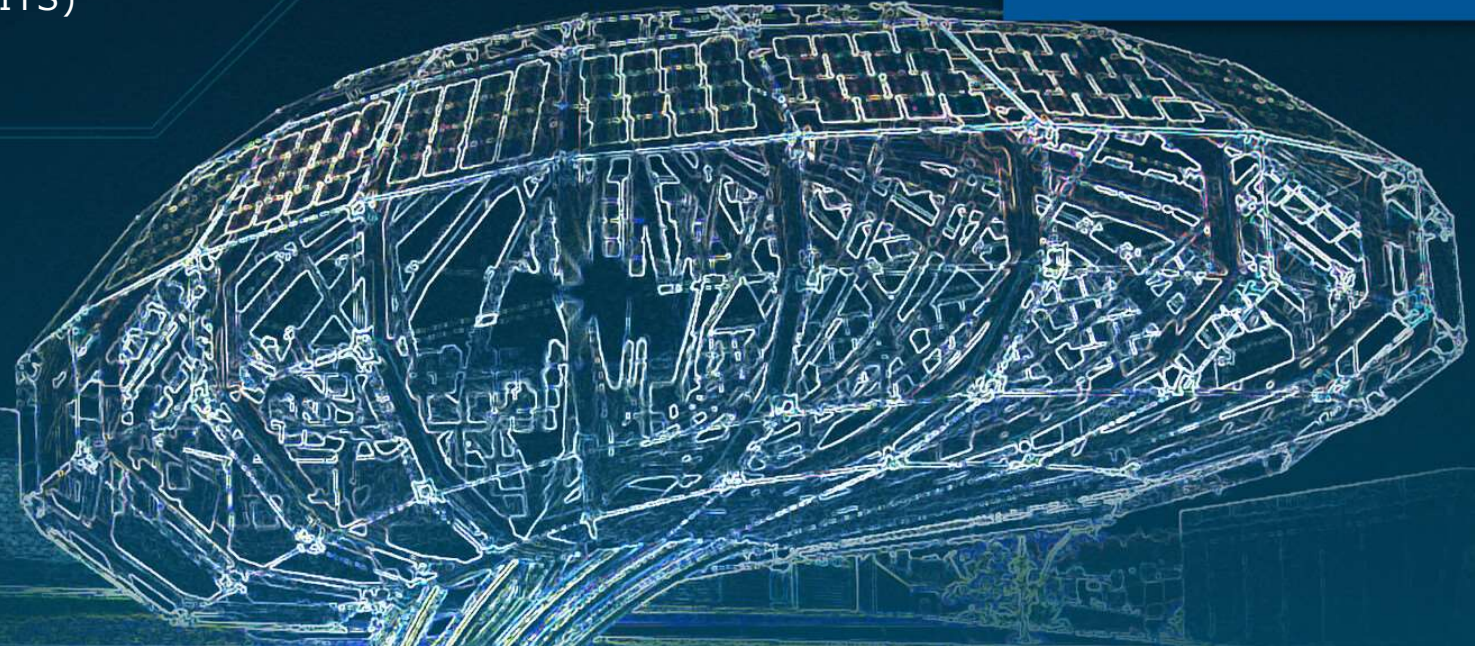




AVL United Kingdom Ltd. (ITS)



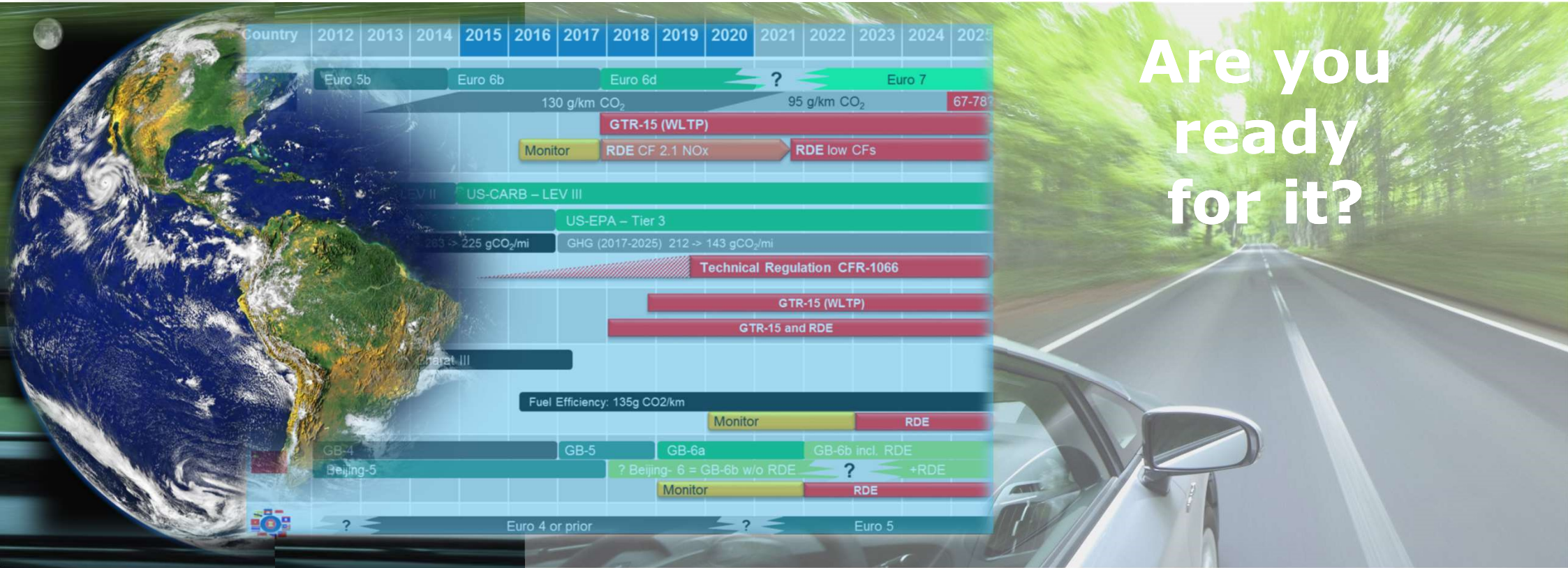
Complete RDE Toolchain

UNICEG 2019

Salman Safdar

Public

Regulations drive development



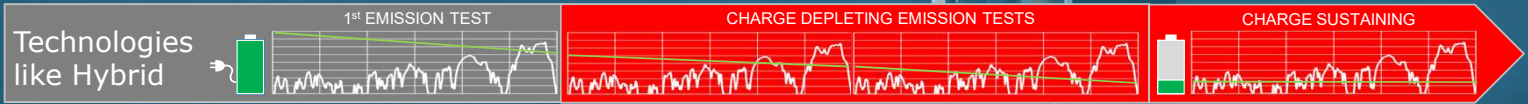
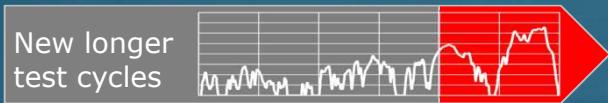
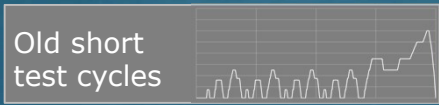
Are you ready for it?



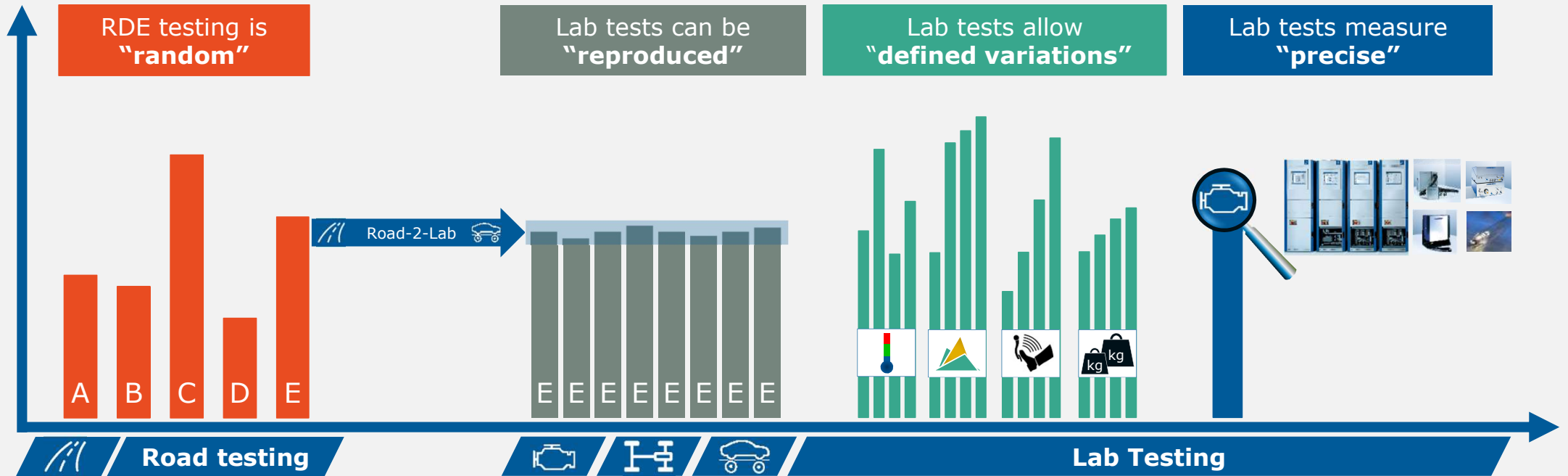
DEVELOPMENT Drives testing



Much more to do!



RDE Type Approval on the Road - R&D in the Lab

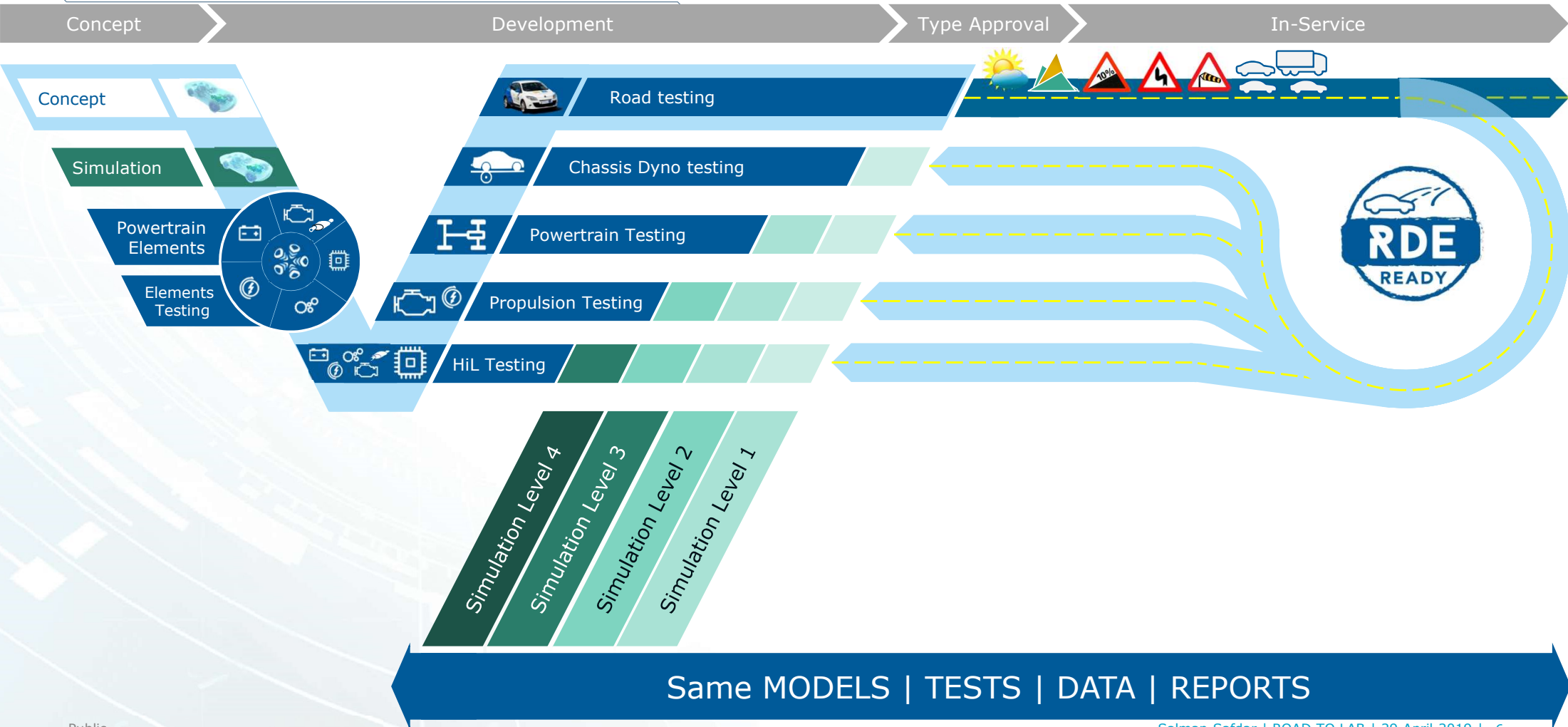


RDE Development Challenge



“Shifting RDE development tasks from road to testbeds is a necessity, not just an option.”

Powertrain Development Process



Road 2 Lab: Why?

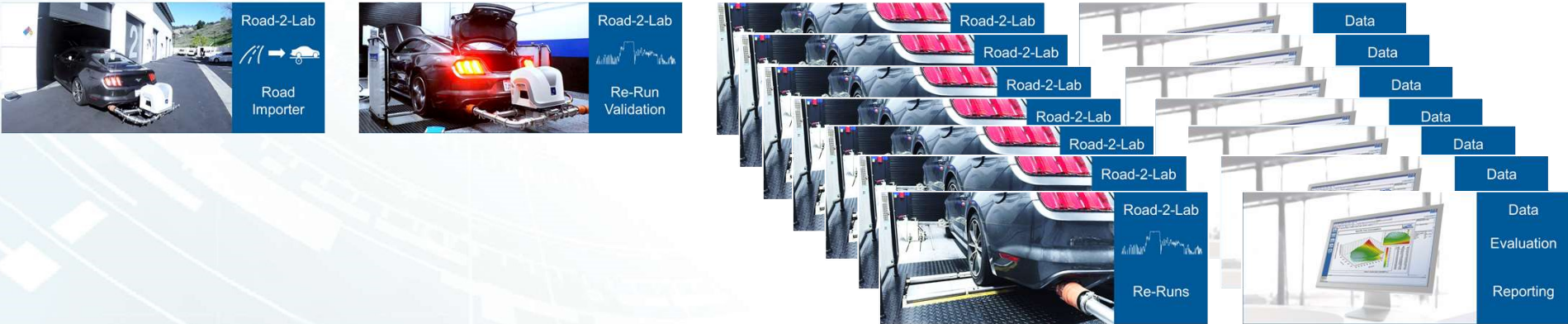


AVL – RDE Workflow - Tasks

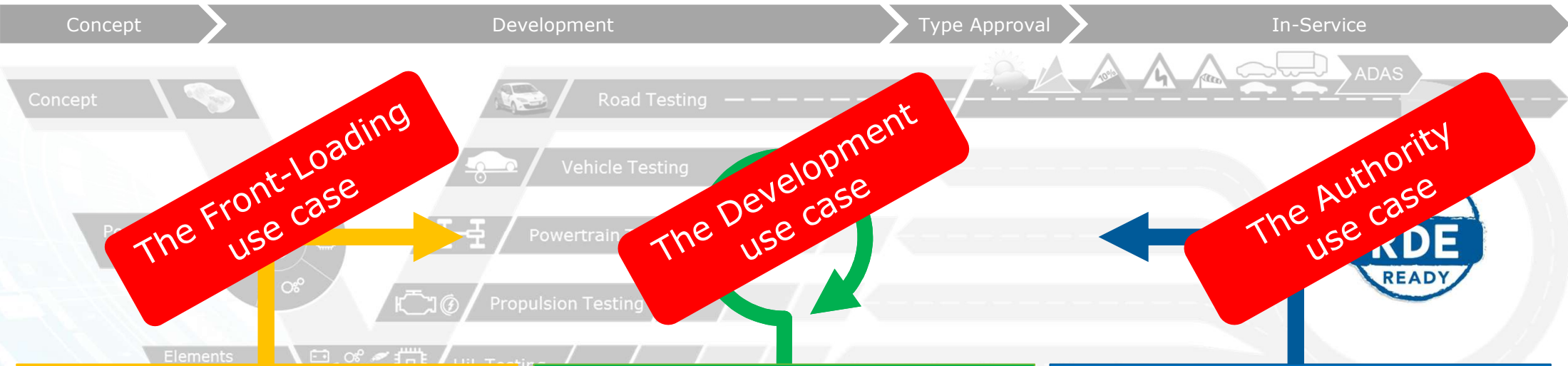
Typical tasks of an Real Driving Emission test:



Typical tasks of RDE Development on chassis dyno testbeds:



RDE Use Cases



Use Case 3: Virtual Development

- 100% Software simulation
- HiL Testing and ECU Front Loading
- Combinations of Simulation and testbeds

Use Case 2: "Conventional Drive Cycles"

- Standard- or OEM specific Drive Cycles
- Random Drive Cycles
- Re-Run of road testing

Use Case 1: Reproduction

- Re-production of a road test

What	Variations of all properties
How	Traffic simulation
Why	Concepts and Front loading

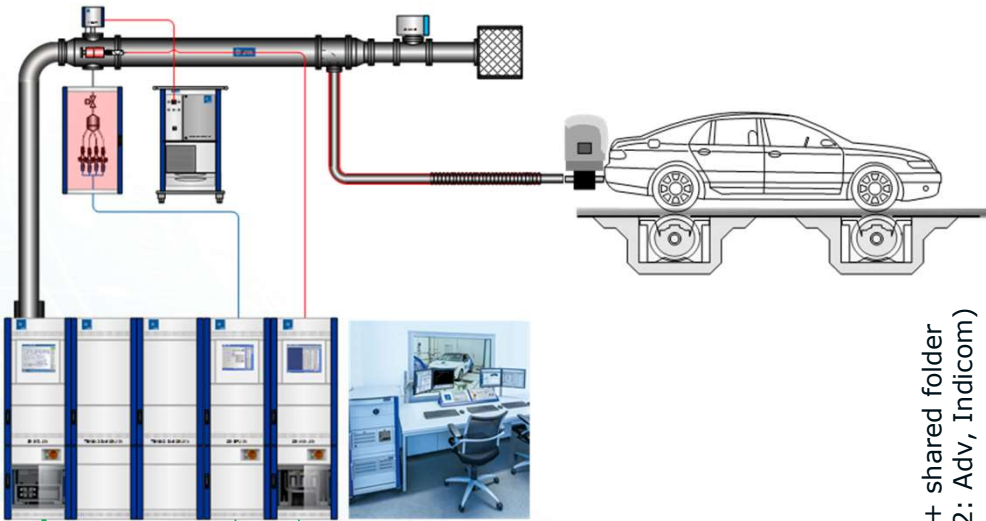
What	Variation of vehicle and some boundary conditions
How	Vehicle speed over time
Why	Conventional Development

What	one individual road test is re-produced for the identical vehicle
How	Engine "a" replay and vehicle speed
Why	Root cause analysis

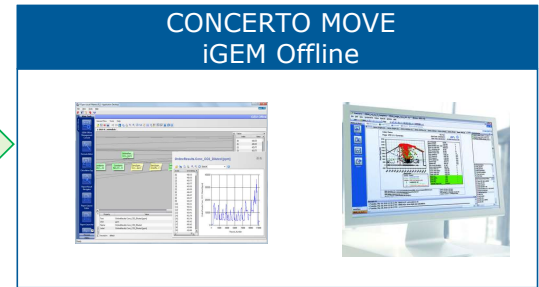
Correlation Test



AMA + PSS + APC + CVS Automation **PEMS** Chassis Dyno MOVE System Control Server Office PC



DCOM + shared folder
(iGEM 2: Adv, Indicom)



CD BagResults
CD Reports
MOVE correlation report

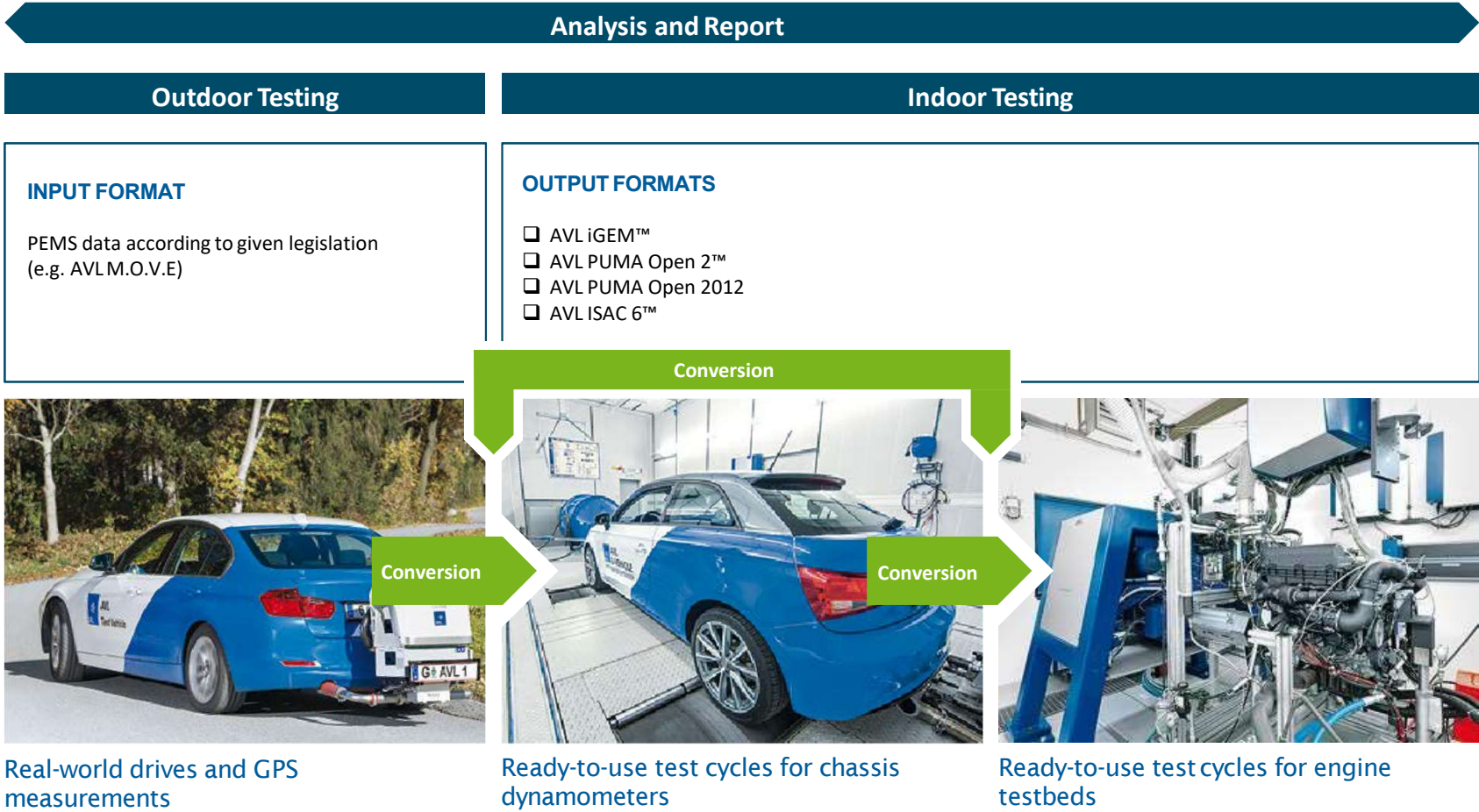


AVL Road-2-Lab

Efficient Testing & Development for RDE

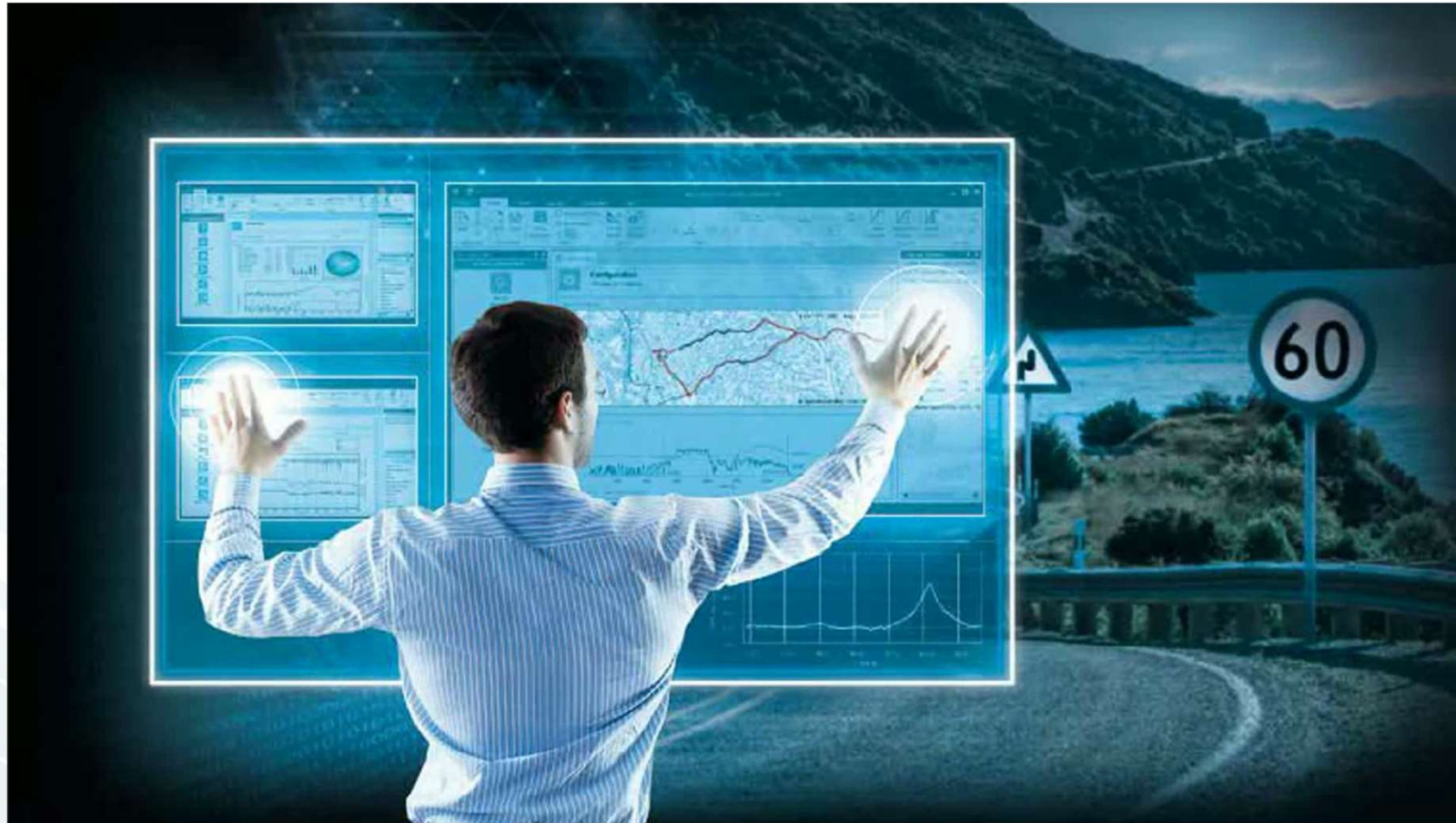
The solution

DATA CONVERSION PROCESS VIA ROAD CONVERTER (1/2)





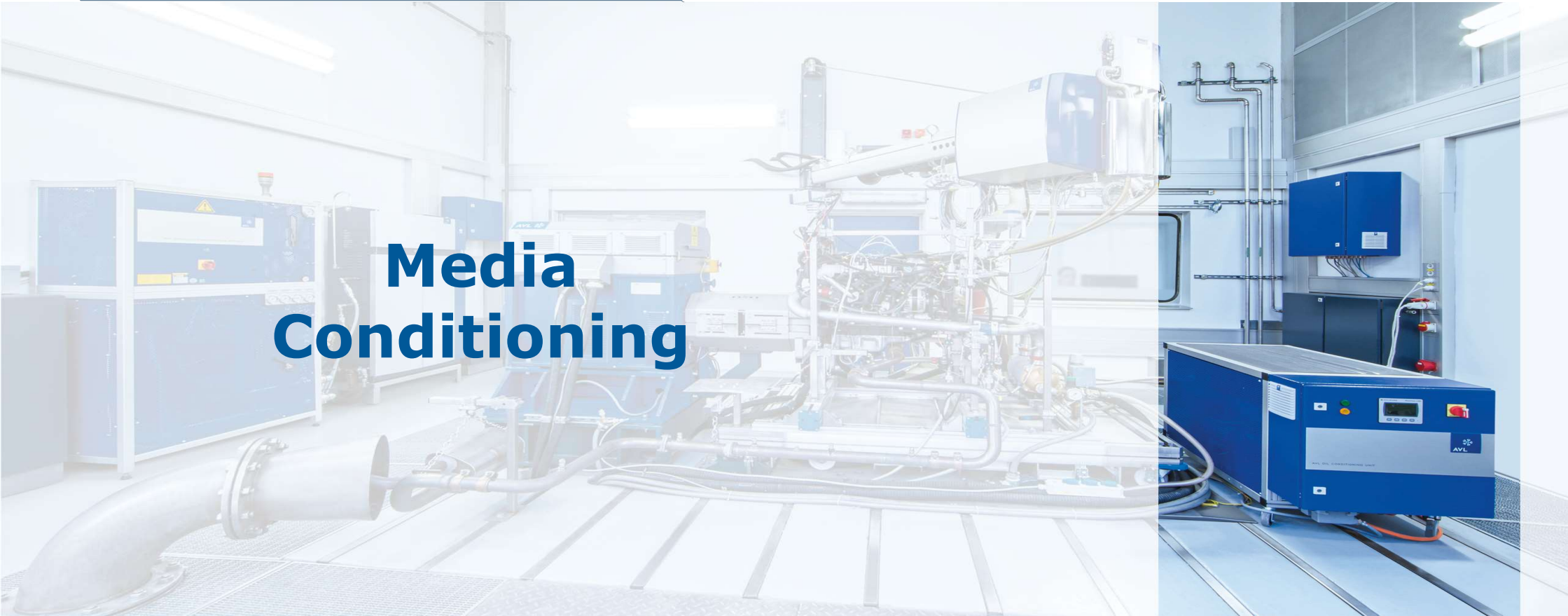
AVL CONCERTO 5™ - Road Converter Toolbox





RDE Engine Testbed

Media Conditioning





RDE Engine Testbed

**ALTITUDE
SIMULATION**



COOLANT



OIL



**AIR
CONDITIONING
SYSTEM**



BOOST AIR



**Conditioning
Portfolio**



RDE Engine Testbed

Ambient & Altitude Simulation

FULL ALTITUDE TESTCELL



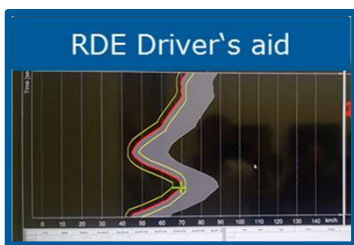
AVL COMPACT ALTITUDE SIMULATION





AVL Solution: Emission Chassis Dyno

special RDE Driver's aid



Road load simulation (RDE additions):

- Road gradient (maybe curve)
- Wind / Temperature / Pressure

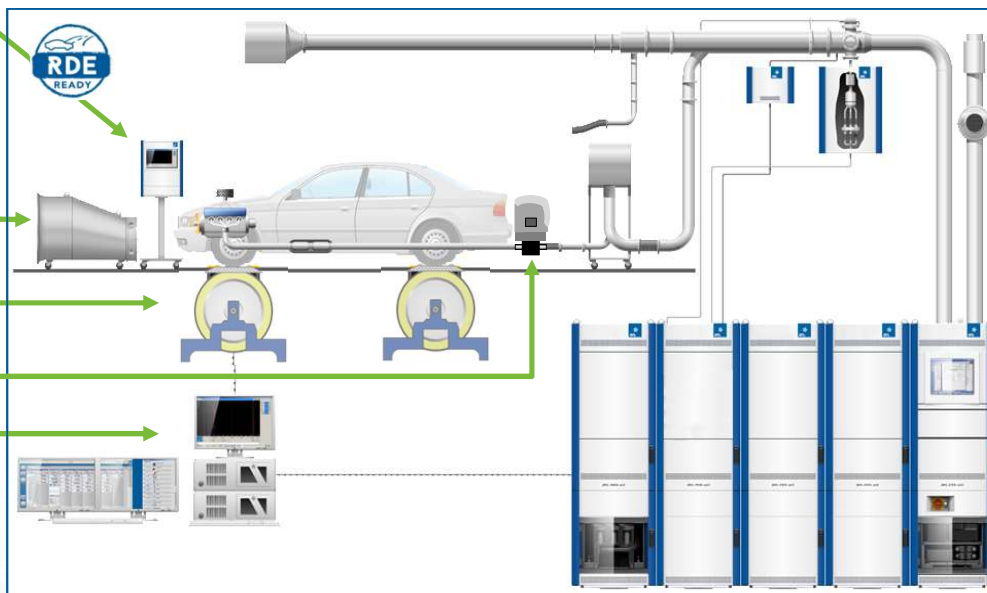
160 km/h cooling fan

2 axis Chassis Dyno

Restraints system & PEMS

Automation RDE add-ons:

- advanced simulation
- PEMS Integration
- PEMS Validation report
- Road-2-Lab Converter
- RDE Test report



Conditioning:

- Temperature and humidity
- Altitude (€€€)

Emission & Energy testing:

- CVS, AMA, PTS, APC, ...
- Raw modal emissions
 - Pre-/Post-Cat all gaseous
 - Pre-/Post-DPF EC (Soot), PN
 - Pre-/Post-GPF EC (Soot), PN
 - Pre-/Post-SCR NO, NO₂, NH₃
- Hybrid, BEV, FC
 - Power analyzers
 - H₂ consumption for fuel cell
- Tailpipe pressure control
 - If IC engine is not running (Start/Stop, Hybrid)
 - Low pressure EGR, especially for gasoline
 - Raw modal analysis with dilution air flow meter



AVL Solution: Vehicle Powertrain Testbed

High dynamic Dynos

- Advanced wheel dynos
- Advanced dyno control

Vehicle road load simulation:

- Fully Open RT Simulation Integration via AVL Model.Connect™
 - AVL Cruise, AVL FIRE, AVL VSM, CarMaker, CarSim, Dymola, OpenModelica, SIMPACK, LabView, MathLab, Customer DLL, ...



Automation RDE add-ons:

- advanced simulation
- Road-2-Lab Converter
- RDE Test report



Conditioning:

- Air temperature and humidity
- Coolant, Oil, Boost Air
- Fast cool down
- Altitude Simulation (€€€)

Emission & Energy testing:

- CVS, AMA, APC, ...
 - Typically same configuration as on Chassis Dyno.
 - Tailpipe pressure control
- Raw modal emissions
 - Pre-/Post-Cat all gaseous
 - Pre-/Post-DPF EC (Soot), PN
 - Pre-/Post-GPF EC (Soot), PN
 - Pre-/Post-SCR NO, NO2, NH3
- Hybrid, BEV, FC
 - Power analyzers
 - Battery Simulator



AVL Solution: Engine / Powertrain Testbed

High dynamic Dyno

- AC Synchronous PMM with Ultra Low Inertia
- 10kHz Fast Controller Platform and interfaces



Testbed Clutch

Automation RDE add-ons:

- advanced simulation
- Road-2-Lab Converter
- RDE Test report



Vehicle road load simulation:

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 - AVL Cruise, AVL FIRE, AVL VSM, CarMaker, CarSim, Dymola, OpenModelica, SIMPACK, LabView, MathLab, Customer DLL, ...



Conditioning:

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Emission & Energy testing:

- Raw modal emissions
 - Pre-/Post-Cat all gaseous
 - Pre-/Post-DPF EC (Soot), PN
 - Pre-/Post-GPF EC (Soot), PN
 - Pre-/Post-SCR NO, NO2, NH3
- Maybe also CVS, ...
There is more and more requests
- Hybrid, BEV, FC
 - Power analyzers
 - Battery Simulator





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