

Future SCR Technology for Heavy-Duty Aftertreatment Systems for Bharat Stage VII and beyond Emission Regulations

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Outline

01 **BS VII / Eu7 HDD Legislation**

02 **System Architecture**

03 **SCR technologies trade-off**

04 **Advanced SCR technologies**

05 **Summary**

BSVII Emission limits | Expected to follow Euro7

Comparison of EUVI, Eu7 HD , NSVII

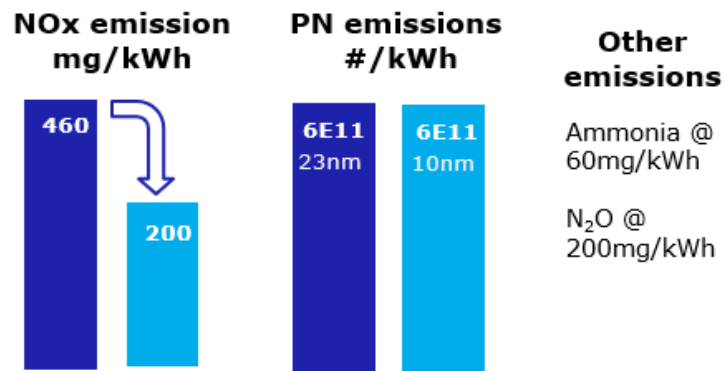
	Heavy Duty Applications >3.5ton			
Emissions	EUVI WHTC	EU7 / BSVII WHTC	EU7 RDE	NSVII WHTC
NOx mg.kWh ⁻¹	460	200	260	140 <i>460 Cold WHTC NOx</i>
PM mg.kWh ⁻¹	10	8	-	10
PN #/km	6x10¹¹ <small>PN23</small>	6x10¹¹ <small>PN10</small>	9x10¹¹ <small>PN10</small>	6x10¹¹ <small>PN10</small>
CO mg.kWh ⁻¹	4000	1500	1950	670
NH₃ mg.kWh ⁻¹	10 ppm Avg.	60	85	65
CH₄ mg.kWh ⁻¹		500	650	400
N₂O mg.kWh ⁻¹		200	260	195
NMOG mg.kWh ⁻¹		80	105	50 <i>200 Cold WHTC Nox</i>
Main lifetime km/yr	700k / 7	700k / 12		
Add. lifetime km/yr		875k / 15		

*BS VII limits as per Gazette Notification dated 13 Oct 2026
Emission limits are fuel neutral | BS7 & NSVII not finalized yet



BSVII / Eu7 HDD Emission limits and ATS architecture

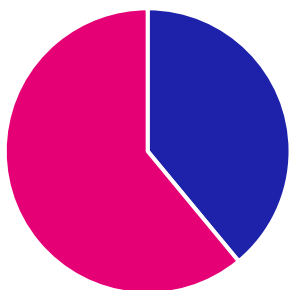
BSVII / Eu7 Emission limits



Euro VI Euro 7

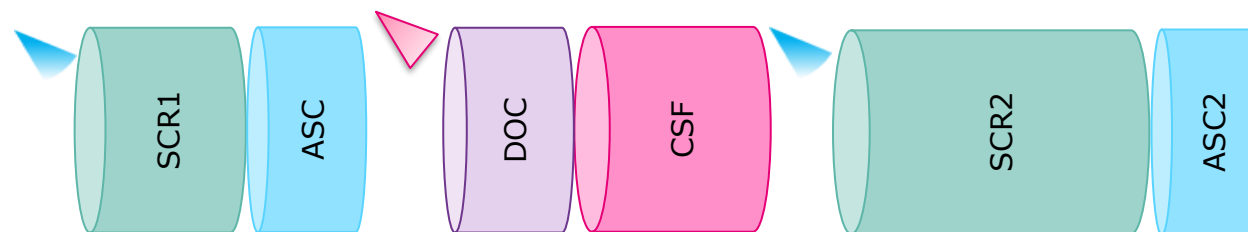


System configuration |Europe

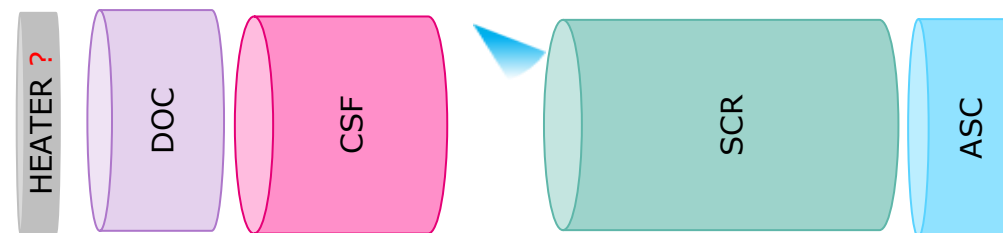


SCRT
Dual Inj.

Dual Injection



SCRT®



- CSF - Enhanced Filtration Coating (EFC) for PN₁₀
- Electrical Heater for Temp management
 - Before DOC or SCR

In Eu7 HDD is majority dual injection

SCR Technologies Trade-off

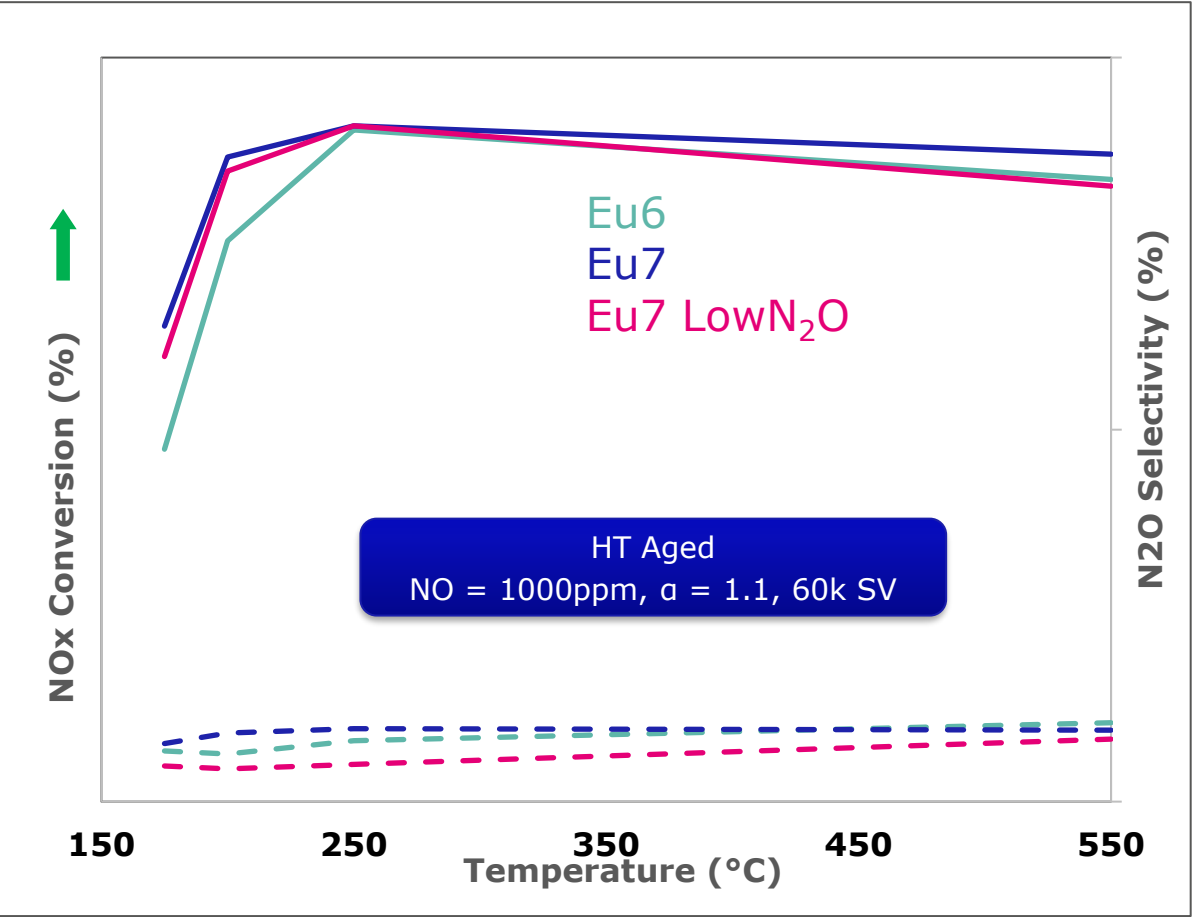
All the existing SCR technologies have advantages and some limitation

Catalyst Technology	NOx Conv	NO ₂ Dependence	N ₂ O Selectivity	Sulfation	HC exposure	Exotherm
CuSCR				Need DeSOx		
VSCR						
FeSCR						
eSCR				Need DeSOx		

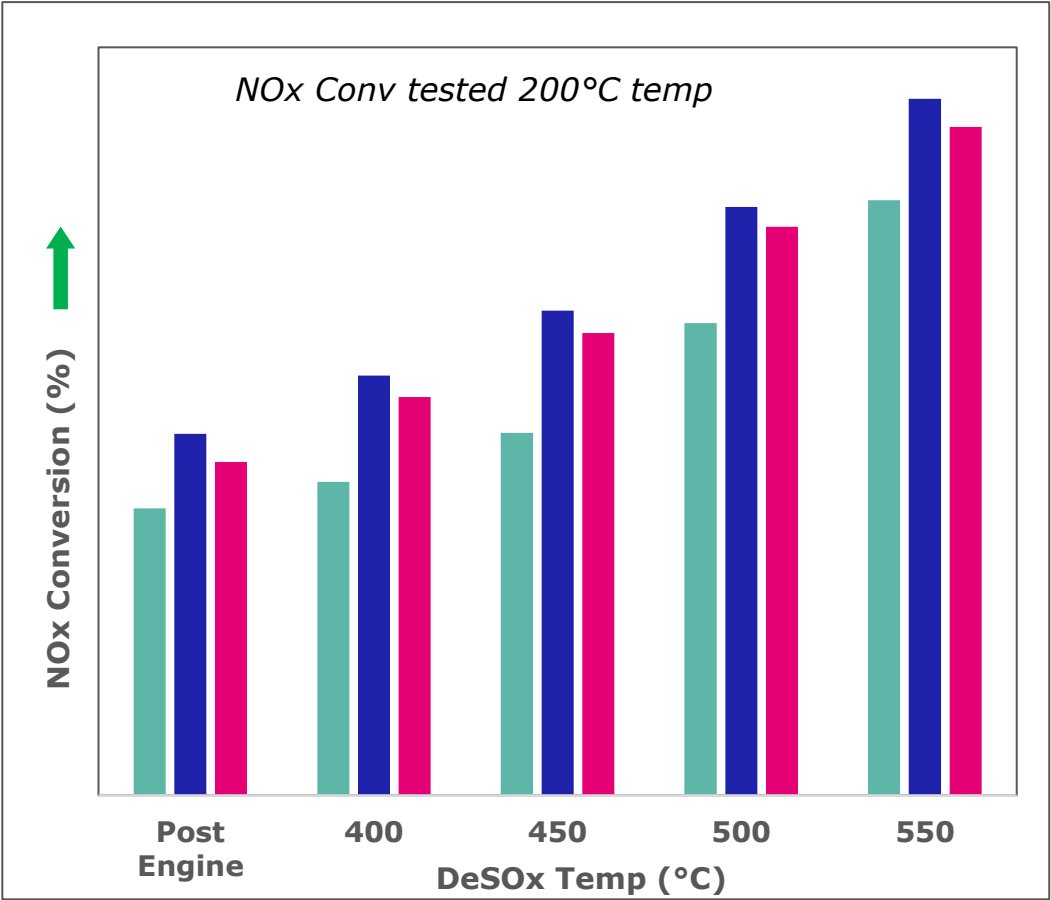
For dual dosing configuration, the light off (close couple) position SCR should have HC exposure and exotherm capability to avoid additional fuel injector downstream before DOC

Eu7 CuSCR show better low temp activity

Improved low temp NOx performance and lower N₂O

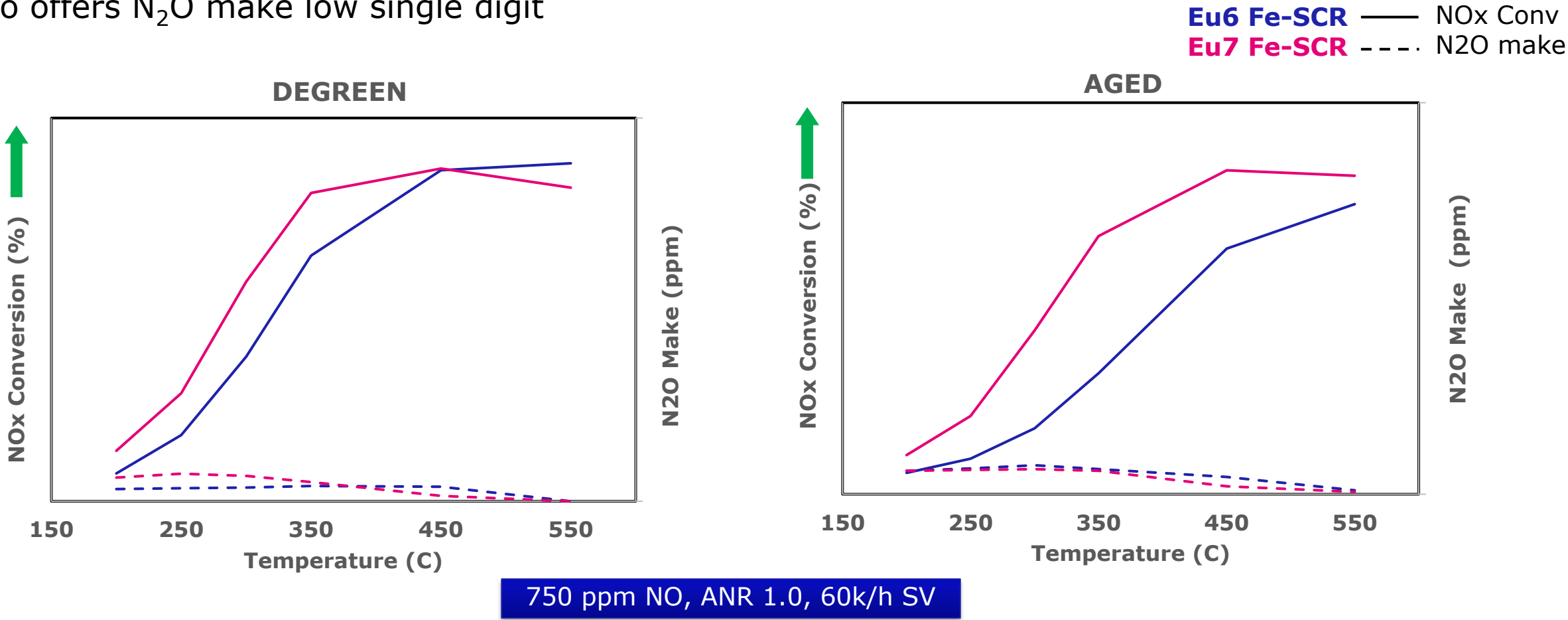


Eu7 SCR show lower sulfation effect and good recovery compared with Eu6 SCR



Improved Fe-SCR as Alternative to Low N₂O CuSCR

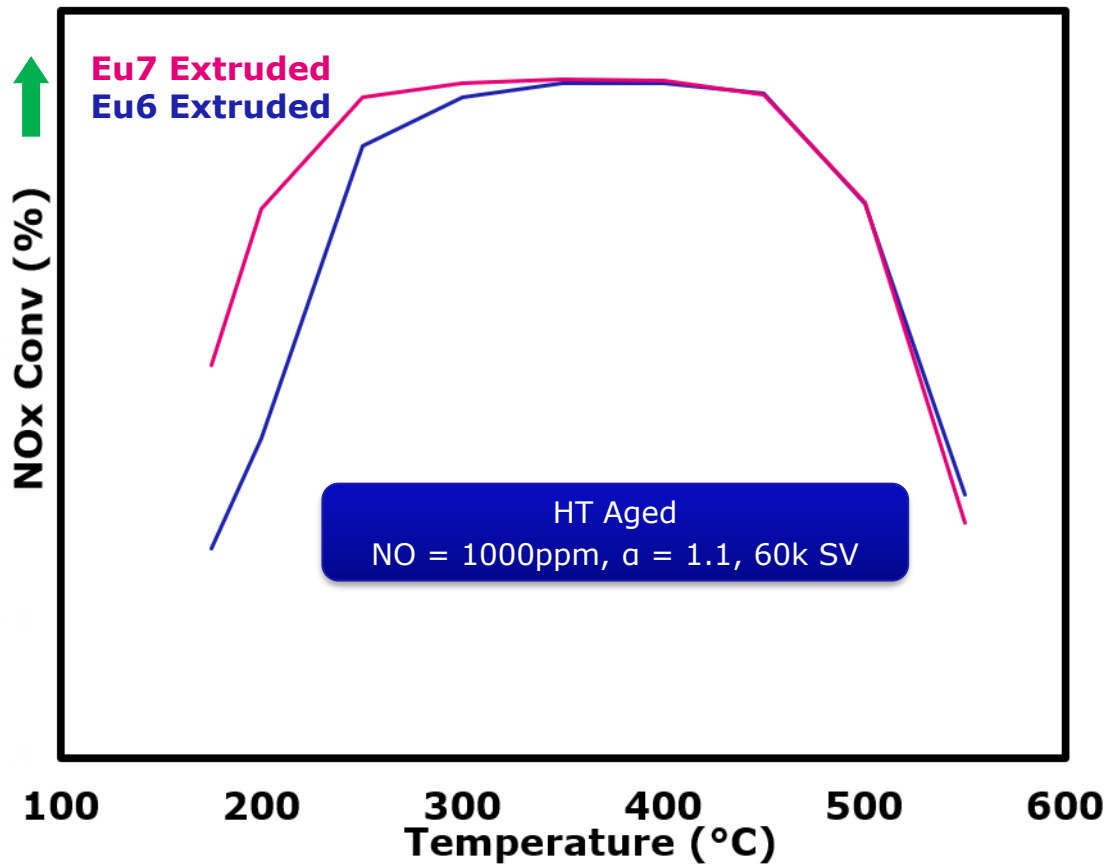
Low Temperature NOx conversion significantly improved in Eu7 Technology
Also offers N₂O make low single digit



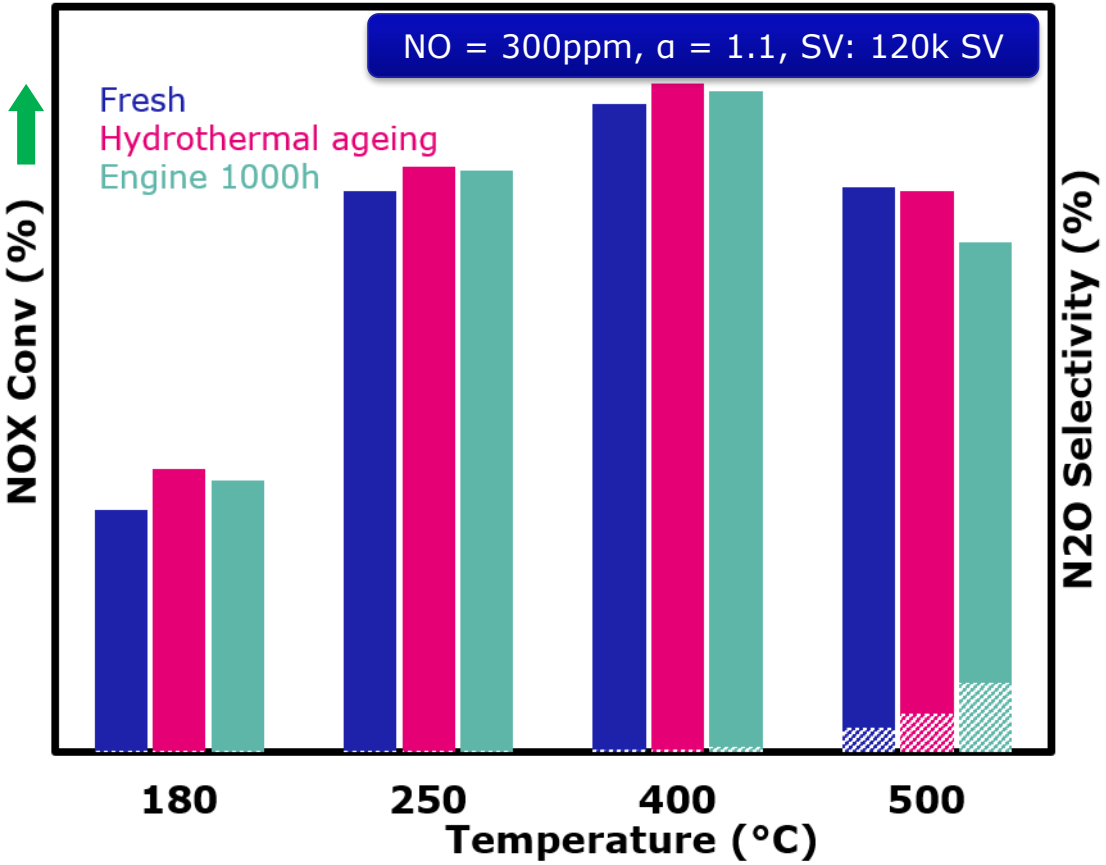
Eu7/BSVII Extruded VSCR has better low temperature performance compared to Eu6/BS VI and excellent stability



Eu7 extruded



Very Good low temp activity, while maintain high temp activity



Very good stability at 580°C, only small impact on N₂O



Introduction to Exotherm SCR (eSCR)

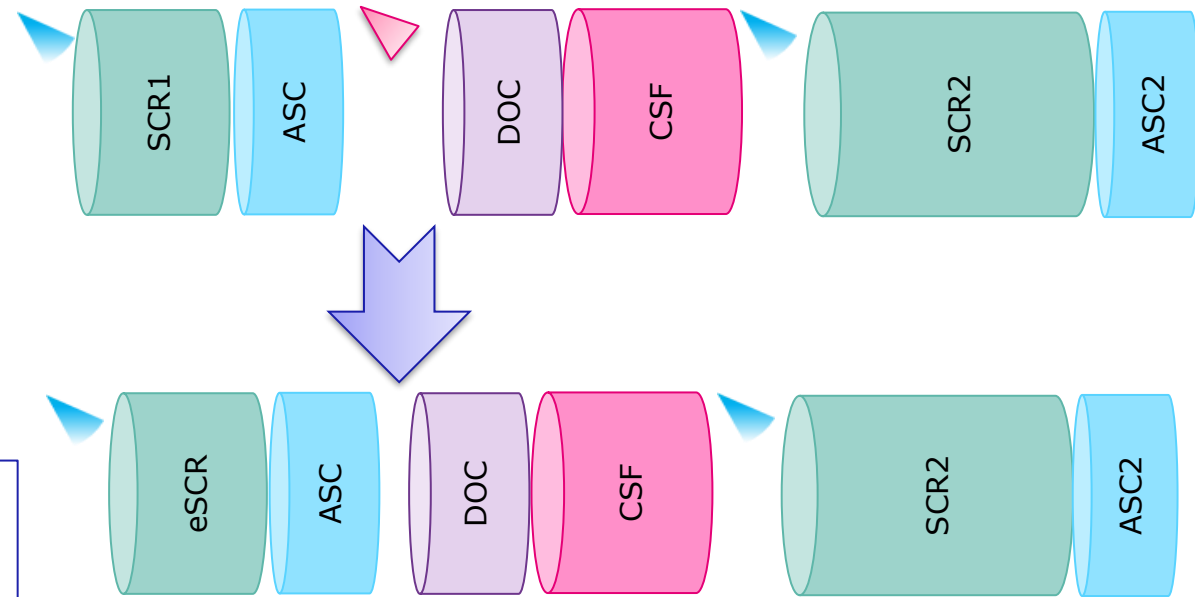
Equivalent SCR activity coupled with HC exotherm capability

- ✓ Combine NO_x conversion and HC oxidation function
- ✓ Comparable SCR activity across the operating window
- ✓ CO/HC oxidation activity, compliment downstream DOC
- ✓ Capability to generate exotherm, with HC injection, enabling self-deSO_x

Dual injection ATS with eSCR™ does not require fuel dosing and mixing before DOC

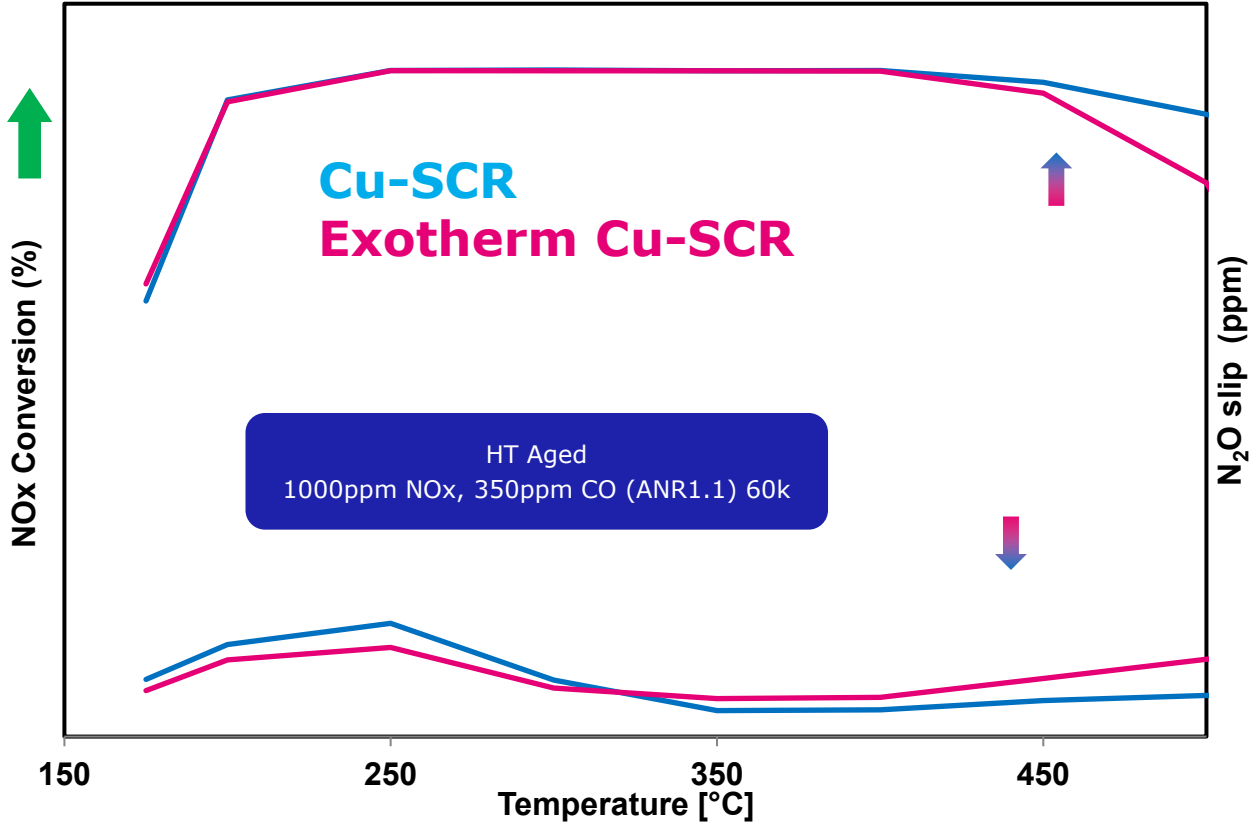
Other possible options for compact ATS:

- *ASC/DOC = 1 brick MOC*
- *DOConCSF*

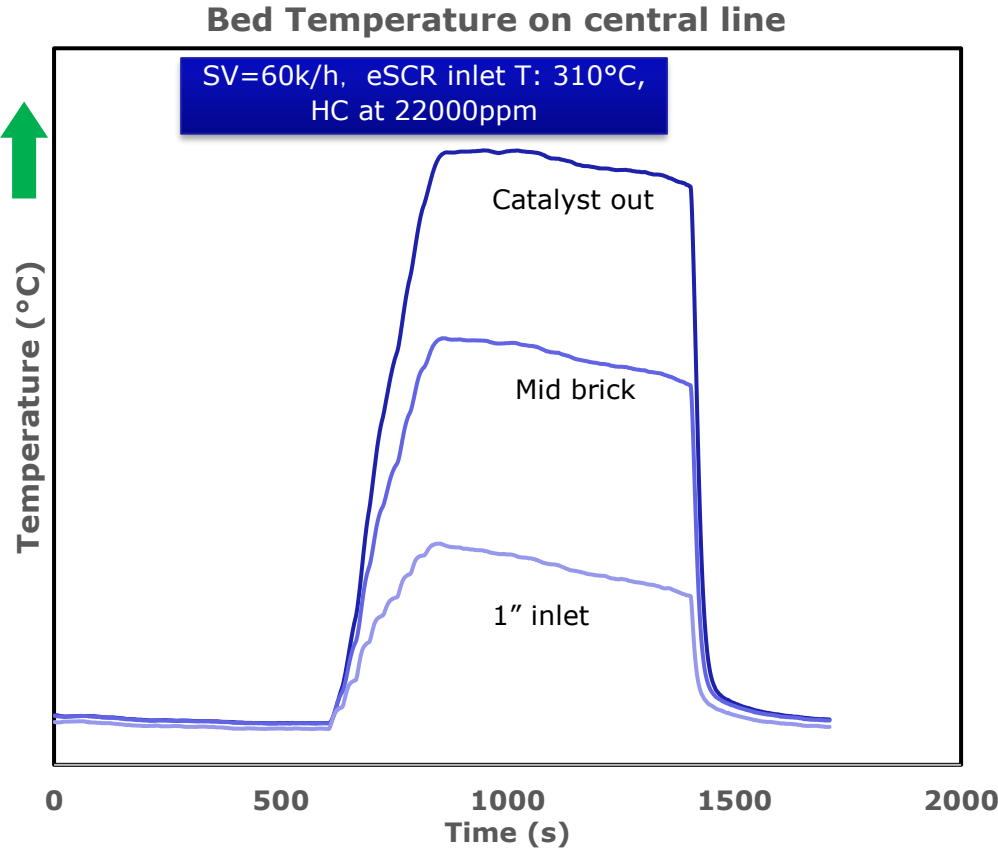


Exotherm-SCR(eSCR) offer alternate option for use of close coupled Cu-SCR in dual dosing configuration

eSCR show comparable NO_x Conv and N₂O slip, and selective HC oxidation function



eSCR can generate above 500°C outlet temp with HC exotherm

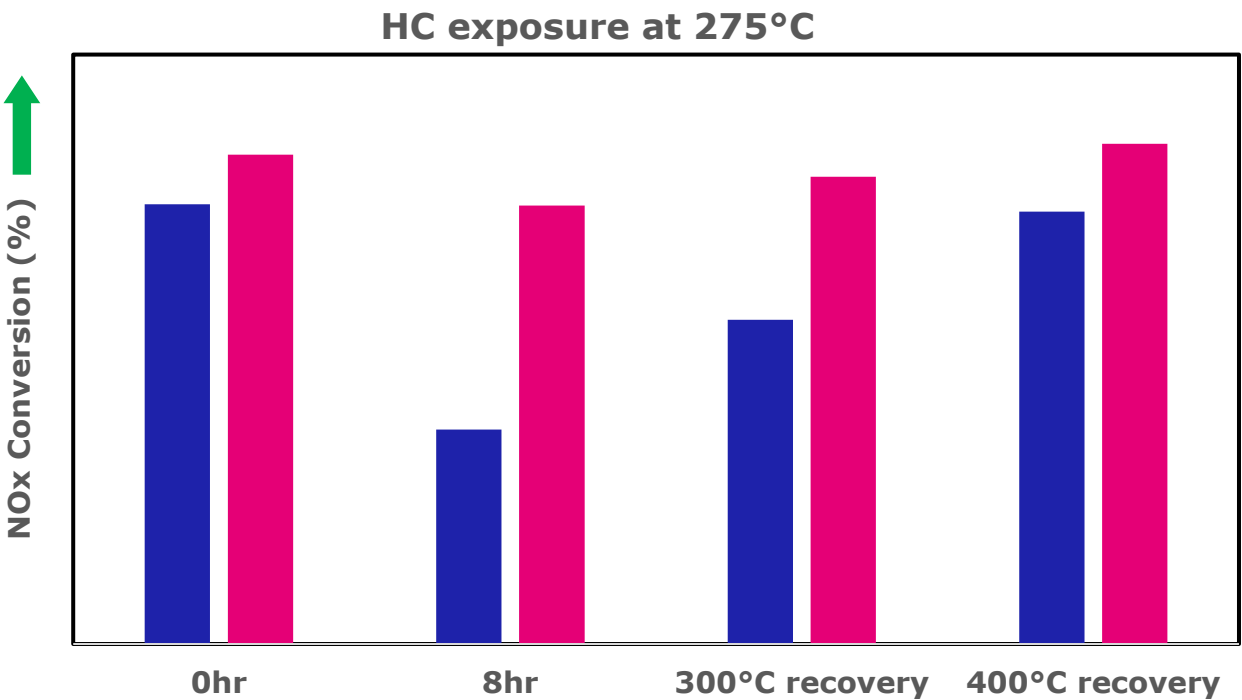
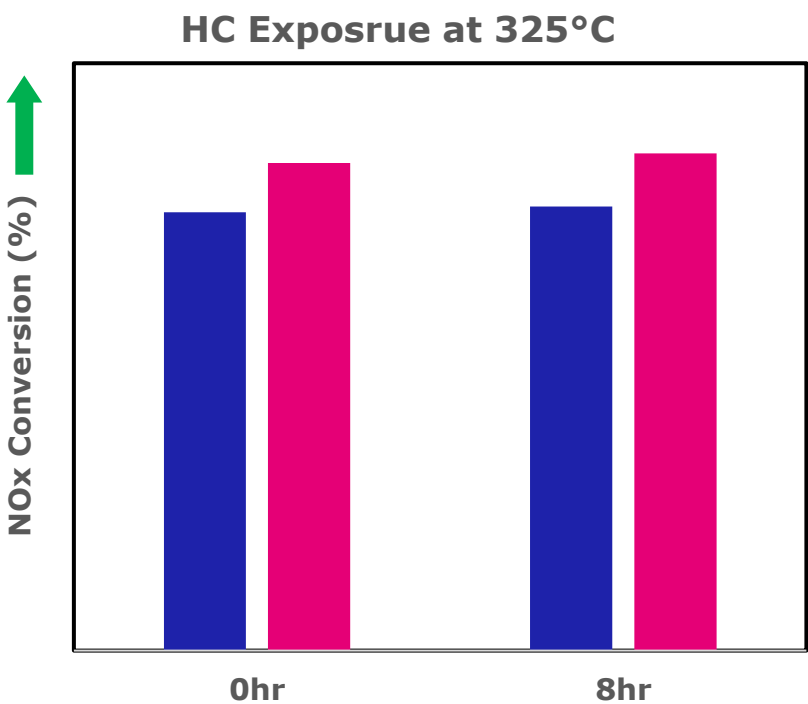


HC exposure effect on NOx Conversion

NOx conversion at 275°C and is completely recoverable at 400°C
No impact on NOx conversion observed at 325°C

NOx conv
at 200°C | at 300°C

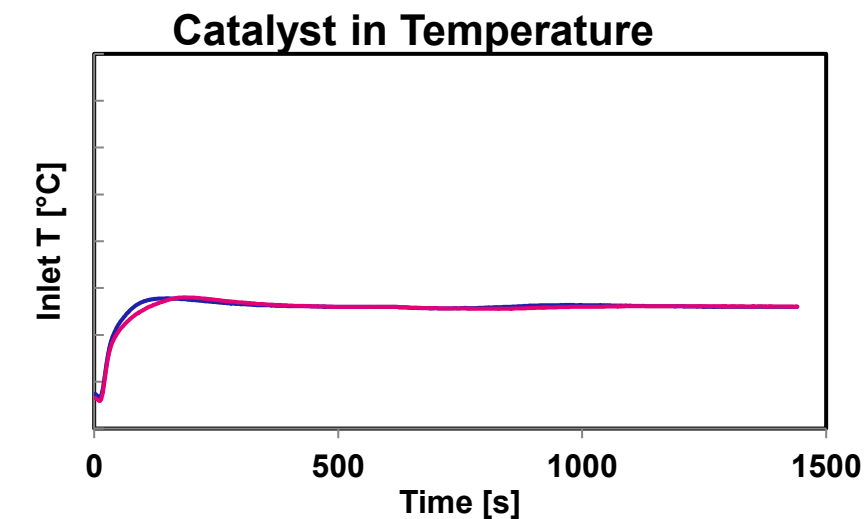
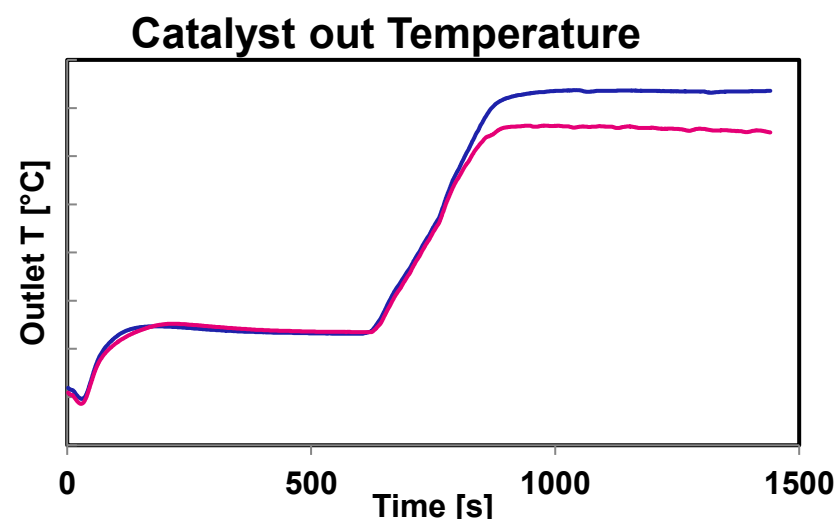
HT Aged
SV=80K, ANR=0.7



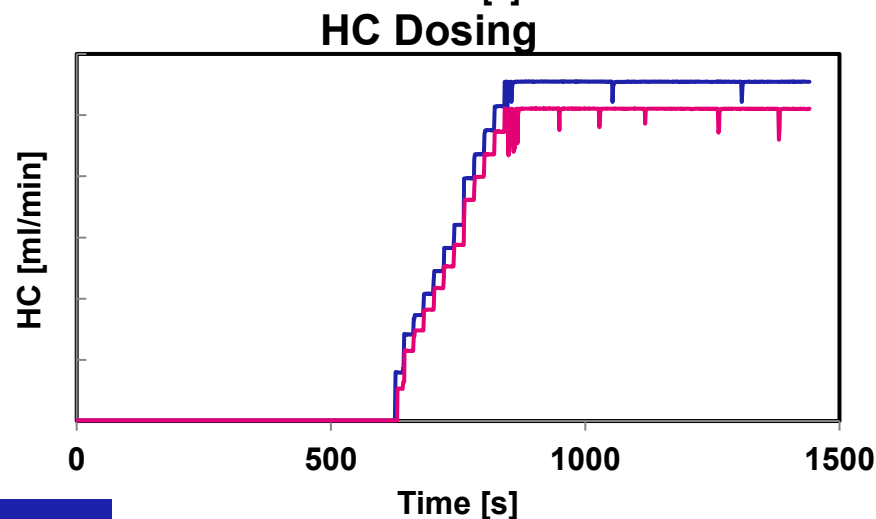
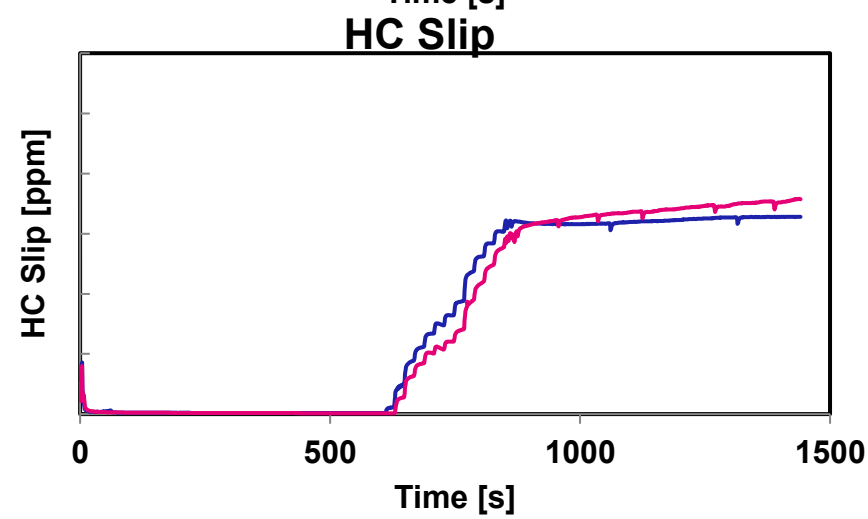
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eSCR Exotherm | sulfation and recovery

eSCR shows good exotherm after sulfation



Aged
Aged + SOx



- Use 3500ppm sulfur fuel.
- SOx 1g/L > deSOx (360°C inlet - 550°C outlet) Total 20g/L SOx
- SOx 1g/L
- Test w/o deSOx

Summary

- ✓ In this presentation JM's advanced SCR technologies to meet BSVII/Eu7 emission limits are demonstrated.
- ✓ Eu7 CuSCR show improved low temperature NOx conversion and comparable sulfation effect and recovery of performance.
- ✓ Eu7 VSCR and FeSCR show significant improvement in low temperature performance and stability
- ✓ The eSCR offers solution to light-off SCR challenges and ease of system complexity
 - ✓ eSCR show comparative NOx conversion and N₂O slip compared with SCR
 - ✓ Good recovery from HC exposure effect for NOx conversion and exotherm are observed

