

EASA Sandwich Structure Meeting New Sandwich Core Material Developments (at EconCore)

Jochen Pflug, EconCore N.V.

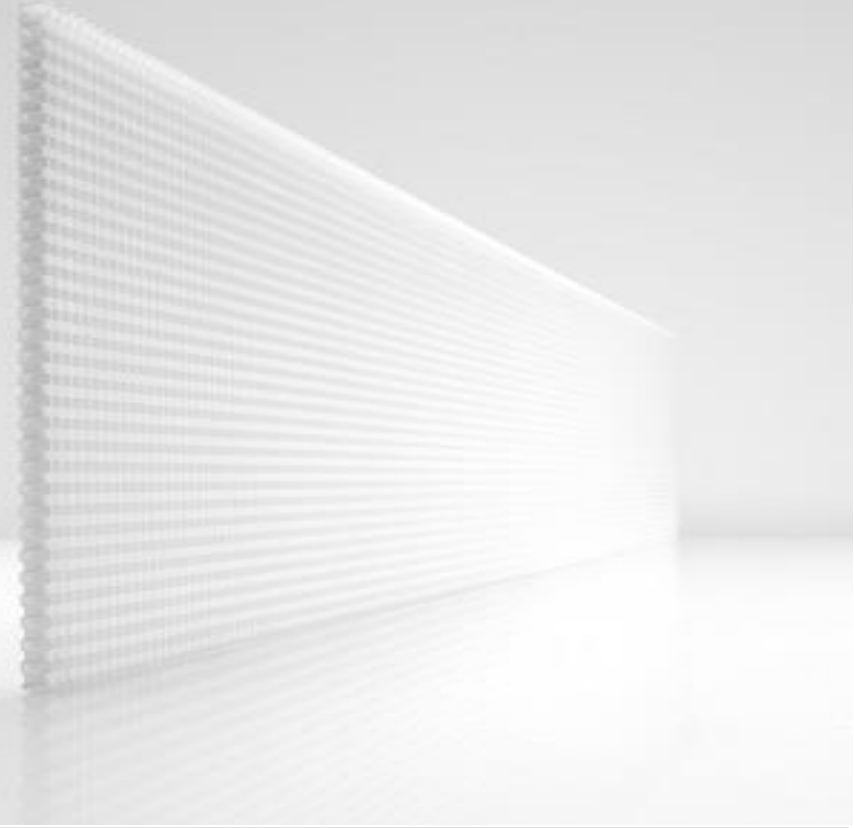
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Dirk Vandepitte, KU Leuven, Department Mechanical Engineering, Division PMA

Cologne, 18th October 2016

Presentation overview

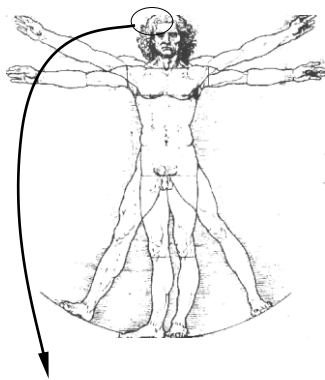
Content:

- Introduction to honeycomb production
- Continuous production and structure of EconCore's thermoplastic honeycombs
- Thermoplastic honeycomb sandwich preforms and processing to sandwich parts
- Hierarchical sandwich honeycomb cores and their additive production process



Introduction: Sandwich construction by nature

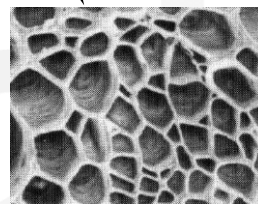
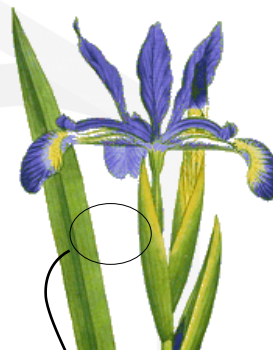
The efficient use of material and energy is a fundamental principle of nature



Section of a human skull



Section of a bird wing



Section of an iris leaf



Honeybee comb

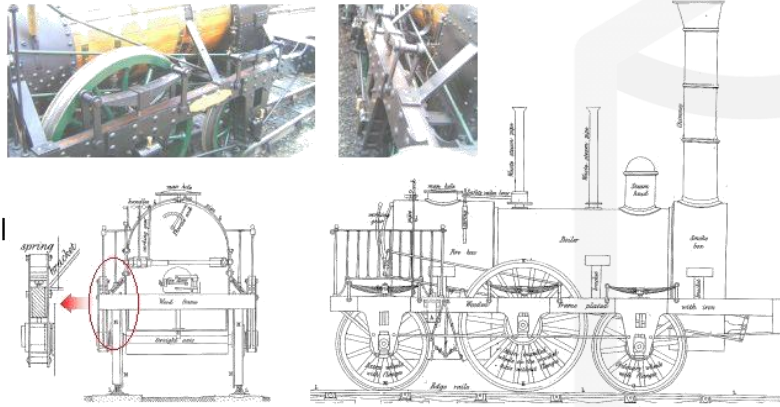


Sandwich construction saves resources and reduces costs

Introduction: Sandwich construction in transportation

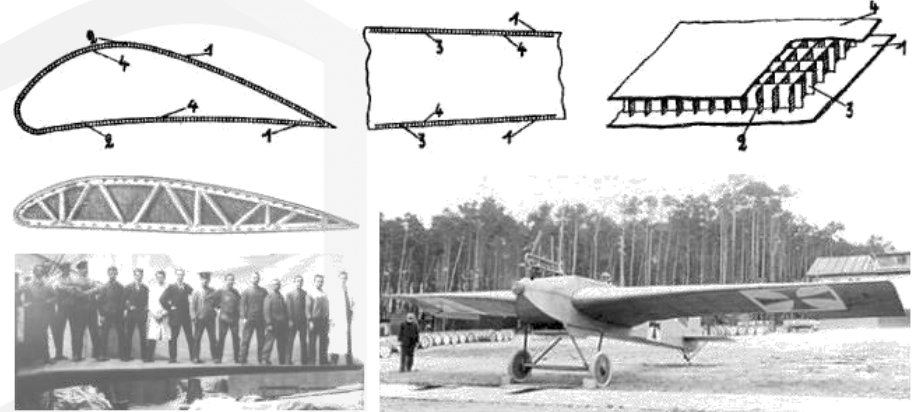
Historical examples of sandwich construction in transportation

Robert Stephenson 1830



Robert Stephenson used sandwich constructions in trains (1830) and bridges (1845)

Hugo Junkers 1915



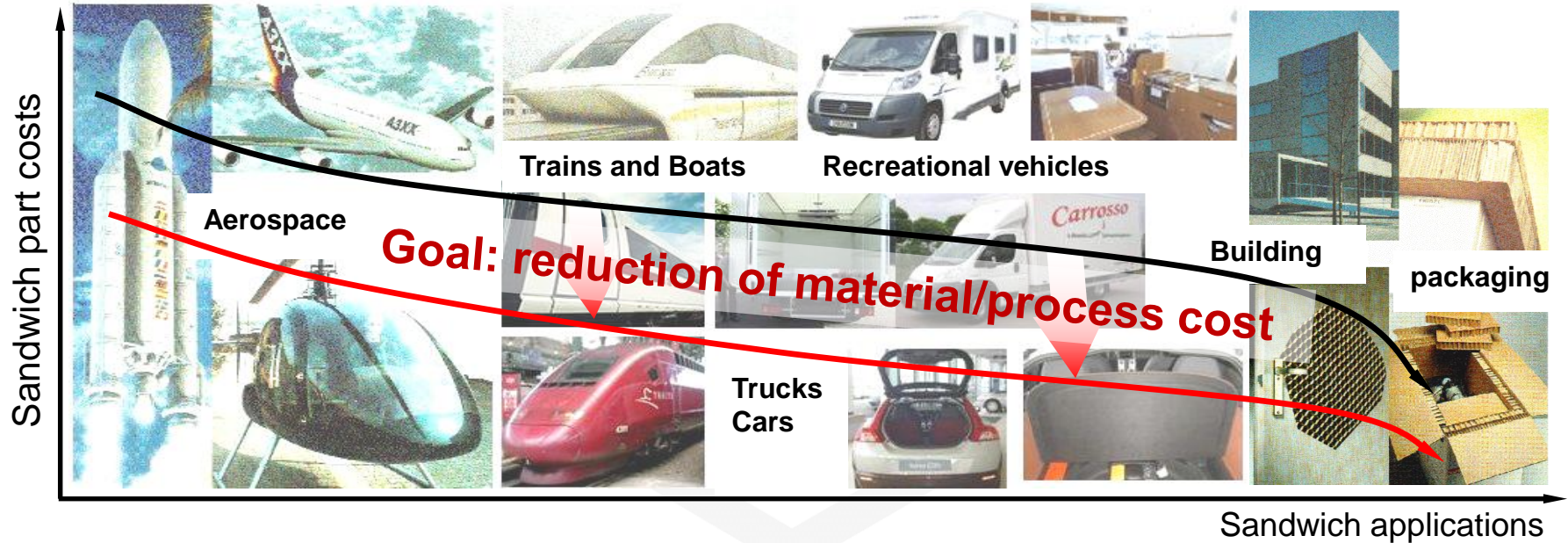
Hugo Junkers patented honeycomb cores and used corrugated sheets in the sandwich wing of the first modern aircraft (1915)



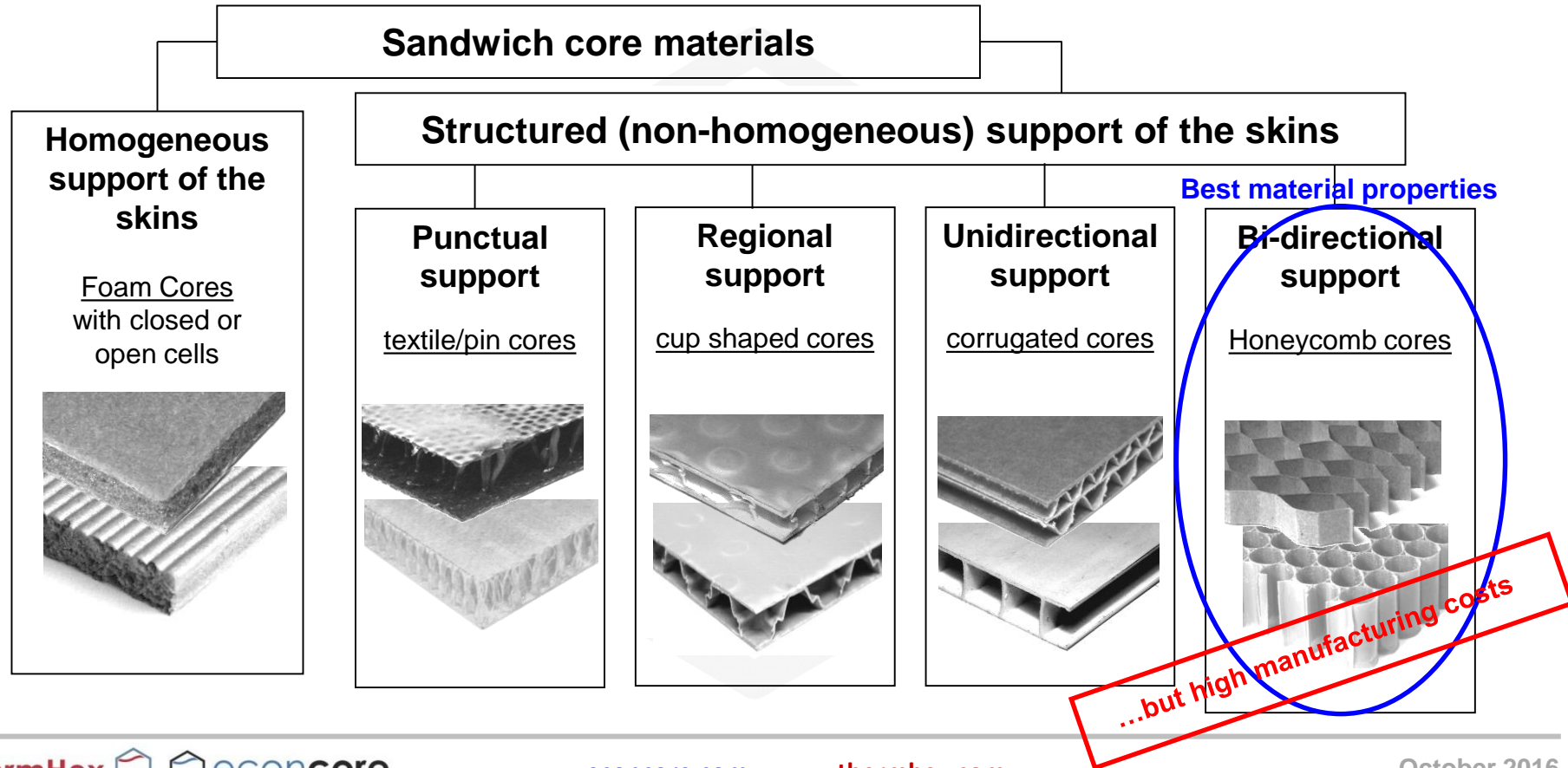
Sandwich construction made innovations in transportation possible

Sandwich construction today

Sandwich construction is used today in various industries

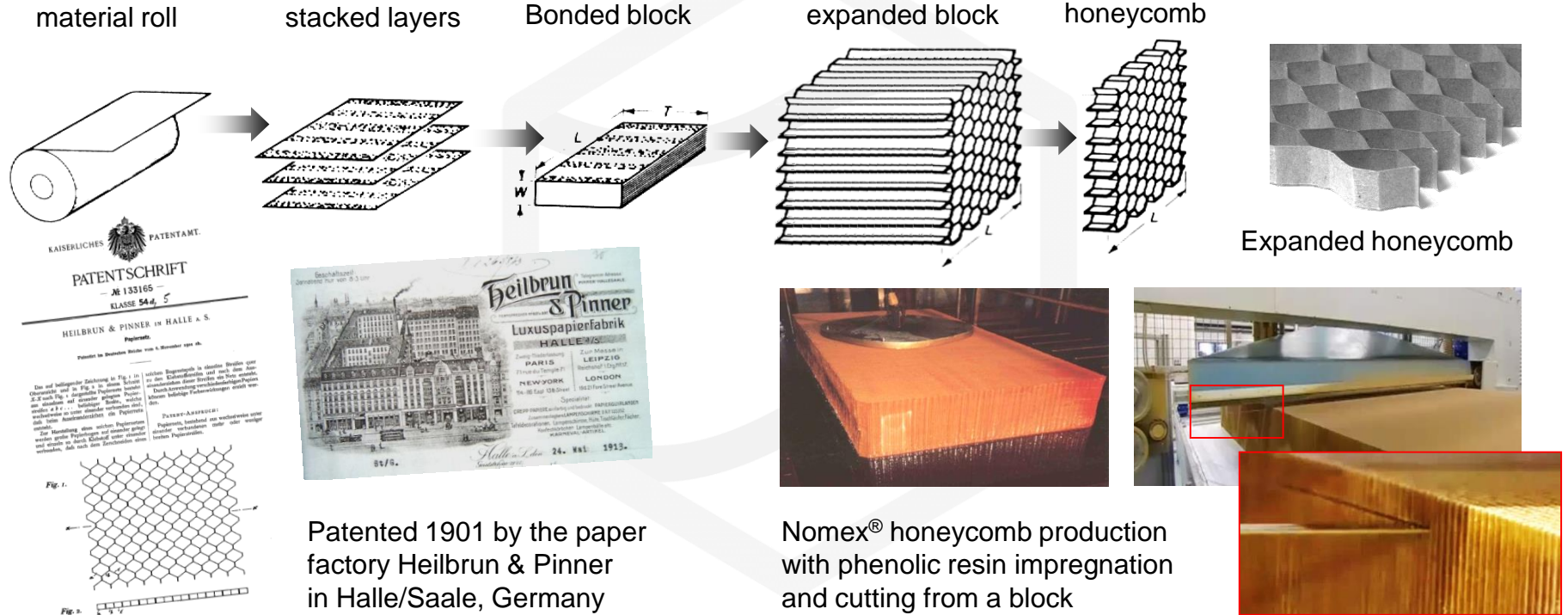


Classification and comparison of sandwich core materials



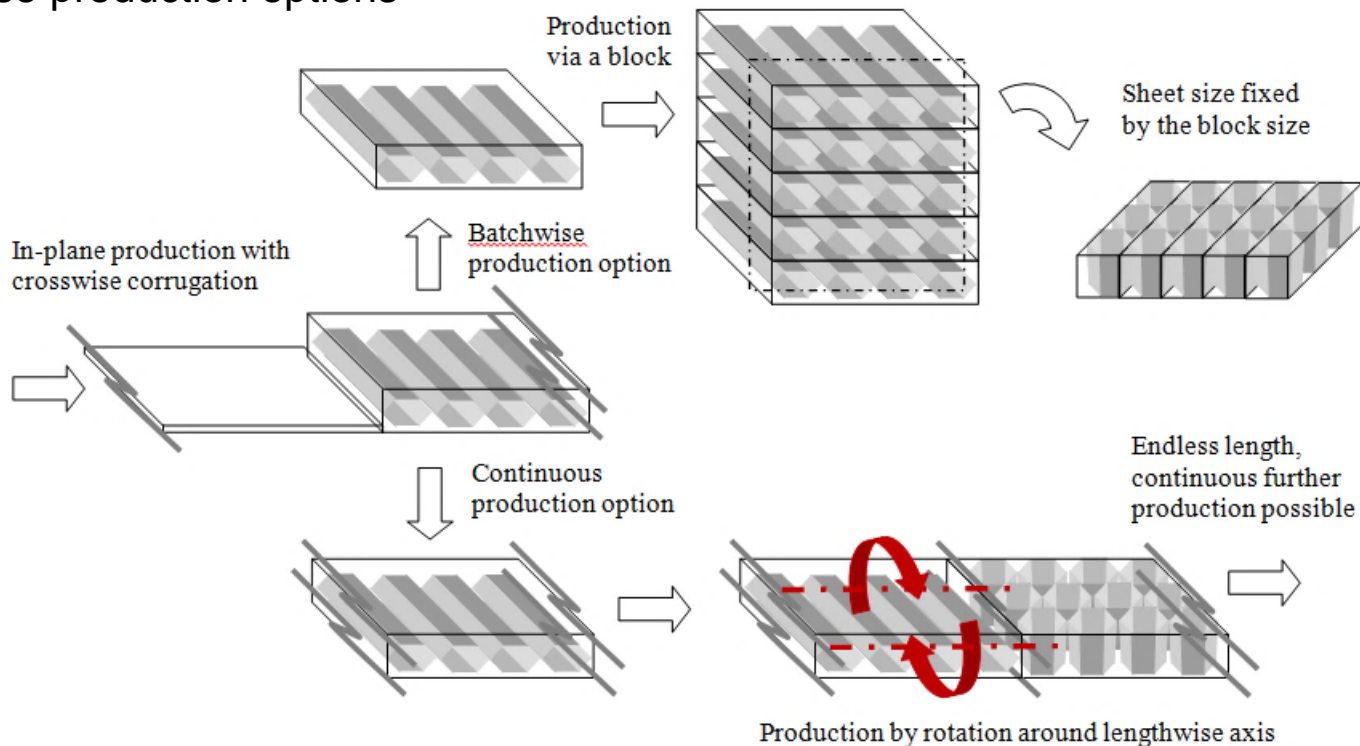
Conventional honeycomb production

Honeycomb production via expansion and cutting from a block



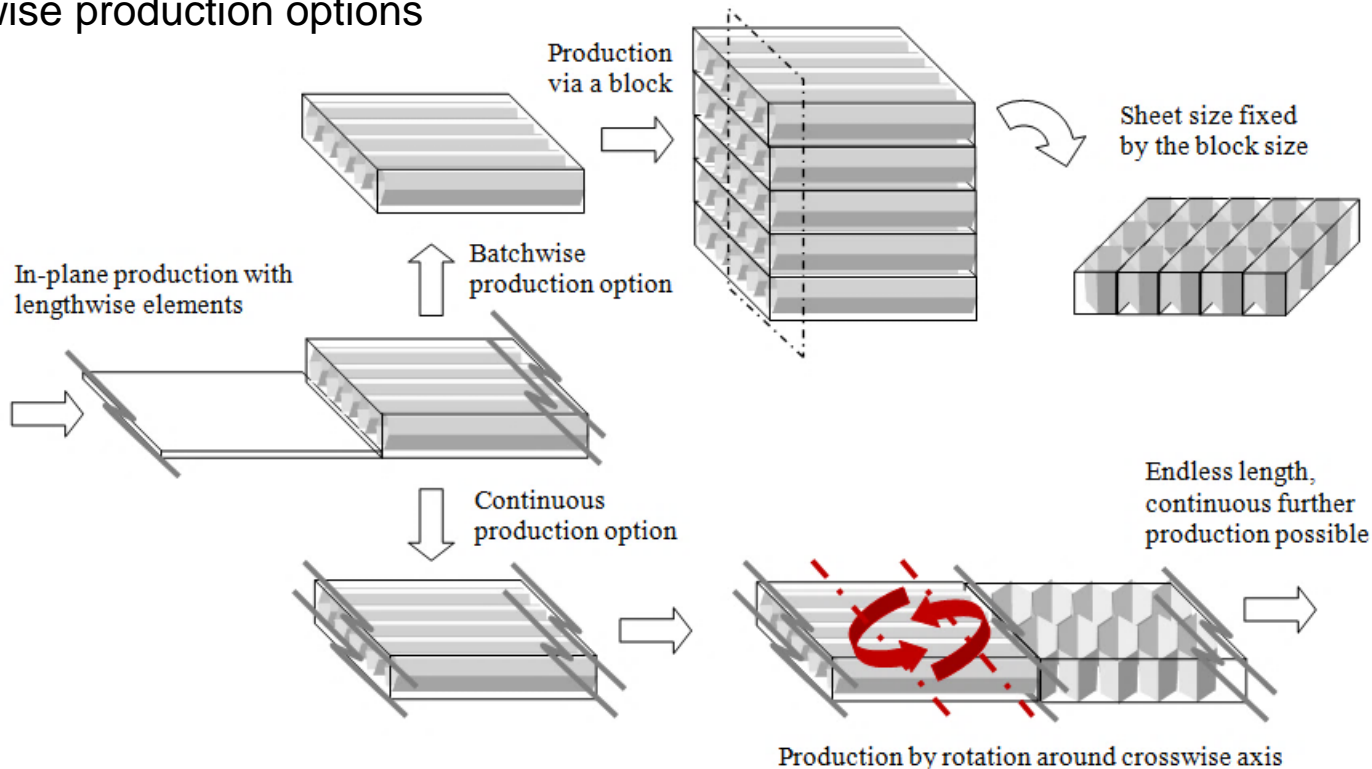
Production with crosswise creation of the geometrical elements

- Crosswise production options



Production with lengthwise creation of the geometrical elements

- Lengthwise production options



Continuous production process for thermoplastic honeycomb

Aerospace industry



Internal structure
and mechanical
properties

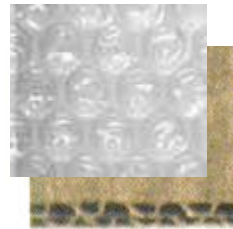
- ⇒ best mechanical properties
- ⇒ very low weight

New Honeycomb Cores

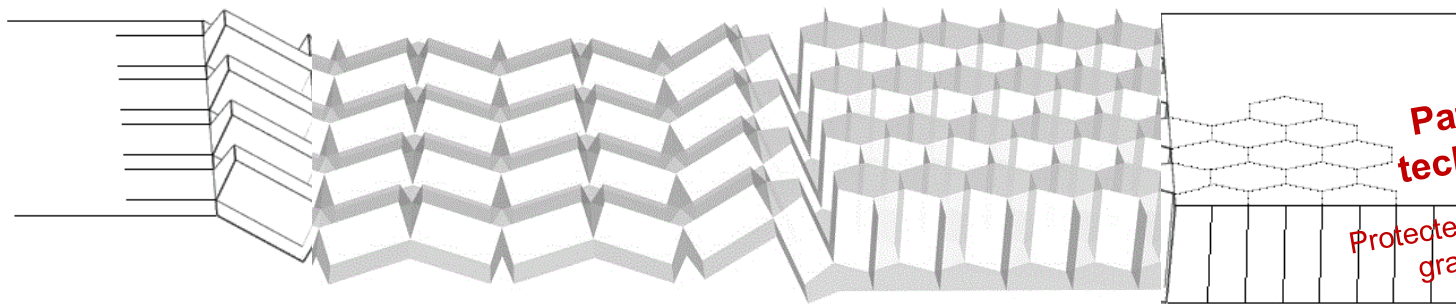
ThermHex
Thermoplastic Honeycomb

Packaging industry

Production concept
and machinery

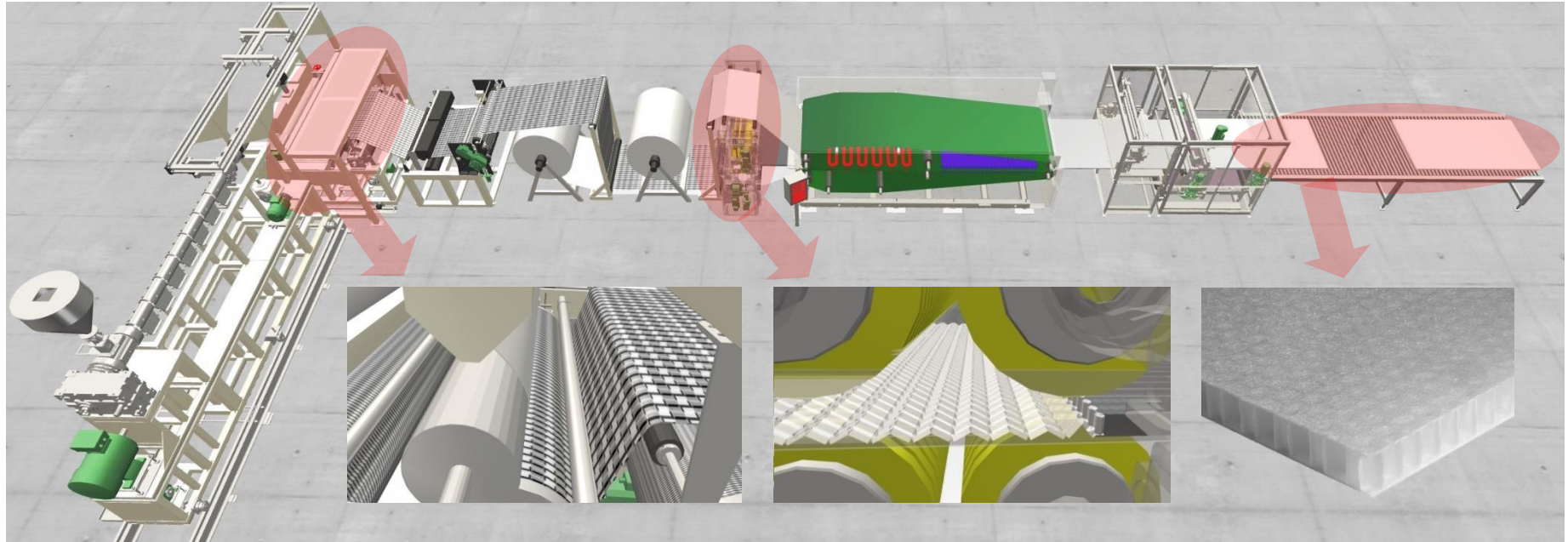


- ⇒ Automatic production
- ⇒ low production costs



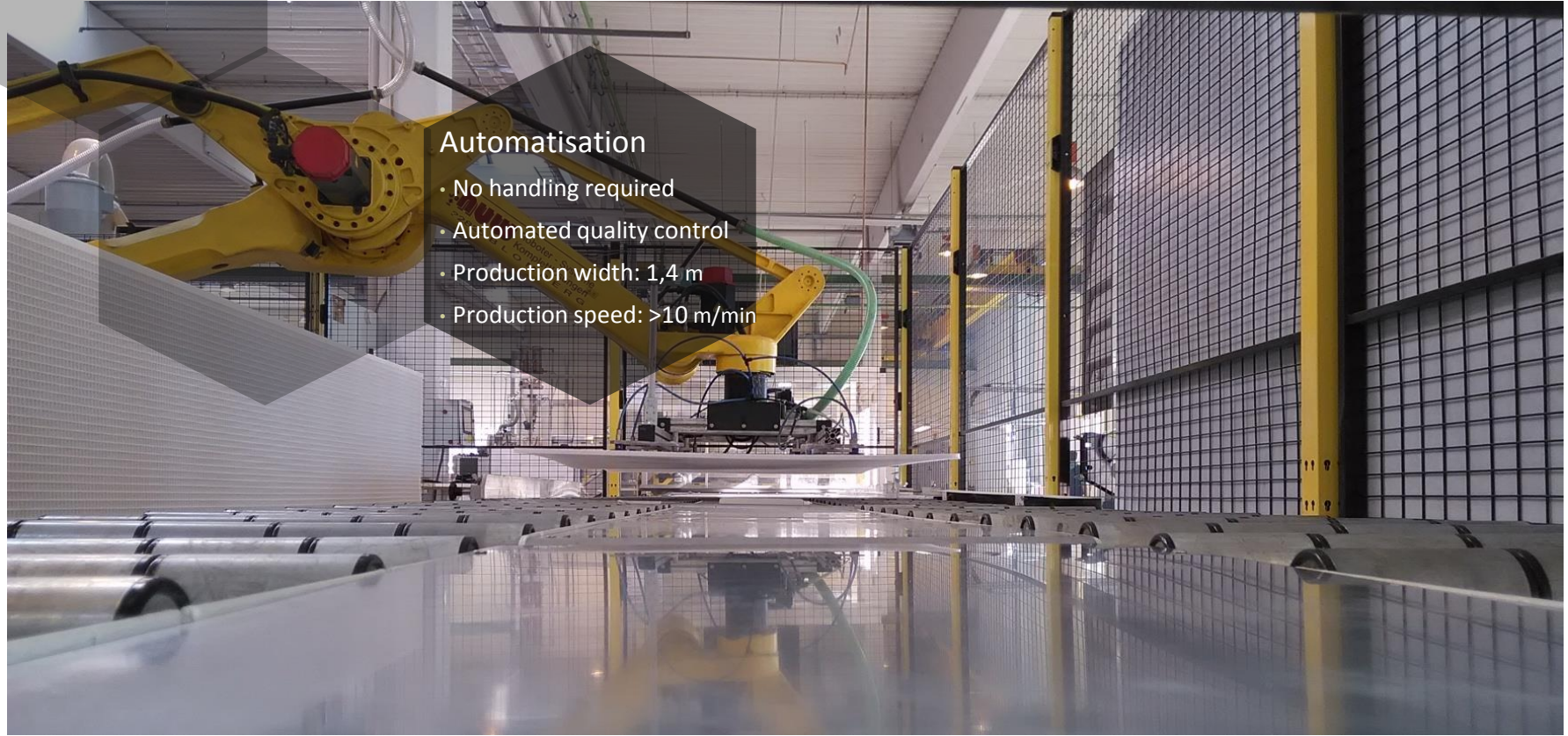
Minimal production costs by automated in-line production

ThermHex production line in Halle/Saale



The production process reduces weight, use of material and costs to a minimum

ThermHex production line



Automatisation

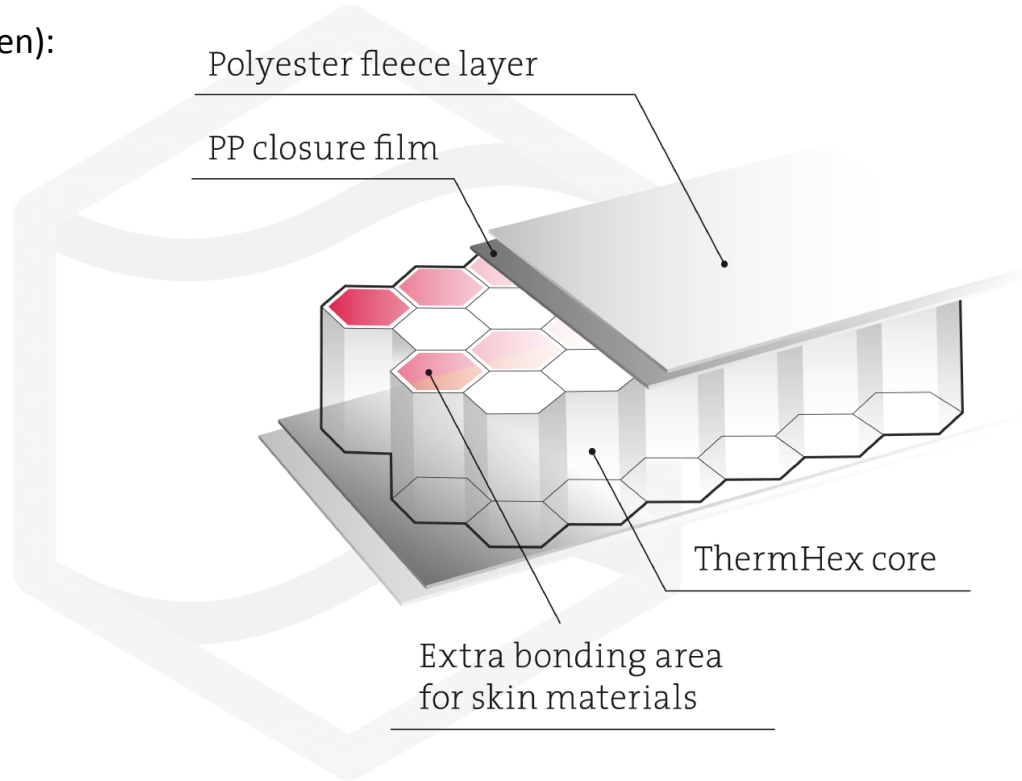
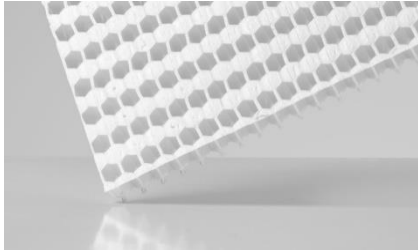
- No handling required
- Automated quality control
- Production width: 1,4 m
- Production speed: >10 m/min

ThermHex PP Honeycomb Core

THPP80-FN (with PET nonwoven):

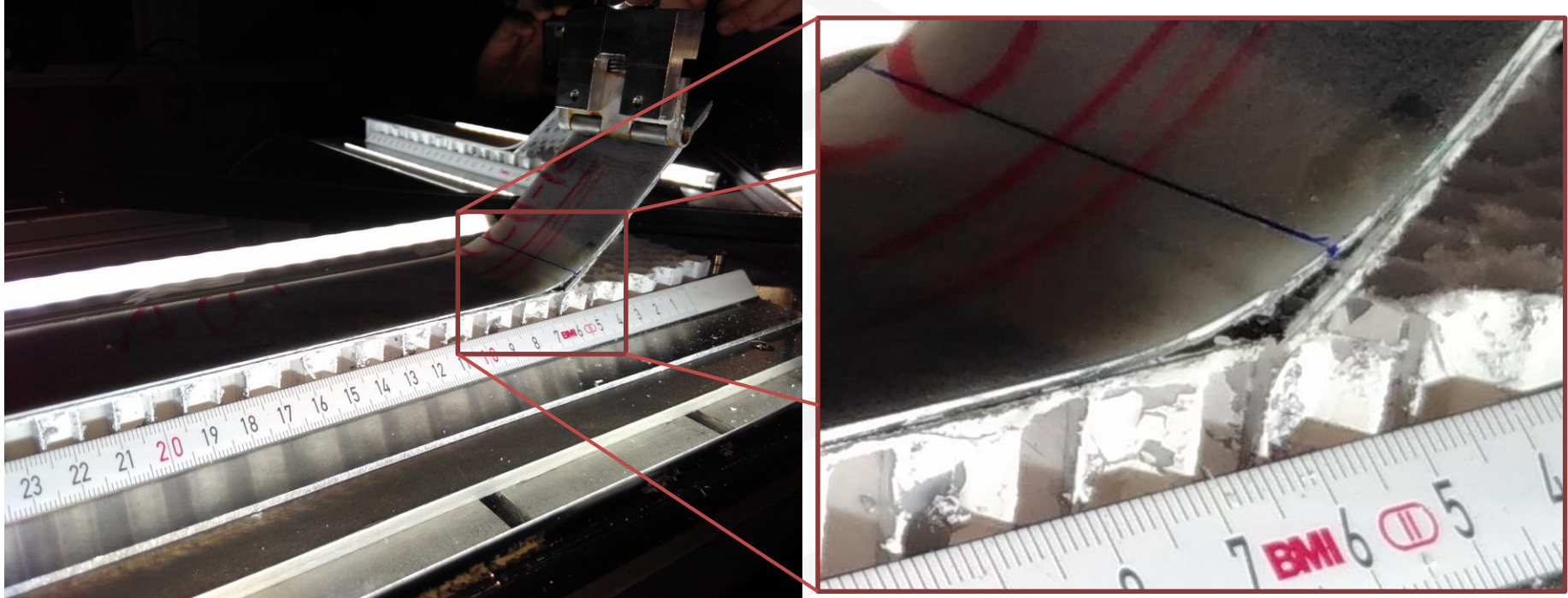


THPP80 (naked honeycomb):

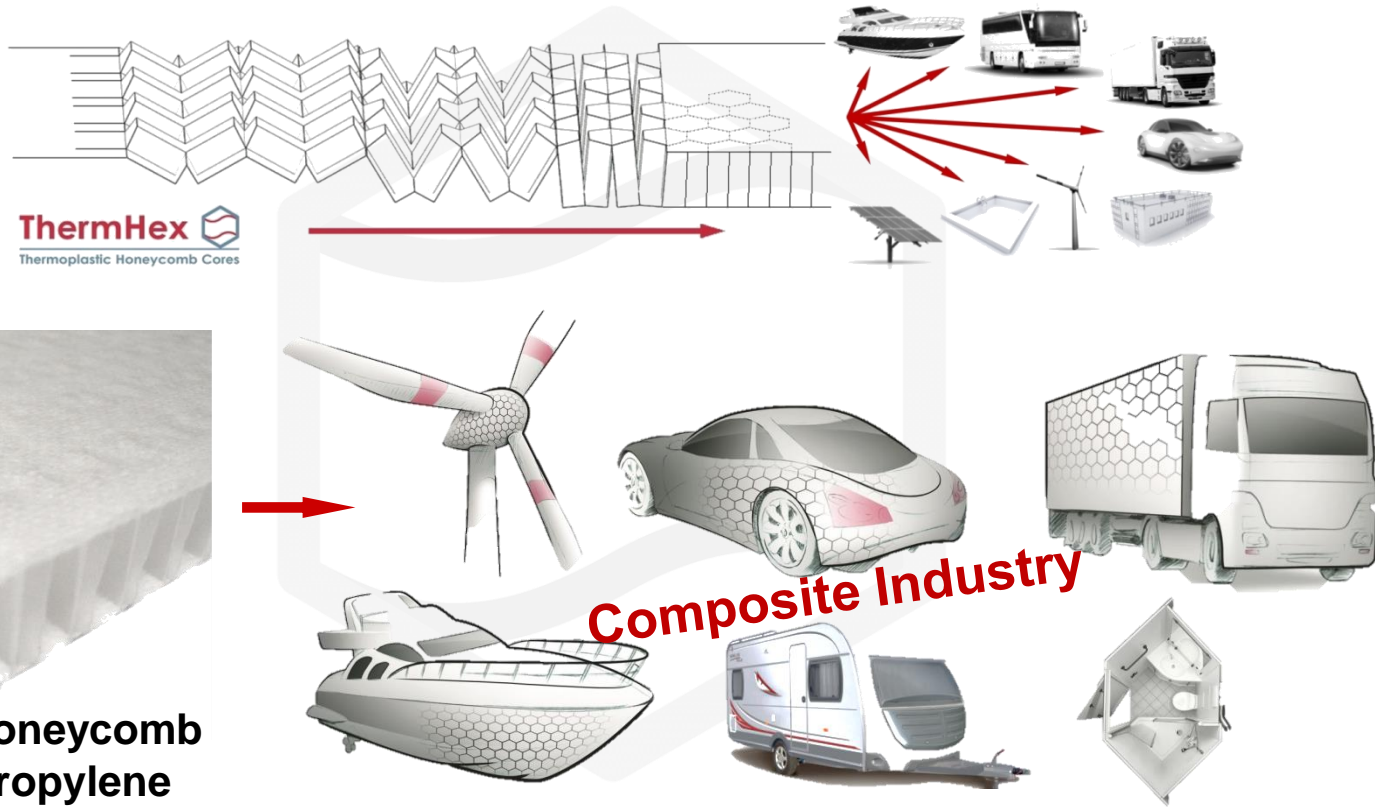


ThermHex PP Honeycomb Core

SCB Fracture Toughness Tests with EconCore's ThermHex honeycombs at Fraunhofer IMWS in Halle



Applications of ThermHex Honeycombs



**ThermHex honeycomb
from polypropylene**

ThermHex Production lines – Global Overview

- 1) EconCore (Belgium) Demo Line – 1400mm and 400 mm (for PET, PA, PC, ...)

Operational since 2006. <http://www.EconCore.com>



- 2) GIFU Plastics (Japan) PP Core + PP skins TECCELL

Operational since mid 2009. Second line since 2012

<http://www.risu.co.jp/teccell/>



- 3) ThermHex Waben (Europe) PP Core only – 1400mm

Operational since mid 2010 <http://www.ThermHex.de>



- 4) Cartonplast (Europe) PP Core + PP skins – 1400mm

Operational since end 2010, EXALITE



- 5) Coroplast (1st Licensee in USA) for PP Core + PP skins

Operational since end 2012, STINGER



- 6) Renolit (Europe) PP Core + WPC skins – 1600mm

Operational since begin 2013, GORCELL

<http://www.renolit.com/composites/en/products/automotive/>



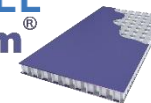
- 7) Röplast (Europe) PP Core + PP skins – 2100mm

Operational since end 2014, HEXAPAN <http://www.hexapan.com/>



- 8) TATA Steel (Europe) PP Core + Steel skins – 1500mm

Operational since mid 2015, CORETINIUM



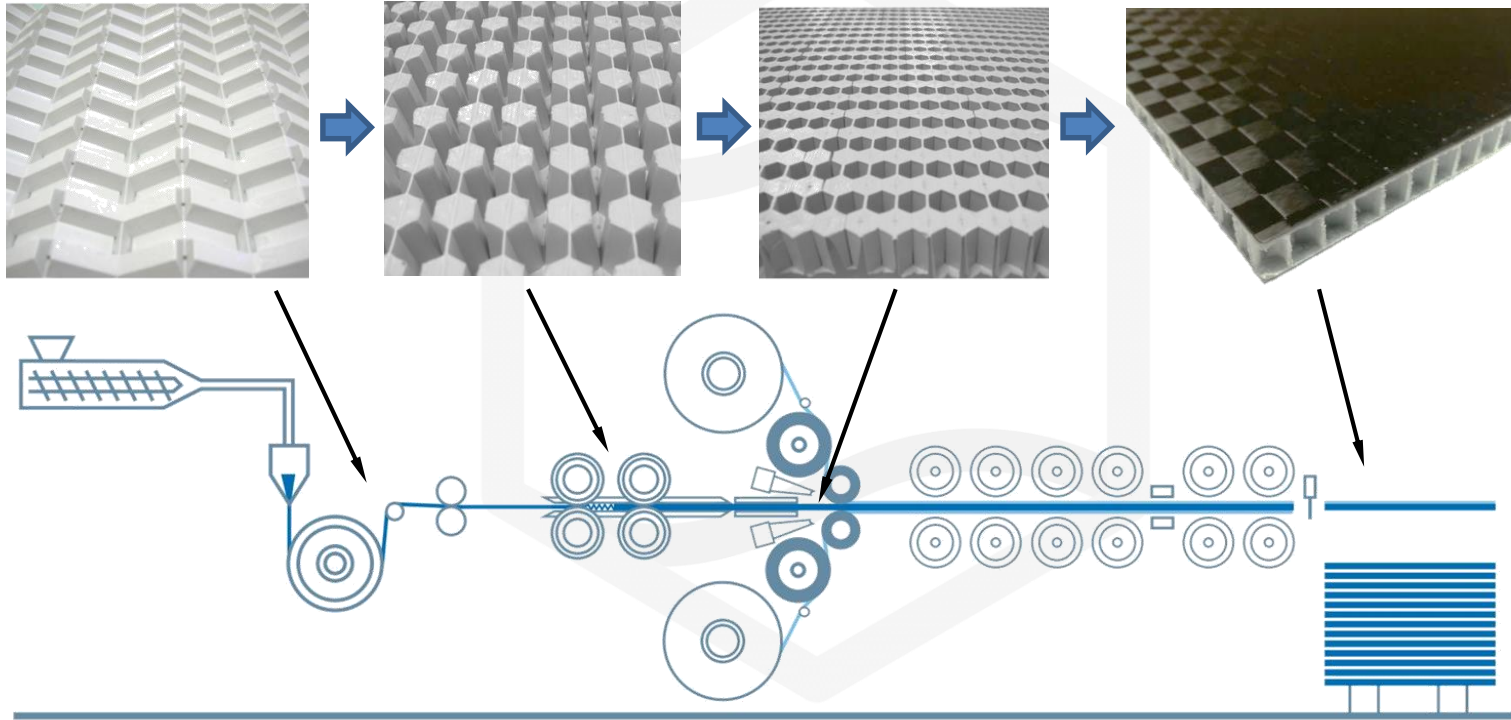
- 9) Wabash National (USA) PP Core + Steel skins – 1500mm

Will be operational in 2017

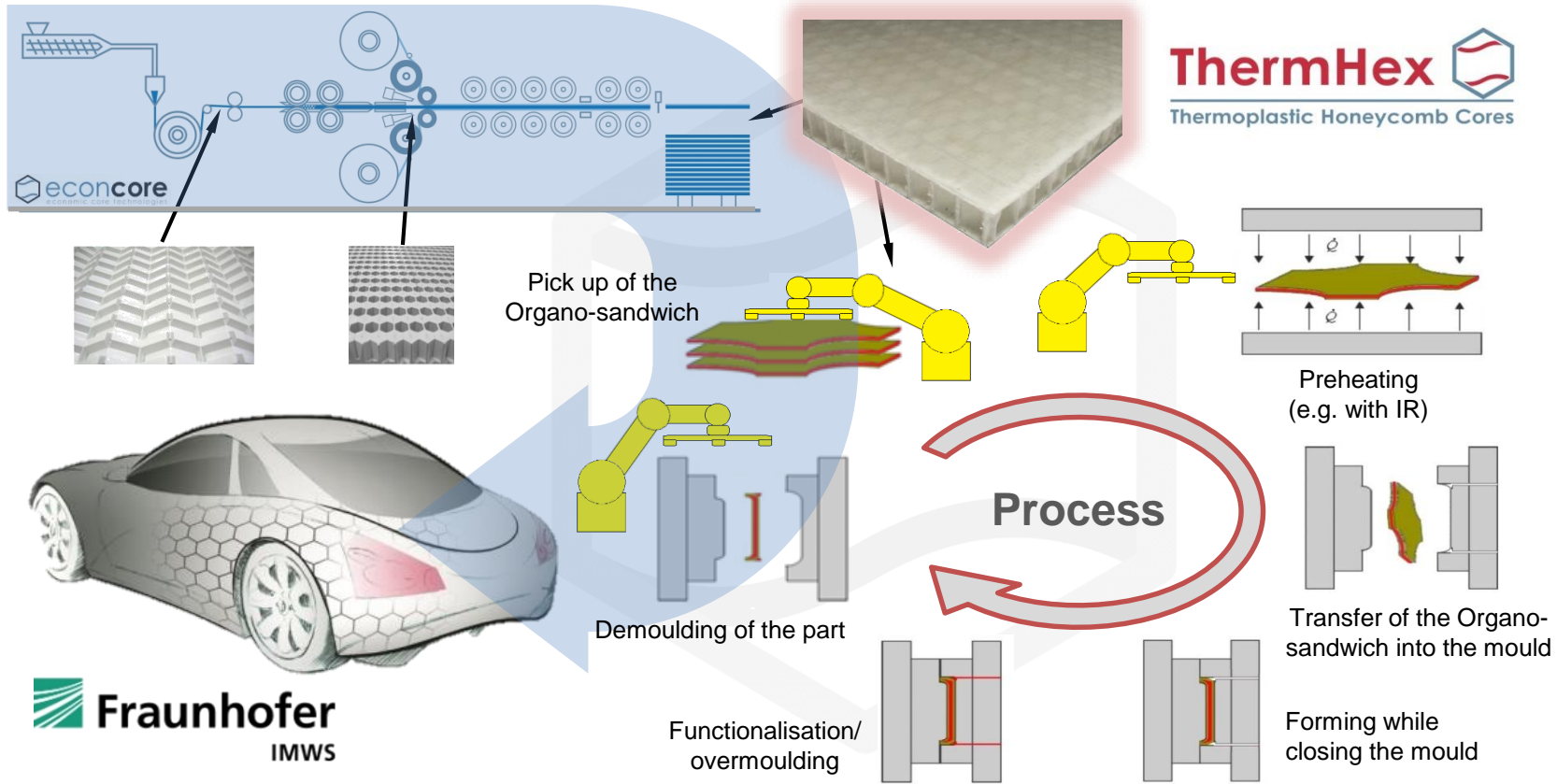


ThermHex sandwich production line

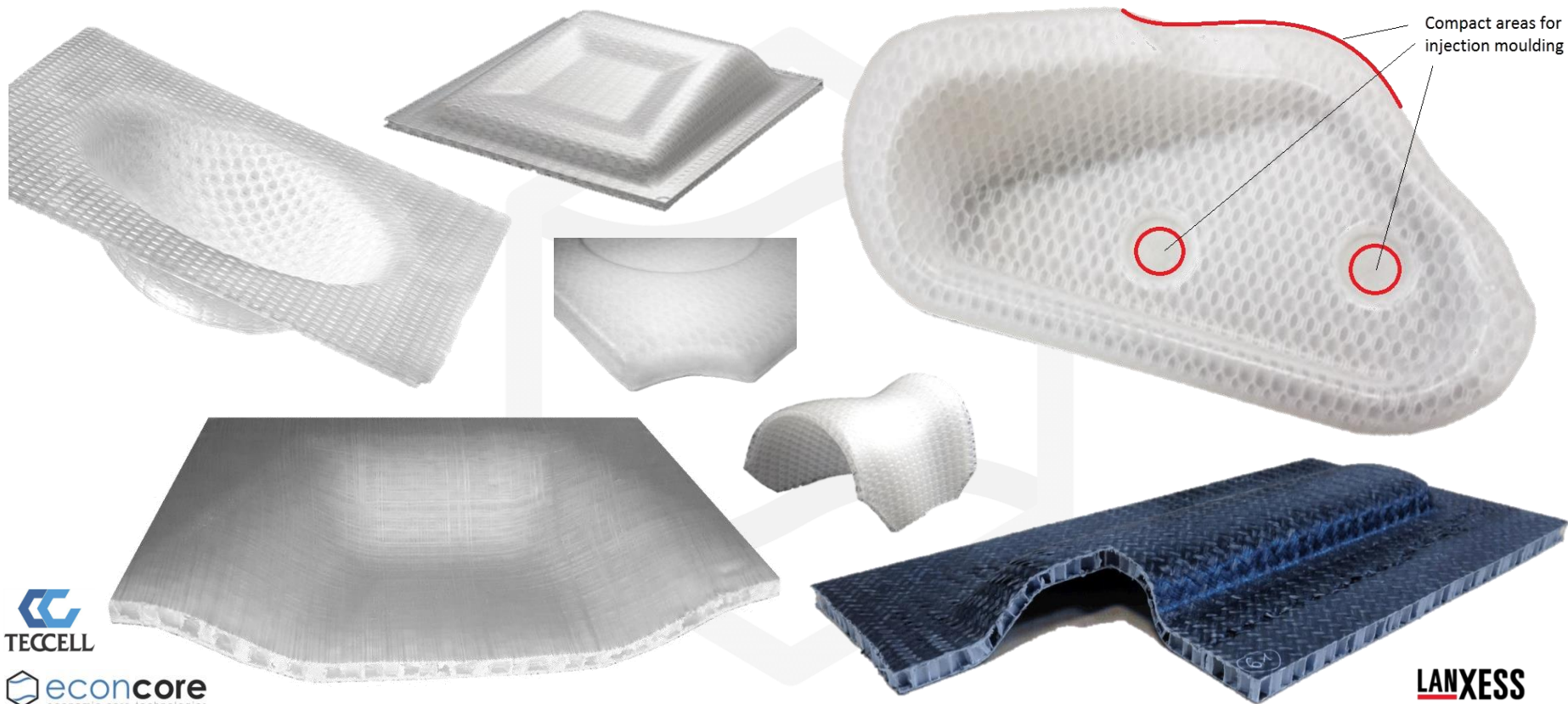
- Automated in-line production of thermoplastic sandwich preforms „Organosandwich“



Organosandwich: Production and further processing



Thermoformed sample parts with PP skins and GF/PP skins



EconCore/ThermHex - PA honeycomb and Organosandwich

Next article 

Previous article 

Toray, EconCore and Itochu Enter into Licence Option Agreement on Polyamide Honeycomb Technology



After preliminary process and product development work, Toray, EconCore and Itochu have entered into an agreement securing an option for a licence for the EconCore's ThermHex technology for Toray.

"The licence agreement among EconCore, Toray and Itochu is a major step forward towards the application of the ThermHex sandwich materials in high performance applications", says Professor Ignace Verpoest, Professor at the Department of Metallurgy and Materials Engineering of the Catholic University of Leuven. "This licence option agreement again shows that breakthrough innovations are made possible when creative entrepreneurship goes hand-in-hand with the long term vision of companies like Toray, worldwide leaders in their field."

TORAY

LANXESS

Energizing Chemistry

April 02, 2014

Innovative material and technology solutions for lightweight construction

LANXESS cooperates with EconCore

Thermoplastic sandwich composites with honeycomb core made of polyamide



Cologne - LANXESS and EconCore N.V. are joining forces to develop new thermoplastic sandwich materials for lightweight construction. The objective of the collaboration is to fabricate honeycomb cores from Durethan polyamides with the help of an automated, continuous process patented by EconCore. In addition, Tepex continuous fiber-reinforced thermoplastic composites from LANXESS subsidiary Bond-Laminates are to be combined with the new polyamide honeycomb cores to produce high-performance composites.

Lightweight construction with Tepex

Polyamide honeycomb cores, and the sandwich composites in which they are incorporated, open up entirely new possibilities in lightweight construction, for instance of

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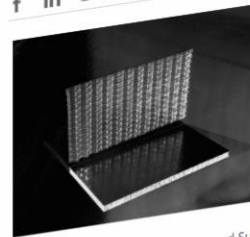
EVENTS

EconCore, DuPont Performance Materials collaborate on production of honeycomb panels

Innovative patented technology delivers strong, cost-effective panels

By Karen Laird in Materials, Consumer Products on May 09, 2016

f in t e



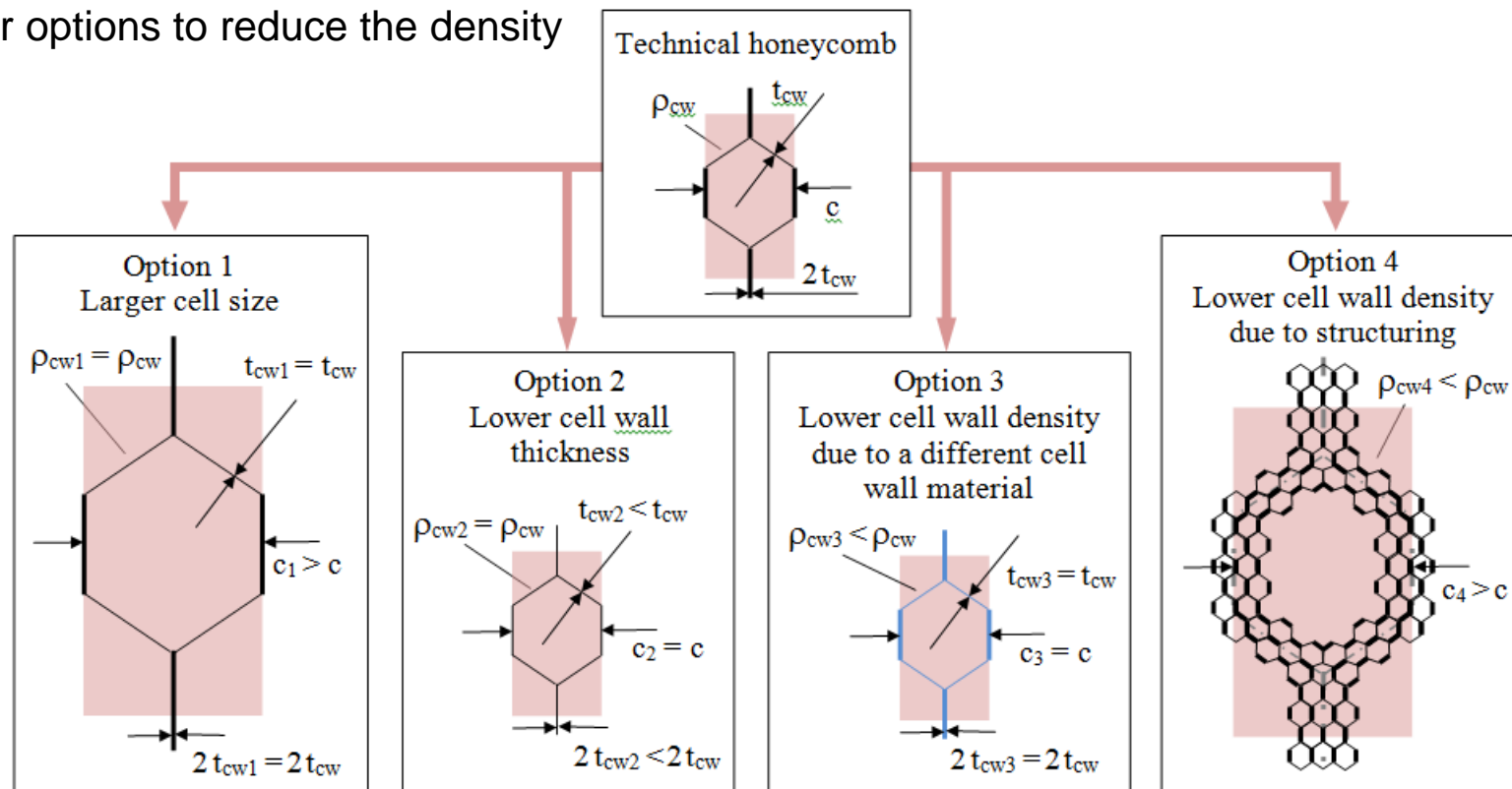
Belgium-based EconCore N.V. (Leuven), whose ThermHex technology for the continuous production of honeycomb sandwich materials has led to earlier collaborations with companies such as Tata Steel and Lanxess, has announced that its newest partnership is with DuPont Performance Materials on the development and production of wide, strong and rigid honeycomb panels, with tunable properties, depending on the choice of Dupont polymer used. EconCore's ThermHex technology has proven to be capable of delivering high-performance sandwich panels at high efficiency and cost levels that, to date, have not been achievable using conventional methods.

Already, Dupont's Zytel nylon resin and Surlyn ionomer resin materials have been applied to produce cost-optimized lightweight sandwich products with tough, resilient and high-temperature-resistant honeycomb cores.

DU PONT

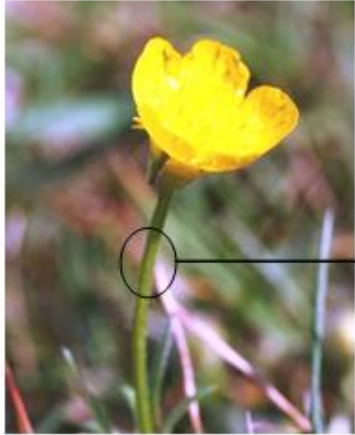
Principle options to reduce the density of technical honeycomb cores

- Four options to reduce the density

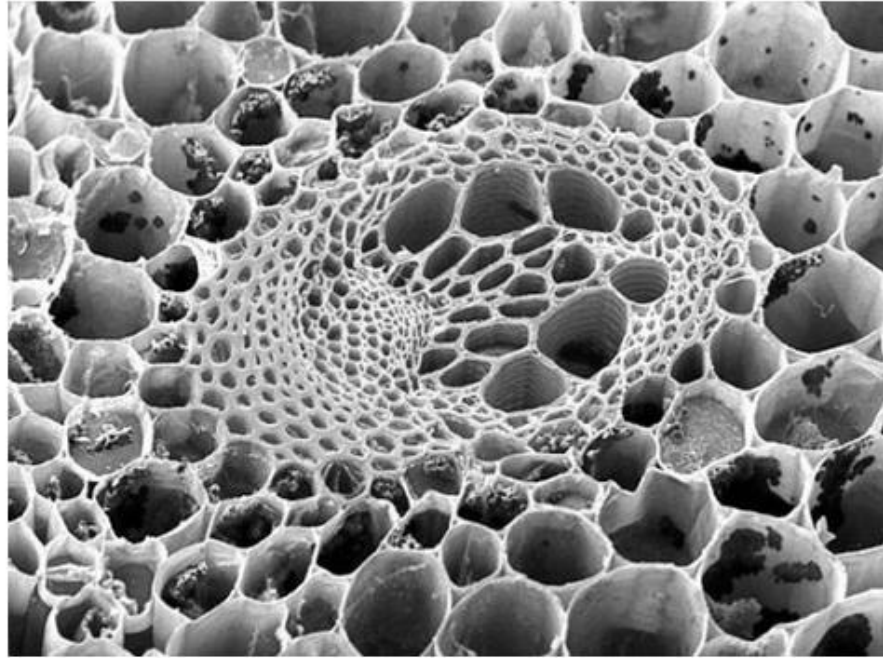


Hierarchical tubular structure in nature

- Cross section of the tubular stem wall of the buttercup flower



Buttercup (Ranunculus)



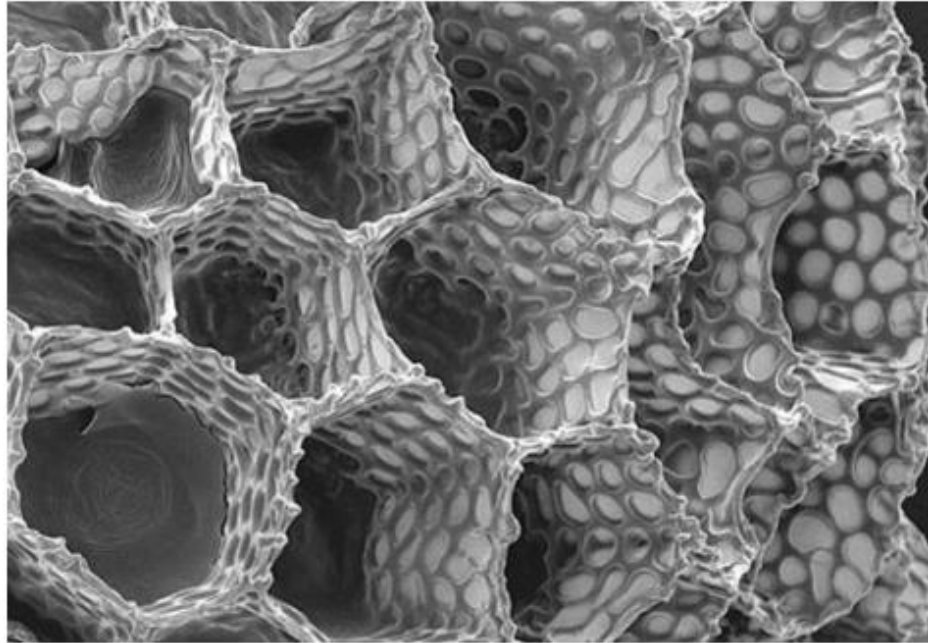
SEM (magnification: x113 at 5x7cm size, by Andrew Syred)

Hierarchical honeycomb structure in nature

- Hierarchical honeycomb structure of the foxglove seed coat



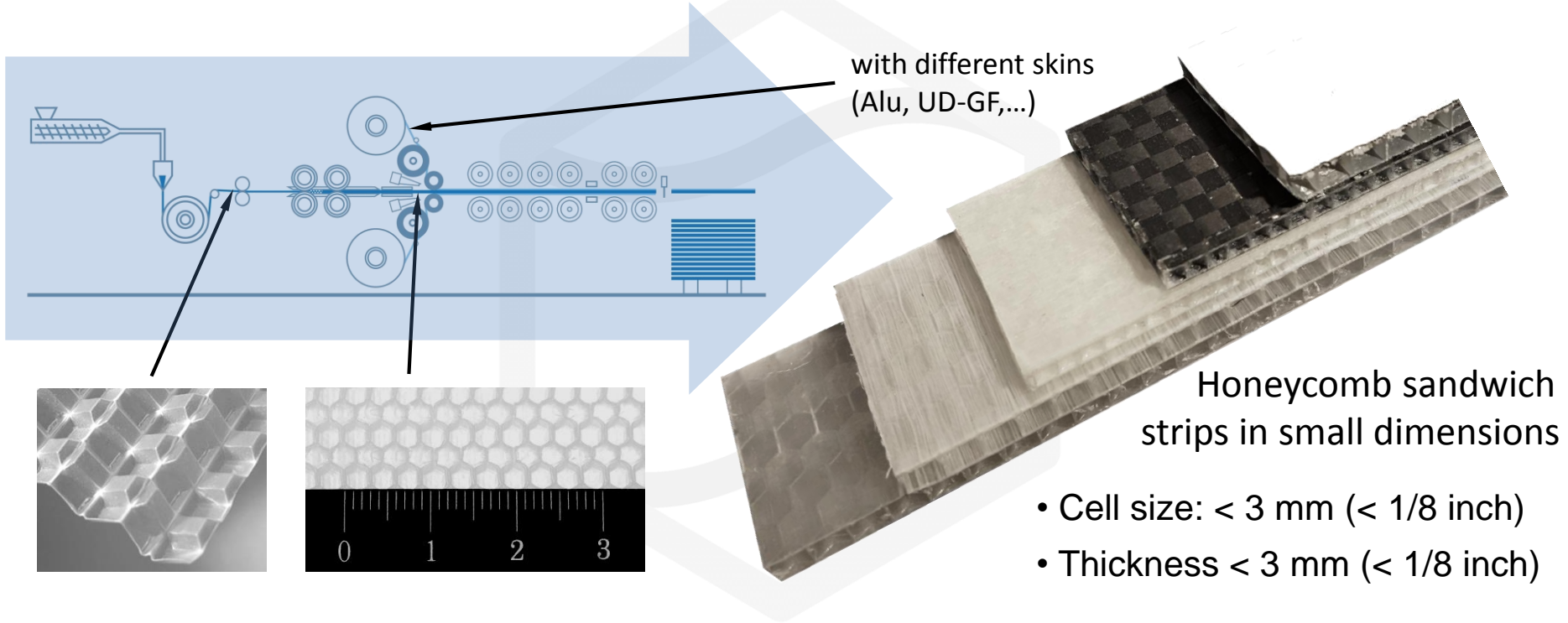
Foxglove (*Digitalis purpurea*)



SEM (magnification: x400 at 6x7cm size, by Andrew Syred)

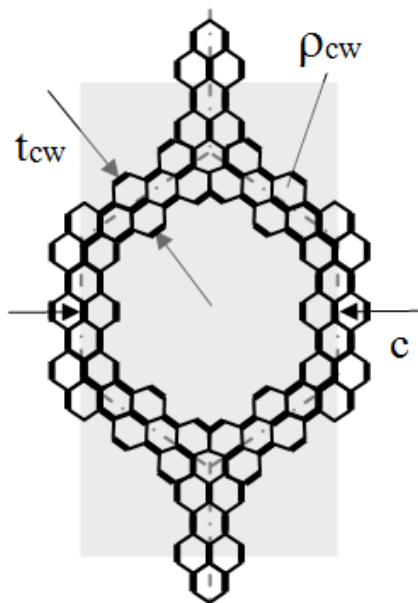
Hierarchical sandwich honeycombs

- Automated in-line production of rather small honeycomb sandwich panels

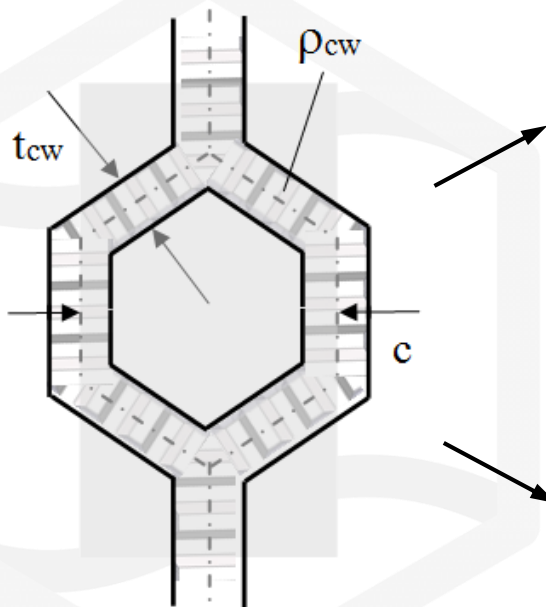


Hierarchical honeycombs and hierarchical sandwich honeycombs

- Cell walls from honeycomb cells **versus** cell walls from honeycomb sandwich panels



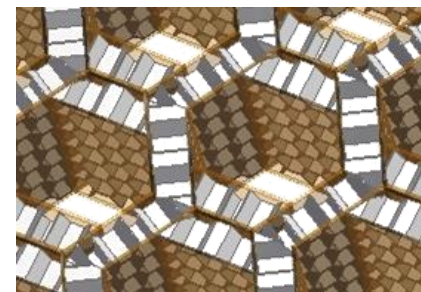
Cell walls consist of
honeycomb cells



Cell walls consist of
honeycomb sandwich panels



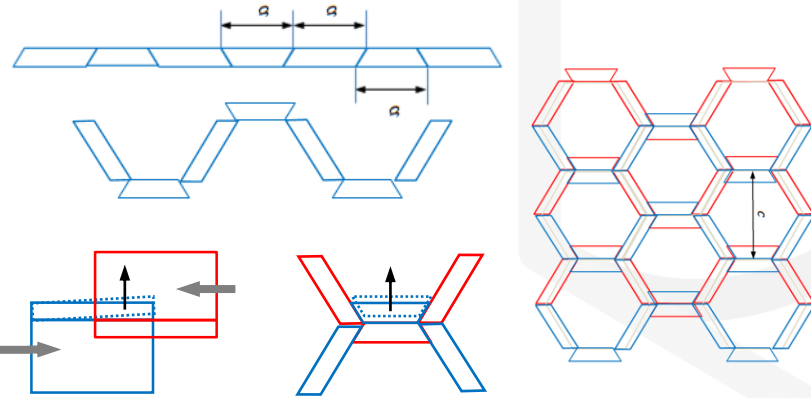
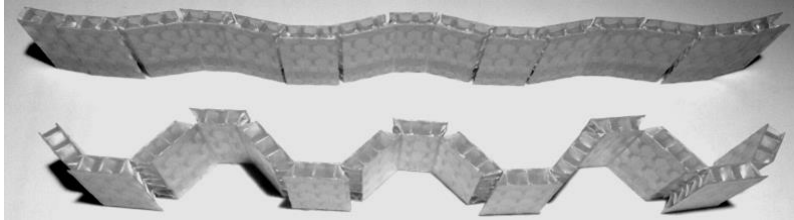
Hexagonal hierarchical
sandwich honeycomb



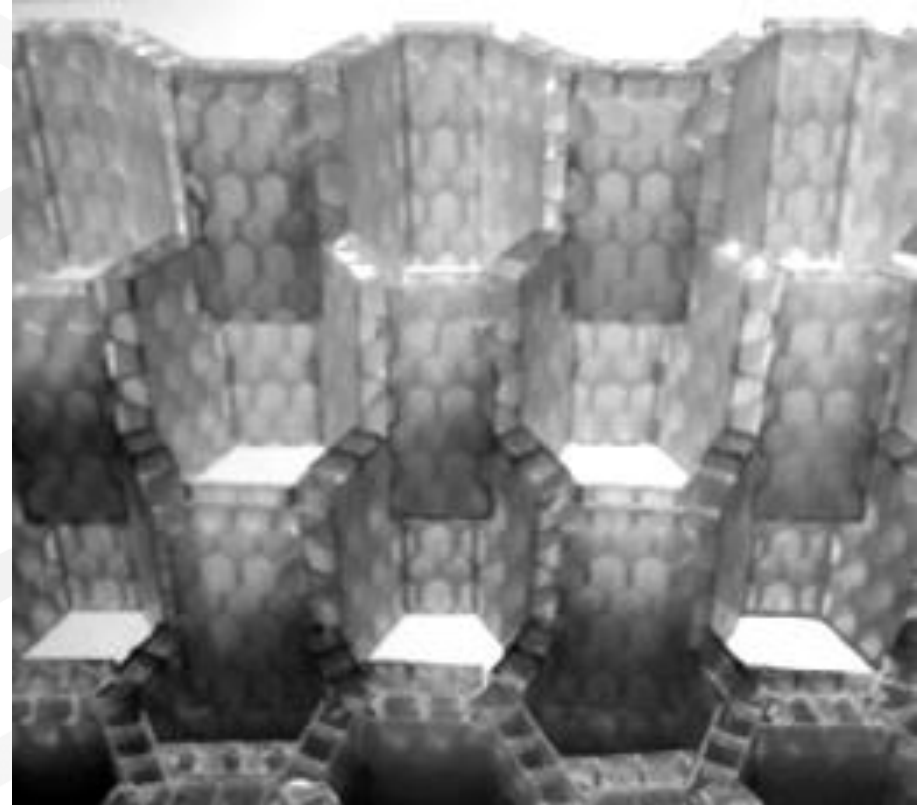
Technical hexagonal hierarchical
sandwich honeycomb

Additive production process for hierarchical sandwich honeycombs

- Production process from sandwich strips

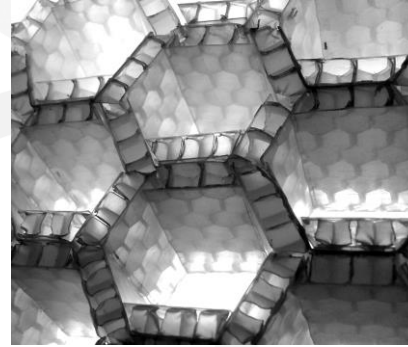
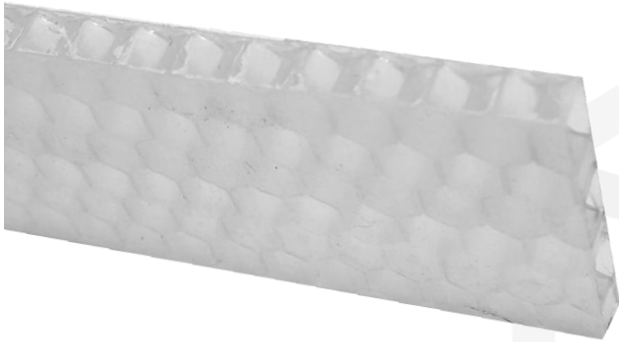


Assembled from sandwich panel strips by slotting

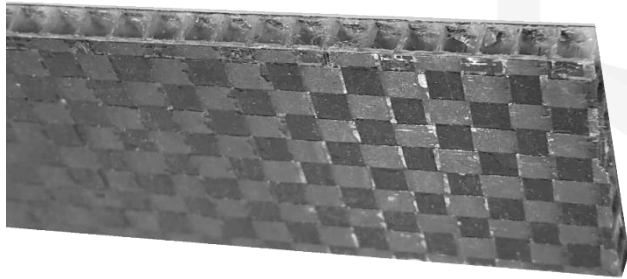


Hierarchical sandwich honeycombs

- All PP hierarchical sandwich honeycomb with cell walls from PP honeycomb and PP films



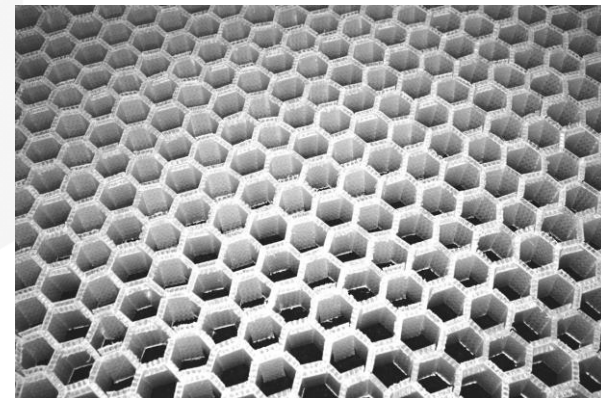
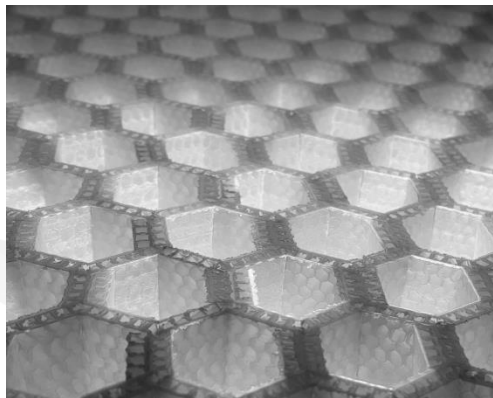
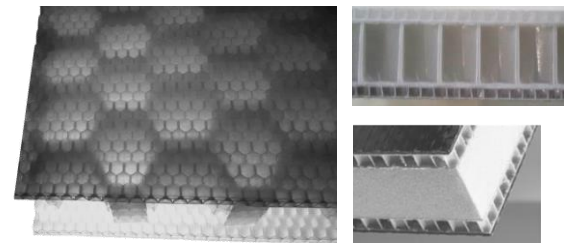
- High performance hierarchical sandwich honeycomb



HPHEX with cell walls
from PP honeycomb
and carbon fiber
composite skins

EconCore's Hierarchical Sandwich Honeycombs - HPHEX

- Hierarchical sandwich honeycombs have the potential to outperform other core material
 - If high performance composite skins are used in the cell walls
 - For application where large a cell size is sufficient to support the skins
- Production of large size samples possible with small equipment
 - The additive production from continuously produced sandwich strips allows large size
- We are looking for partners
 - For reference projects and for modelling and evaluation



EconCore N.V. – ThermHex Waben GmbH



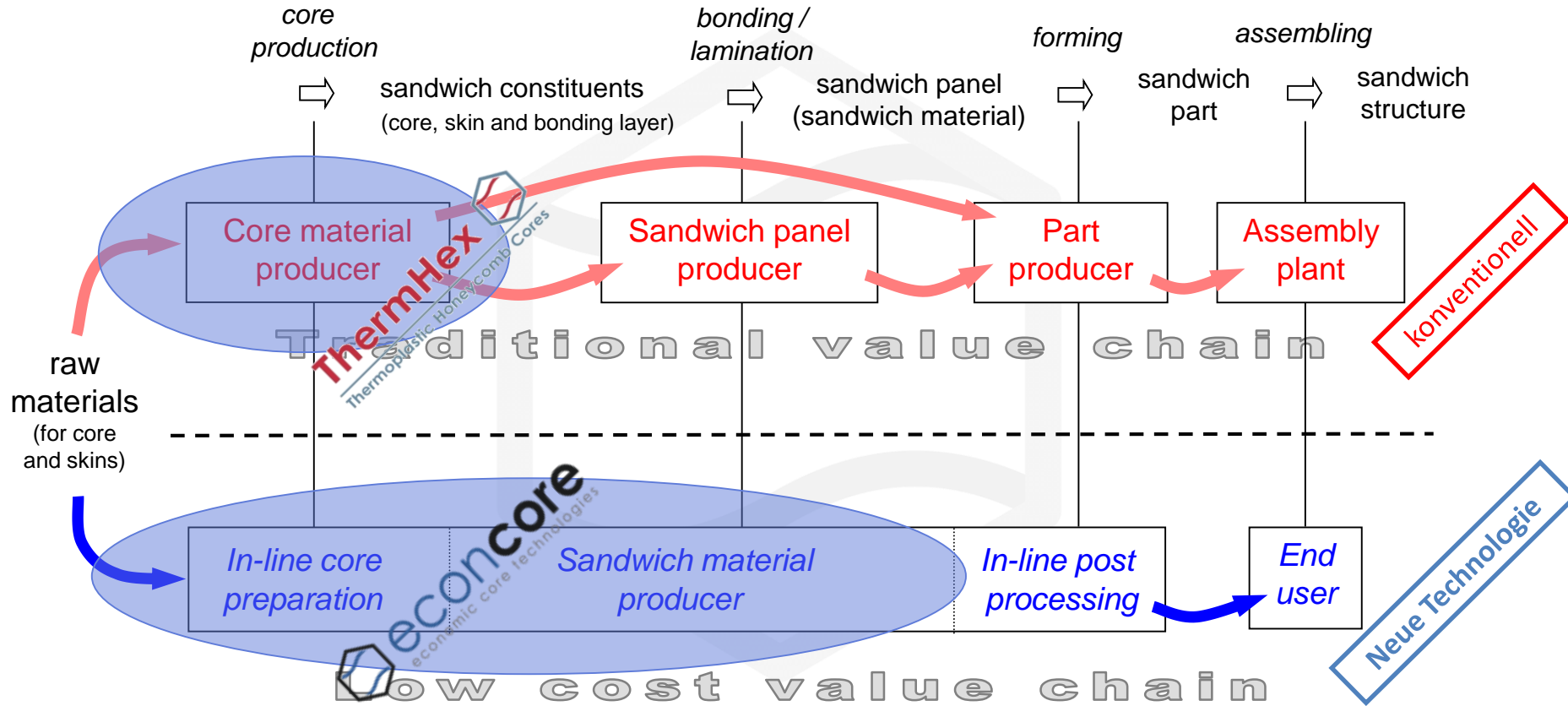
- **EconCore N.V** – technologies for cost efficient production of honeycomb core and sandwich parts
- founded: 22.12.2005



- **ThermHex Waben GmbH** – production of thermoplastic honeycomb cores
- production start: 01.04.2010



Value added chain of sandwich parts



ThermHex Technology enables:



fast, easy, continuous in-line production of honeycomb cores

⇒ **Maximum cost saving**



excellent mechanical properties by an internal structure comparable to honeycomb cores used in aerospace

⇒ **Maximum weight reduction**



minimal amount of recyclable thermoplastic raw material

⇒ **Maximum resource efficiency**



EconCore N.V.

Economic Core Technologies

**The Technology Leader in
Honeycomb Sandwich Materials**

ThermHex Waben GmbH

Thermoplastic Honeycomb Cores

**The new generation of
lightweight material**

Thank you !