

HHP Tier 4 Final:

Meeting Emissions While Satisfying Customer Expectations

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The Emissions Challenge

“The 2015 emissions regulations present the most significant challenge to our customer’s diesel powered equipment design and operation in recent history...”

...and Cummins has the right solution.”





“Right Technology Matters” to Mining Customers

- Tier 4 Final poses unique challenges for HHP
 - Greater diversity of applications and OEMs
 - Greater diversity of emissions certifications
- Finding the *Right Technology* solution is more than meeting emissions regulations
 - Total cost of ownership (TCO), machine integration, power/performance, etc.
- Cummins SCR solution – the *Right Technology* for HHP customers

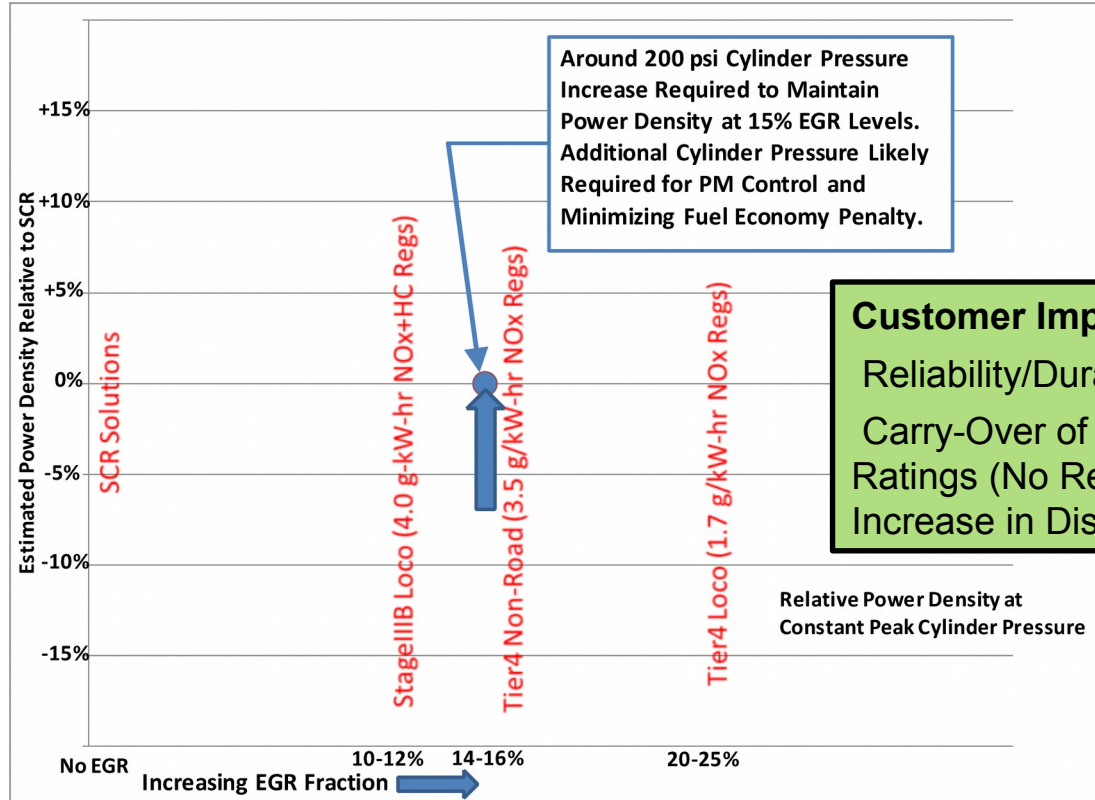


Tier 4 Final Emissions Standard

Emissions Standard	NOx (g/kW-hr)	PM (g/kW-hr)	Implementation Date
MINING and OIL & GAS (Land based)			
EPA Nonroad Tier 4	3.5	0.04	January 1, 2015
RAIL			
Euro Stage IIIB Locomotive & Railcar	4.0 (NOx + HC)	0.025	January 1, 2012
EPA Locomotive Tier 4	1.7	0.04	January 1, 2015

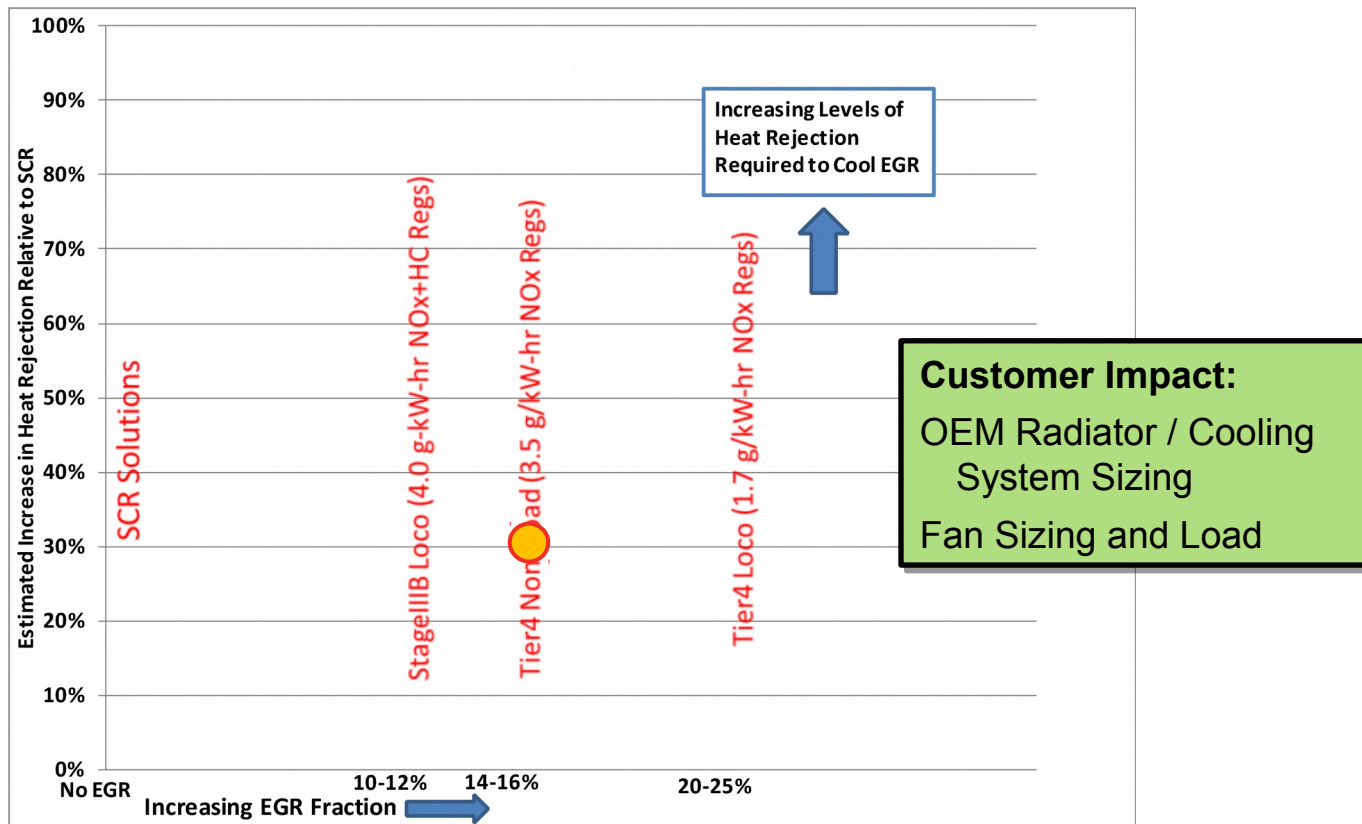


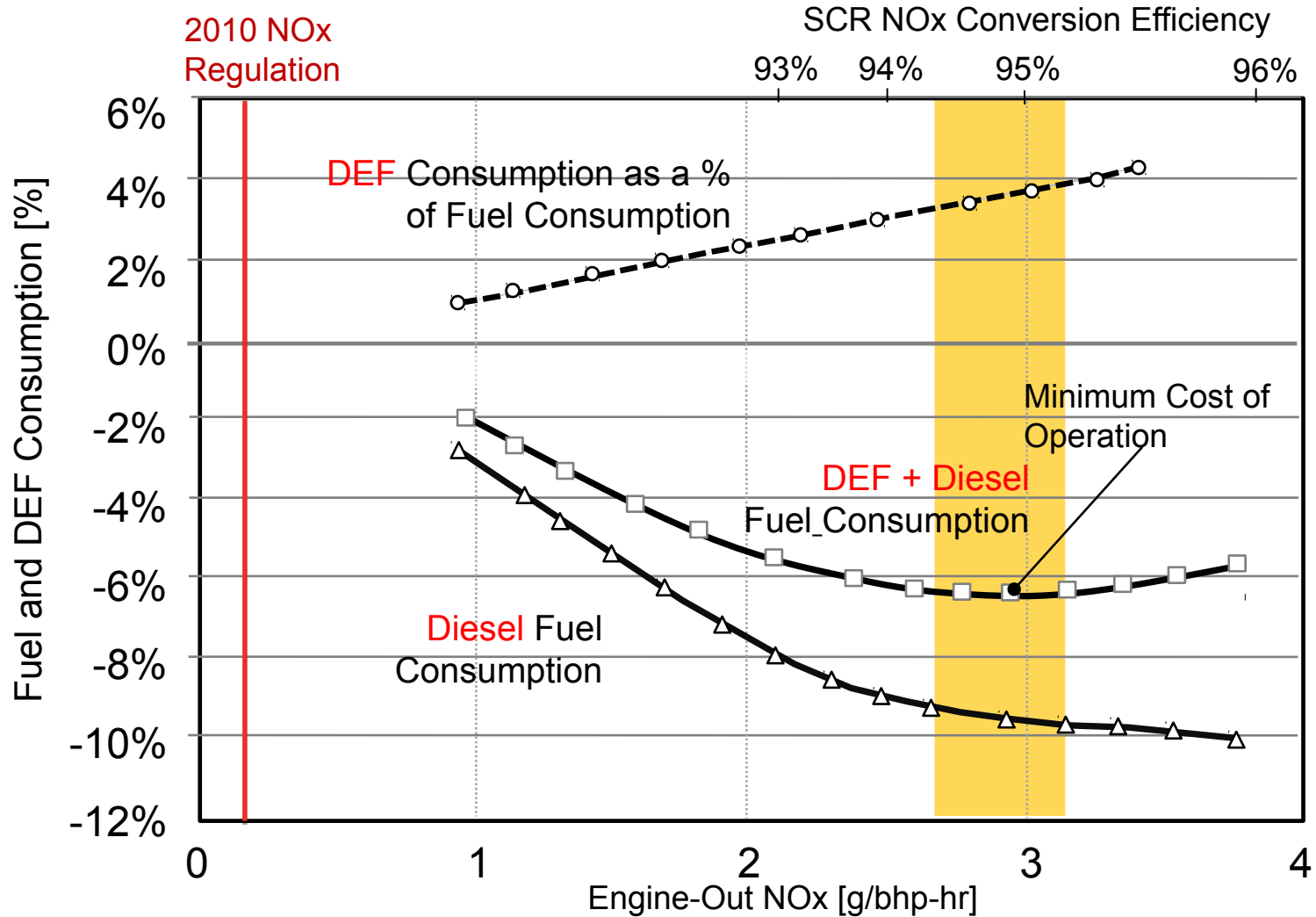
Power Density Implications – CEGR vs. SCR



Customer Impact:
Reliability/Durability
Carry-Over of Existing Ratings (No Required Increase in Displacement)

Nonroad CEGR Engines Heat Rejection – ~30% Increase over SCR Engines







Base Engine Features & Benefits

Starts with

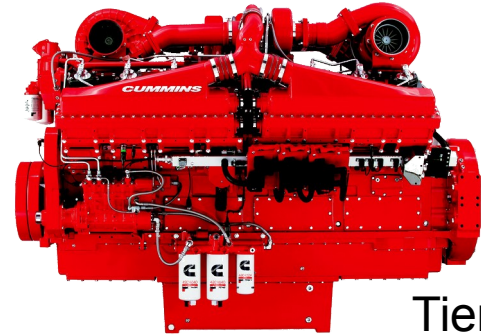
- ✓ Cummins reliability reputation

Then adds

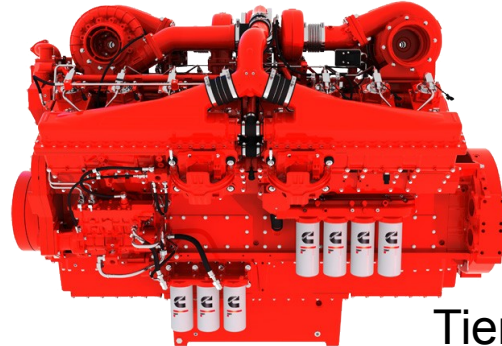
- ✓ Advanced combustion technology
- ✓ Improved crankcase breather

Results in

- ✓ Low particulate generation
- ✓ Improved fuel efficiency
- ✓ Similar heat rejection to Tier 2
- ✓ Same or better power as Tier 2
- ✓ Same or better performance



Tier 2 QSK50

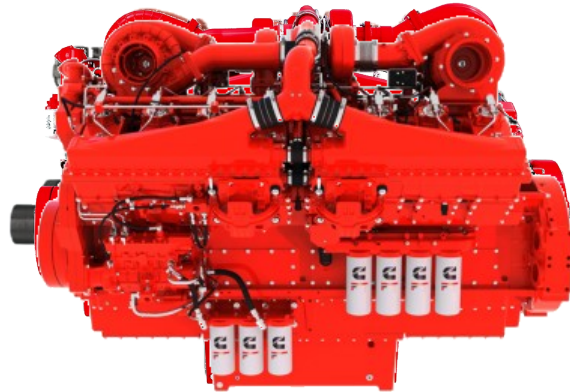


Tier 4 QSK50

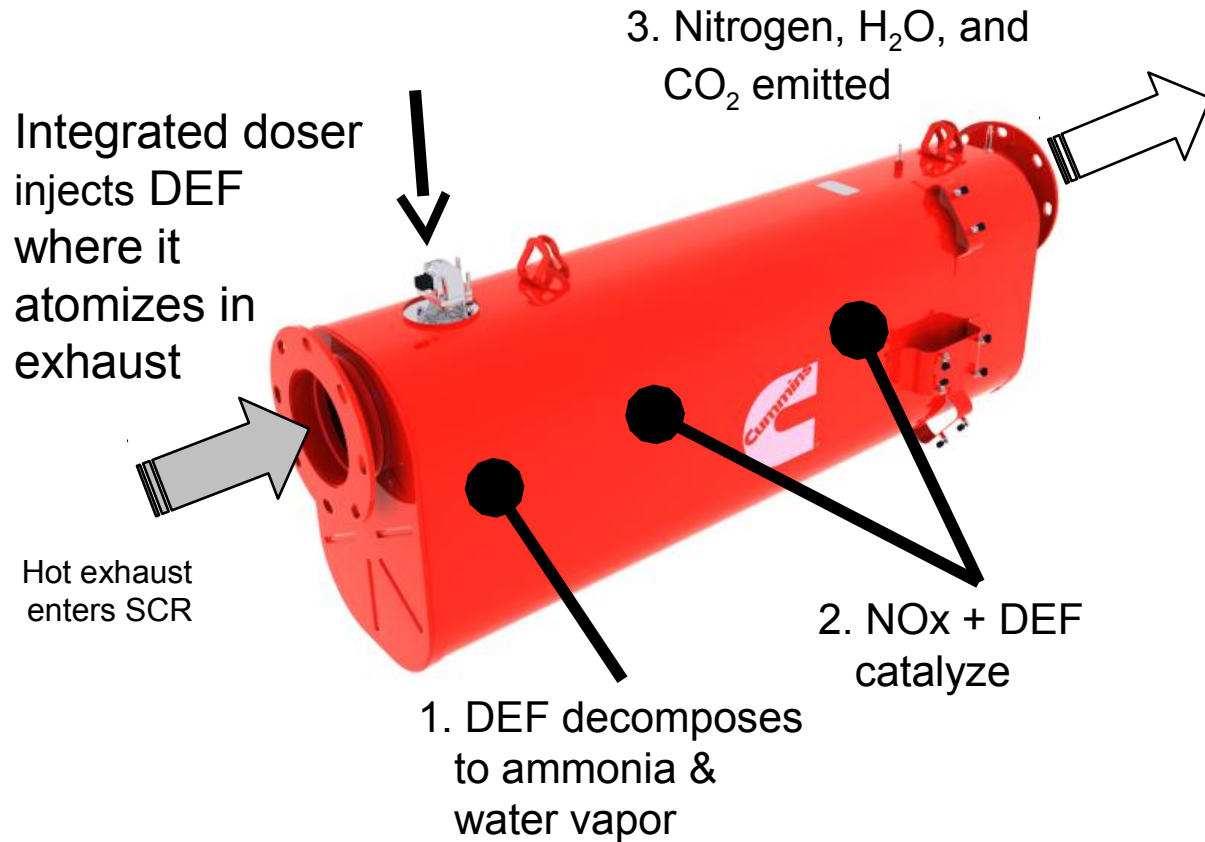
“Drop-in” Replacement

- Engine is basically a “drop-in”
 - Keeps Tier 4 integration design simpler
 - Allows same machine for the world wide market = minimal mounting changes
 - Fewer changes keeps reliability high

K5000
QSK50
Tier 4



Selective Catalyst Reduction Fundamentals





Cummins Tier 4 Final Solution: HPCR and SCR

- **Simplicity**
 - PM controlled in-cylinder;
NOx reduced in the SCR
 - Engine integration: “drop-in”
 - SCR units replace silencers
- 3% to 7% **less fuel consumed**
- Maintains **performance**
- Maintains **durability**
- **Proven** SCR technology

