

CORNING

ECT -2023 International Conference

“Leaping to Cleaner Air for Tomorrow”

Off Road Applications – Keynote

Session -4

2nd Nov 2023



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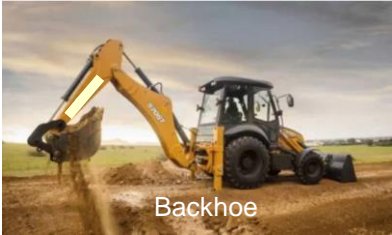
Stop. Think. Protect.

Overview on Off-Road/ Non-Road Regulations and Solutions

CEVs



Excavators



Backhoe

Tractors



Utility tractors



Farming tractors

Power Generator sets



Genset Engines

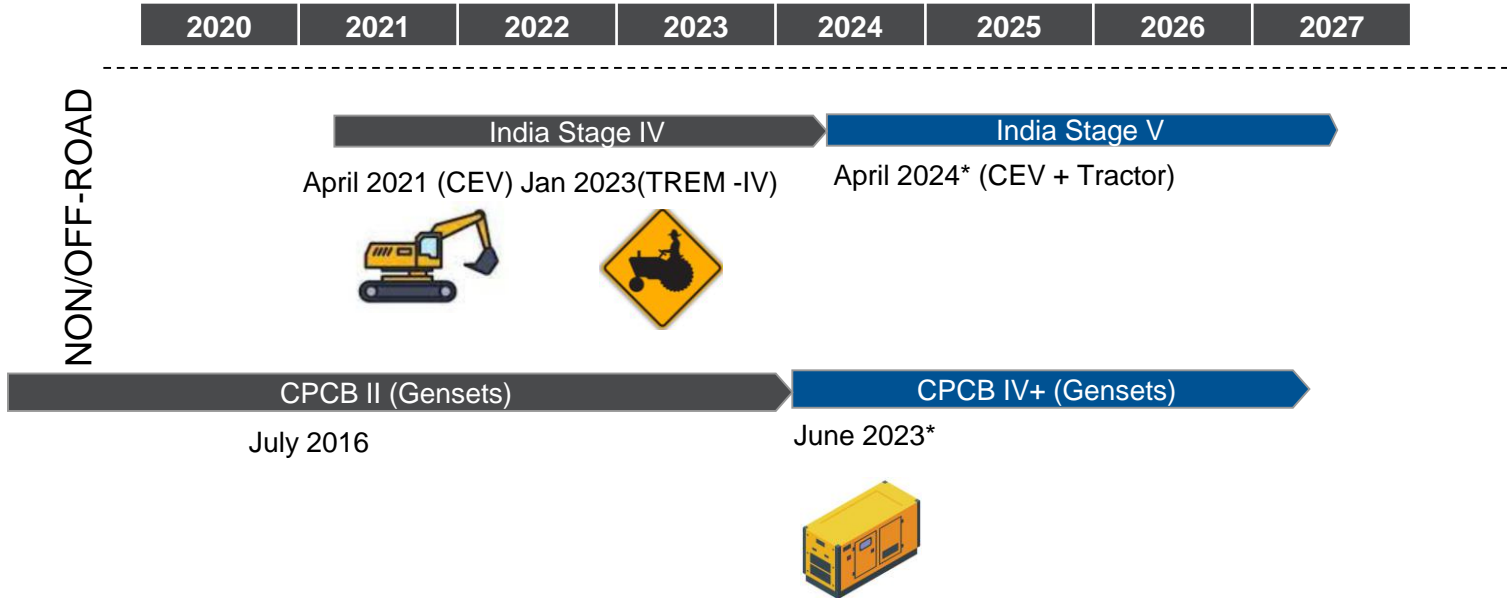


Global Regulations

Non-Road

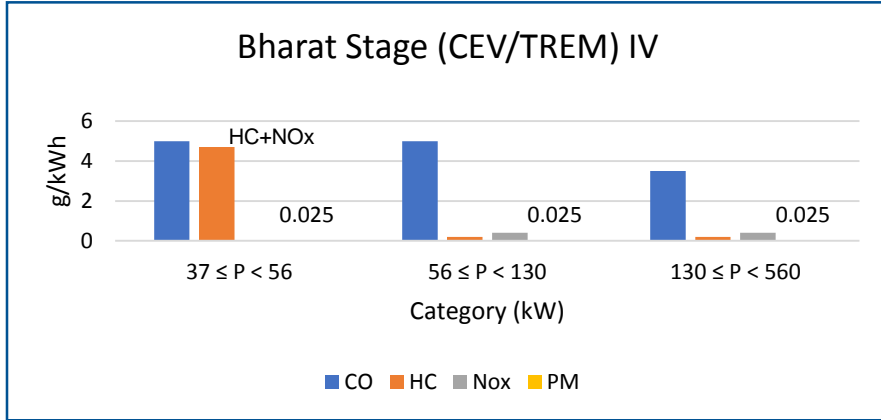
Non-Road		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	
USA	EPA	Tier 4 Final										Tier 5 (?)	
	CARB	SORE : Zero emitting < 19 kW (25 hp)								CARB Low NOx 90% + 1st GHG std (timing tbd.)			
EU		Stage IV		Stage V									
JP		Tier 4 Final										Tier 5 (?)	
Korea		Tier 4 Final	Stage V										
China		China III ~ EU III A			China IV (~ EU III B) + PN limit					China V ?			
India		BS III		BS IV (Apr '22)		BS V (Apr '24)							
Brazil		Proconve MAR-I ~ US Tier 3 / EU III A							Proconve MAR-II ~ EU Stage IV?				
Turkey		Stage IV (agriculture & forestry from 2021)			Stage V (Oct 2022)								
Chile						Stage V / Tier 4 (Oct 2023)							

India Regulatory Timeline: Off-Road/Non-Road



- TREM V- Tractors- Final implementation timeline is under discussion
- CPCB IV+ 12 months extension for CPCB-II Genset sale

CEV/BS IV : BS V (CEV/ TREM)

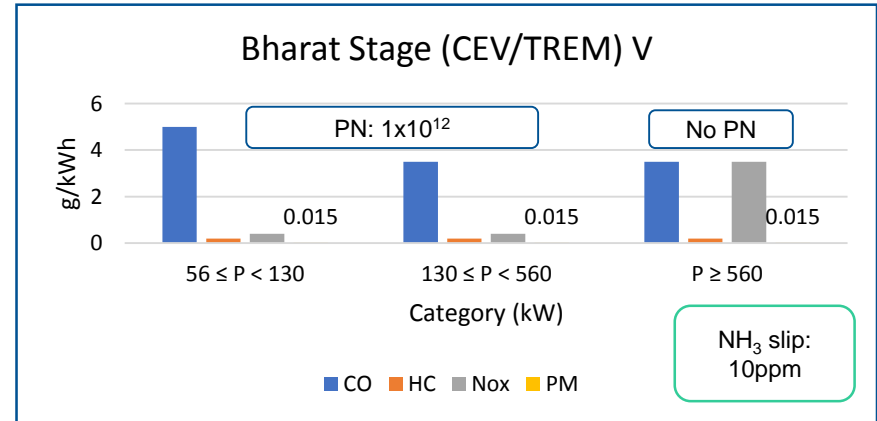
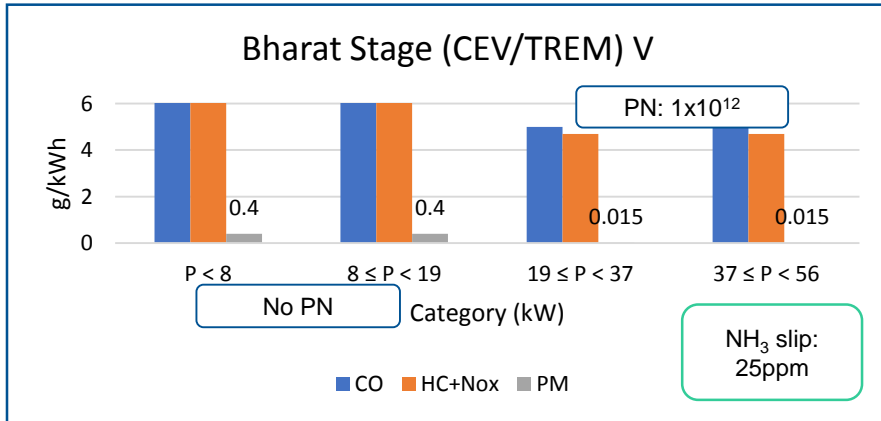


Test Cycles	
BS (CEV/TREM) IV	
All Categories	NRSC and NRTC
BS (CEV/TREM) V	
P < 8	NRSC
8 ≤ P < 19	
19 ≤ P < 37	NRSC and NRTC
37 ≤ P < 56	
56 ≤ P < 130	
130 ≤ P < 560	
P ≥ 560	NRSC

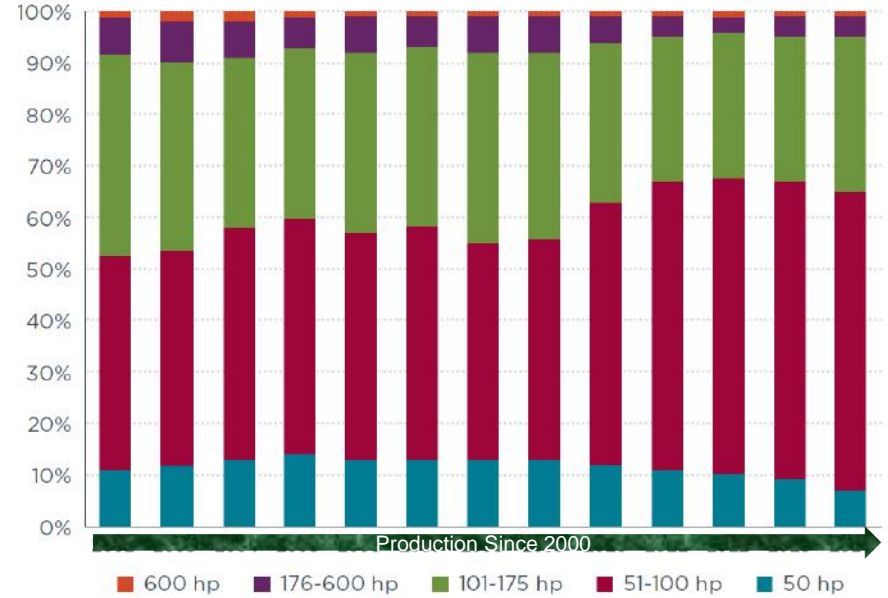
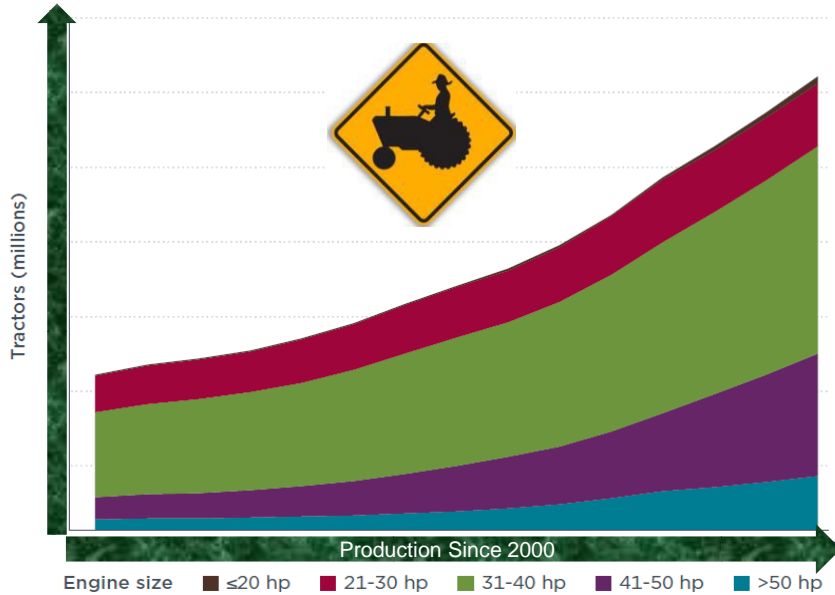
Category (Power Band)	Emission durability period (hours)
≤ 37kW (constant speed Engines)	3000
≤ 37kW (Variable speed Engines)	5000
> 37 kW	8000

Deterioration Factor

Test cycle	CO	HC	NOx	PM
NRSC	1.3	1.3	1.15	1.05
NRTC	1.3	1.3	1.15	1.05



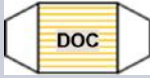





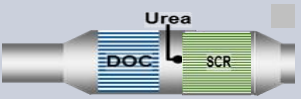
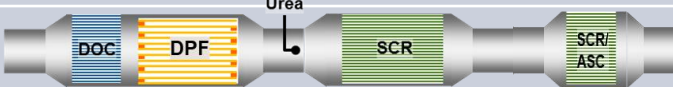


Engine Ratings in India Off-Road/Non-Road market



WORKING PAPER

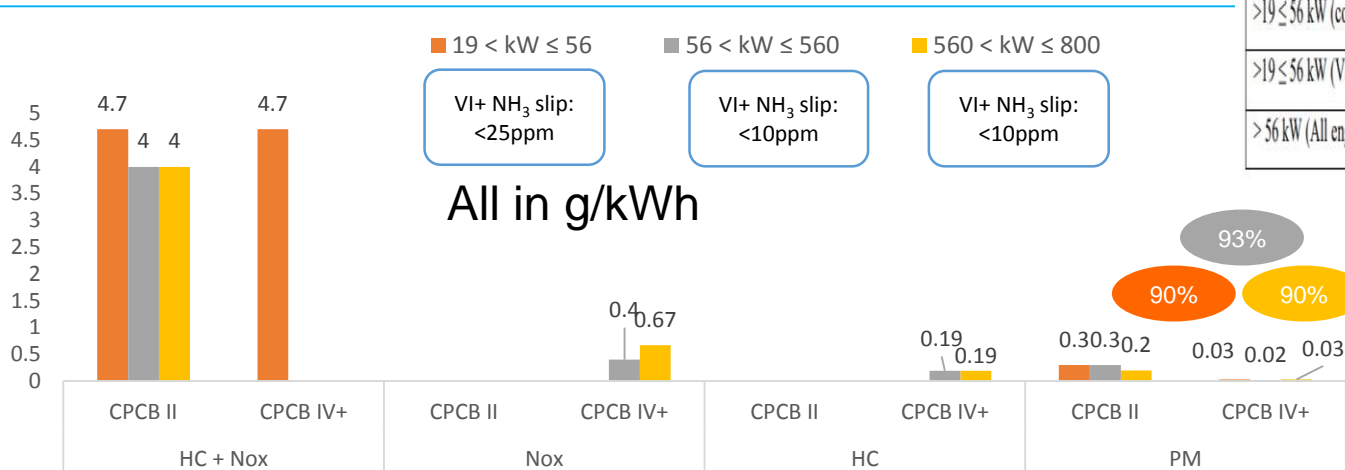


System Configurations Considering Engine Rating

S NO	Engine Rating (P/ kW)	TREM/CEV- IV	TREM/CEV- V	Remarks
1	P<8	Non-Regulated		In CI engine relevant options and in Positive ignition consider TWC only
2	8>P<19			
3	19<P<37			Most of Agri machinery poses in this range with NA Engines
4	37<P<56			
5	56<P<130			Most of CEVs poses in this Range with TC Engines
6	130<P<560			
7	P>560	Non-Regulated		NO PN regulation but NH3 slip control mandatory

CPCB II Vs CPCB IV+

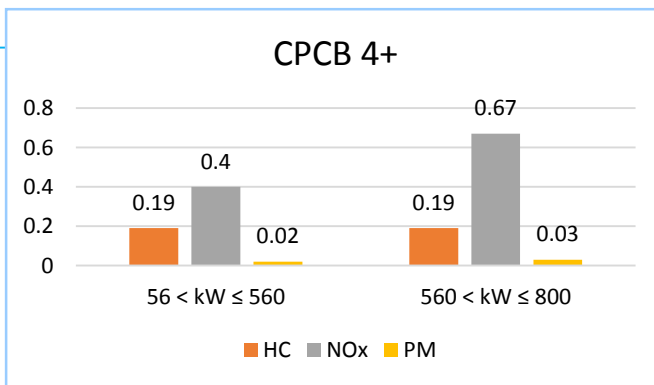
Category (Power Band)	Emission durability period (hours)	Engine Category
>19 ≤ 56 kW (constant speed Engines)	3000	PI and CI
>19 ≤ 56 kW (Variable speed Engines)	5000	PI and CI
>56 kW (All engines)	8000	PI and CI



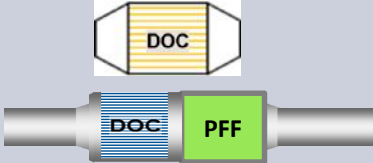

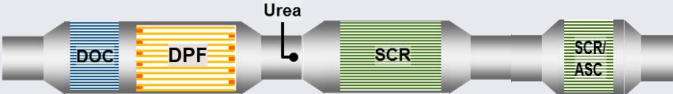
Emission limits for portable Genset up to 19kW powered by PI engines (up to 800cc engine displacement)

Category Engine Displacement in (CC)	CO	NOx+HC
	g/kWh	
Up to 99	<250	<10
>99 and upto 225	<250	<10
>225 and upto 800	<250	<10

- No change in CO : 3.5 g/kWh.
- No change in emission regulation for ≤ 19KW.
- Only PM reduction for 19 < KW ≤ 56.
- HC, Nox, PM to be reduced for CPCB 4+
- 0.7 Smoke Limit (light absorption coefficient, m-1) same in II & IV+



System Configurations Considering Engine Rating

S NO	Engine Rating (P/ kW)	CPCB II	CPCB IV+	Remarks
1	P<8	No need of ATS	No ATS	No Change in regulation
2	8<P<19			
3	19<P<56			Most of systems will be w/o SCR
5	56<P<560			Expected NOx reduction >90%
6	560<P<800			

All PI Engines will need TWC only (including portable Gensets)



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*Helping our customers meet new emissions standards and enabling **cleaner air** worldwide.*





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