



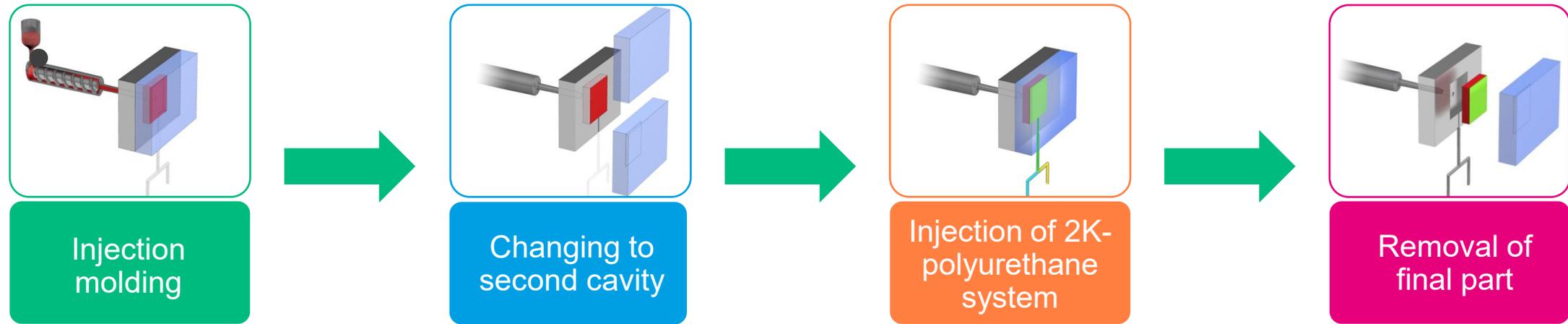
Advanced Direct Coating / In-Mold Coating Solutions

Combining Material Excellence with
Comprehensive Technical Support

IMCcon 2026 | 24.+25.02.2026 |
Lüdenscheid

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In-Mold Coating – process flow



In-Mold Coating (IMC) is a Covestro & partners technology development that combines **Thermoplastic Injection Molding** with the in-mold formation of an almost solvent-free 2K PU coating by **Reaction Injection Molding**.

Advantages of In-Mold Coating technology

Multiplying advantages from one process

Processing aspects:

- ✓ Reduction of processing steps

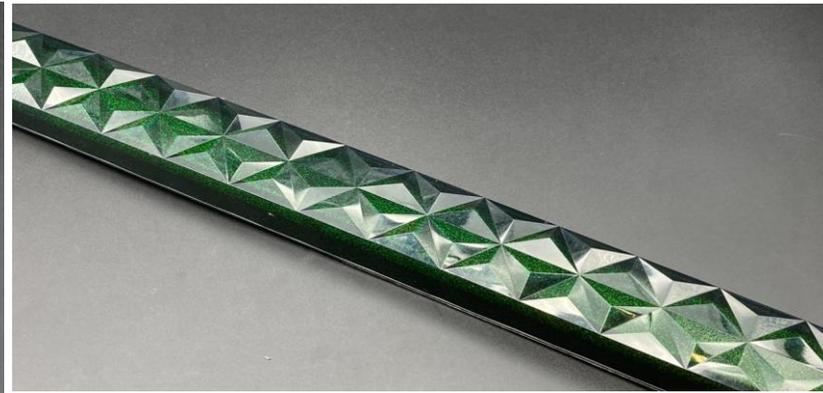
Design aspects:

- ✓ Sharpe 3D structures realized by PUR coating
- ✓ Replication of coating mold texture
 - Matte and high-gloss on the same part surface
- ✓ Reflow effect
- ✓ No orange peel, no fat edges and no coating mass accumulation on edges
- ✓ Can be combined with e.g. FIM, 2K molding, etc..



Advantages of In-Mold Coating technology

Multiplying advantages from one process



Support along the whole project



Covestro as a go to partner for In-Mold Coating projects

Covestro Support	Material Selection	<ul style="list-style-type: none">• Early-stage design support with innovative concepts and material solutions• Tailored material recommendations optimized for specific applications
	Part and mold design	<ul style="list-style-type: none">• Comprehensive part and mold design expertise for injection molding and RIM processes• Advanced rheological analysis for thermoplastics and coating applications• Precise warpage prediction and final setup optimization• Early support in component cost and CO₂ footprint estimation (IMC Analysis Tool)
	Process validation	<ul style="list-style-type: none">• Extensive direct coating trials conducted in our global technical laboratories• Comprehensive testing capabilities available in our specialized Surface Technology Lab• Integrated network support throughout the entire process chain
	SOP	<ul style="list-style-type: none">• Dedicated on-site technical support• Expert troubleshooting assistance during serial production

Covestro global material supplier



Engineering Plastics (EP) material brands

Brand name	Material class	Properties	In-Mold Coating
	PC Polycarbonate	high transparency, high toughness, high heat resistance, high flame retardance, good electrical properties	Serial production at several OEMs AMECA listed in next months Adhesion optimized Makrolon® IMC
	PC High Heat Polycarbonate	high transparency, high toughness, tailor-made Vicat up to 205°C, good electrical properties	
	PC/ABS- or PC/ASA Blends Polycarbonate/Acrylonitrile-Butadiene-Styrene copolymer	high toughness even at low temperatures, high heat resistance, good paint ability, good flowability/good processing behavior	
	PC/PBT- or PC/PET- Blends PBT – Polybutylene terephthalate PET – Polyethylene terephthalate	good resistance to chemicals, high toughness even at low temperatures, high heat resistance, good paint ability	

All material classes suitable for In-Mold Coating

Serial production at several OEMs

Makrolon® IMC

Tailored Makrolon® for In-Mold Coating

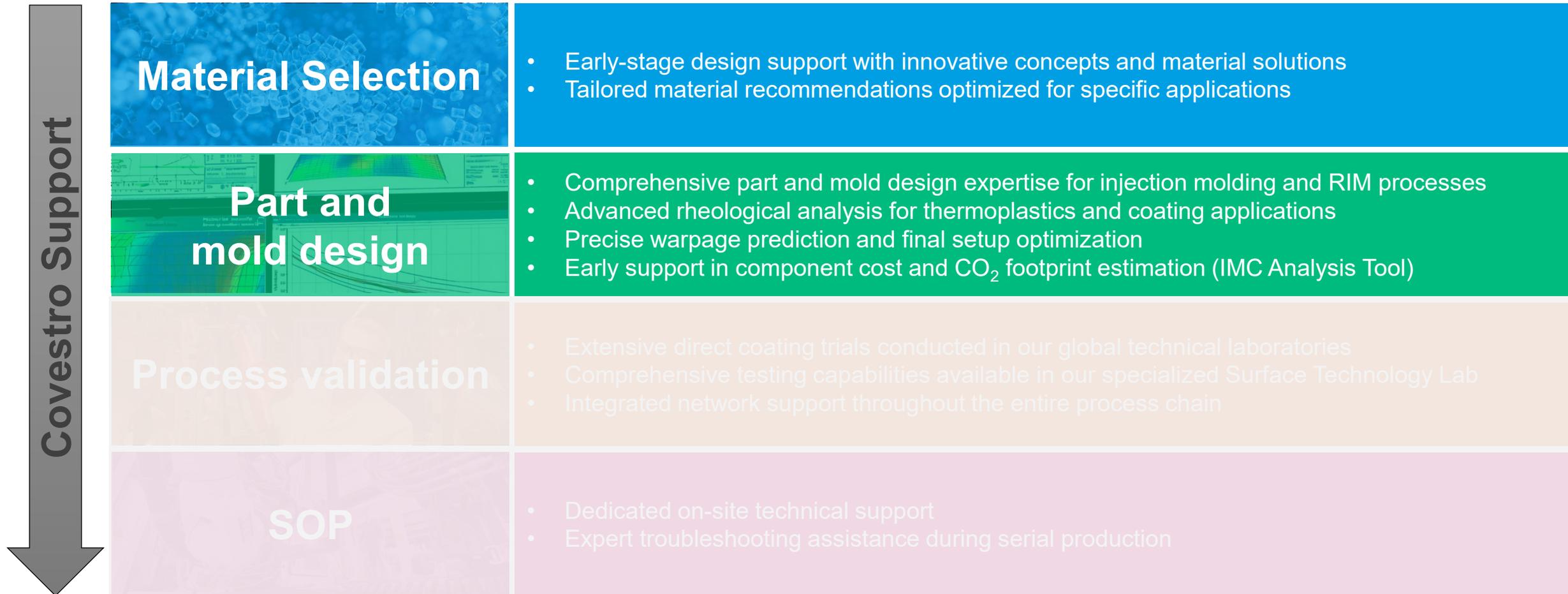


- ✓ Enhanced polycarbonate formulation designed specifically for Direct Coating - the In-Mold Coating technology
- ✓ Superior adhesive strength to polyurethane coating systems
- ✓ Tailored raw material and additive packages
- ✓ Light-stable colorants suitable for exterior applications
- ✓ Available in transparent, tinted, IR-transparent, and opaque variants
- ✓ Suitable for interior and exterior automotive applications
- ✓ Holistic customer service package

Support along the whole project

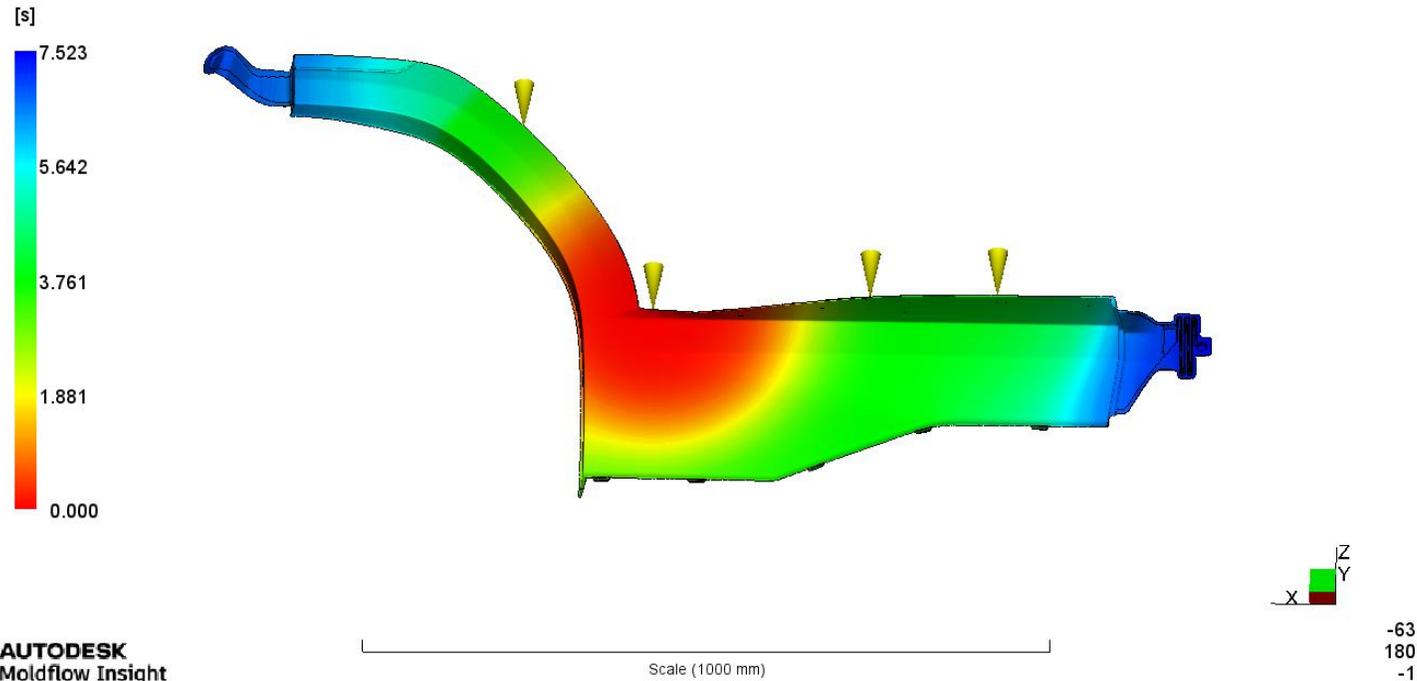


Covestro as a go to partner for In-Mold Coating projects



Rheological analysis wheel arche

Thermoplastic filling calculation – Bayblend® T85 X



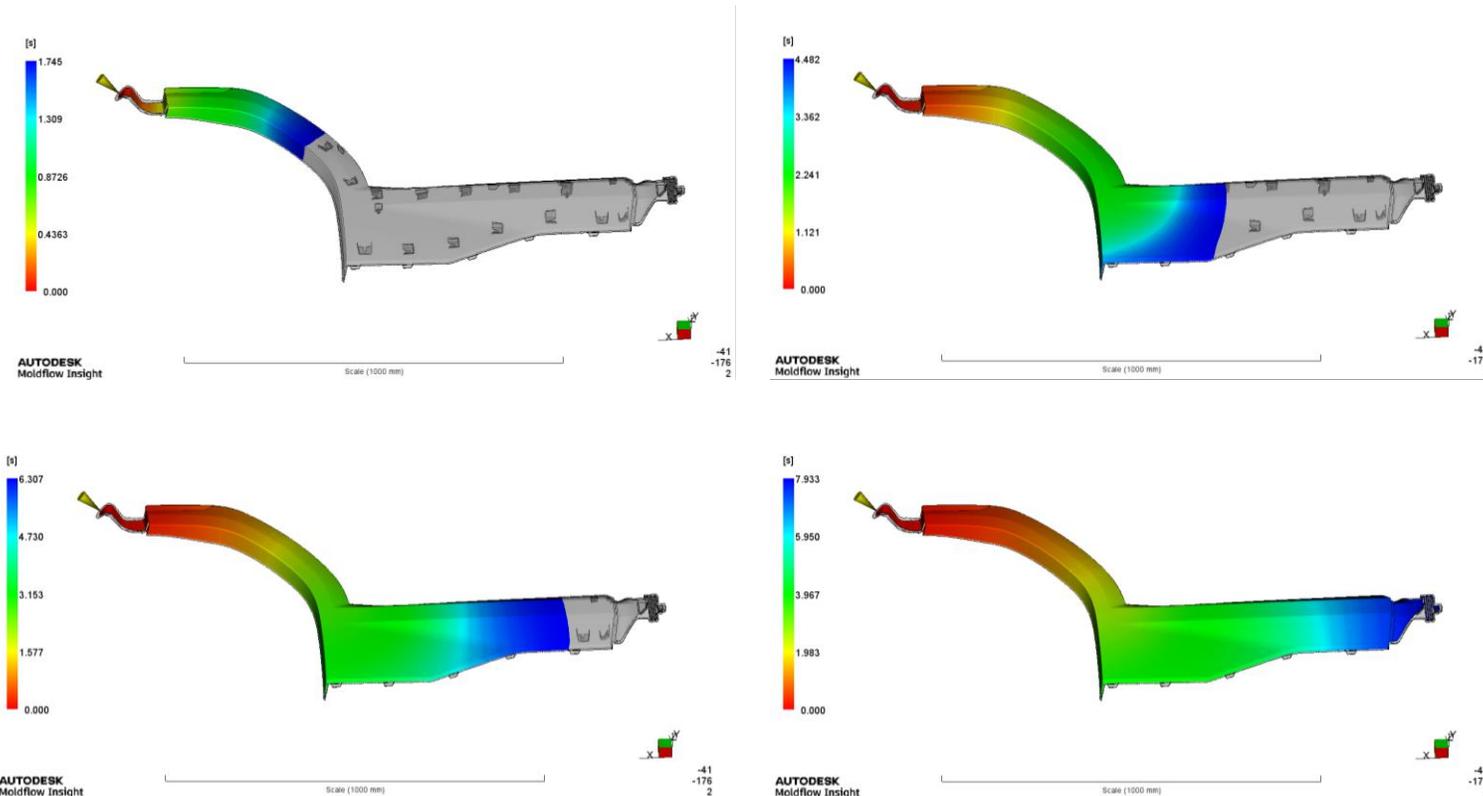
CAD data provided by INEVO

Key Determined Parameters

- **Flow behaviour and flow paths** - Melt flow movement through the component and filling sequence with identifying of optimal gate positions
- **Pressure distribution** - Injection pressure distribution to identify pressure peaks and critical areas
- **Temperature distribution** - Melt temperature profile during filling and cooling phases
- **Shrinkage behaviour** - Volume shrinkage in different zones to predict deformation and dimensional deviations

Rheological analysis wheel arche

Coating filling calculation



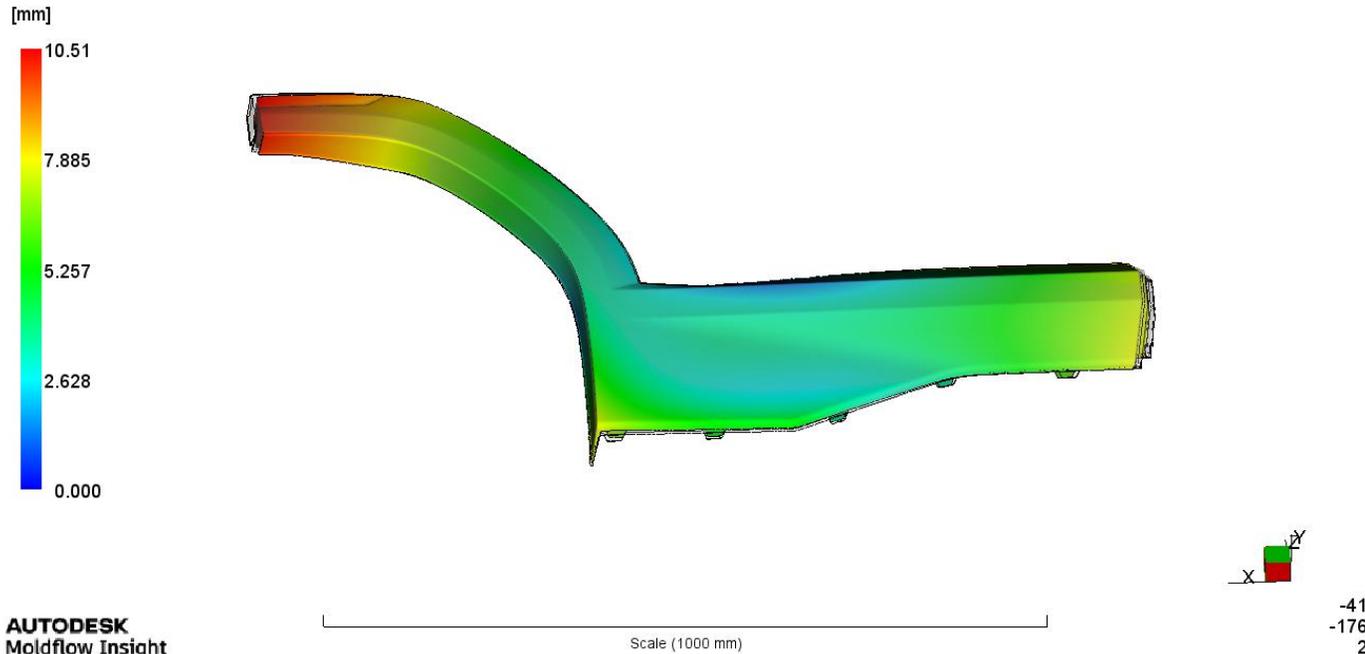
CAD data provided by INEVO

Key Determined Parameters

- **Flow behavior** - Movement and distribution of PU coating system through cavity
- **Fill pressure distribution** - Required filling pressure and distribution throughout component
- **PUR gating and Venting optimization** - Optimal positioning to prevent air entrapment

Warpage prediction wheel arche

Warpage calculation of the whole part



AUTODESK
Moldflow Insight

CAD data provided by INEVO

Key Determined Parameters

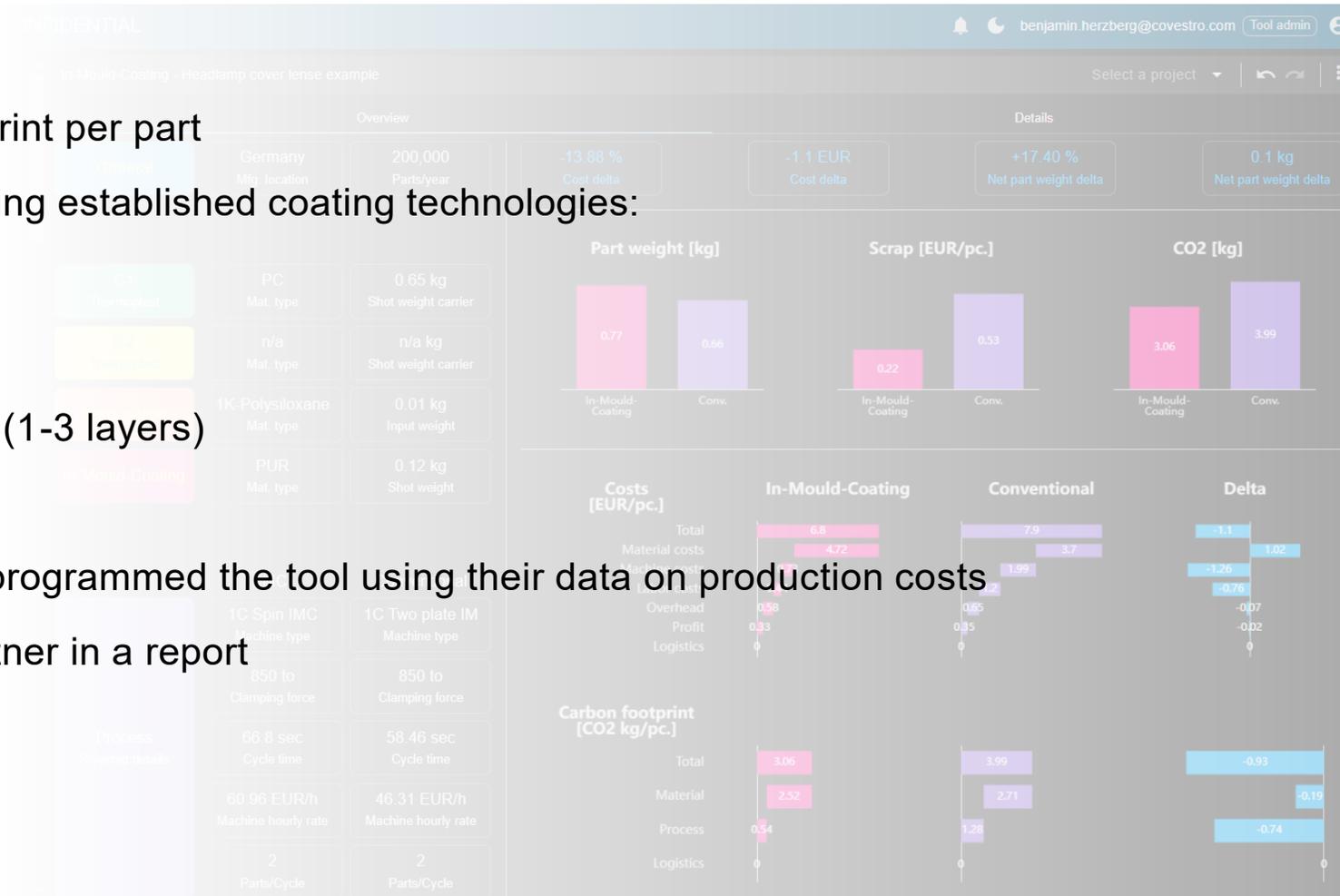
- **Deformation prediction** - Expected warpage and dimensional deviations of the whole In-Mold Coating part

In-Mold Coating analysis tool

Part Cost & CO₂ footprint calculation

Key Features:

- Dual Analysis: Cost comparison and CO₂ footprint per part
- In-Mold Coating can be compared to the following established coating technologies:
 - Single Layer Hard Coating (UV/thermal)
 - Multi Layer Hard Coating (thermal)
 - Multi and Single Layer Exterior Body Paint (1-3 layers)
- Costing specialist AWS Systemtechnik GmbH programmed the tool using their data on production costs
- Created calculation can be shared with the partner in a report



Potential In-Mold Coating applications exterior

Cost and CO₂ calculation examples IMC vs. conventional spray coating

Assumption

- 100.000 cars per year
- Production in Germany

Hard coating

Head lamp cover lens

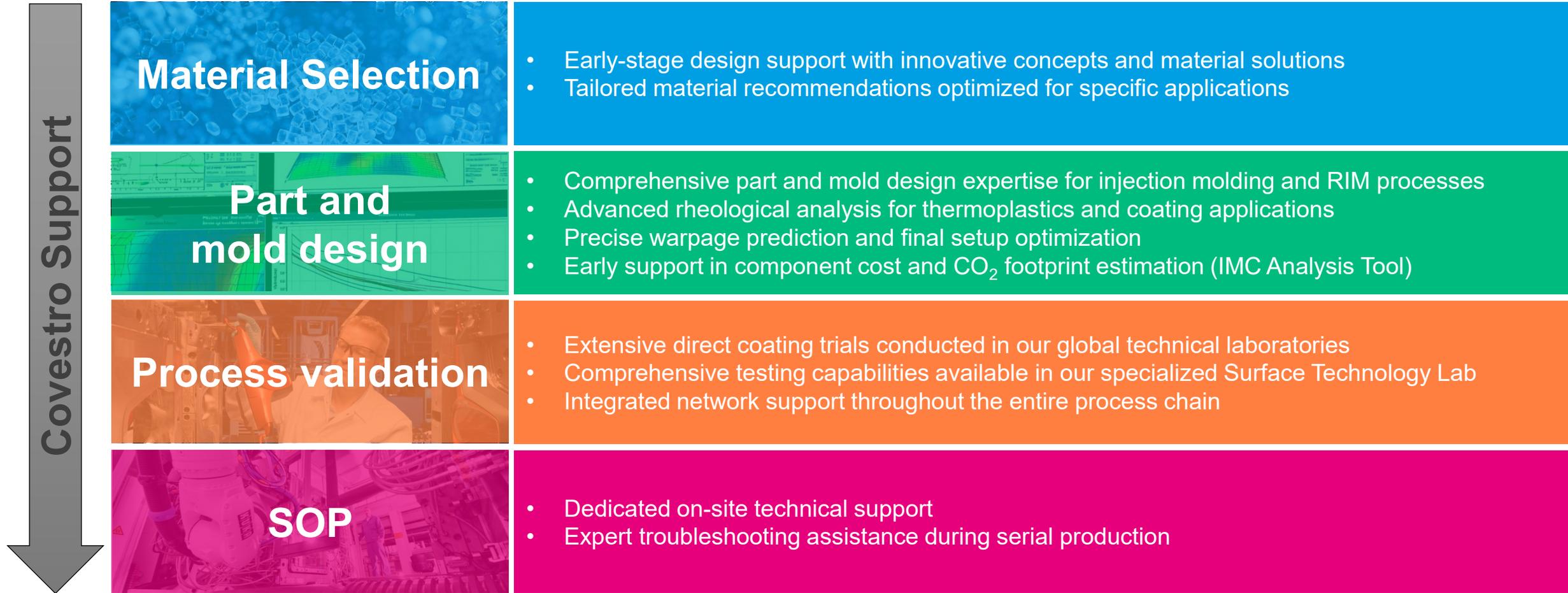


Body paint 3 layer

Wheel arche

Support along the whole project

Covestro as a go to partner for In-Mold Coating projects



Process validation in Covestro technical labs

Globally available In-Mold Coating equipment



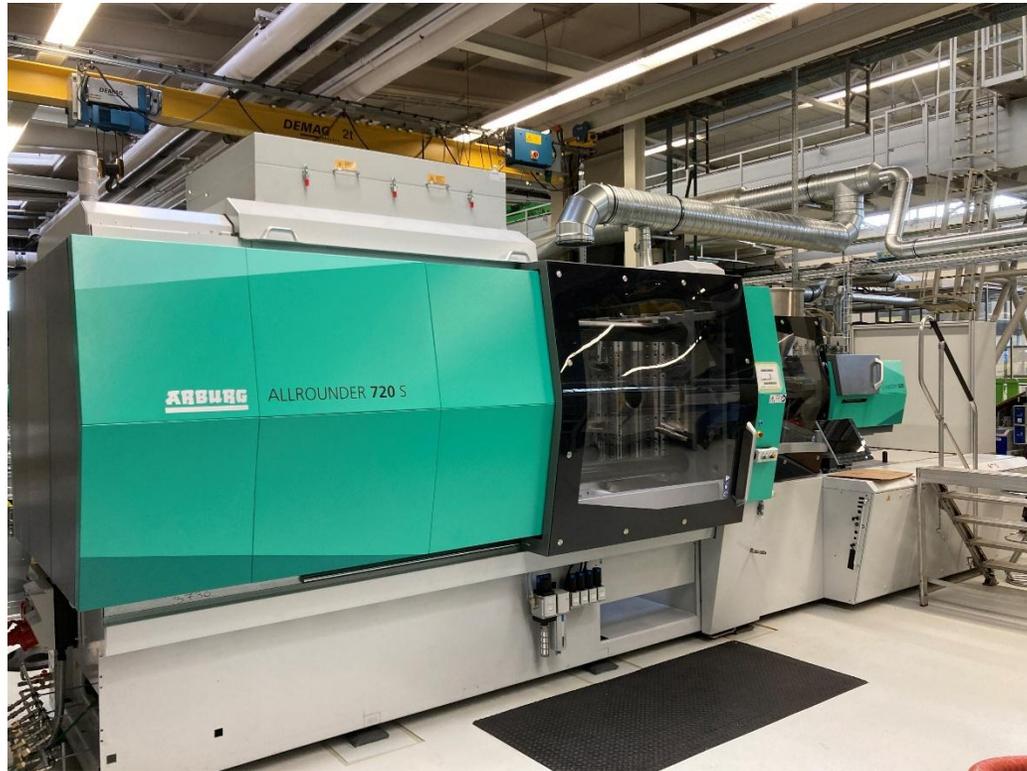
- Local In-Mold Coating support worldwide
- Validation tools available in all regions

Technical center - Leverkusen



Injection molding and reaction injection molding machine

Arburg Allrounder 720 S 3200 kN



Krauss-Maffei RimStar 4/4



Technical center - Leverkusen



Injection molding and reaction injection molding machine

ENGEL DUO 16050H/7050M/2300 Combi

HK100

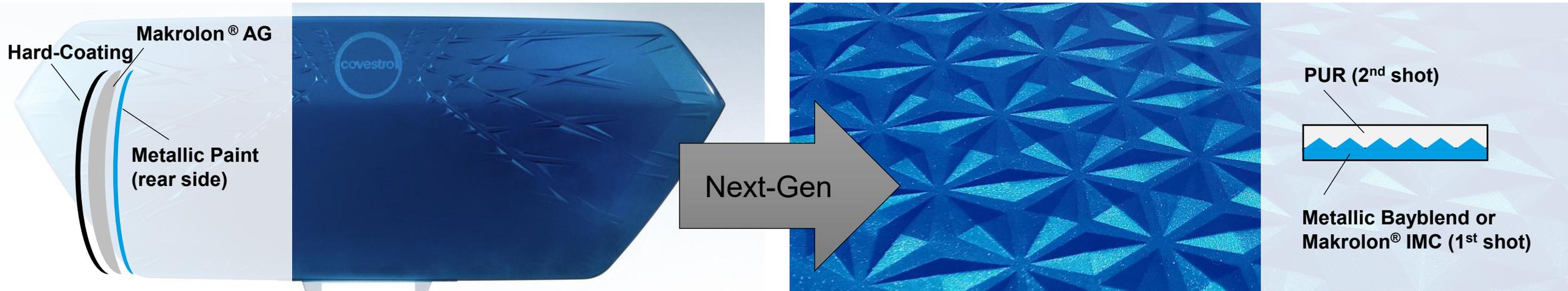


Development Projects

Affordable luxury - next-gen surface design



K 2025 Exhibit



Products

Makrolon® AG (neutral grey tinted)

- Injection-molded 3D structures, offering customizable depth effects with color-neutral light transmission (5%-75%) and UV stabilization
- Conventional coating processes enable color options on the back while serving as a transparent, scratch-resistant protective layer on the front
- Existing coating equipment can be efficiently utilized for innovative premium designs in mass-market automotive applications

Products

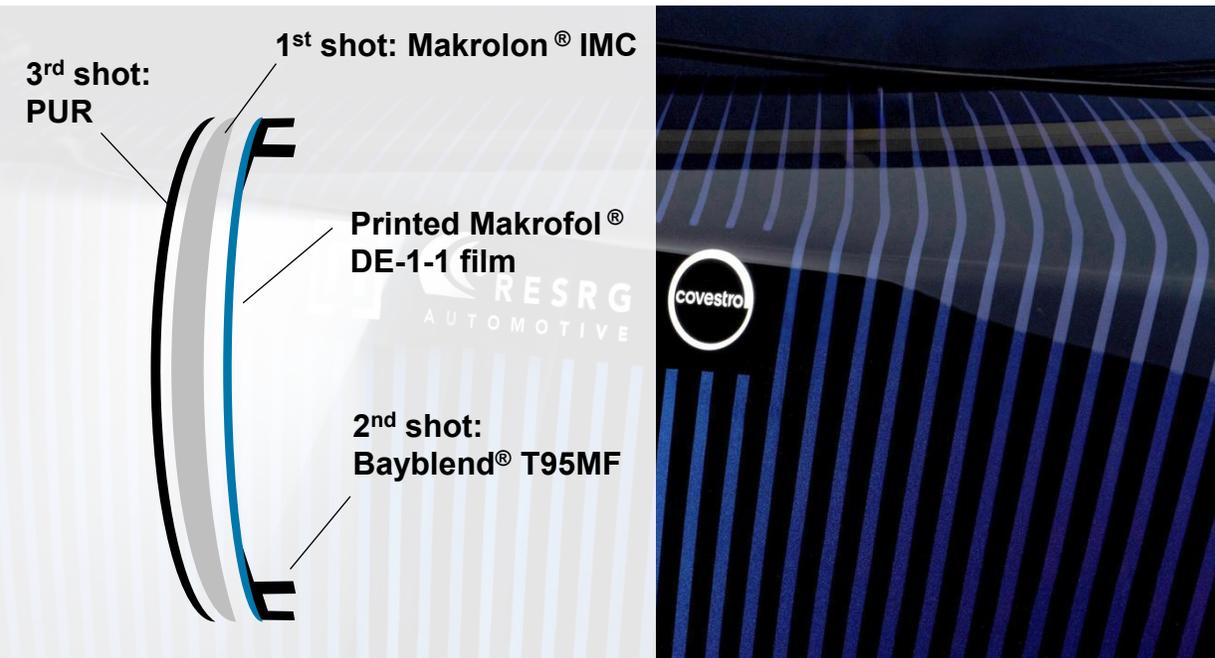
Bayblend®, Makrolon® IMC (metallic opaque tint)

- Bayblend® and adhesion-optimized Makrolon® IMC provide metallic effects with integrated 3D structures for enhanced design depth
- Transparent scratch-resistant PUR In-Mold Coating with self-healing properties for surface protection
- Cost-efficient single-step production process with low investment requirements, enabling easier market entry for mass market suppliers

Multi Component IMC Tech Demonstrator



K 2025 Exhibit



- Pre-printed Makrofol® films deliver highly individualized design options with the potential to integrate heating options for autonomous driving sensors

- Adhesion-optimized Makrolon® IMC enabling integrated signature and functional lighting* with integrated frame and mounting system by 2K injection molding
- Self-healing automotive coating surfaces through PUR as transparent protection layer



Products

Makrolon® IMC2477, Bayblend® T95 MF, Makrofol® DE 1-1

Laser decorated In-Mold Coating demonstrator



K 2025 Exhibit



- Striking light and depth effects by 3D surface structures integrated into adhesion-optimized Makrolon® IMC available in numerous colors
- Seamless logo and design integration without disrupting surface defects by tailored PUR systems that change color and translucence by laser activation
- All achieved with minimal equipment and near-zero rejection rates by In-Mold Coating

Products

Makrolon® IMC2477





Thank you for your attention

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