



# RDE LEGISLATION AND REAL-WORLD EMISSIONS

ERMES (TNO/TUG/LAT)

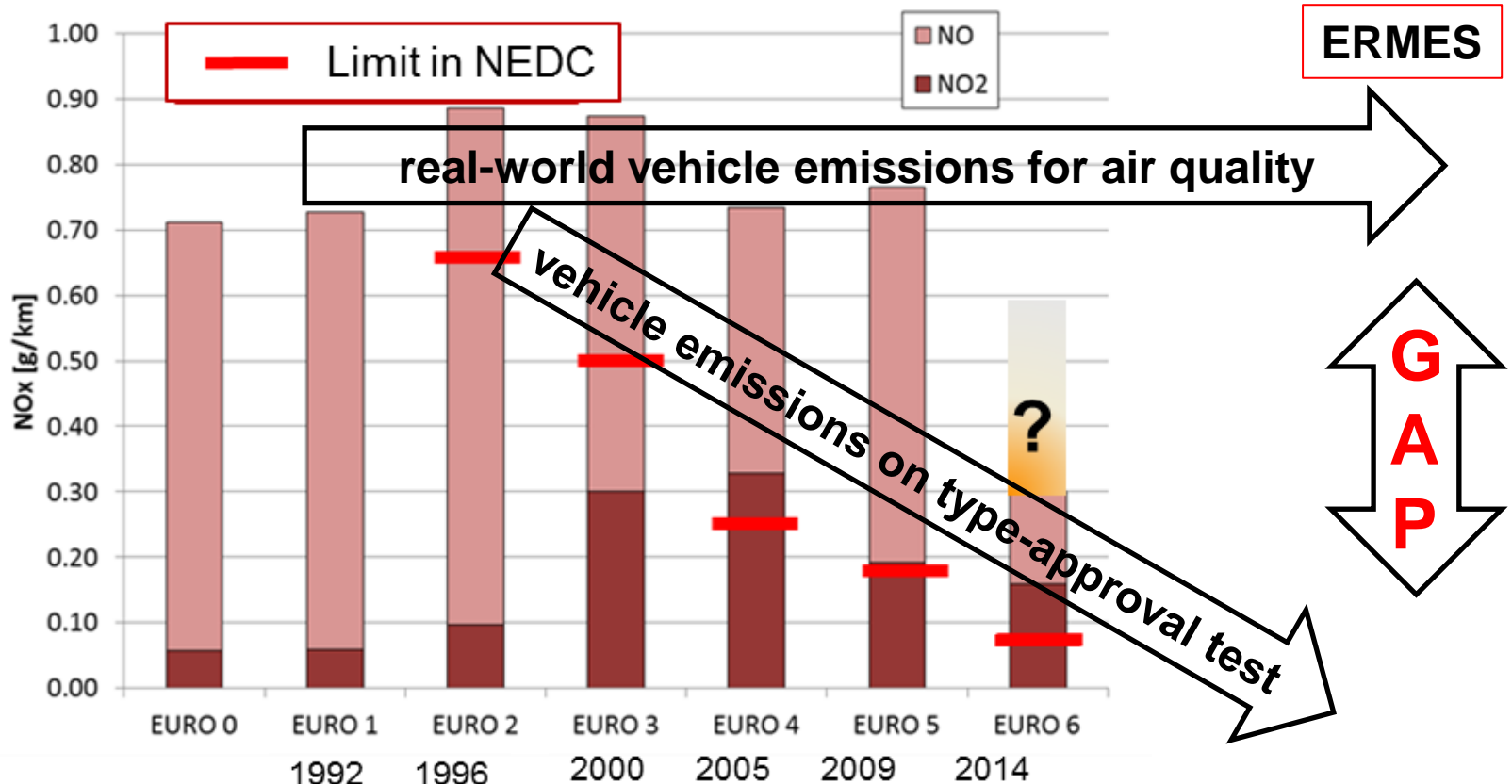
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# EUROPEAN RDE LEGISLATION

- › on-road type-approval emission testing of new vehicles
  - › phase 1: 1 Sept. 2017 (new models)/1 Sept. 2019 (all models) < 168 mg/km
  - › phase 2: 1 Jan. 2020 (new models)/1 Jan. 2021 (all models) < 120 mg/km
  - › separate from, but linked, with WLTP
  - › part of Euro-5/6 legislation EU-715/2007 (comitology)
- › Test protocol:
  - › ensuring “comparable results” for variation in tests
  - › excluding extreme situations
  - › manufacturer’s test burden, responsibility and risk
- › RDE is not the same as real-world emission as captured in emission factors
  - › but the correlation is expected to be much better than with the NEDC test

# PARALLEL WORLDS:

## REAL WORLD EMISSIONS AND TYPE-APPROVAL EMISSIONS



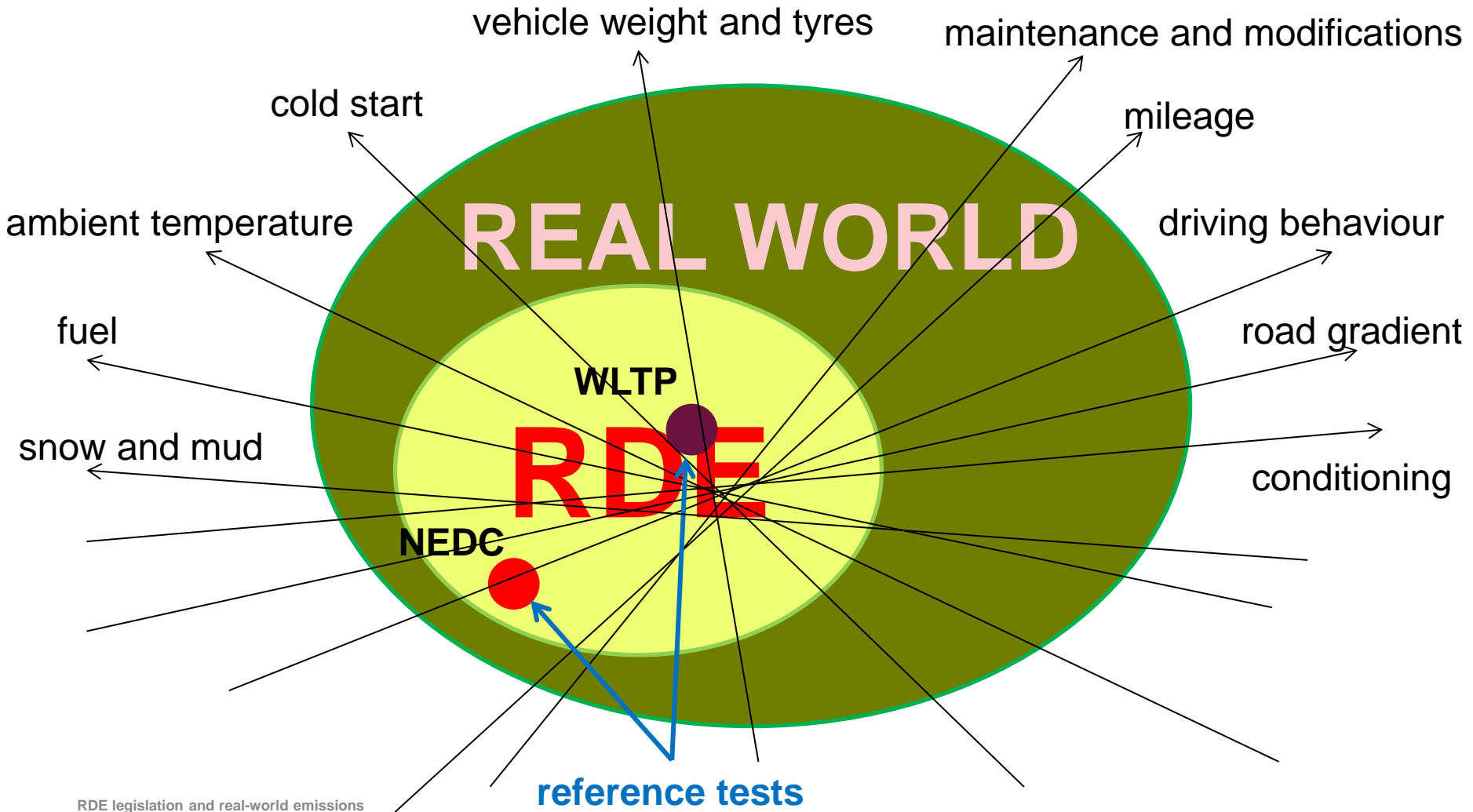
# RDE LEGISLATION COMITOLGY

## *RDE AS PART OF EURO-5/6 LEGISLATION*

### European regulation 715/2007:

- › **article 14(3):** The Commission shall keep under review the procedures, tests and requirements referred to in Article 5(3) as well as the test cycles used to measure emissions. If the review finds that these are no longer adequate or no longer reflect real world emissions, they shall be adapted so as to adequately reflect the emissions generated by real driving on the road. The necessary measures, which are designed to amend non-essential elements of this Regulation, by supplementing it, shall be adopted in accordance with the regulatory procedure with scrutiny referred to in Article 15(3).
- › **article 5(1):** The manufacturer shall equip vehicles so that the components likely to affect emissions are designed, constructed and assembled so as to enable the vehicle, in normal use, to comply with this Regulation and its implementing measures.

# FACTORS FOR REAL-WORLD EMISSIONS

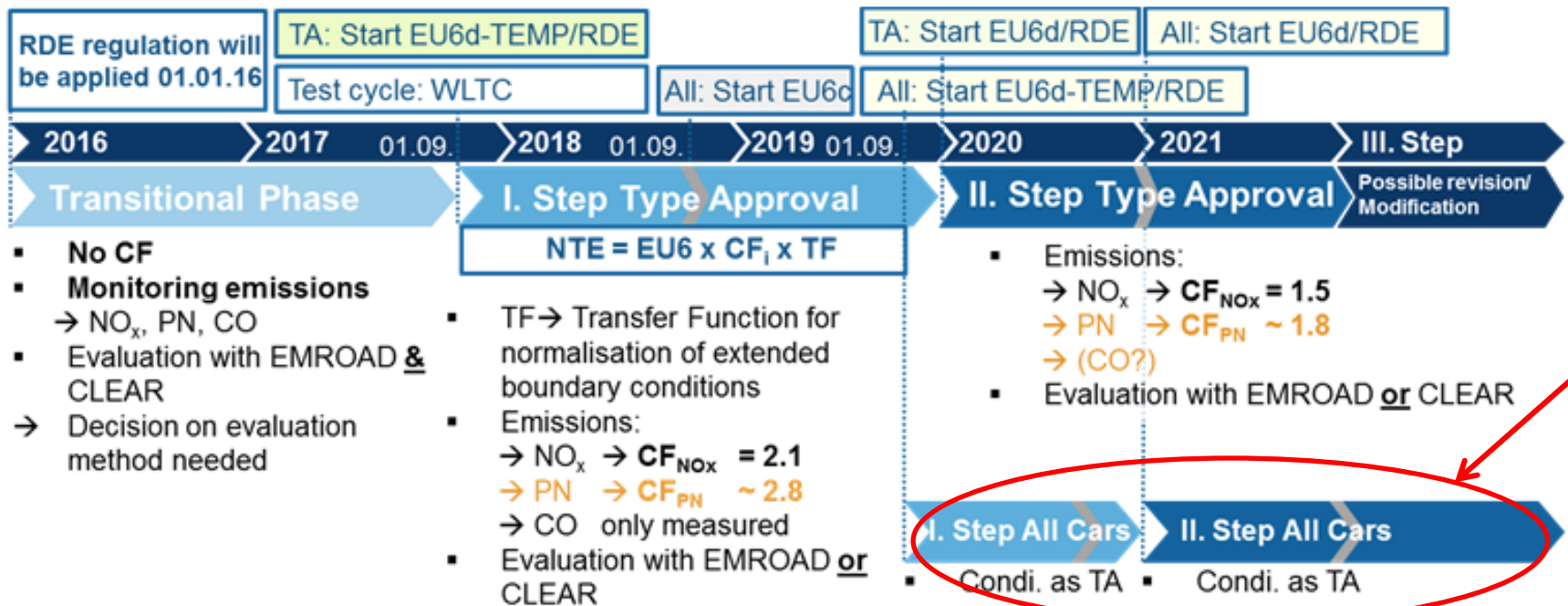


# RDE LEGISLATION IN 4 PACKAGES

- › **determined:**
  - › evaluation methods (EMROAD & CLEAR) to normalize and average results
  - › ambient conditions: temperature and altitude
  - › introduction dates in 2 phases, conformity factors, and urban test
  - › driving behaviour (aggressive and tame limits)
  - › maximal altitude gain
- › **to be determined:**
  - › cold start emissions
  - › hybrid vehicle technology testing
  - › PM/PN PEMS (mainly for GDI)
  - › DPF regeneration
  - › vehicle families & challenging procedure
- › **open issues/recitals:**
  - › transfer functions
  - › driving behaviour ( $v^*a_{pos}$  boundary, based on WLTP)
  - › N1 vehicles testing in RDE
  - › reducing CF = 1.5 for phase 2 on the basis of improved measurement accuracy
  - › small sales volumes
  - › declared alternative emission control strategies
  - › European control on type-approval testing

# DETERMINED PLAN OF INTRODUCTION

expected late introduction due to test burden



Temperature	normal	3 – 30 °C	0 – 30 °C
	extended	-2 – 30 °C	-7 – 35 °C
Altitude	normal	< 700 m	< 700 m
	extended	< 1300 m	< 1300 m

# RDE TRIP REQUIREMENTS

RDE Road Category				
URBAN	$v \leq 60$ km/h			
RURAL	$60 < v \leq 90$ km/h			
MOTORWAY	$v > 90$ km/h			
RDE Requirement Checks/Boundary Conditions				
Value	Unit	MIN	MAX	Description
trip length	s	5400	7200	
trip distance	km	16		Each part (URBAN/RURAL/MW) > 16 km.
share URBAN	%	29	44	Distance based shares for the total trip distance.
share RURAL	%	23	43	
share MW	%	23	43	
Stop periods	%	10		6-30% of urban time with $v < 1$ km/h. time per stop < 180s
avg. speed URBAN $v_{ku}$	km/h	15	40	Stops included.
avg. speed MW $v_{km}$	km/h	90	145	+15 km/h tolerance for < 3% time. $v > 100$ km/h for > 5 min.
RDE Dynamic Parameter				
95 Perzentil $v^*a_{pos}$	$m^2/s^3$	if $v_k \leq 74.6$ km/h	$95 \text{ Perz } v^*a_{pos} \leq (0.136 * v_k + 14.44)$	
	$m^2/s^3$	if $v_k > 74.6$ km/h	$95 \text{ Perz } v^*a_{pos} \leq (0.0742 * v_k + 18.966)$	
RPA	$m/s^2$	if $v_k \leq 94.05$ km/h	and $RPA_k \geq (-0.0016 * v_{average} + 0.1755)$	
	$m/s^2$	$v_k > 94.05$ km/h	and $RPA_k \geq 0.025$	
RDE Moderate/Extended Conditions				
Altitude	m	@ periods with extended cond.	moderate: $\leq 700$ m above sea level; extended: $700 \text{ m} < h \leq 1300$ m	
Temperature	°C	emissions are	Extended $-7^\circ\text{C} < t < 0^\circ\text{C}$ or $30^\circ\text{C} < t \leq 35^\circ\text{C}$ .	

## ensuring:

- variation in the test for full coverage of driving conditions
- average compared with European average driving (WLTP database)
- excluding extreme driving
- excluding extreme conditions
- limiting favorable testing



# WILL THE TWO WORLDS MEET IN RDE?

## *SOME DIFFERENCES*

### **EU RDE legislation**

- a) predefined with slow adaptation
- b) average values only, but with test variation
- c) all vehicle models tested
- d) tested vehicles conform manufacturer standards
- e) special vehicle usage and conditions excluded.

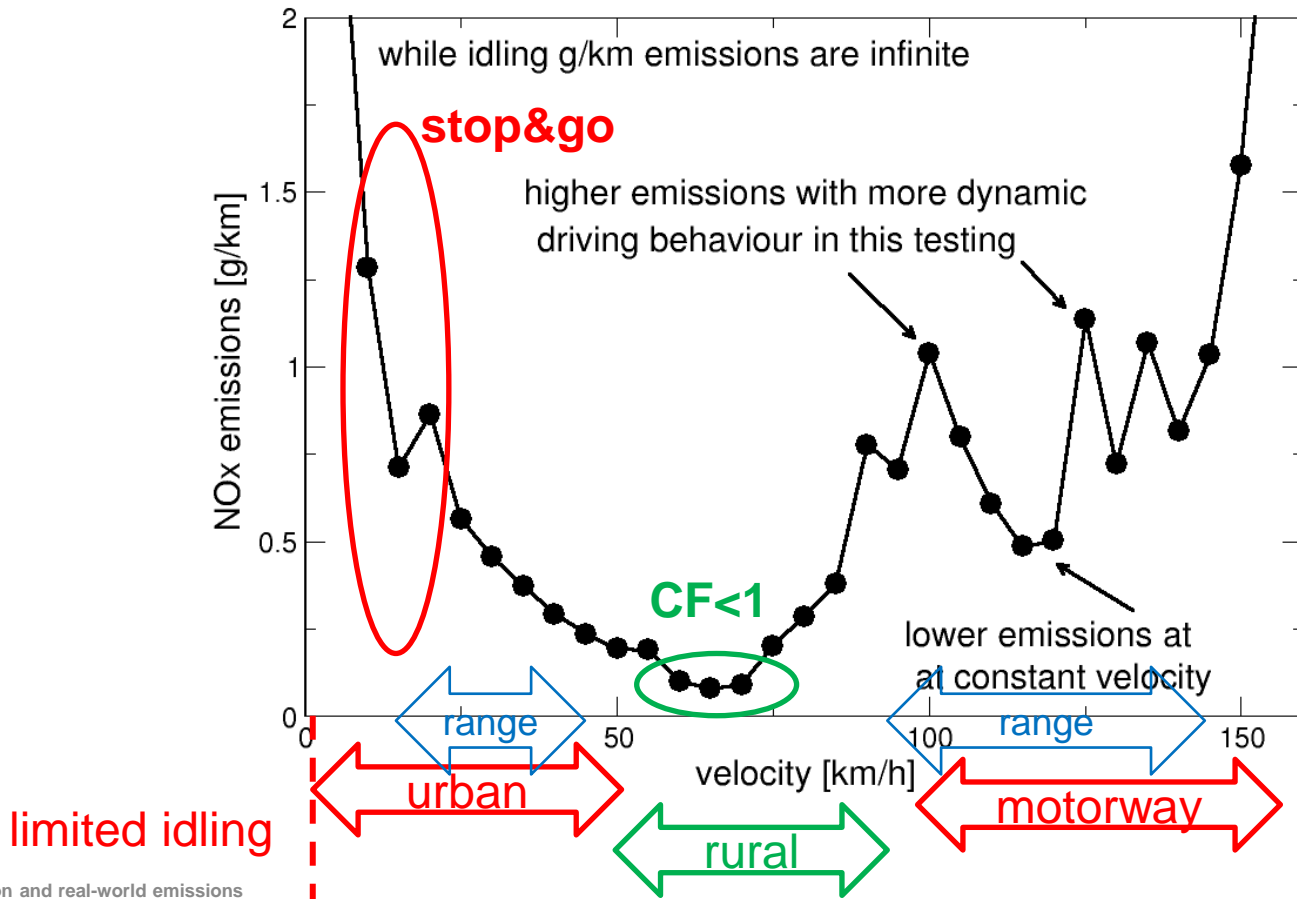
### **ERMES emission factors**

- a) evolving with new understanding
- b) values for specific traffic situations (e.g. stop&go)
- c) limited number of tests
- d) older vehicles often “as is” tested
- e) separate values for cold start, A/C, towing, etc..

# AVERAGING EMISSIONS MAY NOT SOLVE LOCAL PROBLEMS

## DEFINED URBAN RDE EMISSION LIMIT IS VERY WELCOME

example of a common Euro-6 vehicle  
average results for different velocities > 4000 km testing





› **THANK YOU FOR YOUR ATTENTION**

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