



BSVII Challenges for HDV design

CES Engineering

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BS VII What is changing

Lower limits are only one part of the change: RDE, additional pollutants, continuous monitoring and longer life act together.

THE COMPLIANCE BOUNDARY EXPANDS IN FOUR DIRECTIONS

1

Pollutant breadth
NO_x remains central, while NH₃, N₂O and PN₁₀ add coupled constraints.

2

Operating breadth
RDE evaluates real-use windows—not only controlled laboratory cycles.

3

End of useful life breadth
Main life extends into additional life: 700k → 875k km for the heaviest classes.

4

Monitoring breadth
OBM continuously observes emissions and reports exceedance / system health.

Design consequence: architecture + controls + diagnostics + service

EU VII HEAVY-DUTY EXHAUST LIMIT ENVELOPE

Pollutant	Laboratory	RDE
<div>NO_x mg/kWh</div>	200	260
<div>PN₁₀ #/kWh</div>	6 × 10 ¹¹	9 × 10 ¹¹
<div>NH₃ mg/kWh</div>	60	85
<div>N₂O mg/kWh</div>	200	260

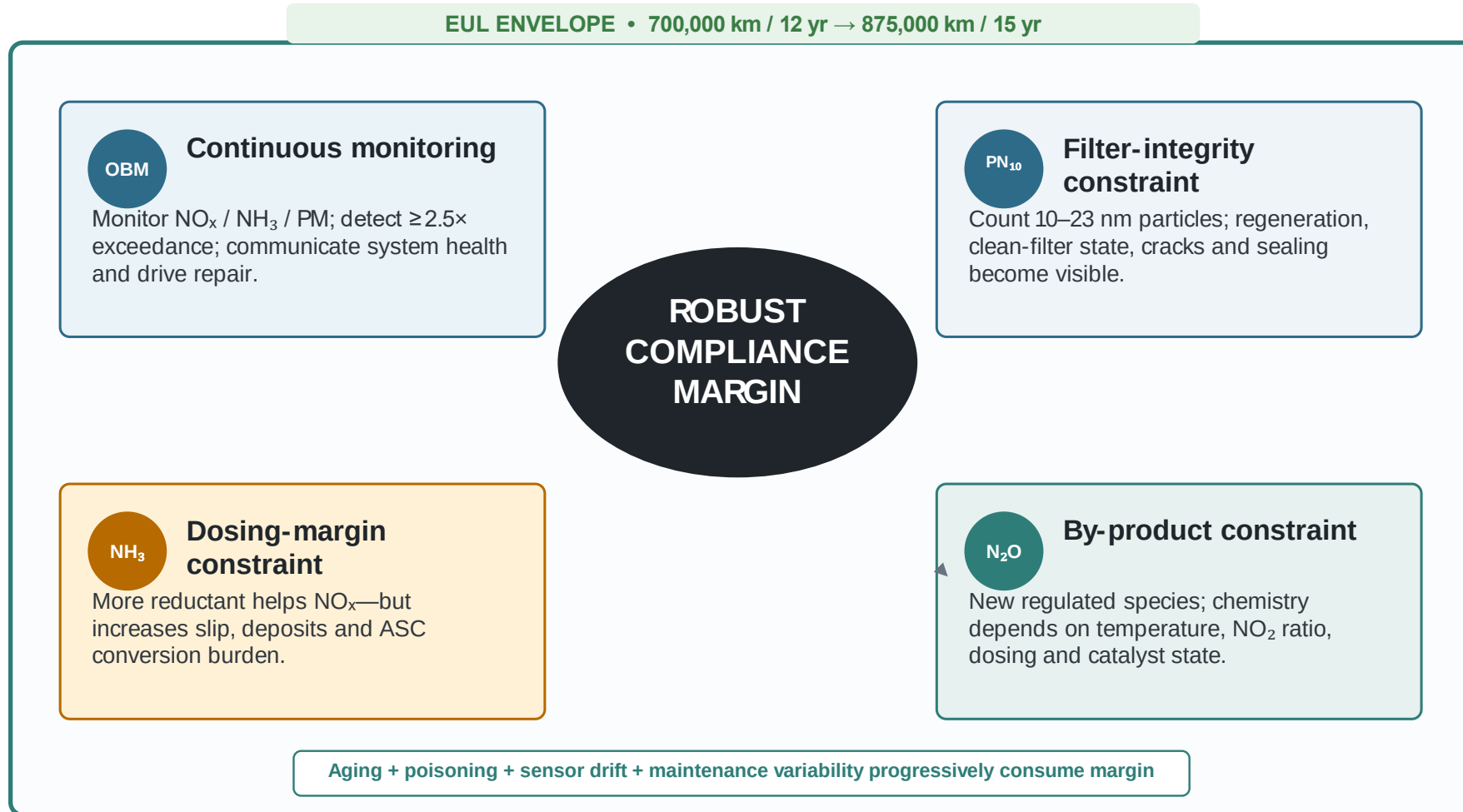
RDE conformity factor = 1.0

PN cut-off shifts 23 → 10 nm

Design target: a monitored, real-world, end-of-life emissions envelope.

OBM, PN₁₀, NH₃ and N₂O and extended EUL

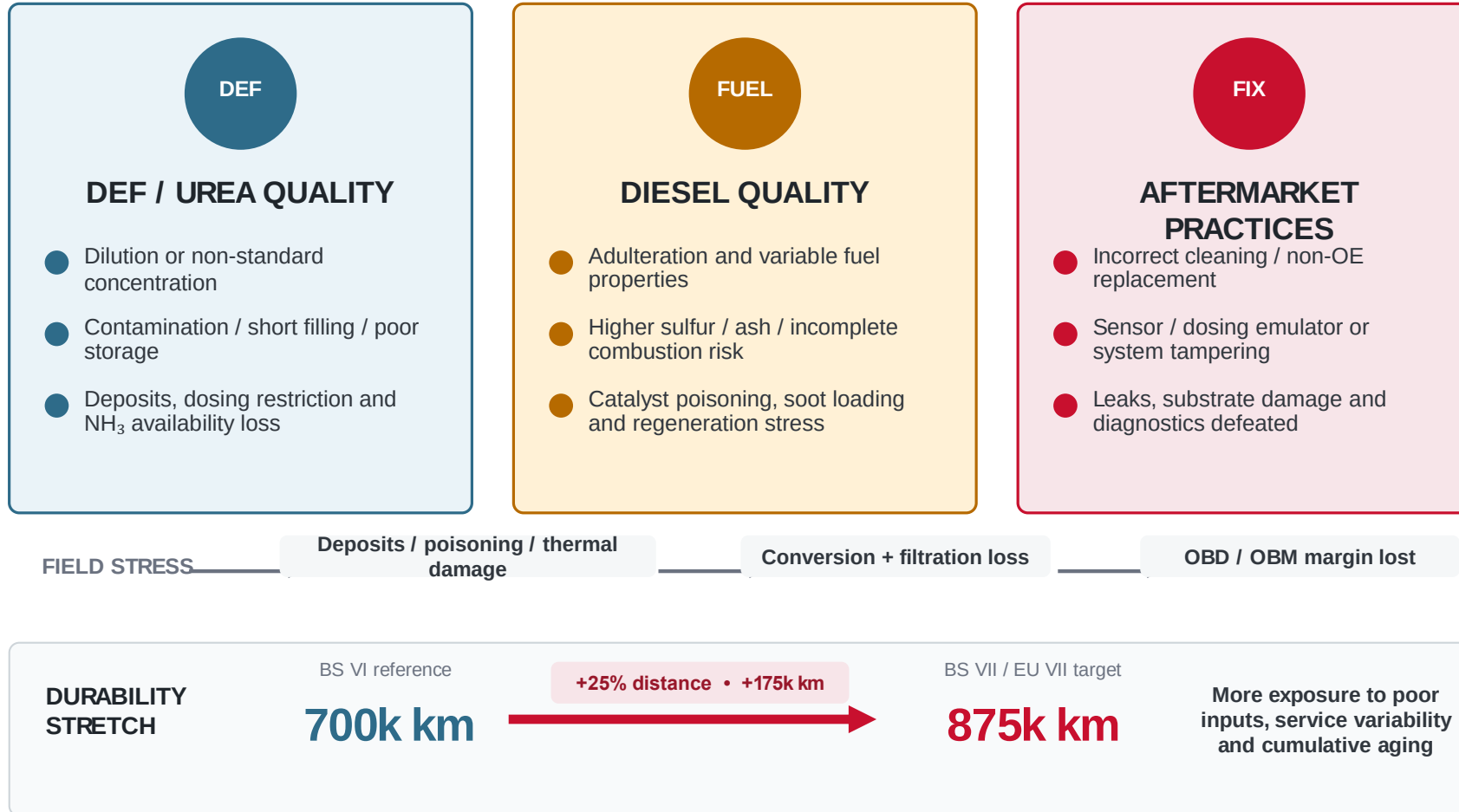
The challenge is simultaneous control: a lever that improves one pollutant can consume margin elsewhere.



EUL impact: Maintaining robust emission compliance over extended EUL is top design constraint

India operating environment

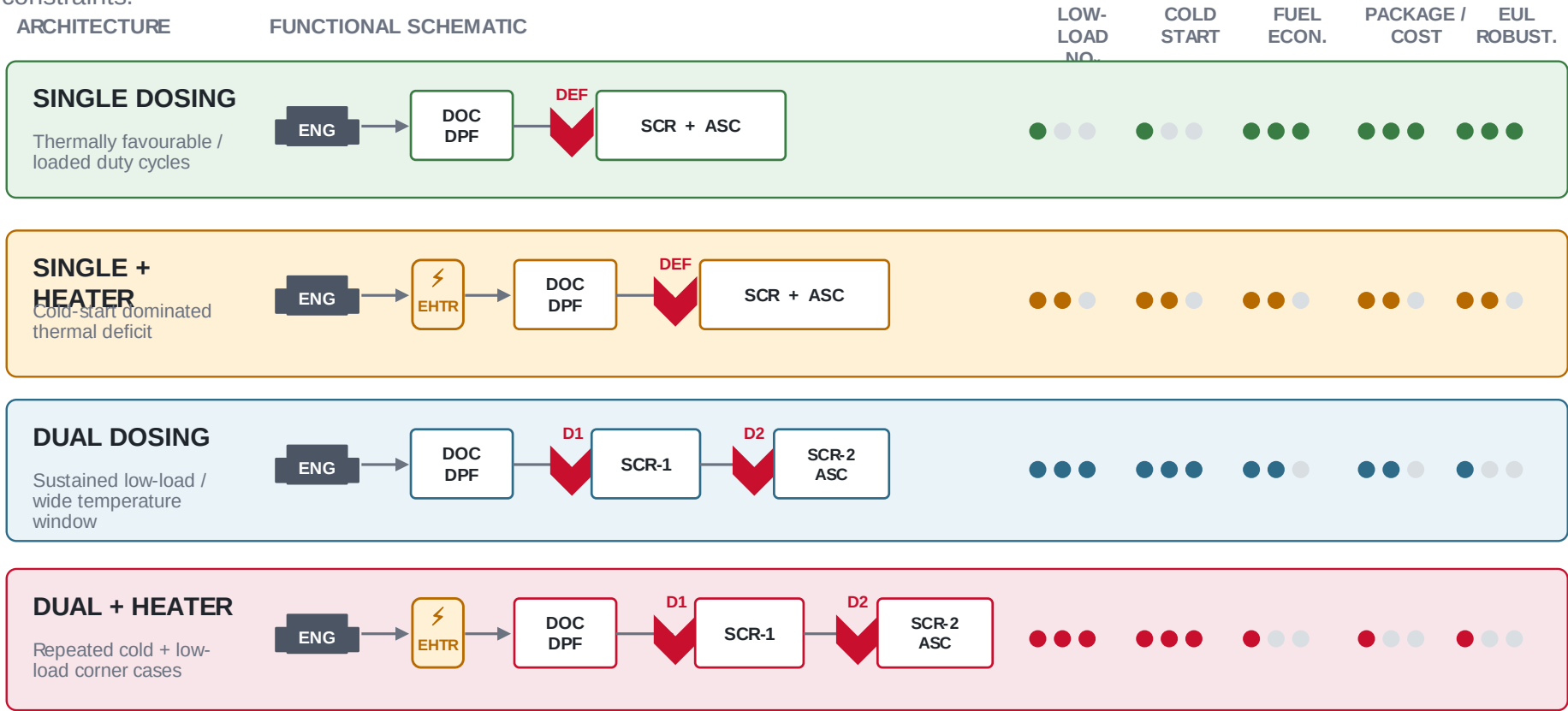
Fuel / DEF quality and incorrect aftermarket practices can accelerate loss of catalyst, filter and diagnostic performance.



India principle: certify on controlled inputs—but design for imperfect fuel, DEF and maintenance through EUL.

One solution does not fit all applications

Architecture choice should match the thermal management requirement, RDE corner cases, EUL risk and vehicle integration constraints.



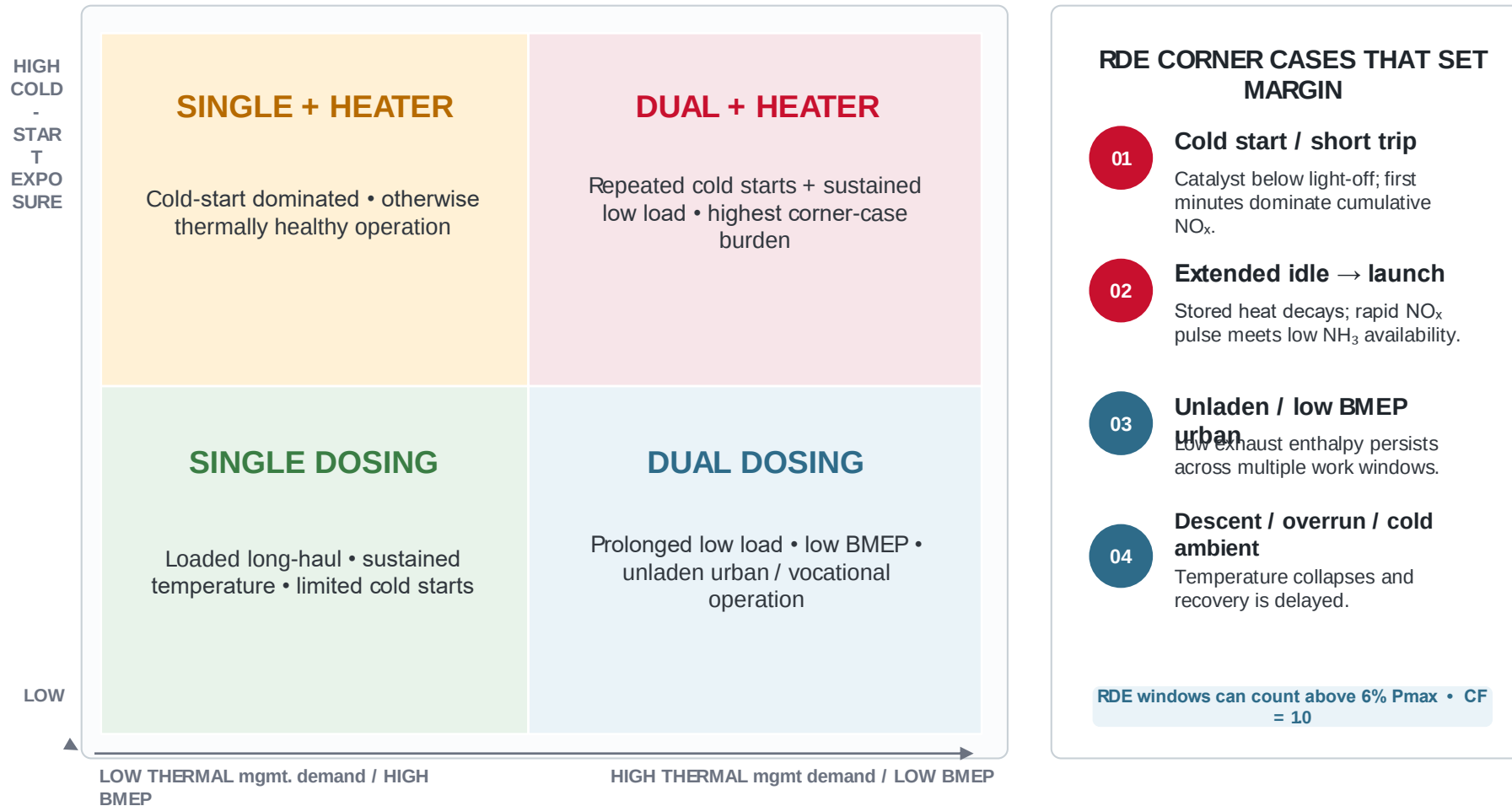
Trade-offs are qualitative and application dependent; final selection requires duty-cycle and aged-system simulation.

●●● stronger / lower burden ●●● weaker / higher burden

Portfolio rule: preserve single dosing where thermal management margin exists; add hardware only where the duty cycle demands it.

RDE corner cases—not average duty cycle—select the architecture

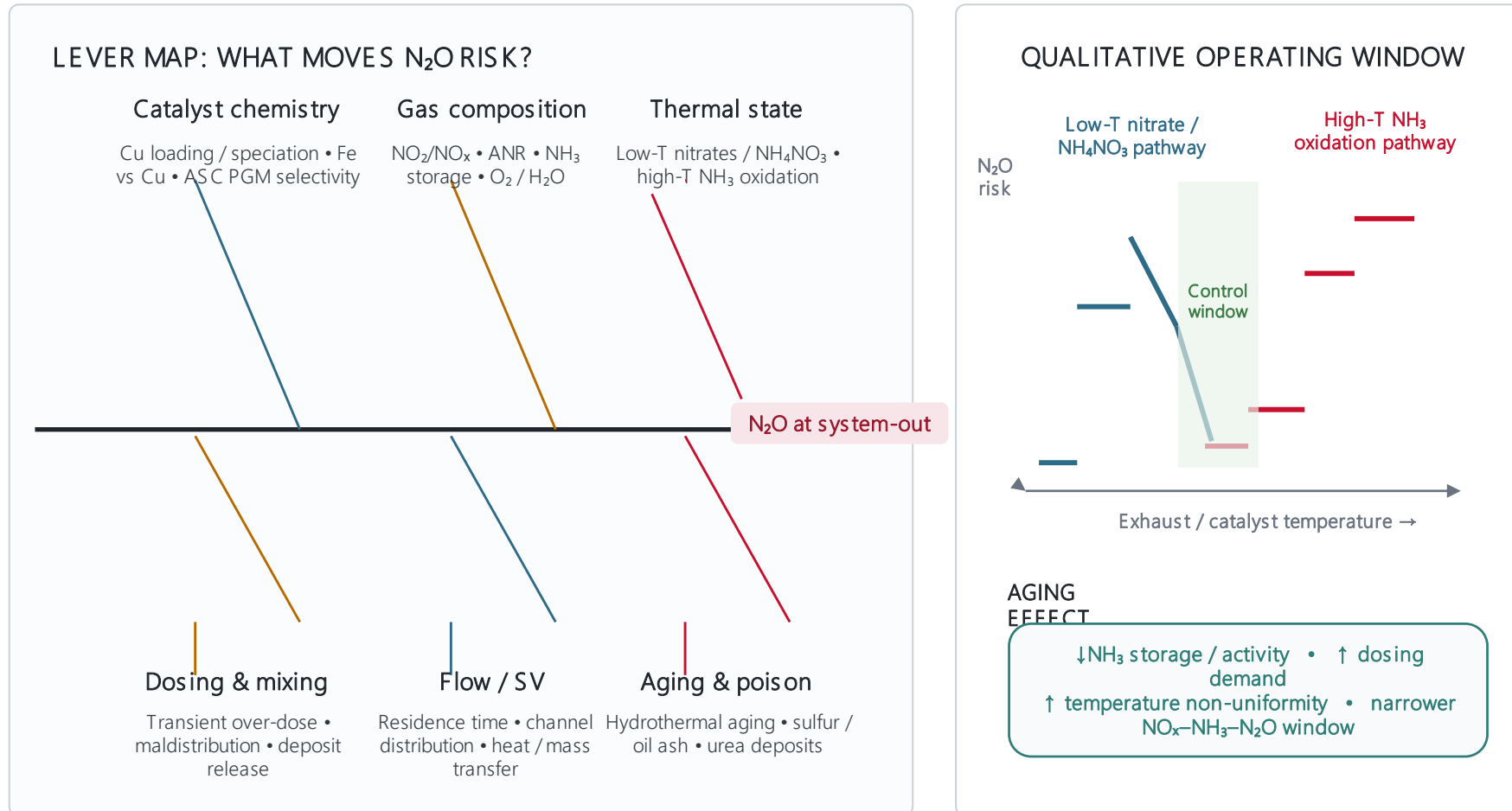
The system must close emissions during its worst thermal windows while avoiding unnecessary fuel, power and packaging penalties elsewhere.



Architecture rule: loaded long-haul can retain single dosing; repeated cold / low-load exposure justifies dual dosing and/or heating.

N₂O Constraints

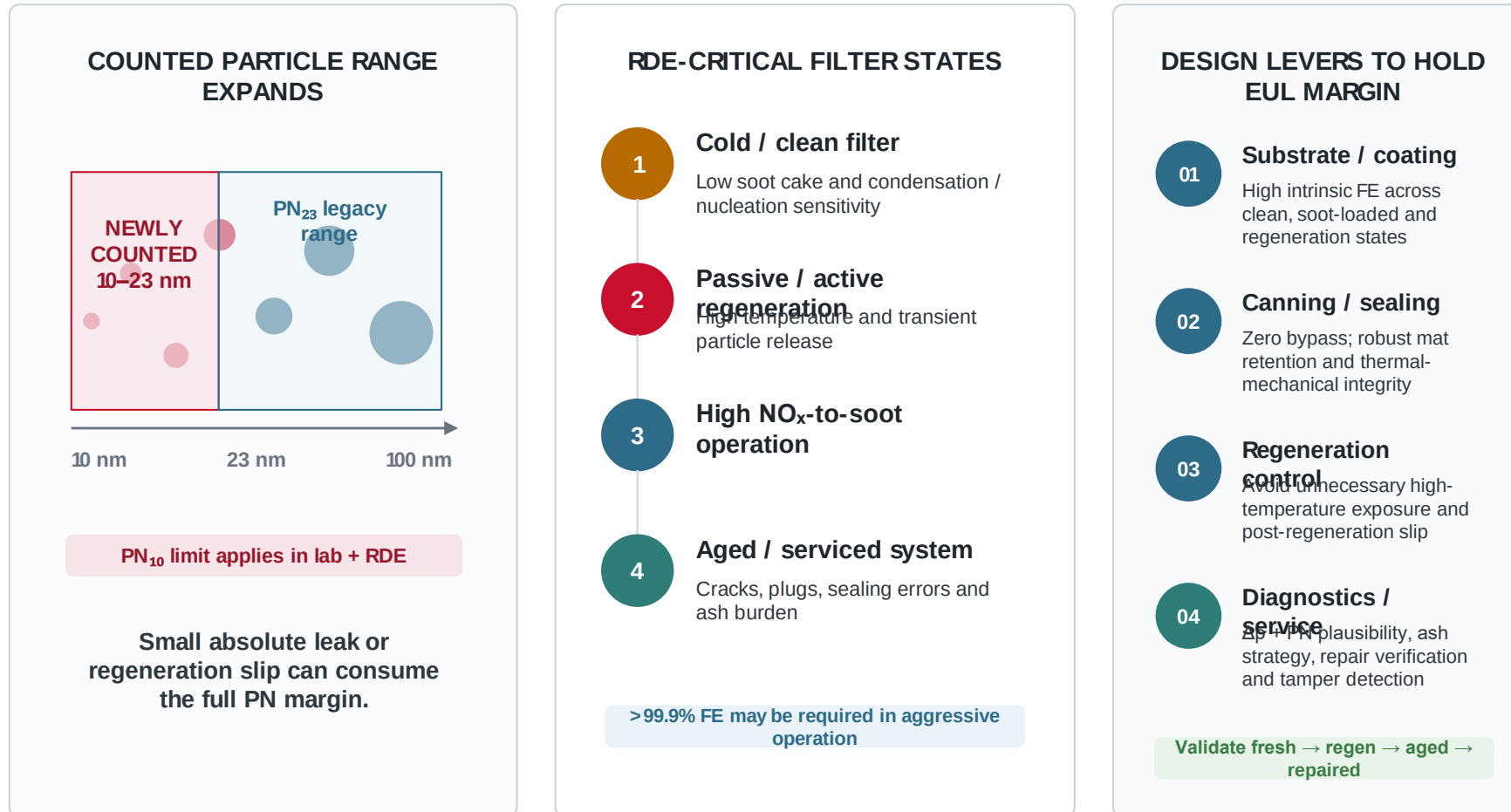
Formation pathways depend on catalyst formulation, NO₂ / NH₃ balance, temperature history, mixing and system deterioration.



EUL requirement: co-optimize NO_x conversion, NH₃ slip and N₂O on aged catalysts—not only on fresh-system maps.

PN₁₀ makes filtration integrity an end-of-life requirement

The new 10–23 nm fraction and real-world transients expose filter states that PM mass or steady-cycle testing can miss.

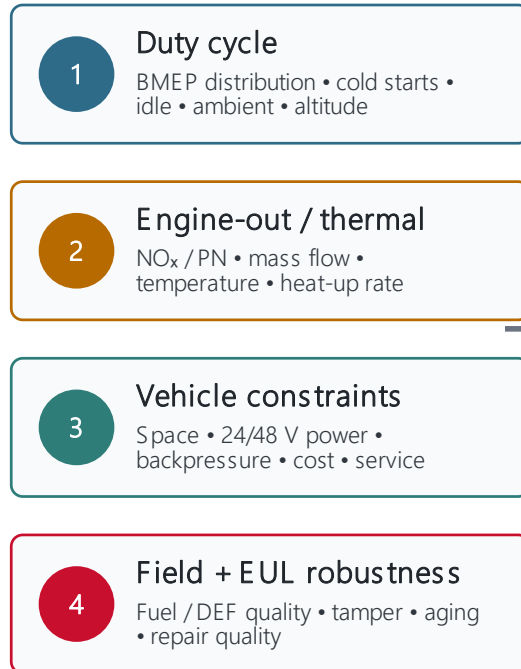


PN₁₀ + RDE requires ultra-high filtration efficiency and zero-bypass integrity through regeneration, aging and service events.

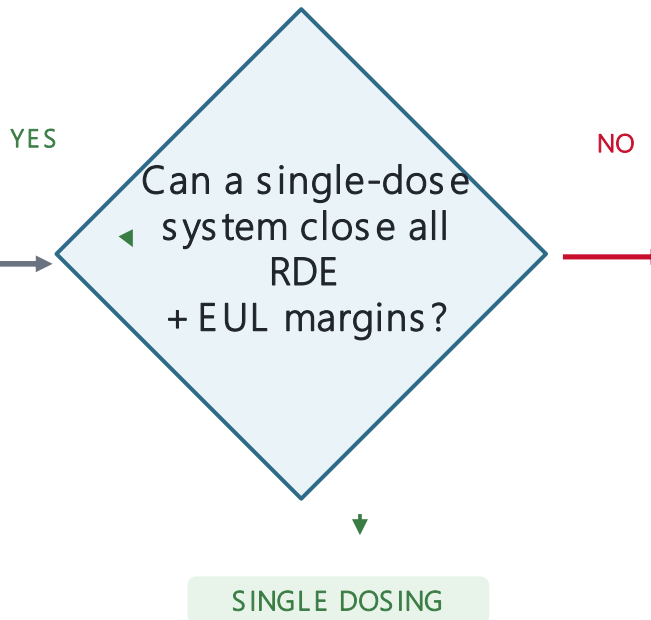
Design elements

Select the minimum-complexity system that closes NO_x, NH₃, N₂O, PN₁₀, OBM and EUL margins for the intended application.

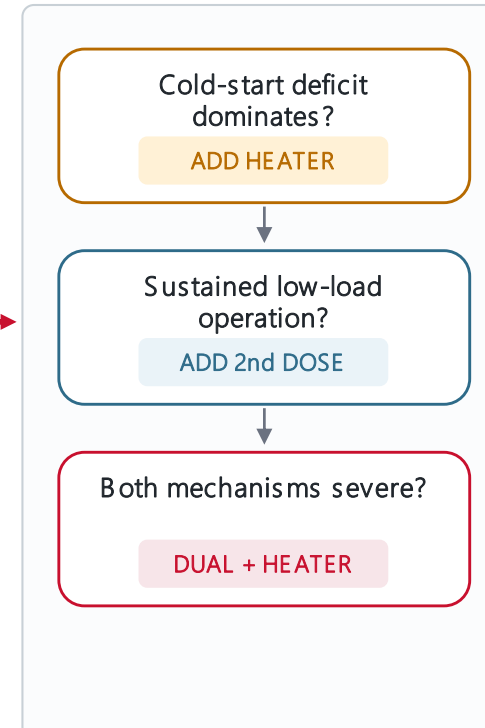
1 DEFINE THE APPLICATION ENVELOPE



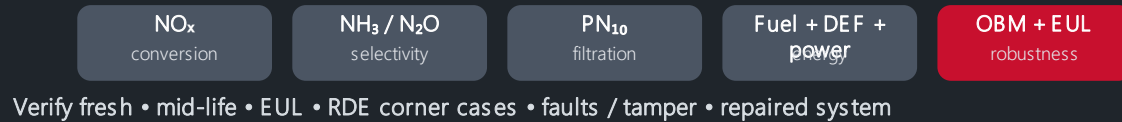
2 QUANTIFY THERMAL DEFICIT + AGED COMPLIANCE MARGIN



3 MATCH THE DEFICIT MECHANISM



4 MULTI-OBJECTIVE OPTIMIZATION + VALIDATION



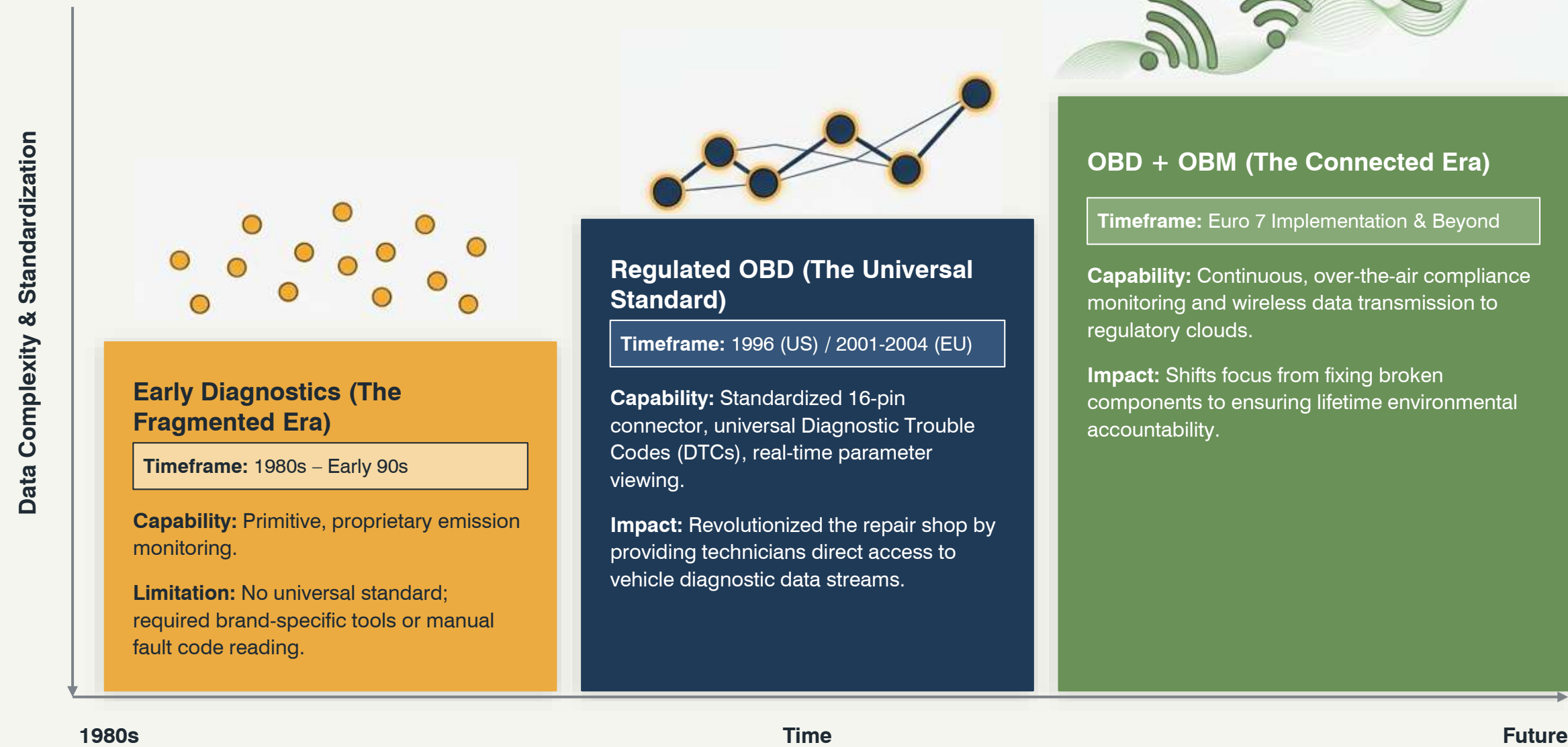
Loaded long-haul → Single dose

Mixed / low-load → Heater or dual

Urban cold + low-load → Dual + heater

One regulation; multiple duty-cycle architectures. The winning design is the least-complex system with durable margin.

The Evolution of OBD to Introduction to OBM



EU7 Emission Threshold Limits



 NO_x Nitrogen Oxides
 NH₃ Ammonia
 PM Particulate Matter

200	260	650	1200
60	85	150	N.A.
8	N.A.	20	25

Limits in mg/kW-hr

Based on EU7 LDV assumptions

Euro 7 OBM calculation challenges

Key technical, validation and implementation risks

1 Sensor performance

Accuracy, drift, ageing, response time and NO_x/NH₃ cross-sensitivity.

2 Model robustness

Cold start, transient operation, altitude, ambient temperature, fuel quality and aged components.

3 Work and flow accuracy

Reliable exhaust-flow and engine-work calculation, particularly during low-work operation.

4 Measured vs. modelled NO_x

Plausibility checks and stable source selection during missing, invalid or noisy sensor signals.

5 Trip suitability

Short or unsuitable trips can provide insufficient data; valid status may need to be retained.

6 PEMS correlation

Cumulative OBM NO_x and NH₃ results must correlate with PEMS during RDE/ISC validation.

7 End-of-life calibration

Conversion-efficiency and NH₃ estimates must remain representative with ageing and component degradation.

8 Signals and communication

J1979-2 versus J1939 coverage, signal definitions, continuous vehicle-mass availability and OEM interfaces.

9 Regulation and data

Evolving HDV PM/NH₃ details, data storage, OTA reporting, traceability, cybersecurity and anti-tampering.

Primary development focus Accuracy across real-world operation • Robust fault handling • PEMS correlation • Stable regulatory interfaces

