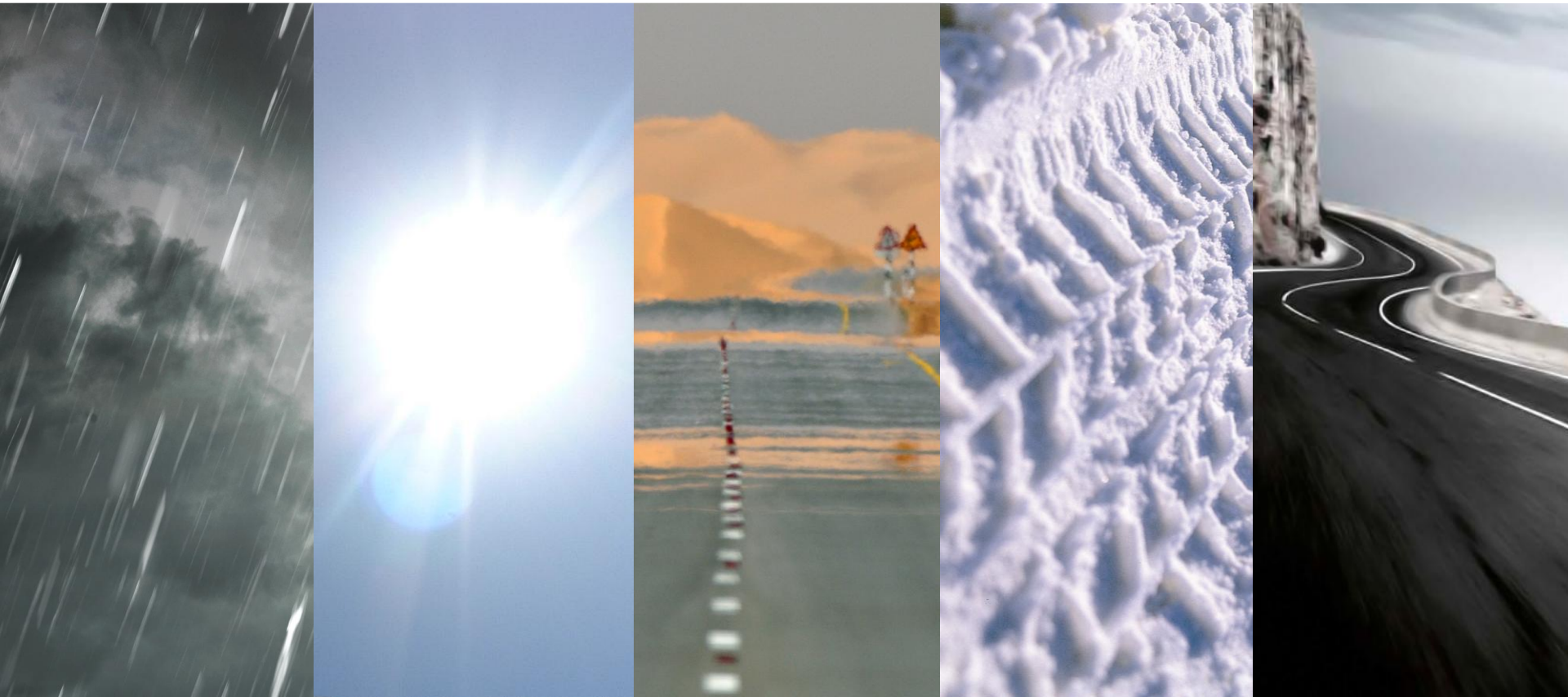
Innovation Days Efficient Dynamics.
Energy and Environmental Test Centre.

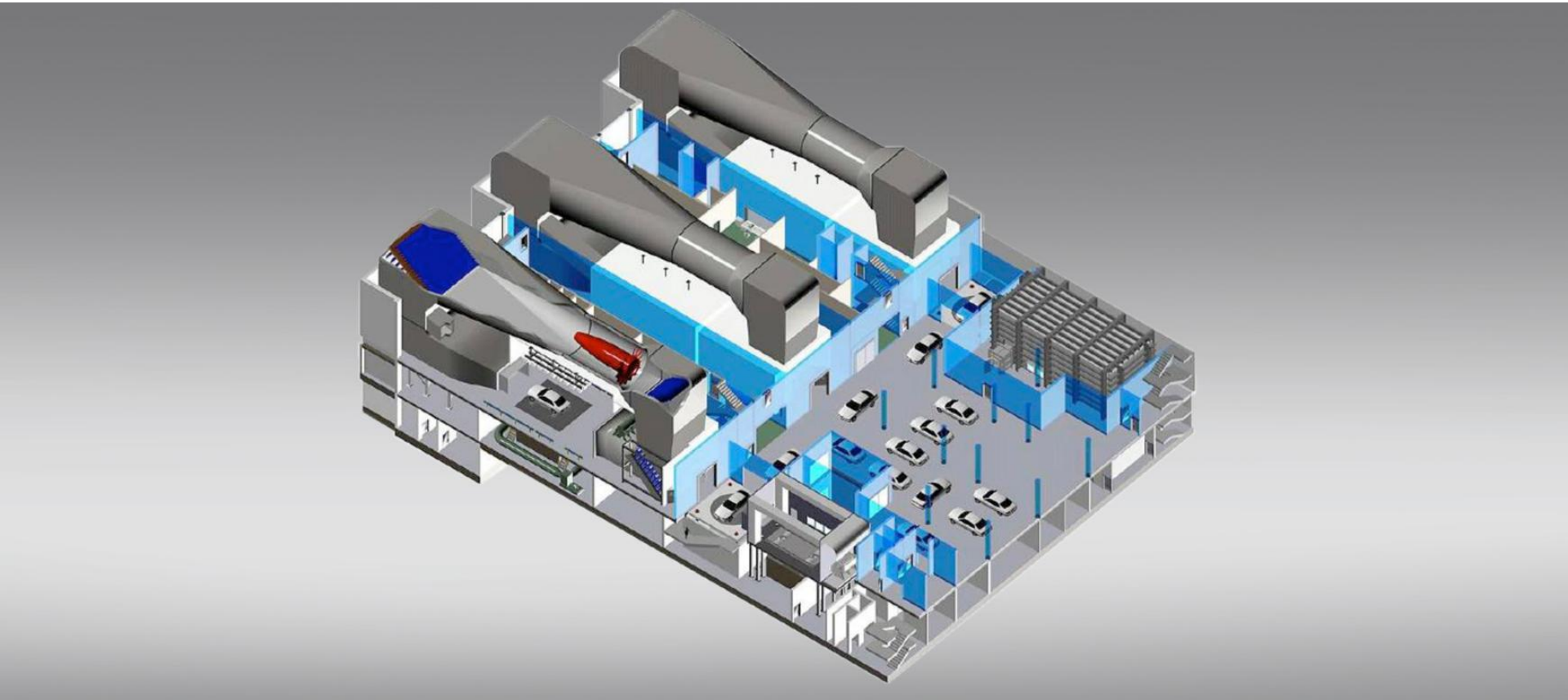
BMW Group

Energy and Environmental Test Centre (ETC).

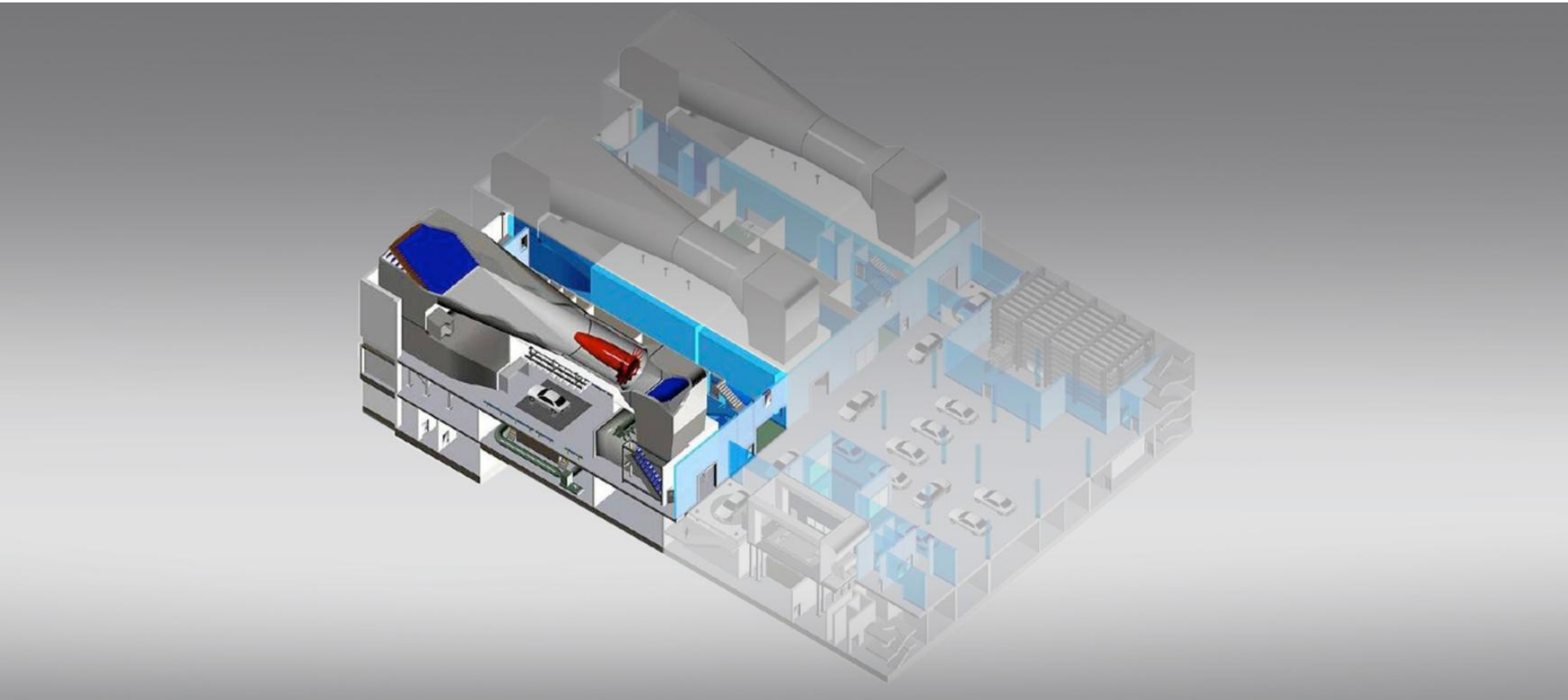
Workshop: Environmental Wind Tunnel.



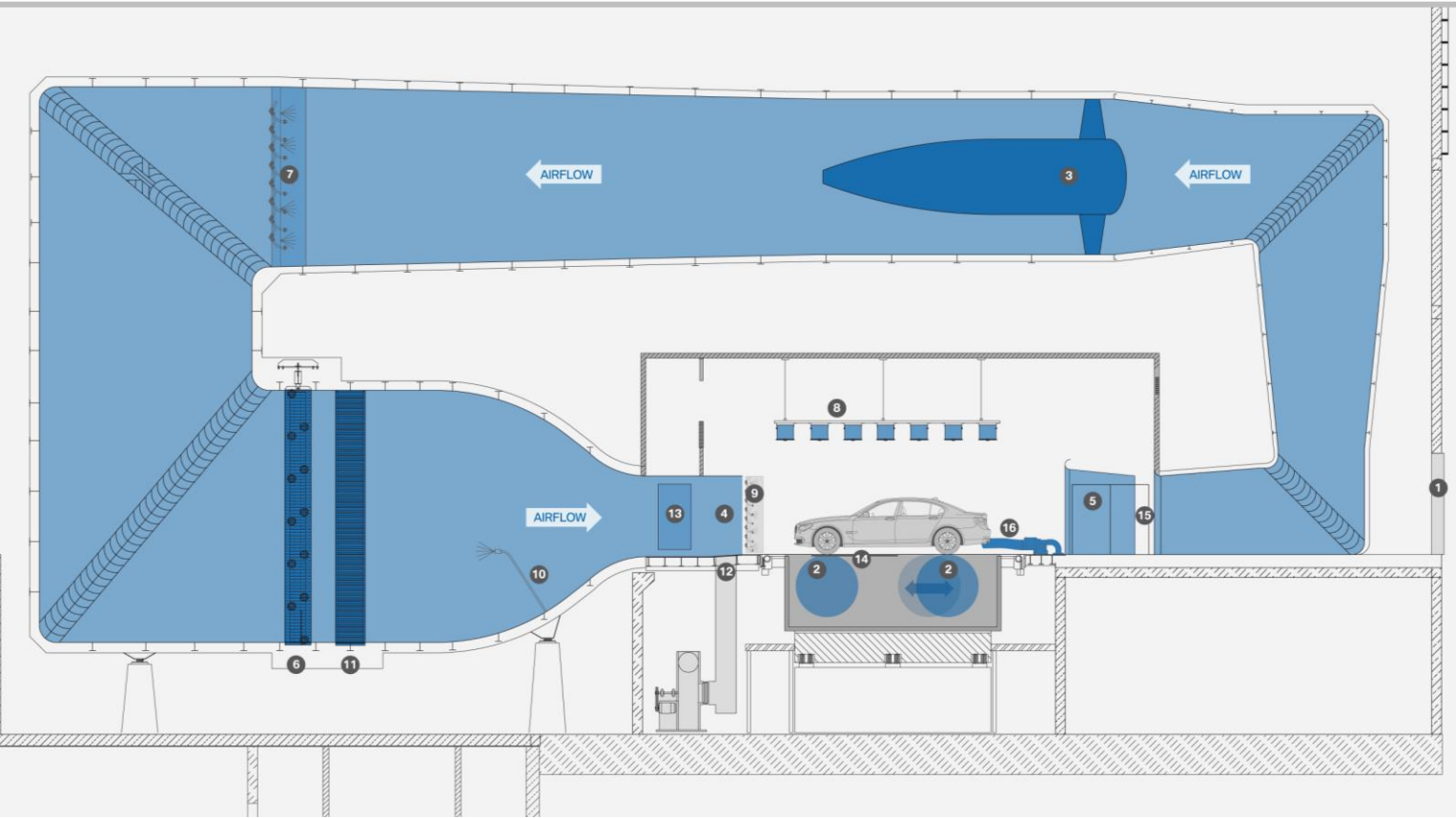
Energy and Environmental Test Centre (ETC).
Environmental Wind Tunnel.



Energy and Environmental Test Centre (ETC).
Environmental Wind Tunnel.



Energy and Environmental Test Centre (ETC).
Environmental Wind Tunnel.



Environmental wind tunnel
Umweltwindkanal

1. Access for vehicle / Einbringung Fahrzeug
2. Roller dynamometer / Rollenantrieb
3. Fan / Gebläse
4. Nozzle / Düse
5. Collector / Kollektor
6. Heat exchanger / Wärmetauscher
7. Humidity regulation / Feuchteregulierung
8. Solar simulation / Sonnensimulation
9. Rain rig / Regensimulation
10. Snow gun / Schneelanze
11. Flow straightener / Strömungsgleichrichter
12. Boundary layer suction / Grenzschichtabsaugung
13. Idle city flaps / Idle City Klappen
14. Flatbelt for motorbikes / Flachband für Motorräder
15. Fuel station / Betankungsstation
16. Exhaust extraction / Abgasabsaugung

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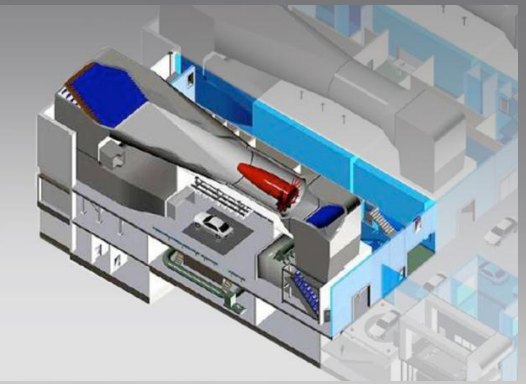
Environmental Wind Tunnel: specifications.



- Plenum: 14 m x 10 m
- Temperature range: -20 to +55°C
- Relative humidity controllable in the range 5-90%, from +5°C
- Four-wheel dynamometer with max. power 750 kW
- Max. wind speed: 250 km/h
- Nozzle: W x H 3.5 m x 2.4 m = 8 sq.m.
- Fan diameter: 4750 mm
  Max. rpm: 518 rpm | max. power: 2060 kW
- Solarium: 400 to 1200 W/m2
- Moving belt: L x W 2.7 m x 0.55 m
- Rain simulation at speeds up to 250 km/h
- Snow simulation at up to 160 km/h

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Range of tests performed in Environmental Wind Tunnel.

Thermal reliability

– Components/ structure
– Cooling performance
– Powertrain
– Brake cooling
– ECU functionality

Operational and functional performance testing under a variety of environmental conditions

– Altitude simulation
– Water management
– Battery charging performance
– Snow simulation
– Emissions performance at altitude
– Engine calibration

Low-temperature performance

– Off-cycle emissions
– Cold-start testing
– Crankcase icing

Heating/climate control development

– Function-testing of heating and climate control systems
– Comfort enhancement of heating and climate control systems

Power management/thermal management

– Power management strategies
– Thermal management strategies
– Powertrain electrification
– Fluid management

Energy and Environmental Test Centre (ETC).
Environmental Wind Tunnel.

Objective: Move testing into the ETC, while at the same time continuing to ensure reliability and safety under all weather conditions

Focus Environmental wind tunnel: Simulation of extreme environmental conditions – heat, cold, sun, rain, snow

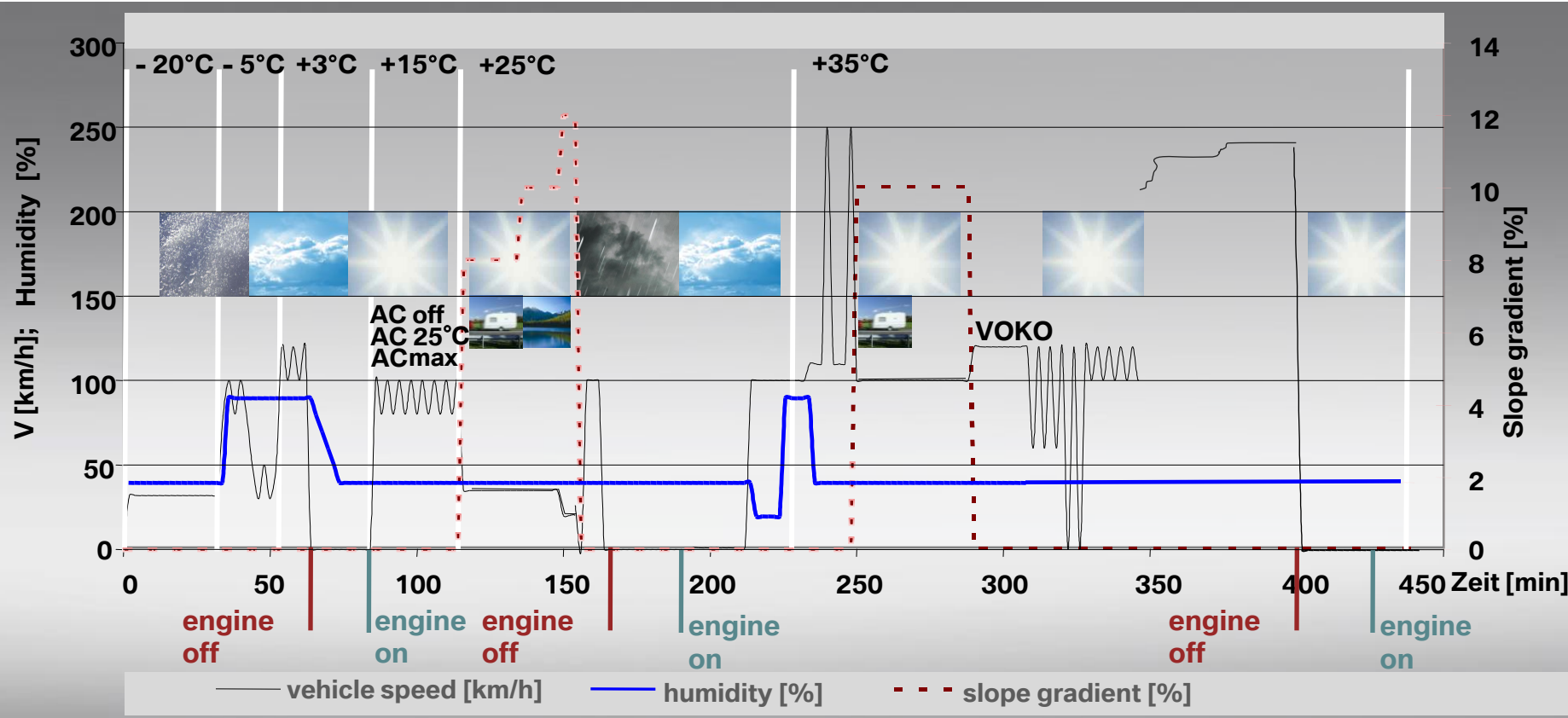
Energy and Environmental Test Centre (ETC).
Complex environmental simulation.

Free body analysis of interaction between vehicles and a wide range of climatic conditions

Transfer of “partial realities” to test bed

Energy and Environmental Test Centre (ETC).

Climate testing in the laboratory – around the world in eight hours.



Energy and Environmental Test Centre (ETC).
Range of tests in the Environmental Wind Tunnel.




Solar simulation Calibration of air conditioning system

Rain simulation A-pillar water management / keep mirrors and side windows free of water / windshield wiper design / wet response of brakes / headlights fogging

Snow simulation Snow deposition on sensors, air inlets, headlights

Motorcycle belt Cooling performance testing, weatherproofing

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Environmental Wind Tunnel – rain simulation.

Water exposure testing (full vehicle) using rain rig.

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Environmental Wind Tunnel – rain simulation. Water exposure testing (full vehicle) for optimised wiper design.

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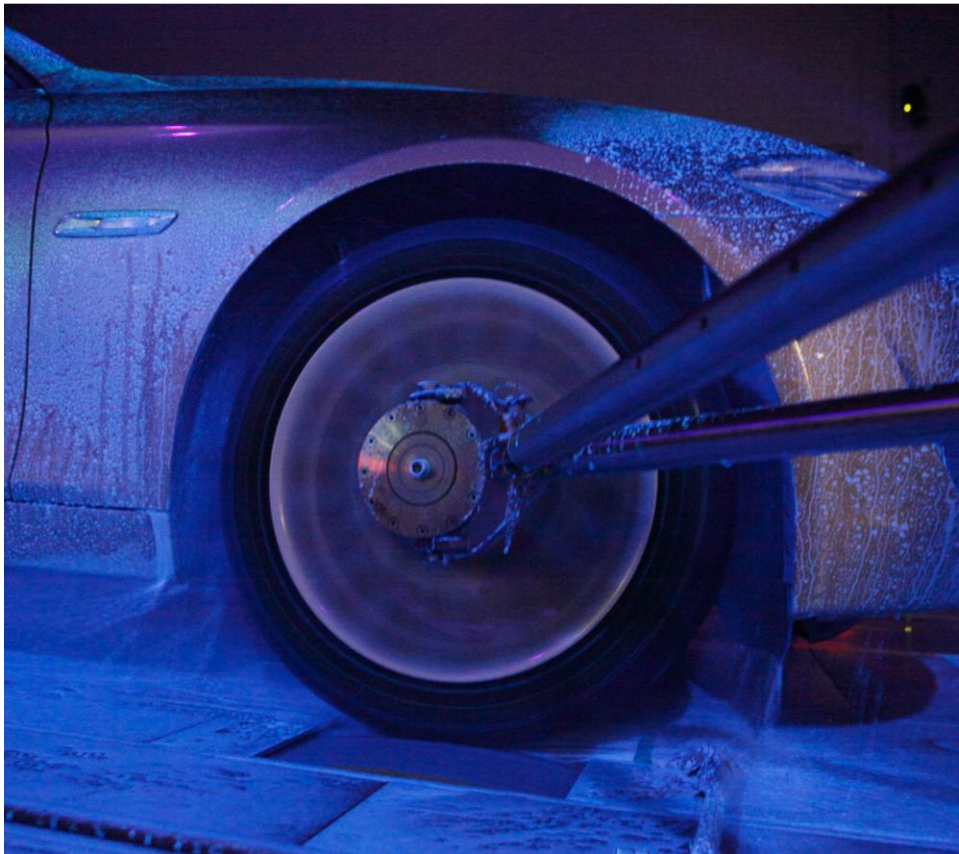
Improvement of A-pillar water management.

Optimisation of braking system wet response.



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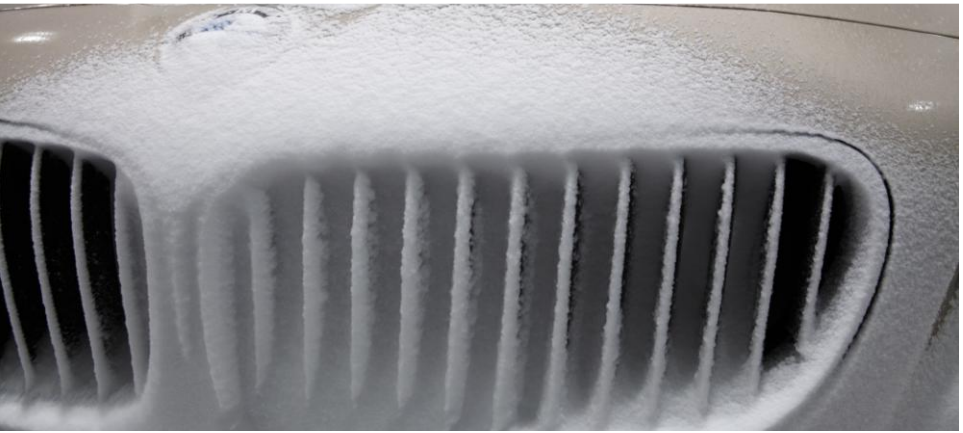
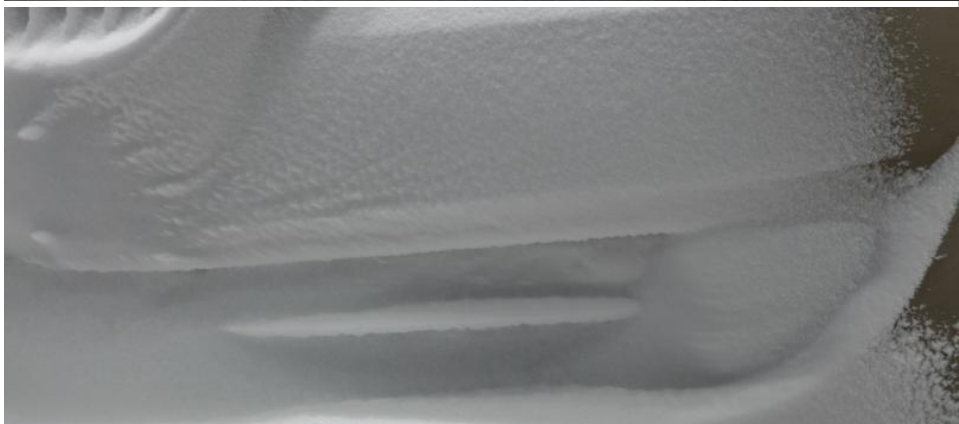
Environmental Wind Tunnel – snow simulation.
Snow making (full vehicle) using snow gun.

Energy and Environmental Test Centre (ETC).

Environmental Wind Tunnel – snow simulation.

Snow deposition on vehicle front and rear, headlights and sensors.





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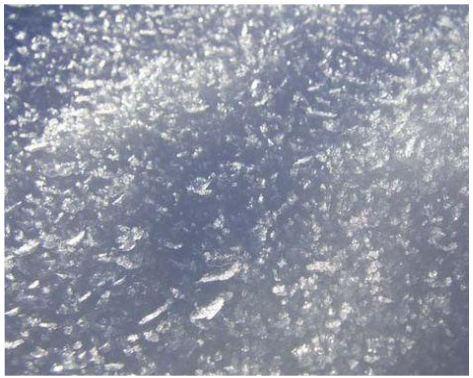
Ensuring snow simulation quality in the ETC.



Energy and Environmental Test Centre (ETC).
Environmental Wind Tunnel – motorcycle flatbelt.



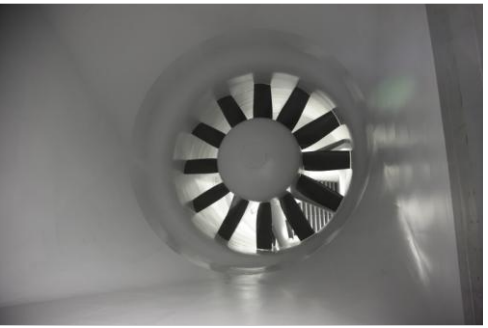


Simulation of extreme weather conditions: heat and rain

Testing portfolio on flat belt: cooling system performance, weatherproofing

Distinctive feature of flatbelt: front wheel is moving, rolling road under the motorcycle
- ensure realistic simulation of airflow at the engine cooling system
- ensure realistic simulation of water spray

Energie- und umwelttechnisches Versuchszentrum (EVZ).
Intelligent energy management at ETC.



- Recycling of electrical energy from the dynamometer and the fan
- Optimal synchronicity between test cells
- Maximum isolation of test cells
- Refrigeration equipment design/optimisation based on the cascade principle
- Free cooling with outside air

Energy and Environmental Test Centre (ETC).

Thank you for your attention.