

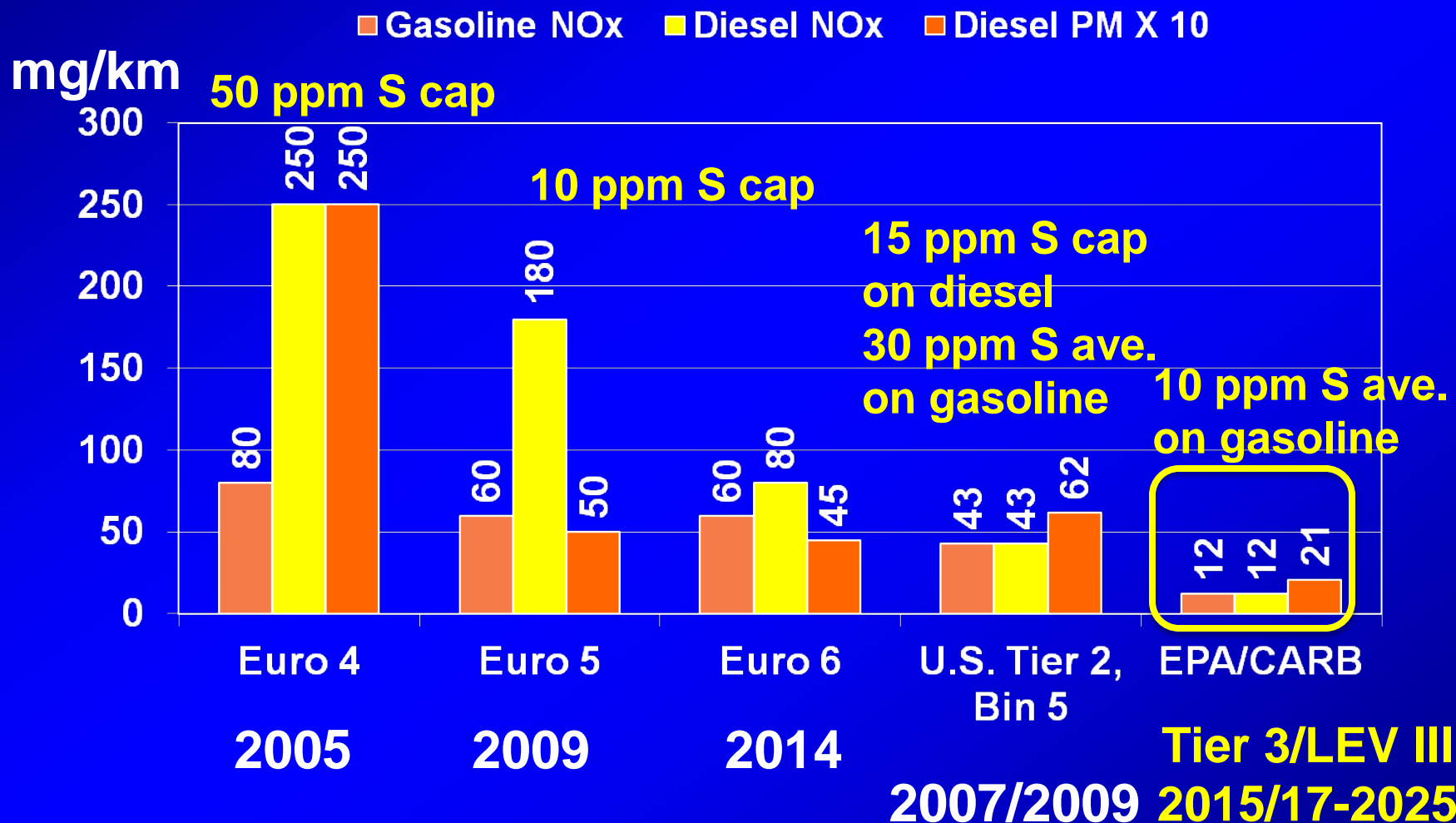
Motor Vehicle Emissions World Wide Achievements And Challenges For Exposure Assessment

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**Founding Chairman, Board of Directors,
International Council on Clean Transportation**

U.S. and Euro Light-Duty Vehicle Emission Standards



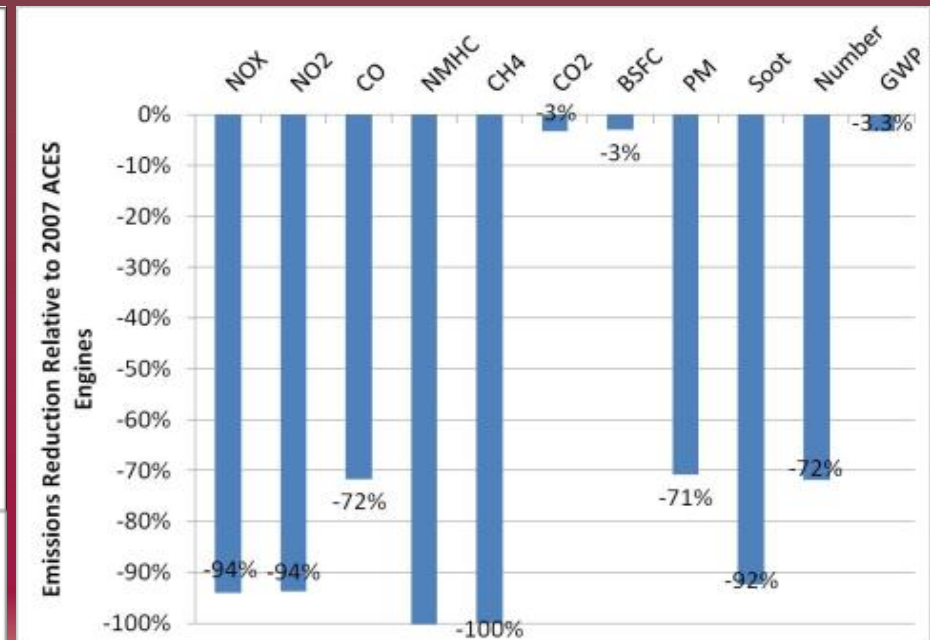
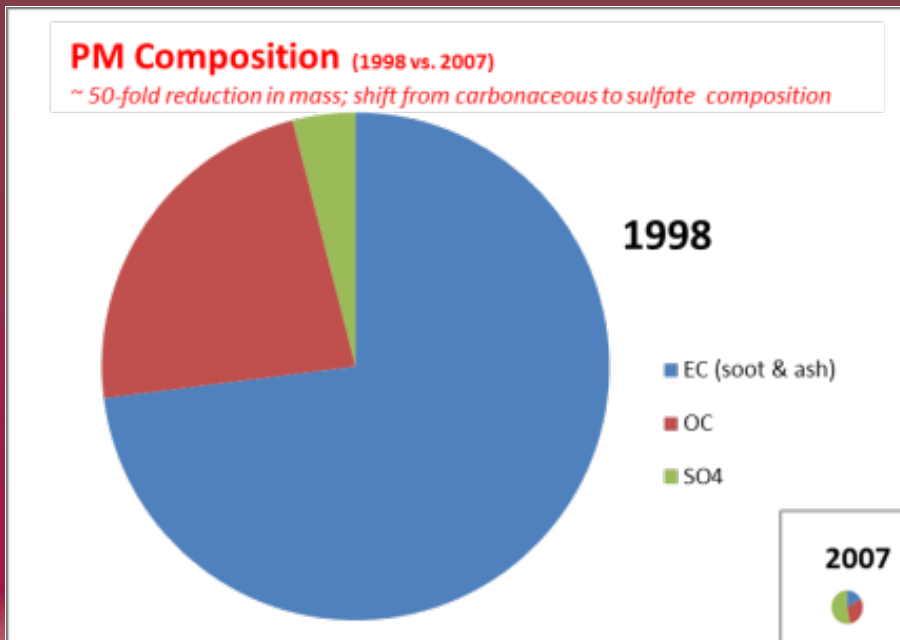
Euro 5+ (2011) and 6 include $6 \times 10^{11}/\text{km}$ diesel particle number limit;

Phase 1 and 2: HEI 2007 and 2010 Engine ACES Results

Compared to earlier Engines (rigorous 16-hour cycle)

2007 Dramatic Reductions
98% reduction in mass
90% - 99% reduction in Ultrafine
Particles, air toxics

2010 Further Reductions
(even compared to 2007)
>90% reduction in NO_x
>70% reduction in Particles



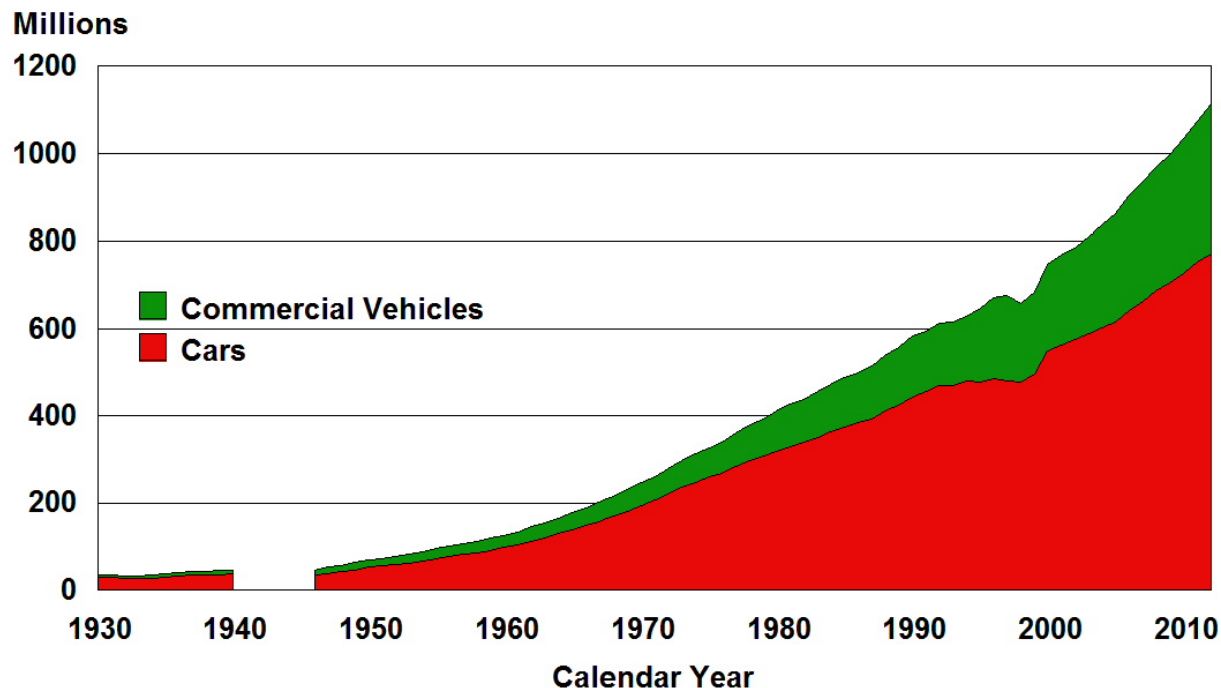
More Stringent New Vehicle Emissions Standards Are Spreading Around The World

Fraction of New Vehicles or Engines Meeting Euro 6 Standards Or Better

Model Year	2015	2025
Light Duty Gasoline Cars	41.4%	78.9%
Light Duty Diesel Cars	65.4%	87.9%
Heavy Duty Diesel Trucks	24.9%	78.9%

Historical High Growth Has Offset Many Improvements Vehicles Remain Important Contributor To Local, Regional and Global Pollution

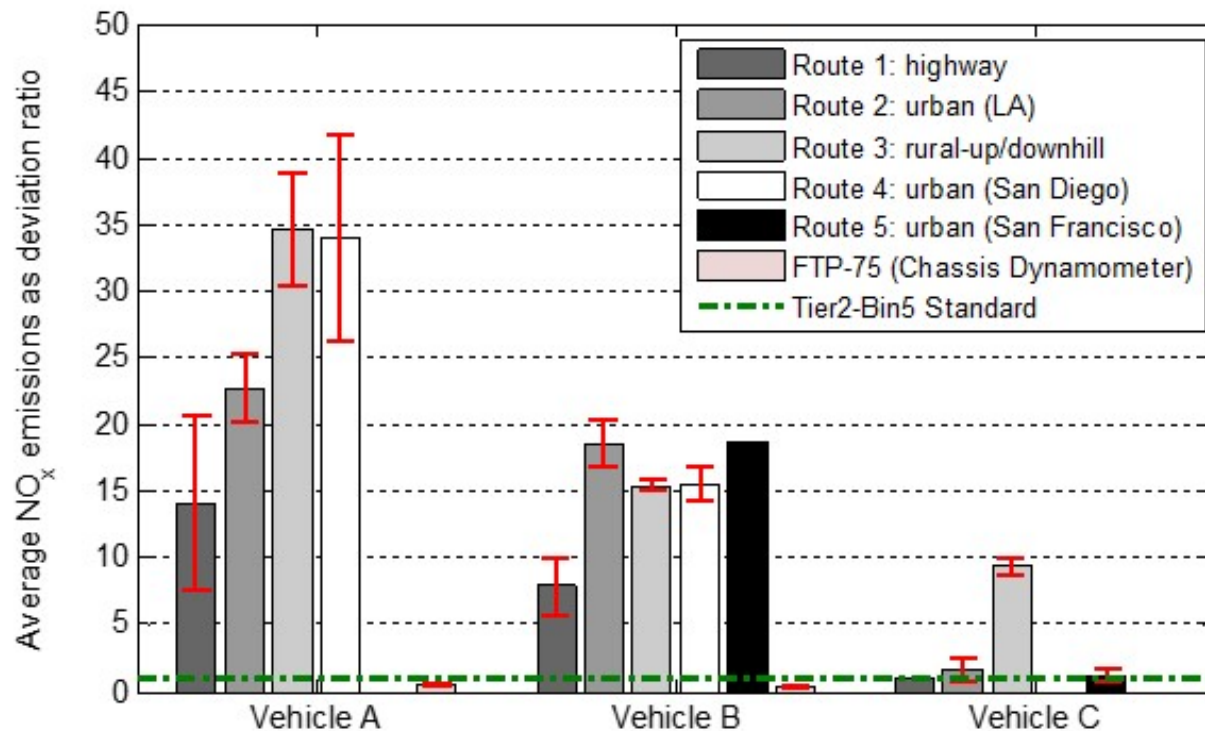
World Population of Cars, Trucks and Buses



In Your Face! Literally!



PEMS Testing Results for NO_x Diesel Cars in the US



**Fortunately
Diesel Car
Population
Is Not Very
Large in the
US**

The Problem is Much More Important in Europe Where Diesel Cars Are Much More Widespread

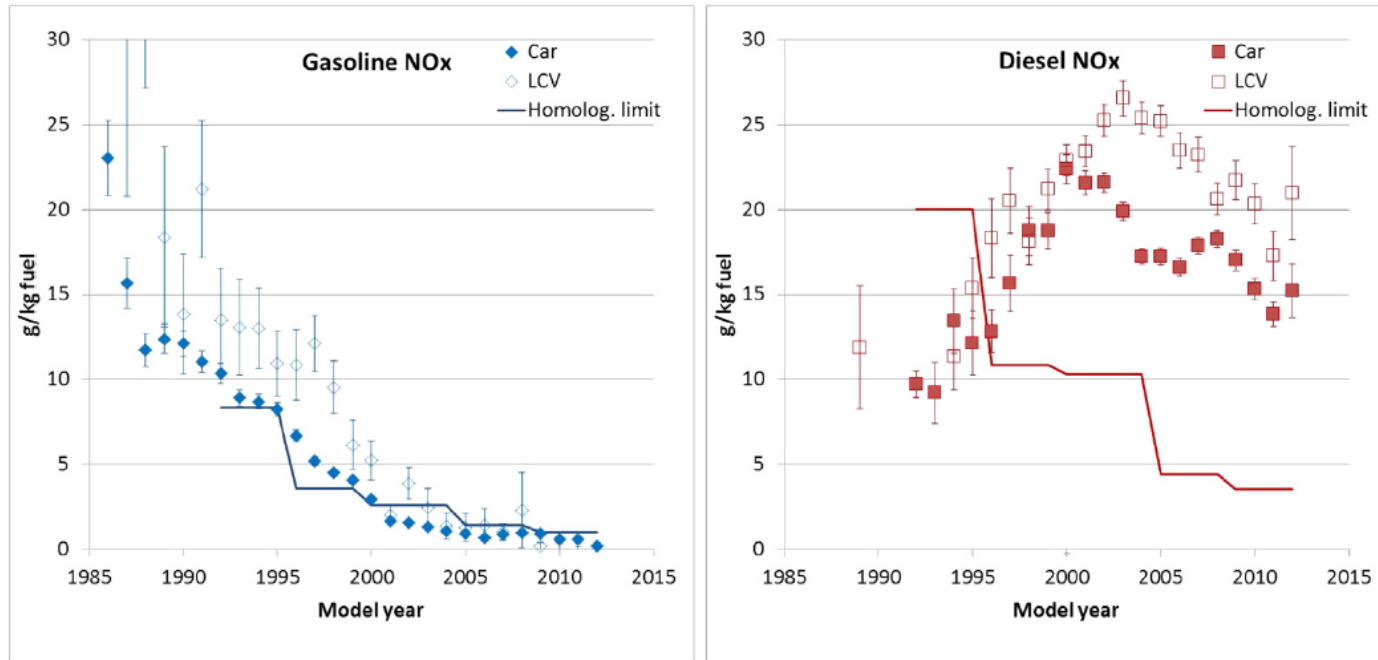
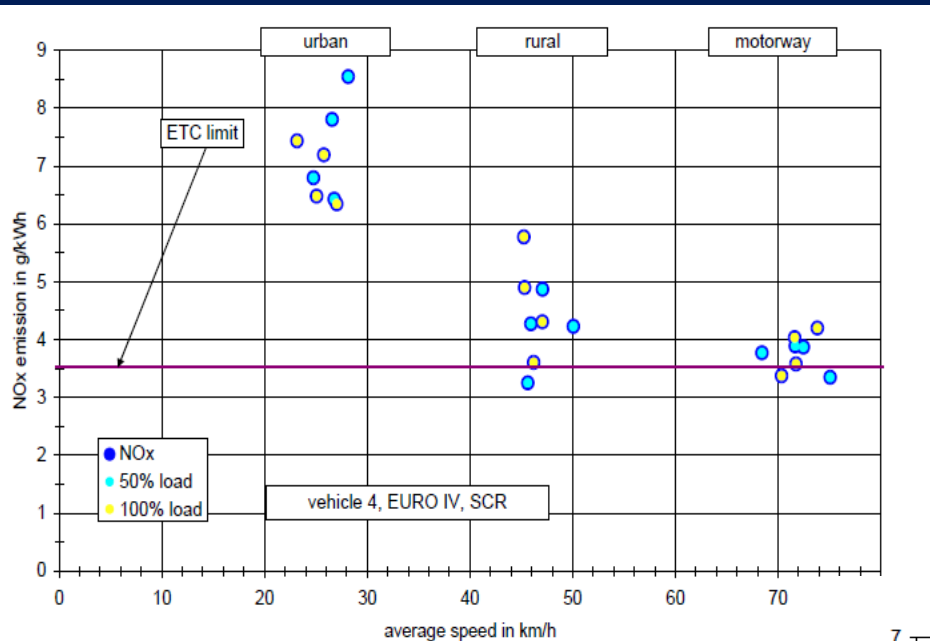


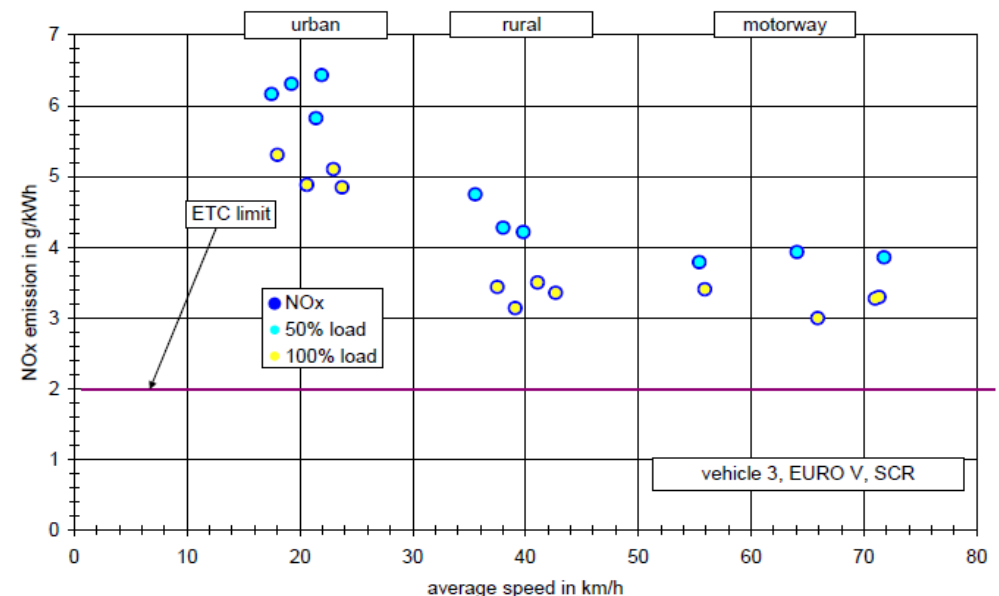
Fig. 4. Mean hot NO_x emission factors of gasoline (left) and diesel (right) passenger cars and light commercial vehicles as a function of model year. Whiskers represent the 95% confidence interval over the mean. Added are the type approval limit values for Euro 1 to Euro 5 passenger cars over the homologation test cycle in force in the respective year. For conversion from limit values in g per km see SI (using measured fuel consumption rates from [Hausberger \(2010\)](#)). For color plot consult online version.

Similar Issues With Heavy Duty Vehicles in Europe

The problem: High off-cycle NOx emissions in urban applications



In-use PEMS testing of Euro IV and Euro V trucks in The Netherlands found emission well above standard in urban driving!



Source: Kleinebrahm 2008

And Europeans are Paying A Health Price
EEA Estimates ~75,000 Premature Deaths Annually
Due to High NO₂ Levels



DPF Removal / Delete

As one of the first companies in the UK to offer DPF Removal we now have years of unmatched knowledge and experience.

DPF (Diesel Particulate Filter) Removal

The Removal Procedure

First of all we remove the filter from the exhaust system, unlike other companies we do not fit a simple bypass pipe, this would likely lead to an MOT failure when new MOT regulations are announced. Instead, we modify the original DPF unit, discreetly cutting a small window in the top of the chamber, removing the internal filter before rewelding the window And refitting to the vehicle. This way the vehicle still appears to have a DPF fitted and appears unmodified in anyway. Once the physical filter removal has been completed the ECU (Electronic Control Unit) is reprogrammed (remapped) and any DPF related structures removed from the vehicles software, this will prevent the vehicle from sensing the missing Filter and will prevent future DPF regeneration and warning lights. This is the most important aspect of the removal process and it is vital that the ECU is reprogrammed correctly or DPF issues will continue.

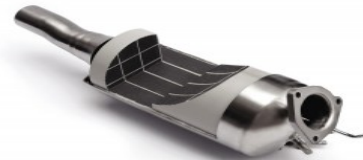
When carrying out this process we can also remap the ECU for better performance and fuel efficiency, this is normally free of charge with our DPF removal service.

Will removing the DPF result in an MOT failure? No, removing the DPF will have no affect on your MOT.

Removing the DPF from your vehicle is not only a cost effective solution but it also boasts the following advantages:

- Increased performance
- Increased efficiency (MPG)
- Less turbo lag
- Reduced maintenance costs

Call now on 01454 800 117



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Performance Tuning

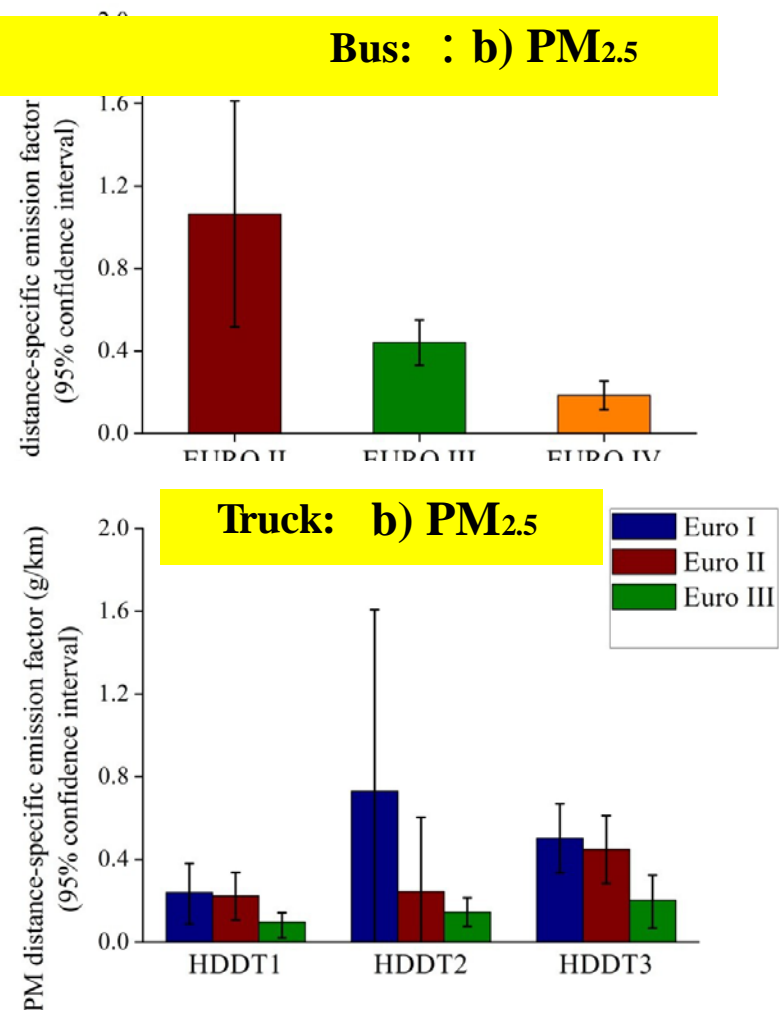
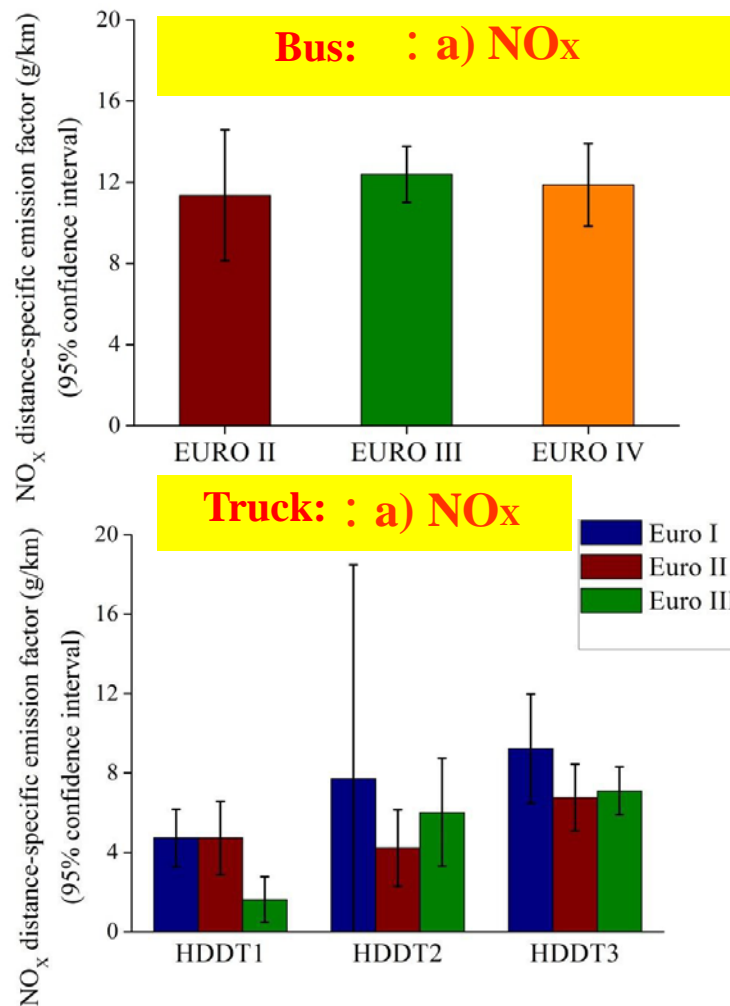
China Is Now Most Important Motor Vehicle Market



- 2015 – 24.61 M Total Sales
- 21.16 M Light Duty
- 3.45 M Commercial trucks and buses
- Stimulated by 50% tax cut on vehicles with engines 1.6 L or less
- **Relatively Few Light Duty Diesels**

Vehicle emission characteristics : heavy-duty vehicles

On-road test of buses and trucks showed no improvement in NO_x emission.

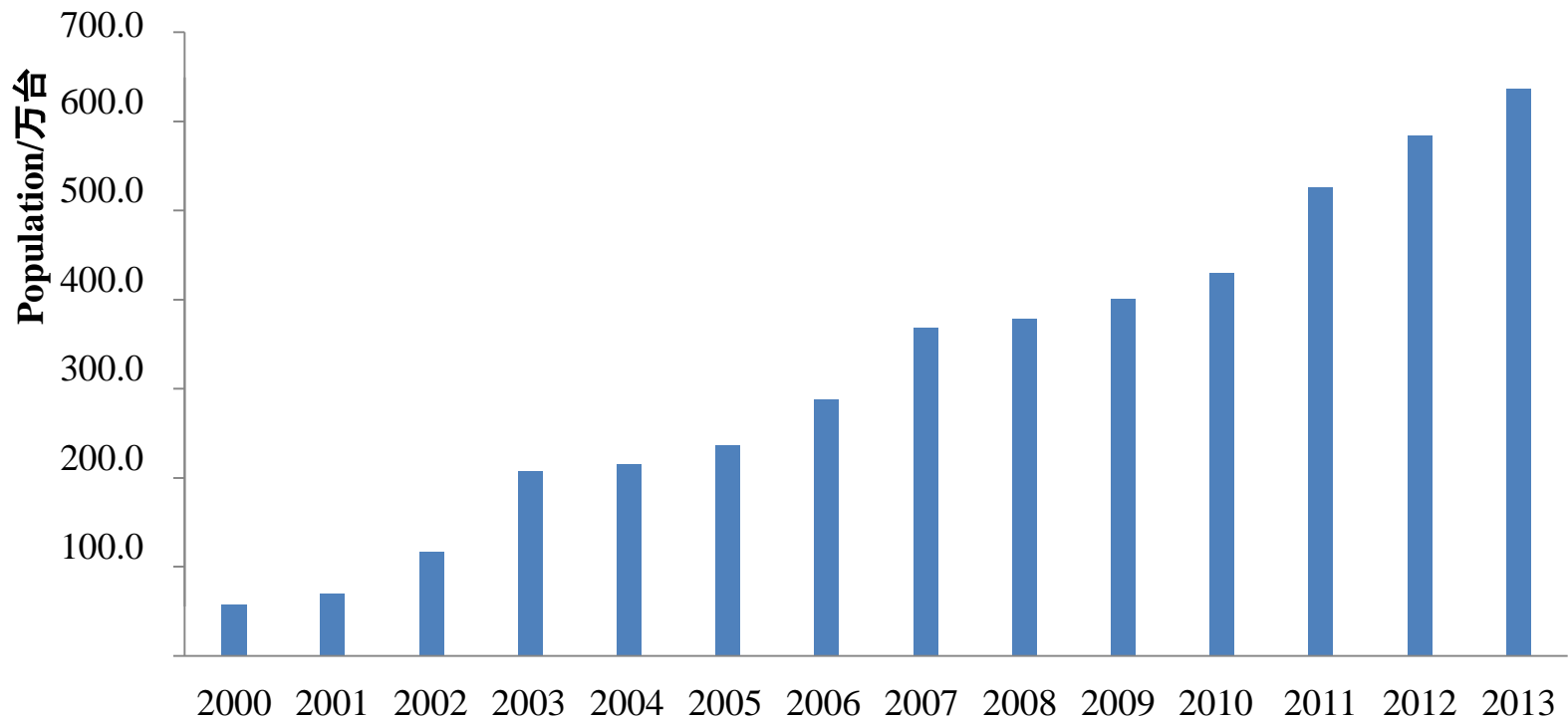


Population of Construction Machinery

Growing Rapidly in China

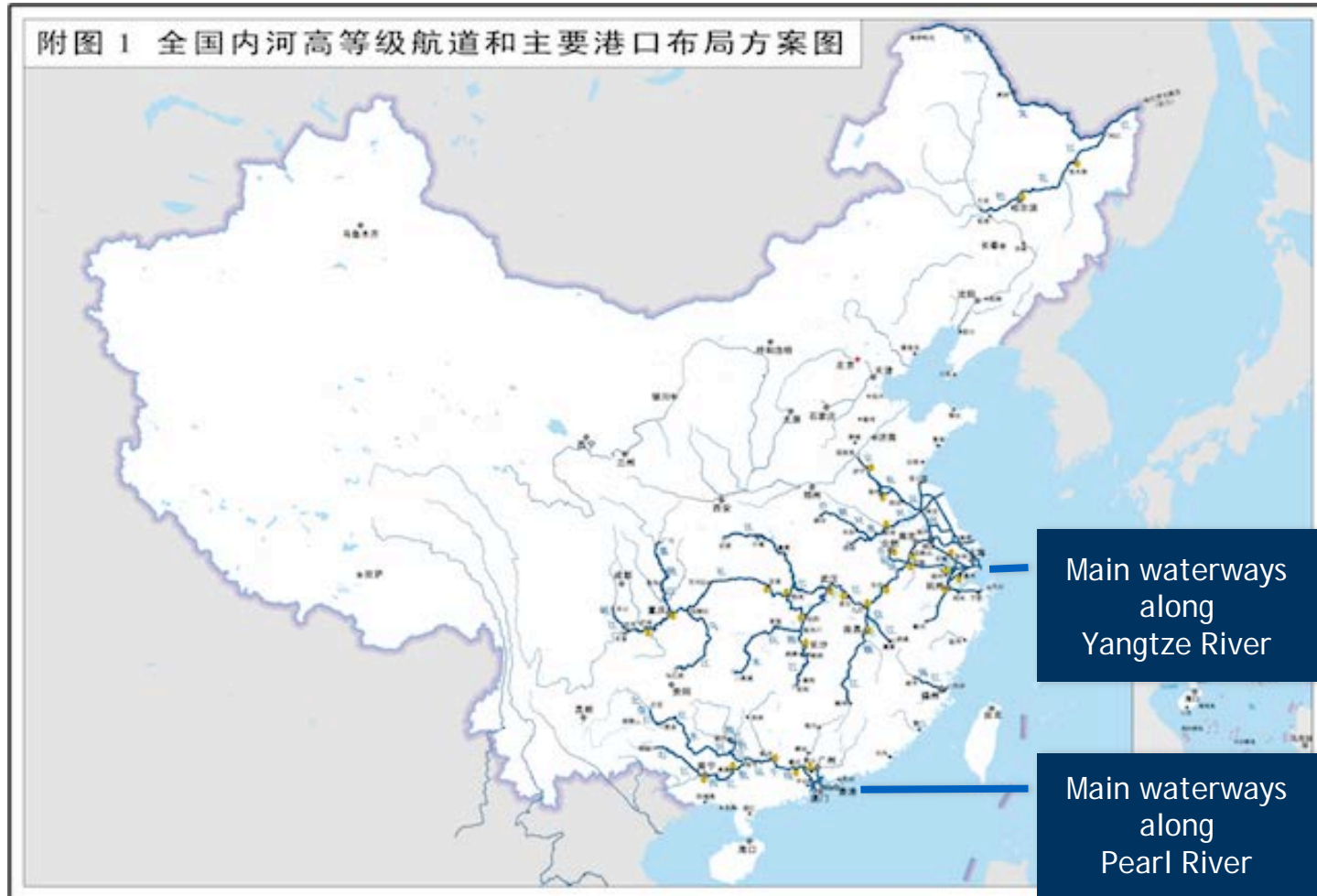
2000-2013年工程机械保有量 (见下图)

Population trends of construction machinery in 2000~2013



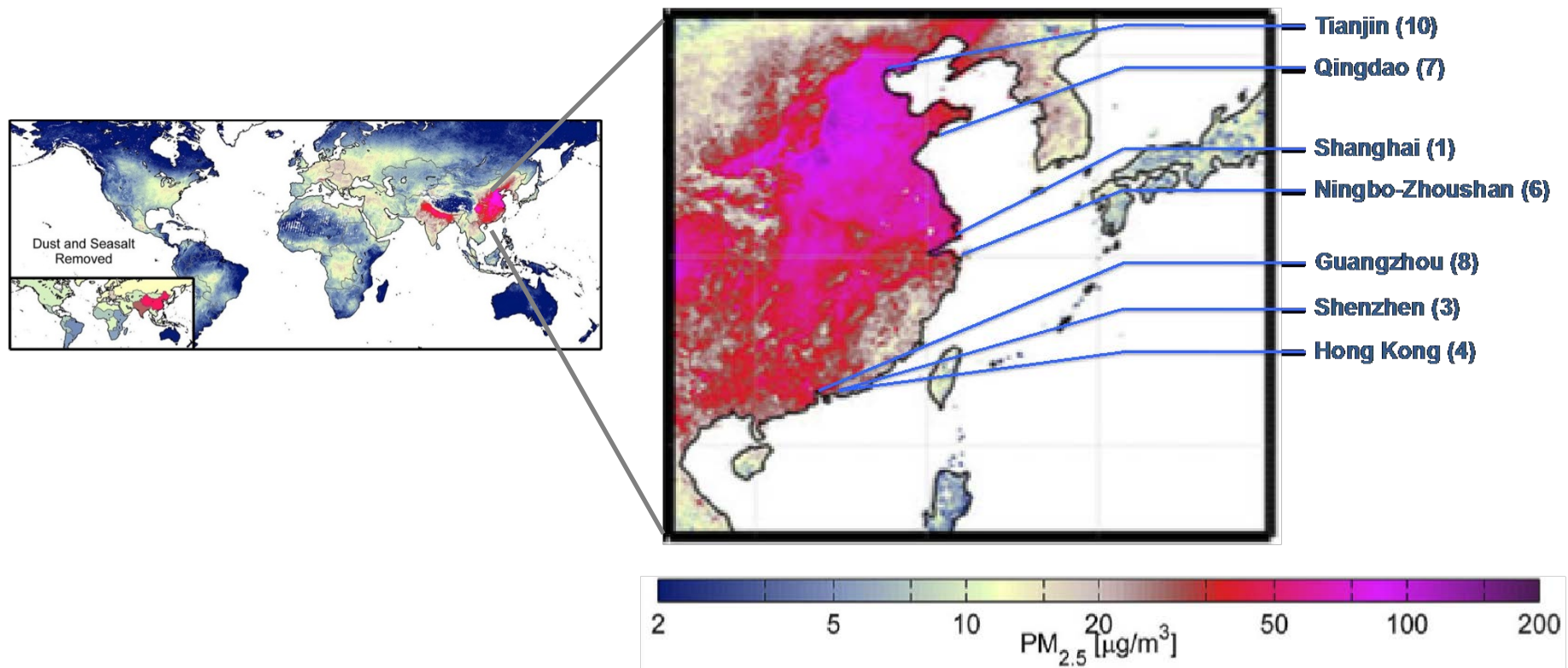
Domestic shipping along busy inland waterway and the coast are also major pollution sources

China has the world's largest inland waterway network, both in terms of length and freight volume

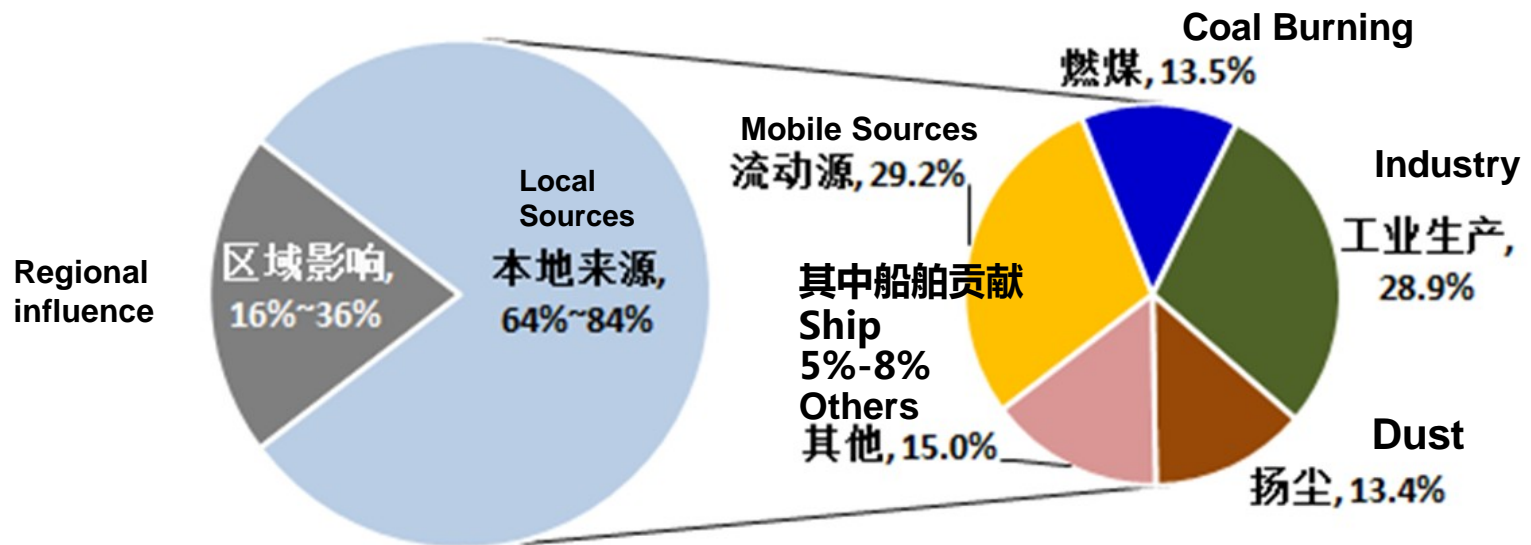
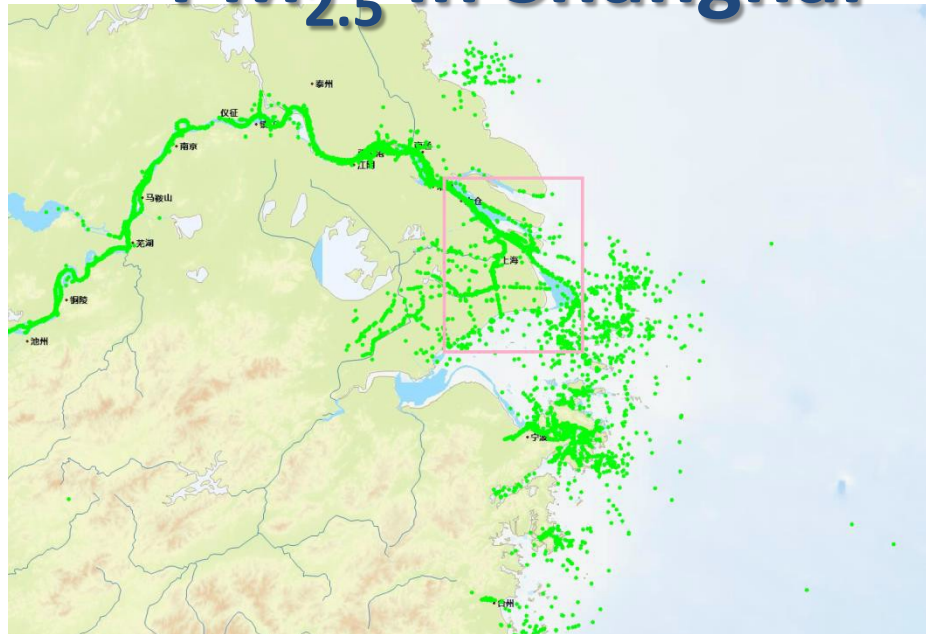


Coastal cities in China:

Home to world's largest ports and affected by high levels of pollution



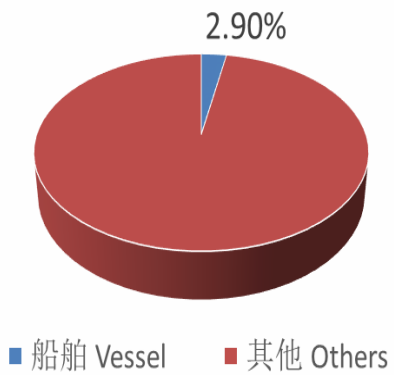
Vessels Are Large Contributors To $PM_{2.5}$ in Shanghai



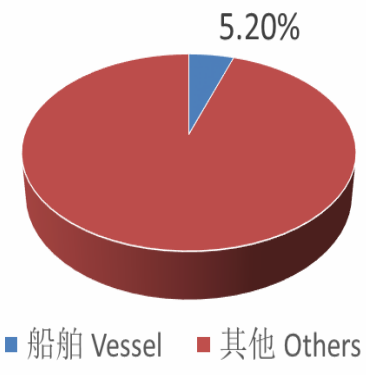
深圳市船舶的排放分担率

Contribution Rate Of Vessels In Shenzhen

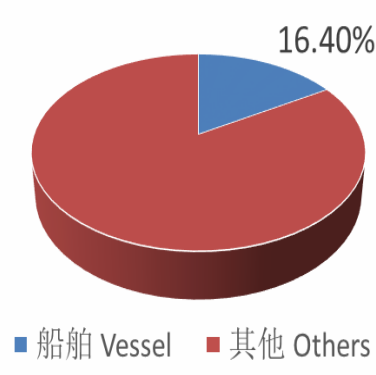
深圳市PM10排放总量是59359吨
Total emission of PM10 in Shenzhen is 59,359 tons



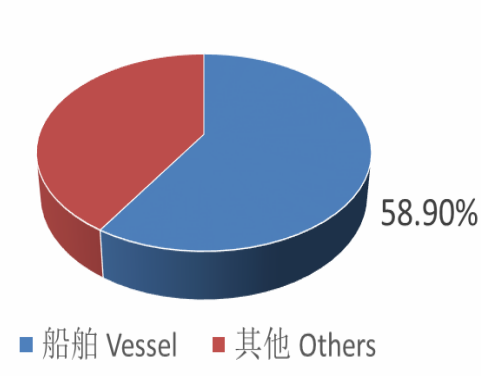
深圳市PM2.5排放总量是27116吨
Total emission of PM2.5 in Shenzhen is 27,116 tons



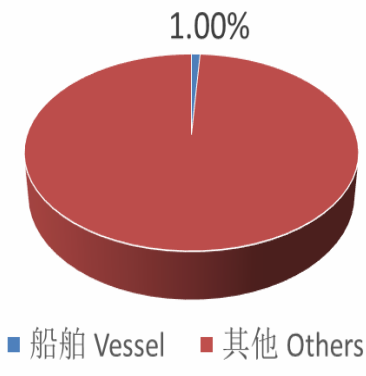
深圳市NOx排放总量是121982吨
Total emission of NOx in Shenzhen is 121,982 tons



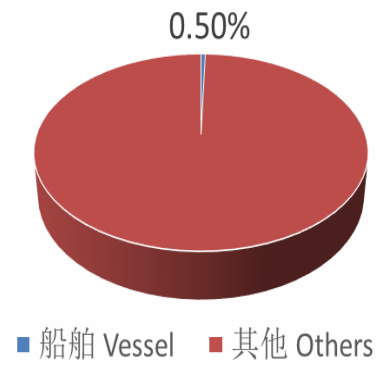
深圳市SO2排放总量是22252吨
Total emission of SO2 in Shenzhen is 22,252 tons



深圳市CO排放总量是230697吨
Total emission of CO in Shenzhen is 230,697 tons

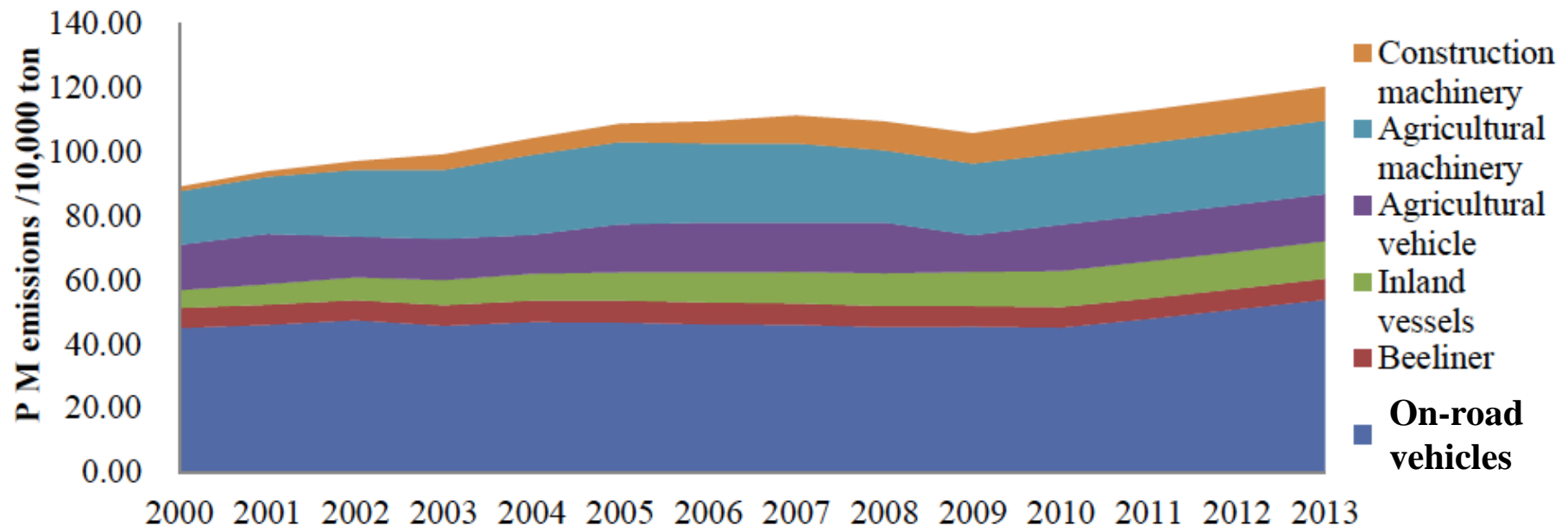


深圳市VOC排放总量是150801吨
Total emission of VOC in Shenzhen is 150,801 tons

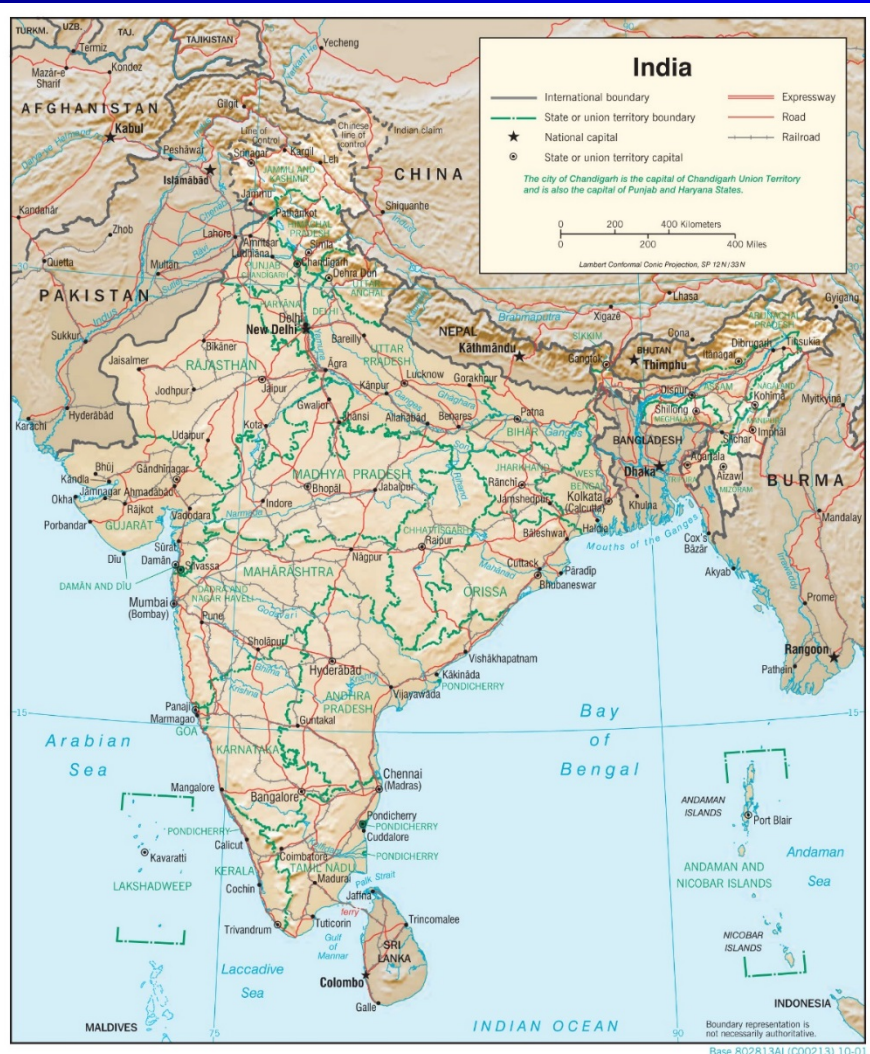


Non-road engine emissions are very significant

Estimated PM10 emissions from diesel machinery in China, 2000-2013



India Is Also Facing an Air Pollution Crisis But With A Very Different Traffic Mix Than China



**2 and 3 Wheeled Vehicles Dominate!
Also Large Diesel Car Population**

VIETNAM URBAN: RATE OF TWO – WHEEL VEHICLE IS ALSO VERY HIGH

In Ho Chi Minh City the rate of household using motorbikes just meets 9%. Two-wheel vehicles take 87% of transportation flow in Hanoi City.



Picture 1. Transportation on Dan Chu six-way cross road, Ho Chi Minh City



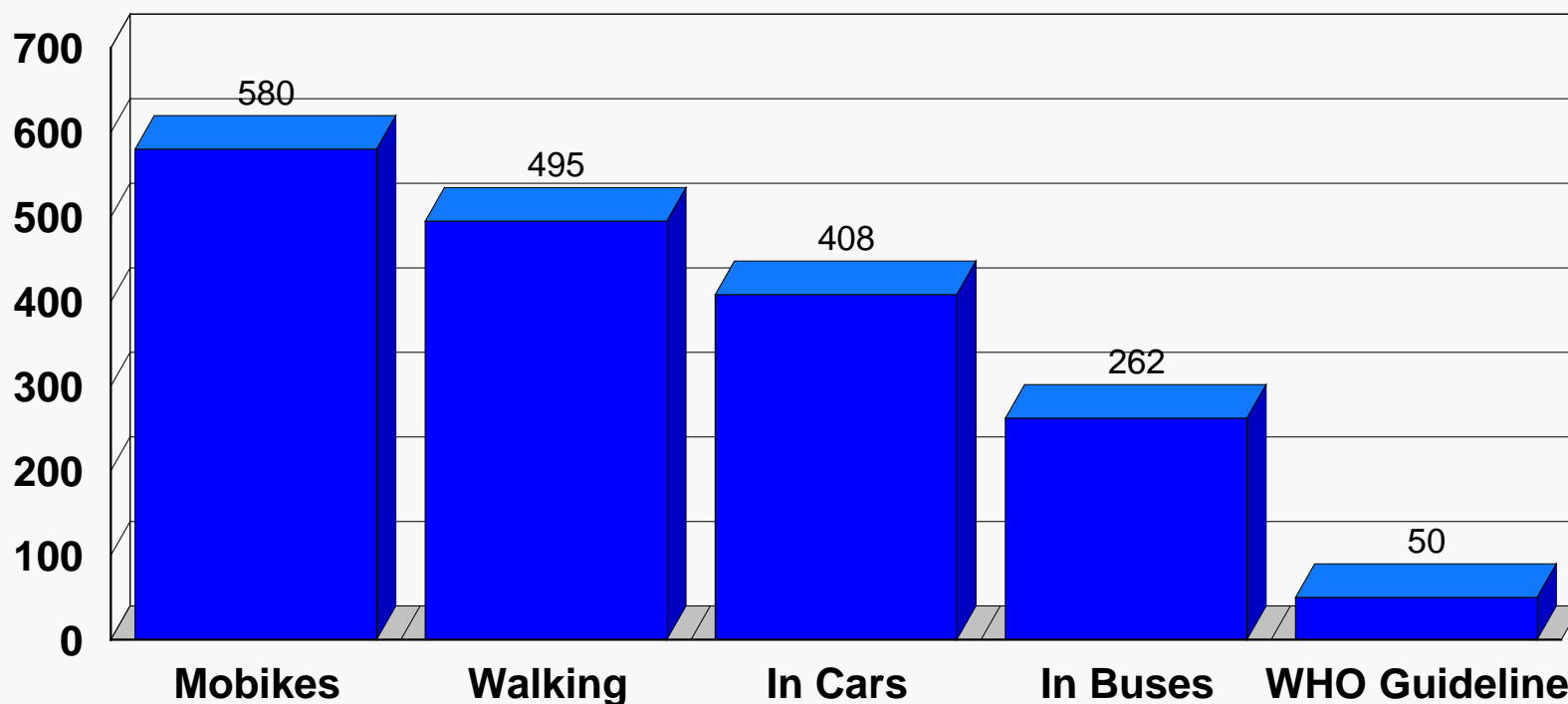
Picture 2. Transportation on Lang Ha street, Hanoi

Vietnam Has A Large Bicycle Population as Well



PM10 Exposures in Hanoi

micrograms/cubic meter



Commuters Exposure to Particulate Matter and Carbon Monoxide
in Hanoi, Vietnam: A Pilot Study
East West Center Working Paper No. 64, Nov 2006

Conclusions

- Technology Exists Today Which Can Dramatically Reduce Exposure to Vehicle Related Air Pollution and Its Use is Spreading
- But Diesel NO_x in the Real World Remains a Big Challenge Resulting in High NO₂ Levels
- Traffic Mix Varies Widely Across the World
 - US – Small Diesel Car Population
 - Europe – Almost 50% Diesel Cars
 - China – Few Diesel Cars but Large Non Road & Marine Sectors
 - India – Almost 50% Diesel Cars; Large 2-3 Wheel Population
 - Vietnam – Dominated by Motorcycles & Scooters with High Direct PM₁₀ Exposures

Conclusions (2)

- US - Exposures to CO, HC, NO_x & PM From Vehicles Coming Down But Still O₃ and PM Problems
- EU – Similar Except Roadside NO₂ Remains Serious
- China – PM_{2.5} Exposures Improving Slowly But O₃ Worsening in Some Areas
- India – Very Serious PM_{2.5} From Multiple Sources
- Vietnam – On Road & Roadside PM Exposures Very High