

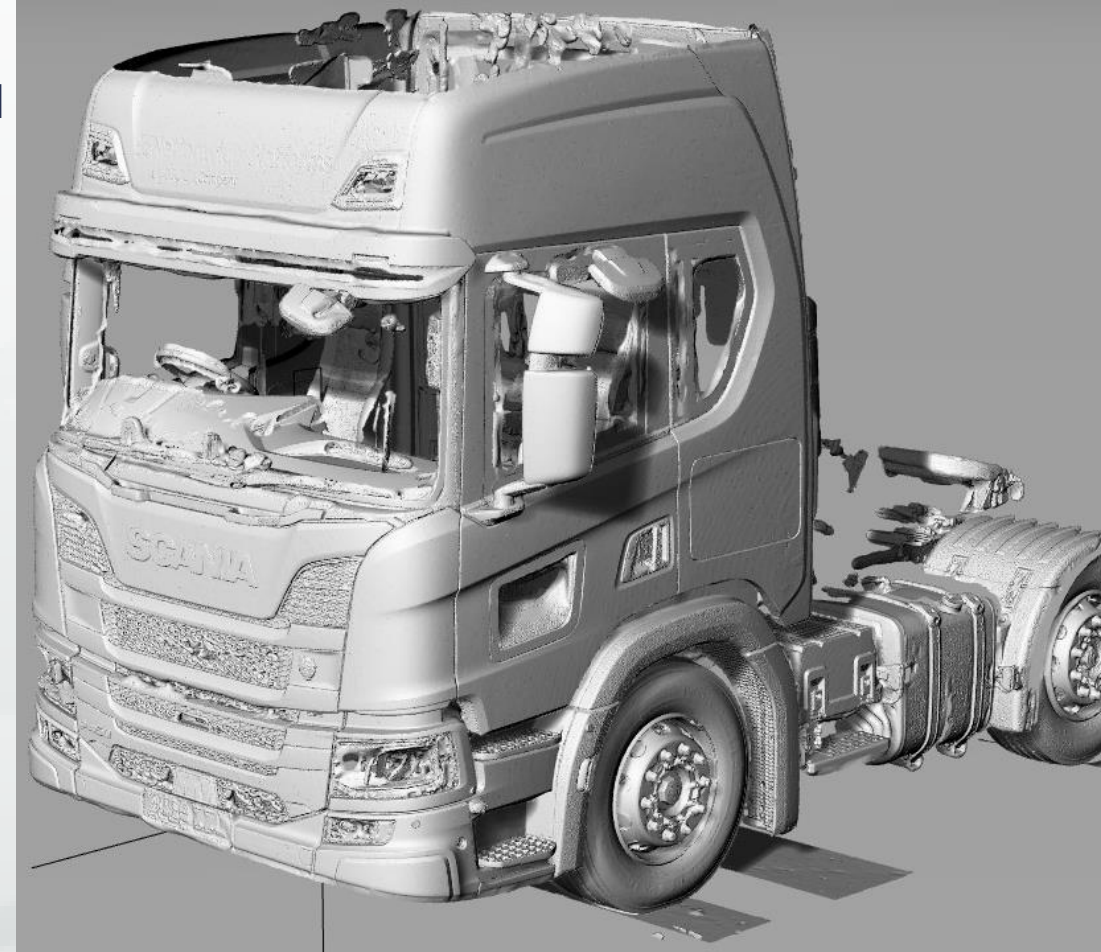
# Direct Vision Improvement – Case Study

Apollo Vehicle Safety



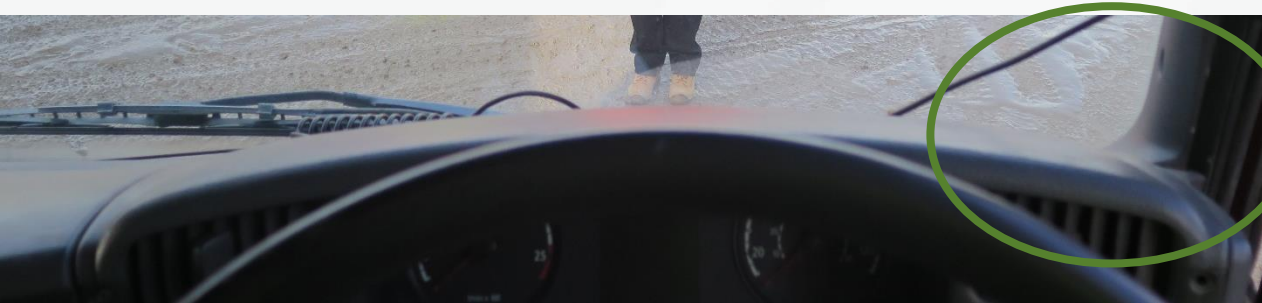
# Background & Introduction

- September Meeting; wide range of proposed limit values
  - Based on Loughborough's recommendations, T&E advocated for a 2 star minimum for all N3
  - - OICA submitted that achieving 1 star would entail huge effort for heavy construction & long haul
- What is feasible for Construction & Long Haul?
  - Comprehensive design analysis not possible
  - Case study on a recently revised vehicle : Scania P series
    - Initial inspection to scope out changes, direct investigation (Apollo)
    - Subsequent measurement & simulation to quantify effects and investigate height (LDS)
  - Not definitive or fully generalisable
  - To provoke & inform further constructive debate



# Fascia

Old



New



- Detail changes to fascia to help reveal small additional areas
- Also appeared fascia was not as deep in new design



# A-pillars and mirrors

Old



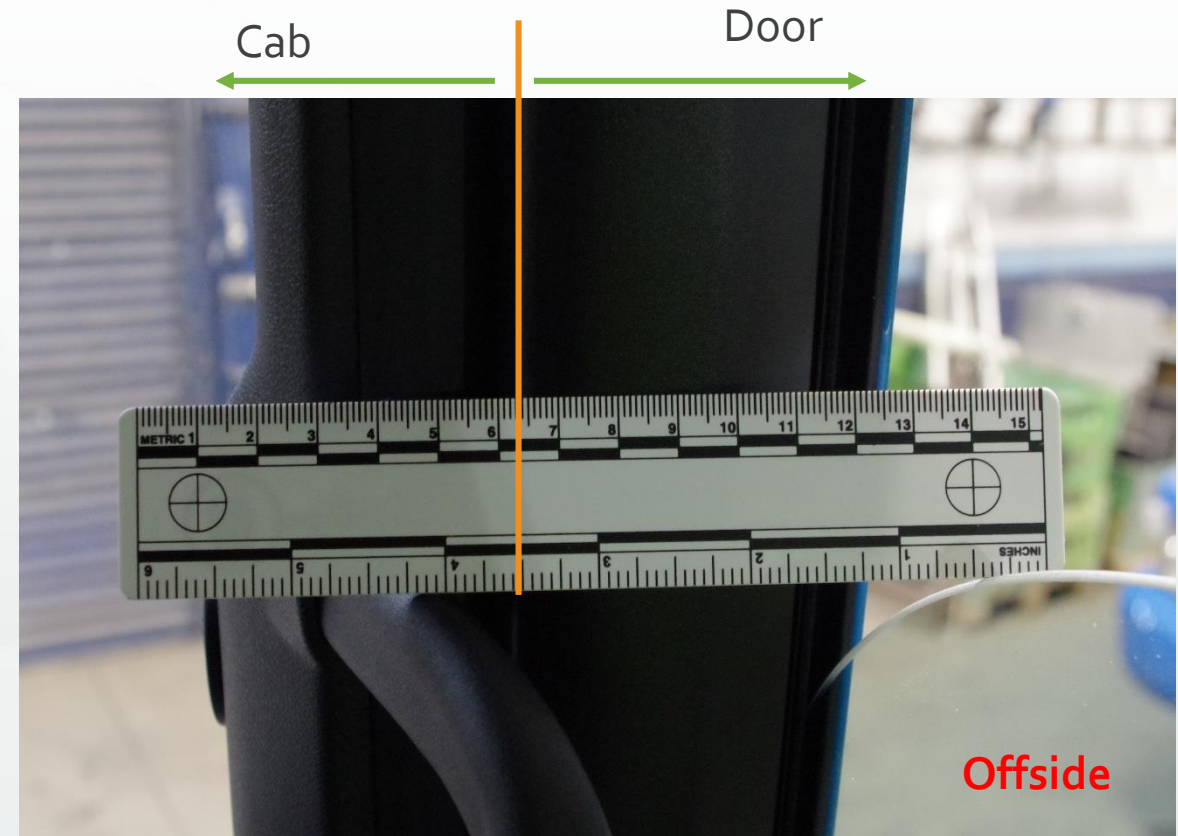
New



- Mirror mountings moved further out of sightline and mirror positions adjusted
- A-pillar thinner, particularly offside (note differences in scale of photographs does not permit comparison)
- Increased opportunity to see people a small distance from vehicle that would otherwise be hidden in A-pillar area.
- Note: A-pillar obscuration is 'dynamic' – relative motion between VRU & vehicle or driver head movement can quickly reveal obscured people

# A-pillars

- Offside A-pillar obstruction reduced from c.14cm to c10.5 to 11.5 (measured 'by eye').
- A-pillar is structural (R29) but some benefit may come from improved trim around the structure.
- More than half of offside obstruction is actually door frame not cab structure
- Nearside obstruction much larger (almost double) due to orientation and view angle. Door frame still significant.
- Distance from eye, monocular assessment, & larger assessment zone should mean greater reward for improvements at nearside





# Door Windows

New and Old overlaid



- Photographic overlay not scientific
- Illustrative of lower window line on door
- Secondary low level window in door also apparent
  - Note: very obscured if passenger seat occupied
  - Also note: a passenger = second eyes
- Add on features (disc holders, and to lesser extent monitors) do detract slightly from view

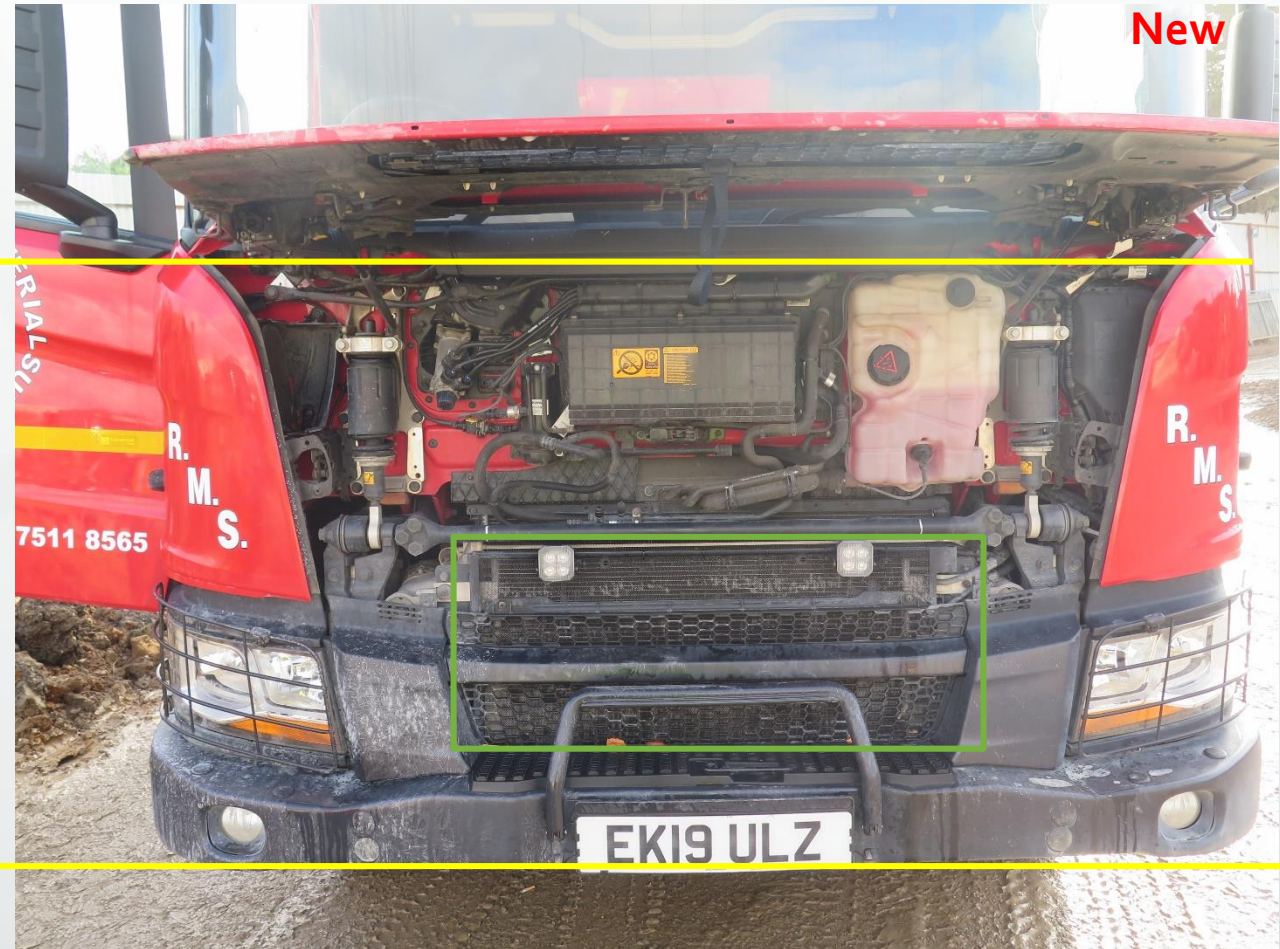
# Windscreen line



Small reduction in height of lower edge of screen in otherwise similar vehicles c.3 cm – note ground conditions



# Constraints on windscreen line



Significant repackaging of components results in clearly visibly less congested under bonnet and allows the lower windscreen line. Cooling requirements constrain lower part and will grow with engine size – Little change in new



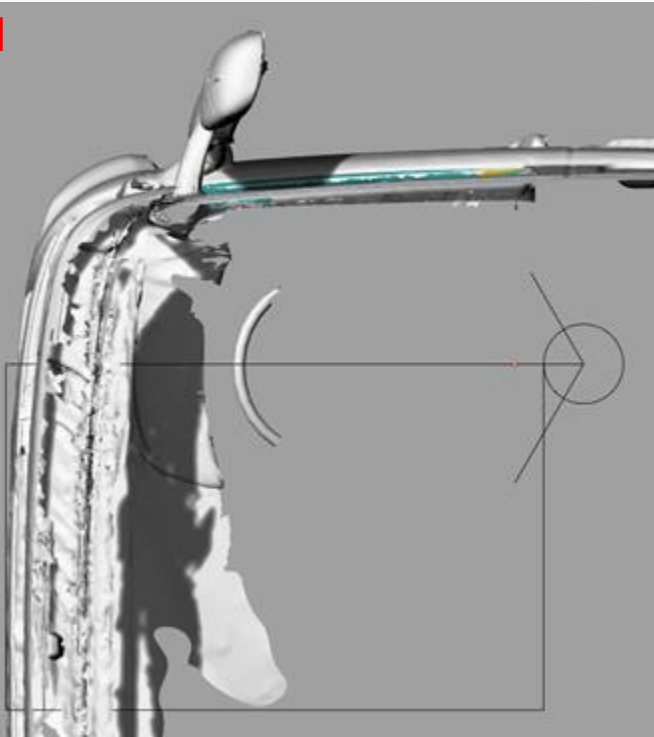
# Translation to tractor for articulated vehicles

- Same model in non 'XT' form as tractor unit for semi-trailer (3+3 44t in UK)
- Window line c. 11 cm lower than for equivalent construction vehicle
- Advertised as urban and regional application
- Used for national transportation of plant in UK – potentially relatively long hauls in UK context
- Clearly better vision than construction vehicle emphasises well documented effect of cab mounting height



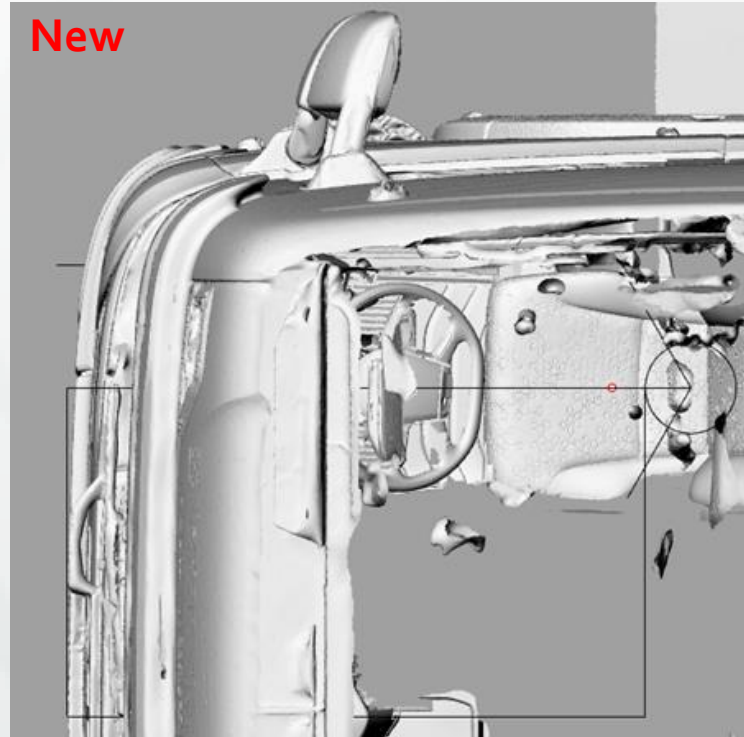
# Influence of AHP/ seating position

Old



X distance to front = 1324mm

New



X distance to front = 1243mm

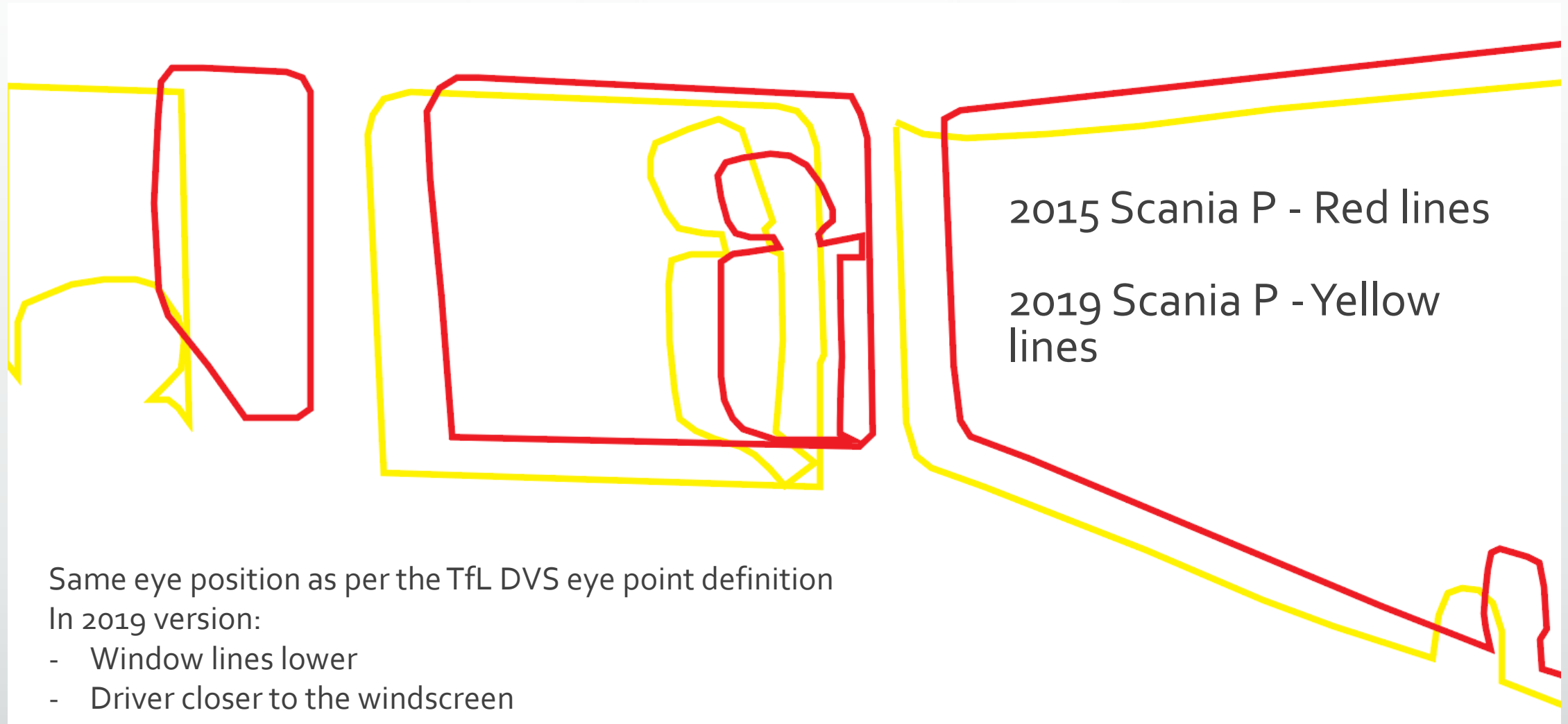
- Not easily measured manually
- Scan results show that Accelerator Heel Point (AHP) and hence protocol defined eye point is c. 80mm closer to the front of the vehicle in new version
- Improves sightline angle to blind spot in front



# Summary of observed changes

Modification area	Structural	Possibly structural	Non-structural
Fascia			↑
Mirrors			↑
A-pillars	↑ Cab Structural element	↑ Door frame element	↑ Trim element
Door windows		↑ Depend on R29 load paths	
AHP/Seating position		↑ Depend on pedal constraint	↑
Windscreen line	↑ Small height large width		↑ Fascia element

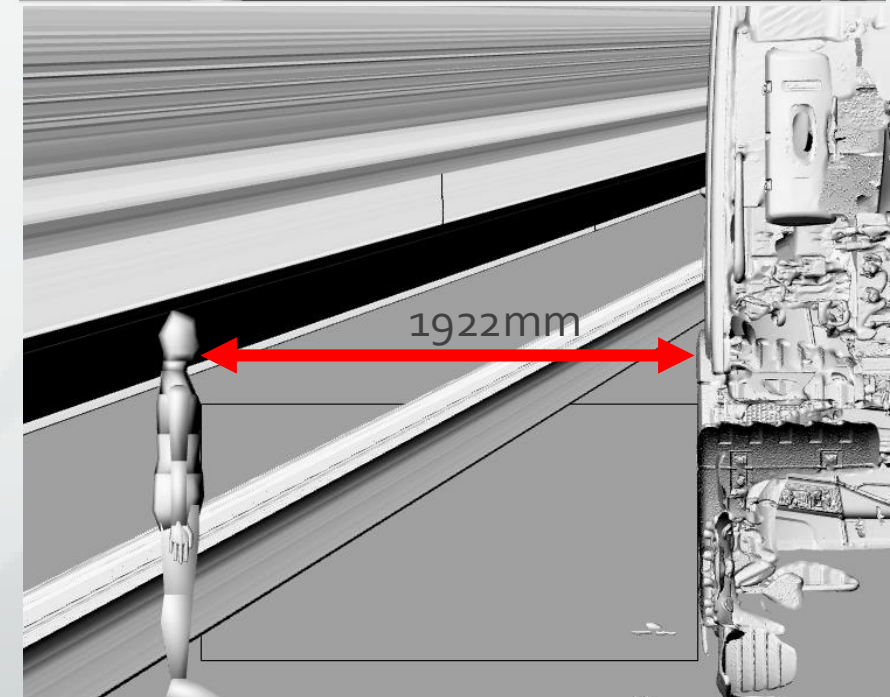
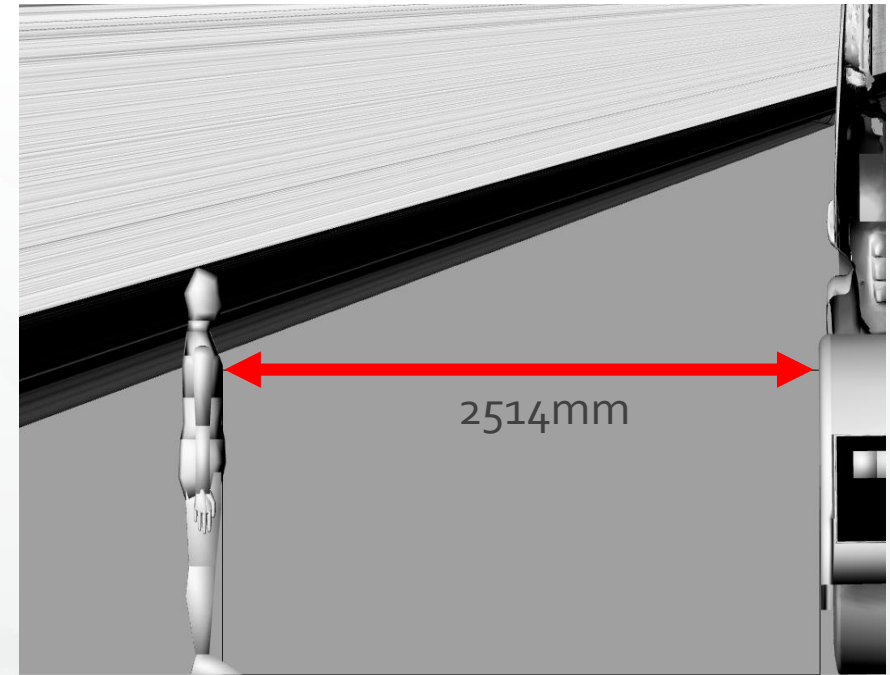
# Measured effect of differences (relative to eye point)



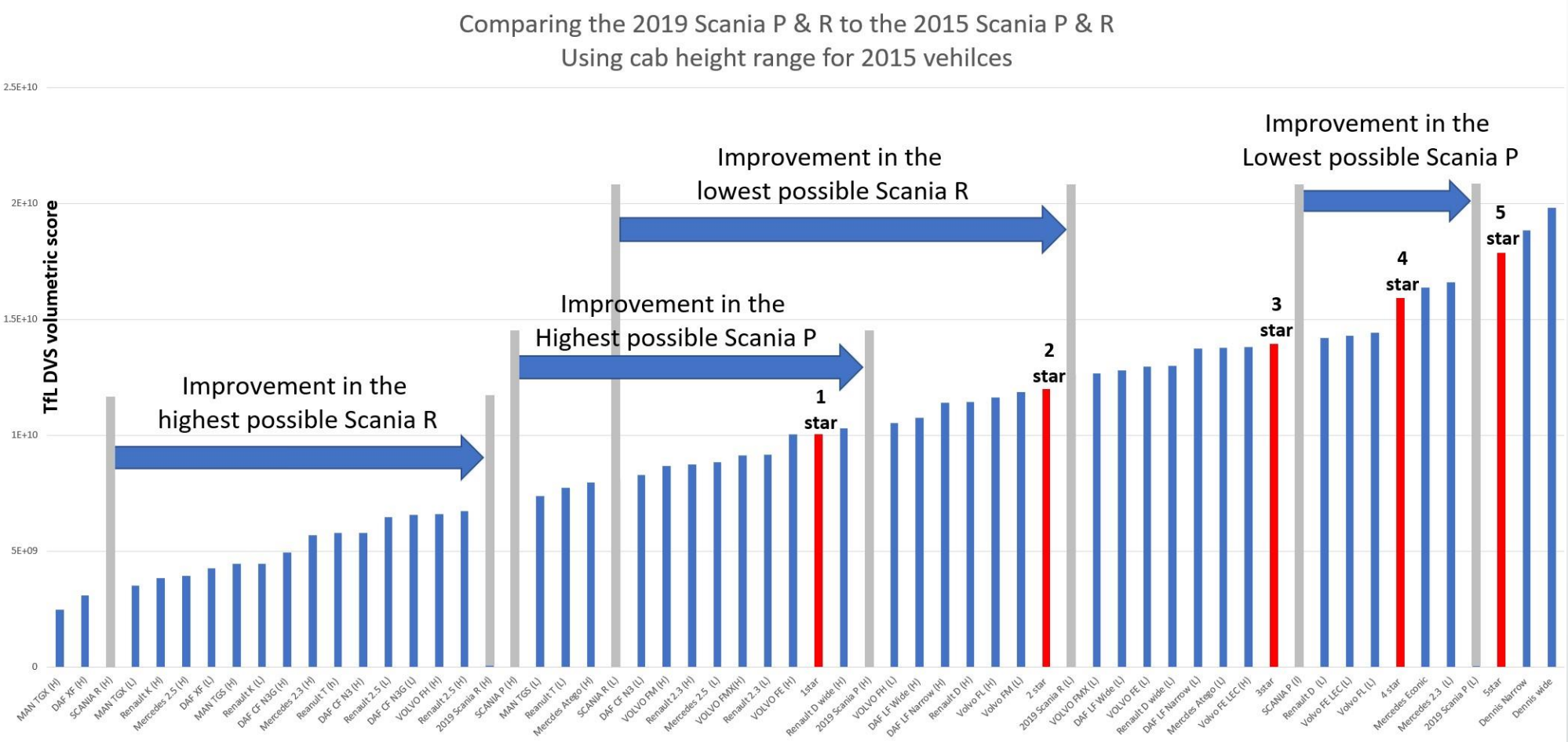


# Effect for VRU

- VRU located 300mm forward of the front eye point at passenger side
- Middle of passenger side window view
- 5<sup>th</sup> percentile Italian female
- Just invisible in main door window
  - Old design 2.51m
  - New design 1.92m
  - Improvement 0.59m
- Additional benefit of lower door window makes a small portion of legs/body visible at much closer distances



# Effect on rating



Note: Old R series cab designs near identical to P – main difference height. Estimate assumes same is true with new design



# What are construction vehicles?

- Can be clearly defined based on off road capability Cat G and body type
- Vehicles inspected are highly capable, powerful (13 litre engine), all purpose construction tippers
  - Sold as 1 star according to operator. Based on scanned vehicle and manually measured height difference, close to 2 star
  - Not the highest possible P series – higher variants than this example can still meet 1 star
- Operators involved happy they can do all jobs needed
- Will also be buying some L-series for London but see these as restricted duty – due to *'under-slung exhaust & lower body ram mounting'*



# What is long haul (extremes)?

- Some rigid vehicles do long haul
- Articulated vehicles typically considered long haul but not all are the same
  - Measured Scania P: Mixed use including some urban and some UK scale Long Haul (med in continental scale)
  - Australian road train: Clearly long haul with no urban use
- Defining the minimum direct vision based on the feasibility for the Australian road train clearly offers little benefit
- Forcing the Australian road train to have the direct vision needed in an EU city will also clearly offer limited benefit
- How should the optimum be defined?





# What is long haul (mainstream)?

Series	Overall height (mm)		Engine size		Website Description
	Min	Max	Min	Max	
L	Not published		9	9	Urban
P	2920	3520	7	13	Urban and Regional
G	3010	3610	9	13	All-round
R	3190	3790	9	16	Long haul
S	3690	3950	13	16	Long haul Luxury

Source: Scania.com/UK – Note figures for off road XT equivalents not published

- Scanned P (Z\_AHP 1217mm) 3 star – not lowest available
- Large overlap in capabilities, e.g.
  - All available as tractor or rigid
  - G, R and S all advertise long haul capability
  - largest engine in P series equal to smallest in S
  - P, G and R all have 0.6m range in height within range but only 0.2m between ranges
  - Only S stands alone with little overlap – all flat floor for driver comfort





# Conclusions

- Based on what Scania have recently achieved
  - 1 star is clearly feasible for construction vehicles at cab re-design stage
  - Significant improvements also feasible without changes to main cab structure
    - Further quantification can be undertaken, subject to usefulness & funding
  - 1 star is also clearly feasible for a significant proportion of long haul vehicles at cab re-design stage
- However, it is not feasible for the tallest
  - Dominant factor in this appears to be comfort (flat floor) – large engines can fit in lower vehicles
  - Excludes consideration that in EU elongated cab designs will make further improvements feasible for long haul vehicles

# Technically feasible policy options (direct vision)

- Not exhaustive, Not mutually exclusive
  - Require 1 star all N<sub>3</sub>: Pros – simple, effective. Cons: major new approach needed for high mounted cabs
  - Set limit based on feasibility for high mounted cabs: Pros – reduces industry burden. Cons – limited benefit in urban areas
  - Set differential limit by vehicle type: Pros - allows optimisation benefit v cost. Cons – more complex and hard to define
    - N<sub>2</sub>/N<sub>3</sub>: Limited benefit – most incidents involve N<sub>3</sub>
    - Rigid/Articulated – More incidents involve rigid vehicles but articulated a substantial minority. 1 star clearly feasible for many articulated vehicles
    - By AHP height – risks perverse incentive to increase cab mounting height, may limit increasing driver height relative to cab
    - Other?
  - Enable cities to ban/disincentivise low performing vehicles (publication of rating?): Pro – long haul vehicles can still be tall and used where intended. Cons – reliant on additional measures from cities and not all may have legal powers to ban
  - Amend timing to allow more time for radical redesign of high mounted cab: Pros – eases industry burden. If manufacturer revising cab anyway, will still design to new standard as uneconomical to change again in short time. Cons – some reduction in safety benefits during the longer lead time for high-mounted cabs