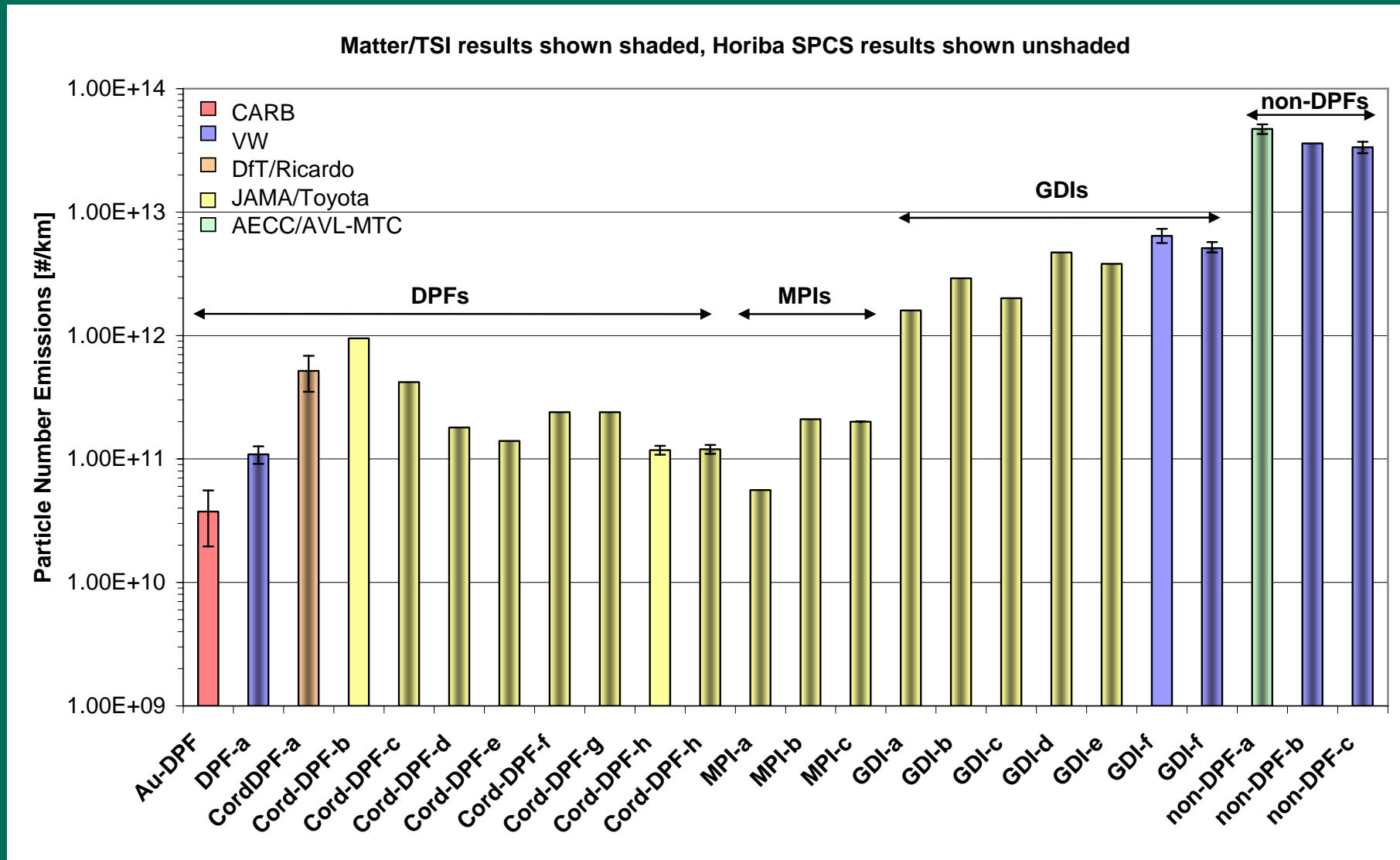


PMP Progress Since GRPE 55

- GRPE 54 agreed a Roadmap of work to address concerns with ECE/TRANS/WP.29/GRPE/2007/8 (adding particle number measurement to Regulation 83) to allow a revised proposal to be adopted in January 2008.
- Roadmap actions were; i) to compile additional existing PN results, ii) to improve calibration procedures, iii) to analyse accumulation of errors/system tolerances and iv) to demonstrate calibration procedures.
- Compilation of Existing Particle Number Test Data from PMP compliant equipment used outside of the PMP ILCE
 - Data was received from AECC, CARB, JAMA, Sweden, Concauwe, UK, Toyota and Volkswagen
 - PMP compliant measurement systems used were the Horiba SPCS and Matter MD19+TSI PNC. Results were submitted on other measurement systems but no data was available to demonstrate that these systems met PMP solid particle penetration and volatile particle removal efficiency requirements.

Consolidation of Particle Number Data



Consolidation of Particle Number Data

- CARB Au Vehicle result (3.8×10^{10} #/km) within PMP ILCE range
- Other SiC DPF vehicle (1.1×10^{11} #/km) towards top end of PMP ILCE results for SiC DPF vehicles. PN trace suggests this vehicle's DPF has a slightly lower efficiency than those tested in PMP ILCE.
- Cordierite DPF vehicle results (1.2×10^{11} - 9.5×10^{11} #/km) spanned the single cordierite DPF vehicle test result in the PMP ILCE (6×10^{11} #/km).
- MPI petrol vehicle results similar to SiC DPF vehicles as in the PMP ILCE.
- GDI vehicle emissions were at least an order of magnitude higher at 1.6×10^{12} - 6.4×10^{12} #/km, consistent with results seen in the PMP ILCE.
- Conventional diesels were an order of magnitude higher again at 3.4×10^{13} - 4.7×10^{13} #/km, consistent with PMP ILCE results for this technology.
- Where assessed repeatability was similar or better than that in the ILCE.
- Matter & Horiba systems showed consistent results

Improved Calibration Procedures

- PMP meetings to discuss calibration procedures held on 7th August and 8th October.
- The following key revisions to the procedures were agreed
 - VPR will be calibrated for particle concentration reduction factor (a combination of particle losses and dilution) which must not be excessively size dependent
 - PNC will be calibrated to reference electrometer level
- This substantially reduces potential offset between systems by correcting out differences in particle losses and PNC linearity
- Revised calibration procedures have been circulated to PMP WG and are being added to PMP webpage

Calibration Measurement Results

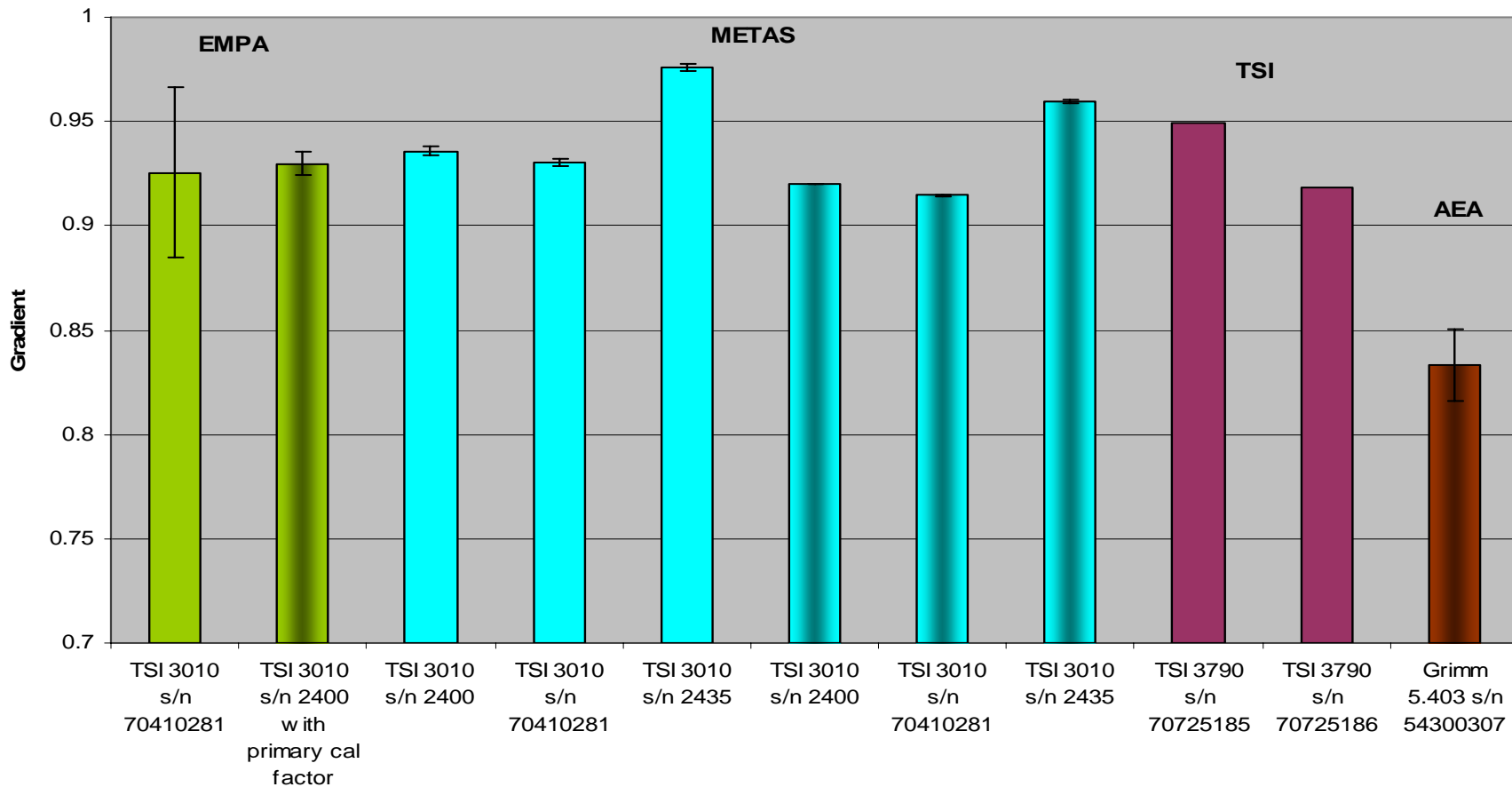
- EMPA, METAS, TSI & AEA undertook measurements during August-September demonstrating the procedures and their repeatability
- Further measurements were made at JRC in December to investigate the influence of aerosol material on PNC cut-off characteristic.

PNC Primary & Secondary Validation Gradients

- Primary & Secondary methods show similar results
- Repeatability generally good

PNC All Validations - Gradient

Validations by Secondary Procedure (reference PNC) Shaded

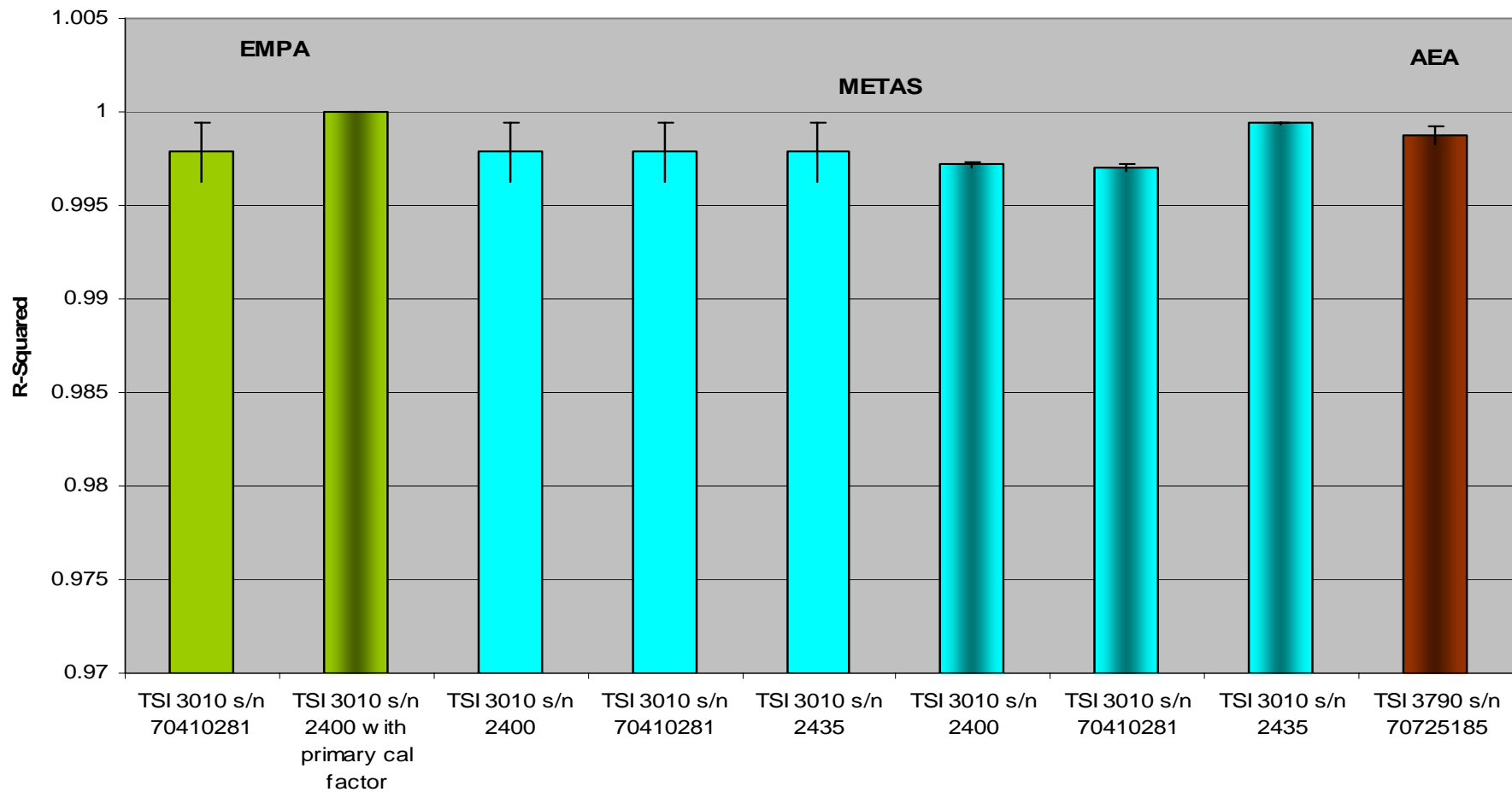


PNC R² Validation Results

- Repeatability very good

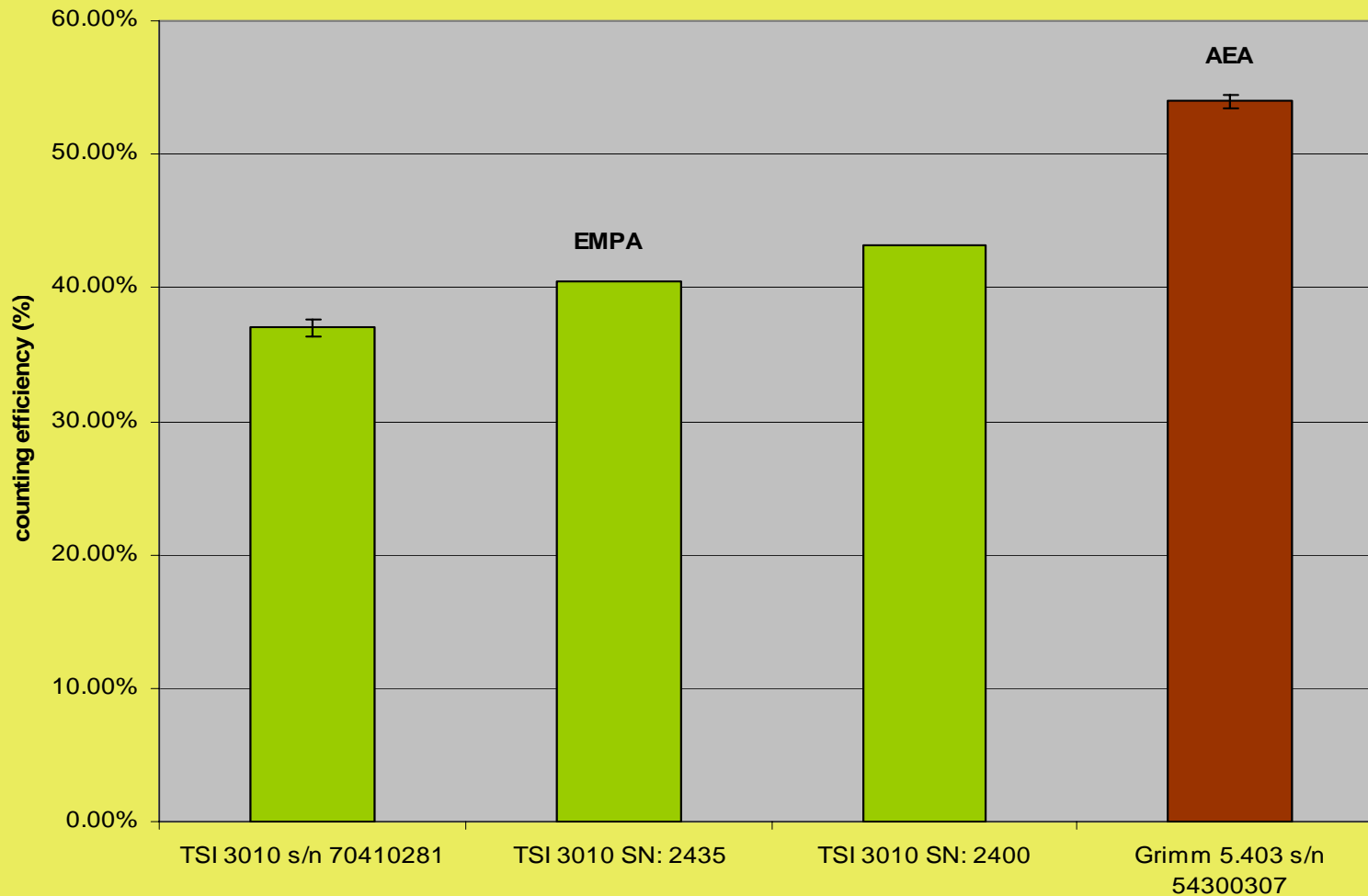
PNC All Validations - R-Squared

Validations by Secondary Procedure (reference PNC) Shaded



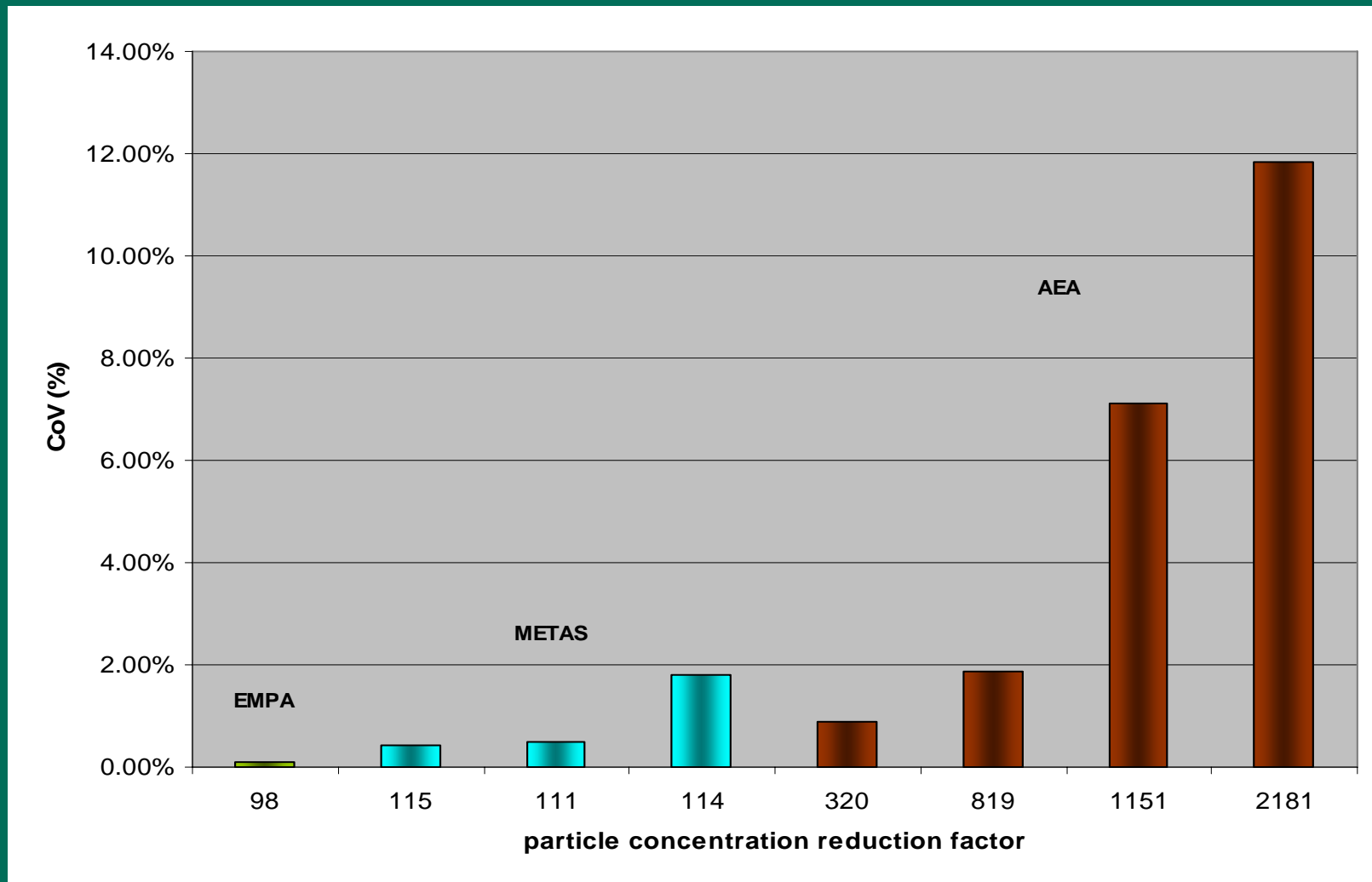
PNC Cut-Off D50 Validation Check

- Repeatability very good



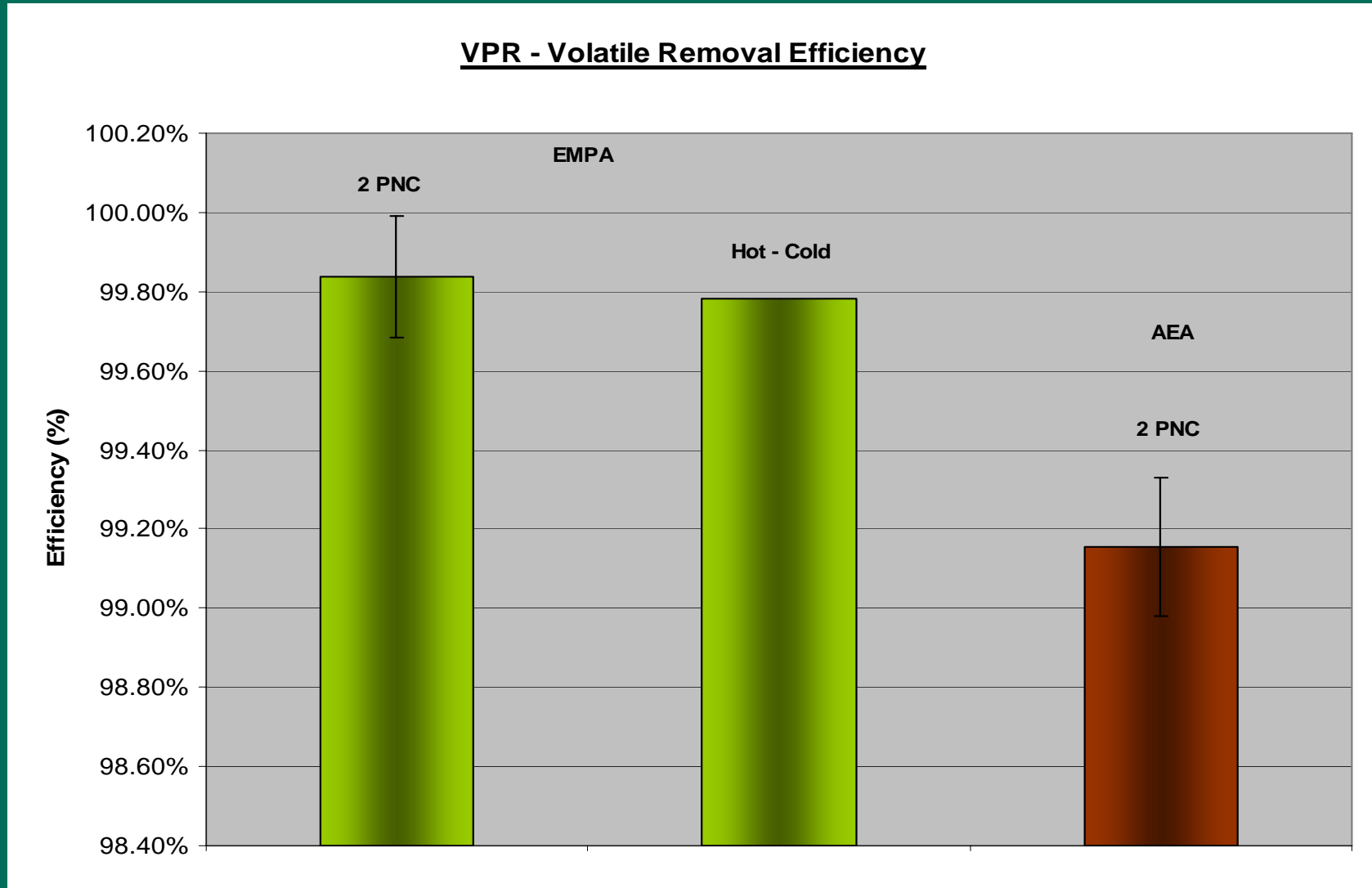
VPR pcrf Repeatability

- Repeatability very good at pcrf settings used for DPFs (typically ~150) and GDIs (typically ~600)



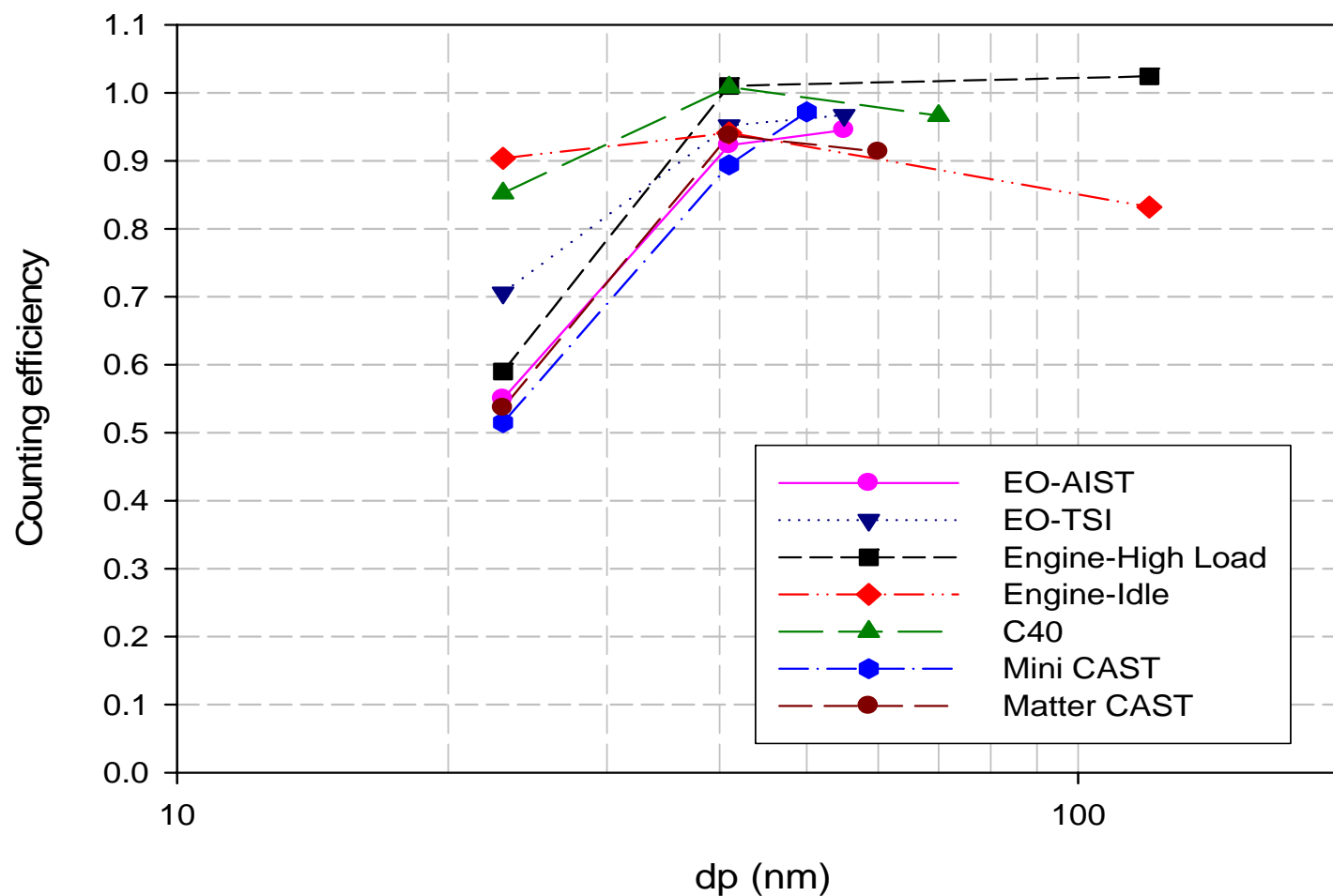
VPR Volatile Removal Efficiency

- 2 PNC and Hot-Cold results similar. Repeatability good



PNC Cut-Off Material Dependency

- Investigation of PNC cut-off material dependency suggests Emery Oil (EO) and CAST give similar results, C40 does not



Accumulation of Errors Analysis

- Analysis performed by the UK National Physical Laboratory according to ISO Guide to the Expression of Uncertainty in Measurement (GUM) taking account of improvements made at August & October PMP meetings. Report circulated as Informal 17.
- Uncertainty at typical settings for post DPF measurement was estimated to be around 15%. Similar levels are achievable for GDI measurement settings provided the procedures in the calibration documents are followed.
- The most significant factors contributing to uncertainty are the PNC calibration and the allowable tolerance on VPR pcrf validation checks

Amendments To Reg 83 Proposal

Department for
Transport

Based on the results of the Roadmap activities and detailed discussion of the draft proposal at the 9th October PMP meeting the following amendments have been made to the proposal to amend Regulation 83

- PN background correction allowed for ISC testing
- Diesel pre-conditioning procedures extended to GDIs also
- VPR must be calibrated for mean particle concentration reduction factor (pcrf) (mean of 30nm, 50nm and 100nm results) across its range of dilution settings
- VPR pcrf for 30nm and 50nm particles must be no more than 30% and 20% respectively higher than for 100nm particles
- VPR must have a minimum dilution factor upstream of the ET of 10
- PNC must be corrected to reference electrometer reading
- Charcoal scrubbing of dilution air is now optional
- Reference filter rejection criteria clarified

Amendments To Reg 83 Proposal

- Upper limit of PNC range no longer restricted to 10,000cm⁻³
- PN measurement system residence time and T90 requirements clarified
- PNC linearity requirements, in secondary calibration process, now assessed on the basis of normal measurements rather than log of measurements
- Validation check of PNC cut-off performance introduced as part of calibration
- Monthly PNC linearity check deleted, PNC flow check changed from daily to monthly
- PNC zero and leak check tolerances tightened
- A number of other detailed corrections and clarifications have been made in particular in response to CLEPA and OICA written comments from GRPE 54