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A Century of Sensing Excellence

Sensata Technologies

传感器行业的机遇与挑战

THE OPPORTUNITIES AND CHALLENGES OF SENSOR INDUSTRY

12-SEP-2016

赵国峰　　森萨塔科技研发工程总监

The World Depends on Sensors and Controls

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主要内容

- 感知与社会进步
- 现时代经济发展面临的挑战与机会
- 传感器应用新的要求
- 森萨塔科技传感器

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感知与社会进步
Sensing and Social Development

传感技术同计算机技术与通信技术一起被称为信息技术的三大支柱。从仿生学观点，如果把计算机看成处理和识别信息的“大脑”，把通信系统看成传递信息的“神经系统”的话，那么传感器就是“感觉器官”。

- 人类生活：
  - 可穿戴设备
  - 智能驾驶
  - 健康
- 智能化
  - 工业4.0
  - 机器人技术
  - 物联网
  - 中国制造2025

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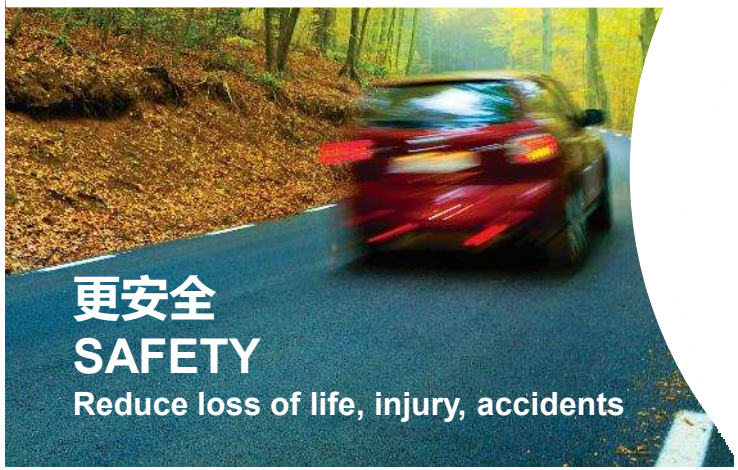
现时代经济发展面临的挑战
Societal Imperatives Drive Markets

Regulatory requirements and economic forces drive sensor adoption

更节能
EFFICIENCY
More efficiently use fossil fuels, increase productivity



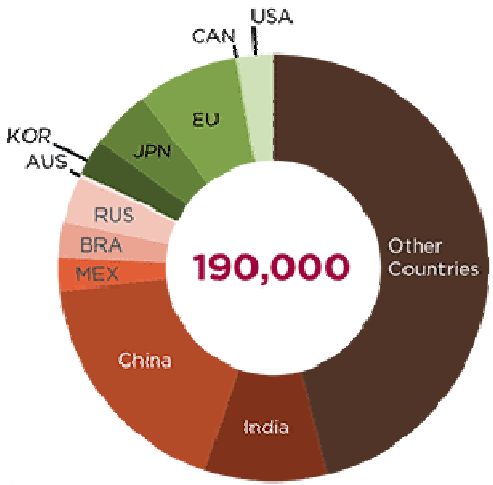
更安全
SAFETY
Reduce loss of life, injury, accidents

更清洁
CLEAN ENVIRONMENT
Reduce emissions in air and water

Premature deaths from vehicle exhaust[1]

车辆废气导致的初生婴儿死亡

2014



1 International Council on Clean Transportation

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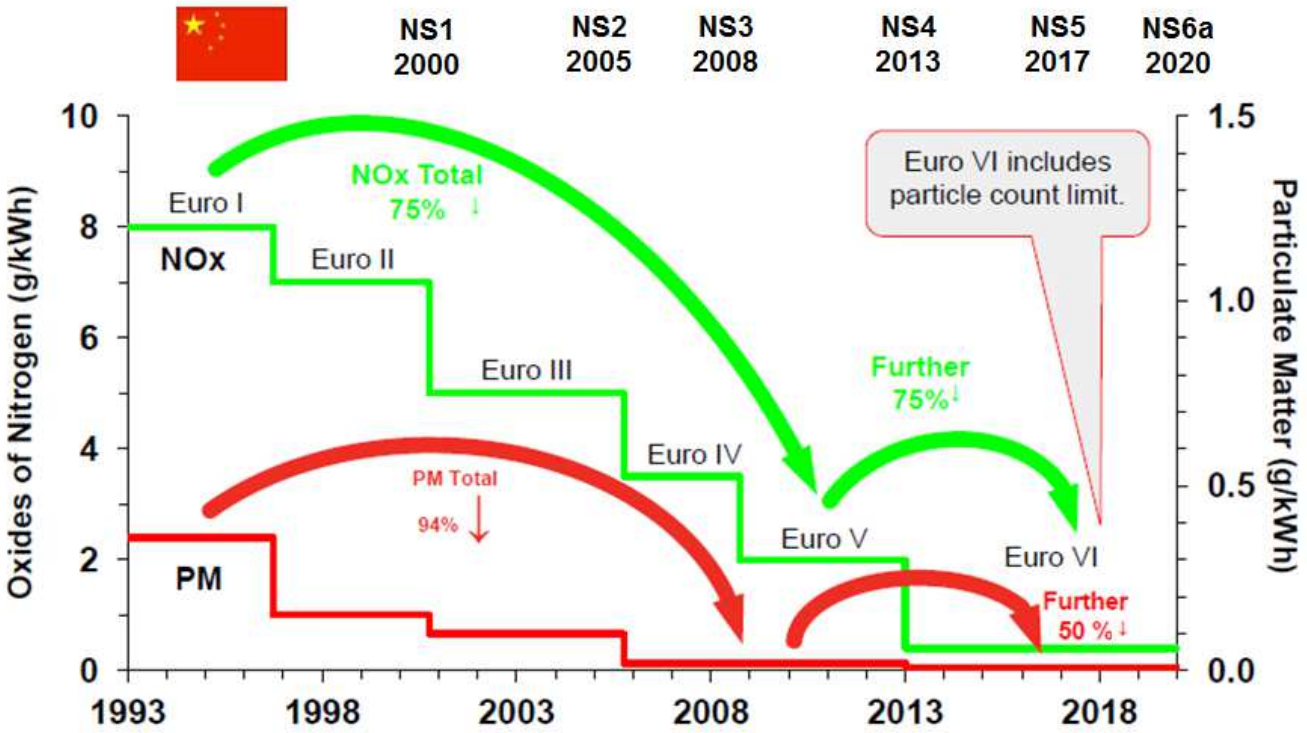
更清洁 – 减少排放污染
CLEAN ENVIRONMENT
Reduce emissions in air and water



Continuously improve combustion and upgrade exhaust / after treatment system are the 2 main routes to reach new emission legislation

持续改善燃烧性能和尾气后处理系统升级是传统燃油车满足新排放标准的主要途径。

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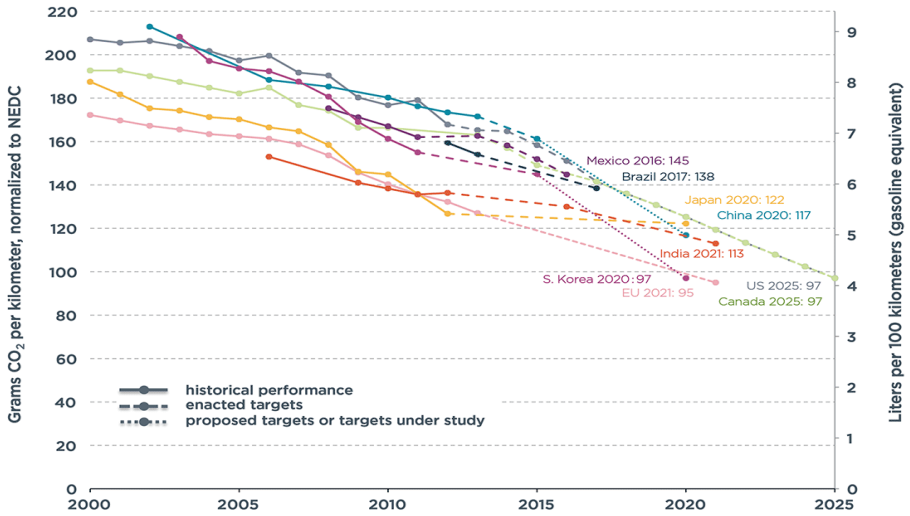
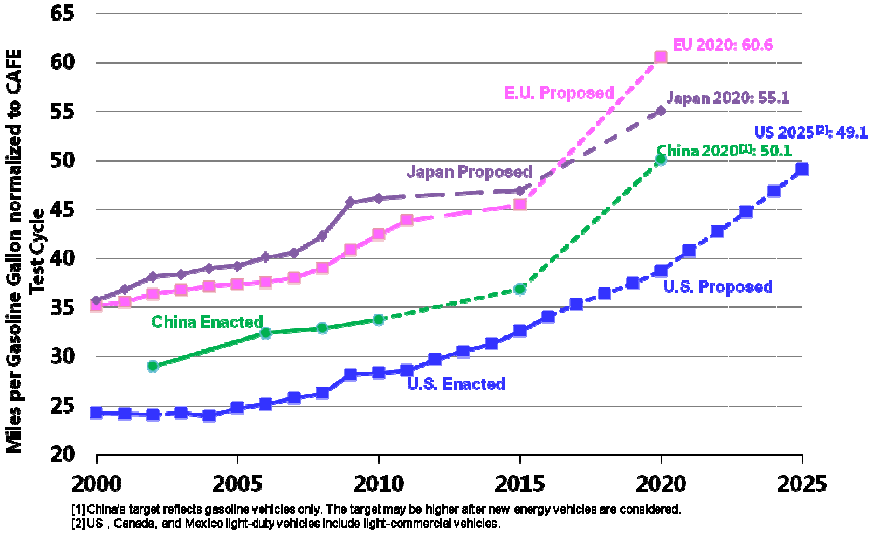
更节能 – 减少CO2排放, 提高燃油效率
Fuel Efficiency – CO2 Reduction, Fuel Efficiency Improvement





Fuel economy improvement broadly impacted by Engine, Transmission, Advanced AC system, Start-stop and EV/HEV

燃油经济性的提升大幅依赖于发动机、变速箱、高效空调系统、起停功能和混合动力及纯电动的普及

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技术发展带来系统功能的日益更新和完善
Technology Evolution Enables Ongoing Improvement

AUTOMOTIVE / HVOR

On / Off Pumps
Fixed Drives, Valve Train

AUTOMOTIVE / HVOR
汽车/重卡机械

Continuously Variable Outputs 连续可变输出
Load Management 负载管理

HVAC

Fixed Compressors
Expansion Valves

HVAC 暖通空调

Variable Refrigerant Flow
可变制冷剂流量

INDUSTRIAL

Single Speed On / Off Pumps

INDUSTRIAL 工业

Variable Speed Pumps for Advanced Fluid Management
高级流体管理系统的变速泵

SMARTER

CONTINUOUS SYSTEM IMPROVEMENTS drive the adoption of closed–loop systems requiring sensing capabilities 系统功能的不断提升要求使用更多传感器的闭环系统控制

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新技术提高燃油效率
Market Driving New Technologies

- CO2 emission reductions is mandated by governments across the world. CO2 emissions is inversely proportional to fuel efficiency (miles/gallon = 8887 / CO2 emissions in gm/mi). To improve fuel efficiency of traditional gasoline engine, manufacturers around the world are considering the following technologies. The corresponding fuel efficiency improvement (as reported by US' Environmental Protection agency) is shown below

Technologies	Fuel Efficiency improvement
Cylinder deactivation	4% to 10%
Turbocharges and superchargers	2% to 6%
Stoich Gasoline Direct Injection (GDI)	2% to 3%
Stratified GDI	Stoich GDI + 8% to 14%
Start stop systems	2% to 4%
Variable valve timing and lift	1% to 11%
Reducing vehicle weight	3% to 4% improvement per 5% reduction in weight
Low rolling resistance tires	1% to 3%
Additional gears	2% to 8%
Continuously variable transmissions	1% to 7%

- To further improve fuel efficiency some auto manufacturers are hybridizing vehicles. Vehicle hybridization (gas + electric) has the benefit of using Atkinson cycle, which conveniently allows for the use of EGR coolers. Usage of EGR coolers, in some cases, requires temperature and pressure sensors for monitoring the flow

CONTINUOUS SYSTEM IMPROVEMENTS drive the adoption of closed–loop systems (requiring sensing capabilities) and faster–than–market secular growth for Sensata

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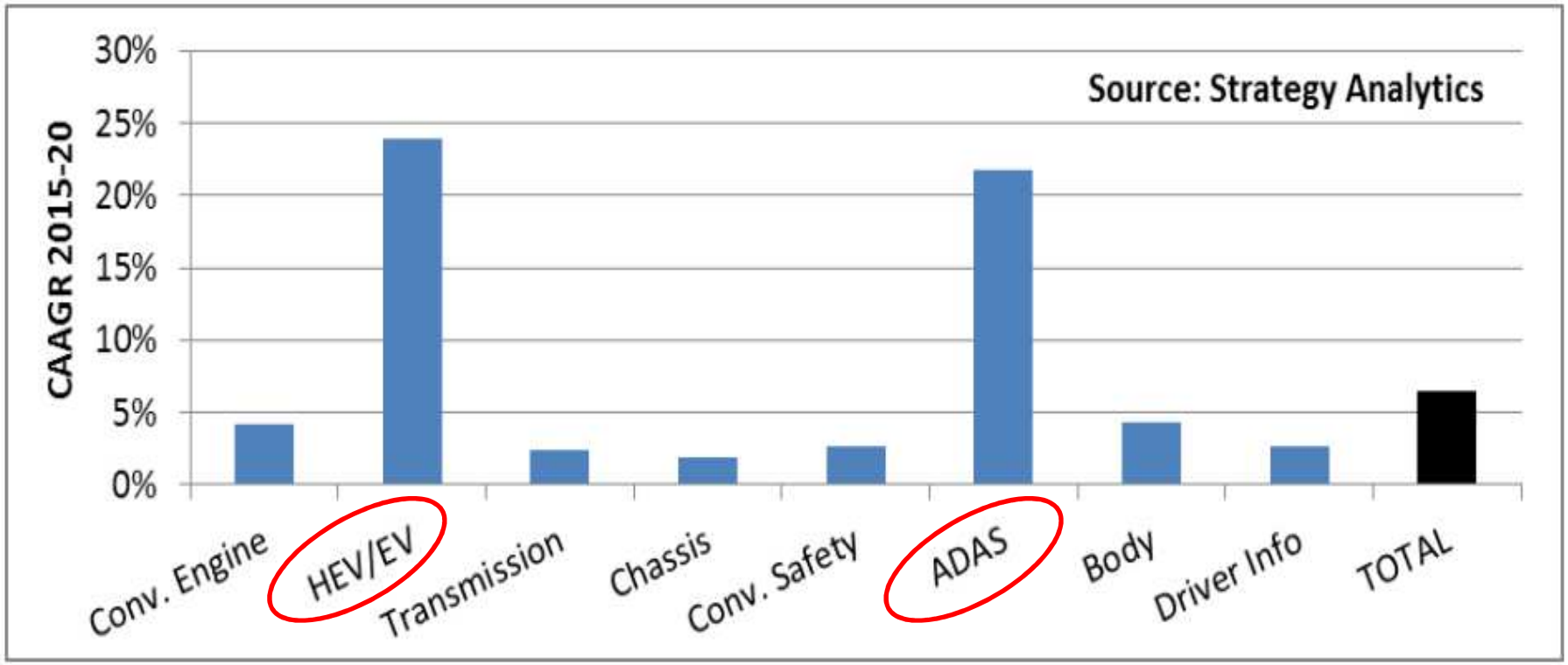
新发展： 电气化和智能化
New Evolution: Electrification and Intelligence



- HEV/EV and ADAS systems continue to offer the best growth prospects
- 新能源和智能辅助驾驶系统将持续快速增长

SOURCE: Strategy Analytics, Apr 2016

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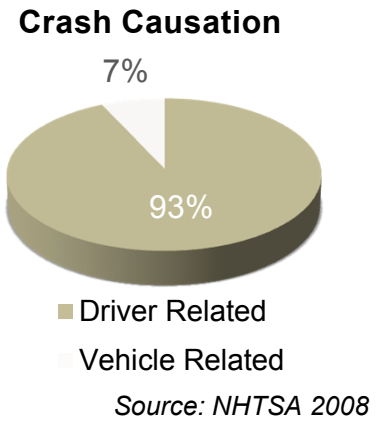
安全 — 从被动到主动 ESP, ADAS
Safety — Passive to Active

- 研究结果表明，ESP可以减少80%由侧滑引起的交通事故，并将严重车祸的数量减少50%。美国、欧盟等早已立法强制装配ESP。

- 93%的交通事故是由于驾驶员的失误引起的。*NHTSA 2008 National Motor Vehicle Crash Causation Survey – Report to Congress DOT HS811 059*
  - Recognition Error – 41%
  - Decision Error – 34%
  - Performance Error – 10%
  - Temporary Physical Disability – 9%



Source: NHTSA 2008

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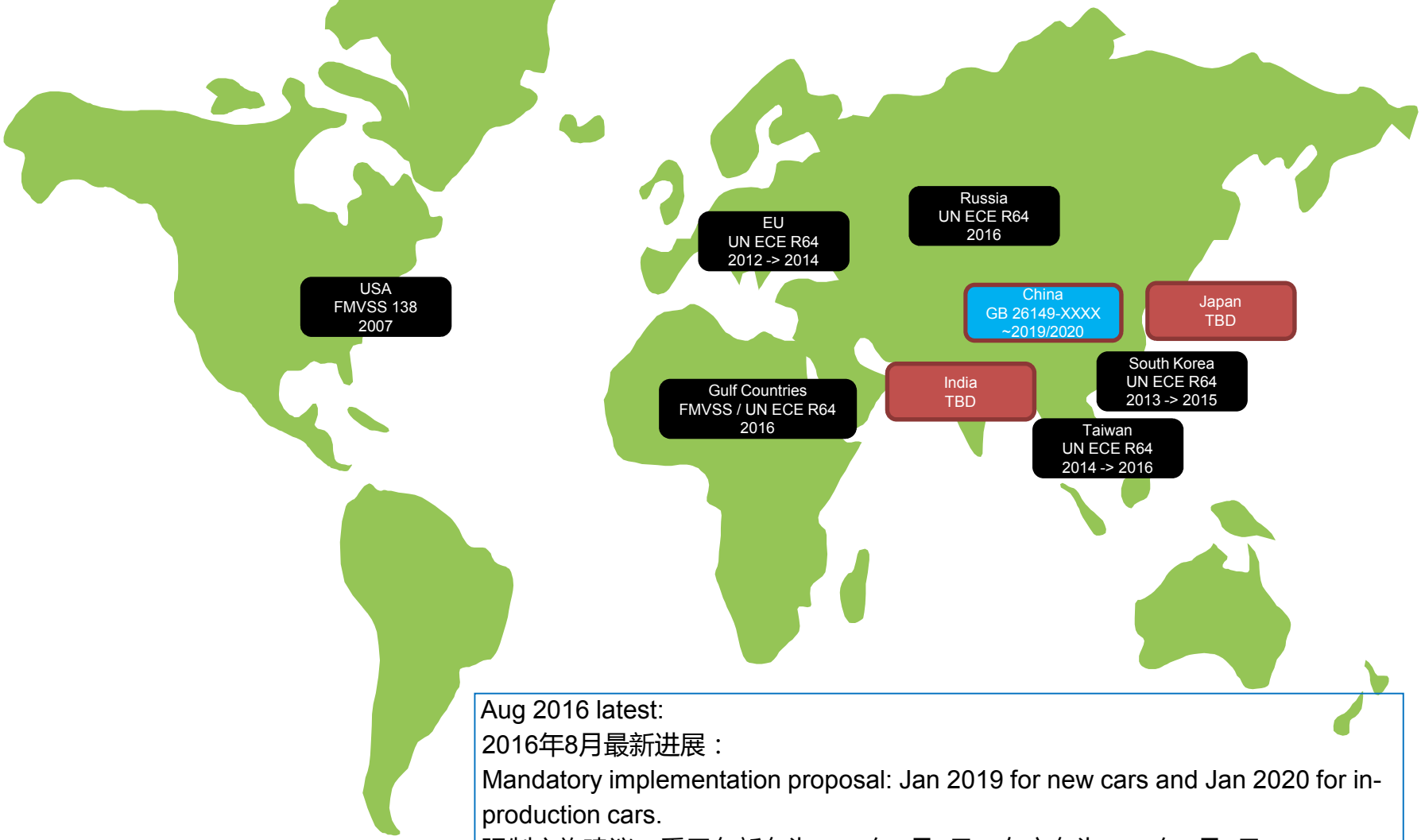
安全 – 全球胎压监测法规
Safety – TPMS Legislation Worldwide Today



Aug 2016 latest:
2016年8月最新进展：
Mandatory implementation proposal: Jan 2019 for new cars and Jan 2020 for in-production cars.
强制实施建议：乘用车新车为2019年1月1日，在产车为2020年1月1日。

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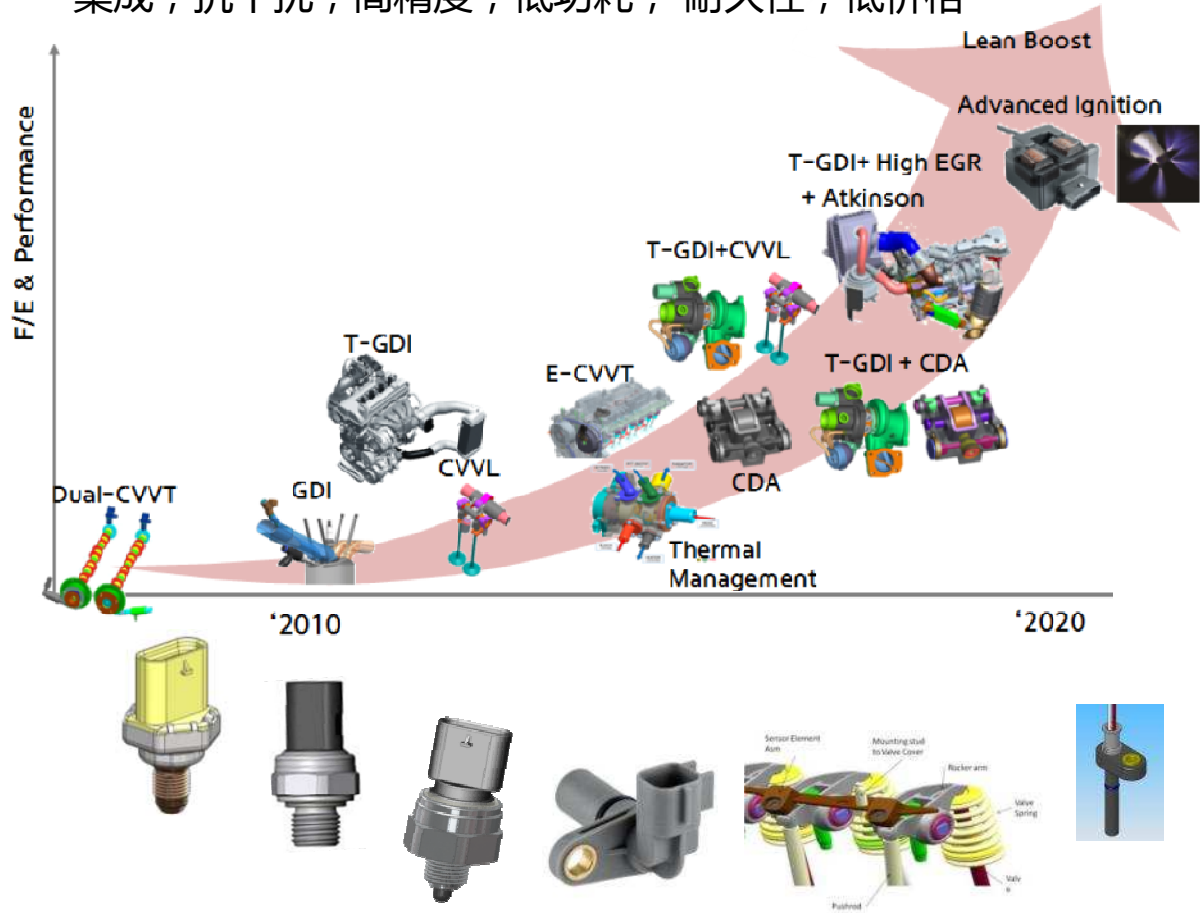
传感器发展趋势
Sensor Development Trend

- 传感器发展趋势
  - 集成，抗干扰，高精度，低功耗， 耐久性，低价格



SOURCE: Dr. Sung Hwan Cho, President, Hyundai America Technical Center, Superior Township, MI, USA; 35th International Vienna Engine symposium 2014

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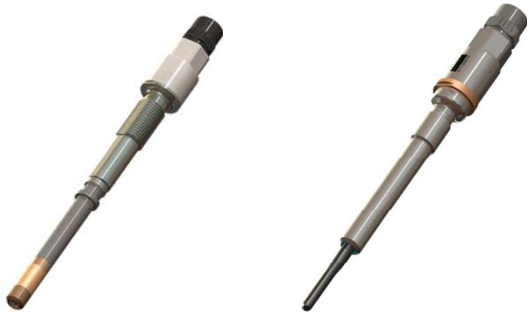
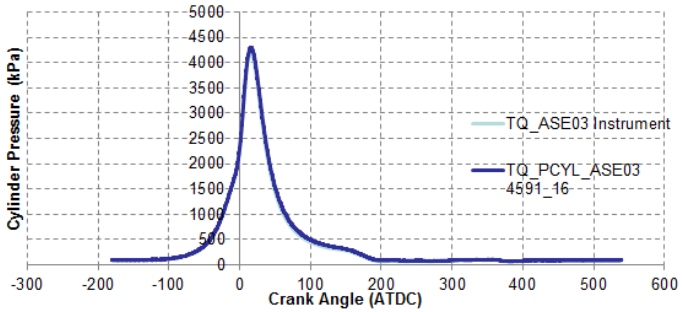
一个例子：缸压传感器的应用

Benefits of Cylinder Pressure Sensing to Customers

Daimler LD Diesel Case

- NOx is reduced with EGR, but high EGR in open-loop can lead to increased ignition delay, combustion time, and ultimately ignition failure. Mitigation is complicated by environmental conditions, cylinder-to-cylinder variation, fuel quality, and wear over life.
- Therefore, Daimler uses Sensata CPOS to detect MFB50 and combustion “shape” across all cylinders, on a per-cycle basis. This information is used to modify injection and pre-injection timing and quantity, improving emissions, efficiency, thermal and mechanical stress, and reducing NVH.
- Daimler concludes that closed-loop-combustion-control facilitates up to 2% fuel consumption and 30% NOx emissions improvements. They further state that closed-loop control can partially (or fully) offset production and aging variances, and significantly compensate for fuel quality differences.





Summary

- *A large step towards achieving future emission and consumption requirements can be achieved with the closed-loop combustion control of diesel engines (up to -2% consumption or up to -30% in nitrogen oxide raw emissions).*
- *Production variances and ageing influences can be offset fully or partially via closed-loop combustion control so that uniform combustion behaviour is ensured over the full service life.*
- *Fuel quality differences (ignition quality) are almost fully compensated.*

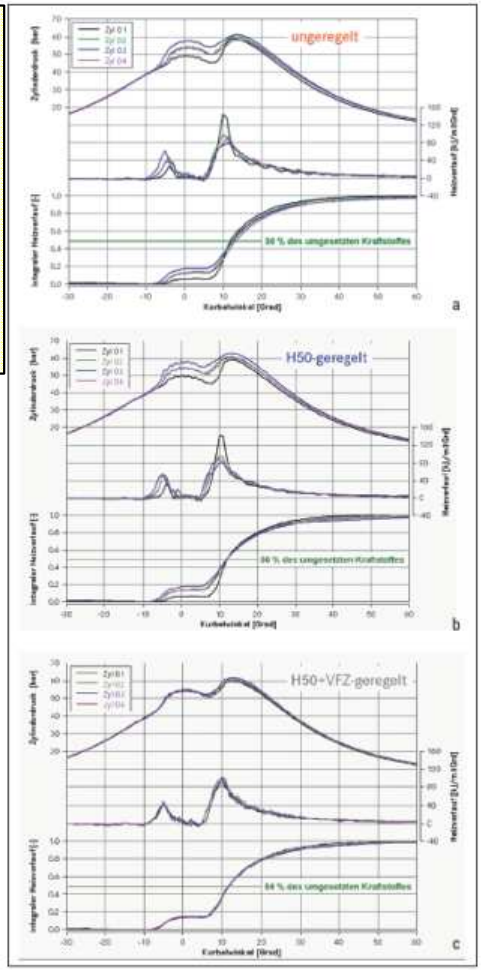


Abbildung15:
Vergleich gesteuerter und geregelter Betrieb bei einem gealterten Motor
Figure 15:
Comparison of open-loop and closed-loop operation in an aged engine

Thank you 谢谢大家

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Where are Sensata devices?

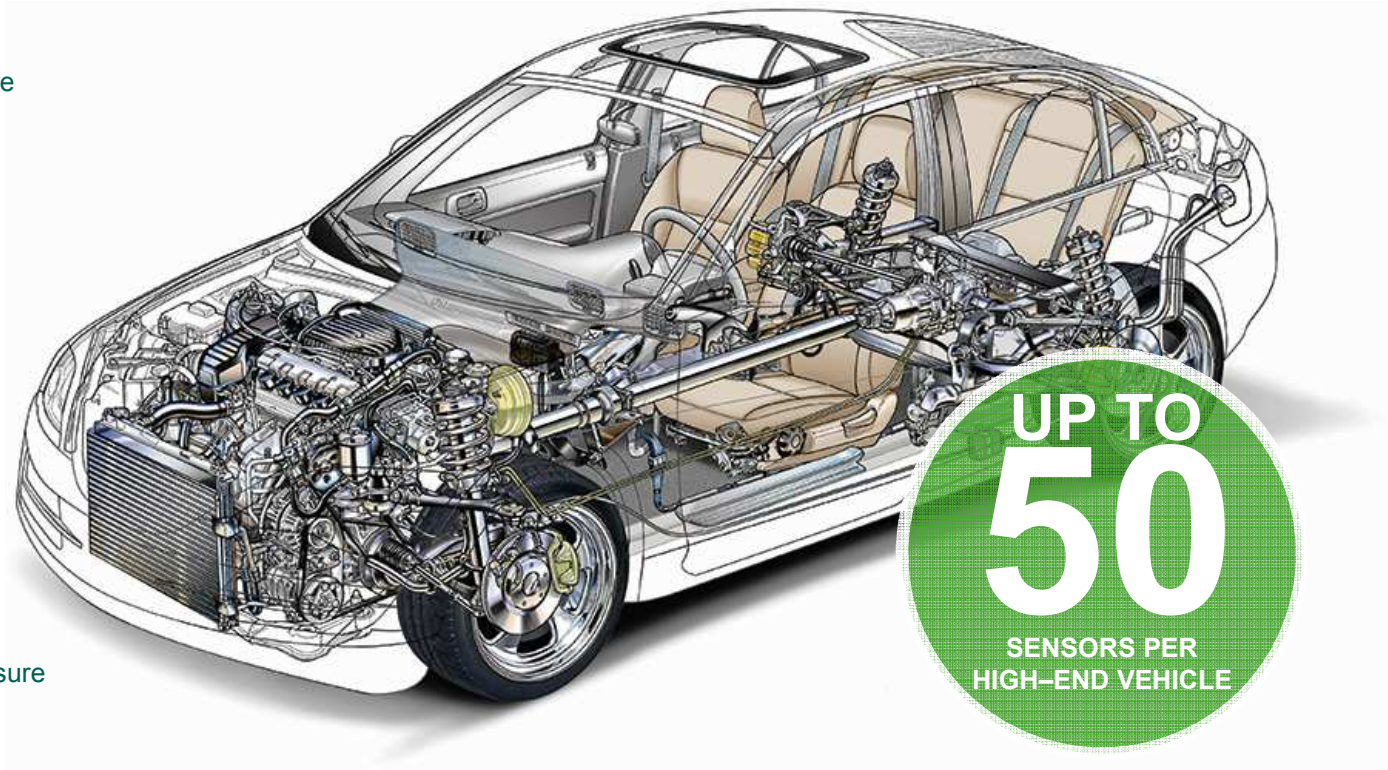
In mission–critical automotive systems

Engine

- ✓ Gasoline Direct Injection Pressure
- ✓ Common Rail Diesel Pressure
- ✓ Returnless Fuel Pressure
- ✓ Cylinder Pressure
- ✓ Throttle Valve Position
- ✓ EGR Valve Position
- ✓ Oil Pressure
- ✓ Air Intake Pressure
- ✓ Cam / Crank Position / Speed
- ✓ Turbo Valve Position
- ✓ Turbo Speed

Transmission

- ✓ Clutch Actuation Pressure
- ✓ Clutch Pedal Position
- ✓ Line Pressure
- ✓ Continuous Variable Pulley Pressure
- ✓ Gear Position
- ✓ Input / Output Speed



Passive Safety

- ✓ Occupant Detection

Active Safety (Brake)

- ✓ Brake Pressure (ESC)
- ✓ Vacuum Boost Pressure
- ✓ Wheel Speed

Cabin Comfort

- ✓ Air Conditioning Pressure
- ✓ Air Classification / Quality
- ✓ Humidity
- ✓ Solar / Twilight Sensor

Chassis

- ✓ Suspension Pressure
- ✓ Tire Pressure Monitoring Systems (TPMS)
- ✓ Pedal Position

Exhaust

- ✓ Exhaust Temperature
- ✓ Particle Filter Pressure
- ✓ Urea Pressure

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Where are Sensata devices?

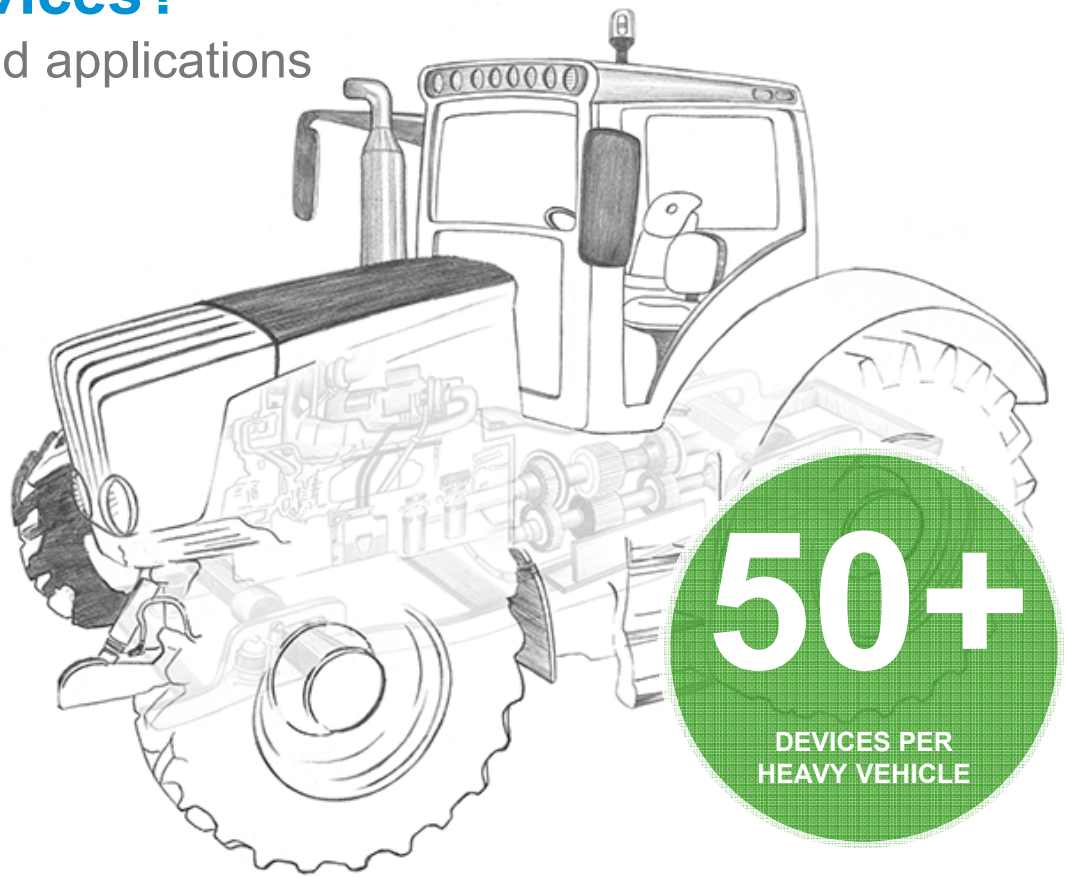
In heavy duty truck and off-road applications

Engine

- ✓ Air Intake
- ✓ Boost, Compressor and Turbine
- ✓ Low Pressure Fuel Filter Pump
- ✓ High Pressure Fuel Rail
- ✓ Cam and Crank
- ✓ Oil Pressure
- ✓ Coolant Pressure
- ✓ Cylinder Pressure
- ✓ EGR
- ✓ Alternate Fuels

Chassis & Safety

- ✓ Brake Pressure
- ✓ Electronic Stability Control
- ✓ Air Suspension
- ✓ Hydraulic Suspension
- ✓ Wheel Speed / ABS Speed
- ✓ Non-Contacting Pedal Position



Cabin Comfort

- ✓ Air Conditioning

Exhaust

- ✓ Exhaust Gas Treatment
- ✓ Urea

Transmission

- ✓ Pressure
- ✓ Speed

Auxiliary Systems

- ✓ Air Pressure
- ✓ Hydraulic Pressure
- ✓ Pedal Position
- ✓ Contacting Rotary Position
- ✓ Non-Contacting Rotary Position

Operator Sensing Technologies

- ✓ Multifunction Grip
- ✓ Joystick
- ✓ Analog Rocker
- ✓ Foot Pedal