

MANAGEMENT SUMMARY

Oliver Wyman Study “E-Mobility 2025”

Power play with electric cars

- **Battery electric vehicles will remain money losers for the next several years**
- **Purely battery electric vehicles will only achieve a market share of around three percent by 2025**
- **New business models offer opportunities to gain a successful start in the electric era**
- **The government must commit to massive investments for a “Germany 2025 program for electric-powered mobility”**

Over the next 15 years, battery electric vehicles will barely reach a market share of three percent in the worldwide automotive sector. Substantial extra costs, which presently reach as much as Euro 20,000 for a car in the same category as the Volkswagen Golf, and limited driving ranges stand in the way of broad distribution of these vehicles. According to the recent Oliver Wyman study “E-Mobility 2025,” the current hype about battery electric vehicles should die down, but there’s no way of getting around electric-drive systems in the long run – after all, battery electric vehicles are vital to the automotive industry’s long-term chances of survival. Until then, the industry will be faced with unprecedented investment requirements combined with an extremely limited earnings potential. Particularly during the automotive crisis, the government needs to make massive investments in the German automotive industry in order to safeguard its future viability. Otherwise, emerging markets such as China will be cutting past the Germans.

Despite boastful announcements by automotive manufacturers, the line-up of battery electric vehicles available to date is rather small. In 2009, fewer than 10,000 purely battery-driven cars will be sold worldwide. From an overall market perspective, vehicles like the Tesla Roadster (Tesla Motors) or TH!NK City (Think) are just a drop in the ocean, with a share of less than 0.1 percent of the total car market. Likewise, the worldwide fleet of around 2.5 million hybrid vehicles is a marginal phenomenon in view of the more than 850 million cars in the world. In 2010, just two percent of new car sales will involve dual or partial electric drive. By 2025, their market share will rise to 16 percent – but at that time at least 76 million vehicles, or 84 percent, will still have combustion engines. As a result, cutting down carbon dioxide is and will remain the hot topic in the automotive industry. Today, automakers are already investing about one-third of their worldwide research and development expenditure of some Euro 75 billion on this goal on these efforts, which include both further optimizing traditional combustion drives and developing alternative drive technologies for serial production. In the next ten years, investments in reducing carbon dioxide worldwide will total around Euro 300 billion – of which Euro 50 billion will be spent on alternative drive systems like hybrid or electric.

New vehicle and drive concepts are crucial elements for the automobile. They are also key ingredients for long-term survival in the competition with other transport modes and concepts. Drive electrification will play a decisive role here because it will either support a combustion engine electrically (mild hybrid), partially replace it during vehicle operation (full hybrid, plug-in hybrid) or replace it completely (battery electric vehicle, fuel-cell vehicle). Apart from the mild hybrid version, these new drive concepts enable emission-free driving at least locally. This new electric game does, however, come equipped with many unknown factors: Customer expectations, markets, vehicle concepts, drive technologies, costs, market participants and business models are leading to unprecedented competition, or rather, power play, in the automotive industry. In addition, there is huge uncertainty about future market prospects for the new drives over the next 15 to 20 years.

Range and costs have top priority

A customer survey jointly carried out with the market research company pulis Marktforschung for the Oliver Wyman study “E-Mobility 2025” shows that car buyers are unwilling to make concessions with regard to use, driving comfort or safety. Among the customers surveyed, insufficient range was the primary argument against buying an electric car; only 13 percent would accept a range below 250 kilometers. In the long run, automotive manufacturers and suppliers will have to achieve ranges of up to 400 kilometers to help the electric car escape its small niche and attain broad distribution. This means that all participants must push forward with drive electrification. Cost modeling indicates, however, that production costs for an average battery electric vehicle today exceed those of a car with a combustion engine by a factor of 2.5, or 150 percent. Even in 2025, production costs will still be 60 percent higher. Although electric cars will be cheaper in some traditional vehicle-related aspects – certain components will not be needed or their costs can be optimized for battery electric vehicles – batteries, electric machines and power electronics will push up the price.

But according to the customer survey, only 14 percent of car buyers are prepared to pay more for an electric car. On average, just a mere Euro 2,200 for an “electric car premium” can be achieved. The extra cost is only worth it to the customer when looking at the life-cycle costs incurred. If comparatively low electricity costs are taken into account, a vehicle in the low mid-range with electric drive not only can draw level with a vehicle powered by a combustion engine, it can actually overtake it in a four-year comparison of life-cycle costs: Accordingly, the life-cycle costs of battery electric vehicles will be about Euro 3,500 lower, or around ten percent, in 2025 despite the higher purchase prices. But this will still not be the case in the foreseeable future as electric cars run up additional costs of more than Euro 12,000 while having comparatively high depreciation on the vehicle and, in particular, on the battery.

Automakers have to start making money again

The market for battery electric vehicles will grow, but only slowly. The number of purely battery electric vehicles competing against vehicles with combustion engines will reach only 3.2 million sold units in 2025. By then, there will be about 15 million battery electric vehicles in the market worldwide; this will constitute less than 1.5 percent of the available vehicle inventory at that point. Mild hybrid and full hybrid vehicles will indeed start taking off, but in 15 years they will only gain a joint market share of nine percent. Mild hybrids will, however, develop into a kind of baseline technology for midsized to large vehicles, but full hybrids will prevail, especially in North America and Asia, in particular for sport utility vehicles (SUVs). Plug-in hybrids (market share in 2025: 3.5 percent) are full hybrids with significantly larger batteries that can be recharged by plugging them in and are the better alternative in weighing costs and benefits. Plug-ins could expand wherever distances of several hundred kilometers are combined with the possibility of purely electric driving up to 50 kilometers. With this approach, a standard drive system is in operation for the long distances over the countryside and a purely electric drive handles city driving. In the small vehicle segments such as Opel Corsa or Smart Fortwo, the purely electric drives are effective wherever the

daily distances usually do not exceed 60 to 80 kilometers. Purely electric cars in vehicle segments higher than mid-sized, such as the Mercedes Benz E-Class, no longer play a significant role. An exception are small vans that cover short distances in the city while delivering goods or bringing trade workers to their job sites.

In light of lower unit expectations for upcoming years, high investment demand and excessive extra costs for battery electric vehicles, the question of battery electric vehicle profitability becomes particularly pronounced. An illustrative calculation for a battery electric vehicle in the Golf category from the recent Oliver Wyman study shows that despite the Euro 3,000 “electric car premium” that can be realized on the market, an automaker today would lose about Euro 12,000 on such a vehicle. For the next ten years, battery electric vehicles will, on the whole, remain a losing proposition along the entire value chain. The profit-making value-added steps are those up- and downstream of the car sale. Upstream, there will be a new market of innovative, highly sophisticated electric-drive components. The market for lithium ion batteries, electric machines and high-voltage power electronics will reach a total of about Euro 80 billion in 2025. This constitutes around seven percent of the total component value added in the automotive industry. Downstream, countless new, compelling opportunities are emerging that automakers must take advantage of to offset losses along the value chain, or at least minimize them, over the coming years. In this area, utilities, whether as competitors or partners, will play an increasingly important role for manufacturers in terms of bundling such products as special “car power packages” or leasing packages.

Government action needed

Two key drivers can be identified for increasing broad distribution of battery electric vehicles: The first driver considers life-cycle costs: There can be no cost disadvantages that result from daily use of the vehicle. As a consequence, broad distribution does not just depend on significant cost degression with respect to the battery and the related depreciation of the battery electric vehicle, but also from further increases in oil and fuel prices. In the second driver, government and municipalities are now coming into play. If they provide support for the purchase and operation of battery electric vehicles or restrict combustion drive, this will have a considerable impact on sales of battery electric vehicles. Great Britain, will, for example, begin providing Euro 2,500 to Euro 6,000 in support for the purchase of a battery electric vehicle starting in 2011. China will offer Euro 6,500 and Japan as much as Euro 11,000. The government will become a new, key participant in the power play of national interests. And he asserts: An ‘e-car premium’ of up to Euro 10,000 should be awarded for the purchase of a battery electric vehicle. In addition, a waiver of the sales tax, motor vehicle tax or sales tax on the power consumption of the battery electric vehicle can be implemented for new sales. Considered more of a temporary initial financing, these tools can be teamed with attractive concepts for downtown traffic such as joint use of the bus lanes and special parking areas for battery electric vehicles. A more drastic impact is achieved through tolls on downtown driving or access limitations for vehicles that emit CO₂.

A Germany 2025 program for electric-powered mobility is required. Germany and the German automotive industry as a key industry must continue to be able to lead the way in technology, including for battery electric vehicles. Think big is the motto here. We’re talking about a subsidy totaling Euro 15 billion distributed over the next ten years. The current subsidy program is not sufficient to play the leading role in the electric power play among countries. Similar to the “100,000 roofs program” for solar roofs at the end of the 1990s, a “1,000,000 e-vehicle program” is now needed to make buying a battery electric vehicle more attractive in the coming years despite the significantly higher sector purchase price and depreciation. The government needs to focus its research and industry policies on electric mobility to keep pace. Furthermore, it must begin comprehensive marketing efforts for electric mobility emphasizing society’s responsibility for sustainability.

Benefit from new partnerships

Up-and-coming car nations like China not only have the ability to launch an offensive against established automotive companies with the electric car. No one should underestimate China – especially not in the current auto crisis that is hitting established players quite hard. Over the long run, competition will not come from Germany, but from the Far East. This applies to the key technologies of the electric drive system – especially battery cells and power electronics – as well as the battery electric vehicles themselves. To ensure the basis for strategic suppliers, automakers must buy stakes in component suppliers, particularly for battery cells and modules as well as for valuable key components of the electric machines such as permanent magnets.

In view of the immense investments that all participants will have to make in the coming years, the focus now is establishing new partnerships and cooperations. An automaker's vertical partnerships with key strategic suppliers and research institutions should be supplemented with horizontal cooperations between manufacturers or suppliers in order to create an extensive network for electric mobility. Through expanded or new business models, suppliers and engineering service providers can leverage opportunities and develop new profit areas with electric drive. In the process, company mergers or acquisitions will play a key role. Players that do not stem from the traditional automotive supplier group, such as consumer electronics companies, are important for securing production expertise for the large lot quantities involved in manufacturing batteries. Established players in the traditional combustion drive area also have the challenge of effectively balancing the major step of electrifying the drive train while also making further investments to achieve competitive advantage with the combustion engine today in order to maintain this edge for as long as possible.

The ten-point agenda “E-Mobility 2025”

- 1. Brand management**
Systematically align the strategy for electric mobility with the brand position and the brand-specific innovation strategy.
- 2. Market understanding**
Expand market understanding for “electric” and relevant sector indicators as well as define pertinent market scenarios and alternative/optional strategic approaches.
- 3. Product portfolio**
Selectively introduce to the product portfolio alternative drive concepts and specific vehicle designs according to vehicle segment.
- 4. Mobility proposition**
Create new downstream products and added-value services related to battery electric vehicles in order to address additional profit areas of electric mobility.
- 5. Cooperations and M&As**
Ensure access to key technologies and partners through vertical and horizontal cooperations as well as company mergers and acquisitions.
- 6. Expertise focus on research and development (R&D)**
Significantly expand “electric” as an R&D core competency of manufacturers by shifting R&D resources and budgets – the goal is 10 percent to 15 percent for battery electric vehicles.
- 7. Investment focus on production**
Invest in the production of valuable electric-drive components, including establishing a transformation plan for traditional component and aggregate plants.
- 8. Supplier businesses**
Expand new supplier business models for key components and systems, including by working with suppliers outside of the automotive industry.
- 9. Government support**
Initiate a government support program similar to a “Germany 2025 program for electric-powered mobility” – on a scale of about Euro 15 billion.
- 10. Communication**
Undertake company-wide, integrated market communication about the potentials and realities of electric-powered mobility.

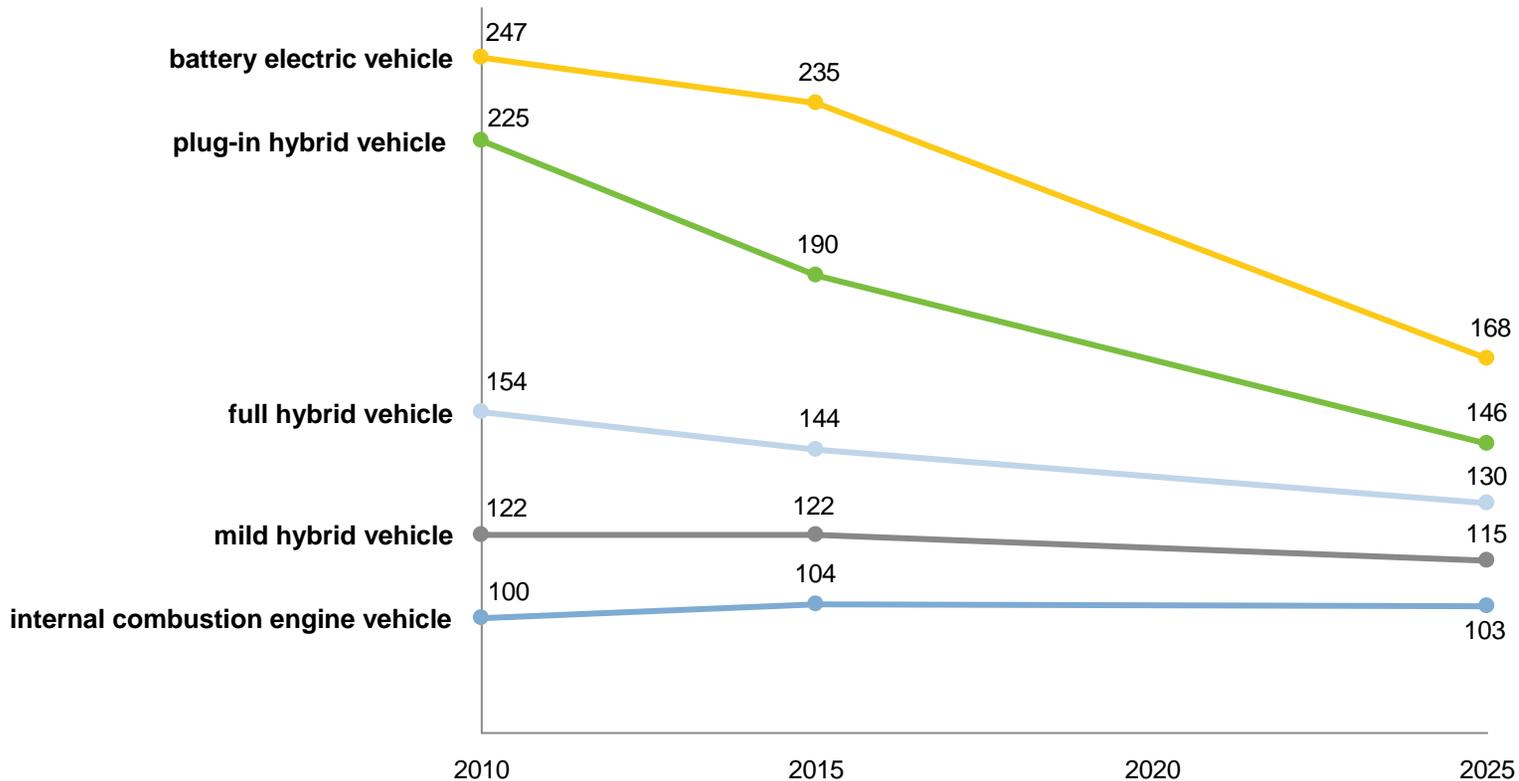
The study “E-Mobility 2025”

For the study “E-Mobility 2025,” Oliver Wyman surveyed experts along the entire value chain of electric mobility manufacturers, suppliers, service providers, energy providers, government ministries and research institutions between February and June 2009. Oliver Wyman carried out the end-customer surveys in conjunction with pulis Marktforschung. The subjects included customer expectations, market potential, technology trends, cost trends, business models, winners and losers. Following the survey, its results were supplemented with comprehensive secondary research and detailed model calculations.

Despite significant cost depression, manufacturing costs remain significantly higher than combustion vehicles in 2025, especially for battery electric vehicles

Vehicle manufacturing costs by drive technology

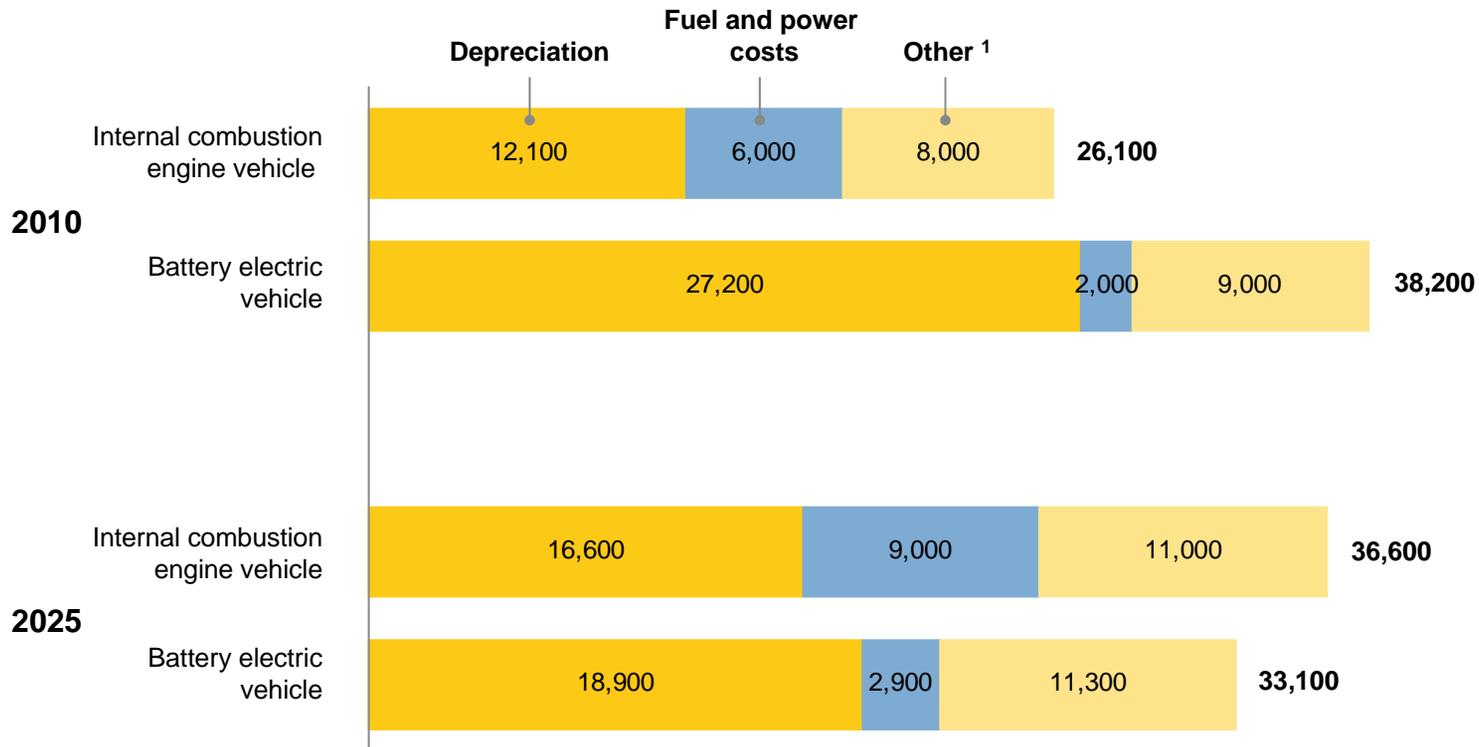
Average passenger car, internal combustion engine vehicle 2010 = index 100



Source: Oliver Wyman study "E-Mobility 2025"

For the end customer, battery electric vehicles today are nearly 50 percent more expensive than combustion vehicles – due to depreciation of the vehicle/battery

Total cost of ownership: battery electric vs. internal combustion engine vehicle
In Euro, average car, usage: 4 years, 15.000 km per year

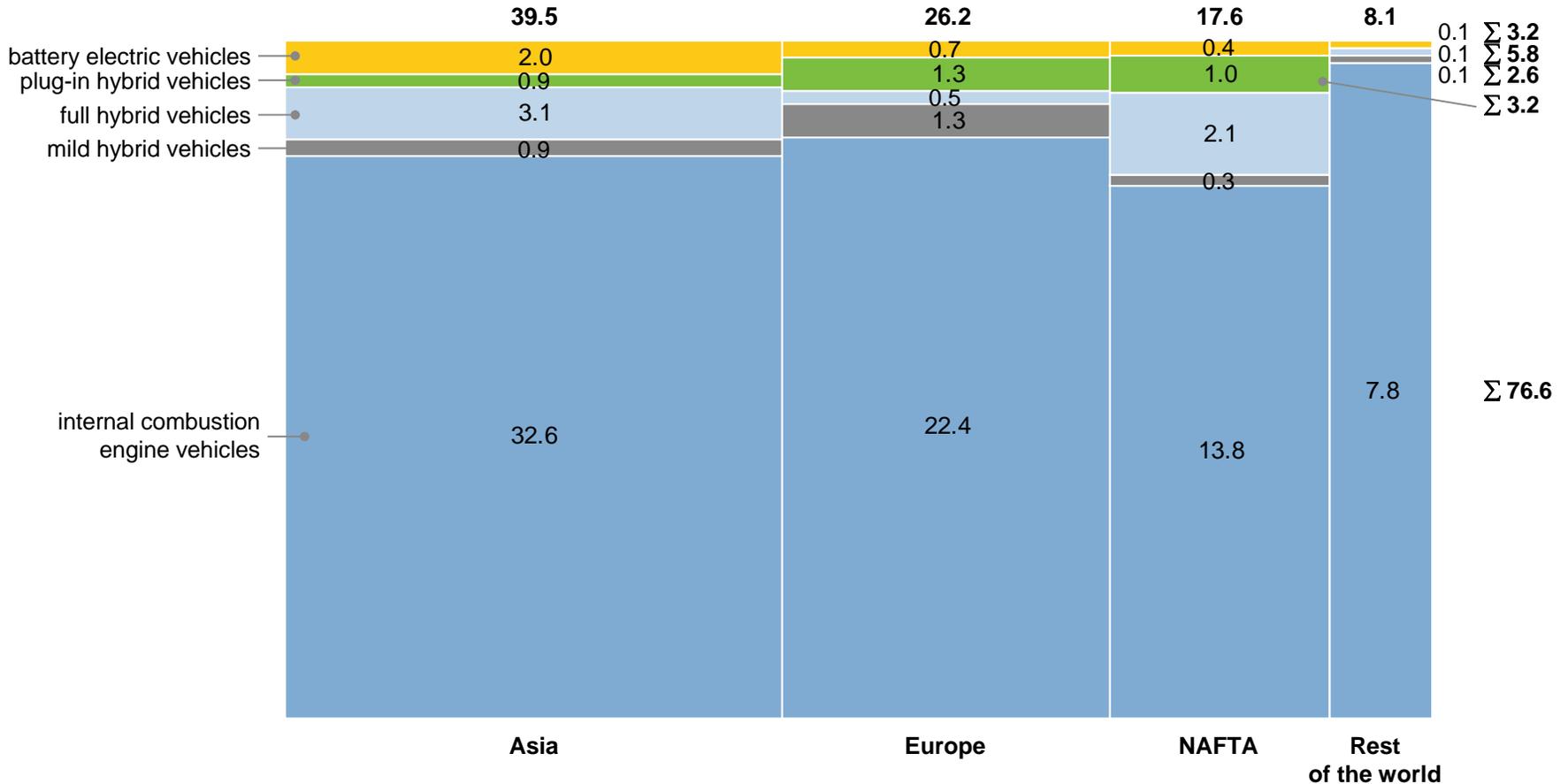


¹ Fix costs (incl. tax/insurance), service and repair, car care
Source: Oliver Wyman study "E-Mobility 2025"

In 2025, a maximum of 3.2 million battery electric vehicles will be sold worldwide. Asia is the primary region for the sale of alternative drive vehicles

Vehicle sales by drive technology and region – 2025

In million units, light vehicles¹



¹ Including pickups, vans based on passenger cars and micro vans (without vans)
Source: Oliver Wyman study "E-Mobility 2025"