

Sidestream valorisation and novel products in papermaking

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REFFIBRE main aim

- Develop tools for ecodesigning resource-efficient paper & board production
 - Paper for recycling and “waste fractions” as main raw materials
 - Paper & board as main products, but also
 - Novel biobased by-products (Multiple Output mill concept)

Evolution of the paper mill: Yesterday

Paper mill

- Limited raw materials (Wood: cellulose or paper for recycling)
- Paper as the only product
- Maximising production, minimising waste
- External waste management: expensive! (landfilling, incineration)

Motto: Pay attention only to the fraction of the raw material that is useful for the only product

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Evolution of the paper mill: Today

Paper mill



Paper mill + Valorisation of sidestreams

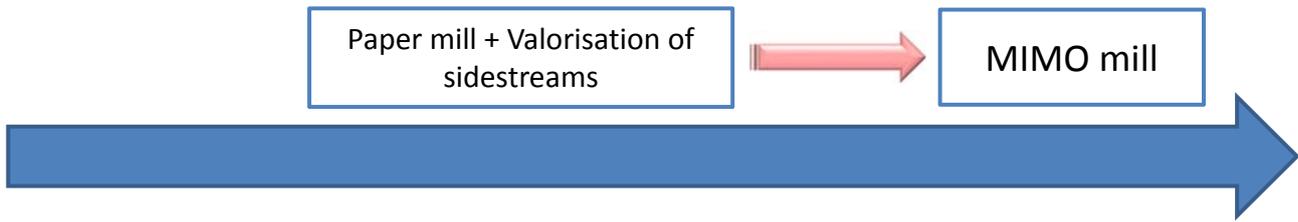
- Several new raw materials added
- Sidestreams get a value (although frequently only less „negative“ or 0)
- New markets and value chains come into existence

Motto: Give a value to sidestreams (mostly non-fibre fraction of the raw material)

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Evolution of the paper mill: Tomorrow



- Transition from *sidestreams* to on-spec produced *sideproducts*
- Reconfiguration of processes so as to fully valorise (new) raw materials in new, additional products

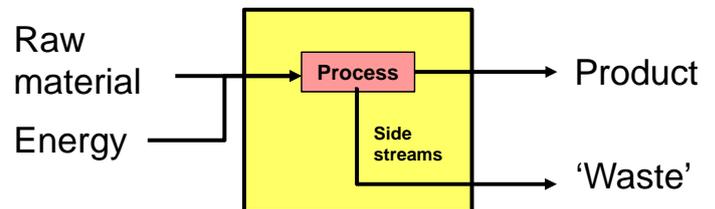
Motto: Everything out of the inputs (incl. wood cellulose and paper for recycling) is converted into a variety of products (incl. paper & board)

(R)Evolution of sidestreams

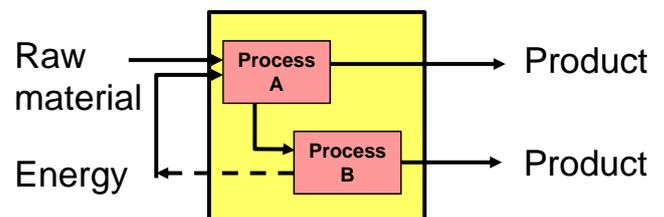
Next steps:

- Extraction of valuable components out of process streams and/or sidestreams
- Adjustment of primary process: producing sidestreams or – products on-spec
- Not thinking from our point of view, but from that of the end user

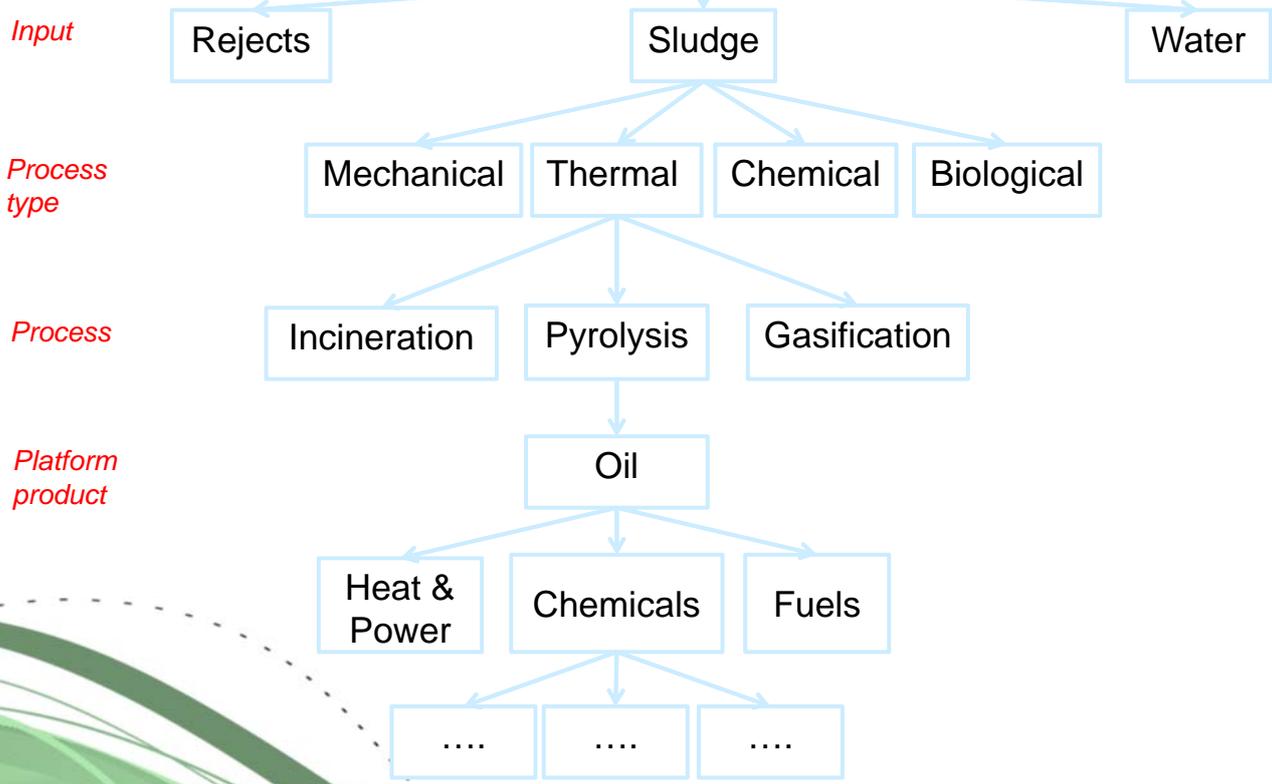
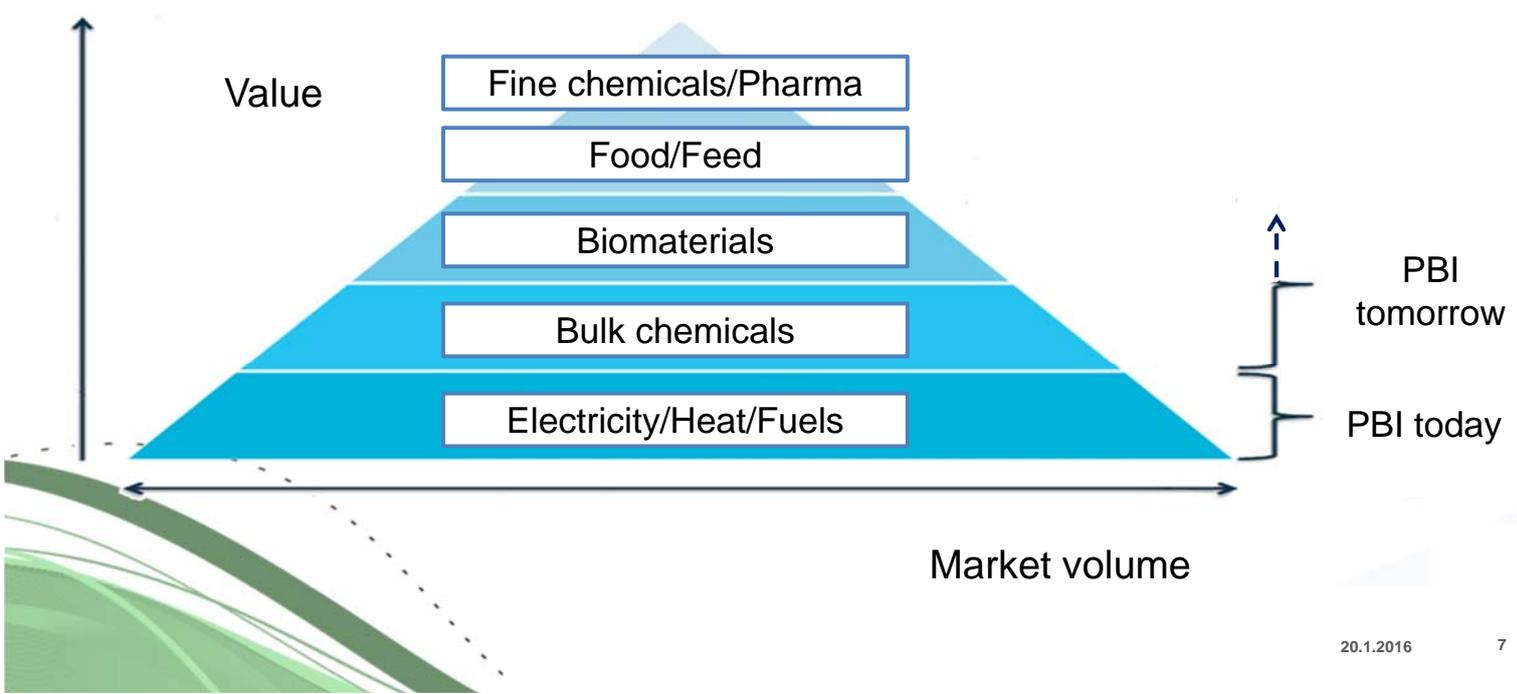
Yesterday



Tomorrow



Volume vs. Value



Route	Status
Lactic acid production	Removed (low TRL)
Bio-aromatics production	Removed (low TRL)
Pyrolysis	To shortlist
Sugars production	Removed (low TRL)
Levulinic acid production	Removed (low TRL)
Nanocrystalline cellulose (NCC) production	Removed (uncertain economic potential)
Bioplastics production	Removed (low TRL)
Absorbing material production	Removed after shortlist (uncertain economic potential, high TRL)
Wood Plastic Composites production	To shortlist
Fatty acids production	Removed (low TRL)
Gasification	Removed after shortlist (uncertain economic potential)
Secondary fuel production	Removed (high TRL)
Green gas production	Removed (uncertain economic potential)
Additives for plastics	Removed (low TRL)
Biogas production	Removed (high TRL)
Animal bedding production	Removed after shortlist (low economic potential)
Wood-based panels	To shortlist
Hydrothermal carbonisation	Removed (low TRL)
Isolation material production	(To shortlist)

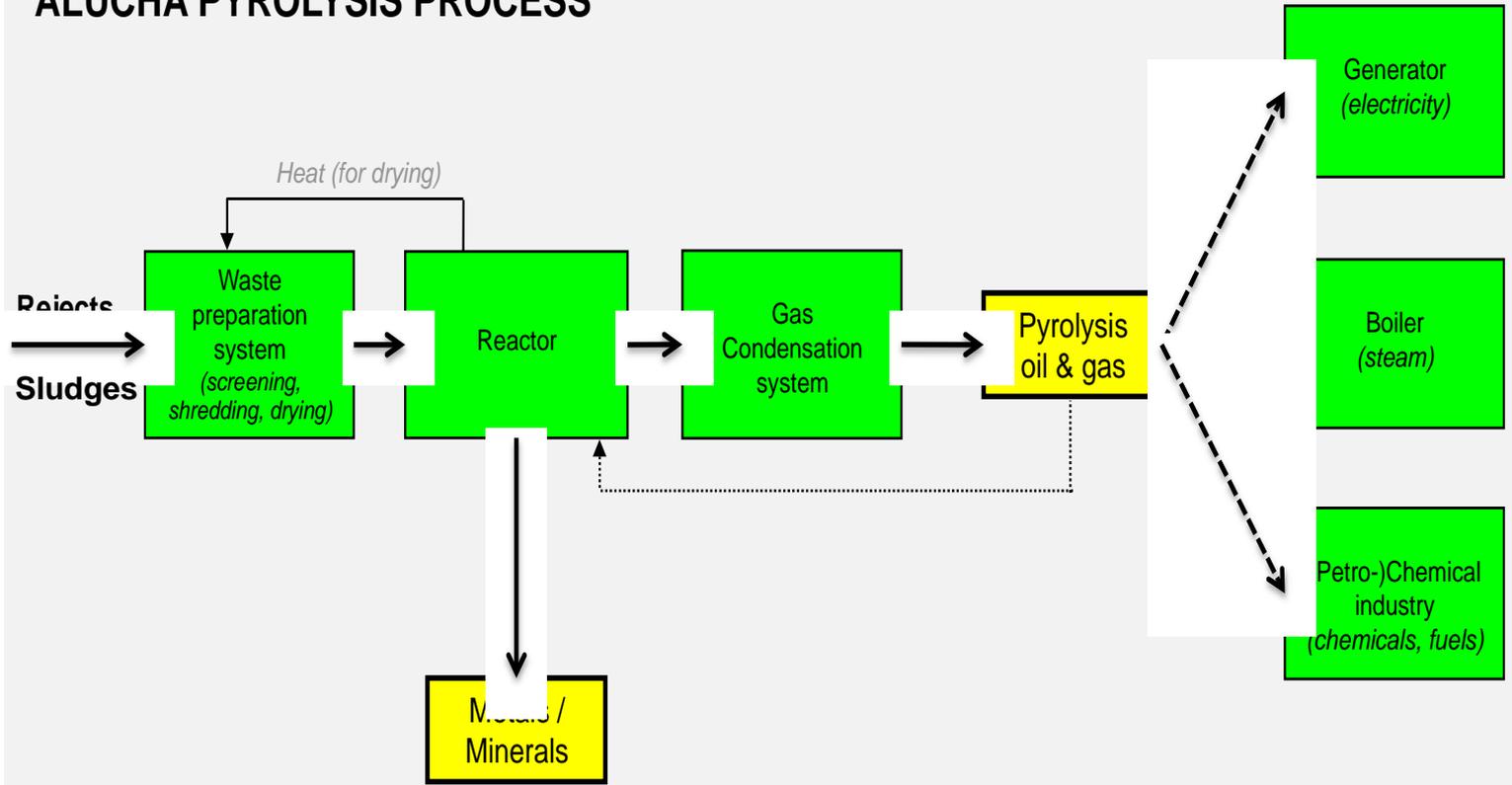
Pyrolysis

- Thermal treatment of organic matter in the absence of oxygen



- Various types primarily on the basis of residence time and temperature -> influence on products' ratio

ALUCHA PYROLYSIS PROCESS



Pyrolysis

- Benefits for a paper mill:
 - Avoided sidestream disposal costs (sludges/rejects)
 - Revenues from pyrolysis products
 - Sold to 3rd parties
 - Avoided energy costs (internal steam/electricity generation)
 - Revenues from reclaimed materials
 - Metals
 - Fillers (sold to 3rd parties or internal reuse)

Indicative case

1,500 kg/h dry sludge



>1 M€ in revenues/avoided costs

Ca. 1-1.5 M€ investment in pyrolysis unit

+

Sludge dryer

Wood Plastic Composites

- Wood fibre + thermoplastic material (PE/PP/PVC/...)
 - Also recycled plastics
- Main production processes: extrusion or injection moulding
- Growing production: 220 kt (2010) -> 350 kt (2015) in Europe



- But what can we make with them?



Wood Plastic Composites

- Economic potential of this route:
 - What kind of end product?
 - How high sidestream content?
 - Drying of sidestreams?
- End application: not only strength important!
 - Colour
 - Odour
 - Adherence to regulations (e.g. volatile compounds)
- Close cooperation with market parties required so as to identify the right applications

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Building materials

- Various applications for paper industry sidestreams could exist within the building sector
- An example: gypsum fibreboard
 - Fire-resistant
 - Humidity-resistant
 - Soundproofing
- Now: use of pre-consumption paper waste
- Opportunity: Paper sidestreams in the raw material mix



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Building materials

- Not open to all types of sidestream!
 - Moisture
 - Ash
 - Heavy metals
 - Formaldehyde
 - ...

- When the quality is right, several tens €/tonne sidestream in income for the paper mill



So, in the end...



"This really is an innovative approach, but I'm afraid we can't consider it. It's never been done before."

or



Waste does not exist.

Acknowledgement

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