

# WLTP IWG - CFD subgroup

## CFD in Aerodynamics at ŠKODA AUTO

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TF08533-R01



**ŠKODA**

# CFD in Aerodynamics at ŠKODA AUTO

## Introduction - our history

1:6 models  
Wind-Tunnel (WT)  
Measurements



1:1 models  
WT Measurements



1930

1970

1980

1990

2000



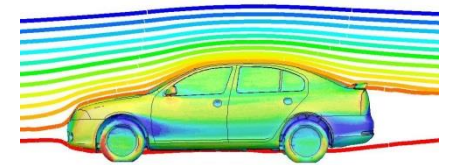
First Steps  
Škoda 935 Dynamic



1:6 models  
WT Measurements



Coast-down  
Measurements



CFD  
Simulations



# CFD in Aerodynamics at ŠKODA AUTO

Introduction – CFD simulations

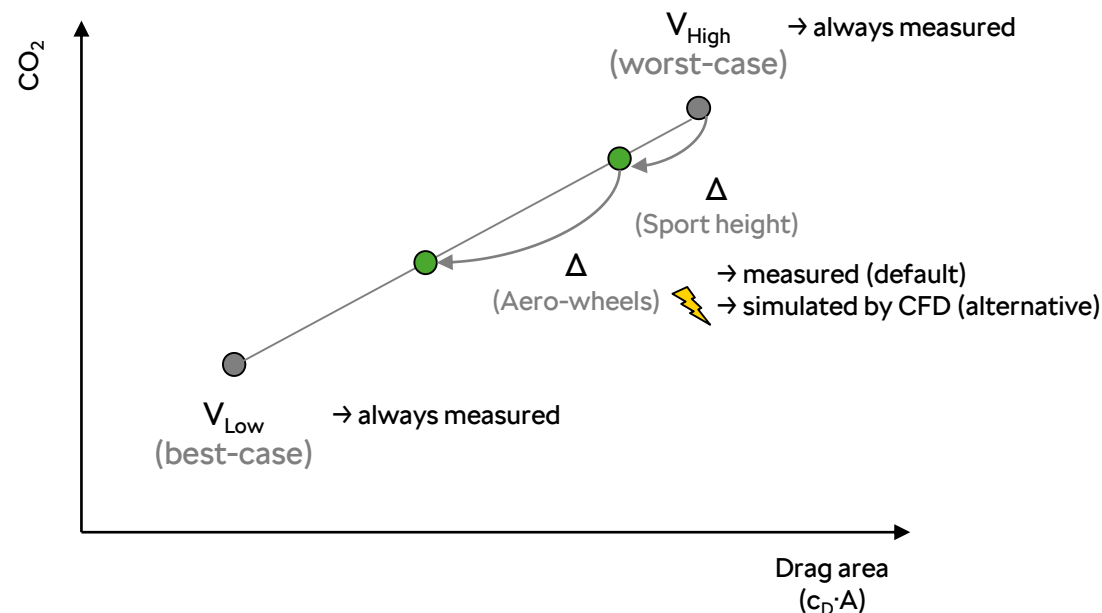
Animation  
Aerodynamics @ SKODA AUTO



# CFD in Aerodynamics at ŠKODA AUTO

## WLTP homologation and aerodynamics

- **Default:** worst-case  $c_D \cdot A$  must be measured
- **Alternative:** worst-case, best-case  $c_D \cdot A$  must be measured
- **Our strategy**
  - individual vehicle - equipment  $\Delta c_D \cdot A$  can be measured (default)
    - ⚡ can be simulated by CFD (alternative)

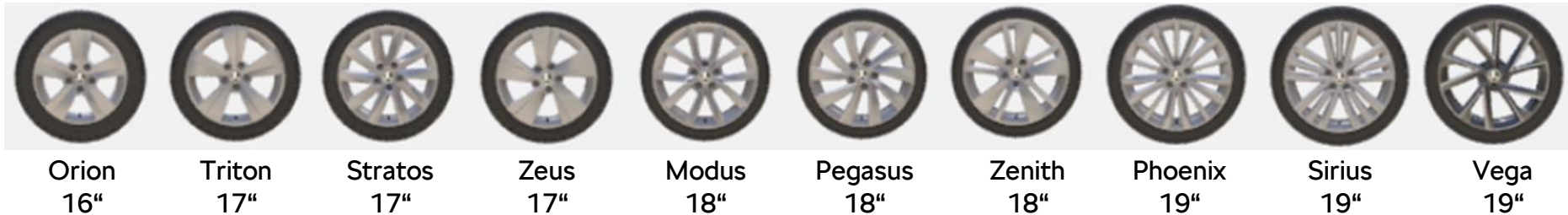


# CFD in Aerodynamics at ŠKODA AUTO

## Individual vehicle example

### ŠKODA Superb MY2019

cca. 20 pcs of optional equipment per model variant



Underbody protection



Sport suspension



Trailer hitch



DCC suspension



Roof-rails



Sport packet



Scout packet



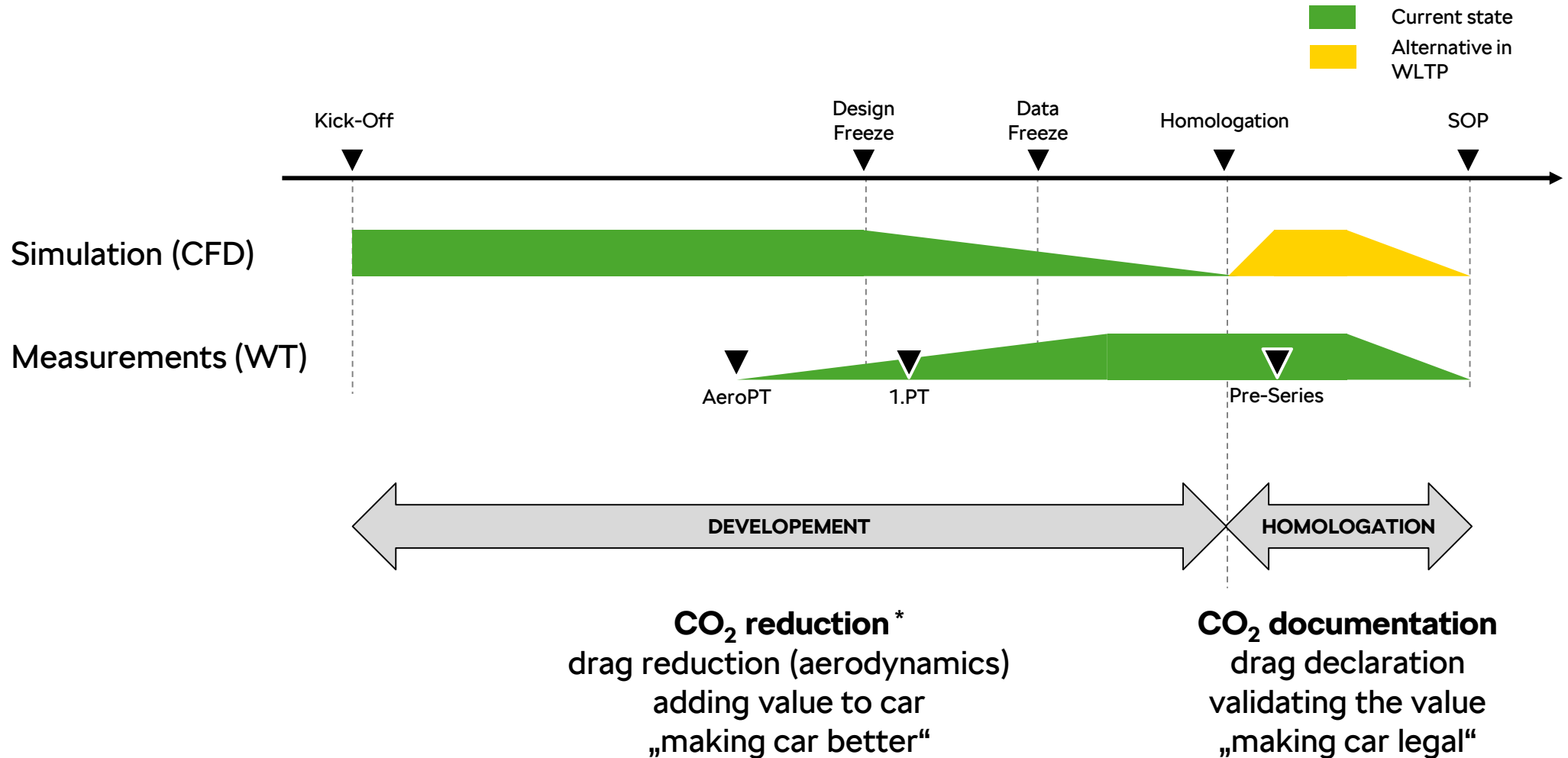
Mudflaps





# CFD in Aerodynamics at ŠKODA AUTO

## Development timeline and aerodynamics

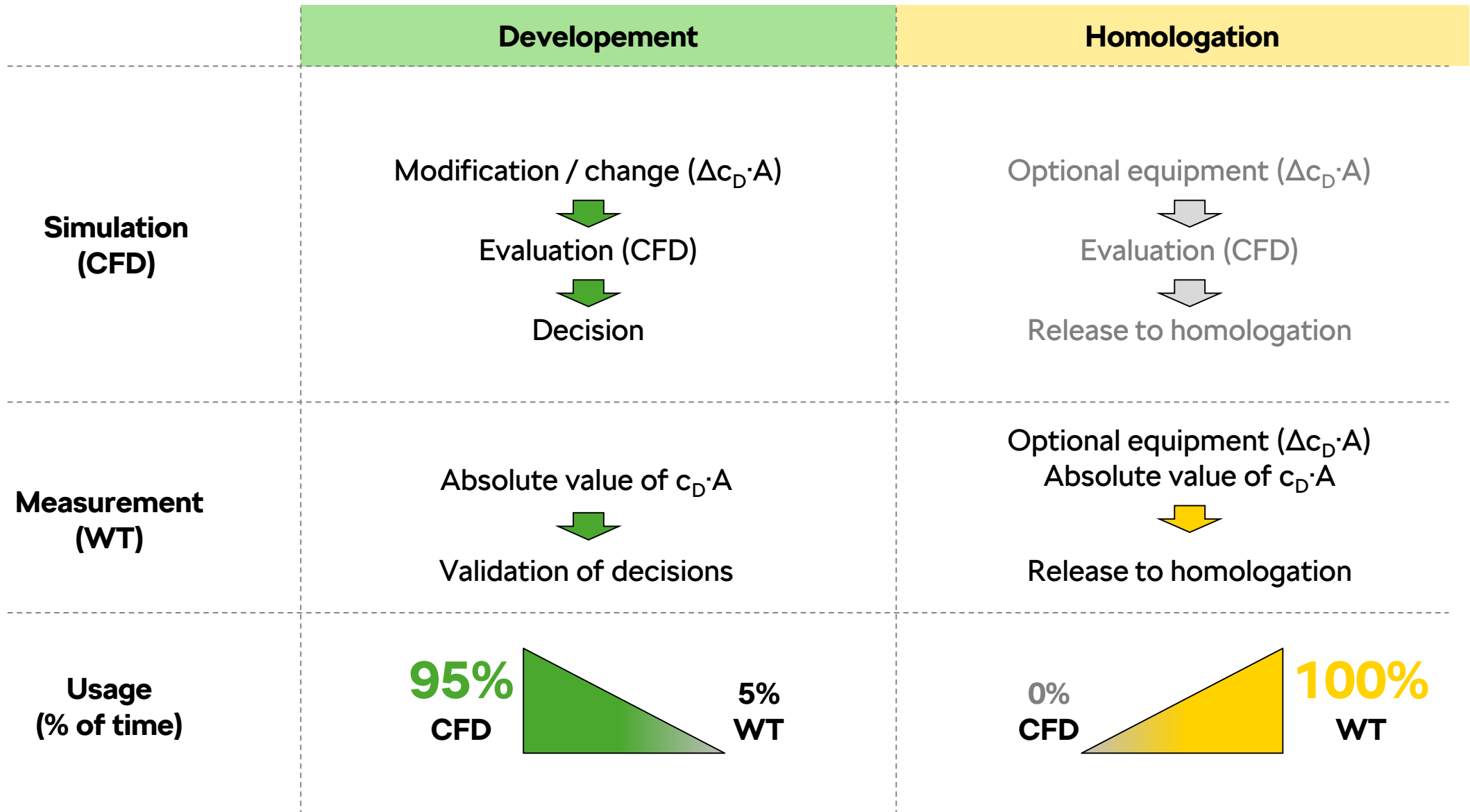


\* Other project targets not relevant for WLTP are not mentioned (driving stability, cooling, etc.)



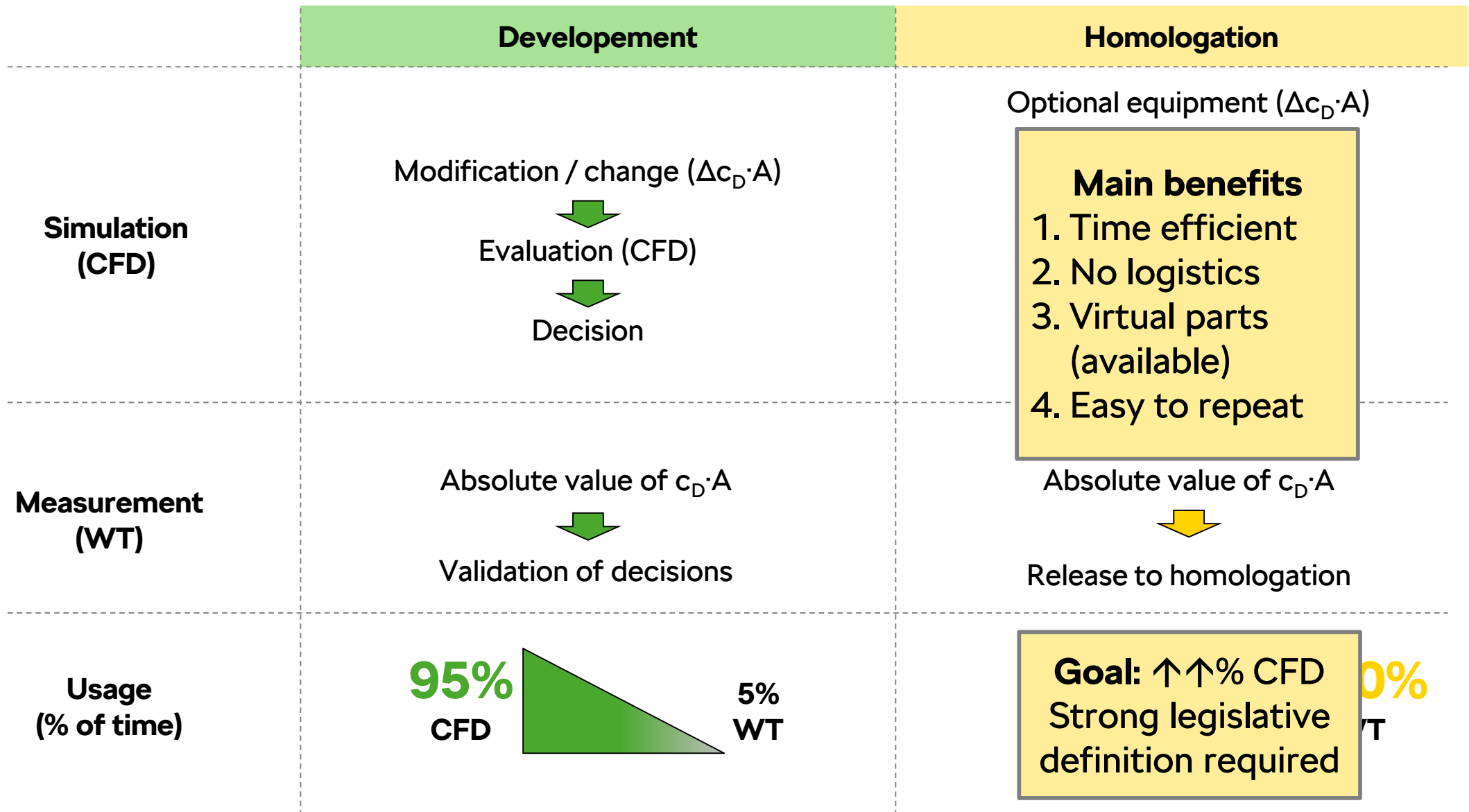
# CFD in Aerodynamics at ŠKODA AUTO

## Development and homologation



# CFD in Aerodynamics at ŠKODA AUTO

## Development and homologation





# CFD in Aerodynamics at ŠKODA AUTO

## Current legislative definition

### Sub-Anex 7, ch. 3.2.3.2.2.3.

- (a) The alternative determination method shall fulfil an accuracy for  $\Delta(C_D \times A_f)$  of  $\pm 0,015 \text{ m}^2$  and additionally, in the case that simulation is used, the Computational Fluid Dynamics method should be validated in detail, so that the actual air flow patterns around the body, including magnitudes of flow velocities, forces, or pressures, are shown to match the validation test results;
- (b) The alternative method shall be used only for those aerodynamic-influencing parts (e.g. wheels, body shapes, cooling system) for which equivalency was demonstrated;
- (c) Evidence of equivalency shall be shown in advance to the approval authority for each road load family in the case that a mathematical method is used or every four years in the case that a measurement method is used, and in any case shall be based on wind tunnel measurements fulfilling the criteria of this Annex;
- (d) If the  $\Delta(C_D \times A_f)$  of an option is more than double than that with the option for which the evidence was given, aerodynamic drag shall not be determined with the alternative method; and
- (e) In the case that a simulation model is changed, a revalidation shall be necessary.  $\Delta(C_D \times A_f)_{LH}$  is the difference in the product of the aerodynamic drag coefficient times frontal area of test vehicle H compared to test vehicle L and shall be included in all relevant test reports,  $\text{m}^2$ .



Model Octavia has cca. 17 road-load families



17x evidence of equality (measurement vs. simulation) in order to certify CFD for Octavia



Not enough WT time  
Not efficient process

### CFD WLTP Paradox

By definition, use of CFD simulation in WLTP increases demand for Wind-Tunnel measurements and physical testing

