China’s Energy-efficient Vehicles Technology Roadmap[1]

Source: 1. China Automotive Engineering Institute, <Energy Saving and New Energy Vehicle Technology Roadmap>, Oct. 2016

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Industrial Market Research & Management Advisory

Energy-efficient Vehicles Technology Roadmap[1]

General Strategy

- Focus on hybrid technologies, support powertrain optimization and upgrades, friction reduction and advanced electronic and electrical technologies, and comprehensively enhance energy-saving technologies and fuel economy in traditional vehicles.
- Combine structural and technical energy conservation, and accelerate promoting compact cars and smaller to significantly increase the proportion of small cars.
- Target natural gas vehicles as an initial initiative, moderately develop the alternative fuel vehicles, and increase low carbon and diversification in fuels to reduce China’s dependence on petroleum.

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Energy-efficient Vehicles_ Goals, Paths and Priorities

Development Goals

Average fuel consumption of passenger cars:

- 2020: 5.0L/100km
- 2025: 4.0L/100km
- 2030: 3.2L/100km

Average fuel consumption of commercial cars compared to 2015:

- 2020: reducing 10%
- 2025: reducing 15%
- 2030: reducing 20%

Market share of energy-efficient cars:

- 2020: 30%
- 2025: 40%
- 2030: 50%

Technology Paths

Energy-efficient passenger cars:

- Improve the engine thermal efficiency
- Optimize the powertrain match
- Reduce heat loss
- Reduce energy loss
- Improve the efficiency of hybrid systems

Energy-efficient commercial cars:

- Improve the thermal efficiency of diesel engines
- Reduce energy loss
- Hybrid systems

Development Priorities

- Combustion mechanism of advanced ICEs*
- Autonomous control systems
- Entirely variable valve technologies
- Waste energy recovery
- Engine thermal management
- Automation, high efficiency and core-component technologies of transmissions
- Low friction
- Superchargers and their applications
- Advanced fuel injection systems
- 48V systems
- Hybrid engines
- Hybrid electromechanical coupling technologies

Remark:

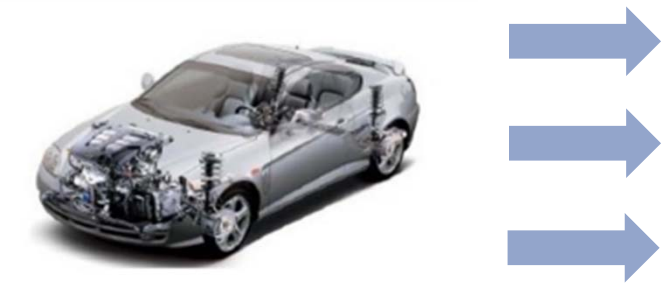
*: ICE is the abbreviation of **I**nternal **C**ombustion **E**ngine

Energy-efficient Vehicles_ Pathways to Energy Conservation

Six pathways to energy conservation for passenger cars: lightweight and miniaturization, vigorously develop hybrid engines, powertrain optimization and upgrade, electronic and electrical conservation, friction reduction, and alternative fuels.

Lightweight and Miniaturization:
- Over 55% in 2020, 60% in 2025, and 70% in 2030 of the compact cars and the smaller
- Accelerate the application of lightweight products, technologies and processes.

Vigorously Develop Hybrid Engines:
- Market share up to 8% and fuel consumption as low as 4.0L/100km in 2020
- 20% and 3.6L/100km in 2025
- 25% and 3.3L/100km in 2030



Powertrain Optimization and Upgrade:
- Engine thermal efficiency up to 40% in 2020
- 44% in 2025
- 48% in 2030 by HCCI* technology

Electronic and Electrical Conservation:
- Develop 48V system
- Standardize the electric air conditioning, EPS technology etc.
- Study on sustained electricity loss

Friction Reduction:
- Lower rolling resistance in the short term
- Lower inner resistance in the middle term
- Lower wind resistance in the long term

Alternative Fuels:
- Mainly use natural gas
- Up to 8% in 2030

Remark:
*: HCCI is the abbreviation of **H**omogeneous **C**harge **C**ompression **I**gnition

Energy-efficient Vehicles_ Pathways to Energy Conservation

Six pathways to energy conservation for commercial cars: powertrain optimization and upgrade, gradually develop hybrid engines, aerodynamic optimization, energy reduction, alternative fuels and continuously promote lightweight.

Powertrain Optimization and Upgrade:
- Engine thermal efficient up to 50% through developing high-pressure, low-speed and high-twist engines, optimizing electric control, reducing rear axle ratio
- 52% through engine thermal management technologies
- 55% through the Rankine cycle

Alternative Fuels:
- Moderately and stably use natural gas
- Demonstration and pilot applications

Continuously Promote Lightweight

Aerodynamic Optimization:
- Low rolling resistance in the short term
- Streamlined design and optimization in the mid-long term

Gradually Develop Hybrid Engines:
- Study on system configuration and core components
- Gradually extend to commercial cars with lower cost in the mid-long term

Energy Reduction:
- Track the new energy-saving technologies, such as lined up vehicles and improved transport efficiency
- Gradually applied when the intelligent network technology is mature

Energy-efficient Vehicles_ Technology Innovation Requirements

Project Types	Technology Innovation Requirements	Priority Measures
Foundation	• New engine combustion theory • New optimized engine structure design • New fuel application	• New optimized engine structures and combustion theory • High efficient powertrains • Advanced electronic and electrical technologies • Promotion and demonstration of the advanced energy-saving cars • Common platforms with electronic control, test and calibration
Application	• New engines and the core components • High efficient transmissions and the core components • Hybrid engines • Commercial powertrains carrying medium and large diesels • 48V systems and the core components • Vehicle power management systems • Intelligent, electronic and low-energy accessory systems • Key electronic and electrical equipment to improve the operating efficiency in commercial cars	
Demonstration and industrialization	• Industrialization and application of key technologies and key assemblies • Promotion and demonstration of the advanced energy-saving cars	
Common platform	• Develop platforms with electronic control, test and calibration • Develop the control strategy software, models, hardware-in-the-loop testing, intelligent calibration	