Top 10 Auto Tech Trends to Watch for in 2021

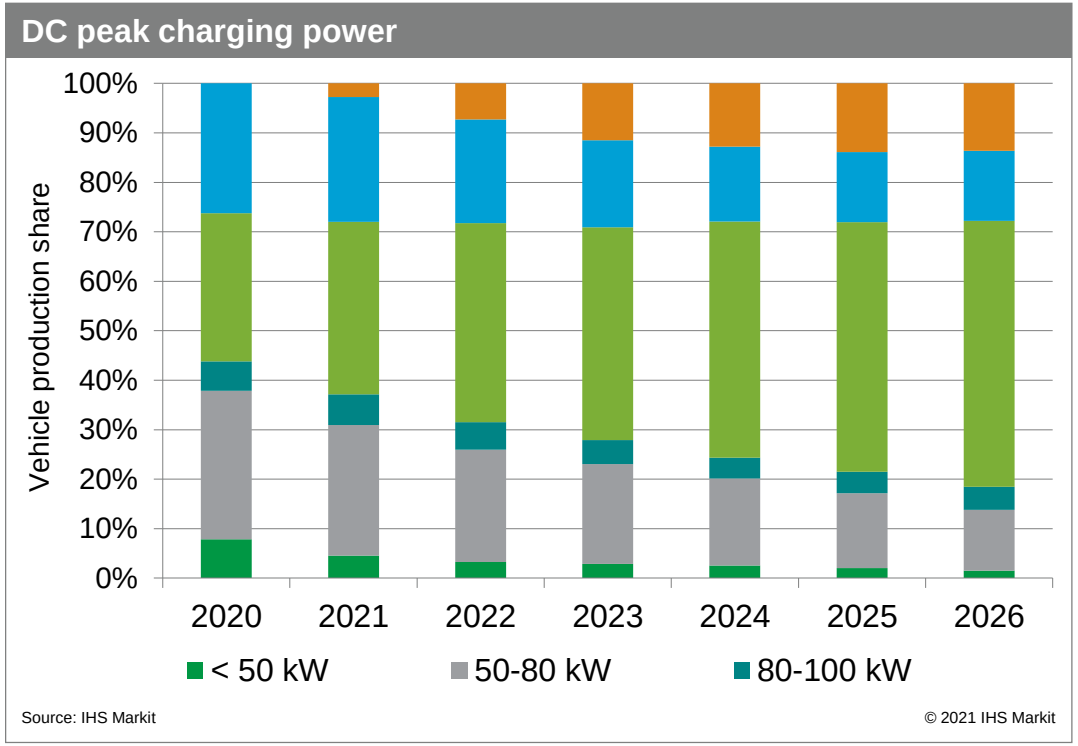
An overview of the key developments happening in 2021

January 2021

#1 – EV charging speeds keep increasing

Over 60% EVs produced in 2021 can charge at 100kW DC or faster

- In FY2021 will be produced **3M** vehicles capable of DC charging with 100kW or more (**+103%** vs FY2020)
- Starting from 2021, the most common power range for DC charging is 100-200kW
- Vehicles with DC charging power >300kW start to appear significantly in 2021, even though they are expected to remain a niche until at least 2026
- DC charging at 50kW, which has been the most adopted solution in the first EVs generations, to become a feature for entry level products



#2 – 5G automotive deployment continues

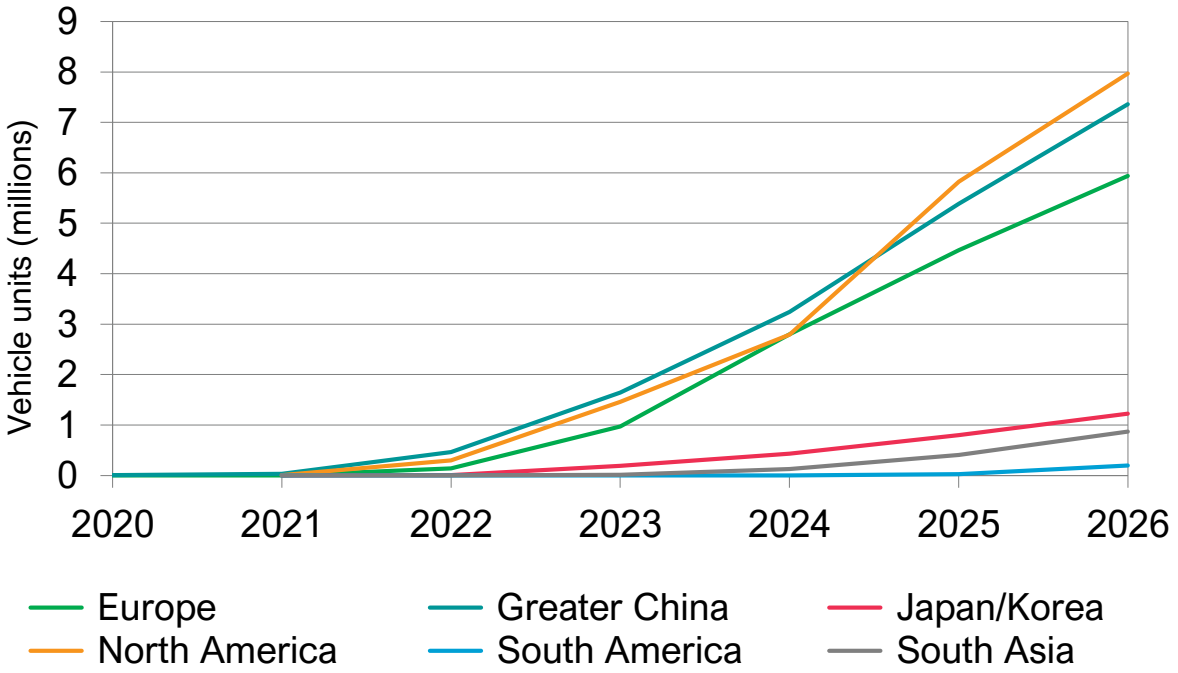
57 million vehicles on the road supporting 5G by 2026

- BMW is set to become the first to launch 5G-capable cars outside of China, 3 years before the technology goes mainstream
- 4.4M new vehicles sold supporting in 2023, the inflection point for new 5G launches
- The first 5 vehicles to launch with 5G – all full EV nameplates:

Domain/Attribute (Expand All)	Guangzhou Auto Aion V, Mainland China (2020)		ARCFOX Alpha-T, Mainland China (2020)		Roewe Marvel R, Mainland China (2020)		Hiphi Hiphi 1, Mainland China (2021)		BMW iX, Germany (2021)	
Connected Car										
TCU: Bandwidth	4G LTE 5G	74.9% 25.1%	5G	100%	5G	100%	5G	100%	5G	100%
TCU: LTE Category	CAT 4 5G NR	74.9% 25.1%	5G NR	100%	5G NR	100%	5G NR	100%	5G NR	100%
TCU: Telematics Type	Hybrid	100%	Hybrid	100%	Hybrid	100%	Hybrid	100%	Hybrid	100%
V2X Type	Not Applicable Cellular	74.9% 25.1%	Not Applicable	100%	Not Applicable	100%	Cellular	100%	Not Applicable Hybrid	71.9% 28.1%

Source: Features and Technology Benchmarking, Connected Car

Sales forecast of vehicles with built-in 5G, by region

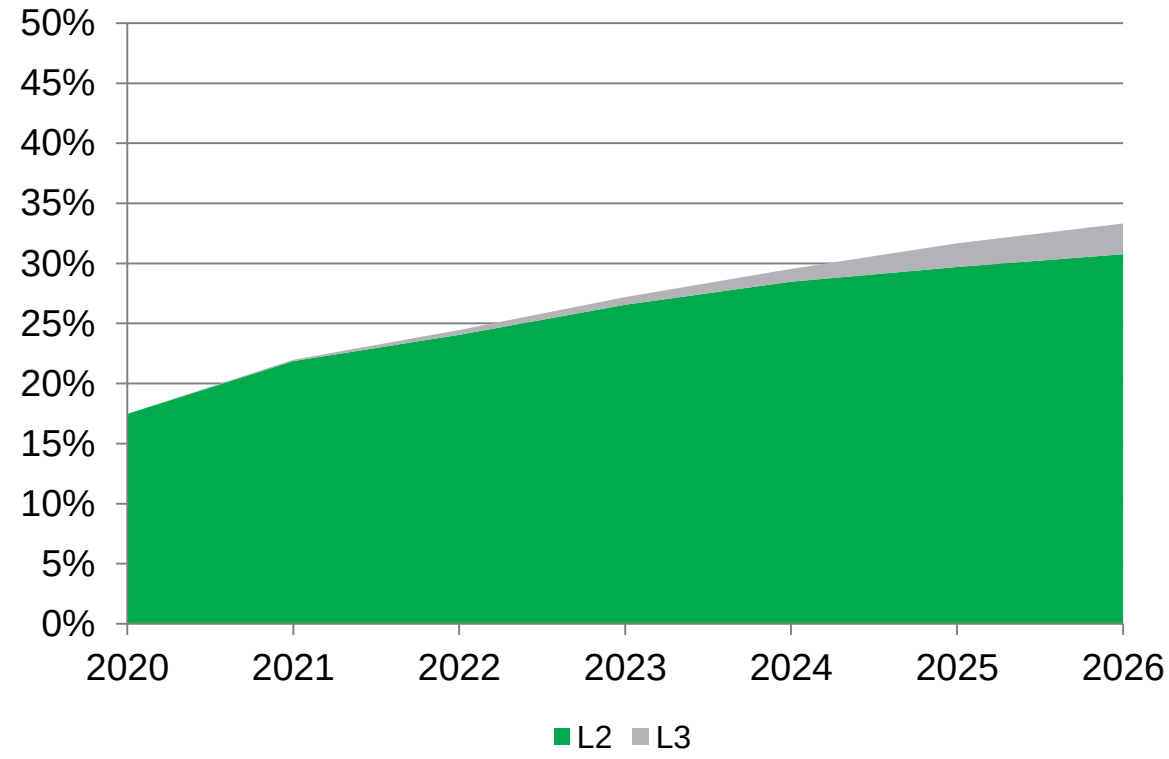


Source: IHS Markit

#3 – Automated driving launches continue to differentiate in L2, L2+, and L3

- Widely available and often standard basic L2 systems set a new baseline for automation
- New and ongoing introductions of L2+ systems and driver monitoring, increasingly delivered via OTA update
- L3 launches expected in 2021 but challenges remain
- Regulation and liability are primary concerns even with ALKS adoption, along with performance and cost— leading some to elect or downgrade to L2+ instead of L3

Levels of automation: Global annual attach rate



Source: IHS Markit, Autonomy Forecasts, December 2020

#4 – Software becomes critical to ACES as new purpose-built mobility vehicles launch for ride-hailing services

- Vehicle sales for MaaS use-cases will grow at an 18% CAGR through 2030, versus a flat personally-owned vehicle sales market
- Developments in digital key and authentication services key for shift to shared vehicle environment
- Concerns over documenting software requirements and testing/validating complex software use cases remain high as the market evolves

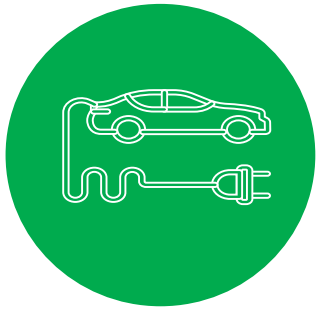
A

- Shift to intelligent sensors
- Shift to robot taxis-control of central computing system
- Superior reliability and higher storage
- Driver workload management

C

- OTA features for HMI ADAS, LBS
- Augmented reality heads-up display, virtual assistant
- V2X connectivity

E



- Driver information for EV
- New energy–specific electronics
- BMS: calculation and energy savings
- Battery life cycle management

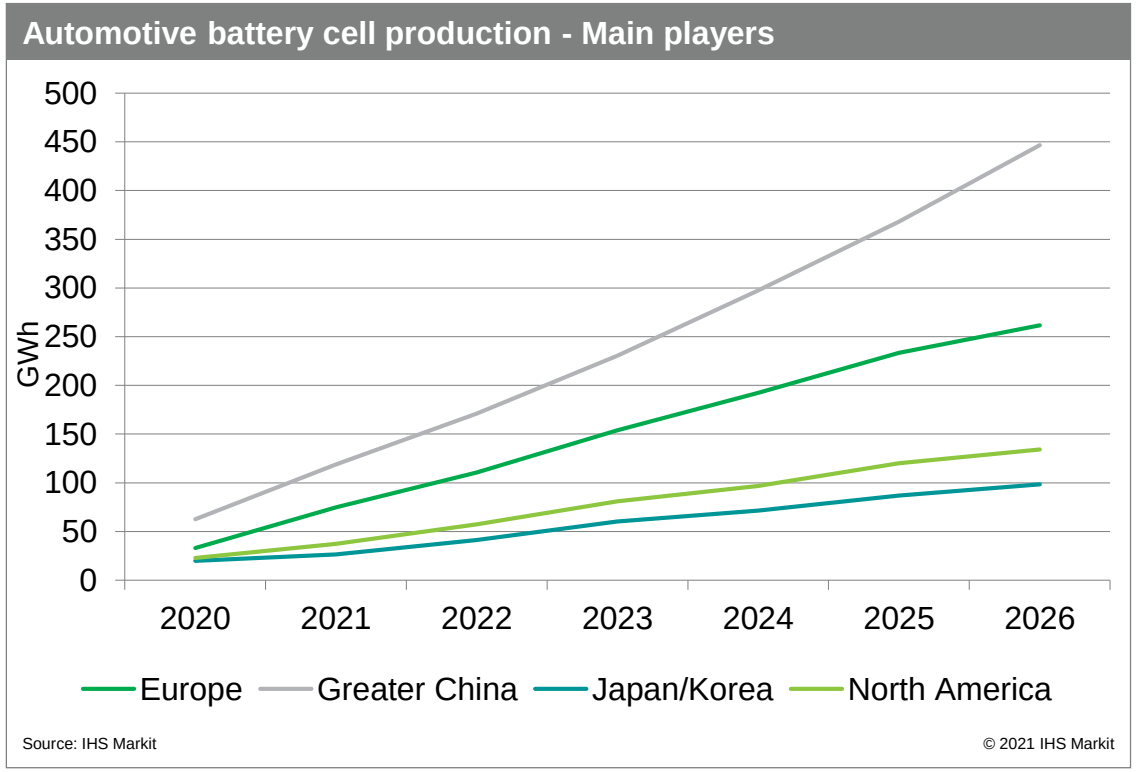
S

- Digital key and authentication service for shared vehicles
- Vehicle personalization features
- Vehicle part of smart city

#5 – Europe to boost battery manufacturing

30% of battery capacity to be produced in Europe by 2026

- Many factors pushing Europe to boost battery cell manufacturing:
  - > OEM push for BEV sales
  - > COVID-19 stress to supply chain
  - > European government incentives
  - > Renewable energy push
- In FY2021 Europe will increase its battery manufacturing up to 75GWh (**+130%** vs FY2020)
- In FY2021 Greater China to reach 120GWh (**+90%** vs FY2020)

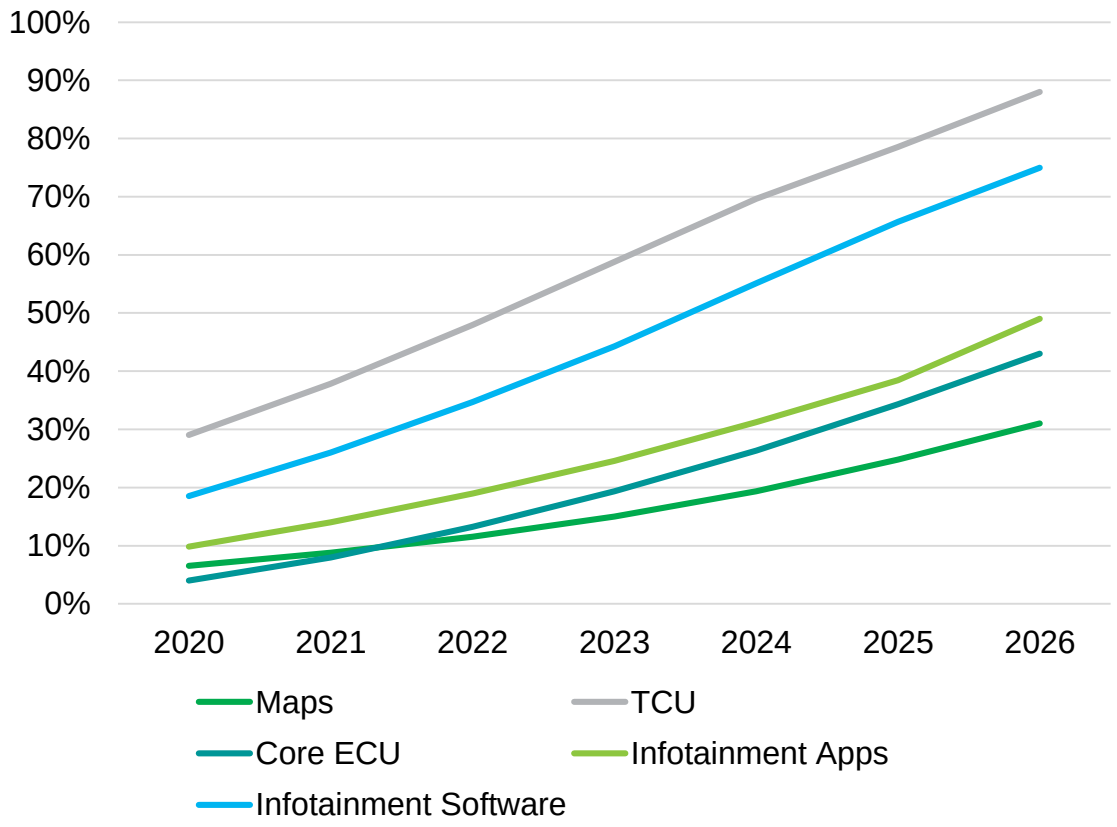


#6 – Over the air software update (OTA) proliferates

350+ million vehicles will offer some OTA by 2025

- OTA updates are becoming an increasingly important capability for:
  - > Recall avoidance and maintenance costs
  - > Bug fixes
  - > Cybersecurity updates
  - > Vehicle life cycle, software, data, and services updates
- TCUs and infotainment lead the adoption trend
  - > By 2024 most TCUs and ECUs will offer OTA
- One third of vehicles produced in 2025 will have the capability to remotely update key software domains, including powertrain, battery management, chassis, and safety

OTA-enabled units: Annual attach rate



Source: IHS Markit

#7 – Automotive chip shortage

- Lead time for automotive semiconductor increased from 12-16 weeks to 26+

- Capacity constraints fueled by spike of chip demand at across several sectors

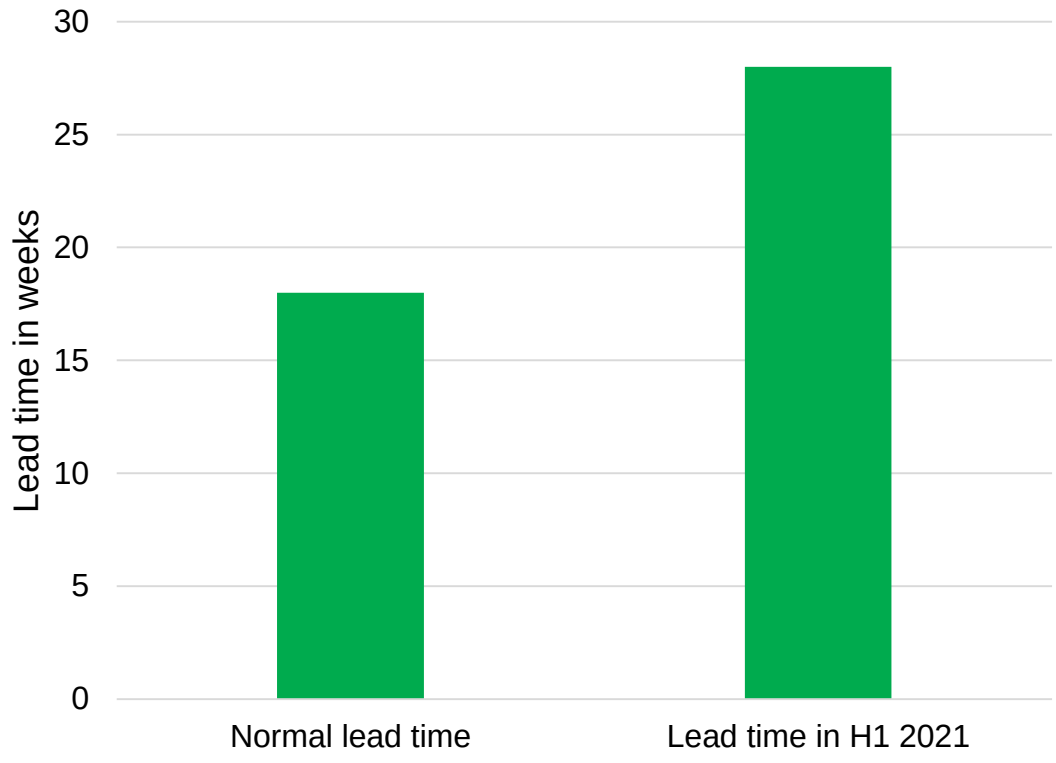
  > Launch of new gaming consoles, 5G phones, Intel outsourcing some demand to TSMC, electric cars...

- IHS Markit expects supply constraints to be resolved second half of 2021

  > In-house capacity increasing where possible

  > Some prices increase

Automotive semiconductor lead time



Source: IHS Markit

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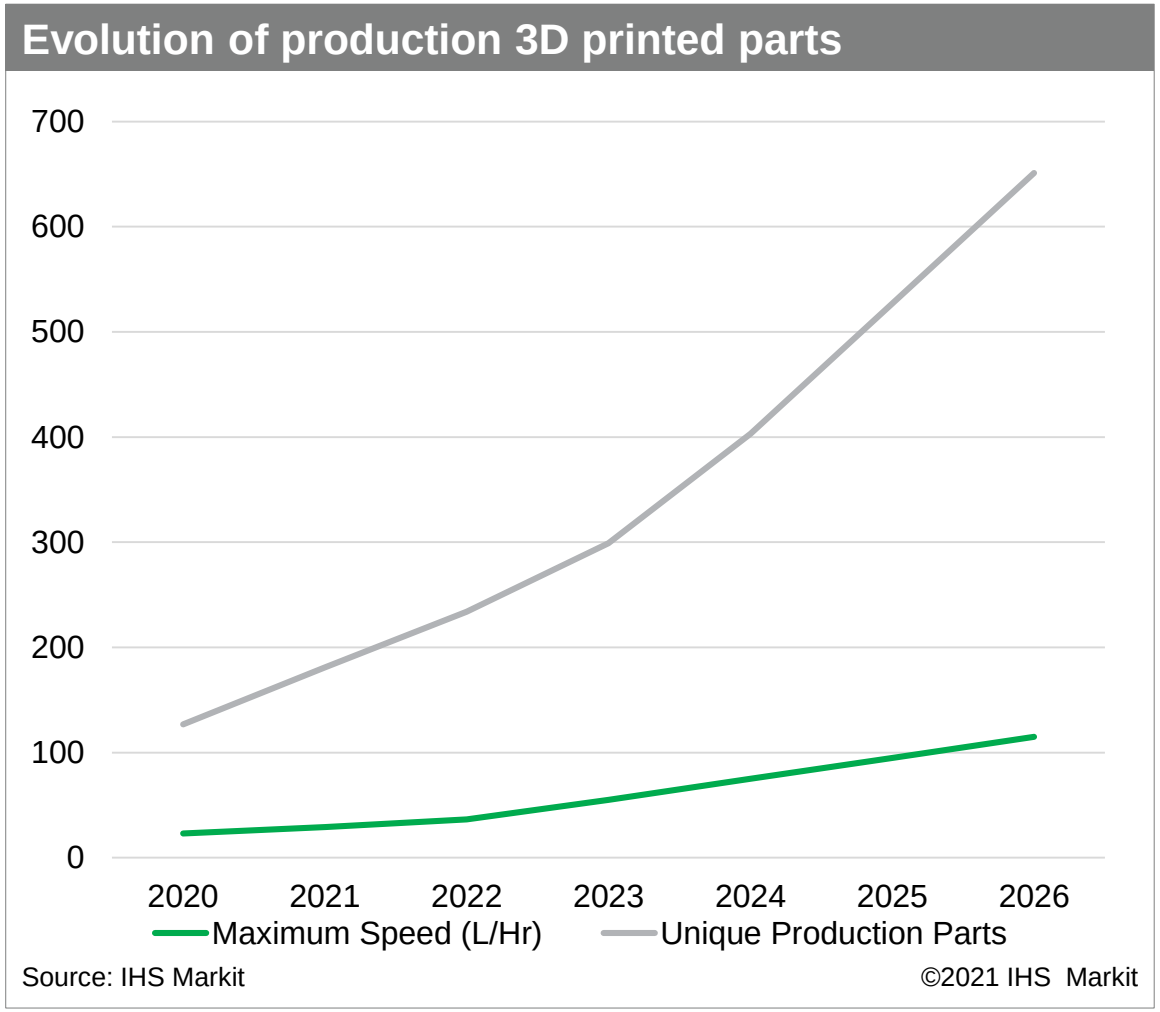
#8 – Production 3D printing enters light production vehicles

- DLP stands poised to disrupt large polymer components such as:
  - > Bumper/fascia
  - > Rocker panel cover
  - > Dash cover structure
- Metal components prove value in high stress applications
  - > Engine Pistons
  - > Brake Calipers
  - > Fuel Injectors
- On demand 3D printing currently enables restoration of classic vehicles without available replacement parts, but also stands to fundamentally change parts banking



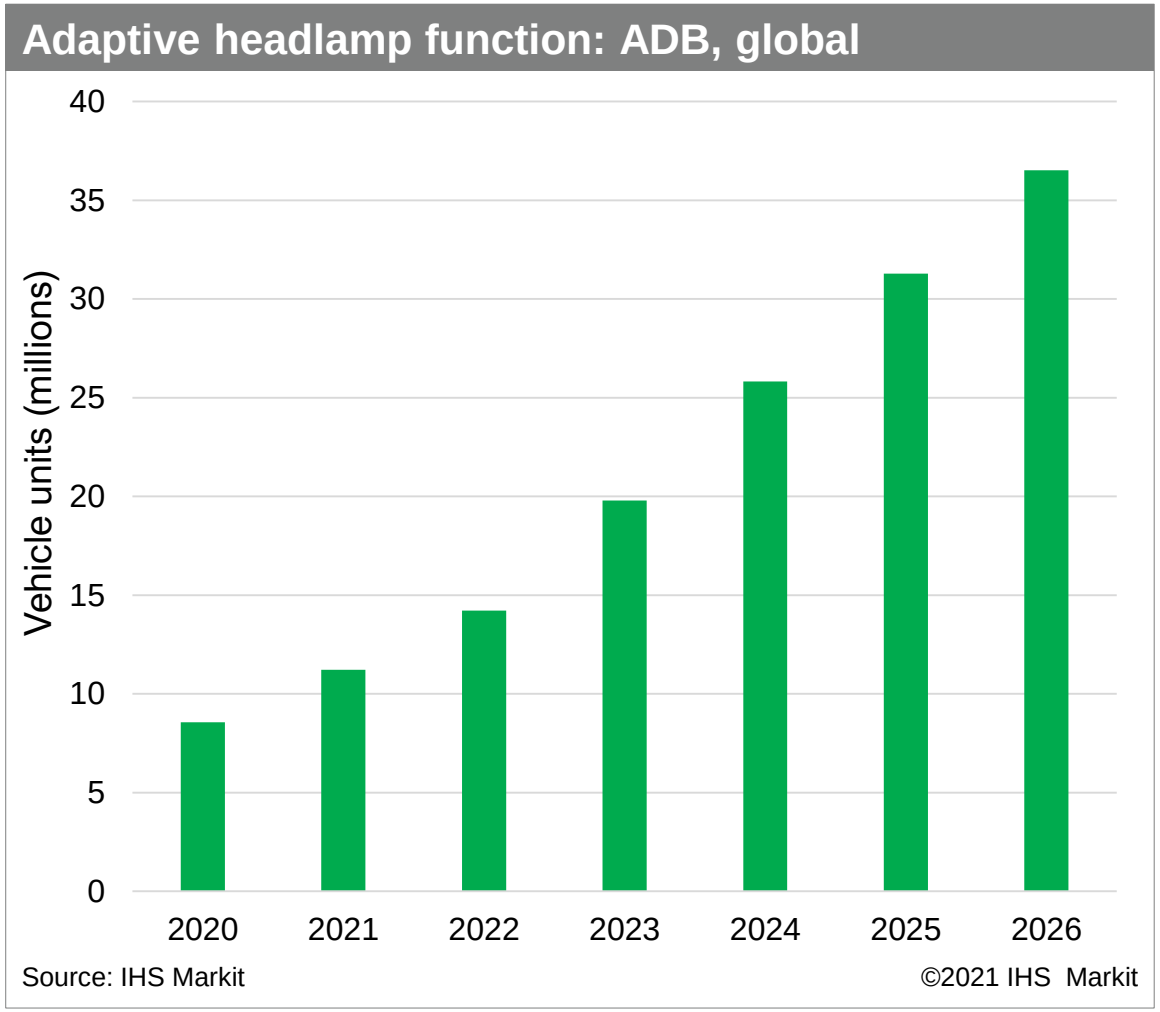
#9 – Matrix lighting proliferates beyond premium

- 46 automakers will offer adaptive driving beam (ADB) headlamps for their vehicles in 2021

- ADB has moved to lower sales segments for European and Japanese OEMs, boosting adoption further

  > Premium segments have shifted to higher pixels per headlamp, with some reaching >1m pixels per vehicle

- Despite growth in Europe, China, and Japan, regulatory hurdles remain in the US, but this is expected to change in the coming years



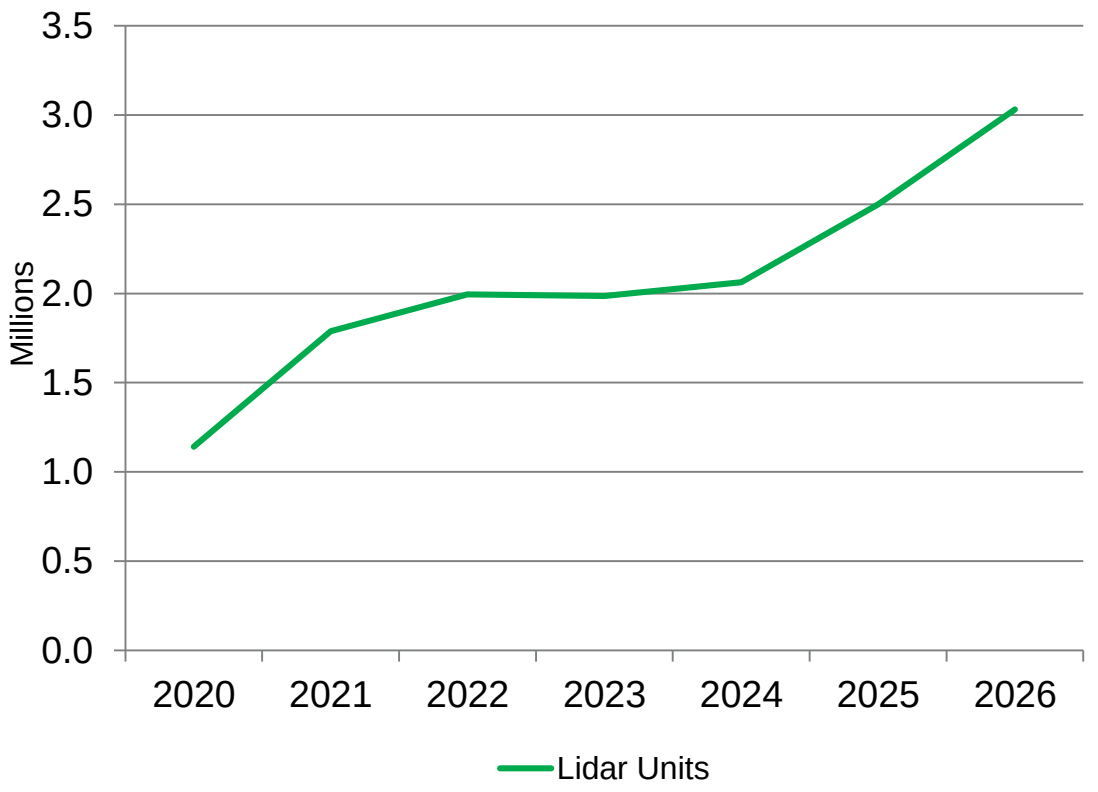
#10 – Lidar sensors enabling automation – especially in L3 and L4 launches

- New automated driving features provide primary use case for new and diverse sensors—especially lidar

- Technology, performance, and cost obstacles exist
  - > High early costs but with relatively predictable declines
  - > Matching performance to cost and launch targets

- Ongoing technology advances and segment maturity
  - > Solid state improves reliability
  - > Frequency-Modulated Continuous Wave (FMCW) is generating interest by providing velocity information
  - > Perception stack development emphasizing the ability to ingest new sensor inputs with greater flexibility

Lidar sales forecast, global



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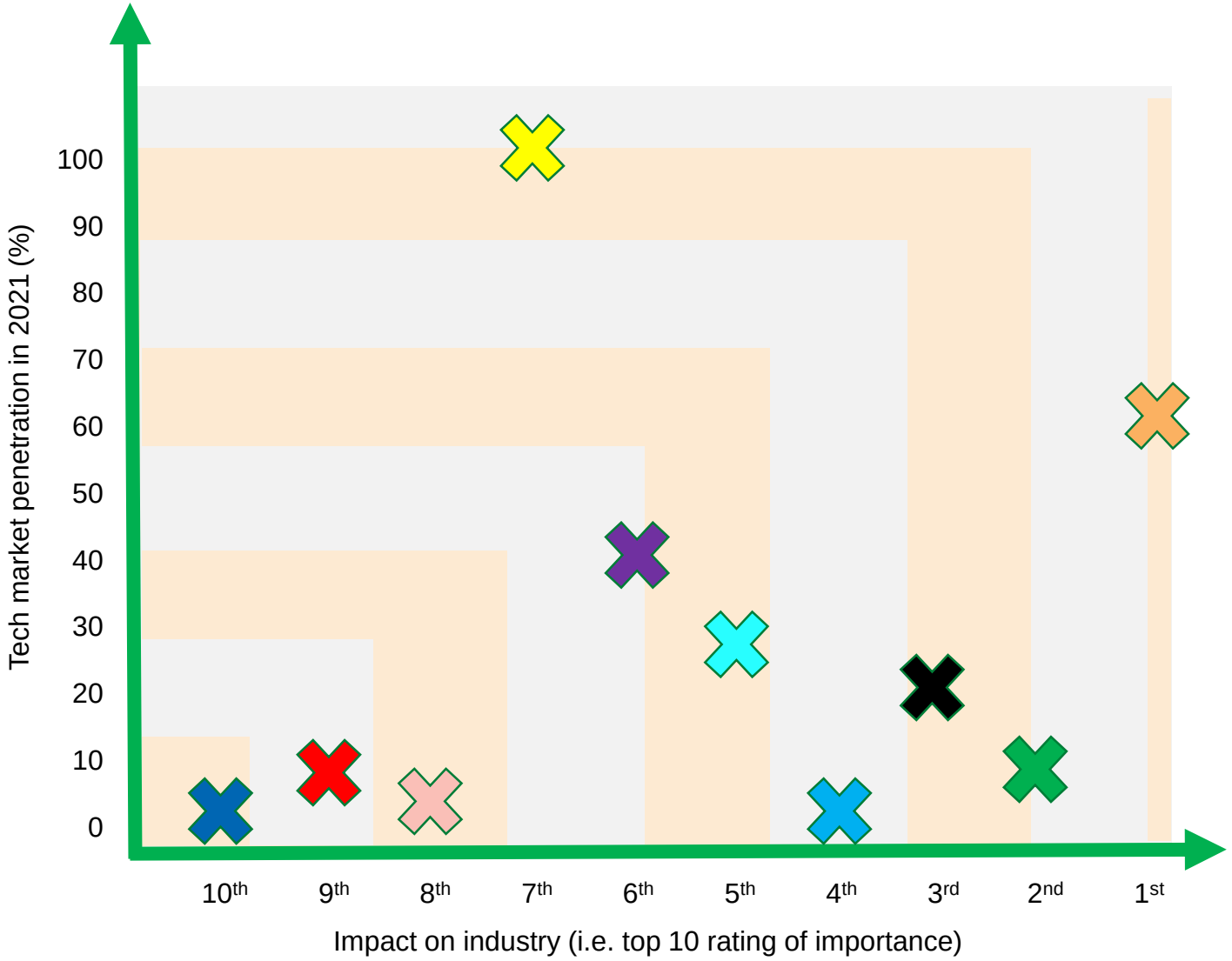

- EV charge output grows
- In-vehicle 5G becomes reality
- L2+ & L3 vehicles launch
- Software for ACES & Mobility
- EV battery capacity expands
- OTA roll-out
- Automotive chip shortage issues
- 3D printing in production
- Matrix lighting evolves
- Lidar closer to market