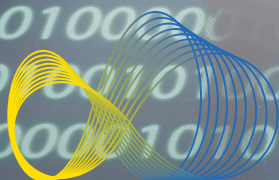




Capital
Markets

Autos - RBC ADAS and AV Forecast



RBC Imagine™

Thinking further forward

EQUITY RESEARCH | NOVEMBER 20, 2022

For Required Conflicts Disclosures, see page 31.



November 20, 2022

RBC Imagine™: Autos - RBC ADAS and AV Forecast

Our view: We present our ADAS and AV forecast through 2030. More automated vehicles are coming and ADAS growth should far outpace sales growth, especially since the features/content are increasing. We are particularly keen on L2+ technology as a strong trend and one that can drive growth for ADAS suppliers and profits for automakers. Our analysis is directly related to the cross-sector theme of the future, Artificial Intelligence Activated, highlighted in RBC Imagine™ : Preparing for Hyperdrive – Themes That Will Define Our New Future.

Expect L1-L3 global light vehicle sales mix should grow from 50% in 2022 to 75% in 2030

Advance Driver Assistance (ADAS) penetration has hit a strong level globally, and particularly in developed regions, driven by incentivization such as regional New Car Assessment Programs (NCAP), regulation, and competition. Automakers continually added ADAS features to either compete or differentiate (driving further competition and higher feature set). Additionally, many ADAS features (especially advanced ones) are part of higher-end, high-margin option packages, so automakers like adopting and selling these systems. We estimate that globally, vehicles with ADAS functionalities (SAE J3016 definitions of L1-L3) represent ~50% of 2022 new global LV sales, with mix being 25% L1 and 25% L2. We do note that L0 vehicles have some basic ADAS features such as blind spot warning. Please see inside for more on autonomy level definitions. Our forecast does adhere to SAE J3016 nomenclature and as such, is only a proxy for how we would prefer to define ADAS. However, we see L1-L3 growing at an ~8% 2022-2030 CAGR vs. a ~3% global sales CAGR forecast. Within this, we see L2 becoming the dominant technology by 2030. We estimate 2022 global L2 systems at ~19.6mm vehicles (~25% mix) but growing to 32.2mm vehicles in 2030 (33% mix) good for a 6% 2022-2030 CAGR. There is a natural evolution that occurs with L0 mix graduating to L1 (we have L0 2022-30 CAGR at -8%) and L1 graduating to L2 (our L1 2022-30 CAGR is ~2%). But similarly, we expect a number of L2 units to graduate to L2+ and L3 over the course of the decade.

L2+ can occupy a very interesting, and profitable, portion of the market

We see a big automaker focus on L2+ or "super-ADAS". L4 has proven to be very complex and L3 has challenges with the required hand-back to driver. Enter L2+ which we believe can be a very strong and growing trend. These systems add safety and convenience but require the driver to stay in the loop; "hands free, eyes on". L2+ examples are Tesla's Full Self Driving or FSD (despite the tricky naming), GM's Super Cruise (and eventually Ultra Cruise), Ford's BlueCruise, and Mobileye's SuperVision product (which they sell to automakers). As more basic ADAS becomes democratized, we believe automakers will want more advanced L2+ systems to differentiate higher-end brands, models, and trims. Further, Tesla has shown that consumers are willing to pay \$15k (in the US) for FSD. L2+ systems may cost between \$1-\$2k, so even if automakers turn around and sell them for \$10k, that helps margins. For ADAS suppliers, a \$1-\$2k system is a meaningful step up from lower level ADAS solutions (we estimate a camera-only system could be ~\$250, camera + radar ~\$400-\$450) driving growth. We estimate 2022 L2+ systems at ~0.3mm units or <0.5% of total sales, but see them growing at a ~58% CAGR through 2030 to 12.7mm units or 13% sales mix. We do have L3 systems also reaching 5% of 2030 sales (~4.8mm units), but admit that the classifications can get tricky, especially the further out you go.

What about autonomous vehicles?

Autonomous driving timelines have been pushed out and expectations lowered. The technical challenge and capital required are great (as evidenced by some industry consolidation). That is not to say technological progress isn't being made, it is. However, we don't expect meaningful L4 (either consumer AV or robo-taxis) unit sales until the later part of the decade. We forecast ~2.9mm L4 units in 2030 (~3% of total). We don't expect any L5 vehicles anytime soon (and potentially in our lifetimes). Please see much more inside including regional forecasts; ask your RBC salesperson for our model.



RBC Imagine™
Thinking further forward

ADAS and AV Forecast

2021-2030E

RBC Light Vehicle Sales Forecast by Automation Level – Key Takeaways


- We present our light vehicle forecast by automation level (according to SAE J3016 nomenclature).
 - This is a proxy for advanced driver assistance systems (ADAS) and autonomous vehicle (AV) sales forecasts.
- The key takeaways from our forecast is that on a global basis, we see:
 - L2 systems growing from ~19.6mm vehicles in 2022 (25% mix) to 32.2mm vehicles in 2030 (33% mix), good for a 6% 2022-2030 CAGR.
 - L2+ systems growing from ~0.3mm vehicles in 2022 (<1% mix) to 12.7mm vehicles in 2030 (13% mix), good for a 58% 2022-2030 CAGR.
 - So “all L2” systems grow at 11% 2022-2030 CAGR vs. global light vehicle sales at ~3% CAGR.
 - By 2030, we have “all L2” systems reaching 57% of US sales, 47% of all Europe sales, and 52% of all China sales.
 - L3 systems growing from a de minimis amount in 2022 to 4.8mm vehicles (5% mix) in 2030.
 - Very low levels of L4 systems over 2023-2026 with units reaching ~0.6mm (<1%mix) in 2027 before growing to ~2.9mm units (~3% of global sales) in 2030. We’d want the widest confidence interval around our L4 forecast. The L4 systems consider both a consumer AV and a “robo-taxi”.
 - We forecast no L5 systems as we do not believe this is possible anytime soon.
 - Regionally, we forecast:
 - The highest L2+ sales by 2030 will come from China, followed by the US and then Europe. However, China is also the largest market. Looking at L2+ regional share relative to overall sales share, the US is an outperformer (+5pp L2+ share vs. overall sales share).
 - We see China having a higher sale of L3 vehicles by 2030 (absolutely at 45% and relative to overall sales share) followed by the US (27% of all L3 systems) and Europe (19%).
 - We forecast China to have ~54% of all L4 systems in 2030, with the US at 25% and Europe at 14%. Note, the number for L4 systems is still small overall, which can impact regional share calculations.

RBC Light Vehicle Sales Forecast by Automation Level Background and Definitions

- First, a caveat. We built our forecast to fit into the construct of SAE J3016 that describes the six levels of driving automation, from Level 0 to Level 5, from no automation to full automation.
 - The definitions and classifications of these levels are not always ideal, in our view. There can be a large gap between Level 2 and Level 3 for instance, which is why we've seen industry participants introduce the concept of a Level 2+ system.
- In general, we prefer to think about feature set, and we see the evolution of driving automation going from driver support features (where the driver is still always in control) to "hands free, eyes on" where the vehicle will do driving maneuvers but the driver must pay attention and be ready to take over, to "hands free, eyes off" where the vehicle can always be in control provided the vehicle is in the defined operational design domain (ODD), which can be geography, condition, etc. limited.
- However, since investors (and many in the industry) tend to refer to the L0 to L5 construct, we align our forecast with that nomenclature. In our forecast, we also broke out Level 2+. The definitions of those levels are:
 - **Level 0 - No Driving Automation.** The performance by the driver of the entire driving task, even when enhanced by active safety systems. This means that by the SAE definition, "features" such as AEB, blind spot warning and lane departure warning are Level 0 automation (and example of how "active safety" and "levels of automation" may differ). In our forecast "No ADAS" does not even have these basic features.
 - **Level 1 – Driver Assistance.** The sustained and ODD-specific execution by a driving automation system of either the lateral or the longitudinal vehicle motion control of the driving task (but not both simultaneously) with the expectation that the driver performs the remainder of the driving task. Example features: lane centering or adaptive cruise control.
 - **Level 2 – Partial Driving Automation.** The sustained and ODD-specific execution by a driving automation system of both the lateral or the longitudinal vehicle motion control of the driving task with the expectation that the driver supervises the automation and complete the driving task in necessary. Example features: lane centering and adaptive cruise control.
 - **Level 2+ – Bridge between L2 and L3.** Building upon Level 2 ADAS-like features that offer more functionality and safety potential but that keep the driver in the loop and thus aren't quite Level 3 from a definition stand point. "Hands free, eyes on" is a good characterization of Level 2+. Examples features: Highway autopilot or urban point-to-point. Tesla FSD and Mobileye's SuperVision offerings are good examples.
 - **Level 3 – Conditional Driving Automation.** The sustained and ODD-specific performance by an automated driving system of the entire driving task with the expectation that the driver supervises and is ready to intervene. Example features: traffic jam chauffeur.
 - **Level 4 – High Driving Automation.** The sustained and ODD-specific performance by an automated system of the entire driving task. Example features: a local robo-taxi.
 - **Level 5 – Full Driving Automation.** Level 4 but not constrained by an ODD, i.e. it can operate on-road anywhere in all conditions autonomously. We do not believe a Level 5 system is possible anytime soon.

SAE Autonomy Level Definitions

- The official SAE J3016 Levels of Driving Automation summary is below.



SAE J3016™ LEVELS OF DRIVING AUTOMATION™

Learn more here: [sae.org/standards/content/j3016_202104](https://www.sae.org/standards/content/j3016_202104)

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		SAE LEVEL 0™	SAE LEVEL 1™	SAE LEVEL 2™	SAE LEVEL 3™	SAE LEVEL 4™	SAE LEVEL 5™
What does the human in the driver's seat have to do?		You <u>are</u> driving whenever these driver support features are engaged – even if your feet are off the pedals and you are not steering			You <u>are not</u> driving when these automated driving features are engaged – even if you are seated in "the driver's seat"		
		You must constantly supervise these support features; you must steer, brake or accelerate as needed to maintain safety			When the feature requests, you must drive	These automated driving features will not require you to take over driving	
<p>Copyright © 2021 SAE International.</p> <div> <div> <h3>These are driver support features</h3> </div> <div> <h3>These are automated driving features</h3> </div> </div>							
What do these features do?		These features are limited to providing warnings and momentary assistance	These features provide steering OR brake/acceleration support to the driver	These features provide steering AND brake/acceleration support to the driver	These features can drive the vehicle under limited conditions and will not operate unless all required conditions are met	This feature can drive the vehicle under all conditions	
Example Features		<ul style="list-style-type: none"> • automatic emergency braking • blind spot warning • lane departure warning 	<ul style="list-style-type: none"> • lane centering OR • adaptive cruise control 	<ul style="list-style-type: none"> • lane centering AND • adaptive cruise control at the same time 	<ul style="list-style-type: none"> • traffic jam chauffeur 	<ul style="list-style-type: none"> • local driverless taxi • pedals/steering wheel may or may not be installed 	<ul style="list-style-type: none"> • same as level 4, but feature can drive everywhere in all conditions

Source: SAE International

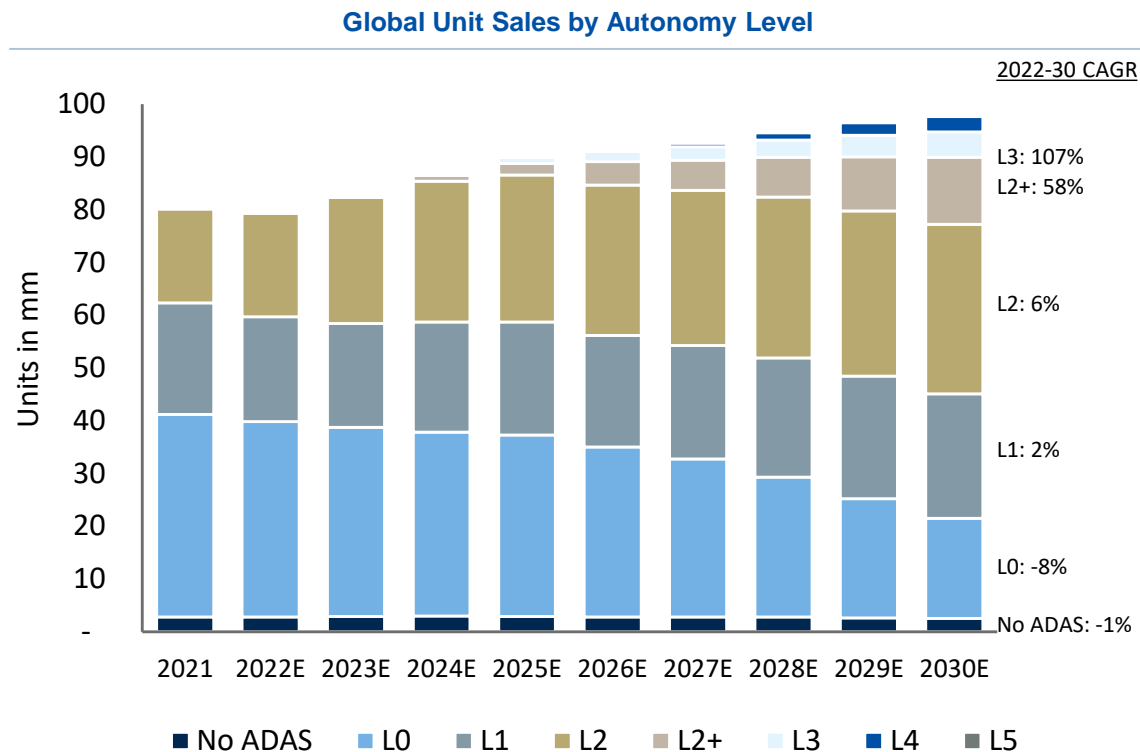
November 20, 2022

Global Light Vehicle Sales Forecast by Autonomy Level

2021-2030E

Global New Light-Vehicle Sales Forecast by Autonomy Level

- Our global light vehicle sales forecast contemplates an overall ~3% CAGR from 2022E-2030E.
- We forecast L2 vehicles becoming the dominant category by 2030 growing a ~6% CAGR to 32.2mm units.
- L2+ vehicles are forecasted to grow at a ~58% CAGR to ~12.7mm units. L3 vehicles grow the fastest at a ~107% CAGR but from a very low 2022 base.



Source: RBC Capital Markets estimates, S&P Global

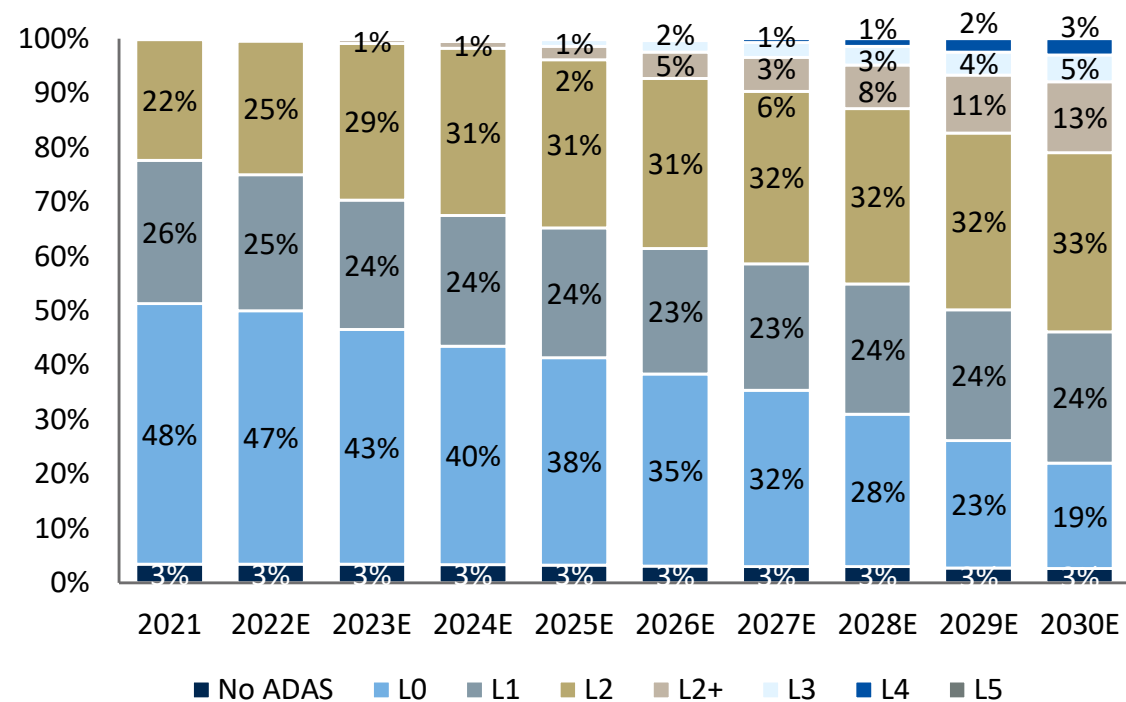
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Global LV Sales Mix by Automation Level

Industry continually transitioning to higher levels of autonomy.

- Lower features L0 vehicles will continue to decline while L1 mix remains mostly steady as some L0 vehicles graduate to L1.
- L2 vehicles become dominant by mix, though some L2 vehicles graduate to L2+.
 - By 2030, we have all L2 vehicles (including L2+) at 46% of global sales.
- L3 vehicles could reach 5% of global sales by 2030.

Global Unit Sales by Automation Level



Source: RBC Capital Markets estimates, S&P Global

November 20, 2022



Regional Light Vehicle Sales Forecast by Autonomy Level

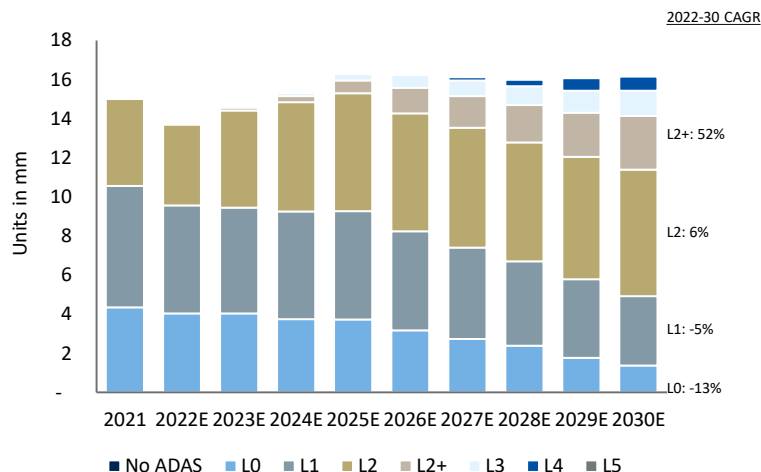
2021-2030E



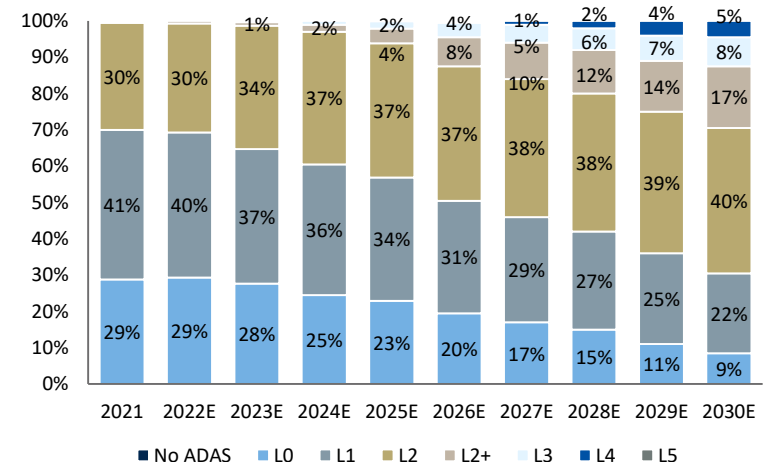
US New Light-Vehicle Sales Forecast by Autonomy Level

- Our US light vehicle sales forecast contemplates a ~2% CAGR from 2022E-2030E settling in at a 16.1mm rate.
- We forecast L2 vehicles becoming the dominant category by 2030 growing a ~6% CAGR from 2022E-2030E to 40% of the total sales mix.
- L2+ vehicles are forecasted to grow at a ~52% CAGR to 17% of the sales mix.
- L3 vehicles reach 8% sales mix by 2030.

2021-2030E US Sales by Automation Level



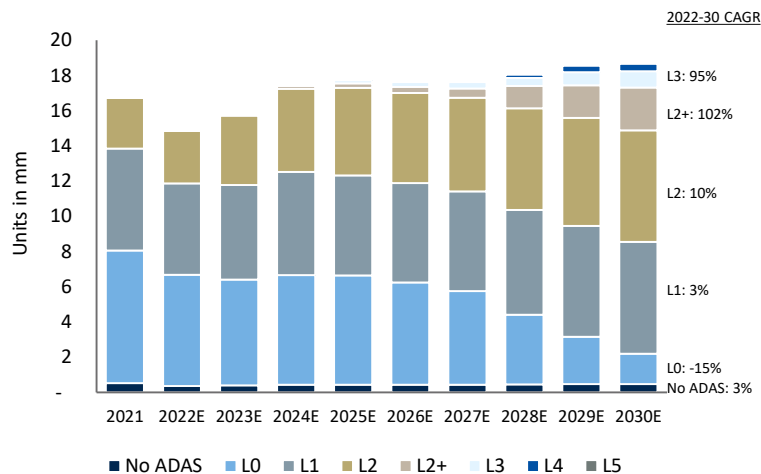
2021-2030E US Sales Mix by Automation Level



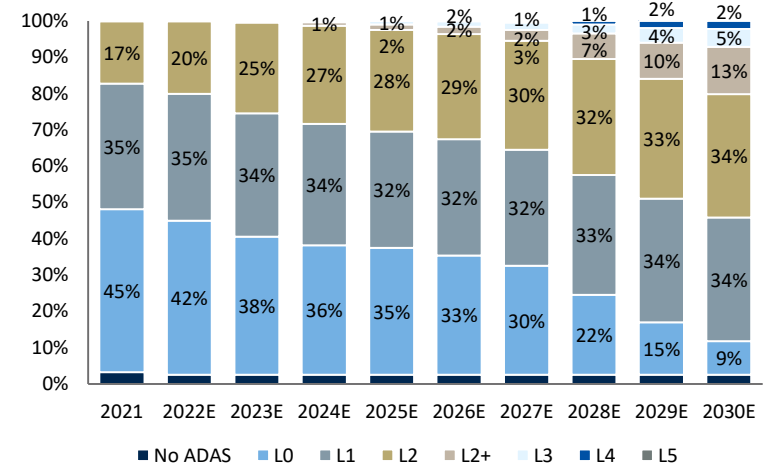
Europe New Light-Vehicle Sales Forecast by Autonomy Level

- The European sales forecast considers a ~3% CAGR from 2022E-2030E, recovering to the ~18.7mm rate from depressed levels.
- We forecast L1 and L2 vehicles each at 34% mix by 2030, however L1 vehicles grow at a ~3% CAGR through 2030 while L2 vehicles grow at a 10% CAGR through 2030.
- L2+ vehicles are forecasted to reach 13% of the 2030 sales mix. So taken together with L2, 47% of vehicles are “all L2” with that category growing at a 14% 2022-2030 CAGR.
- L3 vehicles reach 5% sales mix by 2030.

2021-2030E Europe Sales by Automation Level



2021-2030E Europe Sales Mix by Automation Level



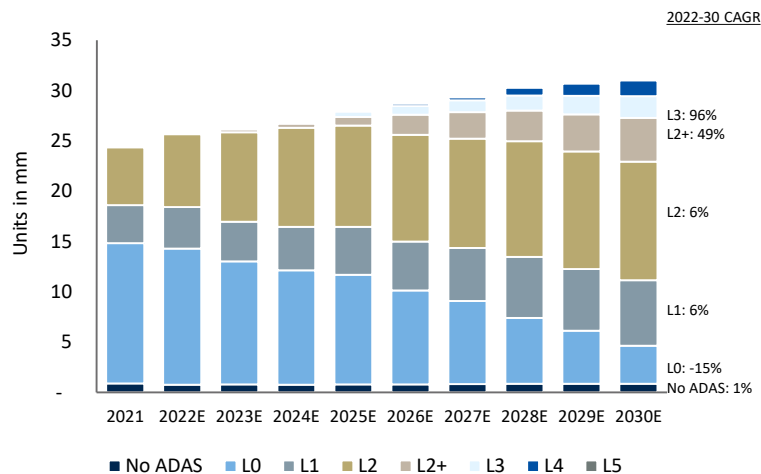
Source: RBC Capital Markets estimates, S&P Global

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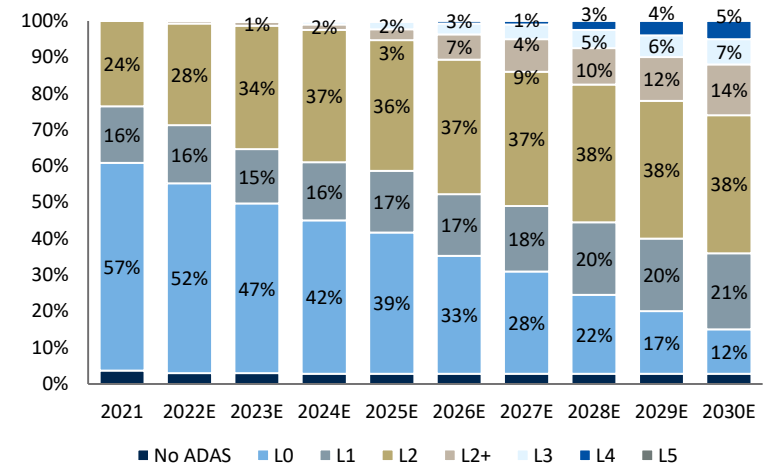
China New Light-Vehicle Sales Forecast by Autonomy Level

- The China sales forecast considers a ~2% CAGR from 2022E-2030E.
- We forecast L2 vehicles to become the dominant category growing at a 6% CAGR to 38% mix by 2030.
- L2+ vehicles are forecasted to grow at a 49% CAGR reaching 14% of the 2030 sales mix.
- L3 vehicles to reach 7% sales mix by 2030.

2021-2030E China Sales by Automation Level



2021-2030E China Sales Mix by Automation Level



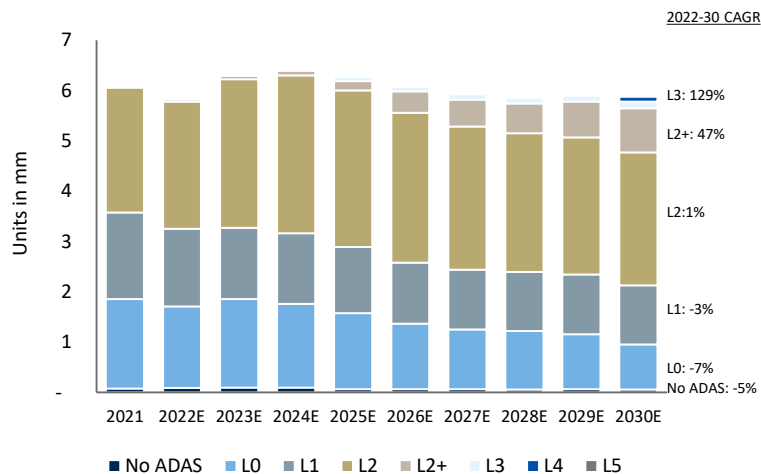
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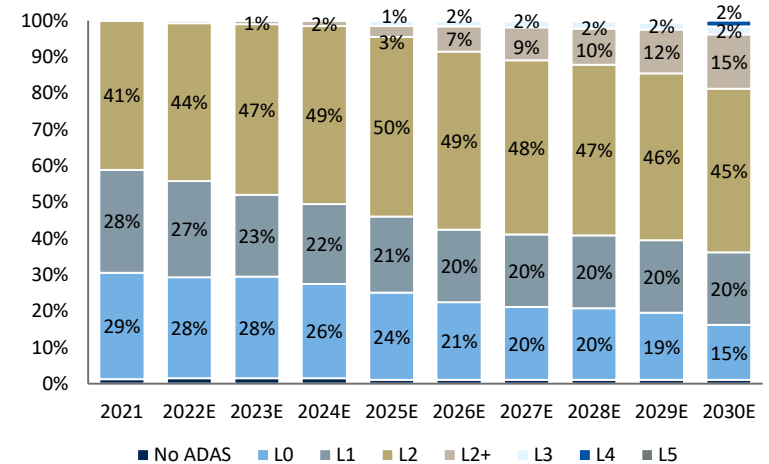
Japan/Korea New Light-Vehicle Sales Forecast by Autonomy Level

- The Japan/Korea sales forecast considers a ~flat CAGR from 2022-2030.
- We forecast L2 as the largest category over 2022-2030 with a CAGR over the same time period of ~1%.
- L2+ vehicles are forecasted at a growth rate of 47% CAGR to reach 15% of sales mix in 2030.
- L3 vehicles are forecasted at a growth rate of 129% CAGR to reach 2% of sales mix in 2030.

2021-2030E Japan/Korea Sales by Automation Level



2021-2030E Japan/Korea Sales Mix by Automation Level



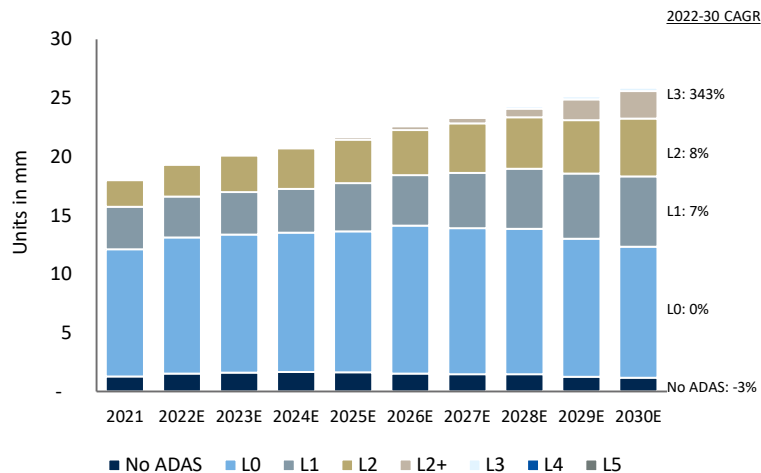
Source: RBC Capital Markets estimates, S&P Global

November 20, 2022

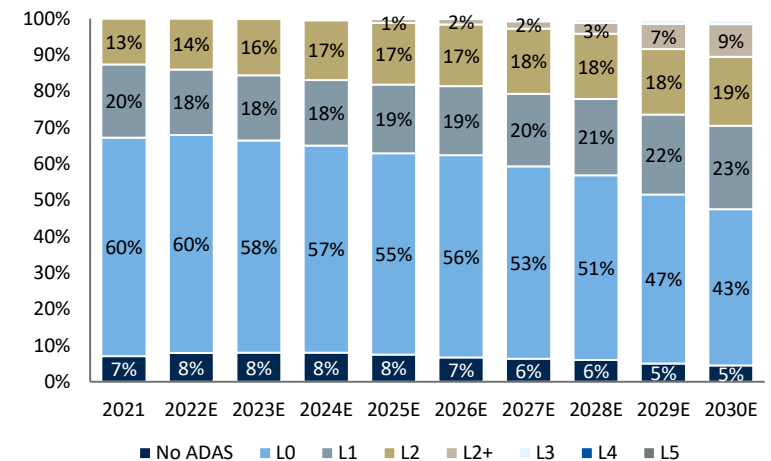
Rest of World New Light-Vehicle Sales Forecast by Autonomy Level

- The RoW sales forecast considers 2022-2030 CAGR of ~4%.
- L0 is forecasted as the largest category over 2022-2030, but declining share y/y, going from ~60% of mix in 2022 to ~43% in 2030.
- L1 is forecasted to grow at 7% CAGR from 2022-2030 to 23% share of new LV sales, and L2 is forecasted to grow at 8% CAGR to 19% of the sales mix.
- L2+ to reach 9% of mix by 2030.

2021-2030E Rest of World Sales by Automation Level



2021-2030E Rest of World Sales Mix by Automation Level





Autonomy Level Sales by Region

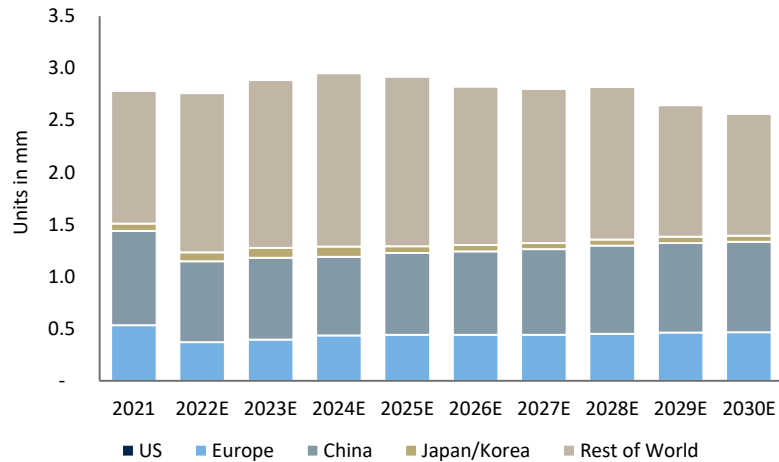
2021-2030E



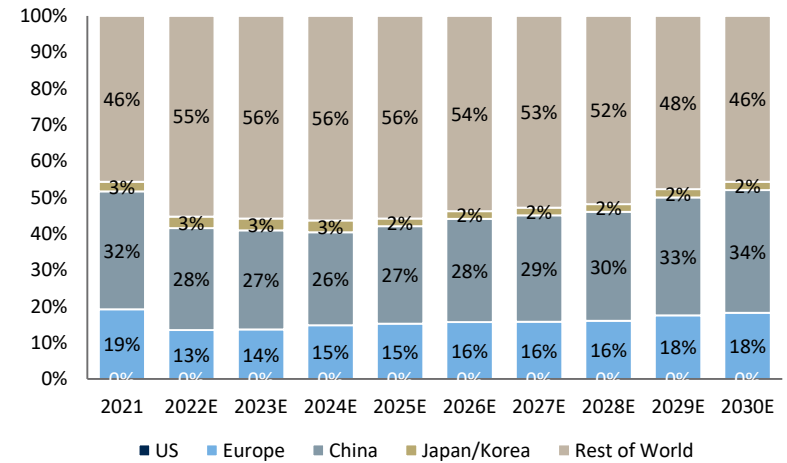


Autonomy Level by Region (No ADAS and L0)

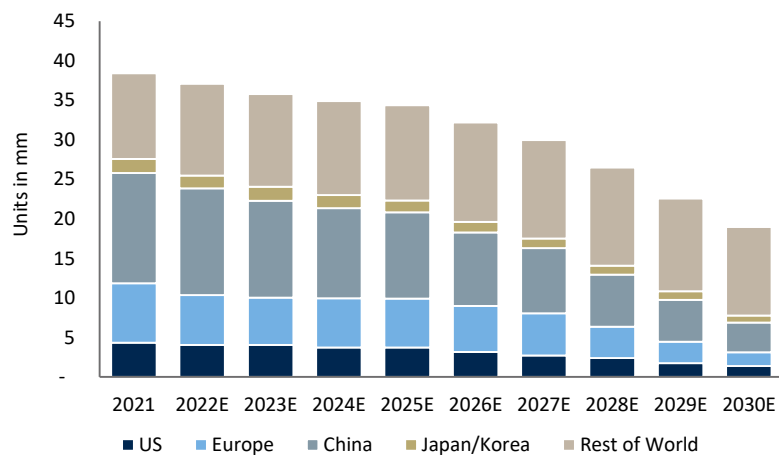
No ADAS Sales



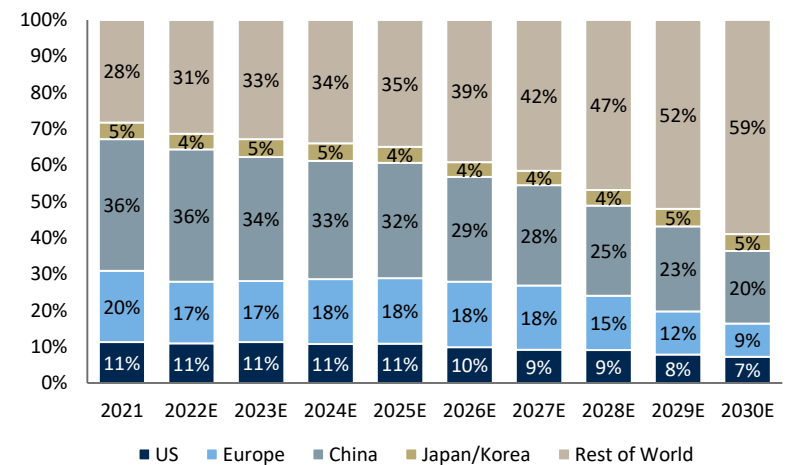
No ADAS Mix



L0 Sales



L0 Mix



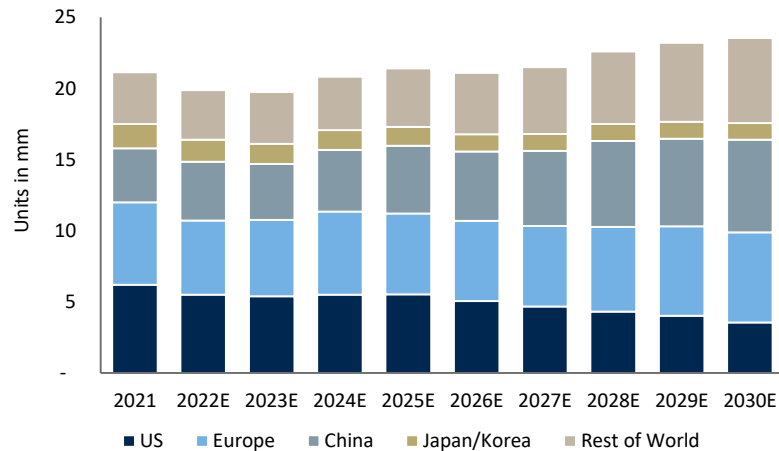
Source: RBC Capital Markets estimates, S&P Global

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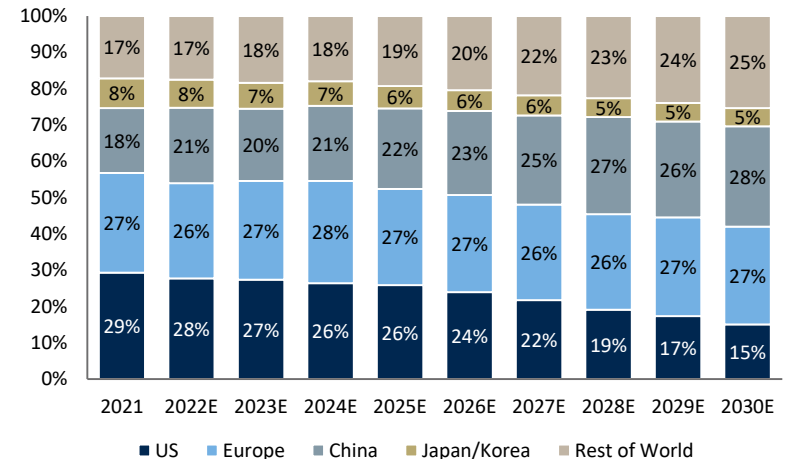


Autonomy Level by Region (L1 and L2)

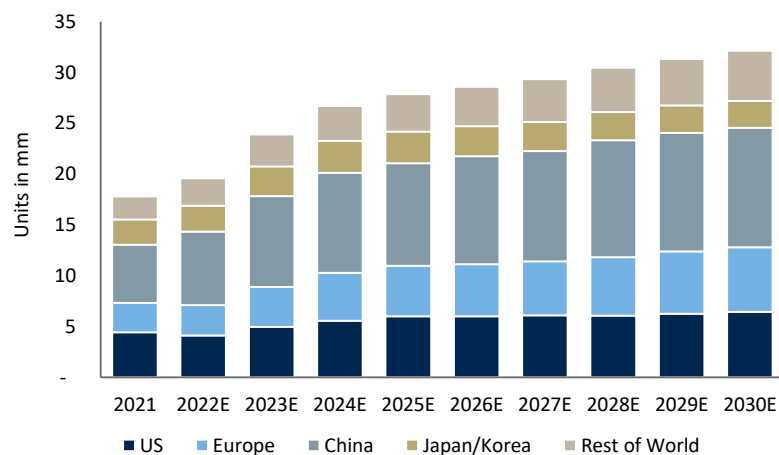
L1 Sales



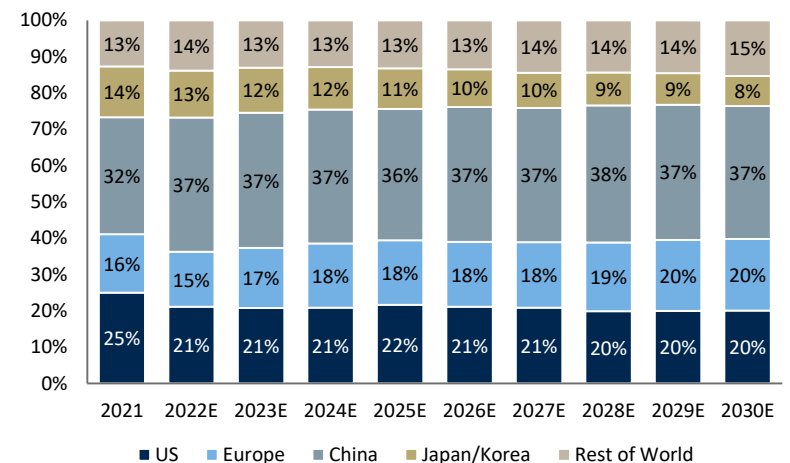
L1 Mix



L2 Sales



L2 Mix



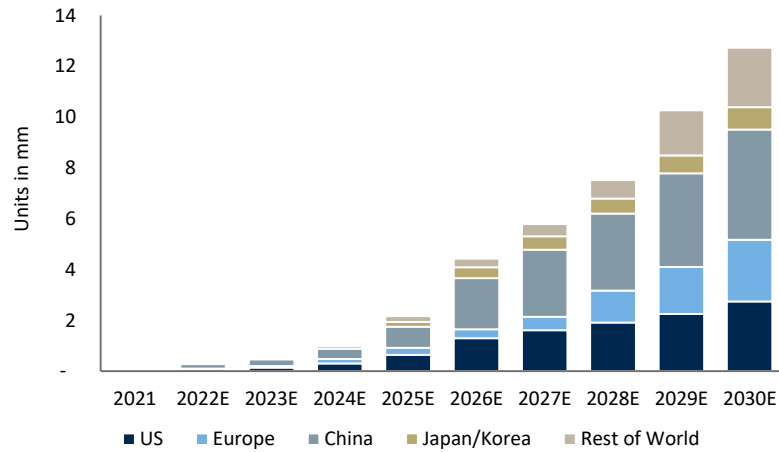
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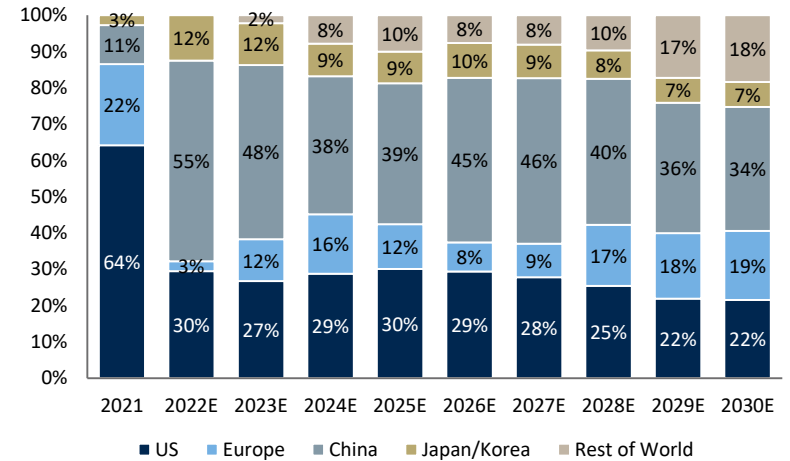


Autonomy Level by Region (L2+ and L3)

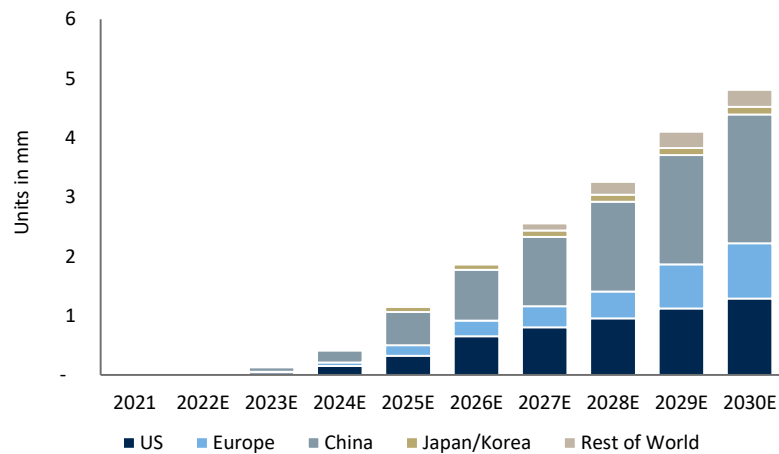
L2+ Sales



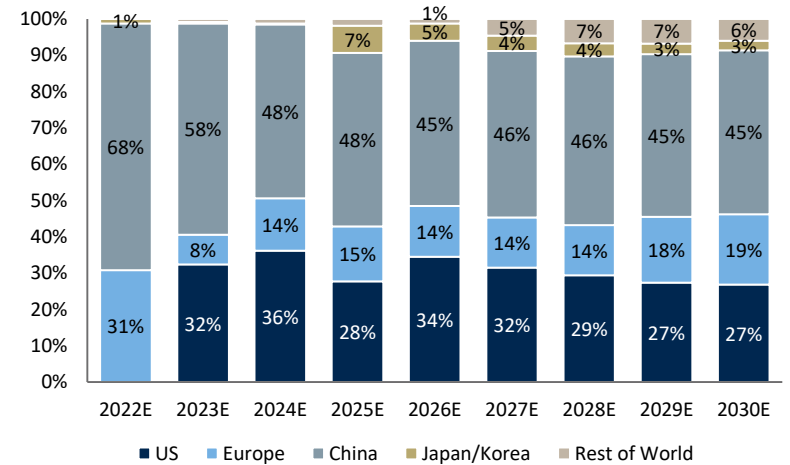
L2+ Mix



L3 Sales



L3 Mix



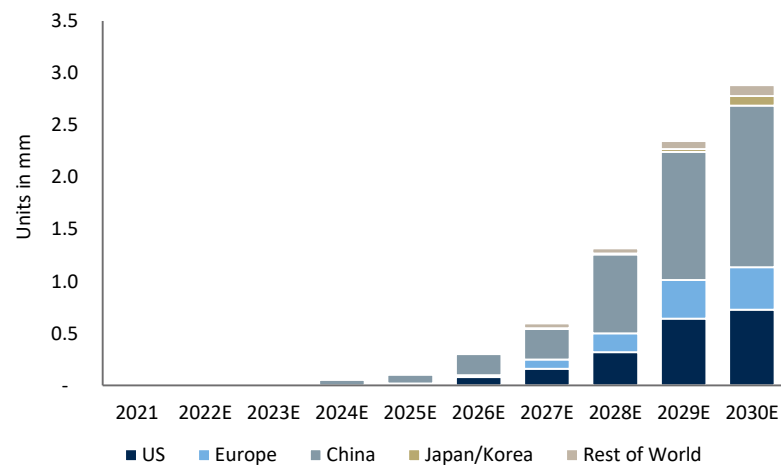
Source: RBC Capital Markets estimates, S&P Global

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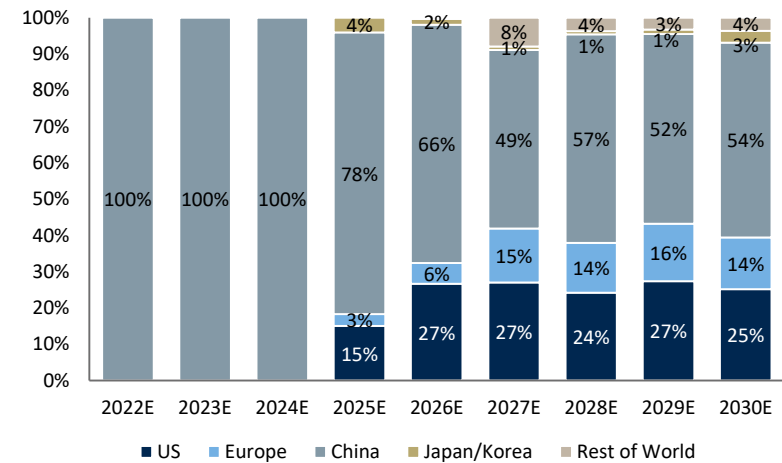


Autonomy Level by Region (L4)

L4 Sales



L4 Mix



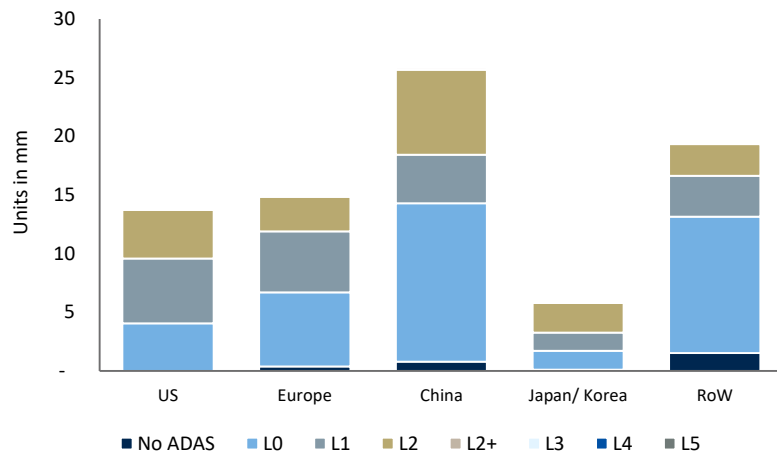
Autonomy Level by Year

2021-2030E

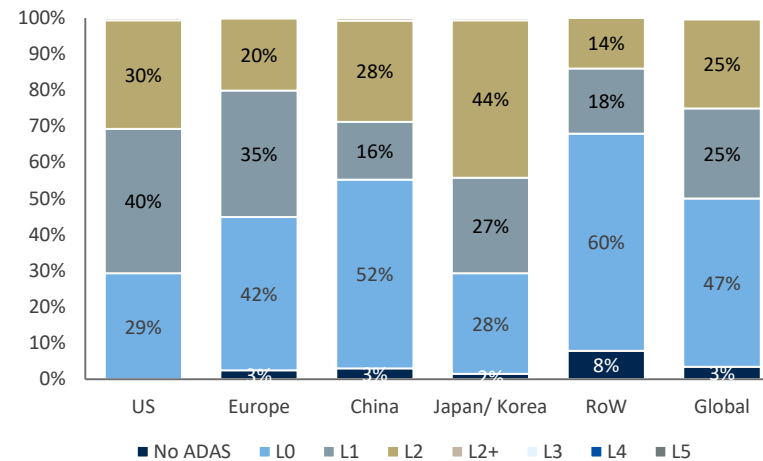


Autonomy Level by Year (2022E and 2025E)

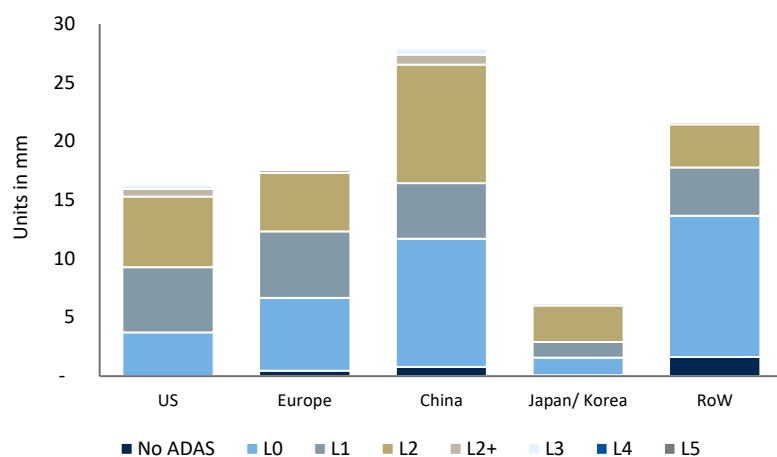
2022E Sales



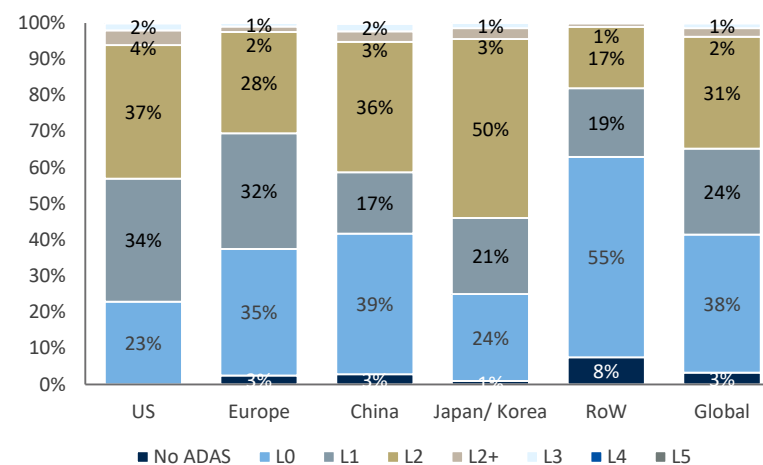
2022E Mix



2025E Sales



2025E Mix



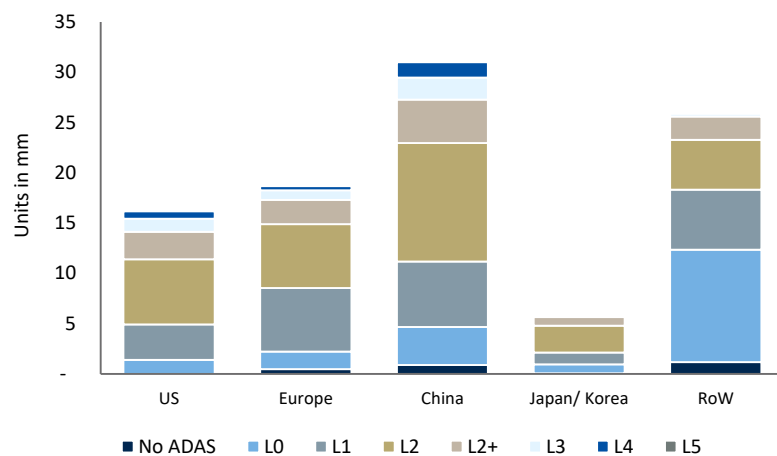
Source: RBC Capital Markets estimates, S&P Global

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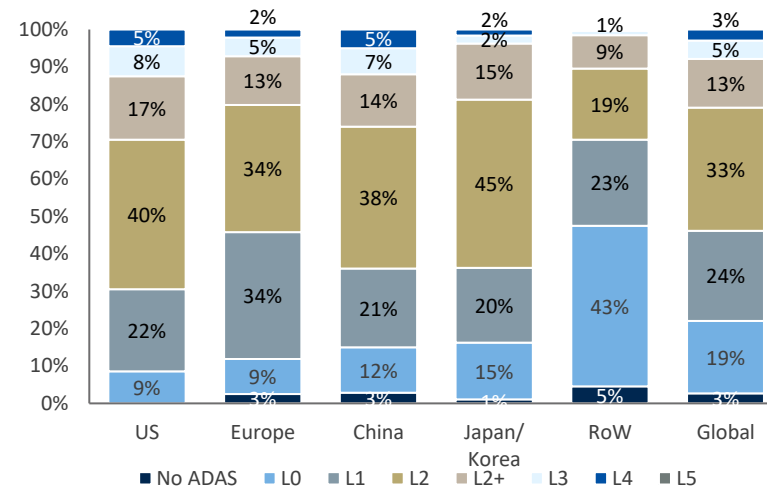


Autonomy Level by Year (2030E)

2030E Sales



2030E Mix



Source: RBC Capital Markets estimates, S&P Global

November 20, 2022



Regional Detail

2021-2030E



US Sales by Automation Level

LV Sales Assumptions (mm)	2021	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	22-30 CAGR
US Light Vehicle Sales	15.1	13.8	14.6	15.3	16.3	16.3	16.1	16.0	16.1	16.1	2%
		-8%	6%	5%	6%	0%	-1%	-1%	1%	0%	
Automation Penetration Forecast	2021	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	
No ADAS	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
L0	29%	29%	28%	25%	23%	20%	17%	15%	11%	9%	
L1	41%	40%	37%	36%	34%	31%	29%	27%	25%	22%	
L2	30%	30%	34%	37%	37%	37%	38%	38%	39%	40%	
L2+	0%	1%	1%	2%	4%	8%	10%	12%	14%	17%	
L3	0%	0%	0%	1%	2%	4%	5%	6%	7%	8%	
L4	0%	0%	0%	0%	0%	1%	1%	2%	4%	5%	
L5	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
US Level of Automation Units (mm)	2021	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	22-30 CAGR
No ADAS	-	-	-	-	-	-	-	-	-	-	NM
L0	4.3	4.0	4.0	3.7	3.7	3.2	2.7	2.4	1.8	1.4	-13%
L1	6.2	5.5	5.4	5.5	5.5	5.1	4.7	4.3	4.0	3.6	-5%
L2	4.5	4.1	5.0	5.6	6.0	6.0	6.1	6.1	6.3	6.5	6%
L2+	0.1	0.1	0.1	0.3	0.7	1.3	1.6	1.9	2.2	2.7	52%
L3	-	-	0.0	0.2	0.3	0.7	0.8	1.0	1.1	1.3	NM
L4	-	-	-	-	0.0	0.1	0.2	0.3	0.6	0.7	NM
L5	-	-	-	-	-	-	-	-	-	-	NM

Source: RBC Capital Markets estimates, S&P Global

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Europe Sales by Automation Level

LV Sales Assumptions (mm)	2021	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	22-30 CAGR
Europe Light Vehicle Sales	16.8	14.9	15.8	17.5	17.7	17.6	17.7	18.0	18.6	18.7	3%
		-11%	6%	11%	2%	-1%	0%	2%	3%	1%	
Automation Penetration Forecast	2021	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	
No ADAS	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	
L0	45%	42%	38%	36%	35%	33%	30%	22%	15%	9%	
L1	35%	35%	34%	34%	32%	32%	32%	33%	34%	34%	
L2	17%	20%	25%	27%	28%	29%	30%	32%	33%	34%	
L2+	0%	0%	0%	1%	2%	2%	3%	7%	10%	13%	
L3	0%	0%	0%	0%	1%	2%	2%	3%	4%	5%	
L4	0%	0%	0%	0%	0%	0%	1%	1%	2%	2%	
L5	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Europe Level of Automation Units (mm)	2021	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	22-30 CAGR
No ADAS	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	3%
L0	7.5	6.3	6.0	6.2	6.2	5.8	5.3	4.0	2.7	1.7	-15%
L1	5.8	5.2	5.4	5.9	5.7	5.6	5.7	6.0	6.3	6.3	3%
L2	2.9	3.0	3.9	4.7	5.0	5.1	5.3	5.8	6.1	6.3	10%
L2+	0.0	0.0	0.1	0.2	0.3	0.4	0.5	1.3	1.9	2.4	102%
L3	-	0.0	0.0	0.1	0.2	0.3	0.4	0.5	0.7	0.9	95%
L4	-	-	-	-	0.0	0.0	0.1	0.2	0.4	0.4	NM
L5	-	-	-	-	-	-	-	-	-	-	NM

Source: RBC Capital Markets estimates, S&P Global

November 20, 2022

China Sales by Automation Level

LV Sales Assumptions (mm)	2021	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	22-30 CAGR
China Light Vehicle Sales	24.4	25.9	26.2	27.0	28.0	28.7	29.3	30.3	30.7	31.0	2%
		6%	1%	3%	4%	2%	2%	3%	1%	1%	
Automation Penetration Forecast	2021	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	
No ADAS	4%	3%	3%	3%	3%	3%	3%	3%	3%	3%	
L0	57%	52%	47%	42%	39%	33%	28%	22%	17%	12%	
L1	16%	16%	15%	16%	17%	17%	18%	20%	20%	21%	
L2	24%	28%	34%	37%	36%	37%	37%	38%	38%	38%	
L2+	0%	1%	1%	2%	3%	7%	9%	10%	12%	14%	
L3	0%	0%	0%	1%	2%	3%	4%	5%	6%	7%	
L4	0%	0%	0%	0%	0%	1%	1%	3%	4%	5%	
L5	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
China Level of Automation Units (mm)	2021	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	22-30 CAGR
No ADAS	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.9	1%
L0	13.9	13.5	12.2	11.4	10.9	9.3	8.3	6.6	5.3	3.8	-15%
L1	3.8	4.1	3.9	4.3	4.8	4.9	5.3	6.1	6.1	6.5	6%
L2	5.7	7.2	8.9	9.8	10.1	10.6	10.9	11.5	11.7	11.8	6%
L2+	0.0	0.2	0.3	0.4	0.8	2.0	2.6	3.0	3.7	4.3	49%
L3	-	0.0	0.1	0.2	0.6	0.9	1.2	1.5	1.8	2.2	96%
L4	-	0.0	0.0	0.1	0.1	0.2	0.3	0.8	1.2	1.6	322%
L5	-	-	-	-	-	-	-	-	-	-	NM

Source: RBC Capital Markets estimates, S&P Global

November 20, 2022

Japan and Korea Sales by Automation Level

LV Sales Assumptions (mm)	2021	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	22-30 CAGR
Japan/Korea Light Vehicle Sales	6.1	5.8	6.3	6.4	6.3	6.1	5.9	5.9	5.9	5.9	0%
		-4%	8%	2%	-2%	-3%	-2%	-1%	1%	-1%	
Automation Penetration Forecast	2021	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	
No ADAS	1%	2%	2%	2%	1%	1%	1%	1%	1%	1%	
L0	29%	28%	28%	26%	24%	21%	20%	20%	19%	15%	
L1	28%	27%	23%	22%	21%	20%	20%	20%	20%	20%	
L2	41%	44%	47%	49%	50%	49%	48%	47%	46%	45%	
L2+	0%	1%	1%	2%	3%	7%	9%	10%	12%	15%	
L3	0%	0%	0%	0%	1%	2%	2%	2%	2%	2%	
L4	0%	0%	0%	0%	0%	0%	0%	0%	1%	2%	
L5	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Japan/Korea Level of Automation Units (2021	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	22-30 CAGR
No ADAS	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-5%
L0	1.8	1.6	1.8	1.7	1.5	1.3	1.2	1.2	1.1	0.9	-7%
L1	1.7	1.5	1.4	1.4	1.3	1.2	1.2	1.2	1.2	1.2	-3%
L2	2.5	2.5	3.0	3.1	3.1	3.0	2.8	2.8	2.7	2.6	1%
L2+	0.0	0.0	0.1	0.1	0.2	0.4	0.5	0.6	0.7	0.9	47%
L3	-	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	129%
L4	-	-	-	-	0.0	0.0	0.0	0.0	0.0	0.1	NM
L5	-	-	-	-	-	-	-	-	-	-	NM

Source: RBC Capital Markets estimates, S&P Global

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Rest of World Sales by Automation Level

LV Sales Assumptions (mm)	2021	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	22-30 CAGR
Rest of World Light Vehicle Sales	18.0	19.3	20.1	20.8	21.7	22.6	23.5	24.4	25.2	26.0	4%
		7%	4%	3%	4%	4%	4%	4%	4%	3%	
Automation Penetration Forecast	2021	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	
No ADAS	7%	8%	8%	8%	8%	7%	6%	6%	5%	5%	
L0	60%	60%	58%	57%	55%	56%	53%	51%	47%	43%	
L1	20%	18%	18%	18%	19%	19%	20%	21%	22%	23%	
L2	13%	14%	16%	17%	17%	17%	18%	18%	18%	19%	
L2+	0%	0%	0%	0%	1%	2%	2%	3%	7%	9%	
L3	0%	0%	0%	0%	0%	0%	1%	1%	1%	1%	
L4	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
L5	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Rest of World Level of Automation Units	2021	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	22-30 CAGR
No ADAS	1.3	1.5	1.6	1.7	1.6	1.5	1.5	1.5	1.3	1.2	-3%
L0	10.8	11.6	11.8	11.9	12.0	12.6	12.4	12.4	11.8	11.2	0%
L1	3.6	3.5	3.6	3.7	4.1	4.3	4.7	5.1	5.6	6.0	7%
L2	2.3	2.7	3.1	3.4	3.7	3.8	4.2	4.4	4.5	4.9	8%
L2+	-	-	0.0	0.1	0.2	0.3	0.5	0.7	1.8	2.3	NM
L3	-	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.3	0.3	343%
L4	-	-	-	-	-	0.0	0.0	0.0	0.1	0.1	NM
L5	-	-	-	-	-	-	-	-	-	-	NM

Source: RBC Capital Markets estimates, S&P Global

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A Summary of Our Methodology

- For sales (demand), we use RBC's US light vehicle demand forecast through 2024. We then keep sales ~16mm units per annum. For other regions of the world, Europe (includes Western, Central and Eastern Europe), China, Japan/Korea, and Rest of World (Canada, Mexico, South & Central America, other Asia Pacific, and Middle East & Africa), we rely on recent S&P Global sales forecasts.
- For the levels of automation mix, we consider recent penetration trends, regulations, automaker and industry supplier and participant plans, cost curves, and channel checks/conversations with industry participants. For more advanced levels of automation, we also consider how prior levels of automation progressed.



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