BOSTON CONSULTING GROUP

Sustainable Mobility Webinar

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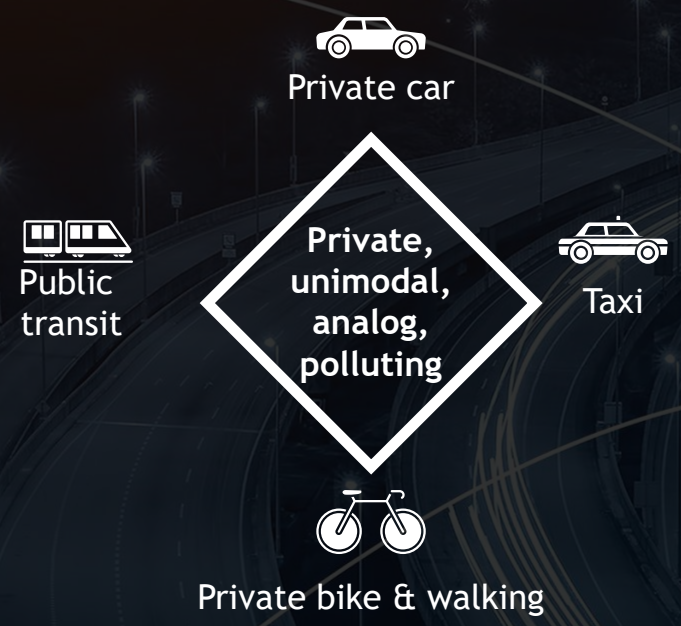
Mobility is rapidly evolving towards new models

4 Key trends are shaping the Mobility space

1. **Electrification** is disrupting the Automotive value chain, supported by growing charging infrastructure
2. **Vehicle connectivity** is enabling new business models based on data monetization
3. **Shared and on-demand mobility** are becoming more popular, impacting modal mix
4. **Autonomous driving** is progressively emerging, allowing a new utilization of urban space

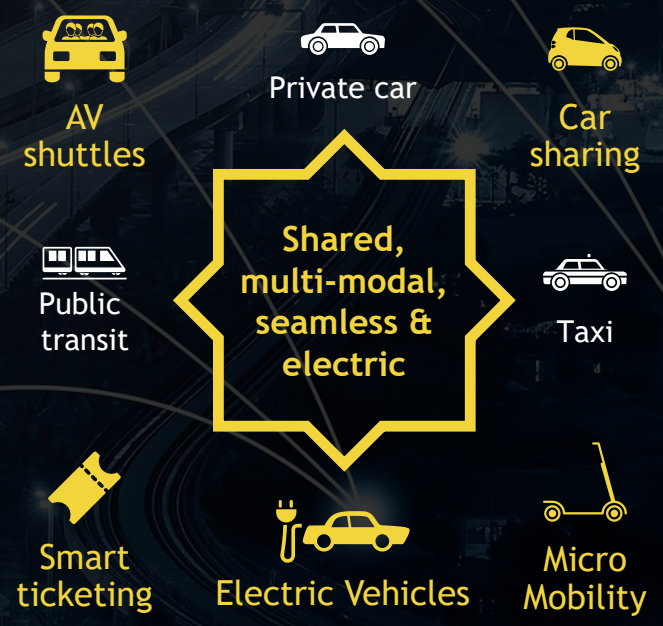
From old Mobility…

Private & unimodal to Shared, multi-modal, seamless & EV

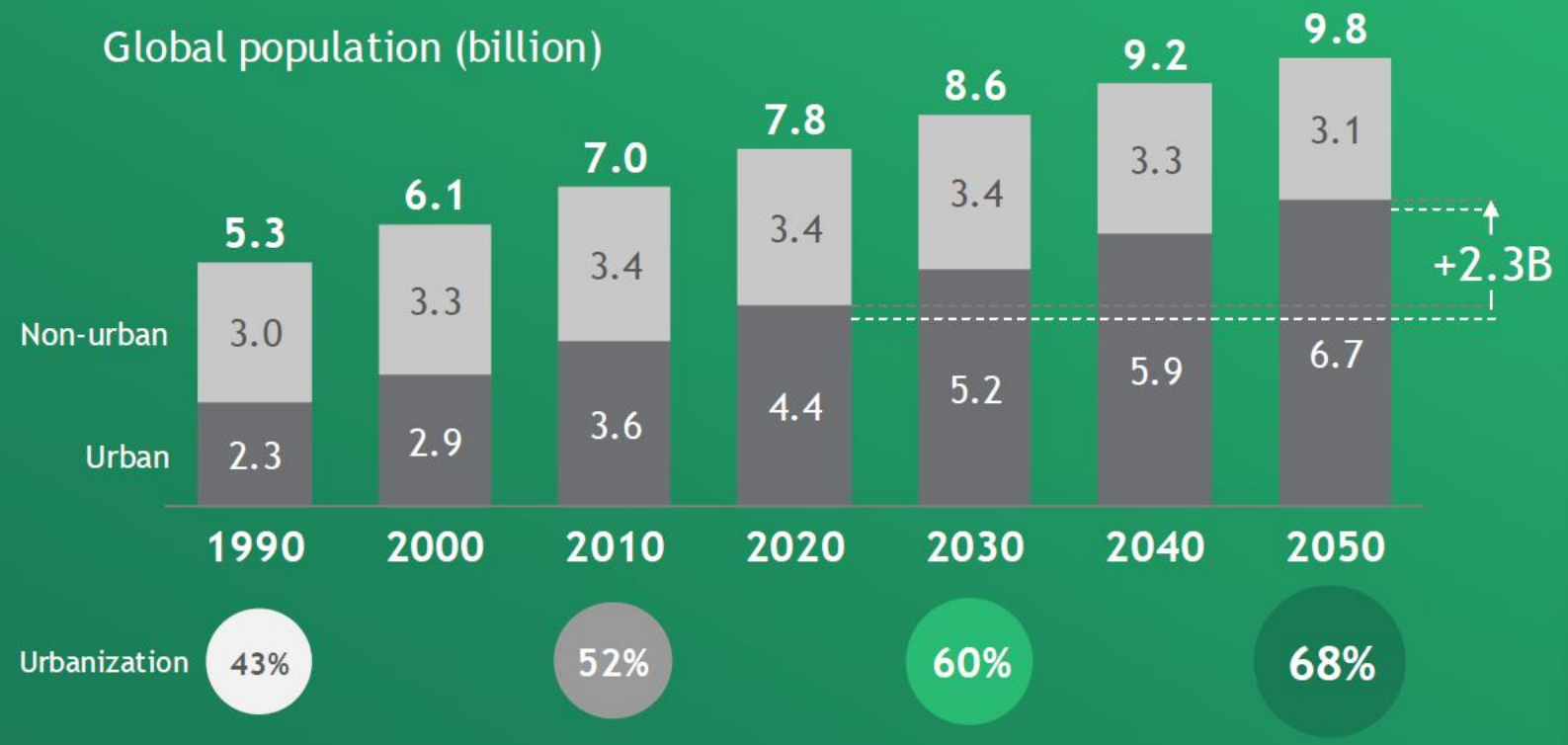


…To new Sustainable Mobility

New urban mobility reality

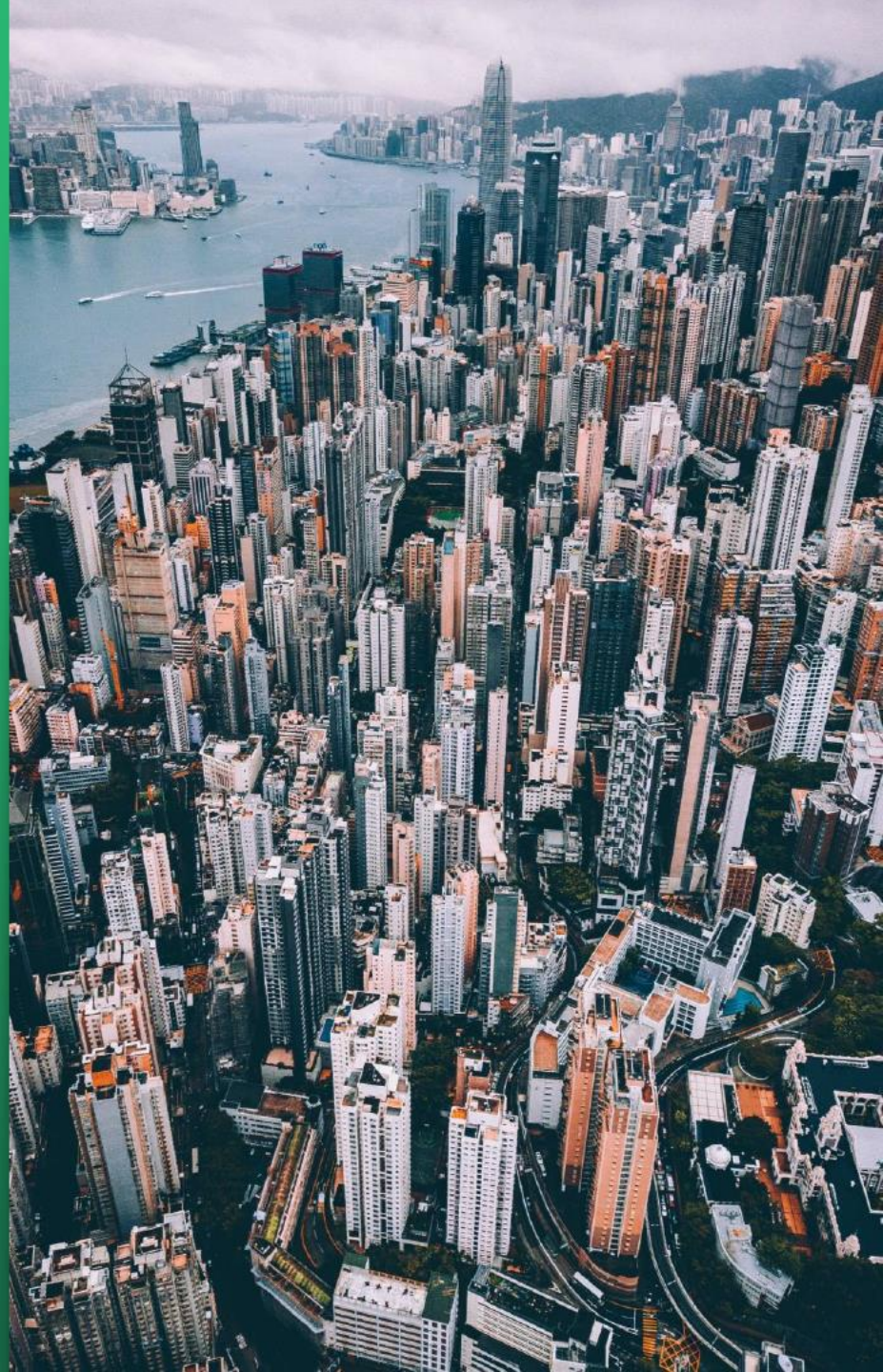


By 2050, ~70% of people will live in cities



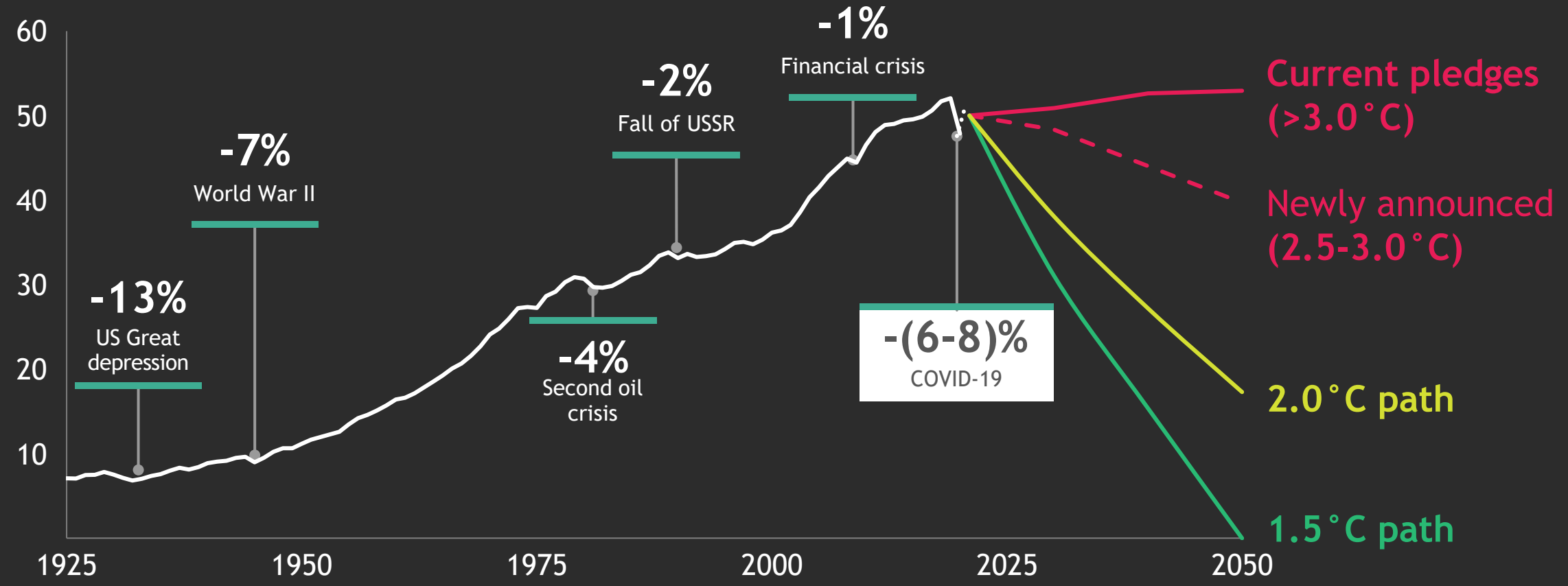
By 2050, also ~90% of GDP will come from cities

Source: The United Nations (2018); BCG



Radical shift needed to limit climate change

Global net CO_2e emissions and pathways (Gigatons per year)



Note: Current pledges assumes countries decarbonize further at same annual rate that was required to achieve NDCs between 2020 and 2030; 2.0°C path assumes 25% reduction by 2030 and net-zero by 2070; 1.5°C path assumes 45% reduction by 2030 and net-zero by 2050
Source: EDGAR 5.0, FAO, PRIMAP-hist v2.1, Global Carbon Project, IPCC, UNEP Emissions Gap Report, WRI, Nature (May 2020), BCG

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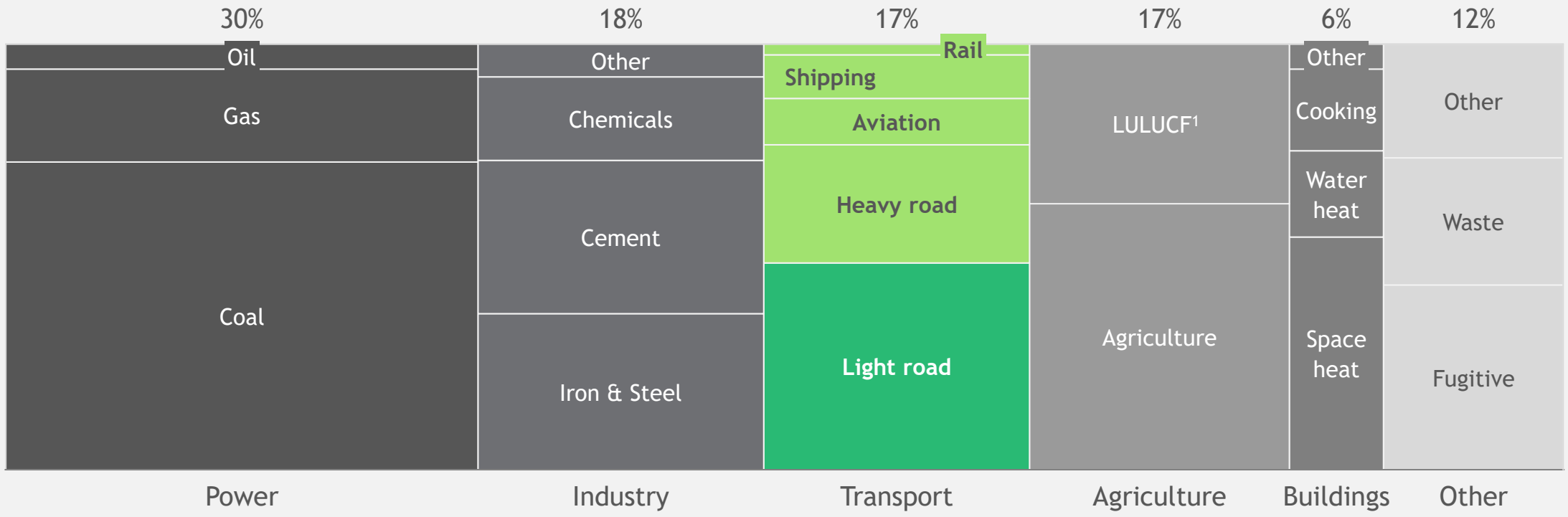
Transport accounting for ca. 17% of global GHG emissions

Global GHG emissions, % share



1. Land Use, Land-Use Change, and Forestry
Source: IPCC; UNEP Emissions Gap Report 2019; BCG analysis

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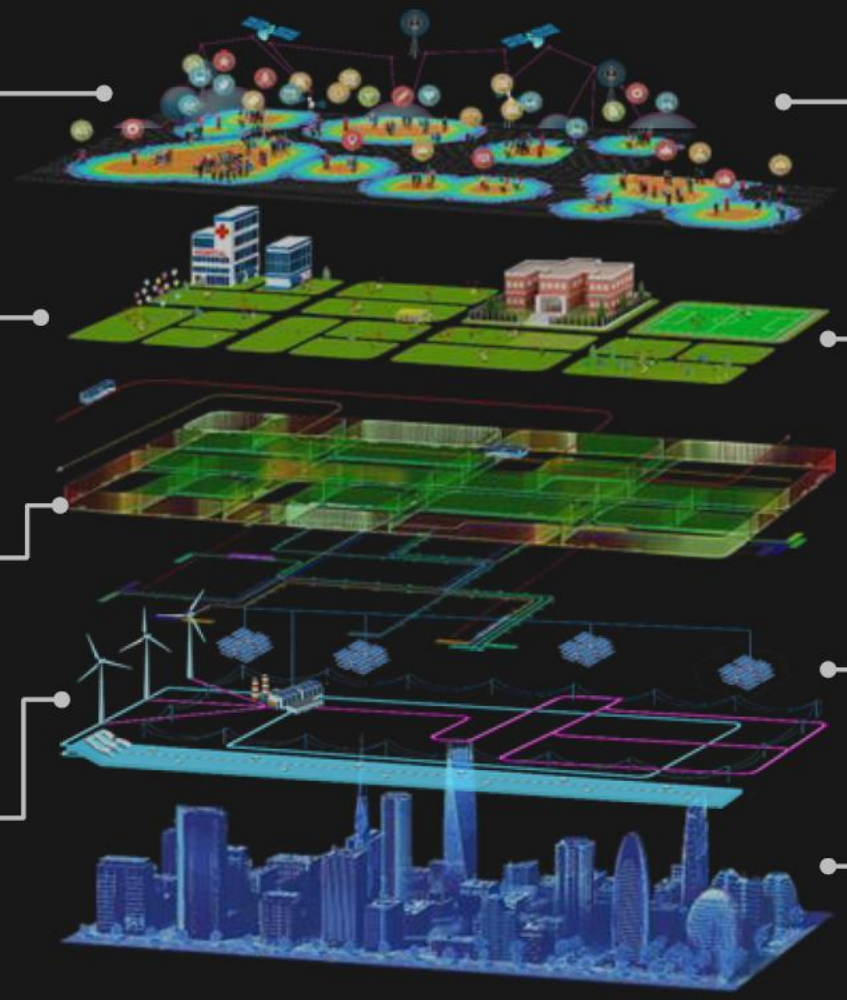
City of the future evolving along several "smart" layers



SMART COMMERCE
Tailor-made retail & commerce services

SMART HEALTHCARE
Connected health devices & services

SMART MOBILITY & TRANSPORT
Intelligent traffic steering, flexible transport modes

SMART ENVIRONMENT
Circularity of city waste and used materials

SMART SAFETY & SECURITY
E2E systems preemptively mitigate risks

SMART GOVERNMENT
Remote citizen services, education and tourism

SMART ENERGY
Connected smart grid to balance load real-time

SMART BUILDING
Interconnected buildings and infrastructure (IoT)

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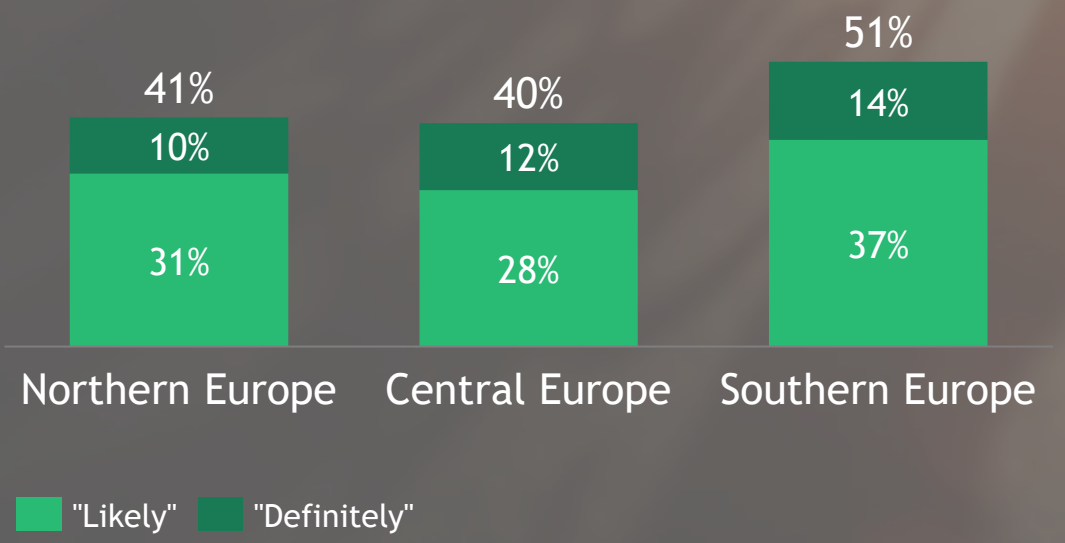
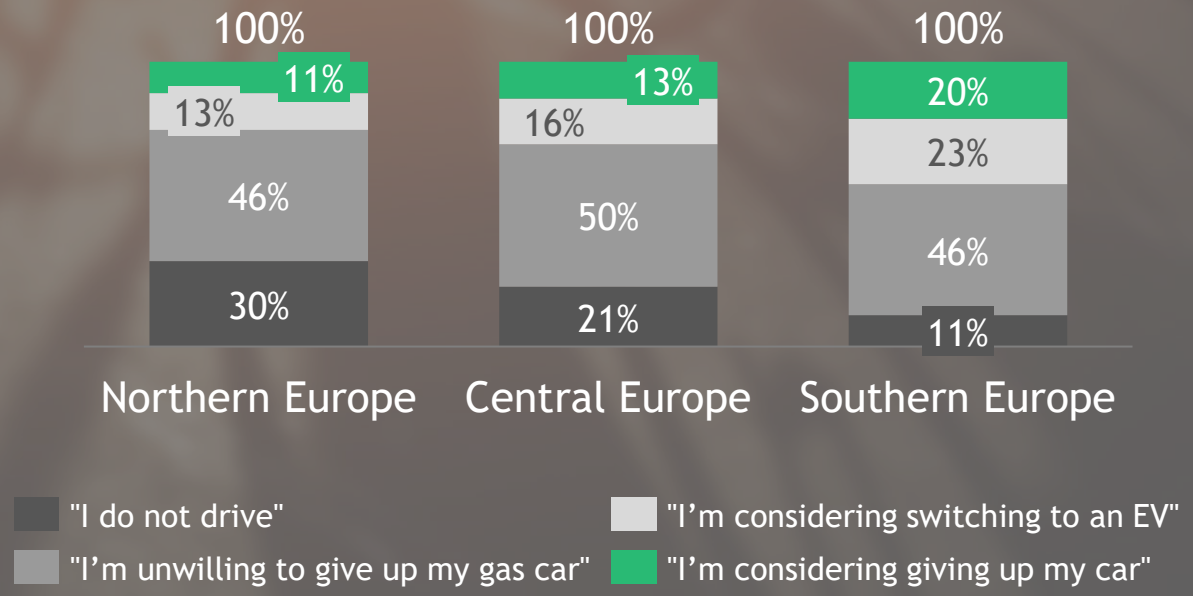
New mobility services are here to stay, and will become a core part of our urban travel behavior

Consumers who want to use mobility services more frequently



Consumers who are considering giving up private cars



Note: Figures are rounded, Northern Europe including DK, NO, SE and FI, Central Europe including DE, AT, CH, UK, NL and BE, Southern Europe including IT, ES and FR
Source: BCG consumer mobility survey, May 2021

Urban mobility as key enabler of the 15-minute city

Rethinking city layout
focusing on independent neighborhoods & decentralization of services

Enhancing urban mobility
with intelligent traffic steering, flexible transport modes & autonomous operations

Deep dive on potential scenarios

Increasing remote, digital services
across healthcare, commerce, government and education, etc.

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Let’s have a look at potential scenarios of urban mobility

1.7B daily trips modelled by mode and city type

Private Car (includes AVs)	Robo-pod (max. 2 PAX)	Robo-taxi (max. 5 PAX)	Robo-shuttle (max. 15 PAX)	Taxi / Ride hailing	Public transport	Micro-mobility (e.g., e-scooter)	Walking
↓	↗	↗	↗	↘	↘	↗	→

The high-compact middleweight	The car-centric giant	The prosperous innovation center	The developing urban powerhouse	The high-density megacity
				
e.g., Berlin, Seattle	*e.g., Los Angeles, Toronto*	*e.g., London, San Francisco*	*e.g., Bangkok, Buenos Aires*	*e.g., New York City, Shanghai*

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Shift from private cars to public mobility

Cities restrict the use of private cars in city centers and encourage green modes; AVs are still in their infancy

Public transit
Micro-mobility ↑

Private cars
AV modes ↓

Strong push for robo shuttles

Cities promote larger semi-flexible robo shuttles (up to 15 PAX), a hybrid between mass transit and more personal transport modes

↑ Robo Shuttles

↓ Robo Pods

4

future Scenarios developed

Dominance of micro-mobility

Cities promote the use of micro-mobility options such as e-scooters, bikes, and e-bikes and other green shared modes

Micro-mobility ↑

Private cars
AV modes ↓

Strong uptake of robo pods

Cities promote small flexible robo pods (up to 2 PAX) because they provide on-demand travel while also accounting for individual preferences

↑ Robo Pods

↓ Robo Shuttles

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Optimized urban mobility with break-through benefits

The high-compact middleweight

$1.6B

Saved annual household budget in Berlin

The car-centric giant

2.7M

Metric tons of CO_2 emissions avoided p.a. in Los Angeles[1]

The prosperous innovation center

-60%

Less annual traffic-related fatalities in London

The developing urban powerhouse

20

Hours saved in traffic per commuter p.a. in Hong Kong

The high-density megacity

900

Freed-up blocks in terms of public space in New York City

1. This excludes additional effects from electrifying public transit, taxis, and private cars; mt = metric tons

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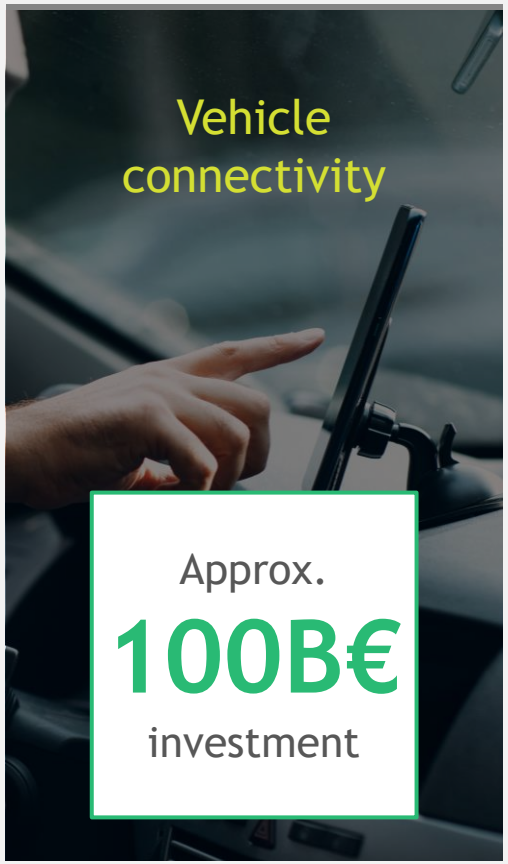
550B€+ inorganic investments in new mobility since 2010

Focus of following charts



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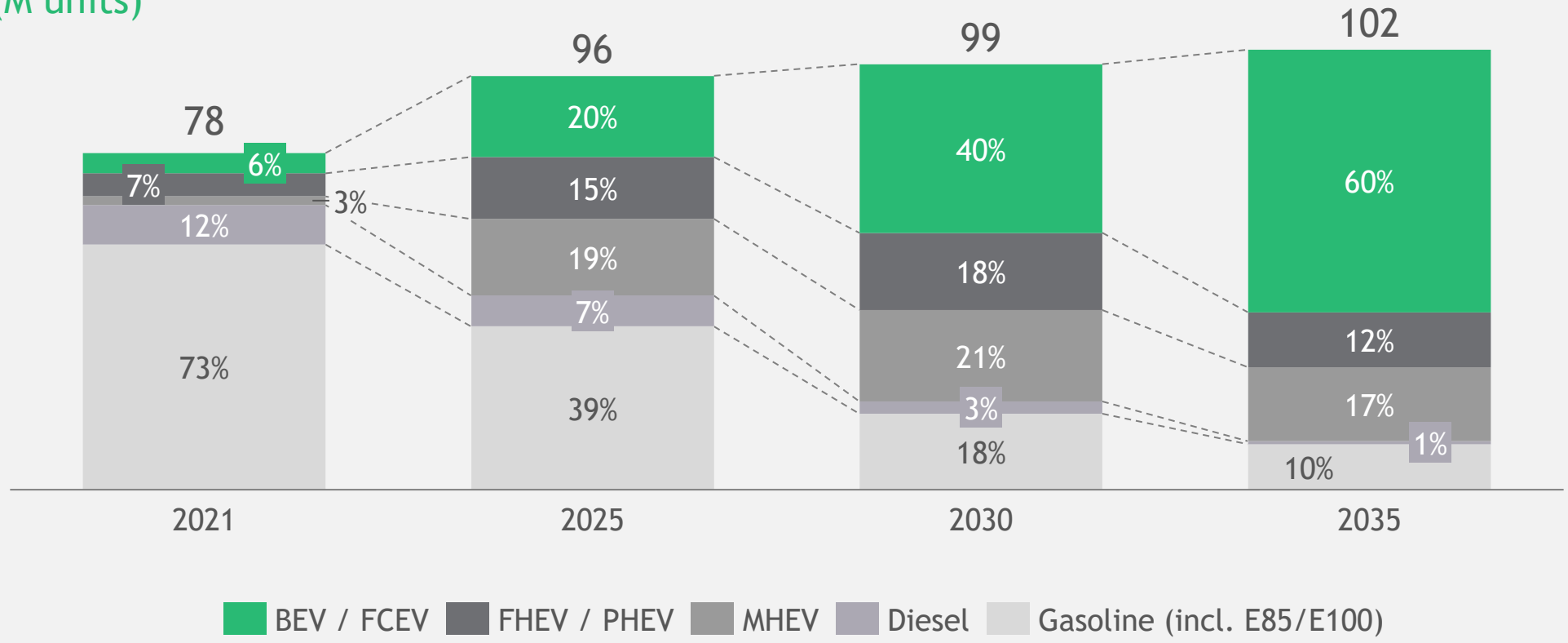
Electrification is disrupting the automotive market

Global LV powertrain production volume (M units)



ICE include PHEV, FHEV, MHEV, Diesel, Gasoline (incl. E85/100); Note: BEV stands for Battery Electric Vehicle, FCEV for Fuel-Cell Electric Vehicle, FHEV for Full Hybrid Electric Vehicle, PHEV for Plug-in Hybrid Electric Vehicle, MHEV for Mild Hybrid Electric Vehicle Source: BCG Powertrain Model

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Many factors supporting EV penetration…

Public policies & regulation

Automotive supply expansion

Decreasing xEV costs

Increasing attention to sustainability

… nevertheless, several external factors need to be true for EV penetration to meet forecast

Value chain	Supporting factors	Today	Our view on current industry concerns
External support	Regulation (with enforcement)	✓	ICE bans with concrete dates for most regions
	Incentives	✓	On track to support growth until price parity
Raw materials	Supply availability	!	Demand outstrips near-term supply, leading to price increases
Batteries	Cost/kWh innovations	✓	Clear path for chem. and pack assembly innovations (e.g., CTP)
	Battery performance (range, safety, temp.)	✓	Clear tech. improvement roadmap (e.g., move to solid state)
	Supply availability	!	On track, but many announced sites already fully booked backlogs
Go-to-market	Model availability	✓	OEM product roadmaps shifting to electrified vehicles
	Model desirability	✓	Model designs growing in diversity across vehicle segments
	Dealer / sales ecosystem	✓	Unequal Dealer participation across networks, but likely to unify
	Customer awareness/education/training	✓	Sufficient levels of consumer awareness on electrified options
Vehicle operation	Mobility shift	✓	Shared vehicles returning to pre-COVID levels; cont. rise of fleets
	Stable and Cost competitive electricity	!	Electricity provision in place, steady shift to green energy required
	Charging infrastructure availability	!	Varies by region; select cities esp. vulnerable to infra constraints
	Service network availability (incl. dealers)	✓	Steep learning curve, but on sufficient path

Legend ✓ On sufficient path ! Somewhat off track ! Off track

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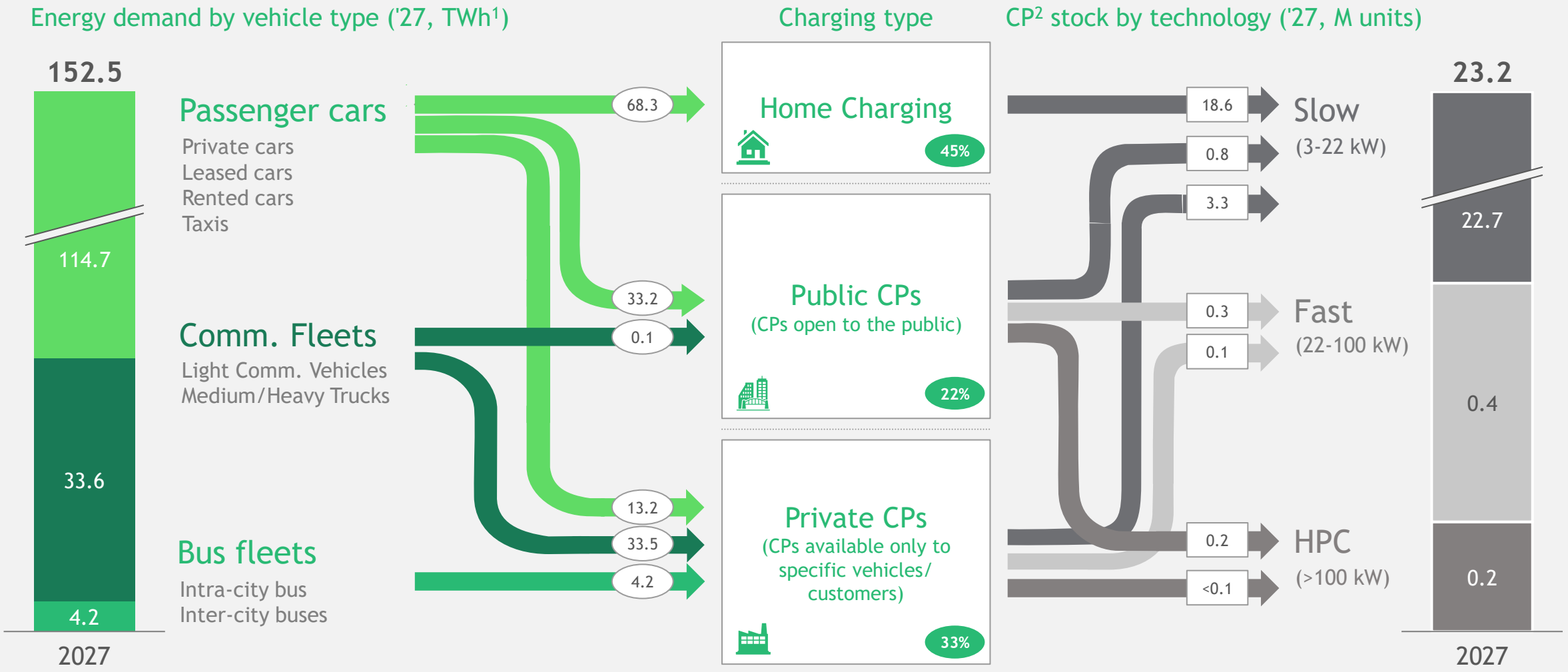
Charging infrastructure as key enabler for electrification

Americas + Europe



1. Terawatt-Hour 2. Charging point

xx Yearly energy demand (2027, TWh) xx Share of energy demand by type (2027, %) xx # Charging ports (2027, #)

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EV Charging revenue pools totaling 46B€ by 2027 in key geographies, driven by charging services to end-users

Revenue pools along the EV Charging value chain (2022-2027, M€)

Americas + Europe

Value chain	Provide/deploy charging infrastructure (B2C + B2B)		Manage infrastructure		Enable EV charging for end-users
	HW solutions	EPC[1] & Installation	SW solutions	O&M services	
	Charging hardware	Site civil works and HW installation	Back-end SaaS platform	Operations and maintenance services for infrastructure	Full energy cost to end-user net of VAT
Key Players *(Not exhaustive)*	TRITIUM, efacec, SIEMENS, ABB, Schneider Electric	E&P: ABB, SIEMENS, TESLA, chargepoint. Construction: Small local and highly specialized players	Shell Recharge Solutions, has·to·be eMobility, evconnect, evway	Small local and highly specialized players	chargepoint, plenitude + becharge, edp, TESLA, Shell Recharge Solutions, EVgo, electrify america, IBERDROLA
2022-2027 Revenue Pool[2]					Of which, ~40% from public infrastructure

2022 Revenue Pool 2027 Revenue Pool

1. Includes Engineering and other professional services (e.g., site scouting), Procurement of solutions & services and Civil works; 2. Size not to scale to improve readability of other streams

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Focus Italy | 4x CPs expected in the next 8y

Number of public Charging Points, Italy

2022 YTD	2027 Est	2030 Est
27k	87k	100k

Investments in public Charging Points, Italy

2022-27 cum.	2022-30 cum.
1.4B€	2.3B€

1. Investments including HW modules, EPC & Installation, SW solutions, O&M

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Key takeaways

- **Mobility is transforming**, from private & unimodal to sustainable, shared, multimodal & electric: 550B€+ inorganic inv. in new mobility since 2010
- **Electrification will play a key role in New Mobility**: BEV expected to account for 60% of new vehicles produced by 2035
- **Increasing regulation, TCO and attention to sustainability** will play a crucial role in the transition to electrification
- **Nevertheless, external factors need to be true for EV penetration to meet forecast**; charging infrastructure & materials supply to be monitored
- **Charging infrastructure as key pillar for mobility electrification**: in Italy we expect investment of approx. 2.3B€ between 2022-27

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