



2026 PCA International Conference

Fraunhofer: Reach Services and Monoterpene Platform

The Fraunhofer-Gesellschaft

Founded in Munich on March 26, 1949



As part of Germany's reorganization and expansion of its research infrastructure, the Fraunhofer-Gesellschaft was founded in Munich on March 26, 1949. We are named after Joseph von Fraunhofer - researcher, inventor and entrepreneur.

The mission: Applied research

Turning research into real-world impact



The Fraunhofer-Gesellschaft at a glance

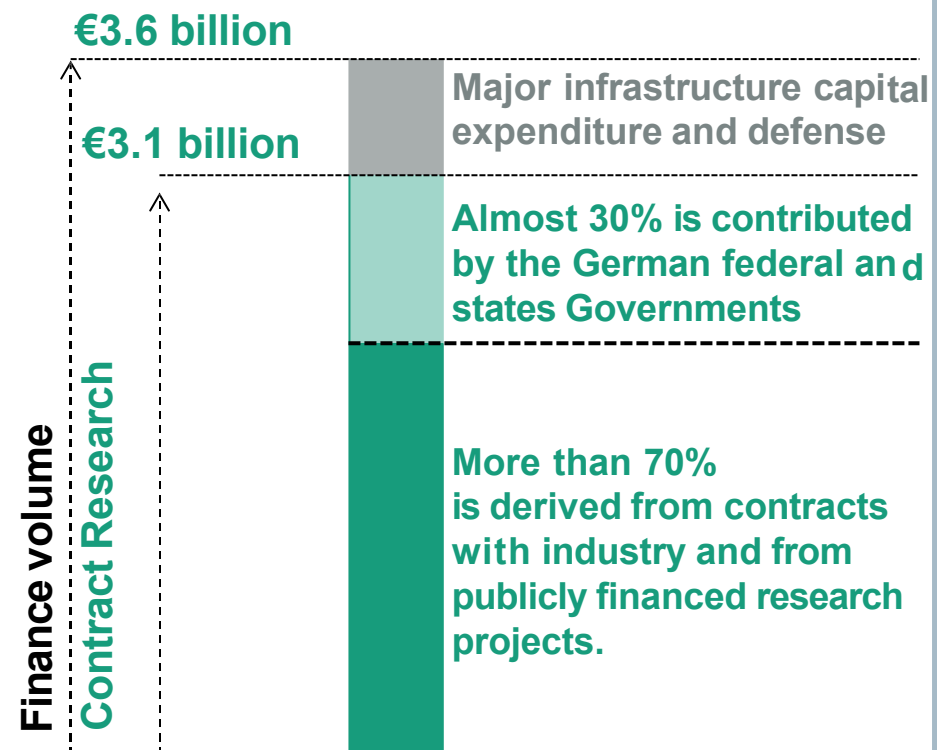
Applied research focusing on key future-relevant technologies and the commercialization of findings in business and industry. A trailblazer and trendsetter in innovative developments.



32,000 staff



75 institutes and research units



Fraunhofer-Gesellschaft

The Fraunhofer-Gesellschaft's global network

8 legally independent foreign affiliates
1 opening soon

Active collaboration with partners in roughly 90 countries

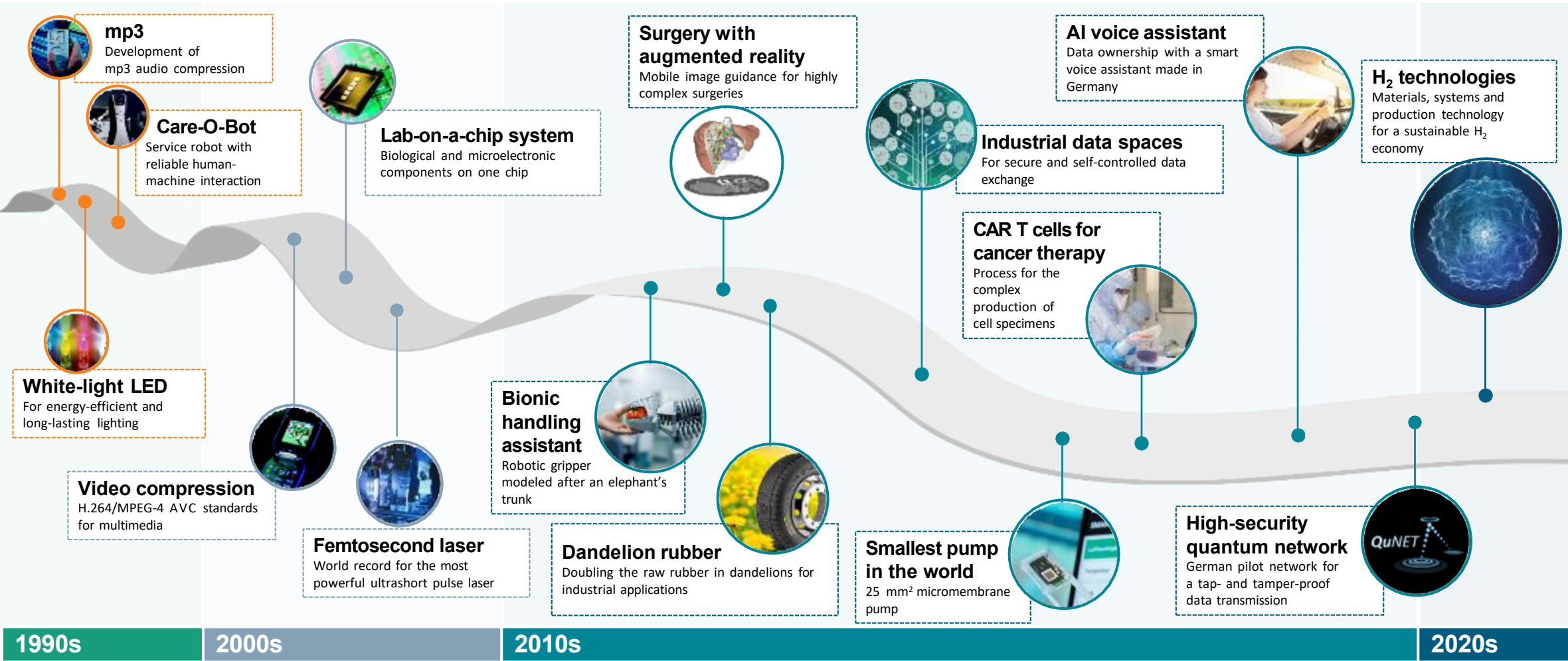
5 representative offices
build bridges to local markets around the world

- | | |
|-------------------------|-----------------------|
| ● Foreign affiliate | ● ICON project |
| ● Center | ● R&D (miscellaneous) |
| ● Representative office | ○ opening soon |
| ● Innovation platform | |



Fraunhofer Research

Highlights





Fraunhofer ITEM

Chemical Safety Assessment and Toxicology

Dr. Oliver Licht, Fraunhofer ITEM

Fraunhofer ITEM in Hannover

Institute for Toxicology and Experimental Medicine

Founded: 1981

Chemical Safety and Toxicology

- Mechanistic toxicology (in-vitro test systems and genotoxicity)
- Bioinformatics
- In-silico toxicology
- Medical devices
- Inhalation-toxicology
- Bio- und Environmental Analysis
- **Regulatory Affairs / Regulatory Risk Assessment**

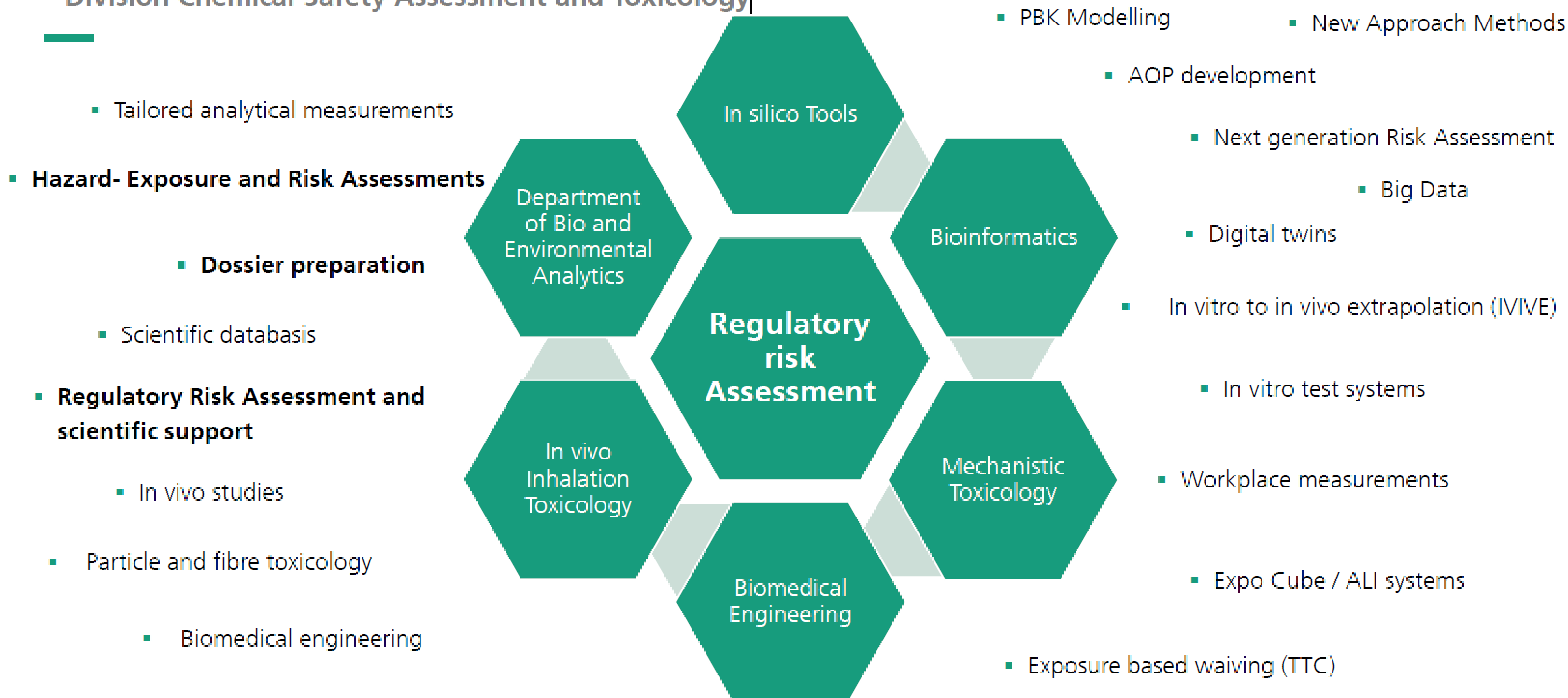
Preclinical Pharmacology and Toxicology

Airway Reserach



Fraunhofer ITEM in Hannover

Division Chemical Safety Assessment and Toxicology



Assessment and authorization of industrial chemicals (REACH)

REACH regulation: Support with regulatory affairs in the registration of chemical substances.

- Industrial chemicals need to be registered according to the **EU REACH chemicals regulation (EU 1907/2006)**
- **We support you in several scientific and regulatory matters:**
 - Strategic decision-making and development of tailored solutions for complex issues
 - Evaluating existing data and assessing potential hazards
 - Conducting data gap analyses
 - Supporting and commissioning standard toxicological studies, study monitoring, dossier preparation
 - Utilizing read-across or bridging principles, integrated testing strategies, and specific in vitro methods
 - Hazard-, Exposure- and Risk assessments of existing and new substances
 - Dossier updates
- **Our aim:**
 - Reduce risks to human health and the environment
 - Without taking of the desired reduction in animal testing (3R principle).
- **Our experience:** > 20 years of experience in the support in scientific and regulatory affairs of chemicals

Contact

Dr. Oliver Licht
Fraunhofer Institute for Toxicology and Experimental Medicine
Division of Safety Assessment and Toxicology
Nikolai-Fuchs-Strasse 1, 30625 Hannover, Germany
Phone 49 511 5350-334
oliver.licht@item.fraunhofer.de
www.item.fraunhofer.de



Fraunhofer Institute for Toxicology and
Experimental Medicine





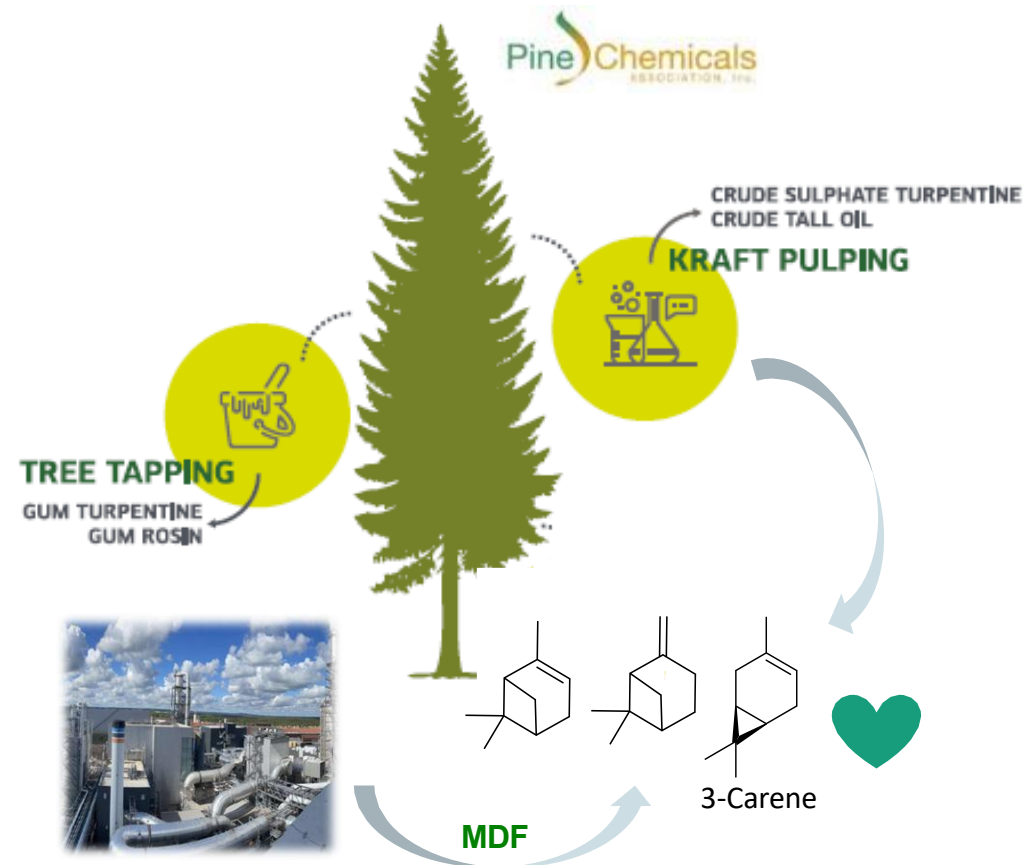
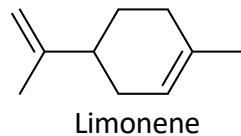
The Monoterpene Platform

Dr. Paul Stockmann, Fraunhofer IGB

Monoterpenes as a resource – sources of supply



<https://pixabay.com/de/illustrations/ai-generiert-orangensaft-trinken-7923488/>



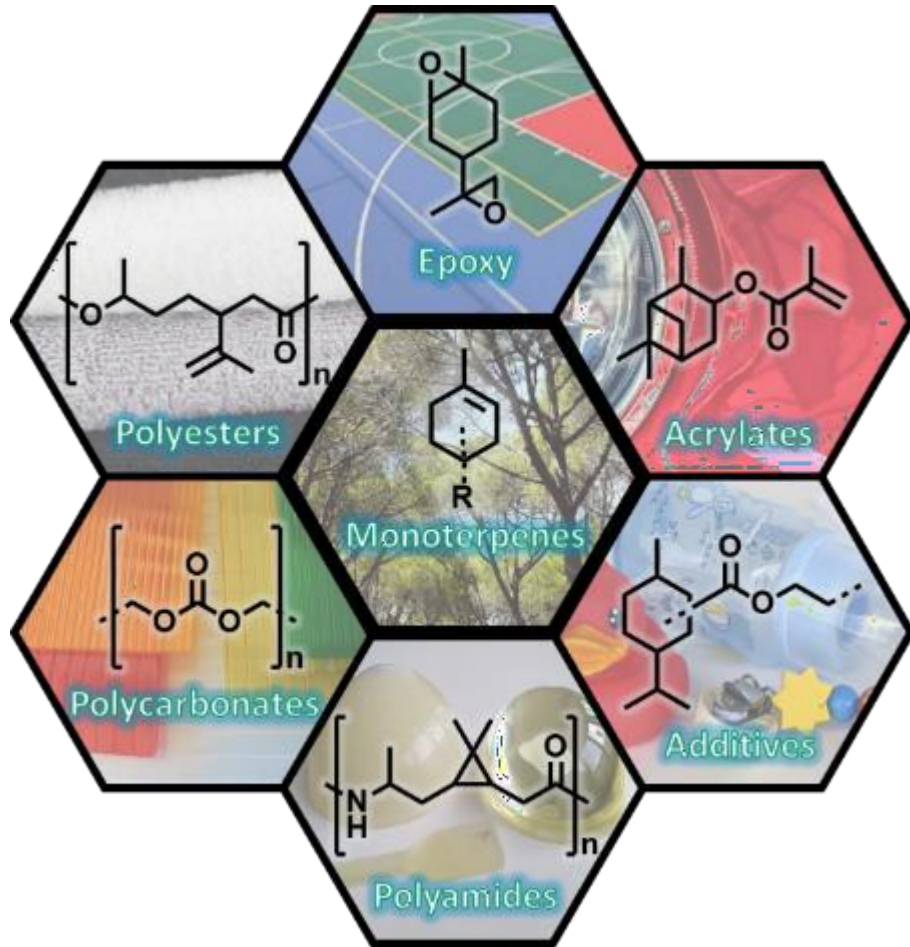
Suitable^[1]

- Availability
- Quality
- Stability
- No food competition (side streams)

And

New chemical structures
Entry point for chemical
Conversion
+ **similar to fossil oil**

Fraunhofer Monoterpene platform^[2]



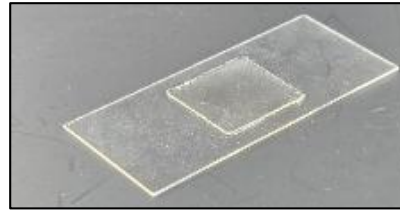
The potential of monoterpenes:

- Abundant secondary plant metabolites
- Replace/enhance petrochemical products in industrial (plastic) applications
- Structural variety – **bio-advantaged properties**

What we do:

- Synthesis of various monoterpene-based small molecules
- Synthesis of monoterpene-based polymers
- Analysis (small molecules and polymer)
- Scale up
- Contract research
- **Structure-property relationships**

Monoterpene Platform – highlight developments



Bio-polyamides (Caramide, TRL 4-5)

- Patented
- 100% biobased (from 3-carene)
- Cast polyamides (USP)
- Thermal high-performance (T_g up to 120 °C)
- Foams (USP)
- Fibers
- Semi-crystalline
- Amorphous (transparent)
- Soluble types (recycling)
- Monomers in kg scale

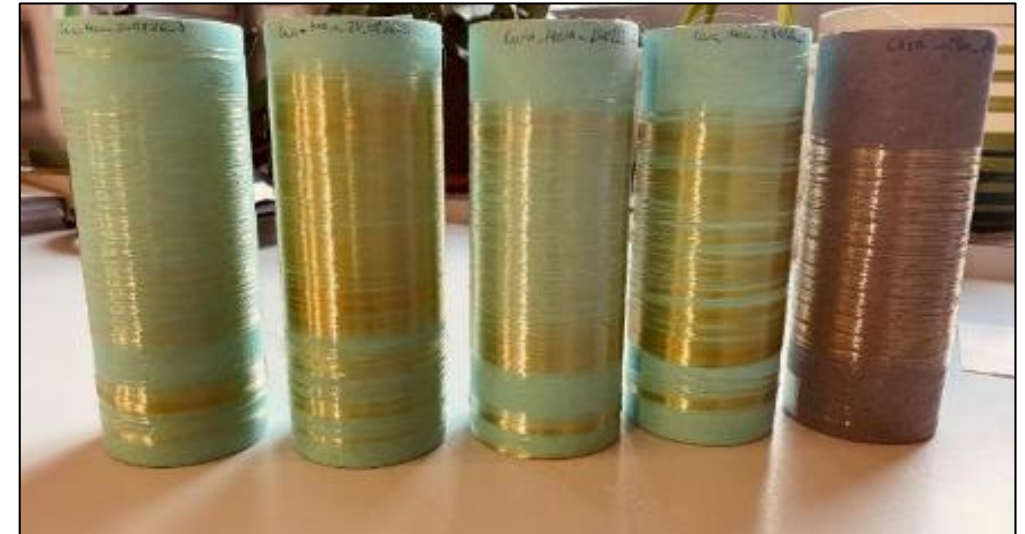
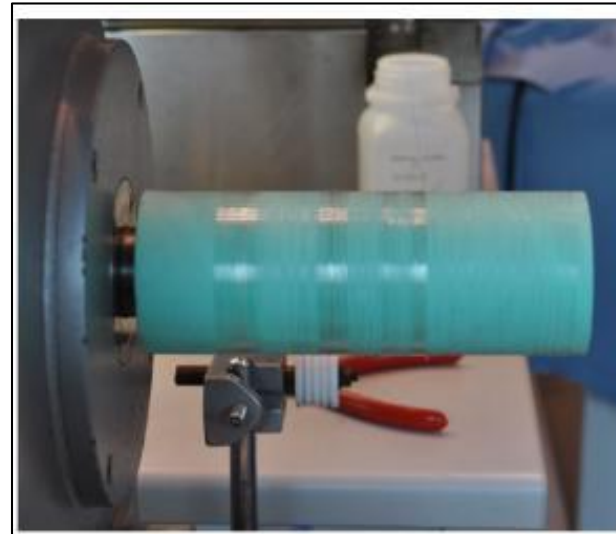
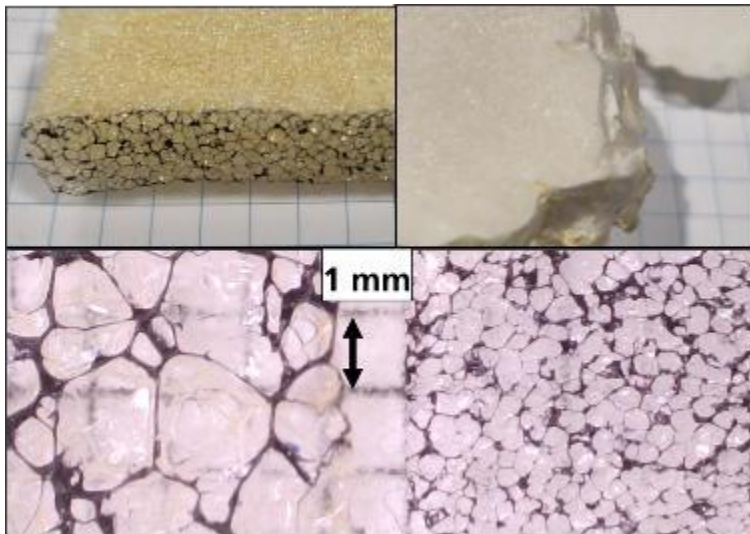
Monoterpene-Methacrylates (TRL 4-5)

- Patent pending
- High bio-content (> 72 %)
- Adhesives & Coatings
- Anti-adhesive/anti-biofilm properties
- Adjustable mechanics
- Adjustable polarity
- Adjustable thermal properties
- Adjustable renewable carbon content
- Suitable in DLP 3D printing
- Monomers in kg scale (from 3-carene)

Monoterpene-plasticizers (TRL 4-5)

- Synthesis from α and β -pinene, 3-carene, limonene, terpinene and mixtures
- High bio-content (> 80 %)
- Additional stabilization effect
- (Bio-)polyesters like PLA
- Polyvinylchloride (PVC)
- Phthalate-free
- Decreased migration
- Plasticizers in kg scale

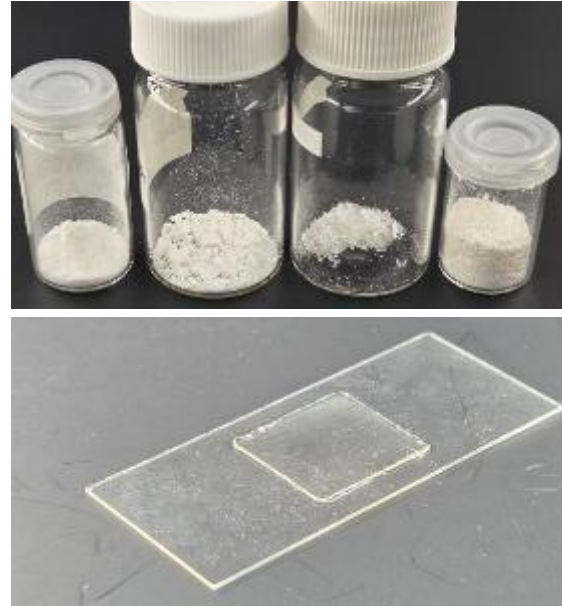
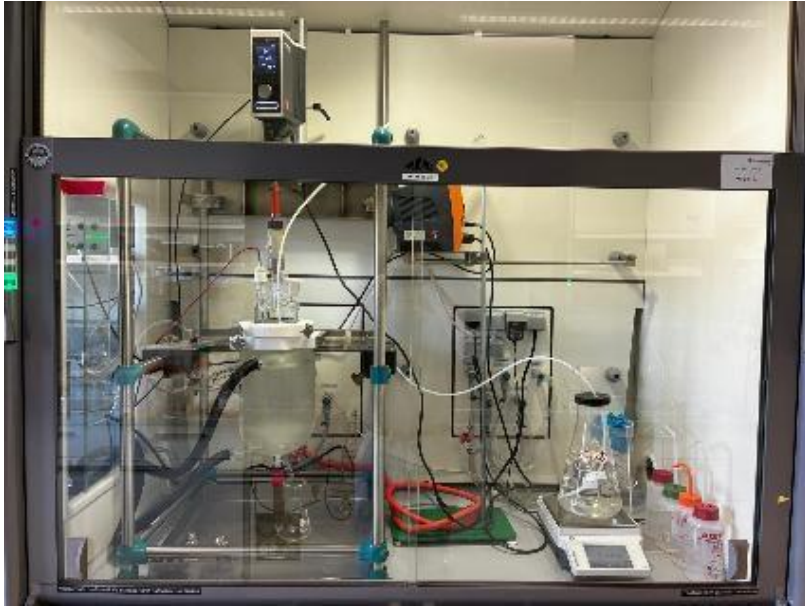
Monoterpene Platform – lab impressions Caramide



Monoterpene Platform – lab impressions Caramide/PA6 flexible foam



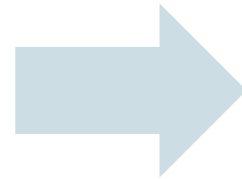
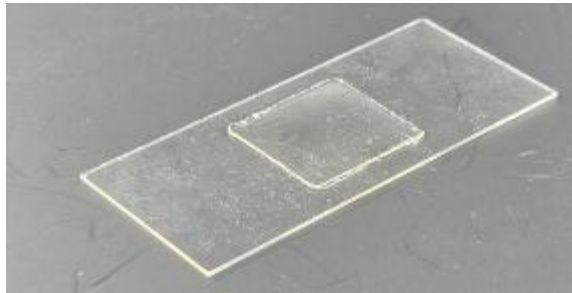
Monoterpene Platform – lab impressions 3-carene-based methacrylates



Industrial adhesive validation:

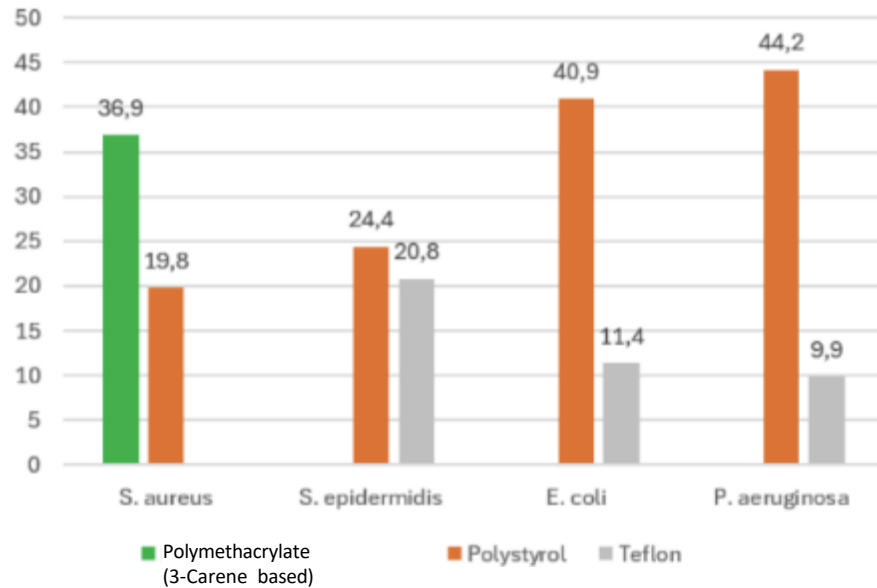
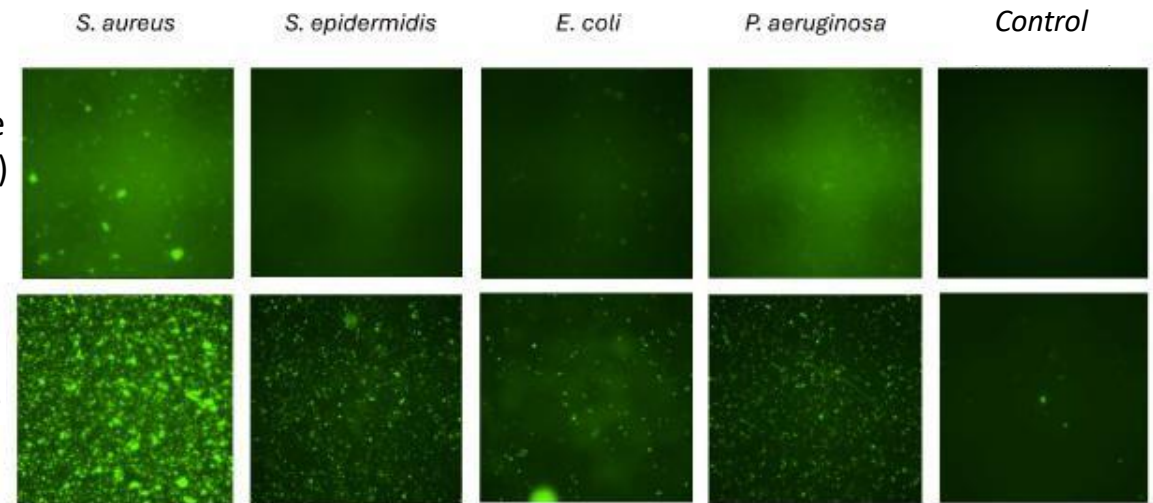
- Compatible in commercial formulations
- Vs. glyfoma: higher reactivity, increased transparency, increased temperature resistance, increased adhesion to polycarbonate

MTA: Anti-adhesion behavior (cross-linked coatings)

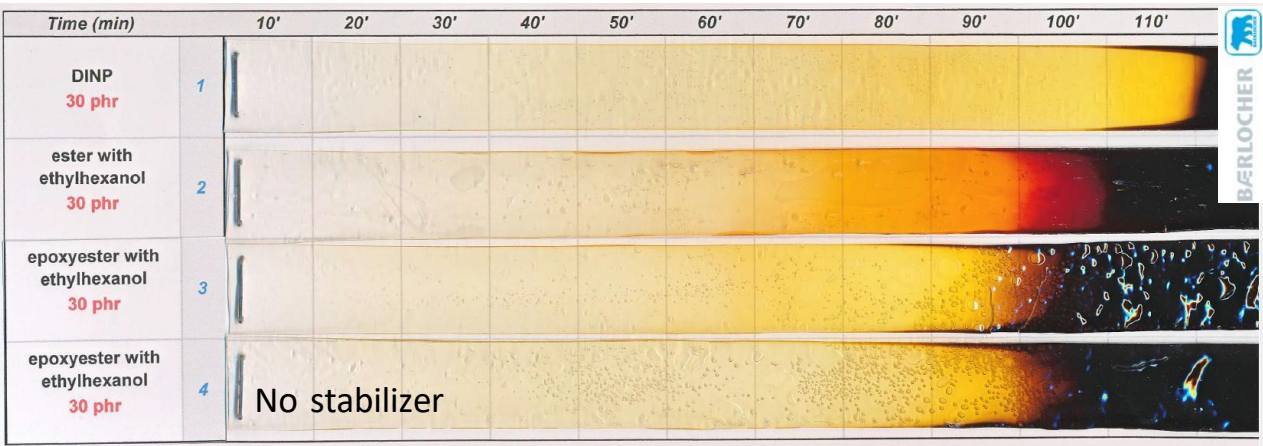
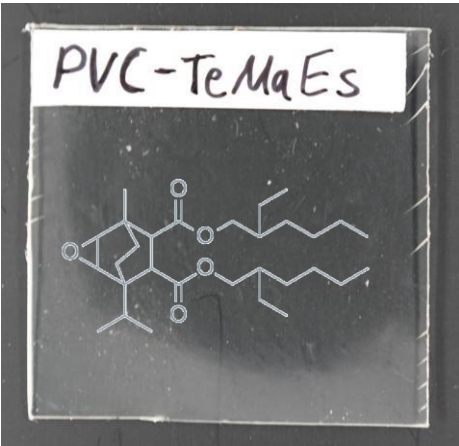


Polymethacrylate
(3-Carene based)

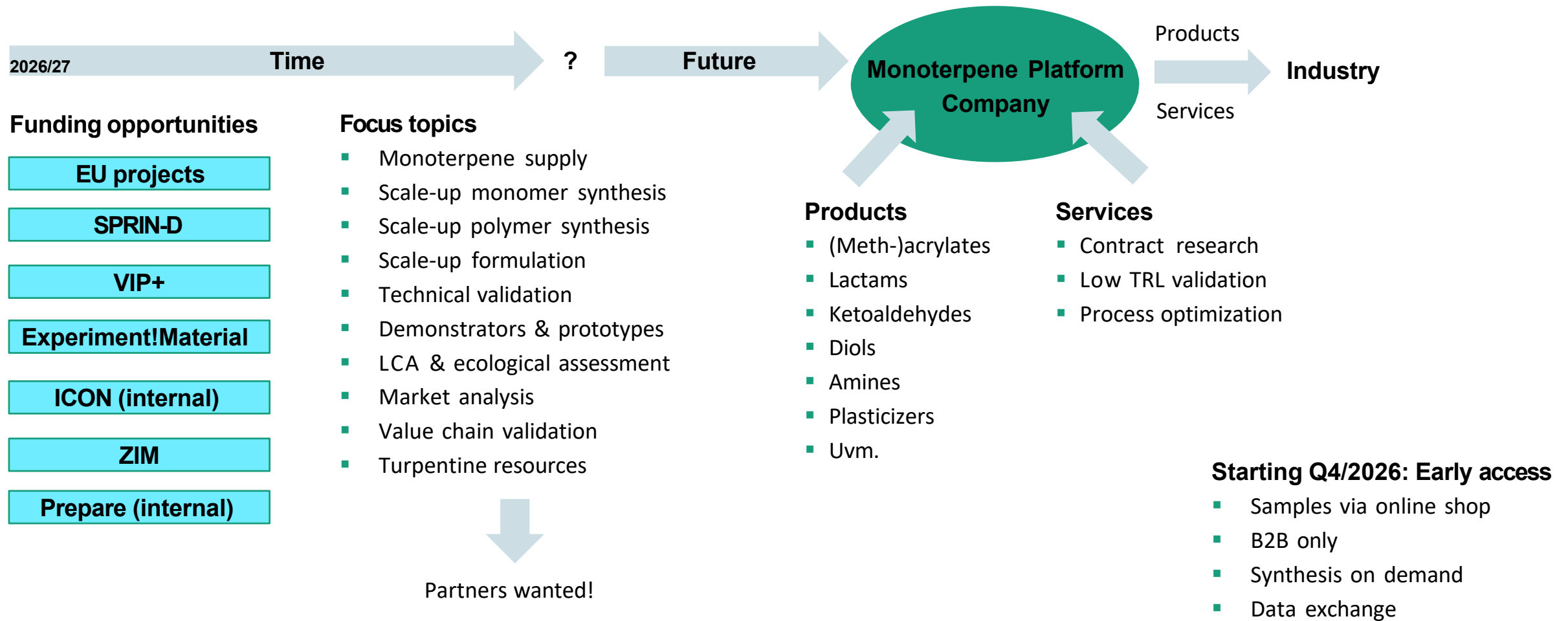
Control
Polystyrene



Monoterpene Platform – lab impressions plasticizers



Timeline Monoterpene platform



Contact



Fraunhofer Institute for Interfacial
Engineering and Biotechnology IGB

Dr. Paul Stockmann
Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB
Bio, Electro and Chemocatalysis BioCat, Straubing branch
Innovative Synthesis Processes
Group Manager Biobased Polymers and Additives
Schulgasse 11a, 94315 Straubing, Germany
Phone [0] +49 9421 9380-1004
paul.stockmann@igb.fraunhofer.de
www.igb.fraunhofer.de

