2023 International Conference Presentations

17 to 19 September 2023

Clayton Hotel | Burlington Road

Dublin, Ireland

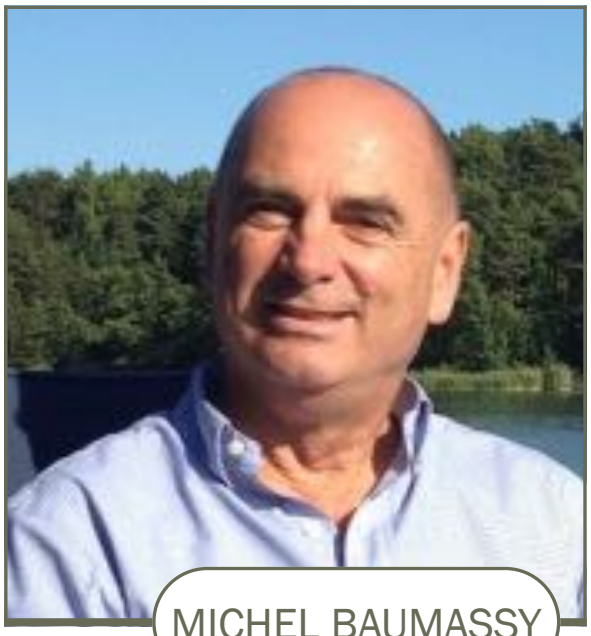
Pine Chemicals ASSOCIATION INTERNATIONAL

The global resource for the Pine Chemicals industry.

ANTI-TRUST POLICY

It is the policy of the Pine Chemicals Association International to adhere strictly to the requirements of all applicable antitrust and competition laws. PCA supports the commitment by its members to full compliance with all such laws, whether of state or federal jurisdiction, and believes that compliance with these laws will foster productive association work while promoting free enterprise.

At PCA meetings, there must be no discussion related to prices, or terms of purchase or sale, or products PCA members buy and sell or of other matters which might inhibit the competitive workings of the free market, including actions which may divide markets or create boycotts. The meeting chairman, or anyone attending the meetings, shall interrupt the meeting at anytime he or she feels discussion is creating the possibility of an antitrust competitive situation, or the appearance of one.



MICHEL BAUMASSY

MONDAY, 17 SEPTEMBER 2023

9:15 AM

Pine Chemicals Industry Global Overview and Trends

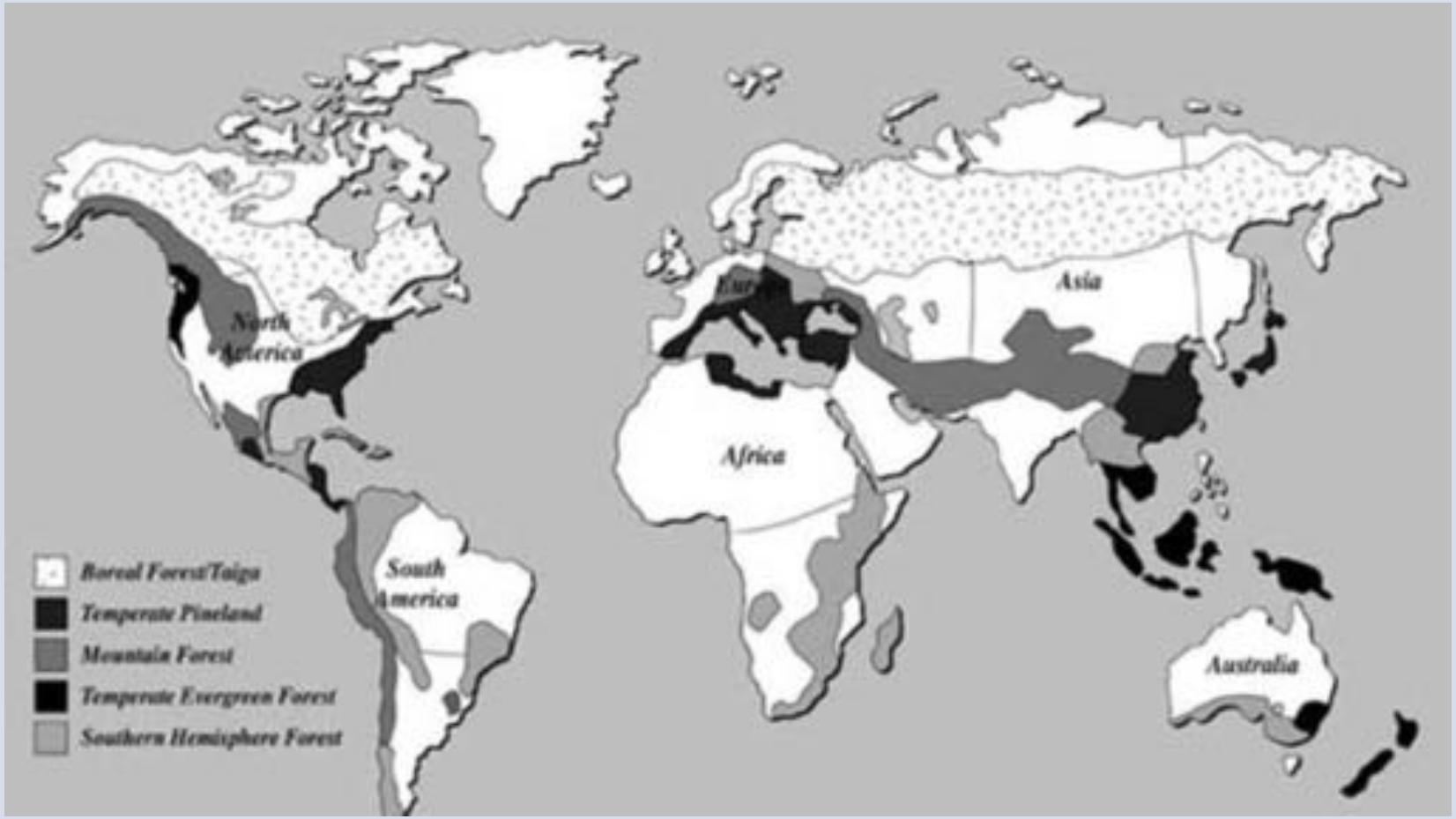
Michel has been in the Pine Chemical business since 1977, upon graduating as a Chemical Engineer. During his career he held several positions: DRT: Sales manager Resin and Tall oil derivatives, Arizona Chemical: Sales office manager, Sales manager Ink resins and CEO of resin plant. He joined Forchem's sales team in 2002 , when the company was created in Finland. He has recently retired from Forchem and has begun a new adventure as President of Fonterines Consulting Michel resides in Nice, France. He is a private pilot and enjoys mountain flying.

2023 PCA International Conference
September 17/19 , Dublin

Pine Chemicals Industry
Global overview and Trends

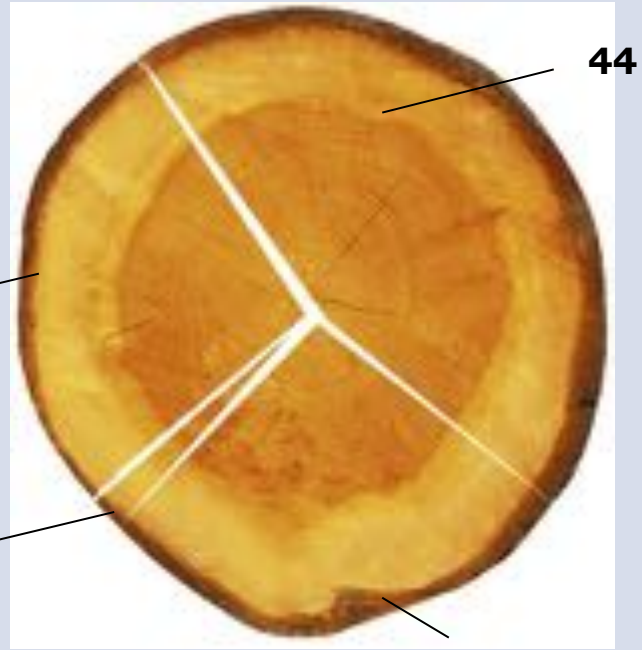
Michel Baumassy , SAS Fonterines Consulting

The World's Coniferous Forests
2 Billions Ha
15% of land area / Largest Land Biome



Pine Tree composition

- Pine trees contain 2-5% of extractives
- Rosin , Fatty acids , Turpentine and Sterols are the main components of the extractives



Pine Chemicals: 3 Different Processes

Tree Tapping:

-Gum Turpentine

-Gum Rosin

Extraction from pine stumps:

-Wood Turpentine

-Wood Rosin

Kraft process at Pulpmills:

-Crude Sulfate Turpentine

-Crude Talloil (CTO) :

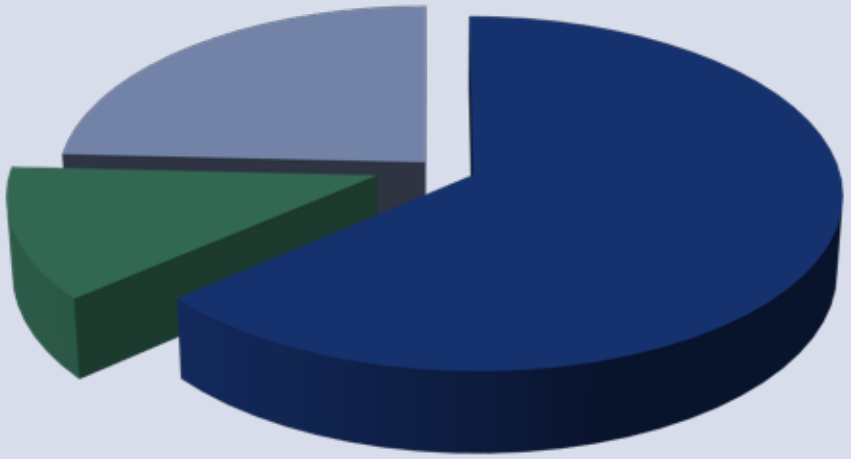
Talloil Rosin

Talloil Fatty acids

Talloil Pitch

Sterols

Pulp Production



Global Pulp Production from virgin + recovered fibers: 330 Million T
Global Virgin Wood Pulp Production: 160 Million T
130 Million T Chemical process
30 Million T Mechanical process
Kraft process 90% of Chemical process

- Softwood Kraft pulp from coniferous trees : 43 Million T mainly concentrated (90%) in North America and Europe/Russia.

- Crude Tall Oil is mainly obtained from softwood kraft pulp.
- 40-50 Kg CTO /T softwood kraft pulp.

- Global Crude Talloil production : 1.95 Million T

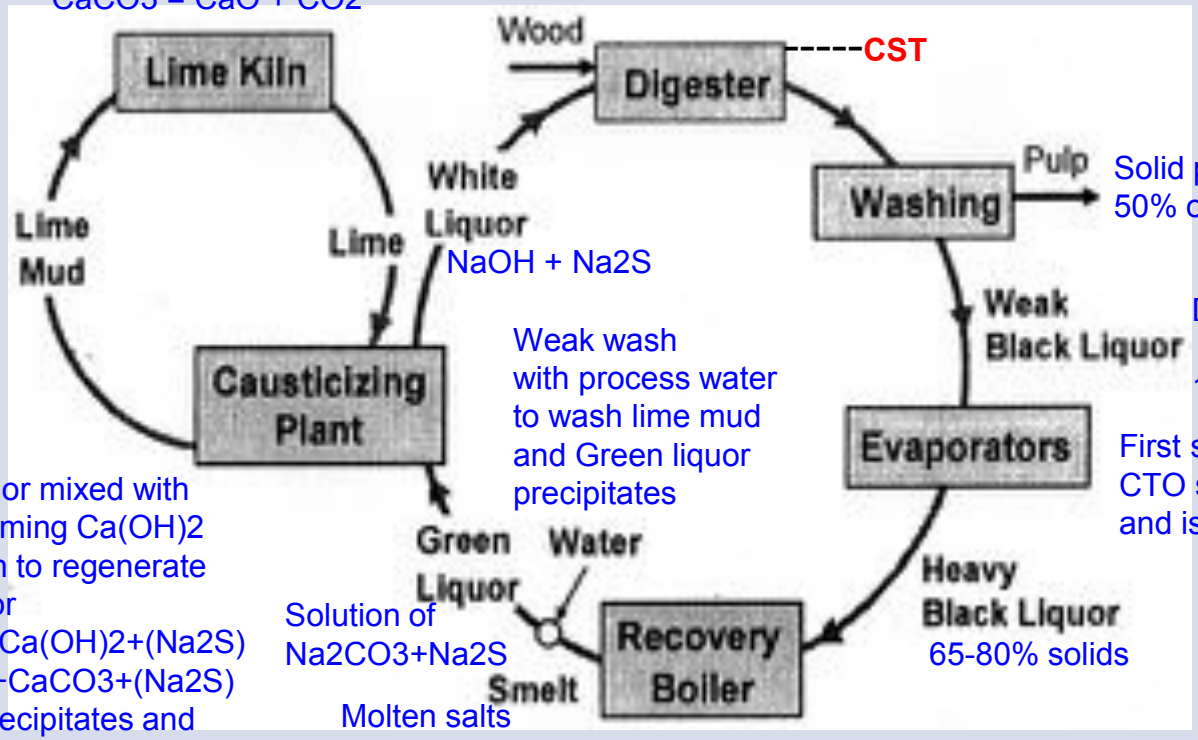
KRAFT Process

- Invented in Danzig/Prussia in 1879 by Carl Dahl
- Superior strength of the resulting paper (Kraft = Strength in German)
- Invention of the recovery boiler in 1930 enabling the recovery and reuse of the inorganic pulping chemicals
- Raw Talloil soap which rises to the surface of the intermediate black liquor tank is skimmed off and acidified with sulfuric acid to produce Crude Talloil
- Dissolved organic compounds in heavy Black Liquor are burned to produce steam and power.
- **Black liquor can be considered as the most important renewable bio-fuel**

KRAFT Process

Extra energy needed (CTO, Talloil Pitch or Fossil Fuel)

$CaCO_3 = CaO + CO_2$



Solid pulp
50% of dry wood chips

Degraded soluble lignin & hemicellulose + extractives
15% solids

First step:20-30% solids.
CTO soap rises to surface and is skimmed off

Acidulator

Crude Talloil

Removal of CTO soap improves further evaporation step

Weak wash with process water to wash lime mud and Green liquor precipitates

Green liquor mixed with CaO becoming Ca(OH)2 in solution to regenerate white liquor
$Na_2CO_3 + Ca(OH)_2 + (Na_2S) = 2\,NaOH + CaCO_3 + (Na_2S)$
$CaCO_3$ precipitates and heated in Lime Kiln

Solution of $Na_2CO_3 + Na_2S$

Molten salts

Heavy black liquor burned to recover inorganics for reuse
$Na_2SO_4 + 2C = Na_2S + 2CO_2$
Boiler generating steam and electricity

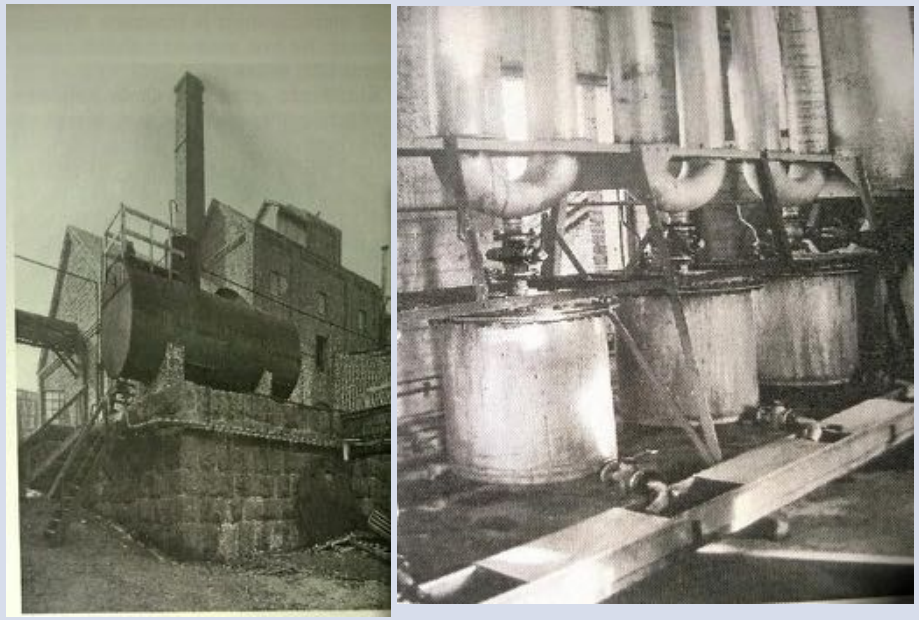
Ca,Na and S: closed cycle

CTO History

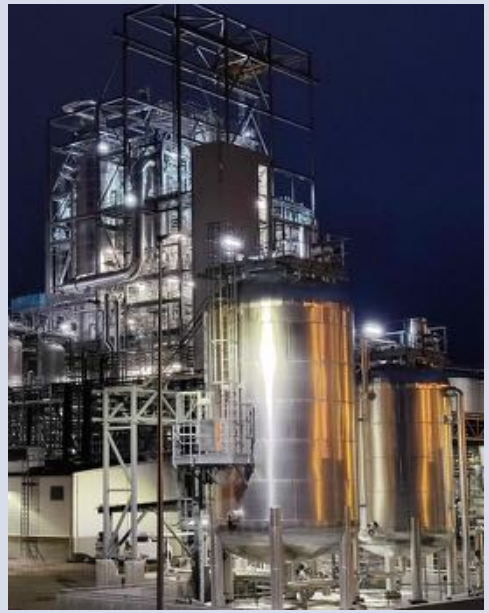
Late 19th century: Discovery that black liquors contain fatty acid and rosin acid soaps

1899: Production of Crude Talloil starts at Skutskär/Sweden

1911:Patents in Finland, Sweden by Hellström and Bergström

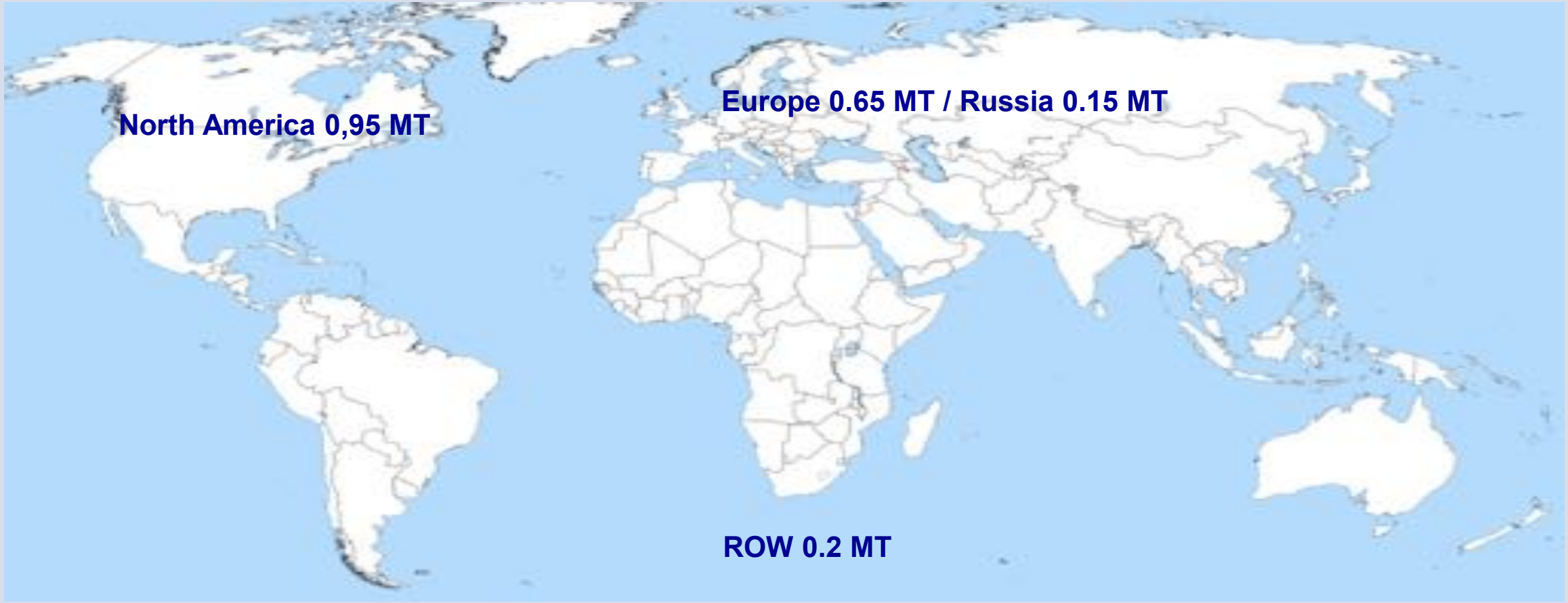


1913 : First CTO Vacuum Distillation Plant in Kotka/Finland



2022 Newest CTO fractionation plant

Y2023 CTO production :
1,95 Million T (Y2021: 2.05 Million T)

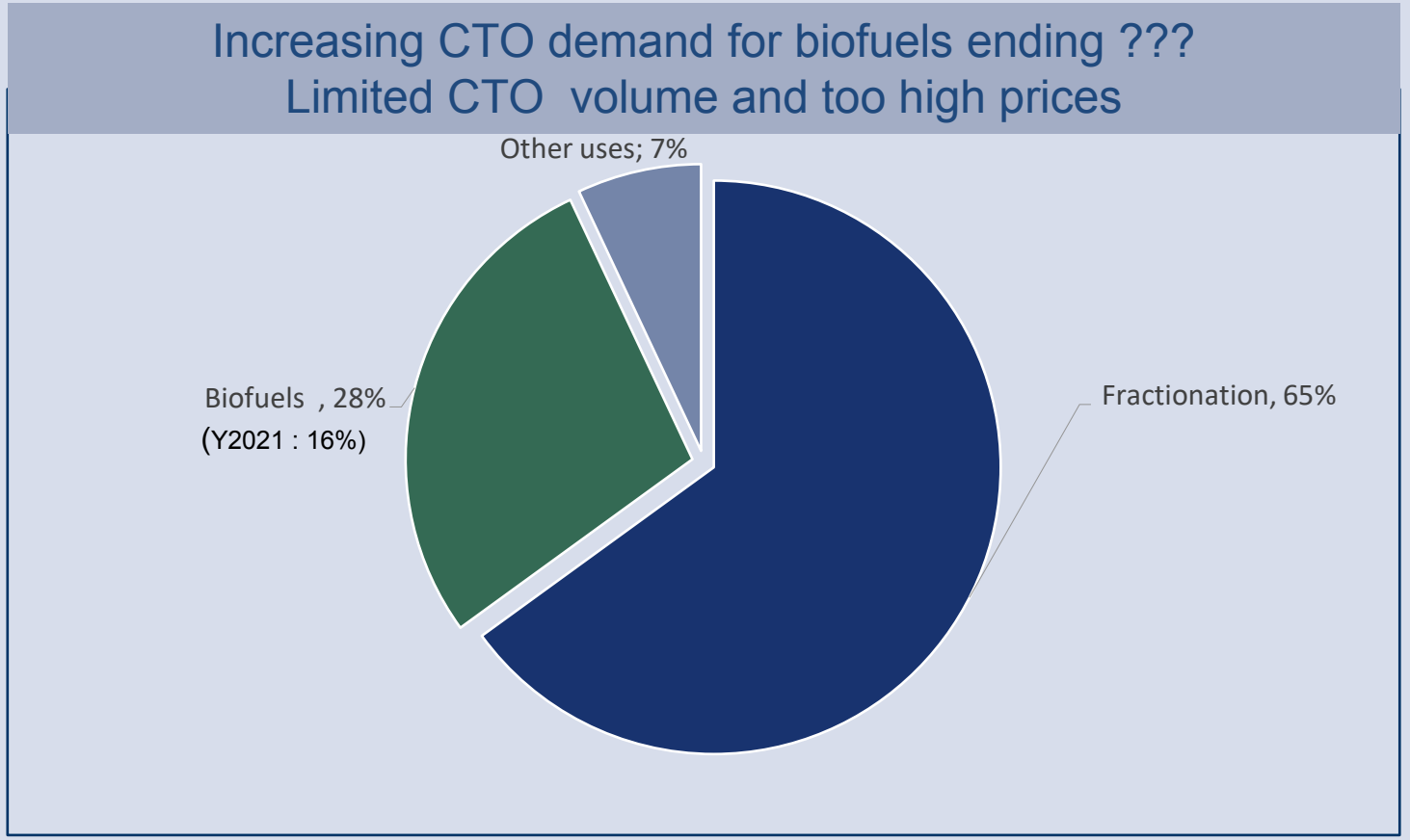


1 MT= 1 Million Metric T

Pulp and CTO News

- 50 000 T Russian CTO no longer available for exports to Europe due to Russia/Ukraine war
- Lower yields due to climate change
- Lower demand for pulp
- Pulp mills closures : Latest announcements : Canton mill NC , Sunila mill Fi , Tacoma WA…
- 100 000 T CTO have disappeared !
- Nevertheless CTO prices are declining with softening demand (high prices no longer affordable, lower fractionation rates …)
- New Metsä/Kemi mill will replace the older one (Net CTO gain +40KT)

Y2023 CTO Demand / Market Segment



Biofuels : Ambitious goals (1)
Sustainable Aviation Fuels (SAF)

- Air transport : 3% of Greenhouse gas emissions in 2023
- July 13 , 2023 : 137 225 flights according to Flightradar 24. Twice more by 2030 ?
- EU rules for SAF : 2% in 2025 , 6% in 2030 , 20% in 2035 , 70% in 2050 !!
- EU needs in 2050 : 400 Millions T SAF (235 KT in 2022)
- SAF can be produced by Oleochemical biomass (UCO, animal fat, …) , lignocellulosic biomass (wood and forest residues…) , E-Fuels (H2 produced by electrolysis with 'green electricity' + C02)
- SAF from Biomasses can represent only 10 to 20% in 2050
- E-Fuels might be a solution but need huge capital investments and huge amount of electricity (37 MWh / 1T SAF)
- In 2050 25% of European sustainable electricity would be needed to produce SAF !!!
- SAF 2 to 6 times more expensive than kerosene (Will improve … but will anyway result in higher priced flight tickets)
- Airlines are signing contracts based on plants to be built without time frame
- Are the goals realistic or way too ambitious ?

- **2 Million tons CTO volume is negligible compared to biofuels huge needs and cannot bring any sustainable long term solution**

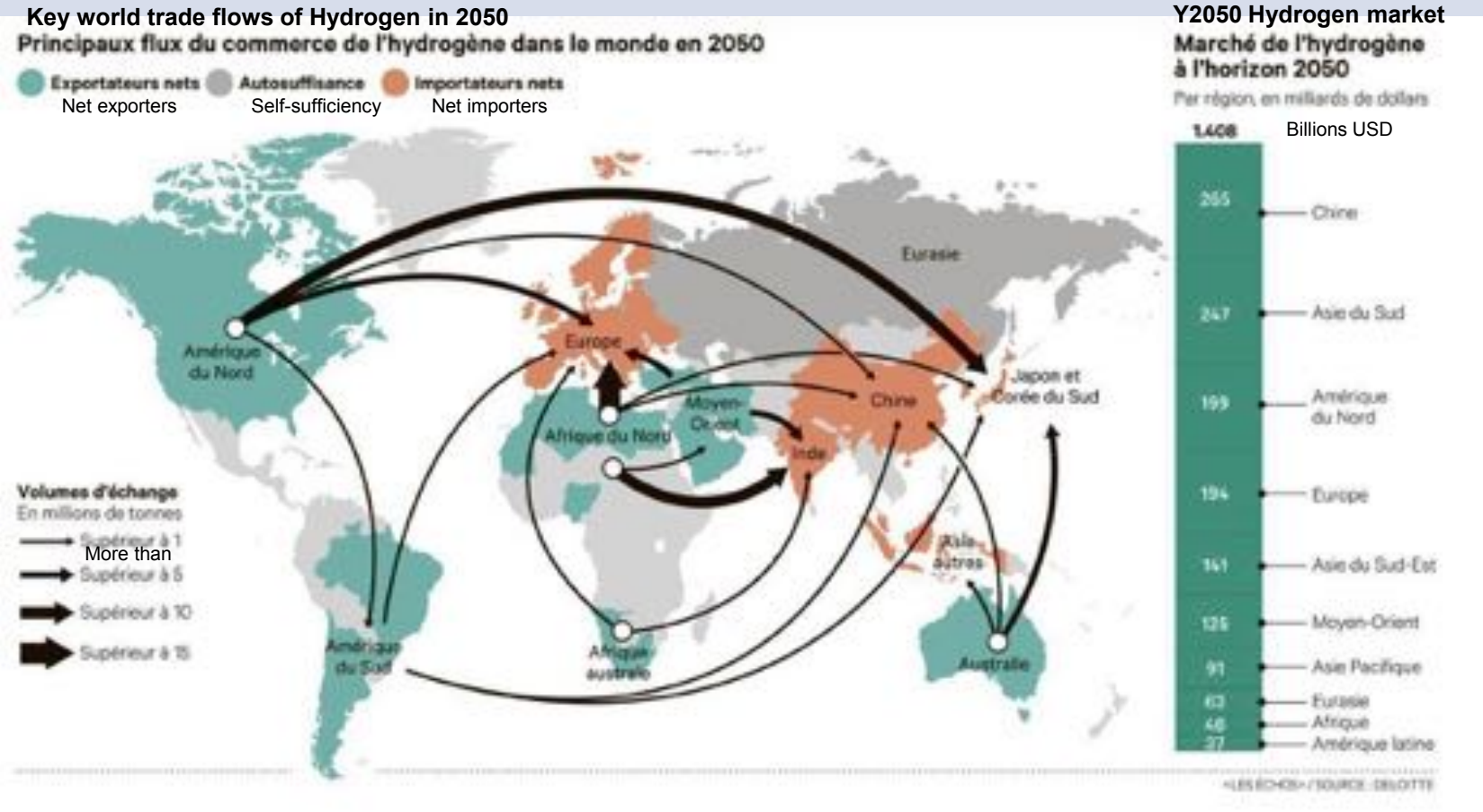
Biofuels : Ambitious goals (2)
Ocean freight

- Ocean freight : 3% of Greenhouse gas emissions in 2023
- Transporting 80% of world consumed products
- Ocean freight might triple by 2050
- UNO goals (July 2023 London meeting) : 20-30 % lower emissions by 2030 , 70-80 % by 2040 , carbon neutrality in 2050 ?
- Ships with additional sails : Saving 20% of fuel
- Reduce speed of the ship and better control of the flows (nowadays ships are rushing across the oceans and then wait in line days or weeks to enter into the harbours
- LNG (transition fuel) , biofuels (H2 , CH4 , Methanol , NH3 …) …but volume won't be enough for everyone
- E-Fuels : Huge amount of electricity needed
- Only for the french fleet 40% of the nuclear electricity produced in France would be needed !
- 150 000 wind turbines needed for the world fleet
- 300 Billions USD / year between 2030 and 2050 to decarbonize the ocean freight … but would represent only 1% price increase of all consumed goods.

- **Once again : 2 Million tons CTO volume is negligible compared to biofuels huge needs and cannot bring any sustainable long term solution .**

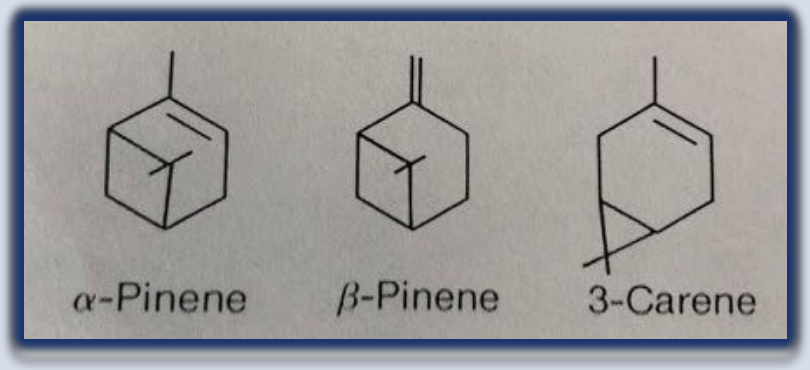
Hydrogen Market Y2050 (Source Les Echos/Deloitte)

‘Green’ Hydrogen produced from renewable energies might represent 85% of volume by 2050 . Today it represents less than 1%.
Heavy investments required ….but equivalent to those of oil and gas sector today



Turpentine

- Volatile fraction of the oleoresin in the conifererous trees
- Largest volume essential oil in nature
- Chemical composition depending on the species and age of the tree and geographical location.
- Main components are C10H16 bicyclic , unsaturated monoterpene hydrocarbons such as:



. Chemical structure: Terpenes can be considered as polymers of isoprene (C5H8)n but isoprene is not involved in the biosynthesis

Turpentine Main Components Average Composition (%)

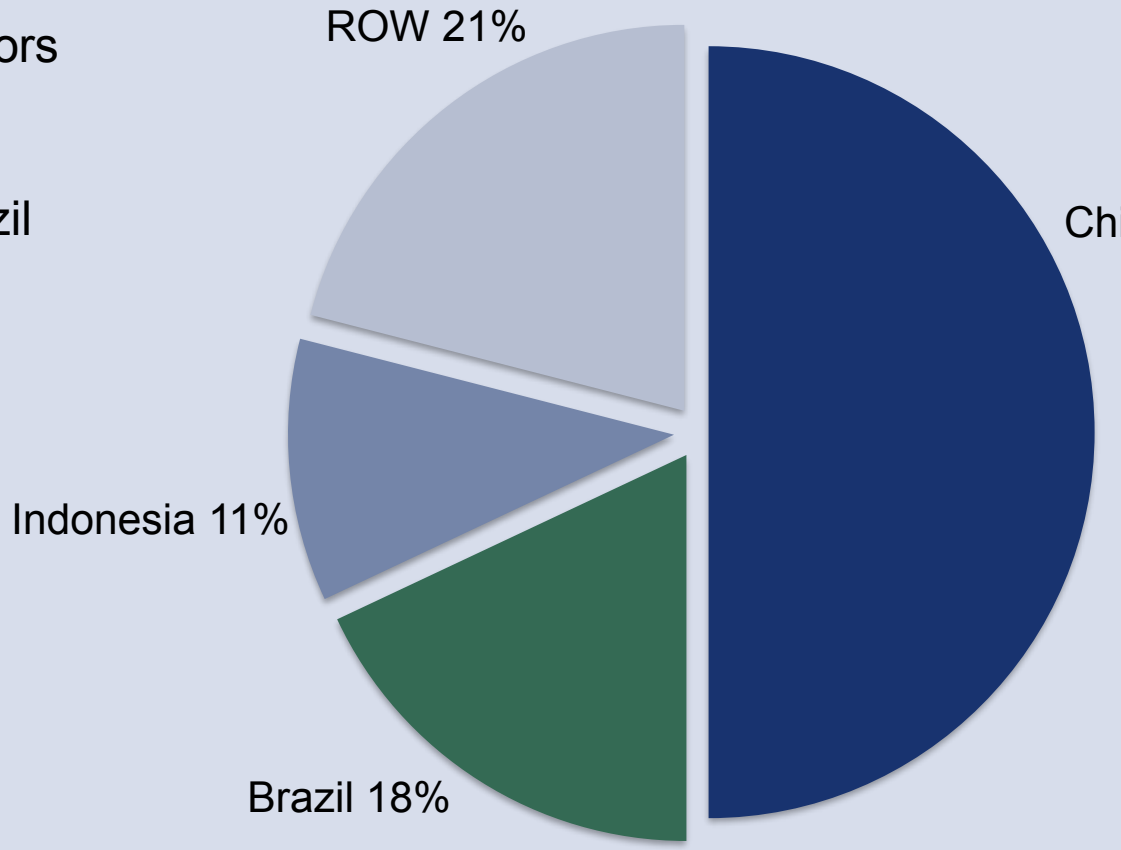
	Alpha Pinene	Beta Pinene	Delta 3 Carene
China / P.Massoniana	80	7	
China / P.Elliottii	52	36	
China / P.Yunanensis	60	25	
Brazil/P.Elliottii	40	45	
Brazil /P.Tropical	80	5	
Indonesia /P.Merkusii	80	2	12
Portugal	75	17	
India	25	3	60
USA (South East)	62	25	
USA (NW)/Canada	30	10	20
Finland/Sweden/Russia	55	4	25
Austria	60	13	15

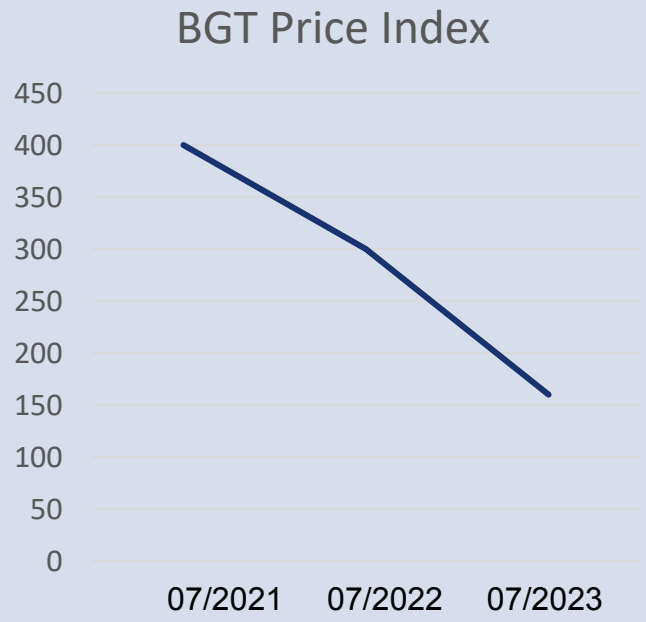
CST: Sulfur compounds 1 – 5 %

Y2023 Gum Turpentine Production: 150 000 T

Low demand from Flavors and Fragrances

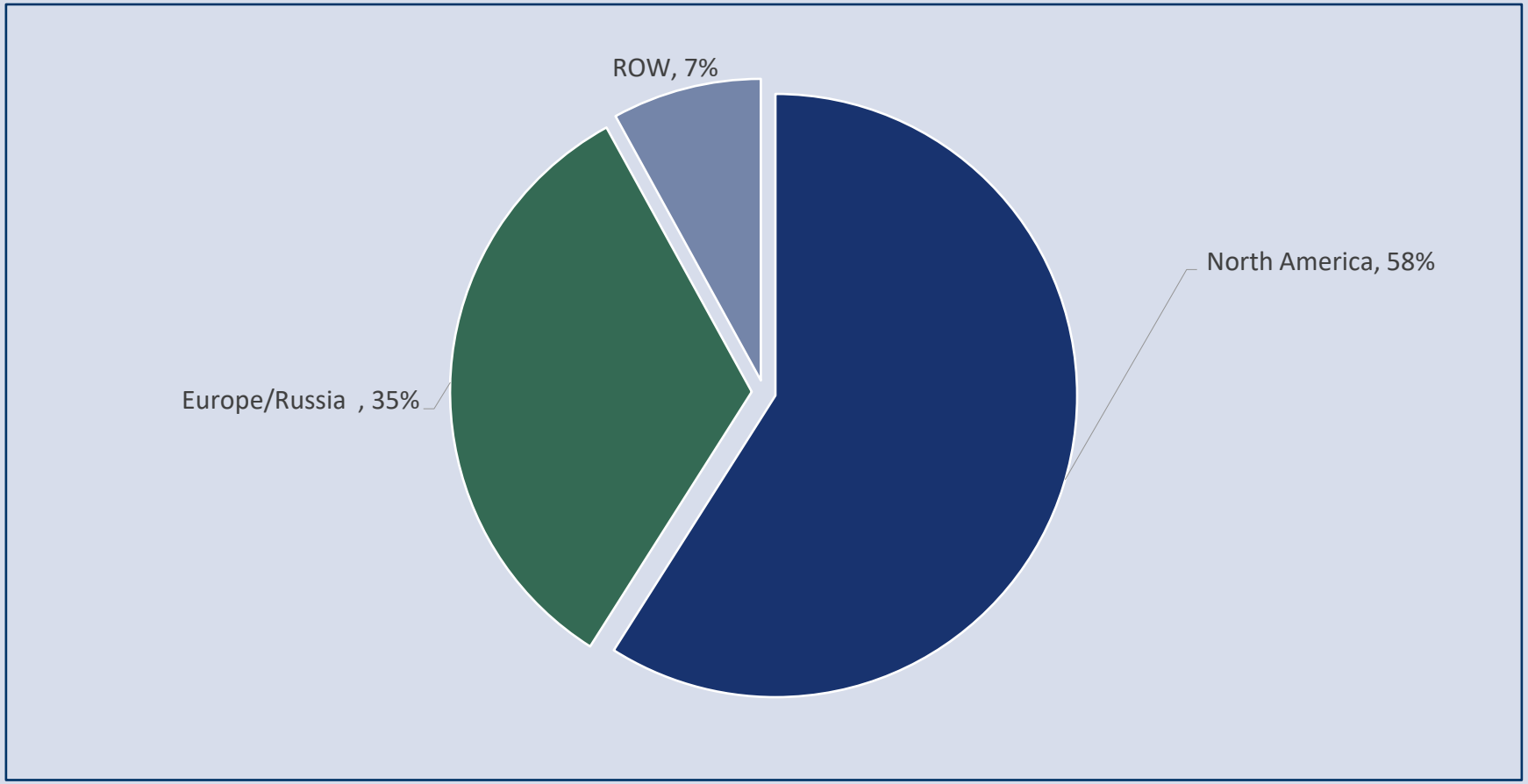
High inventories in Brazil





Y2023 CST Production: 195 000 T* (Y2021:210 000T)

3-5 Kg / T Softwood Kraft Pulp



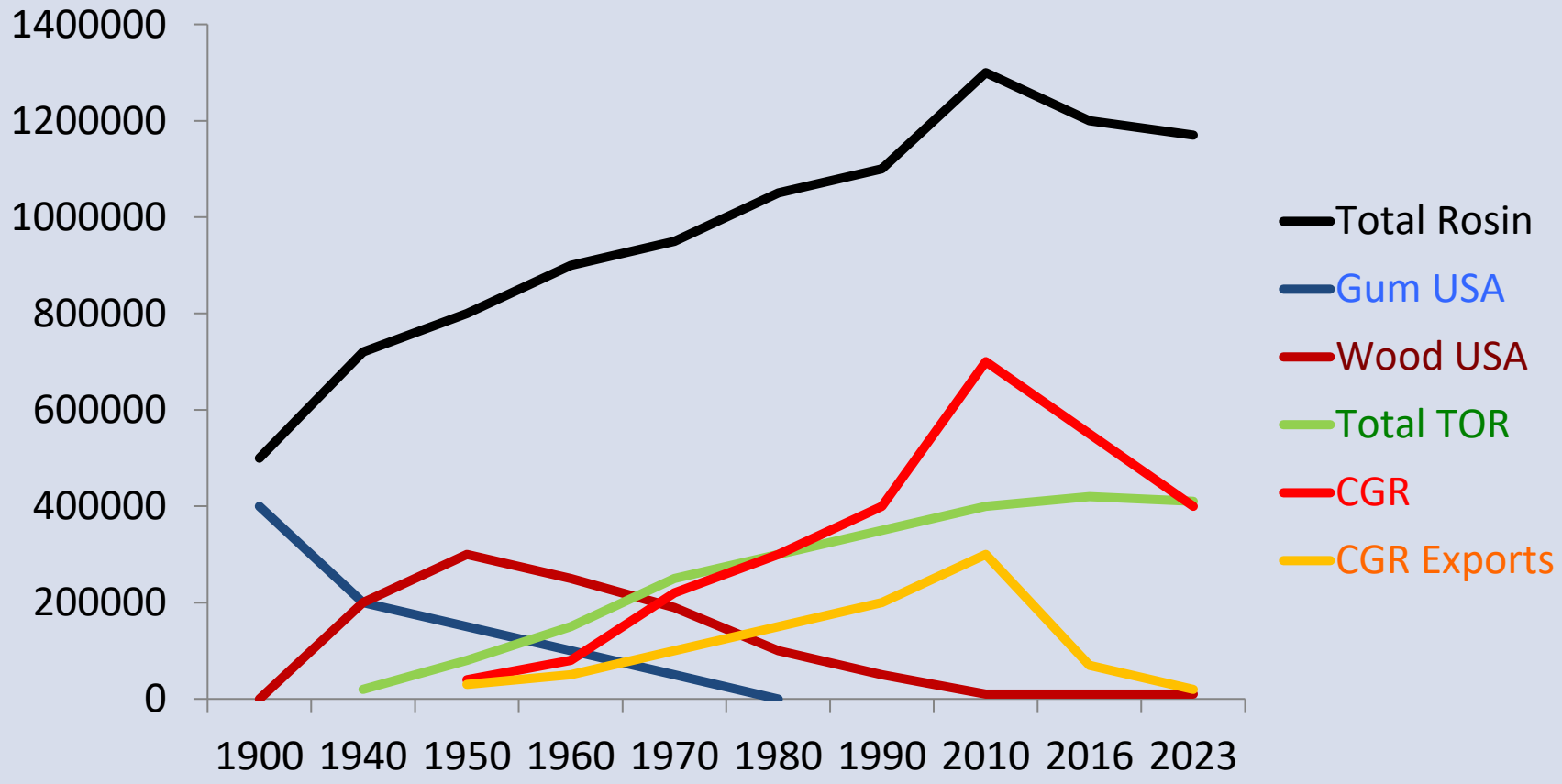
*Including 20 000 T CST from CTO

Volume down:
Pulp mills closures
Lower fractionation rates

Pinova plant closure affecting CST demand and Terpene resins production

Limonene production down (Consequence of EL Nino in Brazil and hurricane Ian in Florida

Rosin production



Rosin quality

- Significant differences in composition
- Fast growing Pinus Elliotii with lower PAN content

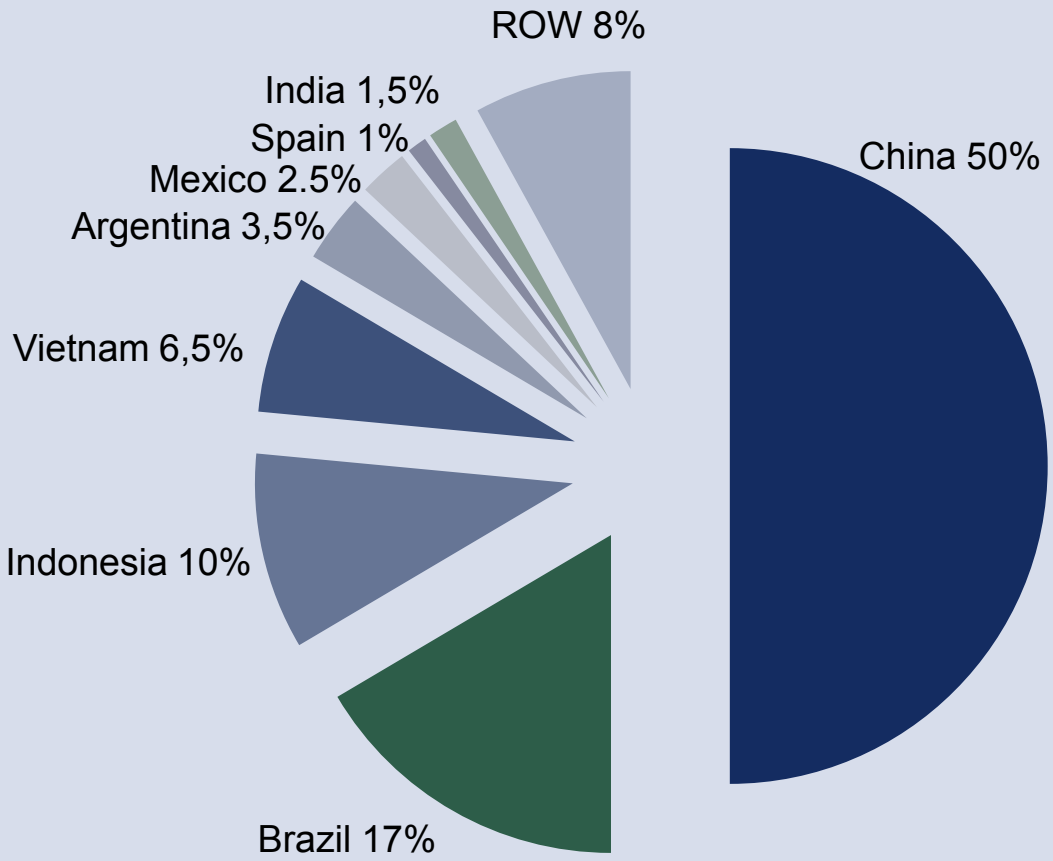
	P. Massoniama	P. Elliotii	SCAN TOR	P. Merkusii
Pimaric acid	8%	4%	2%	0.5%
Sandaraco pimaric acid	1.5%	1.5%	1%	9%
Isopimaric acid	1%	14%	7%	17%
Dehydroabietic acid	3%	3%	19%	4%
Palustric acid	16%	20%	13%	22%
Abietic acid	49%	20%	43%	20%
Neoabietic acid	14%	16%	4%	11%
Others (RA,Unsaps)	7.5%	21.5%	11%	16,5% (10% Merkusic)

Y2022 Global Gum Rosin production: 750 000 T

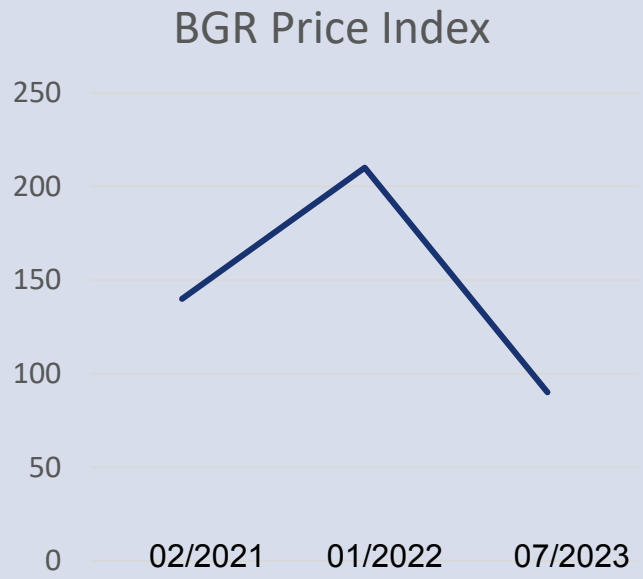
Low demand from China.

High inventory in Brazil and price of oleoresin below production + forest rent costs?

Some pine tappers might stop?



ROW:
Portugal
Africa
Greece
Madagascar
Fiji
Russia
USA …



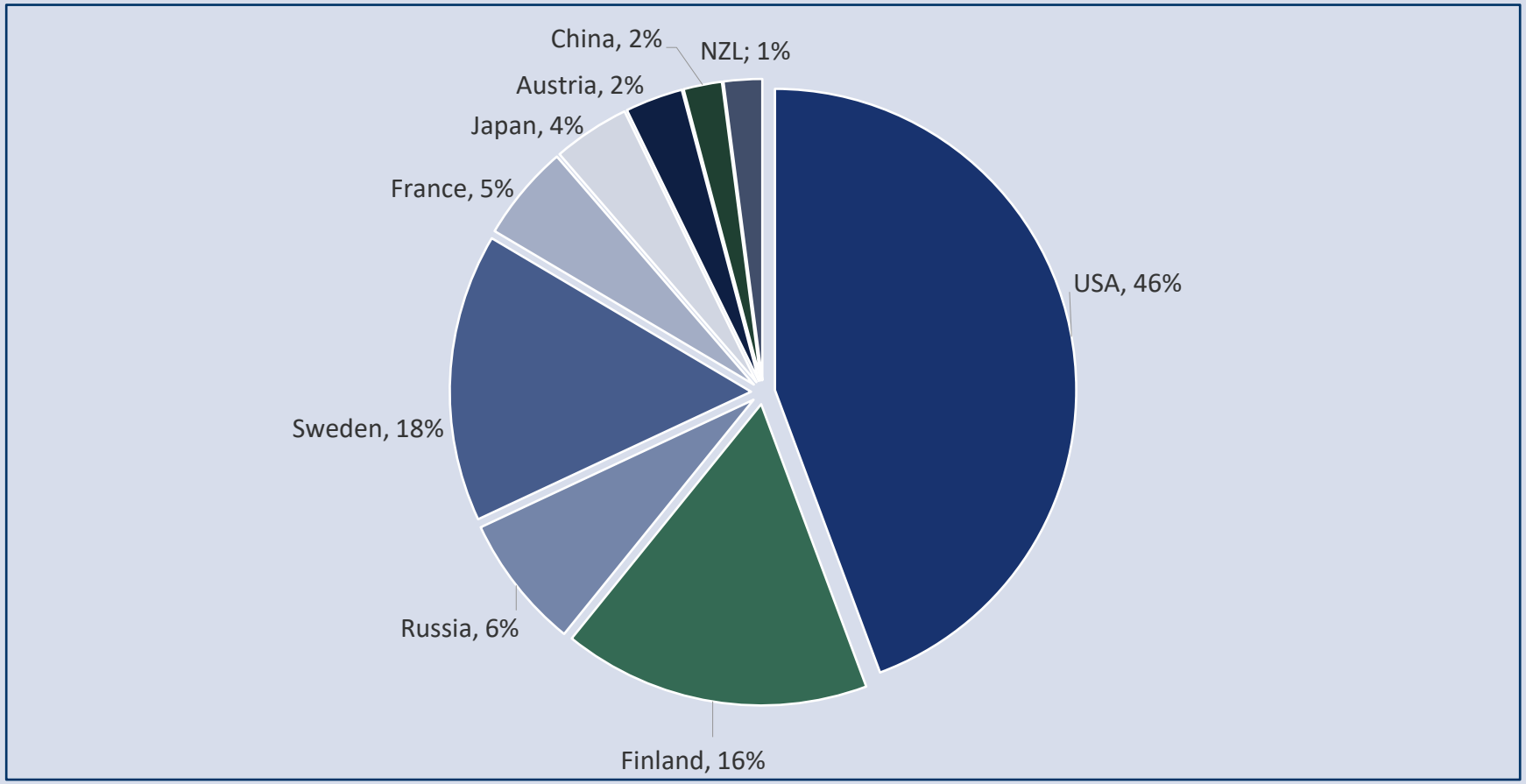
Y2023 Global Talloil Rosin (TOR) Production
400 000 T (Y2021: 450 000 T)

Low demand from Inks and Adhesives industries

Competition from lower priced Gum rosin derivatives and Hydrocarbon resins

Lower fractionation rates

One fractionation plant moved away from CTO feed



Y2023 TOFA Production : 400 000 T

Y2020:
Demand of Talloil Derivatives for Oilfield declined sharply in USA
Lower Tofa demand from coatings and other end-uses
Crop of other vegetable oils affected by Covid 19 pandemia

Y2021:
High demand for all vegetable oils and Tallow-based oleic acid.
Tofa supply short

Y2022:
H1:High price increase of all vegetable oils due to
invasion of Ukraine by Russia
H2:Vegetable oil prices declining, starting to impact TOFA in Europe.

H12023:
Demand still high in USA despite high prices (oilfields sustaining prices)
Lower demand in Europe (cheaper alternatives) for both coating and HVO markets but lower produced volume supporting high prices

World Trade : The big traffic jam is over

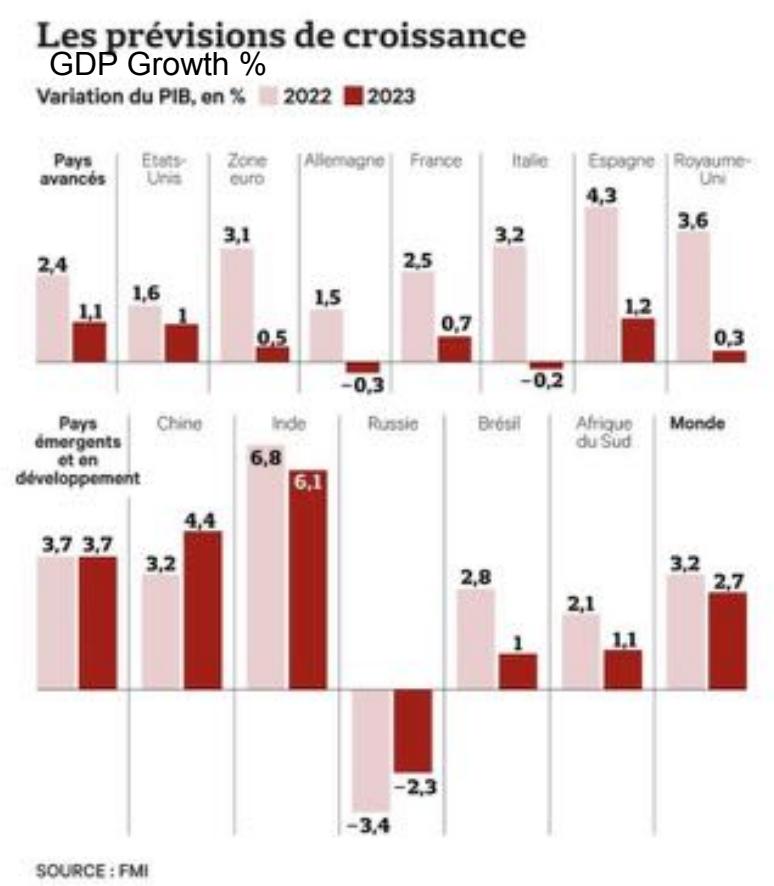
Overcapacities
Lower demand for ocean freight
Freight rates ‘melt like snow in the sun’
Back to Y2019 volume

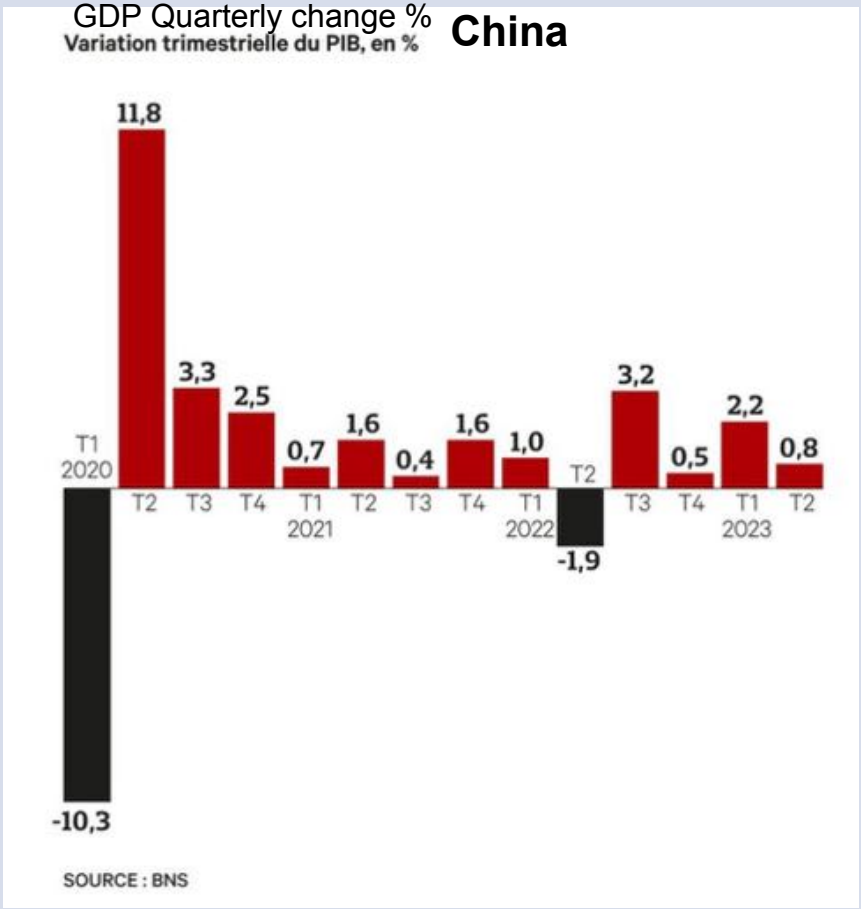
- Billions of profits during Covid period
- Almost 900 new container ships have been ordered to arrive 2023-2025 representing 28% of the existing fleet (expressed as the number of containers)
- Positive effects:
  - Early withdrawal of old ships
  - Reduced speed of the ships (Will lower CO2 emissions)

… till the next upward cycle as ocean freight might triple by 2050 !

GDP Growth 2022/2023 (Source IMF/BNS/Les Echos)

Price Inflation , Higher interest rates , Economic slowdown ….
China: Disappointed hopes of the after Covid





Outlook for the Pine Chemicals industry

- Y2023: 100 000 T less CTO volume …but softening demand
- Excess of fractionation capacity might lead in the future to consolidations and plant closures ??
- Weak demand for all rosin and terpene derivatives
- Threats on the global economy due to Russia/Ukraine war , high energy prices , inflation still at high level, risk of financial crisis ….
- China: GDP growth not reaching the after Covid expectations . Low domestic demand, youth unemployment , decrease in real estate prices decourage investors, willingness to make Western economies less dependent on China …
- Y2024 : Fast recovery ?? , demand for Pine Chemicals improving ??…. But lower volume available
- Trend around biobased and sustainable materials remains high. CTO is a very good source for biobased materials . Markets will have to clearly position themselves to support CTO derivatives and avoid this source to move away

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DAVID ÖQUIST

MONDAY, 17 SEPTEMBER 2023

10 AM

Sustainability, Technology, and Innovation in Pine Chemicals

David is the CEO at SunPine AB, SunPine is a sustainable development company that uses residual materials from various industries to create innovative and sustainable products. We produce raw tall diesel, bio-oil, rosin, turpentine, and district heating from tall oil, a byproduct of the pulp and paper industry. Our products are sold worldwide and used in a variety of applications, including diesel production and perfume manufacturing. SunPine's vision is to extract renewable products for the benefit of society. Established in 2006, we are owned by a team of experts representing the entire production chain.

SUNPINE™

DAVID ÖQUIST, CEO SUNPINE AB · 09-18-2023

How to create sustainable business benefits

DAVID ÖQUIST, CEO SUNPINE AB · 09-18-2023


DAVID ÖQUIST CEO SUNPINE AB
sunpine


DAVID ÖQUIST CEO SUNPINE AB
5 times more love
Soft-firm
Speed before secrecy
sunpine


THIS IS SUNPINE
SUNPINE


OUR HISTORY
sunpine

SunPine in numbers

SunPine since
2006

360
million USD

5

Sustainable products made from residual products from the forest industry

85

24/7

250 000
tonnes of crude tall oil per year

sunpine


40%
60%
EQUALITY
SunPine aims for equality with 50-50%
sunpine


SUSTAINABILITY
sunpine

The current situation, **according to science:**

We need to stay below 1.5 degrees of global warming.
We are now moving towards 2.8 degrees

- United Nations Panel on Climate Change (IPCC)

sunpine


The current situation, according to science:
“We are on a highway to climate hell with our foot on the accelerator ”
- UN Secretary General: Antonio Guterres
sunpine


The current situation, according to science:
Today, 1% of the world is a barely habitable heat zone.
In 2070, that percentage is expected to rise to 19%.
- ProPublica, The New York Times Magazine and Pulitzer Center
sunrise


The current situation, according to science:
68% of the worlds population of fish, birds and mammals have disappeared
- World Wildlife Fund (WWF)
sunpine

The current situation, **according to science:**

July was the hottest month ever recorded on Earth

- EU Climate Observatory

sunpine


The current situation according to science:
In Sweden, the summer of 2018
We had 50% of our animal feed ruined due to a heat wave that lasted only a few weeks.
sunpine

The current situation, **according to science:**

Earth Overshoot Day: August 2nd 2023
By 2030 we will need 2 planets.

- Global Footprint Network and World Wildlife Fund (WWF)

The current situation, **according to science:**

sunpine

The current situation, **according to science:**

EU:s taxonomy for a sustainable economy

sunpine

9 planetary boundaries: the earths ecosystem stability

Biodiversity

Climate change

Land use

Dispersal of chemical substances

The ozone layer

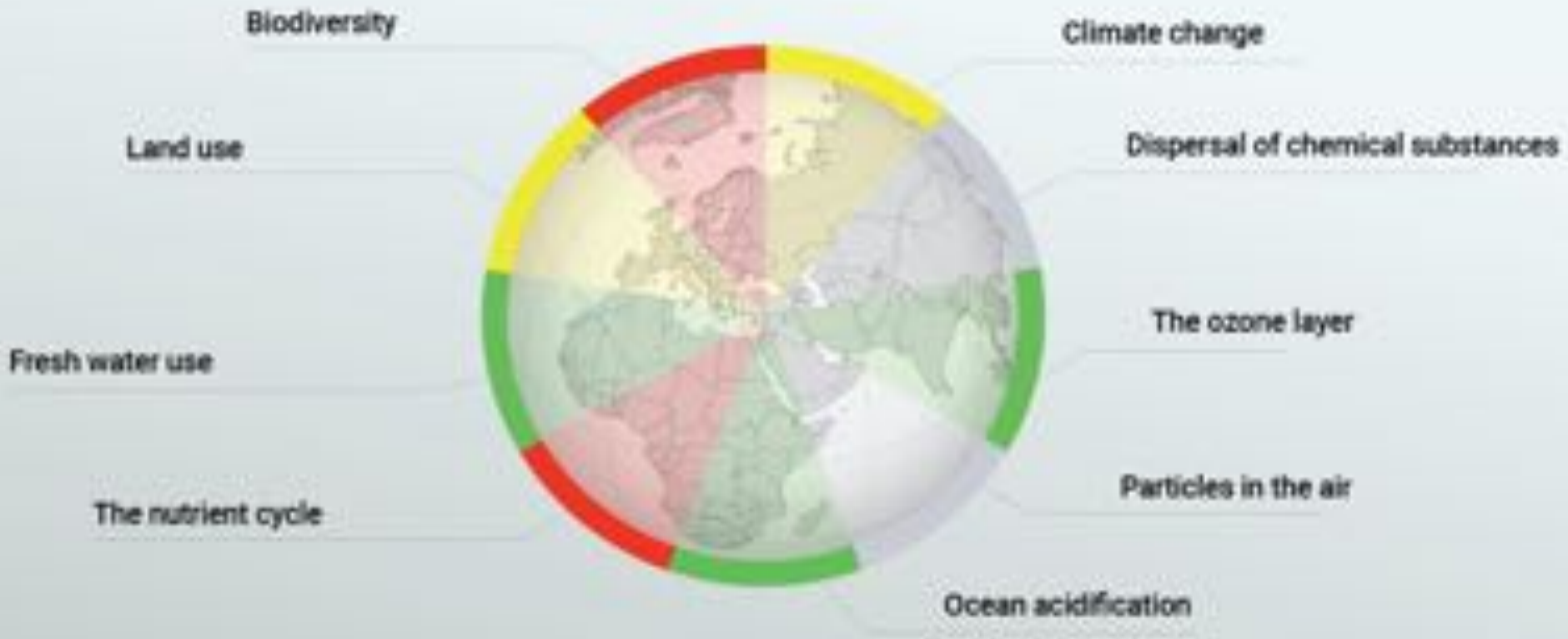
Fresh water use

Particles in the air

The nutrient cycle

Ocean acidification

9 planetary boundaries: the earths ecosystem stability




CLIMATE CHANGE
sunpine


BIODIVERSITY
sunpine


How does this all affect business?
sunpine


“There’s no business on a dead planet”
sunpine


climate change =
rational competition
biodiversity =
emotional competition
sunpine


Challenges How does this affect our industry?
sunpine


Solutions What is our approach?


OUR SECRET
sunpine


Successful business within the planetary boundaries
sunpine


Our sustainability work creates business benefits
sunpine

Our sustainability work creates business benefits

- Sustainable companies are more competitive.

Our sustainability work creates business benefits

- Sustainable companies are more competitive.
- They create growth and long-term profitability.

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- These companies are more interesting partners for both current and new customers.

SUNPINE

Our sustainability work creates business benefits

- Sustainable companies are more competitive.
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- They can more easily attract investors and recruit the sharpest minds.

SUNPINE

Our sustainability work creates business benefits

- Sustainable companies are more competitive.
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- A sustainable business operation will strengthen the brand value

SUNPINE

Our sustainability work creates business benefits

- Sustainable companies are more competitive.
- They create growth and long-term profitability.
- These companies are more interesting partners for both current and new customers.
- They can more easily attract investors and recruit the sharpest minds.
- A sustainable business operation will strengthen the brand value
- Most importantly it will create opportunities to work with business development in a whole new way.

SUNPINE


3 decisive factors

sunpine


3 decisive factors
Conditions.
Business development.
sunpine


3 decisive factors
Conditions.
Business development.
Communication.


Conclusion:


Conclusion:
We are all part of the same ecosystem


Conclusion:
We are all part of the same ecosystem
We are all dependent on forestry


Conclusion:
We are all part of the same ecosystem
We are all dependent on forestry
The industry is changing


Conclusion:
We are all part of the same ecosystem
We are all dependent on forestry
The industry is changing
We all need to be part of the solution


Thank you!

VITALY ROGACHEVSKY

MONDAY, 17 SEPTEMBER 2023

11:05 AM

Sustainable Journey of Adhesives: Yesterday, Today, and Tomorrow

Vitaly has been involved with the adhesive and related industries for almost 35 years. He formulated with and strategically sourced hot raw materials for H.B. Fuller global operations for 27 years. Following 5 years Mr. Rogachevsky spent with Argus Media where he was responsible for their C5 olefin publishing and consulting business. And since early 2020 Mr. Rogachevsky had been working at the helm of his own company, working within the industry to help his clients develop business in his areas of expertise which continue to evolve.

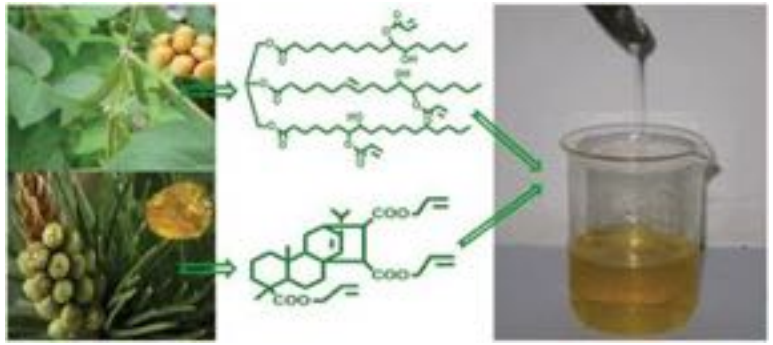
IT IS NOT EASY BEING GREEN

PCA – 2023, DUBLIN

By Vitaly Rogachevsky

Vitrina LLC.

What is “green”?



What is the definition of “green”?

Depends on which industry person you are talking to is working or lobbying for

Green – original definition

Does not pollute the environment nor causes health defects.

- Vitrina, LLC

- Unattributed via www search

- Thermo Fisher Scientific

Green – original definition

Pine Chemicals Fit

Both CTO and Rosin derivatives are deemed greener, less toxic alternatives to hydrocarbon-based chemicals. Rosin and derivatives have been around for millennia and do not cause adverse health effects, they are biodegradable (more so than hydrocarbons) and non-polluting. Most derivatives are suitable for use in direct food contacts applications, as well as in flavor and fragrances and chewing gum.

There was a balance from supply and demand side and rosin-based products co-existed with hydrocarbons. However, customers were not paying extra for being green.

Biobased

- **What are biobased products and what sort of products are included in the BioPreferred Program's definition?**
- Biobased products are derived from plants and other renewable agricultural, marine, and forestry materials. Biobased products provide an alternative to conventional petroleum derived products and include a diverse range of offerings such as construction, janitorial, and grounds-keeping products specified and purchased by Federal agencies, to personal care and packaging products used by consumers every day.
- Biobased products also include biobased intermediate or 'upstream' materials such as bioresins or biopolymers, or the biobased/renewable chemicals used to create commercial, industrial, or consumer goods. Biobased products, from a BioPreferred Program perspective, do not include fuels, food, or animal feed.

- USDA

Biobased

Pine Chemicals Fit

- Consumer companies are starting to notice and are increasing their requirements for biobased products.
- However, pine chemicals represent such a minor portion of their articles that they are not willing to pay extra nor mandate use and focus strictly on performance.
  - For example: Adhesives represent such a small percentage of either a corrugated, paper or plastic package, that using all or nothing does not move the biobased needle in either direction.
- Developing headwinds
  - Perceived odor concerns in hygiene applications result in change away from CTO pine chemical derivatives to hydrocarbons

Recyclable

- **DEFINITIONS.** As used in this Chapter, unless the context requires otherwise, the singular shall include the plural and the plural shall include the singular, and the following phrases shall mean:
  - **Recyclable Materials:** Material that has been recovered or diverted from the nonhazardous solid waste stream for purpose of reuse, recycling or reclamation and a substantial portion of which is consistently used in the manufacture of products, which may otherwise be produced using raw or virgin materials.
  - **Processing Facility:** A facility where recyclable materials are sorted and processed or prepared for bulk shipment to a manufacturer for use as a raw material.

City of Decatur, IL – (edited for continuity)

Recyclable

Pine Chemicals Fit

- Consumer companies place less emphasis on Biobased products as long as they can claim recyclability. More recyclable content means less virgin material production, including paper.

- Developing headwinds
  - Pine chemical derivatives have an inherently higher density than their hydrocarbon-based counterparts. Recycling technology at the time works on skimming principle – non-plastic contaminants are skimmed off the top so hydrocarbon-based solutions are preferred and required by companies that manufacture recyclable articles.
  - Skin sensitivity symbol mandated in Europe for products using rosin and rosin esters makes pine chemical derivatives less attractive for use by converters.

Renewable and Circular

- **Renewable energy** is energy that is generated from natural processes that are continuously replenished. This includes sunlight, geothermal heat, wind, tides, water, and various forms of biomass. This energy cannot be exhausted and is constantly renewed.
- **Biomass**, is a renewable organic matter, and can include biological material derived from living, or recently living organisms, such as wood, waste, and alcohol fuels.
- Wood energy is derived both from harvested wood as a fuel and from wood waste products. Waste energy can be generated from municipal waste, manufacturing waste, and landfill gas. Biomass alcohol fuel, or ethanol, is derived almost exclusively from corn.
- **Biodiesel** is fuel made from plant oils that can be used in diesel engines. They are typically made of renewable organic raw materials such as soybean or rapeseed oils, animal fats, waste vegetable oils or microalgae oils.

- Daniel Ciolkosz, P.E., Penn State

Renewable and Circular

What is a circular economy?

- A circular economy keeps materials, products, and services in circulation for as long possible. The Save Our Seas 2.0 Act refers to an economy that uses a systems-focused approach and involves industrial processes and economic activities that are restorative or regenerative by design, enables resources used in such processes and activities to maintain their highest value for as long as possible, and aims for the elimination of waste through the superior design of materials, products, and systems (including business models). It is a change to the model in which resources are mined, made into products, and then become waste. A circular economy reduces material use, redesigns materials, products, and services to be less resource intensive, and recaptures “waste” as a resource to manufacture new materials and products.

- US EPA

Renewable and Circular

Pine Chemicals Fit

- Consumer companies place more emphasis on Biobased products to generate carbon credits they can use to grow, primarily with hydrocarbon-based chemistry.
- Pine Chemical derivatives are experiencing resurgence as every ounce of Biobased products used can be converted to use more hydrocarbon-based derivatives.
- Nascient use of more vegetable oils in biodiesel spurs more production of TOFA as a replacement.
- Developing headwinds
  - Development of low density polyolefins allows customers to use less adhesive to get the job done, in the process lightweighting articles and reducing adhesive per article cost.
  - Unfettered increase in capacity of hydrogenated hydrocarbon resins craters market prices, challenging competitiveness of rosin derivatives.

Sustainability and Carbon Accounting

What Are Sustainable Materials?

- Sustainable materials are materials used throughout our consumer and industrial economy that can be produced in required volumes without depleting non-renewable resources and without disrupting the established steady-state equilibrium of the environment and key natural resource systems. Such materials vary enormously and may range from bio-based polymers derived from polysaccharides, or highly recyclable materials such as glass that can be reprocessed an indefinite number of times without requiring additional mineral resources.

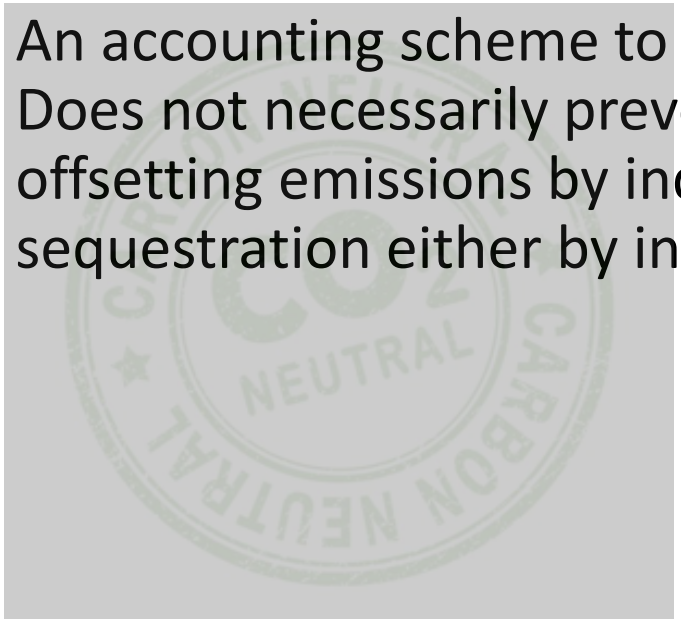
- Rutgers – Center for Sustainable Materials

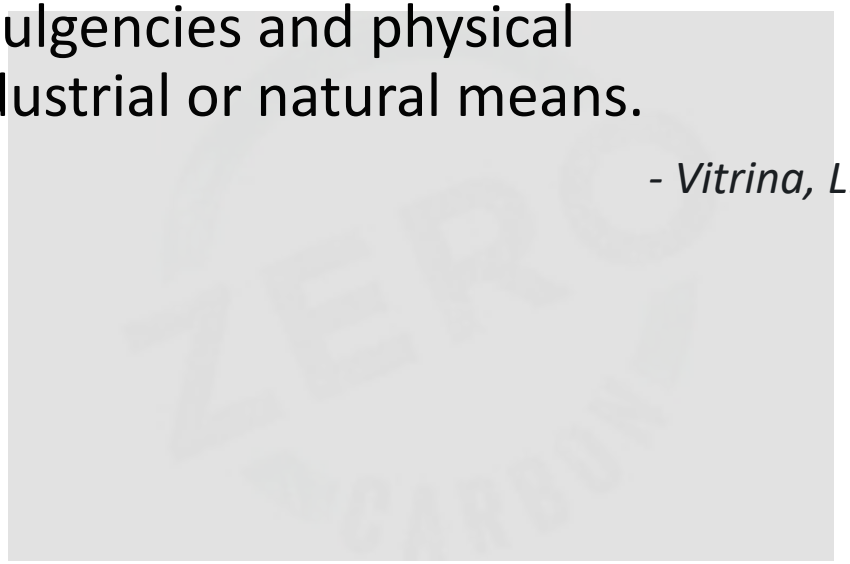
Sustainability and Carbon Accounting

What is Carbon Neutral/Carbon Zero?

- An accounting scheme to offset anthropogenic effluent. Does not necessarily prevent pollution but allows for offsetting emissions by indulgencies and physical sequestration either by industrial or natural means.

- Vitrina, LLC





Recommended reading

- Explainer: What is carbon neutrality, and can it really be achieved?

- Eco-business.com

Sustainability and Carbon Accounting

Pine Chemicals Fit

- Consumer companies focus on Carbon count across the entire supply chain. Biobased, Renewable, Recyclable, Sustainable, Circular products are all calculated based on Carbon generation score and that is the only criteria used to determine procurement pattern. The further upstream the benefit, the further downstream value it carries.
- Pine Chemicals, especially those derived from CTO, have to compete with energy companies who crack bionaphtha to produce “green” benzene and “green” polyolefins.

The Future of Green

Using only one side of the accounting ledger leads to very large corrections when time comes to balance the books.

- RINs are due for a correction within 2 years as supply is outstripping RIN demand, which will lead to a spike in price of biodiesel.
- Bionaphtha is now trading on Argus and other platforms, and its price usually trades 2x-3x higher than conventional naphtha.
- Sustainability of government subsidies during an inflationary period is questionable.
- How much standard of living erosion can populace tolerate before starting to question the reason for decline?

The Future of Green

- Pine chemicals are still true green raw materials that no accounting scheme can cancel. Scheme just shifted molecules from one bucket into another.
- Since all economic trends are cyclical, market will once again demand rosin and derivatives, and rosin manufacturers will have to able to meet that demand.
- Now is the time to focus on generating as much profit as possible via upstream ventures to fuel Research and Development to address market performance demands by, for example, coming up with products and systems with lower density and better organoleptics.

Pine Chemicals are here to stay, they are just undergoing a renewal cycle to their upstream biobased roots, before being recycled into sustainable green downstream products

THANK YOU!

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Vitrina LLC

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Phone: +1 763 360 6517
Office: Houston, TX USA

LEONARDO SIQUEIRA

TUESDAY, 18 SEPTEMBER 2023

9:15 AM

The Changing Feedstock Panorama: The Future of Pine Chemicals

Leonardo is an editor on the pine chemicals team at Argus Media, a leading provider of energy and commodity price benchmarks. The team covers the global markets for pine oleoresin, gum rosin, gum turpentine, crude tall oil (CTO) and its derived bio-fractions. Leonardo has over ten years of expertise covering the commodities and financial markets. With a specialization degree in Science Journalism from the Campinas State University (Unicamp) in Brazil, and a master's degree in Strategic Communications from the University of Lisbon, Leonardo has worked for consulting and publishing companies in the US and the UK, including RELX and USA Today.

Navigating pine chemicals markets in challenging times

PCA International Conference - Dublin, Ireland
17-19 September 2023

Presented by: Leonardo Siqueira

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A view of Argus

- Headquartered in the UK, Argus has Over 1,200 staff working in 29 offices in the world's principal commodity trading and production centres.
- Argus publishes more than 42,000 daily and weekly spot and forward price assessments, along with commentary, news and analysis for global commodities and energy markets.
- Coverage includes markets for:
  - Oil, natural gas, power, hydrogen, coal, biomass, asphalt, base oils, emissions and carbon
  - Biofuels
  - Fertilizers
  - Agriculture
  - Chemicals, including petrochemicals and oleochemicals
  - Metals, ferrous, non-ferrous, battery materials, and scrap
- Services:
  - Market reporting, news, and analysis
  - Consulting and forecasting
  - Conferences
- Argus prices are used as benchmarks worldwide, including for:
  - US crude oil
  - European gasoline and biofuels
  - Asia-Pacific LPG
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  - European steel
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Agenda

- Global markets overview
- Asian, South American rosin and turpentine markets
- CTO market overview: supply and demand fundamentals
- Global HCR picture: supply, demand and capacity rates
- Concluding thoughts

Bearish global sentiment

- Soft demand across various end markets
- Elevated inventory, higher priced stocks and lower selling prices affecting supplier margins
- Delayed rebound in Chinese economy


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WORLD | THE OUTLOOK

Fueled by Long Credit Binge, China's Economy Faces Drag From Debt Purge

Consumers, businesses and local governments are looking to


Bloomberg

Economics

China Debt Ratio Hits Record But Pace of Borrowing Is Easing

- Total debt rose to 282% of GDP, Bloomberg estimates show
- While there's no 'balance-sheet recession,' there are concerns

By Tom Hancock

27 July 2023 at 05:35 CEST

Updated on 27 July 2023 at 10:00 CEST


South China Morning Post

Economy / China Economy

Could China's rising household debt threaten Beijing's consumer-led growth vision?

- By the end of last year, China's household debt as a percentage of disposable income had reached a record high of 130.9 per cent
- Servicing loan payments is eating up disposal income that could otherwise be used to buy goods and services to support the economy

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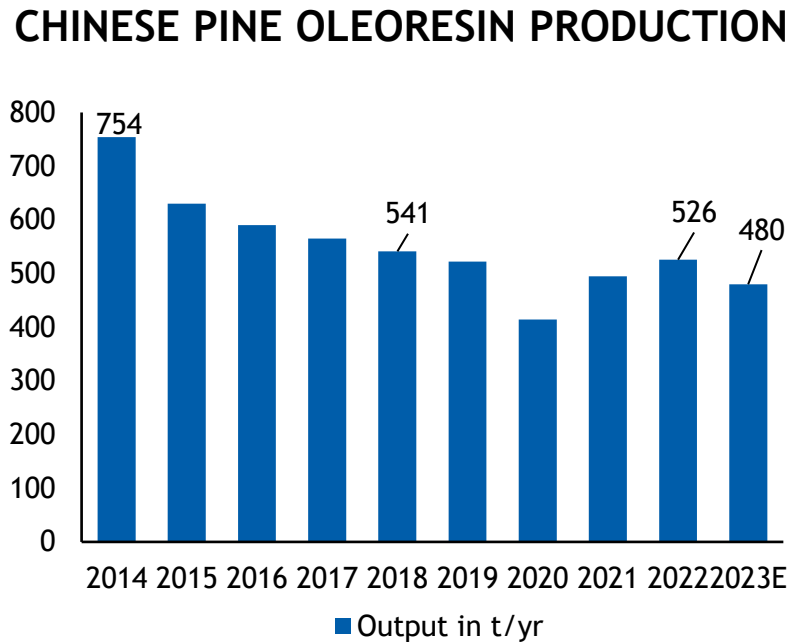
Asian pine oleoresin market overview

- Chinese pine oleoresin production in 2023 to slightly decrease over previous harvest seasons
- Tight, negative margins affecting market sentiment in Asia
- Slow moving stocks in key buying markets



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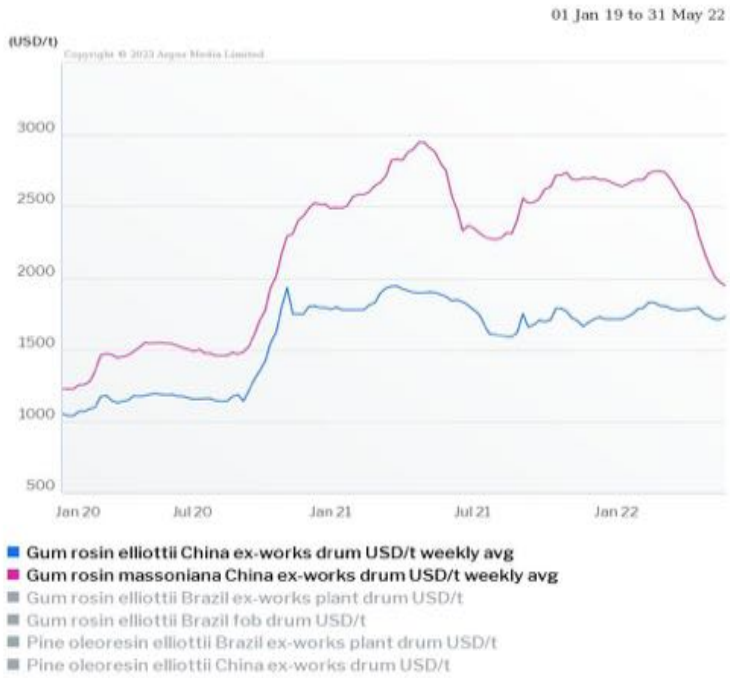
Asian gum rosin market overview

CHINESE HISTORICAL GUM ROSIN PRICING



- Downward pressure affecting Indonesian, Vietnamese markets in peak season
- Abundant supply amid persisting weak demand scenario
- Southeast Asian markets on alert for El Niño

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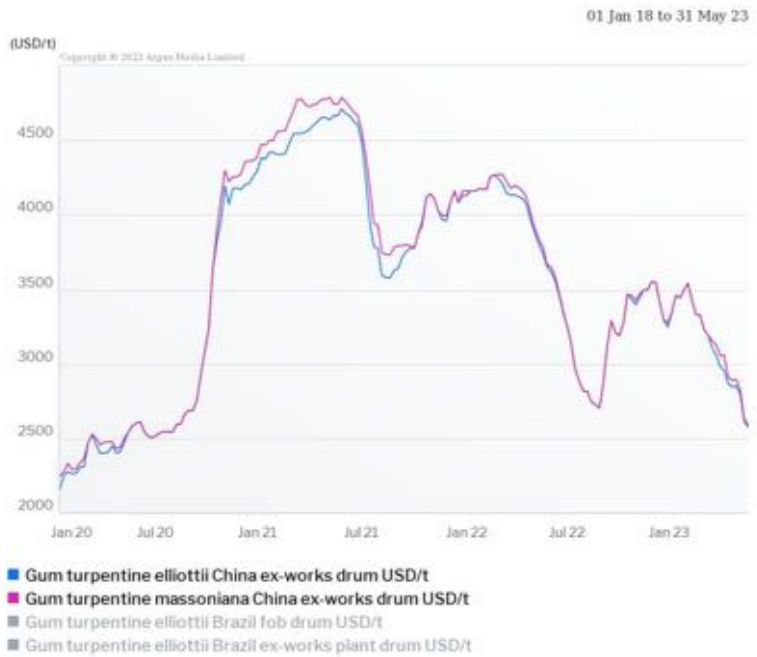
Asian gum turpentine market overview

CHINESE HISTORICAL GUM TURPENTINE PRICING



- Pricing is sensitive because limited market size, increasing demand can push up prices quickly
- Chinese gum turpentine supply expected to be sufficient in the coming months
- Soft demand on weak economic fundamentals

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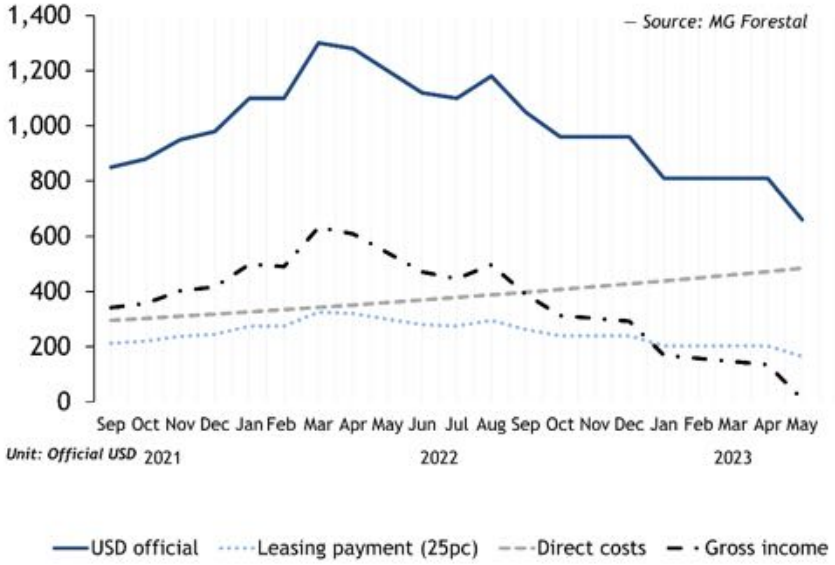
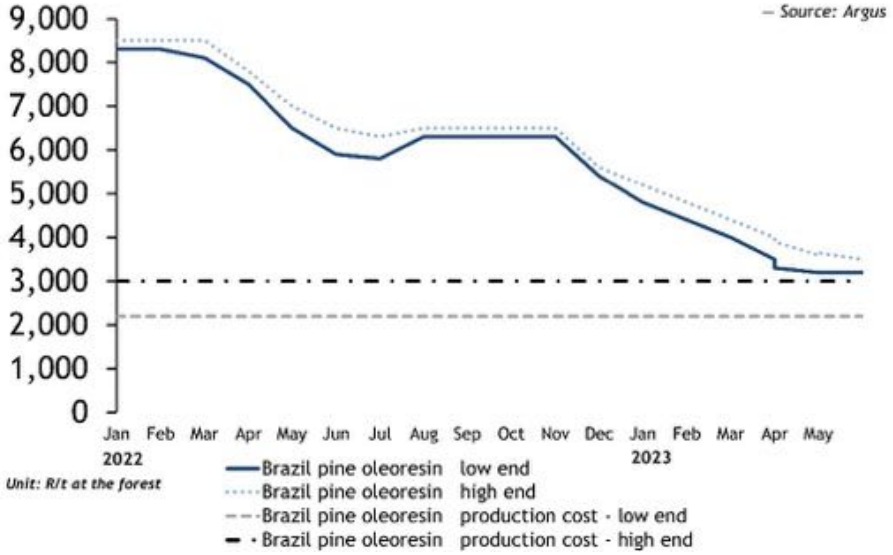
South American pine oleoresin

ARGENTINA PINE OLEORESIN PRICES AND COSTS



BRAZIL PINE OLEORESIN PRICES AND COSTS



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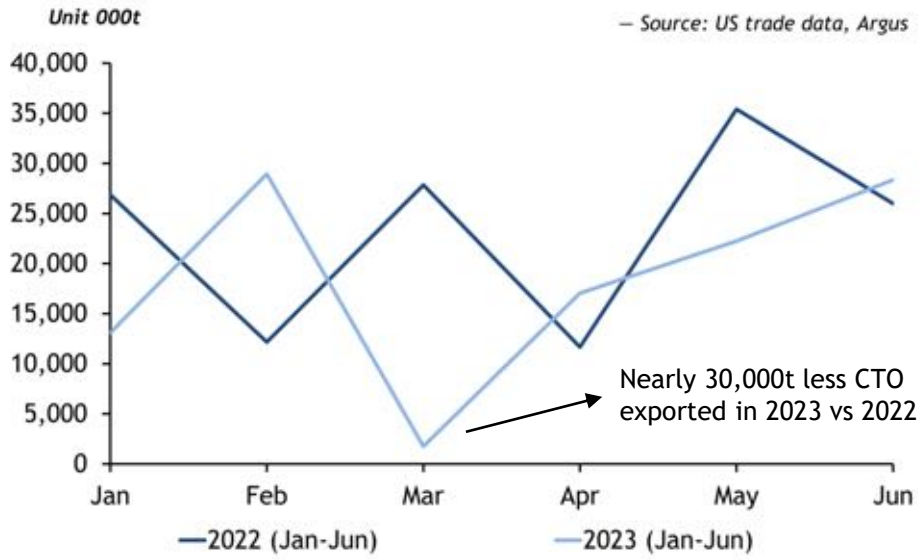
Depressed rosin markets driving lower CTO demand

- Demand for rosin into adhesives and other sectors weak during 2023
- High rosin stocks, soft demand and ample Brazil gum rosin supply during peak season led to downward price pressure
- Weaker rosin demand (TOR and TOR esters) reducing appetite for CTO and driving lower fractionation rates

US CTO EXPORT VOLUMES 2022 vs 2023



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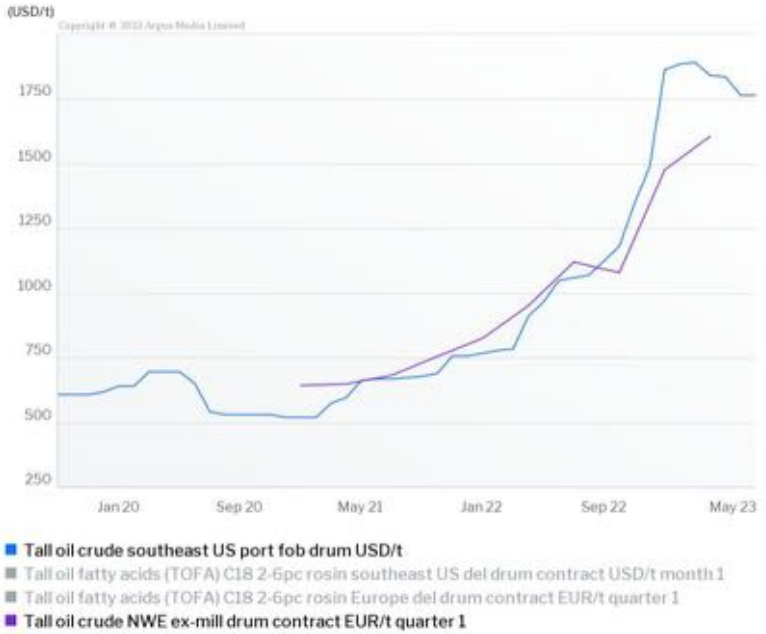
CTO and pine chemicals short term outlook

- Europe's sole CTO expansion project will only partially offset capacity losses
- Unbalanced demand/supply for CTO fractions will result in price volatility
- Plentiful and cheaper priced petroleum-based tackifying resins and gum rosin available

HISTORICAL US, EUROPEAN CTO PRICING



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Reduced CTO supply, rising costs and replacement opportunities

- More refiners demanding CTO: Fintoil, SCA/St1
- Inelastic supply, growing interest into biofuels and specialty chemicals
- Pulp mill shutdowns in the US, Europe and Russian war affecting supply
- Buyers looking for TOFA, TOR and TOR ester replacements such as SOFA, HCR, and gum rosin esters

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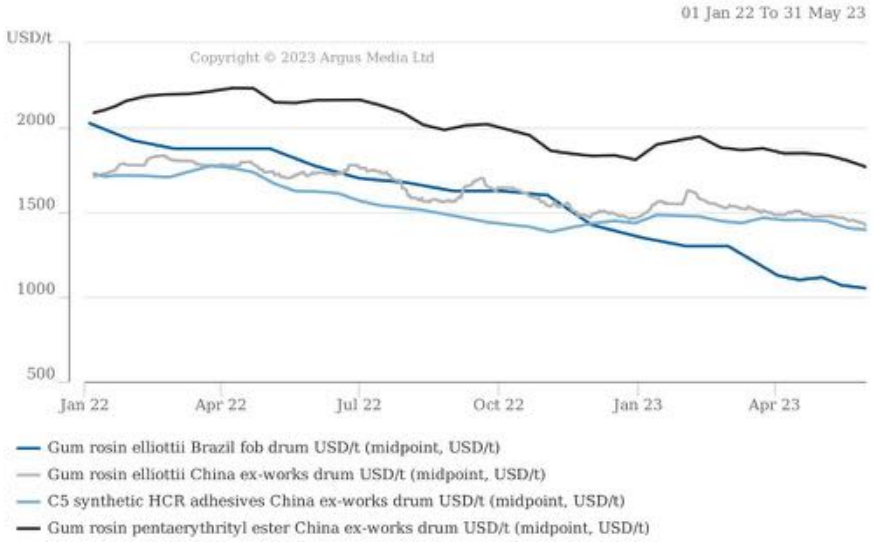
Replacements for TOR esters

- Challenging short-term supply outlook for both gum rosin esters and TOR esters
- Gum rosin inventories elevated on soft demand
- TOR esters supply long due to weaker demand
- Increased usage of HCR may hinder efforts towards a reduced carbon footprint

GR, HCR AND GR ESTER PRICING TREND



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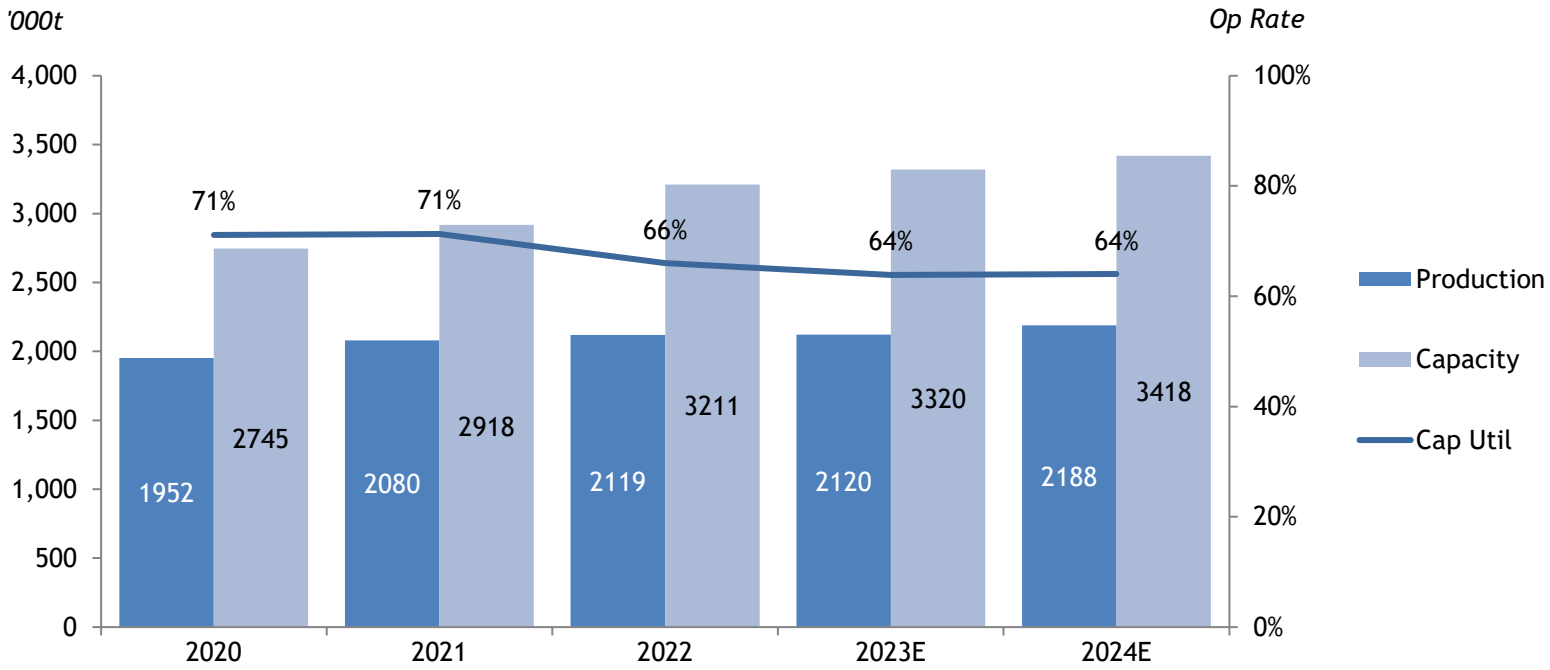
Hydrocarbon Resins (HCR) – Global Picture



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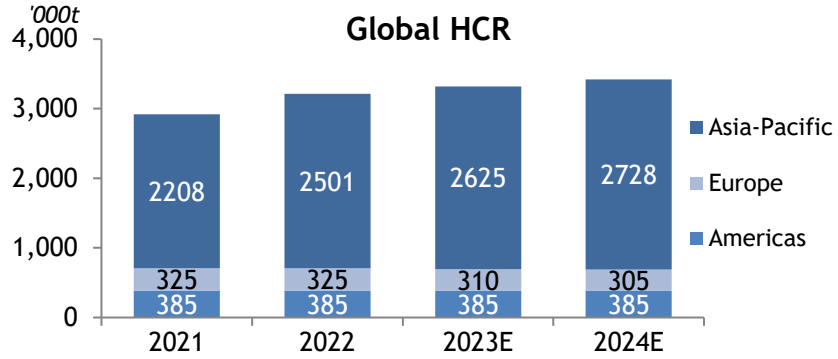
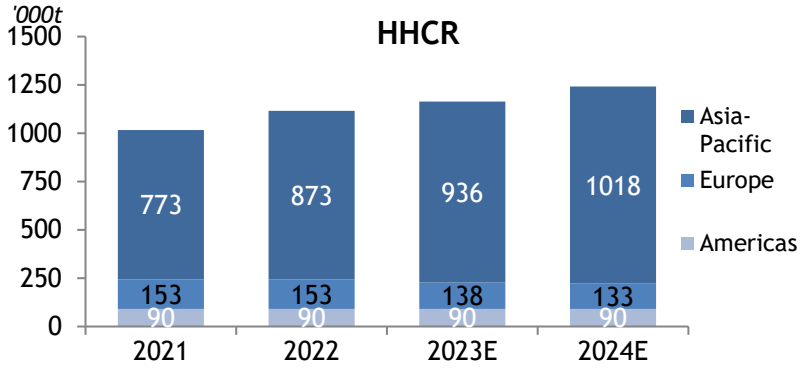
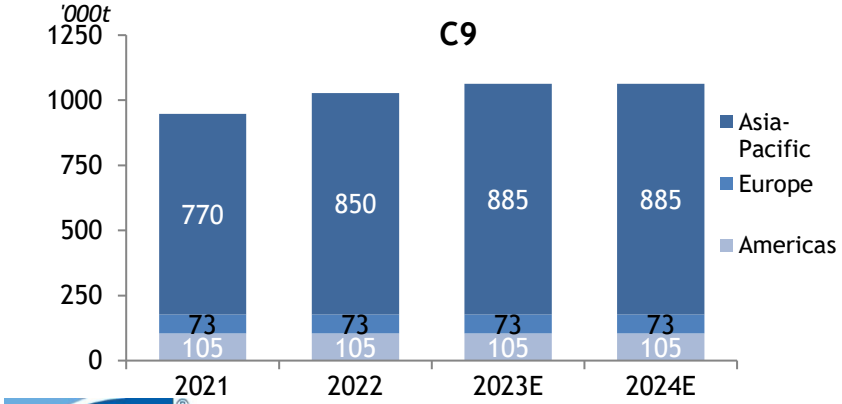
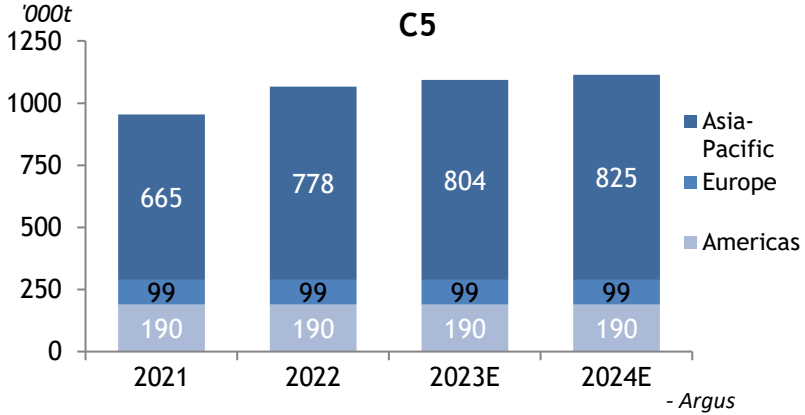
HCR Capacity by Type and Region









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Concluding thoughts

- Elevated stocks, slack downstream demand still affecting rosin, turpentine markets
- Higher fractionation rates dependent on feedstock pricing, fractions balance (TOFA/TOR balance)
- Replacement of rosin esters with HCR may hinder efforts towards a reduced carbon footprint
- Tighter margins and higher operating costs for tackifier producers in Europe could lead to more shutdowns

Argus Pine Chemicals and Argus C5 and Hydrocarbon Resins teams

Thank you!

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PRO DR BERND BUNGERT

TUESDAY, 18 SEPTEMBER 2023

10 AM

Turpentine from Medium Density Fibreboard: A New Industrial Process, A New Source of Turpentine

Bernd Bungert studied chemical engineering at the University of Dortmund, the University of California at Berkeley and at Technical University of Berlin. From 1998 to 2008 he worked in chemical industry at Hoechst AG in Frankfurt in process development, in global engineering and as a plant manager.

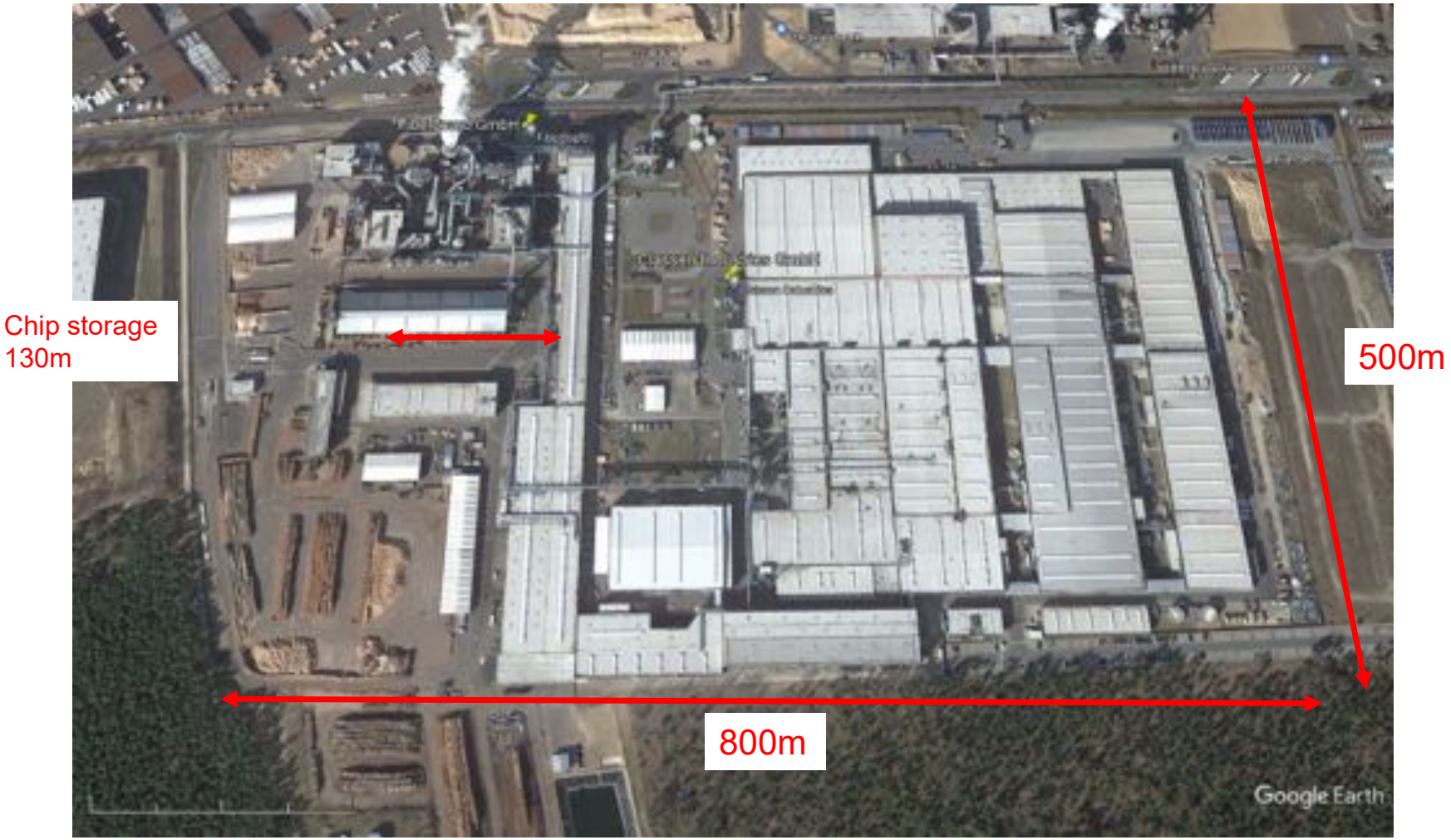
He joined the faculty of the the Berlin University of Applied Science and Technology, Berlin in 2008. There he is working on energy- and resource efficiency. He is also serving as a consultant in the process industries. A focus has been in the wood-panel industry. For over 10 years he has been working as process-engineering manager for Fiberboard GmbH in Baruth, Germany.

Turpentine from Medium Density Fibreboard: A new industrial Process, A new worldwide Source of Turpentine

PCA International Conference Dublin
September 19th, 2023

Prof. Dr.-Ing. Bernd Bungert, Kai Greten
Fiberboard GmbH, Classen Group
Baruth, Germany
Berlin University of Applied Science and Technology

Production site in Baruth, Germany:
Classen Group operates largest integrated MDF- and laminate-flooring site worldwide

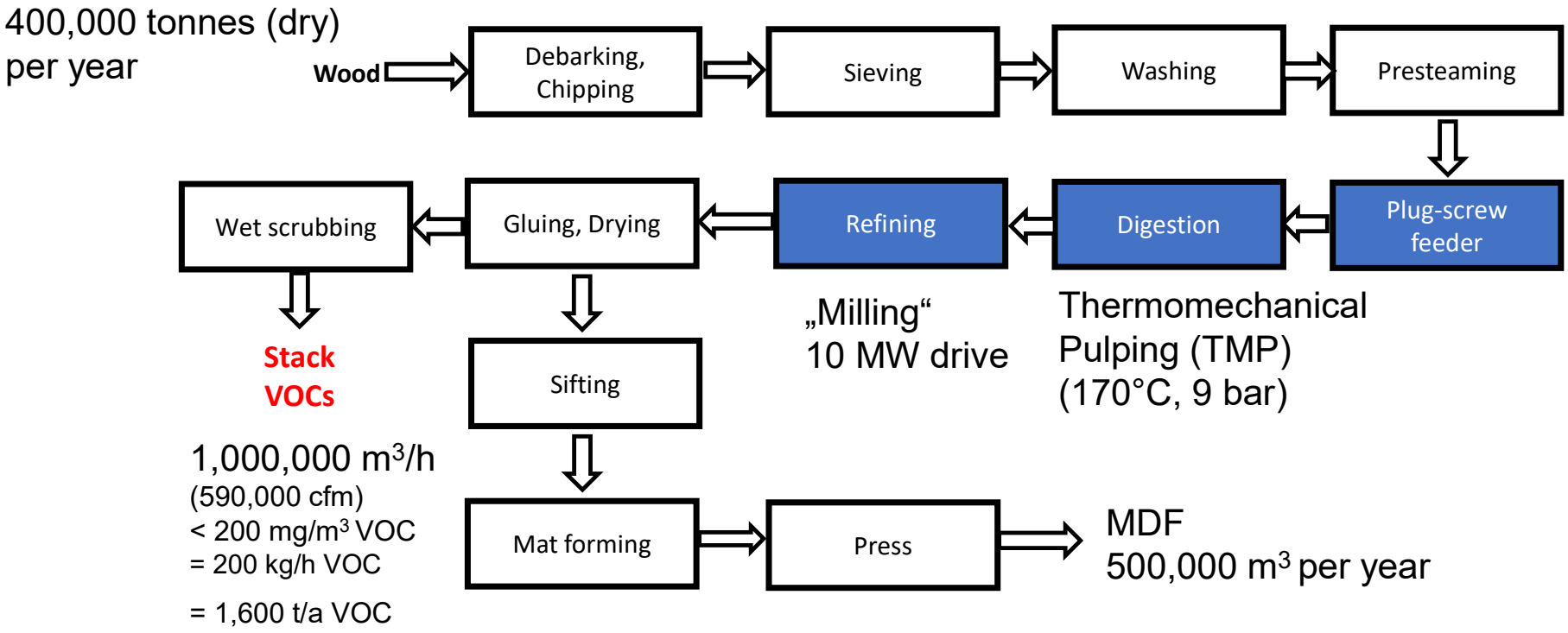


Fiberboard in Baruth/Mark

VOC: Volatile Organic Components

MDF Process

Fiberboard GmbH is part of the CLASSEN Group



New route to turpentine

- Tree tapping	Gum Turpentine (GT)
- Extraction from pine stumps	Wood Turpentine
- Kraft process at pulp mills	Crude Sulfate Turpentine (CST)
- Medium Density Fiberboard production	MDF-Turpentine (MDF-T)

MDF-process with VOC reduction with turpentine production

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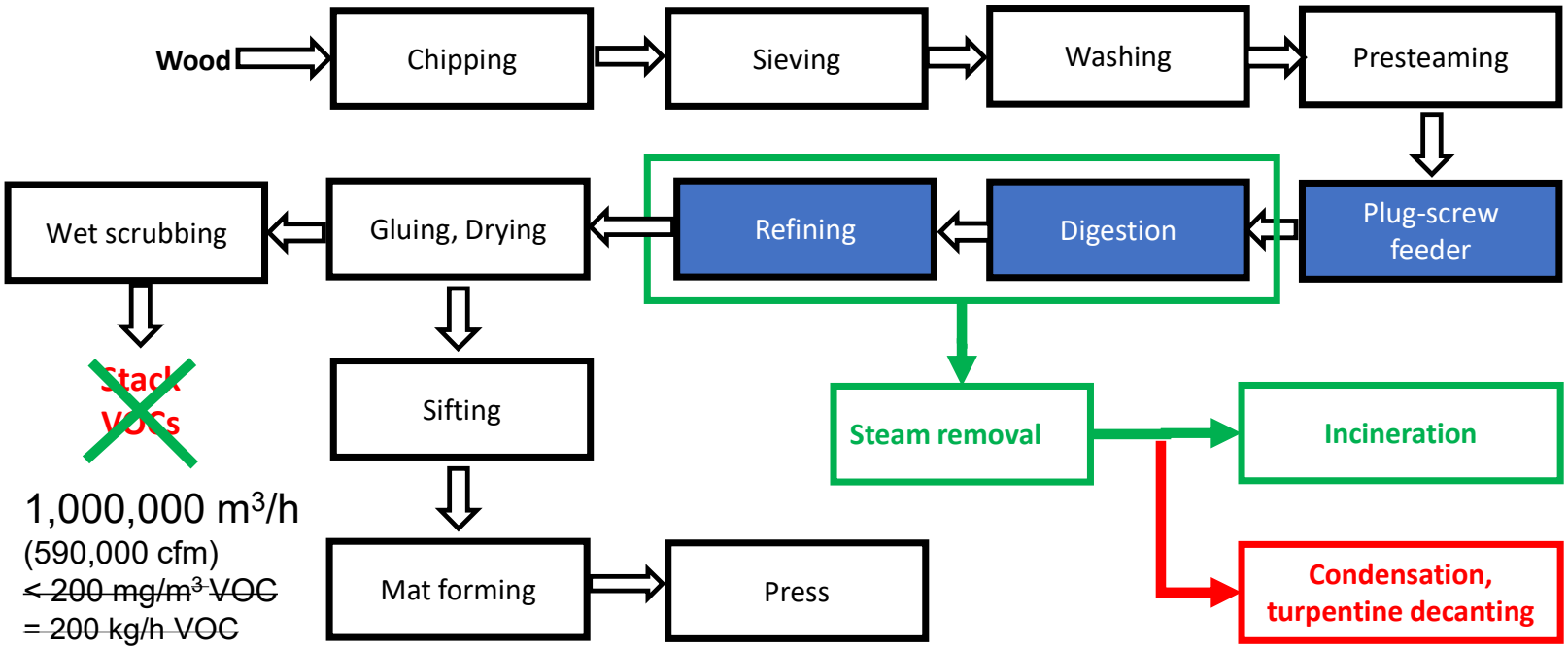

System installation

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Steam removal

Pipe to hot-gas generator

Combustion-chamber inlet

Turpentine plant: installation in 2 steps

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- Emission reduction
  - In industrial production
  - Incineration of steam in power plant
  - Low investment, Low operating costs
  - No authority approval

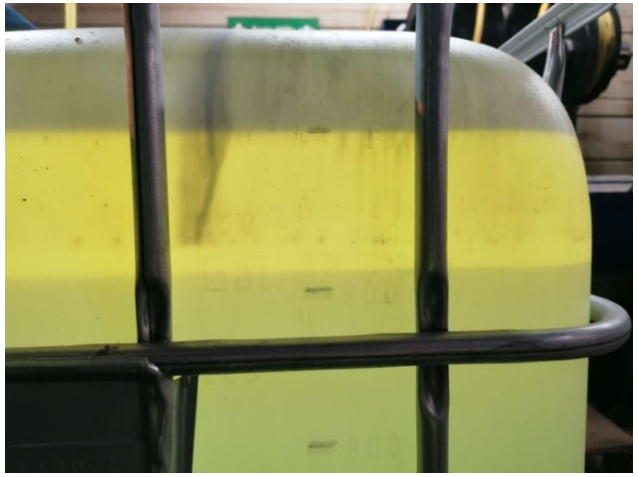
- Production of turpentine
  - Detailed engineering finished, procurement under way
  - Condensing of steam, separation of turpentine
  - Authority approval applied, REACH certification finished
  - Low operating costs due to heat recovery
  - Fast amortization

MDF Turpentine

Fiberboard GmbH is part of the CLASSEN Group

Typical Composition by GC MS for Baruth MDF-T

1. alpha-Pinen e	48,5
2. Camphen	1
3. beta-Pinene	3
4. beta-Myrcen	0,9
5. delta-3-Carene	35,2
6. alpha-Terpinene	0,4
7. p-Cymene	0,7
8. Limonene	3,8
9. Eucalyptol	0,1
10. Ocimene	0,1
11. gamma-Terpinene	0,5
12. Terpinolene	3,3
13. beta-Caryophyllene	0,1



Comparison to former East German Gum Turpentine

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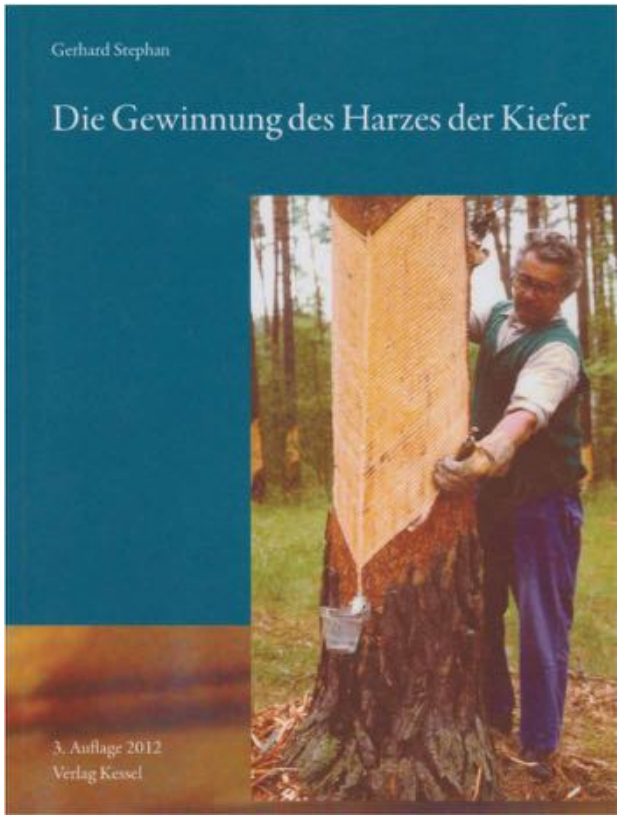


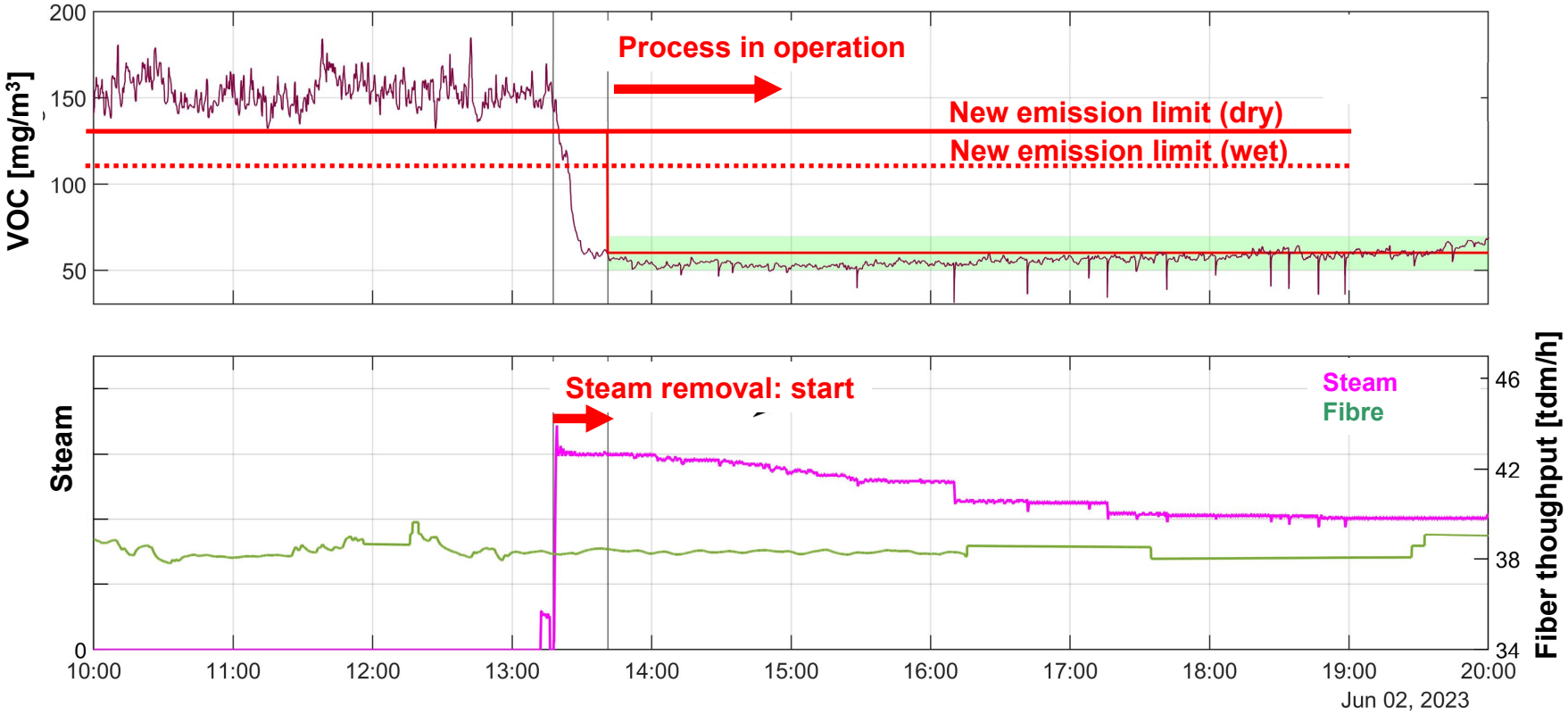
Tabelle 1: Die Zusammensetzung des Terpentinöls. VK = Variationskoeffizient.

Bestandteil	Variation (%)	Mittelwert (%)	VK (%)
α-Pinen	41,5-61,4	52,9	10,0
Camphen	1,2-2,2	1,6	18,8
β-Pinen	1,7-3,6	2,5	25,1
Δ_3-Caren	23,7-35,3	31,5	11,8
Dipenten	0,3-12,8	7,2	49,1
α-Phellandren	0,4-1,3	0,6	38,9
β-Phellandren	0-6,0	0,7	69,3
Terpinolen	0-0,5	0,1	121,9
Cymol	0-4,1	2,9	33,0

MDF turpentine process does not change composition!

Compliance with new emission values

CLASSEN
Fiberboard GmbH is part of the CLASSEN Group



- ✓ Reliable attainment of emission limits
- ✓ Proven in industrial operation

Benefits

CLASSEN®
Fiberboard GmbH is part of the CLASSEN Group

1) Compliance with environmental legislation
   - ✓ EU-BAT: 100 mg/m^3 (wet, old basis)
   - ✓ USA: PSD/ BACT

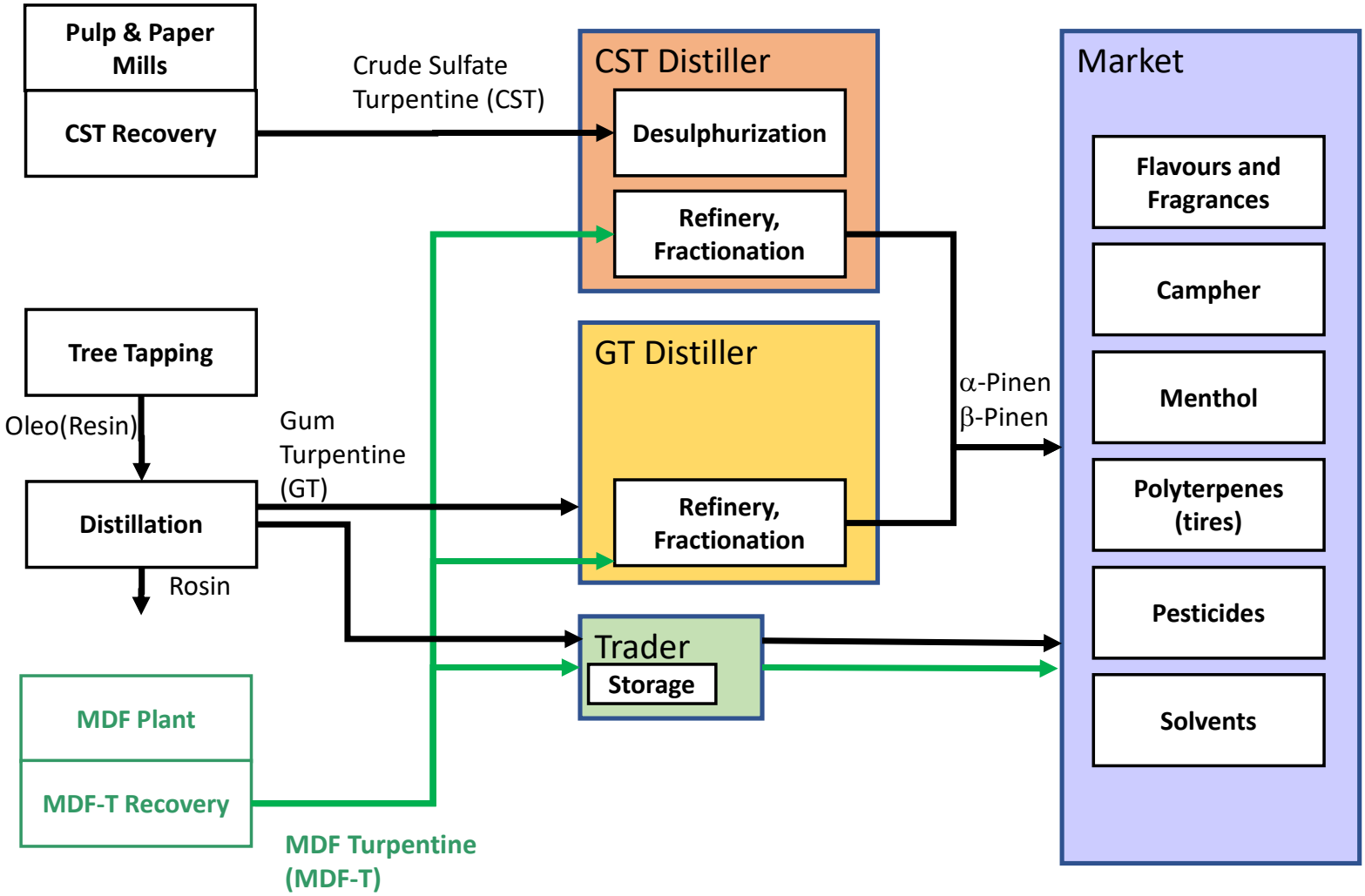
2) Reduction of operating costs
   - ✓ Alternative to Thermal Oxidization (RTO)

3) Revenue creation by turpentine production

4) No influence on product performance

5) Low investment costs, almost no operating costs

Production and Market route for CST, GT, MDF-T



CST, GT: market and amounts

- Crude Sulfate Turpentine (CST, 200 000 tpy)
  - Desulphurization necessary: oxidization of sulfides, costly fractionation
  - Production worldwide, based on pulp and paper industry

- Gum Turpentine (GT, 150 000 tpy)
  - China 72 000 tpy
  - Brasil 30 000 tpy
  - Indonesia 18 000 tpy
  - Spain, Portugal, France 9 000 tpy
  - Mexico, Honduras 8 000 tpy
  - India 3 000 tpy
  - Vietnam 3 000 tpy

Comparison CST, GT, MDF-T

-	**CST**	Continuous Production +	Sulphur components -	worldwide production O
-	**GT**	Seasonal (price volatility) -	no sulphur components +	Dependency on regional suppliers -
-	**MDF-T**	Continuous Production +	no sulphur components +	Diversification and local sourcing +

✓ MDF-T combines all the advantages of the available turpentine sources

MDF market worldwide and possible theoretical yield *(assumption: 100% use of softwood/ pine)*

MDF market					
Country/ Region	**m3/a**	**t/a**	**Yield low (0,5kg/t) t/a**	**Yield medium (3kg/t) t/a**	**Yield high (6 kg/t) t/a**
Germany	4.100.000	3.280.000	1.640	9.840	19.680
Belarus	1.050.000	840.000	420	2.520	5.040
France	1.040.000	832.000	416	2.496	4.992
Italy	1.050.000	840.000	420	2.520	5.040
Poland	2.890.000	2.312.000	1.156	6.936	13.872
Russia	4.400.000	3.520.000	1.760	10.560	21.120
Spain	1.350.000	1.080.000	540	3.240	6.480
Portugal	625.000	500.000	250	1.500	3.000
Turkey	7.494.000	5.995.200	2.998	17.986	35.971
Europe	**23.999.000**	**19.199.200**	**9.600**	**57.598**	**115.195**
China*	65.000.000	52.000.000	26.000	156.000	312.000
Thailand	4.300.000	3.440.000	1.720	10.320	20.640
Iran	3.000.000	2.400.000	1.200	7.200	14.400
India	2.000.000	1.600.000	800	4.800	9.600
Korea	2.000.000	1.600.000	800	4.800	9.600
Vietnam	900.000	720.000	360	2.160	4.320
Others	5.500.000	4.400.000	2.200	13.200	26.400
Asia	**75.000.000**	**60.000.000**	**30.000**	**180.000**	**360.000**
Australia	530.000	424.000	212	1.272	2.544
New Zealand	810.000	648.000	324	1.944	3.888
Oceania	**1.340.000**	**1.072.000**	**536**	**3.216**	**6.432**
North Am.	**6.150.000**	**4.920.000**	**2.460**	**14.760**	**29.520**
South Am.	**8.800.000**	**7.040.000**	**3.520**	**21.120**	**42.240**
WORLD*	**115.289.000**	**92.231.200**	**46.116**	**276.694**	**553.387**
* Installed capacity, real production not known					

- Predominant material is softwood from pine or spruce
- Hardwood, eucalyptus, rubber tree, acacia are used in lesser amounts
- 150,000 tonnes per year is a realistic potential

Softwood: turpentine composition and yield

- Turpentine composition and yield are compiled from all over the world (ongoing)
- Additional data is generated by steam distillation and GC-MS in lab (ongoing)
- Evaluation of quality by
  - Yield [kg turpentine/ t dry wood]
  - α, β pinene content
  - Quality factor QF

$$QF = \frac{(\%\ \alpha,\beta\ \text{pinene})}{(\%\ \alpha,\beta\ \text{pinene Pinus eliotti, Brasil} = 90\%)}$$

Projekt: **Turpentine composition and yield**
Datum: 21.04.2023
Autor: Bungert
R07

MDF plant size 500.000 m^3
400.000 t
BGT 2.300 €/t

Tree	Botanical name	Region	a-Pinene	Camphen	b-Pinene	Phellan-drene	D3C	Limo-nene	Terpino-lene	Terpineol	a+b content	Yield [kg/t dry]	(a+b)/90	(a+b)/90*yield	Production [t/a]
Balsam Fir	Abies Balsamea	Canada East	35	1	13		5				48	3,1	0,53	1,65	1.240
Tamarack	Larix Laricia	Canada Southeast	15	1	28	3	10	2		3	43	0,4	0,48	0,19	160
Common Spruce, gemeine Fichte	Picea Abies	Central and Northern Europe	42	2	27		5	17	1		69	0,4	0,77	0,31	160
White spruce	Picea Glauca	Canada throughout	32		22		3	16			54	0,21	0,60	0,13	84
Black Spruce	Picea Mariana	Canada	11		9		0,4	0,5			20	0,24	0,22	0,05	96
Sitka Spruce	Picea Sitchensis	Pacific West, Oregon	12,8		7,9	31		8			21	0,43	0,23	0,10	172
Jack Pine	Pinus Banksiana	Canada Southeast	62	2	28		1	3			90	2,7	1,00	2,70	1.080
Caribean Pinne	Pinus Caribaea	South Africa, Kenya	50		2	20-30	<2	<3			52		0,58		
Caribean Pine, Turkish Pine, East Mediterranean Pine	Pinus caribeae var hondurensis	Caribean, Honduras, China, Turkey	75	<2	6	<1		<5			81		0,90		
Sand Pine	Pinus Clausa	Florida	29,6	1,8	54,2			6			84	1,6254	0,93	1,51	650
Lodgepole Pine	Pinus Contarta	New Zealand, USA Northwest	5	1	2	60	20				7	5,6	0,08	0,44	2.240
Shortleaf Pine, Yellow Pine, Southern Pine, Arkansas Pine, shortleaf yellow pine, southern yellow pine	**Pinus Echinata**	**USA Southeast**	**58**	**2**	**32**	**1**	**1**	**4**			**90**	**2,9**	**1,00**	**2,89**	**1.156**
Slash Pine, Southern Yellow Pine	**Pinus Eliotti**	**USA Southeast, Argentina, SA, Zimbabwe, Australia**	**50**	**1**	**40**	**<5**	**<2**	**2**		**4**	**90**	**4,6**	**1,00**	**4,60**	**1.840**
Spruce pine, white pine, cedar pine, poor pine	Pinus Glabra	USA Southeast	41	1	44	2	1	6	0,4	0,7	85	3,8	0,94	3,59	1.520
Aleppo Pine, Alep Pine	Pinus Halepensis	Greece. North Africa	90		2	<1	<1	<1			92		1,02		
Simao Pine	Pinus Kesiya, Pinus Insularis	China, India, Thailand, Myanmar, Laos, Thailand	80		4	<0,5	<1	<2			84	?	0,93		
Chinese red pine, horsetail pine, Masson's pine	Pinus Massoniana	China central and southeast, Vietnam	85		8	<1	<1				93		1,03		
Merkus Pine	Pinus Merkusii	Indoensia, Phillipines, Thailand	74	1	2		19	2	1		76		0,84		
Longleaf Pine, Southern Yellow pine, Georgia Pine, Pitch Pine	**Pinus Palustris**	**USA Southeast**	**71**	**1**	**21**		**1**			**3**	**92**	**13,4**	**1,02**	**13,70**	**5.360**
Maritime Pine	Pinus Pinaster	Europe Southwest	73		19	1	1	1,6			92	4	1,02	4,09	1.600
			63		26,5						90		0,99		
			79		10						89		0,99		
Ponderosa Pine	Pinus Ponderosa	USA westcoast	10	1	17	2	36		2	2	27	3,2	0,30	0,96	1.280
Monterrey Pine	Pinus Radiata	Australia, New Zealand, Chile, Spain, USA west	34		64		6	2			98	1,7	1,09	1,85	680
Monterrey Pine	Pinus Radiata	Australia, New Zealand, Chile, Spain, USA west			98						98		1,09		
Monterrey Pine	Pinus Radiata	Australia, New Zealand, Chile, Spain, USA west	23		65			2	3	3	88	2,32	0,98	2,27	928
Monterrey Pine	Pinus Radiata	Australia, New Zealand, Chile, Spain, USA west	22		67						89	0,447	0,99	0,44	179
Red Pine	Pinus Resinosa	USA Northeast, Canada Southeast	80	2	10		5				90	3,2	1,00	3,20	1.280
Pitch Pine	Pinus Rigia	USA Northeast	60	1	35		1				95	3,7	1,06	3,91	1.480
Pond pine	Pinus serotina	USA Southeast	12,5	0,5	4,5	15,9	3	56,1			17	3,13	0,19	0,59	1.252
Eastern White Pine	Pinus Strobus	USA North East, Canada Southeast	67	3	18		1				85	3,4	0,94	3,21	1.360
Scots Pine (Kiefer)	Pinus Sylvestris	Eastern Europe	47		3		35	5	3		50	3,0	0,56	1,67	1.200
Loblolly Pine, Southern Yellow Pine	**Pinus Taeda**	**USA Southeast**	**64**	**1**	**28**		**2**	**2**		**3**	**92**	**3,2**	**1,02**	**3,27**	**1.280**
Virginia Pine, Jersey Pine, North Carolina Pine, Spruce Pine	Pinus Virginiana	USA, East, Northeast	62	2	26	1	2	2	2	1	88	20,0	0,98	19,51	7.981
Douglas Fir	Pseudotsuga Menziesii	USA westcoast	58	2	4	2	2	6	2	6	62	2,4	0,69	1,65	960

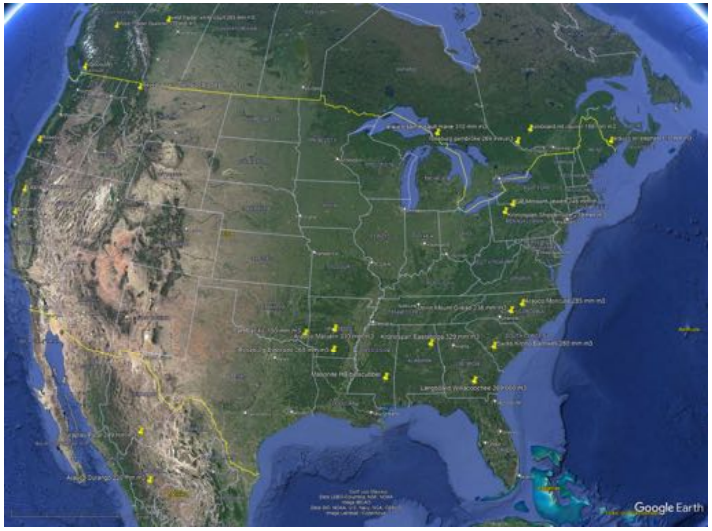
Business case examples: MDF Turpentine from 6 locations

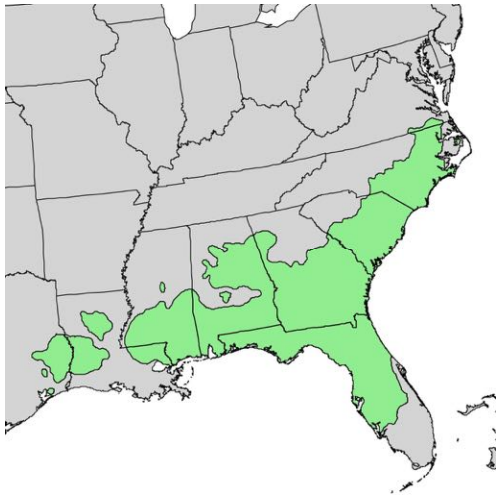
1) Baruth Germany (500,000 m^3/a; Pinus Sylvestris)
2) Brasil (600,000 m^3/a; Pinus Eliotti)
3) USA (300,000 m^3/a; Pinus Palustris)
4) Australia, New Zealand (300,000 m^3/a; Pinus Radiata)
5) Portugal, Spain (300,000 m^3/a; Pinus Pinaster)
6) Turkey (880,000 m^3/a; Pinus Sylvestris)

Business Case	Tree	Botanical name	Region	a-Pinene	b-Pinene	a+b content	QF = (a+b)/ (a+b) El.	Yield [kg/t dry]
	Common Spruce	Picea Abies	Central and Northern Europe	42	27	69	0,77	0,4
	Shortleaf Pine, Yellow Pine, Southern Pine, Arkansas Pine, shortleaf yellow pine, **southern yellow pine**	Pinus Echinata	USA Southeast	58	32	90	1,00	2,9
2) Brasil	Slash Pine, **Southern Yellow Pine**	**Pinus Eliotti**	**USA Southeast, Argentina, Brasil, SA, Zimbabwe, Australia**	**50**	**40**	**90**	**1,00**	**4,6**
3) USA	Longleaf Pine, **Southern Yellow pine**, Georgia Pine, Pitch Pine	Pinus Palustris	USA Southeast	71	21	92	1,02	13,4
5) P, E	Maritime Pine	Pinus Pinaster	Europe Southwest	73	19	92	1,02	4
				63	26,5	90	0,99	
				79	10	89	0,99	
4) AUS, NZ	Monterrey Pine	Pinus Radiata	Australia, New Zealand, Chile, Spain, USA west	34	64	98	1,09	1,7
	Monterrey Pine	Pinus Radiata	Australia, New Zealand, Chile, Spain, USA west	23	65	88	0,98	2,32
	Monterrey Pine	Pinus Radiata	Australia, New Zealand, Chile, Spain, USA west	22	67	89	0,99	0,45
1) D	Scots Pine (Kiefer)	Pinus Sylvestris	Eastern Europe	48	3	51	0,57	3,0
	Loblolly Pine, **Southern Yellow Pine**	Pinus Taeda	USA Southeast	64	28	92	1,02	3,2

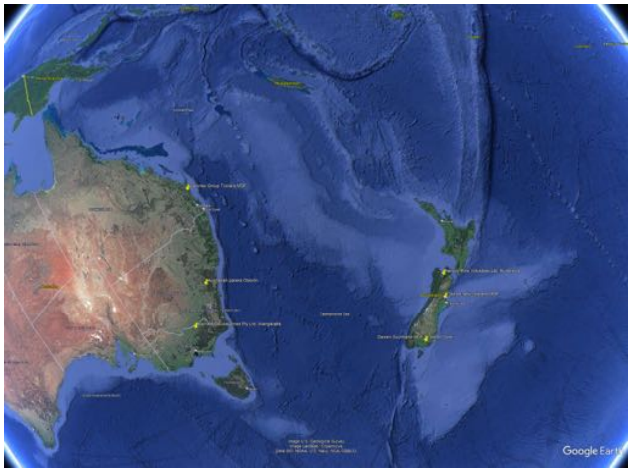
Brasil: Slash Pine, Southern Yellow Pine (Pinus Eliotti) 600,000 m^3/a

USA: Longleaf Pine, Southern Yellow pine, Georgia Pine, Pitch Pine (Pinus Palustris) 300,000 m^3/a

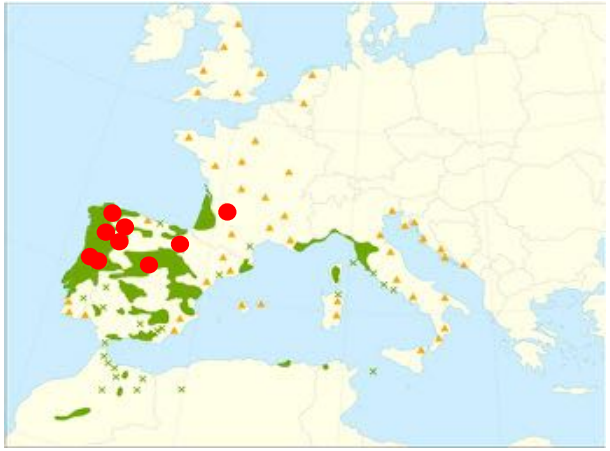




Australia, New Zealand: Monterey pine (pinus radiata) 300.000 m^3/a



Portugal, Spain: Maritime pine (pinus pinaster) 300.000 m^3/a



● MDF sites

Source: wikipedia

Brasilian Gum Turpentine: monthly price and sales

Source: Comexstat, Brazilian foreign trade statistics

Comparison of 6 busines cases

- For purposes of illustration only
- An hypothetical price* was calculated from the (α+β) content based on
  - 14 year average price for Brasilian Gum Turpentine
  - BT = $ 2300/ ton (€ 2150/ton)
  - Price = QF * BT
- All cases are interesting for the MDF industry to start turpentine recovery

Nr.	Site	MDF m^3/a	Wood t/a	Turpentine kg/t	Turpentine t/a	(a+b)/ (a+b) e	Turpentine €/t *	Estimated* Revenue [€]	€/m^3 MDF
1	Baruth, Germany	500.000	400.000	3	1.200	0,55	1.183	1.419.000	2,8
2	Brasil	600.000	480.000	4,6	2.208	1,00	2.150	5.520.000	9,2
3	USA	300.000	240.000	13,4	3.216	1,02	2.193	8.200.800	27,3
4	Aus, NZ	300.000	240.000	1,7	408	1,09	2.344	1.111.800	3,7
5	Spain	300.000	240.000	4	960	1,02	2.193	2.448.000	8,2
6	Turkey	880.000	704.000	3,5	2.464	0,68	1.462	4.188.800	4,8

* No business information, only meant to assess an order of magnitude

Timeline for projects

✓ Emissions (MDF-VOC)

- Installation within less than ½ year possible
- In Europe: usually only notification of authorities necessary
- In US: application process with EPA and local authorities + continuous monitoring of VOC emission

✓ Turpentine Recovery (MDF-T)

- Installation within 1 year (delivery time of long-lead items like automization parts has to be checked)
- Technology transfer via Process Design Package (PDP) after commercial agreement
- Authority engineering: application process necessary
- System built modular (2 sizes, 3 options for heat recovery depending on site specific heat sinks)
- Engineering, procurement, construction (EPC)
  - Inhouse or
  - Preferred contractors experienced from turpentine recovery from pulp mills (CST) are available

Market & Project development

✓ Emissions (MDF-VOC)

- After Baruth, the first system of a licensee will be installed in Q4.2023
- Negotiations with other European and US producers in progress

✓ Turpentine Recovery (MDF-T)

- Negotiations have begun
- Most important market segments have been identified and are beeing adressed:
  - Over 320 MDF sites worldwide
  - Production rate, raw material (pinus xxx) are known
  - Marketing and Sales Process has started
- Possible licensing options:
  - Gobal MDF players (internationally operating companies)
  - Turpentine Distillers
    - Sales agreement, e.g. countrywise
    - Contracting/ Operating model
  - Turpentine Recovery Contractors

Conclusions

- New source of turpentine: MDF-Turpentine
- Process solves environmental problems and additionally creates revenue for MDF producers
- Worldwide potential > 100 000 tpy
- Yield and composition depends on raw material used („pinus xxx“)
- All of the ~ 320 worldwide sites and their turpentine potential are known
- Licensing options are still open
- A completely new business in pine chemicals industry has started

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HENNA POIKOLAINEN

TUESDAY, 18 SEPTEMBER 2023

11:05 AM

Pine Chemicals:
Making the World a Better Place

Henna is the Senior Principal, Head of Biorefining, AFRY Management Consulting, specialized in bio-based chemicals, liquid biofuels and new business development. For the past 10 years, she has been supporting clients in transactions; sourcing, market entry, and partnering strategies; in supply, demand and cost analyses; and in technology reviews and pre-feasibility assessments.

Pine Chemicals – Making the World a Better Place

HENNA POIKOLAINEN
AFRY MANAGEMENT CONSULTING

19 SEPTEMBER 2023 | PCA INTERNATIONAL CONFERENCE | DUBLIN, IRELAND

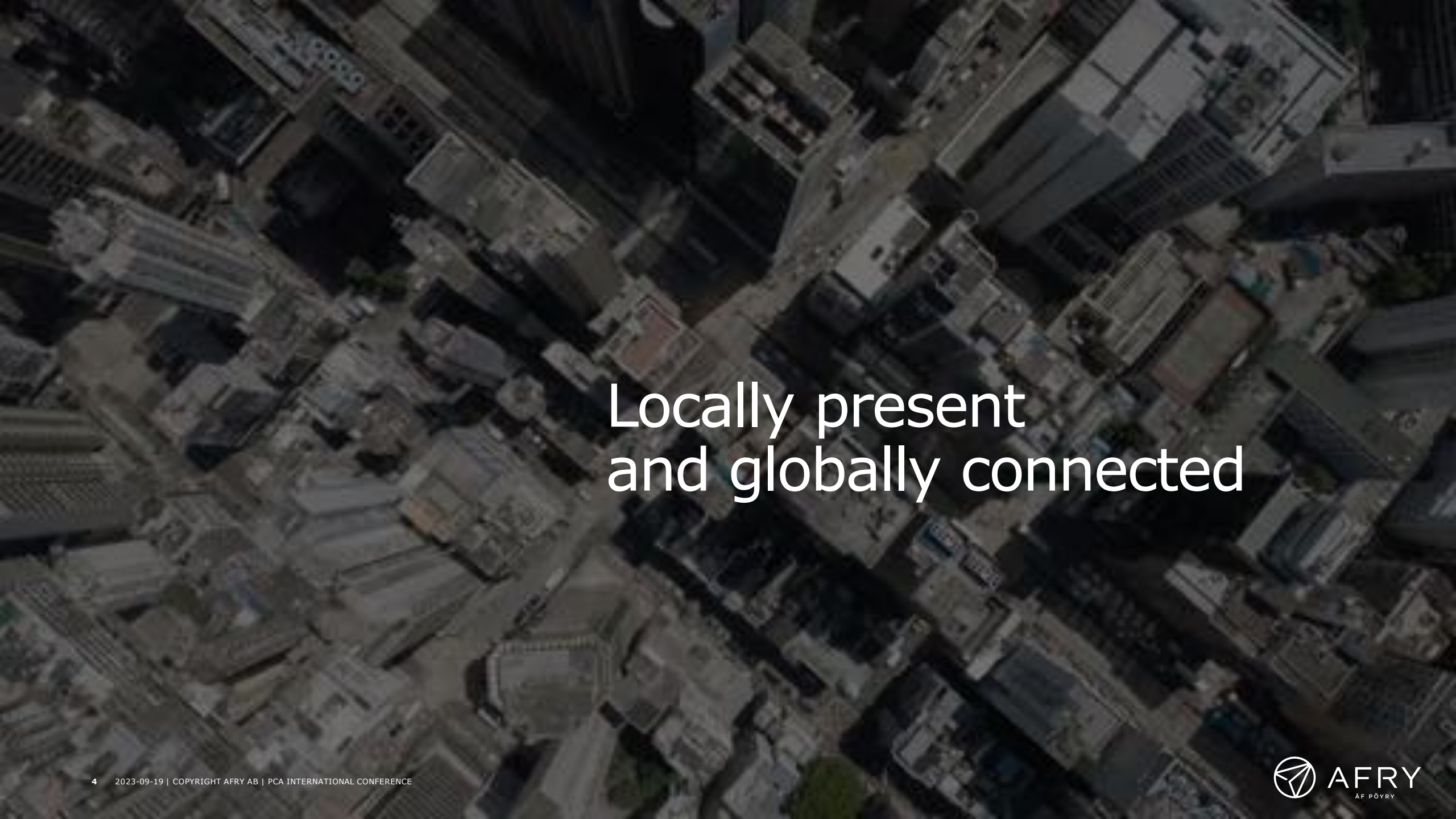
No. of employees: 19,000

Approx. Net sales: 24 bsek

Industry
Infrastructure
Energy

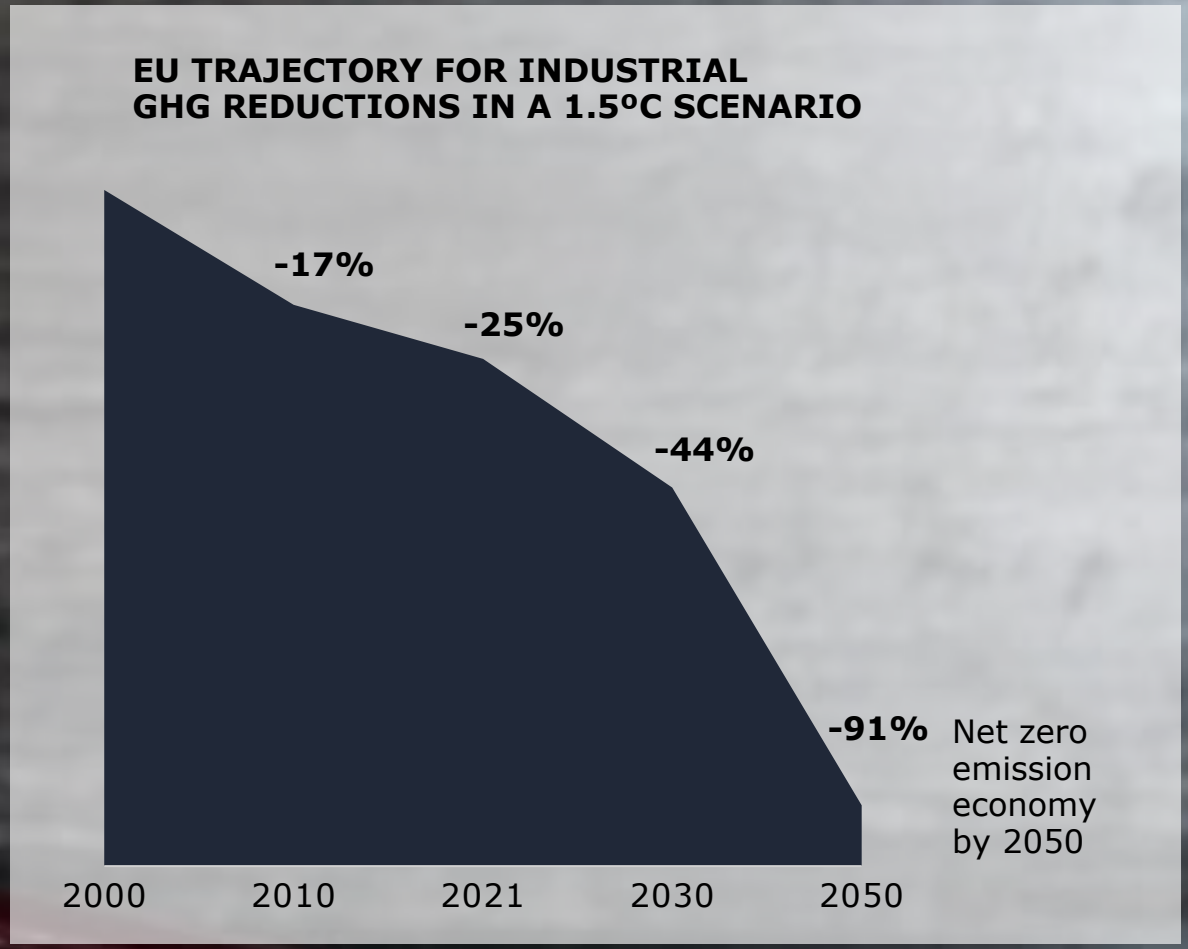
Offices in more than countries: 40


Infrastructure
Industrial and Digital Solutions
Process Industries
Energy
AFRY X
Management Consulting
37%
22%
19%
12%
5%
5%

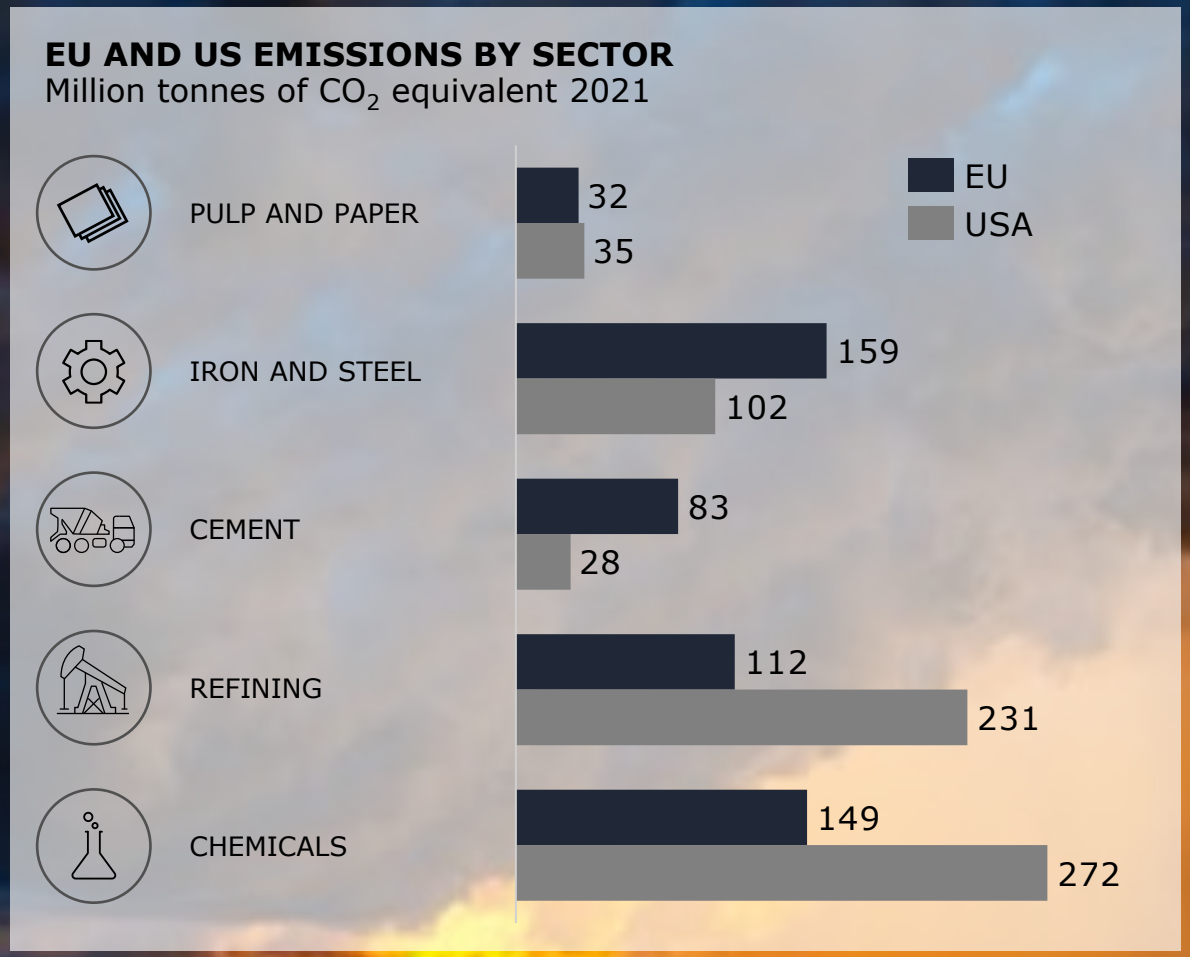


Locally present and globally connected

The USA has set an overall 50% emission reduction target by 2030 and a net zero economy by 2050



Source: EU; Eurostat, USA; Department of Energy, Pulp and Paper; Environmental Protection Agency



Source: EU; Eurostat, USA; Department of Energy, Pulp and Paper; Environmental Protection Agency

Industry emissions 2021, Mt CO_{2eq}

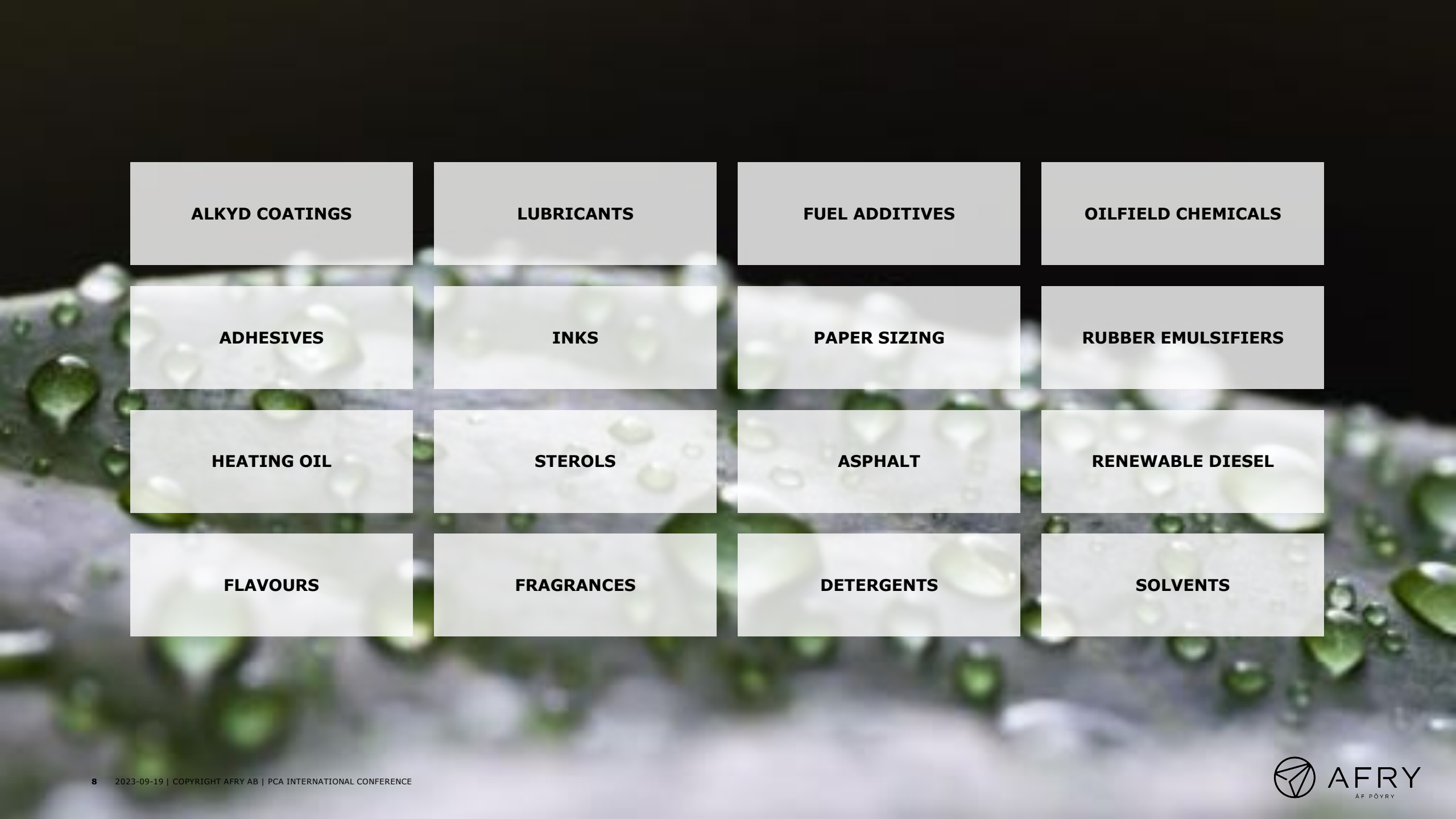
1 360 USA

800 EU

Zero tonnes of fossil CO2 emissions (scope 1 & 2) by 2030

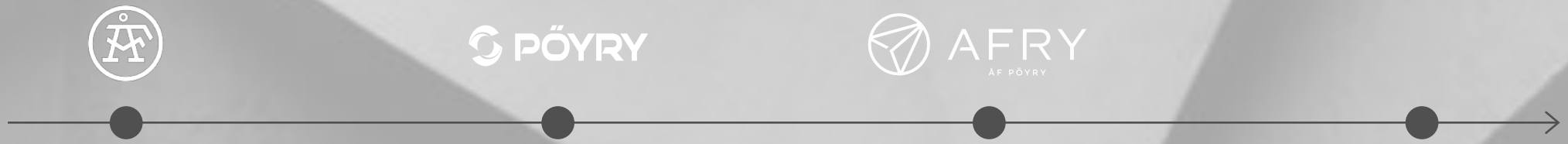
100% of fossil-free raw materials and packaging materials by 2030

AFRY ÅF PÖYRY


ALKYD COATINGS
LUBRICANTS
FUEL ADDITIVES
OILFIELD CHEMICALS
ADHESIVES
INKS
PAPER SIZING
RUBBER EMULSIFIERS
HEATING OIL
STEROLS
ASPHALT
RENEWABLE DIESEL
FLAVOURS
FRAGRANCES
DETERGENTS
SOLVENTS


If you think you are too small to make a difference, you haven't spent the night with a mosquito.
- Dalai Lama

AFRY has a long history in advising the forest industry sector



1895

The steam boiler association is founded by owners of steam boilers and pressure vessels to prevent accidents

1958

Jaakko Pöyry starts his business with the roots in Finnish forest industries

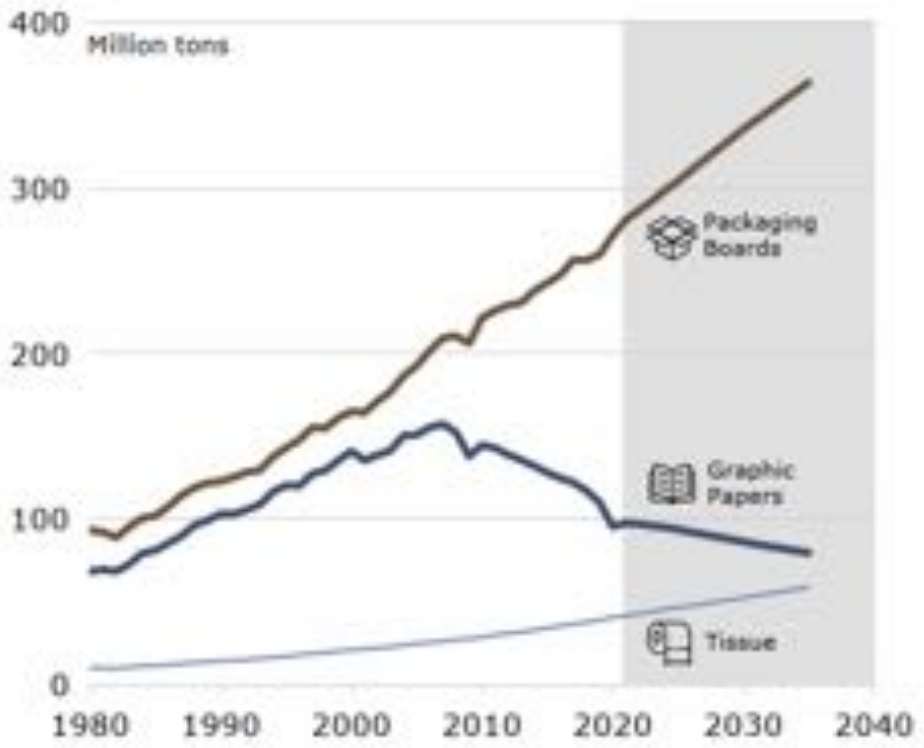
2019

ÅF and Pöyry join forces, creating a leading company within engineering, design and advisory services

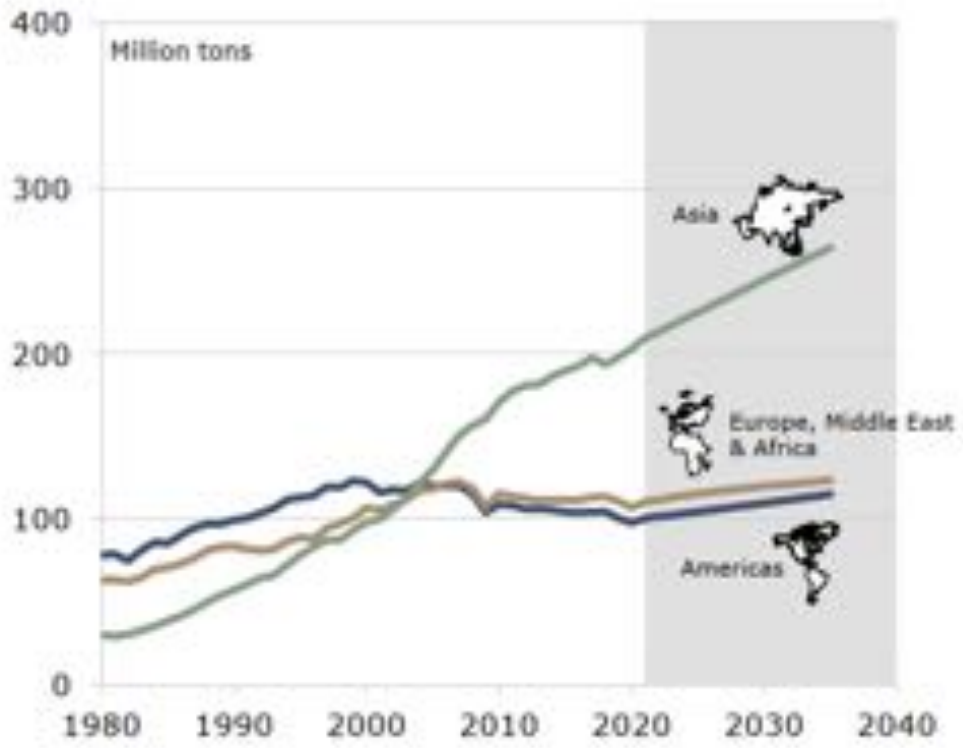
Today

A European leader in sustainable engineering, design and advisory with a global reach.

PAPER & BOARD PRODUCTION BY MAIN GRADE



PAPER & BOARD PRODUCTION BY GEOGRAPHY



GRAPHIC PAPERS

97 Mt
GLOBAL DEMAND IN 2020

-17 Mt
2020-2035

TISSUE PAPERS

40 Mt
GLOBAL DEMAND IN 2020

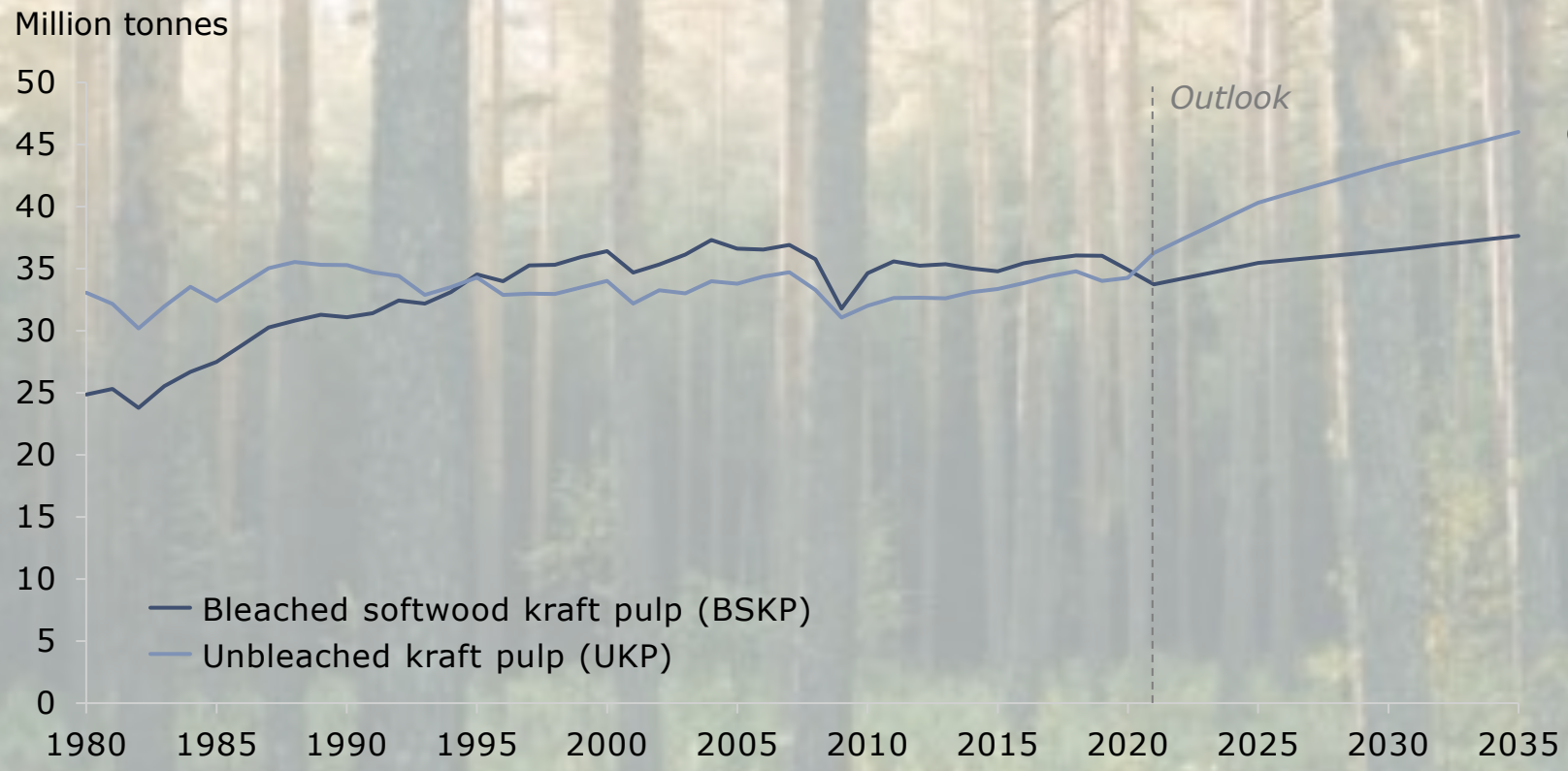
+18 Mt
2020-2035

PACKAGING PAPERS & BOARDS

272 Mt
GLOBAL DEMAND IN 2020

+91 Mt
2020-2035

BSKP AND UKP PRODUCTION DEVELOPMENT, 1980-2035



CAGRs

1980-2021

BSKP **+0.7%**

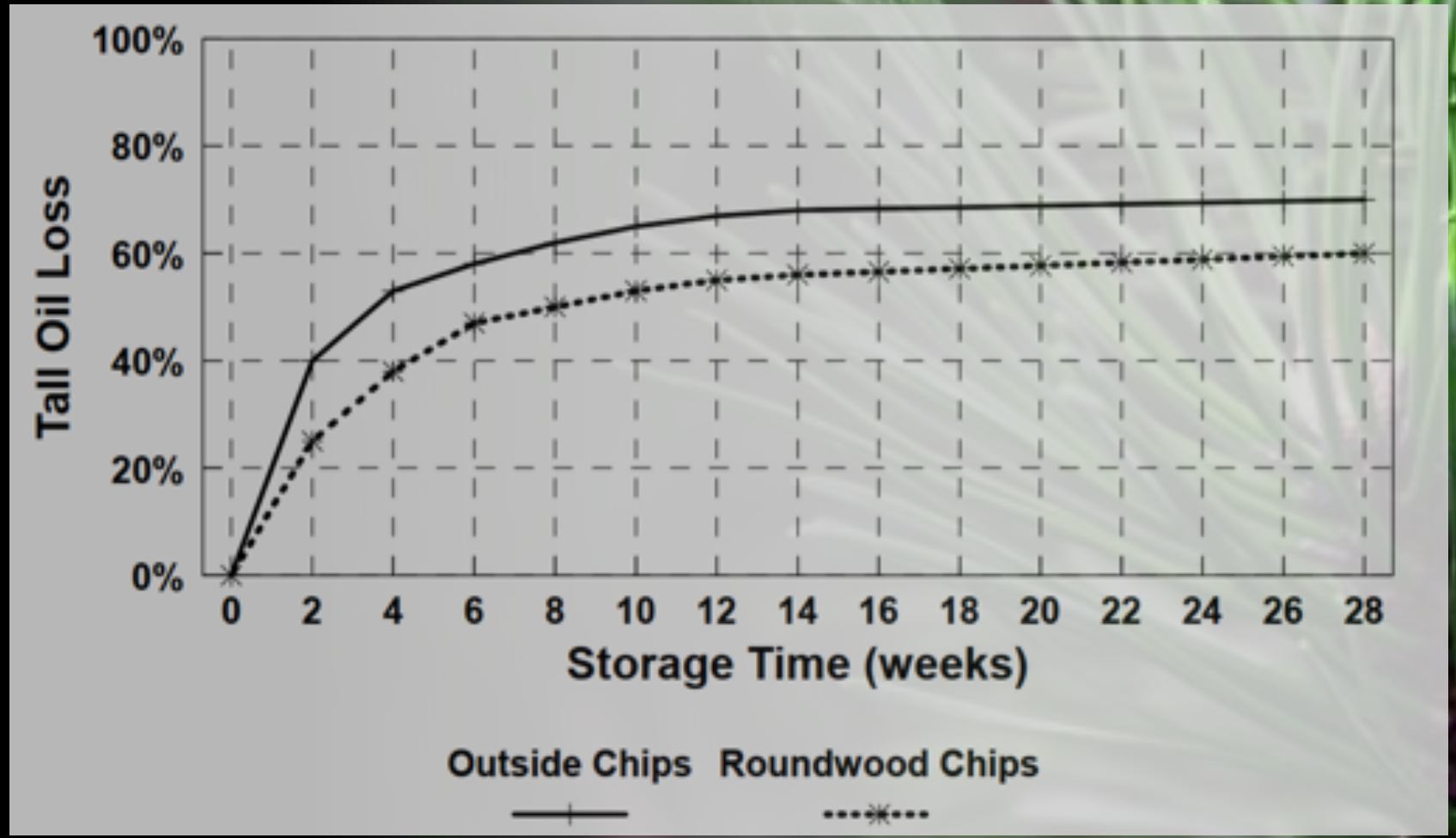
UKP **+0.2%**

2021-2035

BSKP **+0.8%**

UKP **+1.7%**

IMPACT OF STORAGE TIME ON TALL OIL LOSS



Source: C. Douglas Foran, Tall Oil Soap Recovery

AFRY HDS® Tall Oil Plant Technology

2000-2020's

			t CTO/h
On-going	Gascogne Papier, Mimizan	France	-
On-going	Stora Enso, Oulu	Finland	-
On-going	Metsä Fibre, Kemi	Finland	10+
2017	Metsä Fibre, Äänekoski	Finland	10
2015	Stora Enso, Varkaus	Finland	4
2015	Stora Enso, Sunila, Kotka	Finland	3.5
2013	M-Real Husum, Husum[1]	Sweden	5
2011	Södra Cell Mörrum, Mörrum[2]	Sweden	4.2
2011	Zellstoff Pöls AG, Pöls	Austria	2.5
2010	Södra Cell, Mönsterås Mill[2]	Sweden	5
2008	UPM-Kymmene, Kuusankoski	Finland	7
2007	Iggesund Paperboard, Iggesund	Sweden	4.2
2006	Stora Enso, Enocell Mill, Uimaharju	Finland	7
2005	Billerud Karlsborg, Kalix	Sweden	5
2005	Stora Enso Skoghall Mill, Skoghall	Sweden	3.5
2004	UPM Kymmene, Wisaforest, Pietarsaari	Finland	8
2004	Zellstoff Stendal GmbH, Arneburg	Germany	4.5
2001	Stora-Enso Kaukopää Mill, Imatra	Finland	7

1980-1990's

			t CTO/h
1999	Assi Domän Kraftliner, Piteå	Sweden	5
1999	Phoenix Pulp and Paper Mill, Nanning	China	2
1998	Södra Cell, Mönsterås Mill	Sweden	5
1997	MoDo Paper, Husum Mill	Sweden	5
1996	Cariboo Pulp & Paper Mill, BC	Canada	5
1996	Cell-Krems Ltd., Ostroleka Pulp Mill	Poland	1
1995	Metsä-Rauma Pulp Mill, Rauma	Finland	5.5
1993	Qingzhou Pulp Mill, Fujian	China	2
1990	Joutseno Pulp Mill, Joutseno	Finland	3.5
1989	Enocell, Uimaharju	Finland	2
1987	Sunila, Kotka	Finland	2
1986	Arizona Chemical, Port St. Joe	USA	

Advantages of AFRY HDS®

- Continuous process, easy to automate and to connect to mill DCS
- 90% lower maintenance costs compared to centrifuge of similar capacity
- High CTO yield
- Reduced operator requirement, high availability and low noise level

KEY TAKEAWAYS

- Pine chemicals – performance & sustainability
- Operational changes as an incremental source for CTO

Thank you!

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The Pine Chemicals Association International (PCA) is the only association dedicated exclusively to the global pine chemicals industry. Pine chemicals are environmentally friendly products that use natural, renewable products as primary raw materials originating from sustainable forestry sources. The chemicals produced by this industry are used in consumer products such as flavors and fragrances, vitamin intermediates, disinfectants, inks, adhesives, paints, papermaking, synthetic rubber production, soaps and mining chemicals. PCA represents rosin and terpene producers and consumers of crude gum tapped from pine trees, and producers and consumers of papermaking co-products, including tall oil rosin, tall oil fatty acids and terpene chemicals.

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It is the policy of the Pine Chemicals Association International to adhere strictly to the requirements of all applicable antitrust and competition laws. PCA supports the commitment by its members to full compliance with all such laws, whether of state or federal jurisdiction, and believes that compliance with these laws will foster productive association work while promoting free enterprise.

At PCA meetings, there must be no discussion related to prices, or terms of purchase or sale, or products PCA members buy and sell or of other matters which might inhibit the competitive workings of the free market, including actions which may divide markets or create boycotts. The meeting chairman, or anyone attending the meetings, shall interrupt the meeting at anytime he or she feels discussion is creating the possibility of an antitrust competitive situation, or the appearance of one.

Pine Chemicals
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