GFEI Workshop on In-use Fuel Economy

Relationship of in-use FE to tested FE, "gap" factor estimates

Jul.16, 2014 @ London

Japan Automobile Manufacturers Association, Inc.

Driving Sustainability through an Integrated Approach

Driving Sustainability www.drivingsustainability.com

ACEA
European Automobile Manufacturers Association

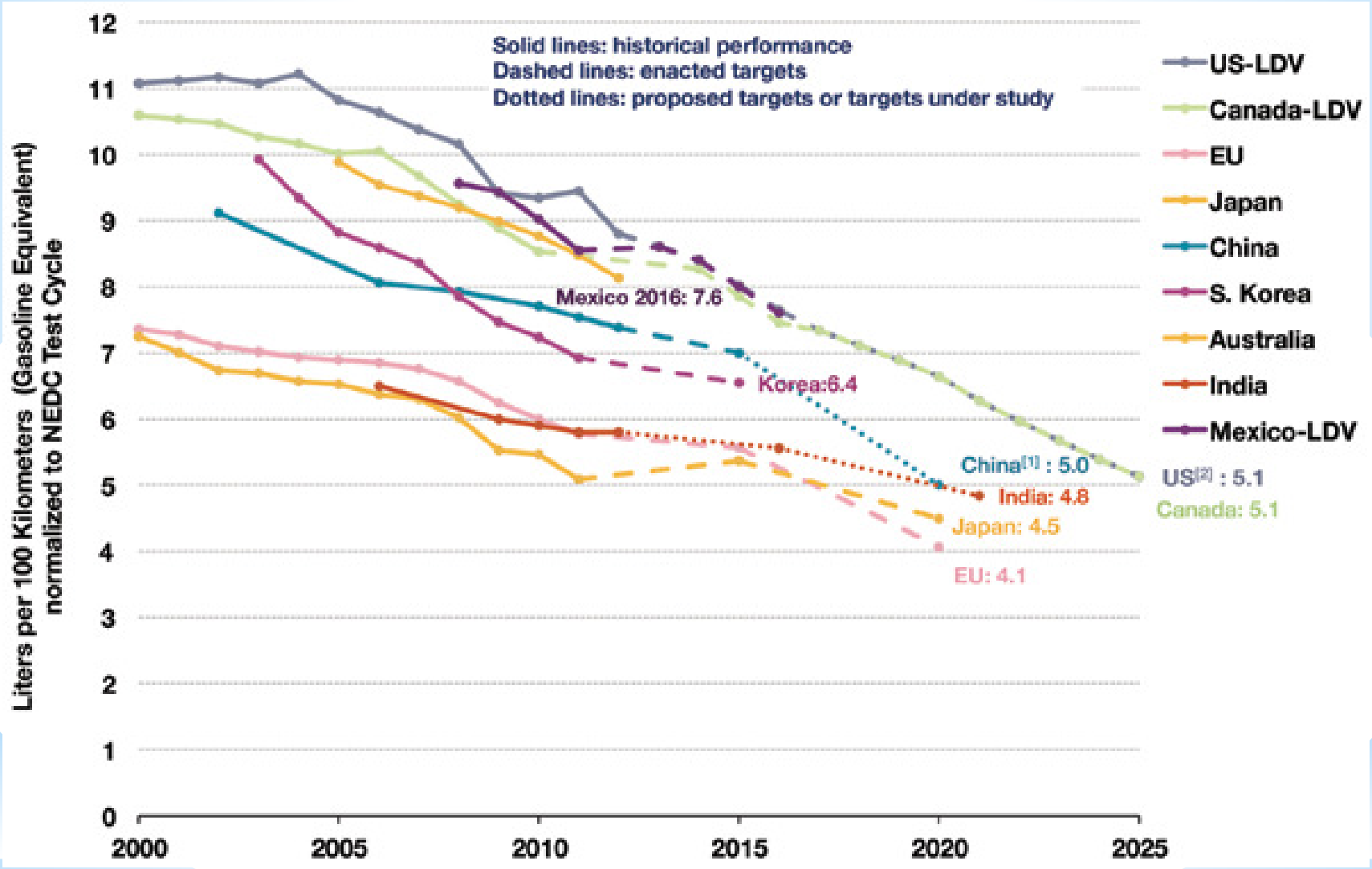
JAMA
Japan Automobile Manufacturers Association

AUTO ALLIANCE
United States Alliance of Automobile Manufacturers

To achieve significant reductions in CO2 emissions in global road transport, Japanese, European and US automotive associations advocate the adoption of an integrated approach.

Fuel Economy Regulations Trend

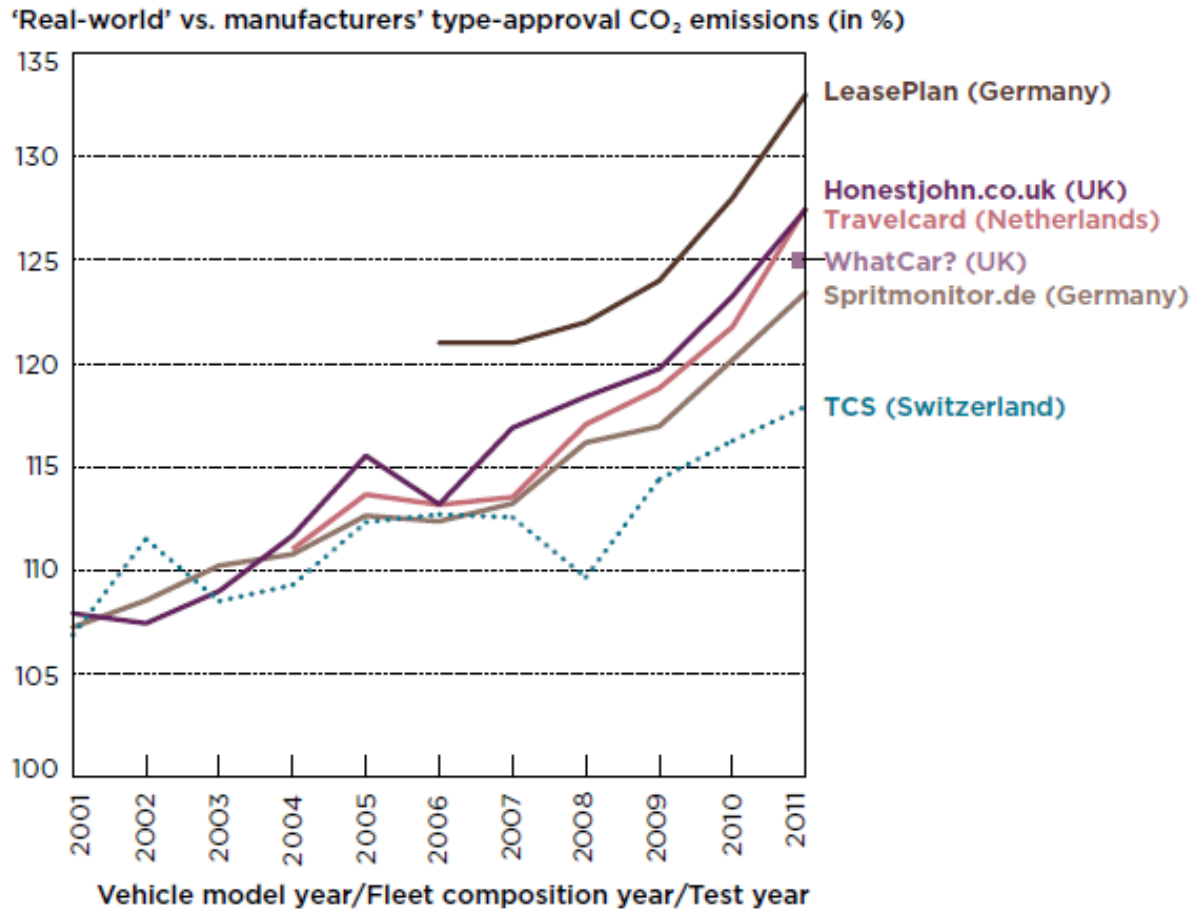
Data : GFEI



Most regulated countries are tending to >5L/100km in 2020+. 3-6% per /yr reduction needed which is very challenging.

Tested and Real World FE (EU)

Data : IPCC

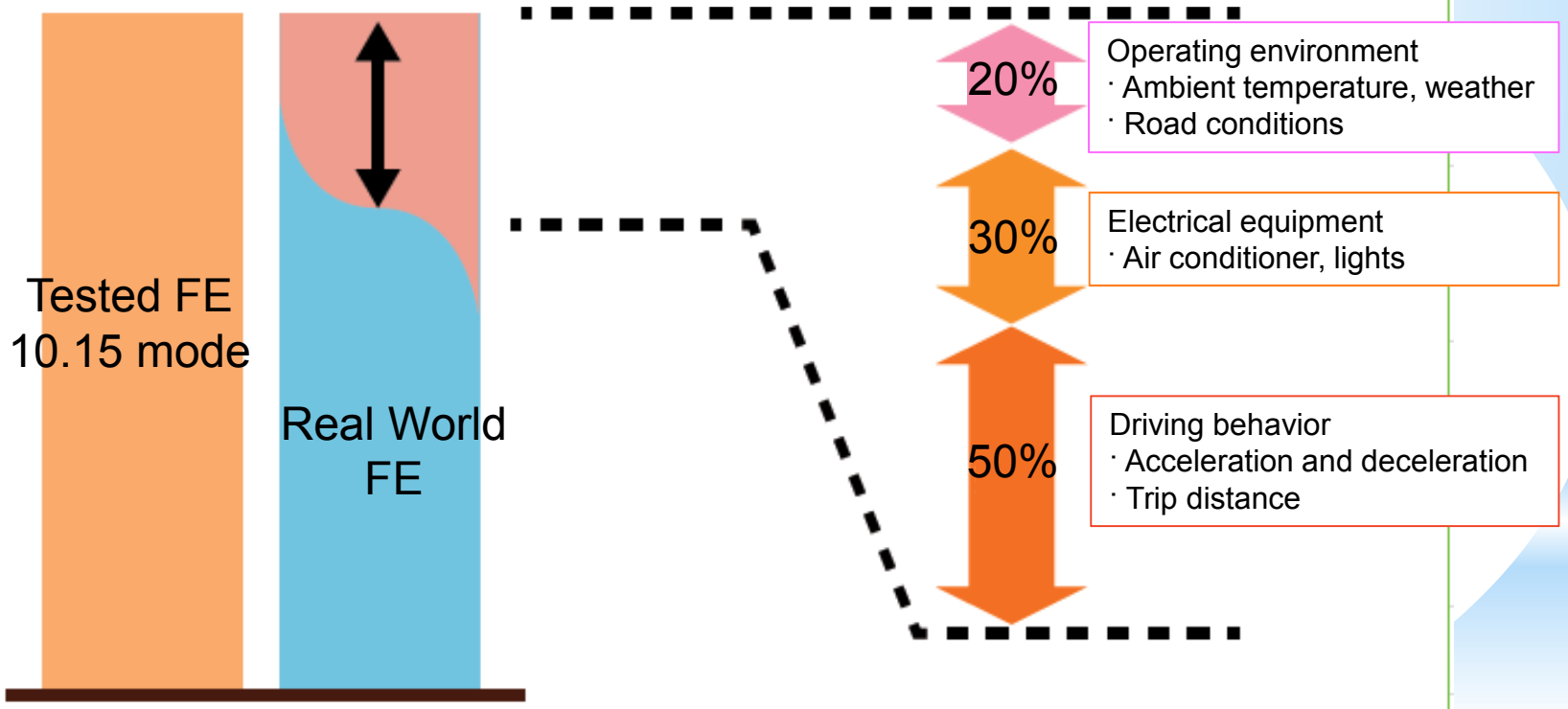


A recent analysis of driving data in EU, there is an increasing discrepancy between Tested FE and Real world FE.

FE Gap Factors

Data : JAMA

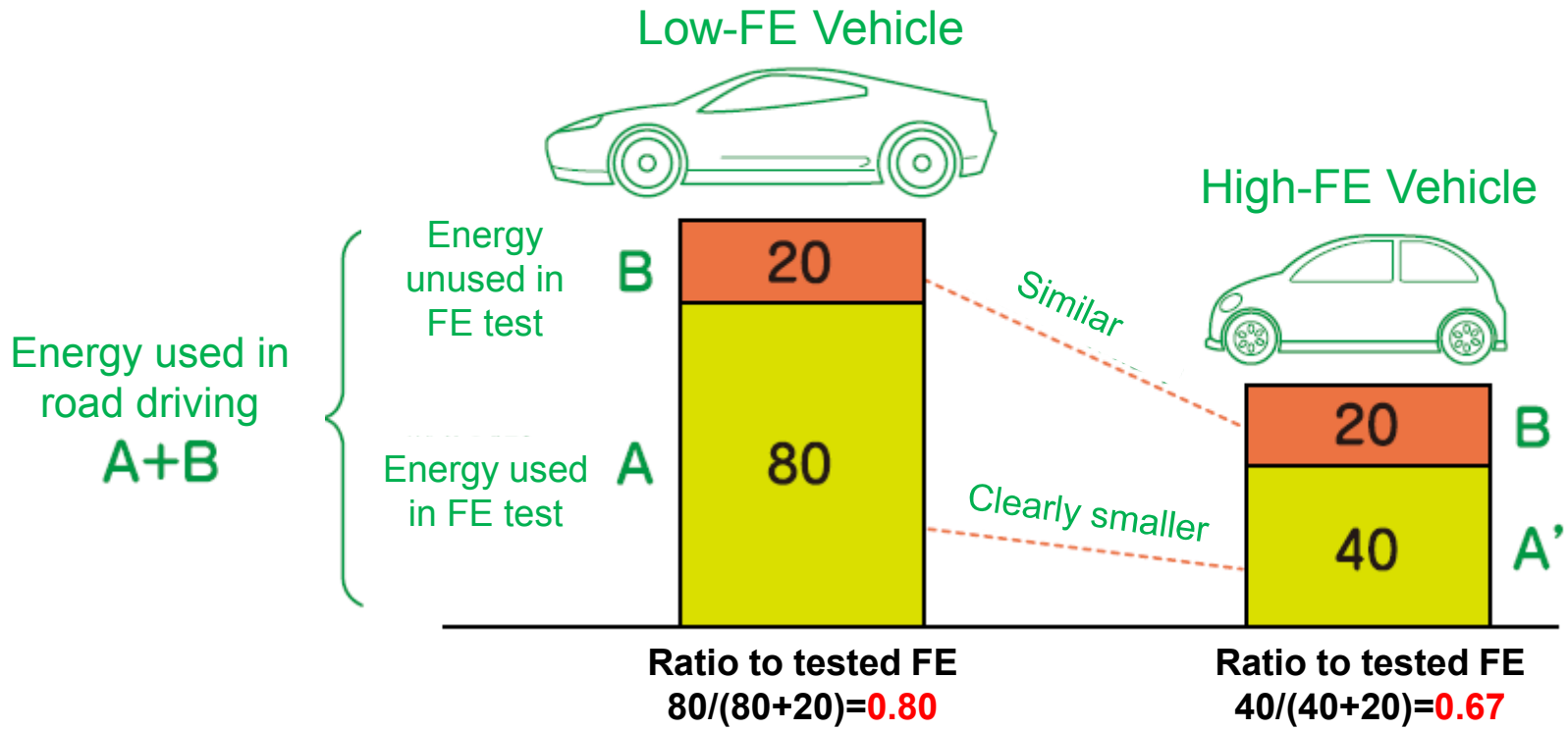
FE performance varies according to: A) operating environment, B) electrical equipment and C) driving behavior for the vehicle.
A) accounts for about 20%, B) 30%, and C) 50% of the FE gap (between “tested” FE and “Real world” FE).



FE Gap Factors Investigation: Hi and Low FE Vehicles

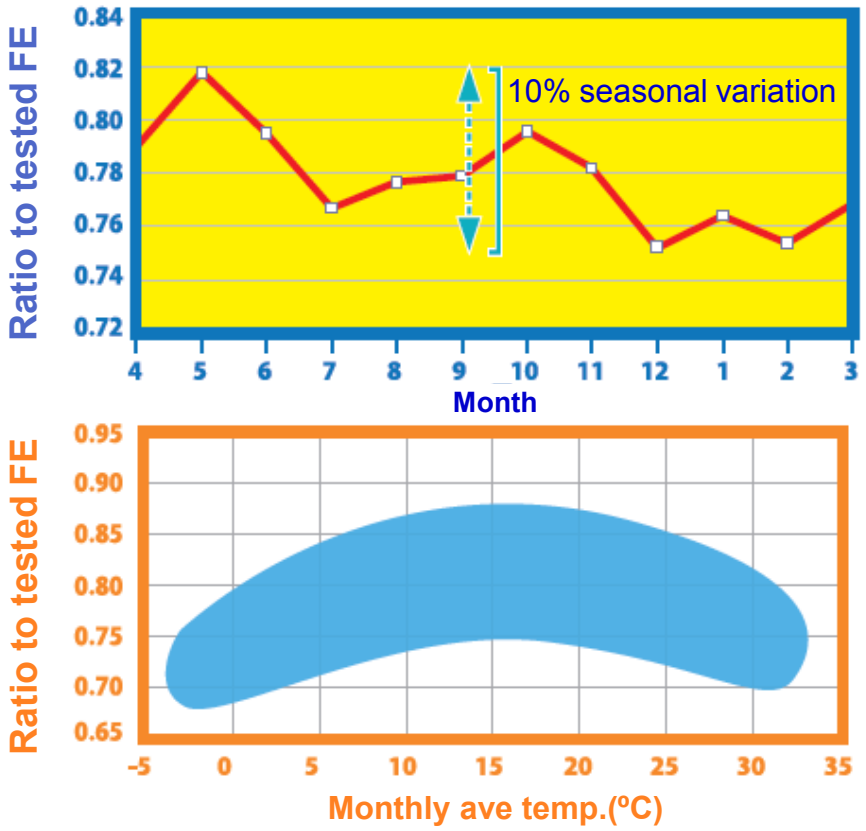
Data : JAMA

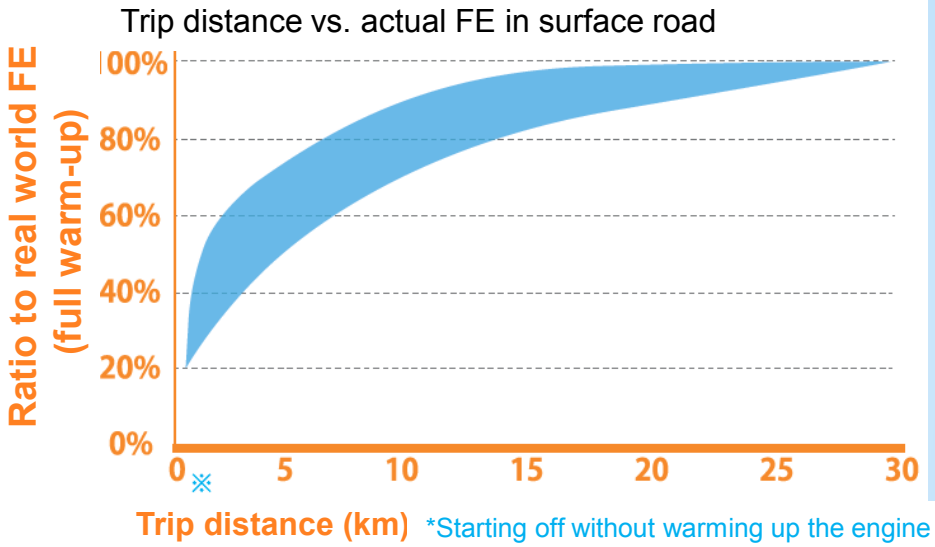
Some of the vehicle fuel is used in operating the electrical equipment like the air conditioner and in maneuvering through jams during road driving, but not during FE testing. Since the amount of this energy unused in FE tests is similar among different vehicles, the ratio of real world FE to tested FE is bound to be smaller for high-FE vehicles.



FE Gap Factors Investigation: Amb temp, Trip distance

Data : JAMA





【Ambient temperature】

15℃-20℃ is best temperature for FE.
The other temperature areas have negative impact shown below.
Lower temp : Warming up impact
Higher temp : A/C load impact

【Trip distance 】

Short trip driving does not have enough time to finish engine warm up.
When engine temperature is cold, several frictions (engine, brake drag, tire rolling resistance, etc.) make negative impact for FE.

Real World FE Improvement by Driving Behavior Change

IPCC AR5

5-10% improvement in on-road fuel consumption can be achieved through efforts to promote “eco-driving”.
Another 5-10% may be achievable by an “integrated approach” including better traffic management, intelligent transport systems and better vehicle and road maintenance.

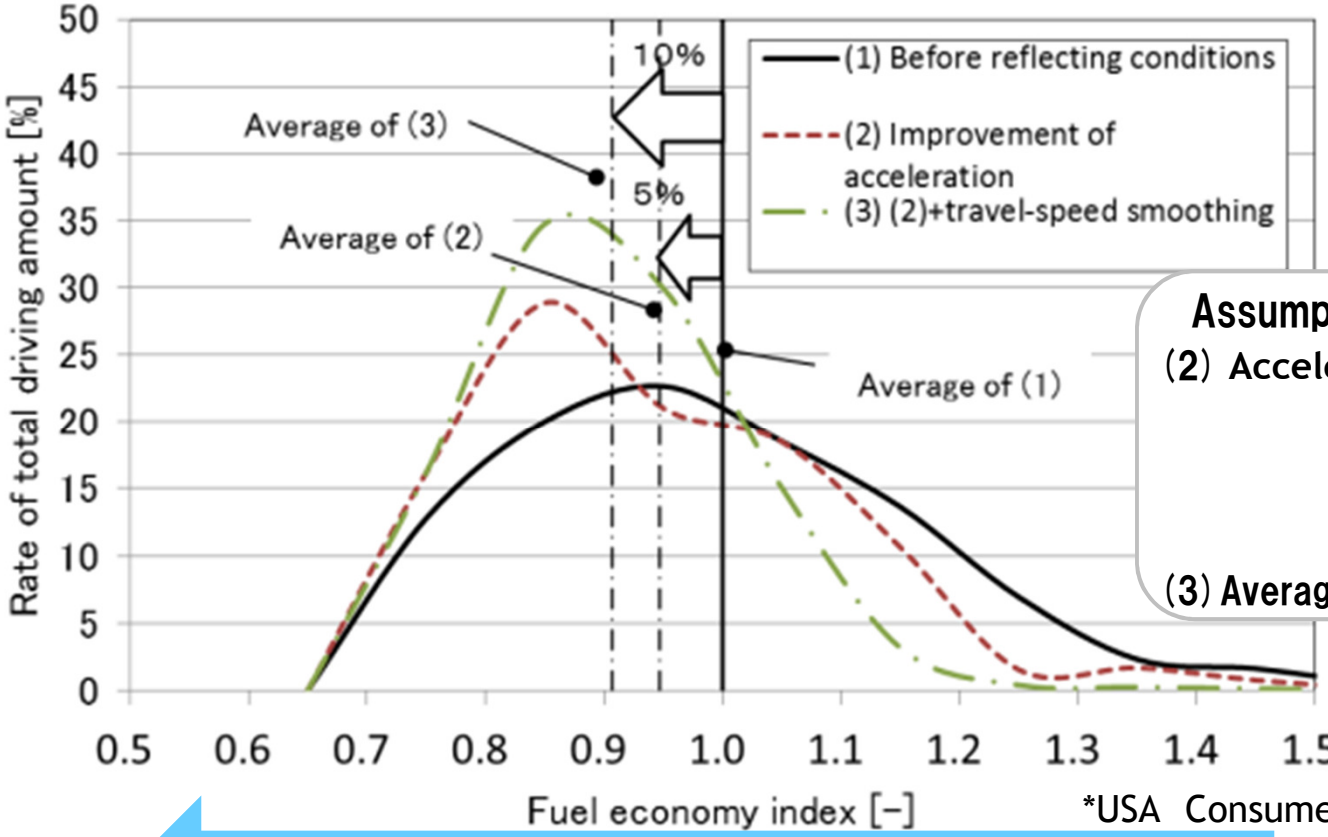
Eco-driving and traffic management are possible to improve real world FE

■ **Coaching function**
Ambient meter

■ **Teaching function**
Advice display

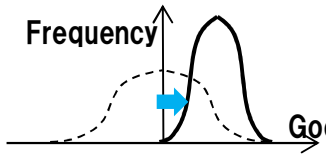
Real World FE Improvement by Driving Behavior Change

Honda 2013 US SAE document



Assumptions

(2) Acceleration energy equivalent



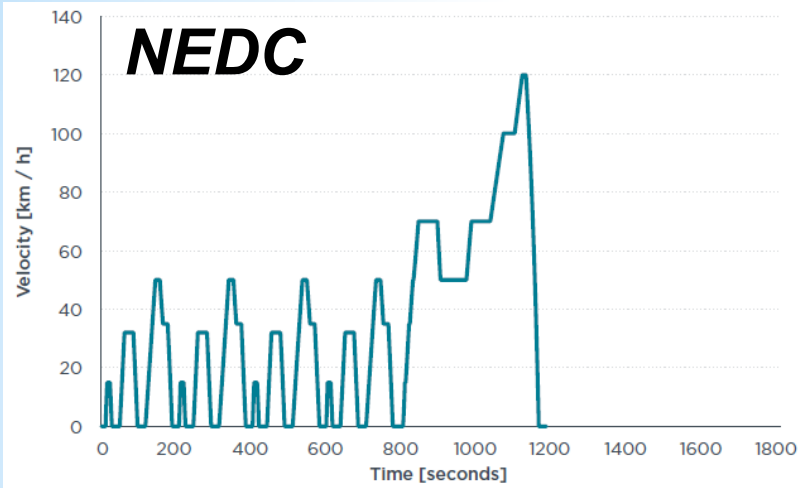
(3) Average travel speeds: +10km/h

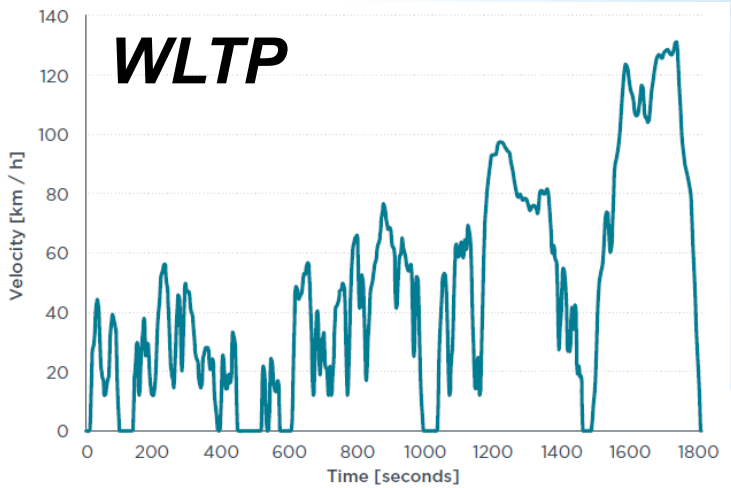
*USA Consumers-contracted data

GOOD

Approximately 10% better FE potential by eco-driving behavior

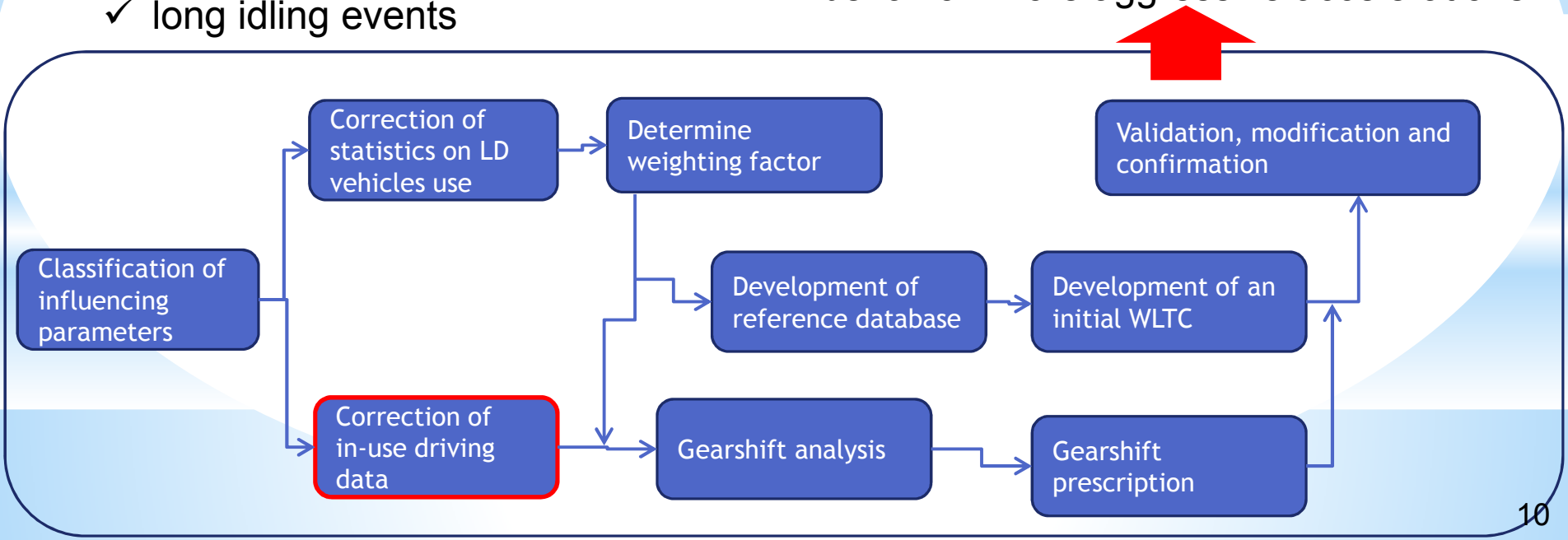
Improve representativeness of test driving cycle (WLTP)





- ✓ Less accelerations
- ✓ constant cruising speed
- ✓ long idling events

WLTP is developed by worldwide driving behavior. More aggressive accelerations



Summary for Tested and Real world FE Gap factors

FE gap factors between Tested and Real world are summarized as below.

1. **Vehicle driving style** (Acceleration/deceleration, 1trip distance)
2. **Accessary device** (A/C, electric feature)
3. **Environmental condition** (Ambient temperature, road condition)

Driving behavior is the most critical factor for the gap.
Eco-driving helps to reduce hard acceleration and improves real world FE. OEMs will apply several technologies to support Eco driving.

The new type approval test **WLTP** has been developed as “global harmonized” to unify existing test procedures worldwide to the maximum extent, increasing the representativeness of average driving behavior globally. Hence with this process, **it is expected to see the tested FE that is close to the real world.**