



3rd Iberoamerican Congress
4th Latin American Congress
2nd International Symposium on Lignocellulosic Materials
Biorefineries
Science, Technology and Innovation for the Bioeconomy
November 23 to 25, 2015, Concepción-Chile

» FIBRES AND
COMPOSITES

» PACKAGING AND
CONFORMITY

» PRINT AND
FUNCTIONAL SURFACES

» INDUSTRY 4.0

» MATERIAL TESTING
AND ANALYTICS

Between two stools: the paper industry in a change

Frank Miletzky
Papiertechnische Stiftung (PTS), Germany

Papiertechnische Stiftung

Fibre-based solutions for boosting innovations



Founders

- VDP – German Pulp and Paper Association
- HPV – German Employers' Association of the Paper, Board and Plastics Converting Industry
- FPT – Paper Technology Research Association

Facts

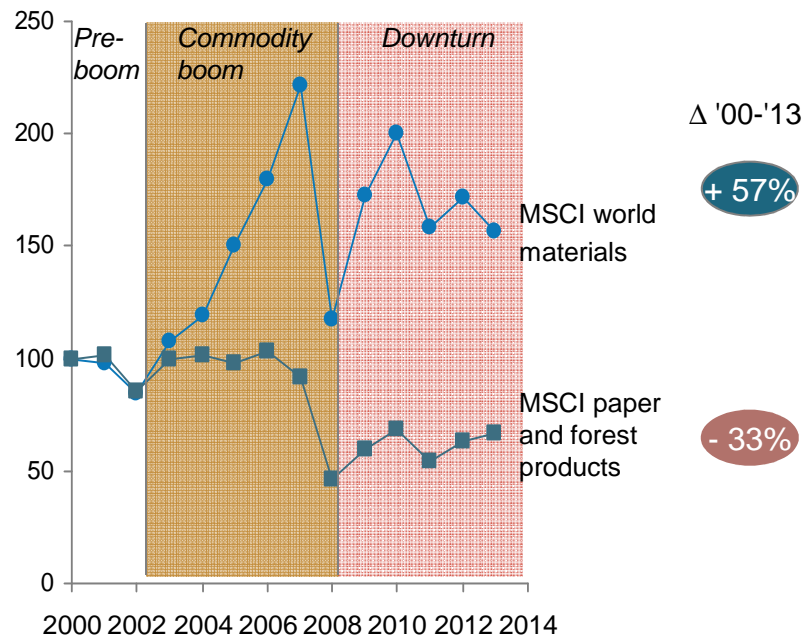
- Founded in 1951
- 120 employees
- Munich and Dresden
- Independent and neutral

Paper world is getting dark...



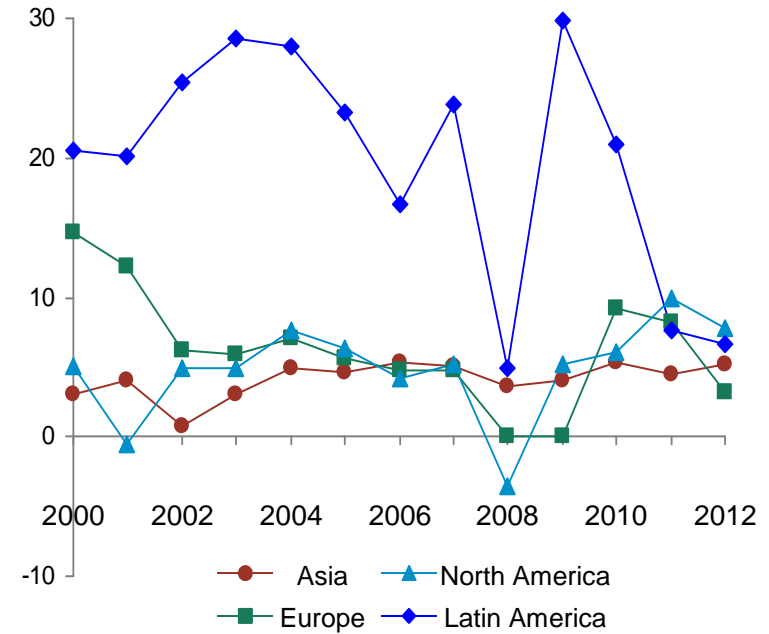
Declining share prices ...

Share price index (2000 = 100)



... and declining margins

EBIT margin (in %)



Source: Thomson Reuters Datastream; BCG analysis
 Courtesy of R. Haslehner (Boston Consult Comp.)

... how is the paper sector challenging this?



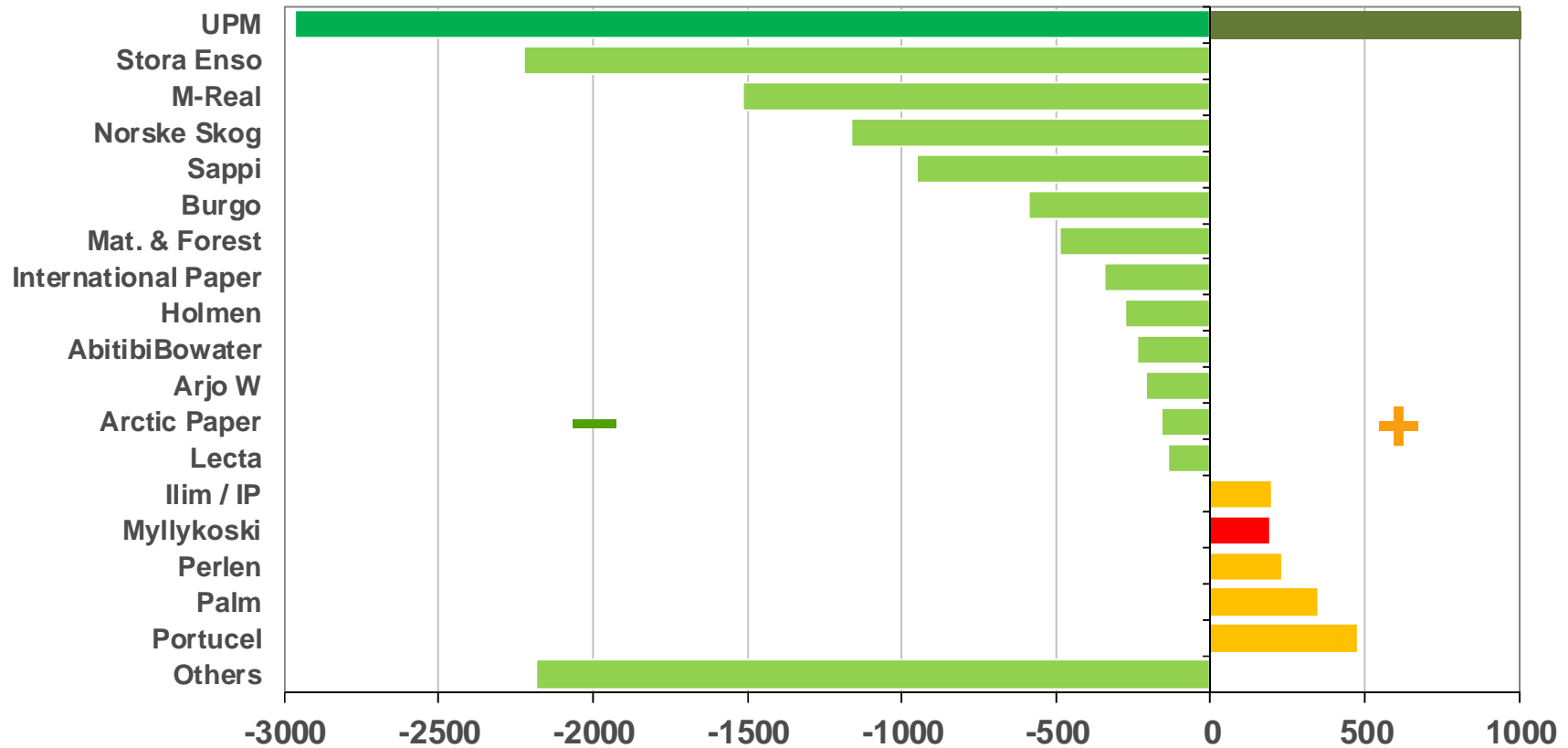
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The graphic paper market

Net capacity reduction by company

11.7 million tonnes (22%) in Europe in 2005–2013



Sources: Pöyry, UPM, public sources

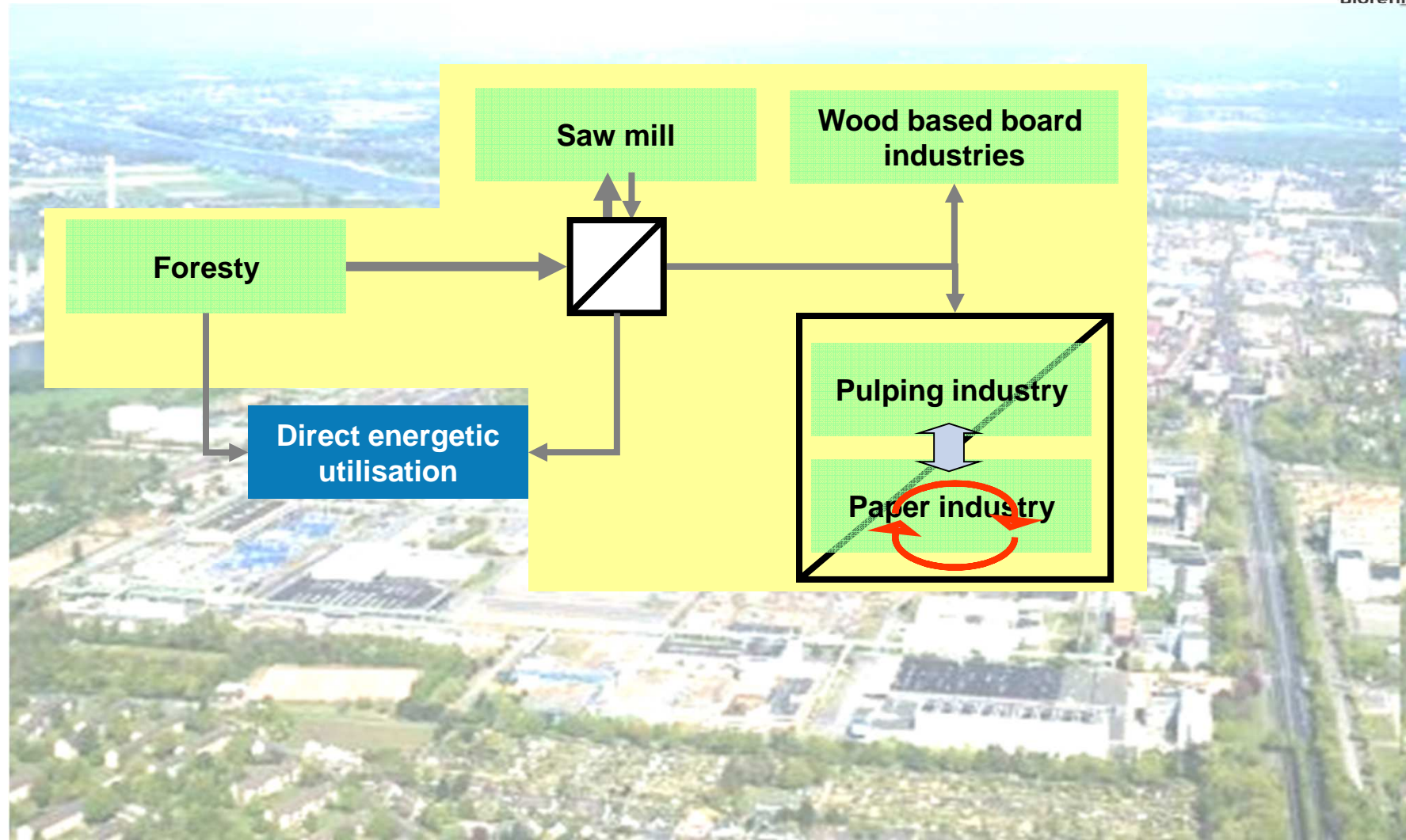
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... how is the paper sector challenging this?



- Global growth of P&B based packaging has been forecasted by appr. 7 % annually within next 10 years, acc. to different studies (Capital Mind, Catalyst Corp. Finance).
- Consequently new built (or rebuilt of former graphic) paper machines (e.g. Sappi Europe, Heinzl Group Austria, UPM/Leipa Germany,...) for packaging and specialty P&B

The traditional value chain



„Past time“ Biorefineries



Sulfite pulping

Bio-Ethanol from sulfite spent liquor

appr. 140 l/t Sulfite spirit, 95%ig

Yeast (Pekilo) from hardwood liquor

appr. 150 kg/t proteins

Lignin products with low or medium value (substitute of ...)

No significant platform chemicals (vanilline, phenols, ...)

Sulfate pulping

Better utilization of hemicelluloses by improved pulping kinetics; remaining on the fibres (mainly Xylane)

Thermal liquor recovery (pulping chemicals)

Tall oil

30 ... 50 kg/t crude oil

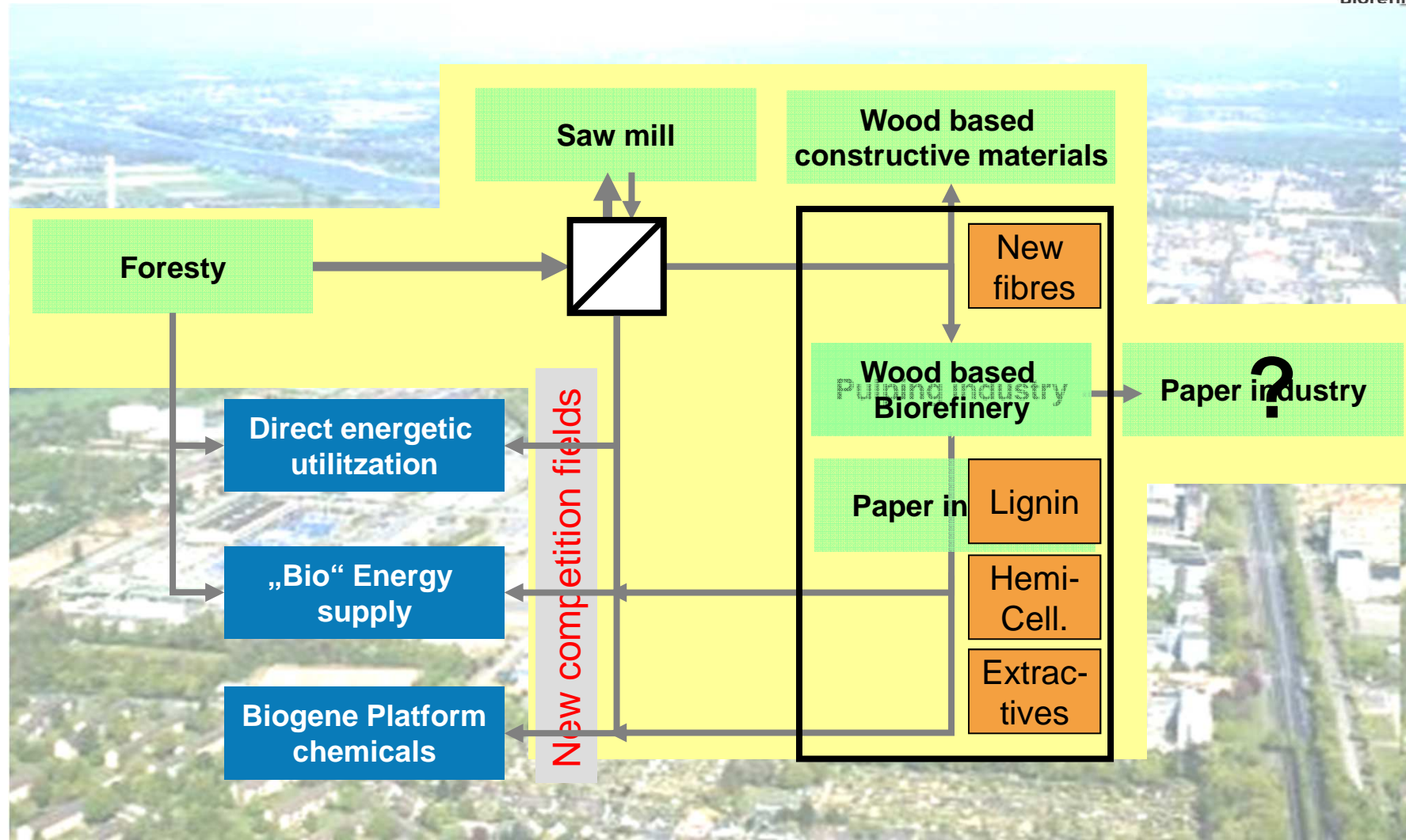
Turpentine

3 ... 6 kg/t crude material



Target products were chemical pulp and self-sufficiency

The changing wood based value chain



10.12.2015



Biorefineries
An International Congress
on Biorefining
2015, Copenhagen, Denmark

Biorefineries appear to be moving from the “sulfite state” to sulphate

So far – sulfite mills

Borregaard, Norway Borregaard

- World’s largest producer of lignosulphonates
- Ethanol production
- Vanillin and other specialty chemicals

Tembec

- Large producer of resins and lignosulphonates, primarily in Temiscaming, QC, mill

Domsjö Fabriker, Sweden

- Transformed pulp mill into bio-refinery, producing ethanol and lignin products aside from dissolving pulp main stream

Lenzing, Austria

- New “sCore TEN” strategy: producing 50% DWP for high end appl. by 2020, but also extracts C5s (xylose) and other chemicals Furfural, acetic acid, sodium sulphonate

Next wave?

Metsä Fibre, Finland MetsäFibre

- Building new Äänekoski mill as bio-factory
- Main product still paper pulp but maximizing extraction of by-streams and adding lignin products, bio-chemicals, and bio-energy products like methanol, ethanol, bio-oil

Stora Enso, Finland

- Lignin extraction at Sunila (40 kt/y)

Fibria, Brazil

- 20% of revenues from other than pulp in 2025
- Working on biofuels (with Ensyn), lignin products, etc



... how is the paper sector challenging this?

UPM today



UPM BIOREFINING



pulp, plantations, biofuels, timber

UPM ENERGY



UPM RAFLATAC



UPM PAPER ASIA



UPM PAPER ENA



UPM PLYWOOD



2 | © UPM

TURNOVER €9.9 BILLION • PERSONNEL 20,000 • SHAREHOLDER



Source: UPM

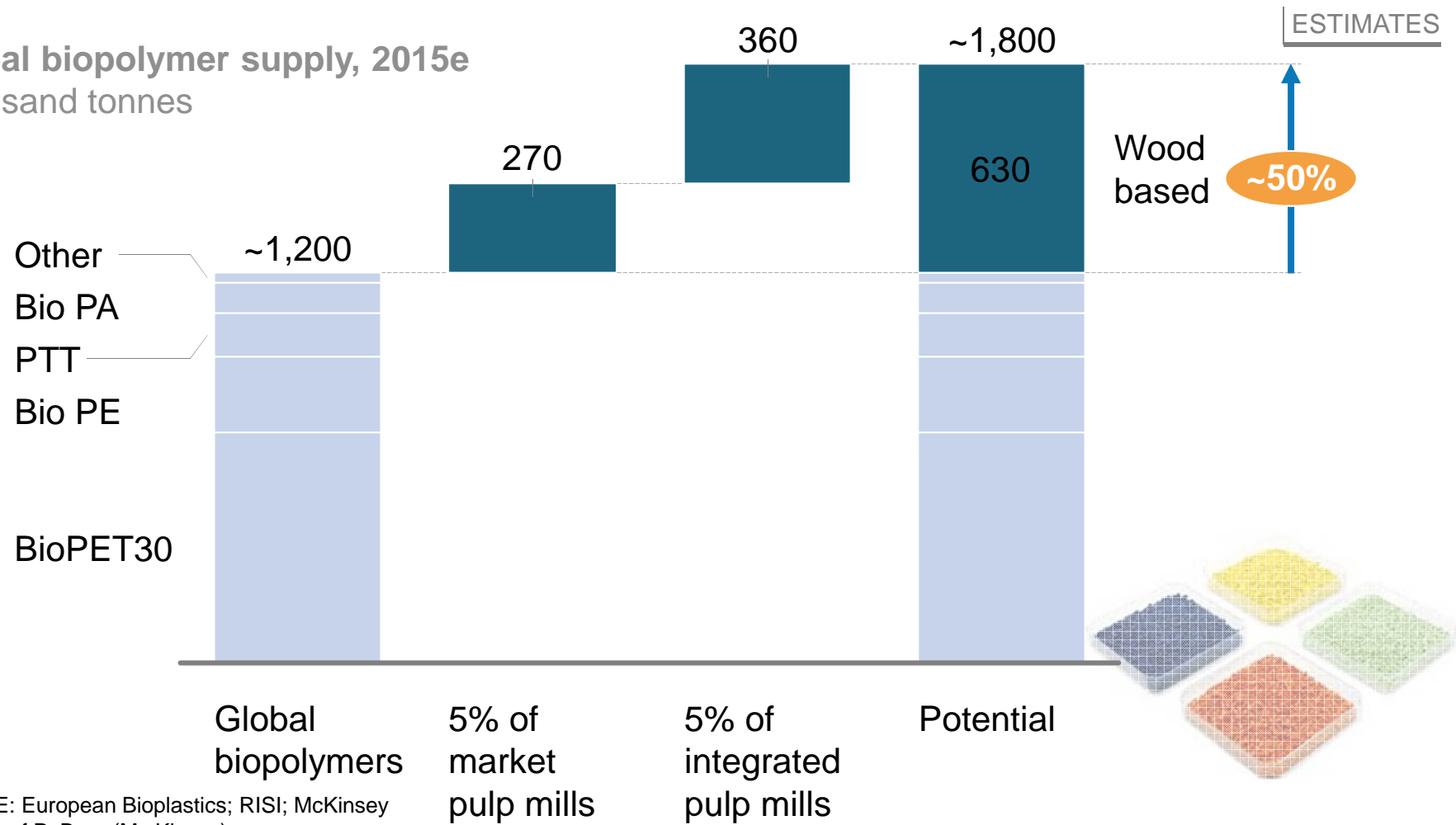
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Hypothetical example – if only 5% of pulp lines were to extract hemicellulose as sugar, could boost biopolymer supply by more than 50%

Global biopolymer supply, 2015e
Thousand tonnes



SOURCE: European Bioplastics; RISI; McKinsey
Courtesy of P. Berg (Mc Kinsey)

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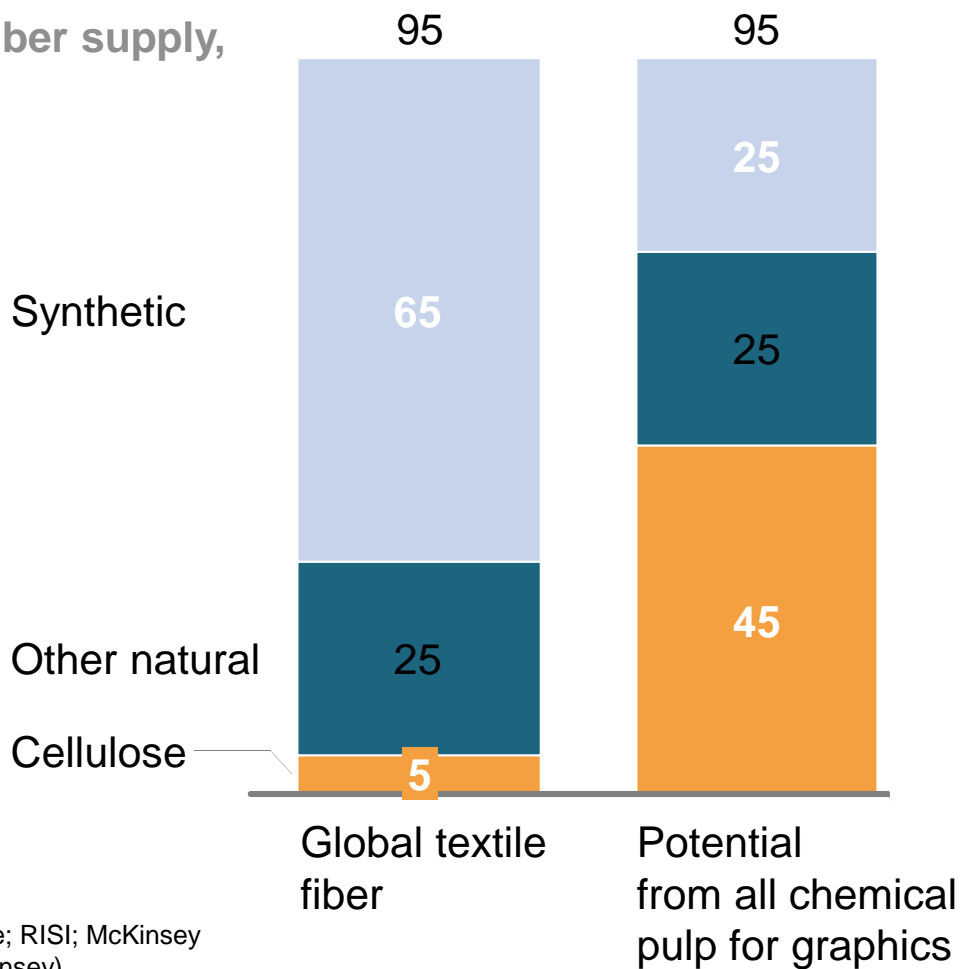


Hypothetical example

Cellulose-based textiles can significantly reduce the need for synthetic textiles

Global textile fiber supply, 2015e
Million tonnes

ESTIMATES



SOURCE: Oerlikon Textile; RISI; McKinsey
Courtesy of P. Berg (McKinsey)

The strategic approach of the paper sector in Europe

unfold the future

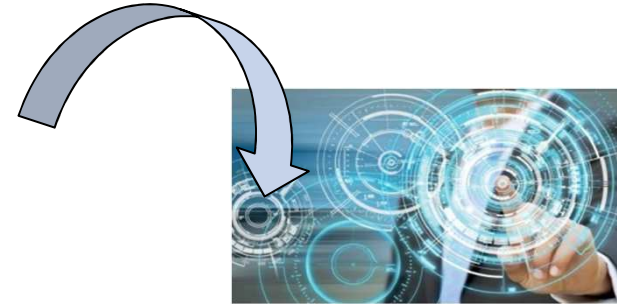
- 80 % fossile CO₂ emissions
 +50 % value creator



Contribution and effort of Paper industry sector for sustainable development

The CEPI TWO TEAM PROJECT

„Break Through“ technologies for significantly improved processes



FASER & PAPIER 2030
Nachwachsende Zukunft gestalten



Ideas for tomorrow's „Paper“ and other fibre based materials

Quellen: <http://image.slidesharecdn.com/roadmap2050-120702034623-phpapp02/95/drupa-2012-european-paper-day-road-map-2050-11-728.jpg?cb=1341201120>;
<http://www.paperindustryworld.com/files/2014/02/TheTwoTeamProject.jpg> ; http://www.papierverarbeitung.de/wpv-wAssets/img/Cover_Faser_Papier_2030.JPG ;
<http://unfoldthefuture.eu/images/download-thumb.jpg>

What about recycled fibre as part of renewable resource?



Global wood harvesting: 4 bn m³ p.y.

Appr. 50 % for industry use,
./ 40 % PPI

Est. 500 Mill t wood p.y.

Global recycled paper supply (all qualities)

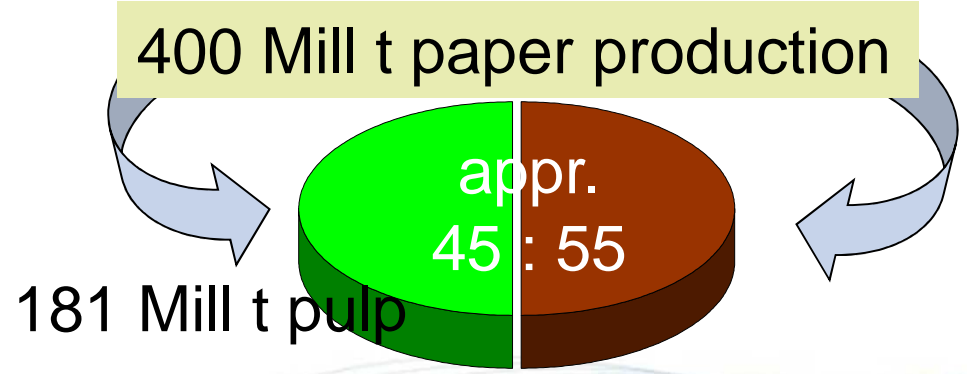
230 Mill t rec. paper p.y.

Wood supply is limited for further growth in traditional and new applications

Sustainable use of renewable resources means:

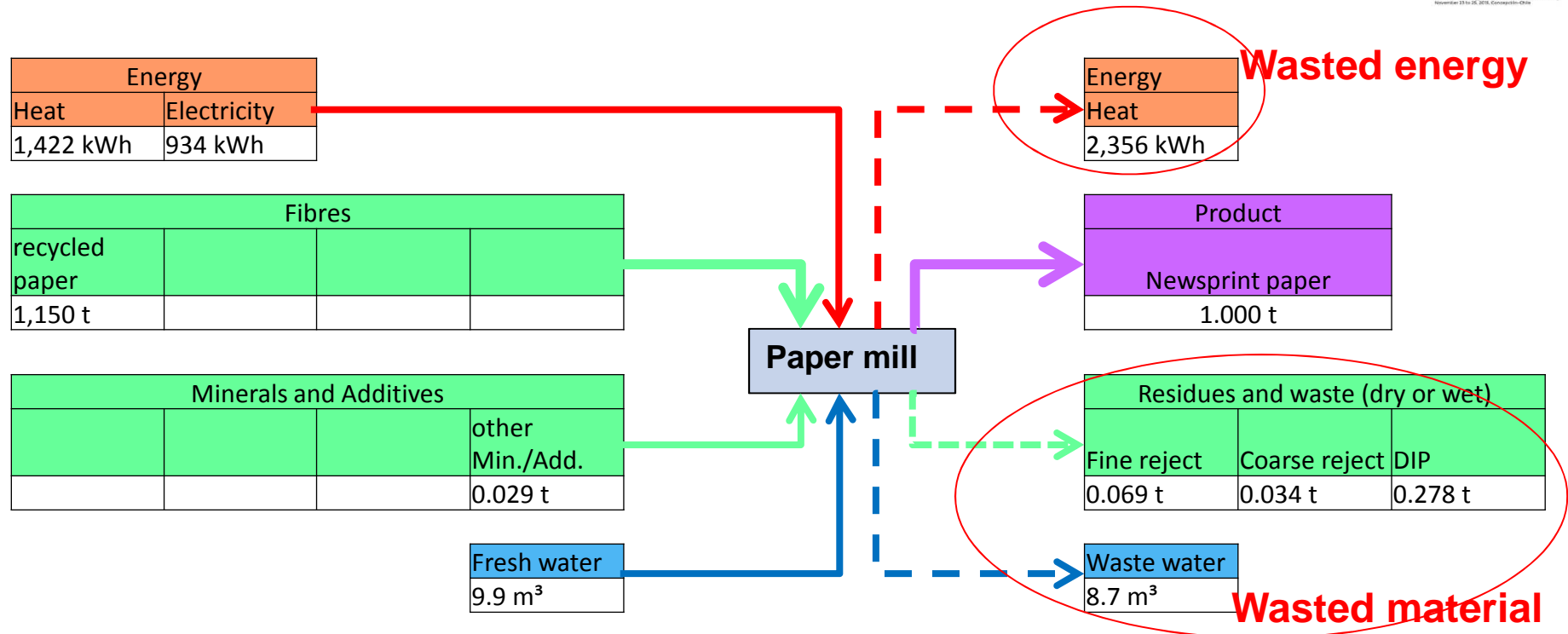
- Need for loss free reuse of consumed materials on highest level of both product quality and technology
- Clean circuits
- use of products as a temporary CO₂ capture

Sources: FAO statistics; VdP Report 2015





Mass & Energy Input/Output of a Newsprint paper mill



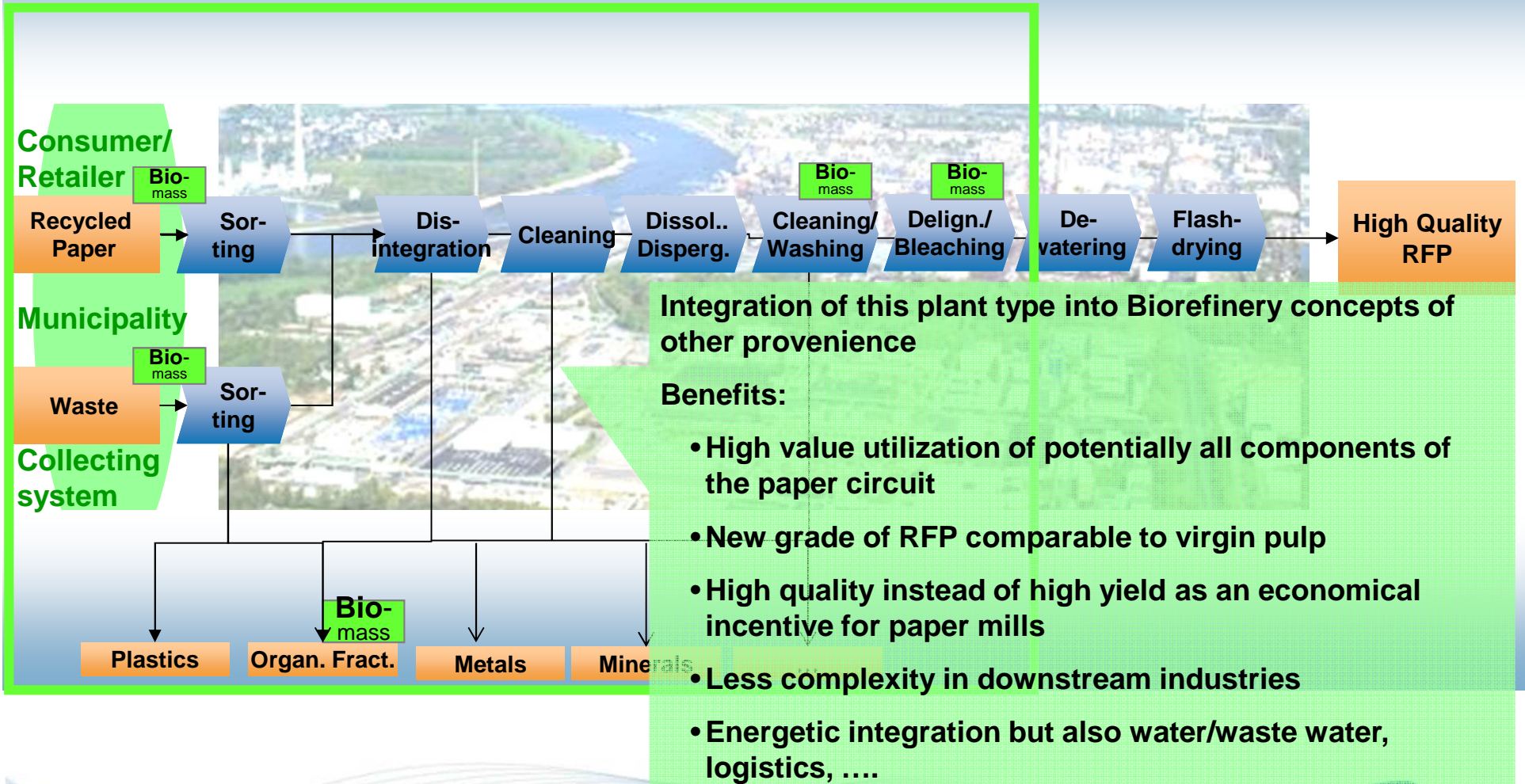
- From 7...9 theoretic cycles we are using approximately 2 statistically
- Wasting about 20 % of the input material plus wasting energy gives serious concern in terms of sustainability
- Revenue from commodity product Newsprint paper has to pay all cost for losses and treatment of residues (complexity is very high)



Urban refinery as a concept to get more value from circulating recycled paper



Integration of recycled paper into the concepts of Urban Refinery



The strategic approach of the paper sector in Europe

unfold the future

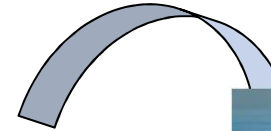
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<http://www.paperindustryworld.com/files/2014/02/TheTwoTeamProject.jpg> ; http://www.papierverarbeitung.de/wpv-wAssets/img/Cover_Faser_Papier_2030.JPG ;
<http://unfoldthefuture.eu/images/download-thumb.jpg>

Fields of activity acc. to the „Fibre&Paper 2030“ study



Cities & Architecture
(Noise & climate regulation in buildings, emergency shelter, new systems of building materials, integrated planting areas, Energy storage systems, ...)

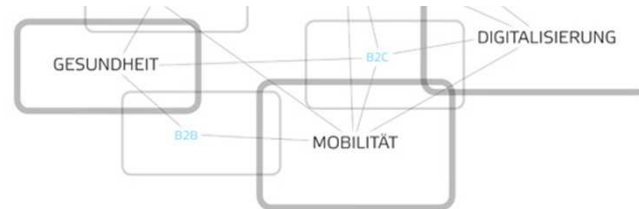
Living & Working
(modulare and adaptive room elements, smart wall coverage, ambiente lightning, ...)



Doing the thinkable, not thinking the doable!



Heat care & Hygiene
(Filters, smart wound treatment, Implants, Prothesis, ...)



Mobility
(fibre based lightweight construction , fire resistant materials, ...)



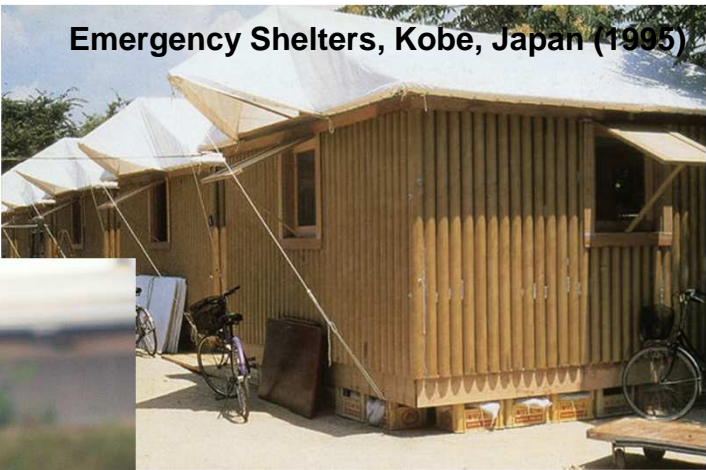
Nutrition
(modular green houses, Substrates for planting in urban environment, ...)



Paper for construction? It works!



Bridge over Gardon River, France (2007)



Emergency Shelters, Kobe, Japan (1995)



Pictures: Shigeru Ban



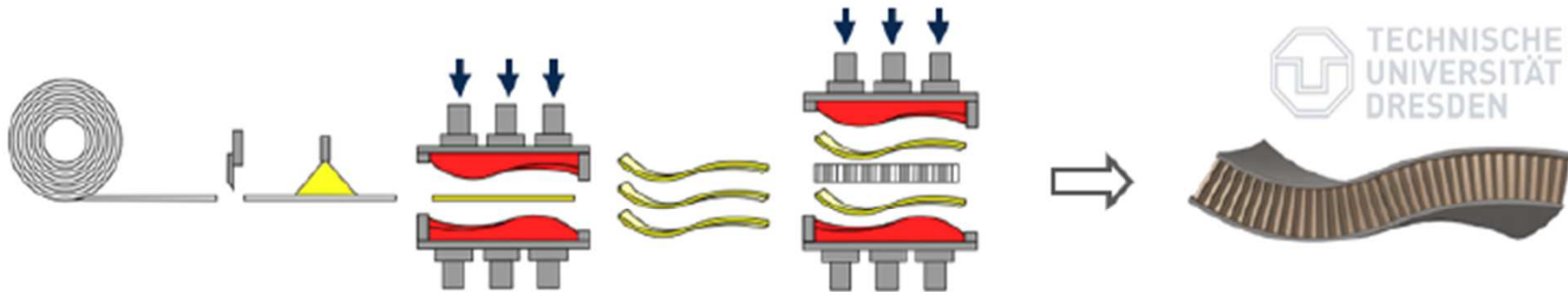
Cathedral, Christchurch, New Zealand (2013)



Emergency Shelters, Byumba Refugee Camp, Rwanda (1999)

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Expansible honeycombs or foldcores for furniture, automotive or aircraft applications



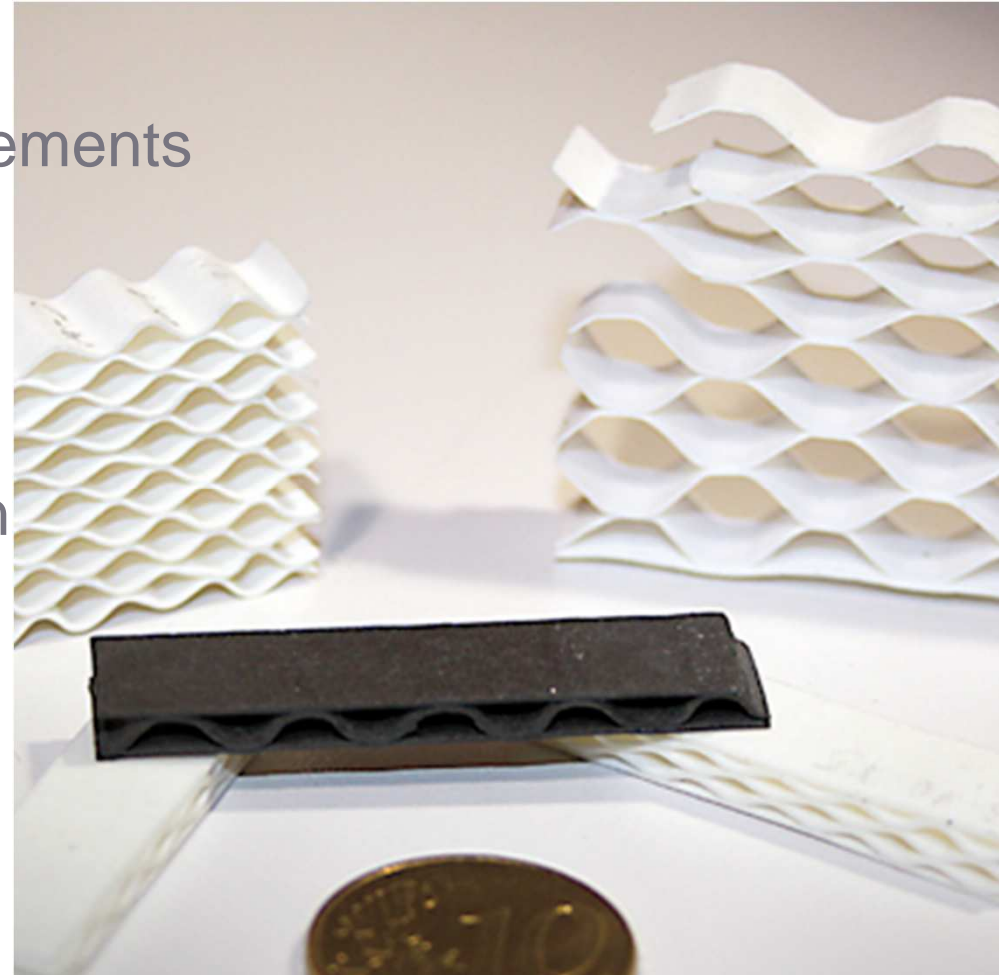
Source: Britzke et al. (2011) TU Dresden, Foldcore GmbH

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Paper technology platform for new types of materials

Ceramic papers

- Lightweight construction elements
- Filters and membranes
- Nozzles and evaporators
- Catalytic converters
- High temperature insulation



In cooperation with



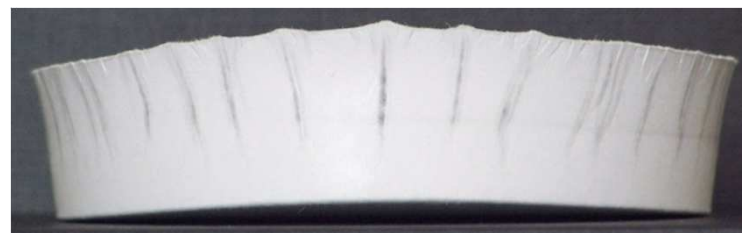
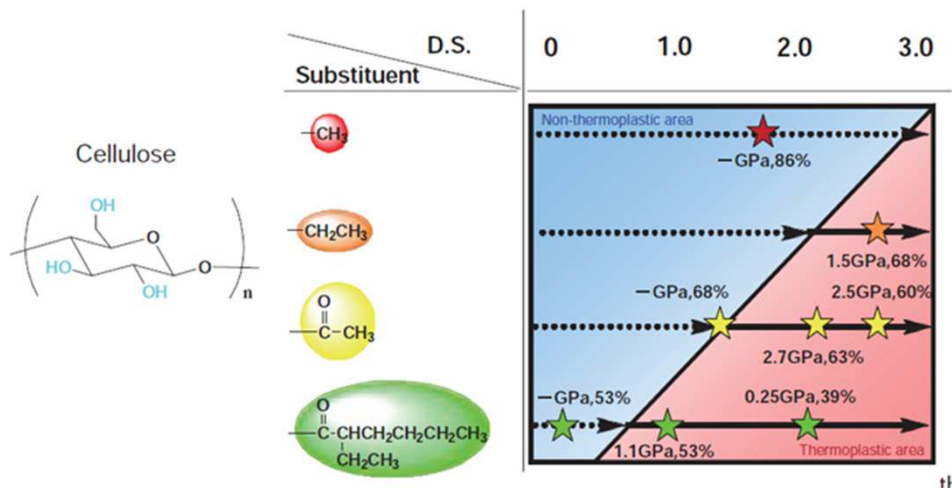
Funded by



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Source: PTS

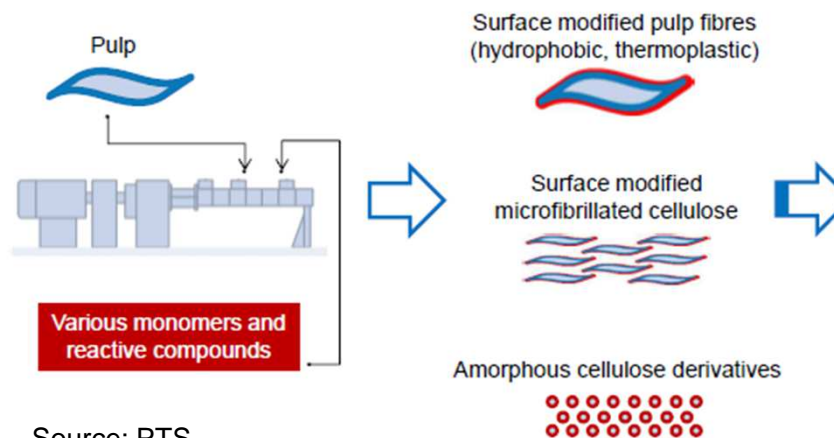
Deep drawing of paper



Reactive extrusion processing

New markets / products

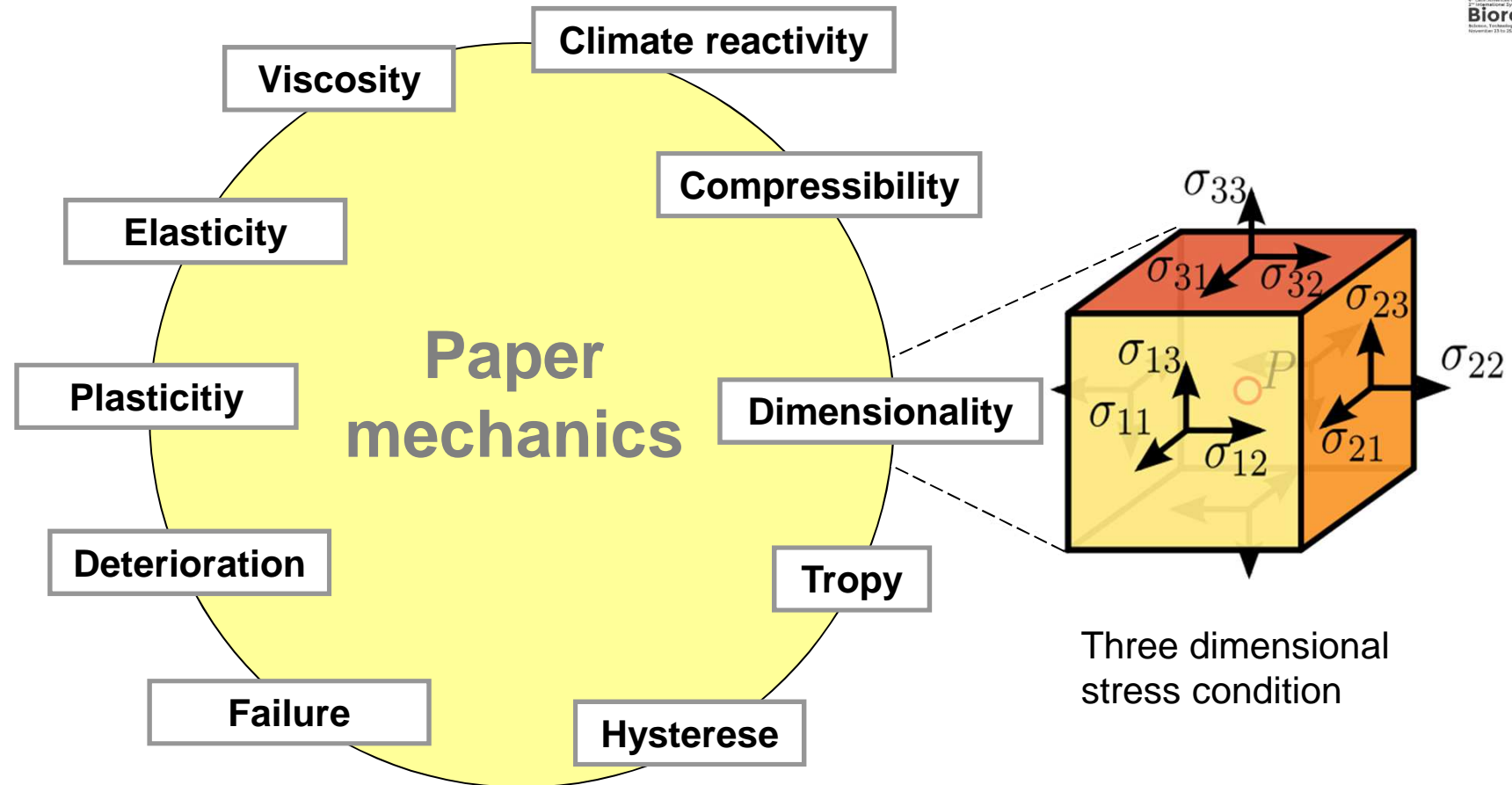
Source: Sawai et al. (2012), Development of New Cellulose-based Polymers with Excellent Melt-processability



- Thermoplastic paper based products
- Reinforcement in composites / Light weight construction
- Masterbatches
- Injection moulding

Source: PTS

What really do we know about paper mechanics?



Comprehensive classification of materials following continuum mechanics

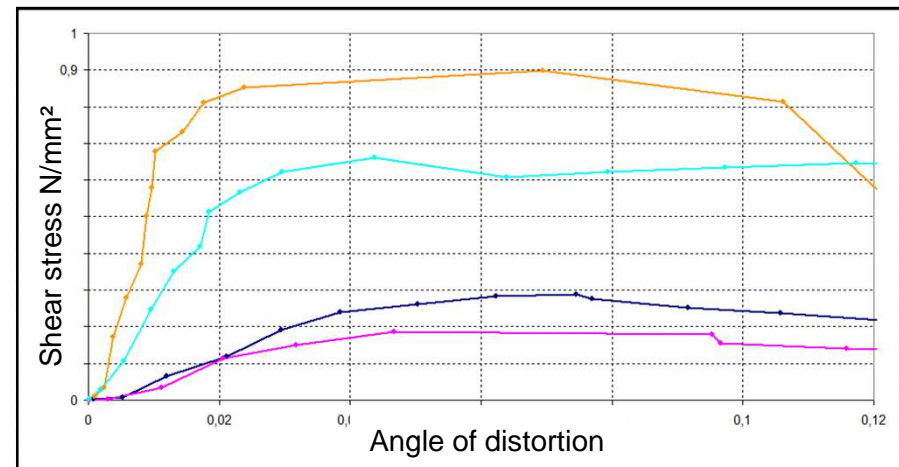
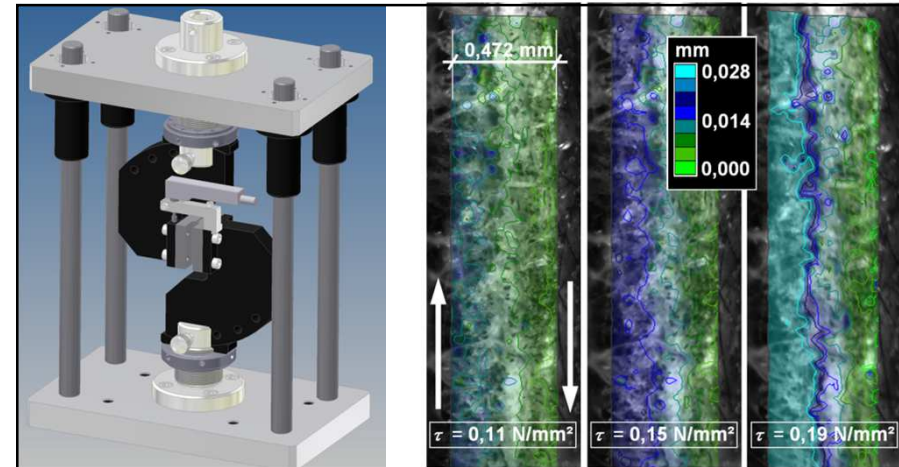
Material testing: shear resistance out-of-plane

Test rig in a standard tensile test machine in combination with optical deformation analysis

Sample 15x43 mm², thickness 0,2 to 2,2 mm; fixation using viscous two-component adhesive

Results Optically identified areas of displacement and expansion over thickness of the sample
Shear stress diagrammes (out-of-plane)
Elastic shear modulus and plastic shear tangent moduli
Shear strength and location of failure

Application High-grammage paper, fold box board, adhesive joints



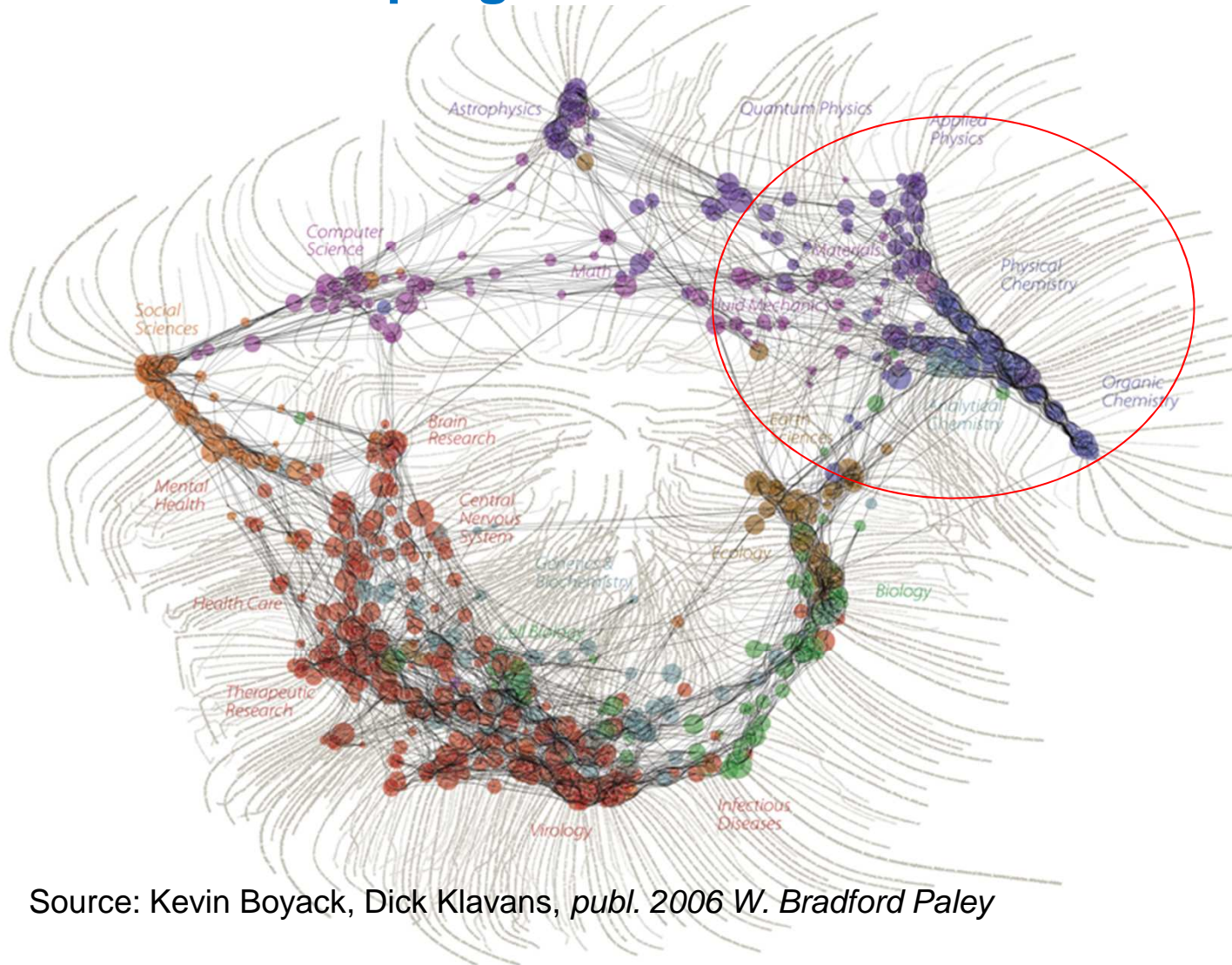
Source: PTS

Bridging the Gap: Value creation!





Intersectoral networks dominate technological and scientific progress



Material science as intersection of Mathematics, applied Physics, phys. and organic Chemistry, fluid Mechanics and Analytics

Source: Kevin Boyack, Dick Klavans, *publ. 2006 W. Bradford Paley*

Paper yesterday, today... and tomorrow!



Be part of it!
 It pays off.



PTSPaper
 efimeries
 2015, Conceptin-Orla



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10.12.2015