

Pragmatic emission regulation for Iran with focus on Ultra Fine Particle (UFP) reduction

Private Public Partnership for elimination of ultrafine particle emissions in Iran

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VERT®: Created to eliminate particle emissions
from internal combustion engines (ICE)
by means of best available technology

○ What does VERT® stand for?

- Swiss based international association of manufacturers of DPF and SCR systems, testing devices, substrate producers, chassis builders, engine manufacturers and others - 35 members
- Certification of diesel particle filters with Best Available Technology (VERT® filterlist) - more than 65 verified filter systems
- Acting as partner of Megacities to support and execute air pollution reduction programs from road traffic and nonroad
- Retrofitting of more than 400,000 vehicles worldwide (onroad and nonroad) with diesel particle filter systems
- Influential role in international legislation (EURO VI Heavy duty regulation; NRMM Stage V)



○ What to take home?

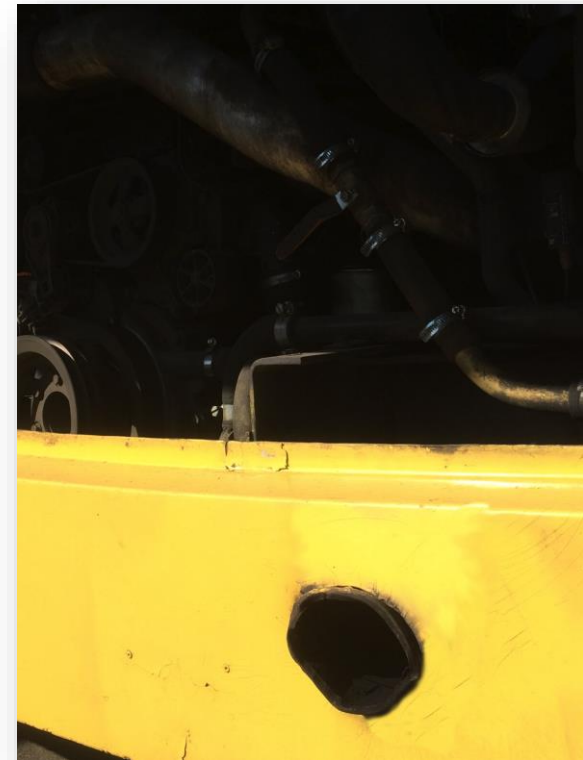
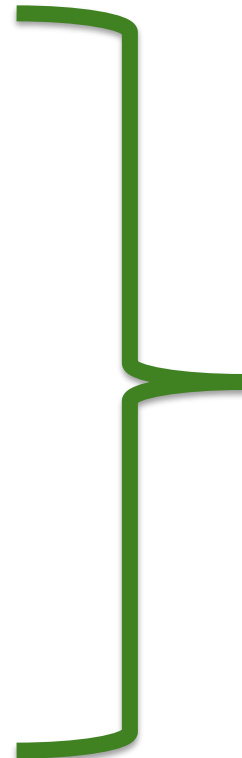
- **Reducing Ultrafine Particles (UFP)** emitted by combustion engines **must have priority**
- The challenge of Iranians legislation is to solve **fast** local high priority air quality problems by **pragmatic** emission regulation
- **Copying EU or USA** emission legislation models **are not the best choice**
- Only **closed DPF systems** can perform the needed high efficiency



○ Substances of Diesel Exhaust

Substances of Diesel Exhaust

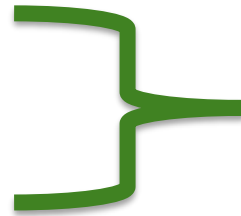
- Solid particles:
 - Soot particles
 - Ash particles
- Liquid droplets
- Gases:
 - O₂, HC, NO, NO₂
 - PAH, Nitro-PAH
- Many trace substances



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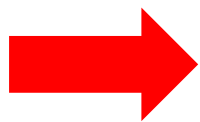
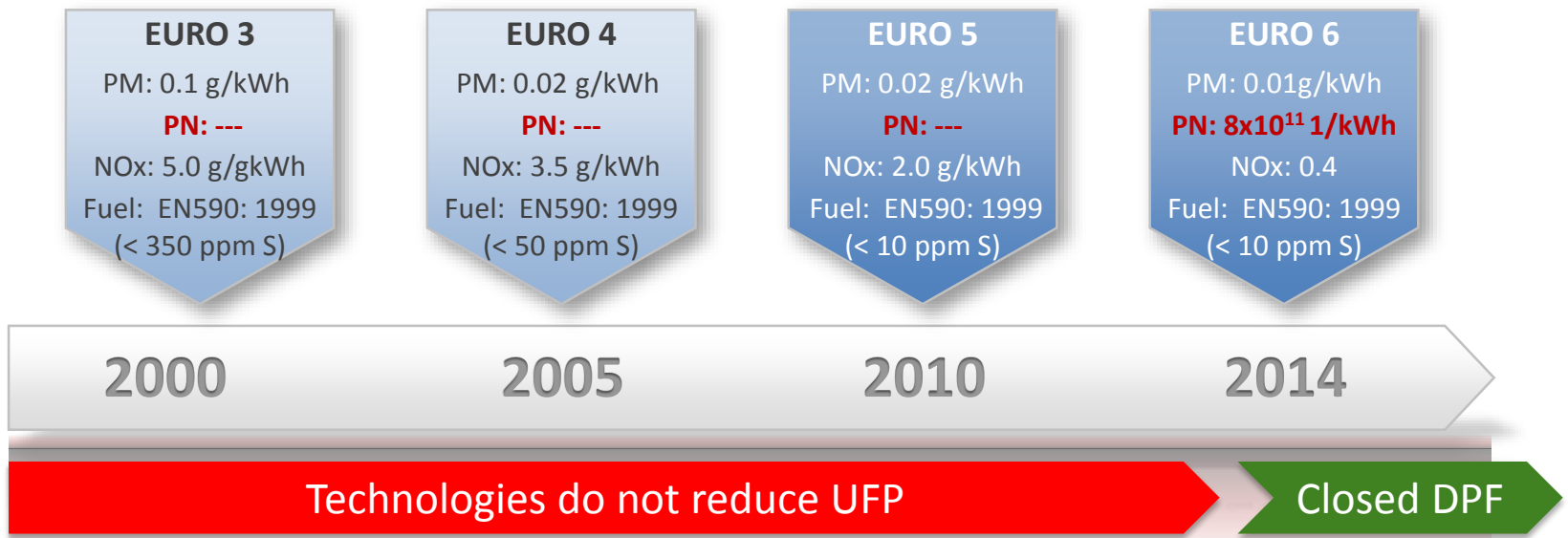


- Very small < 100 nm
- High surface > 100 m²/g
- Transporting toxics persistent in organism
- Carcinogenic
- Black colour | global warming effect
- Long life toxic aerosol (weeks to month)

Defined by WHO since 2012 as evidenced carcinogenic (class 1 like asbestos)

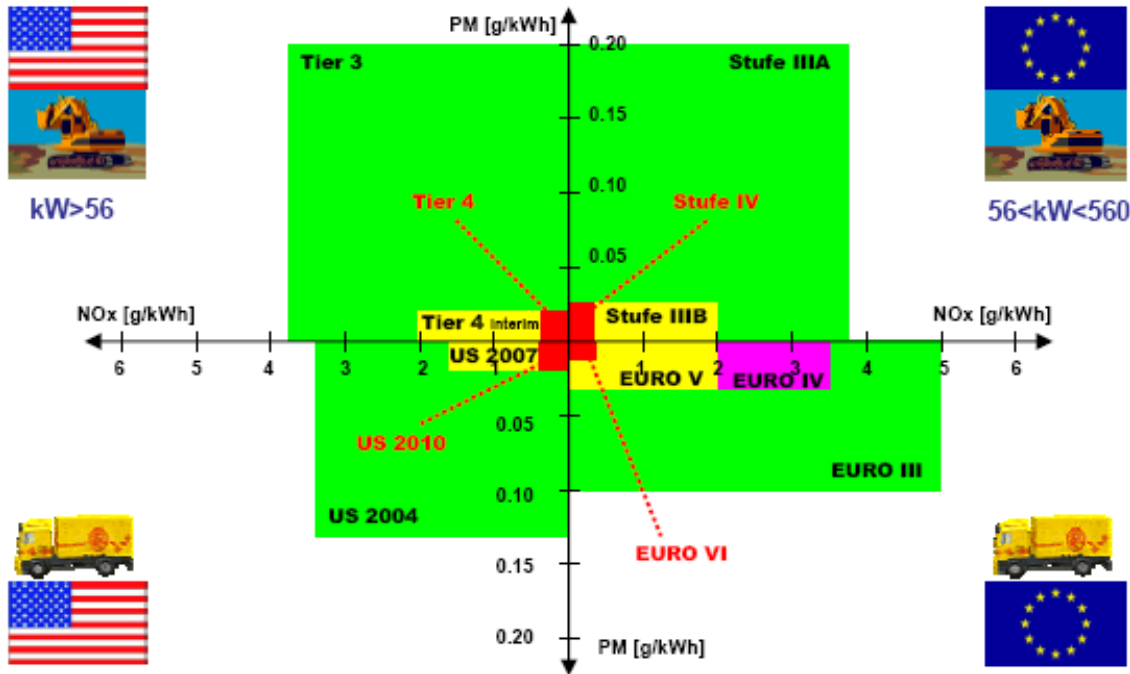
PN of UFP were not reduced by EU Legislation up to EURO V

Heavy Duty Emission Standards



EU-Legislation failed to reduce UFP –Emission until 2009
 no closed Particle Filter used up to EURO V - no UFP reduced

Overview of Emission Legislation (USA & EU)

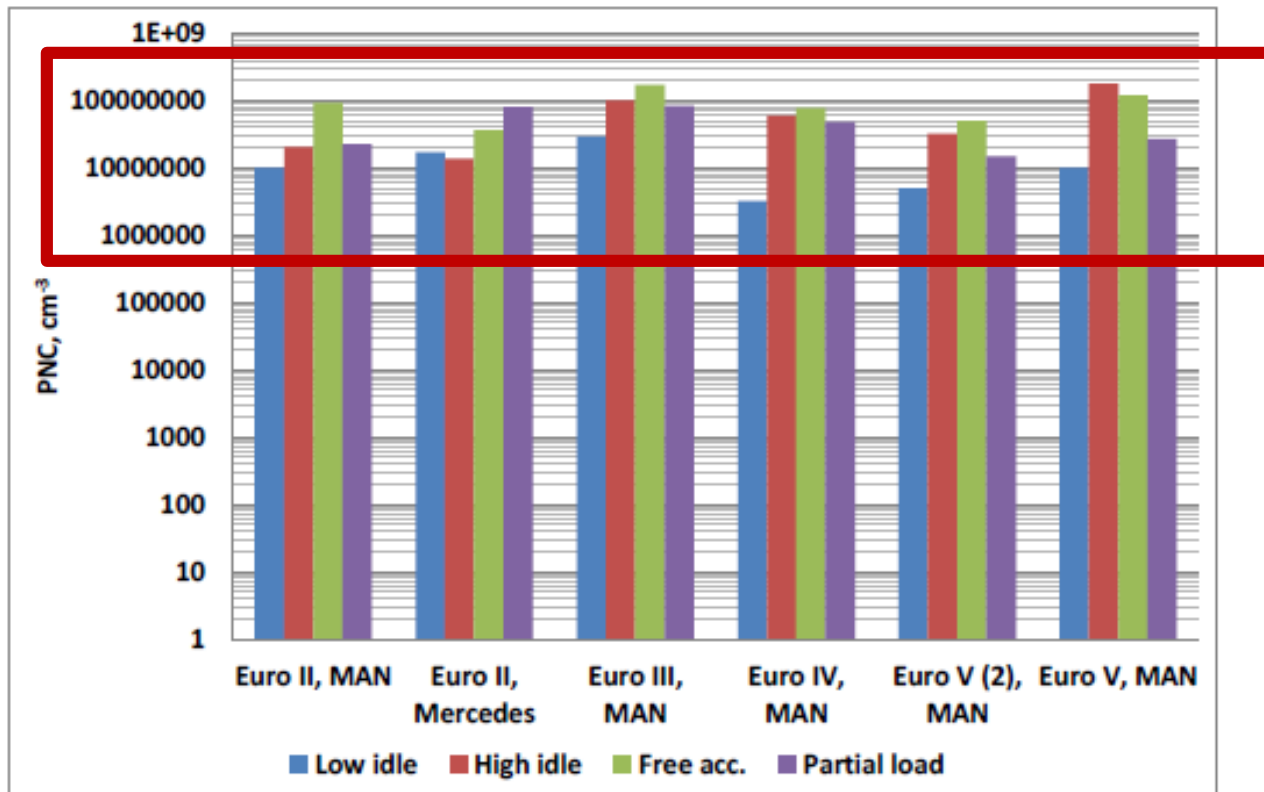


PM and NOx impressively reduced
 but these are not the toxic air contaminants of highest health priority



USA-Legislation limits only particle mass PM fails to reduce UFP Emission until today

PN of UFP were not reduced by EU Legislation up to EURO V

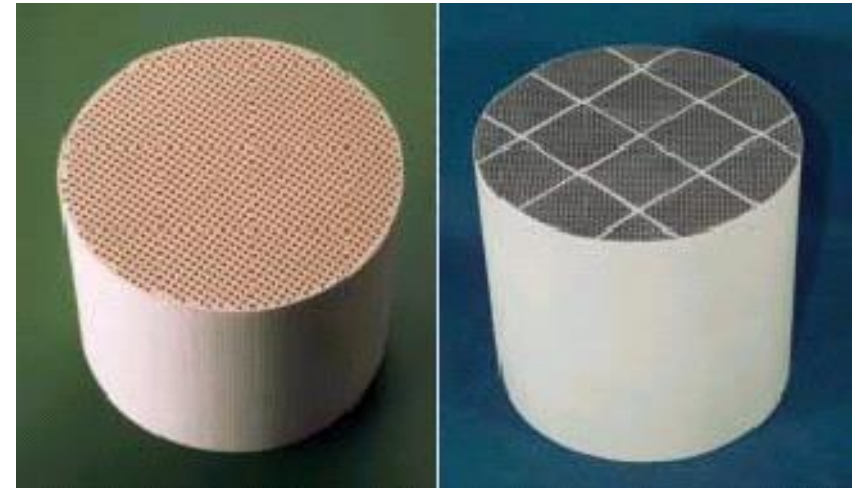
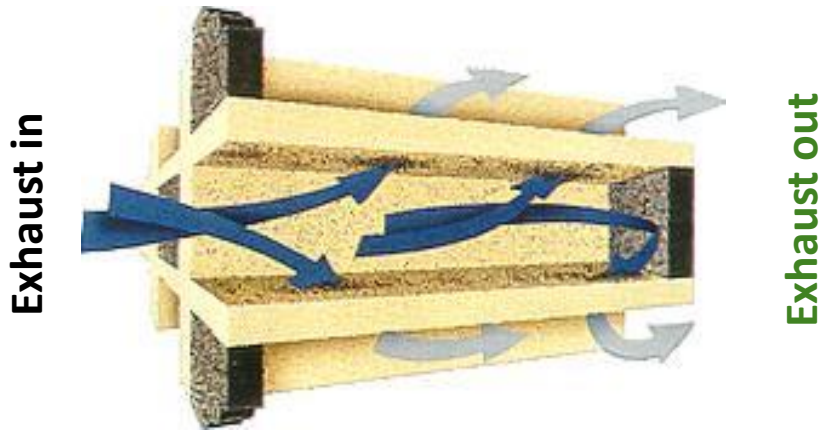


- EURO V reduces mass PM but **not number PN of UFP** compared to II / III / IV
- **Euro VI** will bring the solution with the mandatory introduction of particle filters

○ Conclusion on European Level EU CO-Decision (Art.12, Rec.15 - 2008)

- In order to **achieve these environmental objectives it is appropriate to indicate that particle number limits** are likely to reflect the highest level of performance with **particle filters using best available technology**
- ... the commission shall **introduce particle number based limit values** at a level appropriate to the technologies actually being used.

○ The Solution is available - Classic Wall Flow Filter (since 1982)



Cordierite

Silicon Carbide



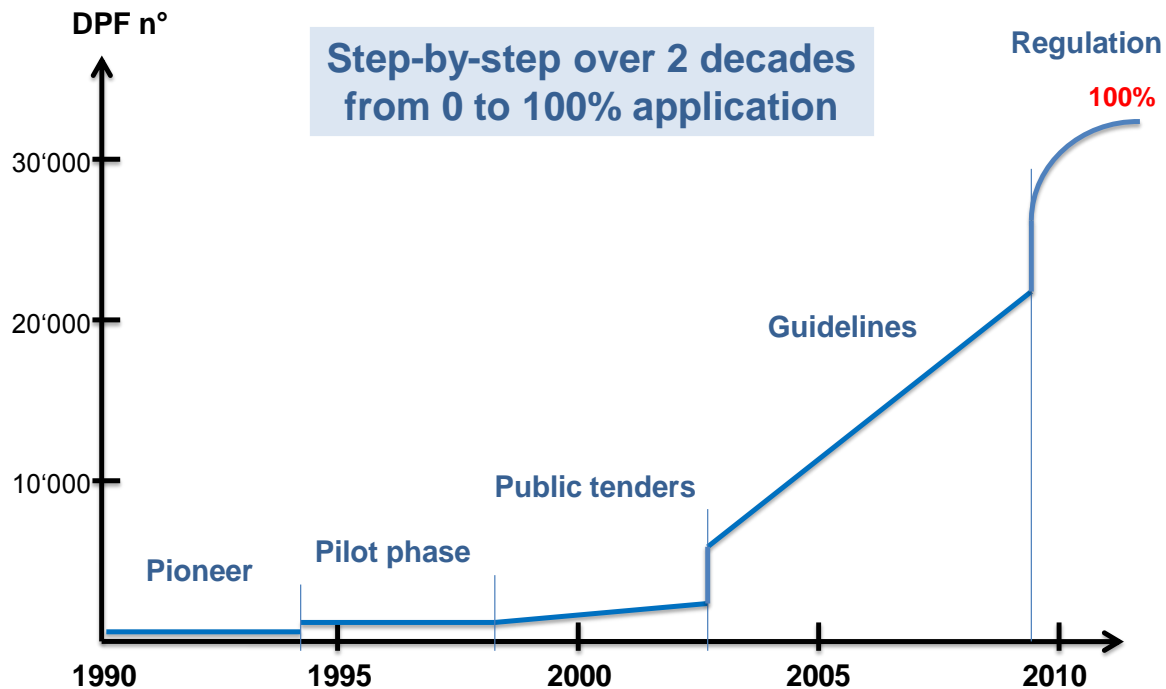
Sintered Metal Filter

○ Experience with DPF Switzerland

- Switzerland started retrofitting in 1992 / mandatory 2002
- Requirements:
 - **97% Filtration efficiency** based on PN
 - Testing acc. Swiss Standard SN 277206
 - VERT quality and durability standards
- Which kind of Diesel applications are effected?
 - Busses, construction machines, trucks, locomotives and ships

○ The Swiss Learning Curve –Example Construction Machines

DPF Retrofit of Construction Machines Switzerland



Best Practice Example Bogotá

With VERT support The **Bogotá DPF Project** aims at the introduction of DPF applications in Colombia's capital

Policy framework introduction of 10-year plan of air pollution per decree. **Control emission systems (DPF) for busses**

DPF Retrofit Pilot Tests

Know-how & technology transfer, leverage the participation of main DPF manufacturers

Implementation Phase

Stage 1 – 18 busses, stage 2 – 300 busses until end of 2015



Pictures: Secretaría Distrital de Ambiente Bogota-Colombia

Best Practice Example China

China and Switzerland authorities supported by VERT[®] started the Sino-Swiss program Black Carbon Emission of Mobile Sources (BCEMS) with VERT[®] certified DPFs.

Policy framework for in-use heavy duty

National diesel vehicle after treatment guideline is drafted

DPF Retrofit Pilot Tests 10 coaches in Nanjing, 10 city busses in Xiamen, 11 construction machines in Beijing

Implementation Phase

About 10,000 diesel vehicles in Beijing are already retrofitted and got the green labels



Best Practice Example Santiago de Chile

3500 Buses equipped with Diesel Particle Filters in Santiago de Chile

6000 Buses = 100 % in 2018 requiring VERT Particle Filter on. New busses need **Euro III + DPF**

Policy framework

For in-use and new busses DPF Regulation for EURO III busses

DPF Retrofit Pilot Tests

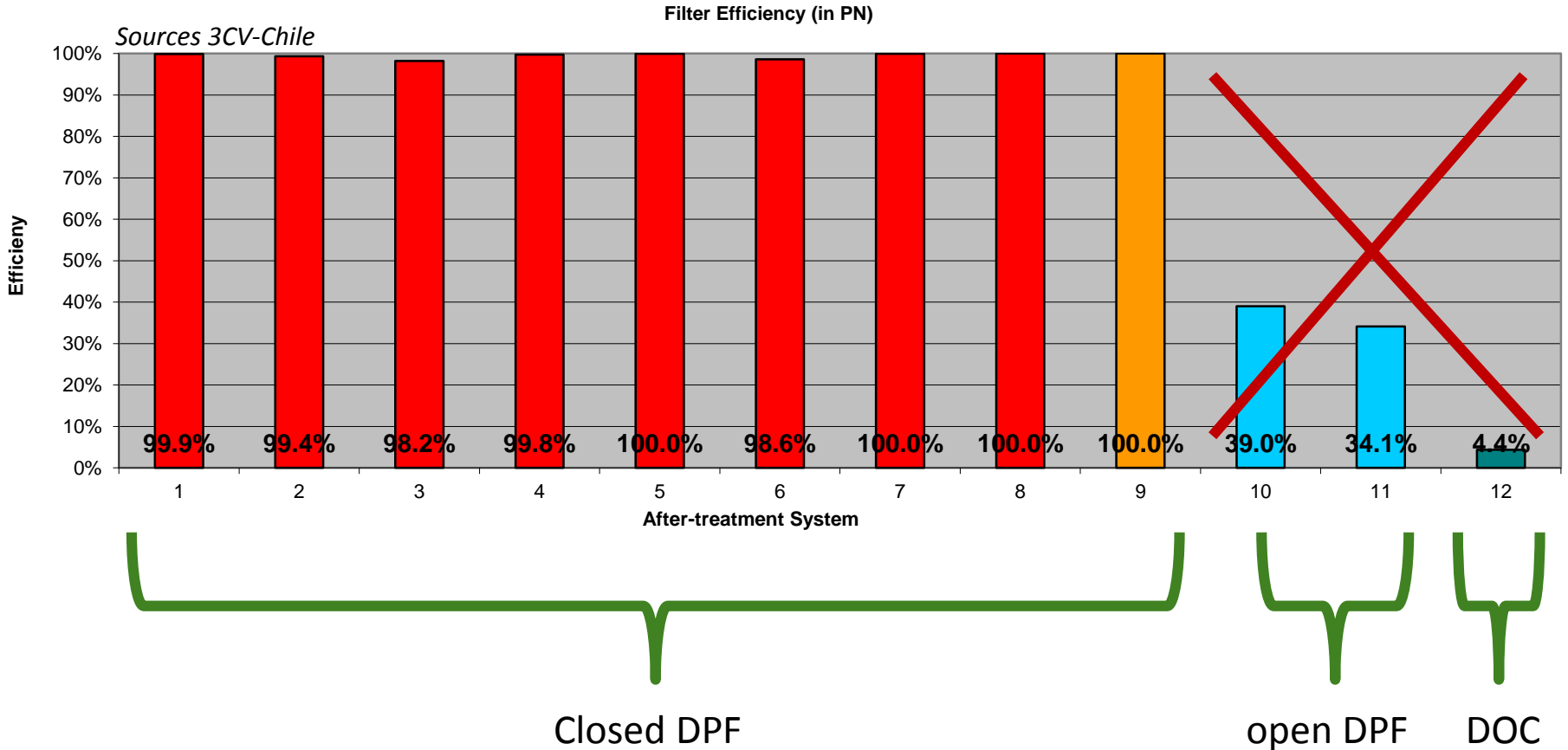
Pilot bus fleet of 12 busses. Representative bus routes, data logging, installation and operation

Implementation Phase

Stepwise implementation. 2004 – 2009 Retrofit. Since 2010 New busses EURO III + DPF

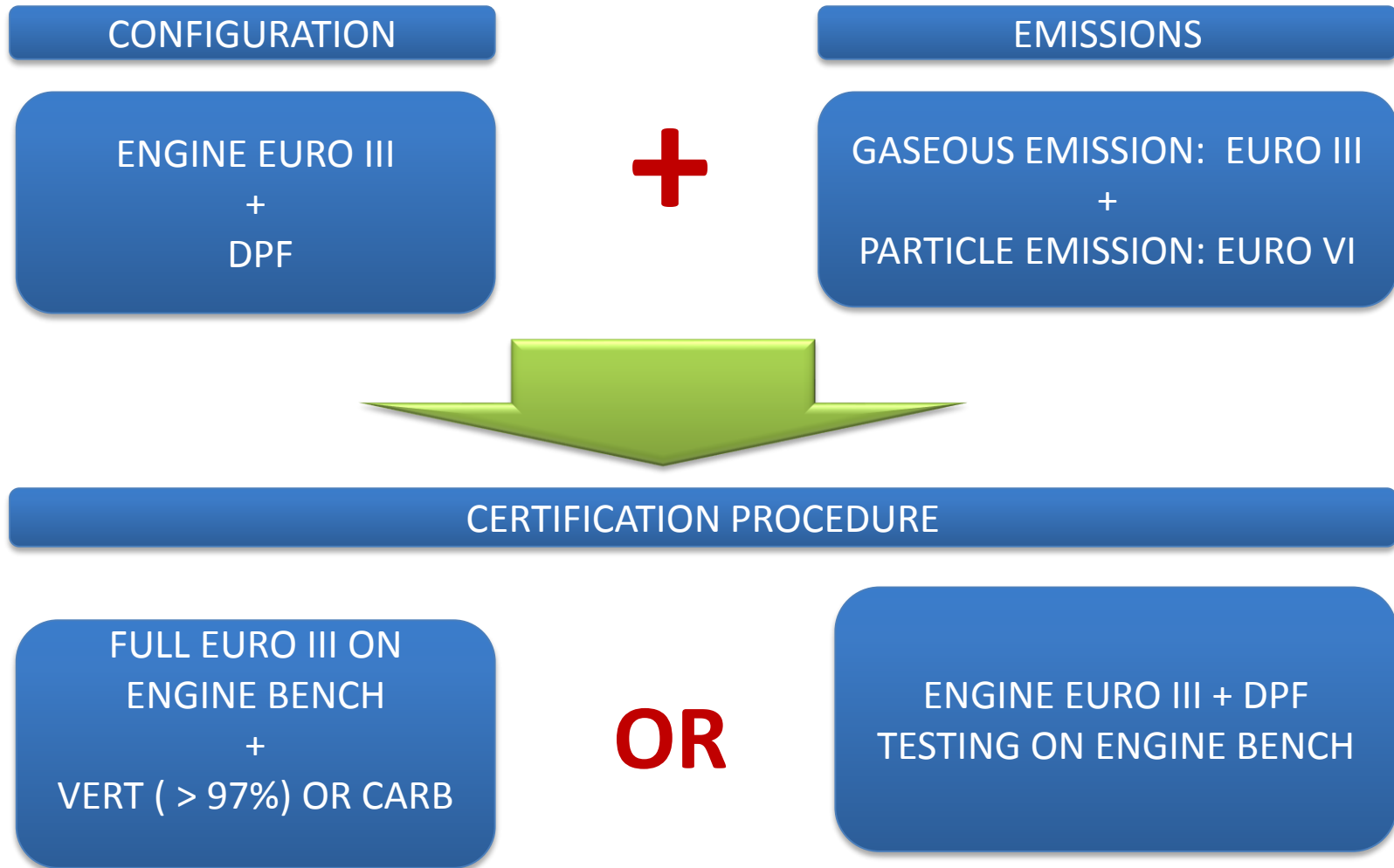


Results of the Santiago Pilot Test



 Don't repeat failures, use only closed DPF

Policy for new busses -Supreme Decree 49/2009 (EURO III + DPF)



○ Global Experience with DPF and EURO III + DPF

- Today 84 mil. vehicles world wide (Heavy Duty and passenger cars) with DPF in-use
- Santiago de Chile 3.500 application with EURO III + DPF
- Cities in Switzerland have successfully implemented EURO III + DPF
- Gemany: truck retrofit > 30.000 vehicles have been retrofitted - EURO II / III with DPF within the maut and LEZ program
- London: EURO III + DPF retrofit
- Italien: EURO III + DPF retrofit
- ...
- EURO III engine homologation plus verified DPF is a success model in various countries

“Few risks have a greater impact on global health today than air pollution; the evidence signals the need for concerted action to clean up the air we all breathe.”

Dr. Maria Neira,
Director of WHO’s Department for Public Health,
Environmental and Social Determinants of Health, 2012

Thank you for your attention