



China Hybrid Vehicle and Dedicated Hybrid Powertrain Insights.

Why hybrid vehicles are booming in China

White Paper

Giving substance to a new reality.

Authors

Christian Koehler

Cheng Xie

Chen Chen

Dr. Can (Candice) Rao

Shanghai, February 2022

© Strategy Engineers

Management Summary

The “Energy-saving and New Energy Vehicle Technology Roadmap 2.0” for the automotive industry released on October 27th, 2020 by the China Society of Automotive Engineers (China-SAE) sets the target to achieve peak carbon emissions in the automotive industry in 2028 and decrease carbon emission by 20% until 2035.

China’s New Electric Vehicle (BEV and PHEV) market has experienced an exponential growth during last year with 169% growth reaching a share of 14.8% (2.98 mil units).

Moreover, China’s Hybrid Electric Vehicle (HEV) market has grown by 43% (586 thousand units = 2.9% market share) in 2021 with almost all leading Chinese OEMs releasing own Hybrid Electric Vehicles with Dedicated Hybrid Transmission (DHT-HEVs).

With this different market perspective, and favoured by current legislation, most Chinese OEMs have chosen an electrification strategy that puts hybrid systems equal besides Battery Electric Vehicles (BEV) at the heart of their product strategy.

As a result, Chinese OEMs are making investments into combustion engines (DHE) and transmission system (DHT) as well as shared technologies across xHEVs and BEVs.



China records sales of 2.98m NEVs in 2021

China roadmap 2025/2030/2035

On October 27th, 2020, the “Energy-saving and New Energy Vehicle Technology Roadmap 2.0” for the automotive industry was released. It was revised by the China Society of Automotive Engineers (China- SAE) under the guidance of the Ministry of Industry and Information Technology (MIIT). The goal is to set the target to achieve peak of carbon emission in the automotive industry in 2028. By 2035, the total carbon emissions in the automotive industry are expected to decrease by more than 20% compared with the peak.

In the currently binding roadmap, the targets for NEVs (BEV and PHEV), HEVs, and ICE vehicles are set as below:

Target Segment	2025	2030	2035
PC vehicle (including NEV) CAFC under WLTC	4.6L/100km	3.2L/100km	2.0L/100km
Energy Saving Vehicle (ESV)	<ul style="list-style-type: none"> CAFC under WLTC <= 5.6L/100km; Percentage of HEV>=50% 	<ul style="list-style-type: none"> CAFC under WLTC <= 4.8L/100km; Percentage of HEV>=75% 	<ul style="list-style-type: none"> CAFC under WLTC <= 4.0L/100km; Percentage of HEV=100%
New Energy Vehicle (NEV)	<ul style="list-style-type: none"> Sales percentage: 20% Total number of FCEV:>= 100k 	<ul style="list-style-type: none"> Sales percentage: 40% 	<ul style="list-style-type: none"> Sales percentage: >=50% Total fleet of FCEV: >=1m
AI connected vehicles	<ul style="list-style-type: none"> PA/CA of new sales >=50% Sales start of HA vehicles C-V2X >=50% 	<ul style="list-style-type: none"> PA/CA of new sales >=70% HA >=20% C-V2X =100% 	Fully connected and autonomous driving widely used in China; China specific AI vehicles deeply integrated with Intelligent energy & transportation systems & cities

Table 1: Energy-saving and New Energy Vehicle Technology Roadmap 2.0 by China-SAE

For 2035, China is thus currently aiming for 50% NEVs and 50% ESVs (HEVs) to achieve the fleet fuel consumption targets. Hybrid technology is gaining more and more attention besides NEV as an approach to reduce carbon emission and achieve those CAFC targets. Government policy favours HEV technology for the time being.

BEV/PHEV/HEV records sales in 2021

China’s NEV market has experienced an exponential growth during the year of 2021, even though under the impact of Covid-19 and chip shortage.

After a 3-year mediocre market feedback, NEV (BEV and PHEV) market has finally gained momentum , reaching, 169% growth and a share of 14.8% (2.98 mil units). The growth rate is distributed quite evenly within two segments (BEV: 168.6%, PHEV: 171.2%).

2.98 mil
=14.8%

China NEV sales accounts for total passenger vehicle sales

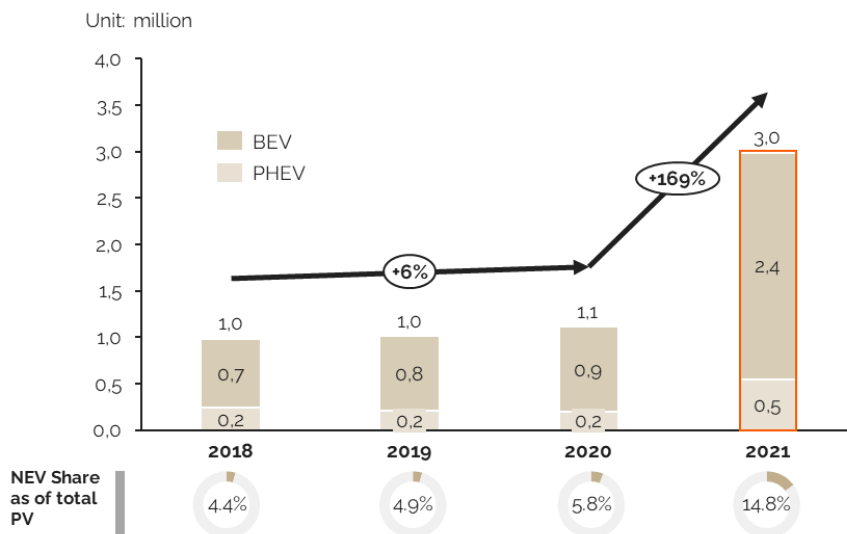


Figure 1: BEV and PHEV sales volume in China

Though their market share remains low (586 thousand units = 2.9%), HEV vehicles have grown over 40% two years in a row with 40% growth in 2020 and 43% growth in 2021.

Moreover, almost all leading Chinese OEMs have announced their own DHT-HEV products since 2020. As a result, the HEV market that was previously dominated by Toyota and Honda will start to see more diversified offerings from local OEMs.

The BYD DM-i series and Great Wall 'Lemon hybrid DHT' HEV/PHEV vehicles are the most popular and delivery time is over 3 months. Geely Leishen hybrid technology and the first Xingyue-L HEV have just started to deliver.

43%
growth in
2021

China HEV growth rate,
2021

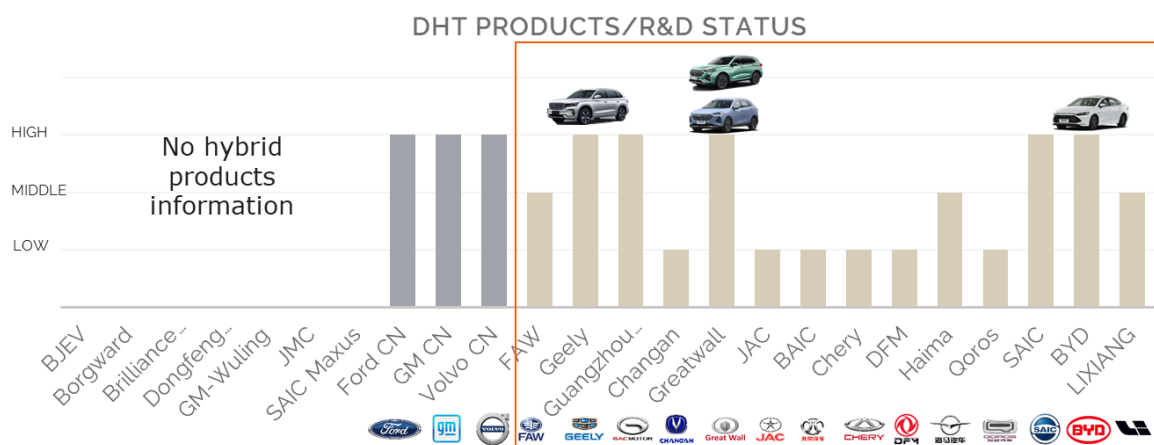


Figure 2: DHT product status in China

Prospects of future hybrid vehicles market

With technology advancements brought by investments in BEV components (such as electric traction-motor, battery, inverter, etc.),

most Chinese OEMs are now launching vehicles equipped with 'Dedicated hybrid powertrain' (Dedicated hybrid engine + Dedicated hybrid transmission) in P1 to P3 configurations. From one base hybrid architecture, technical solutions for both HEV, PHEV and with some adjustments, REEV are derived.

This enables Chinese OEMs to stop improving conventional ICE powertrains while competing in areas that are traditionally not their strong suites. Instead, their focus will now be how to gain a competitive edge through leveraging electric components to control overall powertrain costs, improve fuel economy and decrease carbon emissions of hybrid vehicles.

The current policy roadmap favours HEVs as described above as an affordable solution to have cheap and efficient powertrains which achieve emission and fuel consumption targets. The question remains, how long this legislative focus will last and what can be expected for the next revision of SAE / MIIT roadmaps. The past has shown that China is very flexible and quick in changing directions fundamentally.

OEM electrification strategy and Dedicated Hybrid System development

Add-on solution vs. dedicated hybrid solution

The **strategic position of hybrid technology** varies significantly among major OEM groups, impacted by their global/regional market focus, and strategic decision. Among major European OEMs, hybrid is a contingency solution to support a quick transition from ICE to full-electric vehicles. Therefore, their hybrid offerings (primarily 48V and PHEV) reuse existing powertrain parts, controlling powertrain investments into areas other than BEV.

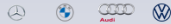

	Roadmap 1 (Add-on hybrid)  Hybrid is positioned as contingency solution	Roadmap 2 (Dedicated hybrid)  Hybrid is at the centre of their offerings
Electrification target	Ambitious electrification target Full-speed into all electric vehicle	Conservative/Achievable electrification target Roll-out hybrid & BEV simultaneously
Powertrain portfolio	BEV is core product Add-on 48V & PHEV as contingency solution to extend the lifecycle of current ICE products	BEV is the core in the long term HEV is a recent hotspot Decreased low voltage application
Dynamics in hybrid system	Minimum investment into hybrid system Reuse current ICE components	Large investment into dedicated hybrid system HEV, REEV and PHEV three in one solution
Dynamics in battery electric system	BEV is one of the major investment area Modular BEV platform, fast pace into market	BEV launch is not as efficient compared to EU OEMs
Compatibility between different powertrain	PHEV reuses BEV and ICE parts	Shared electric drive components on HEV, PHEV, and BEV

Figure 3: OEM Electrification Roadmap

HEVs based on dedicated hybrid transmissions bring benefits of lower fuel consumption, less CO₂ emission against traditional ICE / add-on hybrid, and lower powertrain cost and no range anxiety compared with BEVs.

Most local Chinese OEMs put hybrid systems equal to BEV within their product strategy. With large investment into dedicated hybrid systems, HEVs are expected to play a significant role as an intermediate solution towards full electrification.

Dedicated hybrid engine development

With the introduction of electric motors driving vehicles in most use cases, combustion engines become, most of the time, range extenders in dedicated hybrid system. The requirements for engines shift from providing torque and power output to primarily converting energy efficiently to recharge hybrid battery. The very few scenarios when engine is still required to provide direct output and propel vehicle are scenarios when e-motor is less efficient, such as high-speed driving and cruising.

Relieving combustion engines from its inefficient operation points, provides potential to decrease engine cost by applying low content technology, increase thermal efficiency, and decrease GHG emission by keeping engine operating only in its most efficiency areas.

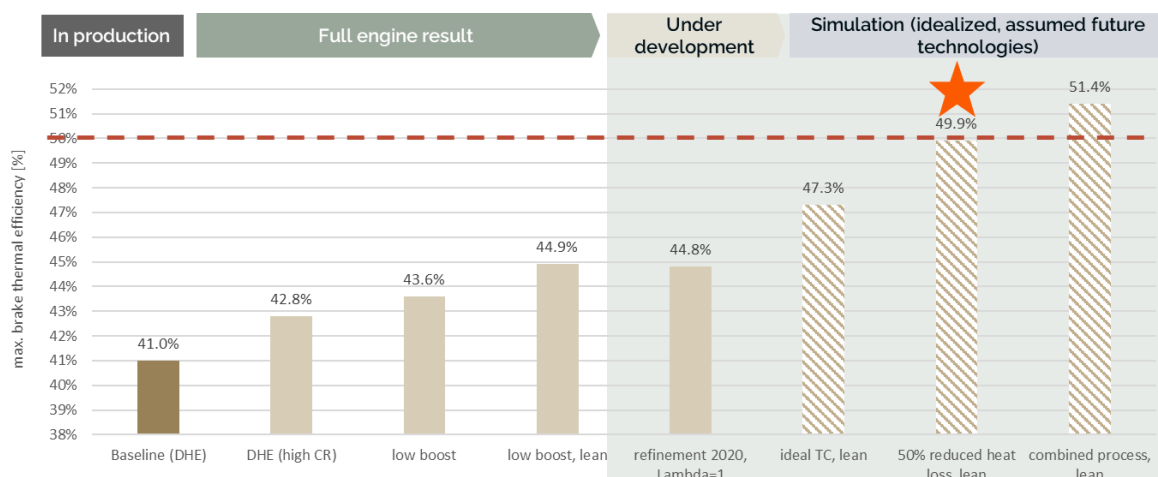


Figure 4: DHE thermal efficiency target

At this moment, most Chinese OEMs' announced DHE thermal efficiency lies between 41% - 43% (Geely Leishen DHE15). The potential of DHE to further improve thermal efficiency mainly lies in the upgrading of combustion technology and electrification of engine's peripheral functions. The goal for some Chinese OEMs is to achieve 50% thermal efficiency by 2030.

Dedicated hybrid transmission development

The two most widely recognized dual-motor DHTs architectures are power split (Toyota Prius HEV, GM Volt PHEV) and parallel-series (BYD DM-i, Honda i-MMD). As the core component in hybrid system, the choice of DHT architecture is very critical in developing hybrid systems.

Most Chinese OEMs (Great Wall Motor, SAIC, BYD, Changan, GAC, Dongfeng, etc) have chosen parallel-series DHT architecture over power split due to its less complex system design, more e-motor driven operation modes, potentially lower cost and the possibility to reuse components that were originally developed for BEVs.

Shared technology in HEV/PHEV/BEV

HEV technologies seem to have a promising future in Chinese market at this moment, however the ultimate solution towards carbon neutral remains 'Zero emission' technologies.

Therefore, knowing that HEV technologies will phase out sometime in the future but without knowing the exact time frame, most OEMs attempt to mitigate this risk of uncertainty through developing electric components that could be used across xHEV and BEV.

Through increasing system voltage of electric drive components in xHEV, (voltage is one of the major requirement gaps between hybrid and BEV), OEMs managed to increase xHEV system efficiency and meet the requirements of BEV at the same time.

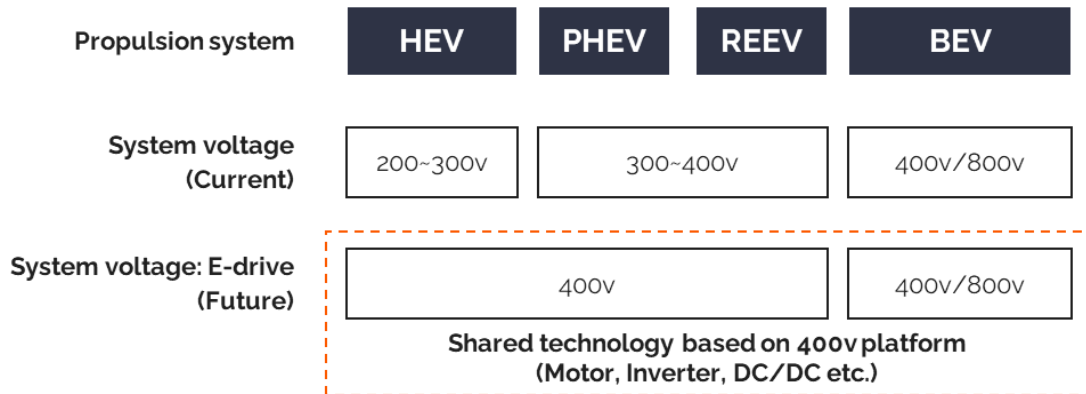


Figure 5: Shared technology in HEV/PHEV/BEV

Additionally, to further mitigate risk and quickly recover initial investments, Chinese OEMs are spinning off their powertrain department to setup independent companies and supply powertrain system to external users.

Implications for Global OEMs & Suppliers

Under the goals of 'Fit for 55', EU for example, national governments have made it attractive to produce battery-electric vehicles to achieve emission targets. However, 'Global Emerging Markets' (China is the largest emerging market in the world) with a somewhat stringent green transition policy to achieve climate neutrality allow for a more diversified powertrain portfolio towards 'Zero emission'. Overall powertrain efficiency and cost are critical, however.

For most Global OEMs operating not only in Europe but in most global emerging markets as well, it is important to notice that there are other market opportunities rather than BEVs. Before the raw material cost of battery could decrease to a favourable level, a more affordable HEV with no range anxiety and reduced greenhouse gas emissions (GHG) might be a better market and regulation fit solution in emerging markets for the next decade.

For global automotive suppliers, as OEMs in China are still in the process of developing their current or next generation hybrid powertrains, opportunities to support development activities and supply key components are expected to emerge. Since efficiency and cost are the key targets of dedicated hybrid system, the demand for service and parts in areas such as high-efficiency engine, hybrid system power coupling optimization, and the expanded deployment of xHEV e-drive technology to BEV or vice versa will be the highest.

The authors



Christian Koehler

Partner

Christian Koehler is based in the SE Munich office and has more than 30 years of experience in management consulting. He is focused on product and technology strategies, and company transformation. He has lived and worked in Asia for over 8 years.

E-Mail: cjk@strategyengineers.com



Cheng Xie

Principal

Cheng Xie is based in the SE Shanghai office and has more than 16 years of experience in management consulting and OEMs. He is focused on corporate strategy, product development, supply chain, operation excellence, and project management.

E-Mail: chx@strategyengineers.com



Chen Chen

Associate

Chen Chen is based in the SE Shanghai office. He graduated from National University of Singapore with a master's degree in business administration. He is focused on corporate strategy, R&D management, product & technology planning, market entry strategy.

E-Mail: cch@strategyengineers.com



Dr. Can (Candice) Rao

Associate

Dr. Can (Candice) Rao is based in the SE Shanghai office. She graduated from Tsinghua University and earned her doctorate in Mechanical Engineering. She is focused on new technology, market strategy, project management.

E-Mail: cra@strategyengineers.com

About SE / Strategy Engineers

Strategy Engineers is an international strategy and management consulting company focused on mobility. Our vision is to make mobility sustainable. We share one common purpose: To unlock our client's potential to navigate uncertainty towards achieving this goal. Our consulting services are based on combining commercial and technical perspectives. We understand our clients' unique situation, as trusted advisors, and deliver innovative, customised, and implementable solutions. This way, we help our clients to make robust strategic decisions and craft unique strategies to find their way to a winning place in the market.

In 2022, we have been honoured as „Best Consultants“ in Germany for the ninth year in a row. The award is based on actual client feedback and is respected as the leading award for the German consulting industry.

Best Consultants
9x in a row!





Strategy Engineers GmbH & Co. KG

Phone: +49 89 4161 7235
E-Mail: publications@strategyengineers.com
Website: www.strategyengineers.com

HRA 96163, Munich District Court
© Strategy Engineers GmbH & Co. KG 2022, all rights reserved