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EU Real Driving Emissions Regulation
Analysis of PEMS data: EU-EMROAD Tool

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European Commission

Outline

- **EMROAD – Introduction and short History**

- **Main principles and features**

- **EU Regulatory calculations**

- **Useful features for the RDE IWG**

Introduction

- **EMROAD is a Microsoft Excel add-in for analysing vehicle emissions data recorded with Portable Emissions Measurement Systems (PEMS). In the frame of the European legislative PEMS programs for heavy-duty vehicles (HDV), non-road mobile machinery (NRMM), and light-duty vehicles (LDV), EMROAD was developed as a research tool, primarily used to support the development of PEMS data evaluation methods for emissions legislation.**

- **EMROAD was updated by the JRC to fulfil:**
  - **For light-duty vehicles, the applicable methods and requirements are laid down in Regulations 2016/427 and amendments (2016/646, 2017/1147 and 2018/1832).**
  - **For heavy-duty vehicles, the applicable methods and requirements are laid down in Regulations 582/2011 and amendments.**
  - **For non-road mobile machinery, the applicable methods and requirements are laid down in Regulations 2017/655.**
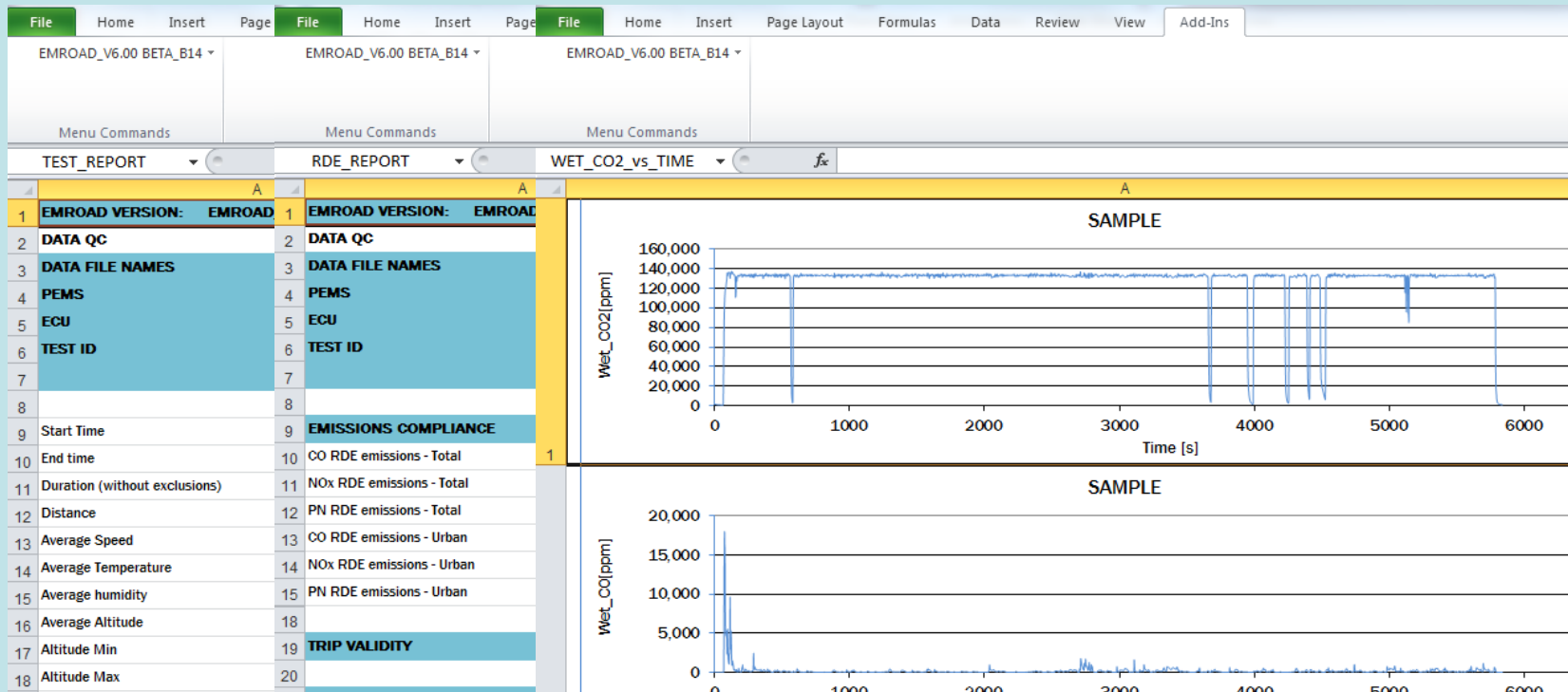
Short History

- **2005-2009 [Versions 1 to 3]: Support to PEMS legislative developments for PEMS heavy-duty engines In-Service Conformity**

- **2009-2011 [Versions 4 & 5] : Added support to PEMS legislative developments for NRMM engines In-Service Monitoring**

- **2012-2018 [Versions 5.6 to 5.96]: Added support to PEMS legislative developments for Light-Duty Vehicles Real Driving Emissions (RDE)**

- **2019+ [Version 6 <u>BETA</u>]: Reference calculation tool for HDV, NRMM and LDV EU PEMS based regulations.**

- **Adding golden data files to benchmark other calculations tools**

- **Added support of official RDE data exchange files (EXF) containing vehicle info and analyzers verification data**

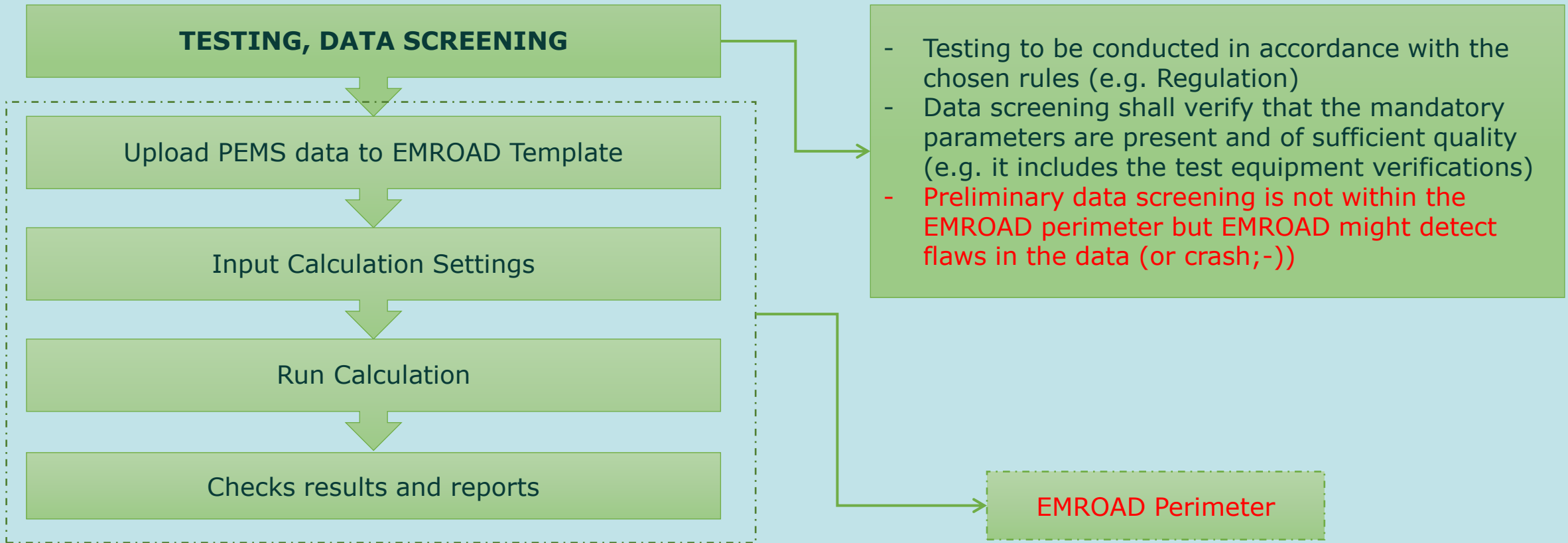European
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Main principles

- **EMROAD is a Microsoft Excel add-in, importing and processing PEMS data in a pre-defined template**

- **EMROAD PEMS data files generated by the main PEMS instruments on the market (AVL, HORIBA, SENSORS) and Exchange Files (EXF, as soon as available from instrument providers)**

- **EMROAD uses the reference units set by the EU Regulations**

- **EMROAD is able to conduct:**
  - **Regulatory calculations (Calculation settings according to the chose Regulation)**
  - **Advanced calculations (Advanced users, step-by-step functions, not supported)**
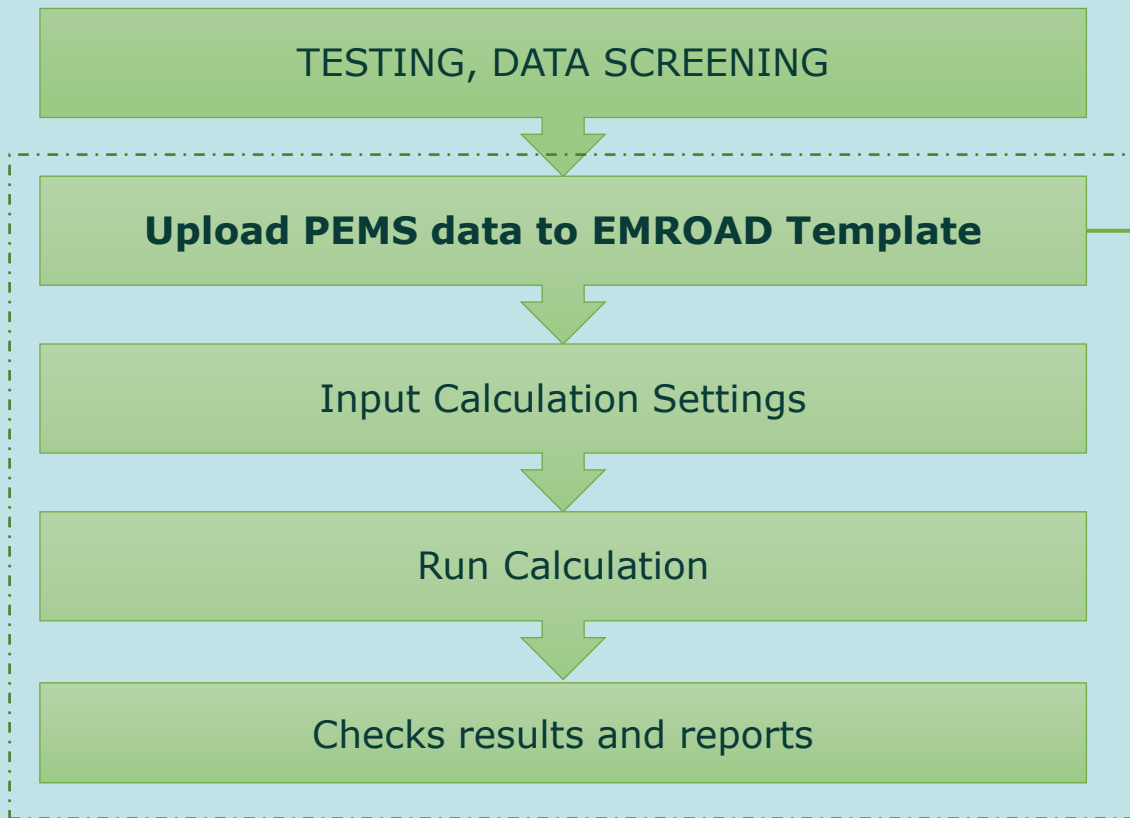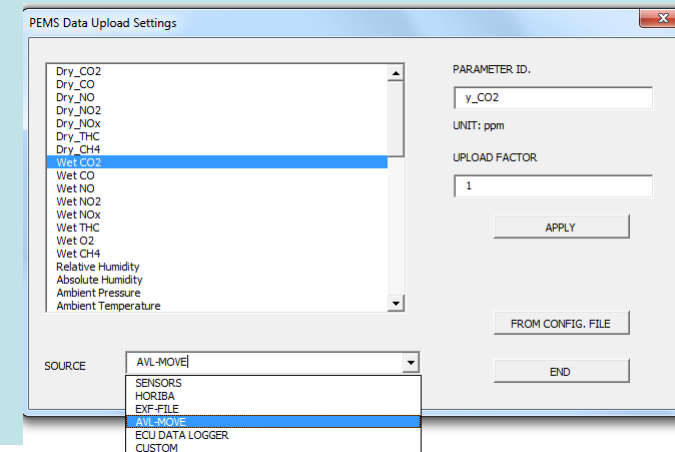
Main principles

- **EMROAD Template**

Main principles - Sequence

TESTING, DATA SCREENING

Upload PEMS data to EMROAD Template

Input Calculation Settings

Run Calculation

Checks results and reports

- Testing to be conducted in accordance with the chosen rules (e.g. Regulation)
- Data screening shall verify that the mandatory parameters are present and of sufficient quality (e.g. it includes the test equipment verifications)
- Preliminary data screening is not within the EMROAD perimeter but EMROAD might detect flaws in the data (or crash;-))

EMROAD Perimeter

European Commission

Main principles - Sequence

TESTING, DATA SCREENING

Upload PEMS data to EMROAD Template

Input Calculation Settings

Run Calculation

Checks results and reports

- All types of PEMS instruments data files, or custom
- EU data exchange files (EXF) also containing analyzers checks and vehicle information according to EU-RDE requirements
- Custom Upload Settings
- Uploads the data to the TEST DATA worksheets and converts the data to the EU reference units

Main principles - Sequence

TESTING, DATA SCREENING

Upload PEMS data to EMROAD Template

Input Calculation Settings

Run Calculation

Checks results and reports

- EU-Regulatory (LDV, HDV, NRMM) with simplified interfaces
- Non-regulatory calculations (advanced, not supported)
- Possibility to run step-by-step (advanced, not supported)

EU-RDE-LDV Settings interface

RDE LDV - SIMPLIFIED CALCULATION SETTINGS

Data Source	AVL-MOVE
Vehicle Type	LIGHT-DUTY VEHICLE - M1-N1 CLASS 1
Fuel Type	DIESEL (B7)
Emissions Limits	LDV EURO 6 - M1 - N1 CLASS 1 - COMP. IGNITION
Exhaust Flow	EXHAUST FLOW METER
Distance	GPS

Vehicle Conditionning
- Cold
- Hot

Start Altitude
- GPS
- Manual [m]

Moving Averaging Window - Reference Quantity & WLTC Reference CO2 Values [g/km]

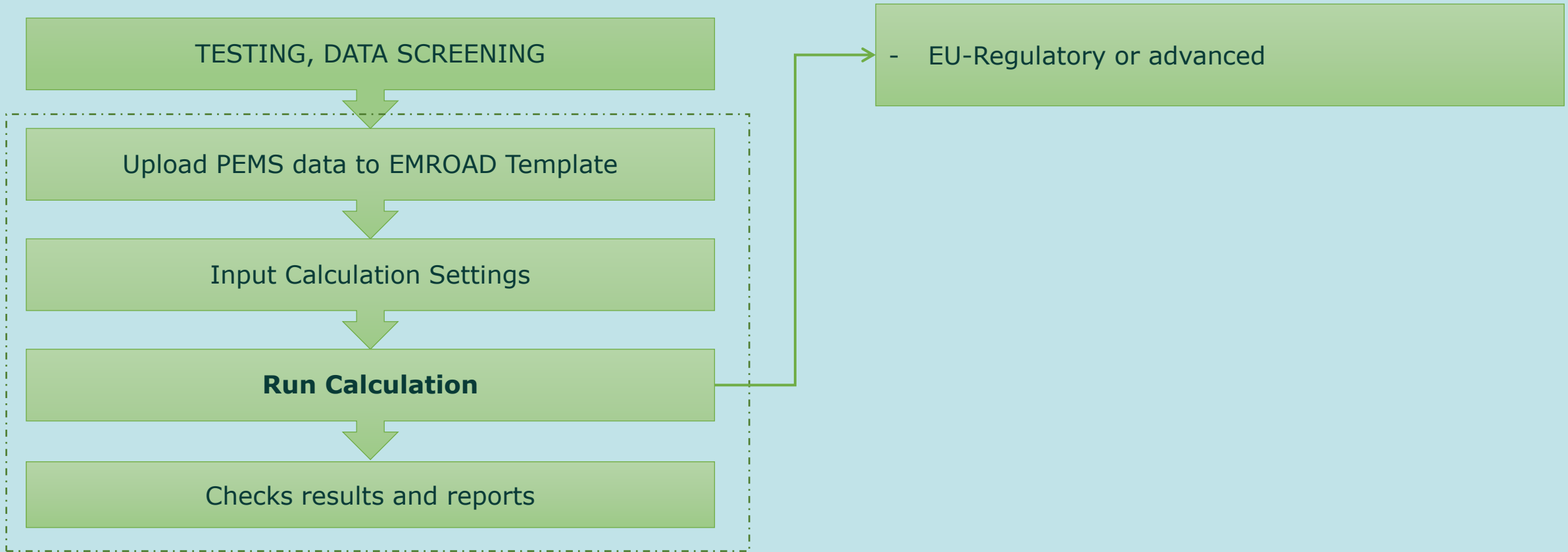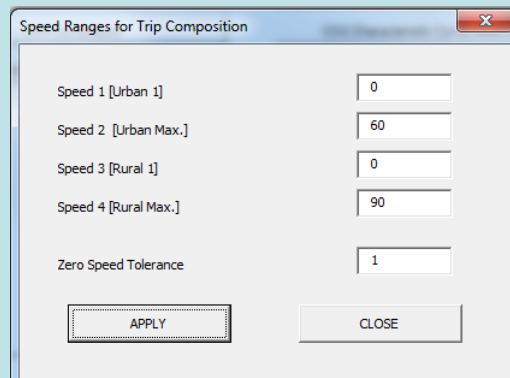|			
Reference CO2 Mass (WLTP/2) [kg]	1.474		
WLTP [g/km]	126.714	[OVC- HEV] WLTP Charge Sustaining	
Low Speed Phase [g/km]	152.893	High Speed Phase [g/km]	118.370
Medium Speed Phase [g/km]	111.963	Extra High Speed Phase [g/km]	135.040

Euro 6 - RDE Stage
- Type Approval after 1/1/2020
- RDE3 [JRC]

INFO
In this simplified interface, only test and vehicle specific parameters may be input - The parameters specific to the RDE evaluation are set as default values. (e.g. Speed binning of windows, CO2 characteristic curve, Trip...)

ADVANCED...   APPLY   CLOSE

Main principles - Sequence

TESTING, DATA SCREENING

- EU-Regulatory or advanced

Upload PEMS data to EMROAD Template

Input Calculation Settings

Run Calculation

Checks results and reports

Main principles - Sequence

TESTING, DATA SCREENING

Upload PEMS data to EMROAD Template

Input Calculation Settings

Run Calculation

Checks results and reports

- Instantaneous emissions and MAW results in CALCULATED data
- Integrated and average values (no regulatory processing)
- EU-Regulatory (RDE REPORT for LDV, PASS-FAIL REPORT FOR HDV and NRMM): **verification of emissions and all parameters for test validity**
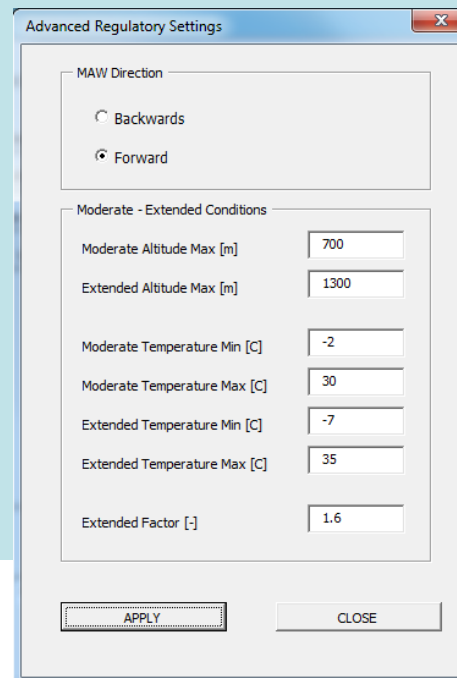
Example: EU-RDE-LDV Report

Application to RDE-IWG

- **Possibility to input regional settings**
  - **Speed binning values defining the speed based conditions (e.g. low, high speed)**
  - **MAW Speed binning values**
  - **Altitude and temperature values for moderate and extended conditions**
  - **Shape of the CO2 characteristic curve for MAW calculations**
  - **Conformity factors**

Speed Ranges for Trip Composition

Speed 1 [Urban 1]	0
Speed 2 [Urban Max.]	60
Speed 3 [Rural 1]	0
Speed 4 [Rural Max.]	90
Zero Speed Tolerance	1

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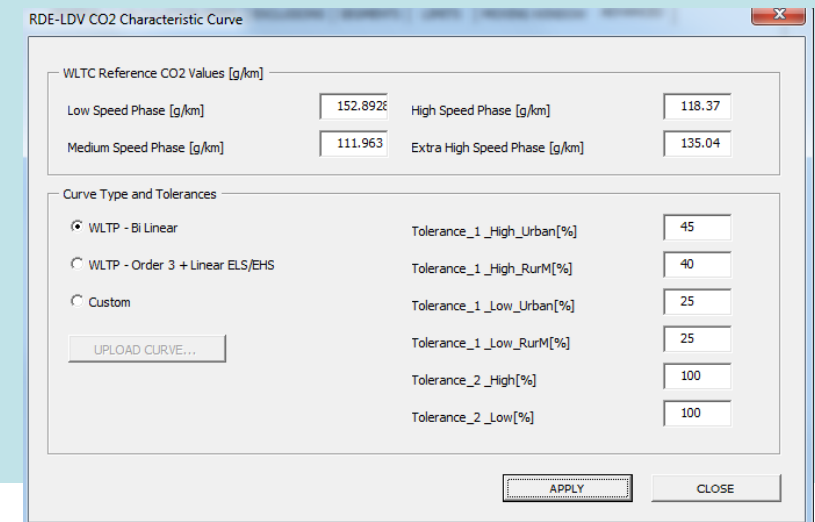
Advanced Regulatory Settings

MAW Direction
- Backwards
- Forward

Moderate - Extended Conditions

Moderate Altitude Max [m]	700
Extended Altitude Max [m]	1300
Moderate Temperature Min [C]	-2
Moderate Temperature Max [C]	30
Extended Temperature Min [C]	-7
Extended Temperature Max [C]	35
Extended Factor [-]	1.6

APPLY   CLOSE

RDE-LDV CO2 Characteristic Curve

WLTC Reference CO2 Values [g/km]

Low Speed Phase [g/km]	152.8928	High Speed Phase [g/km]	118.37
Medium Speed Phase [g/km]	111.963	Extra High Speed Phase [g/km]	135.04

Curve Type and Tolerances
- WLTP - Bi Linear
- WLTP - Order 3 + Linear ELS/EHS
- Custom

UPLOAD CURVE...

Tolerance_1 _High_Urban[%]	45
Tolerance_1 _High_RurM[%]	40
Tolerance_1 _Low_Urban[%]	25
Tolerance_1 _Low_RurM[%]	25
Tolerance_2 _High[%]	100
Tolerance_2 _Low[%]	100

APPLY   CLOSE

RDE-IWG

- **RDE specific values might be reported upon request in the RDE REPORT worksheet**

- **Current version: 6, open for BETA testers and EU Regulatory calculations**

- **The tool is available in the CIRCABC group "New light duty test procedures: WLTP, MAC, ...", in the section "RDE-LDV Reference documents and tools".**

- **Access to this section is open to all and does not require any registration or membership:** https://circabc.europa.eu/w/browse/79a4a9b6-4003-4e02-956d-048dcef1a169

- **Release of functions useful for the RDE IWG in May**