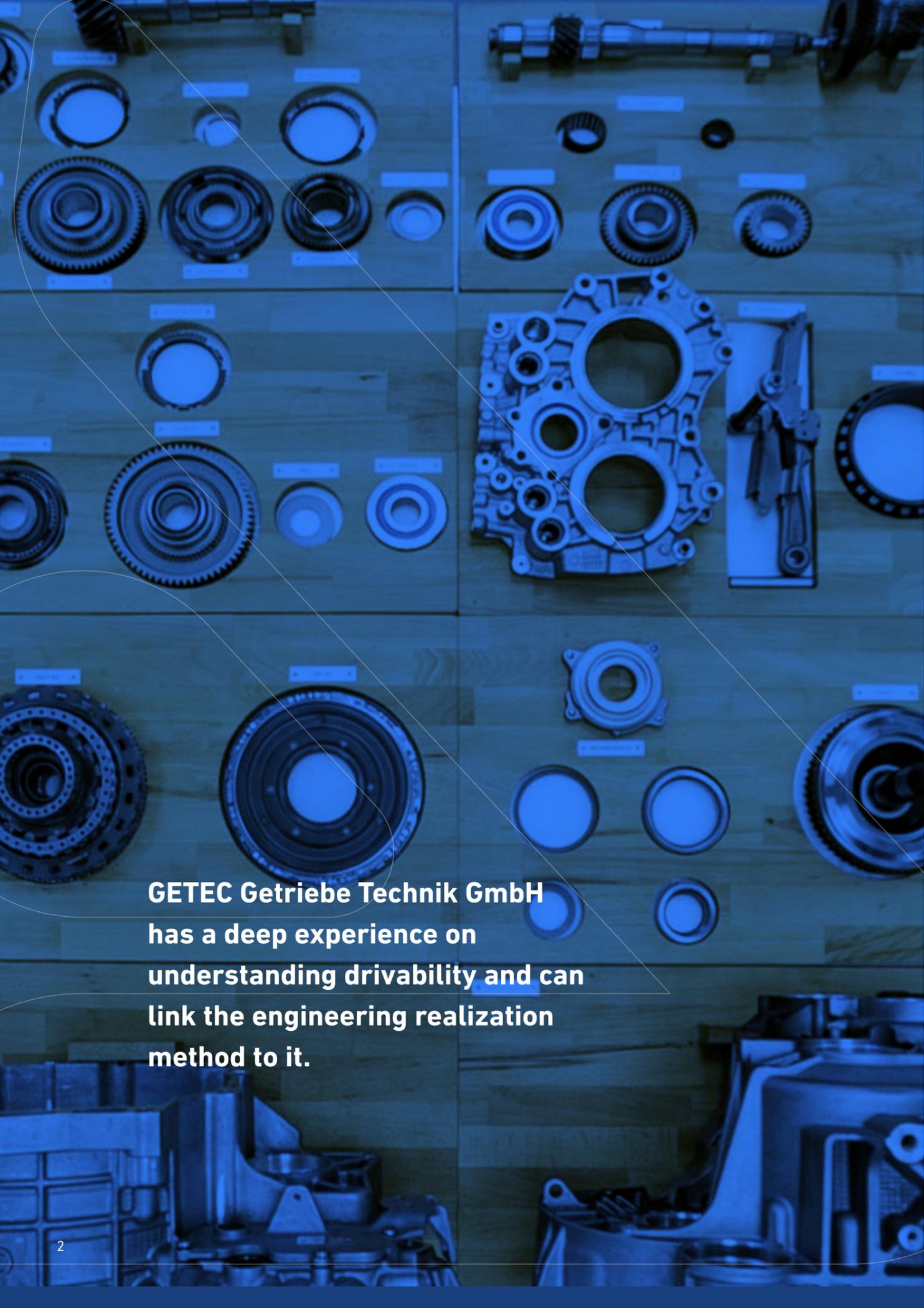


# NEWSLETTER

English Version | 09/2020

**ADVANCED  
TECHNOLOGY**

Early Stage System Verification



**GETEC Getriebe Technik GmbH**  
has a deep experience on  
understanding drivability and can  
link the engineering realization  
method to it.

## Greetings

Author: Mr. Sven Steinwascher | Managing Director / CTO

2020 will be forever remembered as one of the most challenging years in history. The impact of Covid19 to the worldwide economy has been massive and this will be noticeable for a long period. The Chinese market has passed the watershed and the business is returning back to normal. I personally joined the TMC 2020 – the first non-virtual transmission related conference in China. I am personally proud that my speech “Application of Virtual Road Load Data (VRLD) for the development of an EV / REEV / DHT Product Family” has met the interest of the audience. During the past months we have seen that the development of the pandemic and the following business resumption in Germany has followed the situation in China by a delay of three months. Therefore, we are globally looking for a positive business closing of the year 2020. Herewith I would like to specially thank our global GETEC family for the highest dedication to the projects even during those difficult times!

One mayor positive outcome of the pandemic is an increased awareness for the requirement to protect the eco-system of our earth. The transition to emission free transportation will be definitely accelerated. The bridge technologies like plug-in hybrid vehicles (PHEV) and range extender electric vehicles (REEV) will see a market boost. Next generation’s powertrain solutions and products for battery electric vehicles (EV) and fuel cell electric vehicles (FCEV) must be available for application in vehicles in a faster time. Even with the highly increased



demand for sustainable transportation the core of the products acceptance besides value for money is the end-customer’s satisfaction. Here the attributes driving pleasure and performance feeling of the vehicle are counting and defining the market success of a product.

GETEC Getriebe Technik GmbH has a deep experience on understanding drivability and can link the engineering realization method to it. Within this newsletter Mr. Wuyin Hui from GETEC Vehicle Technology (Suzhou) will give a deep insight into the requirement and concept development. Linking the results from benchmarking and our excellent experience on control (from strategy mapping to detail actuator control) enables us to evaluate the concepts performance via our application and CAE expert team. This ensures that the concepts are fitting the requirements of the target market, policies & rules, NVH, cost target, package limitation and at the same time offer driving pleasure and performance.

The verification and validation of the requirements will be done on component level (hardware, electronics and software), on system level or in the vehicle. The article from our colleague Redzo Sakanovic will give a detailed overview about GETEC’s EV system testing capabilities. As an example for the verification on component level Janagan Kanesamoorthy will detailed introduce GETEC’s capabilities for the high-voltage components testing according LV123 standard.

**I hope you enjoy the study of newsletter! Stay healthy!**

**Best regards**

Sven Steinwascher  
CTO

# ADVANCED TECHNOLOGY



Author: Mr. Joachim Trumpff  
Vice General Manager

GETEC is supporting its customers in all development stages as an independent engineering and testing service provider. Within this chapter, GETECs' latest development news for the early stage system verification will be introduced. Customers will benefit from this before the real development starts. Furthermore, after a successful simulation and development, a testing of the hardware is necessary to verify the functionality and proof of concept. Therefore, GETECs' new energy testing solutions and the LV123 testing standard will be discussed in the course of this article.

# EARLY STAGE SYSTEM VERIFICATION

**We could foresee our products' life - what an amazing systematic engineering!**

AUTHOR: Mr. Wuyin Hui  
Control and Software Manager & CTO Assistant



GETEC runs for every new product a full processed development. Only if the product characteristics are meeting the product requirements, GETEC will announce the so called "system stands" status. At the beginning of a development, GETEC evaluates the engineering package with a process to judge whether the development can generate a reasonably close loop by cooperating with customer and supplier.

The project phase can range from "concept" until the "final development package delivery" (the so called "project complete" status).

The development level shall reach from system architecture definition until the detailed development disciplines for hardware, software and electronics.

**GETEC classifies requirements into 3 groups:**

1. Open functional requirement a product can provide to a vehicle
2. Open non-functional requirement a product shall fit into a vehicle
3. Known specified customer requirement - independent of requirement type

By this close loop target, a multi-dimensional map for the generation of requirements can be provided. This map shall contain at least two dimensions: the project phase and the development level.

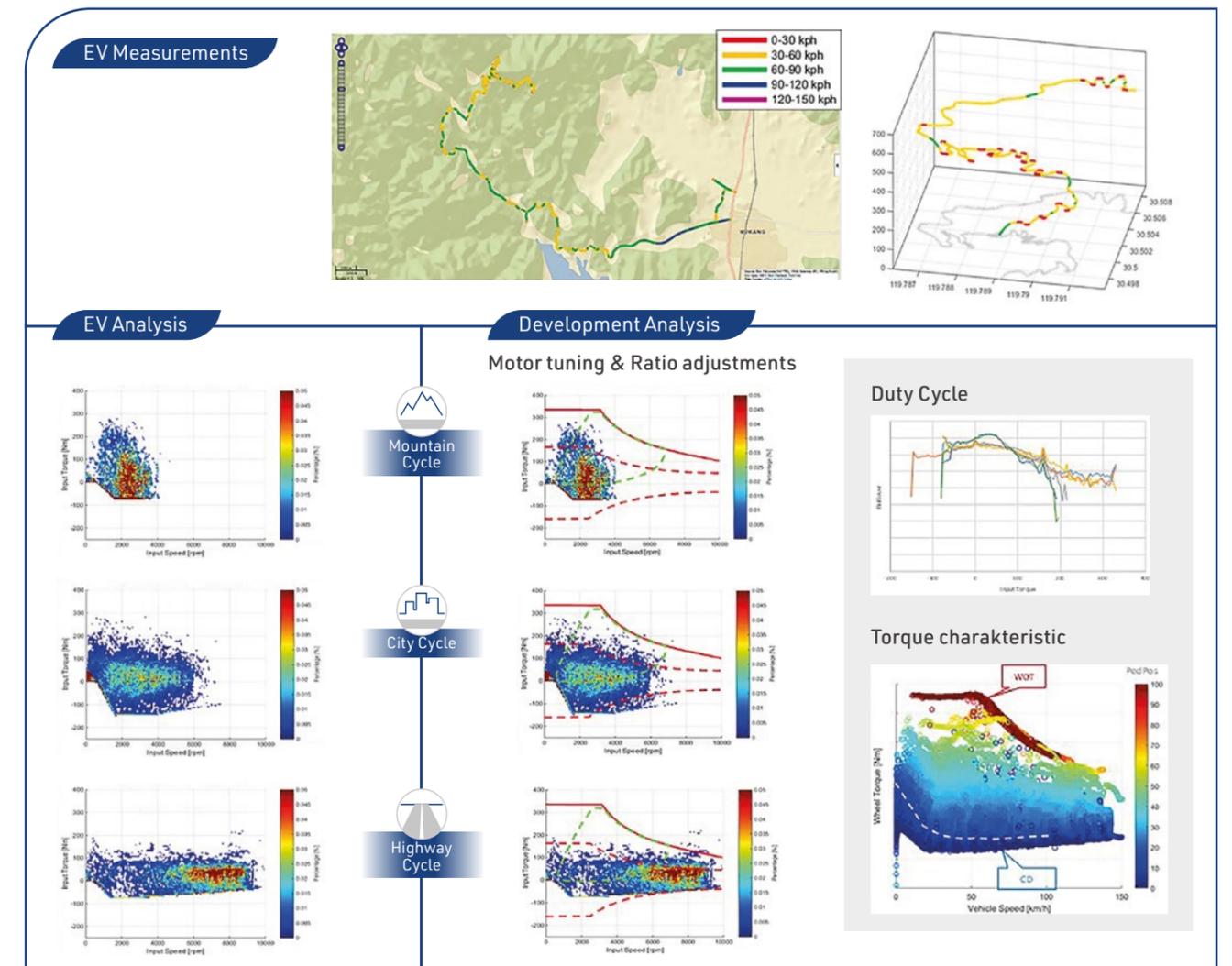
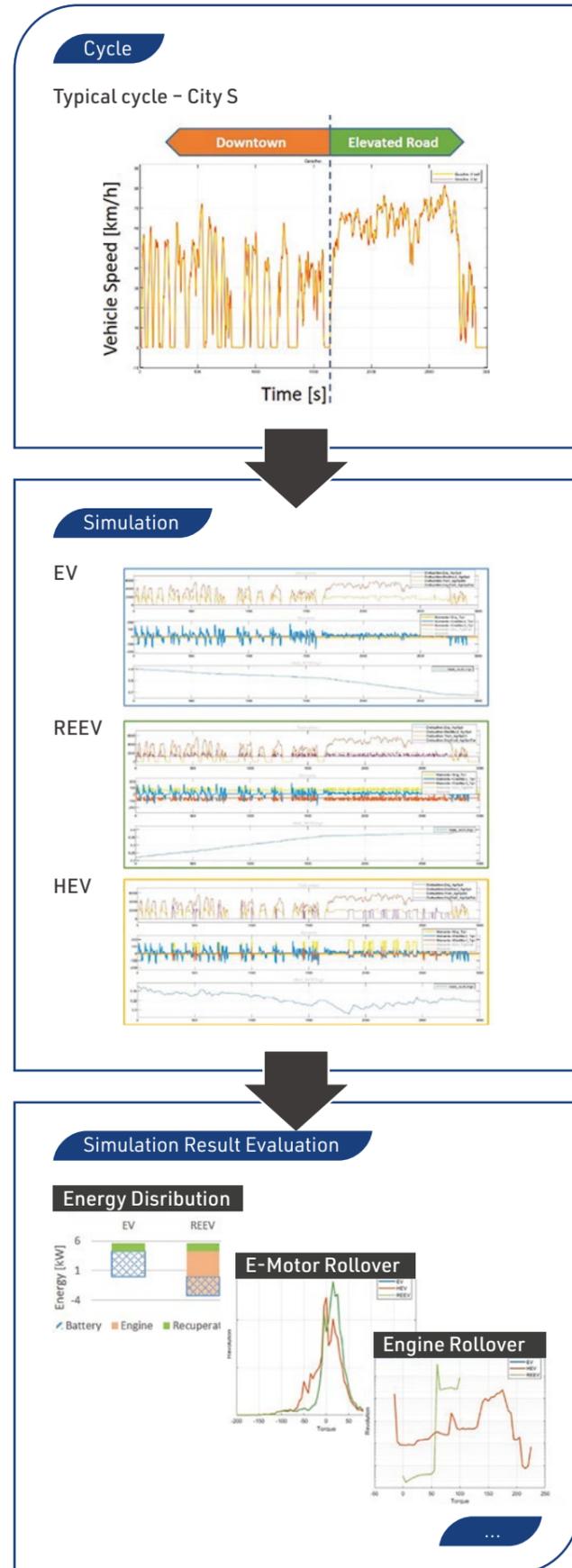


Fig. 1 | EV / REEV / DHT Product Family Requirement Development



Requirements alignment is a first milestone. Passing this milestone GETEC starts the requirement development independently.

GETEC has deep engineering experience on drivability and has multiple skills to link the engineering realization method to it. A deep benchmarking is applied to support a pre-validation of requirement setting and indication of market usage by comprehensive road load data (RLD). Deep insight could be provided by decipher the vehicle network (CAN, FlexRay or UDS) and by sensors.

This information contains the load mapping of how a driver in certain market could use the vehicle, such as transitions of powertrain states (driving mode change e.g. from EV to HEV mode) and adaptations of operation timing windows (the definition when to use which mode based on e.g. battery state of charge). In combination with non-functional requirements, such as target market, policies & rules, NVH, cost target and package limitation the result is a full set of requirements. GETEC will develop based on this a pool of concepts including CAE calculations for its core elements' key performance, such as e-motor map.

GETECs' excellent experience on control (from strategy mapping to detail actuator control) allows to apply the concepts to GETECs' simulation platform. The concept pools' result will be categorized as diverse abstraction model. Each category will be sent into GETECs' simulation platform and stimulated by vRLD.

**The result will be deeply analyzed via GETECs' application and CAE expert team to ensure:**

1. acceptable drivability of the system when applied to a vehicle
2. the provision of every system key element's instant usage limitation or statistic usage profile

Every usage profile will be analyzed by CAE to provide the engineers a performance result of all elements.

The result leads the detailing of concept. All inputs are based on highly experienced analyzation of market / driver usage / drivability / mature understanding of method of powertrain elements / advanced strategy prediction. With this accurate and reasonable input, all engineering force is arranged for the best solution and optimal result.

Engineering shall work for one target whereas keeping engineering work in one direction is a challenge everywhere in this industry. Therefore, GETEC merged different cultures in all departments and the result is a highly qualified engineering solution on a state-of-the-art level. GETEC provides high efficiency development, with deepest understanding of product requirements and characteristics.

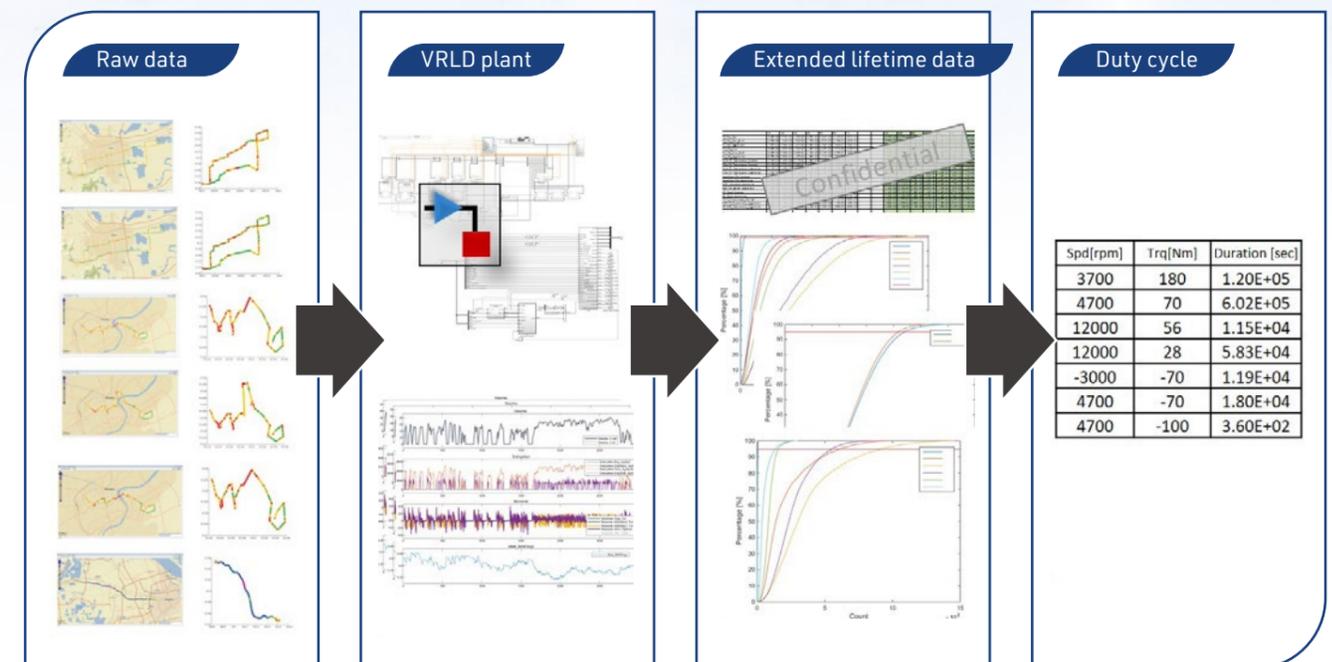


Fig. 2 | VRLD Duty Cycle Development for different applications

Fig. 3 | VRLD Duty Cycle Development

## NEW ENERGY TESTING SOLUTIONS

**AUTHOR:** Mr. Redzo Sakanovic  
Application & Integration Leader



The GETEC E-Mobility test benches have been developed in cooperation with GTSYSTEM with focus to the new challenges introduced by the requirements for electrified or electric drive-trains. In particular, the trend towards higher speeds for electric drives was considered in the design. We offer our customers a highly modern test environment that is constantly being further developed.

### With GETEC as development partner, right away from project start support by engineering team is possible.

The test environment is designed in such a way that it is possible to react extremely flexibly to customer requirements. Drive-trains from (mild) hybrid applications (HEV), plug-in hybrids (PHEV) to battery-electric vehicle drives (BEV) can be tested. The modern and „state of the art“ equipped e-mobility test environment includes highly dynamic drive machines that enable a range of speeds of up to 22,000 rpm and a torque of up to 700 Nm (refer to figure 4).

To test the entire drive unit, output machines with a power range of 3,000 rpm and a torque of 3,500 Nm are available. In figure 5 a 2-Dyno bench is introduced. The output is simulated by the output dynos left and right.

If there is no input motor or if only the gearbox for an electric drive is to be tested, a 3-Dyno configuration is set up as shown in Figure 6. Here the drive of the gearbox as well as the output are simulated with test bench machines. Beside this layout, also a longitudinal layout is possible to be realized.

The vehicle high-voltage battery is simulated using a VES (Vehicle Energy System). The power spectrum of the VES in single mode extends up to 250 kW (300 kW 30s) /  $\pm 1000$  A / 0...1000 V. In addition, GETEC offers the option of operating battery simulators in parallel mode. This results in the following performance data: 500 kW (600 kW 30s) /  $\pm 2000$  A / 0...1000 V.

To carry out the analysis required in e-mobility on 3-phase or multi-phase systems, e.g. to measure electrical and mechanical performance and efficiency, precision power meters are installed.

Another important component is the simulation of different temperature environments. The cold and hot tests are also part of

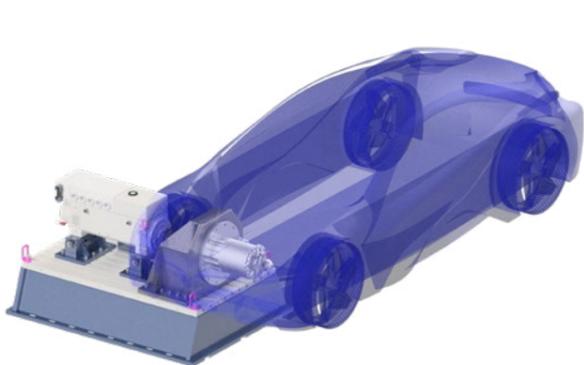


Fig. 4 | 1-Dyno bench (Simulating the drive motor)

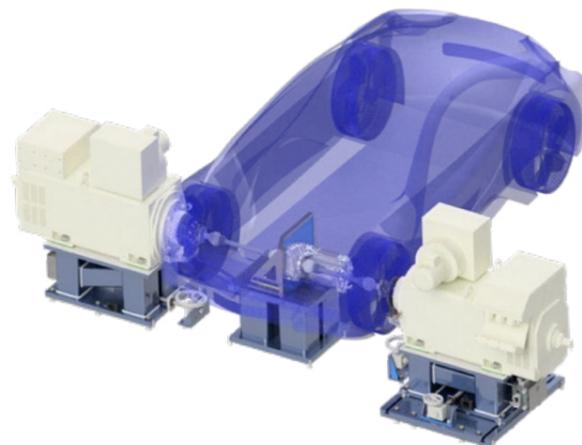


Fig. 5 | 2-Dyno bench (Simulating the output)

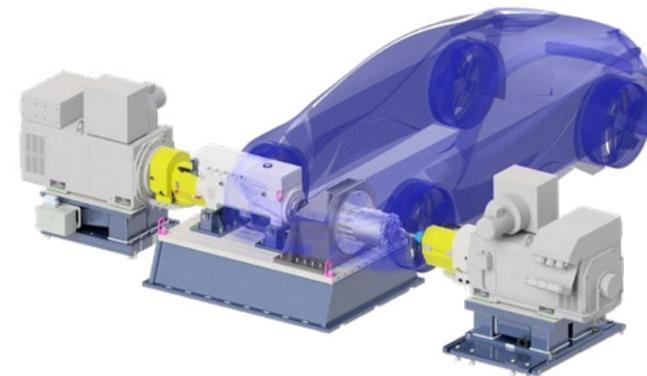


Fig. 6 | 3-Dyno bench (Simulating input and output)

the LV123 test specification. The temperature simulation is implemented using a climatic chamber (-70 °C to 180 °C) and additional coolant conditioning (-30 °C to 130 °C). Due to this large configuration bandwidth, various test execution variants are available:

- Function tests
- System tests
- Security checks
- Measurement services

The sensors used at GETEC are DAkkS certified to comply with the deviation tolerances required in the specification for speeds, torque, current, voltage, pressure, and temperature.

To achieve the jointly set targets in the specifications, open communication with our customers is very important. Because of this, the customer is informed ad hoc about the current test progress at any time. This allows the engineers to intervene in the development process in shortest time and take countermeasures. To be able to optimally involve the development engineers of the customer, various online support methods are available to be able to do program adjustments / adjustments in test sequences in real time during commissioning.

For the first phase of developing the electric motor (standalone), we can offer our customers an engineering service and control the electric motor via a development inverter. With GETEC as development partner, right away from project start support by engineering team is possible.



# LV123 TESTING STANDARD



**AUTHOR: Mr. Janagan Kanesamoorthy**  
Senior Application Engineer

With the electrical test standard LV 123 the safety and the electrical parameters of high-voltage components in the vehicle are verified. German original equipment manufacturers (OEMs) must comply with LV 123, notably AUDI, BMW, Daimler, Porsche and Volkswagen. The advantages for the manufacturers and suppliers are the systematic approach to automotive testing and clearly defined test parameters which are leading to comparable and interchangeable results.

The LV 123 standard can be applied on the inverter as standalone, e-motor or the complete drivetrain. The test standard is separated in two parts. The goal of the first tests is to check the system performance at the entire operating high voltage range and temperature range at the continuously operating capability range. The high voltage starts from 0 and the range is up to 1000 V (based on customer requirements) and the test setup must comply with an ambient temperature range of -40 °C to 85 °C and coolant temperature range from -25 °C to 85 °C.

GETEC is using a Vehicle Energy System (VES) either in single mode or for higher requirements to the current it is used in parallel mode. The capabilities are listed in table 1.

HV	Voltage Range [V]	Current Range [A]	Ripple Frequency [kHz]
GETEC VES	0-1000	0-1000 (Single Mode) 0-2000 (Parallel Mode)	0-15

Tab. 1 | GETEC VES capabilities

**The LV 123 standard can be applied on the inverter as standalone, e-motor or the complete drivetrain.**

The test case for the upper limited operating capabilities for a given HV Voltage range is shown exemplary in figure 7. The purpose of this test is to check the inverter performance at the entire voltage range and temperature range at the upper limited HV voltage operating range.

The cycle is repeated 3 times and the inverter must adapt its capabilities according to the HVDC set-point. It is obvious that the inverter limits its capability if the HV voltage exceeds the upper limit and recovers after the HV voltage falls below the limit value. The complete cycle is running automatically after programming the test bench control software according to the LV123 specification. The cooling circuit target temperature was set in this test case to -22 °C inverter inlet temperature.

Another test is performed to prove that the HVDC voltage is measured by two independent measurement paths and to verify them against each other. The inverter operates at its maximum capabilities for 6 different HVDC voltages up to maximum speed. Figure 8 gives an overview of the test cycle with the maximum torque and speed for generating and motor mode of the inverter. The test bench automation skips the set point if the limit of the inverter is reached. This test cycle is performed with 65°C coolant temperature at the inverter inlet. During the test cycle the test bench automation monitors the critical parameters of the inverter and the e-motor to shut down the system safely in case of incidents and to prevent any damage of the test setup (refer to figure 9).

The advanced automation system of GETEC test benches allows to adapt quickly the already implemented test cycle to new devices under test. This enables to supply the results to the customers within shortest time. The equipment can perform the safety relevant tests for the new energy mobility.

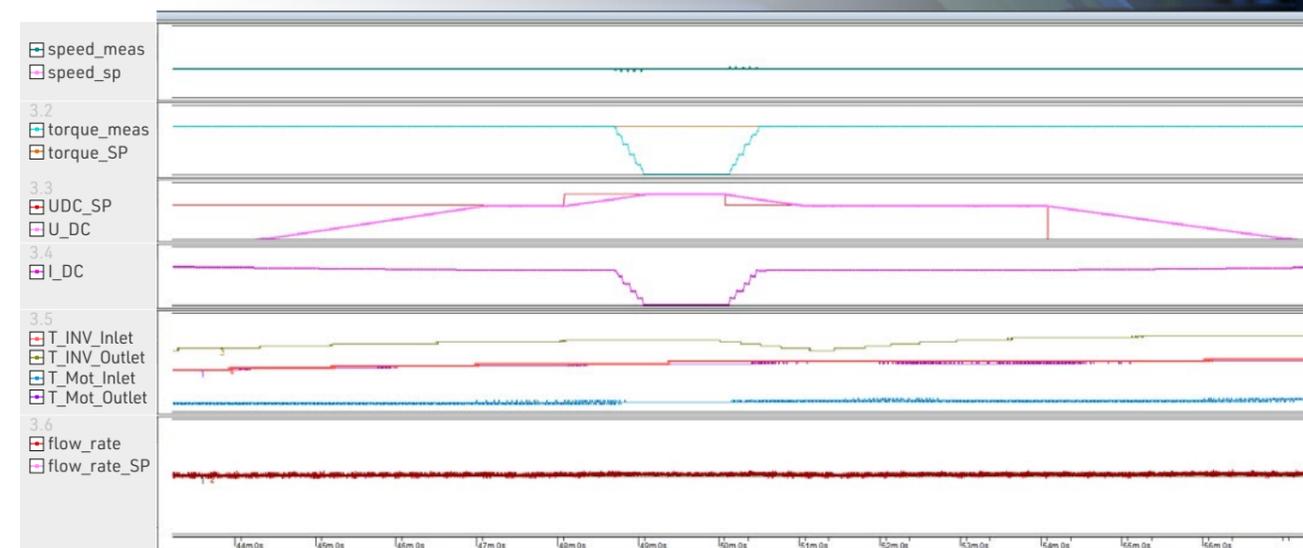


Fig. 7 | HVDC Voltage upper limit operating capability

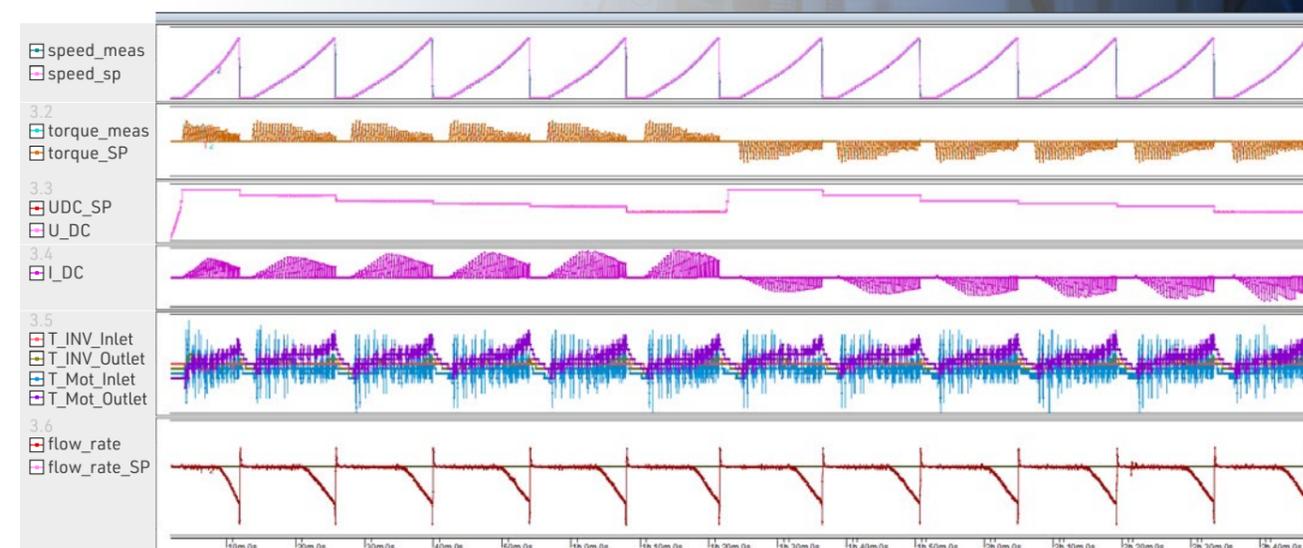


Fig. 8 | HVDC Voltage plausibility check in motor and generator mode up to maximum speed and 6 different HVDC levels

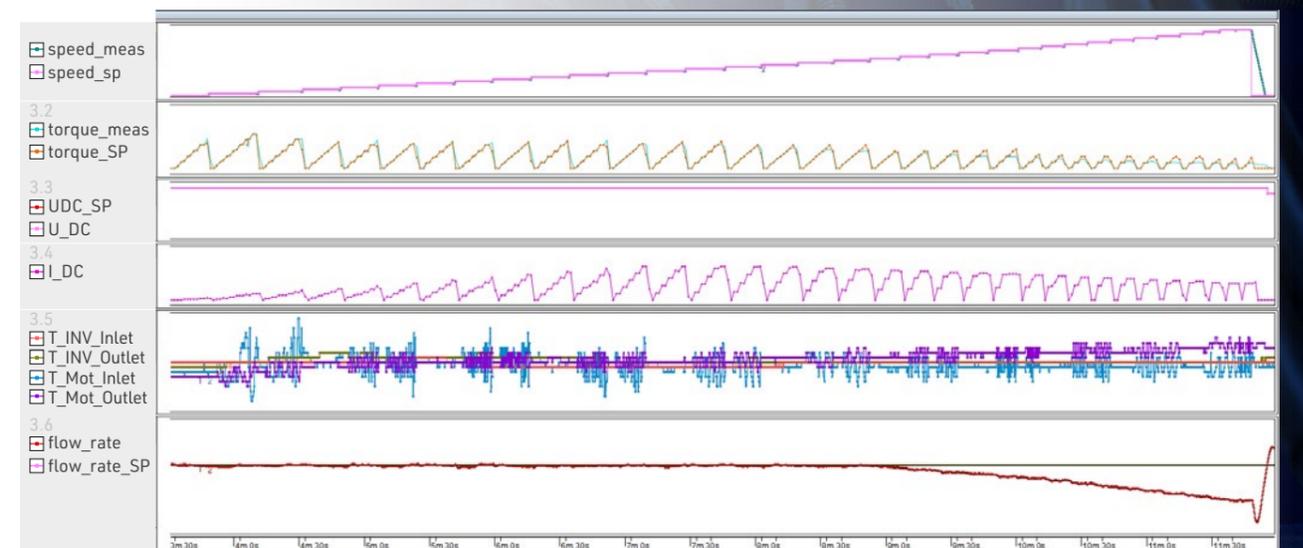


Fig. 9 | HVDC Voltage plausibility check with the inverter working at its limits

## IMPLEMENT THE MOST STRINGENT AUTOMOTIVE CARBON EMISSION STANDARDS A Surge of Europe's Electric Car Sales in July 2020

Source: Sina Tech

Recently, according to data released by European countries, the sales of new energy vehicles in eight major European countries, including Germany, France, and the United Kingdom, exceeded 99,500 units in July, a year-on-year increase of 214 %. Among them, sales in Germany, France, and the United Kingdom were respectively 35,900 vehicles, 17,000 vehicles and 15,600 vehicles, an increase of 289 %, 29 8% and 286 % year-on-year.

The market view generally believes that the growth of new energy vehicles in Europe – against the trend – is mainly due to the EU's implementation of the most stringent automobile carbon emission standards in 2020, setting passenger car carbon emissions temporary target in 2021, 2025 and 2030 to reach 95 g/km, 80.8 g/km and 59.4 g/km.

Among them, 2020 is a transitional period, 95 % of new cars need to meet the carbon emission requirement of 95 g/km, and after 2021, 100 % must meet the requirement. For car companies that exceed carbon emission standards, a fine of 95 EUR/g is imposed for each excess part of the car, in an attempt to restrict the production of car companies. At the same time, European countries are also continuing to promulgate policies, adding new incentive policies for new energy vehicles on the basis of the original policies, including reductions and exemptions of purchase tax, registration tax, ownership tax, corporate tax and other subsidies. Essence Securities pointed out that the annual sales of new energy vehicles in Europe is expected to exceed 1 million in 2020.

### GETEC Comments

#### Testing solutions for new energy

The development of new energy solutions are pushed especially by government regulations and must be launched within shortest development time. To ensure product durability, reliability and highest quality standards, high-tech testing equipment and methodologies are required. The efficient system validation and verification for electric-drive-systems (EDS) is a challenge. Modular developments allow to apply the EDS as single application in FWD or RWD, also in parallel for high performance AWD.

GETEC Getriebe Technik GmbH is supporting customers with new-energy Testbenches in Aldenhoven and Suzhou and is expanding to newest technology up to 20,000 rpm and 700 Nm continuous torque in 2020.

GETEC testing solutions are highly flexible to customer demands and always on eye level with the market development. Beside the testing of inverter IGBT and SiC type), e-motor and reducer in 1-, 2- or 3- Dyno configuration, GETEC provides solutions for Back2Back (B2B) testing. B2B testing can be beneficial for a couple of testcases for e-motors and for complete EDS.

**Less capacity occupied, accelerated testing time, faster results for the customer and more confidence regarding the product quality!**

## AUTOMOBILE AND POWERTRAIN TRENDS AFTER THE COVID-19

Source: GETEC

How the global auto market develops under the epidemic is still unknown. But what is certain is that the trend of the automobile industry to the new four modernizations has accelerated under the epidemic.

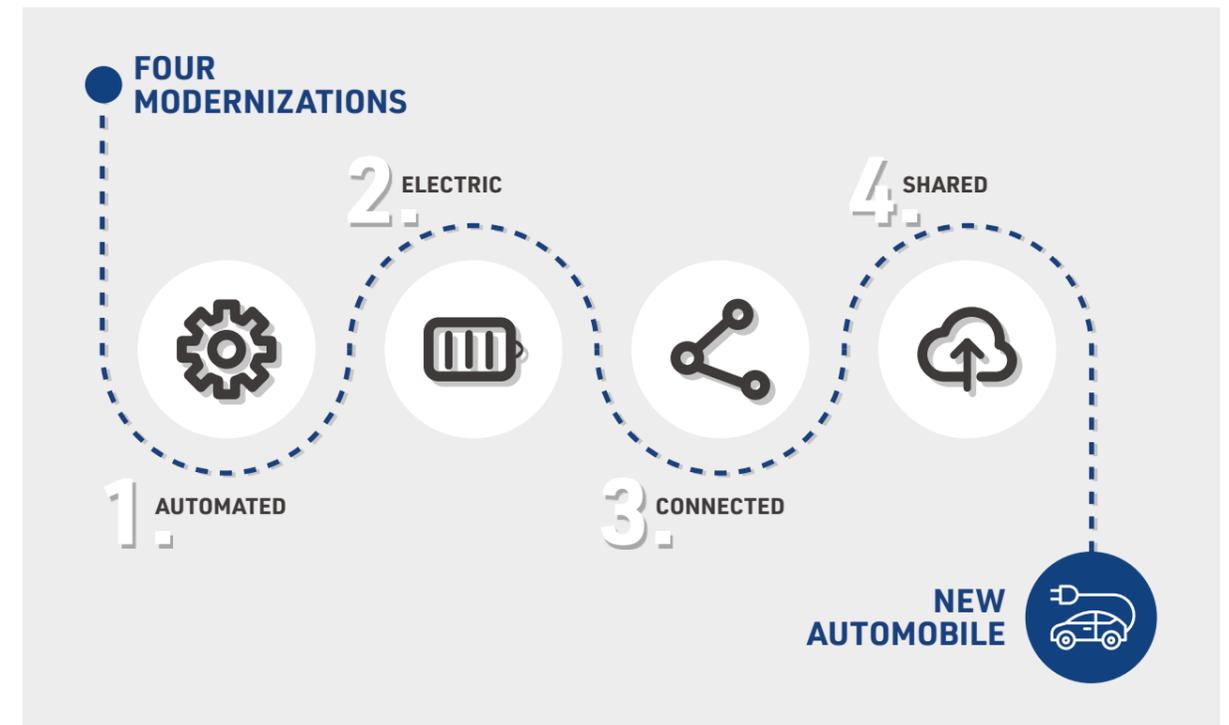
In June alone, Amazon, Didi, Intel, Daimler and other large companies announced major progress in autonomous driving; BYD's blade batteries and Ningde era long-life batteries also received a lot of attention during the epidemic.

#### New automobile four modernizations

Due to the impact of the epidemic on group activities, the cluster living mode of metropolitan agglomeration has been impacted; in terms of travel methods, private travel methods that can avoid contact with each other have become more important. This crisis will profoundly change the original public living habits, not only affecting the original related economic model, but also posing a huge challenge to the sharing economy. The society needs a new type of

sharing economy model with more health protection. The new relationship between cars and smart cities (4S means smart cars, smart transportation, smart energy and smart cities) are intertwined.

Contactless Mobility (mobile travel), digitalization, remote services, and control will become the focus of the industry. The development of electrification will be affected in the short-term, but the longterm development is indisputable. The critical point of digital transformation of auto companies is coming ahead of schedule. The core is based on the digitalization of product development, manufacturing, supply chain management, marketing, after-sales service and other links to form a complete closed-loop system connected end to end. This will be a remote, wireless, and contactless digital enterprise operating system that can significantly improve operating efficiency and reduce operating costs.



## THE DEVELOPMENT TREND OF POWERTRAIN

Data source: IHS

### GETEC Comments

Transmission development towards more advanced transmission designs with several modular hybrid transmissions entering the market now and over the next few years

#### GETEC DHT Development

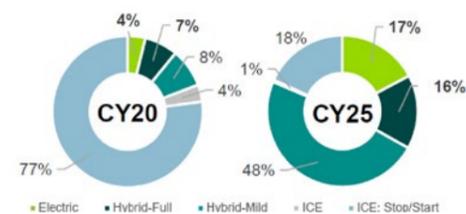
Dedicated hybrid transmissions (DHT) for HEV and PHEV are the third big hype in the automotive industry as powertrain solution – next to full electric vehicles and fuel-cell vehicles. DHTs combine the benefit of mobility with the flexibility of a conventional fuel powered powertrain. OEMs can benefit from government energy saving policies and customers are more independent from infrastructure e.g. EV charging station settings.

GETEC Getriebe Technik GmbH provides engineering and testing services for DHT systems including gearbox, motor(s) and inverter. The main development targets are small package with high power density, high EV performance, optimized NVH, high efficiency and low cost. For the development GETEC focusses on multi-speed solutions which are beneficial for available engine technology for smaller OEMs and Tier 1 – especially not necessary require Atkinson or Miller engines.

GETEC applies for each project a tailored engineering process to ensure that timing, product & development costs, package & weight, performance & economy and drivability are meeting customers' requirements. All engineering and testing disciplines in the product development lifecycles can be fully covered by GETEC based on customers demand.

#### EU28 – Powertrain Demand Mix

The CO<sub>2</sub> compliance challenge comes above all else

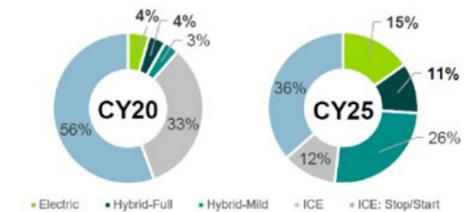


#### Initial status pre-crisis (H2 2019)

- Bar chart icon: Growing xEV consumer acceptance and positive regional economical forecast
- Target icon: CO<sub>2</sub> framework with 95% phase-in 2020
- Car icon: OEM prod plans and strategy defined by mix required for CO<sub>2</sub> compliance

#### CHINA – Powertrain Mix Impact Analysis

Short medium term demand squeeze on NEV creates compliance challenge

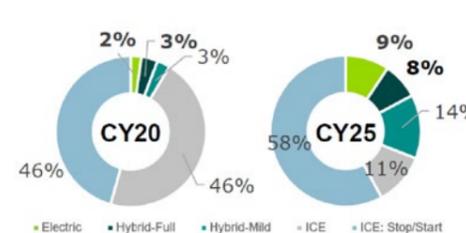


#### Initial status pre-crisis (H2 2019)

- Bar chart icon: Growing xEV volumes and positive regional economical forecast
- Target icon: Phase 4&5 CAFC credit compliance + NEV credit compliance requirements CN6a emission standard starting from July 2020 nationwide
- Stack of coins icon: NEW subsidies & Tax exemption planned to be removed from 2021
- Car license plate icon: Car license plate restriction in 8 big cities

#### US – Powertrain Mix Impact Analysis

Conditions allow xEV market to survive, but struggle to thrive



#### Initial status pre-crisis (H2 2019)

- Bar chart icon: Positive regional economical forecast and steady oil price
- Target icon: CAFE and CO<sub>2</sub> standards for MY2020-2025 PCs and LTDs (2012 Obama-era), Likelihood of being relaxed following the SAFE proposal released in 2018
- Car icon: OEMs plans for further investments on electrified Powertrains

Data and graphics: IHS

## HOTSPOTS IN ASIA



1. BYD and Hino Automobile Co., Ltd. signed a strategic business alliance agreement, focusing on the cooperative development of pure electric commercial vehicles (BEVs). Fully combining the technical and experience advantages of the two parties in the field of pure electric commercial vehicles, deep cooperation in retail and other related businesses is carried out to promote the popularity of pure electric commercial vehicles. Source: CPCA

2. FAW Car signed a strategic cooperation agreement with LEAPMOTOR, and will cooperate in the development, manufacturing and production of key components of smart electric vehicles, and conduct in-depth cooperation in the fields of key basic technology development and production model innovation. Source: AUTOHOME

3. The recommended national standard GB/T „Safety Requirements for Electric Vehicle Replacement“, which was drafted by BAIC New Energy, Weilai, and China Automotive Center, has passed the review. According to the standards, by analyzing the differences in different technical solutions, actual vehicle operating scenarios and operating data, it ensures the safety of users when changing battery during the vehicle's design life. Source: NETEASE

4. The Ministry of Finance of China issued the „Report on the Implementation of China's Fiscal Policy in the First Half of 2020“. The report mentions support for the development of new energy vehicles and the continuous increase in the development of new energy vehicles. It mentions support for the development of new energy vehicles, and the relevant departments have clearly extended the purchase subsidy policy. By the end of 2022, at the same time, the intensity and pace of subsidy decline will be smoothed, and policy support for the development of new energy vehicles will continue. Source: SIAN

5. In the first half of 2020, China's auto export volume was 385,600, a year-on-year decrease of 20.94%. The export of passenger vehicles was 288,600, a year-on-year decrease of 12.05%, and the export of commercial vehicles was 97,000, a year-on-year decrease of 39.22%. The annual auto export volume is expected to drop by about 15% compared with the previous year. Source: sohu

6. At the Chengdu Auto Show in 2020, Dongfeng Citroen will launch a PHEV version of AIRCROSS. It is the world's first plug-in hybrid vehicle equipped with three motors. The

new car is innovatively equipped with a „three-engine four-wheel drive“ structure. It consists of a 1.6T PHEV exclusive high-power engine and front and rear dual motors. The combined maximum power is 221 kW and the combined maximum torque of 520 Nm.

7. Kia announced the use of wire-controlled clutch technology for light-hybrid vehicles that can reduce carbon dioxide emissions by 3%. This technology makes it possible to use traditional manual gearboxes equipped with light mixing and start-stop systems. Kia modified the traditional hydraulic system used to drive the clutch of a manual vehicle. The clutch of this type of vehicle is directly connected to the car's clutch pedal, while Kia's Intelligent Manual Transmission (iMT) places a module between the pedal and the hydraulic system. Source: Yonhap

8. Yonhap News Agency stated that 10 hydrogen fuel cell heavy trucks jointly built by the South Korean government and Hyundai Motor were exported to Switzerland for the first time on the same day. Hyundai also plans to continue to export 1,600 hydrogen energy heavy trucks to Switzerland by 2025. The hydrogen heavy truck exported this time is 34 tons (including trailers), matched with a 190 kW hydrogen fuel cell system, 350 kW motor, and adopts the newly developed hydrogen fuel cell cooling system and its control technology. It can travel 400 kilometers on a single charge. Source: Yonhap

9. BMW officially announced the „Alibaba Cloud Innovation Center-BMW Startup Garage Joint Innovation Base“ co-founded with Alibaba. BMW and Alibaba will share their respective superior resources and form a strategic alliance to create an innovation incubation ecosystem in the „Internet + automotive“ field. Source: Pcauto

10. With the strong market performance in China, Tesla's strategy in China is also changing. Tesla China's user data and authentication services will be migrated from the United States to China, that is, the server will be moved to China to solve problems such as unstable connection of Tesla App. Source: Gasgoo

# COMING EVENTS

## AACHEN COLLOQUIUM GERMANY 2020

Speech: High Speed E-Motor Development – 22.000 rpm and its challenges

**Time:** 05.-07.10.2020

**Speech:** 06.10.2020 | 15:30 | Hall Lissabon

**Speaker:** GETEC | Mr. Joachim Trumpff

**Format:** Online-Conference | virtual booth



<https://www.aachener-kolloquium.de/en>

## CTI BERLIN 2020

Speech: Development of an EV / REEV / DHT Product Family

**Time:** 07.-09.12.2020

**Speech:** 08.12.2020 | 14:45 | Session A: HEV Drives and transmissions

**Speaker:** GETEC | Mr. Sven Steinwascher

**Format:** Online-Conference | virtual booth



<https://www.drivetrain-symposium.world/en>

**GETEC**  
Getriebe Technik GmbH



### German HQ

GETEC Getriebe Technik GmbH  
Galileo-Allee 2  
52457 Aldenhoven

+49 (0) 2464 90266 - 00

+49 (0) 2464 90266 - 29

@ info@getec-gmbh.com

[www.getec-gmbh.com](http://www.getec-gmbh.com)



GETECGetriebeTechnik



getec-getriebe-technik-gmbh

### Headquarters

Aldenhoven, Germany

### R&D Center

Suzhou, China

### Testing Center

Wujiang, China

### Sales Office

Seoul, South Korea

### Sales Office

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