

EPA Marine Emissions Regulations: Categories, Phases, Tiers & Vessel Impacts

Brett Greene

8/5/08



Caterpillar® Marine Power Systems

Excellence on Board

Overview...

- Emission Test Cycles
- Engine Categories (based on Displacement / cyl.)
- Phased Approach
 - Tier 2: 2004 - 2007
 - Overhaul Guidelines: 2008
 - Tier 3: 2009 - 2014
 - Tier 4: 2014 – 2017
- Impacts on Installations and Retrofits

CAT®



MAK

Emissions Test Cycles:

2 Different Tests for Certified Engines

- **Constant Speed**
 - Gensets, Electric Propulsion, Dynamic Positioning, etc.
- **Variable Speed**
 - Vessel Propulsion, Vessel Auxiliary, Crane, Pumps, etc

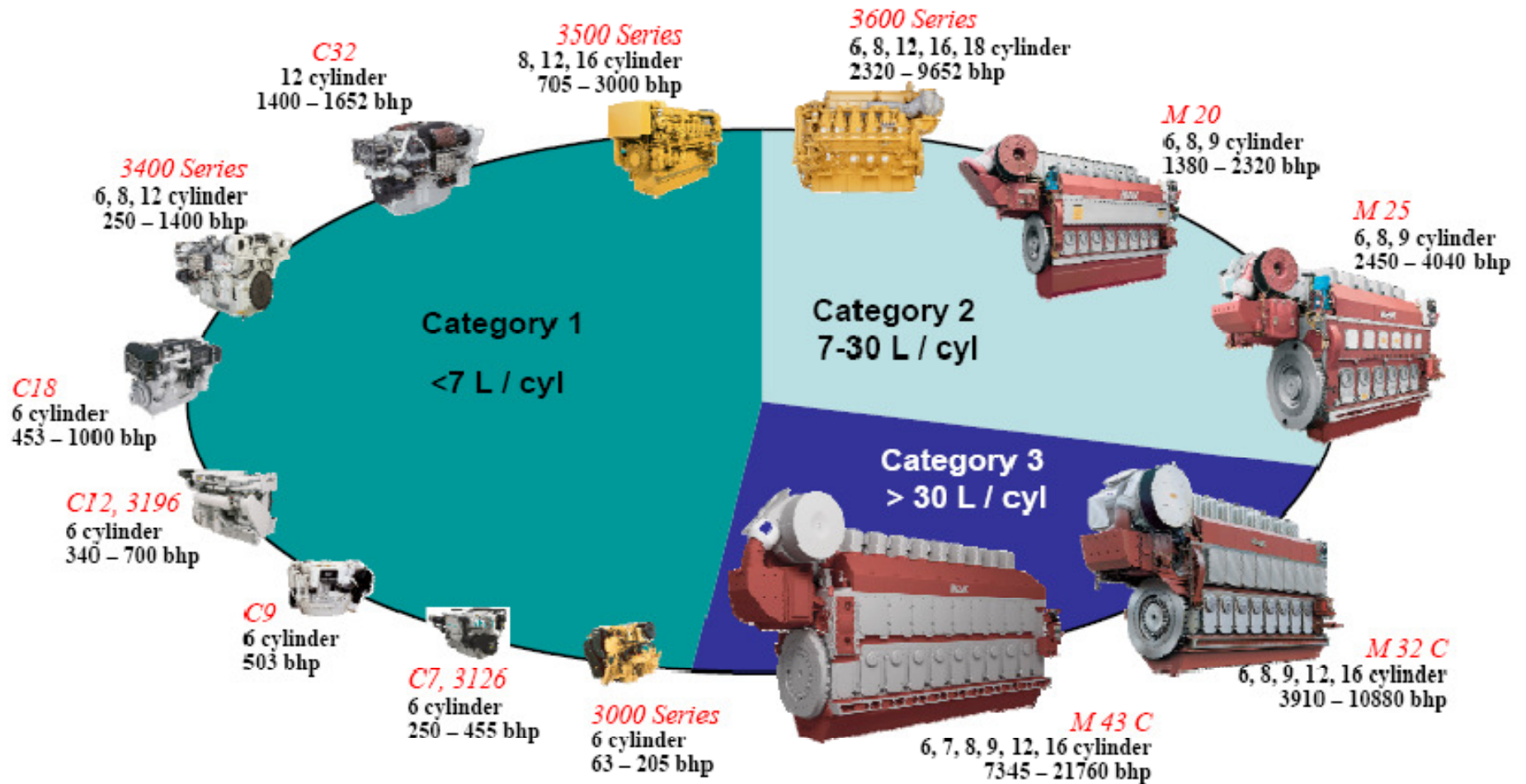
Note: A propulsion engine can't be used as a generator and vice versa.



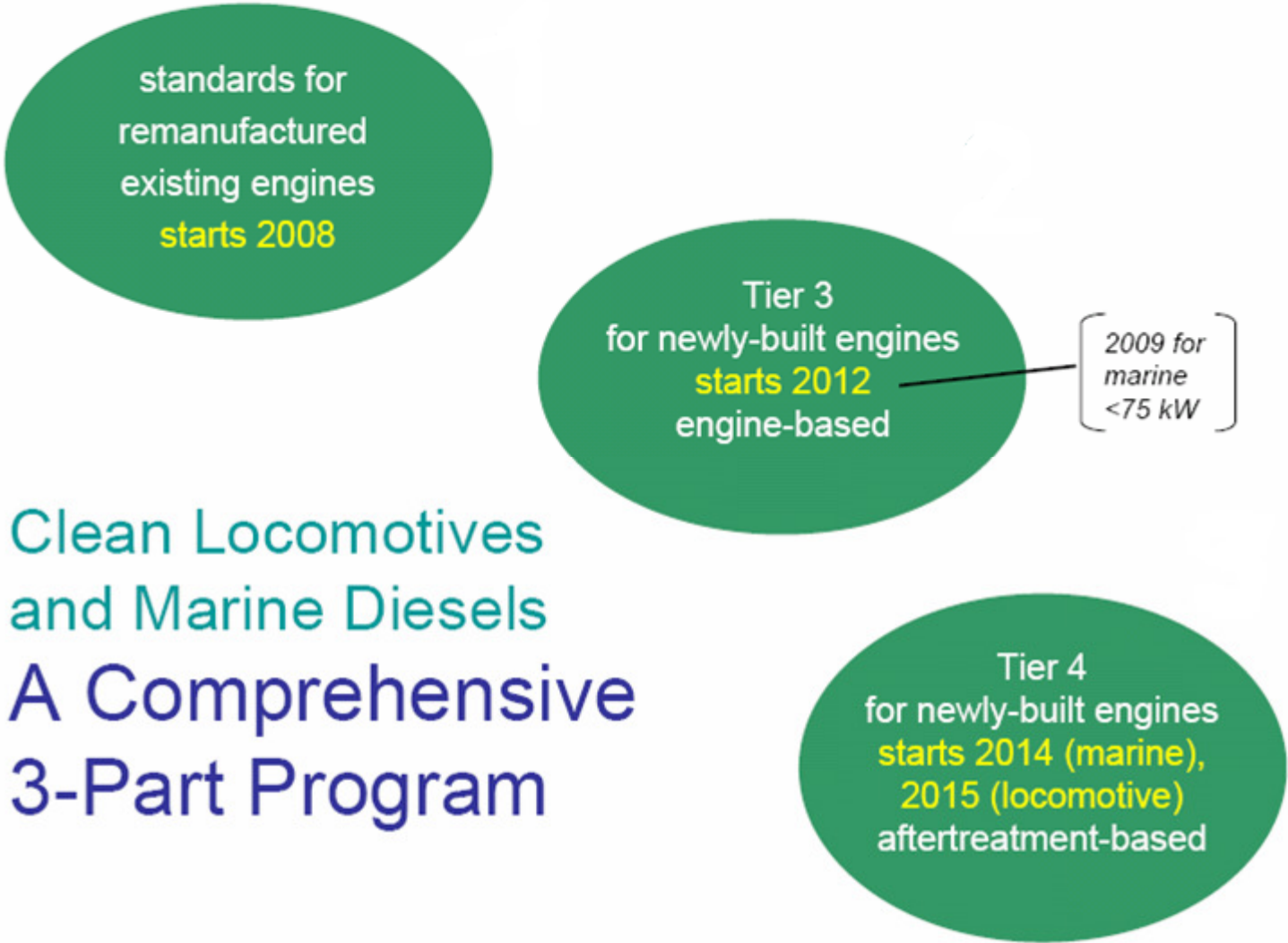
CAT®

MAK

Categories: 1, 2, 3



Looking Forward: A Phased Approach



Overhaul Regulations:

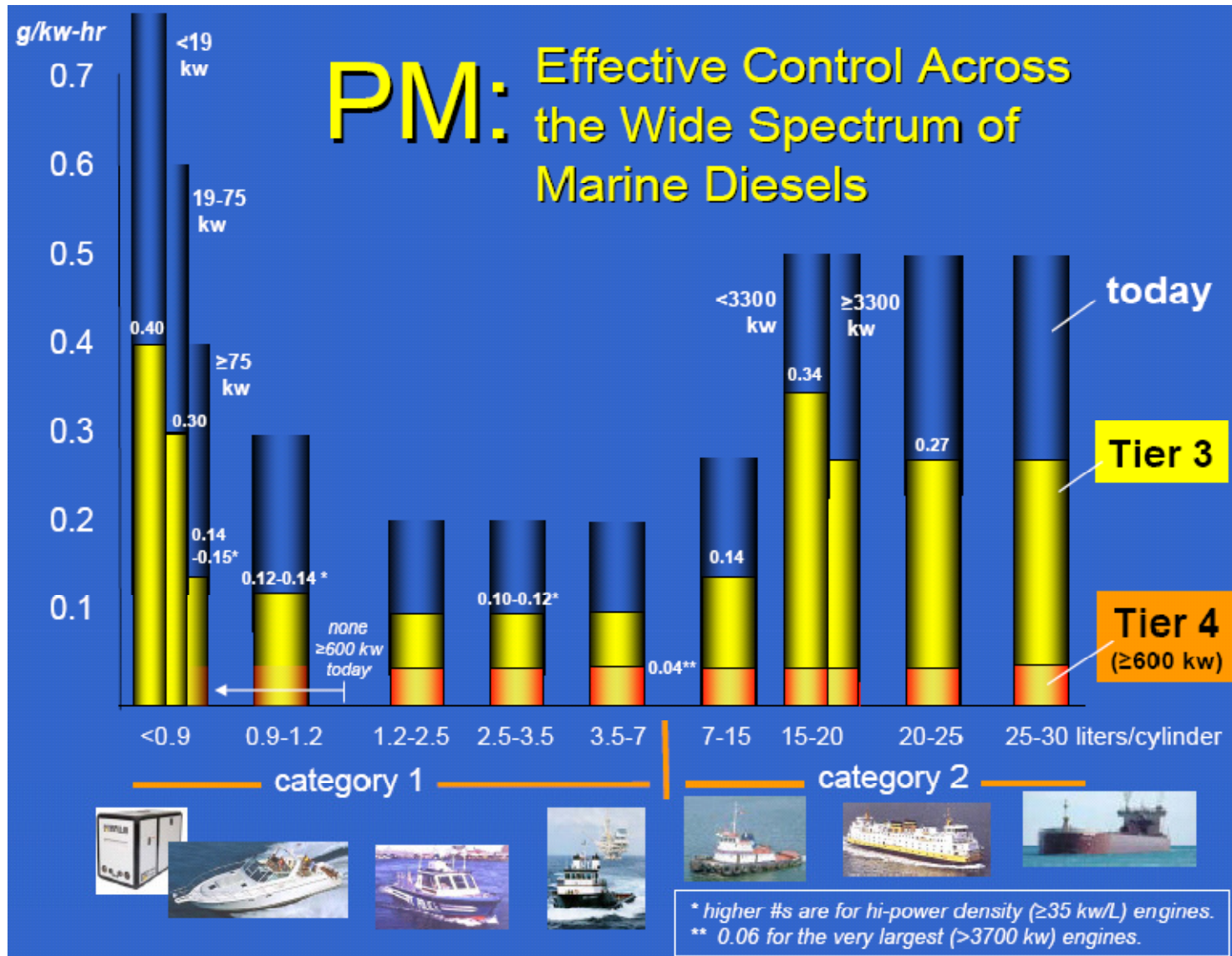
- **Overhaul (def.):** An engine that has all cylinder liners replaced, either on the vessel or at a remanufacturing facility, would fall under the regulation.
- **What:** Existing Engines / In-use engines over 800hp
- **When: October 2008** or as soon as “Certified Remanufacture” systems are available
- **Result:** The Certified Overhaul system must demonstrate **25% reduction** in PM with no increase in NOx.



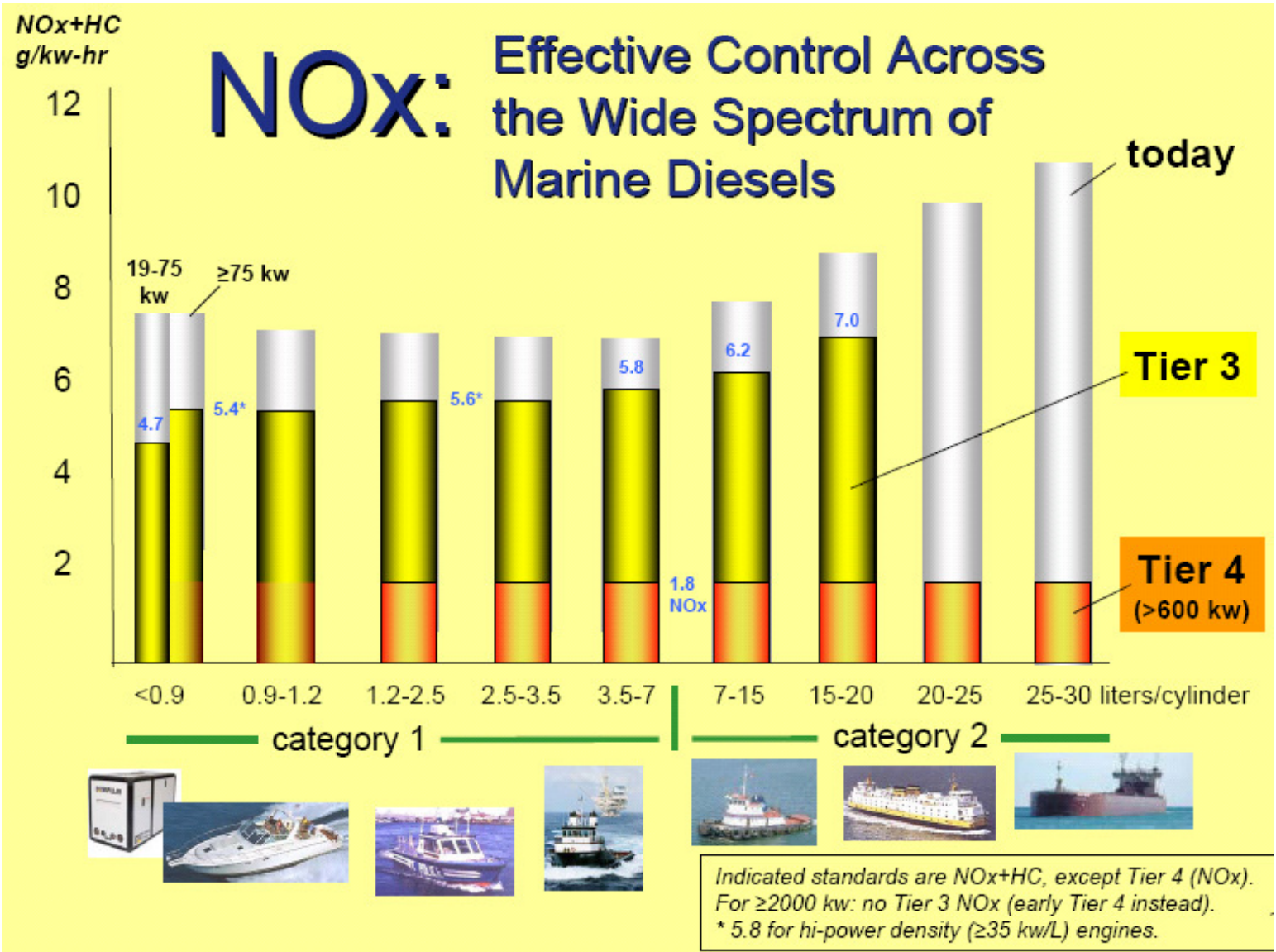
CAT®

MAK

Tier 3 & 4: PM reductions

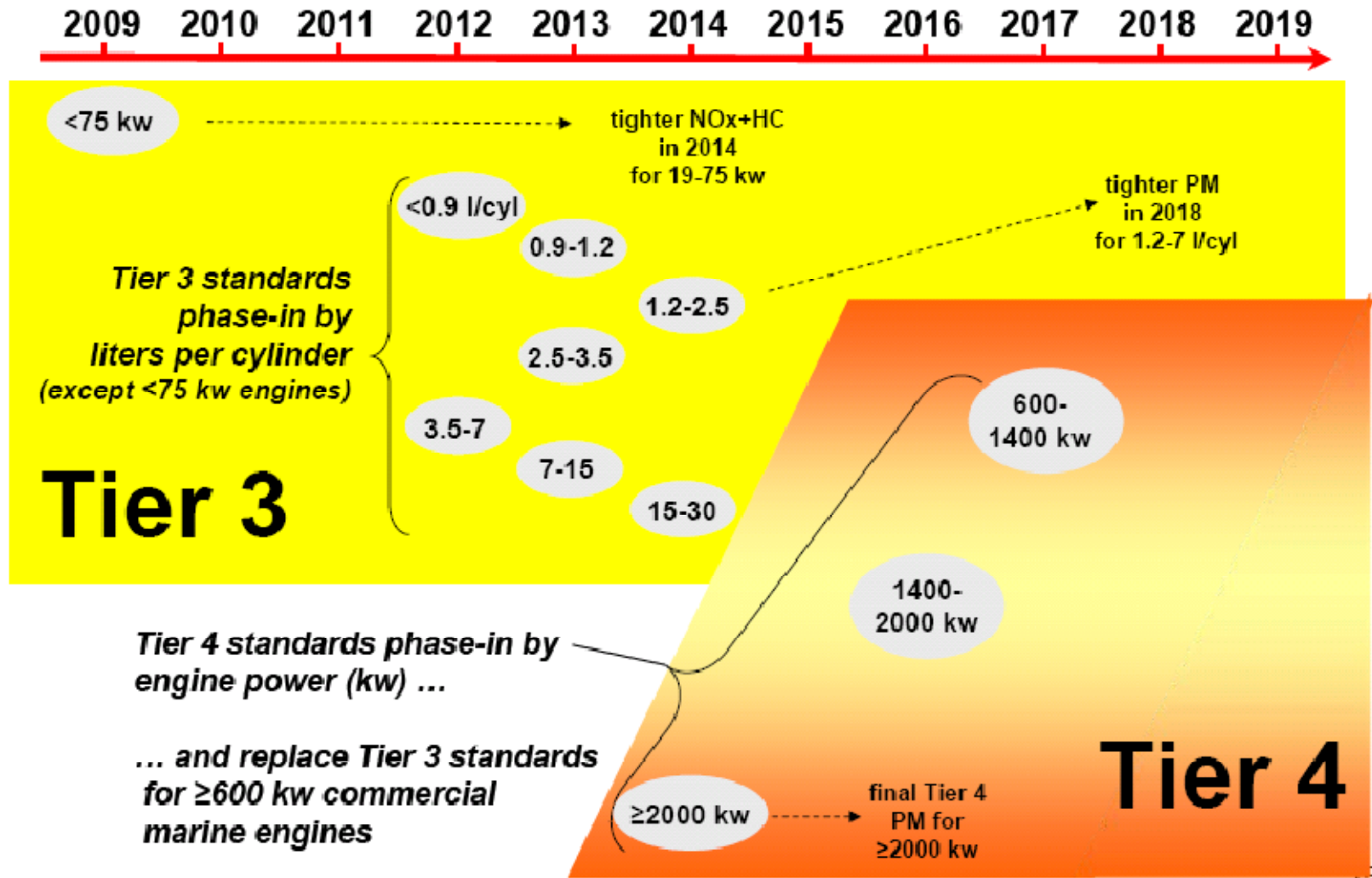


Tier 3 & 4: NOx reductions



Tier 3 & 4: Timeline

Marine Diesel Standards Phase In Starting 2009



Impact on Cooling Systems:

- Tier 0 to Tier 2:
 - Add separate circuit aftercooler - or -
 - Add significant keel cooler capacity for 120 degF water for aftercooler
- Tier 1 to Tier 2:
 - Add cooling capacity due to decreased aftercooler temps from 180 to 120 degF
- Tier 2 to Tier 3:
 - Anticipate 6-15% increase in aftercooler Heat Rejection

Why? Cooler combustion air = Lower NOx!



CAT®

M&K

Options for Cooling System:

- Add channel for increased keel cooler capacity
- Add separate channel for aftercooler circuit
- Use fabricated coolers
- Convert to Heat Exchanger Cooling



CAT®



MAK

Comparison of Options:

Keel Cooling:

- Large coolant volume = added replacement cost
- Large area = more potential for contamination and corrosion
- Less efficient

Heat Exchanger:

- Compact and efficient
- Periodic maintenance by cleaning and zinc changing
- Higher risk with thru hull seawater connections

CAT®



MAK

Questions?



Caterpillar® Marine Power Systems

Excellence on Board

Summary of Sources:

- EPA:
 - <http://www.epa.gov/oms/marine.htm>
 - <http://www.epa.gov/otaq/diesel/grantfund.htm#emerge>
- CARB:
 - <http://www.arb.ca.gov/ports/marinevess/harborcraft.htm>
- BAAQMD:
 - Goods Movement www.baaqmd.gov/goods
 - Carl Moyer Program www.baaqmd.gov/moyer
- Diesel Net:
 - www.dieselnet.com
- Diesel Technology Forum:
 - www.dieselforum.org



CAT®

MAK