

Engineered Sustainability - Bioplastics for Advanced Applications

FKuR Kunststoff GmbH
Siemensring 79, 47877 Willich/Germany

Graham Whitchurch

Overview

- About FKuR
- Plastics & Sustainability
- Compounding Technology
- Multilayer Extrusion of Bioplastics
- Examples of applications
- Conclusion

About FKuR

- Privately owned company
- Started in 1992 as a research institute
- Founded in 2003 as bioplastics spin-off
- Material research and development in co-operation with the Fraunhofer Institute UMSICHT, Oberhausen/Germany
- Brandnames:
 - Bio-Flex®: PLA blends for extrusion and injection moulding
 - Biograde®: Cellulose blends for injection moulding
 - Fibrolon®: Wood Plastics Composites (WPC) for injection moulding
 - Terralene™: Bio-PE compounds based on Braskems Green PE

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Plastics & Sustainability

Natures intelligent packaging



Natural protection



Easy to open



Environmental disposal

Plastics & Sustainability

Renewable Packaging – Nature's role model



Rigid Packaging



Aromatic Packaging

Plastics & Sustainability

Packagings requirements are to:

- Advertise and present products
- Protect the goods
(oxygen, humidity, germs, etc....)
- Extend shelf life
- Enable easy transport
- Carry marketing messages



Plastics & Sustainability

For industrial packaging is nature still the role model ?



Our packaging materials are designed using natural materials

Plastics & Sustainability

Sustainability – A recent buzzword

- **Sustainable** economic growth
- **Sustainable** increase in profits

Sustainability

Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

(World Commission of Environment and Development, 1987)

Sustainability is more than just economic growth.
It's an overall global concept

Plastics & Sustainability

According to this definition of sustainability, using renewable resource materials is a natural consequence



Bioplastics are a result



Alternative end-of-life options

Reduction of CO₂ emission

Plastics & Sustainability

Alternative end-of-life options

Reduction of CO₂ emissions



Bioplastics can be categorised in two classes

Biodegradable plastics
(either fossil or renewable carbon source)

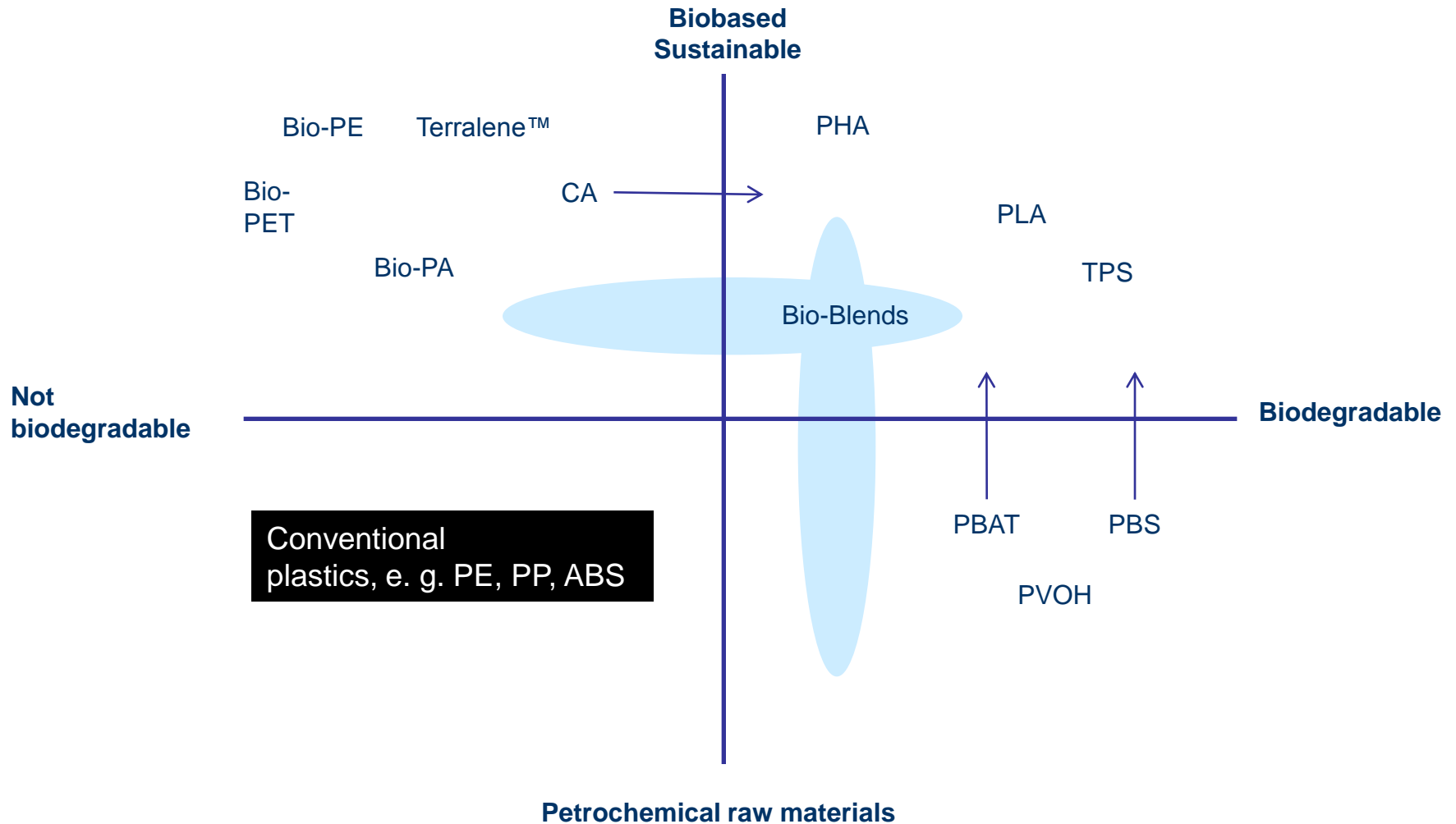
Biological process where materials are degraded by micro-organisms (fungi, bacteria) and ultimately converted to water, CO₂/methane, energy and new cell biomass

Biobased plastics
(only renewable carbon source)

Defined as the feedstock being renewed within two growing seasons or less (e.g. corn, wheat, grass, bacteria).

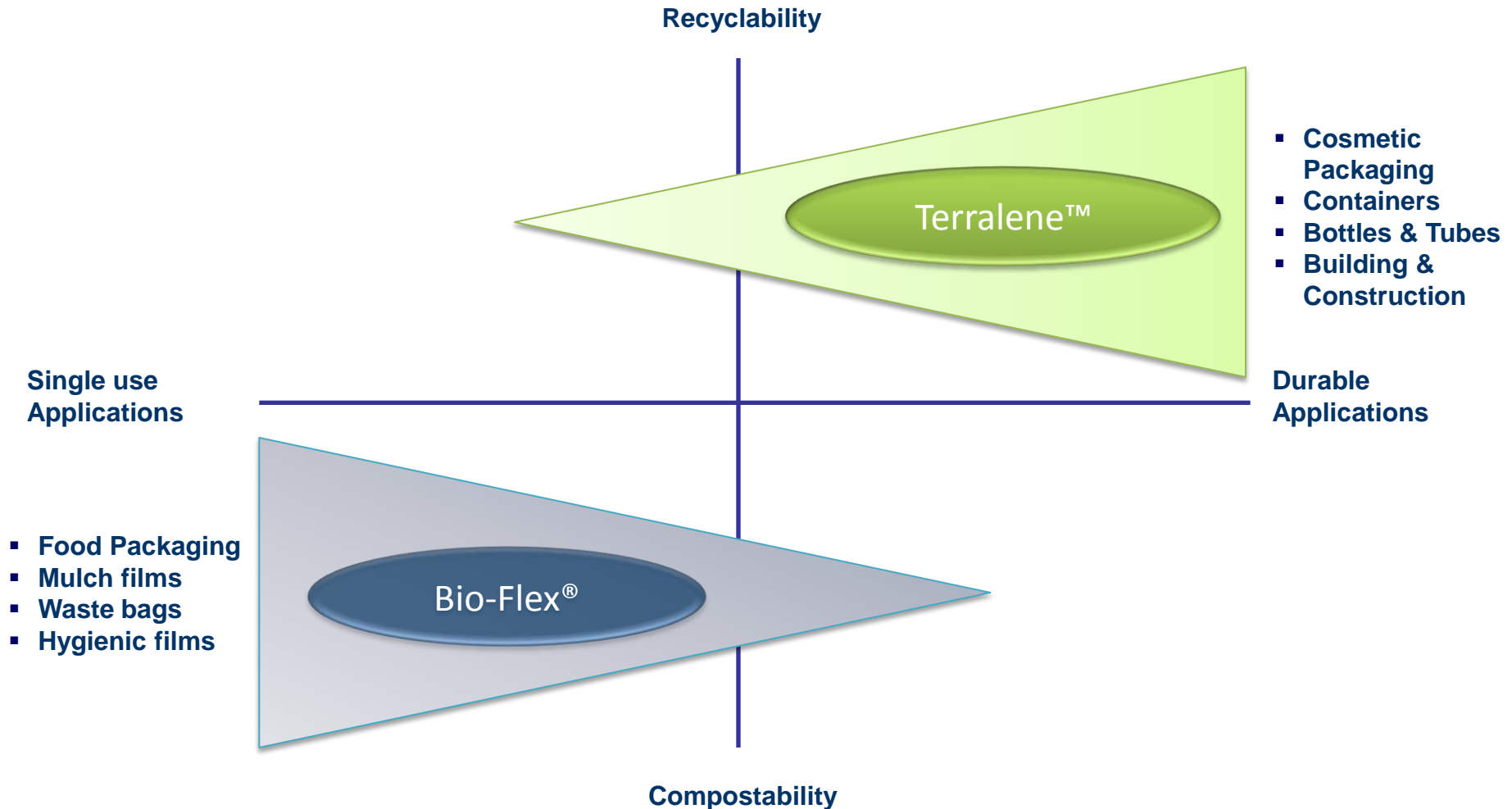
Plastics & Sustainability

The variety of available Bioplastics has increased



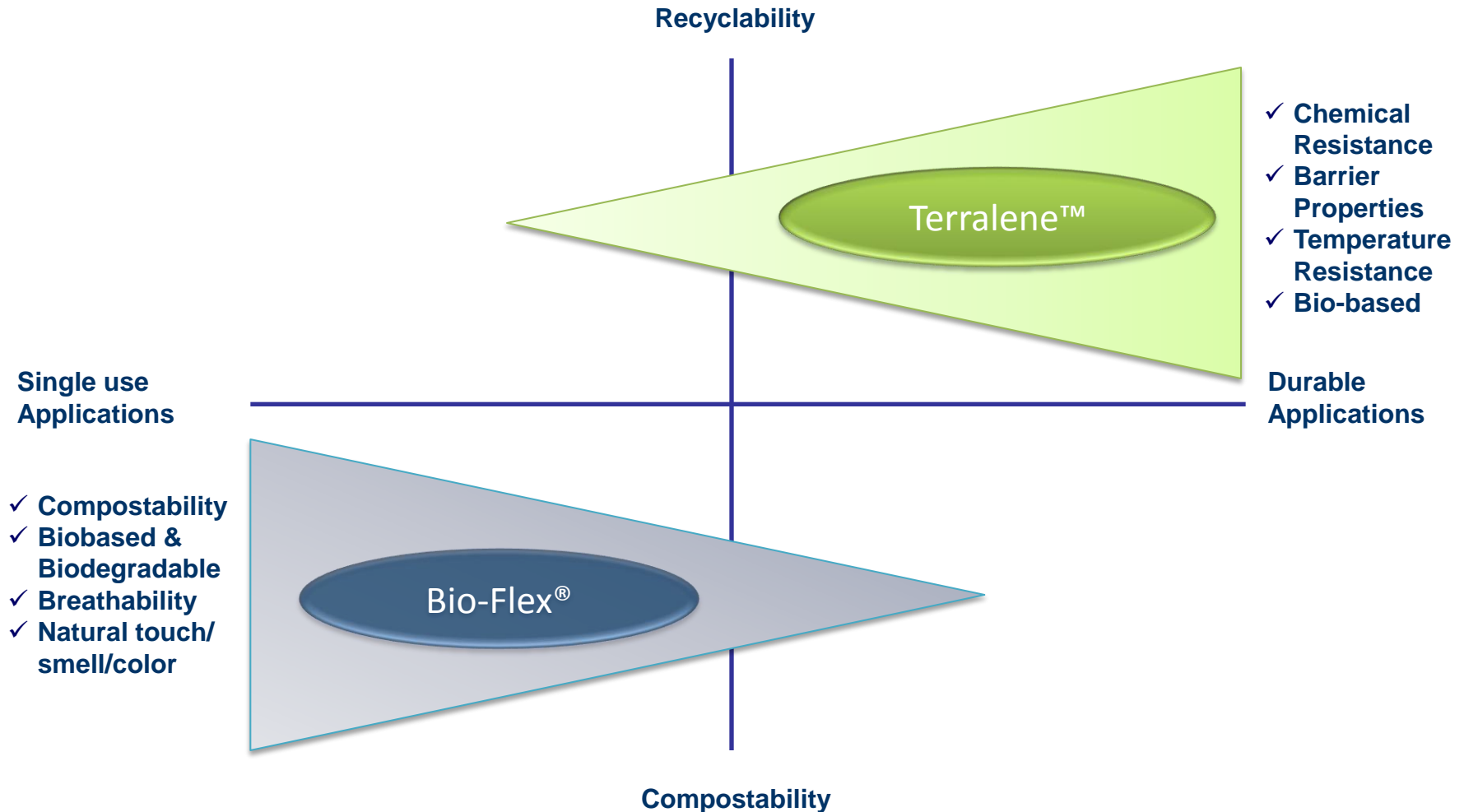
Plastics & Sustainability

The choice is yours



Plastics & Sustainability

Choice of Properties



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Compounding Technology

Which Bioplastics will best meet my product's requirements?

PLA

PHA

PBAT

PBS

CA

Bio-PE

Price

- Bioplastics are more expensive

Performance

- Physical properties can often fall short

Processing

- Not always easy to process

Compounding Technology



Raw Bioplastics
often difficult to process on standard equipment

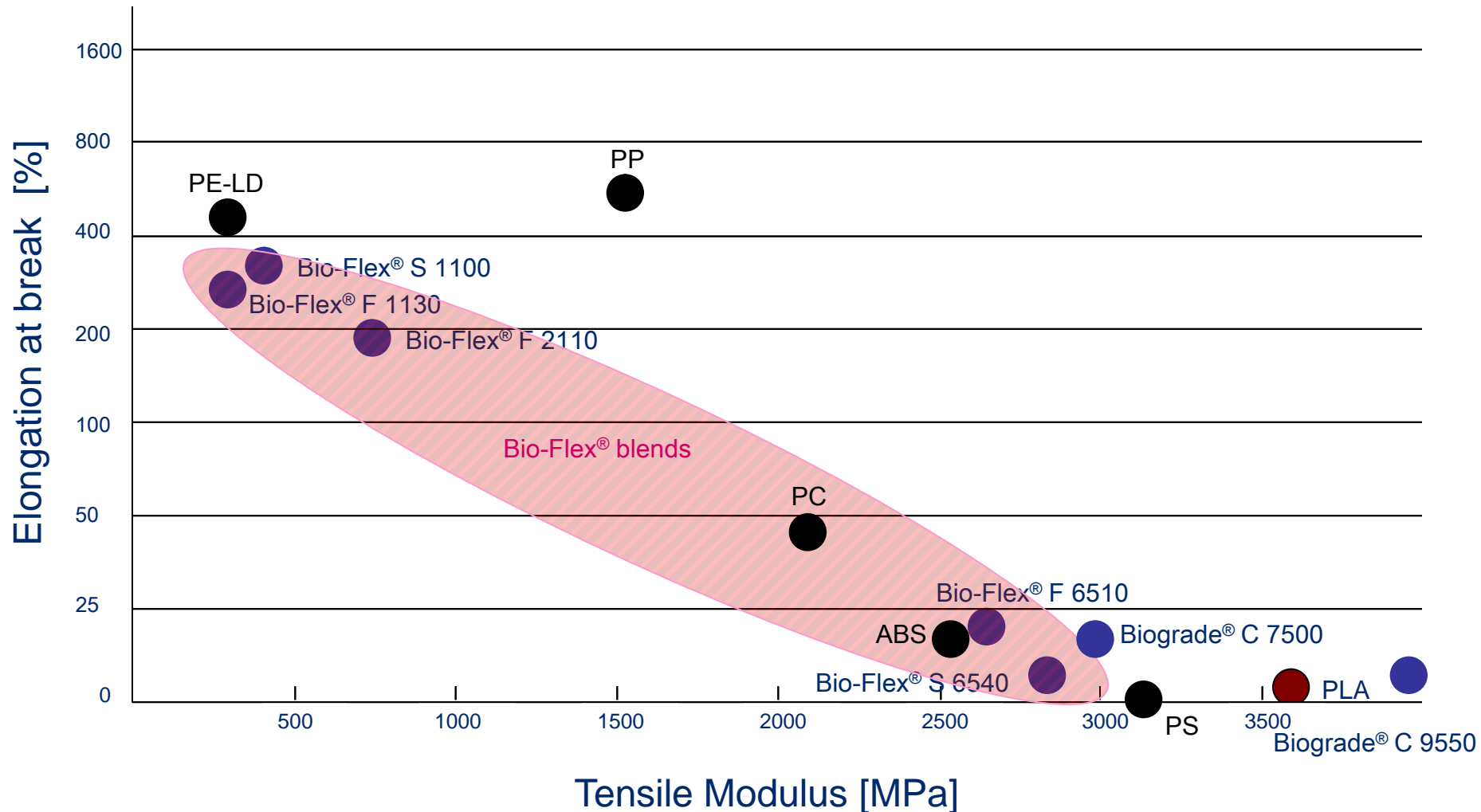
Compounding is the Key!



Easy to handle Bio-Blends

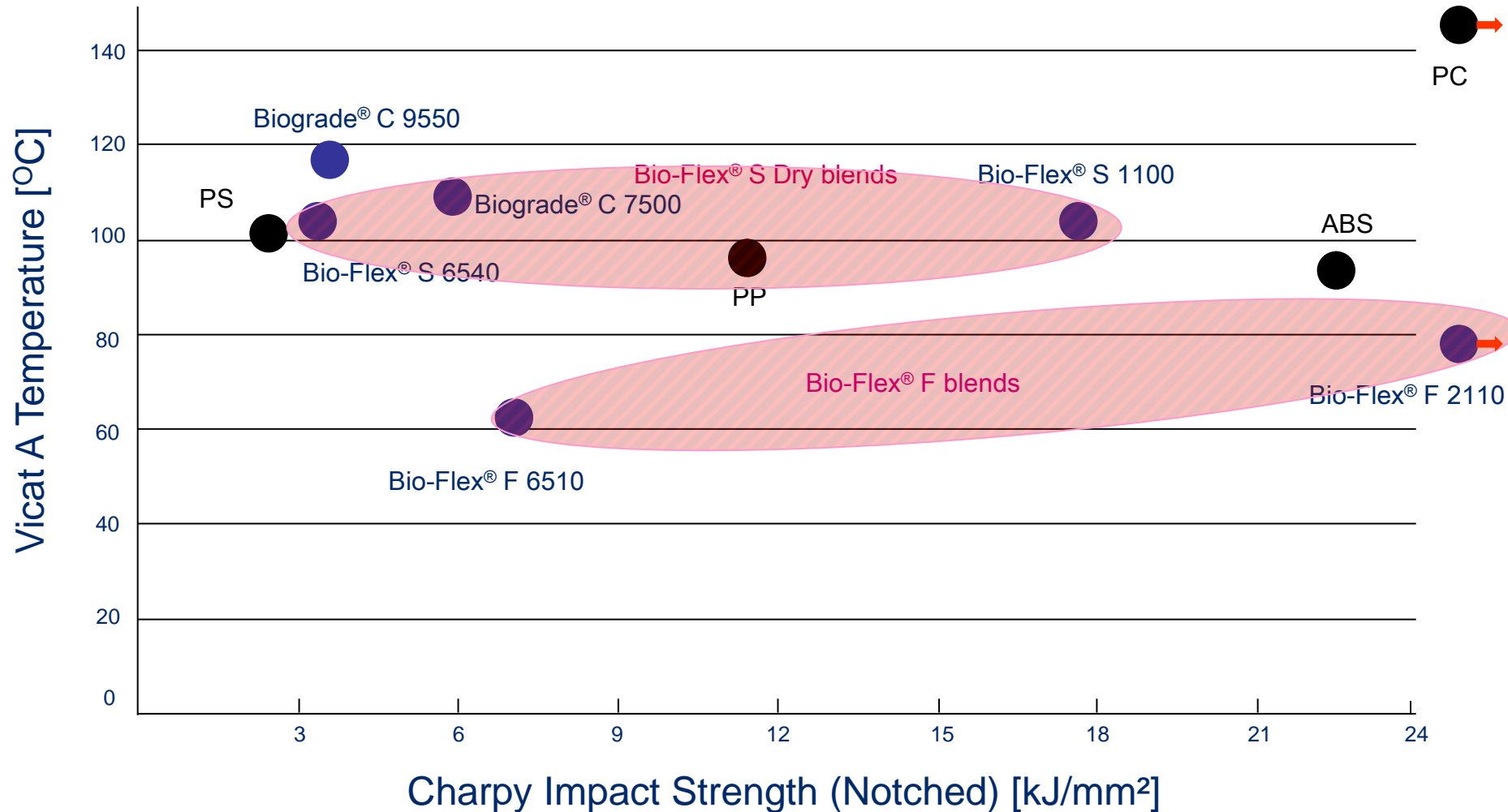
Properties of Bio-Flex® and Biograde®

Bio-Flex® grades can be blended to adjust required properties



Properties of Bio-Flex® and Biograde®

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Multilayer Extrusion of Bioplastics

Co-extrusion of Bio-Flex® Grades

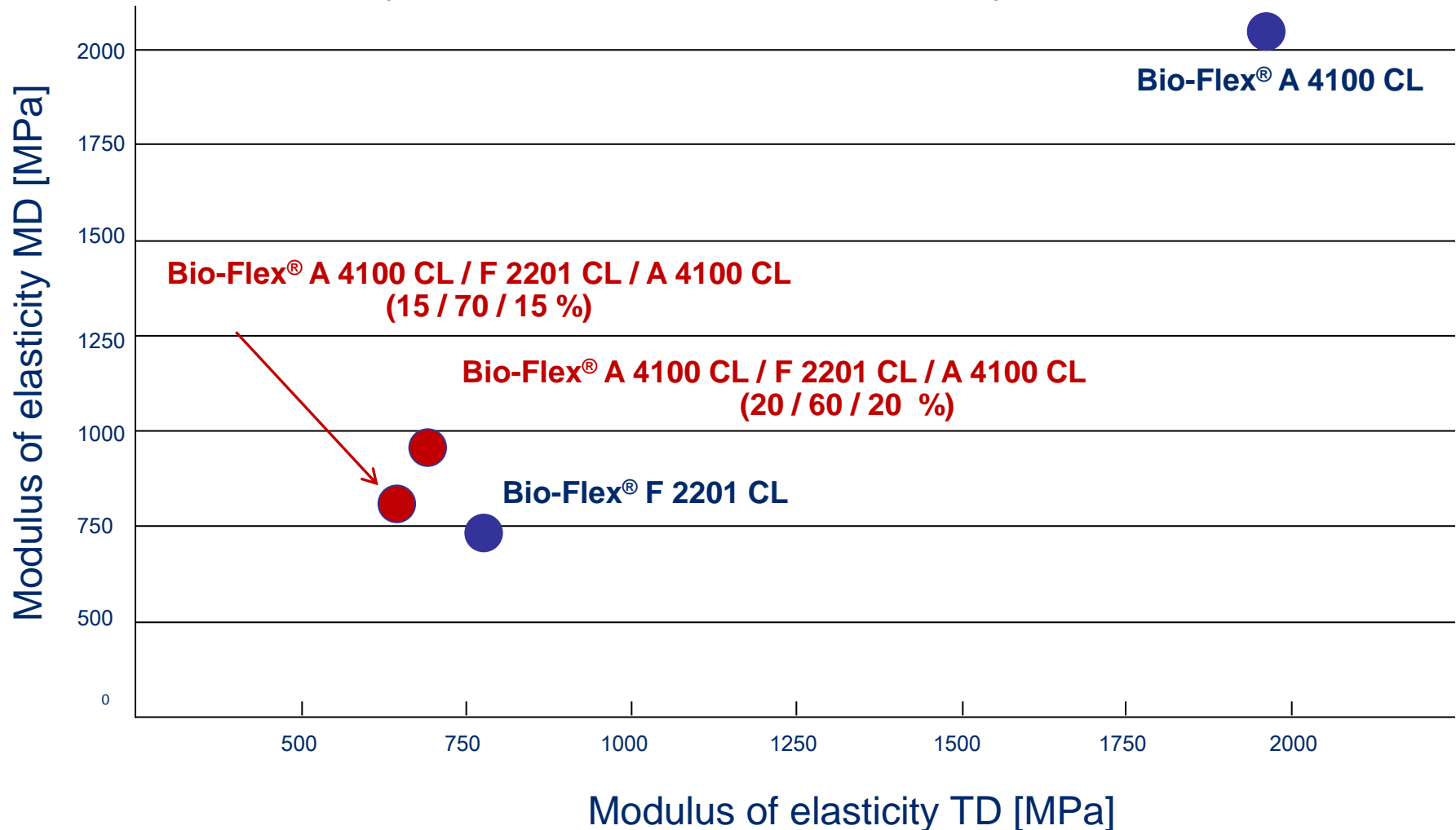
- Similar processing conditions
- Good compatibility and inter-ply strength as similar chemical structure
- Co-extruded Bioflex film can give:
 - Increased content of renewable resources
 - High transparency and flexibility
 - Sealing strength
 - Improved barrier properties
 - Improved mechanical properties by combining different Bio-Flex® grades



3 Layer Co-Extrusion of Bio-Flex®

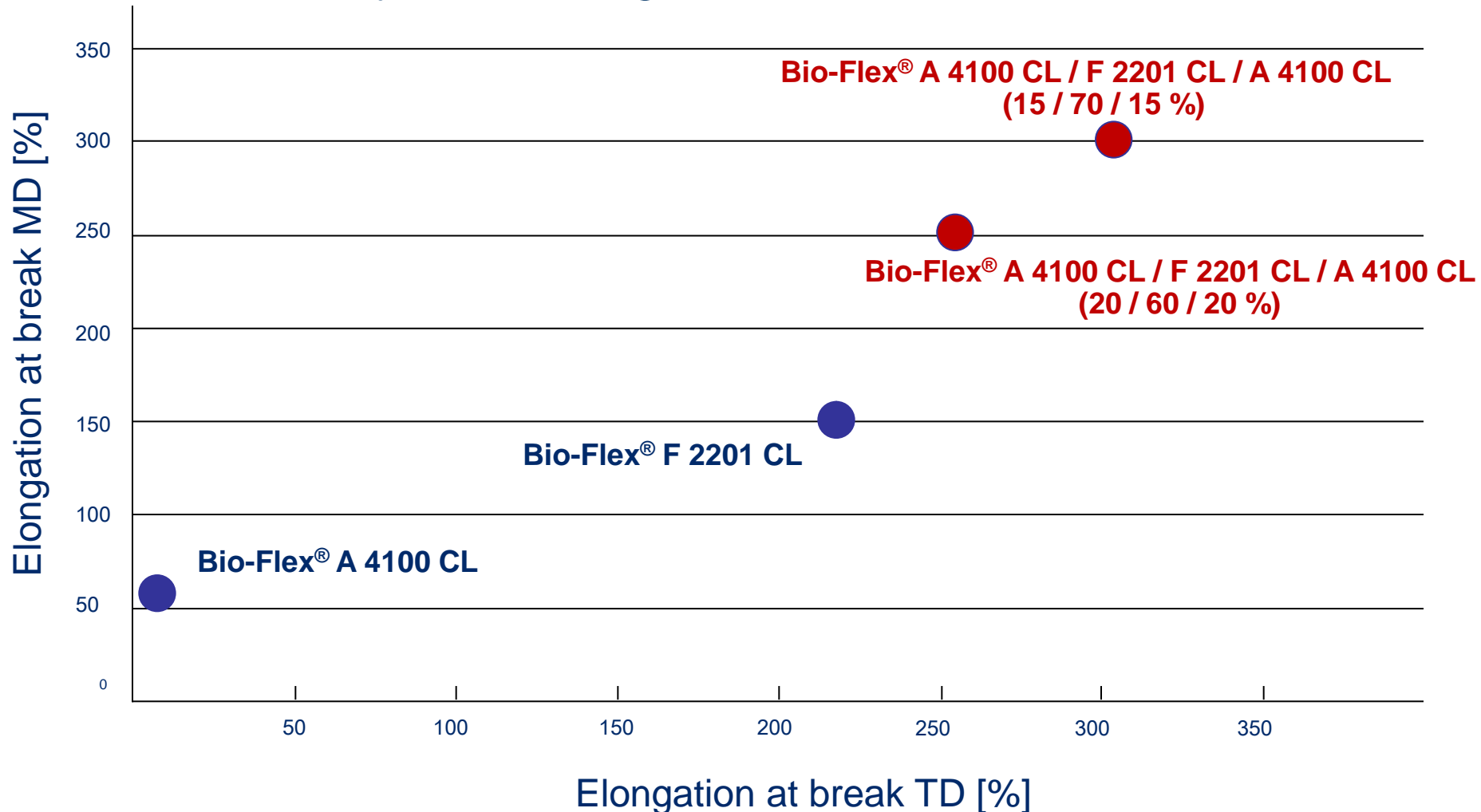
Multilayer Extrusion of Bio-Flex® A- and F-Series

Bio-Flex® Multilayers – Modulus of Elasticity



Multilayer Extrusion of Bioplastics

Bio-Flex® Multilayers – Elongation at Break



Multilayer Extrusion of Bioplastics

New development - 3-layer film:

Bio-Flex® A 4100 CL / F 2201 CL / A 4100 CL (20%/60%/20%)

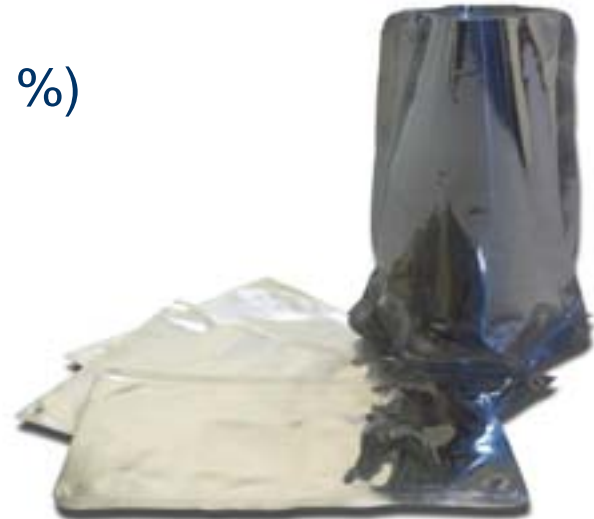
- Processed on conventional LDPE 3-layer blown film extruders
- Good transparency
- 60 – 80% renewable resource
- Tough, flexible film with high puncture resistance
- Adjust mechanical properties by varying layer ratios



Metallisation of Bio-Flex® Multilayers

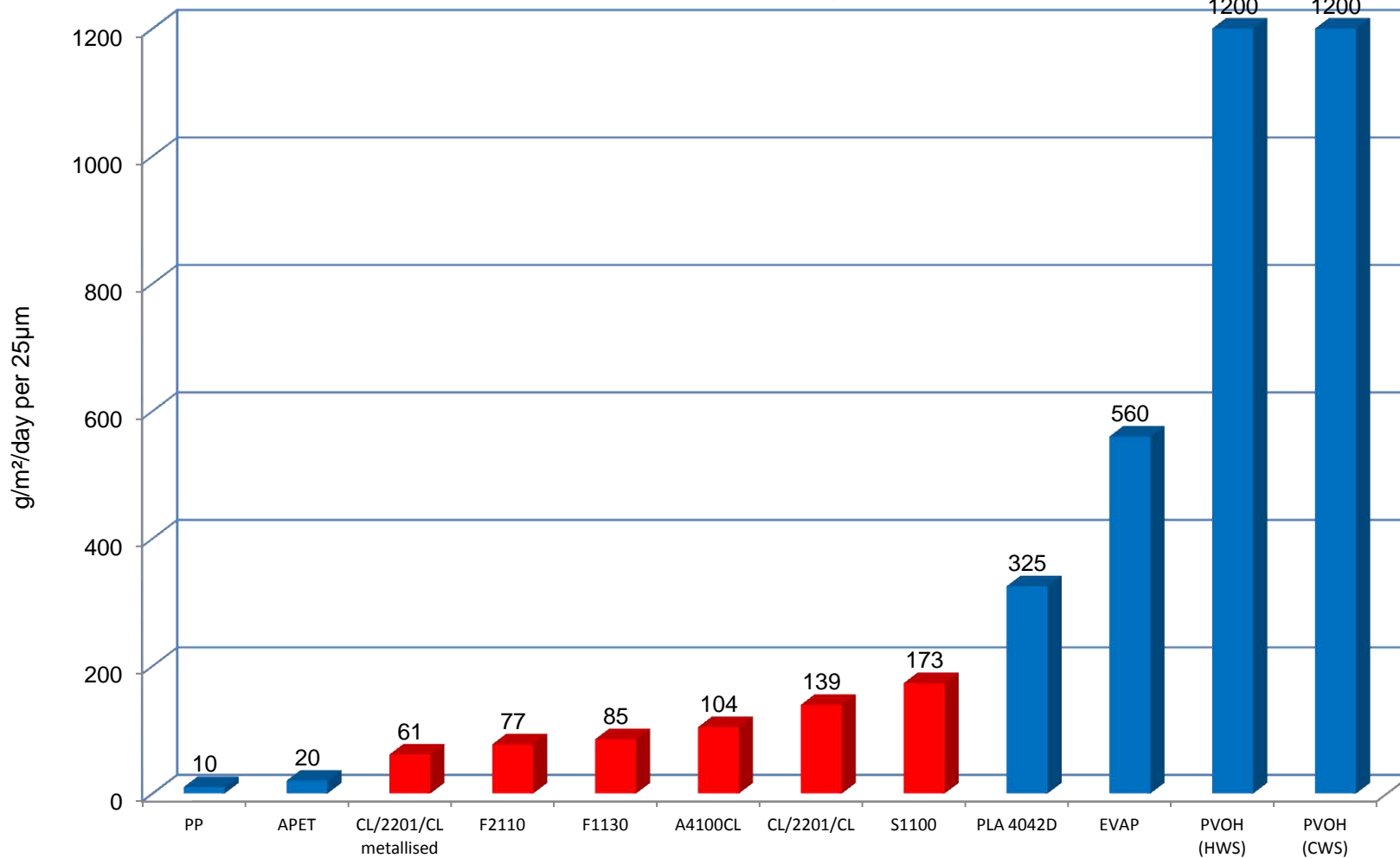
Metallisation and lamination of 3-layer film made from Bio-Flex® A / F / A (20/60/20 %)

- Metallisation and lamination of co-ex structure
- Excellent barrier properties
- High amount of renewable resources (~70 %)
- Tough and flexible



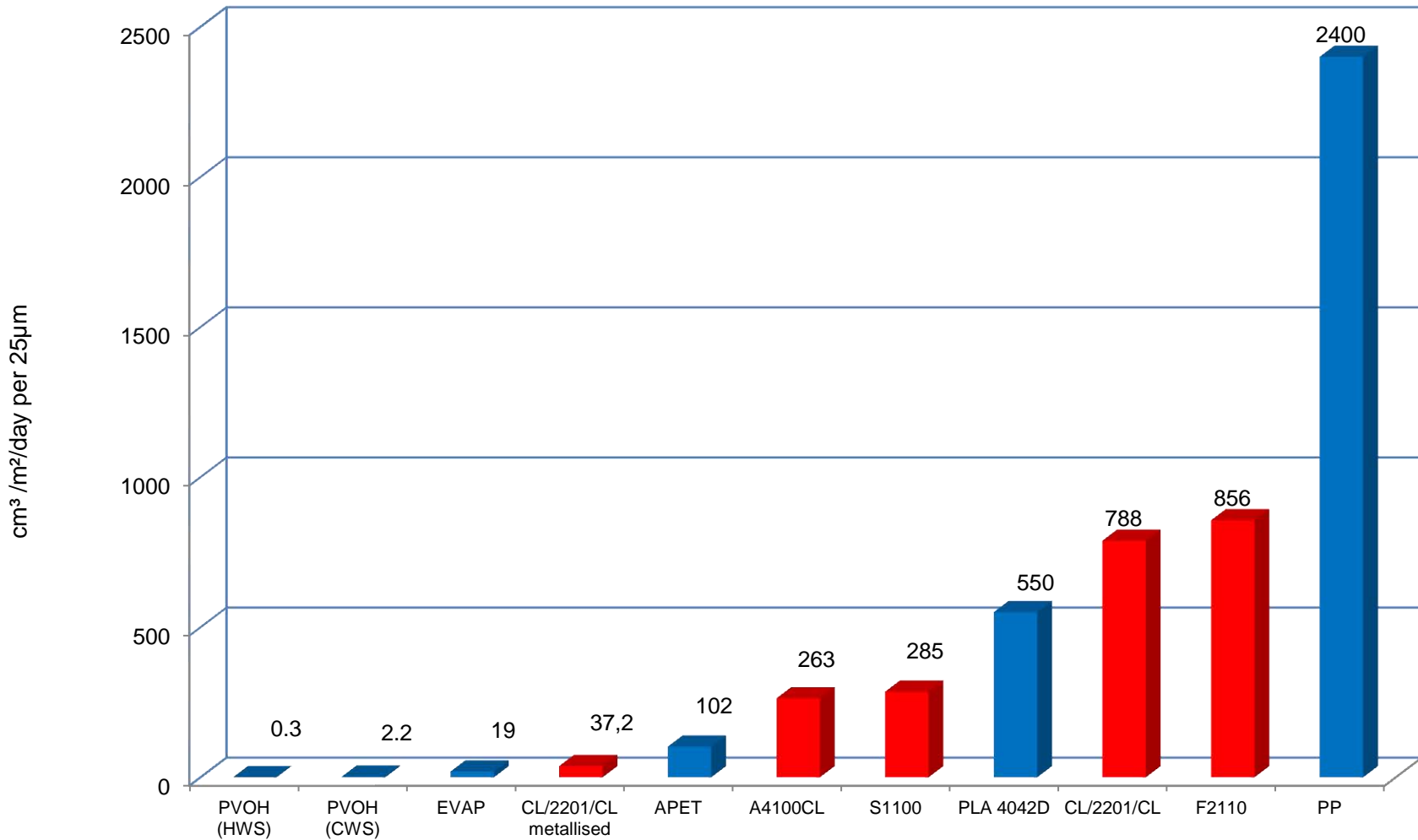
Barrier properties of Bioplastics

Moisture transmission rate (23C 100 % RH)



Barrier properties of Bioplastics

Oxygen transmission rate (23C; 0 % RH)



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Deep Freeze Packaging



Bio-Flex® F 2110 or 3-Layer Film:

- High impact resistance at below freezing point
- VFFS possible
- High content of natural resource material
- Desirable surface gloss

Beauty & Healthcare



Bio-Flex® F

- Breathable but still moisture resistant
- Natural “Soft Touch” without special texture
- Increases products value



Cosmetics Packaging



Bio-Flex® – Multilayer:

- Good barrier properties
- High content of renewable resources
- Resistant to contents
- Printed without corona treatment

Piping bag

MECHANICAL PROPERTIES

- Worlds first biodegradable & compostable piping bag
- Multi-layer bag with good mechanical properties & grip
- Special multilayer system provides required seal strength & modulus



Disposable Catering – heat resistance



- Mechanical properties comparable to polystyrene
- Heat distortion temperature of 117 °C (Vicat A)
- Possible to process on conventional injection moulding machines.
- Can be processed using ABS tools without problems (but the best choice is to modify the tool)

Catering



NEW Biograde® V 2091:

- For injection moulding and thermoforming
- Excellent transparency
- Thin wall injection moulding with 0.35 mm wall thickness

Rigid Packaging



NEW Bio-Flex® S 5630:

- With the essential requirements for elasticity and flexibility
- Surface gloss and pleasant touch
- Can be thermoformed on conventional equipment, cycle time similar to PP

Computer Peripherals



Source: FUJITSU

Biograde® C 7500:

- High heat resistance
- Produced on existing moulds
- Injection moulding using hot runner systems



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Conclusion

- Nature has already created millions of packaging solutions, we at FKUR try to learn from nature and include this knowledge in the development of our products
- Sustainability is becoming more important as main driver for the use of bioplastics
- Currently short life products are by far the largest market segment
- More durable market segments will follow - need to be 'seen as green'
- The renewable resource content will become more important than the biodegradability
- The combination of nature-based content and compostability will be important for short term applications
- Combining different raw biopolymers by compounding increases the range of applications and improves processability
- Further advanced applications can be achieved using multi-layers.

Thank you very much for your attention!

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