



How to implement bioenergy in existing industrial installations

Bark gasification at a P&P mill – *Pertti Lehmonen*

19.1.2022

Agenda

1. Metsä Fibre's sustainability targets
2. Product gas and gasification process
3. Joutseno bark gasification process
4. Äänekoski bark gasification process
5. Experience of bark gasification:
 1. CO2 emissions
 2. Fuel consumption

Metsä Fibre's sustainability targets

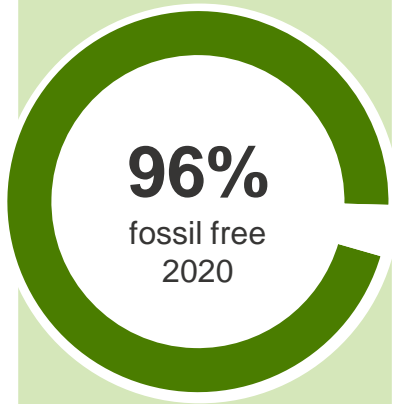
Metsä Fibre's sustainability targets 2030

Forest	Climate and environment	Sustainable choices	Safety and wellbeing
<p>Increasing the amount of carbon stored in forests +30% vs. 2018 This is a Metsä Group level sustainability target and is a Metsä Forest sustainability action.</p>	<p>Fossil free mills Fossil CO₂ emissions: zero Share of fossil free energy: 100% Metsä Fibre status by end of 2020: 96%</p>	<p>Fossil free raw materials Share of fossil free raw materials: 100% Metsä Fibre status by end of 2020: 99.99%. Pulp: 100%. Sawn timber: 99.9%. Fossil based raw materials are only used in sawn timber hoods/wrapping and strapping.</p>	<p>Responsible corporate culture Ethics barometer: 100% Metsä Fibre status in 2020: 83.5%</p>
<p>Increasing the amount of carbon stored in products Amount of carbon stored in products: +30% vs. 2018 Metsä Fibre sawn timber production is included in the target. The Rauma sawmill investment increases sawn timber production by 40%.</p>	<p>Resource efficient production Utilisation of side-streams: 100% Metsä Fibre status by end of 2020: 83%</p>	<p>Sustainable supply chain Sustainable suppliers: 100% Metsä Fibre status by 2020: 95%</p>	<p>Accident-free work environment Accident frequency LTA1: zero Metsä Fibre status by 2020: 6.6 LTA1</p>
<p>Safeguarding biodiversity Increasing the amount of decayed wood This is a Metsä Group level sustainability target and is a Metsä Forest sustainability action.</p>	<p>Resource efficient production Process water use per product tonne: - 25% vs. 2018 Metsä Fibre status by end of 2020: +11%</p>	<p>Sustainable supply chain Traceability of raw materials: 100% Metsä Fibre status by end of 2020: 96%</p>	

We comply with Metsä Group's strategic 2030 sustainability objectives and targets

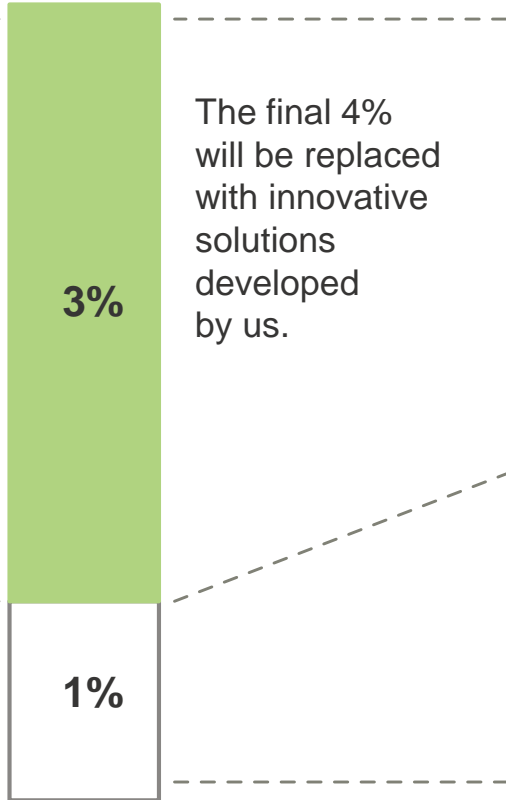


Aiming for 100% fossil free mills by 2030

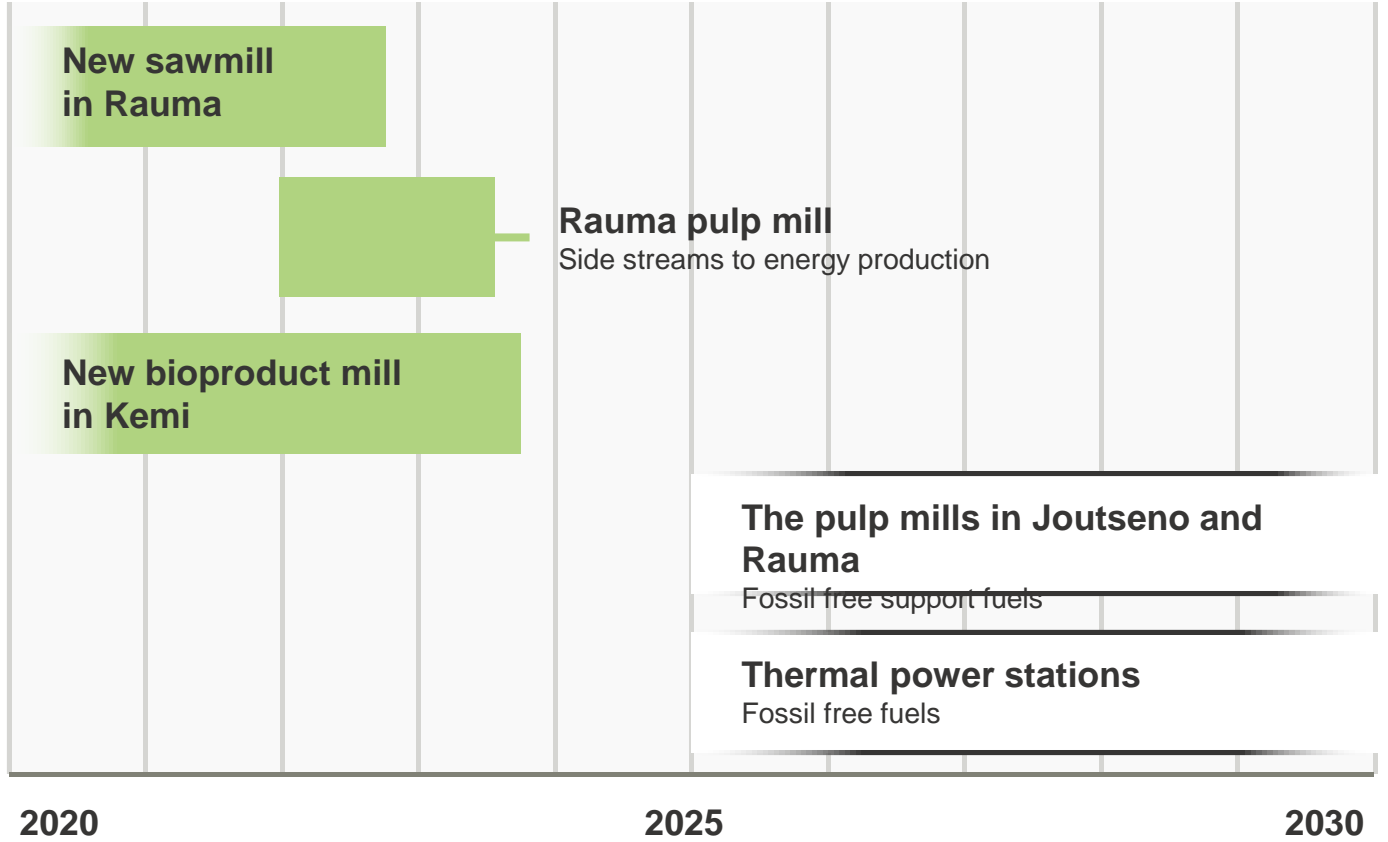


Metsä Fibre's target is that it will no longer use any fossil fuels in its production by 2030. In 2020, 96% of the fuels used in production were biofuels.

Target



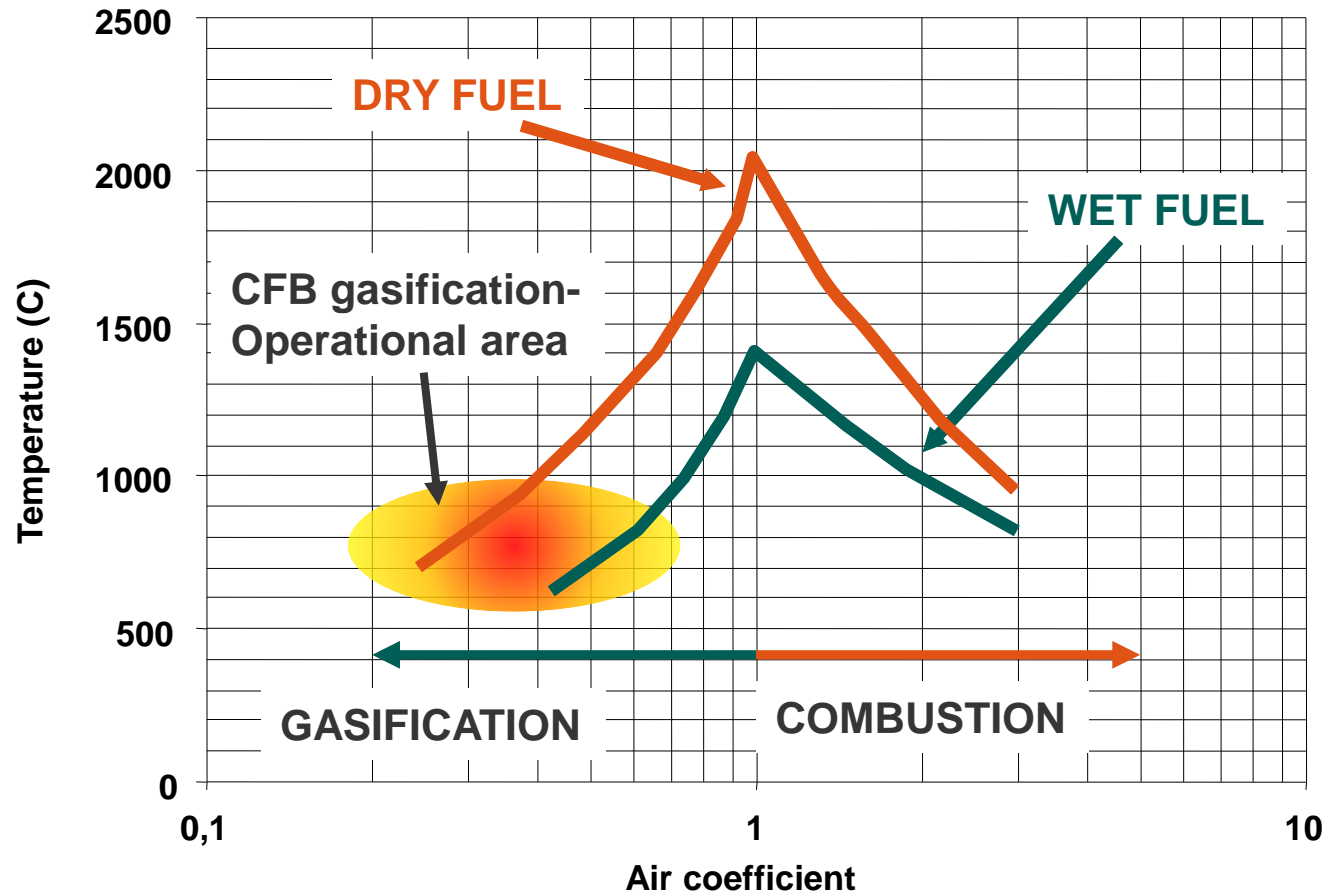
Schedule and measures



Product gas and gasification process

Basics of Gasification

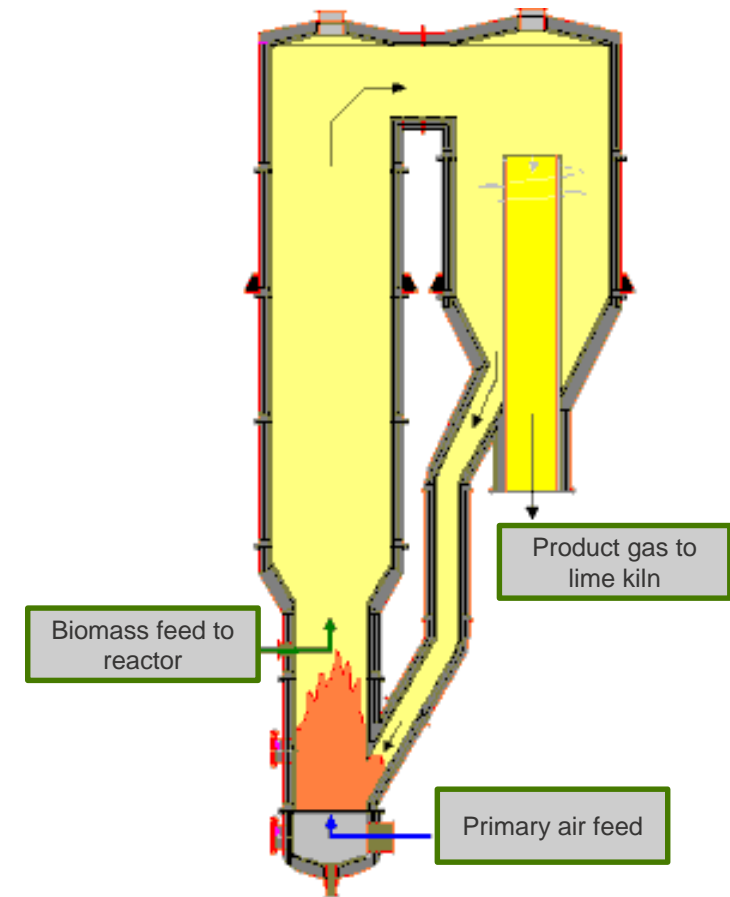
Effect of Moisture: Adiabatic Reaction Temperatures



Heating value of the product gas decrease when moisture of the fuel increase!

Biomass gasifier

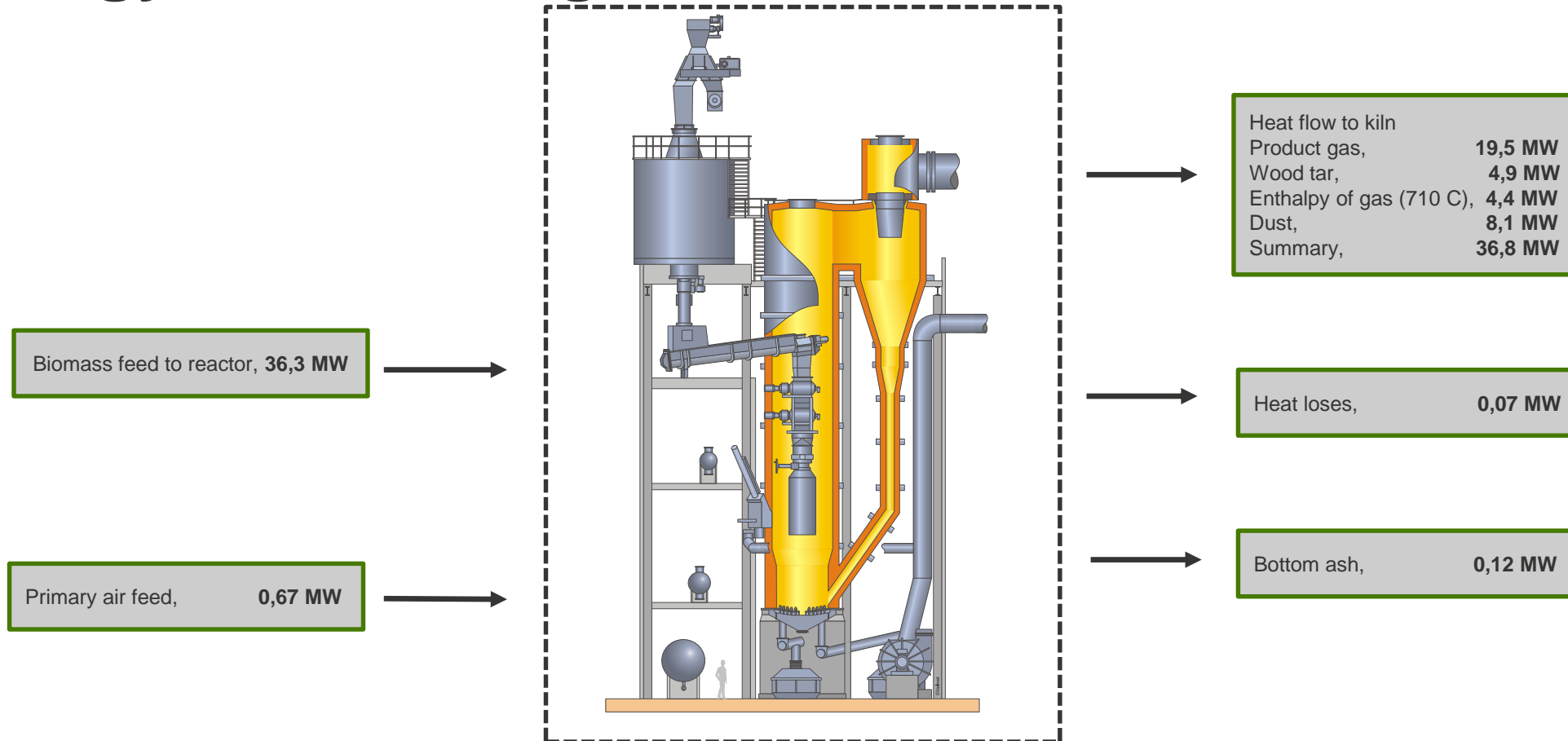
- Gasifier is connected to lime kiln without filtration.
- Major portion of wood ash is fed to kiln.
- Circulating bed material is CaCO_3 .
- Kiln burner power need controls fuel feed to gasifier.
- Pre-heated primary-air is taken from kiln cooler.
- Feed system back-fire is controlled either by N_2 or by steam.



Properties of the product gas

- Self ignition temperature is about 450 C. Normal operating temperature is well above. Gas ignites when it meets oxygen.
- Operating temperature is above tar condensing temperature. Tar don't condensate in the gas line.
- Gasification temperature is made by partial burning of biomass. Product gas contents portion of CO₂. Air factor of gasifier is about 0,3.
- Product gas contents unburnt carbon and ash from the wood. Heat flow of unburnt carbon is about 20 % of total heat flow. This will burn in lime kiln.
- Cold carbon monoxide is heavier than air and won't self ignite.
- Gasifier and biomass dryer are ATEX classified areas.

Energy balance of gasifier



These numbers are measured by VTT at Joutseno gasifier guarantee run. Measuring time for balance was 24 h.

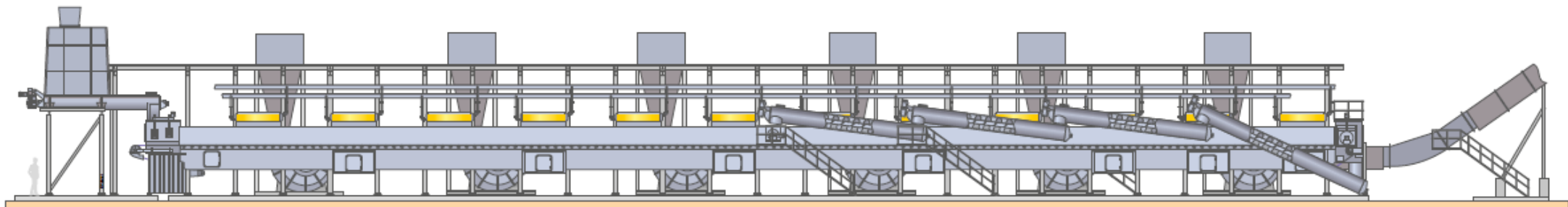
Burning the product gas

- Flue gas flow is bigger compared to fossil fuels
- Fuels can be mixed, and gasifier can be off-line when kiln is operating
- Burner can be operated 100 % product gas without support fuel.
- Fuels can be switched when kiln is operating.
- Kiln control parameters are residual oxygen in flue gases and residual carbonate in burnt lime. (same as with-out product gas)



Biomass dryer

- Wood bark comes from own wood yard where it's pressed to 40 % dry solid and crushed to particle size P-45.
- Dryer is wire type and drying air is heated by secondary heat and/or steam.
- Moisture level of dry bark is 5-7 %.
- Valmet dryer circulates dry-end biomass and Andritz dryer circulates dry-end exhaust air.



Joutseno process

Joutseno process

	Description	Design capacity
Fuel intake	<ul style="list-style-type: none"> Belt conveyer with magnet Disc screen (scalper) for over sized particles. 	Design fuel flow 504 t/d
Bark dryer	<ul style="list-style-type: none"> Single-line wire dryer In-direct air heating through glycol circuit 	Evaporation rate 12 t/h
CFB gasifier	<ul style="list-style-type: none"> Brick lined CFB gasifier which operating temperature is 750 – 850 °C. Bed material is limestone. Primary air is taken from kiln sector cooler. Start-up fuel is natural gas. NO₂ purge for back-fire control. 	Product gas power 48 MW
Burner	<ul style="list-style-type: none"> Fuels: product gas, natural gas and methanol. Option for light oil. 	Burner power 48 MW

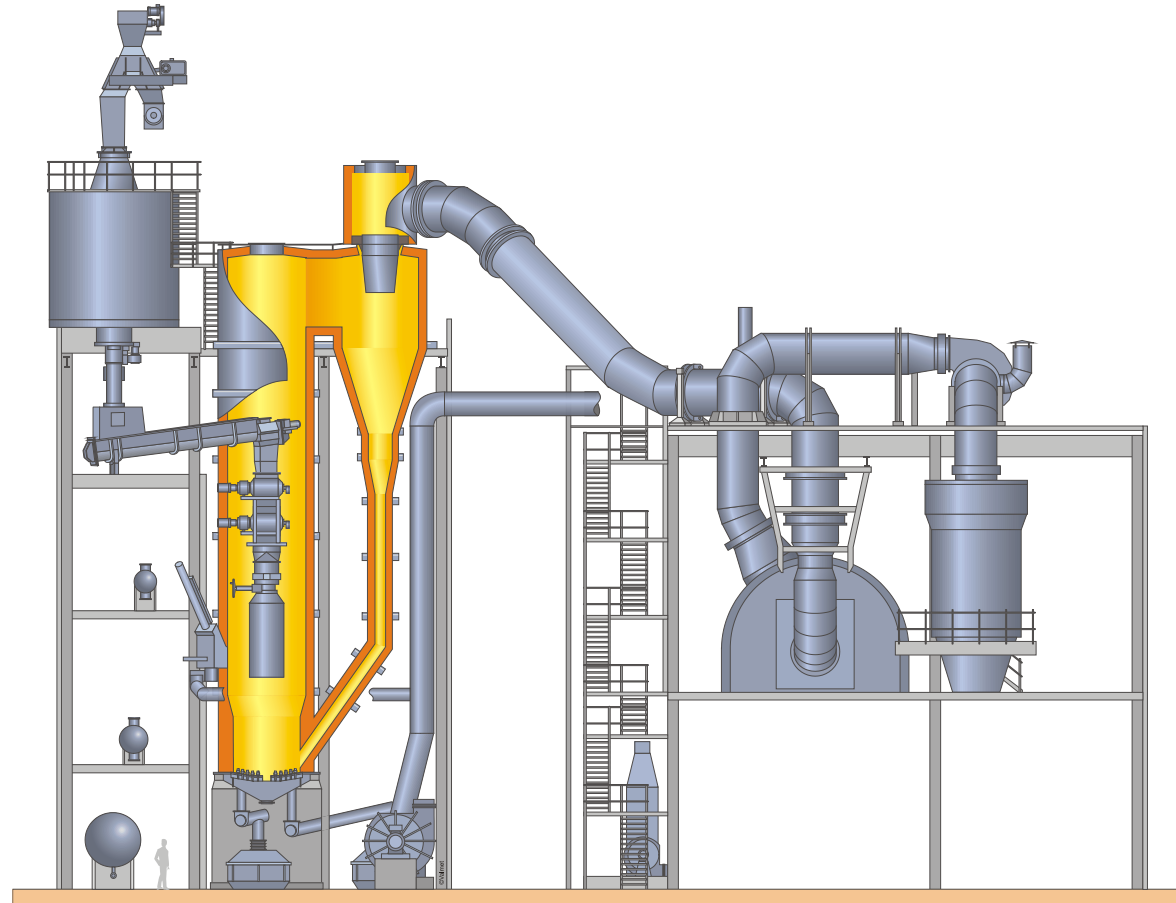


Äänekoski process

Biomass CFB gasifier

Metsä Fibre Oy
Äänekoski Bioproduct Mill
Finland

Product gas 87MW_{th}
Application Lime kiln
Fuels: Birch, pine
and spruce
bark
Start-up 2017

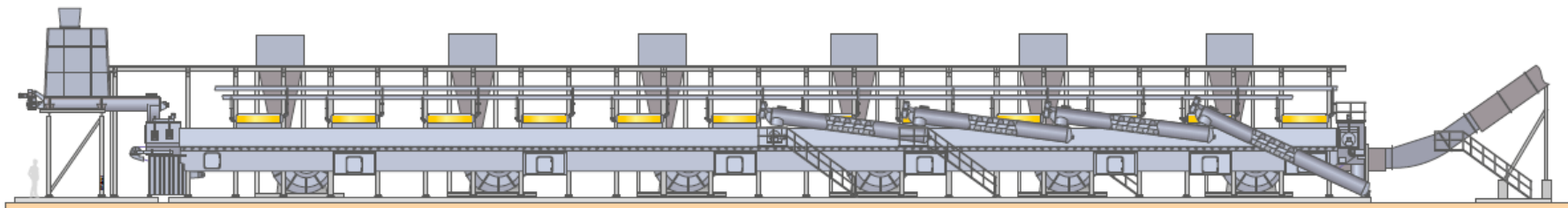


Biomass dryer

Belt dryer technology

Metsä Fibre Oy Äänekoski Bioproduct Mill Finland

Evaporation capacity	23 700 kg/h
Application	Lime kiln gasifier
Materials:	Birch, pine and spruce bark
Moisture in	62%
out	8 %
Start-up	2017



Experience of bark gasification

Lime kiln CO2 emissions in 2020, t/a

Lime kiln emissions (tCO2/a):	Joutseno	Äänekoski	Kemi	Rauma	Summary
Heavy fuel oil	0	0	58082	62671	120752
Naturalgas	8796	0	0	0	8796
Summary	8796	0	58082	62671	129548

- Lime kiln's primary fuel in Kemi and Rauma is heavy fuel oil
- Äänekoski lime kiln was totally fossil free in 2020

Lime kiln fuels in 2020, GWh/a

Lime kiln fuels (GWh/a):	Joutseno	Äänekoski	Kemi	Rauma	Summary
- Heavy fuel oil	0	0	203	217	420
- Natural Gas	44	0	0	0	44
- Methanol	0	0	17	0	17
- Product gas	219	387	0	0	606
- Pitch oil or tall oil	0	121	0	0	121
Summary	263	508	220	217	1207

- Product gas presents half of the Metsä Fibre's lime kiln fuel's
- Kemi mill will have product gas as fuel in future
- Rauma mill has a plan to use saw dust as primary fuel in the lime kiln