Integrated Control of Vehicle Energy Saving and Emission Reduction in China

CATARC

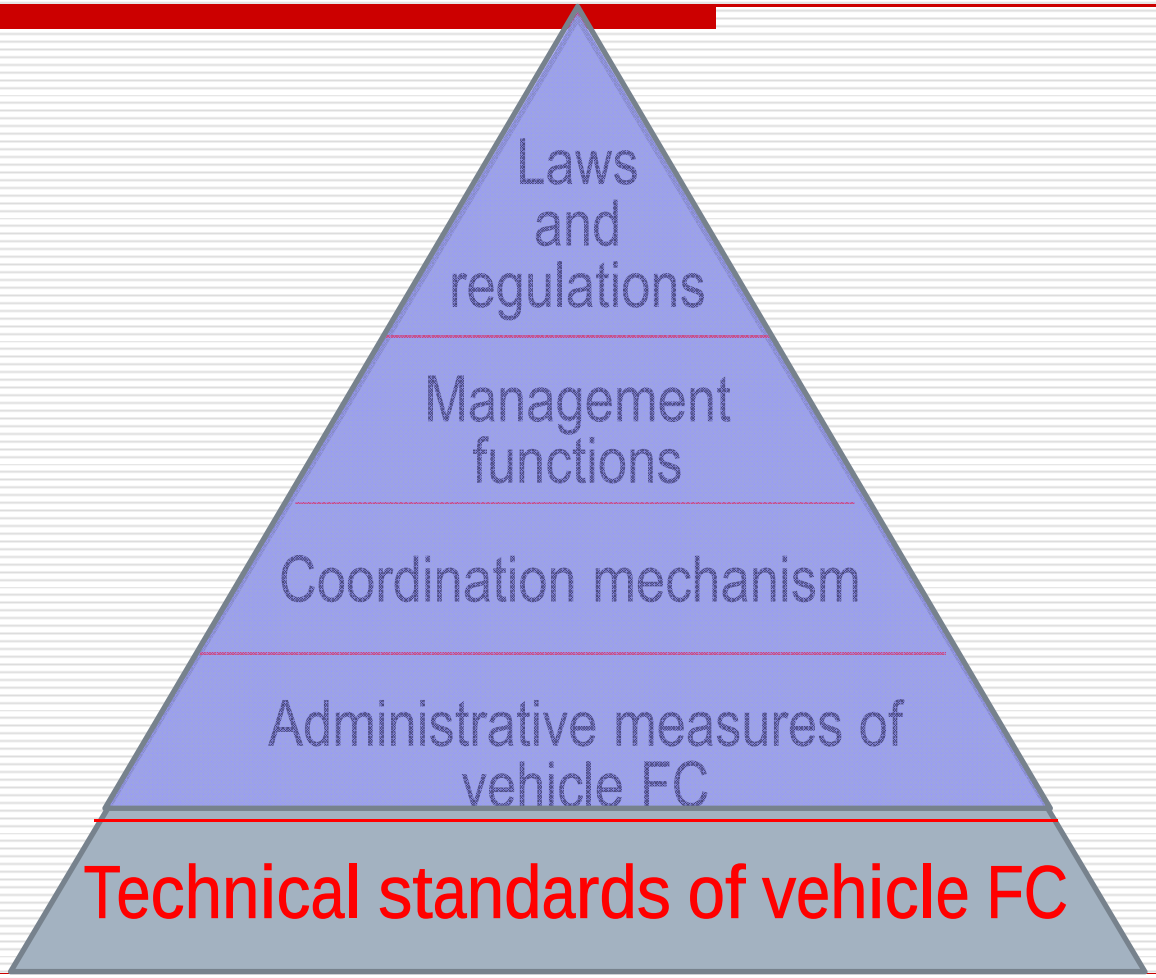
JIN Yuefu

2013.11.14

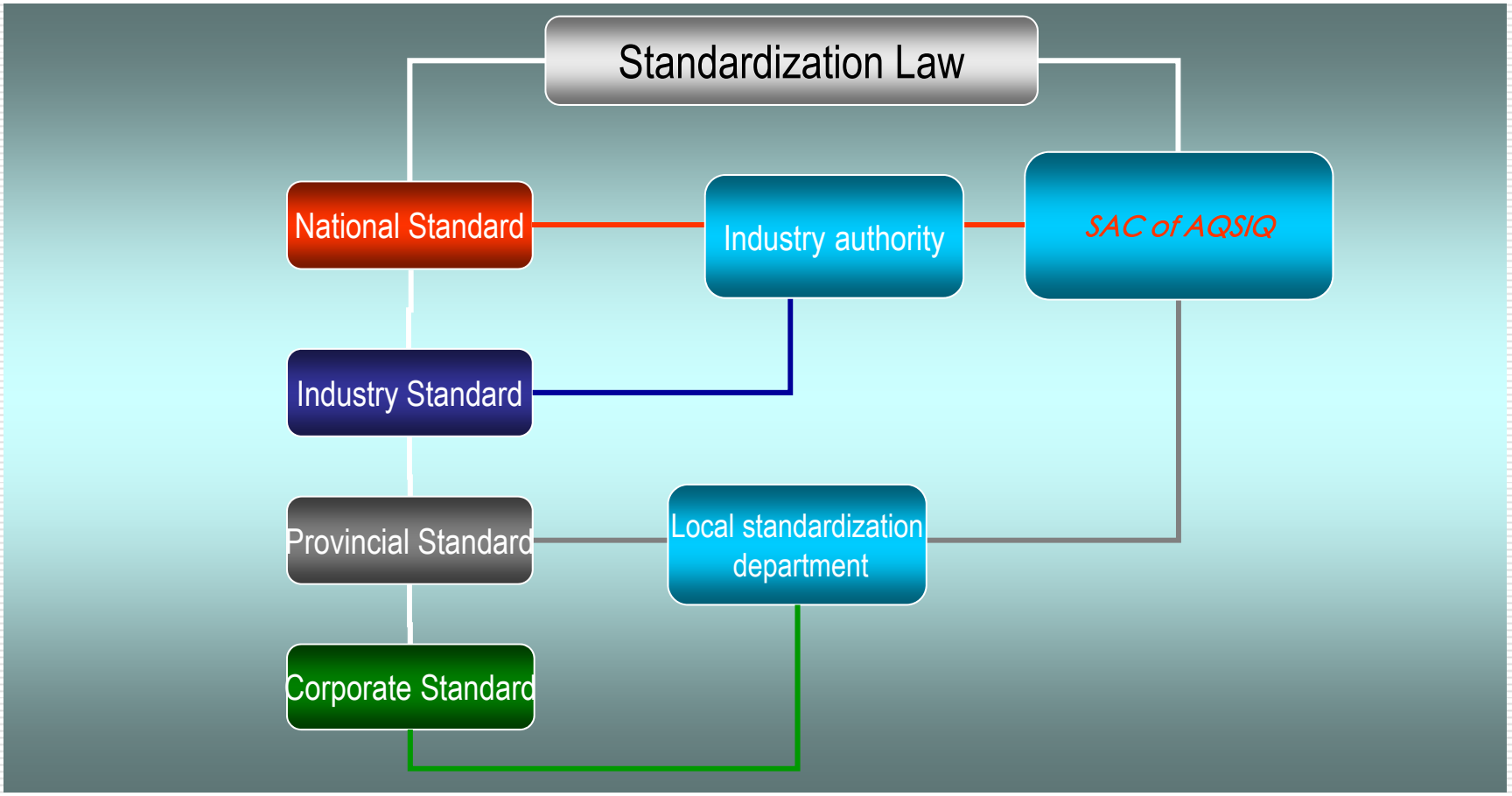
Overviews

1. Legal and regulation system of vehicle FC
2. Quasi administration system of vehicle FC
3. Standard and regulation framework of vehicle FC
4. Test method and current problems of vehicle FC
5. Comparisons to foreign regulations
6. Importance of integrated control of vehicle FC and pollutant emission

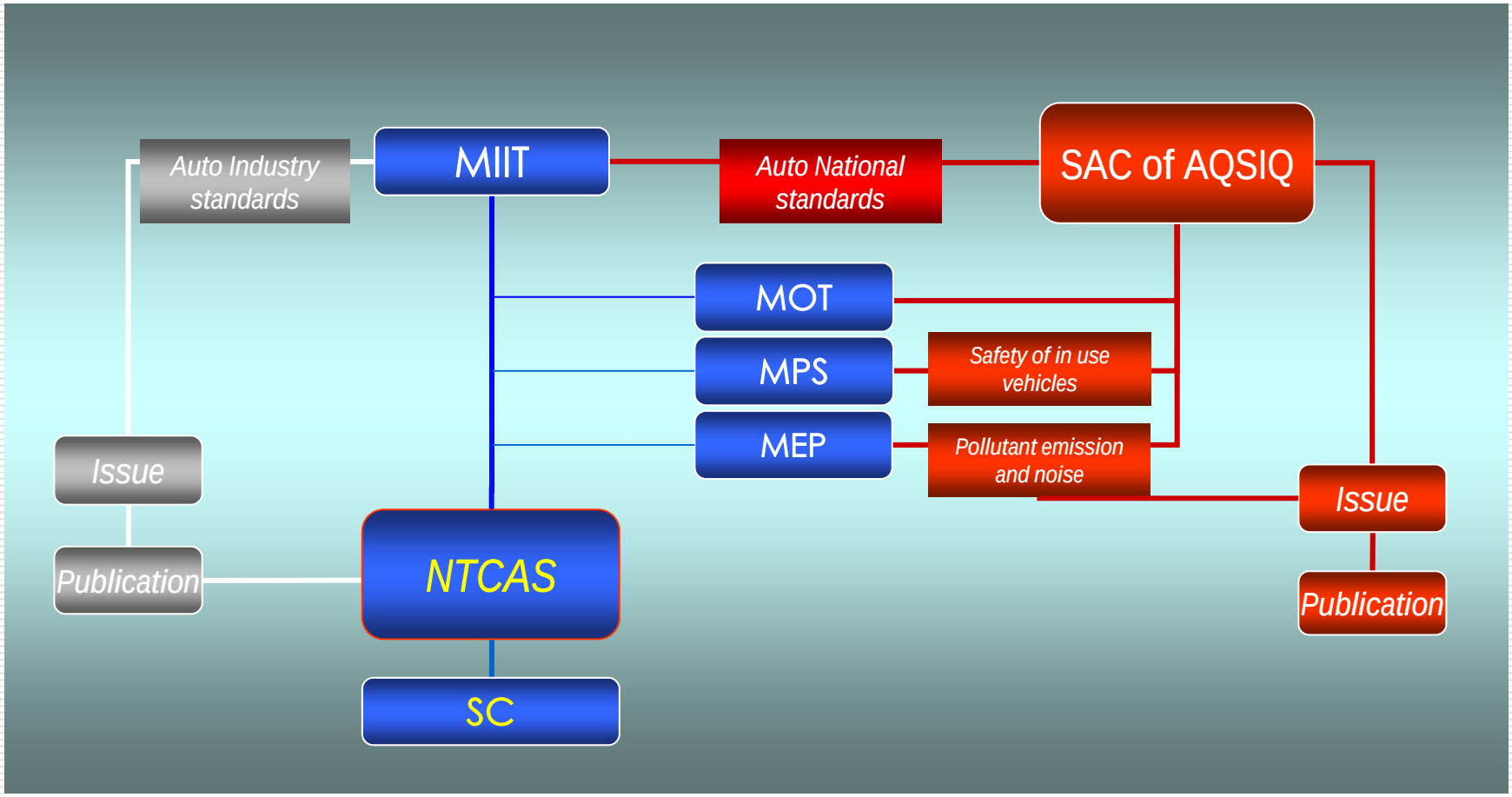
Legal and regulation system of vehicle FC



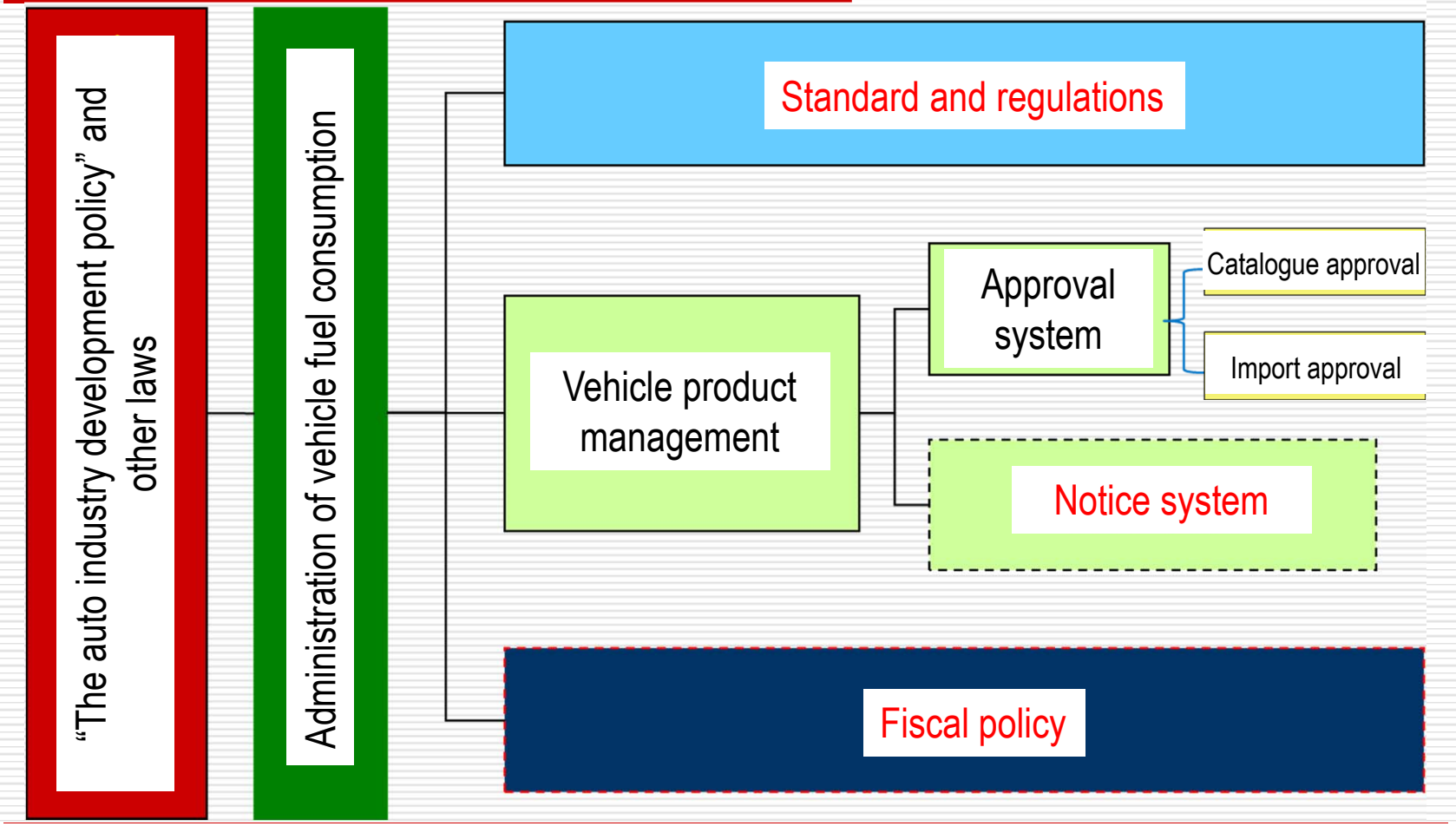
Standardization administration system of vehicle FC



Standardization administration system of vehicle FC



Quasi administration system of vehicle FC



Legal basis of US vehicle FE regulation

- US established “Energy Policy and Conservation Act” in 1970 and authorized:
  - EPA establishes the FE test methods, accepts and examines the test results applied by manufacturers, and releases and implements the FE label requirements.
  - NHTSA establishes and implements the CAFE regulation.
  - DOE release the annual “Fuel economy guideline”
- “Energy Tax Act” in 1978 claims that manufacturers and importers apply and pay the Gas guzzler tax for low FE vehicles.
- “Energy Independence and Security Act” in 2007 claims that NHTSA increase the vehicle FE from 2011 to 2020.
- Supreme court of US rules that EPA establishes GHG emission regulations based on Clean Air Act
  - California and some other states promote to reduce CO2 emission.
  - NHTSA and EPA jointly establish CAFE and GHG regulations for 2016~2020 and 2020~2025.

CO_2 reduction of passenger cars in EU

Evolution and adjustment of "three pillar strategies "

Voluntary commitment of manufacturers **ACEA JAMA KAMA**

CO_2 emission regulation for passenger cars

EEP Excess emission fee

Fiscal policy of CO_2

EC reassess

Extend the basic passenger car taxation system based on CO_2 in EU

Labels

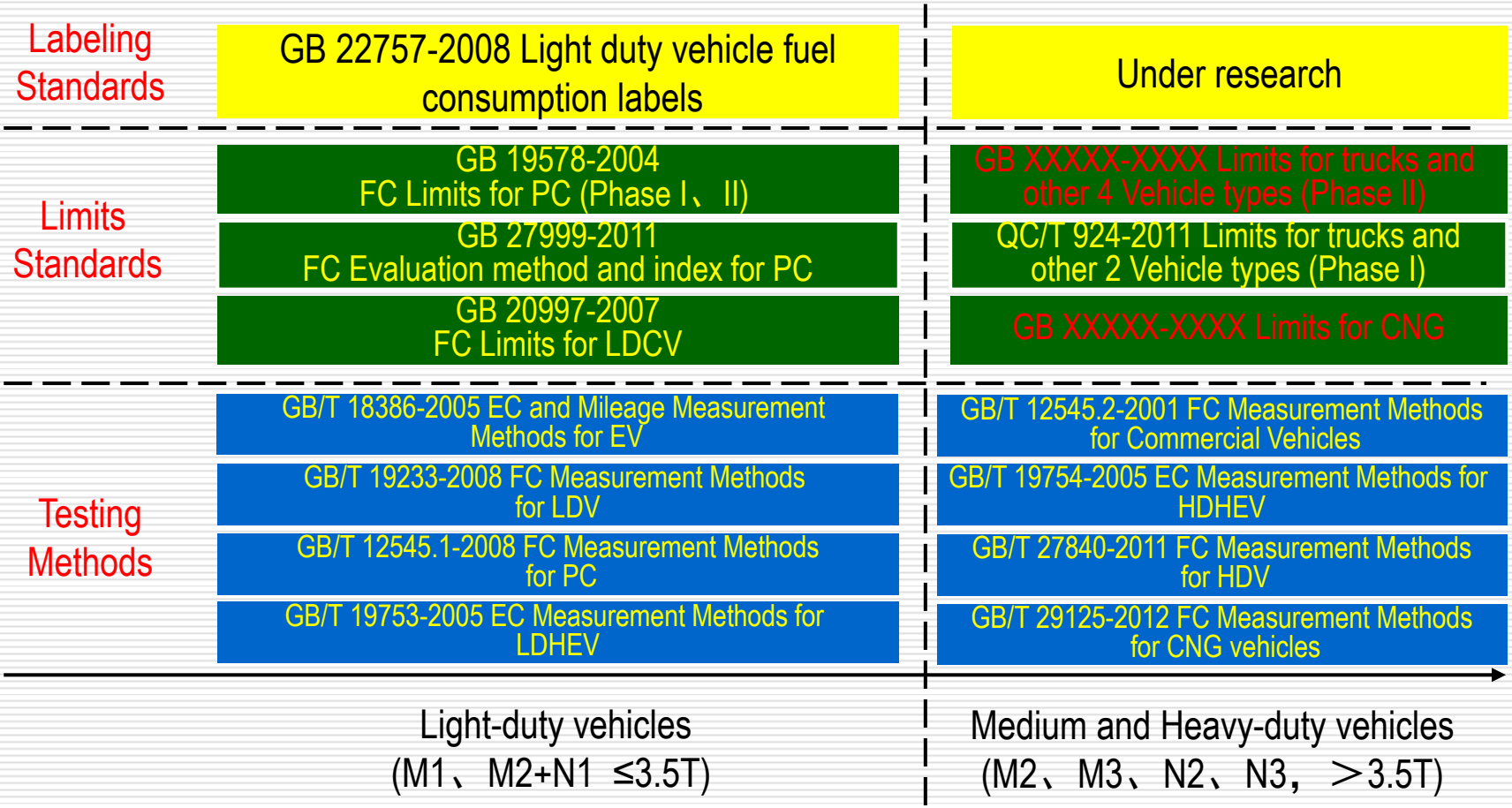
Revise the labels

1995 COM (95)689

2007 COM (2007)19

2009 EC 443/2009

Standard framework of vehicle FC

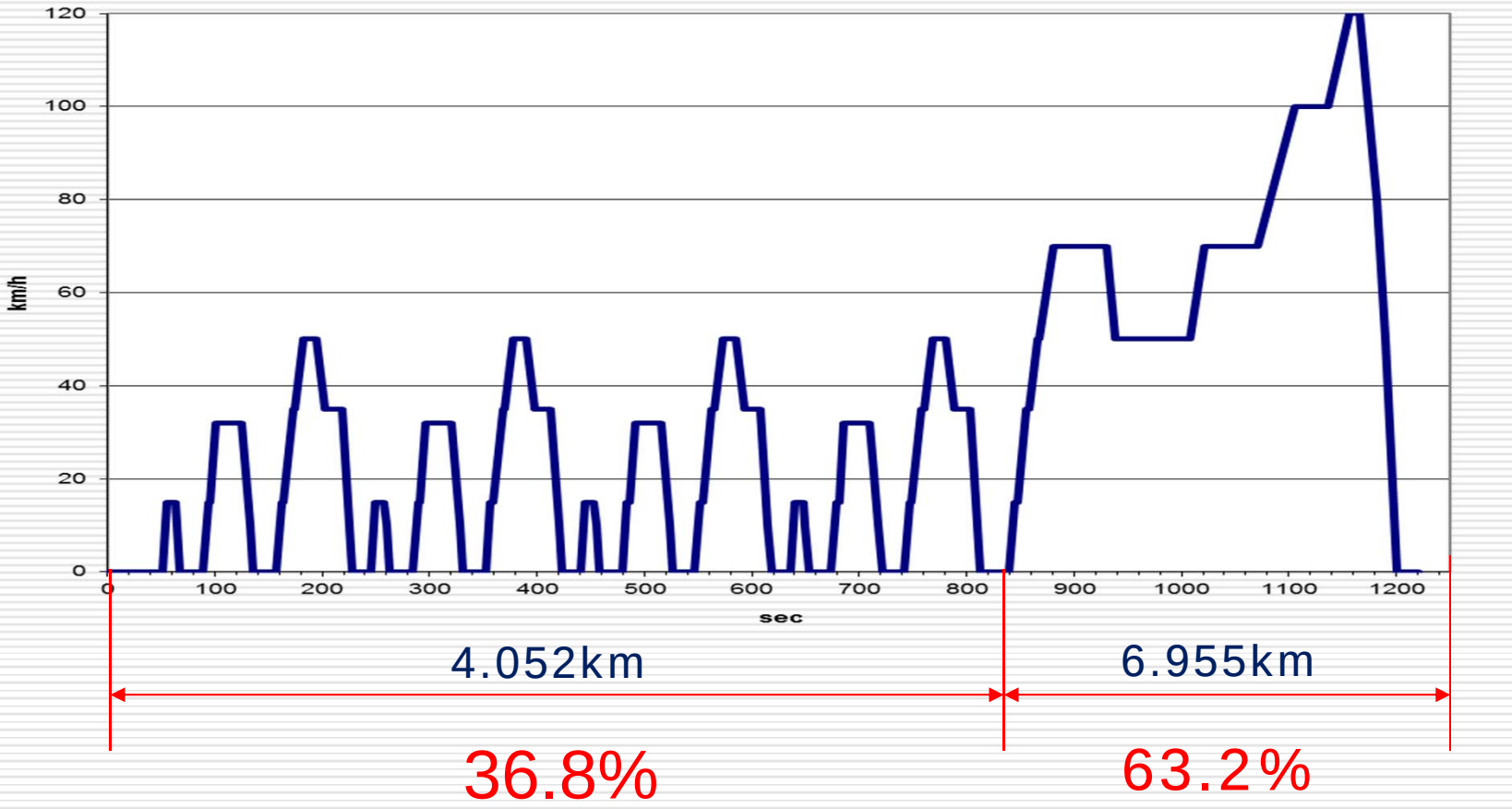


Fuel consumption test method and current problems of light duty vehicles

Driving Cycles

1. China： NEDC
2. US： FTP75+HWFET
3. EU： NEDC
4. Japan： JC08（2012 later）
5. GTR is establishing WLTP to harmonize the global driving cycle

The mileage proportion of NEDC is unsuited in China



Improvement of FE test methods in US

Driving conditions close to actual driving:

- higher speed
- higher accelerated and decelerated speed
- Use of Air conditioner in summer
- Fuel consumption increase in winter

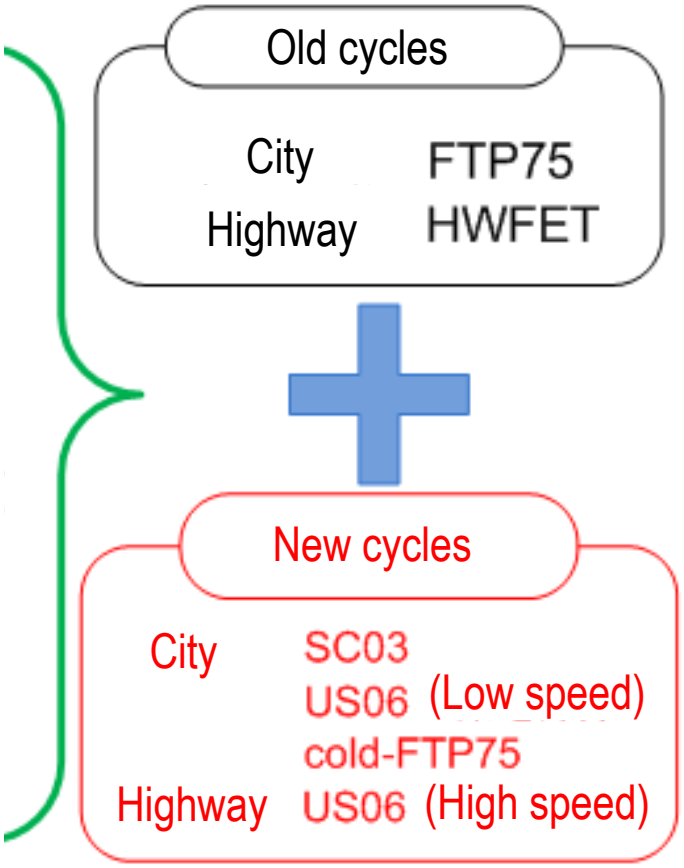
- City cycle

-Include higher accelerated and decelerated speed

- cycle including use of Air conditioner
- cycle under cold

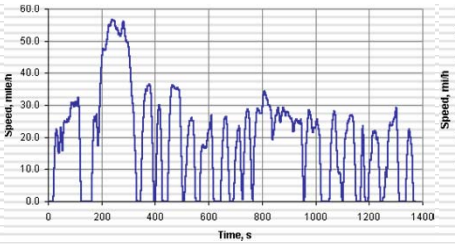
- Highway cycle

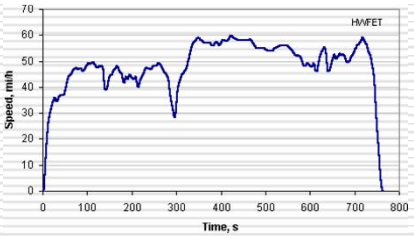
- Cycle with higher speed

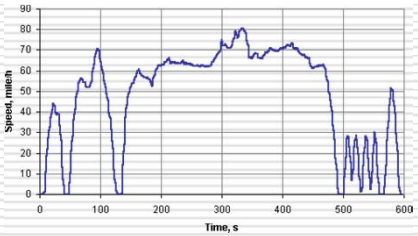


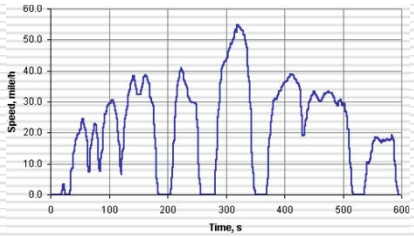
Key points of 5 cycles

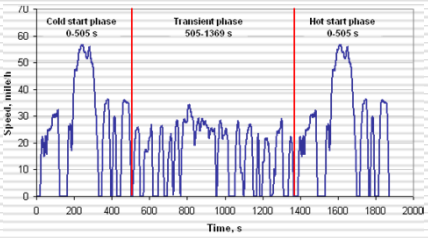
Test	Driving speed	Temperature	Start	Auxiliary
FTP	Low	75°F（23.9℃）	Cold and hot	None
HFET	Medium and high	75°F（23.9℃）	hot	None
US06	Wild, low and high	75°F（23.9℃）	hot	None
SC03	Low	95°F（48℃）	hot	AC
FTP(Cold)	Low	20°F（-7℃）	Cold and hot	None











Targets of 5 cycles

1. Main targets —— to reflect the actual fuel consumption
   - Cold start
   - Air conditioner
   - Wild driving
   - Highway driving
2. Pertinence
   - HEV
3. Main Changes
   - FTP+HFET+US06+SC03+FTP(Cold)
4. Target
   - To cover more than 75% vehicles

To reduce difference between test and actual FC

Acceleration(Deceleration)

- Maximum acceleration of FTP and HFET is 1.475m/s^2
- Current maximum acceleration reaches 4.92-5.36m/s^2, sometimes reaches 7. 6m/s^2

Maximum speed

- 33% vehicles extend the range of FTP/HFET (60mph)

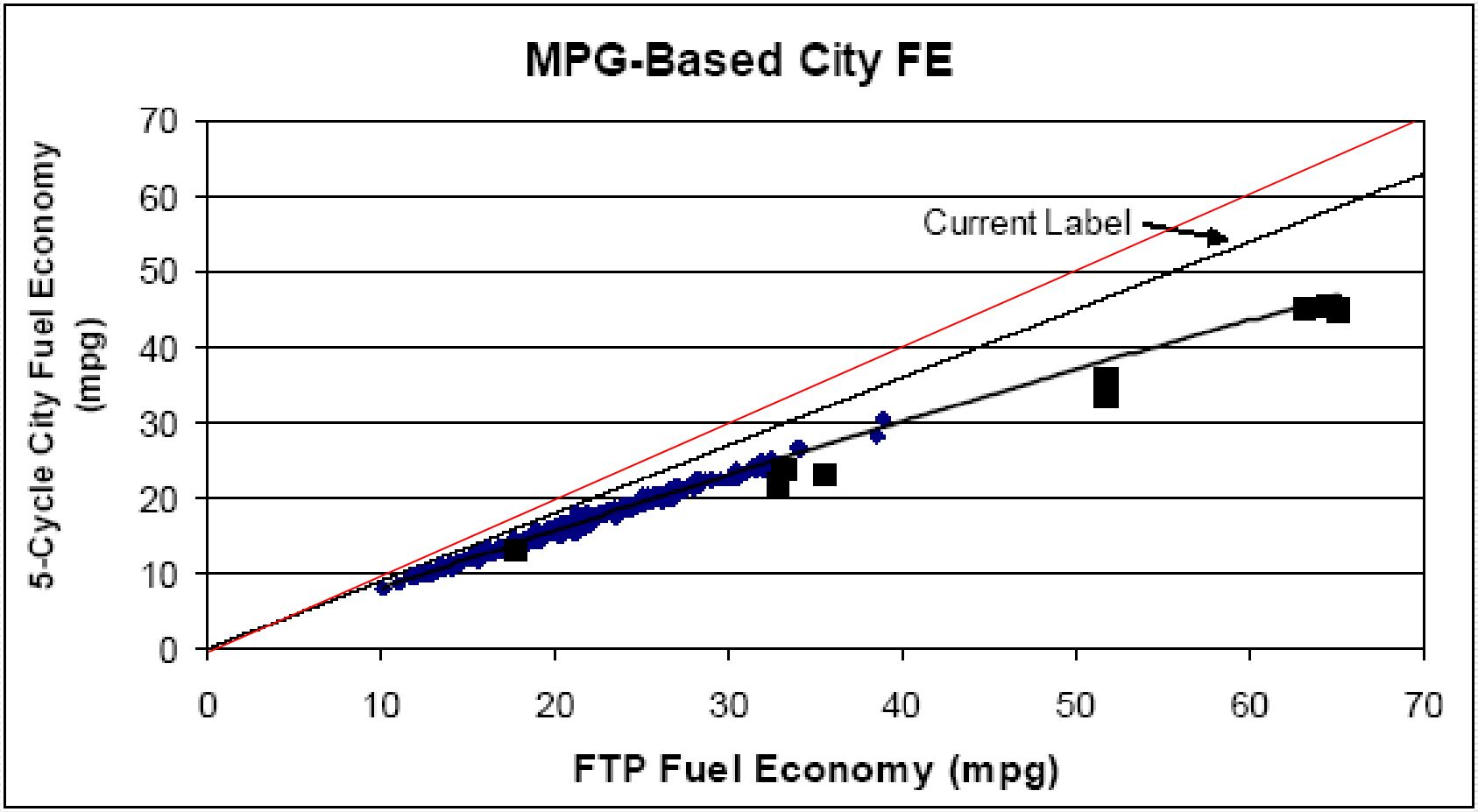
Temperature

- Only 20% vehicles drive under from 70°F to 80°F—— nearly 15% vehicles drive above 80°F, 65% vehicles drive under 70°F

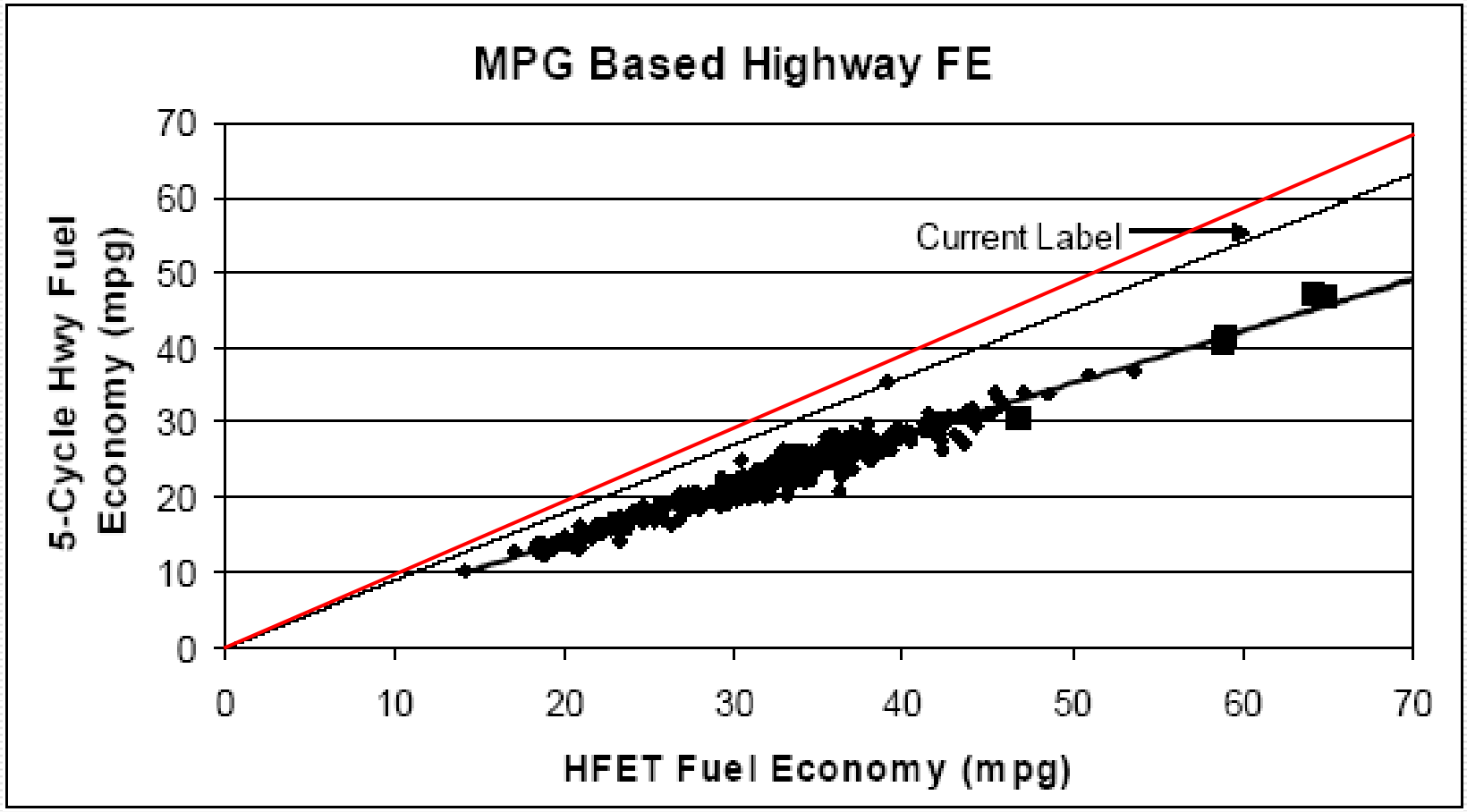
Auxiliary

- Effects of use of air conditioner, heater or defrosting devices on fuel economy

MPG-Based City FE



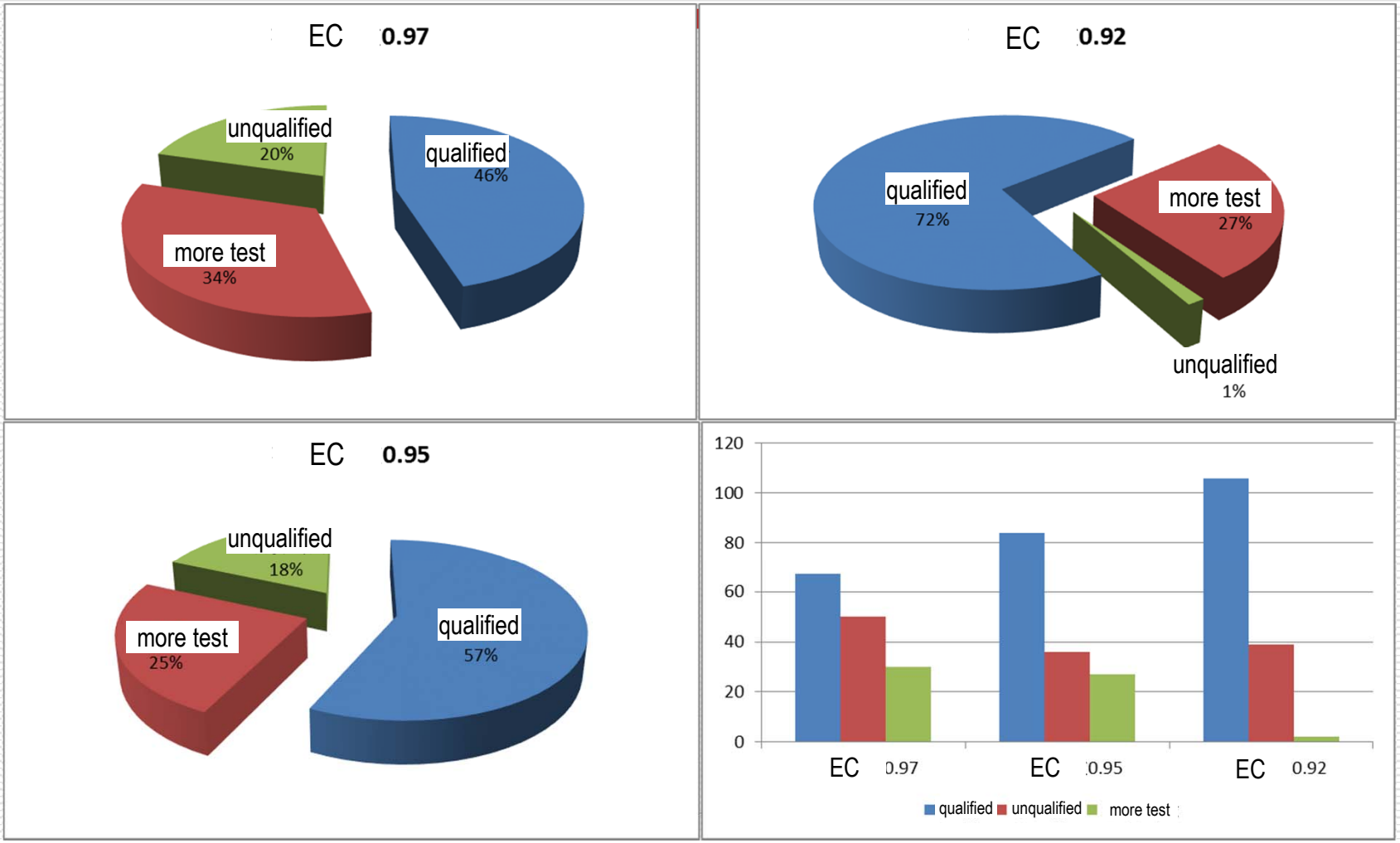
MPG-Based Highway FE



Evolution coefficient

- Technical analysis
  - The fixed evolution coefficient (0.92) has large differences to current situation in China. During the FC examination of energy-saving cars, all manufacturers chose the fixed EC instead of running-in to obtain better results.
- Revise advice——0.96~0.98
- Stricter requirements of conformity
- Dispel effects during CAFC calculation and examination

Technical analysis of evolution coefficient

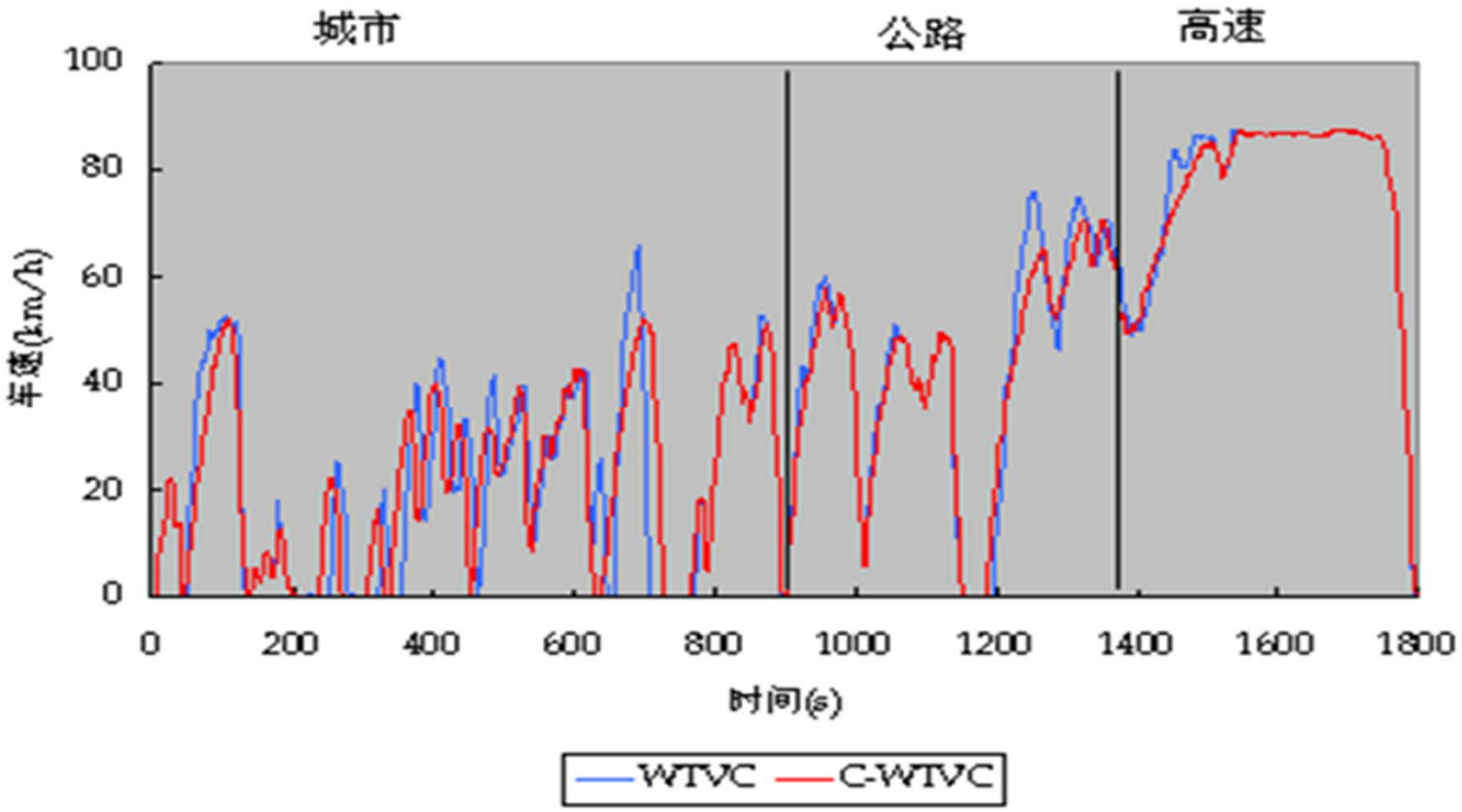


Fuel consumption test method of heavy duty commercial vehicles

Fuel consumption test method of HDCVs

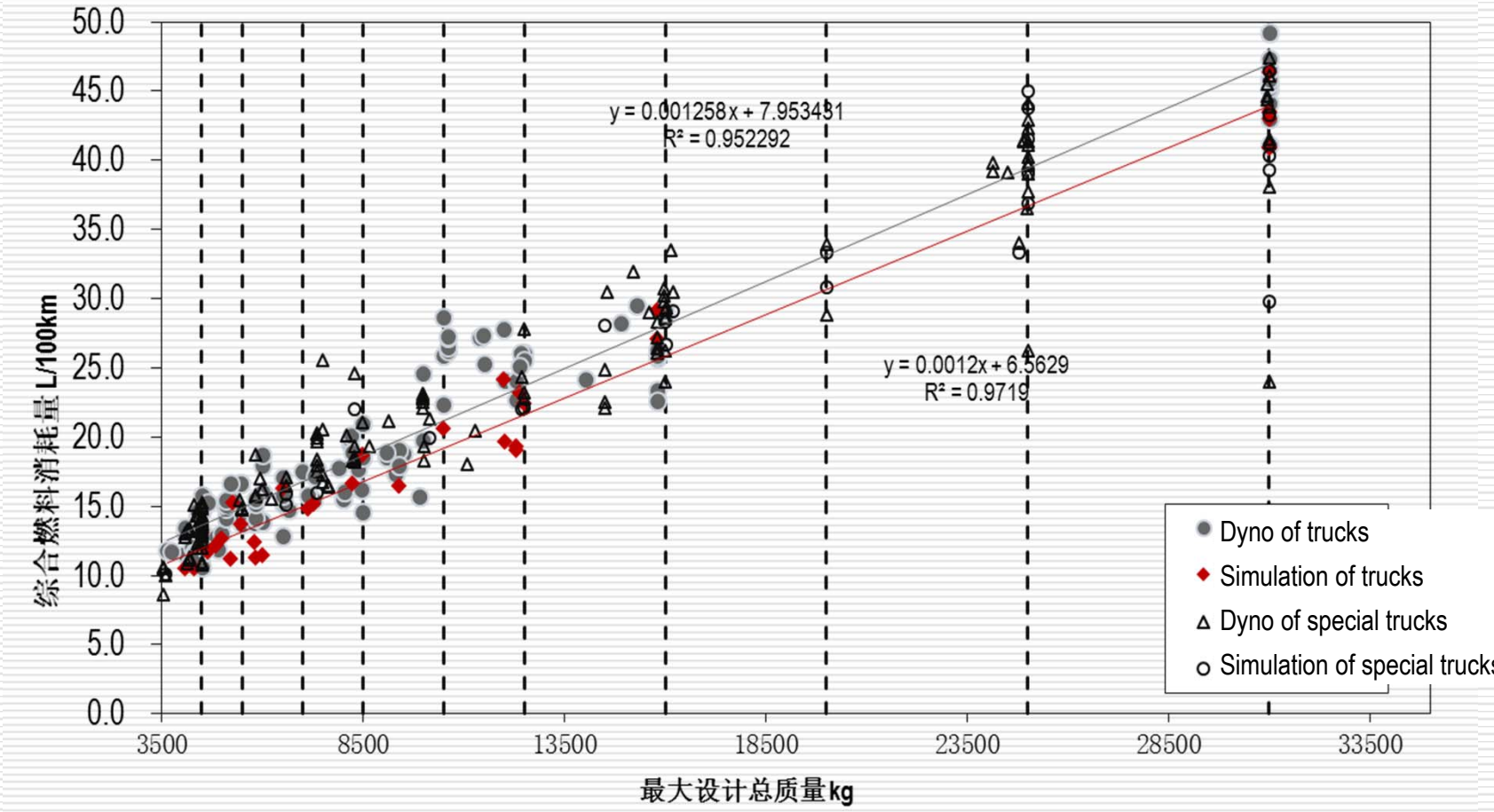
1. Modified GTR WTVC is adopted.
2. Uniformity between chassis dyno and simulation test results
3. How to reflect the transport efficiency in the test methods (FC per seat, FC per ton)
4. Basic and variant type (difference between FE and pollutant emission versions)
5. Effects of shift control

Modified GTR WTVC is adopted

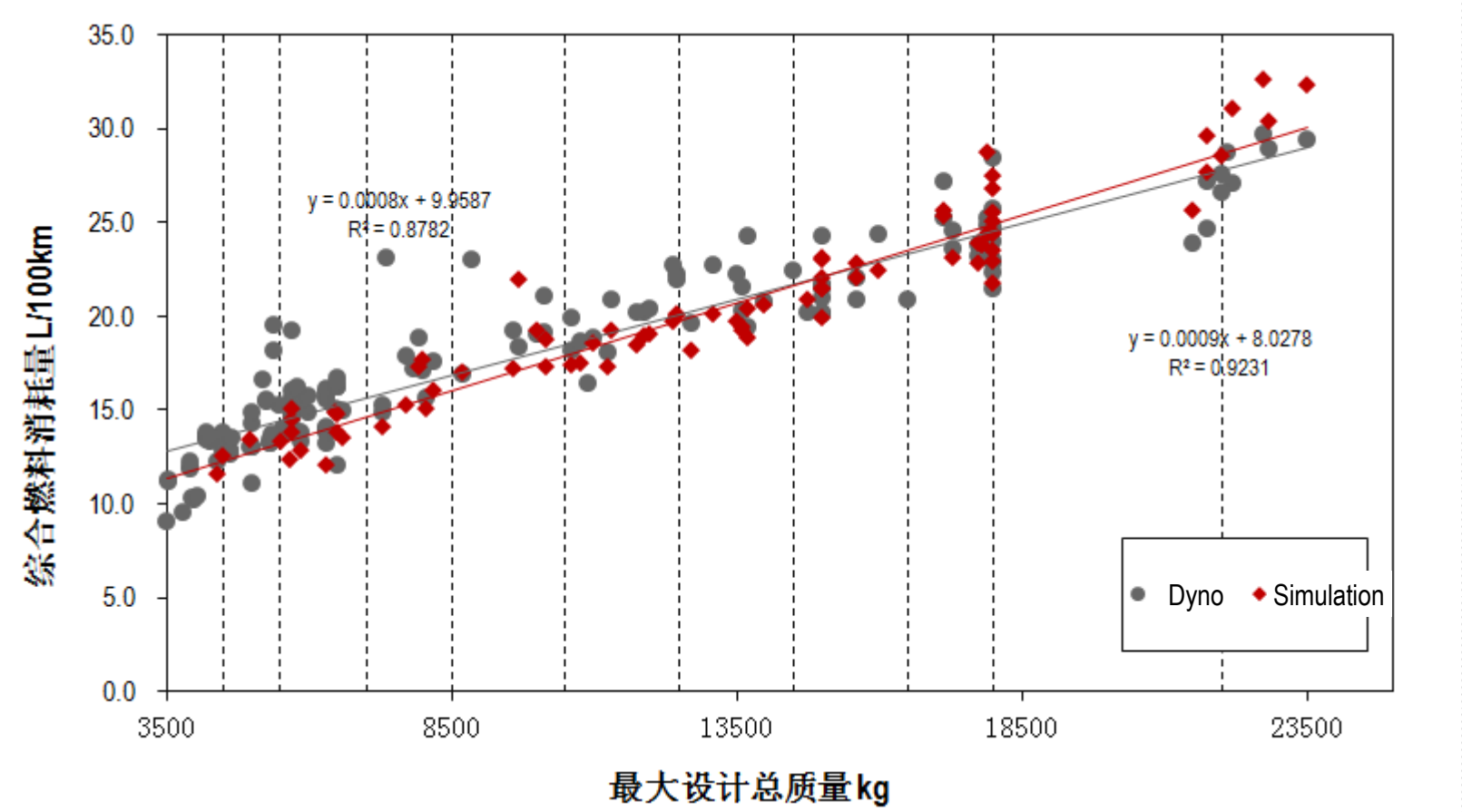


C-WTVC driving cycle, adjusted vehicle and acceleration based on WTVC .
Weighted factors were determined based on survey data.

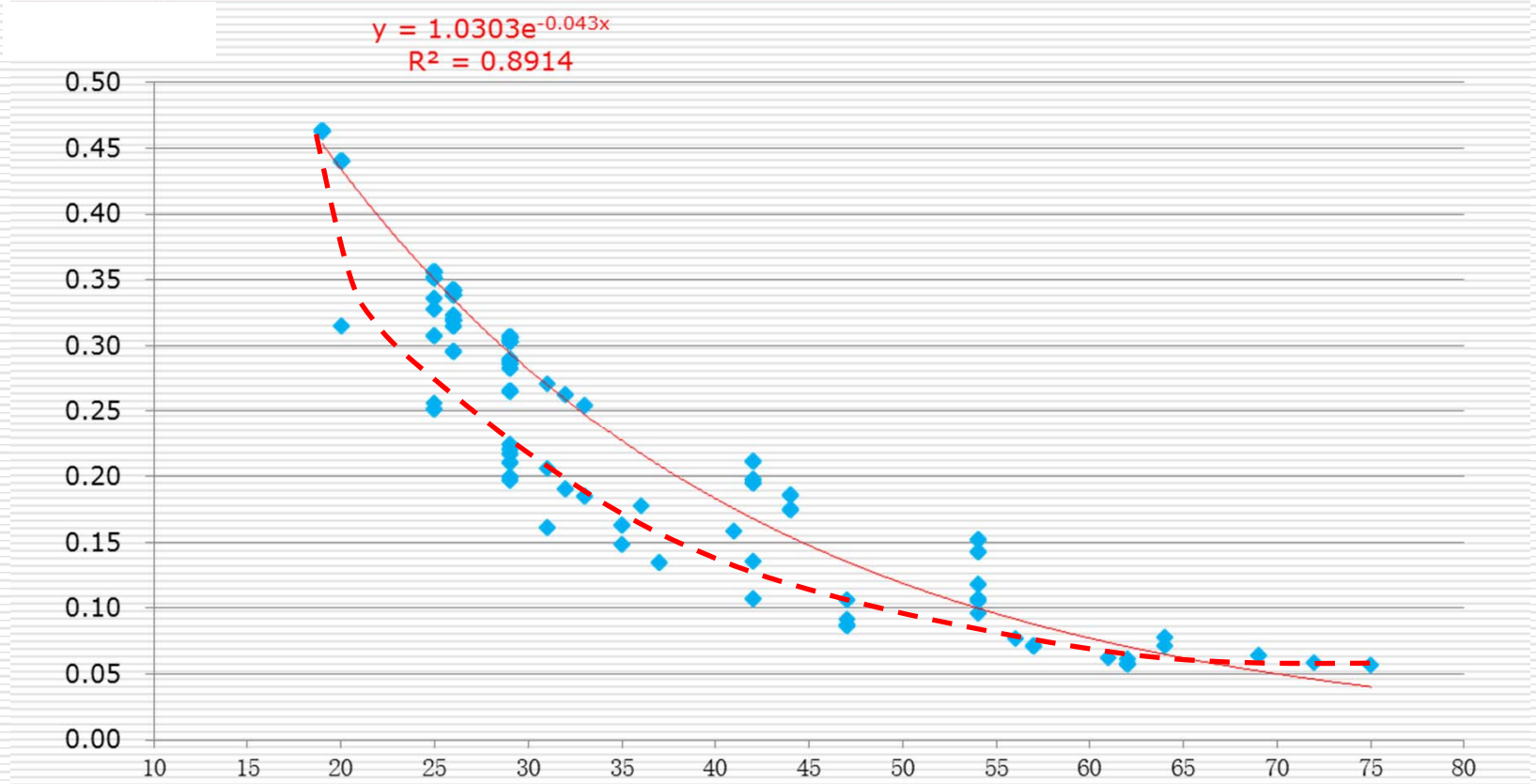
Uniformity between chassis dyno and simulation test results of trucks



Uniformity between chassis dyno and simulation test results of buses



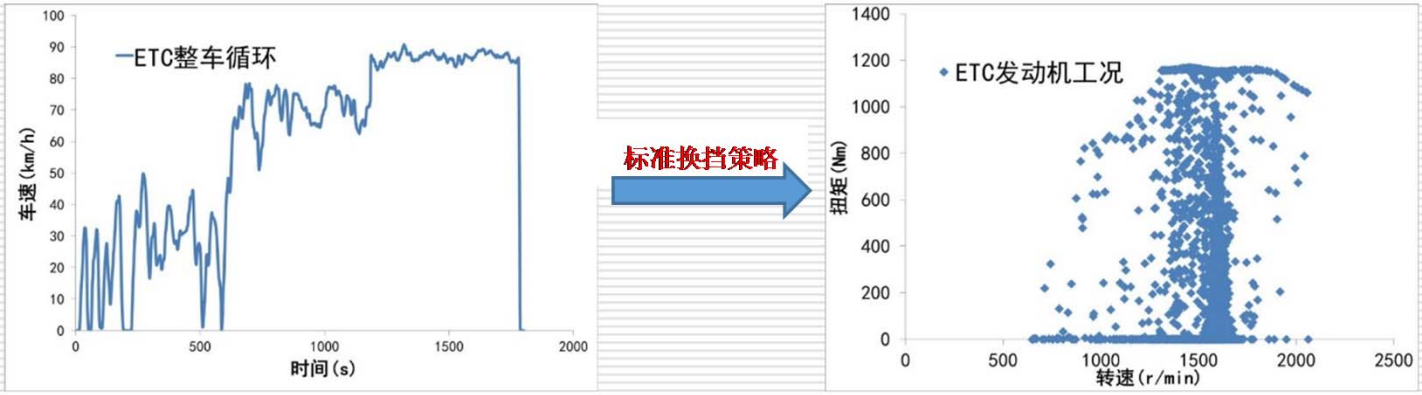
How to reflect the transport efficiency in the test methods (FC per seat, FC per ton)



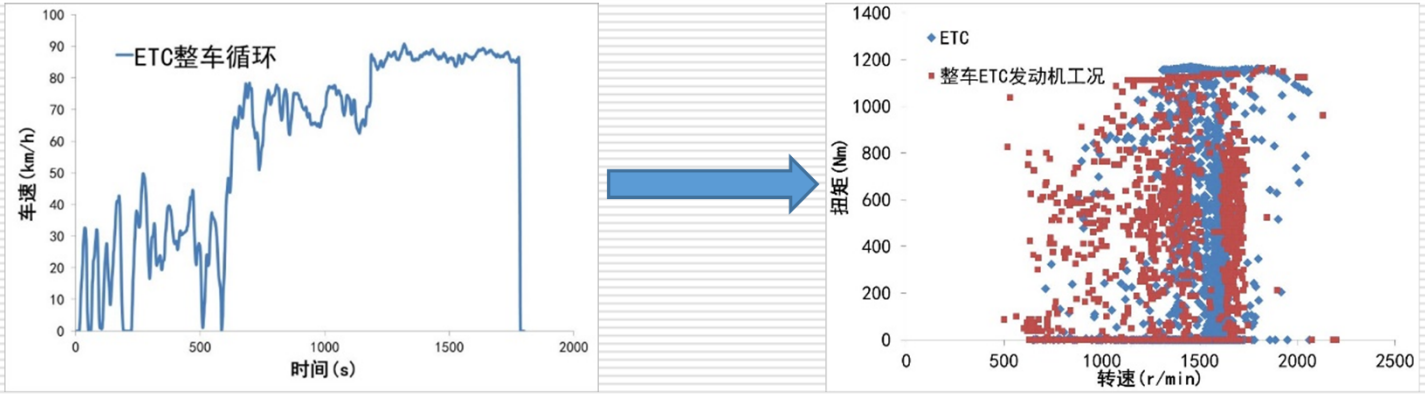
Basic and variant types

- Definitions (basic and variant types) in EU
- Car line (vehicle family) in US
- How to use vehicle family (basic and variant types)?
- If evaluated on the complete vehicle, versions of fuel consumption and pollutant emission may appear in the understanding of basic and variant types.
- How to define the differences between versions of fuel consumption and pollutant emission?

Effects of shift control



不同变速箱、速比、变化换挡控制策略对发动机工况的影响



Common topics of fuel consumption test methods

1. Start-stop
2. Braking energy recovery

   How to solve that significant improvements on FC can not be reflected in the current test method and driving cycle?

Comparisons to foreign vehicle fuel consumption standards and regulations

Comparisons to foreign vehicle fuel consumption standards and regulations

1. The government' concern on energy saving target.
2. Encouraging of fiscal policies (punishment mainly)
3. Confusions about the implement of the 3rd stage passenger car fuel consumption standard.
4. Flexibility is required in CAFC (pooling and credits)
5. Small scale (volume)

The government' concern on energy saving target

1. The Chinese government concerns that whether the CAFC could ensure reaching the energy-saving target.
2. Worries about the vehicle type large-sizing and increasing of average weight.
3. Whether the current evaluating system and slope setting could ensure reaching the energy-saving target.

Encouraging of fiscal policies (punishment mainly)

- In the administration of vehicle fuel consumption, fiscal policies should be "subordinate".
- When manufacturers do not satisfy the CAFC target, fiscal policies will force to fulfill the "social responsibility".
- As one of the compliance measures, according to "external cost" to make manufacturers satisfy the CAFC target.
- It should be a long-term mechanism, and could "readjust industrial structure".

Confusions about the difficulties during the fuel consumption standard implement

- Why mature and effective foreign administration experience can not implement in China?
- Why there are different treatments to domestic manufacturers and importers in China?
- Whether the one-size-fit method of vehicle fuel consumption administration is proper?
- Which is suitable for China, if foreign experience is adopted?

Flexibility is required in CAFC (pooling and credits)

Whether the following could come out:

1. Allow manufacturers to "excess" the CAFC target.
2. Manufacturers not satisfying the CAFC target must undertake social responsibilities
3. Manufacturers can cope with the fuel consumption administration according to pooling to form rational structure.
4. Promote the credit system to fully utilize the adjusting role of market.

Small scale (volume)

- In foreign countries, manufacturers which has small producing volume are given some or graces or favors in the fuel consumption administration.
- Preconditions are:
  1. “Volume” should be less than certain scale (quantification)
  2. The fuel consumption target could be neglected.
  3. There must be a constraint in the “small volume” administration.

Importance of integrated control of vehicle FC and pollutant emission

Status of integrated control of vehicle FC and pollutant emission

- FC and pollutant emission of light duty vehicle are all evaluated on the chassis dynamometer in the world.
- Different methods for heavy duty vehicle:
  1. Pollutant emission——Simulate vehicle running based on engine test (China, Japan, EU and US)
  2. Fuel consumption
     - based on simulation(China, Japan, EU and US)
     - based on chassis dyna (China and US vehicles above 14000 LBS)

Problems existing in separating of FC and pollutant control

1. Relations are not built between FC and pollutant emission which tested separately on engine bench and chassis dynamometer.
2. Manufacturers can cope with relevant regulations separately by producing vehicle types of “fuel consumption” and “pollutant emission” versions.
3. Different units:
   ① “*g/kWh*” for the engine
   ② “FC/ton、FC/seat” for the complete vehicle
4. Actual driving conditions are not be supervised availably.

The purpose of promoting integrated control

1. Three problems to be solved：
   ① Reflect the actual driving conditions
   ② Reflect the real fuel consumption
   ③ Control the pollutant emission availably
2. To solve that after engine installed on vehicles(one engine for different vehicles), whether the FC and pollutant are under control?
3. To solve that after engine installed on vehicles(one engine for different vehicles), whether the FC and pollutant are under control?
4. To solve that after vehicle installing engines (one vehicle with different engines), how to control the uniformity of FC and pollutant?
5. Whether current engine administration could ensure that vehicle's pollutant emission is qualified and easy to supervise?

Uniformity should be solved during the standard improving

1. The point of integrated control is “uniformity”

   g/km and g/kWh

2. To solve that engine and vehicle tests are not uniform
   - ① One engine for different vehicles
   - ② One vehicle with different engines
3. The evaluation systems of FC and pollutant should be “uniform”
   - ① Whether two limits evaluation systems could be uniform?
   - ② Whether there are better evaluation systems?

Proposal!

1. To establish thorough fuel consumption legal system.
2. To establish coordination mechanism between government departments and implement administrative functions.
3. To carry out preliminary standard research, test method improvements, driving cycles and other major projects at the national level.
4. To pay attention to production conformity and standard compliance.
5. To promote integrated control of vehicle FC and pollutant emission.

Thank you!