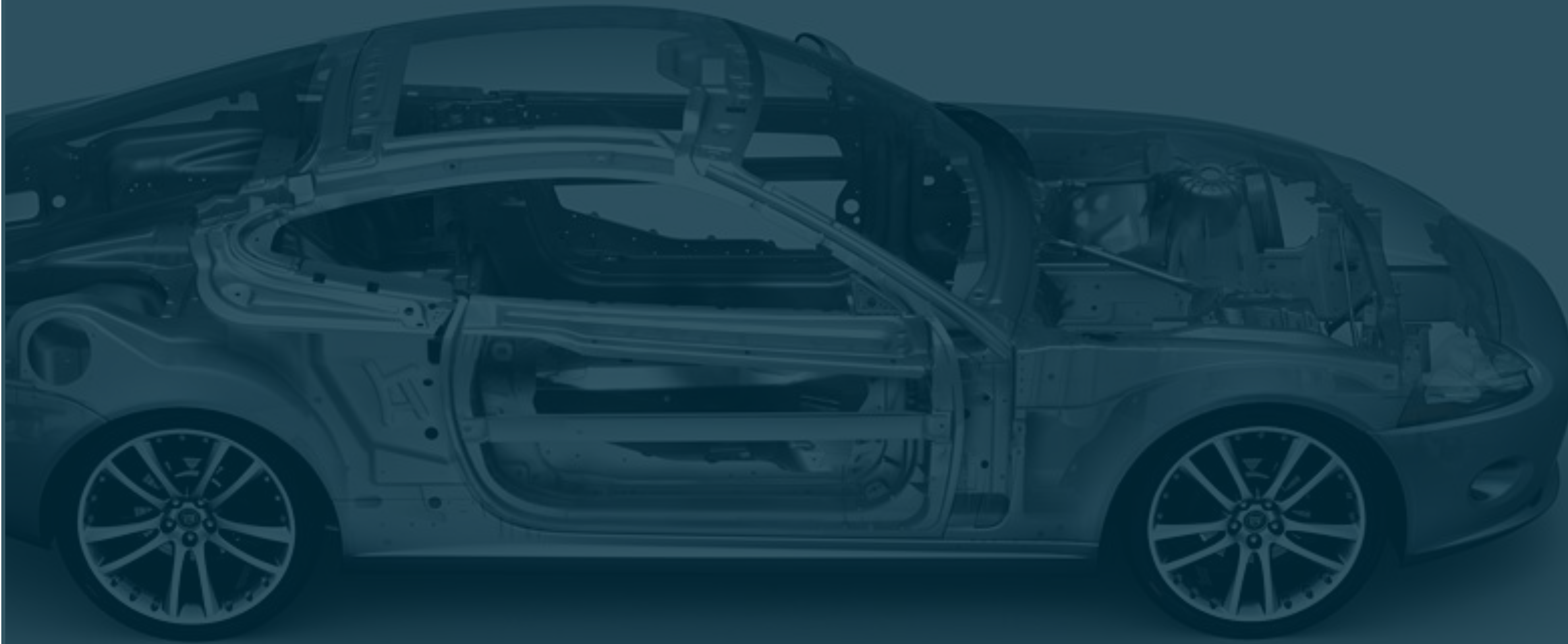


Surging Aluminum Usage in European Cars



Ducker Carlisle LLC

DETROIT | PARIS | BERLIN | SHANGHAI | BANGALORE | LONDON | BOSTON

Prepared by:



DUCKER  CARLISLE

For:

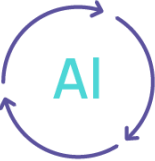
GIFA 2023 Düsseldorf
NEWCAST-Forum bdguss

June 14th, 2023



Key facts & figures

 **€40** Billion annual turnover

 **90%** of aluminium is recycled in construction and automotive in Europe

 Europe produces **6%** of worldwide primary aluminium

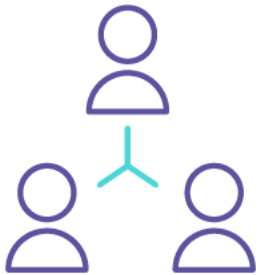
 **51%** of European production comes from recycled sources

Founded in **1981** European Aluminium represents the entire value chain of the aluminium industry in Europe

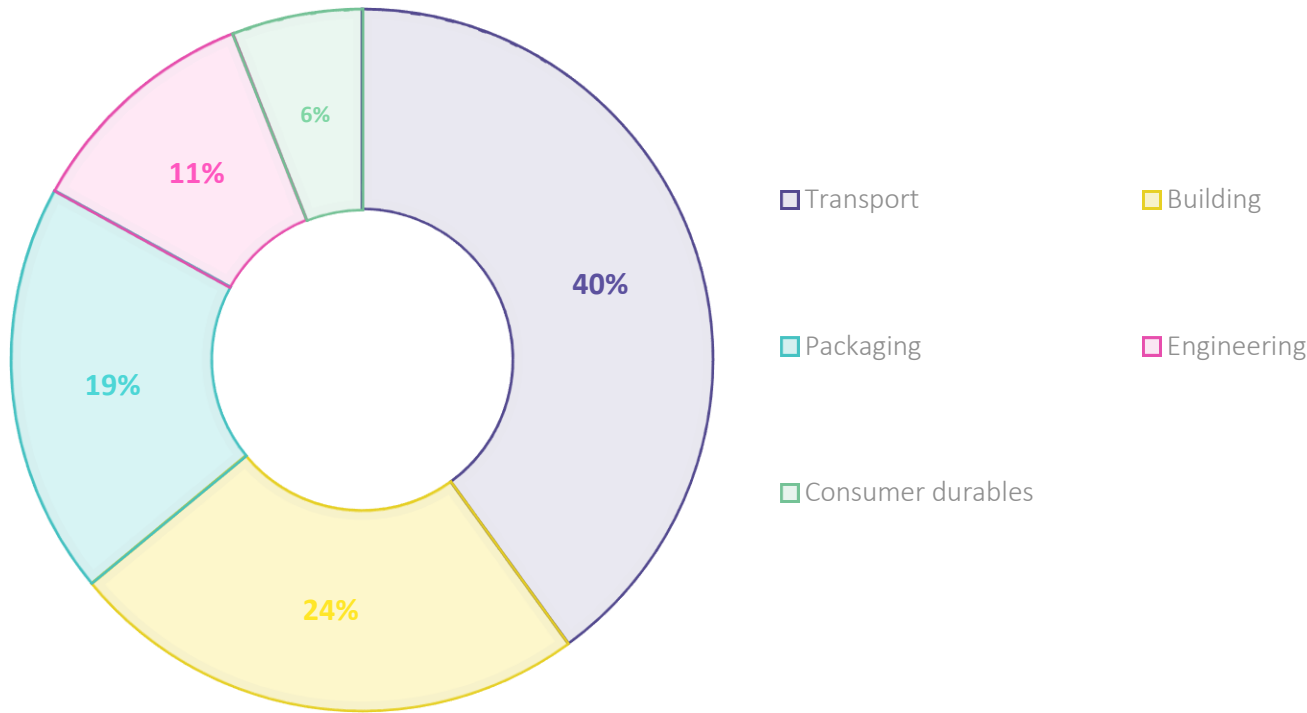
 **100+** members



Approx. **600 plants** in 30 European countries (EU, EFTA, UK, Turkey, BiH)



1 million + Direct and indirect jobs across Europe's value chain



An innovative value chain serving EU key markets (end uses)

Overcome Complex Challenges with Unrivaled Global Consulting Services

Uncovering opportunities starts with mastering the landscape. Our unique continuum of global consulting services combines market intelligence and advisory services from multi-disciplinary experts to enhance your business performance and deliver remarkable outcomes.



Research Intelligence and Analytics

Through industry expertise and insights, we accelerate client planning decisions and implementation.



Insights, Data & Benchmarks

We leverage our proprietary data to drive strategy and solve clients' complex problems.



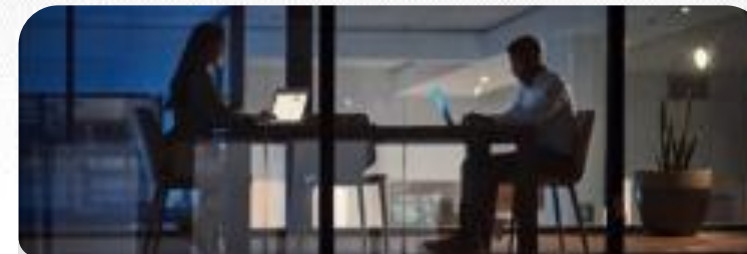
Strategy and Consulting

Practical frameworks and strategic programs increase operational performance, improve customer service, and reduce costs.



Pricing Solutions and Implementation

Proven expertise to deliver aligned brand and channel strategies, along with high, immediate ROI.



M&A Transaction Support

Deep industry expertise and advanced data analytics support comprehensive diligence for buy-side transactions and sell-side market studies.



Supply Chain Operations

Partner with experienced consultants to make your supply chain efficient, resilient, and better connected with your customers.

Ducker has been providing EA with analyses of the Aluminum Content in Cars since 2012. The 2022 edition of this study considers the market in its entirety and highlights the evolutions linked to the electrification of the car market

EUROPEAN ALUMINIUM represents the aluminum industry in Europe, encompassing primary aluminum producers, downstream manufacturers, producers of recycled aluminum and national aluminum associations.



European Aluminium - Automotive & Transport Group Members



PROJECT SCOPE

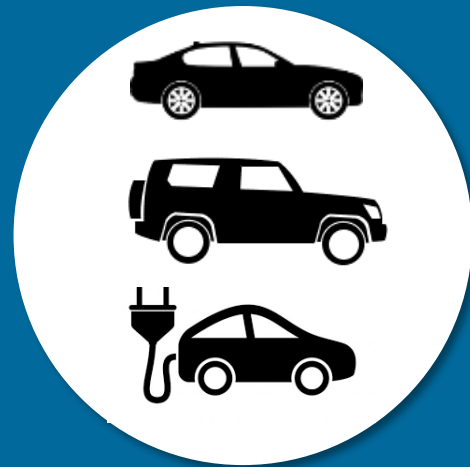


Geography

EU27 + UK

OEM passenger car production taking place in EU27+UK

CKD assembly is not part of the scope



Vehicle Segment

Passenger Vehicles

- All powertrain variants (ICE only, MHEV, FHEV, PHEV, BEV, FCEV)
- All car size segments (A to F)
- All car body types

Light commercial vehicles are not part of the scope



Component Families

1. Body-in-white (BIW)
2. Brakes
3. Chassis
4. Closures
5. Driveline
6. EV-Specific
7. Powertrain
8. Steering
9. Thermal management
10. Transmission
11. Trim
12. Wheels

Extra category "Other miscellaneous parts" accounts for the aluminum weight associated with small parts that are difficult to track



Product Forms

Aluminum:

- Castings
- Sheet
- Extrusions
- Forgings

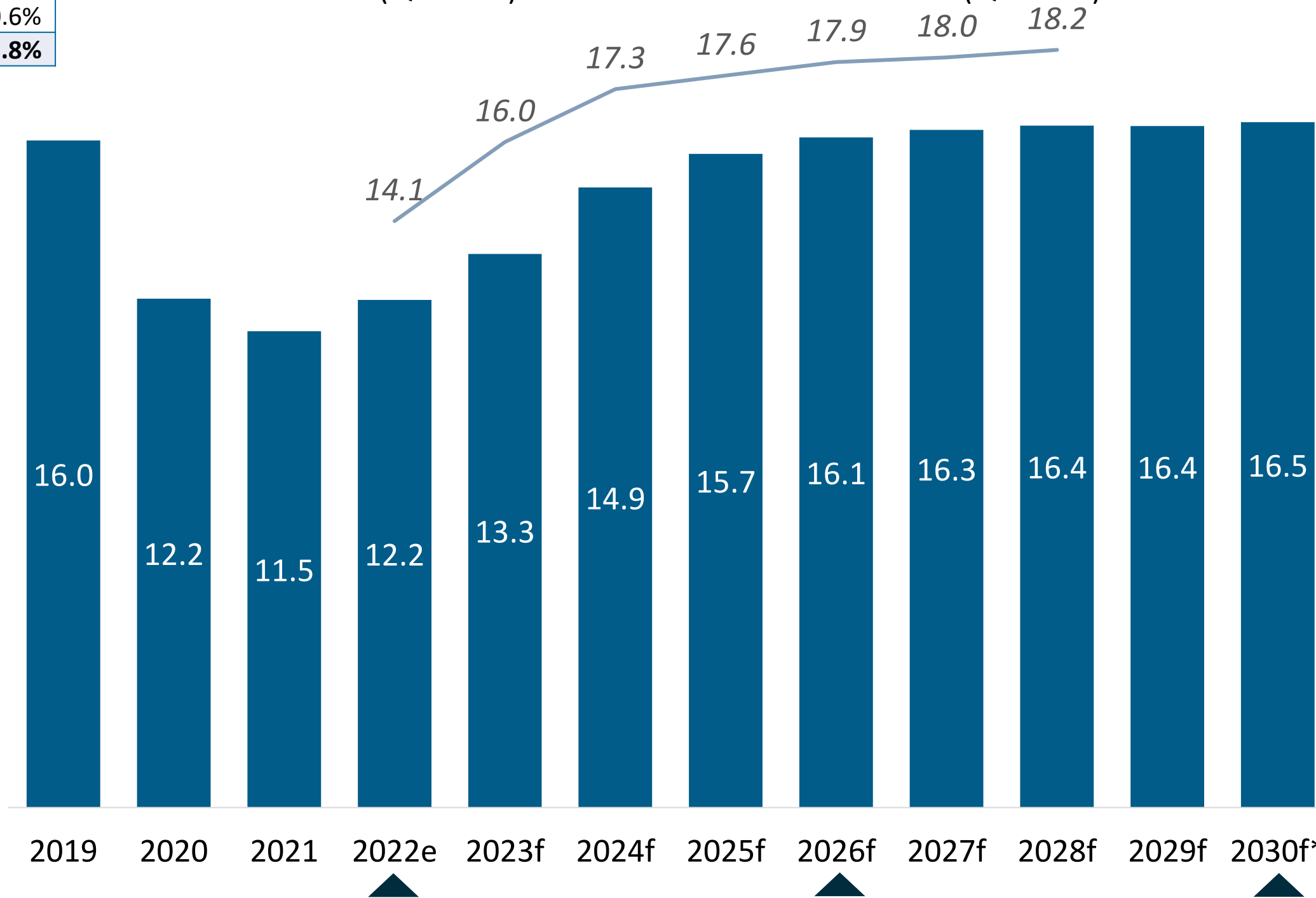
Aluminum foil is not part of the scope

EU27+UK Passenger Vehicle Production Forecast

Million Units of Passenger Cars (Light Commercial Vehicles excluded)

■ Current forecast (Q3-2022) — Pre-Ukraine war forecast (Q4-2021)

CAGR	
2022-2026	7.2%
2026-2030	0.6%
2022-2030	3.8%



- **2020-2021:** COVID-19 made the industry stall
- **2020-onward:** Semiconductor shortage causing major sourcing issues, leading to supply chain disruptions
- **2022-onward:** Ukraine war having a significant impact on European economies and Automotive industry

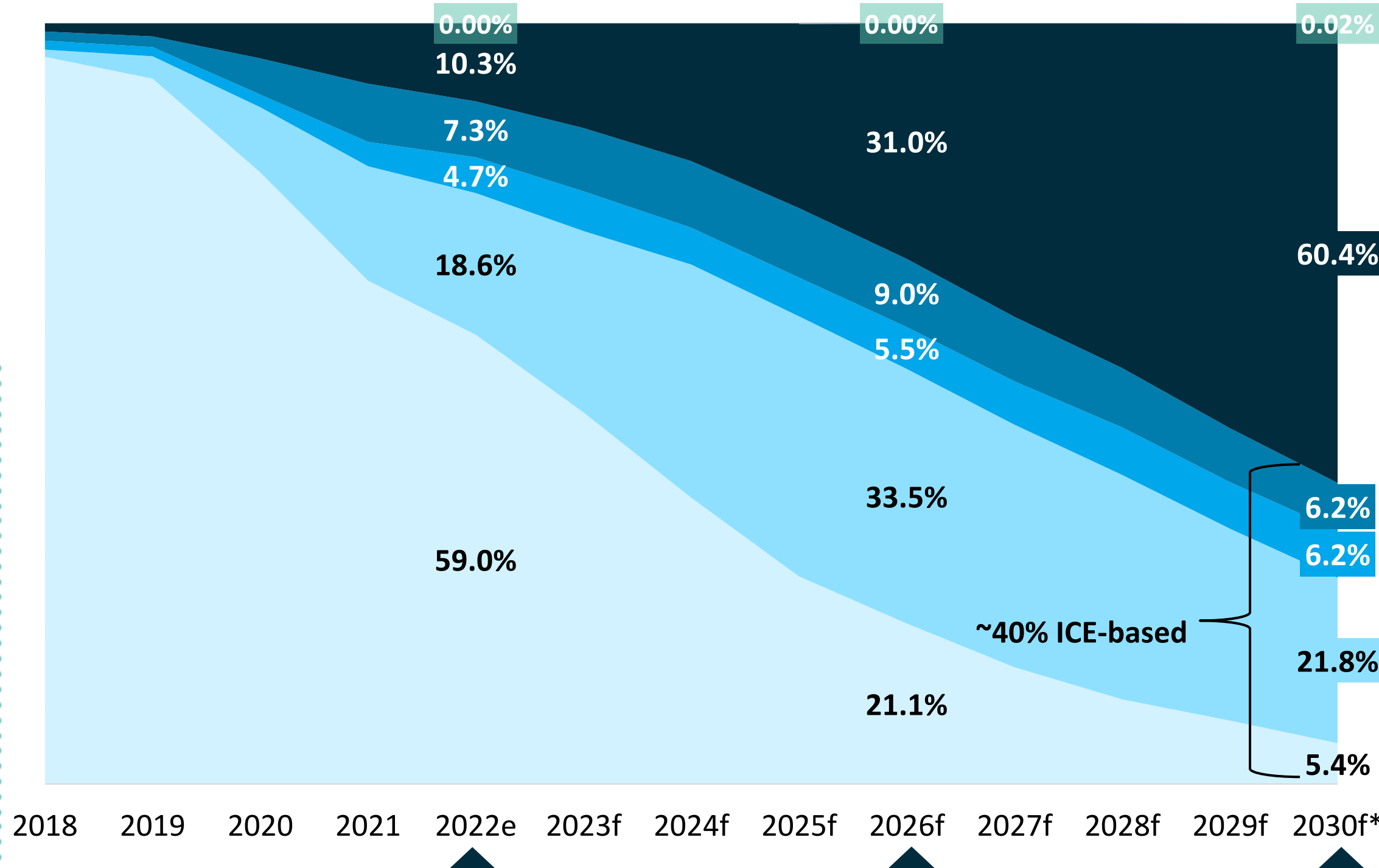
➔ European Automotive production not expected to reach back to 2019 production level before 2026 earliest

Sources: Ducker Carlisle, LMC Automotive Q3-2022, Q4-2021; *Ducker Carlisle applied the 2026–2029 CAGR to estimate the 2030 production volume which is not yet available in LMC forecasts

Driven by regulation, the electrification trend has strongly accelerated in the last few years. 31% of EU passenger car production is forecasted to be BEVs in 2026, potentially up to 60% by 2030

EU27+UK Passenger Car Powertrain Shares

ICE Only MHEV FHEV PHEV BEV FCEV



EU CO2 emission targets drive a BEV strategy:

- **2025 onward:** 15% reduction compared to 2021
- **2030 onward:** 55% reduction compared to 2021 - **NEW TARGET**
- **2035:** Zero emission
- **2050:** Climate neutrality

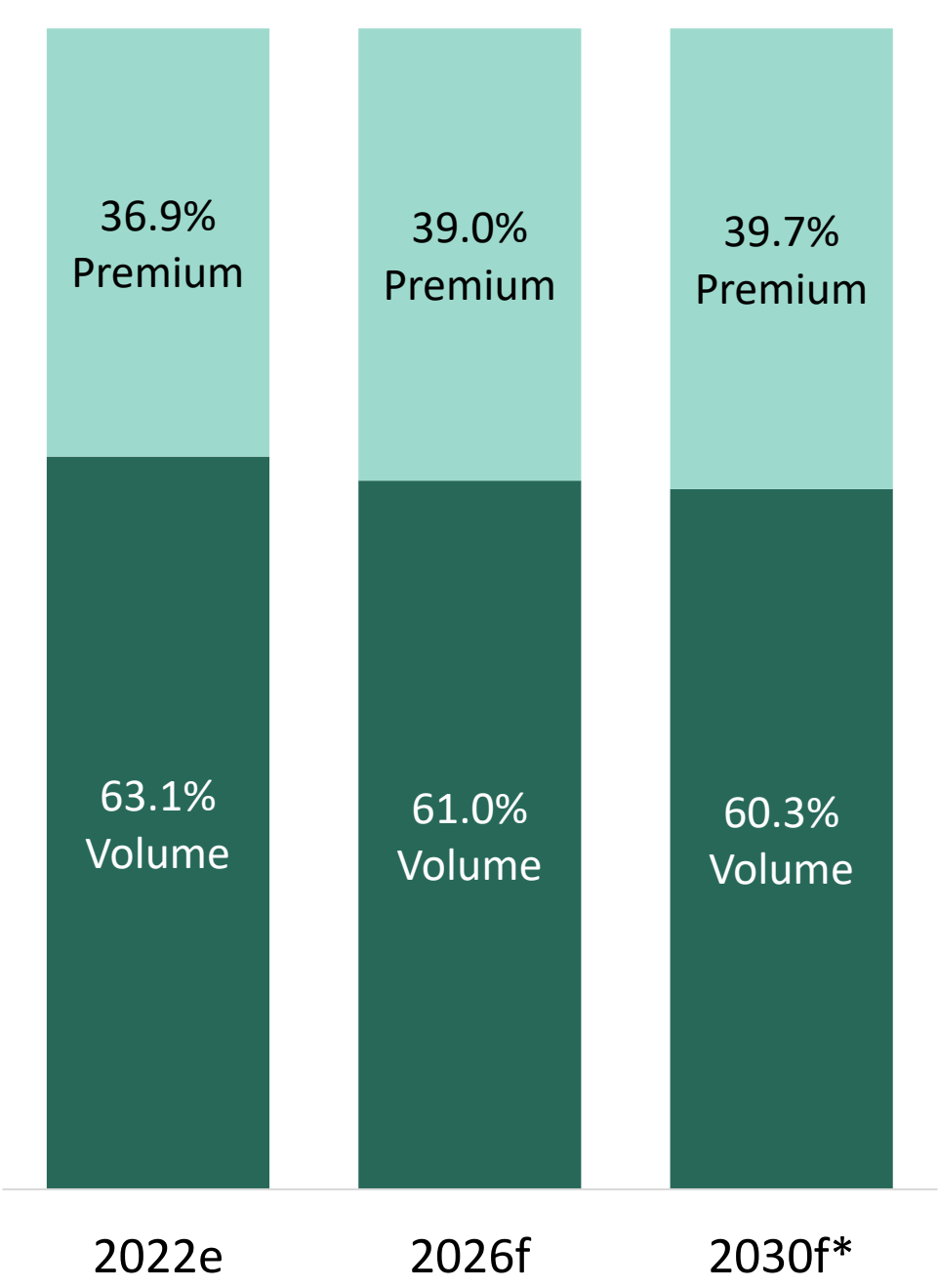
Sources: Ducker Carlisle, LMC Automotive Q3-2022; *Ducker Carlisle applied the 2026–2029 CAGR to estimate the 2030 production volume which is not yet available in LMC forecasts

Premium brands will continue to grow their share. D and C segment will gain shares over B and A. SUVs - already more than 50% of EU production today - will further increase. All in all, production mix evolution will foster increased aluminum usage

EU27+UK Passenger Vehicle Production

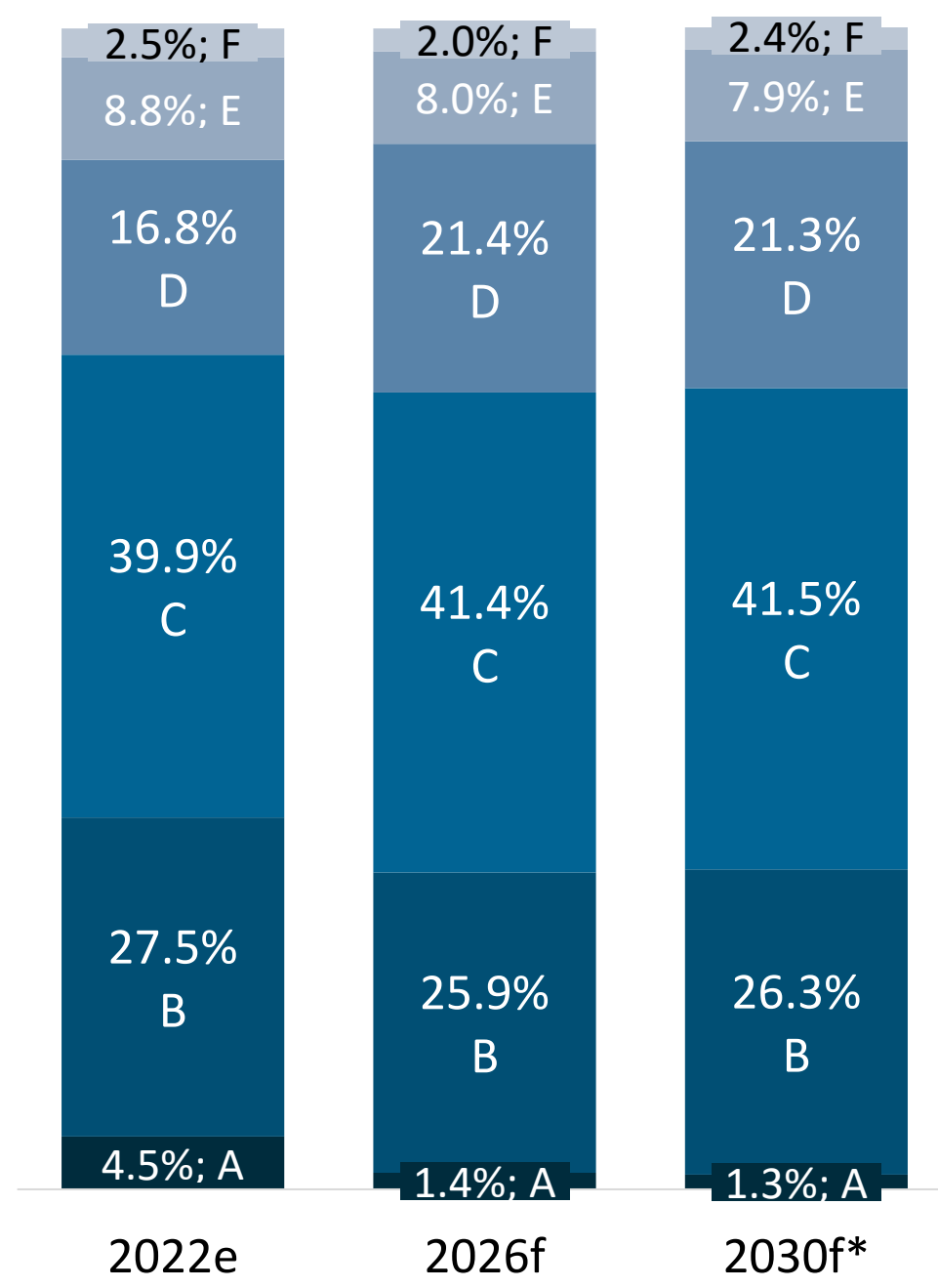
by Brand Positioning

■ Volume ■ Premium



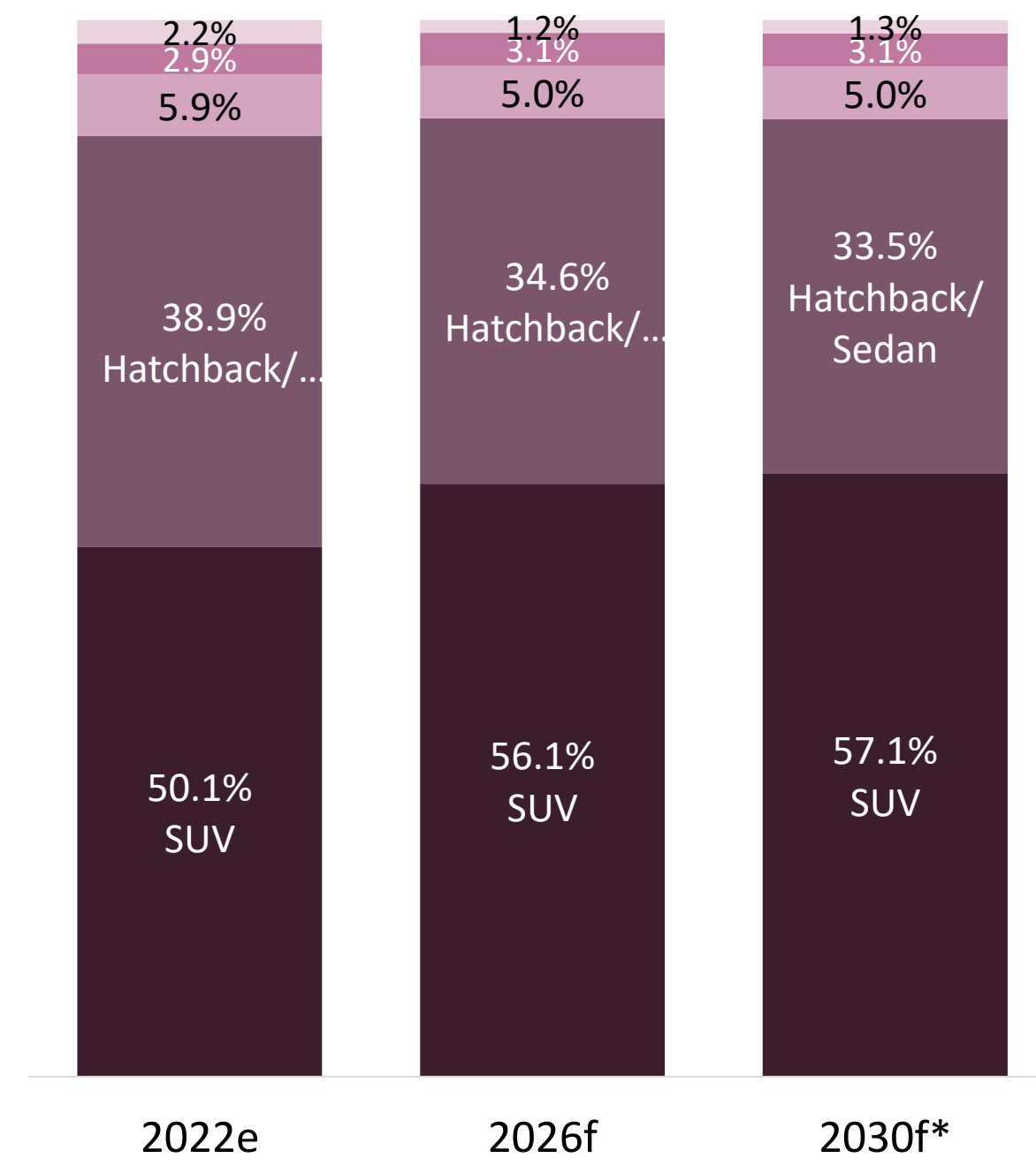
by Size Segment

■ A ■ B ■ C ■ D ■ E ■ F



by Body Type

■ SUV ■ Sedan/Hatchback ■ Sporty ■ Van ■ MPV

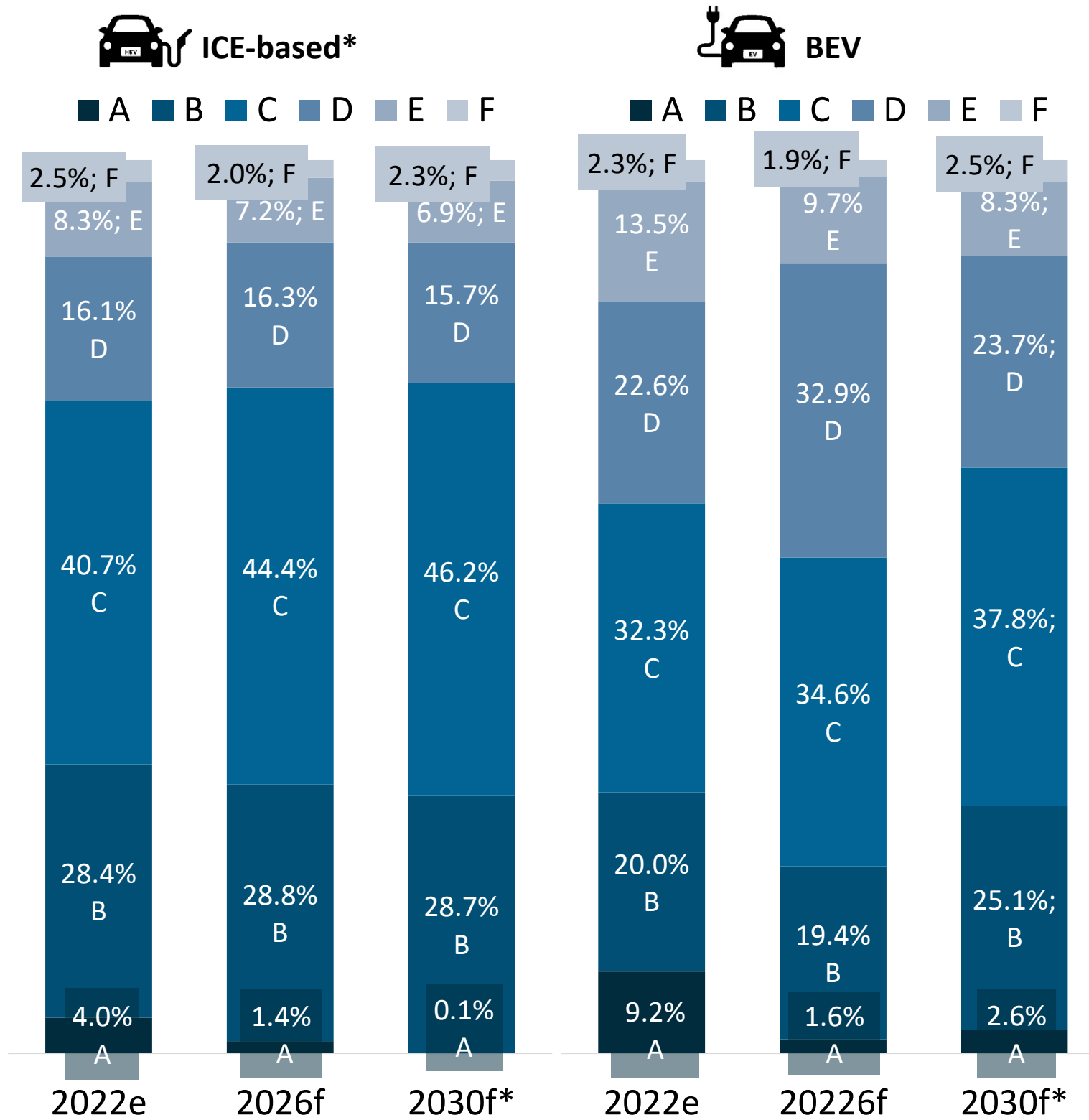


Sources: Ducker Carlisle, LMC Automotive Q3-2022; *Ducker Carlisle applied the 2026–2029 CAGR to estimate the 2030 production volume which is not yet available in LMC forecasts

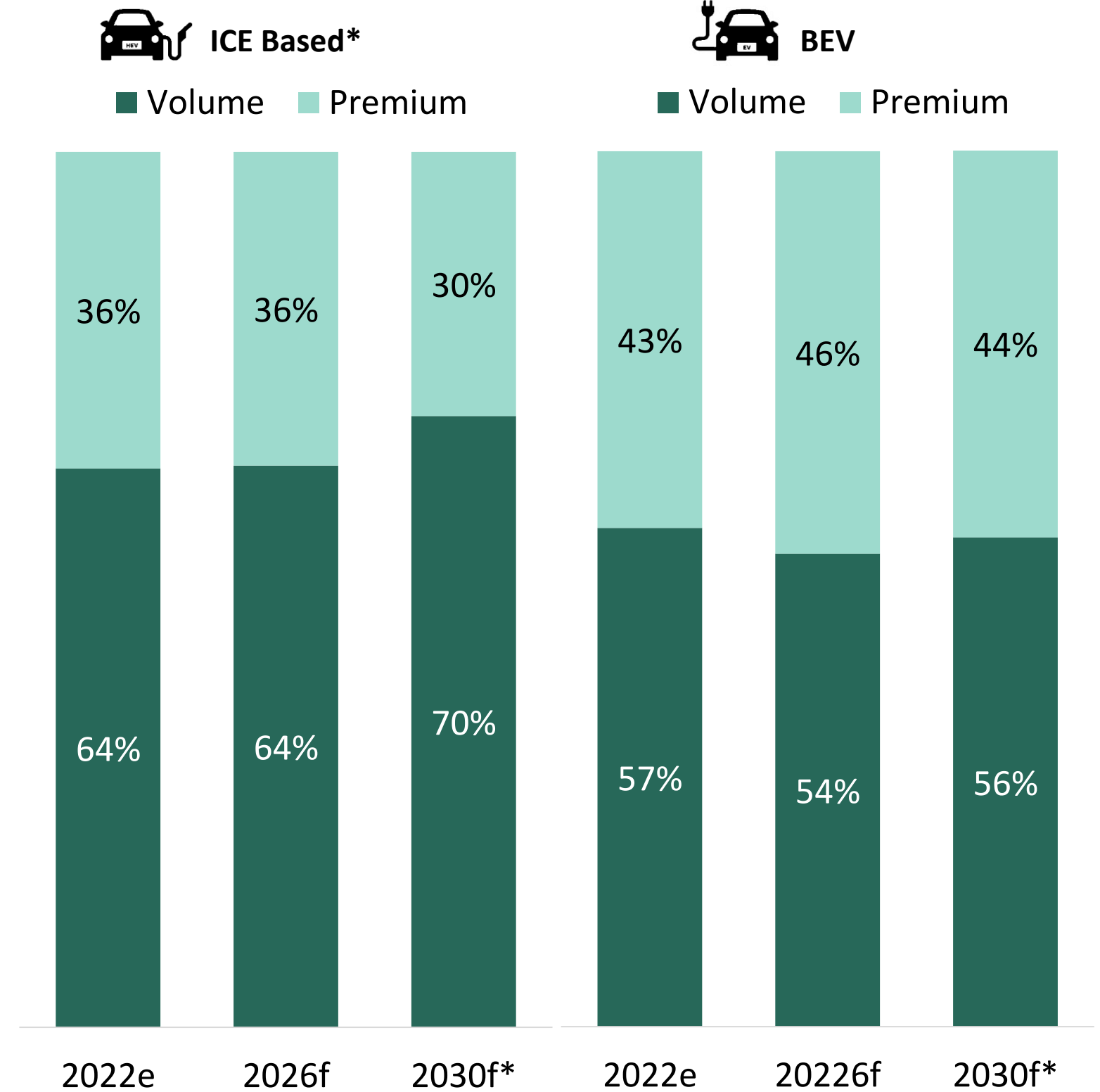
BEVs produced in the EU are positioned in higher size segments than ICE-based vehicles (significantly more D and E) and are more premium-positioned than ICE-based vehicles. This will continue to be the case through 2030, even though BEV production will grow the most in the B and C size segments



EU27+UK Passenger Vehicle Production by Size Segment

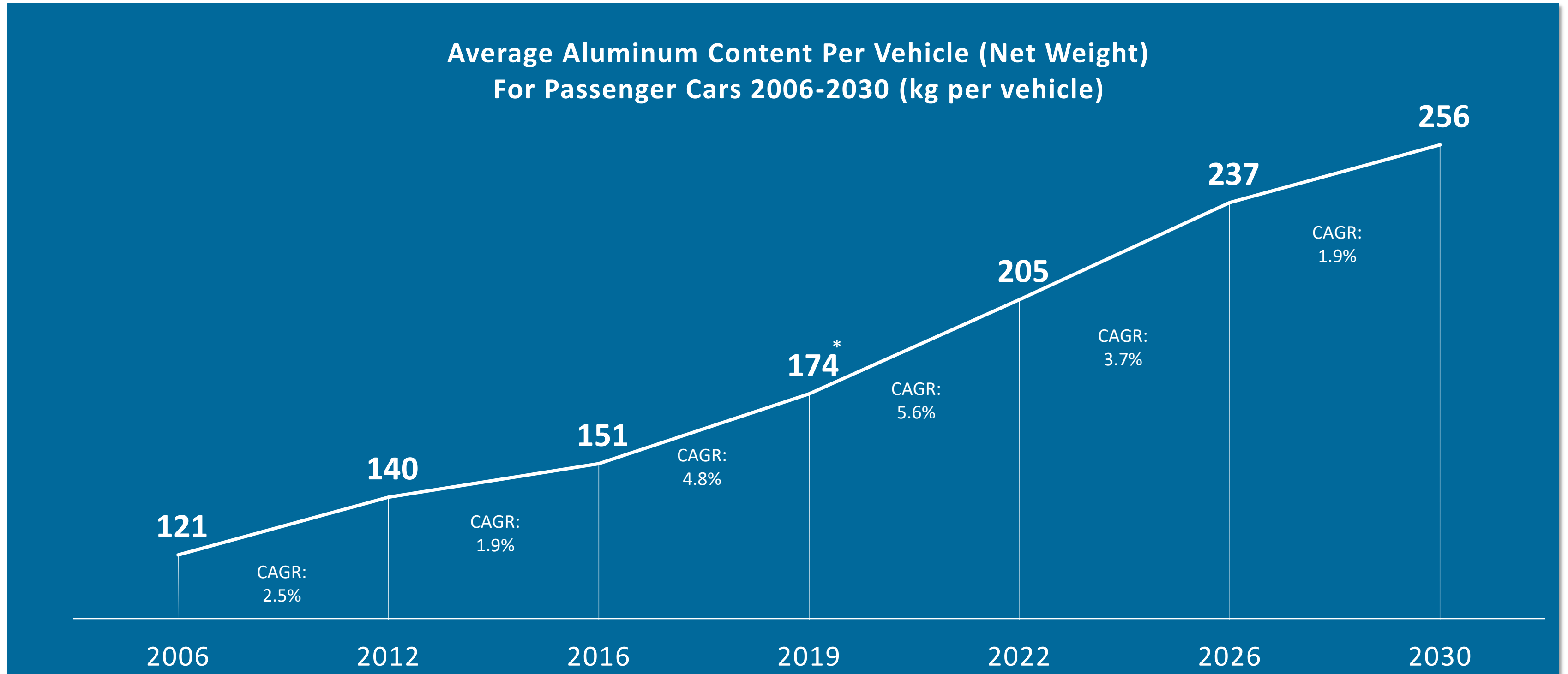


EU27+UK Passenger Vehicle Production by Brand Positioning



Sources: Ducker Carlisle, LMC Automotive Q3-2022; *Ducker Carlisle applied the 2026–2029 CAGR to estimate the 2030 production volume which is not yet available in LMC forecasts; *ICE-based= FHEV, ICE, PHEV, MHEV

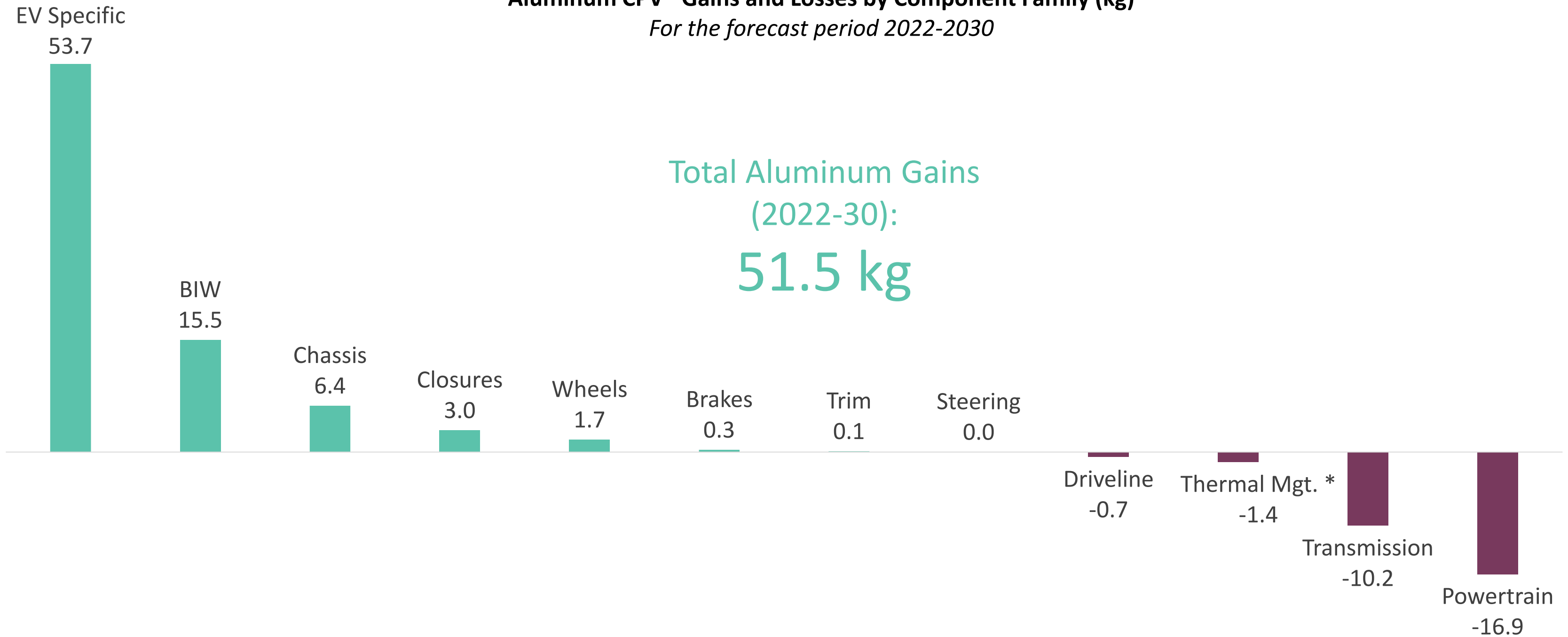
Regardless of vehicle production volume growth, the average aluminum Content Per Vehicle (CPV) has steadily been increasing in passenger cars since 2006 (time when Ducker started monitoring the CPV in the EU). The CPV increase has accelerated driven by further lightweighting needs, electrification and a rising share of larger as well as premium vehicles



Sources: Ducker Carlisle; *Without the second set of OE wheels; the CPV of 179 kg in EA study 2019 included the second set of OE wheels

The highest aluminum gains will come from the 'EV Specific' family - nearly 54 kg more aluminum per vehicle will be needed in 2030 compared to 2022 for EV specific components. The need for additional aluminum content in BIW will also be significant - more than 15 additional kg

Aluminum CPV* Gains and Losses by Component Family (kg)
For the forecast period 2022-2030

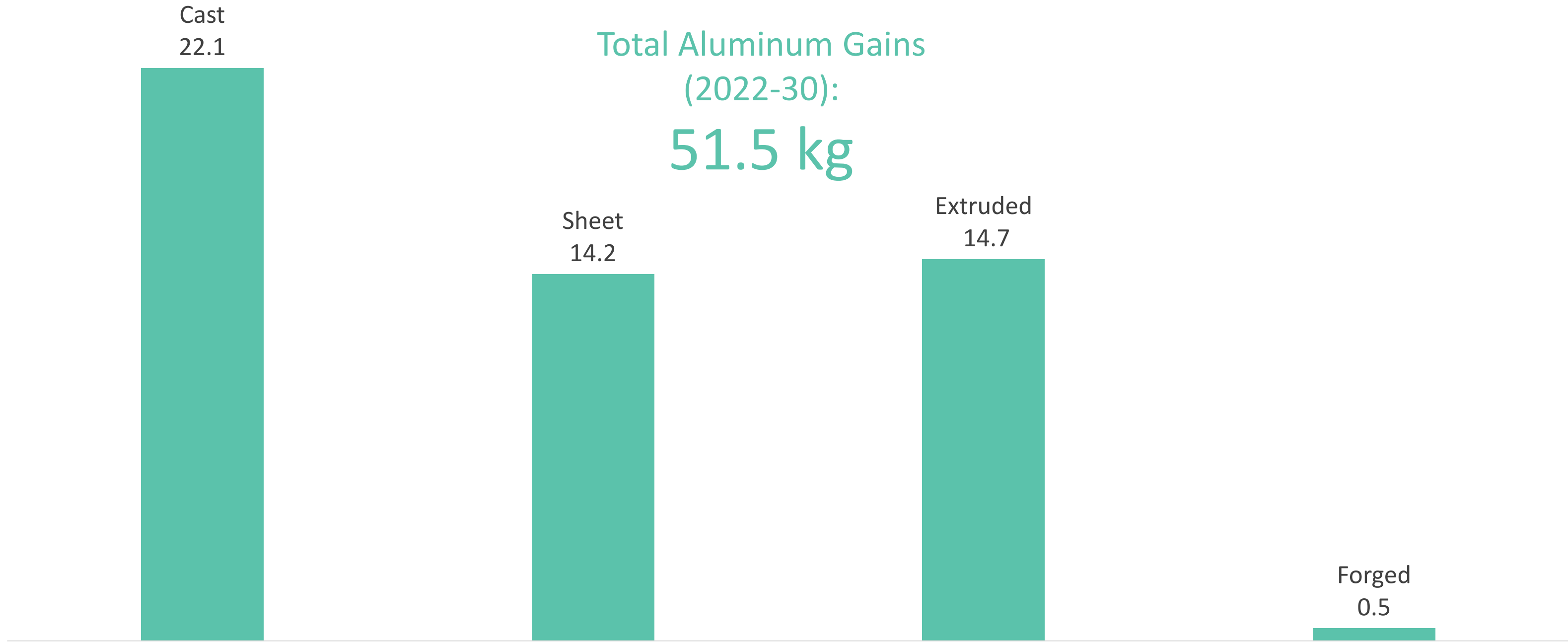


* The component family 'Thermal Management' does not include battery cooling plates, which are accounted in the component family 'EV Specific'. If battery cooling plates were included in the 'Thermal Management' component family, the Thermal Management CPV would show a growth from 20.5 kg in 2022 to 24.1 kg in 2030 (2.1% CAGR)

All aluminum product forms will see their CPV increase by 2030. Castings will benefit from the highest aluminum gains: 22 kg between 2022 and 2030. Extrusions and sheet will achieve significant content gains as well (14-15 kg each). Sole forgings will have a limited gain of 0.5 kg by 2030



Aluminum CPV* Gains by Forming Process (kg)
For the forecast period 2022-2030



Sources: Ducker Carlisle; *CPV = Content Per Vehicle; *Ducker Carlisle applied the 2026–2029 CAGR to estimate the 2030 values

Castings are by far the largest aluminum product form with 123 kg per vehicle, expected to reach 145 kg per vehicle in 2030, and drive the strongest growth in kg per vehicle. The most dynamic CAGR is expected from extrusions due to increasing penetration in EV Specific, BIW and Brakes



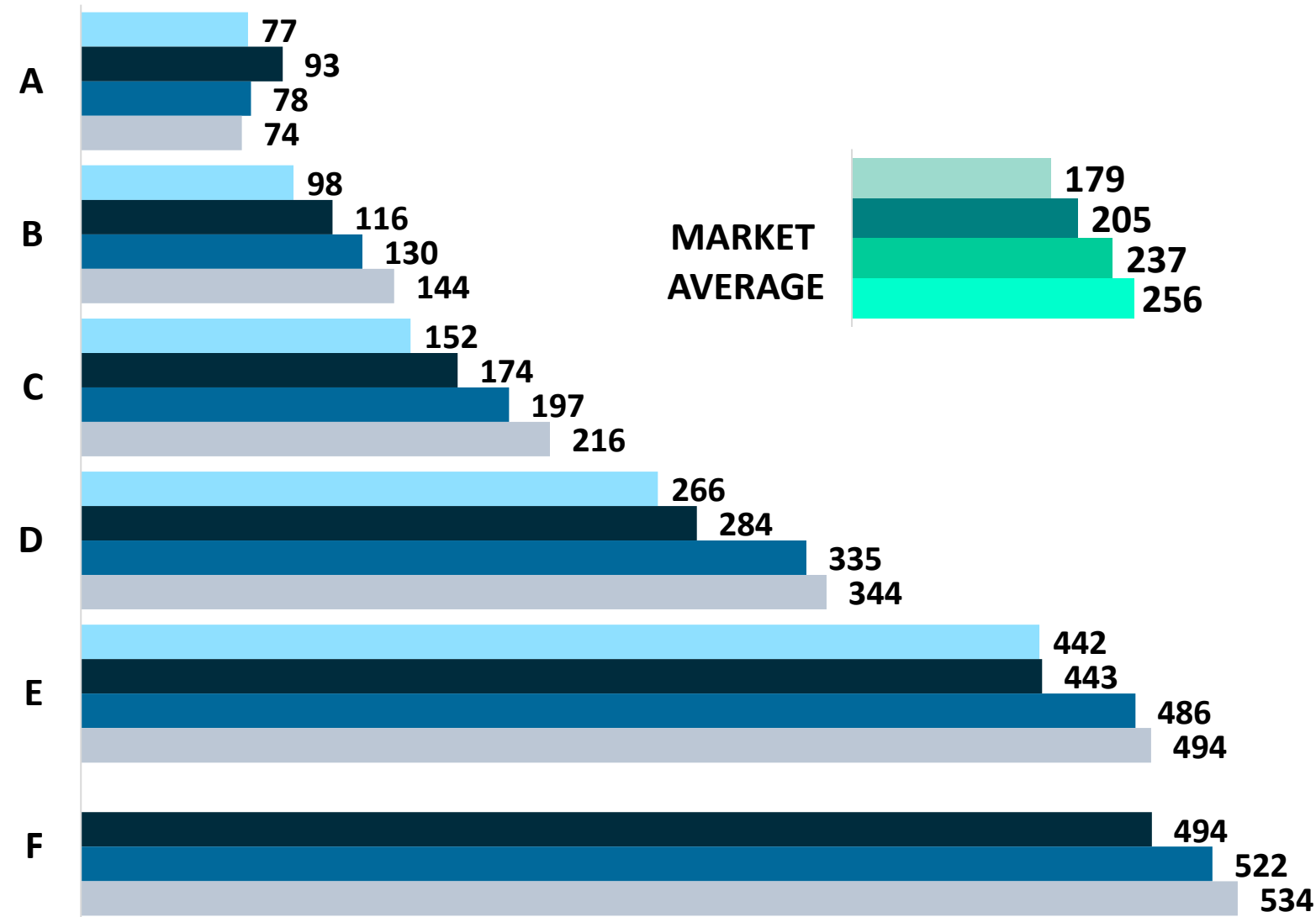
Average Aluminum Content per Vehicle in 2022



The higher the size segment, the higher the aluminum intensity. B and C segments will experience the strongest CPV growth by 2030. Castings will remain the leading aluminum product form in cars and continue to grow

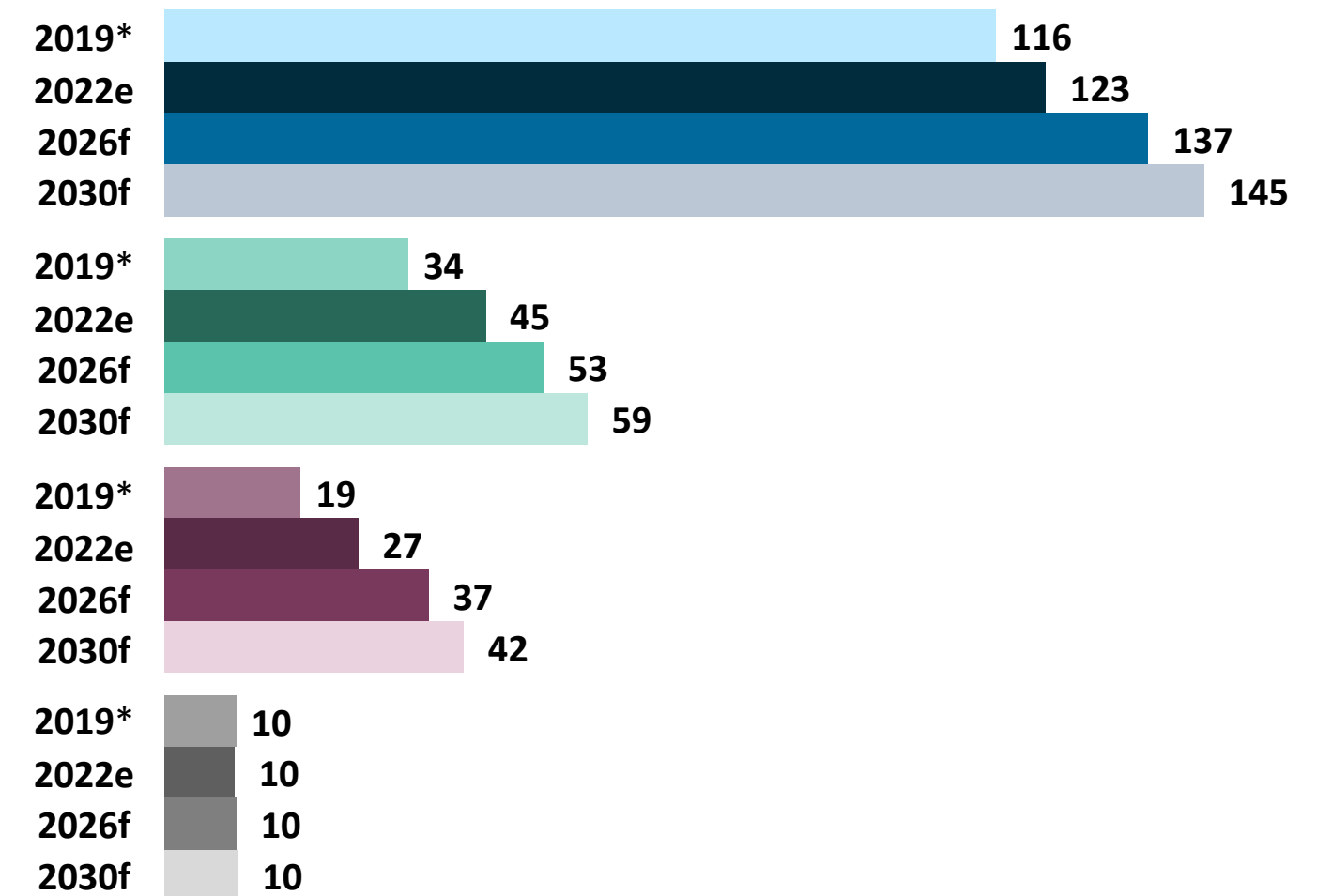
Aluminum CPV* by Size Segment (kg)

2019* 2022e 2026f 2030f



Aluminum CPV* by Forming Process (kg)

Cast Sheet Extruded Forged

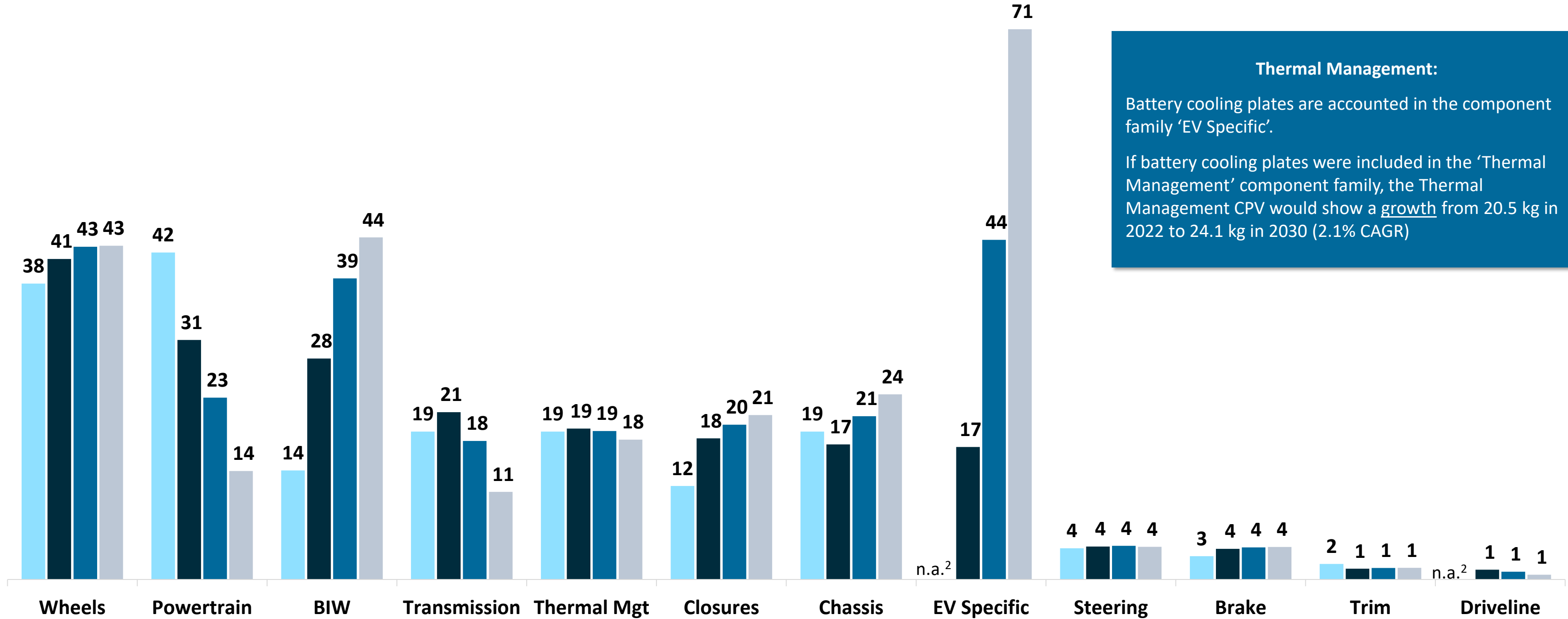


Sources: Ducker Carlisle; *CPV = Content Per Vehicle / *In the EA 2019 study, E and F segments were combined; *Ducker Carlisle applied the 2026–2029 CAGR to estimate the 2030 values; *EA study 2019 included second set of OE wheels

The component family 'EV Specific' will skyrocket and reach, already by 2026-2027, the CPV level of Wheels, before pursuing its tremendous growth. BIW will also experience steep growth by 2026

Aluminum CPV* by Component Family (kg)

2019¹ 2022e 2026f 2030f



Thermal Management:
Battery cooling plates are accounted in the component family 'EV Specific'.
If battery cooling plates were included in the 'Thermal Management' component family, the Thermal Management CPV would show a growth from 20.5 kg in 2022 to 24.1 kg in 2030 (2.1% CAGR)

Sources: Ducker Carlisle; *CPV = Content Per Vehicle

¹ EA study 2019 included the potential second set of OE aluminum wheels; ² n.a. stands for 'not available'; in the 2019 EA study the EV-Specific components were only assessed for a sample of 10 BEV models, and 'Driveline' is a new component family in the 2022 study

The Top 5 growth components driving the highest aluminum content increase are E-drive housings, battery pack housings, large and mega castings, ballistic protection and battery cooling plates - all of them linked to electrification



A. Continuous aluminum growth

- **Continuous aluminum growth** - from average 205kg per vehicle in 2022 to 256kg in 2030
- **New applications drive the growth** (incl. electrification and large/mega castings)

B. Regulation drives growth

- **EU CO2 emission targets foster a BEV strategy**

C. Electrification benefits aluminum

- **Electrification positively impacts aluminum content**
- **Lightweighting remains key to optimize BEV range** and lower adjacent costs

D. Production mix impacts content

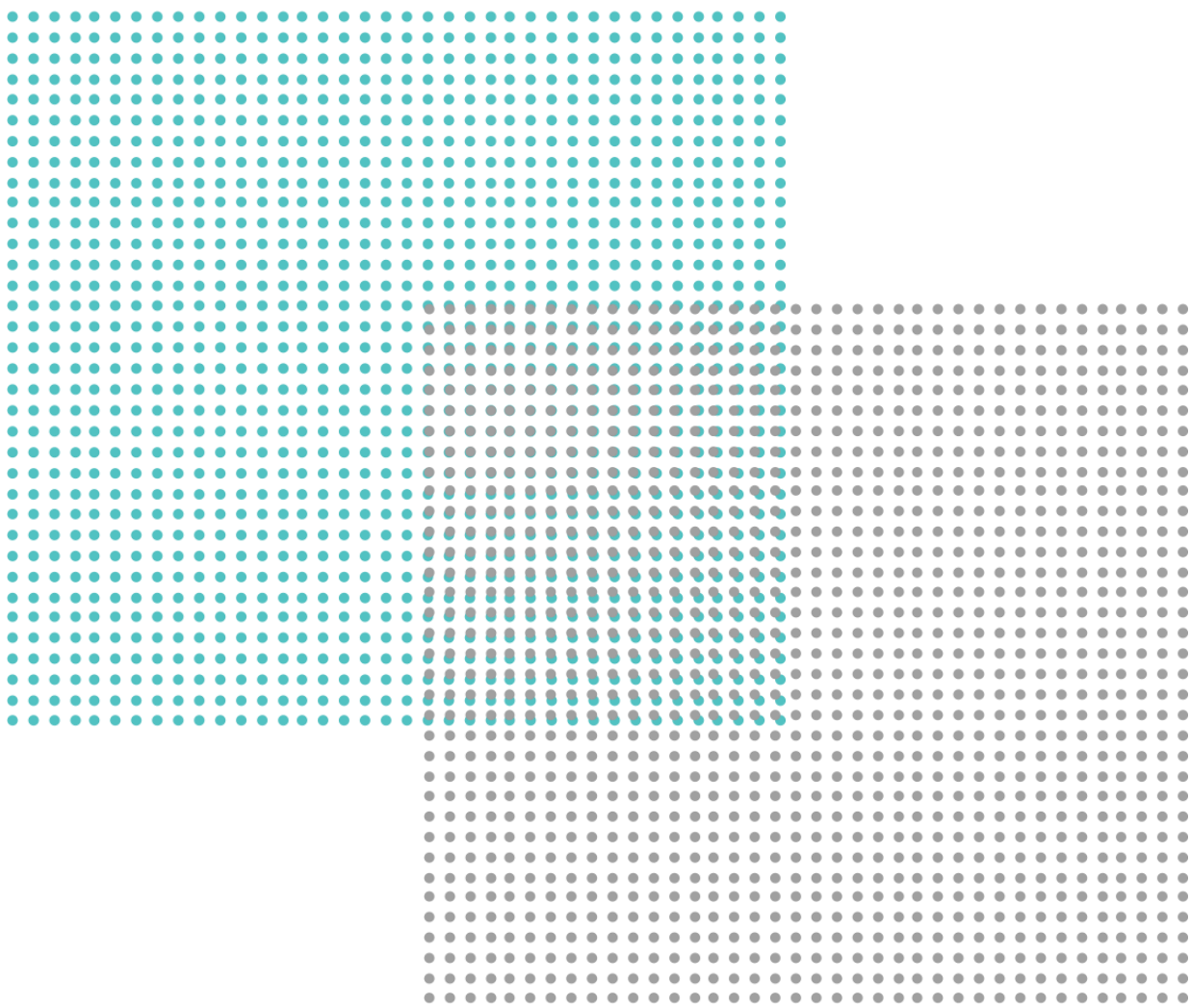
- Supply chain disruptions made OEMs prioritize **larger and higher-margin car models**
- Shift towards **more higher car segments and premium brands contributes to aluminum content increase** by 2030

E. Slow car production recovery

- **COVID 19, supply chain disruptions, Ukraine war and energy crisis** negatively impact production volumes
- European car production expected to **return to 2019 level by 2026 earliest**

F. Sustained competitive pressure

- In a dynamic and competitive environment, **innovation is steadily required for all materials**
- **Focus on sustainability** incl. low-carbon production, increased share of recycled content, and high-quality scrap



THIS CONCLUDES OUR PRESENTATION. THANK YOU.

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