

Emissions Solutions

Edward Woods, Territory Manager
Caterpillar Emissions Solutions Group



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Caterpillar Corporate Initiative: Clean Air

IT'S A WIN / WIN:

**We can be environmentally responsible
and help customers stay competitive**

- **As a company and as individuals, we want to minimize our impact on the environment in every area of our business**
- **We're meeting the emissions challenge through:**
 - **Emissions retrofit solutions for existing machines and engines**
- **Our current focus is on North America;**
 - **2008: Evaluation of EU opportunities;**
 - **2010: Latin America & Asia**

www.cat.com/emissionsolutions

Cat Sustainability Report - 2007

2020 GOALS FOR OPERATIONS



Reduce recordable workplace injury rate to 0.6 and lost-time case rate due to injury to 0.15

20%

Use alternative/renewable sources to meet 20% of our energy needs



Hold water consumption flat



Increase energy efficiency by 25%



Send zero waste to landfills by reducing, reusing and recycling waste

LEED

Design all new construction to meet Leadership in Energy and Environmental Design (LEED) – or comparable – green building criteria

↓25%

Reduce absolute greenhouse gas emissions from existing facilities by 25%

Air Quality and the EPA

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Clean Air Act: History

- 1955: Air Pollution Control Act establishes research funds
- 1963: U.S. Congress passes Clean Air Act
- 1967: Air Quality Act Amendment establishes emission reduction timetables
- 1970: Clean Air Act places EPA in charge of emissions reductions
- 1977: Clean Air Act amendments become law
- 1990: Clean Air Act included regulations for off-road diesel exhaust emissions

State Implementation Plans (SIP)

GOAL:

To move states into compliance with air standards

EPA approves the plan with stipulations

- Highway (construction) funds are subject to compliance
- Metro areas must have transportation projects approved

If states don't meet plans, they take action

- Mandates on emission requirements
- New taxes
- Emissions regulations, even for existing engines
- Retrofit programs

EPA Regional Offices



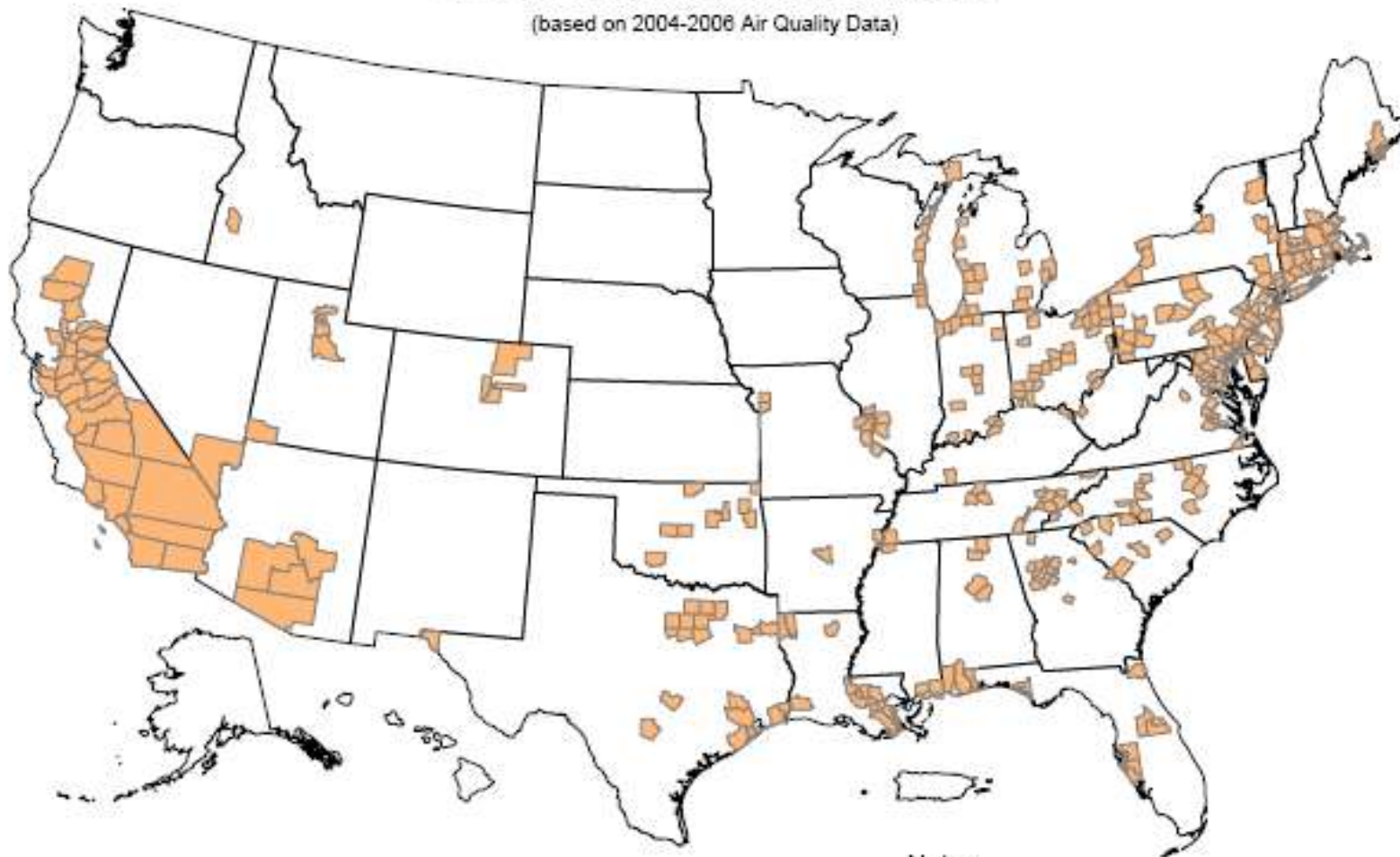
Air Quality Standards and Non-Attainment



Estimates are based on the most recent data (2004 – 2006). EPA will not designate areas as nonattainment on these data, but likely on data from 2006 – 2008 or later, which we expect to show improved air quality.

Counties with Monitors Violating the 2008 8-Hour Ozone Standard of 0.075 parts per million (ppm)

(based on 2004-2006 Air Quality Data)



Notes:

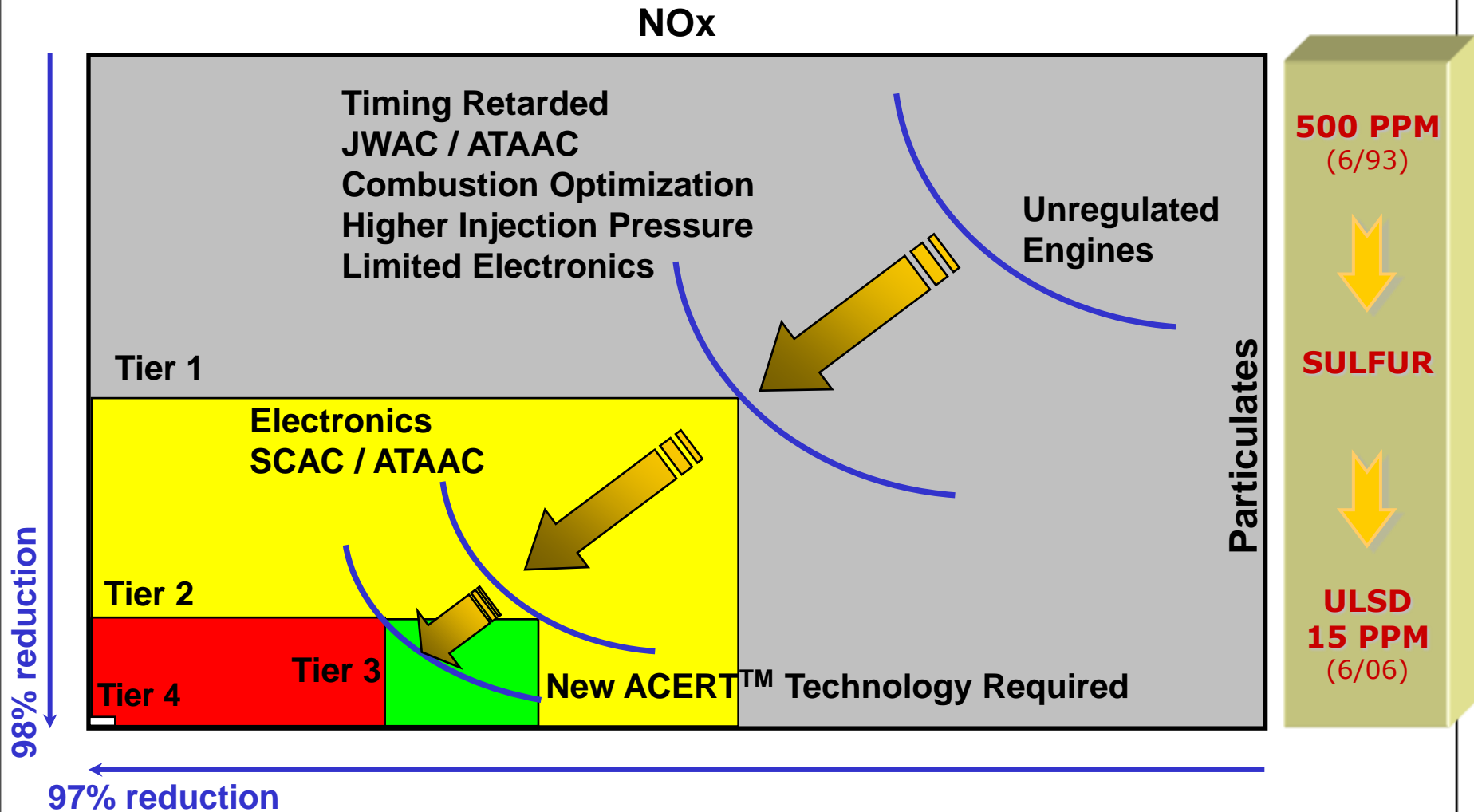
¹ 345 monitored counties violate the 2008 8-hour ozone standard of 0.075 parts per million (ppm).

² Monitored air quality data can be obtained from the AQS system at <http://www.epa.gov/ttn/airs/airsaqs/>

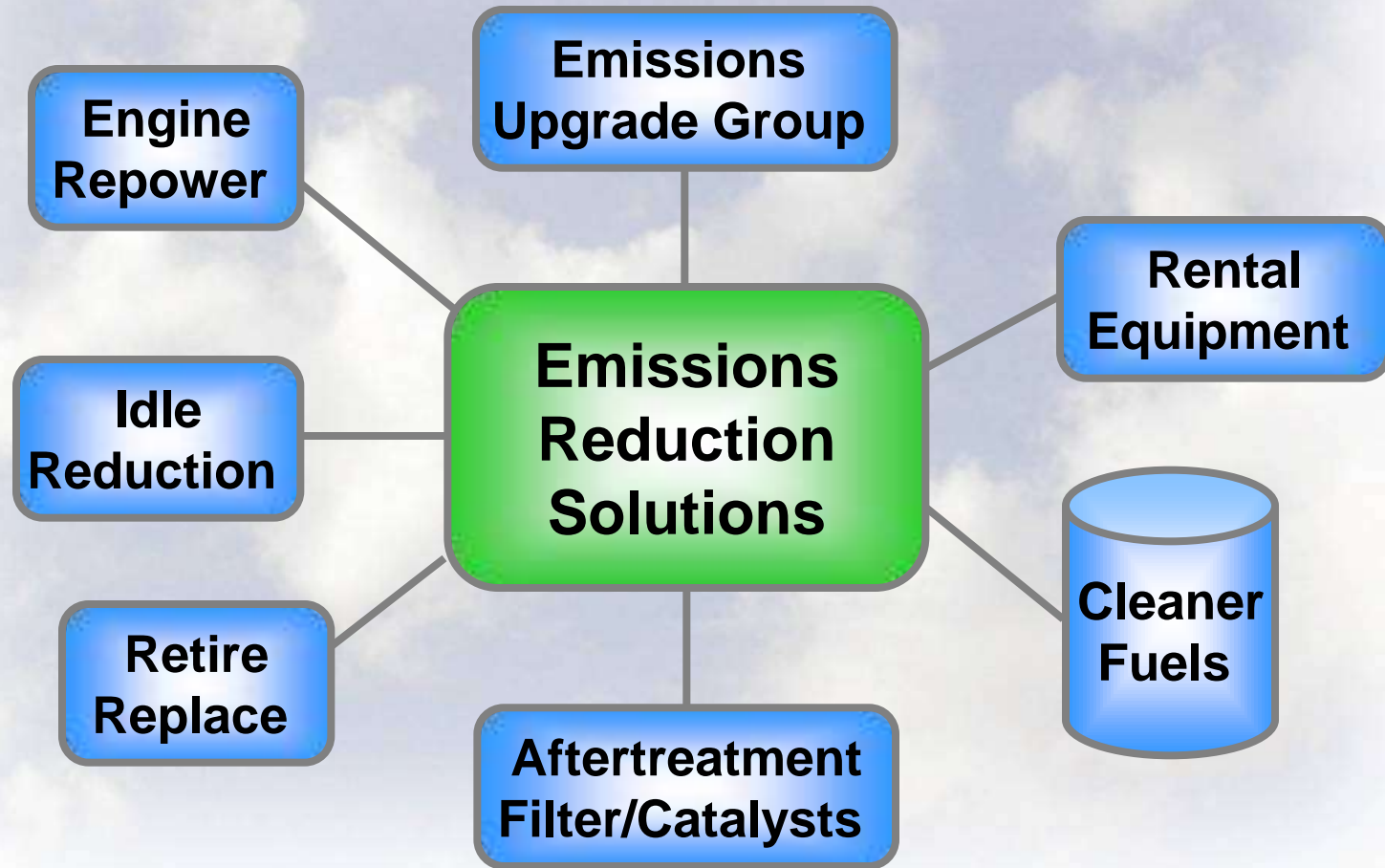
Influencers to Reducing Emissions

- **MSHA**
- **Visibility**
 - Class 1
 - National Park
- **Corporate Sustainability**
 - Construction
 - Natural Resource
- **Community Growth**
 - Quality of Life
- **Special Interest Groups**
 - Sierra Club
 - American Lung Association

Emissions Regulation Challenge



Emission Reduction Solutions Overview



Emission Reduction Strategy



Emissions Strategy

Engine-based



Aftertreatment-based

Mobile

Stationary

On-Road

Off-Road

- DOC (HAPS)
- DPF (PM)
- SCR (NOx)

- DOC (HC)
- DPF (PM)

- DOC (HC)
- DPF (PM)

90-95% reduction in HC, PM and NOx emissions.

DOC: Diesel Oxidation Catalyst
 DPF: Diesel Particulate Filter
 SCR: Selective Catalytic Reduction
 HC: Hydrocarbons
 HAPS: Hazardous Air Pollutant Standards
 PM: Particulate Matter
 NOx: Nitrogen Oxides

Stationary urea-SCR Systems

Selective Catalytic Reduction (SCR)

- > 90% NOx Reduction (Open Loop)
- > 95% NOx Reduction (Closed Loop)
- Requires Urea Additive & Controls
- Large Stationary Engines



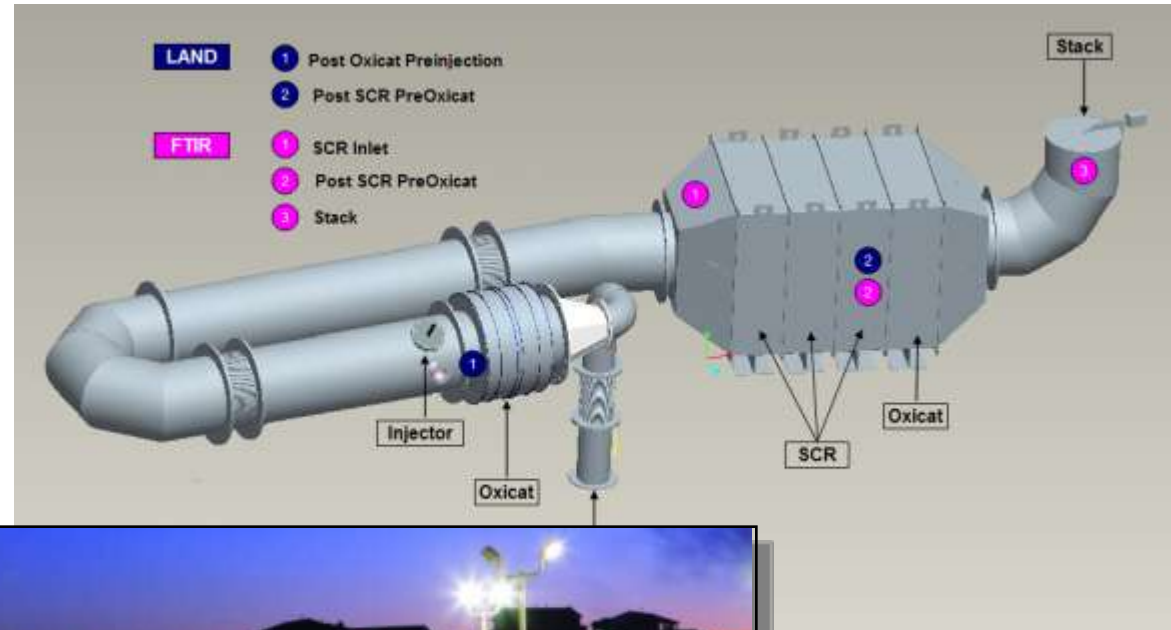
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Stationary After-treatment Products – SCR and Oxidation Catalyst

▪ Emission Reduction

- Up to 95% NOx
- Up to 90% CO, HC



SCR Unit Reference List (Partial)

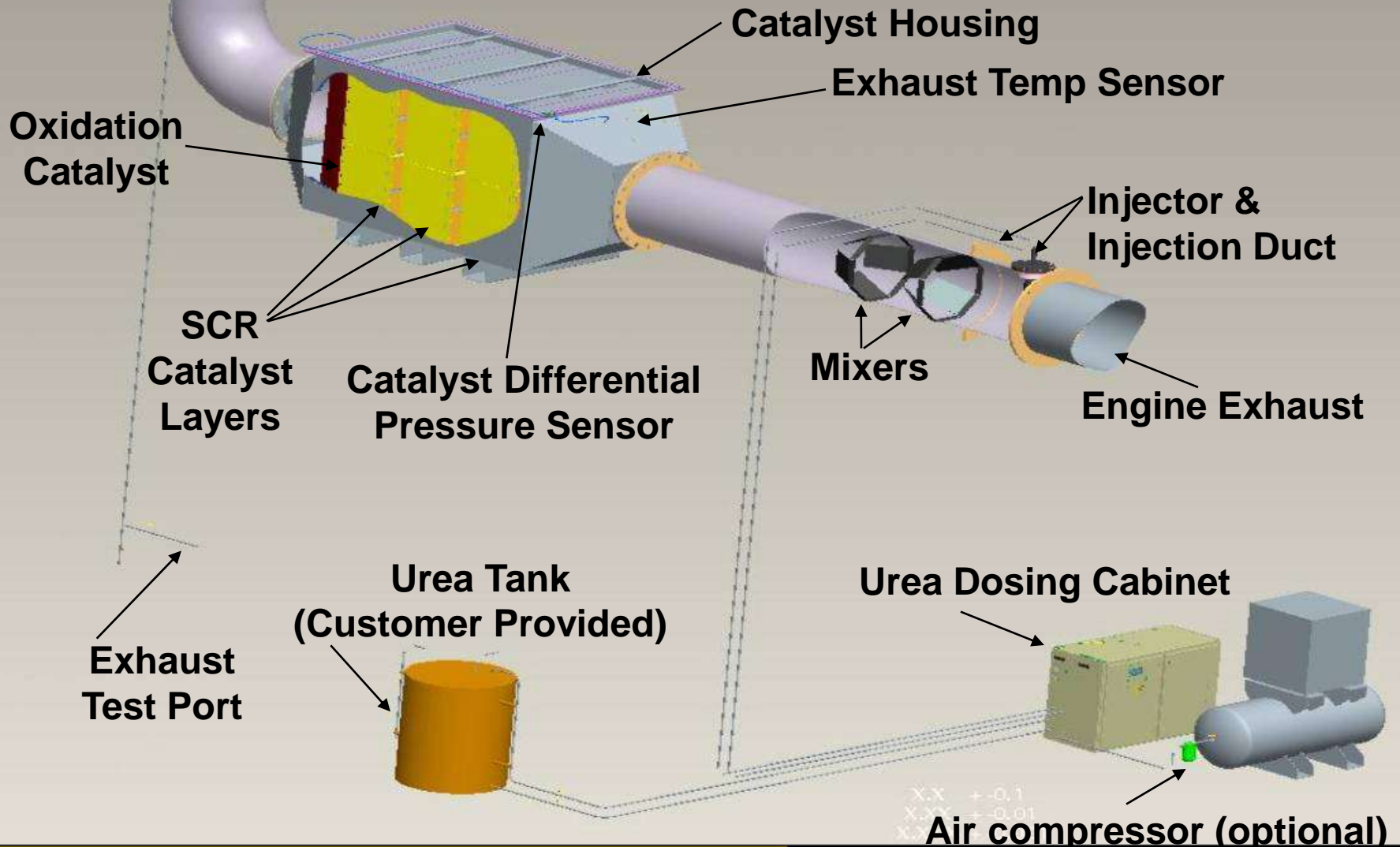
- BIPCO (3) 3516 (1) 3512
- Victorville (2) G3516B LE
- CMEEC (1) 3516C
- Mohegan Sun (2) 3516C
- Indonesia (1) 3616
- Toromont (4) 3516CHD
- Alban Cat (2) 3516CHD
- ESPN (8) 3516C
- Geneseo (1) 3616
- Heber City (2) C-175



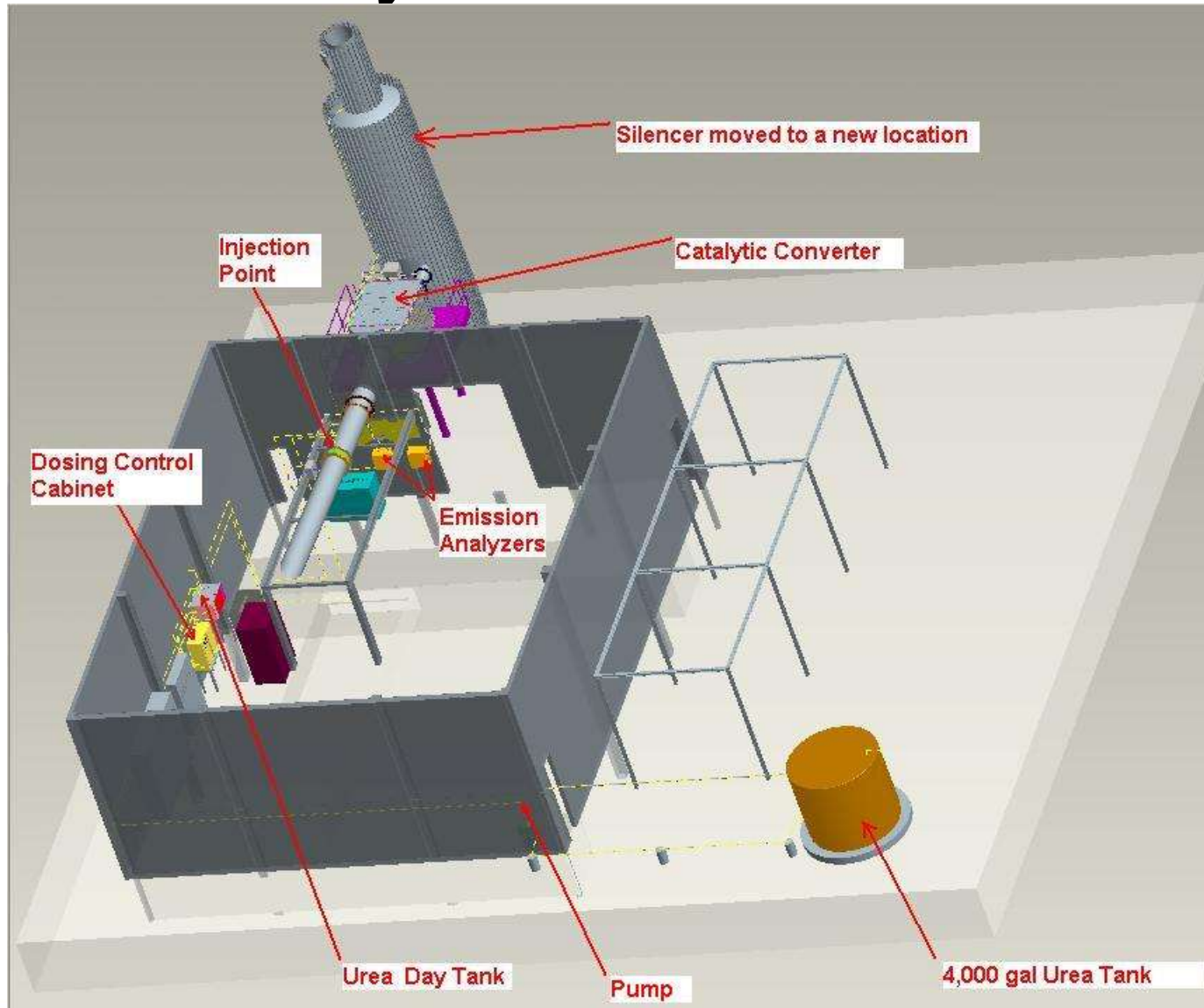
Available for
3400-3600
Engines

Major SCR components

System Overview



System Overview



After SCR Installation

View from Inside



View from Outside



WITHOUT INJECTION OF UREA



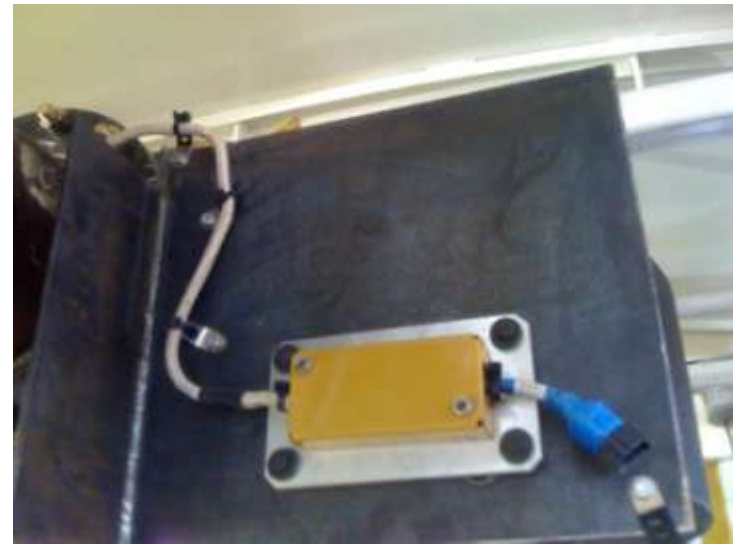
WITH INJECTION OF UREA



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NOx Analyzer vs. NOx Sensor



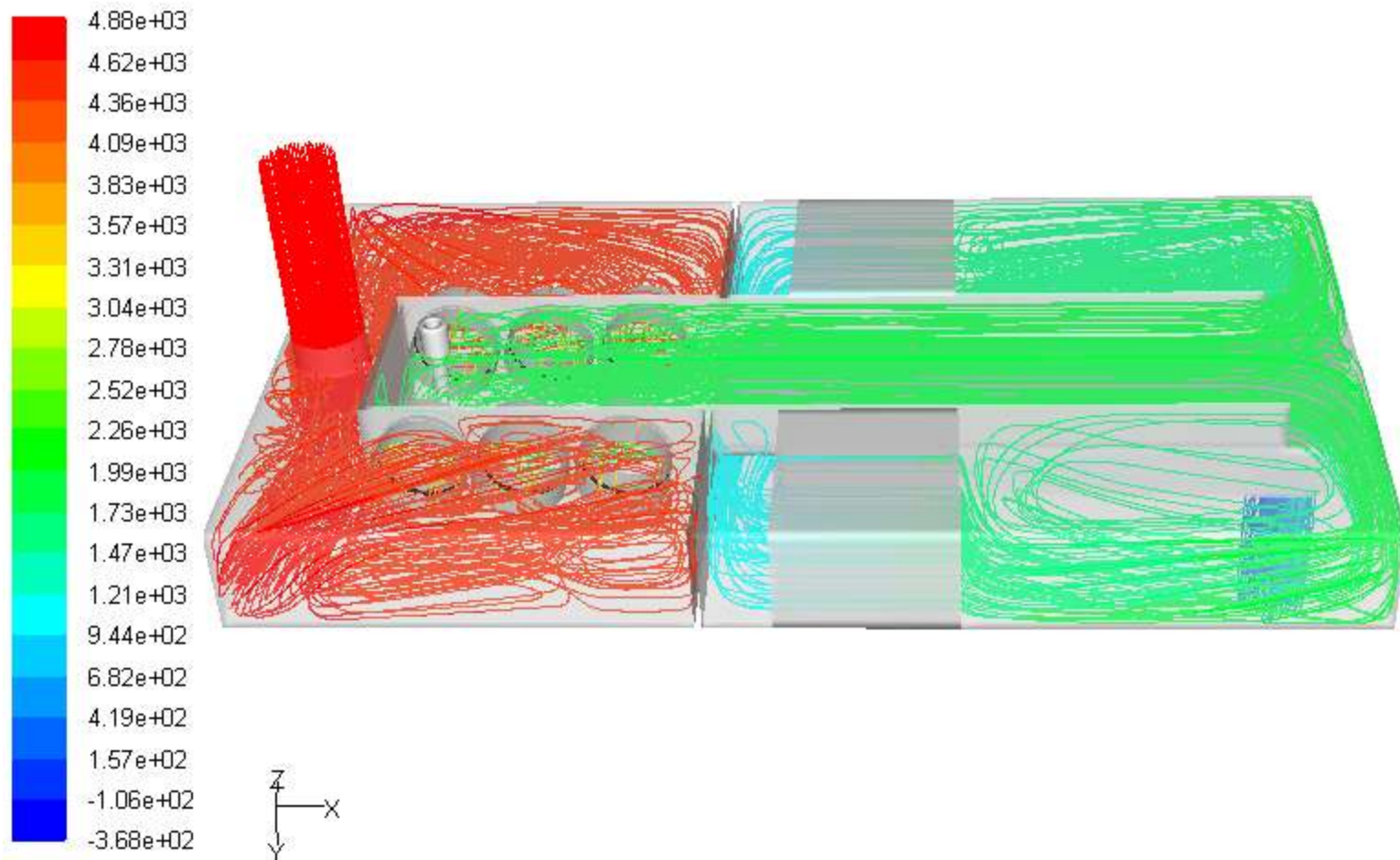
Aftertreatment – Not Just Bolting Parts Together



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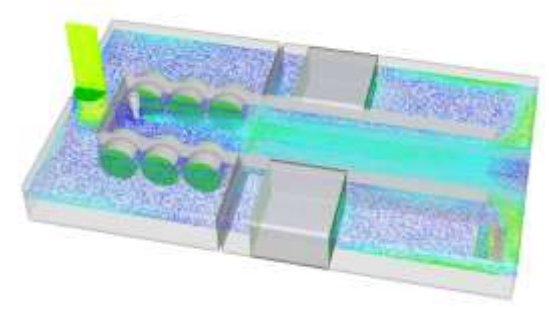
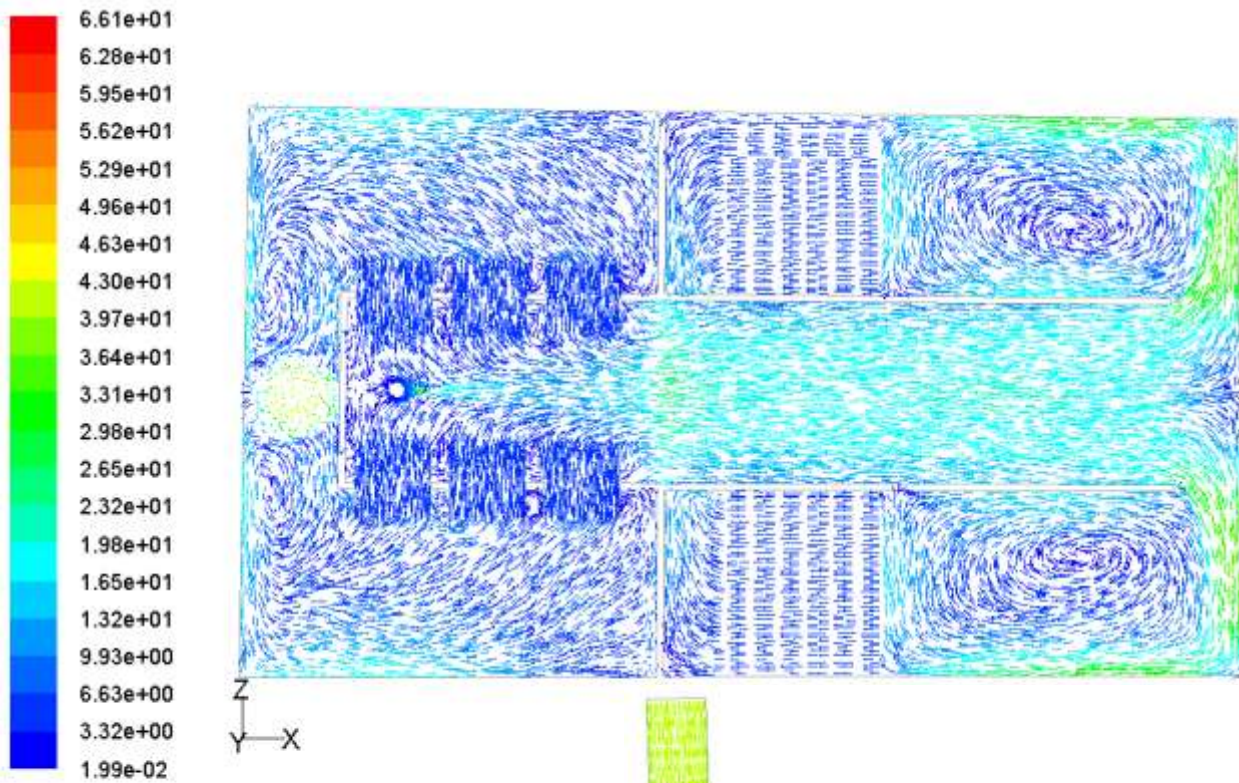
Path Lines (Colored by Total Pressure)



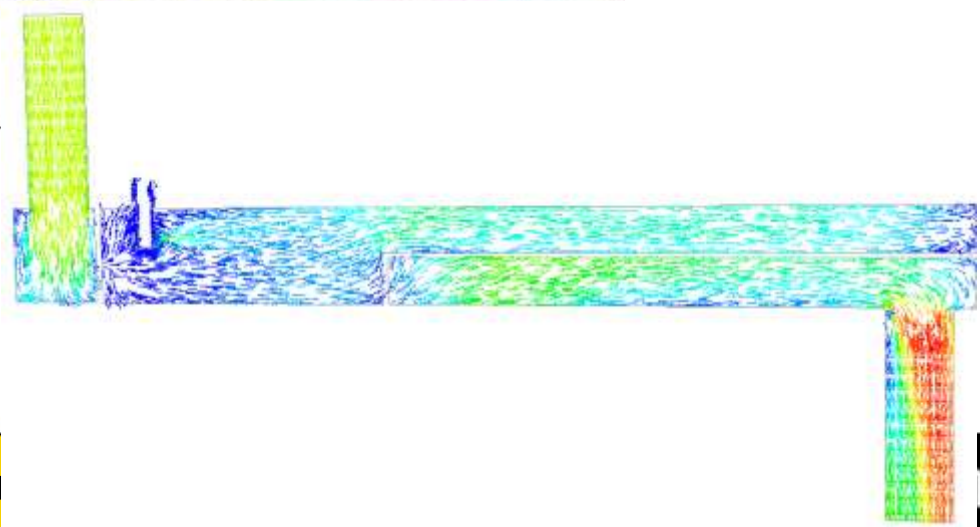
Pathlines Colored by Total Pressure (pascal)

Apr 24, 2008
FLUENT 6.3 (3d, pbns, spe, rke)

Velocity Vectors



Velocity Vectors Colored By Velocity Magnitude (m/s)



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Planning for Emissions Compliance

- Targeted emissions (PM, NOx)
- Emissions rqrmts (e.g. CA ARB)
- Fleet information
 - Make
 - HP
 - Model & Engine S/Ns
 - Model Year
 - Machine/Engine Condition
- Estimated hours of use



- Calculate the average emissions of a customer's fleet
- Determines compliance plan:
 - ✓ Repower, Replace, or Retire
 - ✓ Retrofit with Best Available Control Technology (e.g., DPF, SCR)

Marketing Support...



Keep Your Business Competitive

Caterpillar Emissions Solutions

CATERPILLAR®

Reduce emissions. Stay Competitive.

Caterpillar Emissions Solutions provides the information, products and services you need to comply with emissions regulations, reduce risk, and protect your business for the future.

For more information, contact your Cat Dealer or visit www.cat.com/emissionsolutions



"Our Cat® Dealer helped us meet emissions regulations."

"WE DON'T WORRY about meeting emissions regulations because our Cat® Dealer provides emissions solutions for our machines and other equipment. We get fully compliant equipment at an affordable price without sacrificing performance or durability. Our Cat Dealer helps us take advantage of emissions incentive programs, too."

SERVICE. We'll be there with the solutions you need throughout the life of your Cat machines. Call or stop by soon to find out all the ways we can help you get the most from your equipment.



www.DealerName.com

Dealer Name **CAT**

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Summary

- **Emissions Rules are Changing**
- **New Technologies Can Be Used:**
 - On New Engines / Turbines
 - On Legacy Products
- **Emission Solutions Can Be Used To:**
 - Meet Regulations
 - Support Sustainability Initiatives



Thank You

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