

August 2022

Aluminum Product Form Trends North America light Vehicle

2020 Data vs 2022 Preliminary Insight



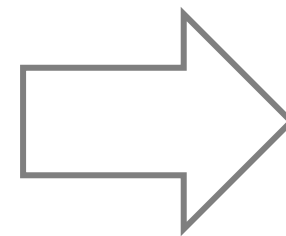
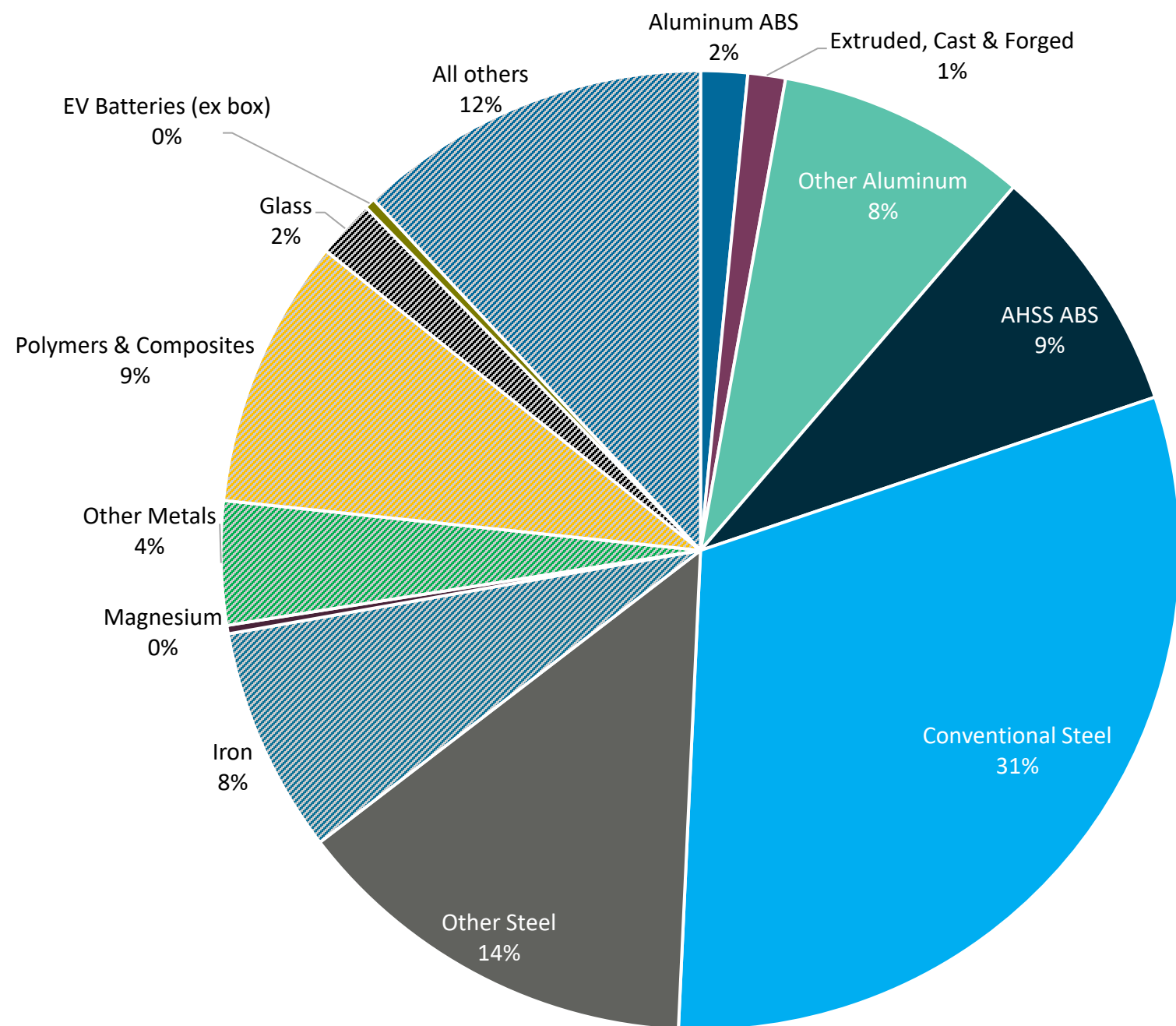
RESEARCH & CONSULTING



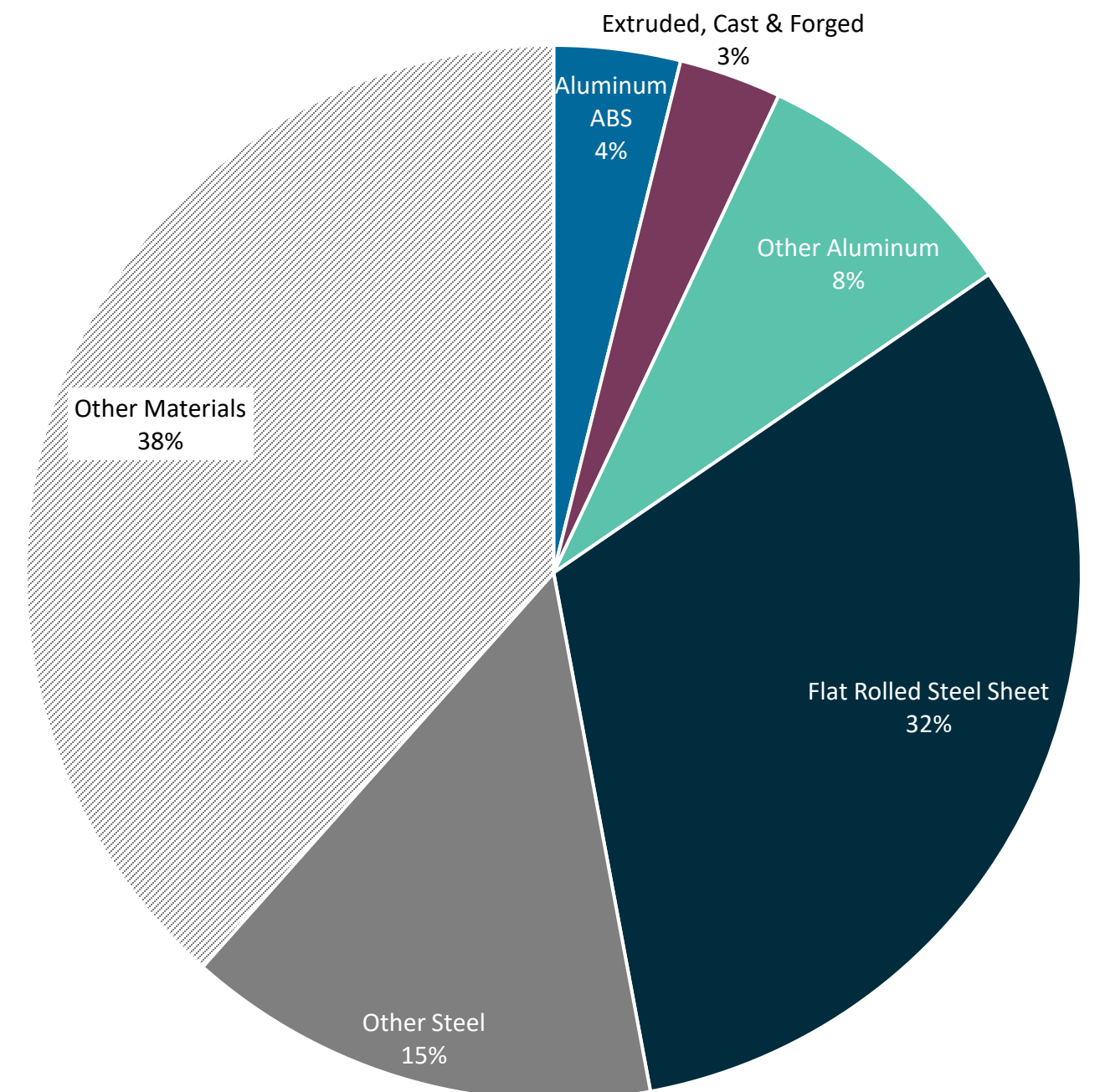
2020 Highlight: Top-Down Analysis Total Material Mix

In 2018, aluminum represented 11% of the vehicle material weight. By 2030, aluminum parts will account for 15% of the weight of a new vehicle. Increased aluminum content will participate in the 4.5% weight reduction expected in vehicles on the forecast period

2018: 3,869 Material Pounds



2030: 3,693 Material Pounds

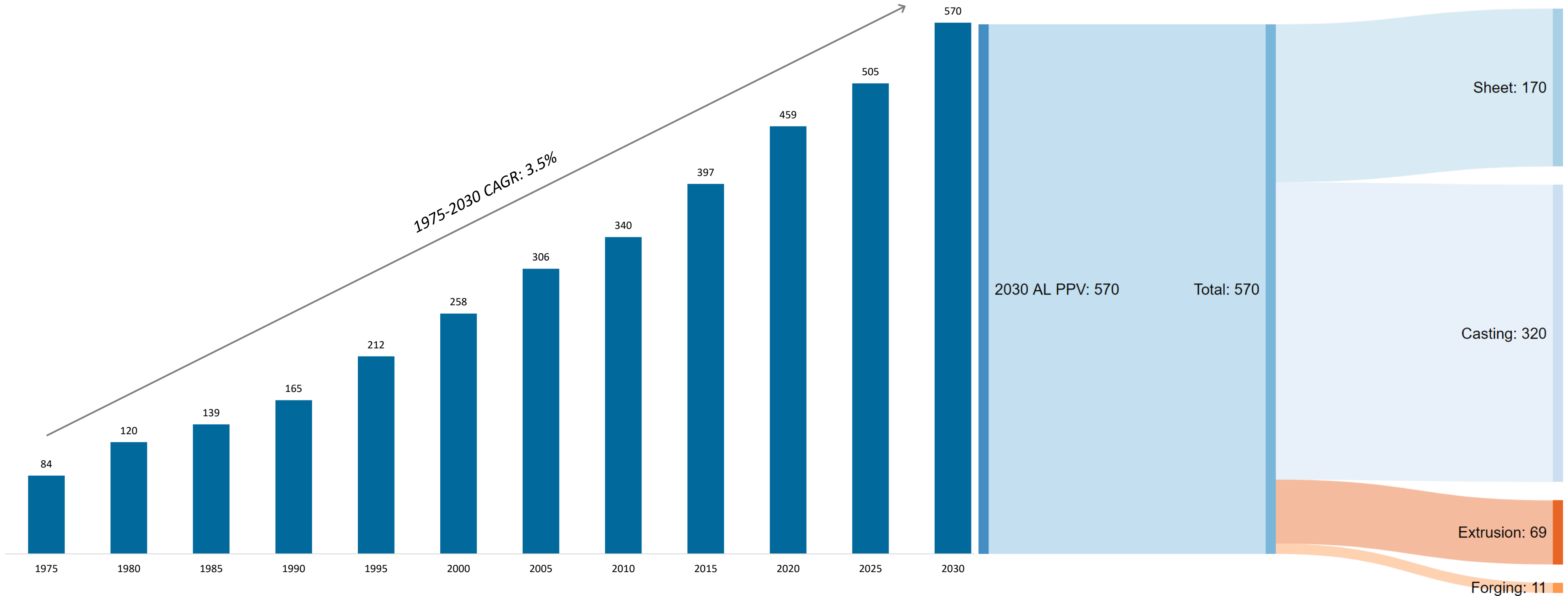


Source: Ducker April 2020

2020 Highlight: Long Term Aluminum Growth

Automotive aluminum content continues to steadily grow within multiple product forms and vehicle applications

North American Light Vehicle Aluminum Content
Net Pounds per Vehicle



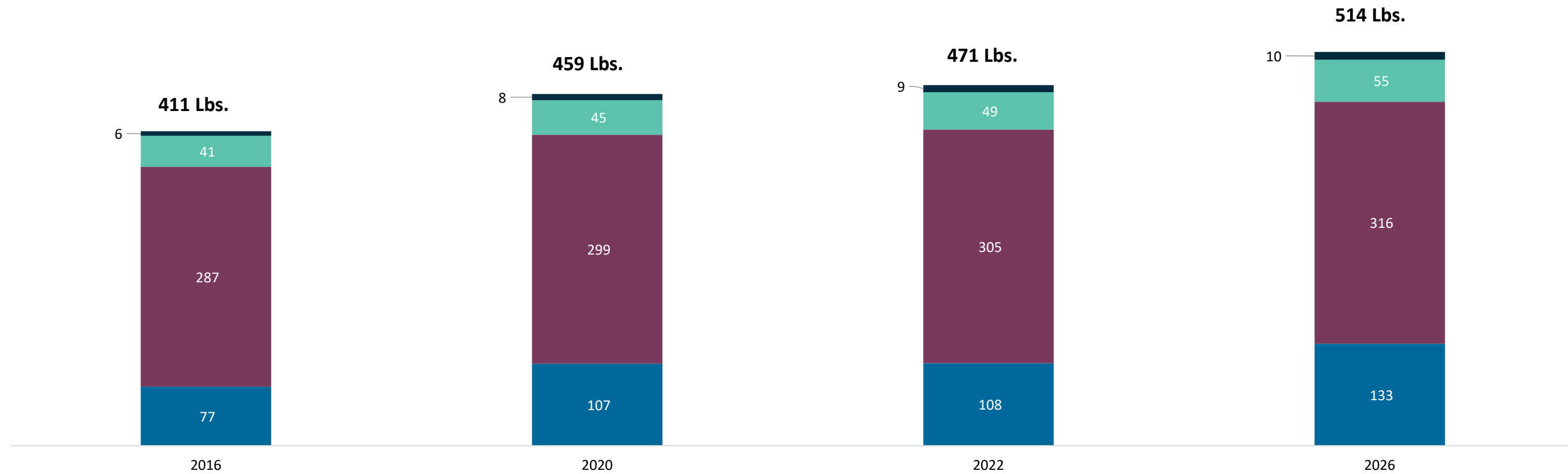
Source: Ducker April 2020

2020 Highlight: Shipment by Product Forms

Total aluminum pounds per vehicle will increase from 411 lbs. in 2016 to 514 lbs. in 2026, resulting in over 10 billion pounds of total gross shipments. Sheet is one of the fastest growing product segments, rising from 77 lbs. in 2016 to 133 lbs. in 2026. Platform parts continue to displace component parts

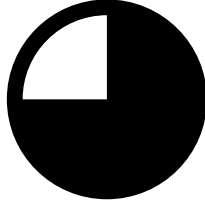

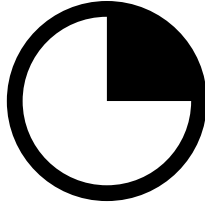
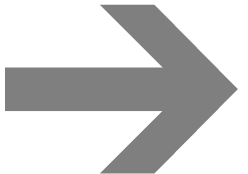
**Aluminum Content By Product Form And Parts Category
In PPV**

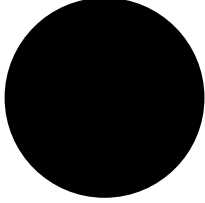

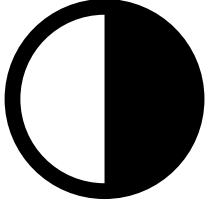
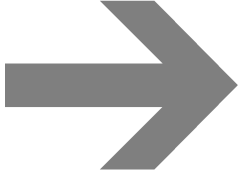
■ Sheet ■ Castings ■ Extrusions ■ Forgings

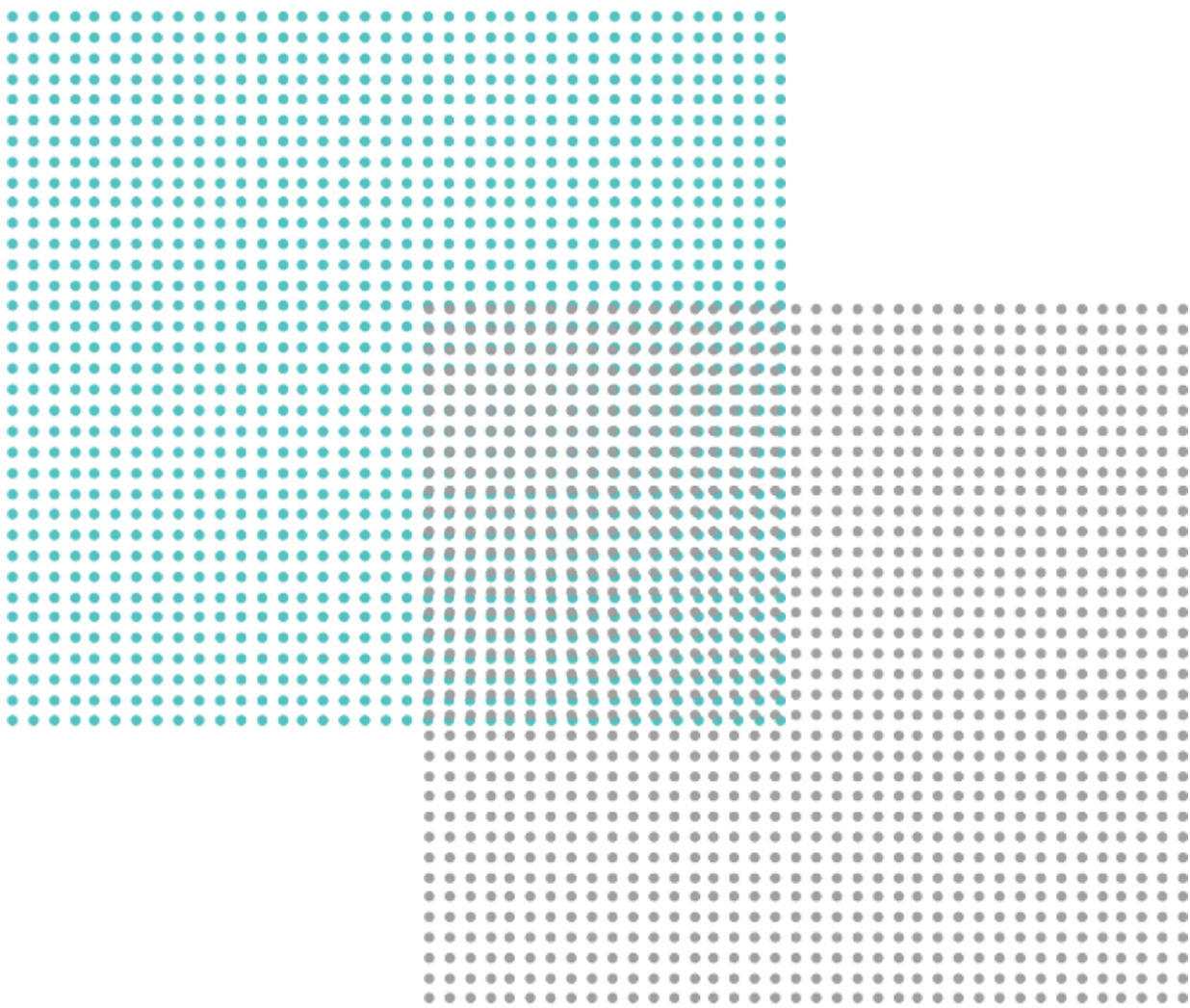


Product Forms	2016-2020 CAGR	2020-2022 CAGR	2022-2026 CAGR
Sheet	9%	1%	5%
Castings	1%	1%	1%
Extrusions	2%	4%	3%
Forgings	7%	6%	3%

Source: Ducker April 2020

#	Process	Summary	EV-Specific Growth Potential	2022 CPV Forecast Comparison <i>2020 Study vs. 2022 Study</i>
01	Sheet	<p>Carbon mandates and “green” goals are driving sheet material decisions</p> <ul style="list-style-type: none"> Reduction of CO2 emissions is a driving force for material decisions, especially when it comes to the cost benefit analysis <p>Some applications are switching to steel due to cost</p> <ul style="list-style-type: none"> With the increase in vehicle cost due to electrification, some OEMs are identifying components that may potentially switch back to steel sheet such as closure inners or select BIW applications; outer closures are expected to remain in aluminum due to its recognized advantages for lightweighting <p>7xxx series sheet is still limited in use</p> <ul style="list-style-type: none"> 7xxx is not being used in significant volumes today, and is still under evaluation at OEMs 		
02	Casting	<p>Mega Castings Growing in Popularity</p> <ul style="list-style-type: none"> OEMS looking into mega castings for BIW and structural components <p>Shift towards HPDC and Structural HPDC</p> <ul style="list-style-type: none"> An Increase in HPDC and structural HPDC is expected to help reduce mass, consolidate parts, while maintaining or increasing strength in structural components to help offset high increased weight of the EV batteries and help extend range <p>EV Impact on Cast Aluminum</p> <ul style="list-style-type: none"> A net increase in demand for cast aluminum components is expected, though, ICE specific components (Powertrain / Trans.) will decline Transition from ICE to EV has worried suppliers, however, cast aluminum EV battery components will overcompensate for these losses 		

#	Process	Summary	EV-Specific Growth Potential	2022 CPV Forecast Comparison <i>2020 Study vs. 2022 Study</i>
03	Extrusions	<p>Interest for Extrusions Remains Robust</p> <ul style="list-style-type: none"> Suppliers have adapted their competitive capabilities in order to meet OEM requirements and preferences over the past decade. The market is installing presses with larger diameter capabilities along with greater tonnage to handle harder alloys <p>Competitive Dynamics with Other Competitive Product Forms</p> <ul style="list-style-type: none"> Extrusions offer more flexibility as subtle changes in processes or design can thus be provided with a low cost <p>Electrification Impact</p> <ul style="list-style-type: none"> Total aluminum extrusion demand is expected to increase over the next few years, primarily due to battery housings; however, there will be a slight shift to more steel as more mainstream and lower segment high-volume vehicles are introduced 		
04	Forgings	<p>Competitive Material Threat with Ductile Iron</p> <ul style="list-style-type: none"> Growing competition from improved ductile iron casting designs to replace forged aluminum knuckles New ductile iron design has increased in competitiveness as it offers higher strength and stiffness at a lower cost <p>Cost Considerations</p> <ul style="list-style-type: none"> Cost considerations of forgings compared to other forming processes limits growth rate over the forecast period <p>Electrification Impact</p> <ul style="list-style-type: none"> Although forged aluminum utilization is expected to gain momentum within EVs due to their increased weight, its higher cost may limit its growth prospects elsewhere 		



THIS CONCLUDES OUR PRESENTATION. THANK YOU.

Today's presentation was prepared by Ducker Research and Consulting/Ducker Holdings LLC. To the fullest extent permissible by applicable law, all information contained herein is for informational purposes only and is provided "AS IS". The information is provided (i) with no guaranty of accuracy, completeness, timeliness or that any defects will be corrected and (ii) without any representations, warranties or other contractual terms of any kind including, without limitation, warranties of title, merchantability or fitness for a particular purpose. Even if Ducker was advised, knew or should have known that claims or damages could arise from the use, misuse or delay of use of the information, Ducker assumes no legal liability for any direct, indirect, consequential, special, punitive or similar claims or damages. The information contained herein does not represent financial, legal, regulatory or other advice and recommendations from Ducker. Any use of the information is undertaken at your sole risk.



RESEARCH & CONSULTING

BANGALORE | BERLIN | DETROIT | LONDON | NEW YORK | PARIS | SHANGHAI

www.ducker.com

