

US EPA ARCHIVE DOCUMENT

Progress Rail Services and Electro-Motive Diesel Locomotive Emissions Webinar

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October 27, 2010

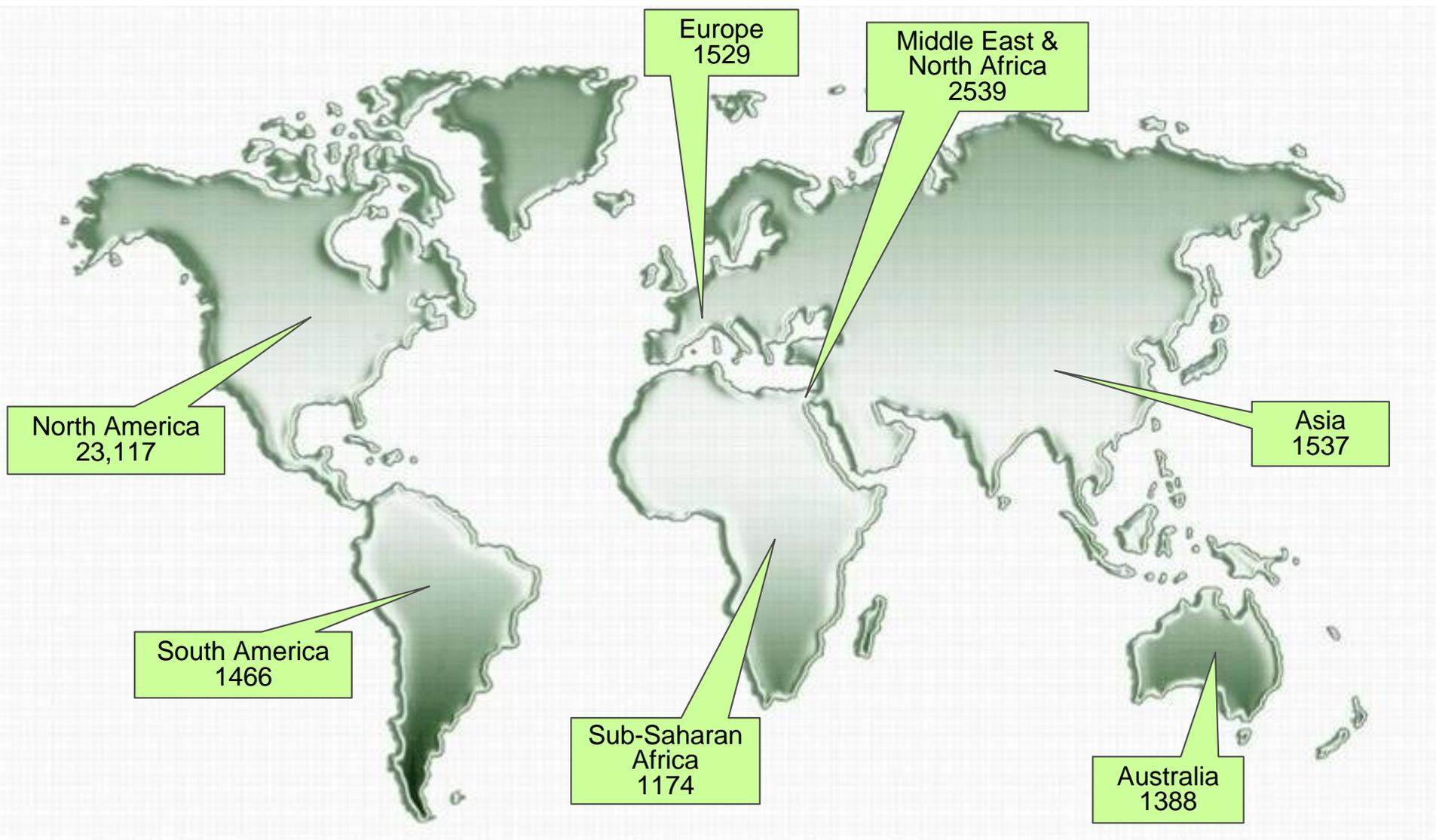
EMD and Progress Rail Update

- The sale of Electro-Motive Diesel to Progress Rail Services was completed August 2, 2010.
- Progress Rail is a wholly-owned subsidiary of Caterpillar Inc. and is one of the largest providers of rail products and services, with locations across North America.
- The combination of EMD, Progress Rail and Caterpillar provides an unmatched breadth of solutions to power trains and deliver sustainable, clean transportation for years to come.



EMD Around the World

Nearly 33,000 active EMD locomotives



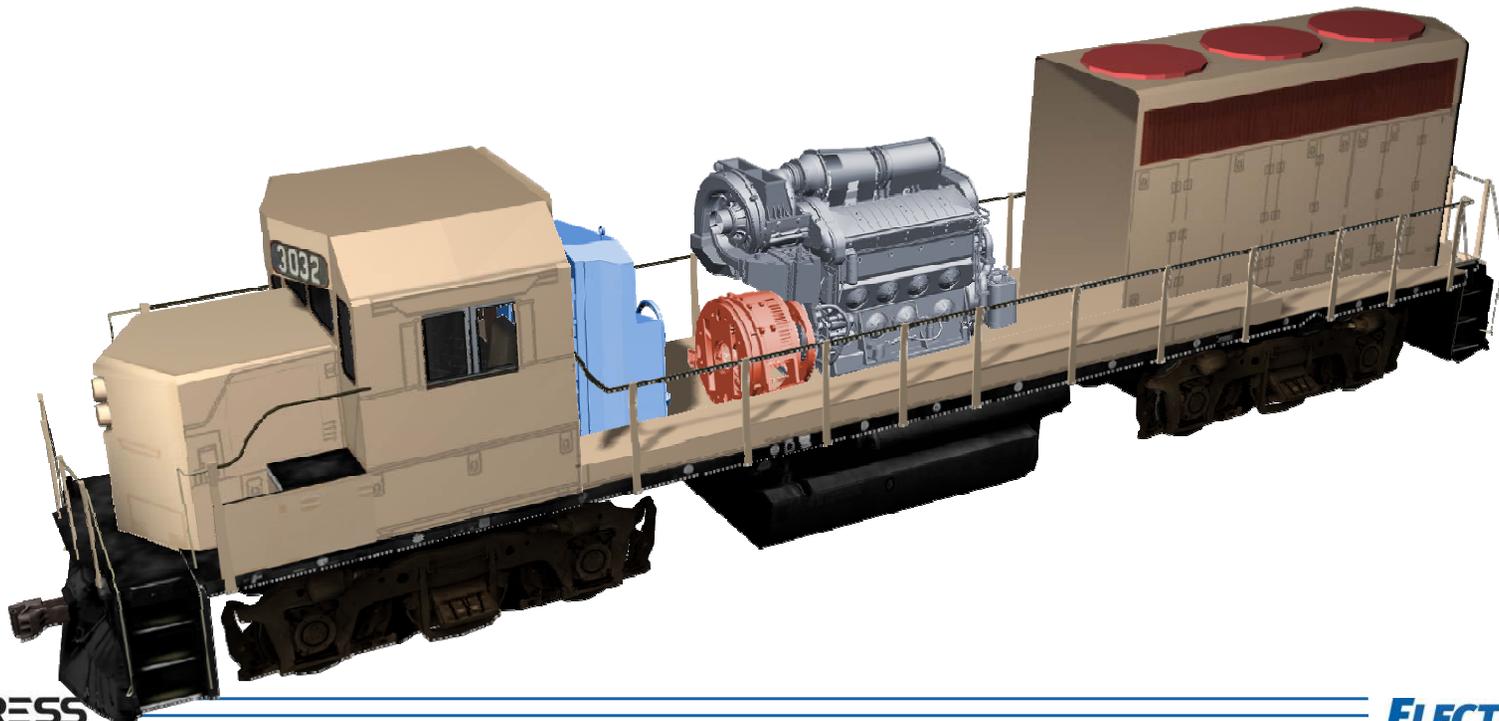
Repower – Locomotive Initiatives

- Leverage the combined engine and emissions technologies of Caterpillar and EMD
- Focus on Re-Powering older locomotives
- Primary Locomotive Segments
 - Low Horsepower Switcher Locomotives
 - Medium Horsepower Regional Locomotives
 - High Horsepower Road Locomotives



What is a 710ECO™ Repower?

Equipment	Characteristics
New 8- or 12-cylinder 710 T2 Engine	Over 8500 EMD 710 engines in service
AR10/CA6 Alternator	Over 10,000 AR10's in service
Separate Loop Aftercooling	Lowers aftercooling temperatures, providing increased fuel economy and lower emissions
EM2000™ Control System	OEM designed, digital control of the engine and generator for increased adhesion and fuel efficiency
Automatic Engine Start Stop (AESS™)	Monitors locomotive idle and safely stops and restarts the engine for fuel and emissions savings



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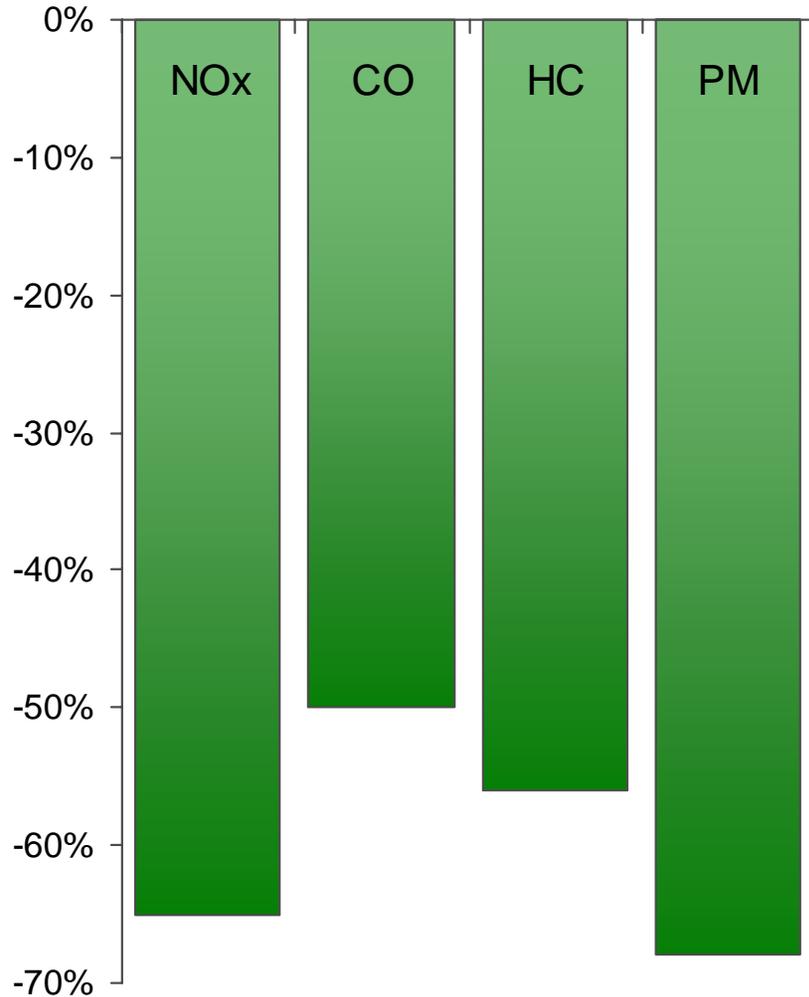
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GP22ECO



710ECO™ Repower Reduces Emissions 50% to 70%

710ECO™ vs. 645E3B



- 710ECO™ Enhancements
 - 20-40% fuel savings with 50% lube oil reduction
 - Improved firing chamber with lower peak pressure
 - Increased efficiency turbocharger
 - Lower idle speed
- EM2000 Control System
 - 15% increased all-weather adhesion
 - Precise cooling fan control
 - Optimized engine speeds in dynamic brake
 - Automatic Engine Start/Stop
 - Software tunable to Tier 0, Tier 0+ or Tier 2

Repower – GenSet Locomotives

- Model PR22B – switcher or road switcher
 - ✓ Service in rail yards, local service, industries, etc.
 - ✓ Built on refurbished frame of older locomotive
- 2200hp or 1500hp – “GenSet” locomotive w/C18
 - ✓ Typically 3 or 2 engines on the locomotive leveraging highly engineered Tier 3 or Tier 4 off-road engines
 - ✓ Modular Design using multiple engine/generator sets working in tandem
 - ✓ Only the engines that are needed are operated
 - ✓ 20% to 40%+ Fuel Savings
 - ✓ Reducing Emissions
 - ✓ CARB ULESL Certified



Repower – 3000hp Locomotives

- PR30C Regional Locomotive
 - ✓ 6-axle locomotive for regional road service
 - ✓ Built upon SD40-2 locomotive - reused frame, trucks, motors, cab, etc.
- 3005hp using single CAT 3516C-HD 16-cylinder engine
 - ✓ Basic locomotive meets US EPA Tier 2 emission (2005)
 - ✓ Exhaust aftertreatment system in to meet future emissions levels
 - ✓ EPA Tier 3 (2012) EPA Tier 4 NOx levels (2015)
 - ✓ Cooperative development program with California ARB & the Union Pacific Railroad



PR43C Regional Locomotive

- PR43C Road Locomotive
 - ✓ 6-axle locomotive for regional road service
- 4300 hp using two CAT engines
 - ✓ Primary Engine – 3600hp C-175 engine (newest engine)
 - ✓ Secondary Engine – 700hp C-18 engine
 - ✓ Proprietary Engine Strategy to minimize emissions and maximize fuel efficiency



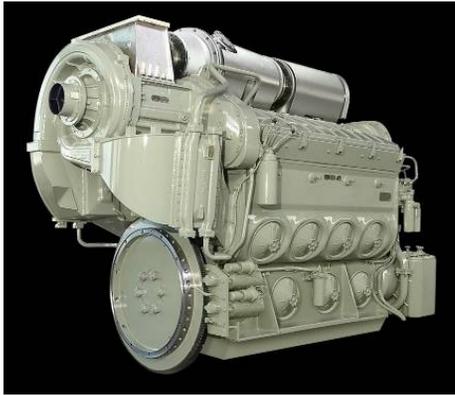
Positive Environmental Impact of Repower vs. New Locomotives

- For every ton of steel produced
 - 2500 lbs of iron ore
 - 1000 lbs of coal
 - 40 lbs of limestone
 - 75,000 gal of water
 - CO₂ emissions - 1.14 tons
- New Locomotive
 - Requires 111 tons of steel, producing 126 tons of CO₂
- Genset Locomotive
 - Requires 71 tons of steel, producing 81 tons of CO₂
- 710ECO™ Repower Locomotive
 - Requires only 18 tons of steel, producing only 21 tons of CO₂

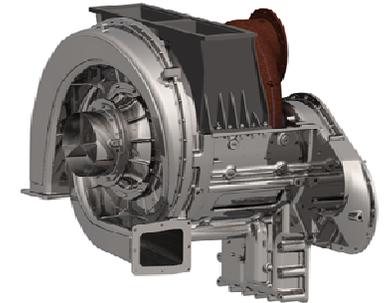


* Based upon repower GP40 4-axle locomotive at 260,000 lbs.

EMD Emissions Kit Development



- Each new Tier of emissions standards has typically required new technology.
- For Part 1033, many earlier EMD Tier 2 technological developments can be leveraged to meet Tier 0+ and Tier 1+ requirements.



	Tier 0	Tier 1	Tier 2
Turbo Matching			✓
Oil Separator			✓
Piston rings & liner			✓
Camshaft		✓	✓
Piston		✓	✓
EUI Injector		✓	✓
Aftercooling		✓	✓
EMDEC Engine Controls	✓	✓	✓
EM2000 Controls	✓	✓	✓

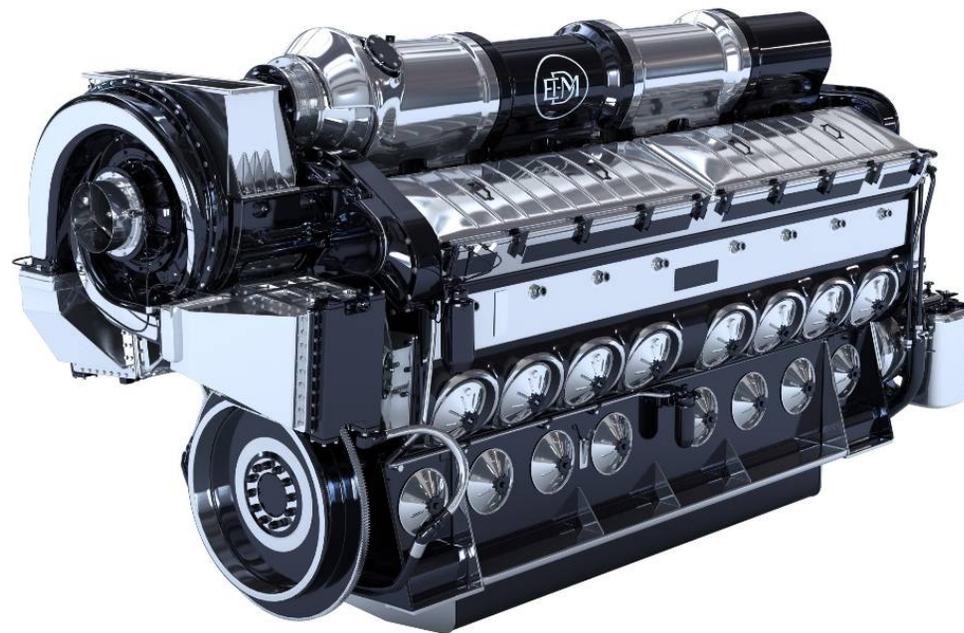


EPA Certificates

- 1033: EPA Locomotive Engine Families
 - Eleven EMD 710 engine families
 - Two EMD 645 engine families
- 1042: 8 EPA Marine Engine Families
 - Eight EMD 645 engine families
 - One additional EMD 710 engine family in test
- Most MY2010 Certificates issued October 2009
 - Tier 2 Marine Sept 2010

Commercial Kit Launch

- EMD's objective is to provide OEM solutions for 1033 and 1042 compliance in all engine applications
- Hundreds of validation and certification tests have been completed
- Over 100 individual kit configurations are currently certified and available for the active EMD fleet



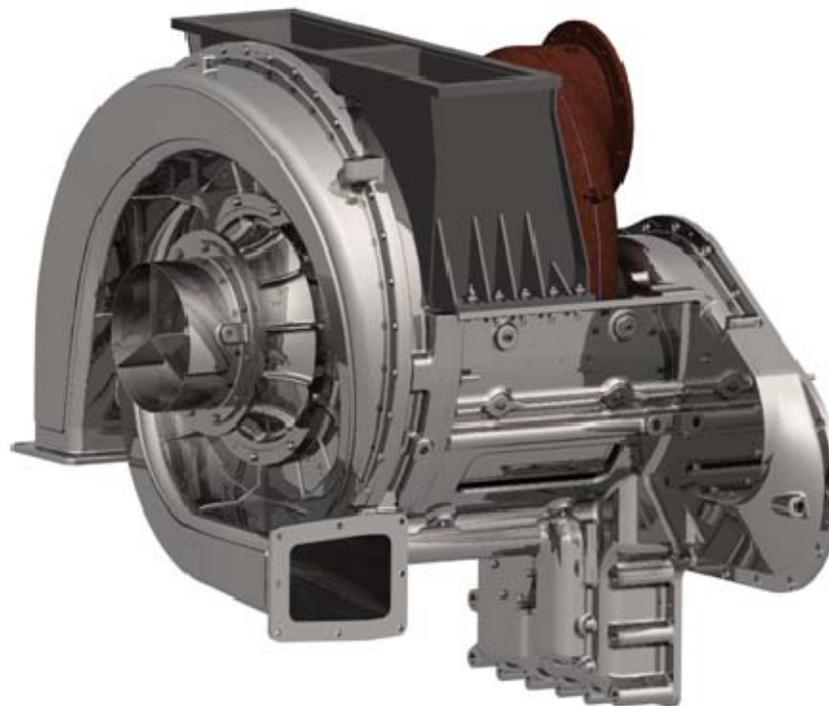
EMD Locomotive Engines – 32 Kits

- Three Kits for EMD 645 Roots-Blown Engines
- Ten Kits for EMD 645 Turbocharged Engines
- Engine Specific Kits
 - ✓ Independent of Locomotive Model / Order
- Seven Kits for EMD 710 MUI Engines
- Twelve Kits for EMD 710 EUI Engines
- Locomotive Order Specific Kits
 - ✓ Every EMD Model / Order covered



Kit Certification, Application, and Maintenance

- Installation Instructions and Maintenance Instructions Including:
 - ✓ Kit component PNs
 - ✓ Emissions Critical Components
 - Turbos
 - Governors
 - Aftercoolers
 - Software



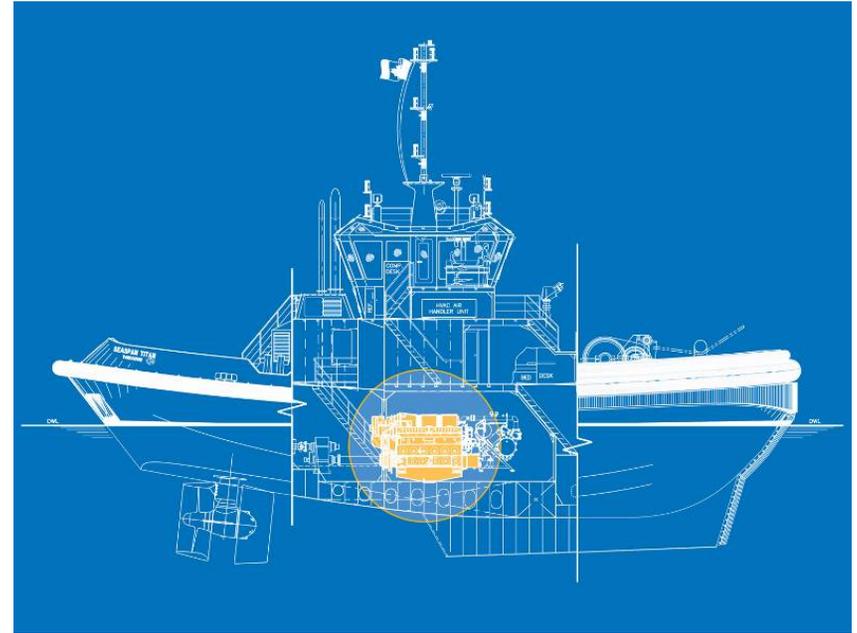
EMD 1042 Marine Kit Options

- 1042 Kits
 - Meet the EPA mandated 25% PM Reduction
- 1042UL Kits
 - Exceed 50% PM reduction
 - 50% - 80% lube oil savings
- 1042+ Kits
 - >50% PM Reduction [UL PAs]
 - 33% - 50% NOx Reduction
- 1042+ kits available today for 710 engines
 - 1042UL kits under development now for 710 engines



645 Marine Engines – Tier 2 Kits

- 645E Roots-Blown
 - D2, E2, and E3 Duty Cycles
 - CARB Approved: ULSD required for E3 Propeller
- 645EB Turbocharged
 - All Marine Duty Cycles certified with ULSD



Solutions Beyond Tier 2

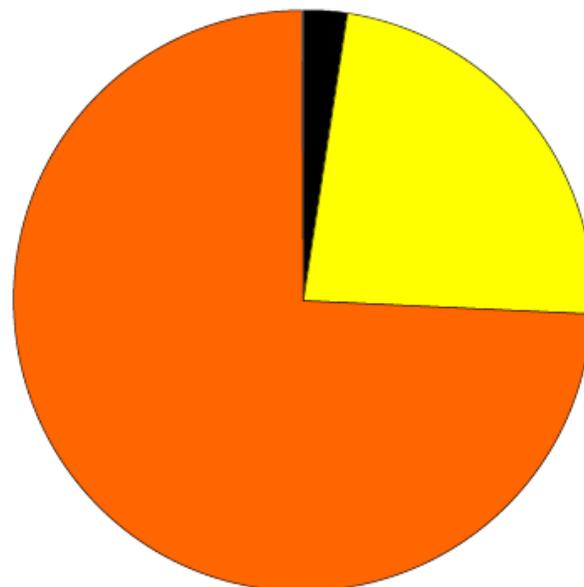
- Tier 2 Kits for 645E and 645EB
- Tier 3 = 50% PM Reduction versus Tier 2
- DOC offers significant additional PM reduction
 - Can be added to 645 Tier 2 Configurations
 - Approaches Tier 3 Levels [e.g. 'Compliant']
 - Commercially available today





Locomotive PM Emissions Dominated by Semi-volatile Organic Compounds

- Elemental Carbon (soot)
- Sulfate
- Organic Compounds (chiefly lube oil)



Tier 2 EMD SD70Ace 2-Stroke Locomotive