

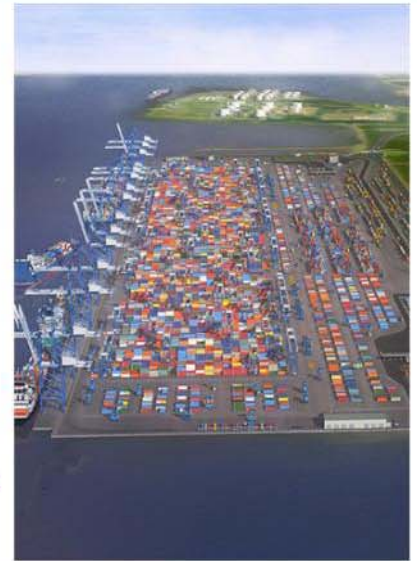
"Don't Breathe Easy" The Maritime Community's Bout with the Clean Air Act

Heather Wood

Director, Environmental Affairs



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Building A Brighter, Cleaner, Greener Future.



September 2010



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3 Categories of Marine Diesel Engines

Category	Displacement/ Cylinder (D)		Basic Engine Technology
	Tier 1-2	Tier 3-4	
1	$D < 5 \text{ dm}^3 *$	$D < 7 \text{ dm}^3$	Land Non-road Diesel / Tug Boats
2	$5 \text{ dm}^3 \leq D < 30 \text{ dm}^3$	$7 \text{ dm}^3 \leq D < 30 \text{ dm}^3$	Locomotive – Tug Boat
3	$D \geq 30 \text{ dm}^3$		Container vessels, oil tankers

* And power 37 kW

Category 1 & 2: 700-11,000hp

Category 3: 3,000 – 100,000 hp



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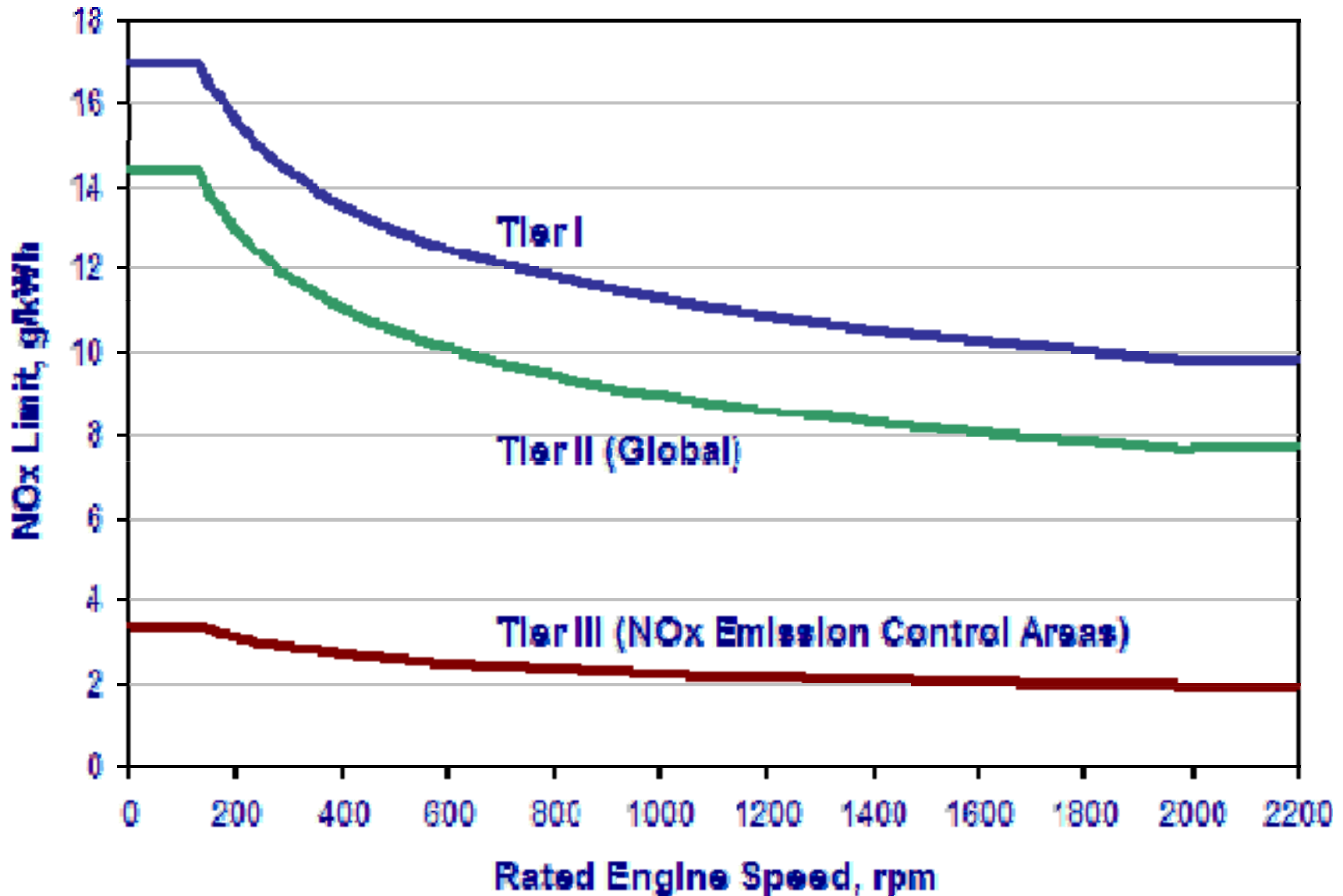
Marine Diesel Regulation

- 1999 Marine Engine Rule
 - Engines above 37 kW (50 hp)
 - Includes Propulsion & Auxiliary Engines
 - Adopted Tier 1 standards for Non-road, Tugs & Locomotives
 - Ocean Vessels – voluntary compliance
 - Foreign Trade Exemption
 - U.S. Vessels operate >75% of time outside U.S. territory (200 mi)
 - Voluntary MARPOL Annex VI NOx standards (2000)
 - Established Tier 2 Standards (2004-2005)



Marine Diesel Regulation

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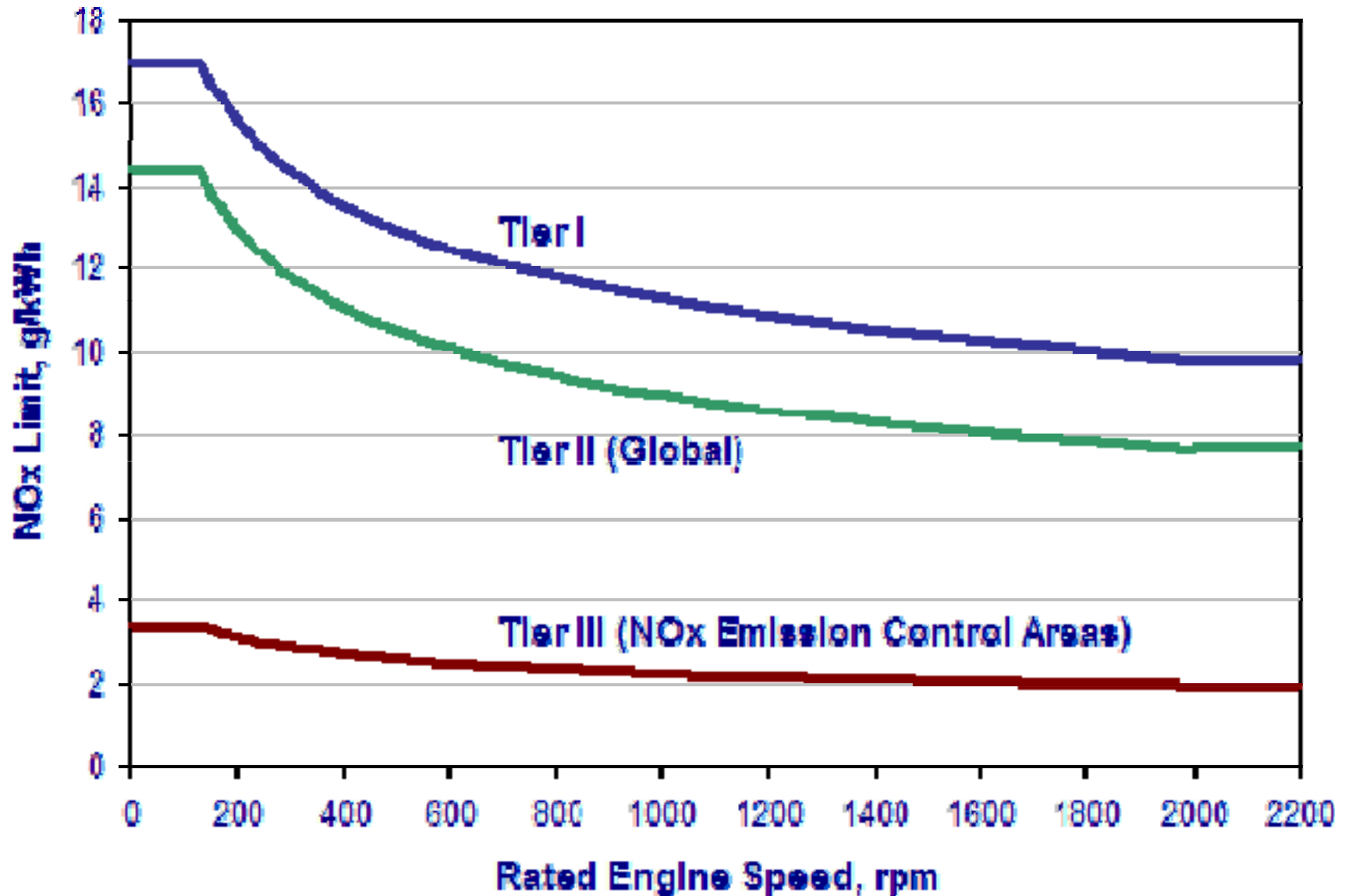
Marine Diesel Regulation

- 2003 Marine Engine Rule
 - Engines above 37 kW (50 hp) including Ocean vessels
 - New marine engines only
 - U.S Flagged Vessels Only
 - Adopted Tier 2 standards for Non-road, Tugs & Locomotives – 15% Reduction
 - Equivalent to MARPOL Annex VI
 - 15% NO_x reduction over 1999 rule



Marine Diesel Regulation

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Tier 2 Marine Emission Standards

Category	Displacement	CO	NOx	PM	DATE
	dm ³ /cylinder	g/kWh	g/kWh	g/kWh	
1	Power ≥ 37 kW D < 0.9	5.0	7.5	0.40	2005
	0.9 ≤ D < 1.2	5.0	7.2	0.30	2004
	0.9 ≤ D < 1.2	5.0	7.2	0.20	2004
	0.9 ≤ D < 1.2	5.0	7.2	0.20	2007
2	5.0 ≤ D < 15	5.0	7.8	0.27	2007
	5.0 ≤ D < 15 Power < 3300 kW	5.0	8.7	0.50	2007
	15 ≤ D < 20 Power ≥ 3300 kW	5.0	9.8	0.50	2007
	20 ≤ D < 25	5.0	9.8	0.50	2007
	25 ≤ D < 30	5.0	11.0	0.50	2007
Tier 1 NOx Limits Mandatory					



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Marine Diesel Regulation

- 2008 Marine Engine Rule
 - Category 1 and 2 Engines
 - Applies to newly manufactured and re-manufactured engines
 - Establishes Tier 3 and 4 standards
 - 90% PM & 80% NOx reductions compared to Tier 2
 - 1st ever standards for remanufactured engines
 - > 800 HP
 - U.S. flagged vessels
 - Ocean vessels not included (Category 3)



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Marine Diesel Regulation

- 2008 Marine Engine Rule – cont'd
 - 2009 Tier 3 Standards apply
 - 2014 – 2017 Tier 4 standards apply
 - Require use of ultra low sulfur diesel fuel (15 ppm)
 - Available 2012
 - GHG reductions with Tier 4
 - HC & CO



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Tier 4 Marine Emission Standards

Category	Power	NOx	HC	PM	DATE
1 & 2	kW	g/kWh	g/kWh	g/kWh	
	$P \geq 3700$	1.8	0.19	0.40	2014
	$P \geq 3700^*$	1.8	0.19	0.06	2016
	$2000 \leq P < 3700$	1.8	0.19	0.04	2014
	$1400 \leq P < 2000$	1.8	0.19	0.04	2016
	$600 \leq P < 1400$	1.8	0.19	0.04	2017



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“Green” Tug & Tow Services

I-64 Express Barge Service Started in 2008

- Weekly service between NIT and Port of Richmond
- 12,000 trucks removed from highways and local roads
- Tier II Engines – ULSD

184,615 gallons of diesel fuel saved annually

\$550,000 annual reduction in fuel costs

30-40% reduction in emissions compared to moves via truck





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“Green” Locomotives

Hybrid and Ultra-Low Emission Locomotives

- 1 - Hybrid Yard Switcher (2,000 HP)
- 2 - Eco-Motive GenSet Yard Switchers (2,000 HP)
 - 50% Reduction in Fuel Consumption (Hybrid)
 - 80% Reduction in NOx Emissions



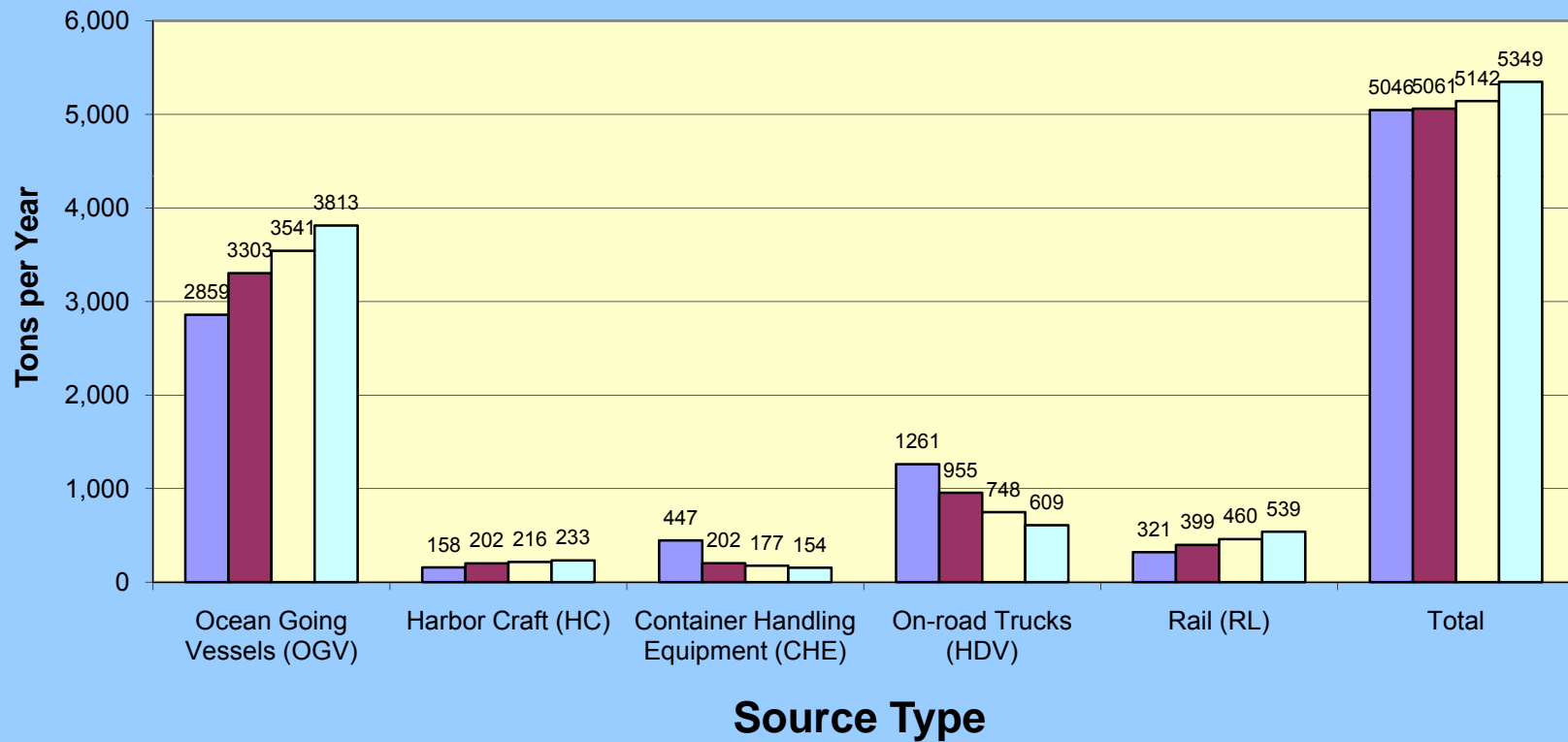
“Green Goat”



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Emission Inventory Update

NOX
Regional (including on-terminal) NOX Emissions Over Time



■ 2005 ■ 2009 ■ 2012 ■ 2015



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HYBRID TUG & TOW TECHNOLOGY



- Foss Maritime Company - Southern California - 2009
- New Build or Retrofit
- \$ 8 Million v 45 million conventional
- 44% reduction NOx and PM



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