

Fleet – Upgrade an Absolute Must to Clean Urban Air

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Agenda

- Motivation background facts
- New technologies versus emission upgrade
- Emission Upgrade tool box and its achievable results
- Economic evaluation
- Conclusion

○ What does VERT® stand for?

- Non-profit organization to eliminate particles and harmful substances from internal combustion engines
- Certification of diesel particle filters with Best Available Technology (VERT® filterlist)
- International membership out of manufacturers of DPF and SCR systems, testing devices, substrate producers, chassis builders, engine manufacturers and others
- Acting as partner of Megacities to support and execute pollution reduction programs from road traffic and nonroad
- 20 years of experience in diesel particulate filter technology



VERT® is a Trade Mark

for Emission Control Devices based on Best Available Technology

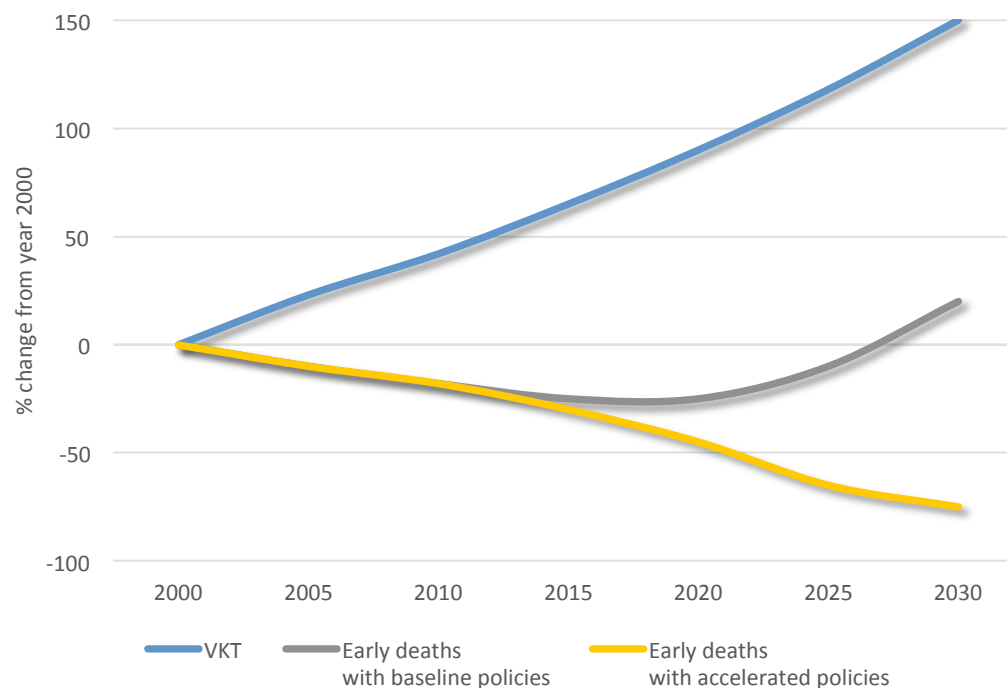
WHO repeats dramatic warning:

- 9 out of 10 people breath polluted air
- 7 mio. death every year by fine particles
- Many of the world's megacities exceed WHO's guideline levels for air quality by more than 5 times



Air pollution | Effects from road traffic

Global trends in vehicle-kilometers travelled (VKT) and early deaths from vehicle-related fine particle exposure

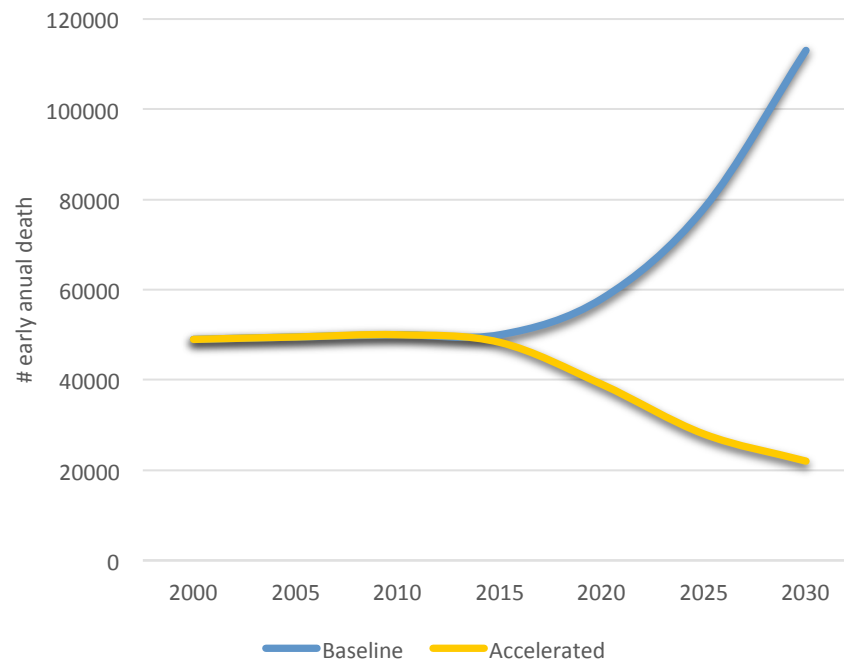


- VKT growth overcomes benefits of current policies by 2020
- Much lower limits on vehicle emissions would save more than 200,000 premature deaths in 2030 (equivalent to a 75 percent reduction)
- Action is most urgently needed
- First fit and retrofit

Air pollution | Effects from road traffic

Annual early deaths under current and possible enhanced policies

Countries: China & India



Effects and options

- India and China are the two most populous countries
- Without enhancing low emission technology plus filters for UFP China and India could see 110,000 early deaths p.a.
- Huge financial burden to the society
- Current actions are not stringent enough

○ We need to do more | Two Options

- Develop and market introduction of alternative drive and mobility concepts
- Upgrading of existing fleets with best available technologies to highest emission standards



○ New technologies and concepts

- Electromobility
- Hybrids
- Fuel cells
- Other alternative drives
- New Mobility Concepts (reduce cars)
- New Metropolitan Living Concept (reduce logistics)
- ~~Buy new Busses and sell old one to other EU Countries~~



needed but takes decades to get remarkable effects

○ Upgrading existing Fleets

- Upgrading our fleets to best available technology
 - onroad
 - non-road
 - marine fleet
 - stationary applications
- We talk about to Best Available Technology NOT retrofit to an acceptable level



○ Upgrading existing Fleets

- It is a joint approach
 - Engine manufacturers
 - Equipment manufacturers
 - Technology Providers
 - Political Frameworks

- We can achieve tremendous improvement by doing it jointly



Existing Tool Box for Emission Upgrade

- High efficient Particle Filters for CI and SI engines
- Catalysis for Reduction of CO, HC, PAH
- DeNOx Systems more efficient then first fit
- Closed Crankcase Ventilation to avoid BlowBy Gas-Emission
- Low Ash lubrication oils
- Nanoparticle cabin filters
- Engine management upgrade Kits
- Repowering
- ...



Existing Tool Box for Emission Upgrade

What we can achieve today

- > 99 % Reduction of carcinogenic nanoparticles
- > 95 % Reduction of NO_x and NO_2
- > 90 % of Blow By Gas Emissions
- HC and CO are practically eliminated
- PN

on the road – these vehicles are
reducing nanoparticles (soot and metals)



Existing Tool Box for Emission Upgrade

What we can achieve today

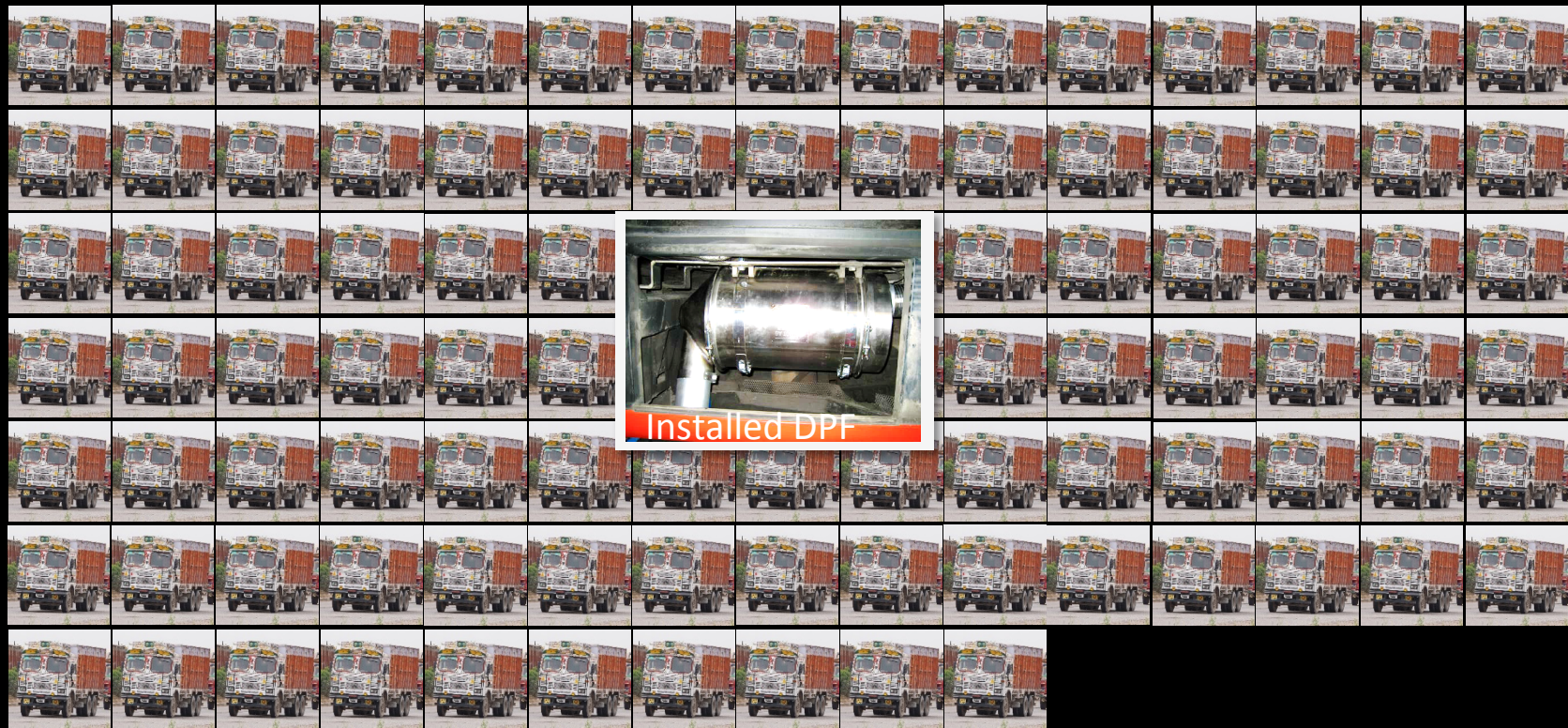
- NRMM -> to Emission level Stage V
- Upgrade EURO III, IV, V and EEV buses to Emission level better than EURO 6/EURO VI
- Upgrade passengers cars to EURO 6 level even under real driving conditions
- City Busses NOx reduction even under specific low temperature driving cycles
- ...



One truck without filter is emitting as much as ...



One truck without filter is emitting as much as **100 trucks with filter**



Emission Upgrade

It is worth the money?

OECD statements on economical consequences

- Health care cost due to air pollution in 2015 estimated with 21 billion USD
- Health care cost due to air pollution in 2060 estimated with 176 billion USD
- Equivalent to apr. 1% GDP by 2060

Emission Upgrade

100 Mio. Diesel Particle Filters already installed

The success of 100 Mio. Particle Filters already installed

- 100,000 km travelled distance @ 0.025 g soot/km
- Collected soot
- Health Cost per kg soot = 400 €
- Correlates with > 100 billions EUR saved health-cost

○ Results of BAT introduction

- **Introduction of 100 mio. DPF worldwide**

Light and heavy duty vehicles and
construction machinery

- **Example Zurich: 550 mio. CHF saved**

2010 1.5 bn. CHF health cost expenses related to PM10

2015 0.95 bn. CHF

- **Reduction of Elemental Carbon**

NEAT tunneling project: 1998 = $760 \mu\text{g}/\text{m}^3$ TC

2004 < $50 \mu\text{g}^3$ EC due to filter technology

Conclusion

- Emission Upgrade of the existing fleet is the most cost efficient, fast and innovative method to increase air quality tremendously
- To be successful a joint approach between the stakeholders are mandatory
- The Emission Upgrade “Tool Box” is available and proved
- Emission Upgrade Technology for In-Use fleets and machines is a realistic vision of Best Available Technology for high polluted areas

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○ VERT – the think-tank for UFP reduction

Challenging the industry for innovation in emission reduction is an engine for European industrial success and competitive advantage ...

Thank you for your attention!

For more information visit
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