



# ***FIBRES & PAPER 2030***

*Shaping a sustainable future*





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# Perpetuating the success story of paper

*The paper market is in transition. Which future business areas and market demands are already visible today for fibre-based materials?*

Looking far ahead is of crucial importance if our sector wants to continue the success story of paper materials. First examples of innovative applications are paper-based building materials, actuators for robotic systems or lightweight construction materials for cars and aeroplanes. It will take a lot of further research to establish them in industry – but they offer enormous chances to the entire paper sector. In a future global bio-economy, the demand for sustainable, bio-based economic concepts will grow steadily, and it is hard to imagine such concepts without fibre-based materials. In January 2014, “Fibres & Paper 2030” was launched as a joint future project aimed at identifying concrete options and courses of action for companies in the paper sector. The fifteen-month project was a journey through time supported by the German Pulp and Paper Association, the Association of Paper Converting and Plastics Processing Industries, the Paper Technology Research Association and the Cluster Paper & Fibres as partner.

Our special thanks go to the core project team of managers and senior executives from the paper chain. In numerous intense, very open discussions, they identified fields of action that are expected to offer the companies of our sector business opportunities with high added value in attractive future markets. By means of these results and together with competent partners, the companies will be able to develop new ideas and business concepts for innovative, previously unthinkable applications of fibre-based materials.

Based on a preview of the year 2050, representatives of various sectors, trade associations and academic institutes “looked back” on the period from 2014 to 2030 to develop conceptual premises for eight topical areas expected to be relevant to paper. The premises will be described in detail in the brochure. In six regional brainstorming workshops, project participants developed more than 1000 ideas for future demands and evaluated them in terms of market potential and expected time to market. The results can be found in this brochure and on the project website [www.fibre-paper-2030.com](http://www.fibre-paper-2030.com) – they are also meant as an invitation to work together for our sector’s future. Our world is full of challenges, but offers numerous chances as well. Pointing the right way ahead is therefore a key prerequisite for safeguarding the sector’s future growth and responsible use of resources. Paper is a bio-based material made from renewable resources that will certainly find its place also in tomorrow’s world.



**Professor Dr. Frank Miletzky,**  
Papiertechnische Stiftung (PTS),  
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# RETROPOLATION: LOOKING 35 YEARS AHEAD AND THEN BACK TO FIND NEW IDEAS

Aim of the Fibres & Paper 2030 project was to look ahead in the future of paper and its value chain. Over a period of 15 months, representatives of trade associations and companies worked together to describe future markets and business opportunities for the year 2030. The main challenge was to do this in such a way that it produces practically useful findings and results for course-setting strategic decisions and new, attractive business options. Is this still creative thinking – or already pure fantasy?

Neither, says “travel guide” Thomas Strobel, who acted as chairman and methodological adviser for the project of Papiertechnische Stiftung (PTS). From the vast experience he has gained in numerous previous projects and business planning activities, he knows that a virtual “journey through time” can be a good starting point for open-minded people to “realistically anticipate the future”. It enables them to intensely discuss all data and possible effects to develop a “gut feeling” about what could happen in future. Instead of looking at numerous separate, rapidly changing and often mutually interacting trends, the team members will identify main elements of a realistic future scenario as basis for further discussions and the systematic exchange of thoughts and ideas.

The basic idea is providing entrepreneurs with enough feasible options for the future. Strobel compares this with defensive driving, which has proved to be the best way of getting smoothly through even the heaviest traffic.

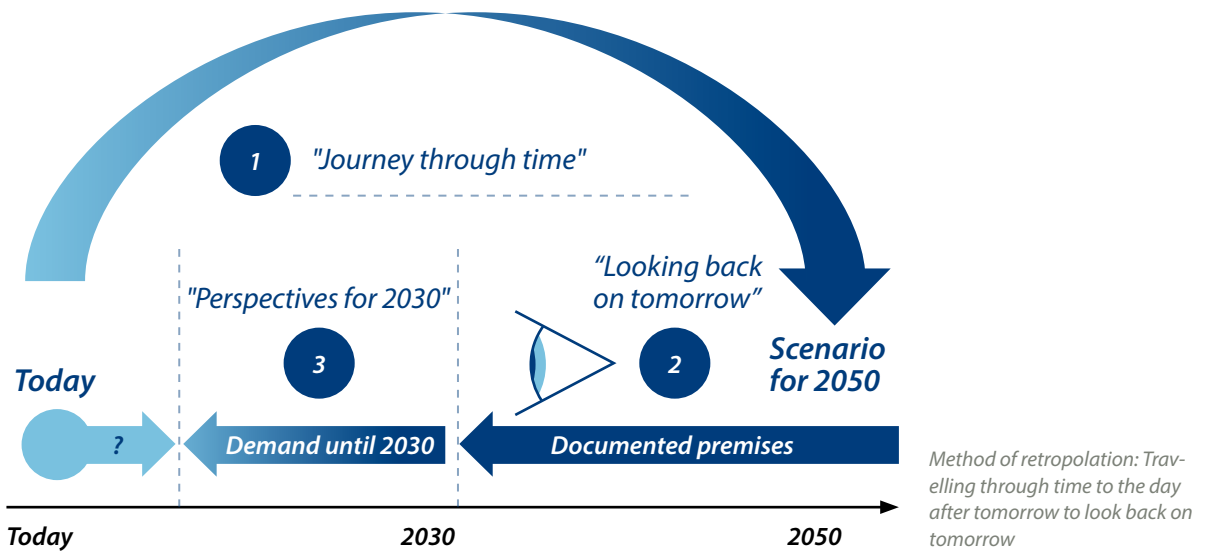
Looking between five and 500 metres ahead makes it possible to avoid nasty surprises and drive smoothly, which feels as comfortable to passengers as to the employees of a foresightedly acting company.



*Thinking in topical areas broadens the view to identify future demands*



*Interdisciplinary exchange leads to ideas for new applications*



Pursuing the method of “retropolation”, the project team started with a journey to the year 2050 to develop ideas about the future. *(Step 1 in the diagram)*

They collected and evaluated lots of information about the period to define assumptions describing important characteristics of a realistic scenario for 2050. Eight topics were identified as being most relevant in this context: nutrition, health & hygiene, mobility, information/communication/education/knowledge, logistics, future cities & architecture, living & working, and general conditions. The future scenario was documented for the subsequent project work in the form of 106 premises, i.e. concrete assumptions derived from studies on future issues carried out by several other sectors. *(Step 2)*

From the perspective of this scenario of the distant future, they looked back on the year 2030 to answer the question:

“What must have been accomplished by 2030 to pave the way for 2050? Which demands will have emerged until then, resulting in which requirements?” *(Step 3)*

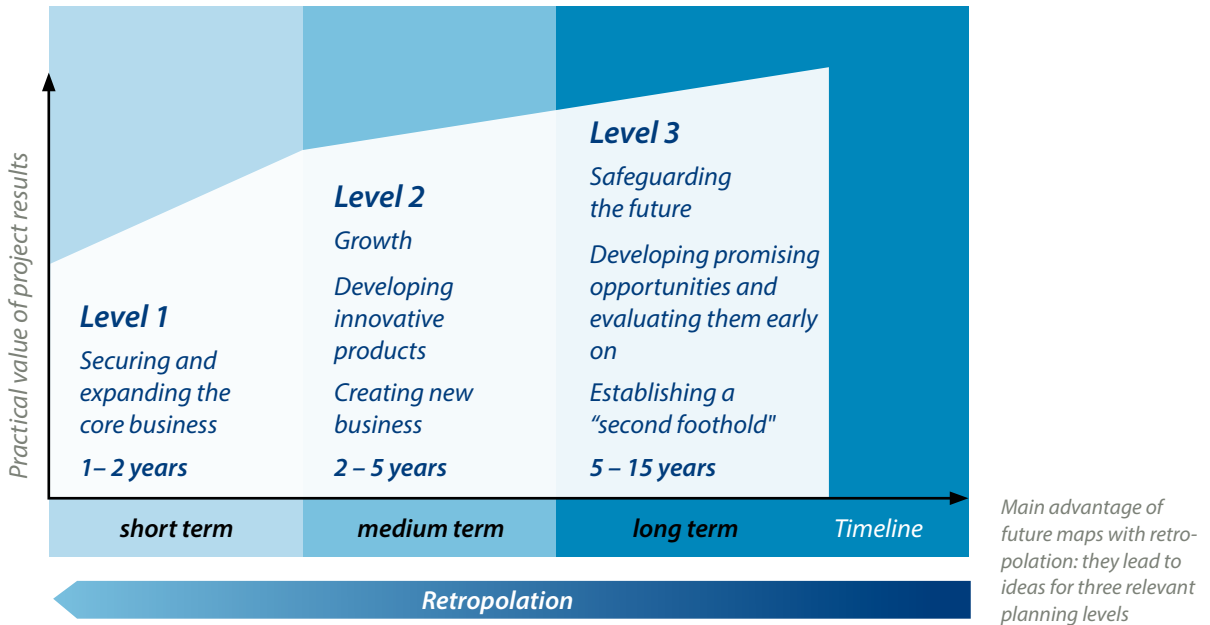
In six brainstorming workshops, 103 project participants from various fields and sectors looked back from 2050 on the year 2030 and even further behind towards the present, to develop almost 1500 ideas for new business opportunities. After consolidating and evaluating these ideas, a total of 640 were left. 375 of them were considered to be directly related to paper

*(cf. Table on page 5)*, i.e. they can probably be realised with the know-how currently available in the paper chain. 275 ideas were indirectly related to paper, which means they are recognizable as attractive future demands but require further research to clarify how future paper materials can contribute to meeting them.

### Assessing market opportunities

To prioritise the ideas, the core team evaluated them in terms of economic efficiency and estimated time to market, i.e. how long it will probably take to develop them into marketable products or services. The ideas directly related to paper were also assessed on their attractiveness to individual parts of the value chain – suppliers, manufacturers or converters. Possible new business models that include also areas currently outside the sector’s core business were identified as well. The estimated time to market was evaluated for three periods: 2015-2020, after 2020-2025 and 2026-2030 and beyond. Evaluation criteria for ideas indirectly related to paper were how attractive it would be to realise them by means of future paper materials, and how long it would probably take for a future demand to result in marketable products.

It soon became obvious that issues of sustainability and resource conservation will be of particular importance in these periods.



### Focus on recycling

Fibre-based materials made from renewable resources meet important ecological demands – they are suitable for recycling and enable closed circuits. New application areas for these environment-friendly materials must therefore be at the centre of intense research – even if they might not seem very profitable today. The latter will change immediately when resource consumption is made a mandatory evaluation criterion for eco-balances. Wood and cellulose-based materials developed specifically for these new applications will then play a very prominent role. To make this happen, we must work together in interdisciplinary networks to gather and exchange information about requirement profiles, and we must include developers, engineers and designers at an early stage to take full advantage of all the new design opportunities offered by “papers for the future”.

The project team has prepared the ground – it’s now up to the companies to use the results and draw conclusions for their own business and corporate strategies. The project has shown that profitable niche markets will be much more important than mass products in future. Companies obeying the maxim of the Fibres & Paper 2030 project “Doing what’s thinkable instead of thinking what’s doable” will therefore have the best chances to succeed.

Thematic area	Ideas directly related to paper	Ideas indirectly related to paper
General conditions	74	28
Nutrition	38	38
Health & Hygiene	83	48
ICEK	10	14
Logistics	56	20
Mobility	15	39
Living & Working	60	43
Future cities & Architecture	39	35
<b>Total</b>	<b>375</b>	<b>265</b>





*Fibre-based seating furniture – filigree but robust*

### **Moving house will be easier**

Living and working will be highly interlaced, much more individual, flexible and decentralized in the mid of the 21st century, which makes it necessary to create conditions and environments that are equally flexible and dynamic. Manufacturers will need adaptable, versatile materials that can be recycled and reused in ecologically sensible ways. Modular, recyclable and variably designed paper and board packages can serve as role models for modular, convertible room concepts and furniture. Standardized wall and furniture modules that can easily be adapted to changing needs and situations will make it much easier to move house or change one's job in future. Paper and board packages with printed electronics are used for logistics and communication in decentralized, interconnected production units.

### **Premises for 2050**

➤ *Highly individualized living and housing environments require furniture that can be moved easily, solutions for more flexible room concepts, sliding walls, new utilization concepts for expensive urban housing.*

➤ *Numerous remotely controllable, smart or autonomous functions (energy conservation, temperature control, energy generation in shaded areas, higher power consumption in off-peak times).*

➤ *Flexible room concepts/modules for increasingly interlaced work and living.*

➤ *Dynamic and flexible employment contracts, new management and organisational concepts, collaborative forms of work, increasing and continued automation.*

➤ *Growing integration of reactive and versatile systems in production: change from centrally controlled factories to decentralized smart units.*



# THEMATIC AREA

## LIVING & WORKING

### *Ideas directly related to paper until 2030*

- ▶ **Paper furniture:** mobile furnishings made of paper and board for homes and offices – robust and stable, lightweight, inexpensive, recyclable and based on renewable resources.
- ▶ **Modular flats:** adaptable, modular components for variable living and working situations – sliding walls, partitions and other modules made of paper and board; flexibly designed, integrated housing and work spaces.
- ▶ **Intelligent accessories:** wall papers, curtains, blinds and shutters with temperature and moisture control or air-conditioning functions, made of recyclable, renewable materials.
- ▶ **Paper homes:** complete modular systems made of paper, paperboard and board for frequent moves or as lightweight, highly robust emergency shelters for disaster areas.
- ▶ **Computer cases:** lightweight and inexpensive PC or notebook cases etc. made of recyclable, renewable materials.

### *Ideas indirectly related to paper*

- ▶ **Multi-functional furniture:** chairs that can be turned into beds or tables, desks convertible into beds – flexible furnishings for space-saving home and office solutions, adaptable to changing needs and situations; potential new markets for paper converters; R&D demand: fireproof finishing of paper materials for furniture applications.
- ▶ **Furniture kits:** walls and partitions for variable room structures, flexible extensions or size reductions necessary because of age or changing circumstances, shifting importance of work/living, homes for single persons or groups/families; potential new markets for paper converters; R&D demand: fire-proof finishing.
- ▶ **Thermal insulation circuits:** energy-saving indoor climate control/air conditioning systems that respond to changes in outdoor weather conditions; comfortable room climate for each individual occupant; research demand: paper-based storage media; also conceivable: switchable acoustic insulation components.



### **Many futuristic ideas**

“I was familiar with the paper sector and its recent challenges, and aware of the sector’s rather conservative attitude towards innovation, which means that paper companies sometimes take a bit longer than e.g. car or electronics manufacturers to realize new ideas. Before joining the project, I had a rather vague idea of how to manage the future. In my new position as innovation manager, I first tried to get an overview of potentially suitable approaches and methods. At the beginning I thought that the retropolation approach chosen in the project (looking on tomorrow from the day after tomorrow) – especially the journey to the distant future – was a bit too fantastic for the conservative paper sector, and perhaps too intuitive for our mainly technically oriented minds. I was pleasantly surprised that the core project team and its travel guide managed to get on the right track and bring lateral thinkers from many different areas aboard. The regular core team meetings and interdisciplinary workshops held in a relaxed atmosphere led to eight relevant thematic areas and many futuristic ideas. These serve as basis for individual future concepts and to identify future demands. Let’s see what really lies ahead.”



**Dr. Katharina Kehren**, Innovation Manager at  
Voith Paper Fabrics GmbH & Co. KG  
[www.voith.com](http://www.voith.com)

### **The premises for 2050 are the most valuable project result**

*Dr. Matthias Schulte is responsible for technology at the paper mill August Koehler SE, an independent manufacturer that can look back on more than 200 years of company history. With his vast expertise in innovation management and future planning, he was an obvious candidate for the core project team of Fibres & Paper 2030.*

#### **Dr. Schulte, how much time did you spend on the project?**

Ten core team meetings plus overnight stay, time for travelling, careful preparations and follow-up work – all this certainly adds up to several work-weeks, but the results were really worth it.

#### **Did you know this right from the start?**

Retropolation was a method I wasn’t familiar with; I really had to embark on it. I was open-minded, but a bit impatient at first – we seemed to have such a long way to go to develop concrete ideas. The latter turned out to be just one fraction of the many useful project results. Much more important, I think, is the premises we have identified for eight thematic areas to describe the prospective global scenario for the year 2050. This was the main prerequisite for drawing any conclusions about the future, and we were right to spend a lot of time on this task.

#### **Why?**

Because of the method we used: I think the premises are the result we will all profit most from. To be able to draw the right strategic conclusions, we must get away from short-term thinking, leave all present technologies and applications behind and learn to see beyond the end of our noses.

#### **Some of your competitors were in the core team as well – was this a problem?**

Not at all. Our cooperation was highly professional,

strictly goal-oriented and became ever more efficient in the course of the project, also thanks to the precompetitive character of the project.

### And the benefits?

I am sure that every core team member has benefited from the project – especially from how we dealt with issues that are of vital importance to our sector. What will people need in future, which demands will emerge? How will we live in the year 2050? Can we meet future demands with our existing products and technologies, or do we need completely new approaches?

### Could you give me some details – how exactly did your company benefit from the project?

We still have to translate abstract concepts into concrete ideas to create real added value for each single company. My company has already scheduled an in-house workshop to analyse and filter the premises and conclusions for our own work and incorporate them in our corporate future planning.

### And your final conclusion?

What I found most useful was the much broader conceptual approach taken in the project. The sector's traditional, sometimes rather ponderous attitude and focus on capital goods is becoming increasingly inappropriate for the ever faster development cycles and



*Dr. Matthias Schulte*, Corporate Director Technology of Koehler Paper Group

rapidly changing markets we are faced with today. F&P 2030 has opened up new chances and opportunities to make our traditional sector fit for the future. We have made a good start – and I'm sure politicians and the public at large will notice it.

[www.koehlerpaper.com](http://www.koehlerpaper.com) ◀



*Highly competent staff, state-of-the-art know-how ...*



*... provide the basis for future success*





## Premises for 2050

- ▶ *World population has grown to 9–10 billion; 2/3 thereof live in cities.*
- ▶ *Climate change has increased the demand for flood protection and irrigation systems, more efficient food production and adequate supply of clean drinking water can only be realised by means of eco-friendly products and green technologies.*
- ▶ *New farmland has been sustainably developed in previously barren areas (self-sufficient greenhouses), cities (Vertical farming) and oceans (Aqua farming) for vegetarian food production; decreased land demand for conventional farming; maximum agricultural yields through systematic watering and fertilization.*
- ▶ *Meat is produced in large-scale laboratories; Functional Food with individualized ingredients prepared by “food printers” enables healthier and more balanced diets. Monitoring of bodily functions by sensors integrated in the clothing makes it possible to detect diseases and health risks much earlier to reduce the consumption of medical drugs; less food is wasted or thrown away.*
- ▶ *Innovative packages with freshness indicators keep food actively fresh and usable whilst increasing its safety – also in remote areas.*
- ▶ *New technologies for drinking water treatment – often local and decentralized treatment of rainwater, service water or sewage.*

*Recultivation and hydropapers for sowing and raising seedlings*

### **Focus on environmental issues**

Trends already noticeable today will continue also in future: The global population has grown to much more than nine billion, most people live in megacities. Clearly visible effects of climate change like water shortage, floods or the desertification of vast areas have caused a strategic rethink: Climate-neutral green technologies are no longer an officially promoted option – they have become mandatory. Constantly rising drinking water prices have led to an entirely new sector – companies specializing in the abstraction and eco-friendly use of this valuable resource. The continued loss of agricultural areas has pushed the development of new, more efficient and resource-saving ways of food production. People are much more aware of the value of food.

# THEMATIC AREA

## NUTRITION

These changes can be felt drastically in the paper industry – they are both risks and chances. Towards the end of our century, the acceptance of paper-based products will increasingly depend on the development of carbon-neutral products. The pulp and paper sector will have to further diversify its product range to enter new markets.



*Innovative packaging solutions conserve resources and reduce losses*

### *Ideas directly related to paper until 2030*

- ▶ **Agricultural films with climate control function:** paper films enable higher crop yields despite global warming; films work as UV filters and water management devices to create an optimum climate for crop plants.
- ▶ **Food production:** recultivation papers are used to revegetate desertified areas and industrial wasteland or to grow crop plants; seed is combined with specifically selected fertilizers on paper-based substrates to optimally start the plantation, protect it against predatory herbivores and erosion, regulate the water supply in the first months of growth; substrates rot when the plants have taken root.
- ▶ **Drinking water purification:** papers with smart coatings are used as nano filters in municipal sewage treatment plants to remove ultrafine drug particles, hormones, bacteria, viruses etc.; seawater desalination contributes significantly to meeting the global drinking water demand.
- ▶ **In everyone's mouth:** paper itself becomes food through vitamin and mineral additions – low-calorie, available immediately and in manifold flavours.

### *Ideas indirectly related to paper until 2030*

- ▶ **Smart Living:** intelligent packaging materials prevent waste and significantly extend shelf-life of food; best-before dates are communicated in the environment – fridge knows which of contents are about to perish and must be eaten up soon.
- ▶ **Floating islands:** rapidly growing population makes oceans increasingly attractive as housing and agricultural areas; shipyards build huge artificial islands – an entirely new market segment; water-based energy and food production (farms).
- ▶ **Artificial steaks:** rapid progress in food technology makes it impossible to tell the difference between meat that comes from a farm and meat obtained from cultivated non-animal cell tissue – they taste the same, but artificial steaks have a better eco-balance and healthier nutrient composition.
- ▶ **Hydro cultures:** paper shreds serve as substrate for sowing and growing seedlings.

## **Tremendous potential thanks to great commitment**

*Thomas Strobel, managing director of the company FENWIS in Gauting, has been working as team- and industry-oriented 'future pilot' for many years. Trade associations and innovative companies from many different sectors have used his skills and expertise in developing future scenarios by means of 'retropolation' to derive strategic options. With his wide-ranging professional experience, he was cut out for chairing the Fibres & Paper 2030 project.*

### **Mr. Strobel, which practical value has a "map of the future"?**

Based on my experience from projects with industrial companies and especially from the 'Perspectives for 2025' project of Forschungskuratorium Textil completed in 2012, I can say that companies or sectors whose business environment is in a state of transition and dramatic change are well advised to look ahead and adopt a "foresighted" corporate strategy. This will sooner or later affect every company because our economy is becoming ever more multidisciplinary and boundaries between sectors continue to disappear. Companies anticipating future scenarios to identify promising options well in advance are well prepared for the future. They can use the money they are earning today to develop business opportunities for tomorrow.

### **You have successfully chaired the F&P project over 15 months. Which methods did you use to answer questions about the future?**

We used the method of "retropolation", which means anticipating the day after tomorrow to look "back" on tomorrow. This makes it easier to develop ideas and concepts about future demands because by travelling to the distant future – in our case to the year 2050 – you can leave all present limitations and constraints

behind. This "frees" the mind to imagine what our world could be like in the distant future. If you look back from this perspective on e.g. the year 2030, you can identify future demands more accurately and systematically than based on previous experiences.

### **1500 ideas about future demands – that's quite a lot for around 100 workshop participants thinking about eight thematic areas. How was this possible?**

As already explained in this brochure, our proven brainstorming concept makes it easy to "think outside the box". An open exchange between interested partners frees the mind, activates billions of brain cells and triggers many new associations. Moreover, we allay our fellow travellers' fears about voicing thoughts or ideas that may sound "crazy" – something they would never do in their jobs. Our brainstorming sessions were always based on the maxim "Doing what's thinkable instead of thinking what's doable". What may sound like a mere play on words here has always led to the desired effects in our workshops.

### **Was there something that really impressed you on your journey through time?**

Yes, I was surprised by three things: the high commitment of the core team, the sector's dazzling diversity regarding "paper for the future", and the sustainability of papermaking and converting processes.

About the core team: 18 people from various parts of the paper chain worked with great personal commitment and dedication for 15 months, exchanging ideas in an outstandingly goal-oriented manner. They paved the way for the creative work of more than 100 workshop participants.

About the sector: I'm always delighted when people improve their existing know-how by interdisciplinary thinking and exchanges. This makes them aware of their potential and enables them to multiply it with new ideas for future opportunities.

About sustainability: The paper industry is world leader in recycling and the use of renewable raw materials – and nevertheless often seen as a sector that cuts



down trees and destroys forests. Its eco-friendliness and sustainability must be communicated much more than in the past to correct this unfair and false image.

### Which findings on “paper for the future” will you take home?

As a fibre-based material obtained from renewable resources, paper offers enormous potential for a world that is more sustainable and resource-conserving than our present one. The project has convinced me that through interdisciplinary cooperation and research, people in various creative lines of work – designers, developers, engineers etc. – can take full advantage of the new design opportunities offered by “papers for the future” and use them for new applications with innovative properties – provided that the paper sector communicates the potential paper materials offer beyond conventional applications like printing papers and folding boxes: as fire-resistant or lightweight construction materials, insulating material for buildings and so forth ...

[www.fenwis.de](http://www.fenwis.de) ↩



**Thomas Strobel,**  
Managing director of the company FENWIS

## Key data of the Fibres & Paper 2030 project

- ▶ Project time: January 2014 to March 2015.
- ▶ Core team of 18 representatives from all parts of the value chain: suppliers, paper producers, converters.
- ▶ 90 studies on future issues were evaluated to create a pool of information.
- ▶ 8 thematic areas were identified to develop perspectives for the future.
- ▶ 314 premises for the year 2050 were compiled.
- ▶ 106 premises were selected to develop a scenario for 2050.
- ▶ 6 interdisciplinary workshops attended by 103 people from different age groups led to 1457 ideas about the future demands in the eight thematic areas.
- ▶ 640 ideas were found to be able to create significant value for customers, 375 thereof are directly related to paper and can be realised with the know-how currently available in the sector, 265 are future demands indirectly related to paper, i.e. it's worth thinking about how “papers for the future” could contribute to realizing them.



*Basic and applied research for the (paper) world of the future*

### **Contributing to prevention and therapy**

People are much more health-conscious, eat balanced diets and spend growing amounts on healthcare – all this increases their life expectancy steadily: Centenarians are no longer an exception, and former patients have become clients and health-conscious consumers. Health and healthcare are lifestyle products, and hygiene forms the cornerstone of comprehensive, sustainable healthcare systems. Intelligent filter systems, functionally coated surfaces in homes, work environments or clothes as well as changes in people's habits and behaviour have caused pathogens and allergens to recede. Preventive measures have lastingly improved the health standard and physical condition of people. Revolutionary therapies combined with proactive ambient assisted living systems enable people to live healthily and independently into old age.

### **Premises for 2050**

➤ *Health sector has changed from a regulated supply-driven into a highly diversified demand-driven market: former patients are now health-conscious clients; health has become a consumer good and lifestyle product.*

➤ *Core issues related to ageing societies: ageing healthily, staying mobile, curing chronic diseases, regenerating tissue and organs, growing demand for therapeutic and nursing.*

➤ *Functional filter systems provide clean drinking water and air (e.g. rainwater and sewage purification, fine particle filters).*

➤ *Inexpensive diagnostic systems are widely available.*

➤ *Implantology and tissue engineering are mainly based on bio-fibres. Artificial organs or replacement parts produced in the laboratory have become state of the art in transplantation medicine since rejection is no longer an issue.*

# THEMATIC AREA

## HEALTH & HYGIENE

### ***Future strategies must be developed today***

“The paper industry is in a period of transition; its traditional structures, markets and requirement profiles are changing dramatically and with great dynamics. Digitalisation has led to completely different media consumption habits, whilst e-commerce increases the demand for packaging solutions. All this makes it necessary to open up new markets and application areas for paper. Current developments like Industry 4.0 will require new corporate structures and shorter innovation cycles.

Together with its neighbouring associations from the paper converting and supply industries, the German Pulp and Paper Association VDP has therefore funded Fibres & Paper 2030, a project aimed at developing a vision of the pulp and paper sector in the year 2030 and answering questions relevant to its future. Several VDP members were actively involved in the core project team, and quite taken with the new perspectives they have gained on paper and paper products.



**Dr. Stefan Karrer**, Chairman of the VDP Pulp and Paper Industry Research and Technology Board  
[www.vdp-online.de](http://www.vdp-online.de)

The project has led to a broad spectrum of ideas about future applications: in the area of mobility, for example, lightweight aircraft components could be manufactured from honeycomb structures based on fireproof paper to save weight and fuel. Papers with closed hollow structures or fire-resistant paper shreds could be used as insulating materials for house building.

The proposals did not include concrete product designs – they outline future life spaces, demands and markets, which can then be used to derive new applications with higher value for paper materials.

The Fibres & Paper 2030 has created fundamental knowledge, visions and ideas for new business areas, which companies can use to develop their own specific future strategies.”

### ***Ideas indirectly related to paper***

- ▶ **Growing organs:** bone, sinew, skin or other implants are obtained from cell cultures grown on biocompatible substrates made from natural fibres.
- ▶ **Drug design:** microorganisms serve as raw material and/or growth stimulants; pharmaceutical industry uses bacteria for drug design and production.
- ▶ **Bacteria scavengers:** patients swallow scavengers that assimilate pathogens in the body and excrete them afterwards to avoid complicated surgery.



### Ideas directly related to paper until 2030

- ▶ **Biobased filters:** made from renewable raw materials, recyclable in closed loops, protect against infectious diseases and pathogens, remove bioactive substances from liquids, gases and air; used in healthcare and analytics, to ensure the adequate supply of clean drinking water or breathing air in cities, regions or entire nations.
- ▶ **Faster curing:** reduced treatment times and costs through smart fibre-based dressing materials with integrated indicator function; colour change in the dressing informs about the healing progress or possible inflammations without having to be removed; dressing material contains active pharmaceutical ingredients and releases them systematically.
- ▶ **Functionalised sheets, covers and bedticks:** für antibacterial, absorbent and made of fibre-based, decomposable materials, for hospitals and nursing homes; hygienic supply, use and disposal.
- ▶ **Detection of diseases:** fibre-based substrates for diagnostic systems and flash tests – inexpensive, easy to use, tests can be done on skin, in respiratory air or urine to detect diseases early for immediate therapy.
- ▶ **Radiation protection:** functionally coated fibre-based surfaces protect against laser or electromagnetic pollution in homes and at work; absorbent/reflective surfaces (nonwovens, wall papers, lining materials in clothes).



### An exciting look at the distant future

**Stefan Raum** is Product & Technology Director for Africa, Middle East and India at SCA, a leading manufacturer of sanitary products. Besides personal care products, sanitary towels and incontinence supplies, SCA produces mainly sanitary papers for end users and bulk buyers in catering, healthcare and other commercial sectors. The 44-year-old mechanical engineer (MBA) contributed the perspective of a consumer goods manufacturer to the Fibres & Paper 2030 project.

#### Mr. Raum, future planning is something you are well familiar with?

Changing market conditions, customer and consumer demands force us to constantly look for promising future technologies, new markets and application areas. Both in my company, the German market leader, and at Zellcheming, the Association of Chemical Pulp and Paper Chemists and Engineers, where I am on the main committee, we consider future perspectives to be at the very top of the agenda. What was really new for me was the methodological approach of the Fibres & Paper 2030 project, i.e. looking at the distant future and then several years back on the mid-term future.



### Which useful results were achieved for the sector as a whole?

We developed many new ideas, e. g. for new products and product groups, applications or even entirely new business models. I was really impressed. Some of them can certainly be put into practice in the short or medium term, while other – especially those indirectly related to paper – will require a lot more staying power, risk-taking and close interdisciplinary cooperation. A great advantage was that the project included companies, trade associations and academic institutes from all parts of the value chain – suppliers, manufacturers and converters. This unique mixture was very important for the successful completion, and has led to tangible results for all participants. Small and medium-size companies specializing in niche markets or products will probably benefit most from the results, but also mass manufacturers will be able to draw useful conclusions for some thematic areas. Last but not least, we have once again demonstrated that the paper sector is genuinely innovative.

### And how did you and your company benefit?

Thanks to the general, precompetitive nature of ideas, we could derive a lot of input for our innovation pipeline and concrete R&D projects. From the 90 international studies we evaluated to identify relevant thematic areas for Fibres & Paper 2030, I gained lots of new insights into future trends, and could draw inspiration for my work. Cooperating directly with colleagues and scientists was very inspiring as well.



**Stefan Raum,**  
Product Manager at SCA

### Which research areas do you think have particularly great potential?

Paper can do much more than most people think. It can be combined with many other materials to achieve completely new functions, for example in lightweight construction, printed circuits or absorbent materials. The fact that it is made from sustainable resources gives it a major advantage over fossil-based materials. Whether in classic or high-tech applications: with its unique properties, paper will play a leading role in industry and technology in both the near and distant future. I'm firmly convinced of it.

### What should be done next?

I'm very much in favour of cooperative cross-sector research. We need to form alliances with other sectors to develop new business models: Our huge and expensive machinery requires high output and great market demand. I could imagine that we will have much smaller lot sizes in future for which we must find new applications and customers now to safeguard our future.

[www.sca.de](http://www.sca.de) ◀

*Left: Fibrous substrates for drugs, artificial limbs and organs –key prerequisites for medical progress*



## Premises for 2050

*Mobility will be dominated by zero-emission vehicles made from renewable fibrous materials in future*

- ▶ *Transport volume has doubled since 2010 – from nearly 40 to 75- 80 trillion passenger kilometres per year.*

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- ▶ *Vehicles are largely made from recyclable materials; communicating vehicles and autonomous driving systems provide adequate road safety and require significantly less material.*

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- ▶ *Principles of lightweight construction enable energy savings and reduce the consumption of fuels and materials.*

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- ▶ *Intelligent monitoring of material parameters is used to record the loading history of components and inform about service life and necessary replacements before defects occur.*

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- ▶ *Competition between biofuel and food production has been abolished by politics and legislation.*

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### **Traffic flows smoothly**

No congestion or traffic delays – even though the transport volume has more than doubled since 2010. The reason for this is techniques whose basic mechanisms were already known in 2015, but which could only be realised later by the joint efforts of several disciplines. Completely new lightweight materials have been developed to build lighter, highly fuel-efficient cars, for example. Self-driving cars must not be as crash-resistant as their predecessors and can therefore be made from lighter materials. Autonomous driving requires smaller distances between the cars, which frees road capacity. The continuous monitoring of material parameters was another step towards more safety and reduced material demand. Since fuels are almost completely made from renewable resources – without competing with food crops – there are no major obstacles to satisfying the steadily growing demand for mobility.



# THEMATIC AREA

## MOBILITY

### *Viewing things from different perspectives*

*Sebastian Mauerer, chemical engineering student at Munich University of Applied Sciences, attended a multidisciplinary student's workshop in the Fibres & Paper 2030 project.*

#### **Mr. Mauerer, how did you like the brainstorming workshop on “paper for the future”?**

I found it very exciting to think about the distant future, it was both work and fun. We had to use our imagination – nobody really knows what the future holds.

#### **What impressed you most?**

How much we all benefited from the heterogenic composition of our group – it made our work easier and much more efficient. No pressure, no constraints – it was great fun!

#### **What was so special about the way you exchanged ideas?**

It was interesting to see the student's different ways of thinking, which also depended on the number of semesters they had already completed. An interesting aspect of my mixed group was that the female students' ideas were more technically oriented than the male students' ones!

#### **Which areas do you think offer the best chances for future products and applications?**

Paper-based body parts for cars and other vehicles in the mobility sector, intelligent packages for logistics, paper substrates – maybe even with fertilizers – for vertical farming in architecture, paper-based furniture or wallpapers with display and ambience effects in working & living look most promising to me.



**Sebastian Mauerer,**

Chemical engineering student at Munich University of Applied Sciences

#### **Was there something that can be directly useful for your future job and career?**

The workshop made me realize that intrinsic motivation and voluntary teamwork without pressure are a good basis for success. Bringing together people with different backgrounds and perspectives, from different professions and age groups holds the key to efficient brainstorming that produces useful results.

#### **Would it be good to include such workshops in academic courses?**

I think that's a good idea because it makes people think about the future. Interdisciplinary workshops would bring together interested students from many different courses for fruitful exchanges among like-minded people. The participants could also improve their social skills – an important prerequisite for their future careers.

#### **Last question – your final conclusion?**

Have fun and look forward to the future!

### **Ideas directly related to paper until 2030**

- ▶ **Deep-drawing:** moulded parts typically used in vehicle construction can now also be made from paper materials to produce recyclable lightweight structures; key step towards lightweight construction; also used for seating furniture.
- ▶ **Car bodies:** deep-drawn parts and lightweight, recyclable paper composites based on renewable raw materials have led to weight and fuel savings in vehicle construction; interior trims and skin are made of paper-based fibrous materials.
- ▶ **Planes:** fire-resistant board for interior trims satisfies all demands but is much lighter and less heat conducting, i.e. not as cold to the touch as earlier materials – manufacturers and airlines are thrilled.
- ▶ **Small missiles:** ultralight drones made from fibre-based, recyclable materials are finally available; technological breakthrough through lightweight construction; drastically reduced energy demand (compared to heavier objects), less dangerous; also used as environment-friendly, lightweight toys.
- ▶ **Road safety:** safer traffic, fewer accidents and injuries thanks to vehicle components made from “self-healing” paper fibres; car body shells can absorb much more impact energy than in the past; regenerative materials rapidly “heal” damaged components.

### ***I could imagine turning this into my profession***

*Anatoli Davydov works as project manager at Papiertechnische Stiftung in Munich. He was also in charge of the Fibres & Paper 2030 project.*

### **Mr. Davydov, what was it like to be not only one of the planners and coordinators, but also the main contact and “good soul” of this rather unusual visionary project?**

Fibres & Paper 2030 is a strategically oriented project that has been the first of this kind in our sector so far: A simulated journey to the future to look back and beyond the ordinary. It was exciting and fascinating to work together with a team of very open-minded people, organize and conduct brainstorming workshops, discuss and evaluate innovative ideas and see what a “future guide” – Thomas Strobel – can do for a concrete sector.

### **What did you like most?**

The brainstorming workshops with people from many different fields and professions, which gave me new



**Anatoli Davydov,**  
Project manager at  
Papiertechnische Stiftung in Munich

insights into the numerous opportunities paper materials are offering beyond the limits of state-of-the-art technology, for example in the fields of architecture and mobility. I also got a completely new idea of what innovation really means.

### Ideas indirectly related to paper

- ▶ **Aircraft construction:** bionic structures adapted from nature, e.g. for wings, can be shaped more easily and are much lighter than in the past; innovative design and construction techniques (like 3D printing) are used to make heavier loaded portions more solid and low-loaded portions thinner – like in trees.
- ▶ **Autonomous driving:** has become part of everyday life thanks to high-speed and ever more powerful Internet connections; conventional road vehicles have been upgraded, new models look completely different – they are much lighter, compact and need significantly less fuel because crumple zones and stiff (heavy) body parts are no longer necessary; traffic jams are no longer an issue; increased road

capacity because communicating vehicles require safety distances of maximally one metre even at high speeds.

- ▶ **Soil proofing:** car wash sites are no longer profitable because dirt-repellent surfaces make vehicles look as good as new.



Once aluminium, now fibres – future materials not only for aircraft construction

### You are 28 years old – which lessons did you learn from the project for your own future?

Like many other participants, I was particularly fascinated by the brainstorming workshops, which made us realize that future demands can be identified best by combining many different views and backgrounds. Discussions among peers can certainly generate innovative ideas as well, but I have seen that cross-sector interaction works much better here. The thorough understanding of medium- and long-term trends enables us to anticipate relevant future developments – without overlooking anything important. Keeping track of ongoing research is very useful here as well.

### Are you planning to use and develop some of the ideas in future research projects?

I used our regional workshops – which were attended by more than 100 students, scientists and entrepreneurs – to build a broad network, which I am planning to use to promote innovative ideas. I met many open-minded people who are really interested in future issues; and we are already discussing possible joint projects.

### Did the project work influence your plans for the future?

Dealing with topics like innovation, future demands and markets really fascinated me. I would like to do something like this also in future – getting many companies in our sector interested in visionary ideas to jointly look for ways how to put them into practice.

### Do you have a message for your colleagues and business partners?

Without good reason, we should never rule out or dismiss any future scenario as impossible or unrealistic. An idea that cannot (yet) be realized by means of state-of-the-art technology can become a highly attractive market in the near future.

### How would you sum up the project in just one sentence?

Paper has and offers excellent prospects – also for me!





## Premises for 2050

▶ **Lifelong learning – continuing education and training – is the key success factor in all trades and professions.**

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▶ **Cross-organisational and globally linked learning activities are prevalent: joint development of skills and competences for both individuals and organisations.**

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▶ **Industry 4.0 accounts for a significant share of the value created by manufacturing.**

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▶ **Open Innovation has become the main driver of developments and innovations.**

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▶ **“Enlightenment 2.0” has led to a new system of values governing people’s lifestyle and consumer behaviour – resource conservation and sustainability are core issues.**

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*Education, knowledge and paper will be closely connected also in future*

### **Education decides on the future**

Our concept of “industry” is changing constantly. “Industry 4.0” means the complete digitalisation and networking of entire manufacturing sequences, products and processes in cyber-physic systems. Concepts like Cloud Computing and Big Data have facilitated and revolutionized the use and processing of data, which has decentralized and automated all workflows or made them even fully autonomous. This has reduced our strain and workload, but in some cases also our freedom of choice. Short-term interactive learning and situation-specific training have become standard measures to overcome skill shortages. Companies are open to cross-sector cooperation and interested in joint interdisciplinary innovation. Freelance experts are temporarily commissioned for concrete projects via Internet platforms. All this has led to products and

# THEMATIC AREA

## INFORMATION, COMMUNICATION, EDUCATION, KNOWLEDGE

services with new customer value, new business models and value chains, followed by new education and training offers for multi-local working environments. Global education levels have significantly increased, thanks to the broader and easier access to all kinds of knowledge. Lifelong learning has become the main success factor in all job markets. Exam certificates and diplomas have been replaced by knowledge certificates confirming a person's present skills and qualification. Interactive, personalized learning media made from fibre-based materials help people develop the independence and flexibility they need in working environments based on communication and networking. The broader access to knowledge and information also makes it easier to solve problems of population growth and climate change.



*Communication will be dominated by interactive media in future*

### **Ideas directly related to paper until 2030**

- ▶ **Learning media:** interactive displays printed on fibre-based substrates make learning an exciting experience and great fun, e.g. questionnaires with “scratch” answers that disappear again, good results can be achieved with little effort.
- ▶ **Rewriteable media:** specially coated papers and special printers enable multiple, temporary uses instead of consumption; special coat layer combinations and innovative printing techniques make it possible to reprint materials by removing older ink layers, which promotes sustainability and circuit closure.
- ▶ **Read-out function:** due to demographic trends – function is integrated in newspapers for old people or people with impaired vision to keep them up-to-date with the latest news, independent electronic media open up new ways of information.
- ▶ **Self-illumination:** fibre-based materials store daylight and release it slowly during darkness – people can read without a light source.

## Vital to our sector's future

**Heiner Grussenmeyer**, chemical engineer by profession, has been in the paper business for 30 years. At the Mönchengladbach branch of the Finish-Swedish Stora Enso group, world leader in pulp and paper production, he manages research and development projects with increased lead time and risk. He represented the manufacturers' view in the Fibres&Paper 2030 project.



**Heiner Grussenmeyer**,  
Chemical engineer, Stora Enso

### What did you expect from the project, Mr. Grussenmeyer?

I was – rightly, as it turned out – hoping to broaden my horizons and reap methodological benefits for our work at Stora Enso. And of course I was also tempted by the prospect of getting results that are still pure and unprejudiced and therefore like gold dust.

### Having worked actively in the VDP research group and other cooperation networks for many years – how would you characterize the joint work of the 2030 project team?

They were the most unprejudiced, open-minded people I have ever met. Our meetings and discussions were highly constructive and respectful, and it was really exciting to jointly look ahead. Our coach did a great job and had many good ideas – without intervening too much.

## Ideas indirectly related to paper

- ▶ **Interactive learning media:** personalised, customized to the needs of specific groups – pupils, students, senior citizens, course content depends on their previous knowledge to increase learning skills and impart knowledge more flexibly; reduced attendance times at universities free time for individual learning; interactive touch displays printed on low-cost paper substrates serve as tools; broad networking enables knowledge transfer in large groups.
- ▶ **Learning systems for kids:** system recognizes the child's behavioural and knowledge patterns to accordingly adjust the way in which knowledge is presented; adaptive, flexible learning aids lead to clearly better results, interactive wallpapers with dynamic colour and voice effects can be used in any children's room to make learning great fun; parents can activate them at any desired time of day.
- ▶ **Chips in newspapers:** recognize readers to mark the contents relevant to them, for time-saving information about specific areas of interest.



### What about the results?

What we did was precompetitive research, relating to the very distant future – everyone must therefore decide for themselves which specific results can be particularly useful for them. We also developed many concrete, tangible ideas which can probably be realized with the know-how and equipment available today. In the end we all agreed that the project had led to useful results for every participant and the sector as a whole. And we could make clear: our sector is innovative and paper has a future!

### You were also involved in the development of the CEPI Roadmap, the paper sector's response to long-term EU directives. Did you find any starting points there?

Roadmap, we wanted to confirm that the paper sector is willing and able to achieve the long-term objectives of the EU – provided that they ensure the suitable political framework and conditions. In Fibres & Paper 2030, the focus was on product trends and new application areas, even though most of them could only be touched upon briefly. In this respect, the project was the logical next step after the CEPI Roadmap. What unifies both is the willingness to safeguard the future

of companies in the face of steadily declining markets – without damaging the environment.

### What does this mean for research and development?

It is quite obvious that we must split our research efforts – to meet current market needs by developing products for the near future and to answer the vital question in which areas we will be willing and able to do business in ten or fifteen years from now. These areas must be the focus of our main research efforts. Fibres & Paper 2030 was therefore of vital importance to our sector's future, I think.

### What you are going to do with all the "gold dust"?

*(laughs)* We are currently analysing the ideas to identify concrete starting points and topics for further research – both in-house and with partners like Papiertechnische Stiftung and the universities in Darmstadt and Dresden. Among other, we are thinking about how to manufacture larger quantities or new products by means of existing systems.

[www.storaenso.com](http://www.storaenso.com) ↩



**Dr.-Ing. Johannes Kappen,**  
MConsult GmbH

### Our sector is going to change

"Companies must be innovative to remain successful in future: they need new products and better processes. The ideas developed in the Fibres & Paper 2030 project are the very impetus the paper industry needs for this. However, innovation is not possible without adequately funded research. It was therefore a fortunate coincidence that the New German Research Agenda was launched simultaneously with the project to create suitable schemes and instruments of public funding for innovation projects. One thing's for sure: The paper sector is about to change. It has a future – and a successful one".



## Premises for 2050

▶ **Households, manufacturing and all other parts of the supply chain are linked in networks for need-driven production and distribution.**

▶ **Innovative materials enable ultralight transport containers, robust refillable and foldable containers reduce volume.**

▶ **Product/brand-specific use of multisensory packages (appearance, feel, fragrance, acoustics).**

▶ **Modular and functional packages with extra (SMART) functions like freshness sensors and indicators, antibacterial surface finishes, cooling effects or RFID tracing functions.**

▶ **Socio-demographic trends have made convenience a key quality criterion in packaging.**

*Efficient logistic systems will be unthinkable without paper materials & co. in future*

### **Sustainability through efficient logistics**

Former logistics chains have been replaced by n-dimensional logistics landscapes where all restrictions or disadvantages we are struggling with today have been overcome. Empty trips or dead freight, excess or underproduction have become things of the past, the same applies to wrong deliveries or losses due to expiry or spoiling of goods. Material and information flows are constantly being adapted to changing requirements. Broader networking makes it possible to reintegrate already delivered, but (currently) unused goods or materials in the logistics landscape to make them available again. Multi-sensory packages eliminate typical risks and dangers due to quality losses caused by improper storage conditions. Information about the quality and usability of packed goods is available at any time. Logistics concepts no longer serve the commercial interests of single groups or

# THEMATIC AREA

## LOGISTICS

individuals, but society as a whole, and are geared towards ecological sustainability. The tasks of primary and secondary packaging, storage and transport conditions and secondary use of all materials and energies involved are comprehensively optimised for each product. The balancing act between optimizing package size and type, material use and product protection and fulfilling all user demands and expectations has been achieved for every age group and lifestyle philosophy

### *Ideas directly related to paper until 2030*

- ▶ **Packages indicating the condition and quality of packed goods:** minimise risks and permit optimum use of materials and goods: spoilage and insufficient raw material or converting quality are immediately visible, package contents may be used after best-before dates in suitable conditions if the informed end user agrees. Load protection: customized, cost-efficient transport solutions are widely available also for shipments from little or undeveloped regions.
- ▶ **Paper cans:** easy to open, unbreakable, low risk of injury also to people with impairments; lightweight, easy to stack or fold flat when empty.
- ▶ **Electrically conductive packages:** no electrostatic charging or damage to sensitive electronic components or devices, no health impairments by contact electricity.
- ▶ **Drawability:** round food packages with complex shapes can be manufactured without material allowance – large variety of shapes can be realized with little material and energy.

- ▶ **Reminder function:** pharmaceutical packages send optical/acoustic signals or messages via mobile phone/Internet to tell people when they have to take their medicine, check how much has been taken from the package, warn of unauthorized access e.g. by children, remind patients/doctors when they are running out of supplies.
- ▶ **Multimedia-based presentation areas:** keep customers better informed; avoid loss of time, bad buys and mistakes; customized presentations for specific target groups and needs.
- ▶ **3D printing:** enables cost-efficient production of single or unit packages for special applications, customized packaging solutions or small lots; resource-saving, optimised solutions for each distribution channel.
- ▶ **Reuse:** fuel production instead of incineration when material recycling makes no sense; decentralized processing of used packages and reuse directly on site offers economic and ecological advantages and avoids transport, centralized storage and distribution.

### *Ideas indirectly related to paper*

- ▶ **Individualised shopping logistics:** opening hours or complicated price and quality comparisons are no longer necessary – centralized, resource-saving, optimally organized; prevents bad buys, transport damage or storage problems; meets actual demands and permits delivery to any desired address and return or re-consignment at short notice and any desired time.
- ▶ **Internet of things:** linking of objects and persons with the Internet leads to new products, business models and use options – packages inform about changes in the condition of packed goods (spoilage, leakage) to accordingly modify the destination, check and clean transport routes travelled, initiate the delivery of replacements and eliminate the sources of faults or trouble.



## Chances far outweigh the losses

**Heinrich Spies (PhD)** is Managing Director of MAY+SPIES in Düren, a family-owned enterprise that was established almost 100 years ago. The company has recently doubled its workforce by various acquisitions. Mr. Spies mainly represented the converting sector's view in the Fibres & Paper 2030 project.

### Mr. Spies, why does someone who is in charge of 270 employees leave his company for several days to meet colleagues and think about the future?

Because this was an absolute novelty: manufacturers, converters and suppliers cooperating in an extremely exciting project. I think that our sector needs a complete overhaul to respond to the rapid market changes caused by digitalisation and the gradual abandoning of traditional use patterns. Paper is and can do so much more: What we know as a two-dimensional material today is in fact much more complex and multi-faceted. The chances offered by paper many times over compensate for the loss of traditional applications and productions. Identifying these chances or at least suitable starting points was what we wanted to do in the project.

### Does everyone in the sector have the same chances?

We converters are certainly the lucky ones: whatever new is developed must somehow be converted. If we stick to our strategy and realize the planned renewal, we will be able to reap the greatest benefits. But nothing of this could work without our partners from the manufacturing and supply sectors.

### How exactly does your company group benefit from the project results?

First of all, it was incredible how much I could learn myself in the Fibres & Paper 2030 project. For the sector as a whole, the project has produced a tremendously long list of ideas for promising product developments. And in my company group, we have



**Dr. Heinrich Spies,**  
Managing director of the company MAY+SPIES

just begun to discuss which ideas could be particularly useful and feasible for us.

### When will we see the first concrete products made in Düren on the basis of project ideas?

That could happen rather soon. One of the ideas on the list, for example, was paper-based 3D printing systems. With the Mcor IRIS 3D colour printer, a robust, ecologically sound solution that became part of our product range just a few months ago and is perfect for this purpose, we have already arrived in the future. Other things will take longer, of course, or perhaps never work. But if we realize just some of the ideas, we can secure our jobs for many years.

### And suitable partners ...

... can of course be found in science. We can look back on many years of fruitful cooperation with Papiertechnische Stiftung. Germany and its academic institutions are extremely competent in the field of paper research. What could still be improved is the coordination of especially basic research activities, also to avoid unnecessary rivalries.

### Let's come back to the project: How did you like the retropolation method?

This was something unusual indeed – you really had to get into it. But all team members did a great job, nobody got lost on the way – which was certainly also owed to the competent work of our guide Thomas Strobel, who intervened carefully and skilfully whenever necessary. In my opinion, the project was a great success.

[www.mayspies.com](http://www.mayspies.com) ◀



**Peter Neßlauer,**  
Chemical engineering student at Munich University of Applied Sciences

### Great teamwork

*Peter Neßlauer studies chemical engineering at Munich University of Applied Sciences and took part in a students' workshop.*

### Mr. Nesslauer, did you get a chance to have your say?

I did. We worked in groups, which made it easy for me to contribute my thoughts. Exchanging views with students from other fields of study was quite exciting and a welcome change in my academic routine.

### What was so different then?

We looked at paper-based materials from completely different perspectives and identified future applications in all topical areas – even though some of them are hard to imagine today.

### How did you like the brainstorming?

I really enjoyed exchanging views with students from different academic levels, i.e. from Bachelor's and Master's courses. We really worked together well – if one had an idea, it was taken up and developed "to maturity" by the other participants.

### As a young consumer, where do you see the greatest chances for paper materials in future?

I reckon that one day paper will be used for intelligent packages in the logistics sector, for facade elements and partition structures in future cities & architecture, in modular furniture elements for living & working, as cultivation substrate for vegetable food in nutrition and, in the last topical area, for intelligent filter systems.

### Did you learn anything for your future career?

Yes, of course. Most important was that I realized how versatile paper really is, and that it has future potential. And I learned how to use retropolation to make potential applications "tangible". This is something I would like to share with others! Teamwork practices can be useful to other sectors as well – maybe I could use them to make people aware of the potential of paper materials.

### And your most important insight?

Paper has a future!

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## Premises for 2050

➤ *Megacities are most efficient living spaces – thanks to their modern mobility concepts, high energy efficiency and degree of land utilisation.*

➤ *Life in densely populated areas is governed by the principle “use rather than own”. Many business models have been changed from sale to rental/sharing schemes, e.g. for cars, e-bikes, DIY equipment.*

➤ *Buildings and infrastructure are important elements of local energy generation from renewable resources – e.g. photovoltaic arrays, wind power and algae production on or in facades.*

➤ *Sustainability considerations have led to increased rainwater use, separate supply systems for drinking and process waters, geothermal power generation in buildings.*

➤ *Tailor-made materials are used instead of steel; high-performance materials enable optimum insulation, building materials are based on synthetics and composites; many biological production processes have become state of the art. Optoelectronics, miniaturisation, energy storage, biofuels, process/building management/network optimisation, photovoltaics, IT-enhanced transport infrastructure, carbon dioxide capture and storage have become major trends.*

*Life in the distant future – sustainable and of high quality thanks to paper and fibre materials*

### **Functional renaissance of paper**

The change to an information society has been completed, which has also changed the world of work: geographic immobilisation, concentration in megacities, newly designed large buildings that combine workplaces, places to eat, healthcare, sports, culture and communication facilities are typical trends. Paper plays an important role in these new developments – thanks to its controllable homogeneity, chemical-physical advantages and versatile functionality. “Sustainability” has become a reality. Sharing models and common sense (what do we really need?) make sure that resources are efficiently conserved. Paper has enjoyed a functional renaissance in many areas – for example as eco-friendly building material for external cladding or interior finishing, for wallpapers with lifestyle functions such as screen display, solar energy storage, odour and humidity optimisation or sound protection. The rapid consumption and availability of goods requires more frequent transports of the materials involved – which can only be realized ecologically with renewable resources like wood and paper.

# THEMATIC AREA

## FUTURE CITIES & ARCHITECTURE

### Ideas directly related to paper until 2030

- ▶ **Functionalized partitions** made of fibre-based materials absorb odours and sound and have antibacterial effects.
- ▶ **Facades** made from weather-resistant paper serving as carrier structures for photovoltaic modules.
- ▶ **Thermo-plaster made from heat-insulating paper spheres** for facades, flooring or wall insulation.
- ▶ **Fire-resistant paper shreds** for electric or thermal insulation or as/in fire walls for buildings.
- ▶ **Gas storage** e. g. by means of porous substances like metallic organic frameworks used as fillers in paper.
- ▶ **Paper-fibre reinforced concrete** for extended service life and less weight.
- ▶ **Advantages:** tailor-made, demand-driven functionalisation leads to novel insulating materials, heat-insulating facades with integrated power generation, energy-saving air conditioning solutions for construction.

### Ideas indirectly related to paper

- ▶ **Biologically-physically active architecture** creates convenient, healthy living and recreation environments without wasting resources.
- ▶ **Self-sufficient buildings:** secure adequate energy, heat, water and food supply.
- ▶ **Radiation protection:** active surfaces combat noise, smog, UV, fine particle and ozone pollution by converting pollutants into harmless substances.
- ▶ **Seasonally active buildings:** air-permeable, insulating windows and external walls.
- ▶ **Active noise protection:** interference phenomena are used for indoor noise control.
- ▶ **Climate protection:** new types of facade greening, vegetal arches over roads.

### Improving the product range through innovation

*Ekhard Beuleke is paper technologist and has been working for Omya, a leading paper industry supplier, for almost 20 years. Today he is Vice President Public Affairs based in the Swiss town of Oftringen, and represents Omya especially in the field of sustainability. His colleague Thoralf Gliese is responsible for global sales and marketing in Omya's paper segment.*

### Mr. Beuleke, why did you join the Fibres & Paper 2030 project?

As a member of the Paper Technology Research Association and manager of a globally acting supplier focusing strongly on innovation and future trends, I was particularly interested in the topic. It was really a pleasure for me to work in the core project team.



**Ekhard Beuleke,**  
Paper technologist, Omya AG



**Did the scientists and industry representatives get along with each other right from the start?**

This was really the first time that someone had brought the various trade associations together for a joint project, an exciting experience. Guided by Thomas Strobel, we didn't take long to "see beyond the end of our noses" and develop future trends and scenarios. All our discussions were very open-minded, creative and fruitful.

**Mr. Gliese, which project results will be useful for the supply sector?**

Suppliers like Omya will mainly benefit from the better anticipation of future needs and opportunities. We all know that the pulp, paper and packaging sectors are in a process of radical transformation – to which we would like to contribute actively. This means also focusing more than before on issues like innovation, long-term strategic partnerships with customers or other suppliers, sustainability and renewable resources.

**What are you planning to do to secure the future success of your company?**

Omya prepared itself well in advance for foreseeable changes in industry and consumer behaviour – by launching specific R&D and innovation programmes, adjusting our organisation and qualifying the staff members involved. We think there are good prospects that we will disseminate and intensify such activities in all segments of the Forest Products Industry – and apply our know-how to other areas like agriculture, packaging/composite materials.

**Could you give us some examples?**

The spectrum is very large – ranging from the use of calcium carbonate for soil improvement in tree plantations to customized liquid packages or barrier solutions developed jointly with packaging producers.



*Professor Dr. Thoralf Gliese,*  
Paper technologist, Omya AG

**Which strategies are you focusing on?**

As I said: Enhancing the product portfolio by innovations geared towards future market needs holds the key to a company's future success. This includes adequate investments in innovation processes and personnel as well as collaboration projects to finance and realize new ideas. This can be quite difficult in our present economic environment!

**Which finding was most important to you?**

The project has confirmed our belief that getting ready today for the market and customer needs of future years and even decades is an essential prerequisite for ensuring a reliable business performance and stable relationships with existing and new customers!

[www.omya.com](http://www.omya.com) ◀

## **Breaking new ground in production and converting**

*Ina Hilker is Director Business Research of Felix Schoeller Group in Osnabrück, a leading specialty paper producer. She took part in a special "lateral thinkers" workshop with representatives from various different sectors in the Fibres & Paper 2030 project:*

### **What was your impression of the workshop?**

I was really impressed by the professional guidance and excellent preparation of this workshop, which enabled us to systematically search for "paper for the future". Its highly creative atmosphere and group dynamics led to very constructive results.

### **Was it difficult to cooperate with all the other "lateral thinkers"?**

The initial round of introductions broke the ice and ensured a pleasant atmosphere right from the start. The workshop has proved once again that groups comprised of people from different fields and backgrounds are particularly creative. We really complemented each other- great teamwork!



**Ina Hilker,**

Director Market Research at Felix Schoeller Group

### **Looking back, how helpful was the simulated journey through time?**

Very helpful. It helped us to consistently focus on ideas without straying into speculation.

### **What do you think of the retropolation method used in the project?**

I found it helpful, interesting and valuable. Envisioning long-term developments enables you to look on the years to come from a different perspective.

### **Do you have a special message for your colleagues and business partners?**

It really helps to discuss future issues also outside your company or core business, i.e. in a different place or environment and with people who are neither colleagues nor partners. In this way, you can use the special dynamics of nonhomogeneous groups and technical knowledge of people from other fields, become aware of megatrends in other industries – interesting ideas can often be found in "fringe areas". I would recommend using retropolation to discuss innovations, and looking at future developments from a much longer perspective than the one we are typically taking today.

### **Which chances did the workshop reveal for the paper sector?**

The paper industry should concentrate more on related sectors or products (e.g. textile, nonwovens). Recognizing megatrends will enable its companies to understand future demands, identify new requirements to raw materials and manufacturing technologies and design the corresponding products. The approach also shows which products have no future prospects.

[www.felix-schoeller.com](http://www.felix-schoeller.com) <



## Premises for 2050

➤ *Widespread and steadily growing use of renewable resources; “cradle-to-cradle” philosophy has made recycling an obligation.*

➤ *Recycling processes are highly economical and provide the basis for resource-neutral products and closed circuits.*

➤ *Sustainable resource use instead of consumption is a firmly established guideline that governs the buying behaviour of consumers thanks to the mandatory labelling of goods and services.*

➤ *Around one third of the landmass is wooded.*

➤ *The feared 100% increase in global energy consumption could be prevented by measures like thermal insulation or ventilation, much more energy-efficient megacities, better mobility and new energy concepts.*

*Innovative fashion – paper can be drop-dead beautiful*

### **Paper continues to be available in sufficient amounts**

Renewable raw materials and recycling solutions are widely used; sustainable resource use instead of consumption has become a well-established principle. The feared 100% increase in global energy consumption could be prevented by measures like better thermal insulation and new energy concepts.

# THEMATIC AREA

## GENERAL CONDITIONS

Around one third of the landmass is wooded, which means there is an adequate supply of renewable, carbon-neutral fibrous material for paper production. CO<sub>2</sub> emissions continue to go down and most of the primary energy demand can be met by biomass power plants since the paper industry is continuously improving its energy efficiency. Recycling processes have become highly profitable and are frequently the basis of resource-neutral production and circuit closure. The precise labelling of goods and services has been made mandatory. Sustainability is a widely accepted principle governing the buying patterns of large consumer groups.

### **Understanding the complexity of paper**

The project gave me inspiring insights to identify new applications for paper materials and the associated research needs, i.e. which scientific groundwork will be necessary to realize them. Moreover, it confirmed my belief that even though we have largely optimised the technology of papermaking, we are only just beginning to understand the complex relationships between the structural and material properties of paper. A deeper, science-based understanding of the fascinating properties of paper materials will enable us to find many new applications with significantly more added value. New findings from fundamental research, for example on the interactions between paper and complex fluids or on new forming methods, will help us to systematically adjust and control the chemical and mechanical functions of paper products. To meet the challenges associated with future paper and fibre-based materials, we must cooperate closely in interdisciplinary networks that include

### **Ideas indirectly related to paper**

- ▶ **Fully automated waste sorting plants:** separate reusable, compostable and residual waste products and materials – large-scale plants for landfill sites, smaller ones for self-sufficient districts/buildings; higher sorting accuracy and optimised processes.
- ▶ **Small-scale biogas plants:** paper fibres are added to the plant biomass for decentralized energy generation in the basements of private houses.
- ▶ **Smart catalytic converters:** inverse papers are used instead of rare earth metals.

all parts of the value chain – from basic research to process technology, mechanical engineering and the implementation of products.



**Professor Dr. Markus Biesalski,**  
Chair of Macromolecular Chemistry and  
Paper Chemistry at TU Darmstadt  
[www.chemie.tu-darmstadt.de/map](http://www.chemie.tu-darmstadt.de/map)



### **We need better networks**

The “2030” project was definitely a step in the right direction. To cope with the enormous research demand associated with the many promising new applications for paper materials – for example in lightweight structures for mobility, architecture or nutrition – we must intensify our cooperation with industry. Paper scientists are often not adequately familiar with the procedures and constraints of industrial practice; and many companies tend to plan and think ahead only for the next two or three years. We scientists must look for industrial partners who are willing to broaden their horizons, keep abreast of their specific requirements and alert them of future opportunities well in advance. The Fibres & Paper 2030 project was a good example of how this can be done. I was very impressed by the great commitment of company representatives; all of them were actively involved all the time.

The project work helped me increase my focus on a number of new issues. Together with colleagues from other institutes and universities, we will now define relevant topics to launch the corresponding projects. Even though our academic community is not very big, we must build closer networks to better coordinate our research. We must attract more attention from politics and the public at large – also to overcome the outdated image of paper as a well-known, rather

boring material, and win more students to secure the future of this sector.

For this purpose, we will make interdisciplinary offers already to first-semester students, offer more optional courses and projects specifically geared towards young people. The “paper house”, a provisional accommodation for disaster areas we have recently presented in a nationwide campaign, or a paper-based boat for professional rowers designed by our students are very promising first examples. Together with initiatives like the Fibres & Paper 2030 project, this really gives me cause for hope and optimism.



**Professor Dr. Samuel Schabel,**

Chair of Paper Technology and Mechanical Engineering at TU Darmstadt

[www.pmv.tu-darmstadt.de](http://www.pmv.tu-darmstadt.de)

### **Ideas directly related to paper until 2030**

- ▶ **Bio bags:** a fibre-based, liquid-proof, recyclable and environment-friendly alternative.
- ▶ **Textile materials with paper fibres:** usefully combine the properties of cellulose and other natural fibres; paper-fibre substrates enable completely new materials and forming processes.
- ▶ **Electrically conductive paper:** lightweight circuit boards printed on paper or paperboard substrates are recyclable and sustainably available.
- ▶ **Water-saving production:** modified or completely “dry” manufacturing processes have massively reduced the demand for water and drying energy, costs and carbon dioxide emissions in manufacturing.
- ▶ **Base materials for electronic components:** combination of cutting-edge electronic components with low-cost papers, e.g. for sensor solutions that make documents visible only after verifying the reader by fingerprint identification.
- ▶ **“Healing paper”:** microencapsulation materials enable “self-healing” surfaces as basis for safer and more reliable components, to prevent permanent damage, reduce maintenance and repair work.

## Highly stimulating discussions

**Christoph Nover** participated in the “lateral thinkers” workshop in February 2015 as representative of SCHAEFER KALK, a globally acting family company based in Diez in Rhineland-Palatinate that has been manufacturing lime, calcium carbonate and dry mortar products since 1860. Mr. Nover is in charge of technical application development at Schaefer Kalk.



**Christoph Nover (PhD),**

Technical application development, SCHAEFER KALK

### How did you benefit from the brainstorming about future demands, Mr. Nover?

Our journey in the distant future, simulated by the core team’s description of how our world could be in many years from now, really changed my way of thinking. Demand was something I used to define on the basis of experience only, which is very limiting. Thinking about future scenarios helped me overcome this limitation.

### How did you like the work with other “lateral thinkers”?

It was stimulating and exciting to exchange views with people from completely different professional backgrounds, for example designers, and experience entirely new thought patterns. They added valuable philosophical and ethical aspects to our mainly technical discussions.

### Did the simulated journey in the distant future enable you to look at future issues from a different perspective?

The approach motivated me to develop “visionary” ideas and blank out some of the limitations firmly anchored in my unconscious. Looking far ahead in what is still a fictitious world today really stimulated my creativity. Dealing with scenarios that are far from being real felt like a game; I had to assume no responsibility for my ideas.

### What do you think about the retroplation method?

Before the project, I really underestimated how useful methods of this type can be. I will use them in future – also for other tasks.

### Looking back at the workshop and experiences you have gained, which advice would you give your colleagues or partners about the forecasting of future markets and innovations?

If you are referring to the method, I will encourage them to use comparable procedures – even though on a smaller scale – also for our core business. Regarding experiences or concrete results: I guess it will be difficult to introduce visionary ideas in our current projects – coping with the problems and tasks immediately ahead of us is challenging enough. Nevertheless, the workshop has left its mark on my way of thinking.

[www.schaeferkalk.de](http://www.schaeferkalk.de) ◀



*Active and motivated – the paper sector pools its resources to take up future challenges*

## Summary

The Fibres & Paper 2030 project has led to 640 innovative ideas about “paper for the future”. These were generated by a core team of 18 professionals from all parts of the paper chain and more than 100 people participating in guided interdisciplinary brainstorming workshops.

Paper is an innovative material that will form an integral part of everyday life even in areas where it is not or rarely used today: in logistics, vehicle construction, healthcare and architecture or in the aerospace industry, to name but a few. The detailed study of eight important spheres of life and industry has revealed numerous possible applications. Interdisciplinary cooperation and research in user networks will lead to new, sustainable solutions with great use value for a “future with paper”, for example:

## Future cities & Architecture

- ▶ Paper-based materials for acoustic, moisture and thermal insulation/air conditioning in houses and flats
- ▶ Paper as building material for low-cost, renewable, easily foldable emergency shelters in crisis or disaster areas
- ▶ Paper as heat-insulating, moisture-regulating aggregate/building material for external and internal walls and ceilings
- ▶ Self-cleaning lightweight construction elements with integrated illumination functions for facades
- ▶ Fibre-based cultivation areas for greening or food production (vertical farming concepts) on facades

## Living & Working

- ▶ Functionalised partitions and wallpapers with integrated sound protection or air conditioning functions
- ▶ Modular, foldable, sliding or moveable wall and furniture elements
- ▶ Electrically conductive papers for room elements that display texts or images /change colour or luminosity (chameleon effect)

# RESEARCH AIMS IN THEMATIC AREAS

- ▶ Antibacterial, hypoallergenic flooring made of fibre-based materials
- ▶ Smart paper blinds/curtains capable of responding to climate changes (light, temperature)
- ▶ Transparent or translucent roof elements made of reinforced, weather-resistant papers

## Mobility

- ▶ Fibre-based lightweight materials for vehicle and aircraft construction
- ▶ Fireproof interior linings for vehicles or airplanes
- ▶ Paper-based elements that can be formed into body parts and attachments by deep drawing
- ▶ Replaceable interior fittings for vehicles (e.g. floor carpets or seat covers for car sharing schemes)
- ▶ Dirt-repellent and self-restoring vehicle surfaces

## Health & Hygiene

- ▶ Portable filters for on-site water and air disinfection
- ▶ Handkerchiefs impregnated with curative or health-promoting substances

- ▶ Self-adhesive plaster/dressing materials impregnated with anti-inflammatory or wound-care agents
- ▶ Smart toilet papers with disease indicators
- ▶ Substrates for diagnostic systems
- ▶ Protective walls shielding from laser, electromagnetic or radioactive radiation
- ▶ Medical implants and prostheses/orthotics made of reinforced paper materials
- ▶ Antibacterial inserts for storage containers for surgical instruments

## Logistics

- ▶ Forgery-proof and anticorrosive packages
- ▶ Packages indicating the residual shelf life or possible spoilage of food by automatic colour changes
- ▶ Packages adapting themselves automatically to the size of packed goods to minimize transport volumes and CO2 emissions
- ▶ Absorbent papers for transporting hazardous goods
- ▶ Easy-to-open packages for older people or singles
- ▶ Integrated colour indicators informing about interruptions in the cold chain of food or medical drugs

### Attractiveness and expected time to market of ideas directly related to paper – supplier opinions

(Basis: 16 evaluations)

Future attractiveness to suppliers in the value chain of paper	great	0	2	2
	moderate	43	102	38
	small	84	66	38
		until 2020	2020 to 2025	2026 to 2030+
		Expected time to market		

50 % of the ideas directly related to paper seemed highly or moderately attractive to suppliers. 79 % were expected to generate business opportunities in the short- or medium term.

### Attractiveness and expected time to market of ideas directly related to paper – manufacturer opinions

(Basis: 16 evaluations)

Future attractiveness to manufacturers in the value chain of paper	great	29	32	8
	moderate	68	97	35
	small	30	41	35
		until 2020	2020 to 2025	2026 to 2030+
		Expected time to market		

18 % of the ideas seemed highly, and 53 % moderately attractive to manufacturers. Nearly half of them were thought to be feasible in the medium term (2020 - 2025). One third was expected to generate business opportunities in the near future.



### Information, Communication, Education & Knowledge

- ▶ Paper-based products with defined secondary uses (“Shelves made of used paperboard”)
- ▶ Interactive wallpapers with e-learning functions and gesture control
- ▶ Foldable displays and touchscreens
- ▶ Repeatedly rewriteable papers
- ▶ Paper substrates making it possible to read in the dark

### Nutrition

- ▶ Paper-based components for planters or modular lightweight greenhouses
- ▶ Nutrient-enriched functional fibre mats as cultivation substrates for seedlings
- ▶ Paper mats or tarpaulins as thermal insulation for agricultural areas
- ▶ Cellulose materials as edible substrates that can be enriched with specific nutrients and flavourings
- ▶ Techniques enabling the increased use of residues from agriculture for papermaking

### General conditions

- ▶ Water-resistant papers that can be used instead of plastic or textile tarpaulins
- ▶ Fire-resistant papers for barrier structures in and between buildings
- ▶ Fabrics made of natural and paper fibre combinations for “green” clothes
- ▶ New converting techniques like foam forming or deep drawing
- ▶ 3D-printing methods for fibre-based substrates making it possible to develop/manufacture new classes of materials
- ▶ Paper-fibre composites for mechanical engineering and automated manufacturing
- ▶ Electrically conductive, low-cost substrates for digital storage media and mass detection

### Attractiveness and expected time to market of ideas directly related to paper – converter opinions

(Basis: 16 evaluations)

Future attractiveness to converters in the value chain of paper	great	55	36	5
	moderate	63	117	34
	small	9	17	39
		until 2020	nach 2020 bis 2025	ab 2026 bis 2030+
<b>Expected time to market</b>				

Converters regarded 26 % of the ideas as highly and 57 % as moderately attractive. Almost 80 % of the ideas were expected to be ready for marketing in the medium or short term. 93 % of ideas with short time to market and 90 % of the ones with medium time to market were regarded as moderately or highly attractive.

### Attractiveness and expected time to market of ideas directly related to paper – new business models

(Basis: 16 evaluations)

Future attractiveness to new business models in the value chain of paper	great	1	4	3
	moderate	14	63	45
	small	39	72	25
		until 2020	2020 to 2025	2026 to 2030+
<b>Expected time to market</b>				

The core team considered 71 % of the 375 ideas directly related to paper capable of generating new business models, 46 % of them were considered to be moderately and 3 % highly attractive. Among the 265 ideas indirectly related to paper, 6 % were regarded as highly and 37 % as moderately attractive to the future value chain of paper. 63 % were thought to be capable of serving short- or medium-term market demands. It should therefore be investigated by interdisciplinary discussion which (and how) ongoing R&D projects could help realizing them.

# Traditional strength

The German paper industry is the forth-largest in the world. Its companies owe their strong standing in international competition to the support of powerful trade associations, the

excellent quality of fundamental and application-oriented research carried out in universities and specialized institutes, and the efficient cooperation of all partners involved in the value chain.





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