BOSTON CONSULTING GROUP

Moving the World Forward

THE FUTURE OF THE AUTO & MOBILITY INDUSTRY

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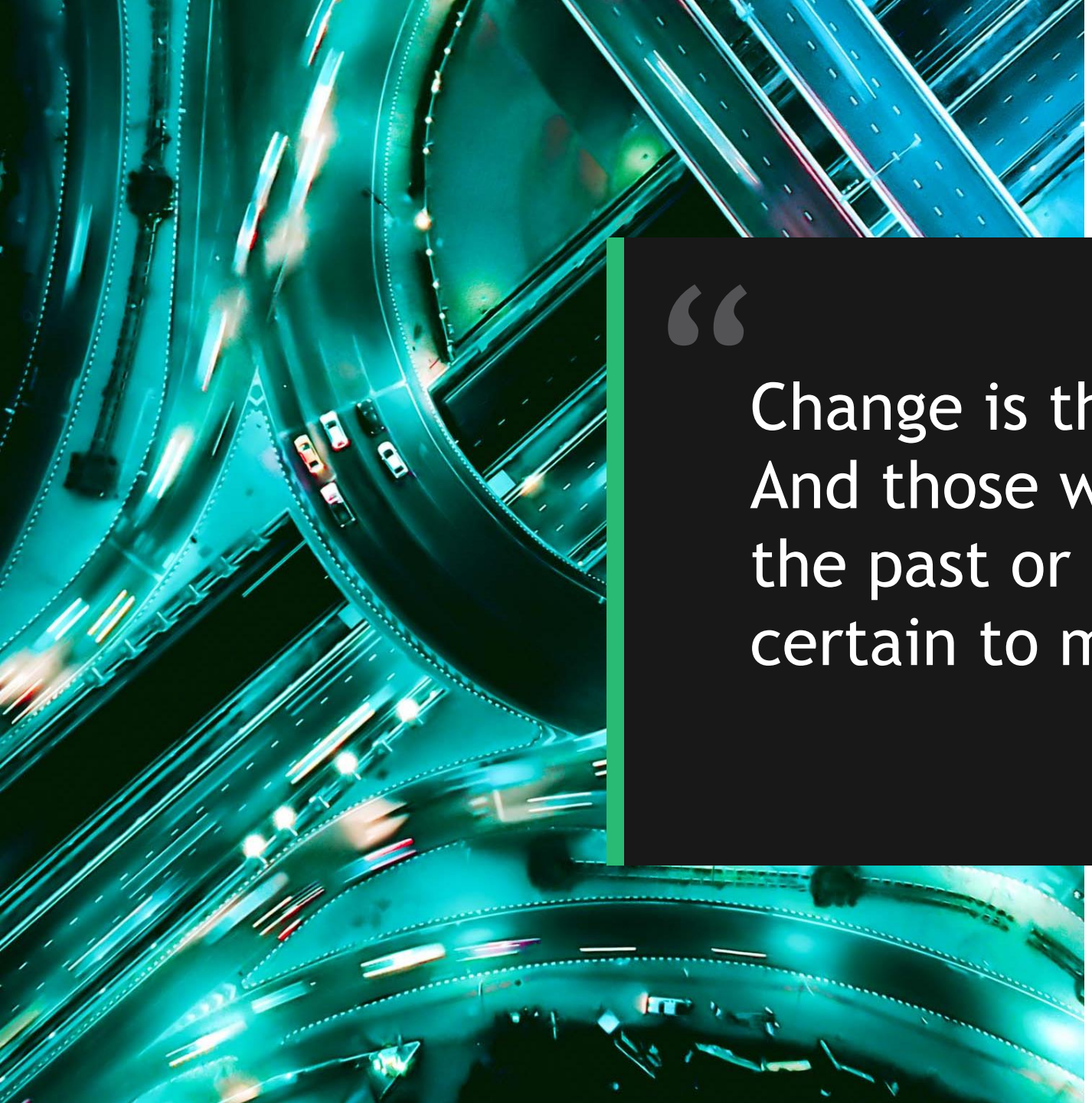


> Change is the law of life. And those who look only to the past or present are certain to miss the future

John F. Kennedy

We have no choice but to get this right

+1H	$88B	70%	1.3M deaths	6 Gt
Daily commute time in Chicago's low- vs. high-income areas … limiting access to jobs & contributing to economic inequality	2019 congestion cost in the U.S. +42% extra daily travel time in Chongqing, China	Population that will live in urban areas by 2050, with more than 40 mega-cities globally	Road traffic deaths every year, 7th leading cause of death in lower-income countries	CO2 emitted from light duty vehicles on road per year, representing 12% of total global emissions

Source: INRIX 2019 & 2020 Global Traffic Scorecard; TomTom Traffic Index 2020; European Environment Agency (EEA); IEA; WHO; World Bank; BCG Inclusivity Quotient Project

Five key forces converging to unlock opportunity never-before possible

1. AI / Machine Learning
2. Tech Maturity (Cost ↓)
3. Connectivity
4. Attitudinal Shifts
5. Regulatory Pressures

NEW MOBILITY

What will this new world look like?

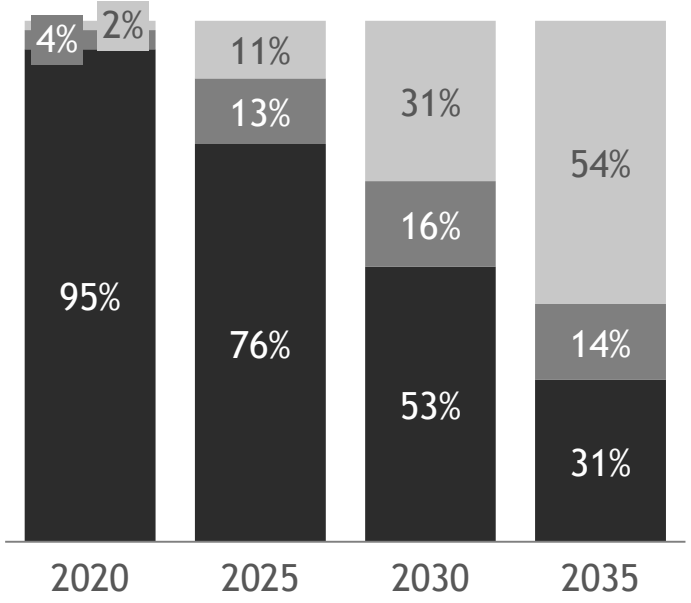
Gas guzzlers to electrified vehicles	→	More than 70% of new vehicles full hybrid or cleaner by 2035, 95%+ if including mild hybrid
Hardware to software	→	100% connected by 2030; OTA updates the norm; new biz models emerge
Product to service	→	Lifetime revenues from subscriptions, upselling, and ecosystem services up to $10k per car
Single-use to circular	→	Net-zero production, recycled content quotas, modular & upgradeable components
Active safety from luxury to common good	→	~50% of new vehicles in 2030 to be L2 /L2+
Privately owned to sharing	→	Sharing to account for ~30% VMT in major MSAs (due in large part to L4); seamless intermodal mobility providing greater mobility access and reliability

By 2025, EV will be advantaged on total cost of ownership (TCO) relative to traditional ICE in most key markets

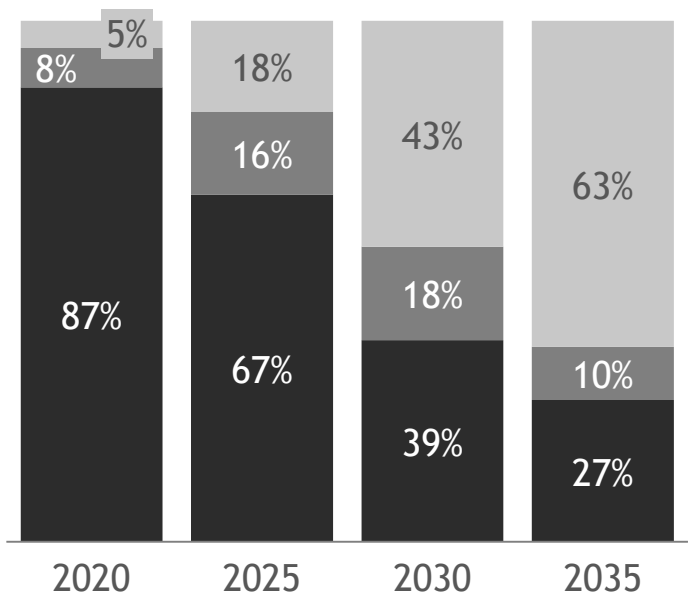
Regulations tightening further in many markets		Battery costs declining faster than anticipated		OEM competition intensifying though broader offerings
Concrete steps toward net-zero; ICE bans starting as early as 2025	+	Purchase cost parity vs ICE; Less than $75 / kWh pack price by 2030	+	400 models by 2025; Availability across all vehicle segments

Nearly 70% of new vehicles sold will be full hybrid or cleaner by 2035

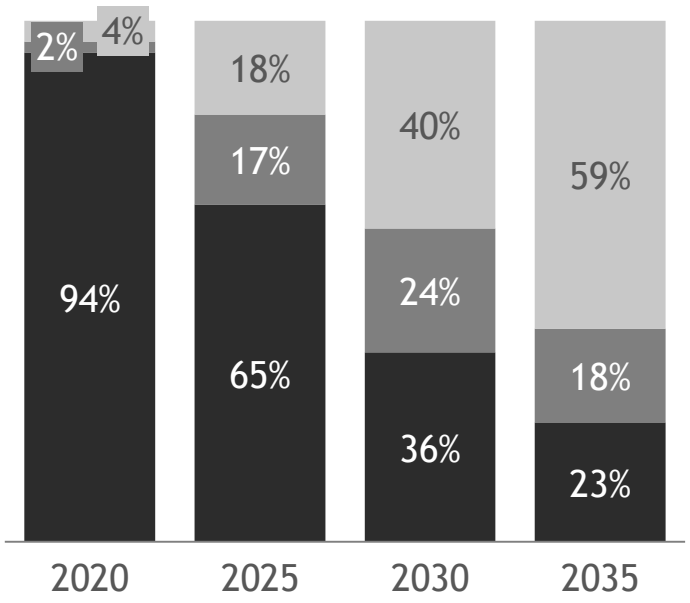
US volume projections



EU volume projections



China volume projections

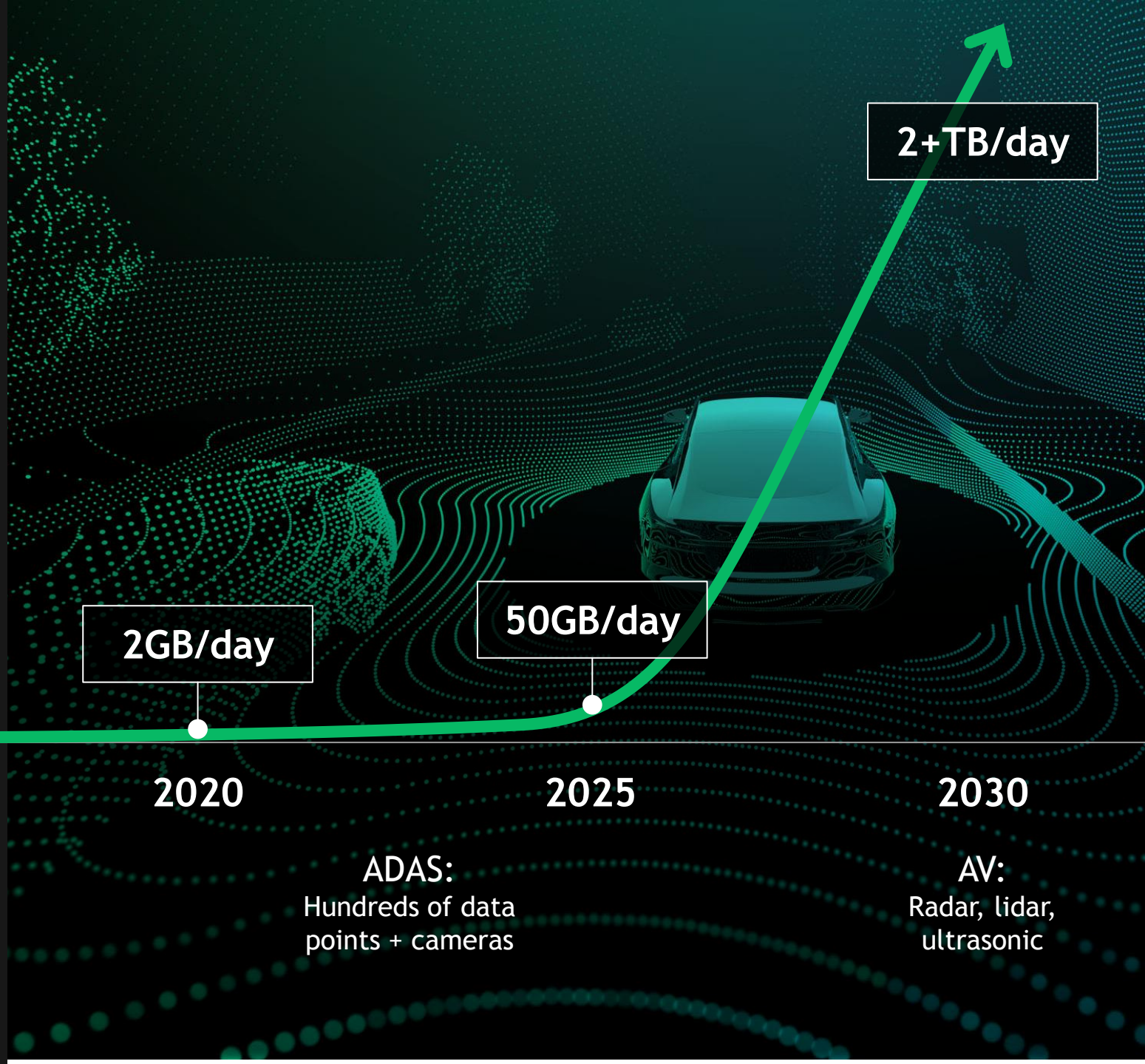


Zero emission | Full hybrid | Gas/Diesel

Note: Forecast includes all light vehicles, except HVAN. 'Zero-emission' is BEV + FCEV, 'Full hybrid' is PHEV + HEV, 'Gas/Diesel' includes MHEV
Source: BCG analysis

Dramatic improvements in technology ushering in a new era of connectivity and software defined vehicles

… from metal to bits at scale



Note: Only small share of (post-processed) data leaves the vehicle
Source: BCG analysis

A software-defined car completely reshapes where value is realized

“ If we want to remain independent, we have to develop car software ourselves

Herbert Diess, VW

“ The critical role of software […] cannot be overstated

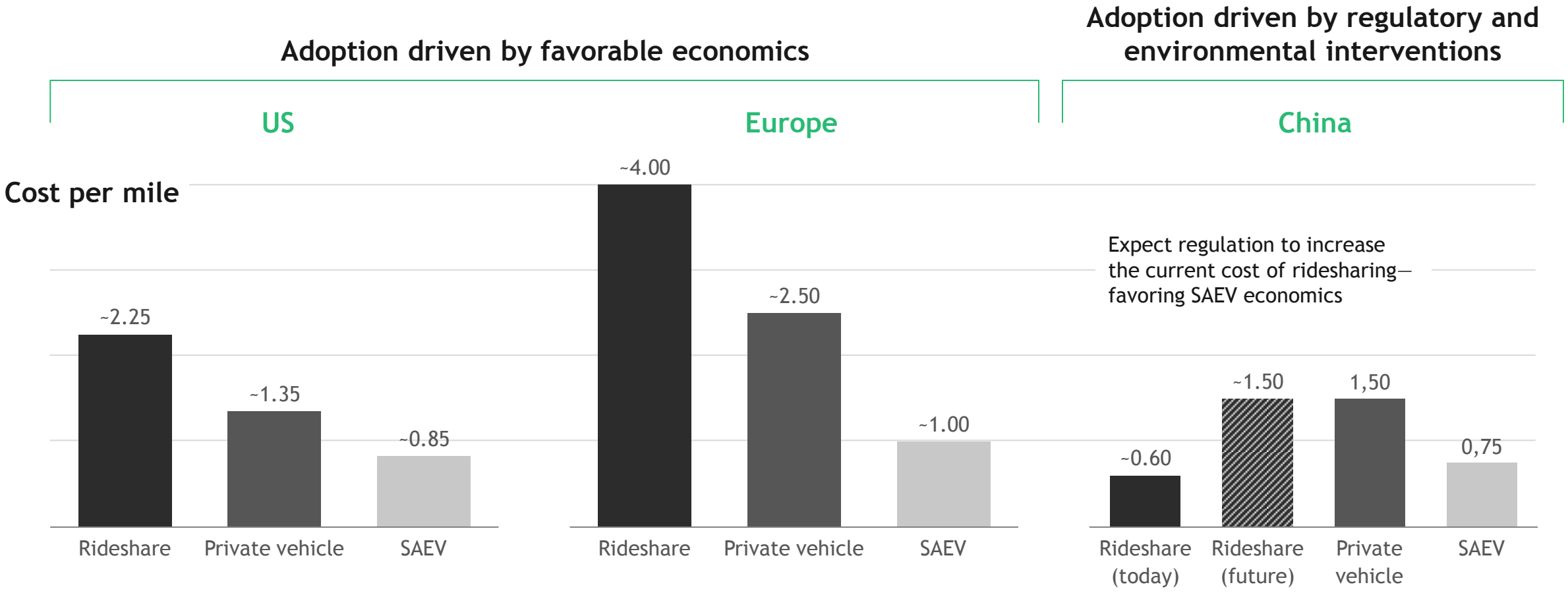
Mark Reuss, GM

… by 2030

90%	of future differentiating car features to be software-based
$26B	annual software R&D spend by suppliers and vehicle manufacturers
$500-1,000	per car BoM reduction opportunity from standards/ commoditization/ re-use
$150B	annual car software market size with competition between OEMs & suppliers
$1B+	potential annual revenue for major OEMs through software-based services

Source: BCG analysis, Expert interviews, Bank of America, CapitalIQ

While euphoria has somewhat waned, compelling SAEV unit economics will spur longer-term adoption



Source: BCG analysis

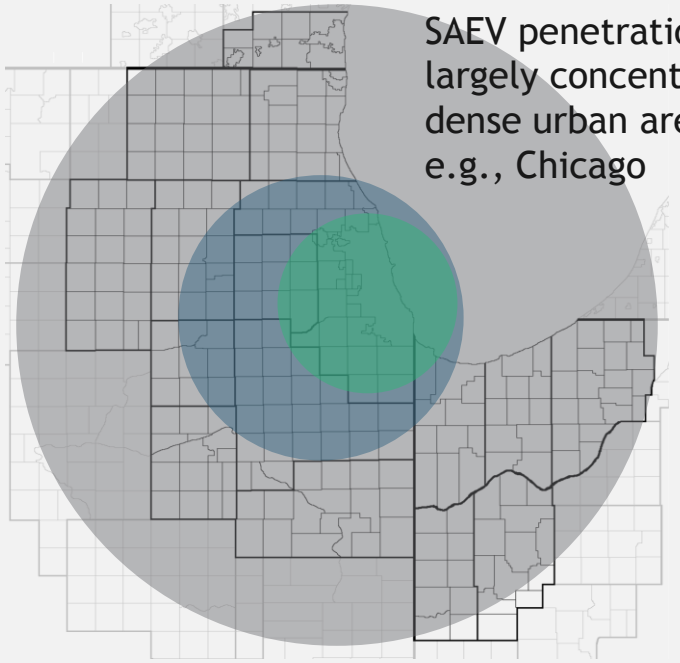
SAEVs to account for over 30% of passenger miles by 2035 in large metro areas

3 elements needed:

Demand density

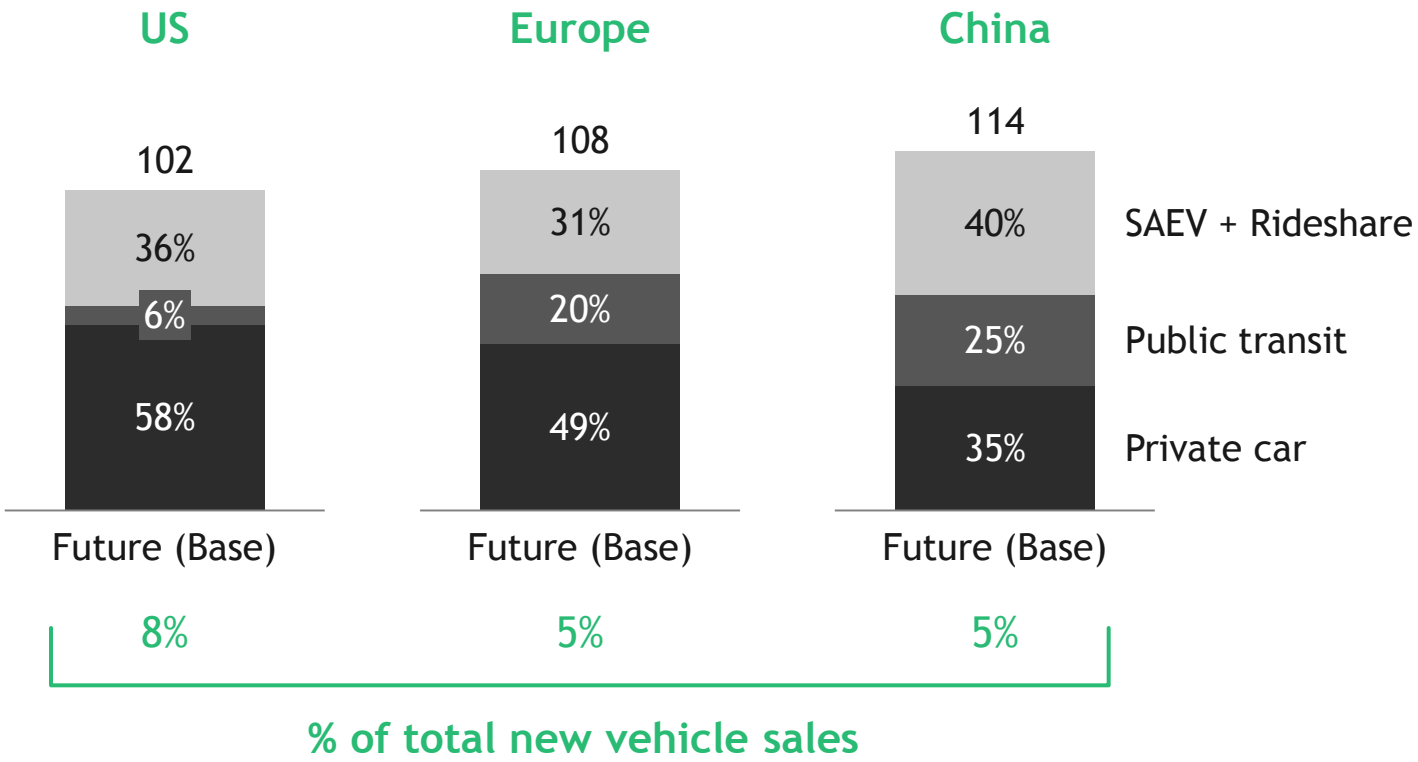
Low complexity environments (ODD)

Major mobility pain points



SAEV penetration to be largely concentrated in dense urban areas — e.g., Chicago

Passenger mile index' in largest metro areas



1. Indexed to current annual passenger miles in each region
Note: Passenger miles calculated on the basis of modal breakdowns, average trip distances, and number of trips (weighted by metro area population)
Source: BCG analysis

But radical industry disruption is never easy — we see five key industry-wide imperatives

Reinvent for Advantage	Strengthen Resiliency	Build the Infrastructure	Align Regulatory Frameworks	Fund the Journey
… business model, cost structure, talent, partnership ecosystem; i.e., challenge everything	E.g., Lost sales of 10-12M vehicles in 2021 due to semiconductor shortage	E.g., Over $1,000 in utility transmission and distribution upgrades required per EV sold in U.S.	E.g., EU's AV policies not harmonized, restricting cross-border travel	E.g., Automakers will require more than $400B in capital by 2025 to enable EV ambition

Source: BCG analysis

Lastly, a note of caution…

The threat of unintended consequences is massive.

Successfully navigating the change before us will require a level of public/private collaboration rarely before seen.

Chicago, 1911

The task before us is immense, but when we get this right, we will change the world

- → A safer, far cleaner world
- → Equitable mobility access & reliability
- → Engine for economic growth

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