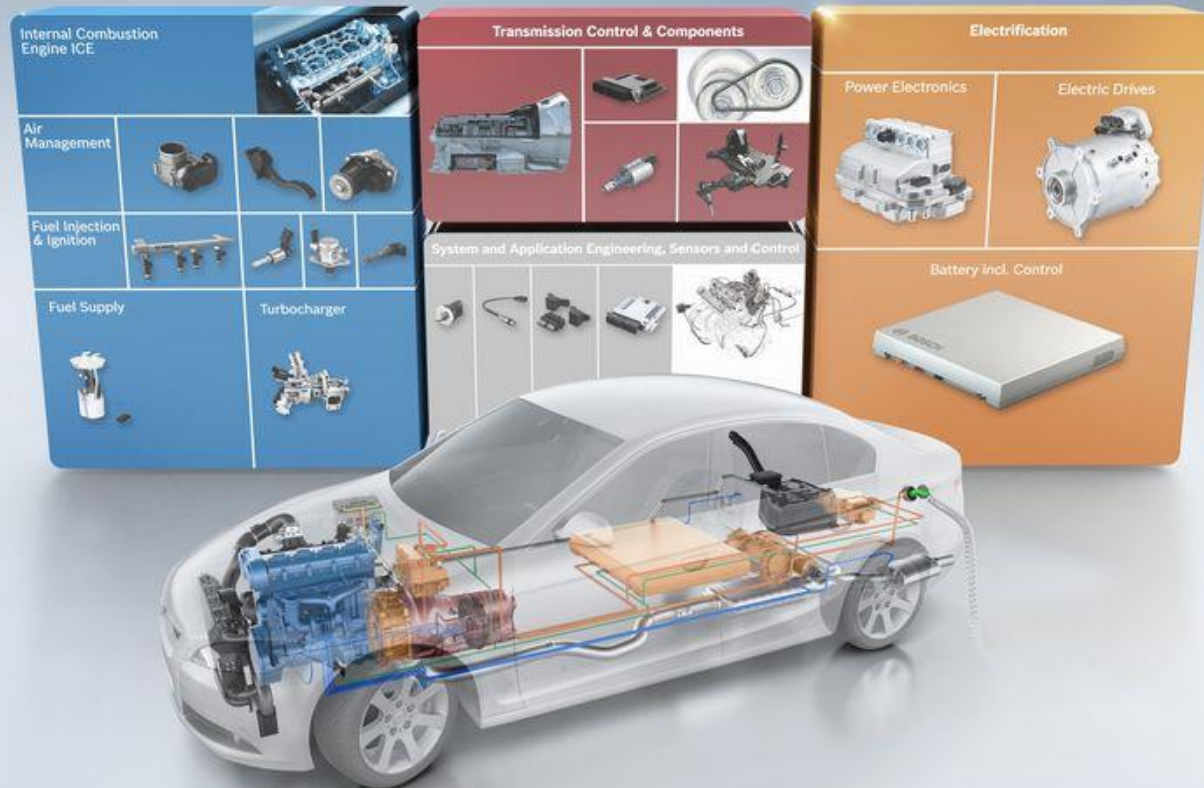


# Bosch powertrain technologies



## Powertrain Technologies for more fuel efficiency 燃油效率动力总成技术

### Gasoline Systems

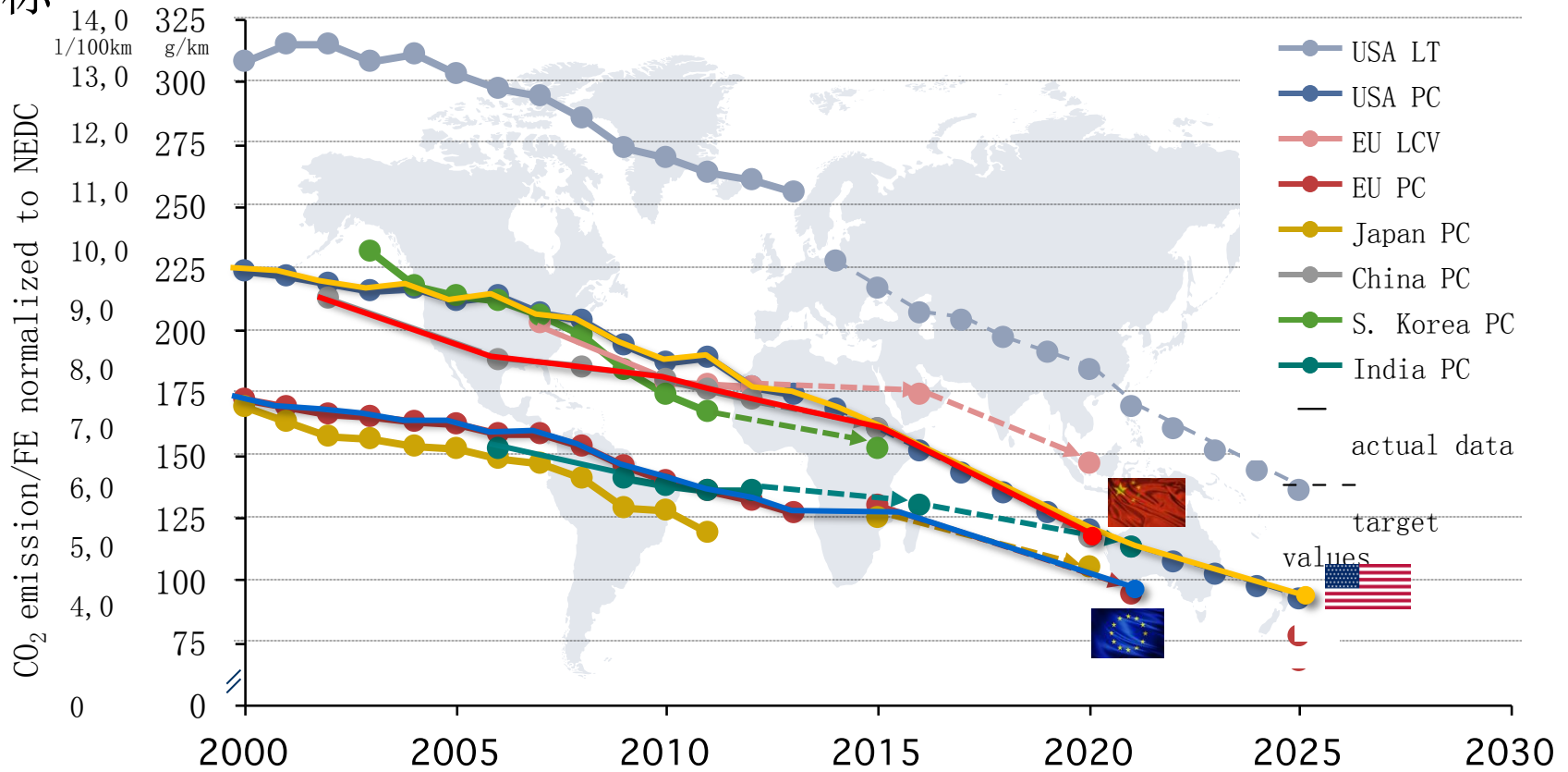
GS/PRM-SYS Ls | 26 May 2014 | © Robert Bosch GmbH 2014. All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights.



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## CO<sub>2</sub> emission/FE target worldwide 全球CO<sub>2</sub>排放或燃油经济性目标

标

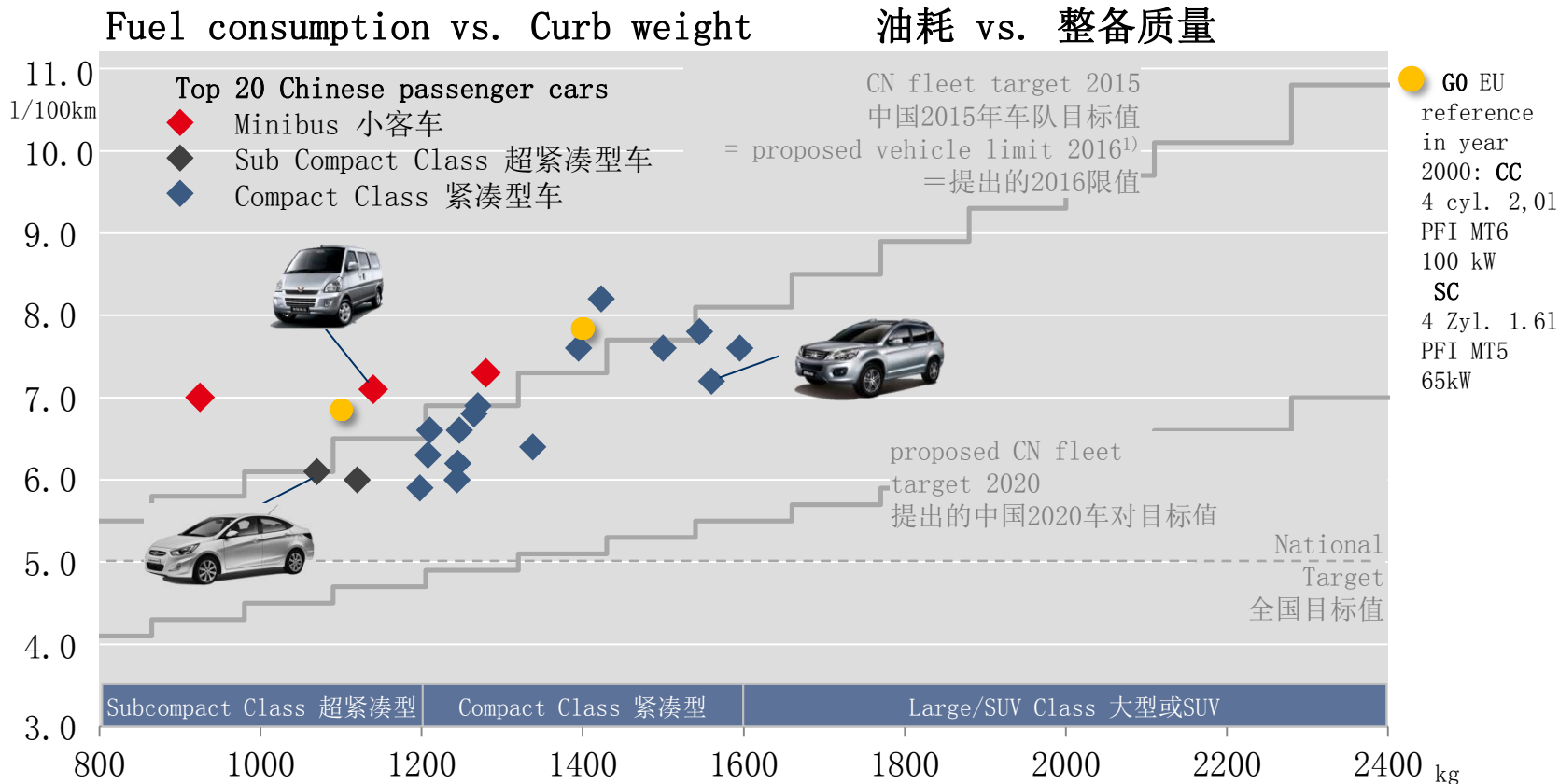


LT = Light Truck 轻型货车, LCV = Light Commercial Vehicle 轻型商用车, PC = Passenger Car 乘用车. Source: ICCT 02/2014\*  
 \* additional data JATO press release 03/2014 (EU PC 2013), AEA/TNO report 11/2009 (EU LCV 2007)

# Bosch powertrain technologies

## CO<sub>2</sub> Emission of Top 20 Chinese passenger cars

### 中国排名前20位的乘用车CO<sub>2</sub>排放



China TOP20 vehicles in SC and CC Segment already implemented FE-Technologies  
中国超紧凑型和紧凑型细分市场的前20位的车辆已经采用燃油经济性技术

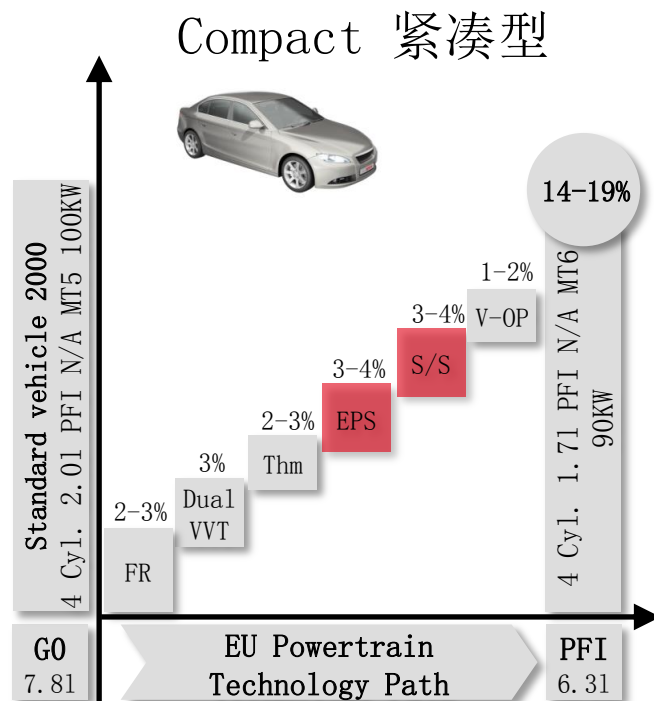
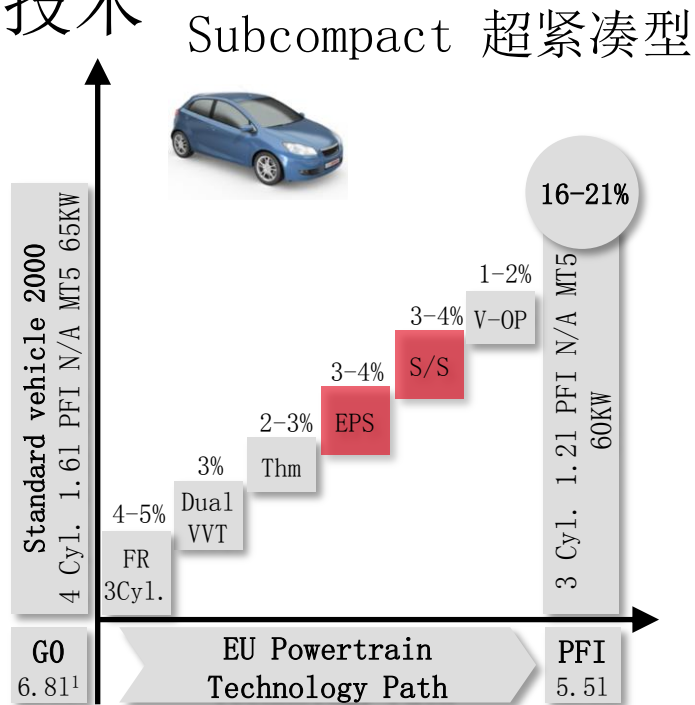
Gasoline Systems

Fuel consumption NEDC <sup>1)</sup> Single normal vehicle FC limit CN  
(New type/All type: 2016. 1.1/2017. 1.1)



**BOSCH**

## PFI fuel efficiency technologies 燃油效率点喷技术



VVT= variable valve timing 可变气门正时 | PFI = port fuel injection 点喷 | N/A = natural aspirated 自然吸气 | FR = friction reduction engine/valvetrain 发动机或气门摩擦减少 | Thm = thermomanagement 热能管理 | EPS = electric power steering 电动助力转向 | S/S = start/stop system 怠速起停 | V-OP = controlled oil pump 可控油泵 | cEGR = cooled exhaust gas recirculation 冷却废气再循环 | MT = manual transmission 手动变速器

Gasoline PFI powertrains offer CO<sub>2</sub>-reduction potential of up to 20%  
减少CO<sub>2</sub>达20%的潜力

汽油点喷动力总成具有减



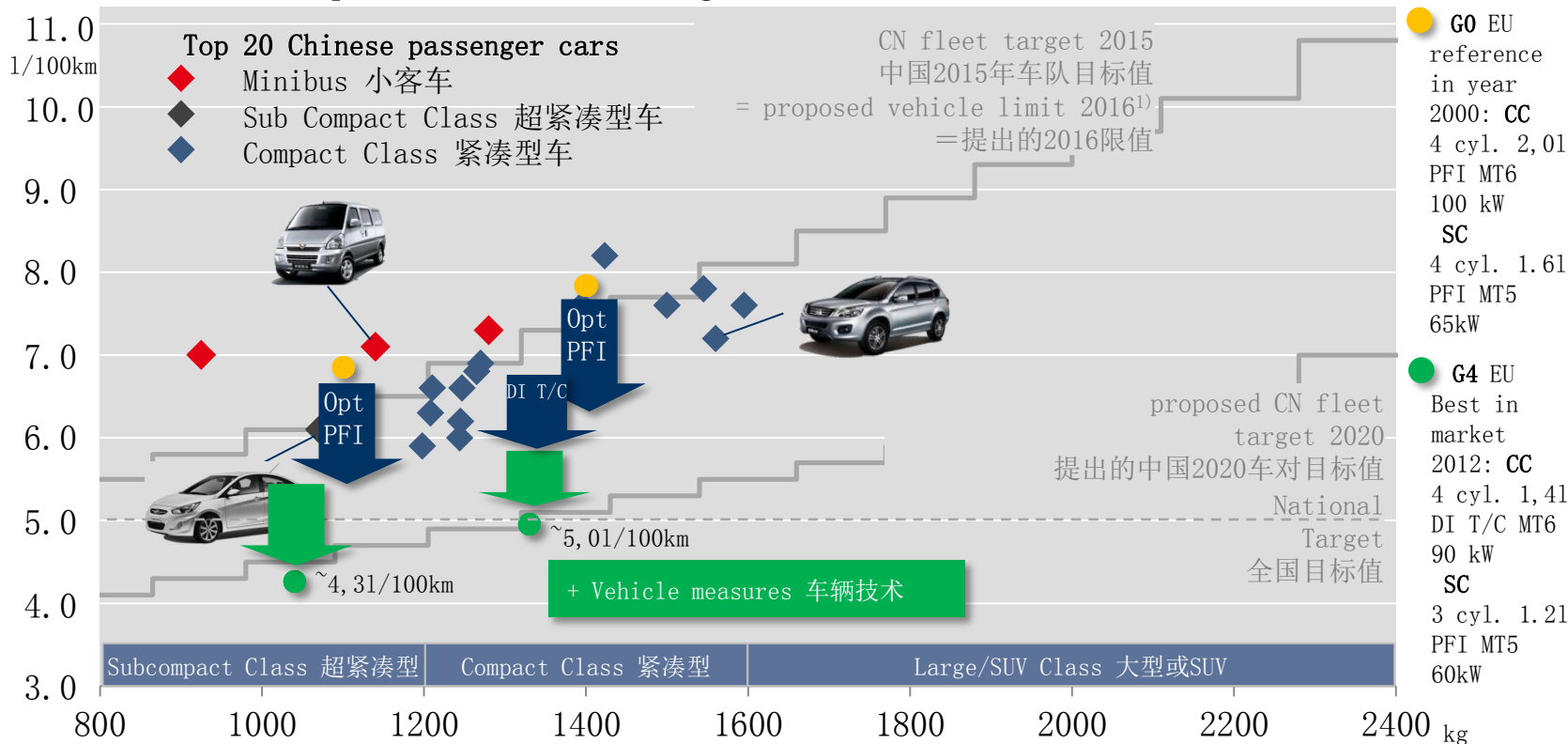
# Bosch powertrain technologies

## CO<sub>2</sub> Emission of Top 20 Chinese passenger cars

### 中国排名前20位的乘用车CO<sub>2</sub>排放

#### Fuel consumption vs. Curb weight

#### 油耗 vs. 整备质量



To fulfill 2020 targets a mixture of PFI, DI and vehicle measures is needed  
 为达到2020目标值，需要混合采用点喷或直喷和车辆技术

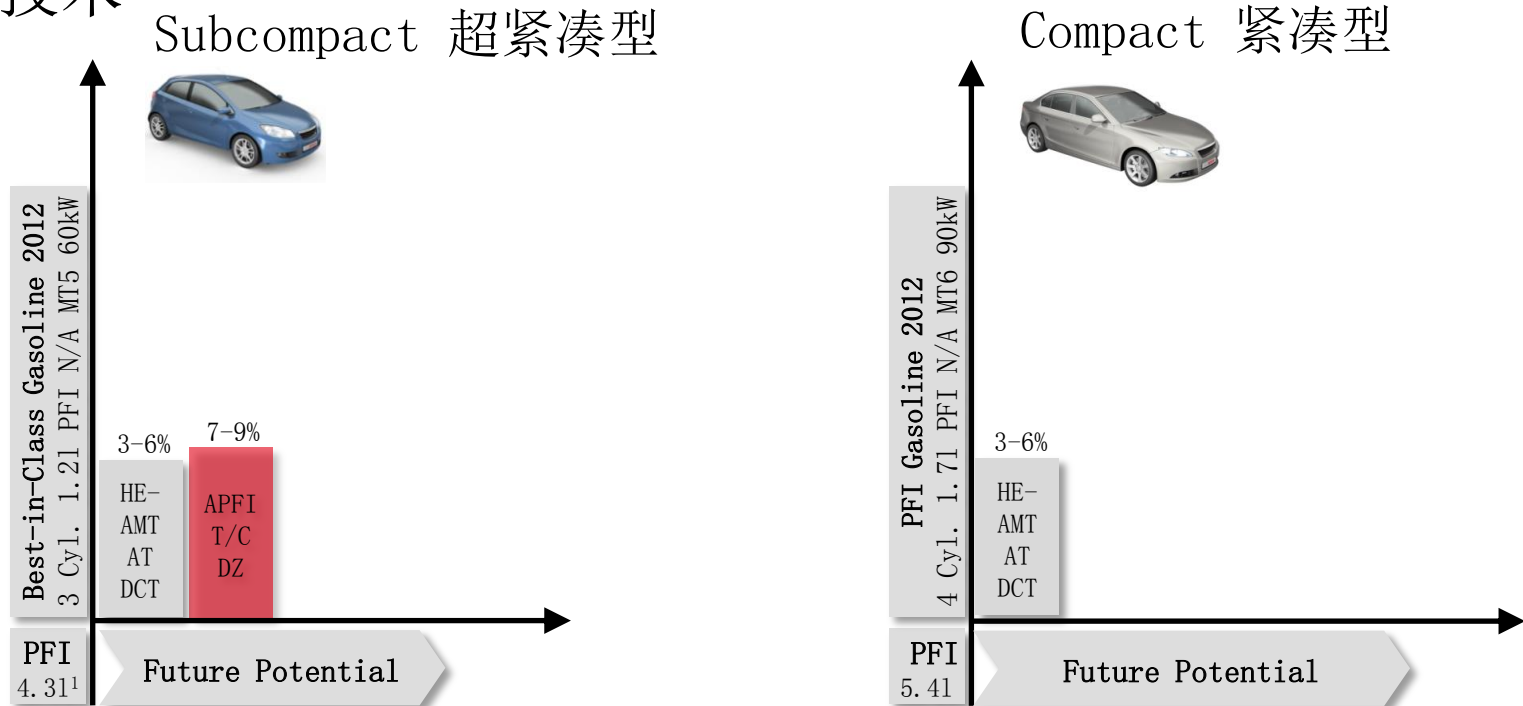
Gasoline Systems

Fuel consumption NEDC <sup>1)</sup> Single normal vehicle FC limit CN  
 (New type/All type: 2016.1.1/2017.1.1)



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## Future fuel efficiency technologies 未来的燃油效率技术



TR PFI TR

HE- = high efficiency 高效 | DI = direct injection 直喷 | APFI = advanced port fuel injection 高级点喷 | AMT = automated manual transmission 手自一体变速器 | AT = automatic transmission 自动变速器 | DCT = double clutch transmission 双离合变速器 | T/C = turbocharger 涡轮增压 | DZ = downsizing 减少排量 | BRS = Boost recuperation system 增压回收系统 | sHEV = strong hybrid 强混合动力 | TR = transmission 变速器

PFI Powertrains offer further CO<sub>2</sub>-reduction potential of up to 9% 点喷动力总成具有进一步减少CO<sub>2</sub>达9%的潜力

## Advanced gasoline port fuel injection (A-PFI) 高级汽油点喷



### Features 特性

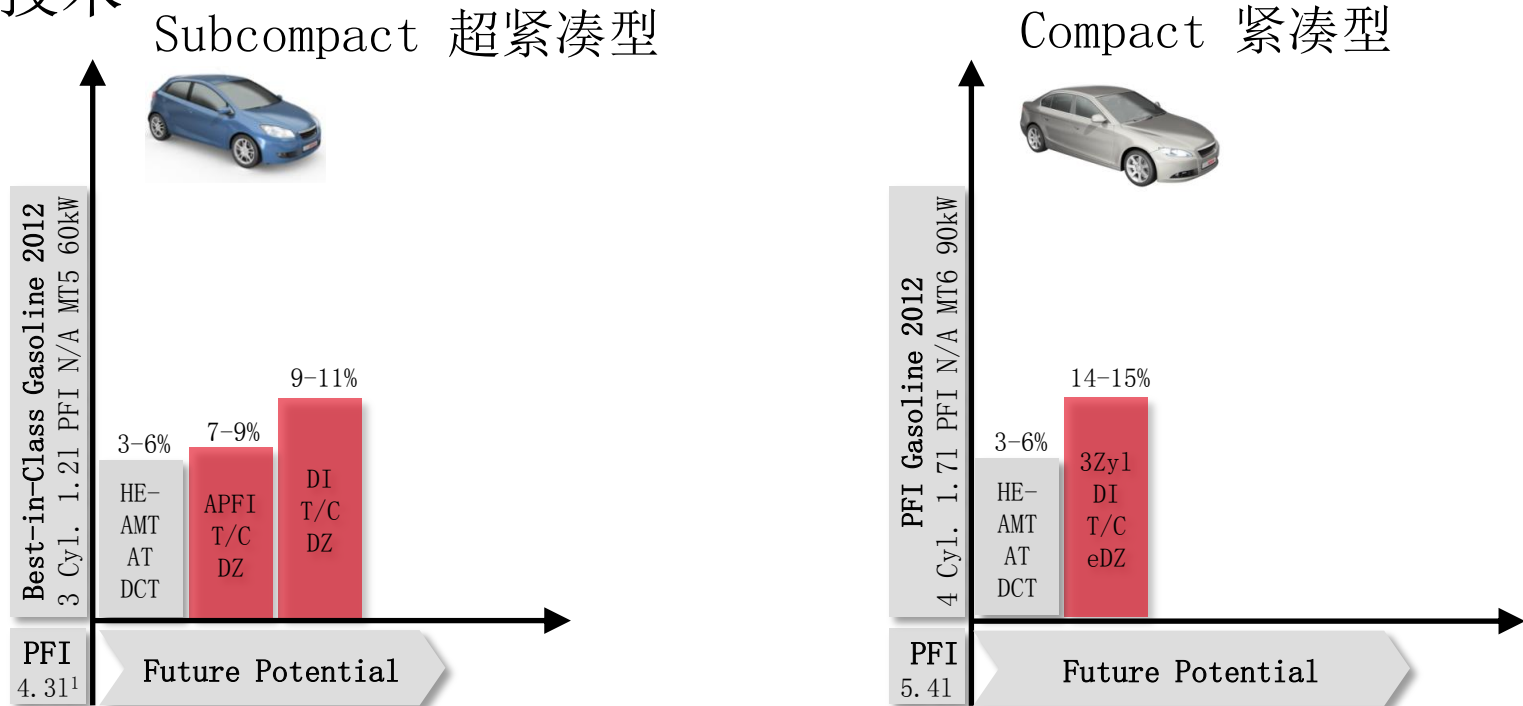
- Combination of new PFI technologies in an integrated system approach 新的点喷技术集成
- Twin-Injection: 2 Injectors per Cylinder 双喷：每缸两个喷头
- PFI Scavenging: using VVT & T/C 采用可变气门正时和涡轮增压
- Pressure Increase: DECOS (variable fuel supply) 增压：DECOS (按需供油)
- Open Valve Injection under WOT (full load) optimized by Twin Injectors 开阀喷射 (满负荷) 由双喷头优化

### Customer benefits / USP 用户利益

- up to 9% CO<sub>2</sub>-Reduction (incl. Twin-Injection, OVI, DECOS, Downsizing & T/C) 减少CO<sub>2</sub>高达9% (包括双喷头, 开阀喷射, 按需供油, 减少排量以及涡轮增压)
- Up to 40% Low end torque increase (Fun2Drive) 可增加40%低端扭矩 (Fun2Drive)
- Enlarge performance range (Engine Power) 增加性能范围 (发动机动力)
- > 20% Emissions-Reduction (Test Cycle) 排放减少>20% (测试工况)
- Further benefits by combination w/ air charge systems (e.g. metering range) and exhaust gas recirculation (swirl concepts) 更多的利益可通过充气系统 (如计量范围) 和废气再循环 (旋流概念)



## Future fuel efficiency technologies 未来的燃油效率技术



**HE-** = high efficiency 高效 | **DI** = direct injection 直喷 | **APFI** = advanced port fuel injection 高级点喷 | **AMT** = automated manual transmission 手自一体变速器 | **AT** = automatic transmission 自动变速器 | **DCT** = double clutch transmission 双离合变速器 | **T/C** = turbocharger 涡轮增压 | **DZ** = downsizing 减少排量 | **BRS** = Boost recuperation system 增压回收系统 | **sHEV** = strong hybrid 强混合动力 | **TR** = transmission 变速器

Gasoline Direct Injection Powertrains offer further CO<sub>2</sub>-reduction potential of up to 15% 汽油直喷动力总成具有进一步减少CO<sub>2</sub>达15%的潜力

1) Fuel consumption [liter per 100km] in NEDC





## Gasoline direct injection (DI) 汽油直喷



### Features 特性

- High-pressure injection directly into the combustion chamber  
直接高压喷射到燃烧腔
- Injection pressure up to 200 bar, higher pressures under evaluation  
喷射压强高达200 bar, 更高的压强还在评估中
- “Scavenging” for better cooling / charging  
“排气”为了更好的降温或充气

### Customer benefits / USP 用户利益

- Fuel savings up to 15% (by downsizing turbo-charger or  $\lambda > 1$ ) vs. PFI N/A  
省油高达15% (采用减少排量, 涡轮增压或 $\lambda > 1$ ) vs 点喷, 天然气
- With Turbo: low end torque increase up to 50% vs. PFI  
采用涡轮: 低端扭矩增加达50% vs. 点喷
- Quick response on kick-down (prevention of typical turbo-delay with DI T/C and scavenging 直喷涡轮增压和排气快速响应 (防止典型的涡轮延迟)
- Emission: all legislation levels (EUVI, SULEV, LEV VIII) 排放:  
有立法层面

### Gasoline Systems

PFI...Port Fuel Injection SULEV...Super Ultra Low Emission T/C...Turbo charged

Worldwide applicable for all specified fuels 所有指定的燃料全适用



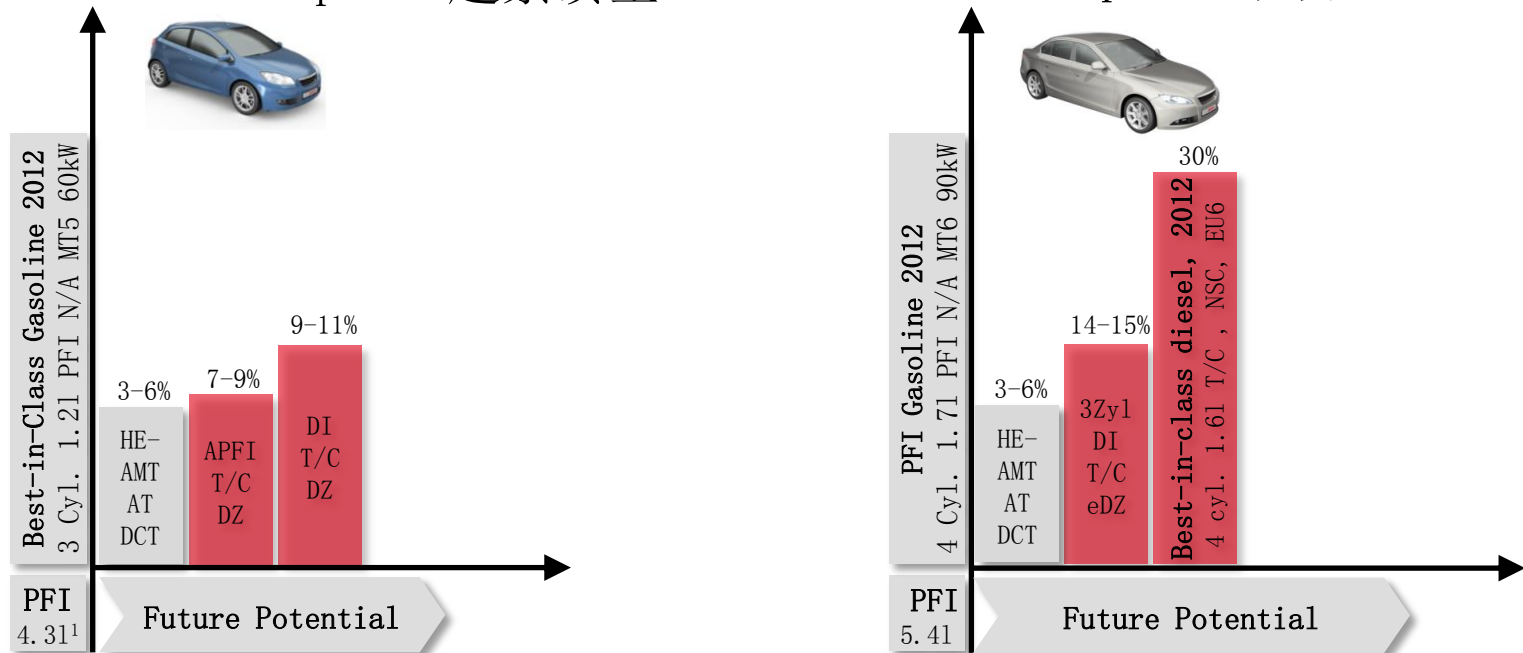
# Bosch powertrain technologies

## Future fuel efficiency technologies

### 未来的燃油效率技术

#### Subcompact 超紧凑型

#### Compact 紧凑型



TR PFI DI TR DI DS  
 HE- = high efficiency 高效 | DI = direct injection 直喷 | APFI = advanced port fuel injection 高级点喷 | AMT = automated manual transmission 手自一体变速器 | AT = automatic transmission 自动变速器 | DCT = double clutch transmission 双离合变速器 | T/C = turbocharger 涡轮增压 | DZ = downsizing 减少排量 | BRS = Boost recuperation system 增压回收系统 | sHEV = strong hybrid 强混合动力 | TR = transmission 变速器

Diesel powertrains offer CO<sub>2</sub>-reduction potential of up to 30% 柴油动力总成具有减少CO<sub>2</sub>达30%的潜力

#### Gasoline Systems

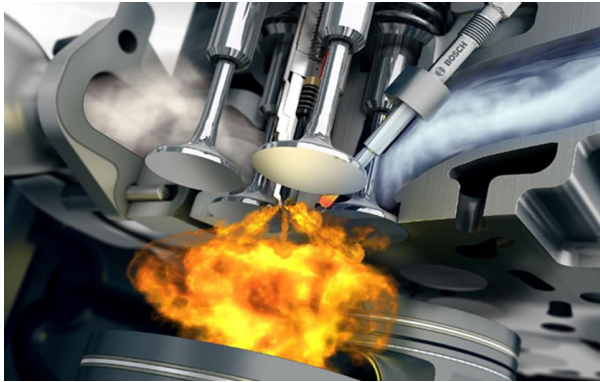
1) Fuel consumption [liter per 100km] in NEDC

Bosch solution available



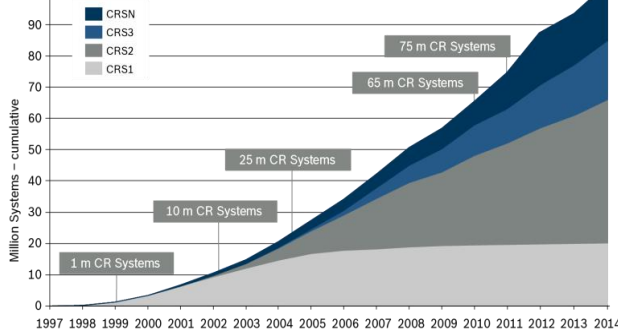
**BOSCH**

## Diesel Common Rail System (CRS) for PC 乘用车柴油共轨系统



### Market success 成功市场

Cumulative volume of Bosch Diesel CR Systems  
Bosch 柴油共轨系统累积数



CRS1/2/3 = CRS system generations,  
CRSN = CRS for commercial vehicles

### Features 特性

- ➔ Available for passenger cars (PC) & light commercial vehicles 适用于乘用车和轻型商用车
- ➔ Adaption for heavy commercial & off-highway engines possible 可能适用于重型商用和非道路发动机
- ➔ High injection pressures of up to 2.500 bar, higher pressures under evaluation for future applications 高压喷射达2,500 bar, 为未来的运用, 更高的压强还在研究中
- ➔ Fewer emissions and noise than conventional diesel systems 比传统的柴油系统更少的排放和噪音

### Arguments pro Diesel 论据倾向于柴油

#### Economical: 经济:

- ➔ Up to 30% better fuel economy than a comparable gasoline\* engine depending on vehicle type and size 根据车辆类型及大小, 比同等的汽油发动机高达30%的燃油经济性
- ➔ Accordingly, up to 20% lower CO<sub>2</sub> emission and up to 35% higher mileage 从而, 减少CO<sub>2</sub>高达20%和高达35%的里程

#### Clean: 清洁:

- ➔ Minimal particulate matter and NO<sub>x</sub> emission 最少的颗粒物和NO<sub>x</sub>排放

#### Fun: 有趣:

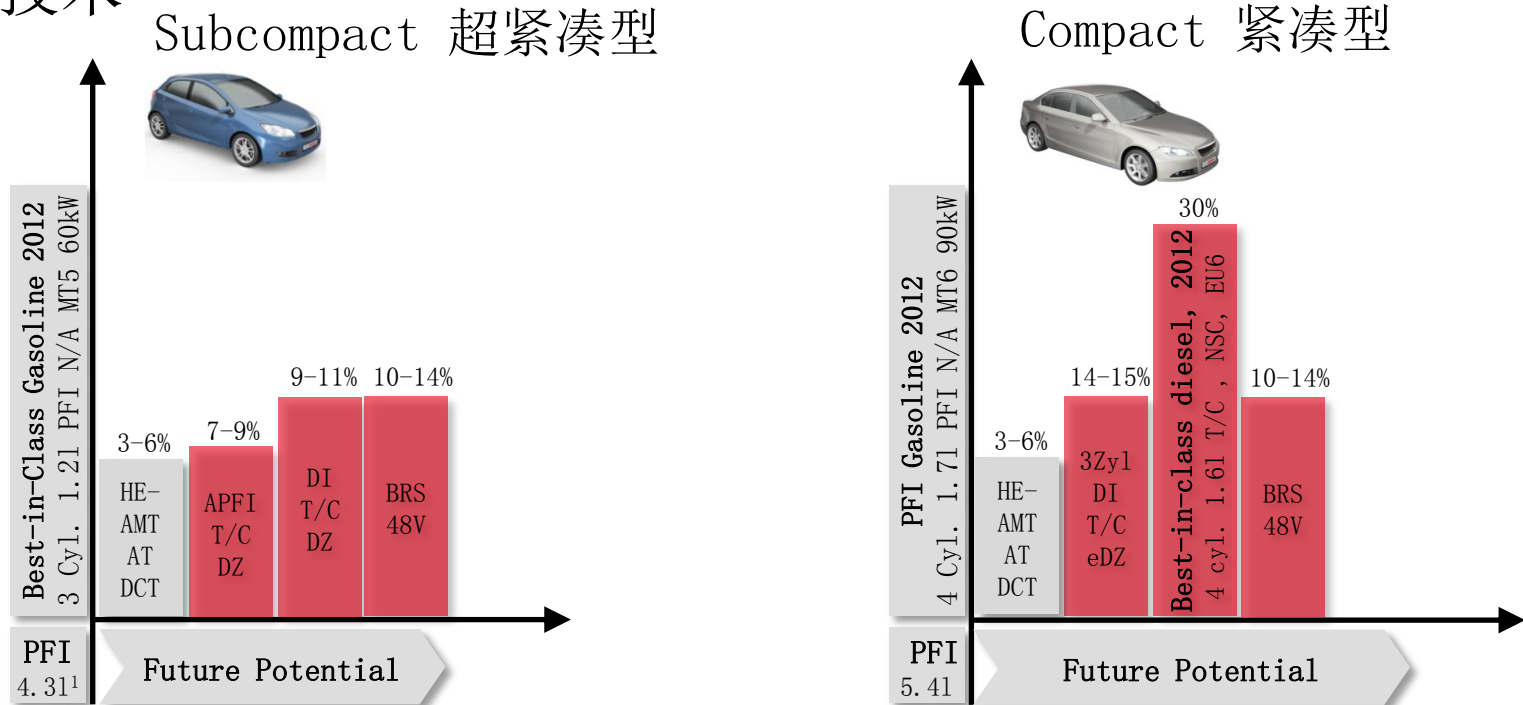
- ➔ Up to 40% higher torque than a comparable gasoline engine depending on the vehicle size & type 根据车辆类型及大小, 比同等的汽油发动机高达40%的扭矩
- ➔ High torque, even at lower engine speeds, for comfortable acceleration and good towing capacity 甚至在较低的发动机转速下具有高扭矩, 且有舒适的加速和良好的牵引性能

\* Based on the comparison of more than 1,200 diesel/gasoline pairs, data provided by ADAC also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights.

### Gasoline Systems



## Future fuel efficiency technologies 未来的燃油效率技术



HE- = high efficiency 高效 | DI = direct injection 直喷 | APFI = advanced port fuel injection 高级点喷 | AMT = automated manual transmission 手自一体变速器 | AT = automatic transmission 自动变速器 | DCT = double clutch transmission 双离合变速器 | T/C = turbocharger 涡轮增压 | DZ = downsizing 减少排量 | BRS = Boost recuperation system 增压回收系统 | sHEV = strong hybrid 强混合动力 | TR = transmission 变速器

48V Boost Recuperation Systems offer CO<sub>2</sub>-reduction potential of up to 14% 48V的增压回收系统具有减少CO<sub>2</sub>达14%的潜力

### Gasoline Systems

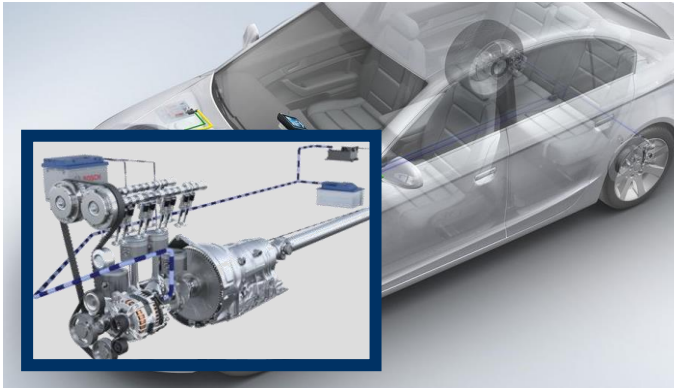
1) Fuel consumption [liter per 100km] in NEDC

     Bosch solution available

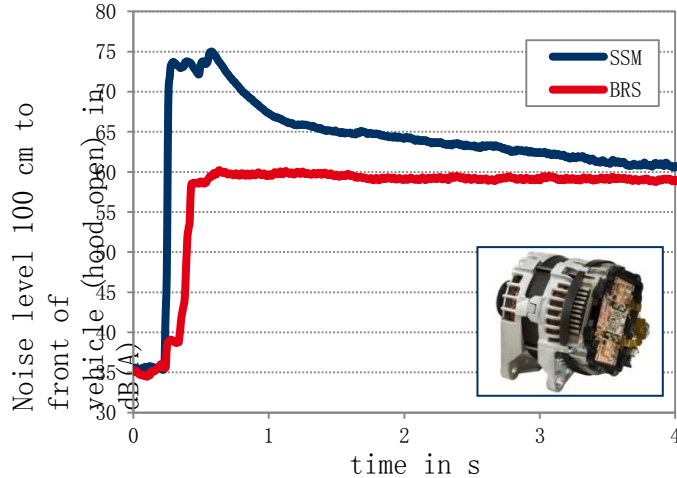


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## Boost recuperation system (BRS) 增压回收系统



Reduced Starting Noise 减少启动噪音



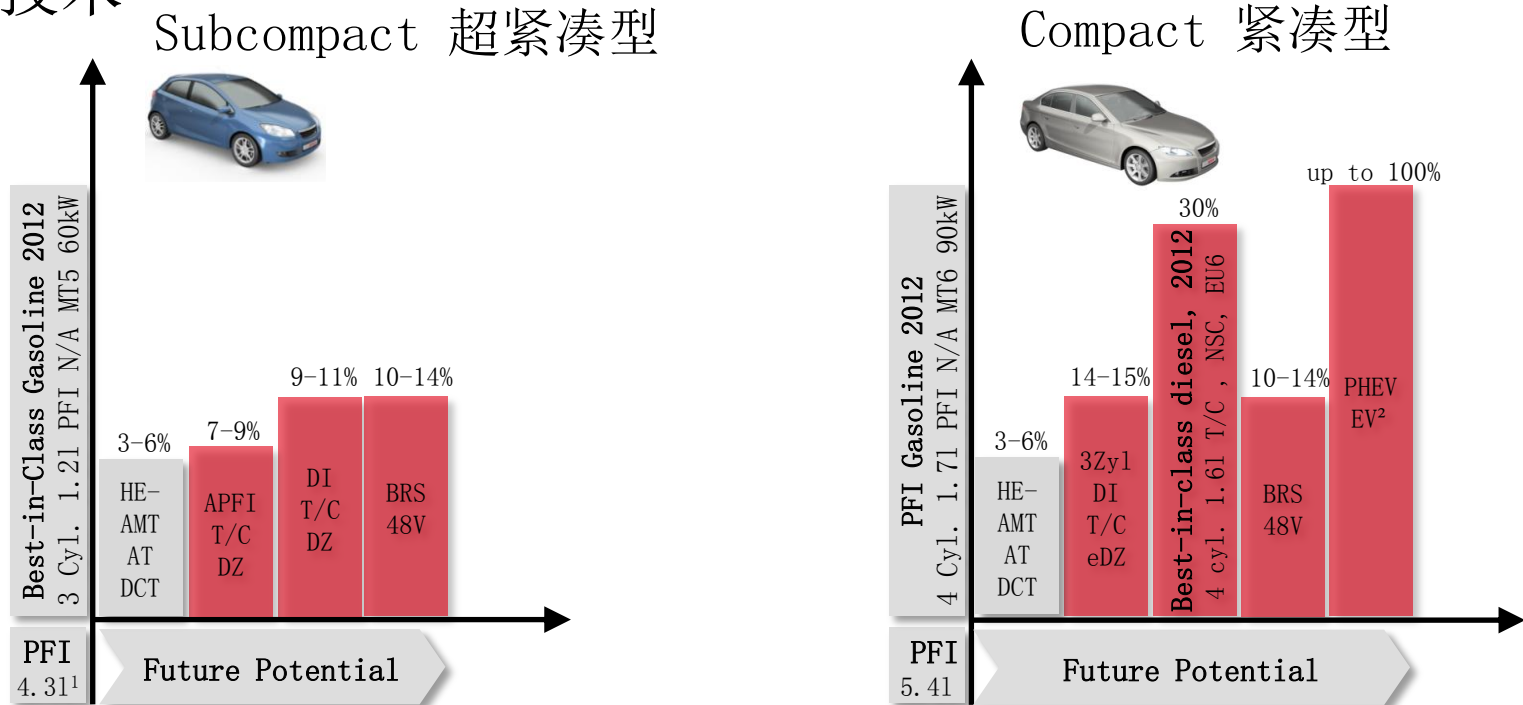
### Features 特性

- Electrical machine delivering up to 10 kW 电机供应高达10 kW
- Energy supply from brake energy recuperation 从制动能量回收提供能量
- Electrical boost function 电激励功能

### Customer benefits 用户利益

- Up to 14% fuel-efficiency improvement in NEDC (without coasting, with gearshift optimization, basis: start-stop) 在NEDC工况下提高燃油效率高达14% (没有滑行, 采用换挡优化, 基本: 怠速起停)
- Very short & comfortable ICE restart feasible, enabling start-stop and coasting 短且舒适的内燃机再启动特性, 可以怠速起停和滑行
- Reduced starting time, noise and vibration 减少启动时间、噪音和振动
- Cost-efficient entry system for electrification 性价比高的电子化系统
- Fun to drive (e-boost) 开起来有趣 (e-boost)

## Future fuel efficiency technologies 未来的燃油效率技术

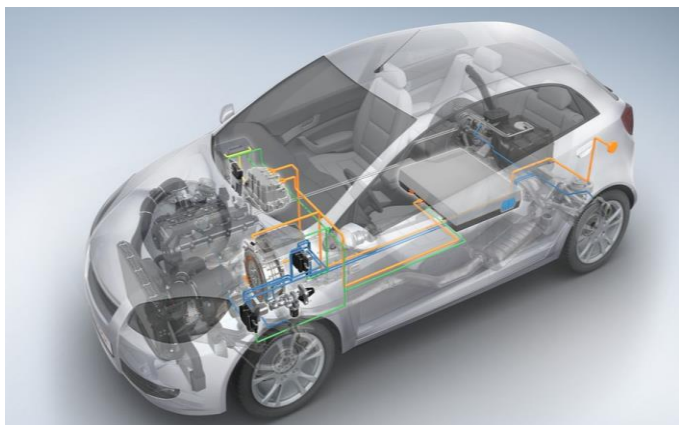


TR PFI DI BRS TR DI DS BRS PHEV

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Hybrids & EV's offer CO<sub>2</sub>-reduction potential of up to 100% 混合动力和电动车具有减少CO<sub>2</sub>达100%的潜力

# Plug-in hybrids (PHEV) 插电式混合动力



High-voltage battery 高伏特电池  
Lithium-ion battery 锂离子电池  
4 - 12 kWh



Power electronics module 电力电子模块  
DC link voltage 直流电压 250 - 450 V  
DC/DC converter 1.5 - 3 kW



Electric motor 电动机  
traction drive 牵引驱动  
30 - 80 kW



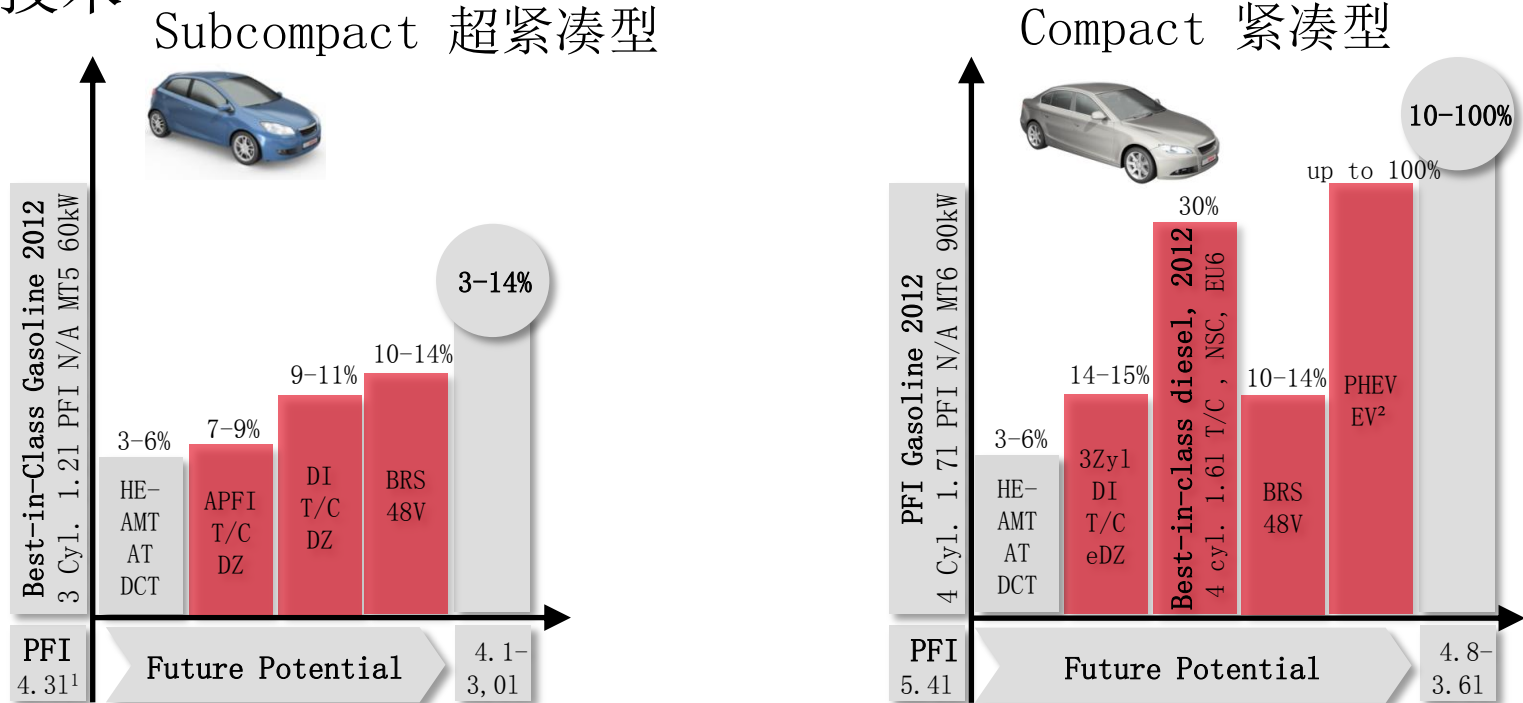
## Features 特性

- Combination of efficient ICE\* & electric driving (comfort)  
高效内燃机和电动驱动相结合
- CO2 reduction and driving enjoyment  
减少CO2排放及增加驾驶舒适度
- Attractive due to legislation and consumer expectations  
由于立法和消费者的期望，具有吸引力
- Electrical energy supply from charge spot (230/400 V)  
电能供应来自充电点 (230/400 V)
- Optimal layout in terms of cost/ benefit and customer acceptance: 50 km el. range and 120 km/h max. el. Speed  
成本/效益和客户接受方面的优化布局: 50 km的电驱动驾驶行程及120 km/h最高电驱动驾驶速度
- Future: market penetration from upper vehicle segment  
未来: 从高端一些的细分市场渗入

## Customer benefits 用户利益

- 50-90% fuel-efficiency improvement in NEDC (e-range)  
在NEDC工况下燃油效率提高50-90%
- Electric driving ranges sufficient to allow access to low-emission zones 电驱动驾驶行程下足够可以进入低排放区
- Green image (electric drive) + driving enjoyment (e-boost) 绿色形象 (电力驱动) 和驾驶乐趣 (e-boost)

## Future fuel efficiency technologies 未来的燃油效率技术



TR PFI DI BRS TR DI DS BRS PHEV

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Future powertrain technologies offer further CO<sub>2</sub>-reduction potential 未来动力总成技术具有进一步减少CO<sub>2</sub>的潜力

### Gasoline Systems

1) Fuel consumption [liter per 100km] in NEDC 2) +credits  
Bosch solution available





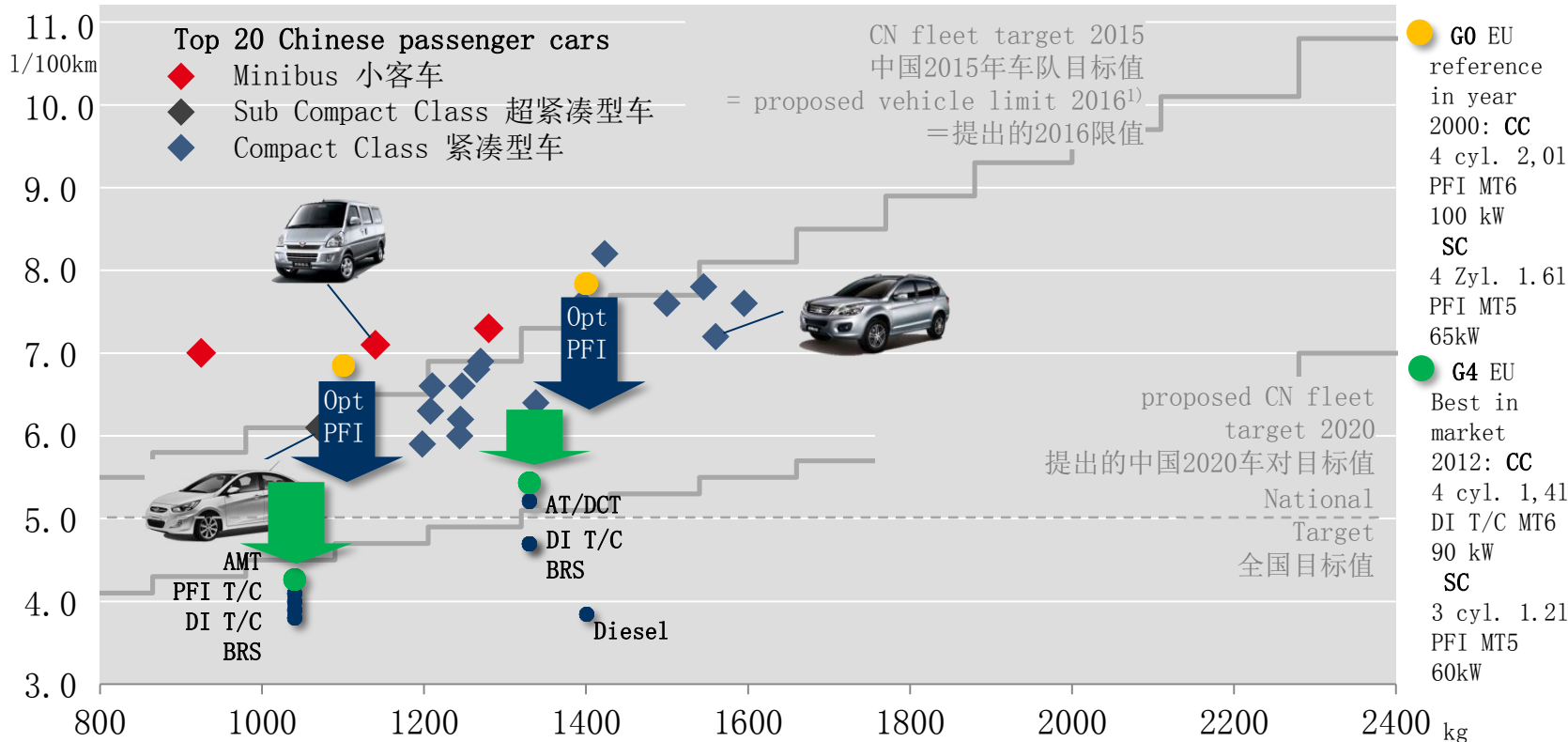
# Bosch powertrain technologies

## CO<sub>2</sub> Emission of Top 20 Chinese passenger cars

### 中国排名前20位的乘用车CO<sub>2</sub>排放

Fuel consumption vs. Curb weight

油耗 vs. 整备质量



To fulfill 2020 targets various technology paths are possible

为达到2020目标值多种技术路径都有可能

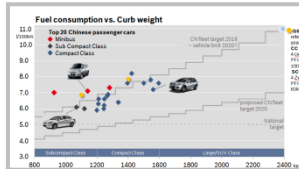
Gasoline Systems

Fuel consumption NEDC <sup>1)</sup> Single normal vehicle FC limit CN  
(New type/All type: 2016.1.1/2017.1.1)

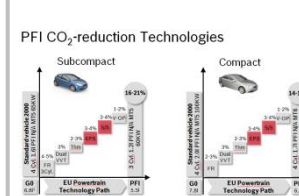


**BOSCH**

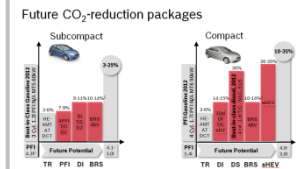
## Summary 总结



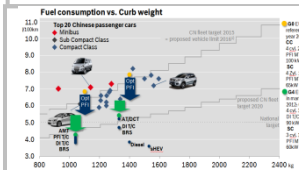
- China TOP20 sales vehicles already implemented FE-Technologies but still have to reduce the fuel consumption by 20-40% 中国销量排名前20位的车辆已经采用了节油技术，但是仍然需要减少油耗20-40%



- There is still optimization potential for PFI engines especially with hybridization 对点喷发动机还具有优化潜力，特别对于混合动力
- For small vehicle classes PFI engine technology with vehicle measures are sufficient to achieve 2020 target 对于小车细分市场，点喷发动机技术与车辆技术结合足够达到2020目标值



- In Compact Class DI, Diesel or PFI + Electrification is needed. Only PFI technology and vehicle measures aren't sufficient 对于紧凑型，需要直喷，柴油或点喷加电气化。只有点喷和车辆技术是不够的
- New Technologies not only fulfill the fuel efficiency targets 2020 they also increase fun to drive and drivers comfort. 新的技术不仅可以实现2020年燃油效率目标，而且增加了驾驶乐趣和舒适性。



- Gasoline Direct Injection with best cost/benefit ratio to achieve 2020 targets in Compact Class but increase engineering effort 对于紧凑型，汽油直喷具有最佳的性价比以到达2020目标，但会增加工程投入
- Diesel and Hybrids enables even Large/SUV vehicles to reach 2020 targets 柴油和混合动力驱使大型车及SUV达到2020年目标

