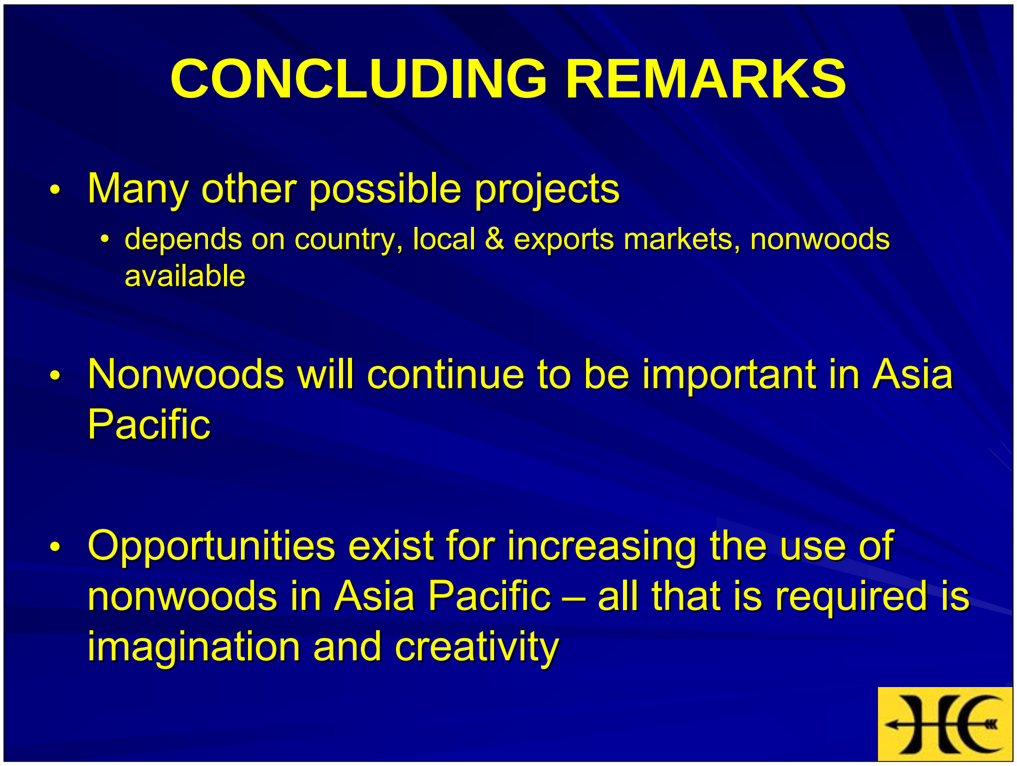
Many Asian countries do not have adequate wood resources and rely on imported wastepaper, imported pulp and nonwoods for their papermaking fibre.

Bamboo and giant reeds can provide a fast growing fibre resource to help meet the fibre supply gap. As mentioned earlier, in-laboratory mass propagation of planting material makes the cost of establishing farms for bamboo and giant reeds economical.

From planting to the first harvest takes about 3 – 4 years which is in the same time frame that it takes to plan and build a large market pulp mill. And, these nonwoods have the advantage that the plants regrow after harvesting without the need for replanting.

My fourth possible project would be a 1000 mt/day or more bamboo or giant reed market pulp mill for the domestic and export markets.

Again, I expect that several similar projects could be built in Asia Pacific.



There are many other possible nonwood fibre based projects and each will depend on the local markets of the country in which they are located, export opportunities and the nonwood fibre raw materials available. And, as mentioned the projects may not be as large as the ones that I have suggested.

In my opinion, nonwood fibre raw materials will continue to be an important resource for the pulp and paper industry in Asia Pacific for the foreseeable future and there are opportunities to see their use grow in our industry as the fibre supply basket tightens due to other uses as well as expanding demand for paper products.

I believe that many opportunities exist to increase the use of nonwoods in pulp and paper in Asia Pacific and elsewhere and that we are only limited by our imagination and creativity.

Thank you.