Selected insights into road transport trends

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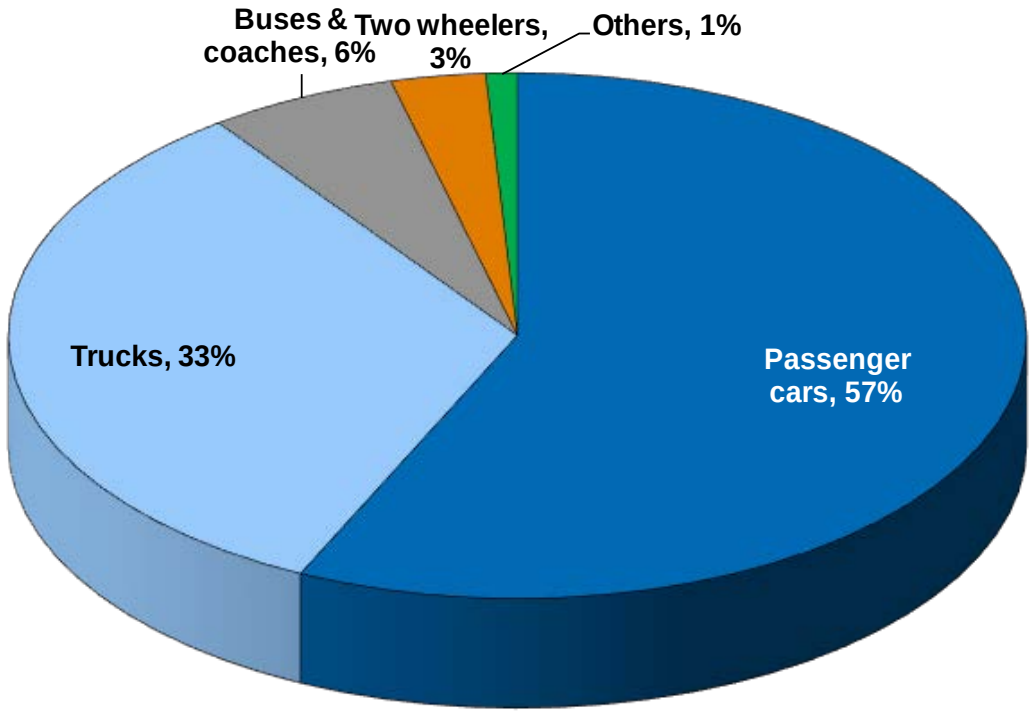
Seventh IEA IEF OPEC Symposium on Energy Outlooks
IEF Secretariat, Riyadh, Saudi Arabia, 15th February 2017

Passenger cars and trucks are key, as they account for circa 90% of road transport fuel demand

2015 Global road fuel demand, by vehicle type



Parc Comparison

Worldwide parc for major vehicle types:

- Passenger cars 1030 million
- Trucks 183 million

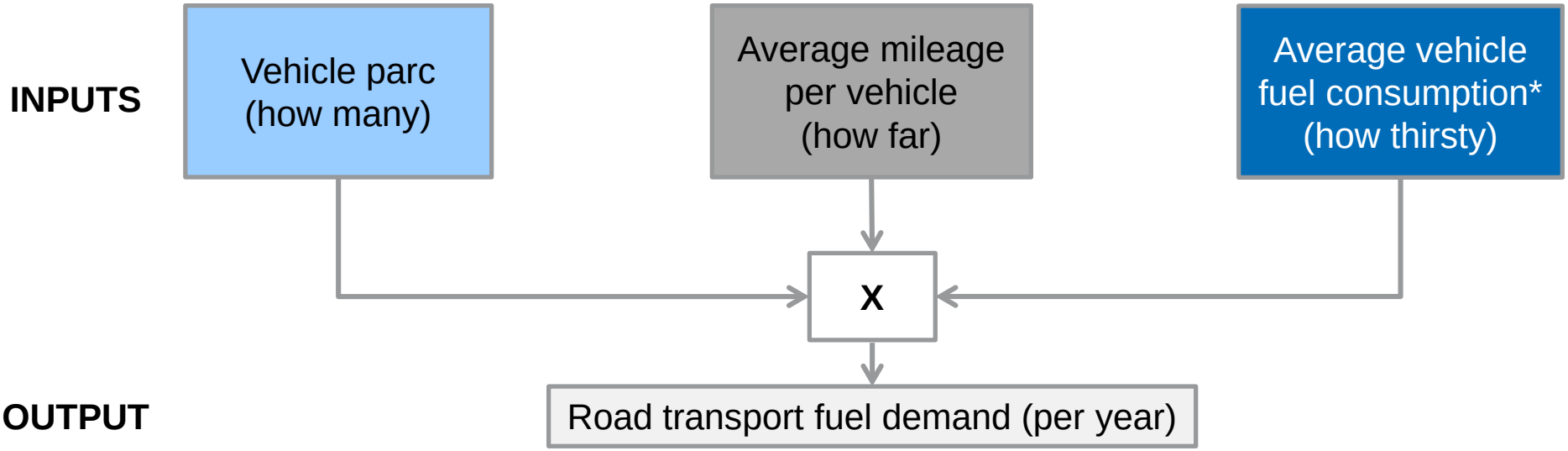
Compared with:

- Two wheelers 485 million

2015 estimated road transport fuel demand: 2005 Mtoe

Source: Ricardo analysis, OPEC World Oil Outlook, European Tyre & Rubber Industry Statistics

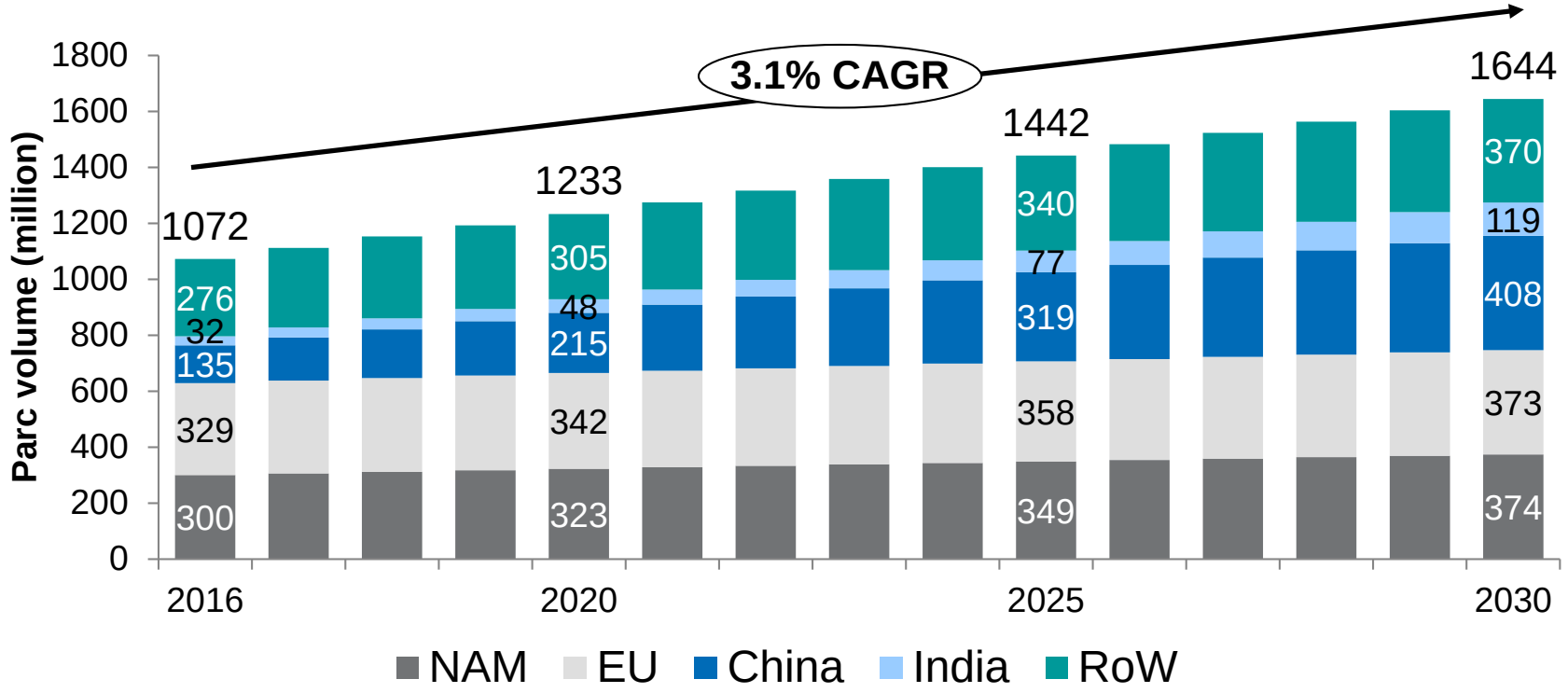
We analyse vehicle parc, mileage and fuel efficiency to determine road transport fuel demand



*Note: Fuel consumption is the inverse of fuel efficiency
Source: Ricardo

The global light vehicle parc is forecast to grow at ~3% CAGR to ~1.6 billion in 2030, with the fastest growth in China and India

*Global light vehicle parc outlook



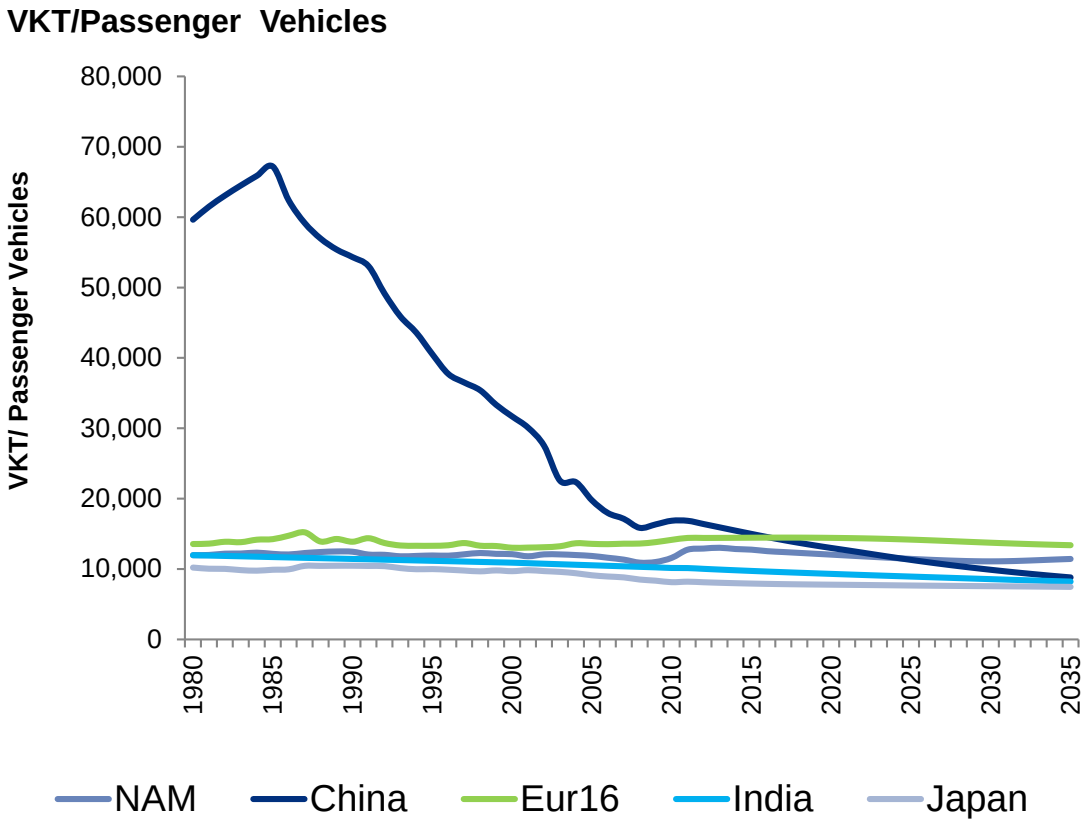
- The global light vehicle parc is expected to grow to 1.6 billion by 2030
- India is the fastest growing region (CAGR ~10%), given the current very low rate of car ownership
- China is expected to grow at a CAGR of ~8%, though growth may decline with efforts to manage congestion
- Slow growth is expected in the saturated regions of N America (~1.5% CAGR) and Europe (~1% CAGR)

Source: Ricardo, LMC Automotive

*NAM: North America; RoW: Rest of the World;
Europe comprises western and eastern countries (including Russia and Turkey)

Urban congestion globally and alternative transport in developed regions lie behind the expected decrease in VKT to 2030

Light duty vehicles - Vehicle Kilometers Travelled (VKT)



Comments

- Travel per car is relatively stable as growth in the parc matches demand for travel
- In developed regions, VKT is expected to gradually decrease due to:
  - Traffic congestion
  - Higher public transport use
  - Telecommuting
  - Environmental awareness
  - Cars are no longer “cool” to urban under 30’s
- In developing countries, congestion is the primary driver for decreasing VKT
- China is a historic outlier; VKT/car fell notably as high mileage taxis and public vehicles became a much smaller share of the car parc

Source: Ricardo

In the last 4 years there have been three powerful, disruptive drivers of change

The shift from urban Diesel

Air pollution in Megacities

- "The 21 million inhabitants of China's capital appear to be engaged in a battle for life on an inhospitable planet…"

Local authorities decide…

- "The Mayor of London has pledged to introduce only hybrid or zero-emission double-decker buses to London's bus fleet from 2018…"

Loss of trust in OEMs

#Dieselgate

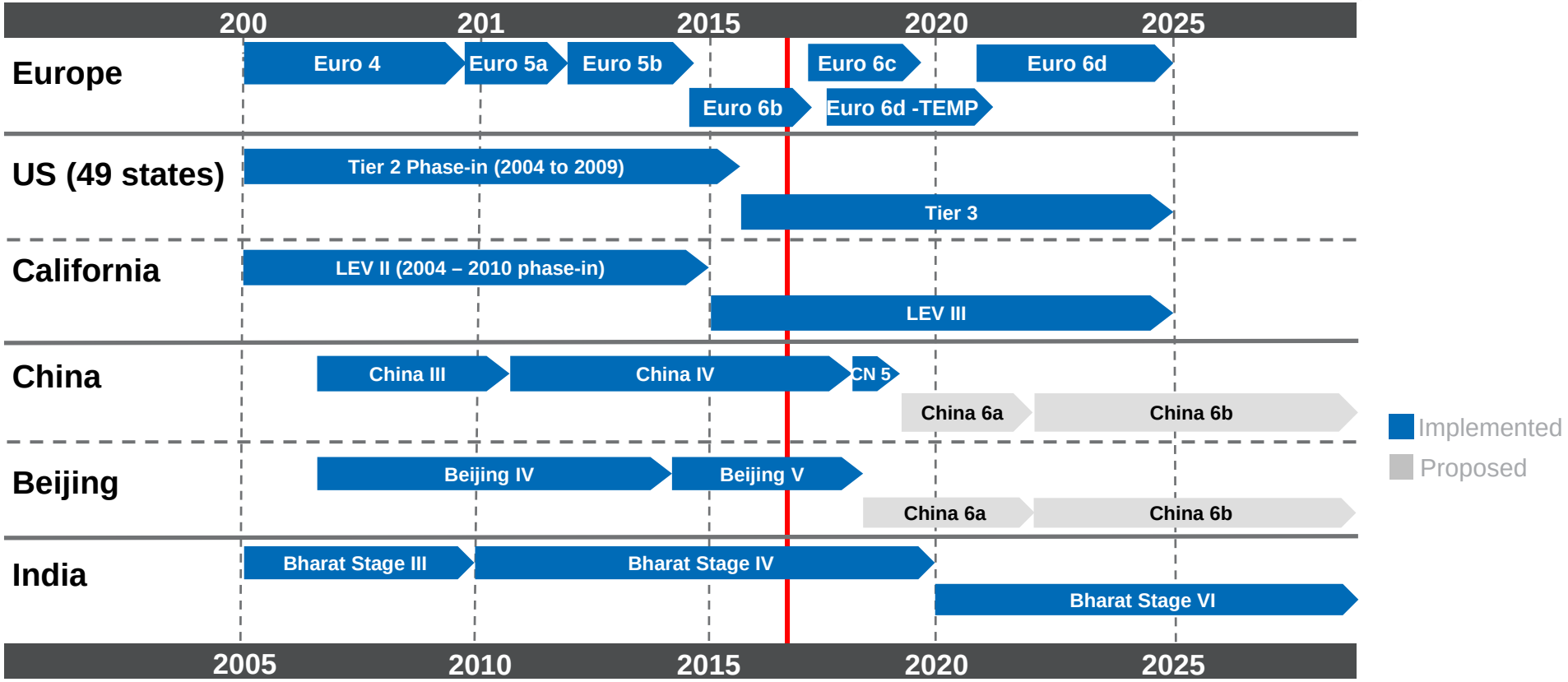
- VW agreed with US authorities to pay ~$15bn to settle claims over Diesel pollution tests
- Other OEMs prosecuted over incorrect fuel economy claims

- Air quality in major cities (Beijing, Shanghai, Delhi, Paris, London etc.) has NOT improved, despite tightening emission standards
- Fuel economy experienced by road users has failed to improve in line with results from most standard test cycles

Source: Ricardo, The Guardian, Transport for London

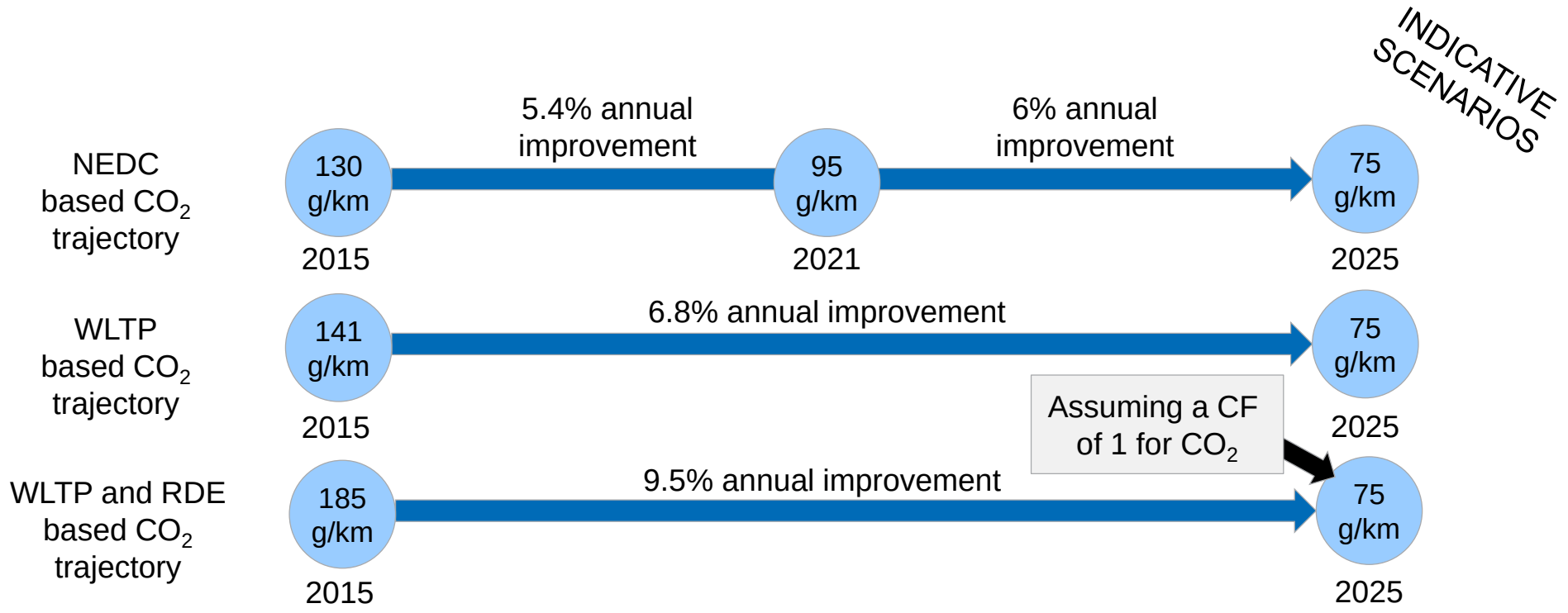
Regulators around the world intensify efforts to tighten noxious emissions standards for passenger cars

Passenger car noxious emissions legislation - global



Source: : National government sources, Ricardo Analysis

With WLTP* and the prospect of Real Driving Emissions for CO_2, OEMs have to accelerate the pace of real world fuel economy improvement



- In EU, the fleet CO_2 measured in 2015 was based on NEDC;
  5-6% per annum CO_2 improvement needed to achieve 2021 and 2025 targets
- Under WLTP*, today's fleet CO_2 would be 7-10% higher, yet still have to reach the 75g/km target in 2025
- The challenge could become much greater if regulators introduce both WLTP and CO_2 RDE**

*WLTP: Worldwide harmonized Light vehicles Test Procedure
**RDE: Real Driving Emissions

Source: Ricardo

Electrification of commercial vehicles is focused on niche, urban applications, where air quality concerns justify the investment cost

Mission	Description	Market Examples
Urban transport	• Public or private transport buses operating as plug-in or hybrid • City mission with frequent stop/start; electrification reduces emissions • Short/medium range and return to base operation makes recharge easier	 BYD Transitbus  Siemens ELFA Series Electric  BAE Systems Hybridrive
Urban delivery	• Private or public delivery trucks • City mission with frequent stop/start and access to Low Emission Zones encourages electrification • Small range & return to base makes recharge easier	 FUSO Canter E-Cell  SCANIA hybrid Delivery truck
Municipal	• Municipal trucks (e.g. refuse collection etc…) • Frequent stop/start and high load operation when stationary. Electrification reduces noise and emissions • Small range & return to base makes recharge easier	 Volvo FE Hybrid  Mercedes Benz Urban E-Truck

Source: Ricardo Analysis, Manufacturers

Any Questions?