EMNANDI BIOPLASTICS

BEYOND NET ZERO

Optimisation Technology and Design for Niche Bioplastic Applications

CASE STUDY

WORLD BIOPOLYMERS AND BIOPLASTICS INNOVATION FORUM
1ST - 2ND MARCH 2023 BERLIN, GERMANY

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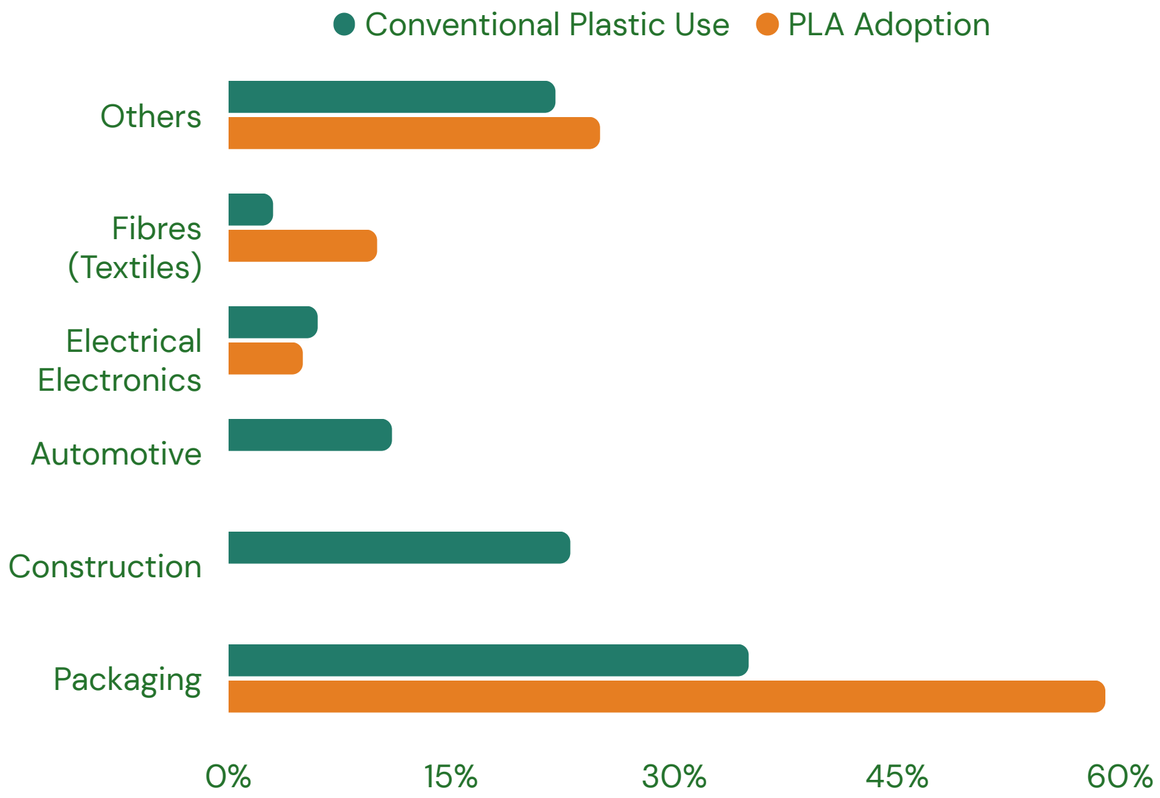
Objective: Accelerate Transition to Bioplastics

Enhance adoption of sustainable materials in new, hard-to-recycle areas

PLA SEGMENTATION VS. CONVENTIONAL PLASTICS



SOURCE: BIOPLASTICS EUROPE, PLASTICSEUROPE

COMPARISON OF KEY CHARACTERISTICS

	PLA	PBAT	PBS	PHA	LDPE HDPE	PP	ABS
Renewable	✓	✗	✓	✓	✗	✗	✗
Compostable	✓	✓	✓	✓	✗	✗	✗
Flexural Strength	▮	▁	▃	▄	▂		▅
Tensile Strength	▅	▃	▇	▇	▃	▂	▇
Impact Strength	▁	▁	▁				▇
Melt Flow Rate	▅	▁	▃		▁	▆	▁

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Key Challenges

Suitable replacement materials, broad requirements

Recognise that each use case has a different set of priorities

Comparison of both performance and sustainability attributes

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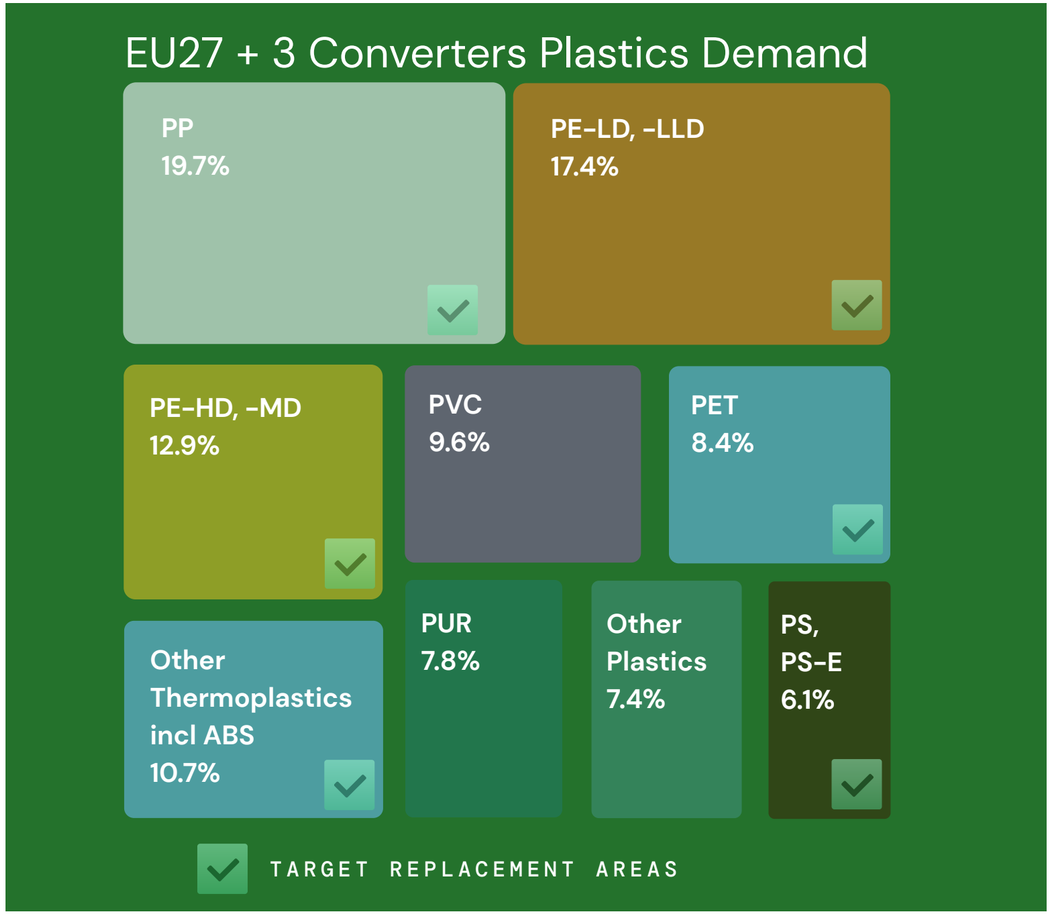
Material Mapping

Relative maturity of conventional plastics vs. compostable creates considerable potential but introduces complexity



SOURCE: UL PROSPECTOR

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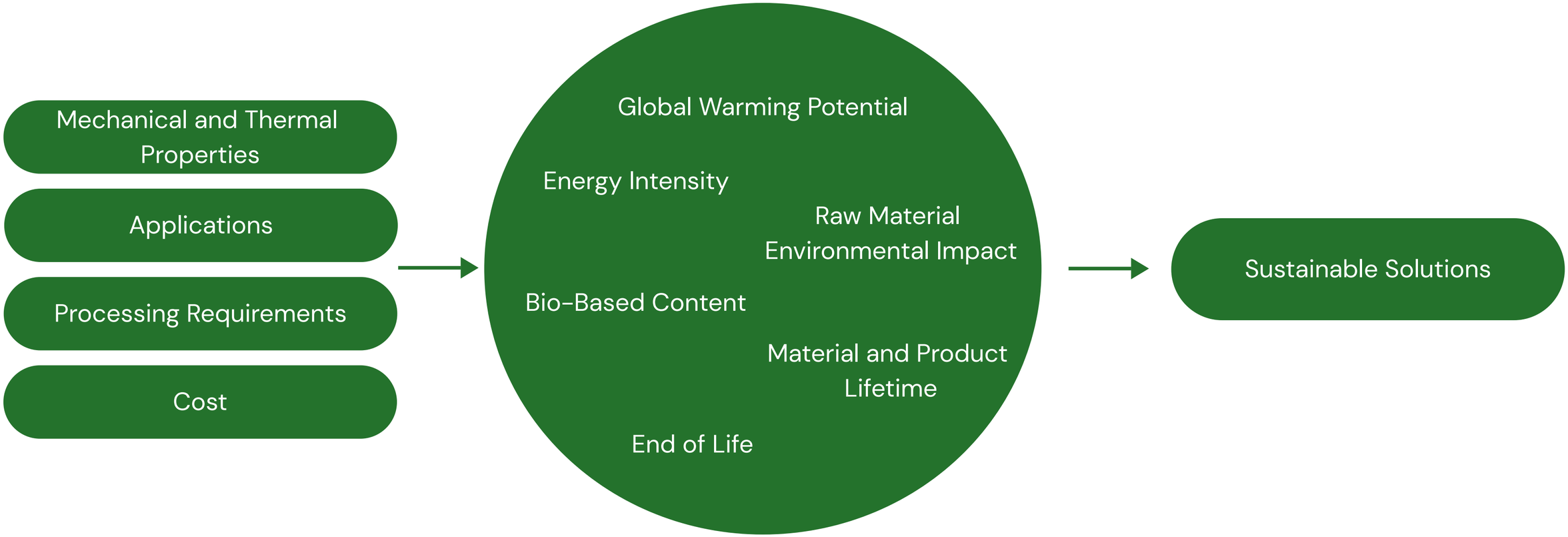
Sustainability: Material and Design Optimisation

Using our proprietary technology, material selection and design is based on the full product's lifecycle with sustainability and circularity at its core



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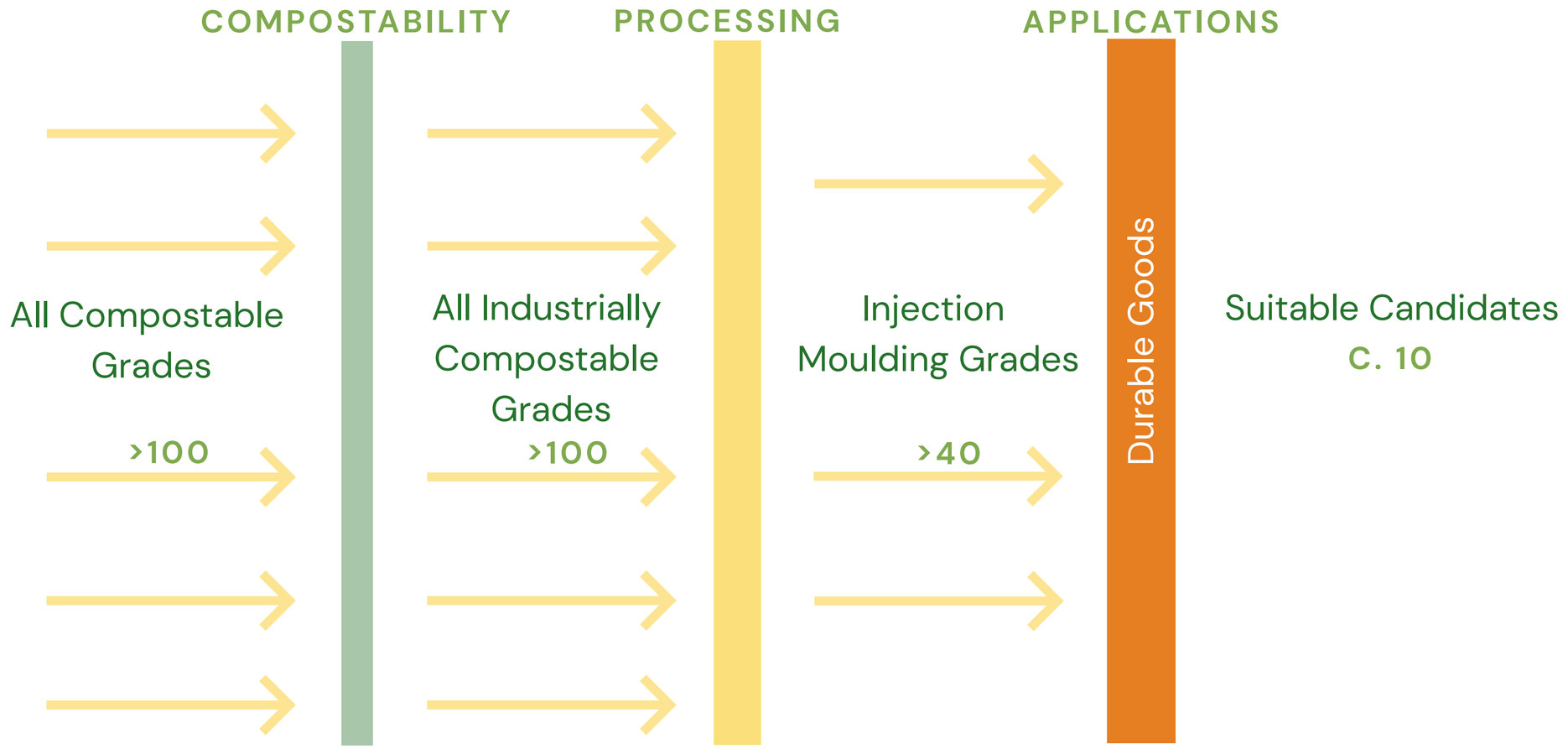
Stage 1: Determine Non-Negotiable Criteria

First set of products are filtered based on essential requirements



Stage 2: Determine & Prioritise Optimisable Criteria

Variables of interest are assigned a weighting which will inform the ranking of materials

PERFORMANCE & COST VARIABLES

Property	Tolerance	Weighting
Tensile Modulus & Strength	25%	3
Flexural Modulus & Strength	25%	3
Impact Strength	25%	5
Melt Temperature	25%	1
Cost	50%	3

SUSTAINABILITY VARIABLES

Property	Targets	Weighting
Bio-Based Content	Maximise	2
GWP: Material Manufacturing & Processing	Minimise	5
Energy Intensity (Material Manufacturing & Processing)	Minimise	3
Manufacturing Environmental Impact	Minimise	2
End of Life Environmental Impact	Minimise	5
Product Lifetime	Optimise	1

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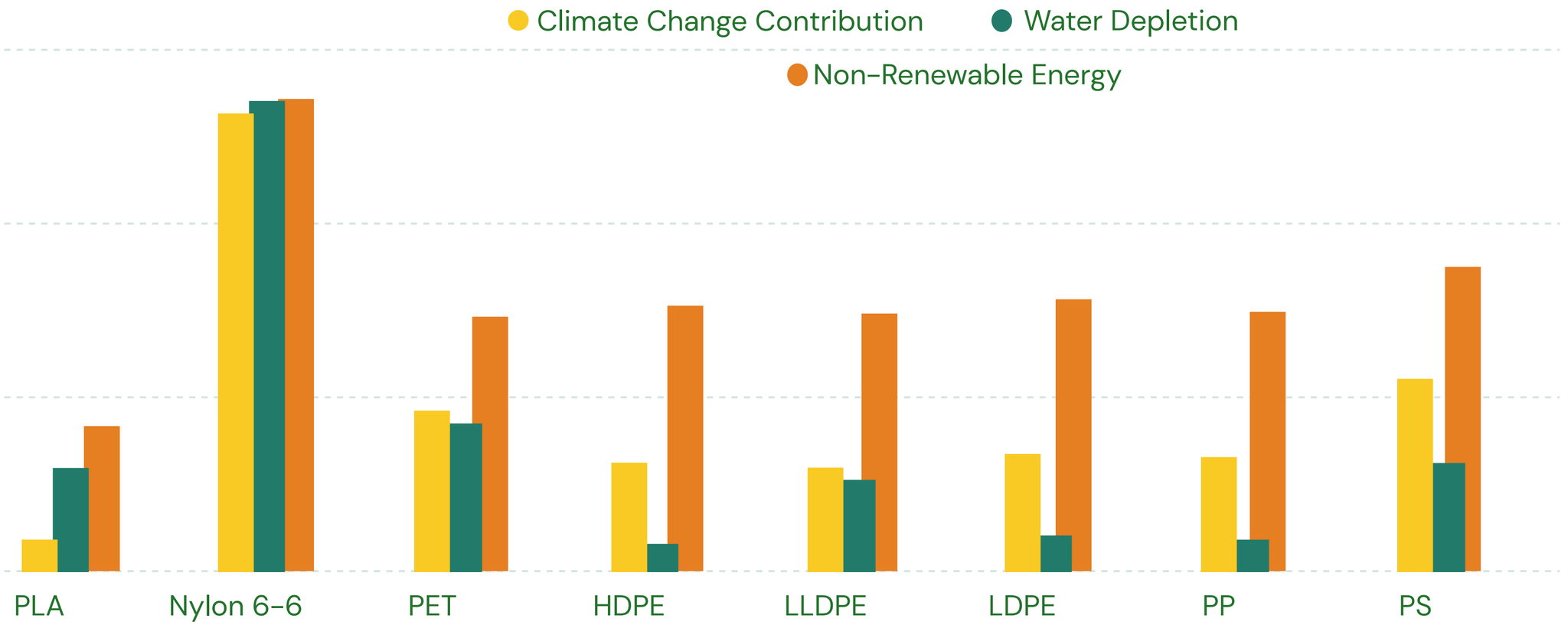
Sustainability: Material and Design Optimisation

Illustrative Sustainability Metrics



SOURCE: CASTRO-AGUIRRE, E. ET. AL., POLY(LACTIC ACID)–MASS PRODUCTION, PROCESSING, INDUSTRIAL APPLICATIONS, AND END OF LIFE. ADV. DRUG DELIV. REV. 14, 4265-4277 (2016)

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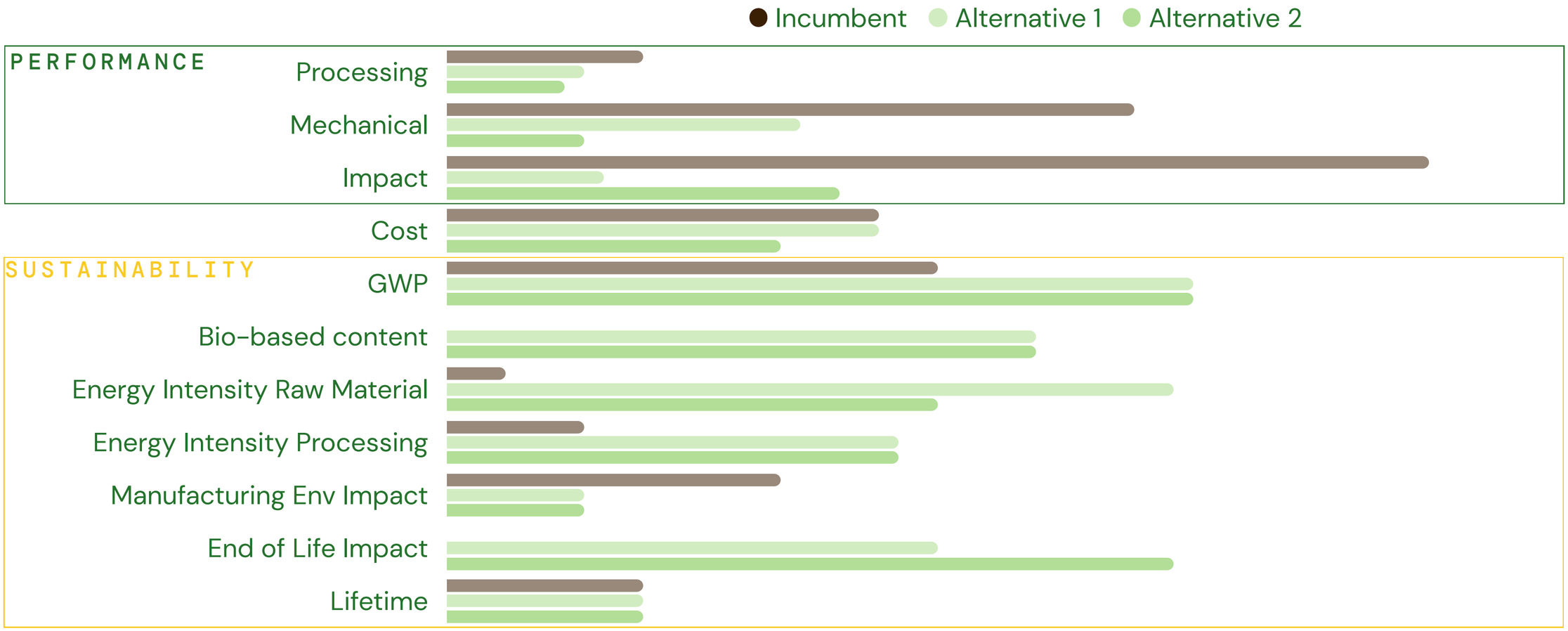
Stage 3: Optimisation & Results – Existing Materials

Based on the criteria, existing materials are determined and ranked

MATERIAL SCORES



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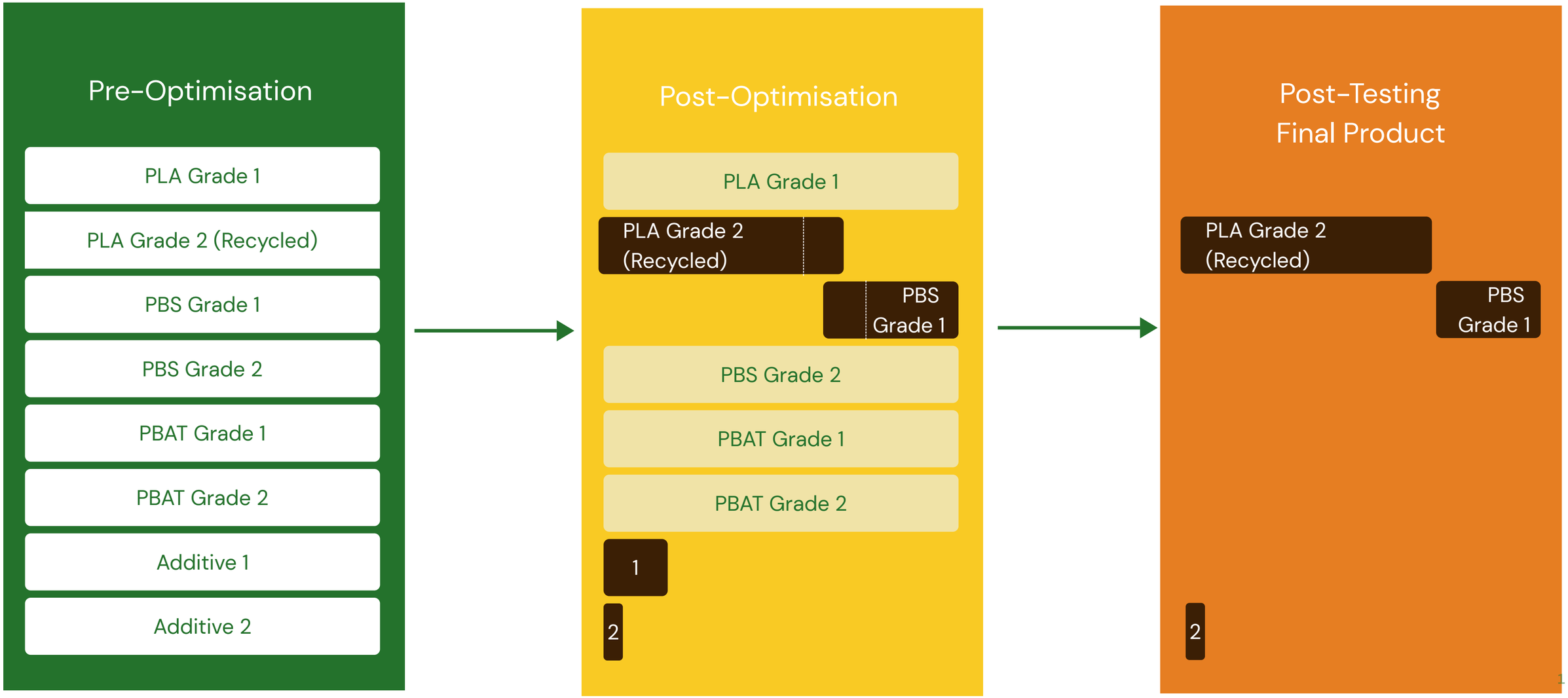
Stage 4: Bespoke Blend

To meet gaps not met by existing materials, the algorithm is used to propose a blend



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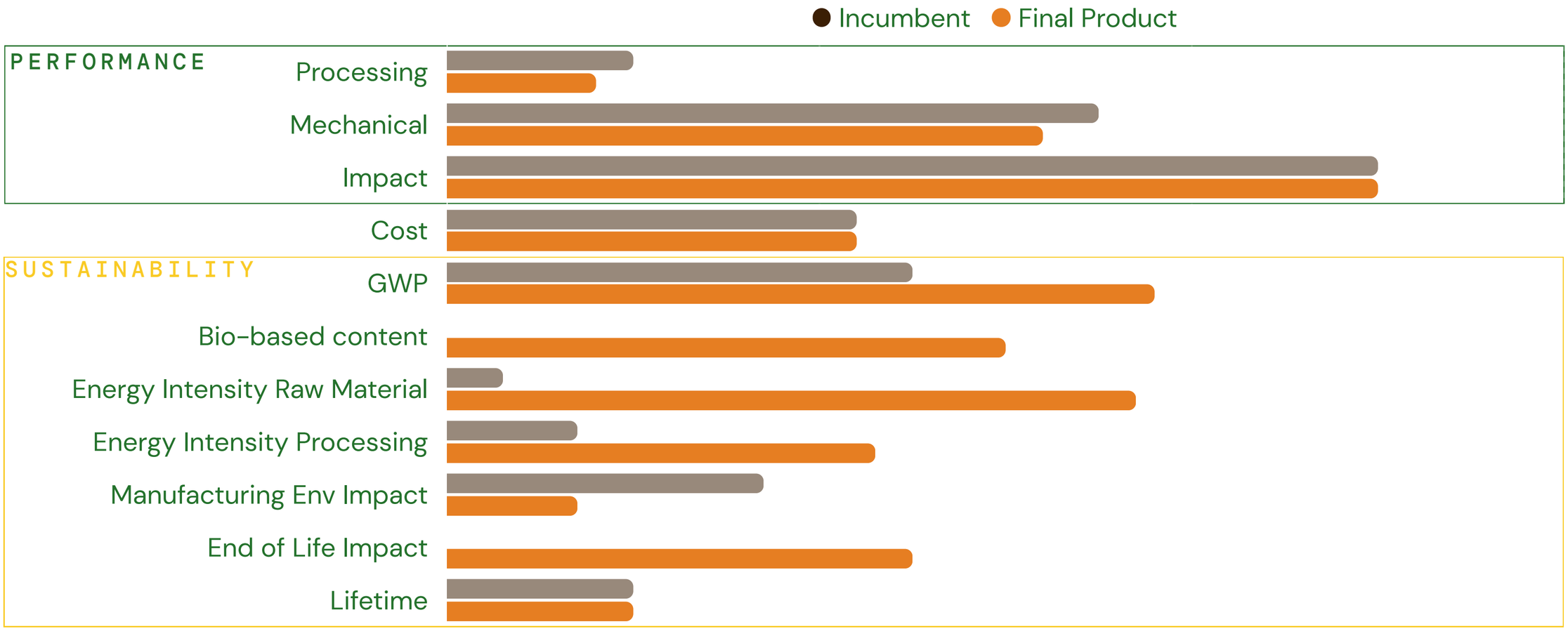
Outcome

A material that met the mechanical properties with superior sustainability results

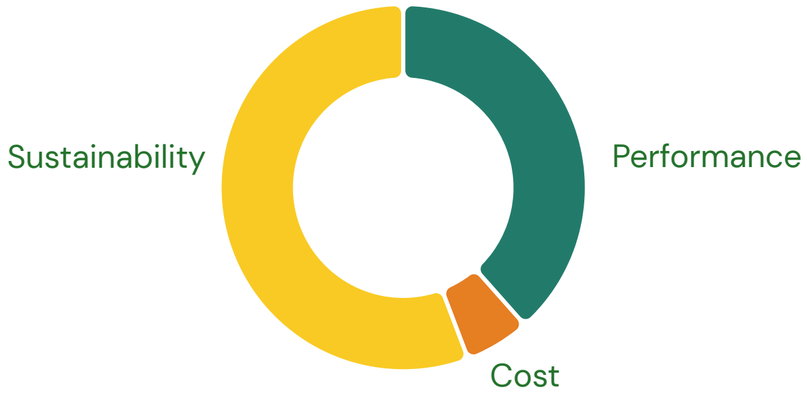
MATERIAL SCORES & DRIVERS



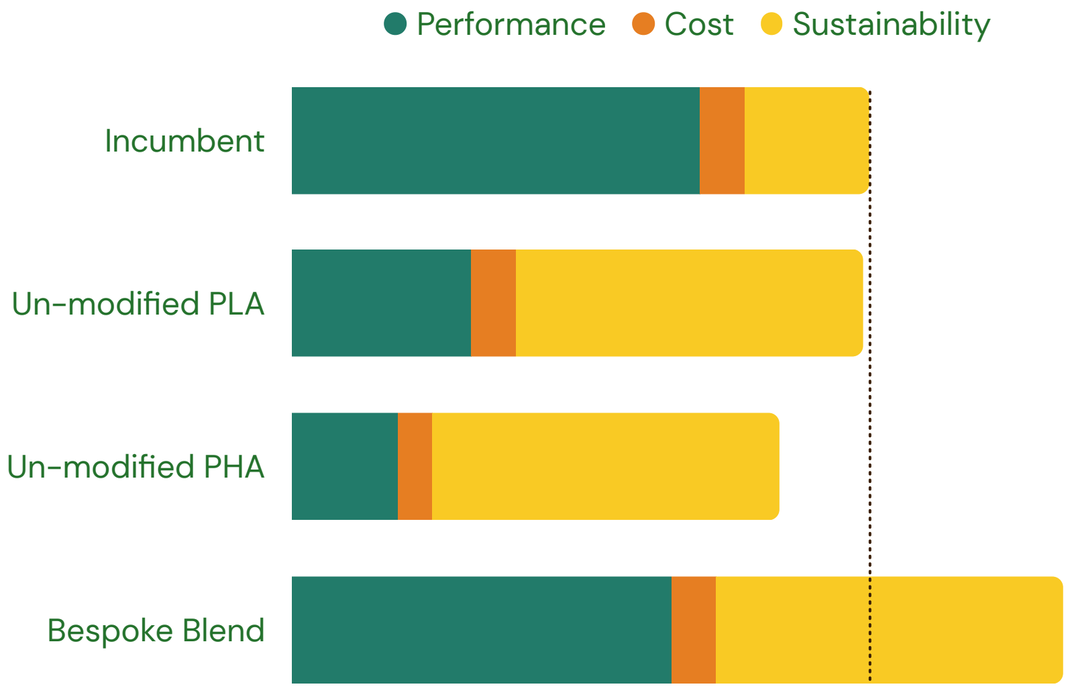
Summary

The outcome was a material which met performance requirements and exceeded sustainability criteria

WEIGHTINGS



COMPARISON



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In Conclusion: Enhancing Adoption of Bioplastics

Benefits of design optimised for performance and sustainability

Draws on expertise of multiple producers

Tailored identification of replacement options

Transparent and comprehensive sustainability metrics

Limits redundant testing and time to market

THANK YOU

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