FRIWO

WHITE PAPER

Smart System Solutions for the Next Generation of Electromobility

White paper and checklist: What matters when selecting power supply and drive solutions for electric scooters and motorbikes

Four Perspectives on Electromobility That You Should Be Aware of as a Provider of Electric Scooters and Motorbikes

1

The global market for electrically powered 2-wheelers is predicted to see year-on-year growth of at least 25 percent. China, India and Indonesia are becoming the largest sales markets for electric scooters and motorbikes.

2

Unlike conventional 2-wheelers with combustion engines, the performance of electrically powered vehicles depends largely on the drive train and the ideal combination of components.

3

Providers of electric scooters and motorbikes aiming for a quick go-to-market should rely on a system partner who can provide both technical and conceptual support.

4

Smart system solutions for electric mobility include the motor, control unit, battery pack, battery management system and the vehicle control unit (VCU) – configured according to a best-of-breed approach in cooperation with first-class manufacturers.

Electric 2-Wheelers Develop Into a Multi-Billion Market

Long before Tesla became a pioneer in the field of electric cars, a small revolution was taking place in another area of electromobility: bikes and other 2-wheelers. With a sales volume of around 15 billion euros, the E-bike market is certainly one of the winners of the E-mobility revolution. But other vehicle segments, especially electric scooters and electric motorbikes, are now true growth champions.

Global market for 2-wheelers

7%

Overall market

7% growth p.a.

25%

E-Mobility market

25% growth p.a., driven by China, India and Indonesia

Like many industries, the overall market for vehicles – mechanical, motorized and electric – was shaken due to the Covid-19 pandemic. However, the long-term prospects are bright. The market for bicycles, scooters and other 2-wheelers is benefiting from the micromobility trend and is expected to grow by 7 percent annually. The forecasts for electrically powered products such as electric scooters and electric motorbikes are even better: experts predict growth rates of at least 25 percent, primarily driven by the high demand in the mega-markets of India, Indonesia and of course, China.

The Heart of Electromobility: The Drive Train of the 2-Wheeler

A central and technically complex element of every electric 2-wheeler is the drive train. This consists of the following components:

- Motor
- Battery Pack
- Motor Control Unit (MCU)
- Battery Management System (BMS)

The drive system can also be supplemented with additional functionalities via a Vehicle Control Unit (VCU) and an intelligent display. Finally, a suitable external charger rounds off the system.

The real "muscle power" of an electric 2-wheeler is determined by the size and power of the motor and battery pack. However, the intelligence for optimal control of the drive lies in the Motor Control Unit (MCU), Battery Management System (BMS) and Vehicle Control Unit (VCU).

While the right drive technology plays a significant role in the performance of conventional vehicles with combustion engines, choosing the right system is an even more crucial decision in electromobility. The great possible performance efficiency and ideal Total Cost of Ownership (TCO) can only be achieved when all components of an electrically powered vehicle are perfectly coordinated.

The system partner concept: What's behind it?

System providers in the E-mobility sector supply all the components required for a modern electric drive train from a single source. In addition to the hardware components, the offering of a system partner also includes the associated control and service software.

For e-scooters and electrically powered motorbikes, the precise selection and detailed coordination of the individual components is a decisive success factor. From a customer's perspective, an unparalleled driving experience can only be enjoyed when all the building blocks are in perfect harmony with each other.

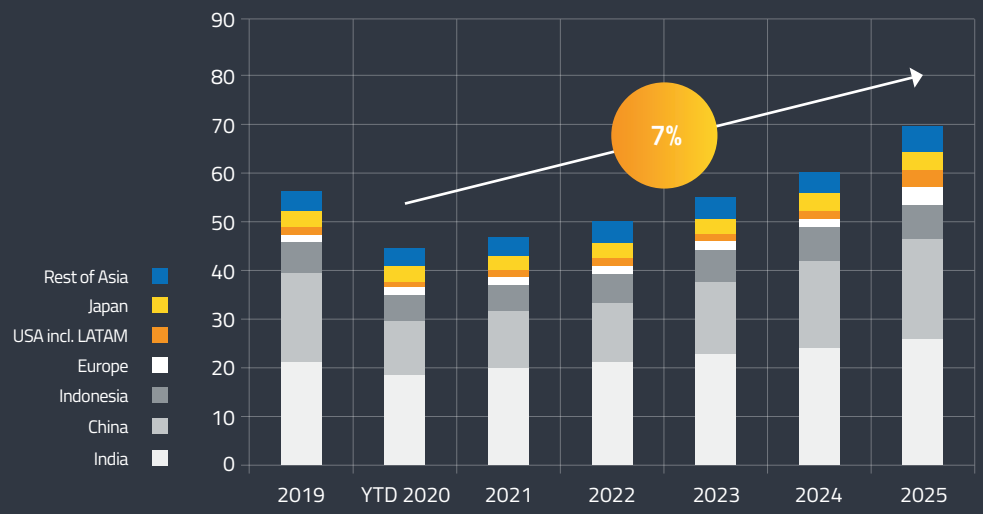
In particular, innovative start-ups and established providers aiming for a rapid go-to-market rely on the system partnership concept to gain a development edge and launch unique products with the help of flexible drive and control systems.

The Market for E-Scooters and Motorbikes Is Growing 25% Per Year

The segment of E-scooters and motorbikes is developing rather dynamically, with a large number of players in the market. Compared to the 4-wheeler market, the 2-wheeler sector is characterized by several different providers and numerous start-ups.

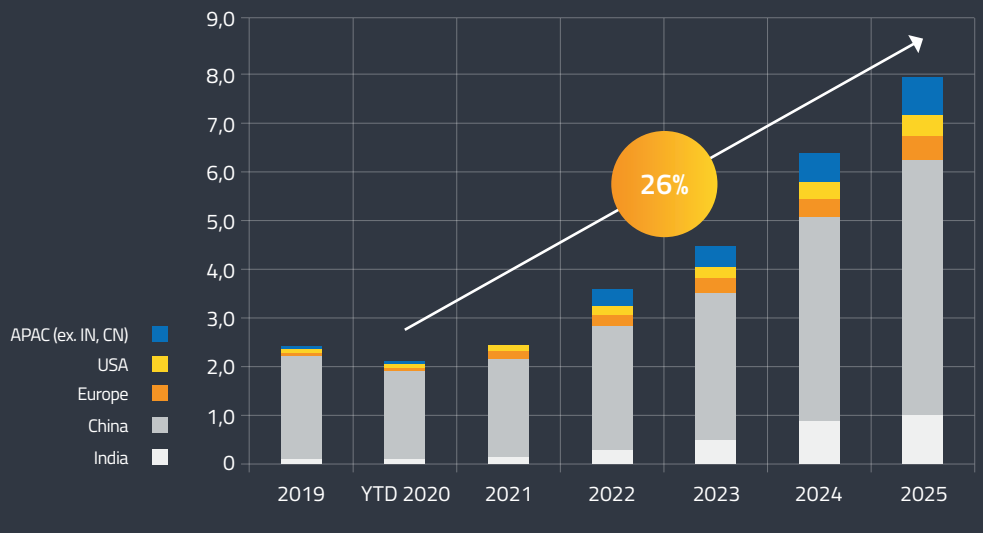
Despite the high demand dynamics, the 2-wheeler market came under short-term pressure in the wake of the Covid-19 pandemic – as did the market for electric 2-wheelers. However, experts continue to predict bright growth prospects for the E-mobility segment featuring E-scooters and motorbikes, which will grow by at least 25 percent per annum in the medium to long term.

Global market for 2-wheelers



Source: FRIWO Analysis

Global market for electric 2-wheelers



Source: FRIWO-Analyse

From E-Bikes to Performance Motorbikes: The E-Mobility Market Matures and Becomes More Structured

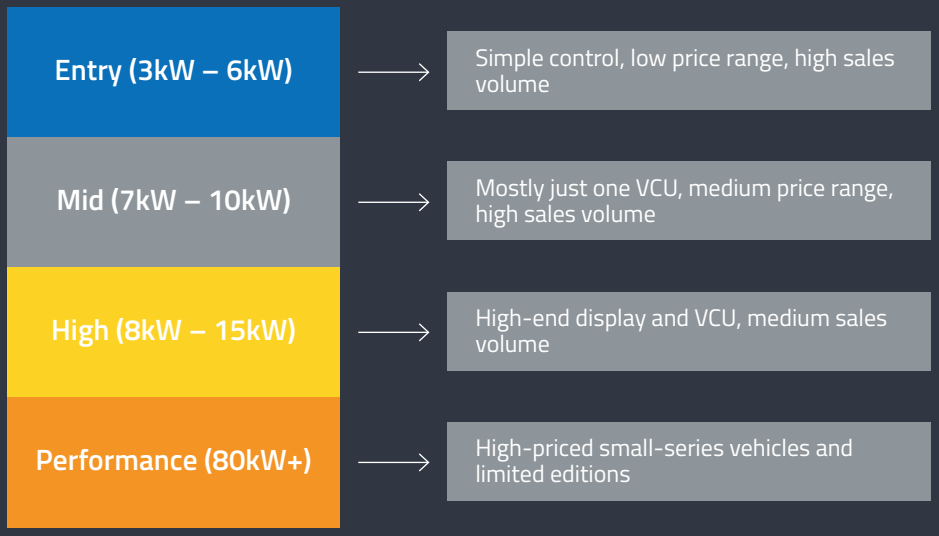
The market for E-mobility 2-wheelers is divided into four segments:

- **E-Bikes** (also called Pedelecs), which are battery assisted bikes
- **Standup E-scooters**, which are mainly used in the context of ridesharing services
- **Seated e-scooters**
- **Electric motorbikes**, which feature more powerful engines and higher reach

The first two are less powerful with a maximum speed of 20 km/h, not as complex, do not require a license and can be used by people aged 14 and over.

On the other hand, e-scooters and electric motorbikes place far higher demands on the drive train and in most cases require a valid driving licence. Since these vehicles are also used in road traffic, providers must take many of the requirements for these vehicle classes into account during development.

Depending on performance and price, these vehicles can be divided into four further categories:



The vehicles in the entry-level segment are usually intended for regional commuter traffic, which serves the sole purpose of getting from A to B. The market for such vehicles is predominantly in emerging countries with a high sales potential.

The vehicles in the mid-segment already offer significantly higher performance and are geared towards individual mobility and driving pleasure. They are primarily aimed at drivers who want a sustainable yet unique means of transport both for urban and non-urban areas with easy off-read capability.

The high and performance segments offer considerable increases in performance. These vehicles promise performance characteristics equal to those of their combustion engine counterparts – with a guaranteed environmentally friendly and sustainable driving experience. Prices are noticeably higher and quantities are usually limited.

Checklist: What to Look for When Choosing Your System Provider

Compared to a conventional drive train for vehicles with combustion engines, the electric alternative is simple in design, at least at first glance. This enables smaller companies to quickly develop innovative vehicles ranging from E-scooters to off-road and commuter motorbikes.

Although engineers don't have to worry about potentially outdated platforms, many providers are failing to meet a very different challenge in the E-mobility sector: getting the desired performance out of their vehicles.

To help you make the best decision when choosing your system provider, we have compiled the most important steps for you in the following checklist.

☐ **1. Identify your target market segment**

As a provider, you should first identify the intended target market according to the segmentation described above. Only then should you select the platforms you need to address the respective market segment.

☐ **2. Determine the price range**

Analyze your target market carefully and determine your customers' willingness to pay. Based on this, you can calculate the target sales prices for your future vehicle models.

☐ **3. Define your business model**

Once you have defined your target market and the price range you are aiming for, you can start defining your business model: Will you rely on your own brand or a white-label product? Will you sell directly or through partners?

☐ **4. Select suitable components**

As a manufacturer, you should now focus on the electronic components of the drive train. Which motor family is suitable? Which battery pack supports an optimal product-market fit? How do you achieve optimal scalability?

5. Come to a make-or-buy decision

Identify the scheduled time for your product launch and calculate backwards: Do you have enough time for in-house development – and do you have sufficient know-how? Then decide on in-house development vs. outsourcing.

6. Choose the right system supplier

Many start-ups and fast-growing providers of electric 2-wheelers rely on a system partnership for time and budget reasons. Choose a partner who can demonstrate many years of extensive experience in the E-mobility market.

7. Get your time, project and cost plan approved

The make-or-buy decision and the choice of system partner are crucial factors influencing your overall costing. Plan your time and financial framework carefully and secure the buy-in of all stakeholders and decision-makers.

8. Start your project

Your plan only becomes a finished product when you get the project up and running together with the system partner of your choice. Rely on a cooperative partnership from day one of your project.

Many E-mobility manufacturers try vertical integration by developing everything in-house. We know from the history of the automotive industry that many OEMs have burnt their fingers trying to develop electronics and software internally. If you don't have a major investor in the background, you can make faster progress by working with a reliable system partner.

When designing a vehicle, it is essential for an E-mobility OEM to consider the total cost of ownership (TCO) and not just the initial investment.

How FRIWO Helped the E-Scooter Start-Up Brekr Achieve Go-to-Market in Record Time

The E-mobility start-up Brekr started developing Model B with the aim of launching an electric moped that surpasses all other models in terms of design and technology. When the two E-mobility enthusiasts and start-up founders Jasper Hagedoorn and Niels Willems wanted to turn an ingenious idea into a highly innovative product, it soon became clear that having reliable partners is essential for technical feasibility.

Brekr started to search for the most important technical components during the design process. The team was looking for a powerful motor, a battery with optimum capacity and a controller that would control them efficiently. After testing numerous battery systems, controllers and motors, FRIWO emerged as Brekr's system partner of choice.

As one of the few technology partners, FRIWO offers holistic system solutions. The decision was made after just a few discussions. FRIWO supported Brekr from the very beginning in developing the system to ensure optimal performance.

"We directly felt FRIWO's desire to develop a first-class product with us. The enthusiasm for the Brekr Model B was sincere", confirms the Brekr team.

Technical Specifications

Motor	2,500 – 4,000 watt hub motor
Battery	2.0 kWh Li-Ion
Frame	Aluminium
Operating range with 1 battery	50 – 80 km
Operating range with 2 batteries	100 – 160 km
Speed	25/45 km/h
Weight	78 kg (incl. 1 battery)

Download the complete success story

For further details about the cooperation between FRIWO and Brekr, read our comprehensive success story. Click here to download it for free!

GO TO SUCCESS STORY

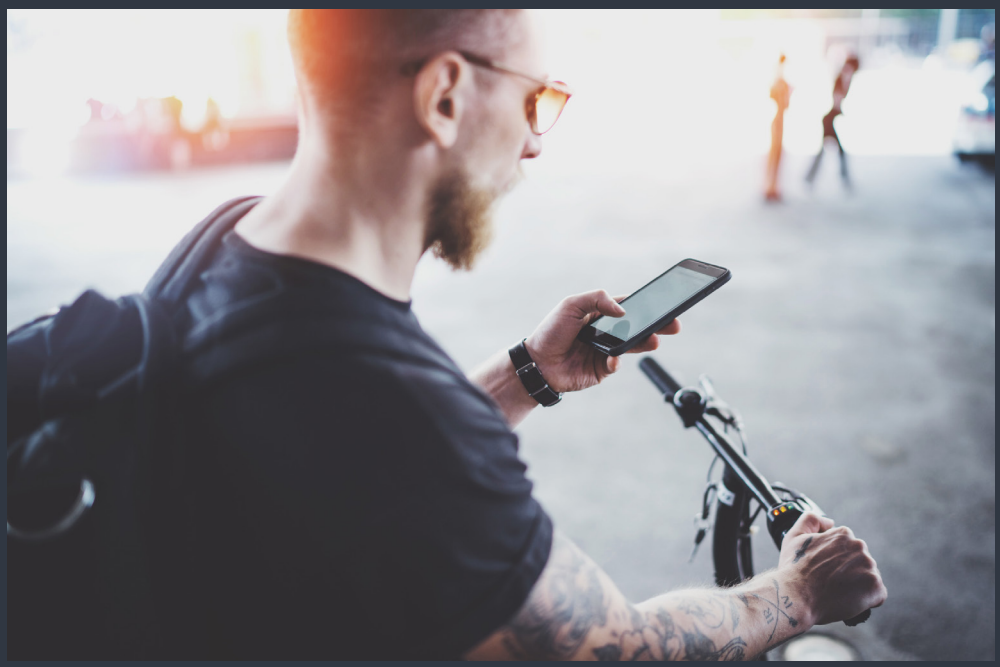
FRIWO as a Partner for Smart Power Supply and Drive Solutions

In order to tap the full performance potential of motors and batteries, it is not only a matter of having a high-quality MCU and BMS. A system provider must also have distinctive expertise in the area of vehicle dynamics and electronics. For this reason, it is important to have a partner with highly qualified experts who can provide you, as an E-mobility provider, with optimal support in covering your specific requirements in terms of functionality, integration and performance tuning.

Together with you, a system provider identifies the requirements of your end customers and suggests the right combination of drive train components to ultimately achieve the targeted performance class.

Proven Engineering Know-How Meets Global Scalability

FRIWO is the only system supplier specializing in the 48V 2-wheeler and 3-wheeler markets. We not only supply the complete set of components for the electric drive train; we also offer our customers all-round services and support – from prototyping to production. With a global development organization and production capacities in Germany, India and Vietnam, FRIWO combines proven engineering know-how with global scalability.



FRIWO produces all components in a scalable format so that manufacturers only need to configure the power supply and drive solutions with a simple GUI software tool. All the necessary parts are already integrated; only the specific functions are activated using secure software. This way, manufacturers are able to develop completely new business models, where value-added functions can be activated by the dealer after paying an additional fee or via a subscription.

While the majority of critical components are designed and manufactured in-house, we have a strong partner network to complement our portfolio. This makes us a one-stop-shop provider. Our partners are located across the globe, enabling us to support all regions quickly and reliably.

Eight reasons why FRIWO is the right system partner for you

1	Specialization in the 2- and 3-wheeler market and 48V applications
2	Global development organization that ensures optimal development costs
3	Company development center in Germany that promotes innovation
4	Product facilities at three major locations to ensure maximum availability
5	Agile organizational structure with short decision paths
6	Focus on premium products
7	Long-standing, reliable partners and distributors
8	Co-marketing support for our customers

How Can We Help?

FRIWO offers innovative power supply and drive systems to ensure unlimited mobility. Discuss your ideas and projects directly with our E-mobility expert:

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FIND OUT MORE

You can find further information on smart system solutions for sustainable mobility on our website.

www.friwo.com