We currently think about the future of mobility as...

- **A**utonomous driving
- **C**onnectivity
- **E**lectrification of vehicles
- **S**hared mobility

We should also think about it as...

- **F**leetification
- **A**ssist and ability
- **C**ollaboration
- **E**nergy transition and efficiency
- **S**ervice

Fleetification

Fleetification involves the transition of end customers from vehicle owners to users

Fleetification can amplify the emergence and impact of ACES through:

Fully integrated and reliable solutions designed for the unique needs of an electric fleet

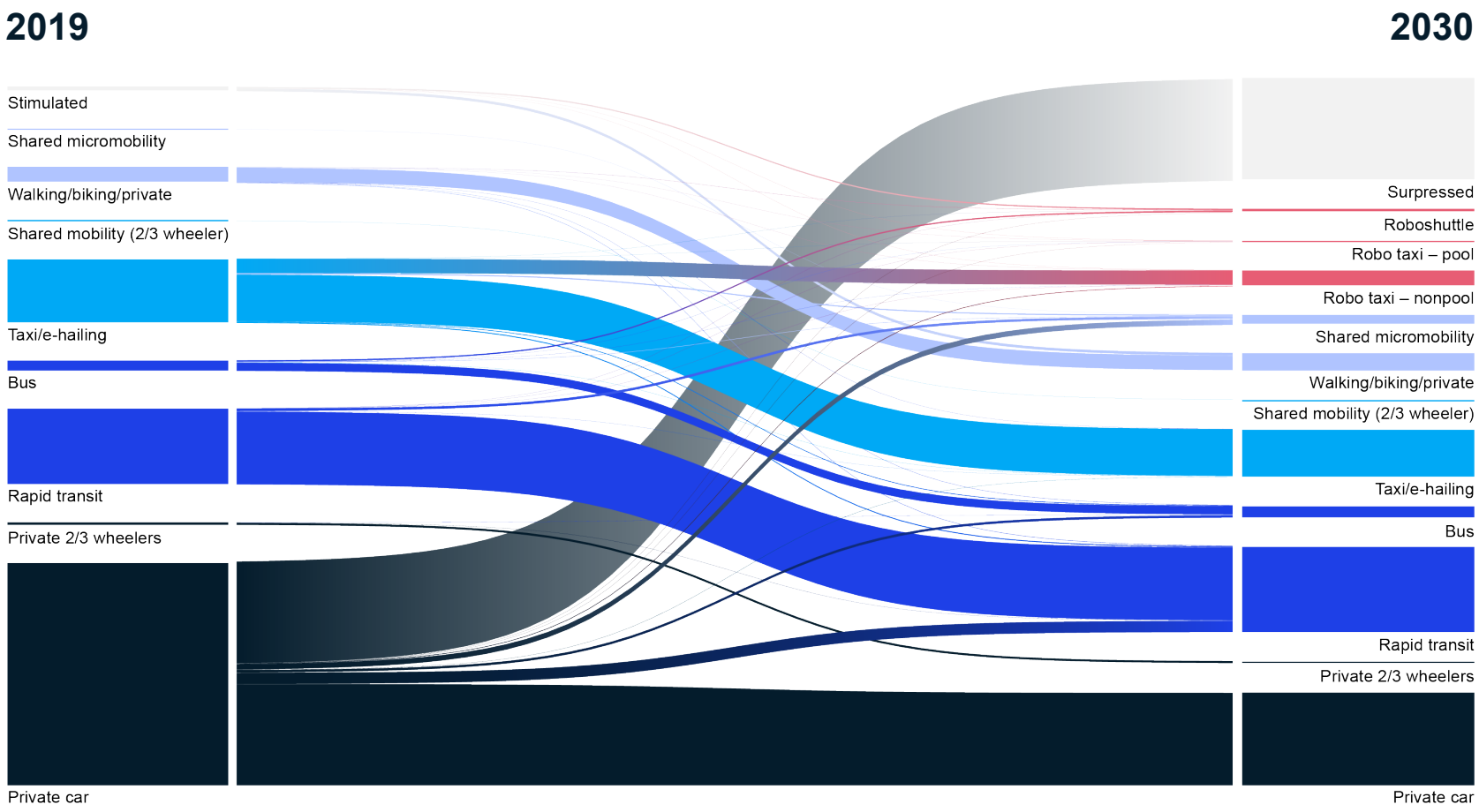
Technological innovations deployed by fleet operators to improve operating margins and drive profitability

Efficiency improvements as the fleet size increases enabling increased competitiveness across transportation landscape

Autonomous vehicles have the potential to significantly disrupt mobility by 2030

Transport mode share 2019 to 2030, % of total miles traveled

Illustrative



1. MCFM Mobility Consumer Insights

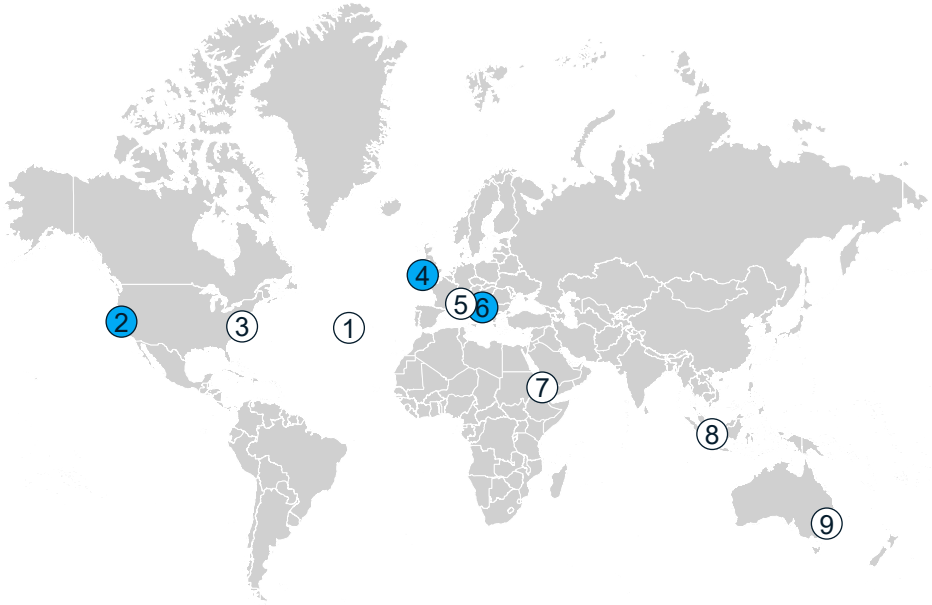
Source: McKinsey Center for Future Mobility, McKinsey Mobility Market Model (M3)

Innovations and availability of personal autonomous driving and shared AV modes will **unlock dependence on cars for many consumers**, especially in an urban setup

67%

Of global consumers would switch car brand for **better autonomous driving technology**[1]

National and international regulation and initiatives are impacting fleet operations



1 **SafeDI, World Economic Forum**
Creating an policy framework to support regulators in evaluating safe performance of autonomous delivery platforms

3 **Pittsburgh, PA, USA**
Policy leans largely on self-certification and NHTSA Voluntary Safety Self Assessment

5 **Headstart, Europe**
Aligning scenario-based approaches to validation of Level 2/3 connected and automated vehicles across Europe

7 **Dubai, UAE**
Code of Practice outlines general approach to certification, but does not detail test parameters

Australia
9 Code of Practice allows self-certification with a safety driver to enable testing

Select regulation and initiatives include:

2 **California, USA**
Assembly Bill 5 (AB5) requires companies that hire independent contractors to reclassify them as employees

4 **United Kingdom**
Uber plans to launch 10,000 EVs in London by the end of 2022 – London is the global leader for Uber's electrification efforts

6 **Paris**
Paris authorities plan to banish oil- and diesel-fueled cars by 2030

Source: Press search

Six trends across the autonomous driving industry are influencing company operations and rider behaviors

1 Enormous revenue potential in the long-term

~400bn USD Market size for autonomous mobility services in 2030

2 Commercial market launch on the horizon

Mobileye is hoping for self-driving taxis in Germany from 2022

Announced launch date in Dubai for 2023

3 Government support for autonomous mobility solutions

Singapore is seeking to become a "smart nation" and offer a AV mobility service in the early 20s

New draft for autonomous mobility regulation

4 Strong cost reduction for autonomous driving technology

Hardware costs of 0.30 USD per mile already today

Jaguar iPACE with Waymo driver costs no more than a moderately equipped Mercedes S-class

5 Consolidation of the market for autonomous mobility solutions

Uber self-driving unit was acquired by Auroa – joint company now with USD 10bn valuation

Toyota acquires Lift Level 5 for USD 550mn

6 Investor rush into autonomous vehicle players

~18 bn USD Total market valuation of autonomous vehicle SPAC targets[1]

Microsoft invests USD 2bn in Cruise Automation

1. As of January 2021

Source: McKinsey Center for Future Mobility

Assist and ability

Collaboration

The connected mobility ecosystem is expected to increase collaboration across various services and players

Illustrative company examples; Not exhaustive

Connectivity infrastructure
Backbone for the entire system; may include 5G, LEO satellites, etc

OneWeb

OEMs and parts suppliers
The vehicles themselves, including the software, sensors, and platforms they need to integrate into the environment

Autoliv

APTIV

Cloud platforms
Some in-vehicle data processing could eventually be transferred to the cloud

Microsoft Azure

App stores
Marketplace/consumer front end for drivers and passengers to access new features and products

mojio

Connectivity providers
Data services to enable communication from vehicles to networks and other service providers

verizon

Operating systems
In-vehicle computer operating systems

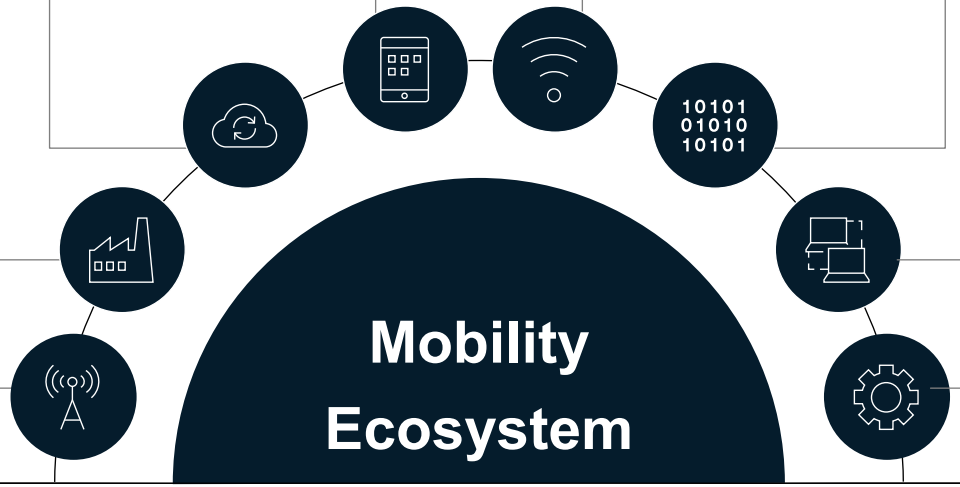
Microsoft Windows Automotive

App services
Application software and add-on features for consumers, such as fleet management, mapping services, and voice recognition

force by Mojio

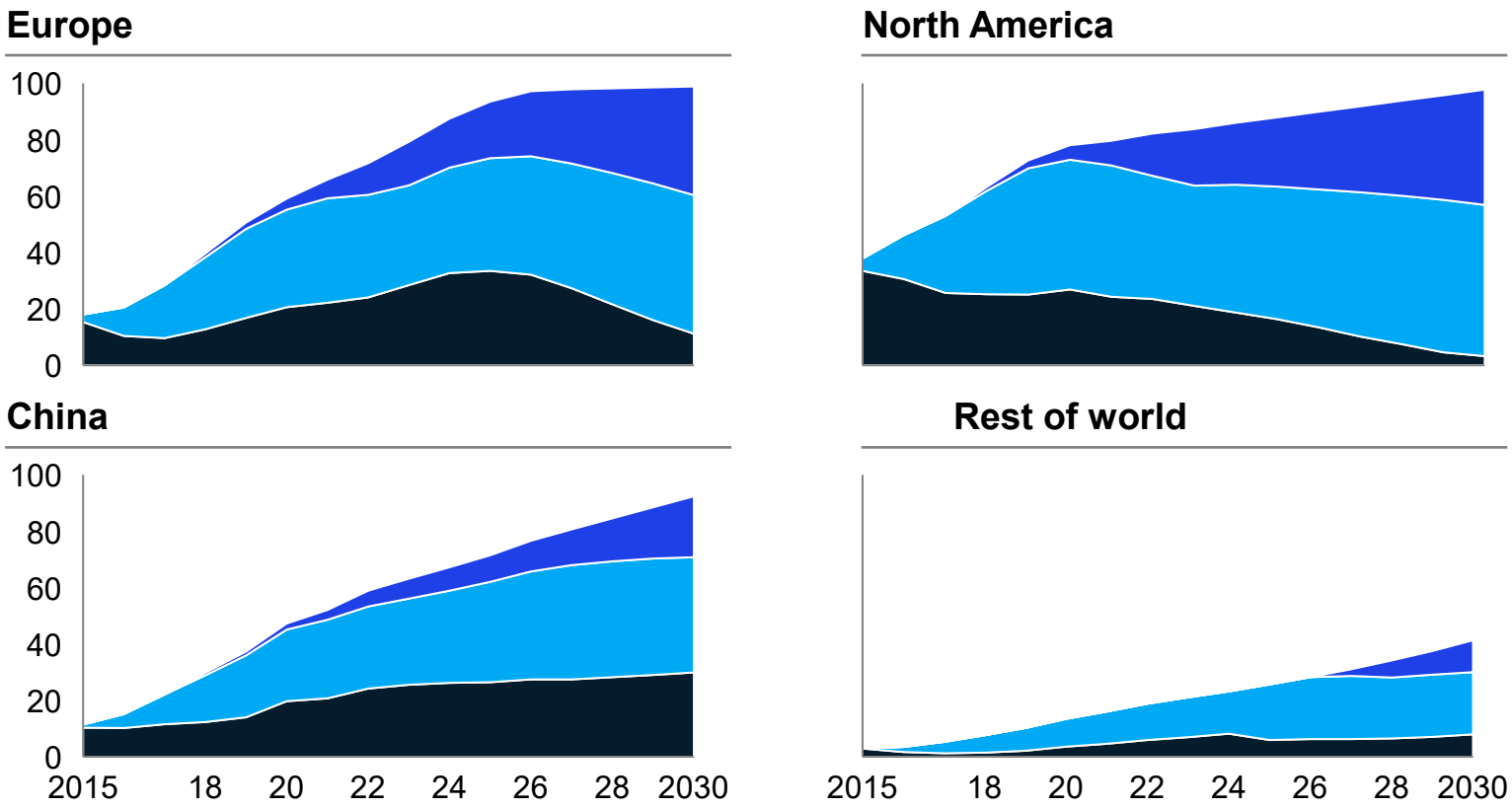
Aftermarket suppliers
Maintenance and service, including critical replacements and upgrades of connectivity hardware and software components

BOSCH



>80% of major market car sales are expected to have some sort of connectivity feature by 2030

Connected cars, % of all vehicle sales



Connected cars archetypes:

Basic

General hardware connectivity; car-enhancing basic features such as guided navigation, driving statistics

Intermediate

Preference-based personalization; car-enhancing intermediate features such as personalization of services, accessible directly from the dashboard

Advanced

Intelligent system; car-enhancing advanced features such as multisensorial live interaction and unsupervised intelligence.

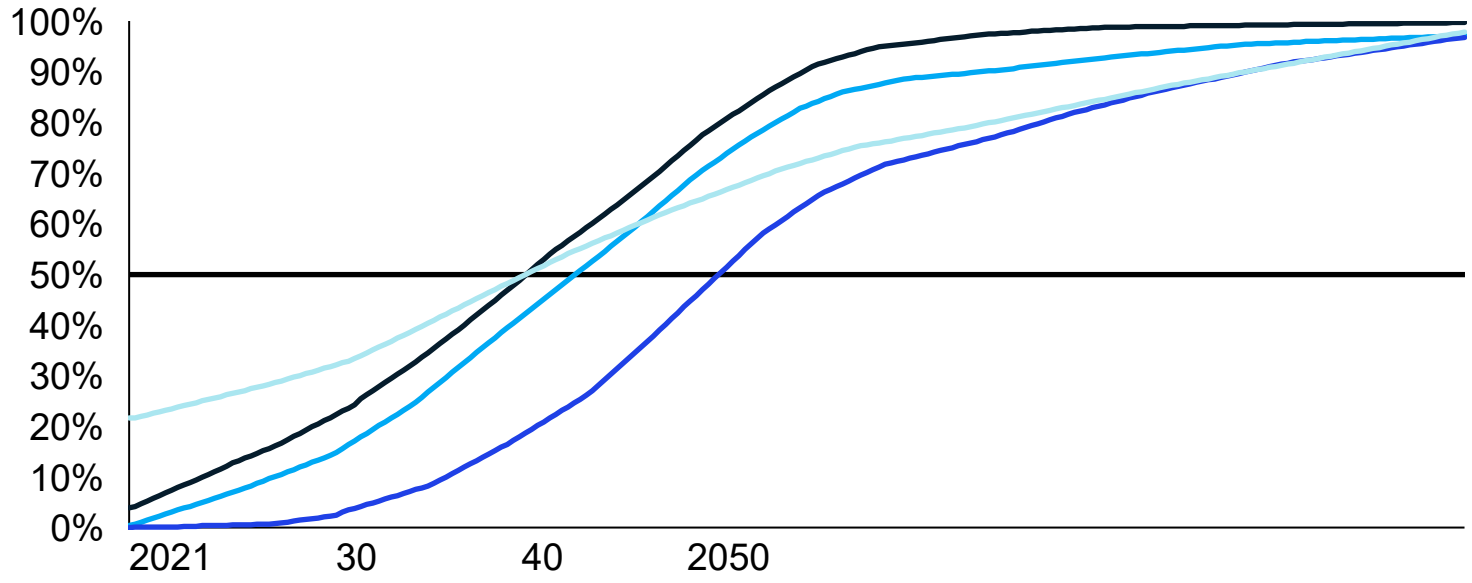
Source: McKinsey Capabilities and Insights

Energy transition and efficiency

EV sales trends project that ~75% of all vehicles on the road will be electric by 2050

EV[1] sales uptake by segment, % of global vehicle sales

- Passenger cars and pickup trucks (weigh <3.5 tons)
- Light commercial vehicles (weigh 3.5 - 6 tons)
- Trucks (weigh > 6 tons)
- Buses includes city buses, school buses, coaches and other buses



1. EVs include battery electric, plug-in-hybrid, and fuel cell vehicles; Combined across US, EU & China

~80%
of passenger cars will be battery electric by 2050

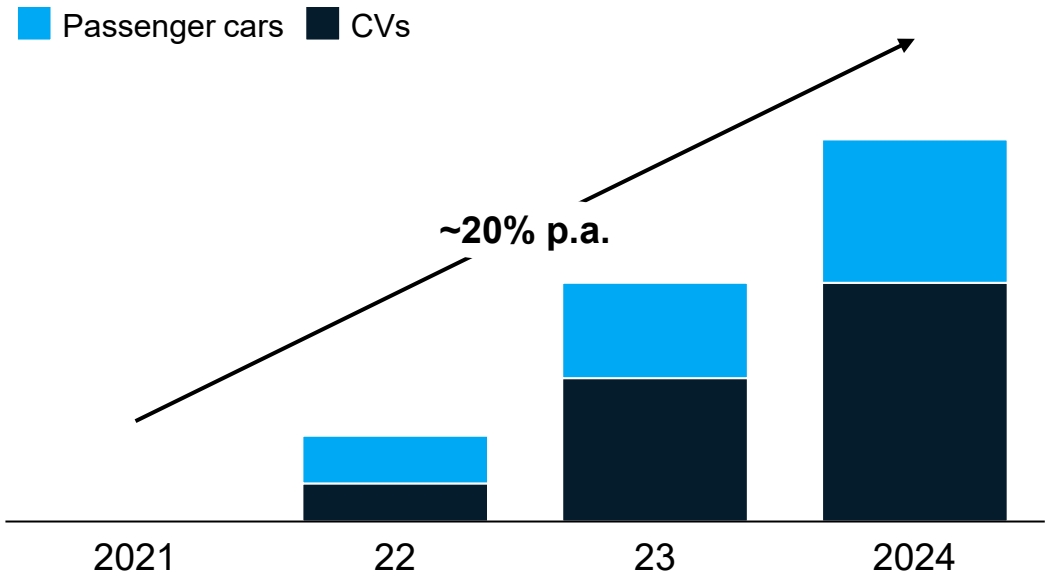
EV purchase intent has substantially accelerated over past year

Leading drivers for increased consideration of EVs include:

- Reducing fuel price risk exposure
- Increased sustainability considerations
- Expectation about rising subsidies for EVs

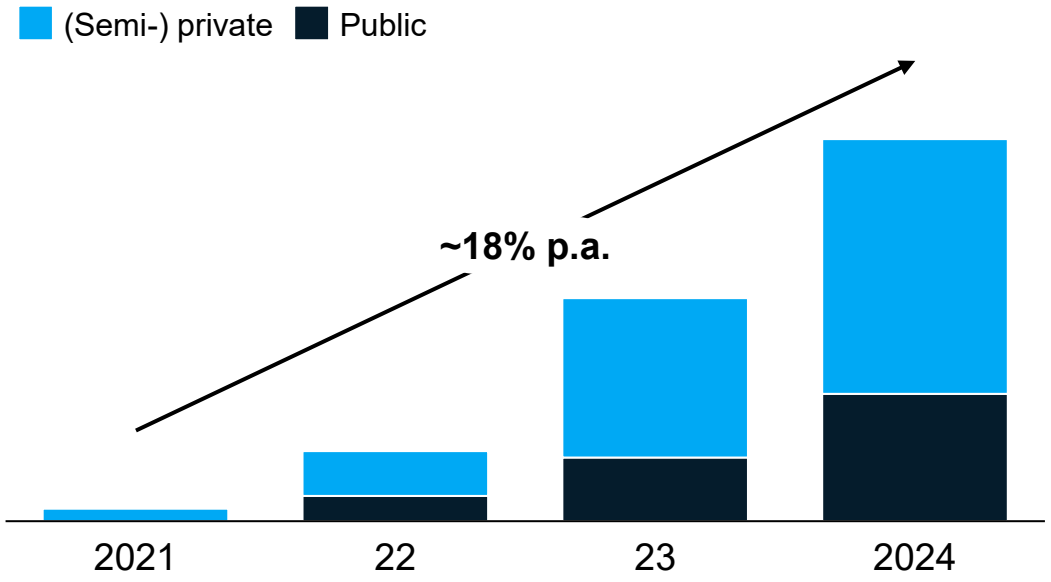
Energy demand is currently growing at ~20% annually until 2050, requiring ~18% annual growth in installed capacity

Global energy demand, TWh



~20% annual growth
in energy demand until 2050 to serve growing electric vehicle fleet

Global installed charger capacity, TW



~18% annual growth
in installed capacity until 2050

Source: McKinsey Center for Future Mobility (2022)

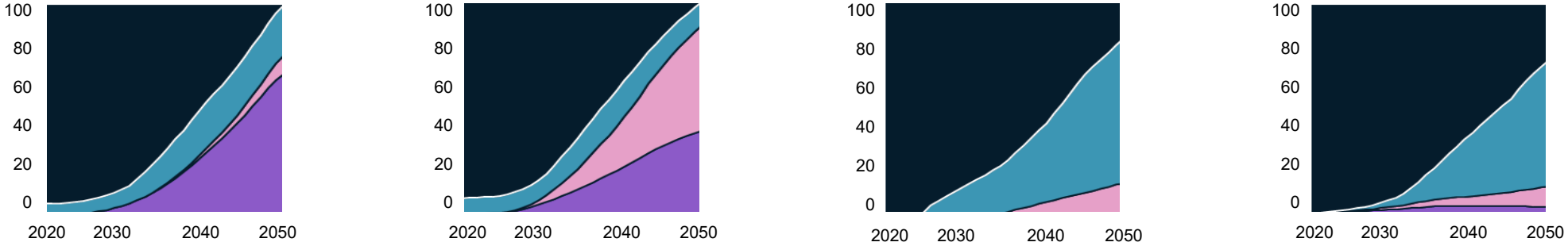
Sustainable fuels could fill gaps in decarbonization and complement electrification

Scenario: backstop for fossil fuels in road transport

Preliminary **Indicative**

X Total demand, in EJ[3] | Fossil fuels | Sustainable fuels, incl. ammonia | Hydrogen | Electricity

Segment	Passenger cars	Commercial vehicles[1]	Aviation	Marine
Outlook for 2020-2050[2]	6.6 4.6 2.1 1.1	3.4 4.0 3.2 2.5	1.0 2.2 2.1 1.9	2.0 2.0 1.9 1.7

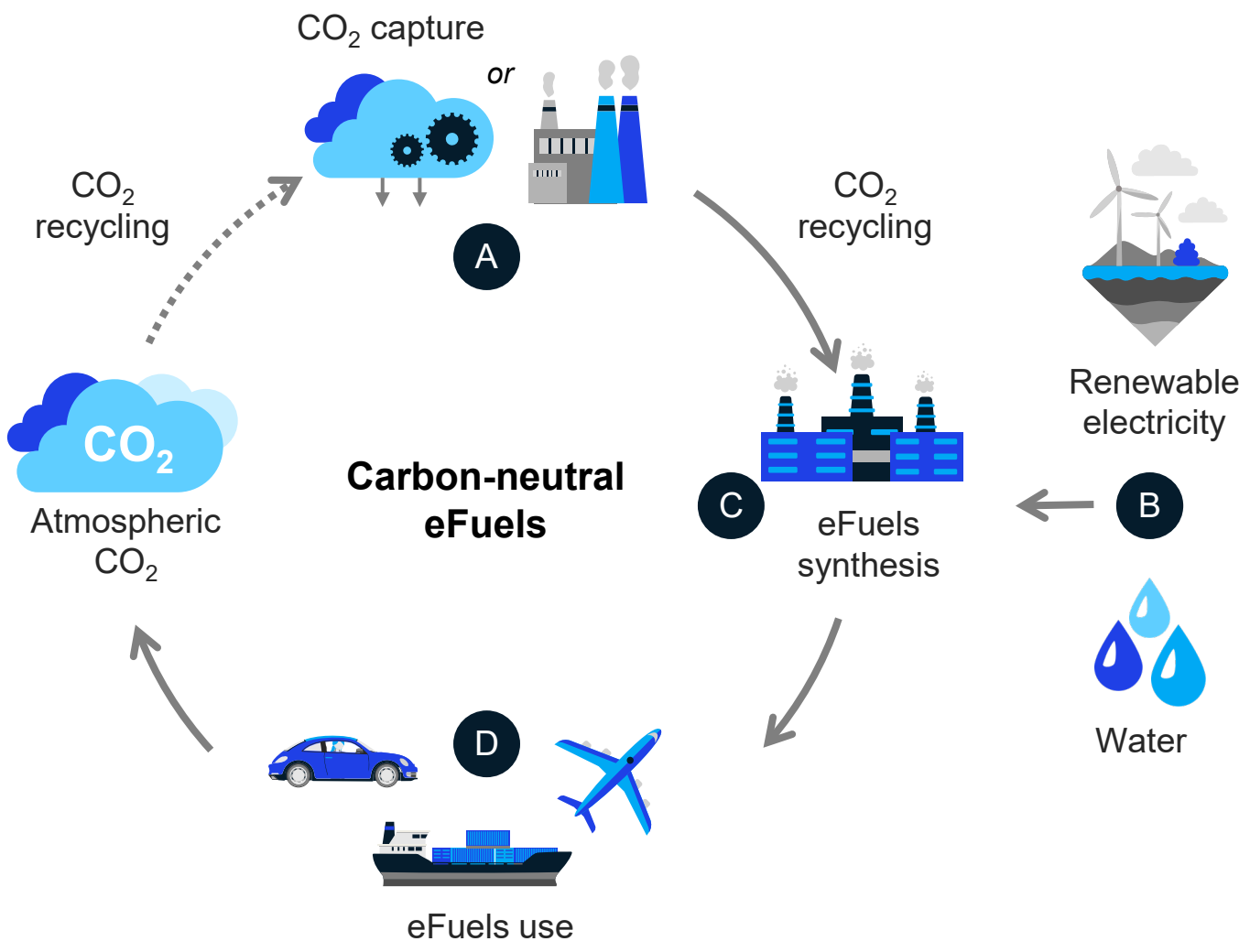


Segment	Passenger cars	Commercial vehicles[1]	Aviation	Marine
Rationale for 2020-2050	**Battery Electric** could gradually become the dominant option, yet sustainable fuels are also needed to meet the emission targets by 2050 and to phase out fossil fuels	Battery Electric is suitable mainly for short-to-medium-range trucks, excluding the heaviest loads with the most challenging driving patterns. The use of **hydrogen** could see a significant increase after 2030.	In aviation, **sustainable fuels** are the only feasible option to replace fossil fuels in wide-body long-distance planes due to the high energy density needs.	In Marine, **sustainable methanol**, R/SNG and non-carbon containing hydrogen derivatives (**ammonia**) are the most suitable energy sources to replace fossils.

1. Includes trucks, buses, and LCVs
2. Accelerated transition scenario
3. Exajoule (1 EJ = 1018 J)

Source: McKinsey Sustainable Fuels service line

eFuels are carbon-neutral and produced from green electricity, water, and captured CO2



- **A** Carbon dioxide (CO_2) captured from industrial emissions as feedstock
- **B** Renewable electricity to synthesize green hydrogen from water
- **C** Captured CO_2 and green hydrogen are combined to produce synthetic eFuels; cleaner than traditional refining
- **D** eFuels replaces fossil fuels. Release of CO_2 completes the carbon-neutral life cycle

EVs have multiple options to "refuel" – Out-of-home use cases possess strongest growth until 2030

Residential
(single & multi family)

Work
(e.g., office, govt property)

Fleet depot
(e.g., vocational, courier)

Public overnight
(e.g., on street/curb-side)

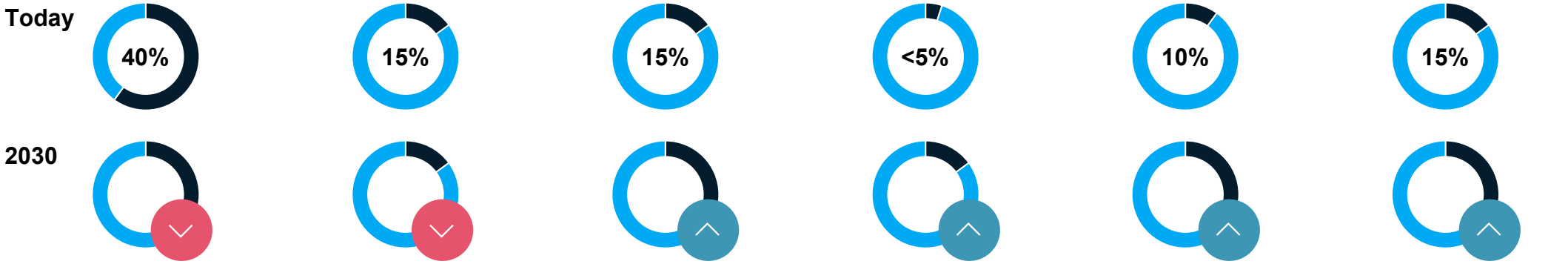
Destination
(e.g., mall, car park)

On-the-go
(e.g., retail EV charging stations)

Charging use case

Residential	Work	Fleet depot	Public overnight	Destination	On-the-go
Private and/or shared parking	Shared parking	Private parking	Public parking	Public parking	Public parking
Multiple hours/day	Few hours during work (2-10 hours)	Charging need dependent on fleet management	Multiple hours overnight (>8hrs)	Few hours during visit (<4 hours)	Quick necessary on-the-go (<1hr)
Wallbox (AC)	Wallbox (AC)	Depending on use case (AC 11kw & DC fast)	(AC 11Kw & DC slow)	AC & DC mostly up to 150Kw	DC fast charging

% of energy charged

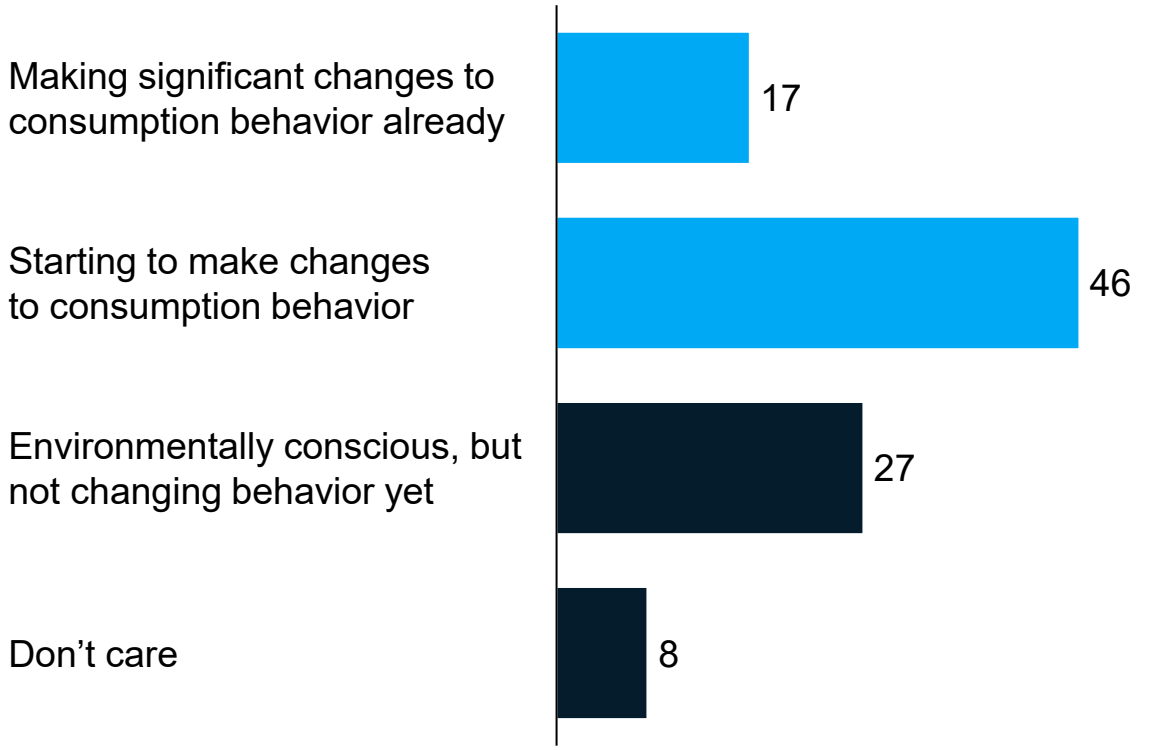


On-the-go use cases

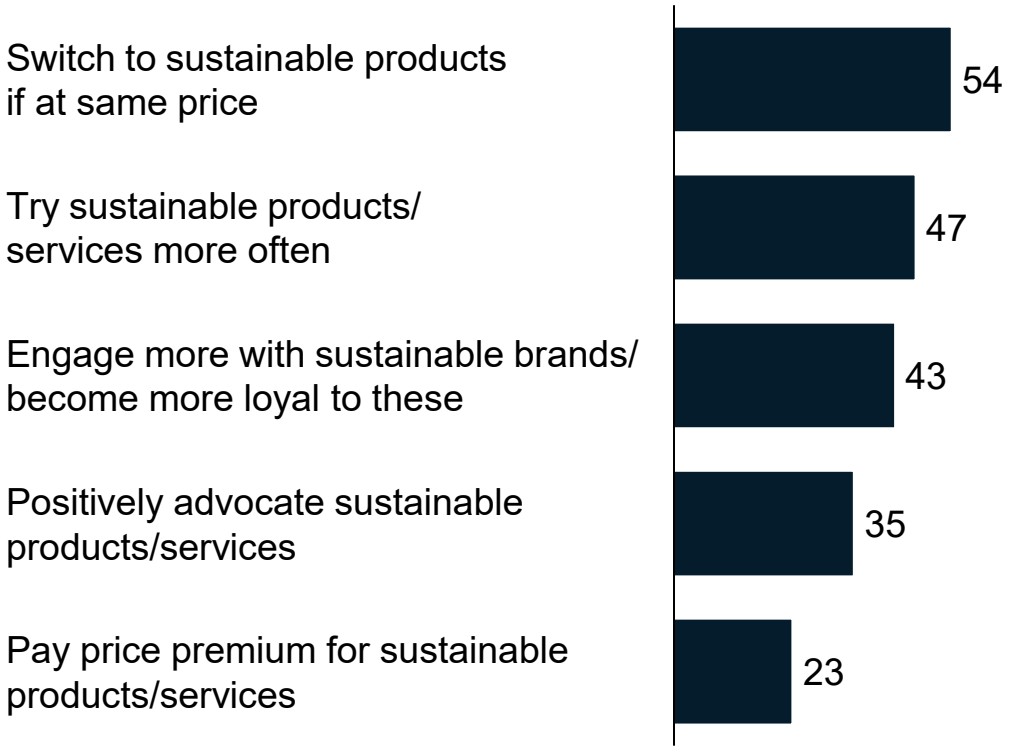
Source: McKinsey Center for Future Mobility (2022)

Sustainability considerations more and more shape consumer behavior and mobility usage patterns

Influence of sustainability considerations on consumption
Share of respondents, globally



Changes out of sustainability considerations
Share of respondents, globally



Source: MCFM Mobility Consumer insights, Annual MCFM consumer survey, dated December 2021, global n = 26,285

Service

Truck-as-a-Service, capacity sharing, and mobile services present potential growth opportunity for fleet operators

Opportunity	Description	Case examples
Truck -as-a-Service	• **Truck-as-a-Service present potential growth opportunity for fleet operators**, offering trucks on a pay-per-mile base and the possibility to extract value from truck idle time through **peer-to-peer truck availability platform** • **Operators can add value from reduced** electric and hydrogen **TCO** through service economy of scale and **asset utilization maximization** of vehicle utilization	fluidtruck **Fluid Truck is an on-demand rental platform offering access to commercial vehicles** (e.g., trucks, vans, electric vehicles), **enabling businesses to grow their fleets, manage employee scheduling, and complete zero-emission** last-mile delivery services without committing to ownership
Commercial truck capacity-sharing	• **Commercial truck capacity-sharing platforms offer businesses the opportunity to generate revenue by listing and renting underutilized commercial vehicles –** ~8 million commercial vehicles in the U.S., ~25% of total, sit idle for more than one day of a work-week[1]	COOP BY RYDER **COOP by Ryder is a vehicle-sharing platform that connects businesses who have idle commercial vehicles** (e.g., vans, trucks, tractors, and trailers) with other trusted companies that need to rent commercial vehicles
Mobile servicing of electric fleets	• **ACE enables mobile service models which aim to meet the needs of fleet users on the road** (e.g., wheel and tire replacement equipment, a crane for lifting heavy objects, and all the tools in between) – various services can save a fleet **up to 10% of their entire operations costs**[2]	TESLA **Tesla has launched an electric fleet of Model S sedans that have been transformed into mobile customer service workshops** • 31% of airbag recalls have been completed by Mobile Service in ~30 minutes on average[3]

1. Fleet Owner
2. Work Truck Online
3. CNET

Source: Press search

Companies can drive adoption by aiming to provide tailored services to consumers based on their usage habits

Rather car-reliant mobility consumers | Green travelers | Sharing & multi-modal on demand users | Constrained or inert mobility consumers

+/- directional indication of expected size of change until 2020

26%

Objectively car-dependent mobilist

"I need a car to master my everyday life but could consider getting rid of it in the long-run"

6%

Sharing queens/kings

"Don't need own car but use multiple shared mobility options"

Leisure driver

"My car gives me freedom and I drive for fun"

8%

1%

Mobility innovation pioneer

"I'm always among the first to try out new disruptive mobility services"

32%

Mobility traditionalist

"I rely on the known and don't like to change my established mobility behaviour"

Multimodal urbanist

"I use whatever is available to get me from A to B as conveniently as possible"

2%

Micromobility enthusiast

"Ride bicycle or e-kickscooter to get around in and out of town"

5%

Cost-constrained traveler

"I need to get from A and B as cheap as possible"

9%

6%

Eco-conscious car complementor

"Still need a car but actively seek to reduce my trips and consider more flexible/sustainable options"

5%

Net-zero conscious traveler

"Actively seek to be emission-free in my mobility behaviour"

Source: MCFM Mobility Consumer insights

Shared mobility today – did you know…

- That over 40 million e-hailing trips are being booked on the two biggest e-hailing platforms every day?
- That auto players made only 5% of all investments in the Shared Mobility Industry?
- That the investments made in the ride-hailing market accounts for over 90% of the investments spent in shared mobility globally since 2010?
- That the number of e-hailing trips almost tripled in four years and the number of micromobility trips more than doubled within one year?
- That >60% of people would share their shared mobility ride with a stranger if the estimated additional travel time is less than 15% and they can save costs?

Source: MCFM Mobility Consumer insights