Balancing single and double dosing SCR systems for BS-VII HDD applications in India

ECT2026-HD

Shantanu Tamhankar

CONFIDENTIAL

Content

- Umicore Introduction
- BSVII Emission Norms for HD
- Market Trends for upcoming Norms- System Architectures
- Single vs Double dosing system
- Summary

Umicore in the HDD Catalyst market

More than 20 years of business experience in HDD EATS market

Umicore is a real Global Supplier

- Significant business presence in all major markets
- Global production footprint (plants for HDD products in NA, SA, EU, IN, KR, CN)

Umicore brings leading technology expertise

- Full range product portfolio with highly competitive technologies
- High end test facilities all over the globe (engine & gas benches)
- Dedicated Modeling Team with accurate & reliable catalyst models
- Full inhouse system expertise to optimize Volume/PGM layout & application

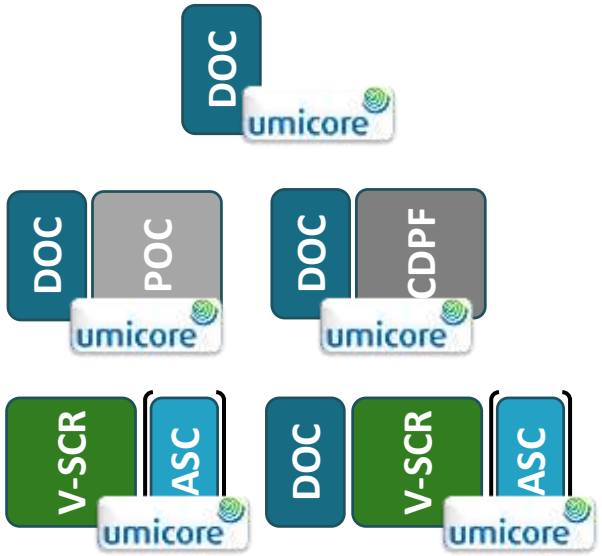
Umicore is committed to a long-term HDD business support

- Sustainable business & application support
- Supply security

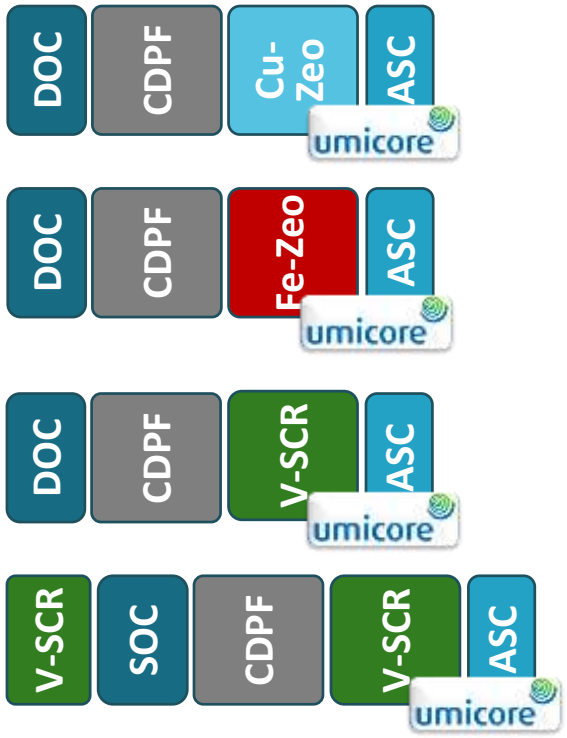
Umicore in the HDD Catalyst market

Systems running in the field with Umicore components

“Euro IV” / “Euro V”



“Euro VI” / US2010



As indicated Umicore is supplying components to all system types (for different OEMs)

BSVI vs BSVII Requirements

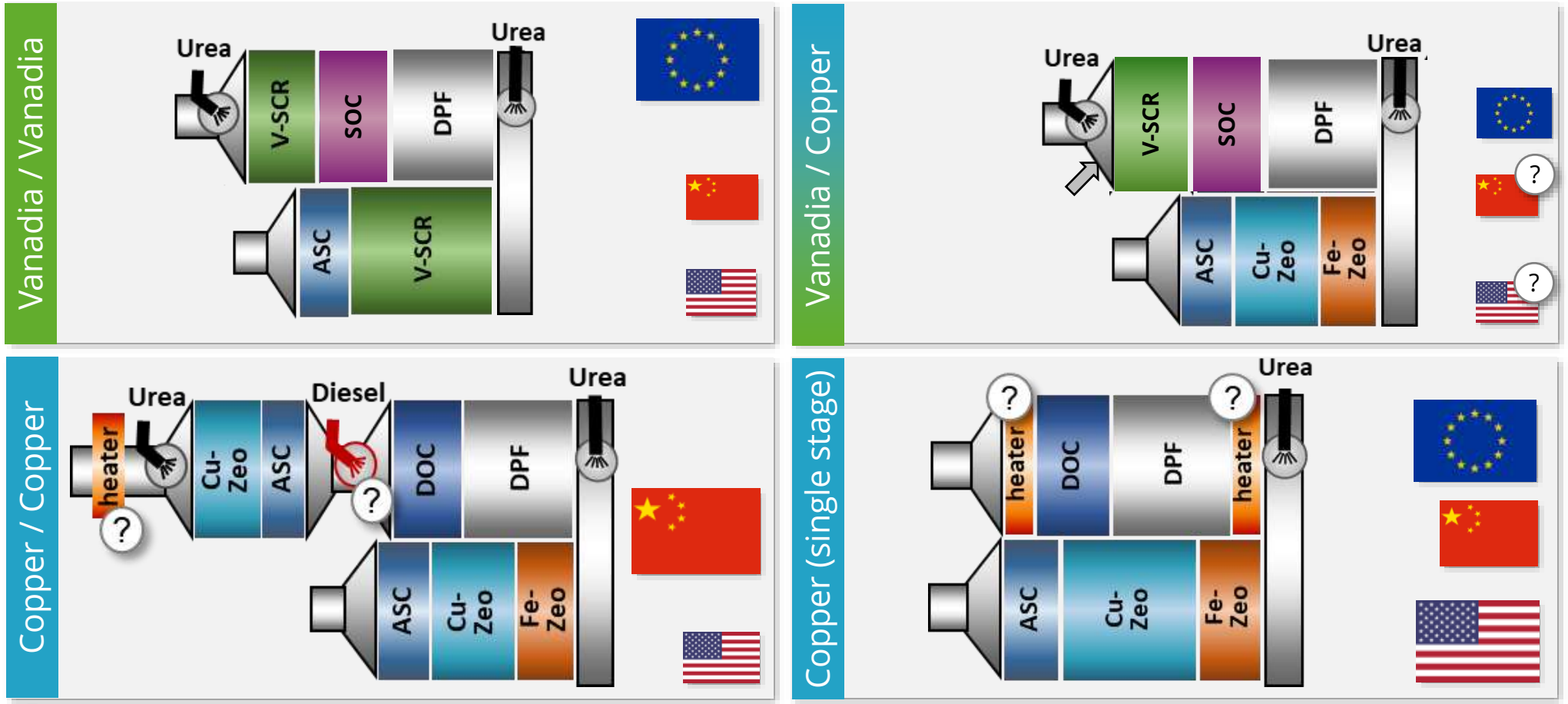
Parameter	BSVI HD	BSVII HD	Change
NOx	460 mg/kWh	200 mg/kWh	↓ 57%
PM Mass	10 mg/kWh	8 mg/kWh	↓ 20%
Particle Number	8×10^{11} #/kWh (>23nm)	6×10^{11} PN10 #/kWh	↓25% + shift to 10nm particles
N_2O	Not regulated	200 mg/kWh	New

BSVII targets taken from latest notification for HD released on 13th Oct'26

Market Trends

System Layouts for next Legislations (Global View)

Considered Layouts and their regional relevance

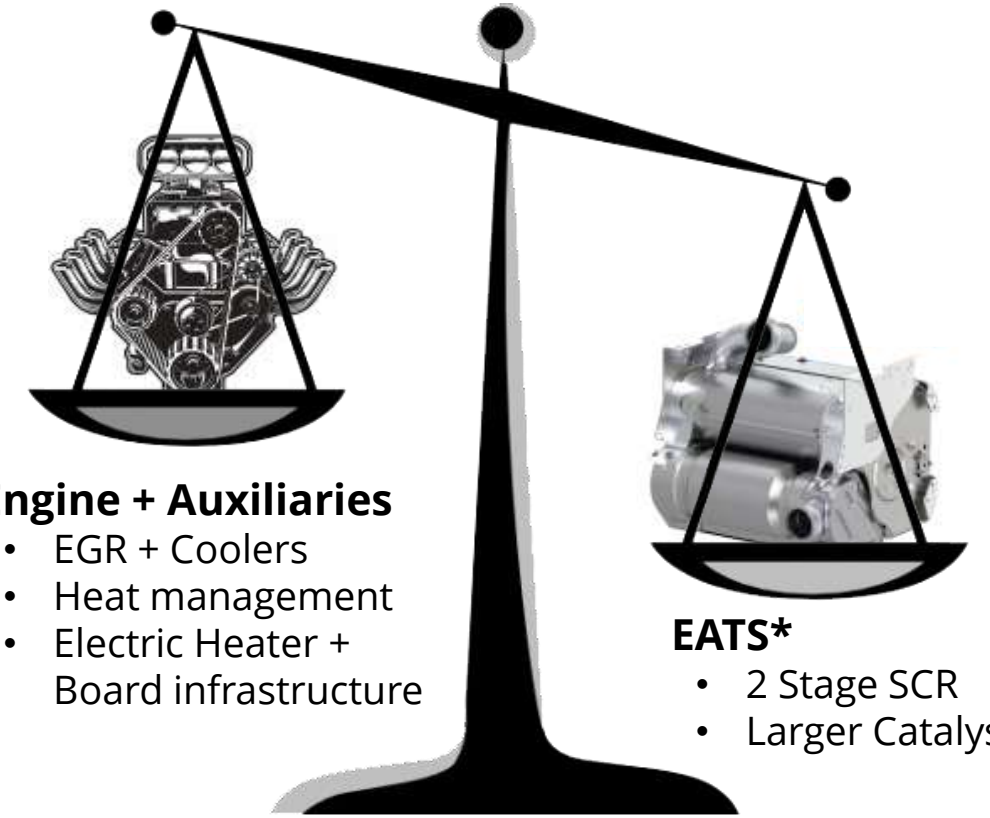


(?) = optional component, implementation uncertain or only with some OEMs

⇗ =HC dosing integrated in muffler/ in cylinder injection

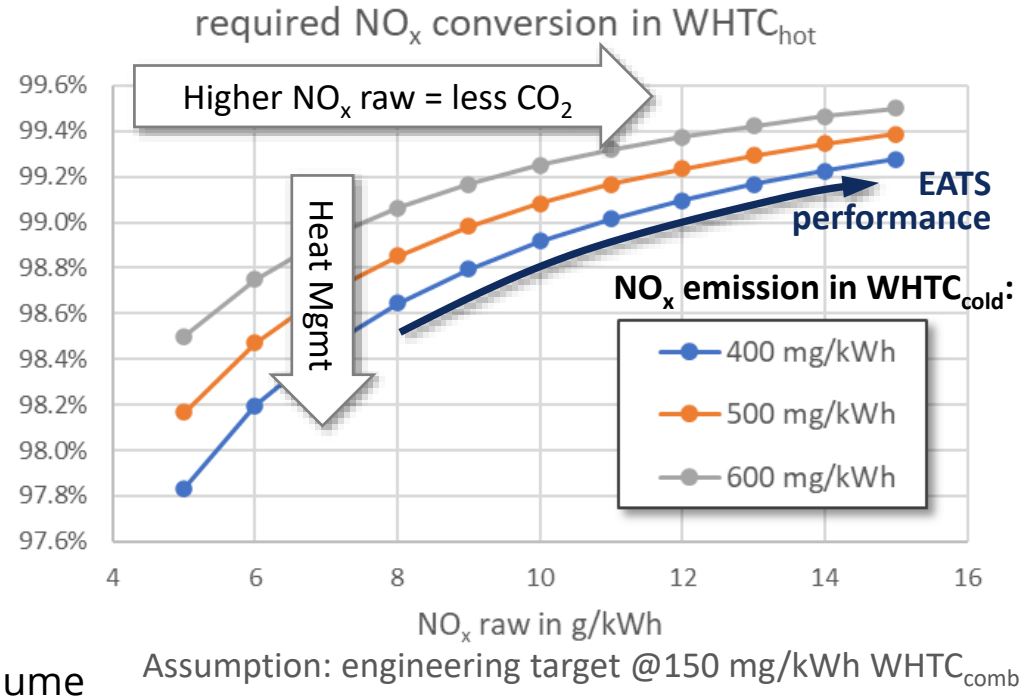
The right System for BS VII – Single or Double Stage SCR?

Where to invest – Engine or EATS*?



Engine + Auxiliaries
- EGR + Coolers
- Heat management
- Electric Heater + Board infrastructure

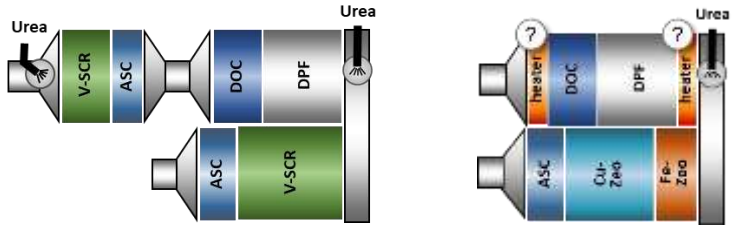
EATS*
- 2 Stage SCR
- Larger Catalyst Volume



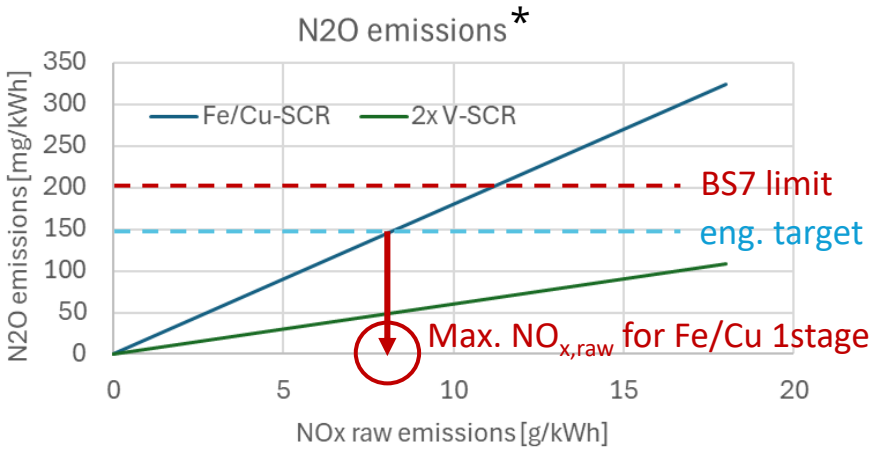
Assumption: engineering target @150 mg/kWh $WHTC_{comb}$

*) EATS = Exhaust Aftertreament System

Driver 1: Fuel consumption

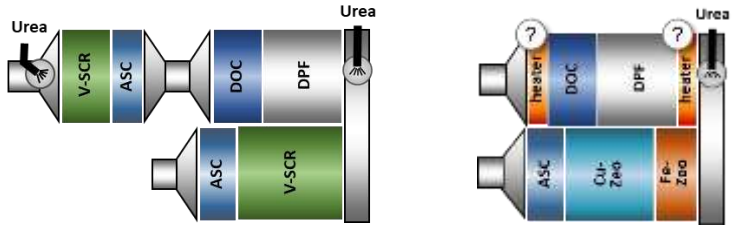


Engine NO_x raw potential:	>15 g/kWh	<10 g/kWh
Heating for Regen:	low to moderate	high
Heating for activity support:	variable	variable



*) Actual values depend on SCR technology details and quality of dosing calibration

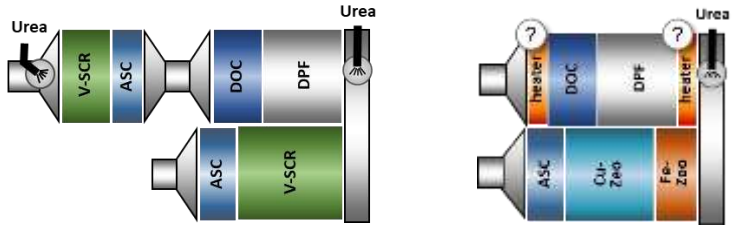
Driver 2: Cost & Complexity



Catalyst & Canning cost	< +20%	-
Engine complexity & cost	moderate	high
Development efforts	high	high
Costs for electrical heating	-	high!

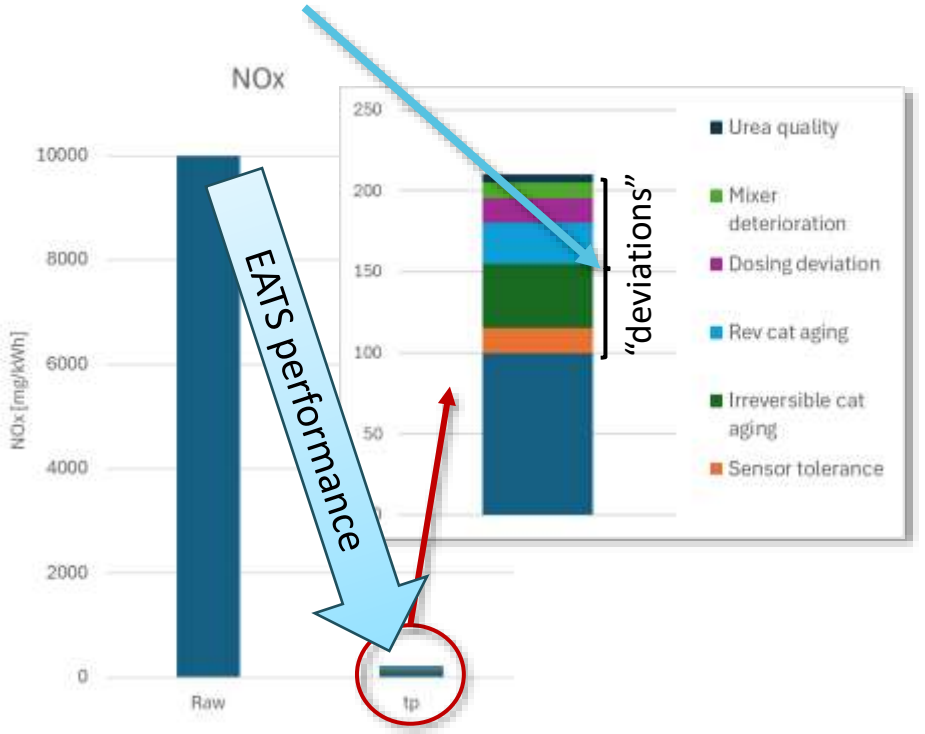
In case no heater is being used more pressure on engine & development

Driver 3: Robustness

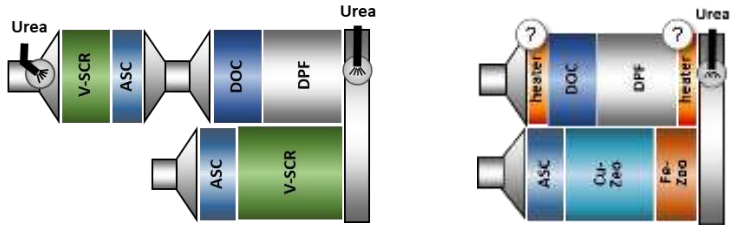


Emissions performance robustness	high	limited
Catalyst robustness:	high (V-SCR)	moderate (Fe/Cu SCR)
Hardware robustness (sensitivity in field)	high	moderate

A 2nd SCR stage (or a heater) can act as compensators for deviations

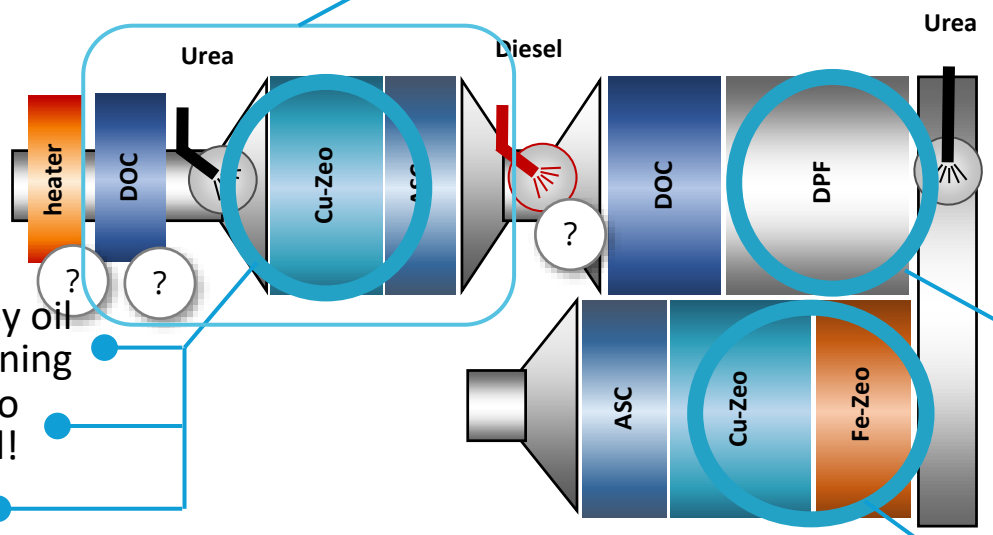


Driver 4: Global Solution



Acceptance in the US	limited	yes
Temperature control strategies demanded by authorities US/CN	required	not required

Specific Challenges for 2 Stage SCR (CuZeo)



Packaging:
Big challenge w/ DOC! Dosing/mixing between DOC & SCR

Deterioration by oil ash poisoning

Desulfation! W/o DOC very critical!

HC adsorption & poisoning if no DOC

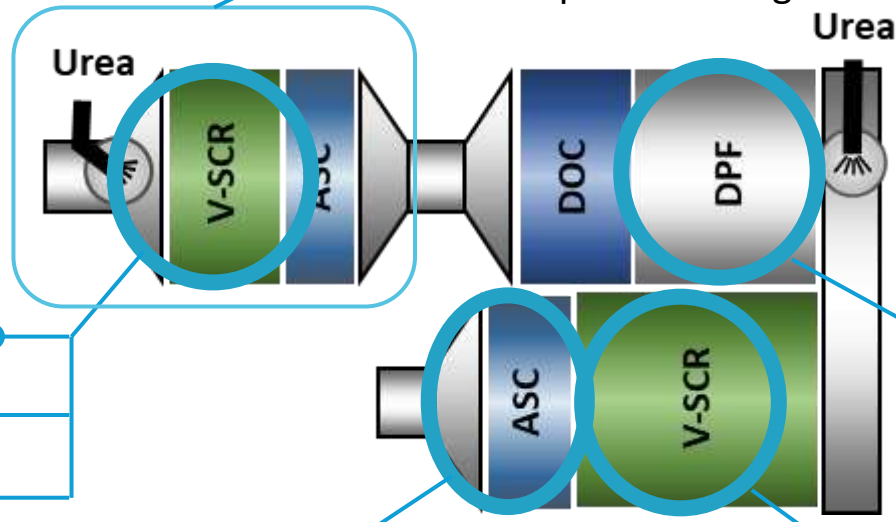
Maintain sufficient CRT efficiency

Limit N_2O formation

DeSOx and heat transport over full system

Specific Challenges for 2 Stage SCR (Vanadia)

Packaging:
Typically, cc unit is integrated in Euro VI muffler box
Option to integrate ASC + DOC → SOC



Deterioration by oil ash poisoning

HC conversion from PI injection

HC adsorption & poisoning, thermal runaway

Achieve DeSOx <400°C

Maintain sufficient CRT efficiency

Sufficient DeNOx and tolerable N_2O >470°C

Summary

- **Dual Dosing** SCR enables **higher engine-out NOx** operation, allowing **better diesel fuel efficiency** while achieving stringent tailpipe NOx targets.
- **Single Dosing** SCR requires lower engine-out NOx, resulting in **higher engine calibration complexity** and **increased thermal management** requirements.
- **Dual Dosing** architecture offers **greater compliance robustness** and durability margin across vehicle life, providing additional headroom for future regulations.
- The primary trade-off of Dual Dosing is higher **ATS hardware cost**, **packaging complexity**, and **DEF consumption.**
- Global HDD emission technology trends increasingly favor stronger aftertreatment (**Dual SCR/Dual Dosing**) to meet upcoming ultra-low NOx requirements with minimum fuel economy penalty.

umicore