strategy&
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Digital Auto Report 2023

What consumers really want

VOLUME 1

Digital Auto Report 2023 – Volume 1

- ✓ Eleventh annual Digital Auto Report, developed by Strategy& and PwC
- ✓ Global consumer survey with a focus on the US, EU and China (n = 3,000)
- ✓ Quantitative market outlook up to 2035, based on regional structural analysis
- ✓ Interviews with industry executives at OEMs and suppliers, and with leading academics and industry analysts

This report: Volume 1

Understanding consumer preferences and implications

- Consumer view – changing mobility preferences
- Implications for auto players – interface, subscription and charging

Coming up next: Volume 2

Assessing global mobility market dynamics

- Market outlook – penetration of technologies and mobility types
- Technology – shifting gears in connected, electric, automated
- Regulation – slowdown or acceleration of key policies?

Addressing changing consumer preferences requires auto players to gear up their user interfaces and business models

Executive summary – Volume 1

1. Consumer preferences

- Our **consumer survey** (n = 3,000 in Germany, US, China) captures current **preferences in auto & mobility** and is contrasted with **expert opinions**
- In respect of **connected services**, consumers first want to **get the basics right** – the highest priority is **safety + navigation**, **phone mirroring is** gaining importance, **on-demand car functions** as well; experts rate the importance of **infotainment and lifestyle** higher than consumers do; **willingness to pay** for full set of connected services **stands at ~€20 / months in GER and the US, and at ~€40 in China** – experts give more conservative estimates
- **Germans still hesitant about BEV** cars – **only 35%** would consider getting one; more openness in the **US ~50%**; **China very open to BEVs** with **>90%**
- **Low trust towards L4 automated vehicles** in **GER and US** with **60-70% feeling uncomfortable** vs. **15% in China;** but on the other hand, Germans who want to use L4 have a **higher willingness to pay to use robo-taxis than to use** driver-driven taxis; in the **US and China willingness to pay is lower**
- **Purchasing a new/used car preferred**; **subscription** models **gain traction; online car purchase scores highest in China** (36% vs.10% in Germany)
- Consumers intend to **use public transport more often than last year**, but show **similar intentions for own car; less interest** in **sharing / hailing**

2. Automotive implications

- **Auto players** face **strategic challenges** with regard to **connected, electric, automated & smart mobility**. Volume 1 focuses on **three key aspects**:

A **Getting the user interface right**

As **software-defined vehicles** open the door to many new markets, **OEMs** need to be clear in **which consumer life areas** they want to play, **which experience differentiators** to focus on (luxury vs. convenience), and how to build a **corresponding service portfolio**. **Investment** decisions should be based on **value creation beyond direct user revenues,** with a balanced view on **build vs. buddy vs. buy** for tech components

B **Rethinking vehicle sales**

OEMs benefit from a **rising demand for car subscriptions -** expected to grow from **0.3m to 2-4m units by 2035 in Europe**. To reach **profitability. OEMs need to balance consumer needs** (model flexibility, transparent pricing) with smart **asset lifecycle management** for maximum **residual value**

C **Going beyond the vehicle**

New business models emerge around **batteries and bi-directional charging**. With **~5m bi-di cars in Germany** by 2035, market **potential is €160-220m for vehicle-to-home / microgrid and €470-550m for vehicle-to-grid solutions –** assuming **successful orchestration** of **ecosystem players**

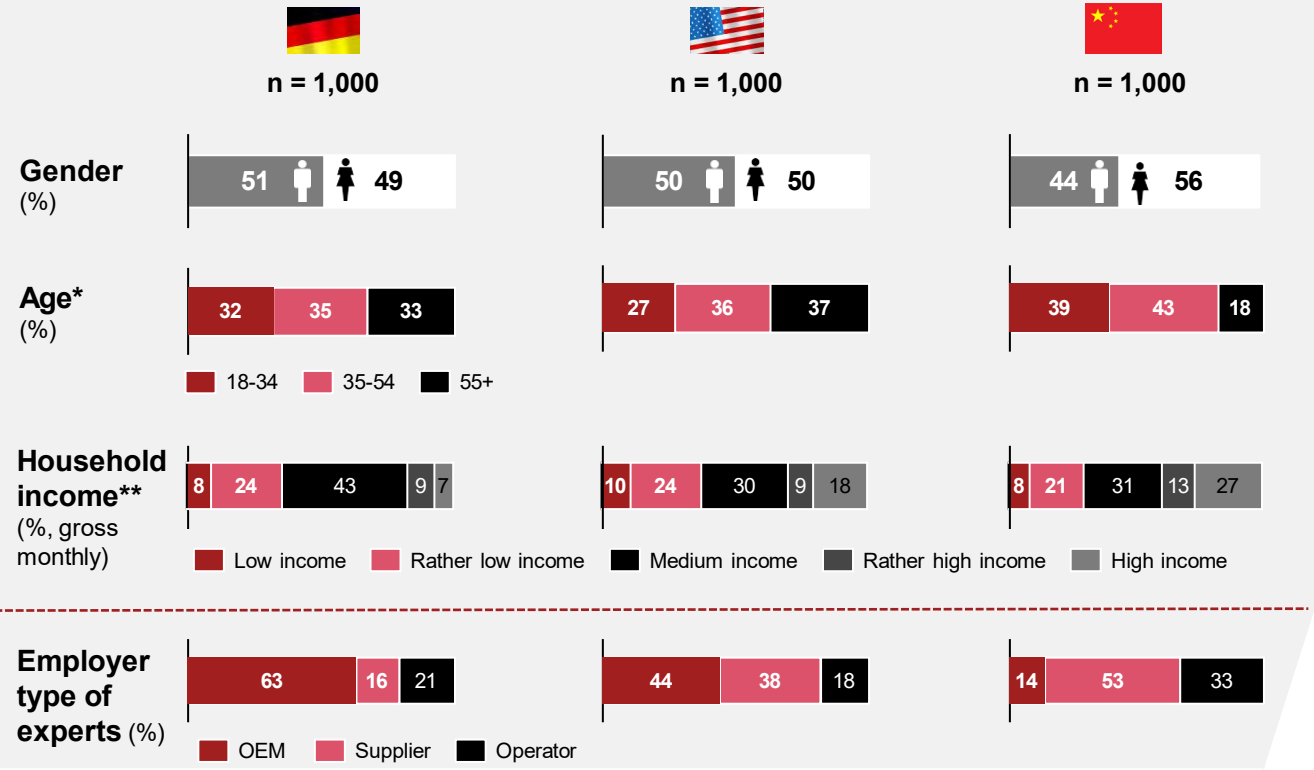
Note: Please refer to respective section for detailed assumptions and sources behind stated propositions

Contents

Latest consumer attitudes within CASE are reflected in a survey of 3,000 respondents in Germany, US and China

Overview of consumer survey

3 regions | **15 questions** | **3,000 respondents** | **50 experts**



Key results

- **Safety + navigation remain the most important** connected services features – on-demand functions gaining popularity
- **Willingness to pay at ~20€ per month in Germany and the US, while at ~40€ in China** – experts more cautious

- **Germans still sceptical about BEV** cars – only 35% would consider getting one, but more openness in the US ~50%
- **In China, overwhelming preference for BEV** with >90% considering such option – vs. only 80% considering ICE

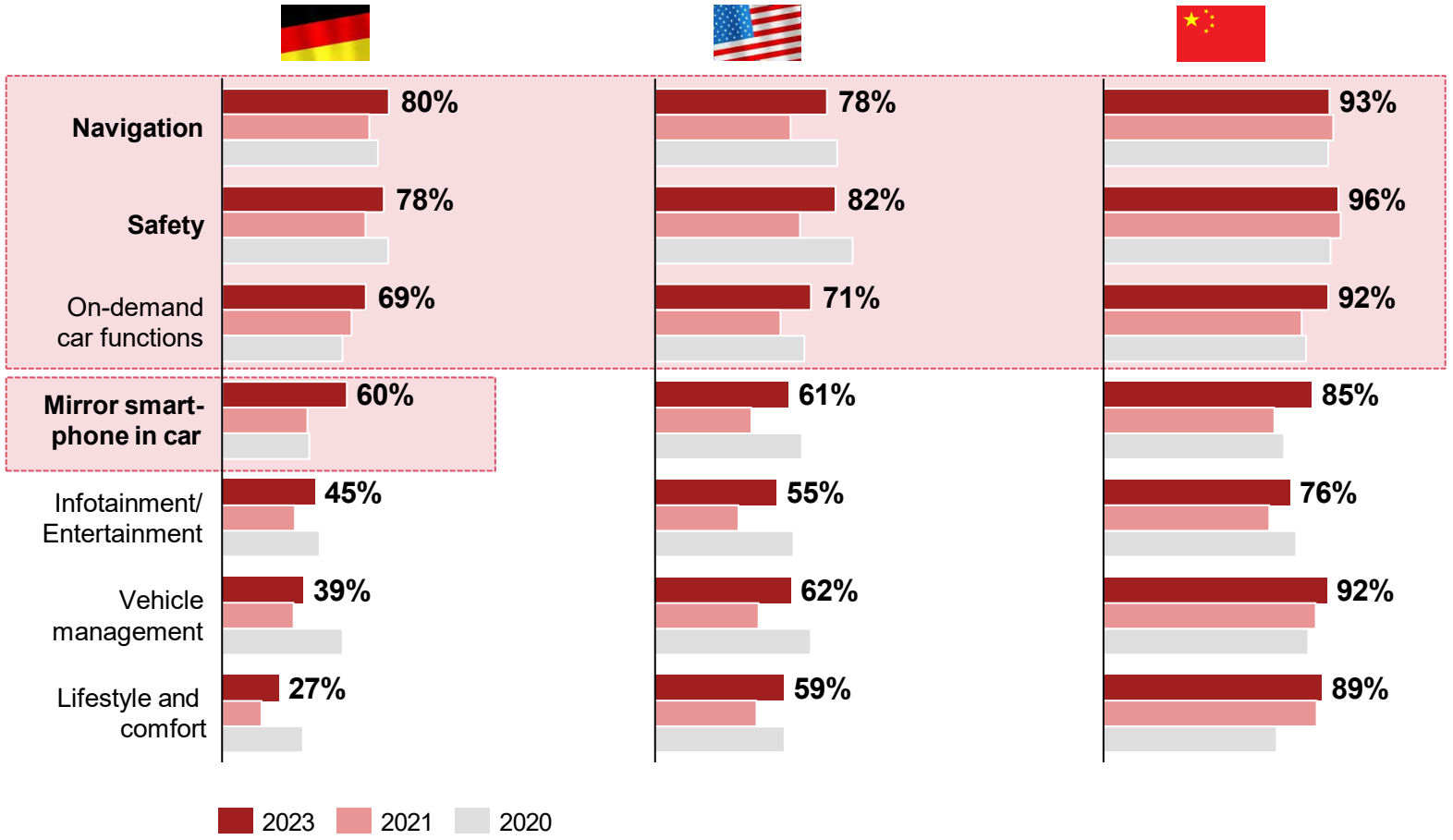
- **German / US respondents sceptical about L4 automated cars** – 60-70% uncomfortable vs. 15% in China
- **Willingness to pay** for robo-taxis vs. driver-driven taxis is **lower in the US and China than in Germany**

- **Purchasing a new or used car still preferred option**, but car **subscription** models are **gaining traction**
- Consumers want to reduce **CO_2** mainly through **more walking/cycling, switching to electric car, and using more public transport**

*Age brackets harmonized; **Low income (<1,6T EUR, <2T USD, <12T YUAN), Rather low income (1,6-3,3T EUR, 2-4T USD, 12-25T YUAN), Medium income (3,3-6,6T EUR, 4-8T USD, 25-51T YUAN), Rather high income (6,6-8,3T EUR, 8-10T USD, 52-64T YUAN), High income (>8,3T EUR, >10T USD, >64T YUAN)

Safety and navigation remain as most important connected services features – on-demand car functions on the rise

Connected services – Share of participants rating feature as important



Question: *"Which connected service categories are particularly important to you?"*

Safety and **navigation** still **most important** feature for respondents across all regions.

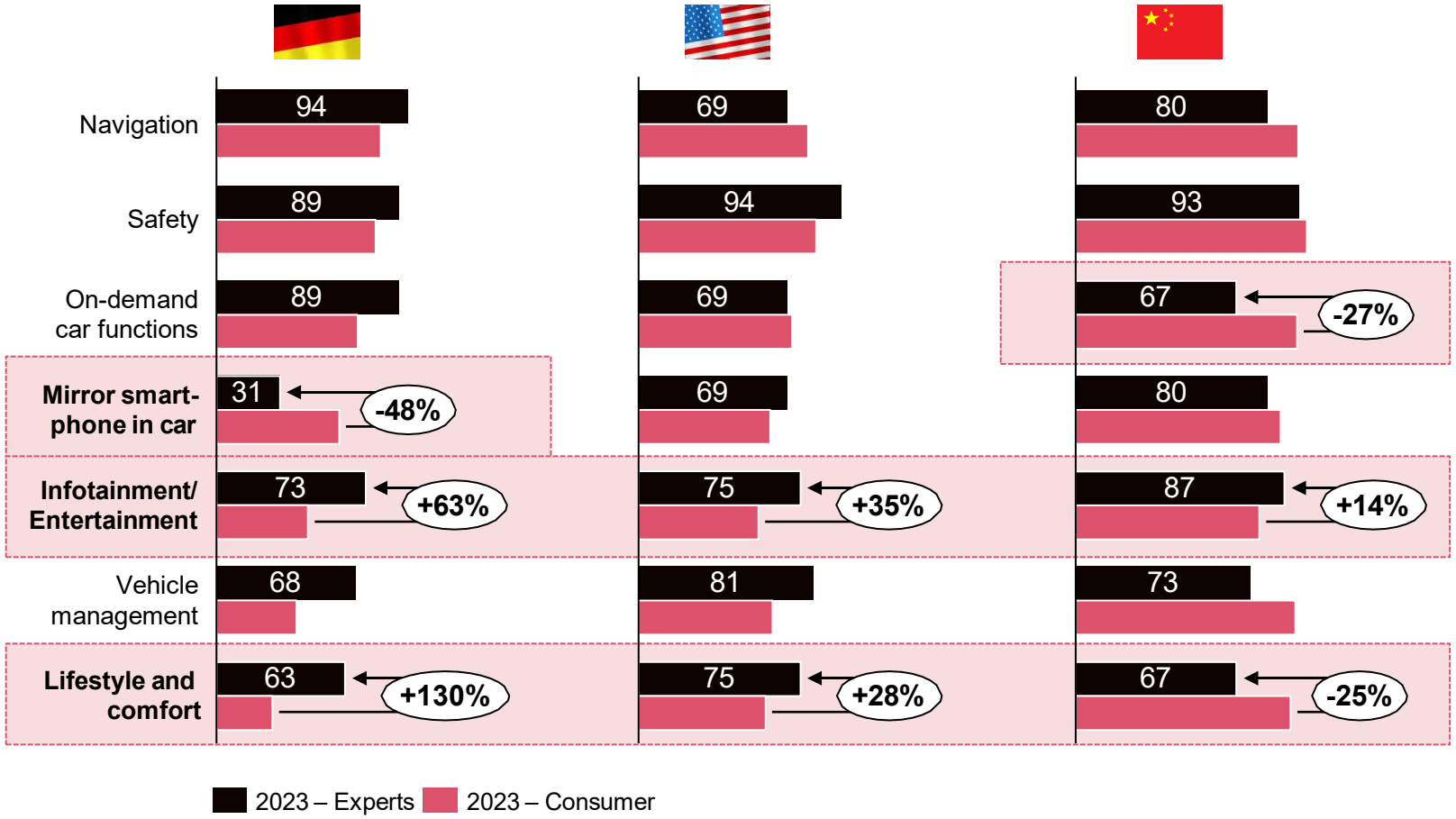
Significant increase in the number of participants in Germany who rate **smartphone mirroring as important**"

Infotainment/entertainment more important for younger consumers

Source: PwC Strategy& consumer research

Experts rate infotainment higher than consumers do –in China, they underestimate relevance of on-demand functions

Connected services – Share of experts rating feature as important



Question: *"Which connected service categories are particularly important to you?"*

Safety, navigation and entertainment are considered the **most important** by experts.

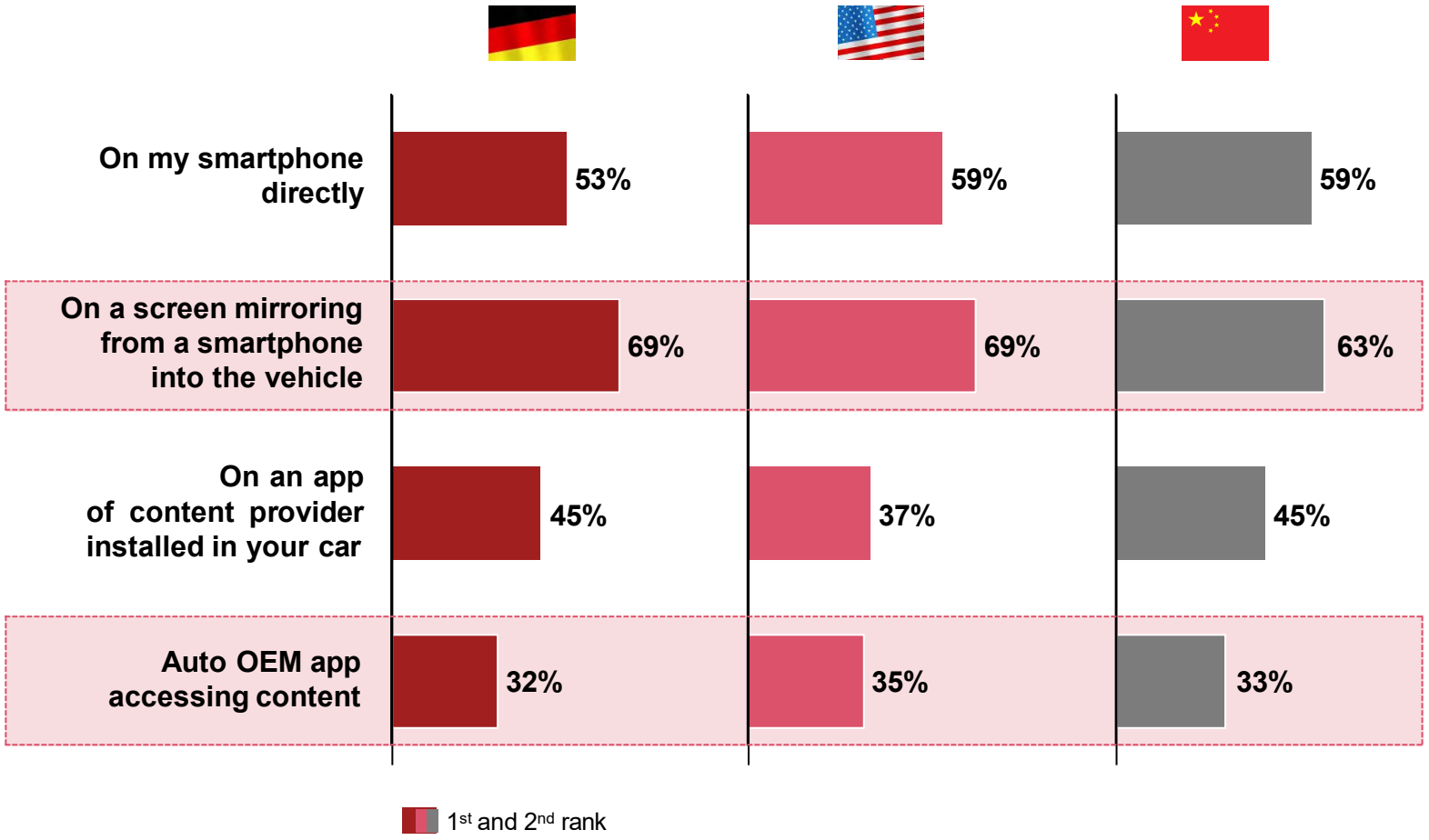
Experts in **Germany** are rather **less enthusiastic** when assessing the importance of **mirroring smart-phones**

Experts in **China** are comparatively less upbeat when assessing the importance of **on-demand functions** and **lifestyle & comfort services."**

Source: PwC Strategy& expert survey

Smartphone mirroring to the car has highest rating; Auto OEM apps for service access are less popular

Connected services and media/entertainment in the car



Question: *"How would you prefer to enjoy connected services and media/ entertainment in your car?"*

Highest **preference** across all countries is for smartphone **mirroring.**

Media/entertainment via an **auto OEM application** is **less popular**."

Source: PwC Strategy& consumer research; Difference to 100%: no/low likelihood

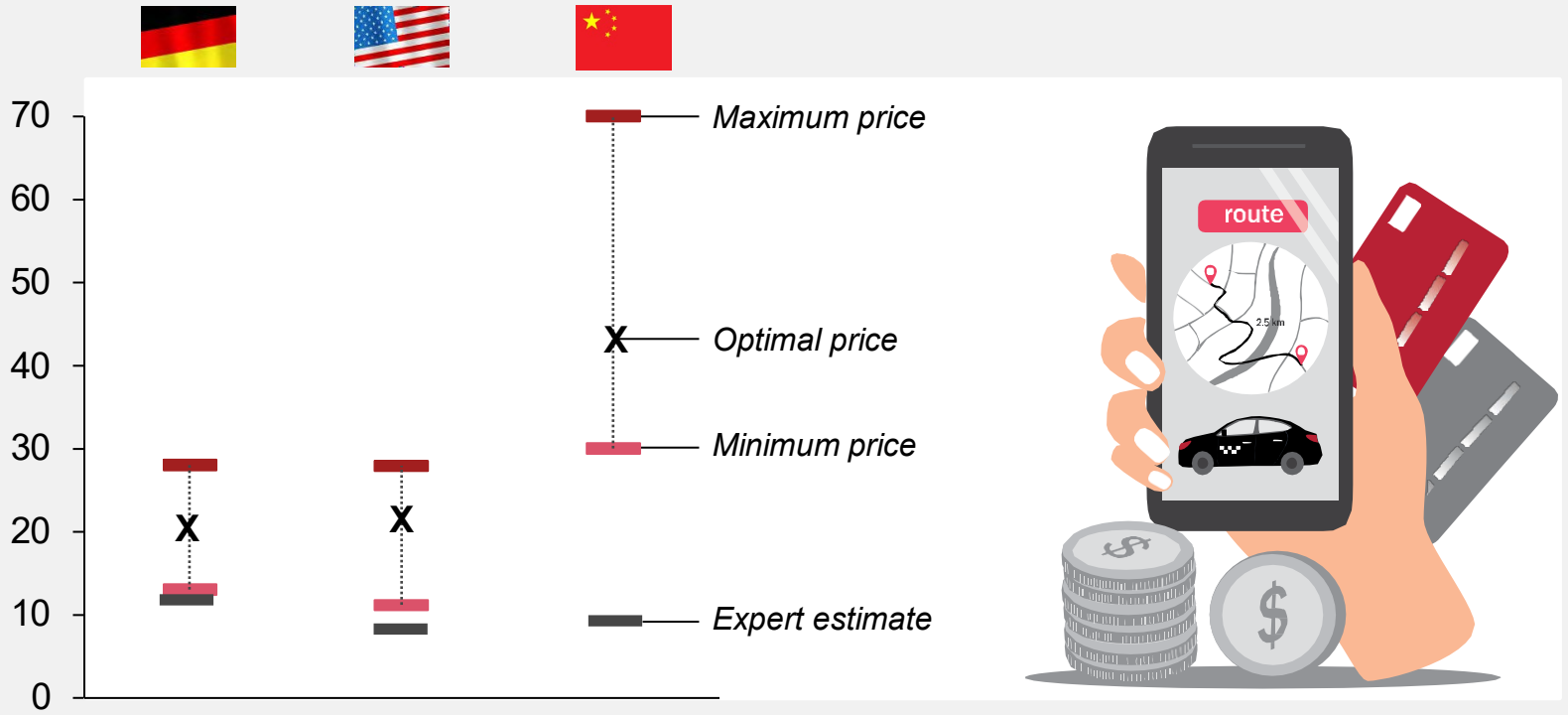
Willingness to pay for connected services around 20€/month in Germany and the US but twice as much in China (40€)

Connected services – Median willingness to pay[1)]

Willingness to pay[1)]
(monthly in €)

…for a **full set of connected services** in the vehicle that "**perfectly fit your needs**"

By nationality



Question: *"At what price would you consider a full set of relevant connected services*
- *Too cheap?"*
- *A good value for money?"*
- *Starting to get expensive?"*
- *Too expensive?"*

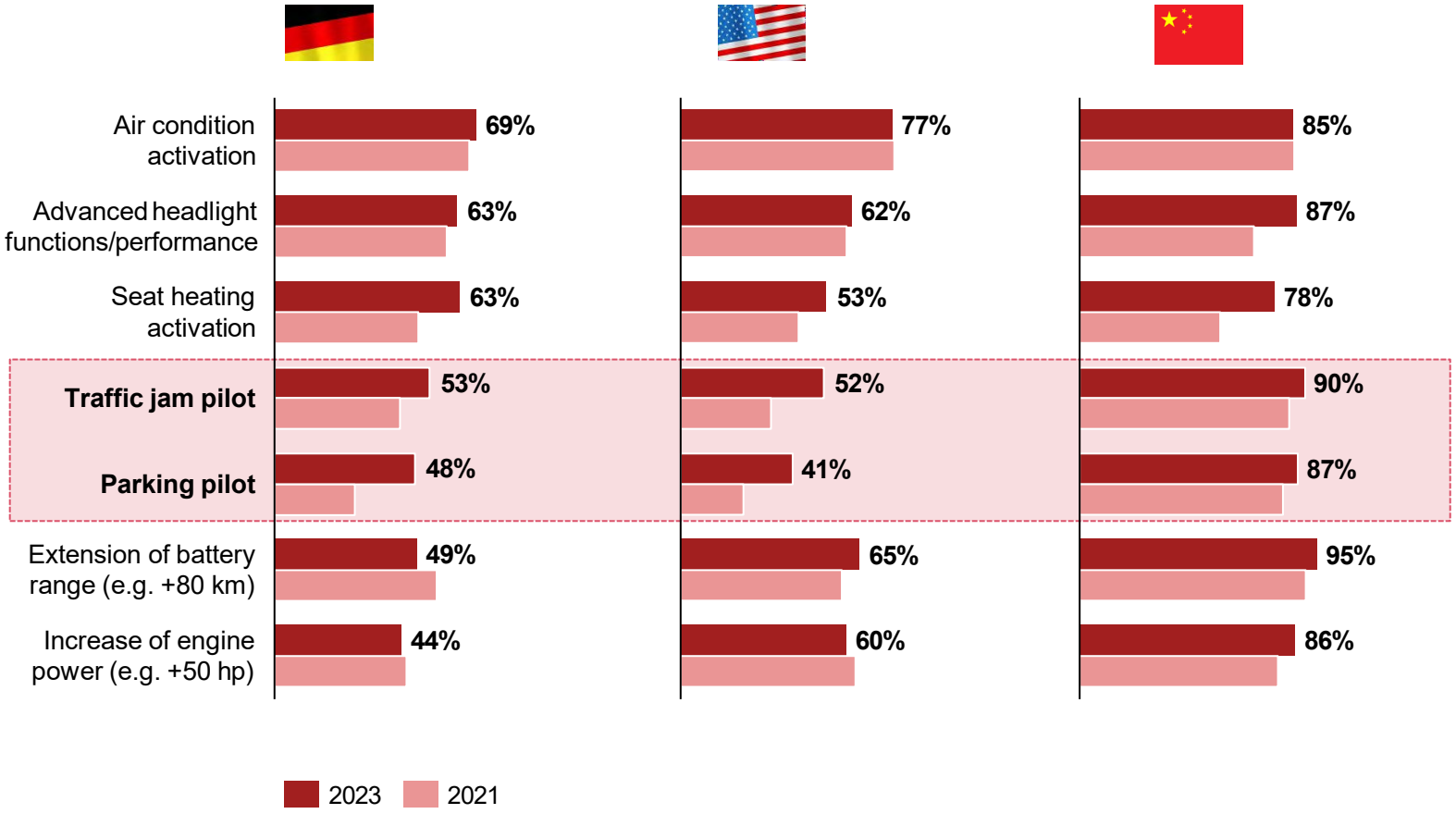
High spread of willingness to pay in China indicates **strong polarisation of luxury vs. budget customers** ➔ differentiated service packaging needed

Higher optimal price in China indicates that **consumers envision more benefits** from the "perfect connected service bundle" than in the US/GER – **expert view** more **conservative on prices**."

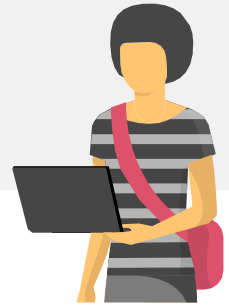
Notes: 1) Calculation of price points based on van-Westendorp-methodology
Source: PwC Strategy& consumer research; Exchange rates: USD/EUR 0.93, YUAN/EUR 0.14 (15.02.2023); PwC Strategy& expert survey research 2023; n=50

Among on-demand functions, automated driving features such as traffic jam pilot / parking pilot are attracting more interest

On-demand car functions – Share of participants rating function as important



Question: *"How important would be on-demand car function [...] to you?"*



Automated driving functions – traffic jam pilot or parking pilot – attract considerably more interest vs. previous year.

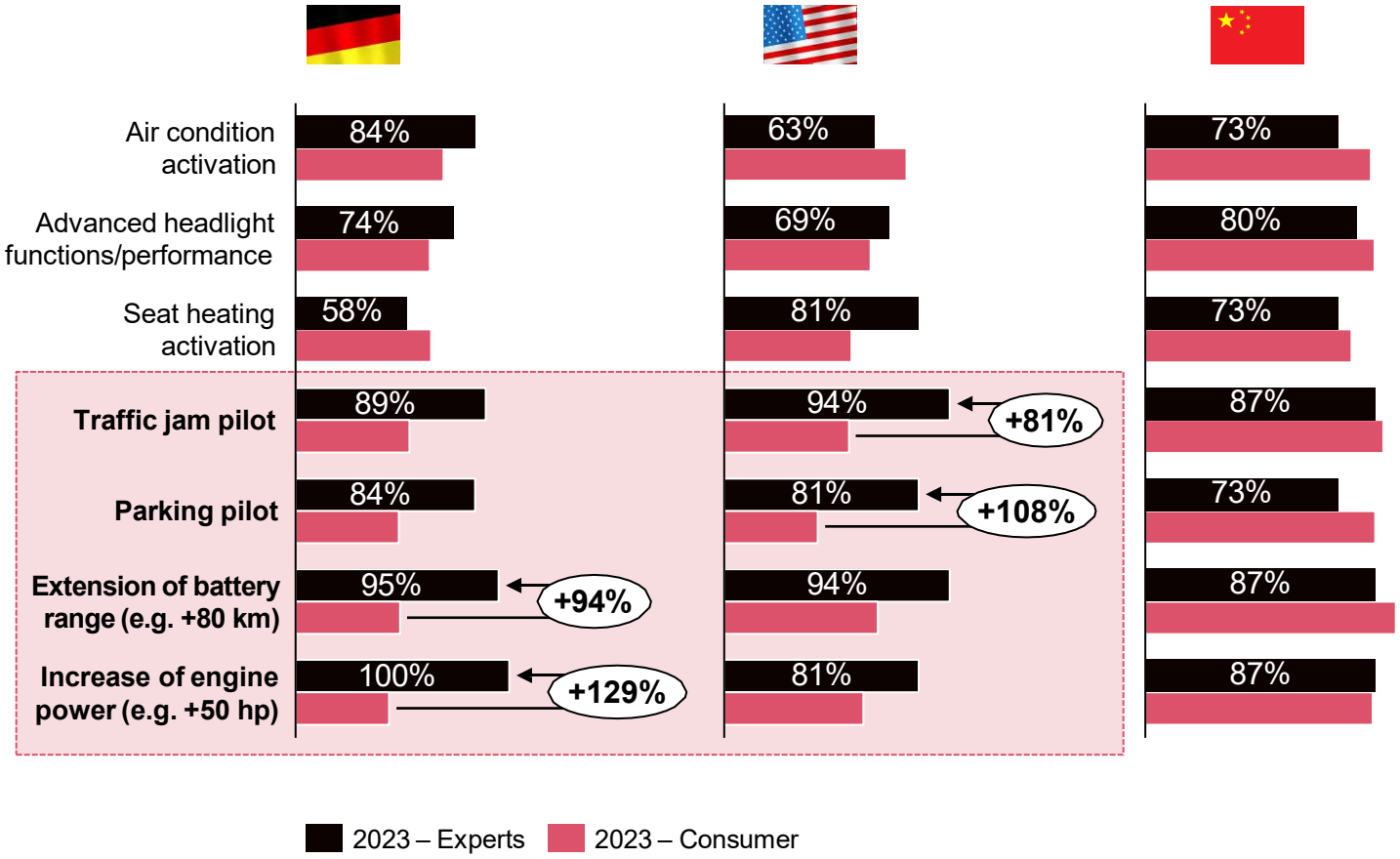
Air condition activation is still viewed as the most important on-demand car function."

Traffic jam pilot more important for older consumers

Source: PwC Strategy& consumer research

Experts in Germany / US attach even more importance than consumers to automated driving function attractiveness

On-demand car functions – Share of experts rating function as important



Question: *"How important would be on-demand car function [...] to you?"*

Extension of battery range and traffic jam pilot are considered the **most important** functions among experts

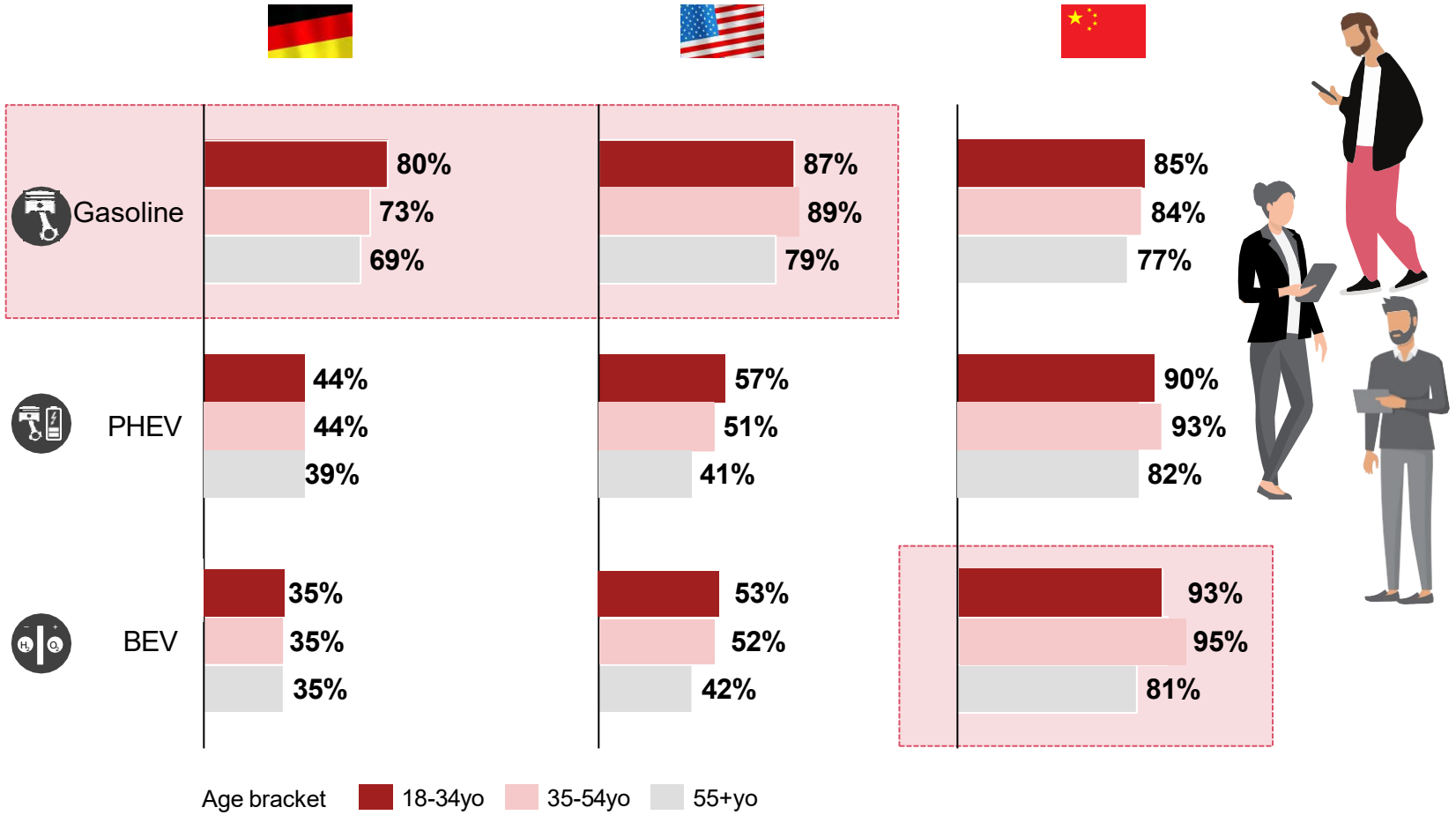
When compared with consumers, experts are particularly bullish about on-demand **engine power."**

Experts in US & China are more conservative in assessing the importance of air conditioning activation

Source: PwC Strategy& expert survey

Looking at powertrain preferences, German and US consumers stick with gasoline, while Chinese prefer BEV

Share of participants rating engine types as likely for next purchase (%)



Question: *"Assuming you wanted to buy/lease/subscribe to a passenger car, how likely are you to consider the following types of engines?"*

Gasoline is most popular engine type in **USA and Germany**, followed by PHEV engines, which are slightly more popular than BEVs.

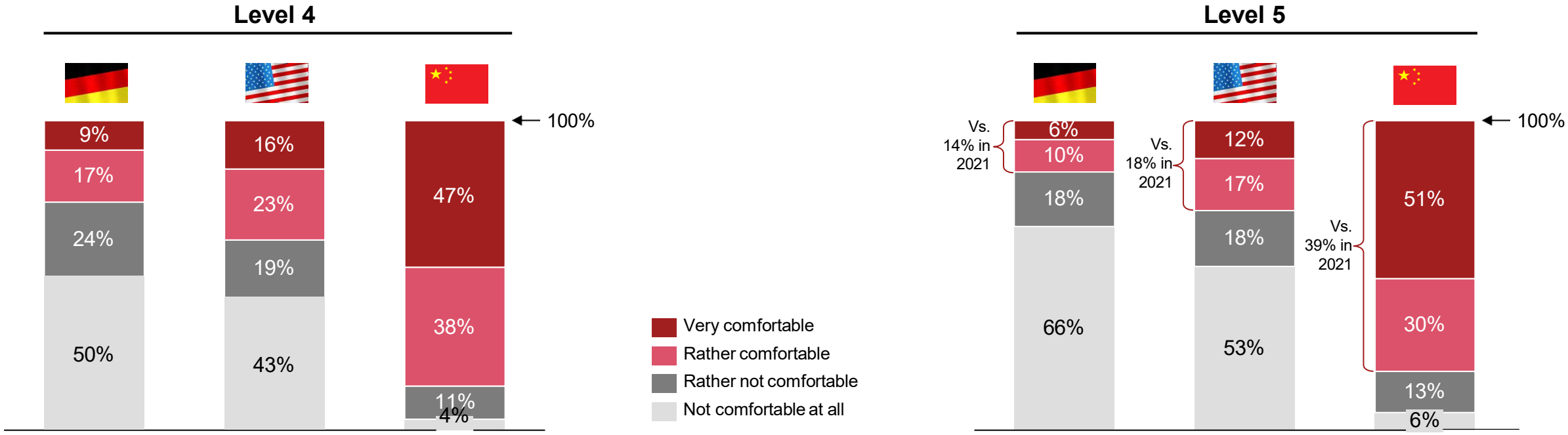
Chinese consumers exhibit opposite preferences with **BEVs being most popular,** ahead of hybrid and ICE engines."

Gasoline engine surprisingly more attractive for younger consumers

Source: PwC Strategy& consumer research

Consumer acceptance of automated driving remains low in Germany and the US – more openness in China

Automated driving – Consumer attitudes



Question: *"How comfortable would you feel using an autonomous vehicle (Level 4[1])"*

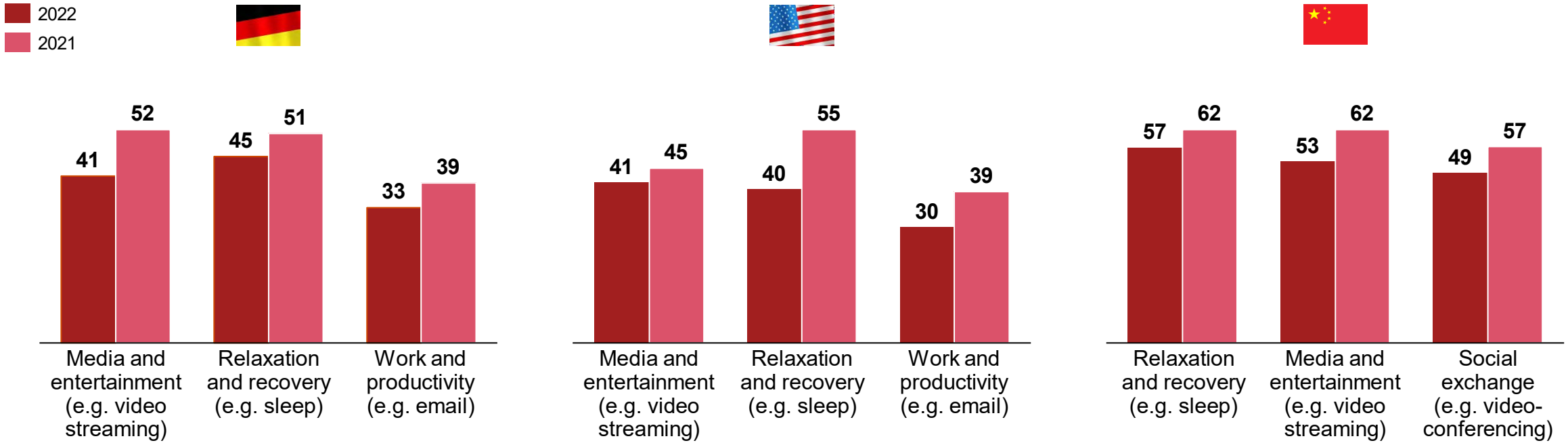
In general, willingness to use automated cars has recovered in comparison with relatively low 2020 figures, which resulted from negative headlines at the time e.g. following accidents and cybersecurity threats. Scepticism towards "fully automated" vehicles (Level 5) still stronger than for Level 4.

Question: *"How comfortable would you feel using a fully autonomous vehicle (Level 5[2])"*

1) There is still a steering wheel and pedals, but no human action or supervision is required, except in more complex cases such as inclement weather or an unusual environment
2) Can operate fully automatically on any road and under any conditions that a human could negotiate. There is no steering wheel or pedals. All you have to do is specify a destination to the vehicle
Source: PwC Strategy& consumer research

On an robo-ride, people want to be entertained or relax – in GER / US they also want to work, but in China prefer to socialize

Automated driving – Top 3 preferences for usage of time gained



Question: *"For which activities would you use the time gained while driving in a fully autonomous vehicle?"*

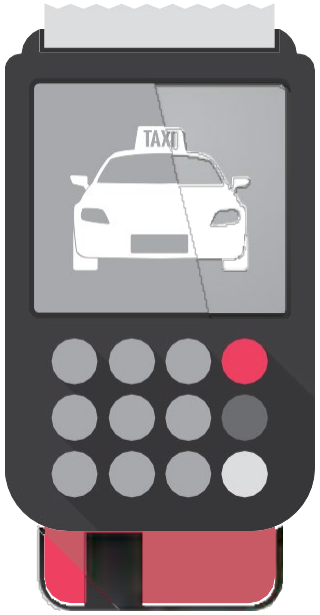
"The intention to use time gained from not driving went down compared to 2021 – the reduction was significant in Germany and the US. Media & Entertainment as well as relaxation are still the main intended activities."

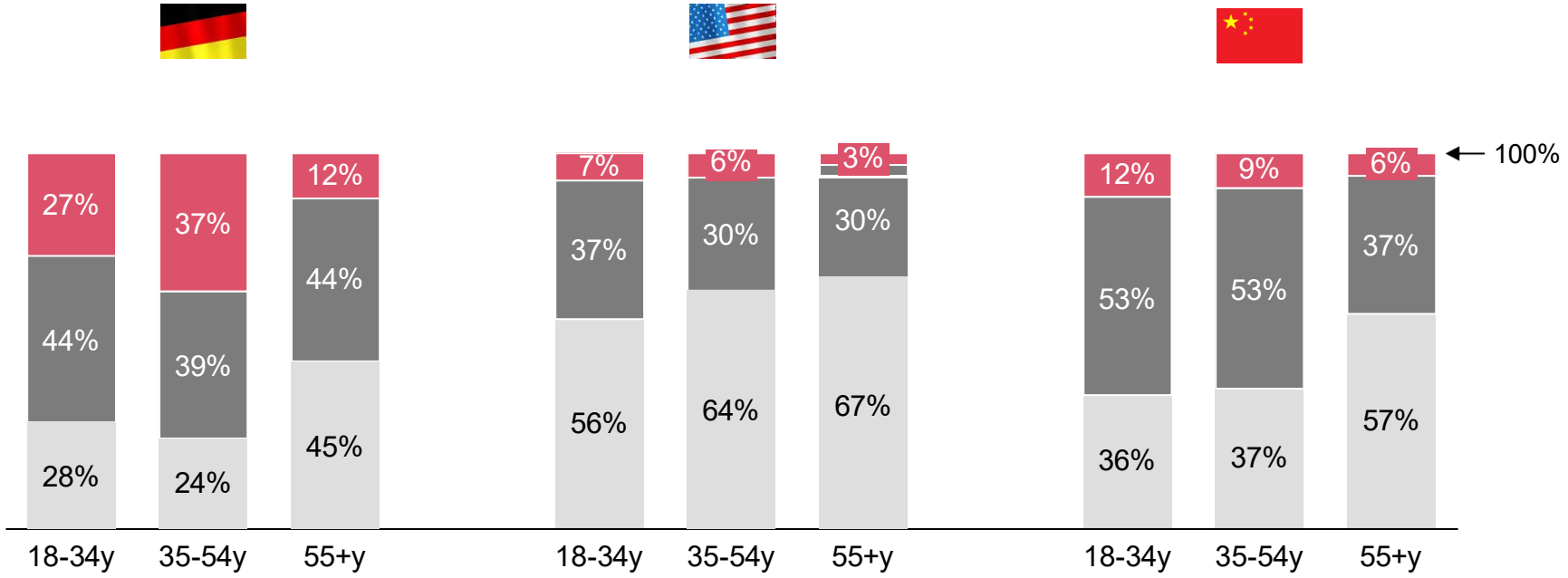
Source: PwC Strategy& consumer research

~60% of US citizens want to pay less for a robo-taxi vs. a driver-driven taxi; only ~5% want to pay more vs. ~30% in Germany

Automated driving – Willingness to pay

Question: *"When considering an average taxi ride and its price, what would be your willingness to pay for an autonomous ride compared to this taxi ride?"*





I'm willing to pay more
I'm willing to pay the same
I'm willing to pay less

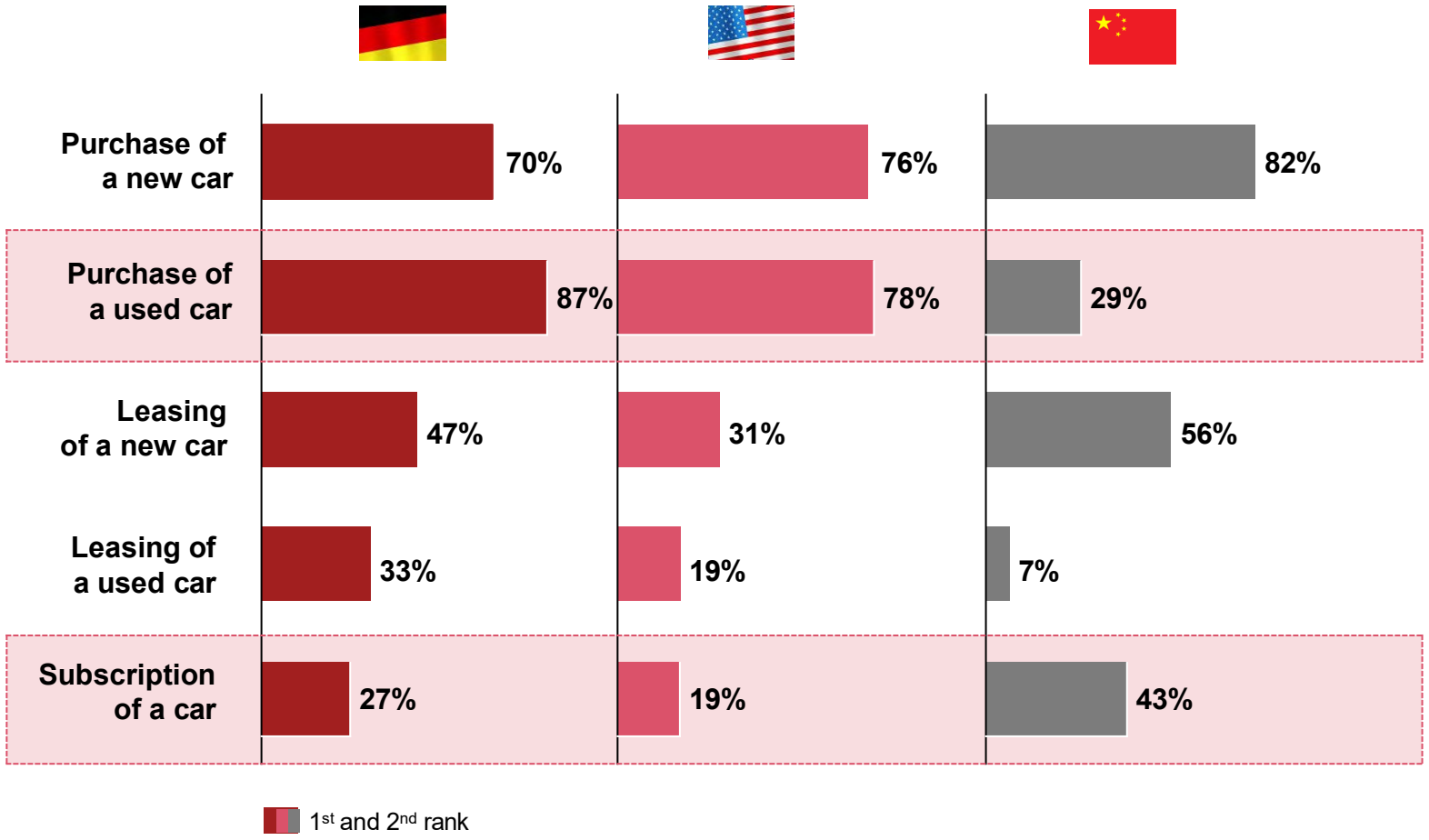
"While younger German respondents are willing to pay more for an autonomous ride, older Germans are less inclined to do so.

US and Chinese respondents overwhelmingly intend to pay less for an automated ride – among those who want to pay less, a 40-50% price cut from driver-driven taxis is the norm."

Source: PwC Strategy& consumer research

Majority of respondents prefer to purchase a new or used car; but car subscription models are attracting interest

Ranking of buying/leasing/subscribing to a car



Question: *"How would you rank the following ways of acquiring a car if you needed to purchase, lease, or subscribe to a passenger car in the next one to two years?"*

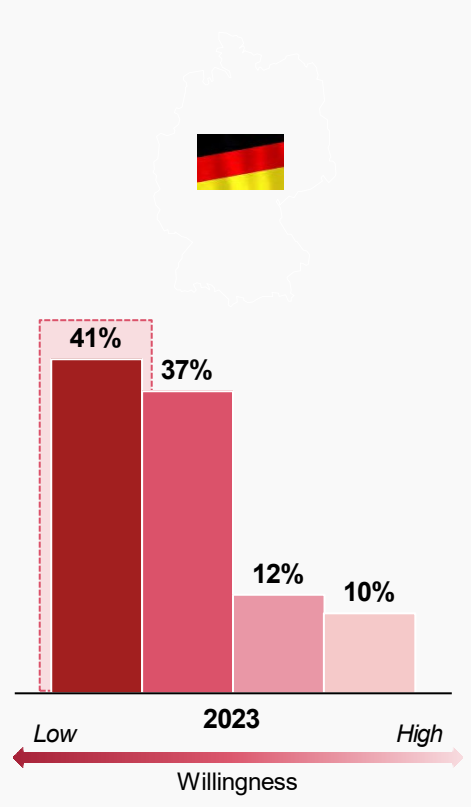
The **intention to purchase a used car is growing,** especially in Germany and the US.

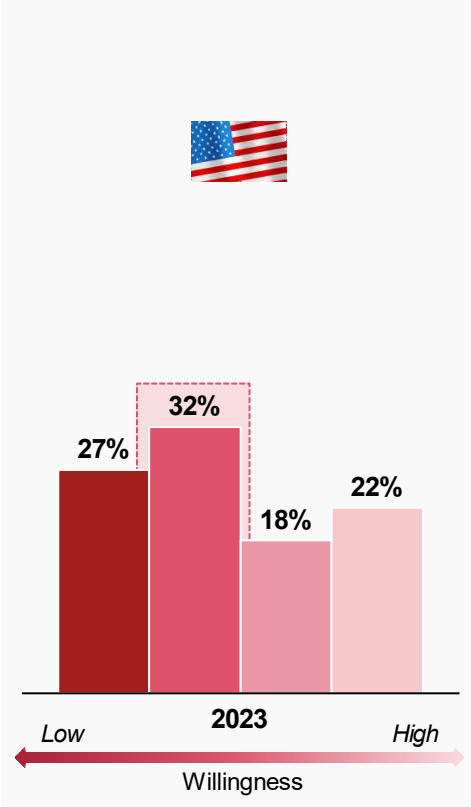
Subscription is gaining in popularity – especially in China. The preference for subscription increased strongly in Germany and the US in 2023 (27% vs. 14% in Germany and 19% vs. 15% in US)."

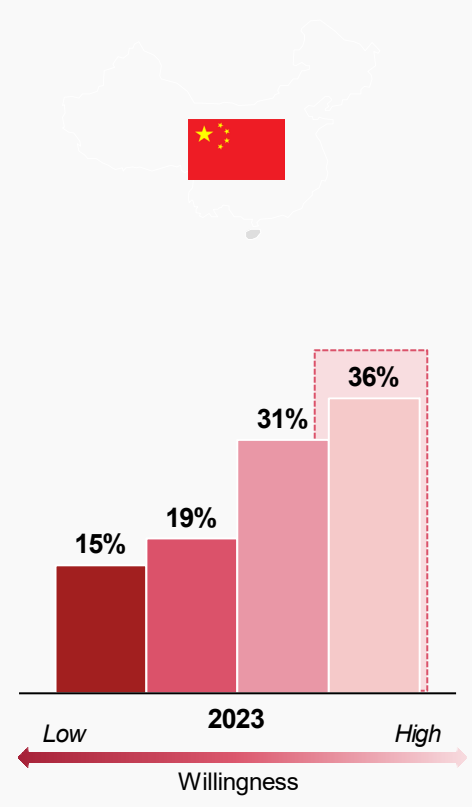
Source: PwC Strategy& consumer research | Difference to 100%: no/low likelihood

Readiness for online car purchases very high in China, while rather low in Germany – the US falls in between

Willingness to make car purchases online

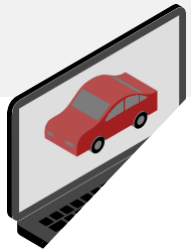






- I would rather do everything at the store
- I would configure it online, but sign and test drive it at the store
- Yes, I feel comfortable configuring and signing online, but I would prefer to do a test drive at the store
- Yes, I feel comfortable with doing all steps online

Question: *"Would you buy your next car online?*



"The willingness to **buy a car online varies significantly across countries**.

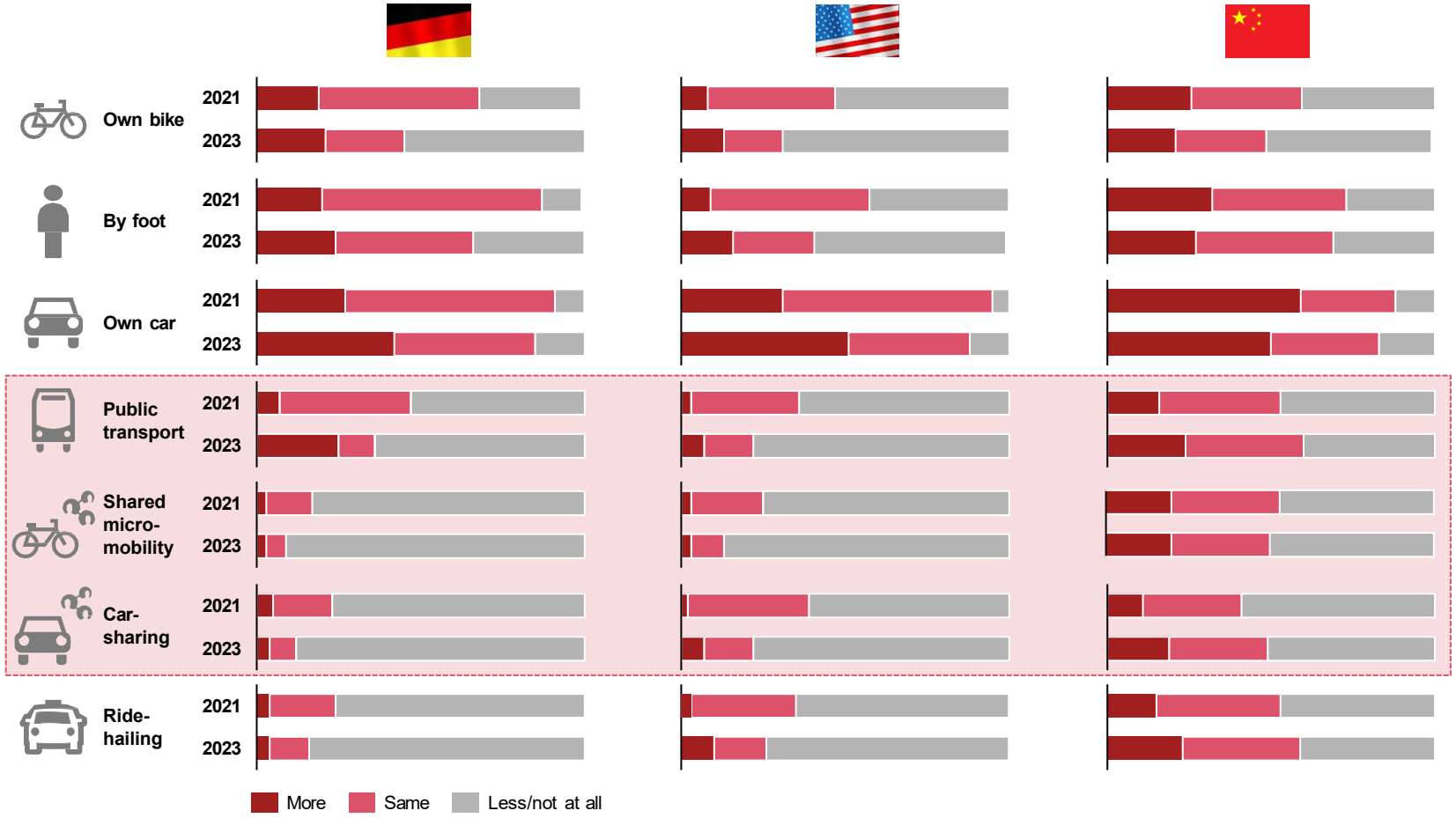
In China, people are **particularly open** to completing certain steps or even the entire buying process online.

In contrast, the majority **in Germany** feel **more comfortable** with store processes."

Source: PwC Strategy& consumer research

Even as immediate COVID-19 risks decline, using one's own car remains popular; increasing use of shared modes in China

Mobility pattern after COVID-19 restrictions (%)



Question: *"COVID-19 has temporarily changed our mobility behavior in many aspects. How do you plan to use modes […] of transport once we have left the pandemic behind us?"*

Using one's own car is **still seen** as the **most convenient** means of transportation – with highest increase in demand **in Germany** and the **US.**

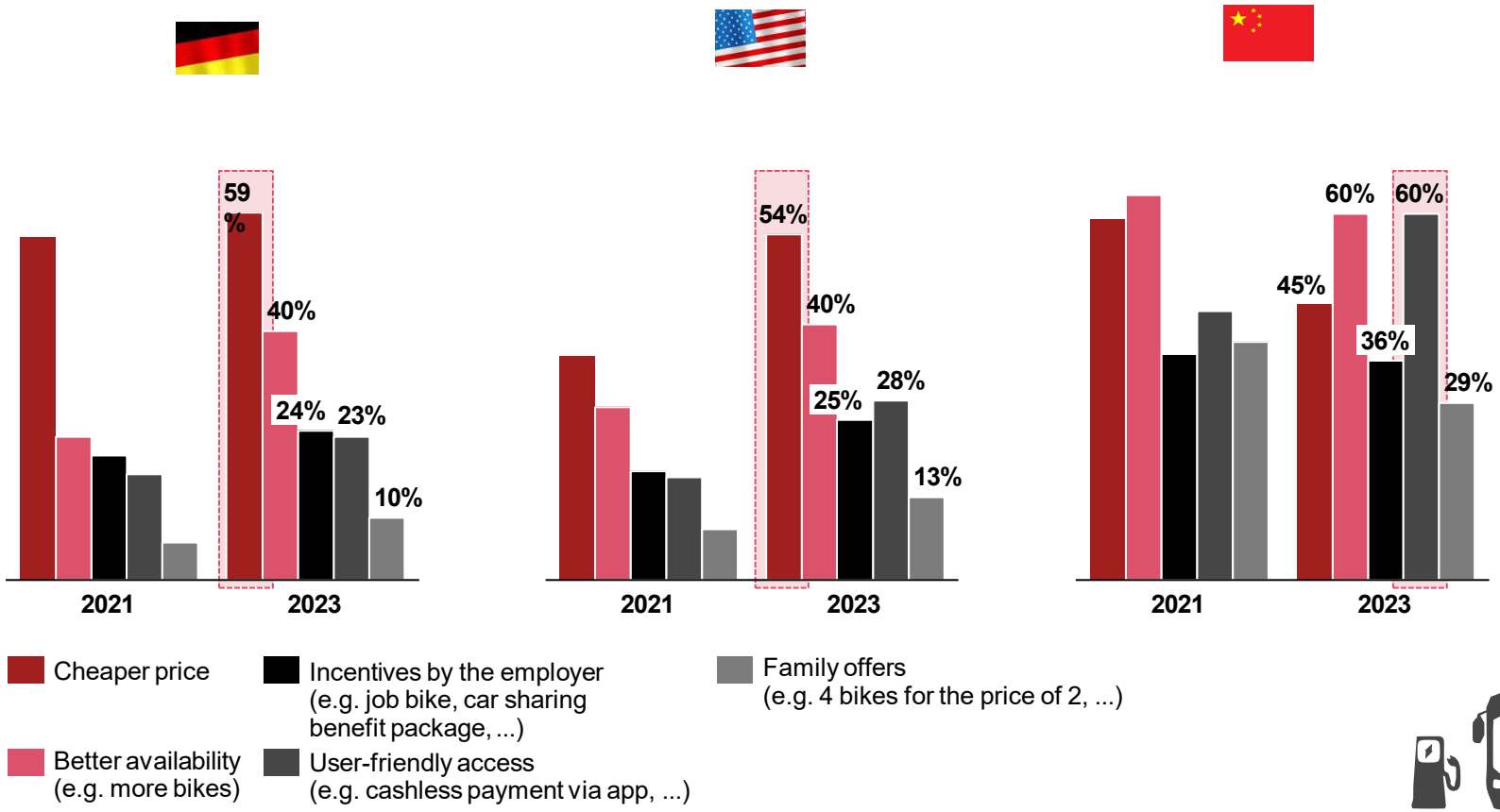
In China, consumers plan to use **shared modes** more.

Across all regions, the number of people planning to use **public transport more has increased."**

Source: PwC Strategy& consumer research

Price and availability are by far the top drivers for encouraging consumers to use sustainable transport

Factors encouraging sustainable transportation modes



Question: *"What would encourage you to use sustainable transportation (e.g. bike sharing, car sharing, public transportation) more frequently?"*

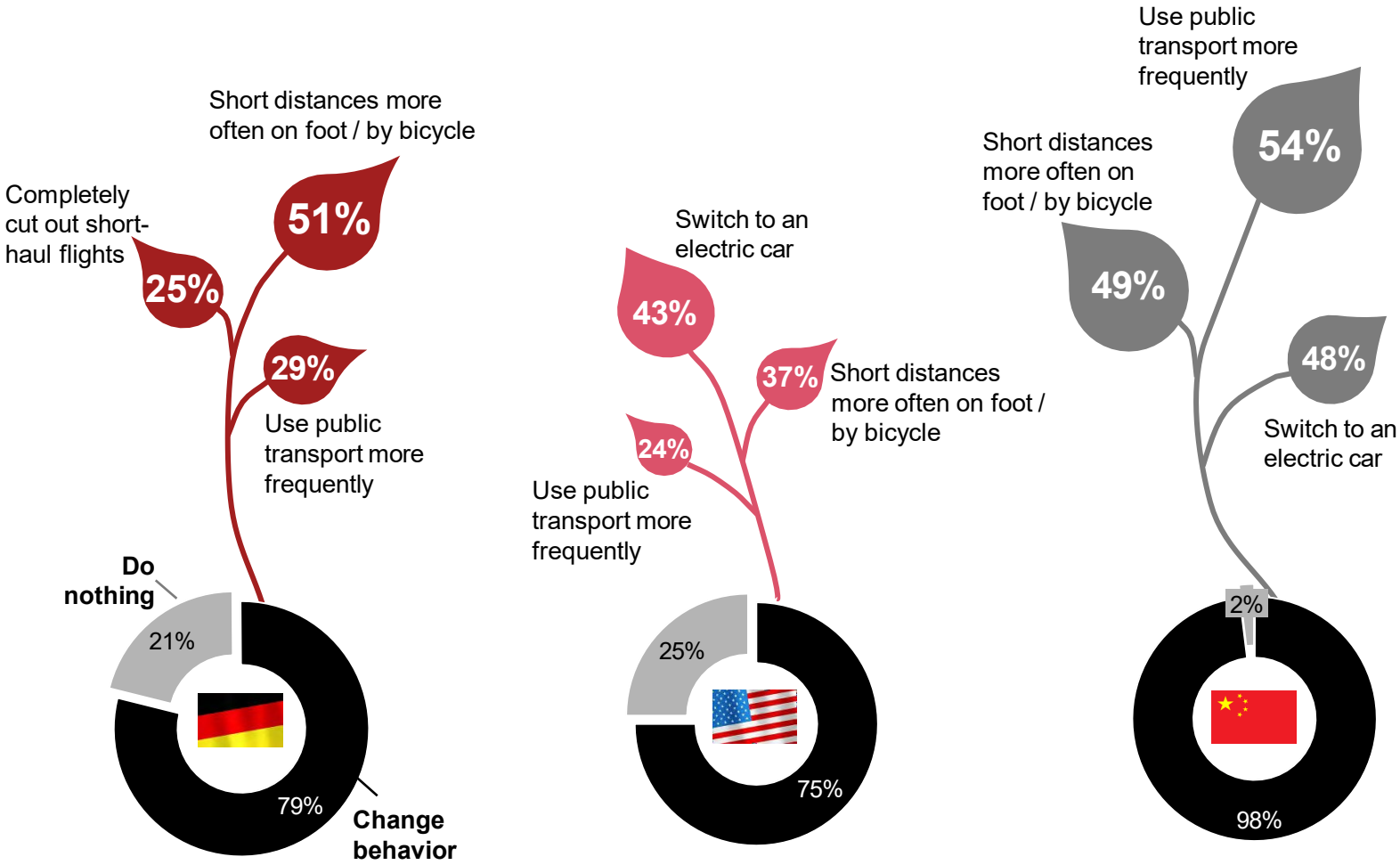
In **Germany**, there has been a sharp increase in the number of consumers who say that **better availability** is an important factor in persuading them to use sustainable transport.

US respondents focus strongly **on cheaper prices**, whereas **user-friendly access** is **most likely to encourage respondents** to use sustainable transport in **China."**

Source: PwC Strategy& consumer research

Every country has different priorities to reduce CO2: In GER more walking, in the US switch to BEV, in CN public transport

Top-3 contributions to CO_2 reduction



Question: *"What major personal changes would you like to do to contribute to a reduction in CO_2 emissions?"*

High willingness to **contribute** to **CO_2** reduction, especially in **China** (98%) – strong **increase in the US** (79% vs. 52% last year)

Main contributions will be completing **short-distance journeys** more often **on foot / by bicycle, switching** to an **electric car**, or **using public transport** more frequently."

Source: PwC Strategy& consumer research

Contents

Getting the user interface right

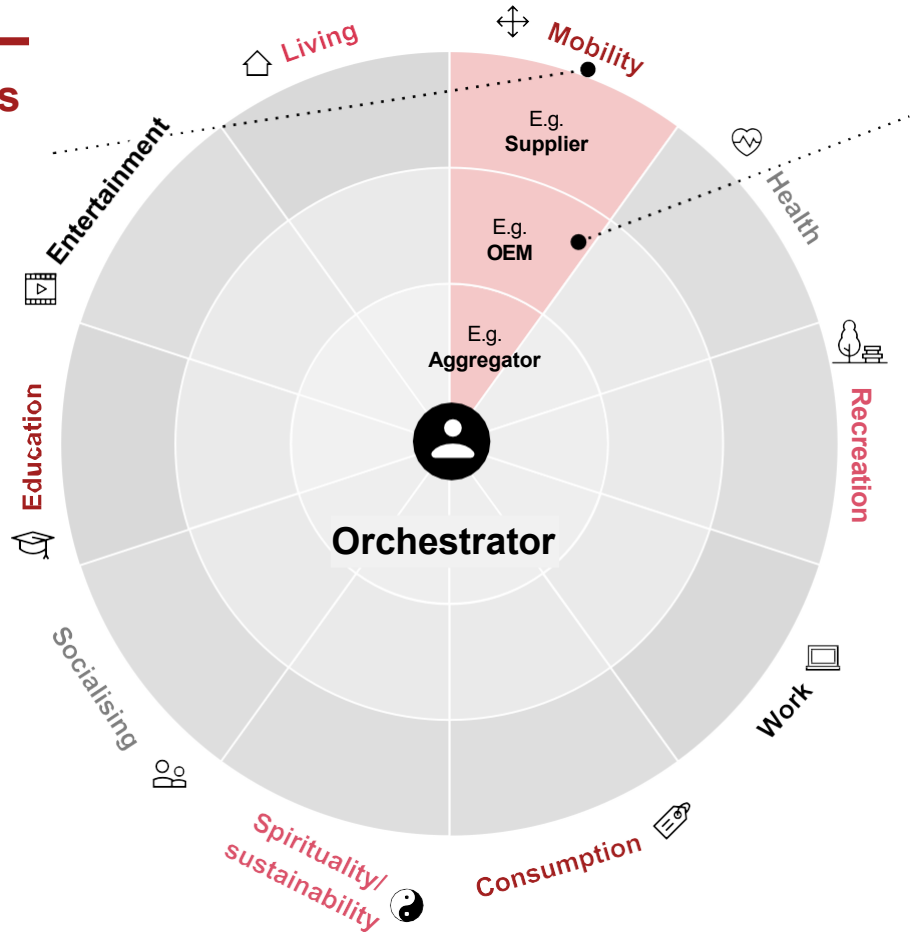
The relevant market for automotive players is expanding beyond the car itself – maintaining user access is crucial

Redefining business models to meet human-centric mobility needs

Mobility demand

Human needs in **mobility Life Areas** determine customer requirements

- **Mobility demand** is influenced by long-term economic, political and social trends as well as generational changes
- The individual user is located at the center of the ecosystem approach **(business to human)**
- Consumer needs can be grouped into ten distinct **Life Areas**
- Within these Life Areas, **ecosystems** emerge in the form of business-to-business and business-to-consumer relationships around specific customer needs



Mobility solutions

Successful **mobility ecosystem players** are clear on four key topics:

Experience differentiators

E.g. luxury, convenience, …

Digital portfolio scope

E.g. life area coverage, niche positioning, …

Value levers

E.g. top-line, bottom-line optimization, …

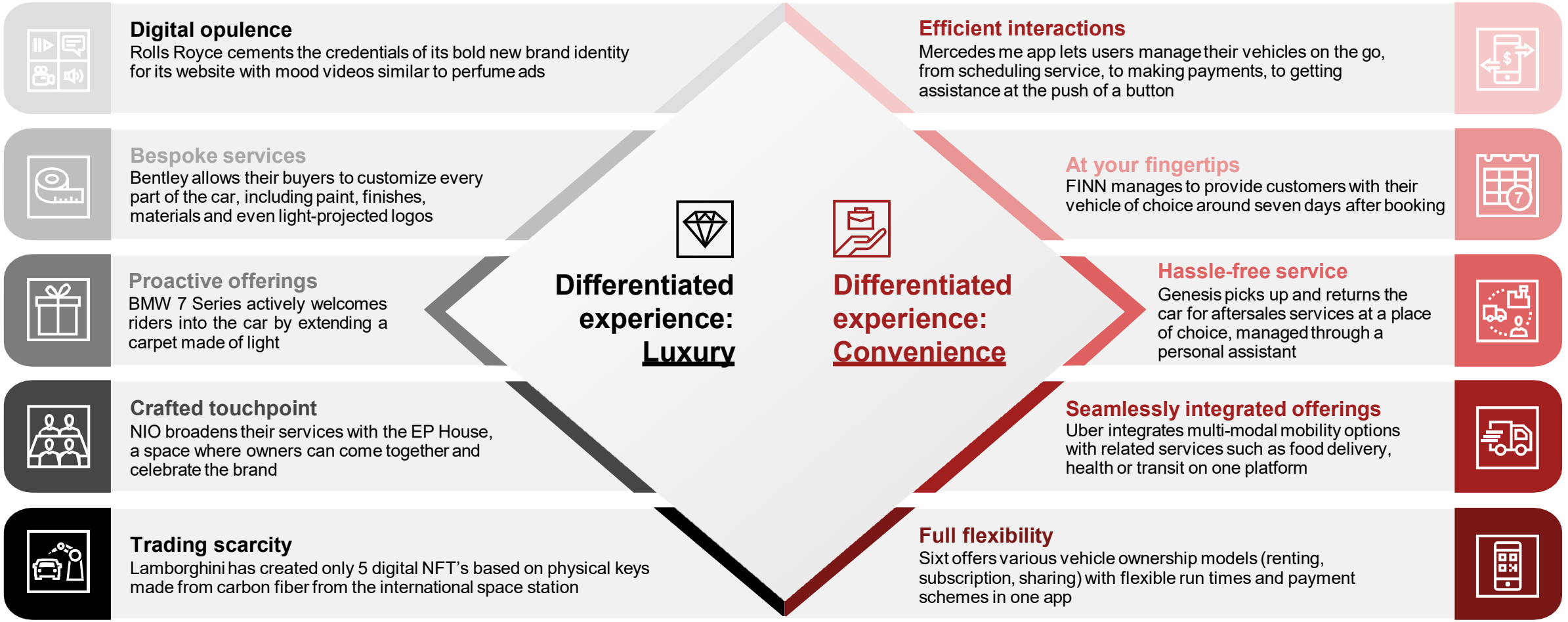
Value chain integration

E.g. vertical/horizontal integration, partnering, …

Source: Strategy&, PwC Ecosystemizer

Getting the digital interface right means creating a differentiated experience for diverse customer needs

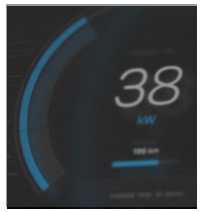
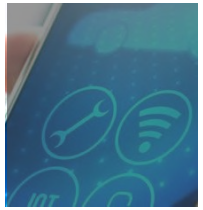
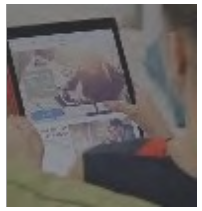
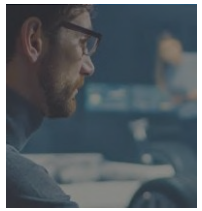
Experience differentiators – Examples



Source: Strategy& analysis

A value-creating digital service portfolio requires automotive players to balance multiple trade-offs

Digital portfolio scope – Examples

	Mobility	Entertainment	Work	Health
 **Vehicle Function -as-a-Service**	**Access** – Tesla virtual bluetooth keys **Light** – BMW high beam assist **Camera** – Tesla sentry mode **Autonomous driving** – Tesla autopilot upgrade **Advanced navigation** – MB live traffic	**Sound** – BMW e-engine sound pack **Intelligent car assistant** – Alibaba, Volvo/Daimler **AI Avatar** – Fetch.ai autonomous agents		
 **Consumer onboard services**		**Gaming** – Tesla arcade, Racing **Entertainment** – Tesla caraoke **Music streaming** – BMW Spotify, NIO Radio **In-car AR gaming** – Audi/holoride partnership	**Crypto Car Wallet** – Various pilots **In-car Office** – Mercedes me connect	**Passenger safety** – NIO fatigue warning **Mood-based lightening** – Mercedes-Benz ambient **Meditation** – Porsche Feel-Good-Coach
 **Consumer offboard services**	**Parking search and pay** – VW we park **P2P car/ride sharing** – Sono motors app **Plug and charge** – VW/Ionity **Automated park and charge** – Bosch Autom. Valet Parking	**NFT Collections** – Roll Royce Phantom **Web3 Loyalty Program** – BMW/Coinweb	**Smart Office Connection** – BMW IFTTT	**Emergency assistant** – GM OnStar guardian
 **B2B/data services**	**Predictive maintenance** – BOSCH, Carmen **Car data based insurance** – BMW CarData **Car data marketplace** – Caruso, Otonomo, High M.		**Fleet mgmt./diagnostics** – Daimler connect business **Driver's log/GPS tracking** – Daimler connect business **Last Mile Logistics** – NIO delivery in trunk	**Roadside assistant support** – Urgently/Otonomo **Safer traffic planning** – Mercedes Data/London

Portfolio Trade-offs

- **Differentiation** vs. **revenue** potential
- **Reach** vs. **profitability**
- **Synergy** focus vs. **risk hedging**
- Touchpoint **control** vs. **open** partners
- **Digital first** vs. BEV/ **AD availability**

Source: Strategy& analysis

Along the value chain and vehicle life cycle, digital services unlock value beyond direct user monetization

Value levers of digital services – Examples

Top-line: Direct revenue and customer lifetime value	**Services monetization**	Connected services activation fees and/or recurring revenues related to monthly subscriptions	**60-70%** *are willing to pay 180$/year for connectivity service set*
	Post-purchase activations	Upselling effect during the ownership cycle by unlocking personalization features or activating built-in hardware	**35-50%** *are interested in post-purchase activations*
	Brand loyalty	Higher satisfaction with on-board experience and creation of 'stickiness' through subscription services	**45-55%** *are more loyal to brands to which they have a subscription*
	After-sales Loyalty	Higher revenues for dealers from original parts sale and workshops traffic triggered by predictive maintenance	**30-40%** *switch to paid subscription after free trial*
	Platform access/ data sales	Direct revenues from granting third parties access to own platform or monetizing (anonymized) data/insights	**50-60%** *of companies indicate that they do sell data to third parties*
Bottom-line: OpEx/CapEx Optimization	**R&D optimization**	Leverage of real time data on customer preferences/behaviors for timely adjustment of vehicle specifications and features	**30-40%** *additional revenue potential based on customer insights*
	Variant management	Reduction of the number of model-specific variants by activating on-demand vehicle features	**20-30%** *cost reduction potential through variant reduction*
	Parts inventory management	Optimized inventory management through advanced planning of upcoming repairs enabled by predictive maintenance	**20-30%** *inventory decrease due to demand forecasting*
	Recall campaigns	Prevention of recall campaigns by leveraging OTA updates to fix potential technical issues within the circulating fleet	**30-40%** *of incidents can partly/fully be prevented by OTA*

Implications

- Ecosystem business cases should extend **beyond vehicle-centric** business cases
- **Direct and indirect revenue** potential, and **opportunities beyond vehicle offerings,** should be considered along the customer life cycle
- **B2B offerings** offer significant **direct monetization potential**
- In addition to external opportunities, a significant amount of **internal opportunities** exist, e.g. to increase efficiency in processes & portfolio

Source: Strategy& analysis + expert discussion

OEMs are forced to partner with technology players to deliver compelling digital services – risking a loss of control

Value chain integration – Range of partnership options

I – No tech player involvement

Operating system and all applications are developed by the OEM

Full control for OEM, no standardization, slower development, reduced offering compared to market leaders

II – Operating system supply

Standardized tech stack is provided by supplier, e.g. Android Automotive OS

Faster development, easier integration of external applications (e.g. Spotify), standardized setting cannot be adjusted by OEM

III – Content mirroring

Apple/Google content is displayed by using apps within the vehicle, e.g. Android Auto

Common mobile apps (e.g. Google Maps) are **immediately available in-vehicle**; less use of OEM native apps / content

IV – Tech player content using vehicle data

Usage of car data to enrich 3rd party in-vehicle apps, e.g. for usage based insurance or location based commerce

Compelling user experience on par with mobile app UX, but **OEM apps loose advantage** of specific driver / vehicle insights

V – External development of the digital experience

Next ?

Entire automotive software is developed by tech supplier

Data governance between involved stakeholders crucial to avoid **downgrading of OEM** to pure hardware provisioning

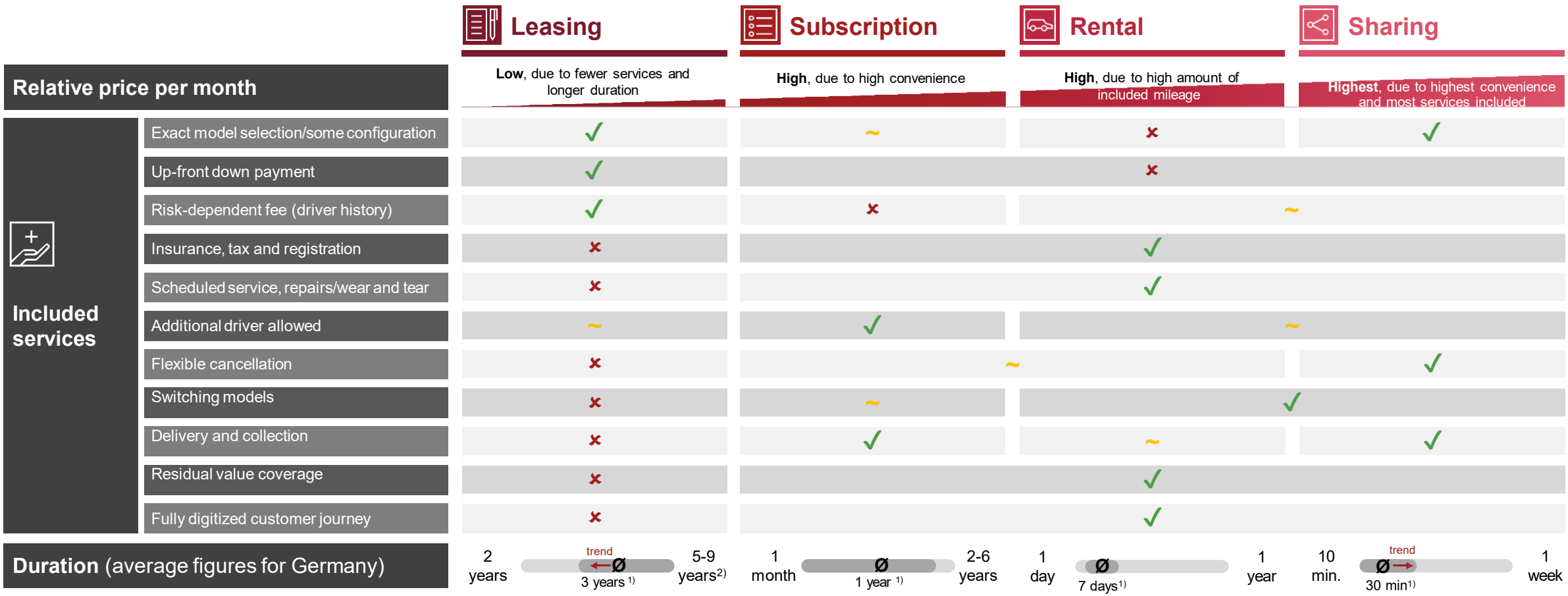
A winning digital experience requires customer proximity, tech capabilities and effective data governance

Source: Strategy& analysis

Rethinking vehicle sales

Subscription fills the gap between leasing and rental offerings – resulting overall in four major vehicle ownership archetypes

Vehicle ownership archetypes

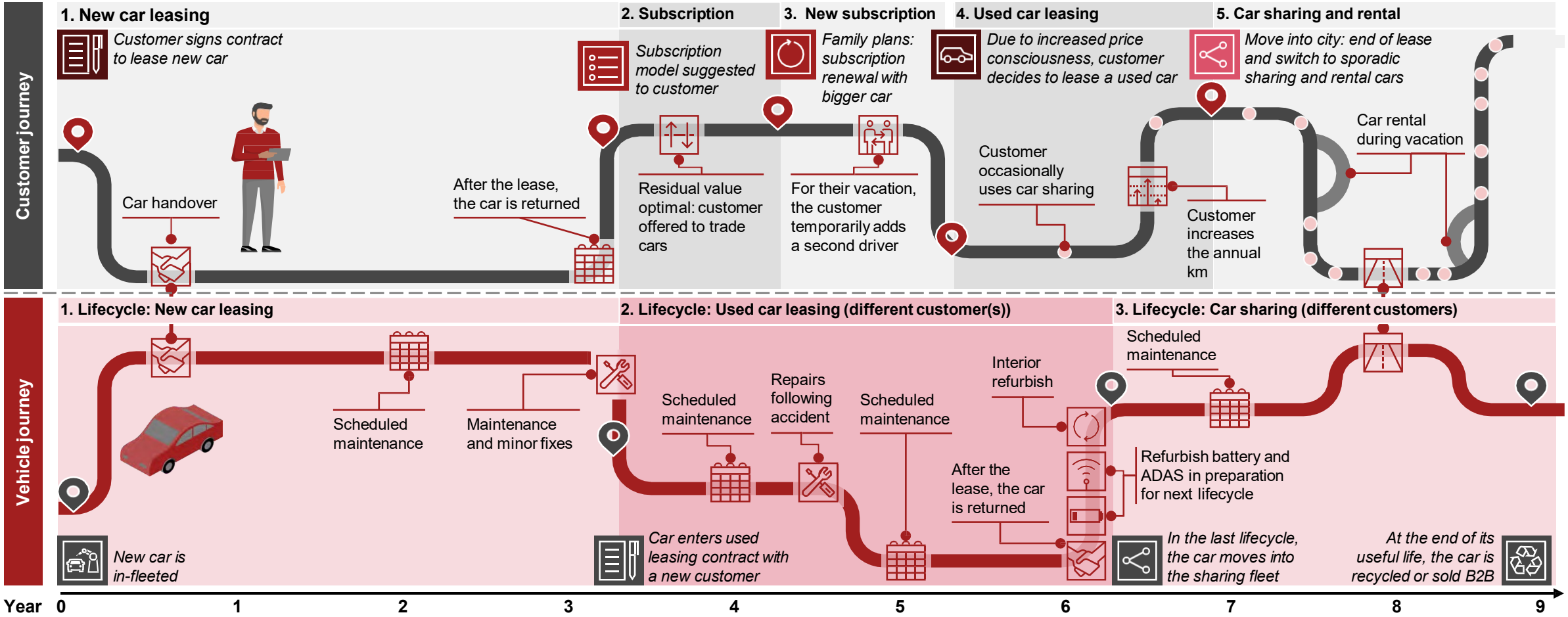


✓/ ~ / ✗ = Usually included / Depends on provider / Usually not included

1) Based Strategy& analysis; 2) Depending on specific regulatory environment allowing "prolonged lease"
Source: Strategy& analysis

As alternative ownership models such as subscription emerge, OEMs need to sharpen their vehicle lifecycle mgmt. skills

Subscription customer and asset journey – Example



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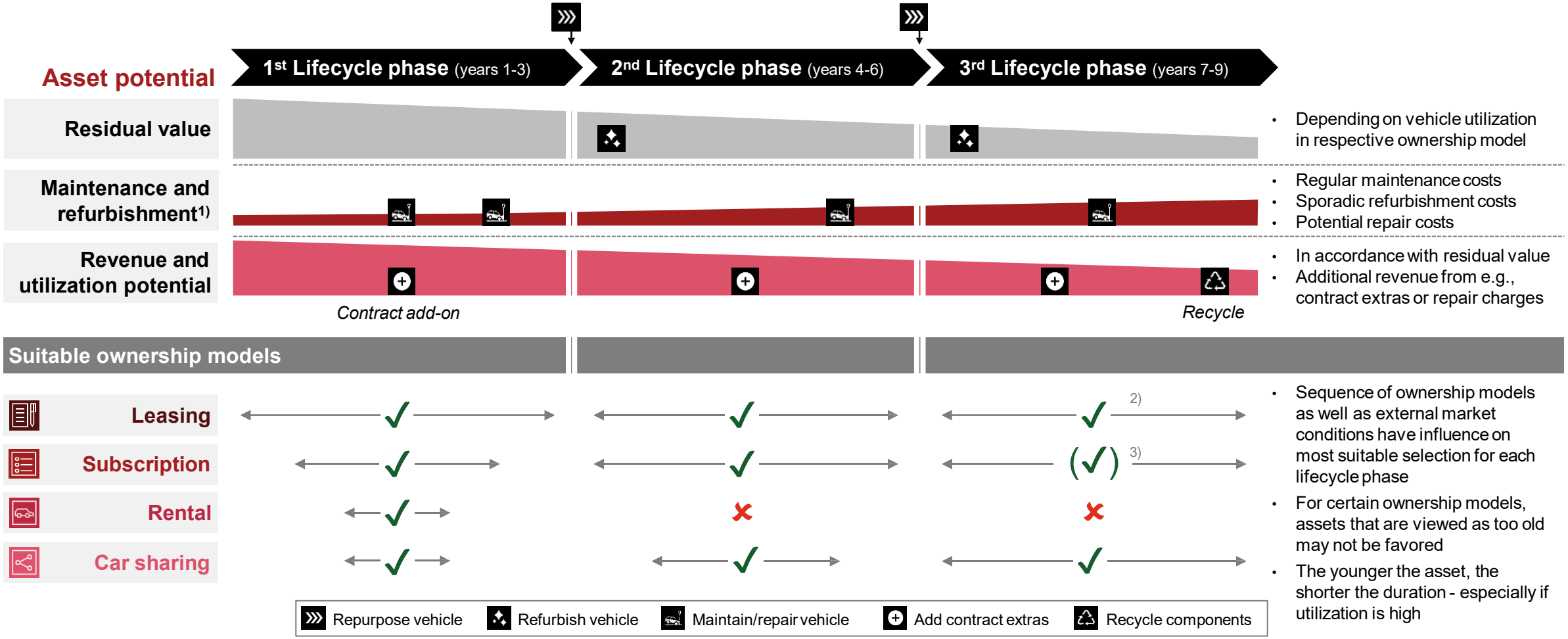
Source: Strategy& analysis

Holistic vehicle lifecycle management aims to increase revenue and utilization, especially during 2nd and 3rd phase

Subscription "3x3" asset lifecycle



- Depending on vehicle utilization in respective ownership model
- Regular maintenance costs
- Sporadic refurbishment costs
- Potential repair costs
- In accordance with residual value
- Additional revenue from e.g., contract extras or repair charges
- Sequence of ownership models as well as external market conditions have influence on most suitable selection for each lifecycle phase
- For certain ownership models, assets that are viewed as too old may not be favored
- The younger the asset, the shorter the duration - especially if utilization is high

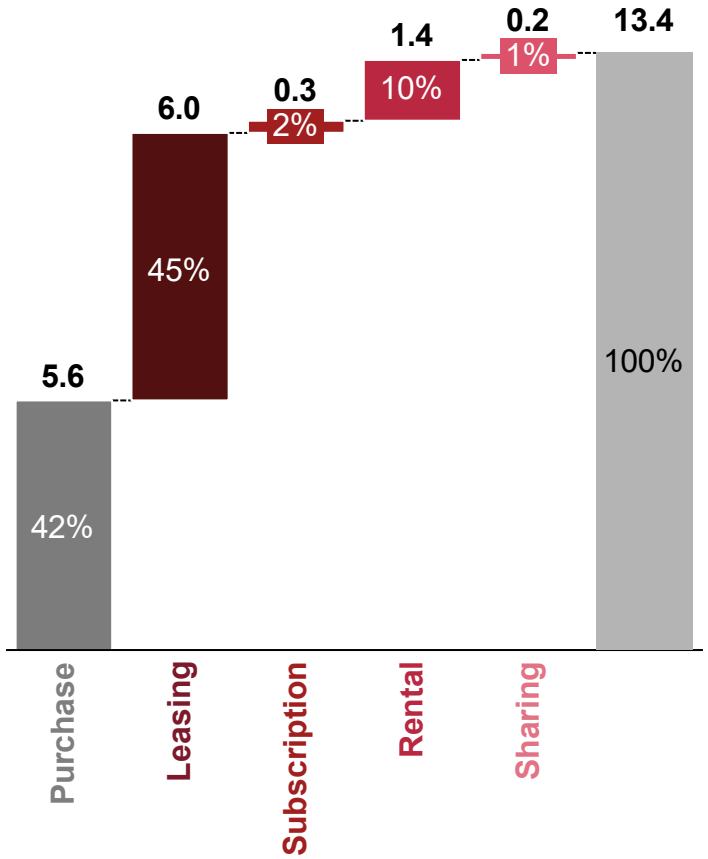
1) Annual OEM-prescribed maintenance/service intervals and use-based repairs – sporadic refurbishment;
2) Depending on specific regulatory environment allowing "prolonged lease"; 3) As low-budget option
Source: Strategy& analysis

Alternative ownership models are on the rise and offer profit potential for OEMs – if the asset life cycle is managed well

Vehicle ownership model split and profitability – Indicative

Ownership model split 2023 [m units]

Region Europe, 40 countries



Subscription has potential to grow to **2-4m units by 2035** in Europe[1)]

Leasing has potential to grow to **7-8m units by 2035** in Europe[1)]

Profitability of ownership models[2)]

Traditional car ownership → Alternative ownership

Ownership models	Purchase	Leasing	Subscription	Rental	Sharing
LCP 1 year 1-3	7%	-115%	-91%	10-15%	<5%
LCP 2 year 4-6	9%	83%	78%	–	<5%
LCP 3 year 7-9	11%	76%	71%	–	<5%
Total	**5-7%**	**10-15%**	**10-15%**	**10-15%**	**<5%**

- ***Overall profitability potential higher for leasing, subscription and rental than for purchase***
- ***Profitability across LCPs varies*** – *from relatively constant to a sharp increase. With rental, there is only one LCP.*
- *It is not individual consideration but a **merged portfolio view that is crucial for OEMs***

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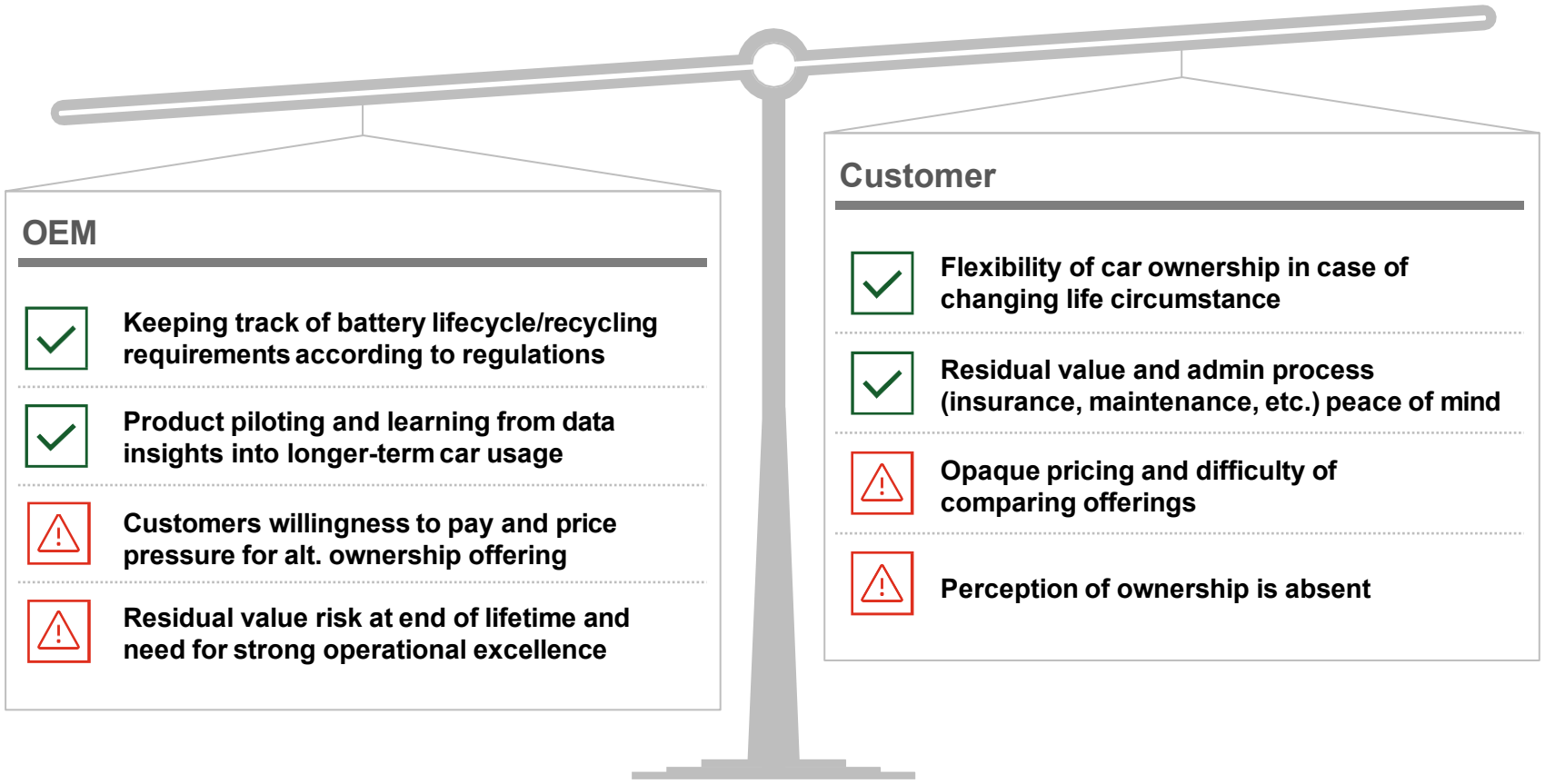
1) Estimate of share development for ownership model depends on shares of competing models; LCP: Life cycle phase;
2) Profitability estimate based on individual consideration of ownership model for average middle class passenger EV (price 53.5k EUR)
Source: Strategy& analysis

More flexible ownership models offer benefits and risks for OEMs and customers – a win-win solution is required

Vehicle subscription benefit and risk perspective

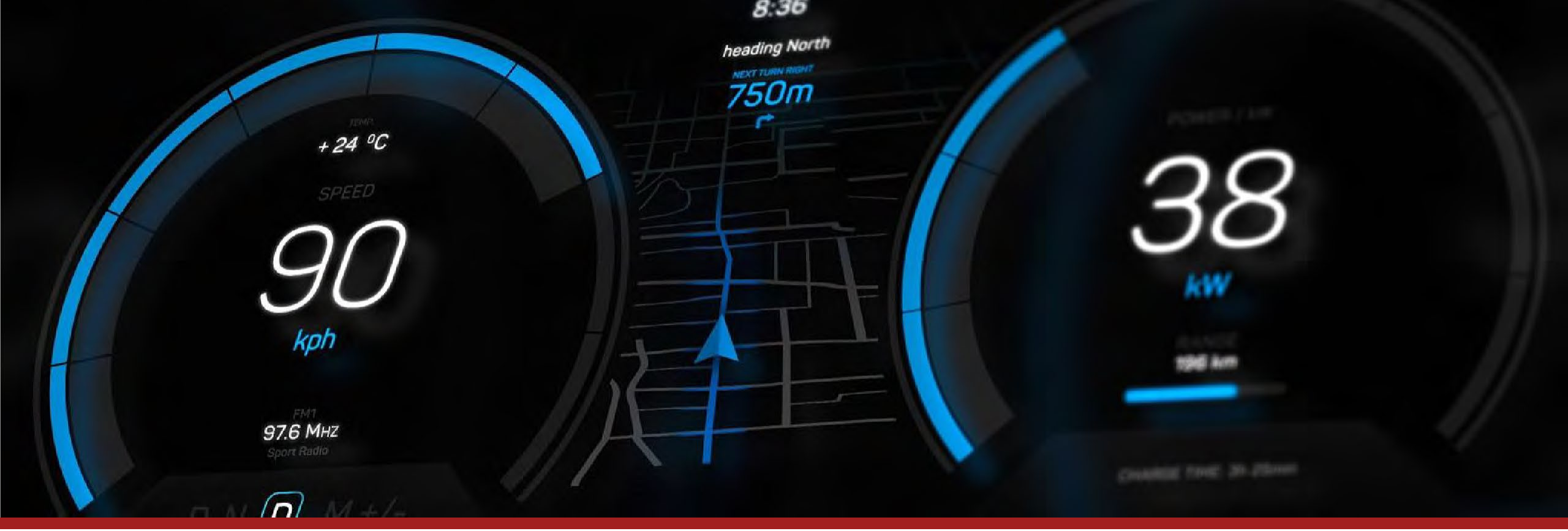


Key takeaways

- Alternative ownership models need to create a **win-win situation** for customers and OEMs
- Currently, they mostly **play into the strategic agenda of OEMs**
- Strong **customer centricity** and efficient **asset management** of used cars are **needed** to reach **profitability**

OEMs may leverage their **existing retail network** and **preferential vehicle acquisition conditions** to differentiate themselves from start-up competitors

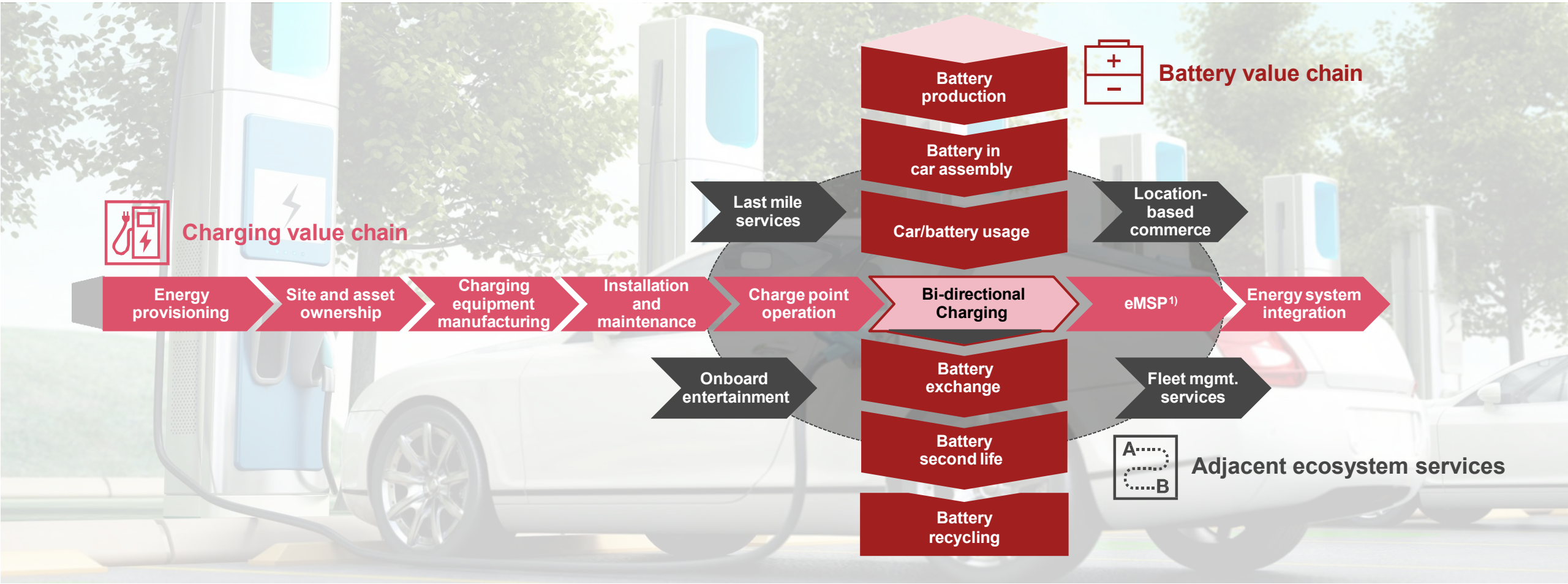
Source: Strategy& analysis



Going beyond the vehicle

Rise of e-mobility provides ample opportunities to capture value beyond the vehicle – e.g. with batteries and charging

Value pools beyond the vehicle – Focus e-mobility



Source: Strategy& analysis

Infrastructure and vehicle penetration are key requirements for successful realization of bi-directional charging use cases

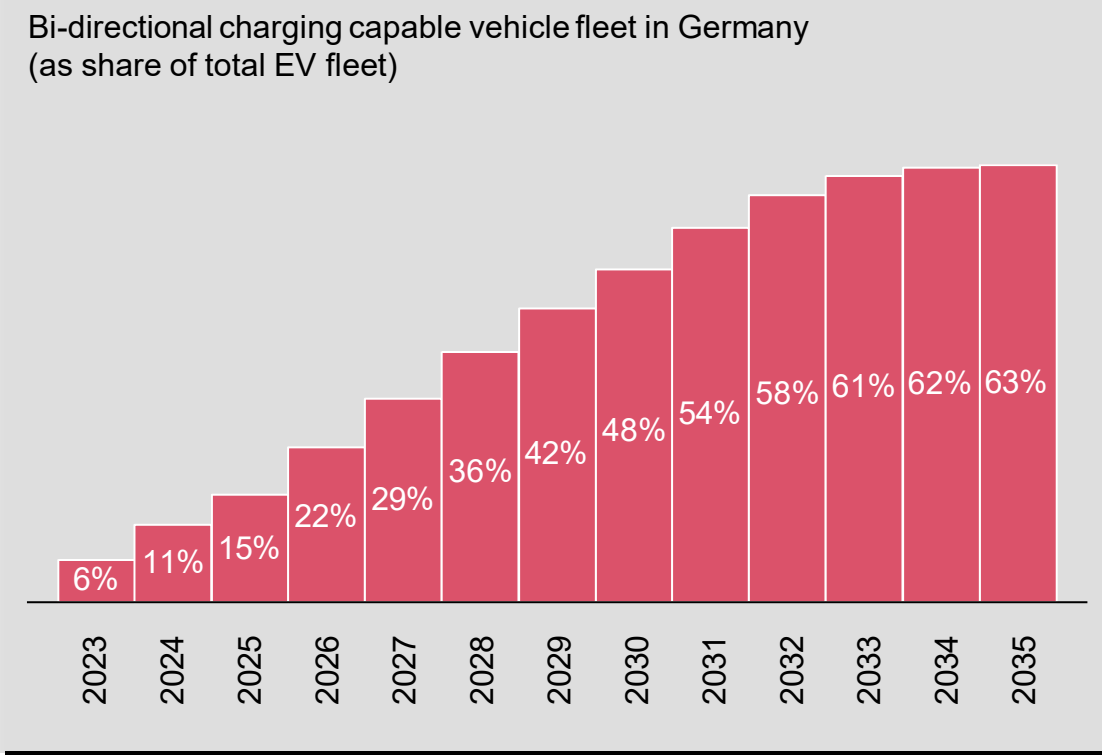
Bi-directional charging – Market simulation Germany

Bi-directional sockets by 2030

	1.8m	**0.7m**
Private 2.5m	**Home and apartment buildings**	**Office**
	0.16m	**0.03m**
Public 0.19m	**Parking**	**Charging hubs**

Total 2030: 2.7 million bi-directional sockets

Bi-directional charging-capable vehicle fleet (#)



Total 2030: ~5 million bi-directional vehicles

Source: PwC Strategy& Study (2022): "Der E-Mobility-Check: Wie bereit ist Deutschland?"; Strategy& analysis

Front-of-meter prosumer use cases depend on a multitude of external factors that limit mainstream adoption in short term

Prosumer charging business model comparison – Germany

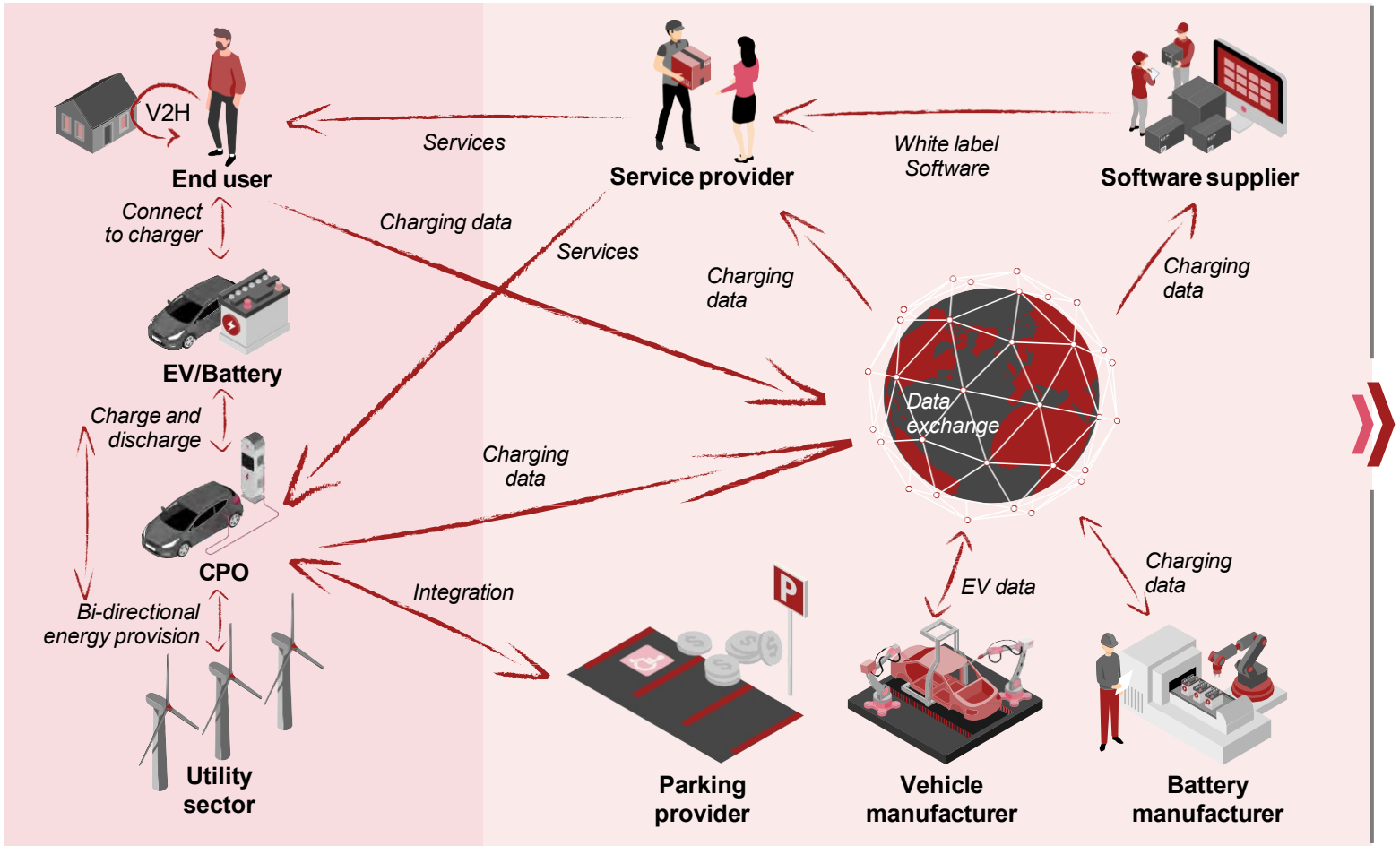
		Behind the meter		Front of meter	
	Application Area	**V2L** 	**V2H/B** 	**V2G / VGI** 	
	Use Cases	**Self-supply optimization**	**Consumption optimization**	**Load shifting**	**Power market trading**
	Enabler Revenues	Potential for software enablers: **€160-220m**[1] in 2030		Potential for software enablers: **€470-550m**[2] in 2030	
Enablers & Limitations	**Customer Demand**	• **Short-term: Growing EV user demand** to use vehicle e.g. as additional storage for home PV or emergency power bank (in the US)		• **Mid-term**: EV user demand driven by **incentive to earn/save money**, but **depending on available solutions & attractive pricing**	
	Energy Tech	• Need for **penetration of bi-directional capable vehicles and infrastructure** (i.e. EV charger) to reach "critical mass" • Need for development of **standard protocols** (interconnection, communication, vehicle and charging station safety & functionality)			
	Regulation	• **Fully supportive behind-the-meter regulation expected by 2024** due to limited complexity of "closed" micro-ecosystem		• **Fully supportive regulation not expected before 2028 at EU level** due to high stakeholder complexity (smart meter as reference)	
	Economics	• **Tech cost reduction** (vehicle / infrastructure) required for scale up • Availability of comprehensive **ancillary services** as important enabler		• Need for **flexible V2G tariffs**: Time-of-Use or Time-of-Day pricing • **Minimum number of kwh** must be available at a certain point in time **for utility providers to rely upon** when managing the grid	

While **front of meter** still requires more **regulatory alignment** at European level, **behind the meter** already has a **high market readiness in the short term**

V2L: Vehicle-to-load (e.g. e-bike, another EV, etc.) V2H/B: Vehicle-to-home / building V2G/VGI: Vehicle-to-grid / vehicle-grid-integration PV: Photovoltaic
1) Includes software for grid optimization of households (V2H) and public charge point operators only; 2) Includes software for power market trading for households and public charge point operators only
Source: Strategy& analysis

Realization and scale-up of prosumer use cases require efficient charging and battery stakeholder coordination

Charging & battery ecosystem stakeholder activation



Main scale-up challenges

Stakeholder fear of losing control points to a central, dominant player (e.g. OEMs see USP in unique charging experience)

Relatively **high transactions costs** for clearing and billing (given comparatively low value of single transactions)

Different interests and priorities across parties (e.g. CPOs want to maximize utilization, whereas OEMs want to maximize charging availability)

Can a decentralized coordination approach help to solve these challenges?

Charging stakeholders

Enabling ecosystem partners

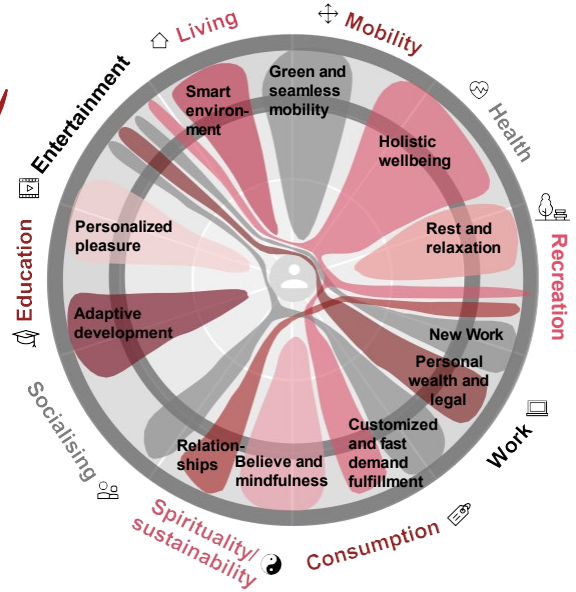
Source: Strategy& analysis

Implication for automotive players: Holistic ecosystem approach beyond core business is key to future success

On the one hand…

- Ecosystems can create lock-in effects based on **differentiated offerings**
- **Customer lifetime value** can be increased through holistic journey coverage
- **Faster growth** and **higher earning potential** can be achieved when compared with traditional approaches to value creation

Ecosystems…



On the other hand…

- Building & managing ecosystems is **complex**
- Theoretically, unlimited number of potential offerings **complicates the selection process**
- Product-centric view carries risk of **missing market/customer needs** (particularly for more advanced topics)

Success factors

- ✓ **Be clear about own ecosystem role – whether orchestrator, realizer or enabler**
- ✓ **Build offering portfolio** and **allocate resources** accordingly
- ✓ Maintain a **holistic and iterative approach** in the selection of suitable offerings
- ✓ **Actively manage the portfolio** and **prioritize clearly** according to a coherent, consistent and multi-layered ecosystem logic

Source: Strategy&, PwC Ecosystemizer

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