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The potential application of the TfL Direct Vision Standard in UNECE regulation – Limit values for different groups of N3 vehicles

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Research Sponsored by Transport for London and the UK Department for Transport

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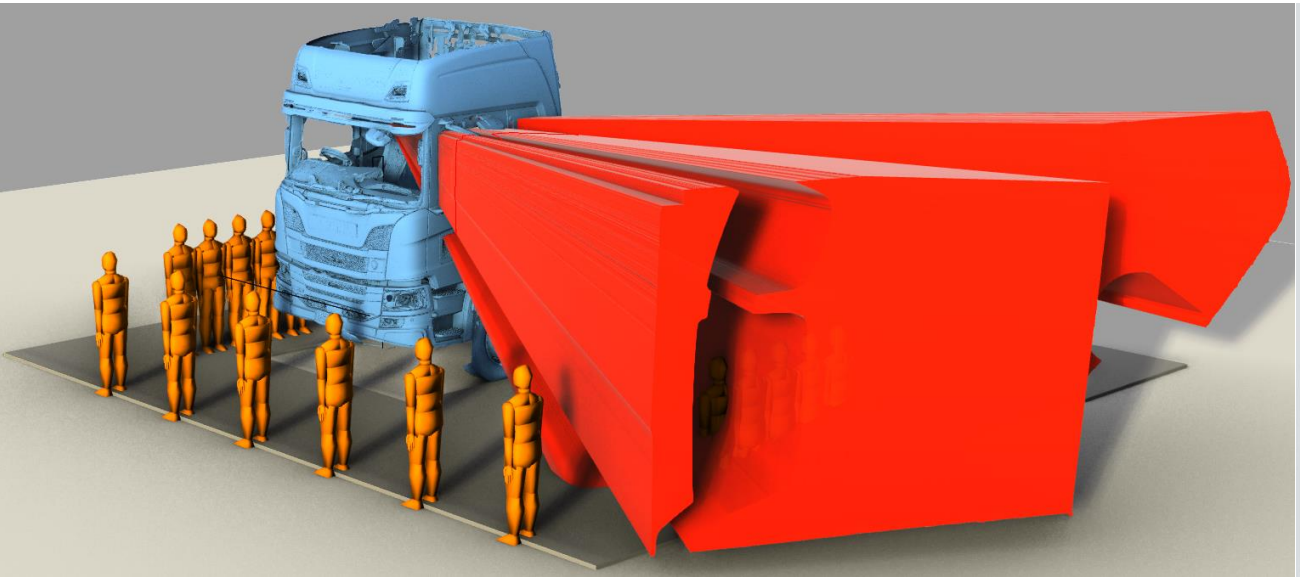

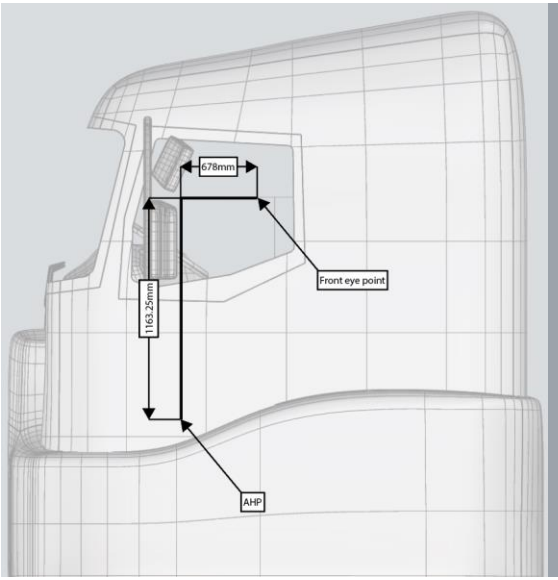

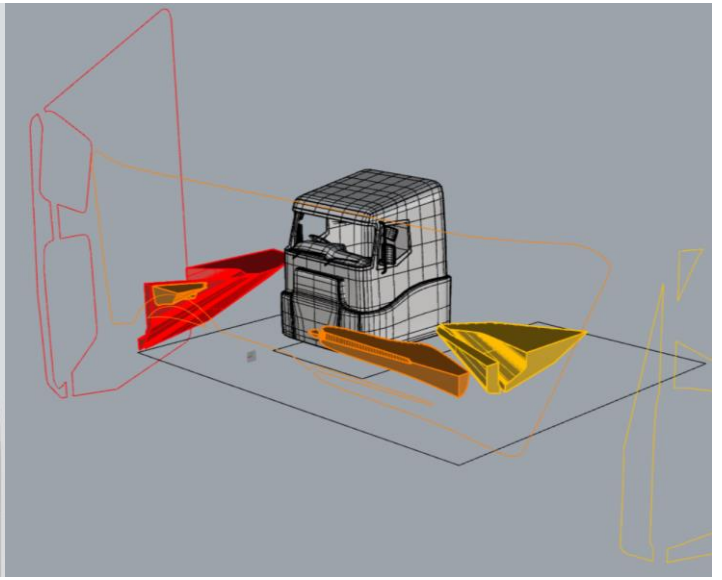

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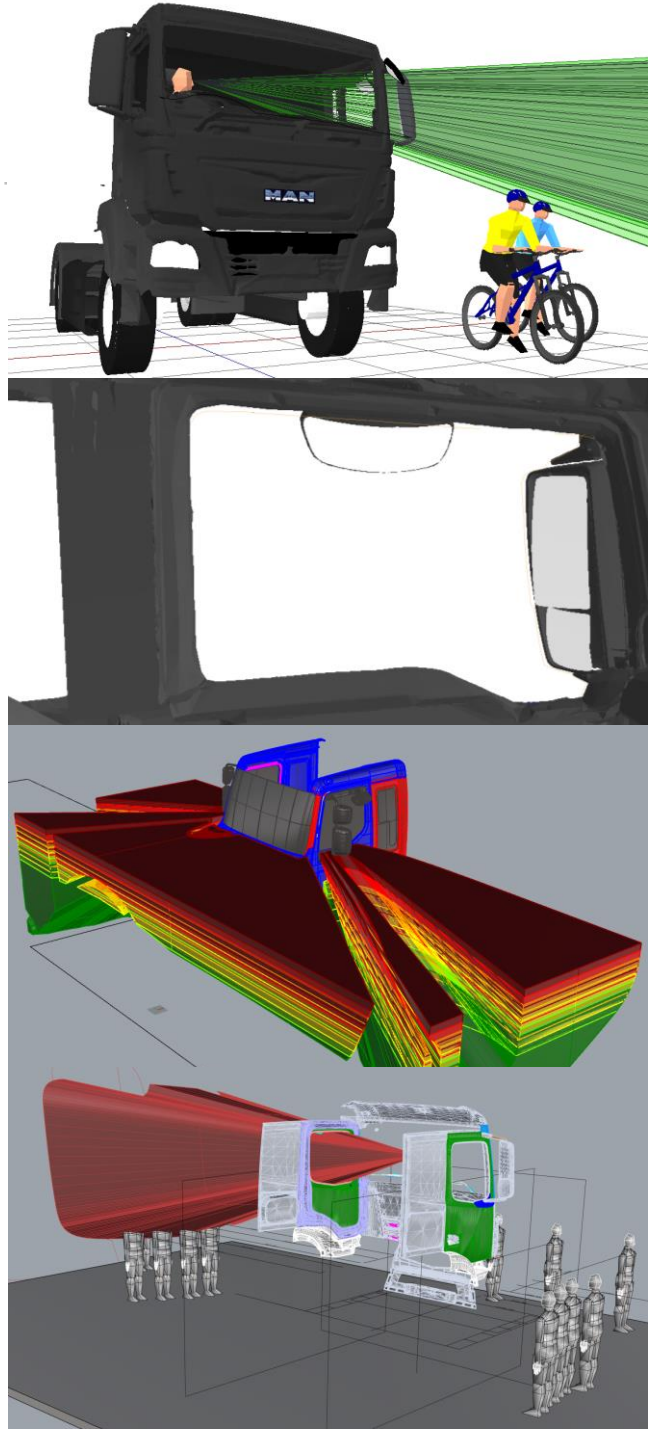


Summary of the current position with regard to minimum limits in the DVS scoring system

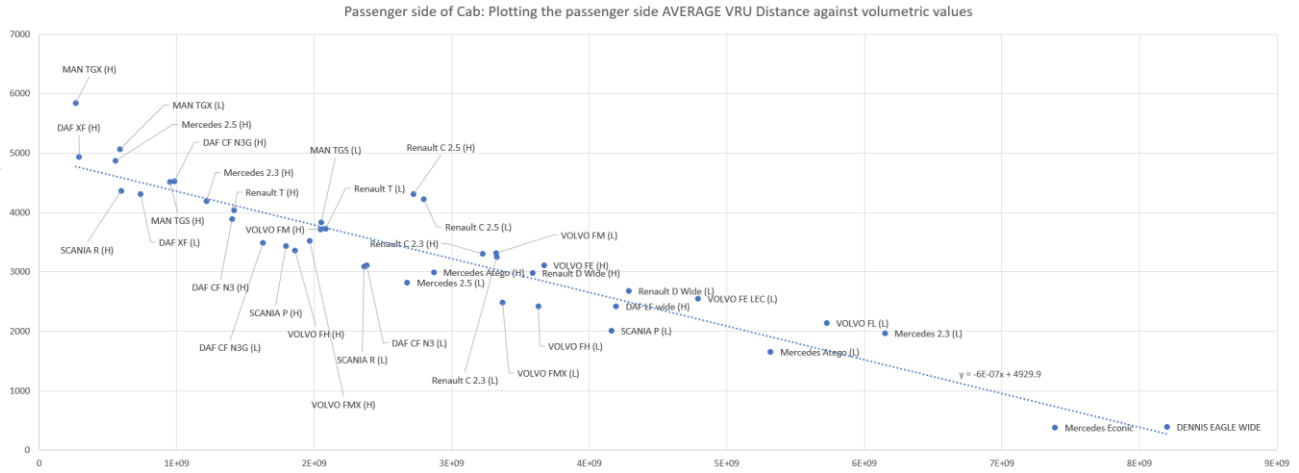
- The 13th meeting in Osaka led to the recommendation for the following limits by the contracting parties.
- The volumes that shall be visible as a **minimum requirement** will be equivalent to an average simulated VRU distance of;
    1. Front = 1.7m
    2. Passenger side = 2.5m
    3. Drivers side = 0.6m
- Manufacturers were opposed to these limits as they stated that it was not possible to achieve with Long Haul type trucks which led to the reopening of the issue of **differentiation** by VECTO vehicle category, first suggested by Samuel Kenny (T&E) in the 6th VRU Proxi meeting

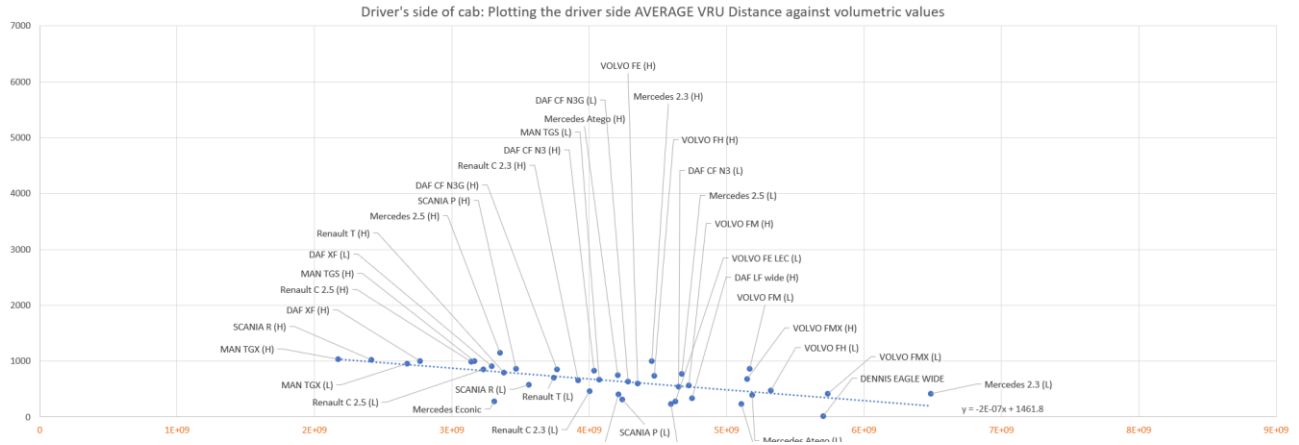
- At the 13th meeting the LDS team were asked to consider the pros and cons of two options for how the scoring system would work;
    - A combined approach where the score to the front, driver's side and passenger side are simply added with the result being compared to the minimum requirement
    - A separated approach where the score to the front, driver's side and passenger side would individually have to meet a specific requirement
- In addition we were asked to explore the implications of the two options above if manufacturers simply removed mirrors and/or lowered windscreen wipers to improve direct vision

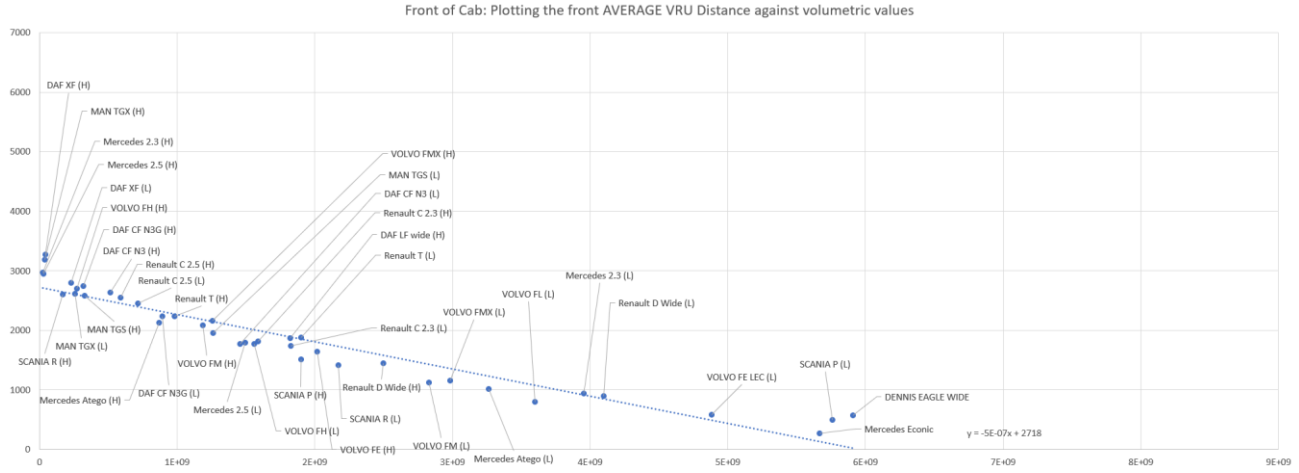
- The results of these activities are summarised below

Comparing the volumes to each side

- The graphs to the right show the **Average VRU distance** values plotted against the **DVS volumetric score** for each side separately
- Here we can use the equation of the **trend line** to show the volumetric score that is required for a range of average VRU distances
- The following slides show the two sets of results
- The volumetric score for VRU distance at the **edge of the assessment volume**
- The volumetric score for the VRU distances at the level suggested by the contracting parties during the **13th meeting**







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Two examples of how to define the minimum requirement to the front

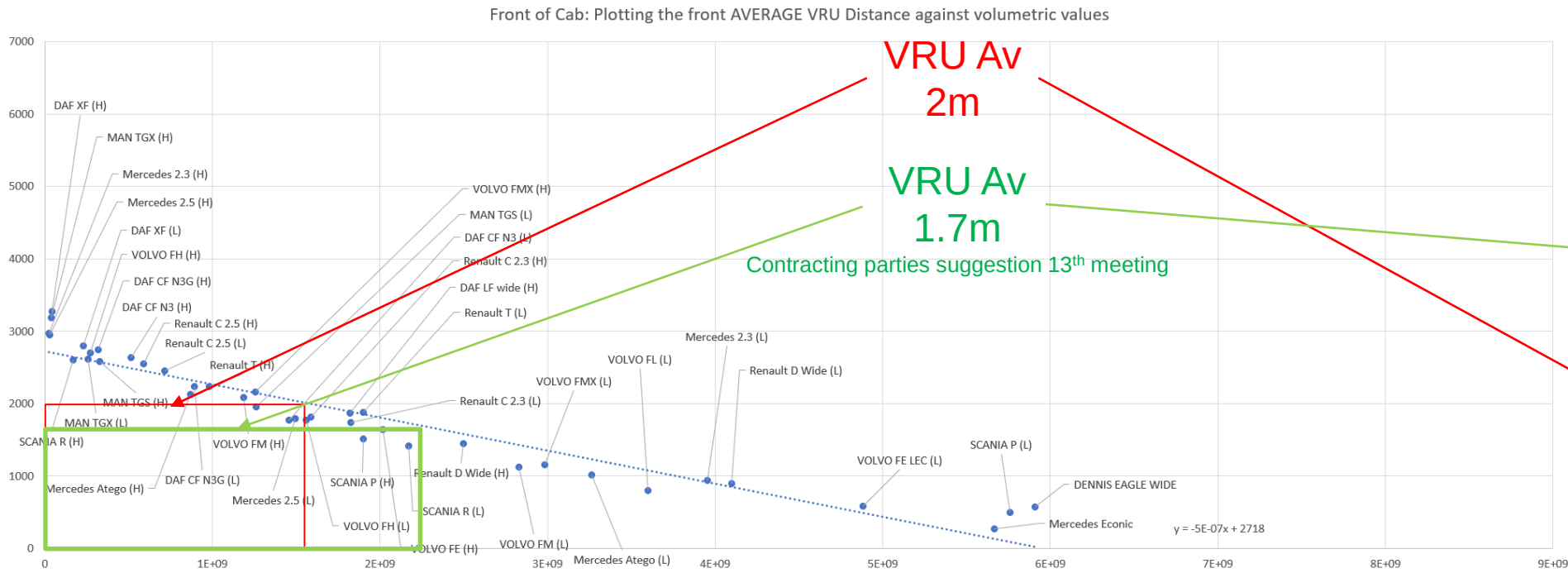

Table of average VRU distance to the front placed in numerical order

	VRU	VOL	
Mercedes Econic	266.0	5.66E+09	
SCANIA P (L)	500.3	5.76E+09	
DENNIS EAGLE WIDE	572.0	5.91E+09	
VOLVO FE LEC (L)	586.7	4.88E+09	
VOLVO FL (L)	797.3	3.60E+09	
Renault D Wide (L)	891.3	4.10E+09	
Mercedes 2.3 (L)	942.7	3.95E+09	
Mercedes Atego (L)	1012.0	3.26E+09	
VOLVO FM (L)	1129.0	2.83E+09	
VOLVO FMX (L)	1152.3	2.98E+09	
SCANIA R (L)	1415.7	2.17E+09	2.2m^3
Renault D Wide (H)	1445.0	2.50E+09	
SCANIA P (H)	1517.0	1.90E+09	
VOLVO FE (H)	1645.3	2.02E+09	
Renault C 2.3 (L)	1744.7	1.83E+09	
DAF CF N3 (L)	1769.0	1.46E+09	
VOLVO FH (L)	1776.0	1.56E+09	1.44m^3
Mercedes 2.5 (L)	1790.7	1.49E+09	
Renault C 2.3 (H)	1816.3	1.59E+09	
DAF LF wide (H)	1867.3	1.82E+09	
Renault T (L)	1881.7	1.90E+09	
MAN TGS (L)	1951.7	1.26E+09	
VOLVO FM (H)	2084.0	1.18E+09	
Mercedes Atego (H)	2126.3	8.68E+08	
VOLVO FMX (H)	2156.3	1.26E+09	
Renault T (H)	2238.7	9.80E+08	
DAF CF N3G (L)	2239.3	8.91E+08	
Renault C 2.5 (L)	2453.3	7.13E+08	
Renault C 2.5 (H)	2546.7	5.90E+08	
MAN TGS (H)	2582.0	3.26E+08	
SCANIA R (H)	2599.3	1.67E+08	
MAN TGX (L)	2619.7	2.58E+08	
DAF CF N3 (H)	2641.0	5.14E+08	
VOLVO FH (H)	2696.7	2.74E+08	
DAF CF N3G (H)	2743.3	3.19E+08	
DAF XF (L)	2803.0	2.29E+08	
Mercedes 2.5 (H)	2952.3	2.99E+07	
Mercedes 2.3 (H)	2970.0	2.35E+07	
MAN TGX (H)	3189.0	3.64E+07	
DAF XF (H)	3275.3	4.17E+07	

Adopting the trend line approach produces a value of 1.44E+09 (1.44m3) which is close to the four vehicles highlighted in the table

Two examples of how to define the minimum requirement to the Passenger side

Comparison of methods 1 & 2 for the Passenger side

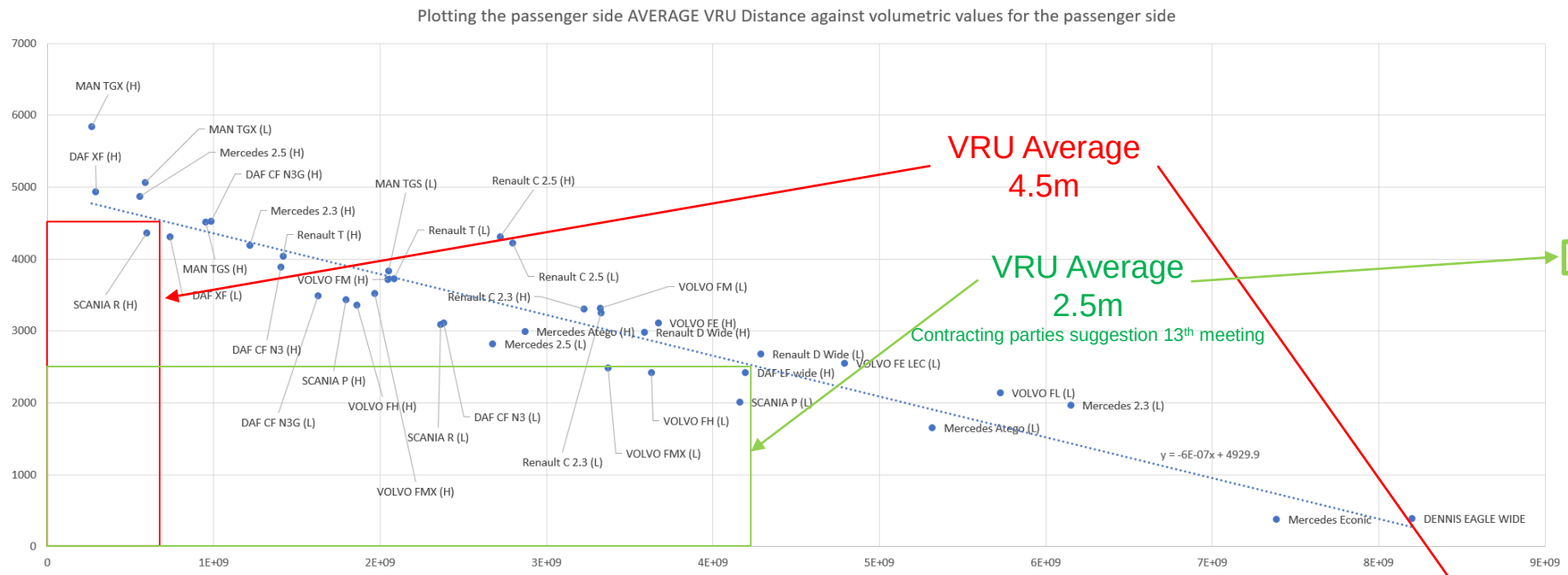

Table of average VRU distance to the passenger side placed in numerical order

	VRU	VOL	
Mercedes Econic	383.6	7.39E+09	
DENNIS EAGLE WIDE	385.2	8.20E+09	
Mercedes Atego (L)	1651.4	5.32E+09	
Mercedes 2.3 (L)	1962.2	6.15E+09	
SCANIA P (L)	2008.2	4.16E+09	
VOLVO FL (L)	2143.8	5.73E+09	
DAF LF wide (H)	2414.6	4.20E+09	
VOLVO FH (L)	2419.526	3.63E+09	
VOLVO FMX (L)	2479.4	3.37E+09	
VOLVO FE LEC (L)	2549.4	4.79E+09	
Renault D Wide (L)	2679.6	4.29E+09	4.26m^3
Mercedes 2.5 (L)	2821.8	2.68E+09	
Renault D Wide (H)	2984	3.59E+09	
Mercedes Atego (H)	2991	2.87E+09	
SCANIA R (L)	3092	2.36E+09	
VOLVO FE (H)	3107.8	3.67E+09	
DAF CF N3 (L)	3111	2.38E+09	
Renault C 2.3 (L)	3250.6	3.33E+09	
Renault C 2.3 (H)	3308.6	3.22E+09	
VOLVO FM (L)	3318	3.32E+09	
VOLVO FH (H)	3353.8	1.86E+09	
SCANIA P (H)	3431	1.79E+09	
DAF CF N3G (L)	3487	1.63E+09	
VOLVO FMX (H)	3516.764	1.97E+09	
VOLVO FM (H)	3718.2	2.05E+09	
Renault T (L)	3726.6	2.08E+09	
MAN TGS (L)	3835	2.05E+09	
DAF CF N3 (H)	3889	1.40E+09	
Renault T (H)	4037	1.42E+09	
Mercedes 2.3 (H)	4188	1.22E+09	
Renault C 2.5 (L)	4221.8	2.79E+09	
DAF XF (L)	4308.6	7.38E+08	0.72m^3
Renault C 2.5 (H)	4309.4	2.72E+09	
SCANIA R (H)	4362.99	5.97E+08	
MAN TGS (H)	4517.4	9.54E+08	
DAF CF N3G (H)	4522	9.85E+08	
Mercedes 2.5 (H)	4866.4	5.56E+08	
DAF XF (H)	4929.4	2.89E+08	
MAN TGX (L)	5062.2	5.87E+08	
MAN TGX (H)	5837	2.69E+08	

Two examples of how to define the minimum requirement to the Driver's side

Comparison of methods 1 & 2 for the driver side

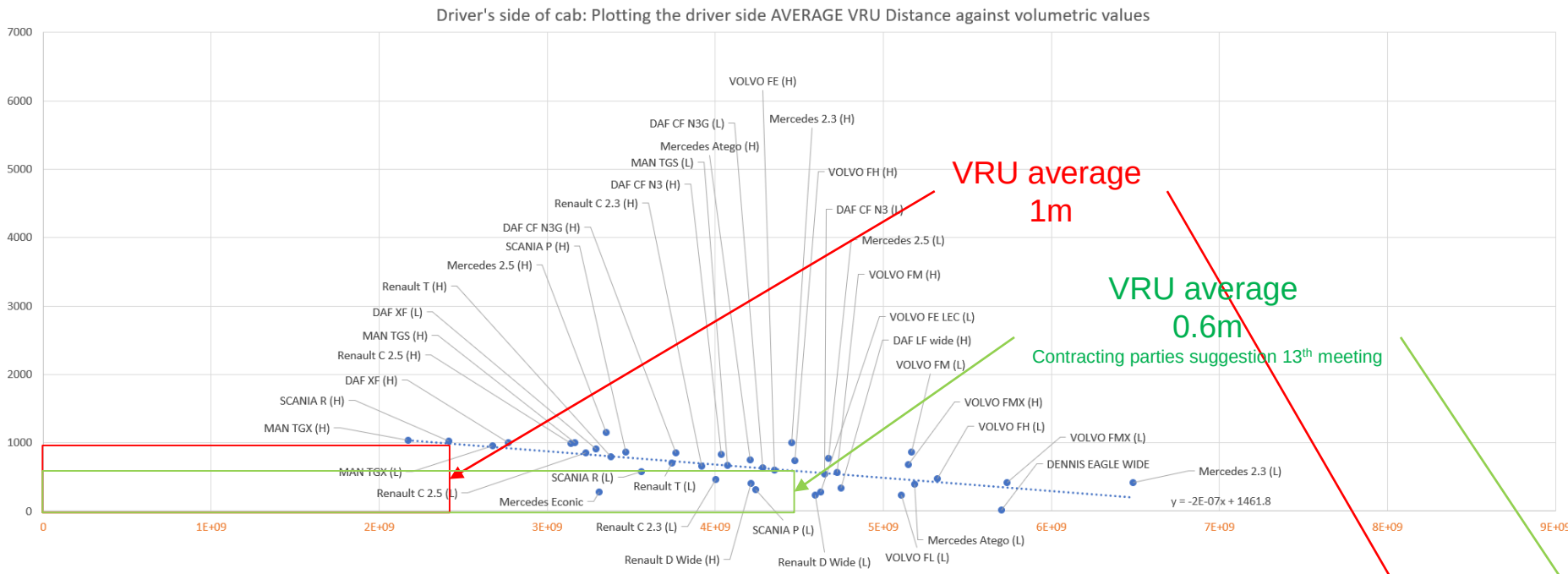

Table of average VRU distance to the Driver side placed in numerical order

	VRU	VOL	
DENNIS EAGLE WIDE	17.8	5.70E+09	
Renault D Wide (L)	231.4	4.59E+09	
VOLVO FL (L)	235.8	5.10E+09	
Mercedes Econic	275.6	3.31E+09	
VOLVO FE LEC (L)	284.2	4.63E+09	
SCANIA P (L)	316.6	4.24E+09	
DAF LF wide (H)	338.4	4.75E+09	
Mercedes Atego (L)	399.8	5.19E+09	
Renault D Wide (H)	405	4.21E+09	
Mercedes 2.3 (L)	413.582	6.48E+09	
VOLVO FMX (L)	422.8	5.74E+09	
Renault C 2.3 (L)	464.2	4.00E+09	
VOLVO FH (L)	472	5.32E+09	
DAF CF N3 (L)	540	4.65E+09	
VOLVO FM (H)	564.8	4.72E+09	
SCANIA R (L)	573	3.56E+09	
VOLVO FE (H)	597	4.35E+09	
DAF CF N3G (L)	634	4.28E+09	
Renault C 2.3 (H)	656.6	3.92E+09	
MAN TGS (L)	674.256	4.07E+09	
VOLVO FMX (H)	677.35	5.15E+09	
Renault T (L)	706.2	3.74E+09	
VOLVO FH (H)	739	4.47E+09	
Mercedes Atego (H)	755.4	4.21E+09	
Mercedes 2.5 (L)	767	4.67E+09	4.54m^3
Renault T (H)	795.4	3.38E+09	
DAF CF N3 (H)	828	4.03E+09	
Renault C 2.5 (L)	847.6	3.23E+09	
DAF CF N3G (H)	856.6	3.76E+09	
SCANIA P (H)	861	3.47E+09	
VOLVO FM (L)	868.6	5.17E+09	
DAF XF (L)	913.52	3.29E+09	
MAN TGX (L)	960.6	2.67E+09	
Renault C 2.5 (H)	994	3.14E+09	
DAF XF (H)	1002.8	2.77E+09	
MAN TGS (H)	1004.6	3.16E+09	
Mercedes 2.3 (H)	1007.2	4.45E+09	
SCANIA R (H)	1028.176	2.41E+09	2.2m^3
MAN TGX (H)	1040.6	2.17E+09	
Mercedes 2.5 (H)	1146.6	3.35E+09	

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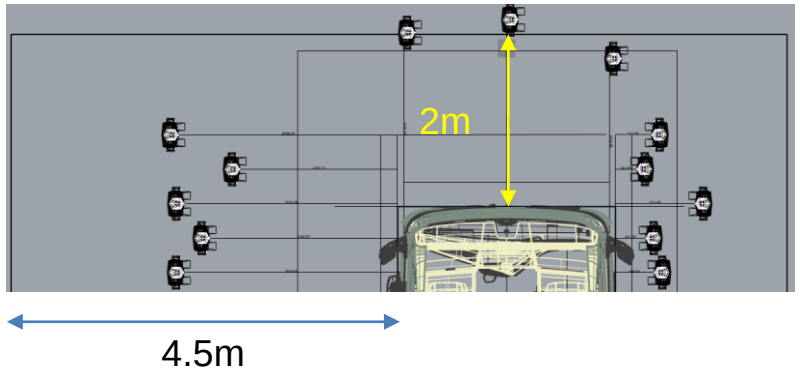
How to select appropriate limits?

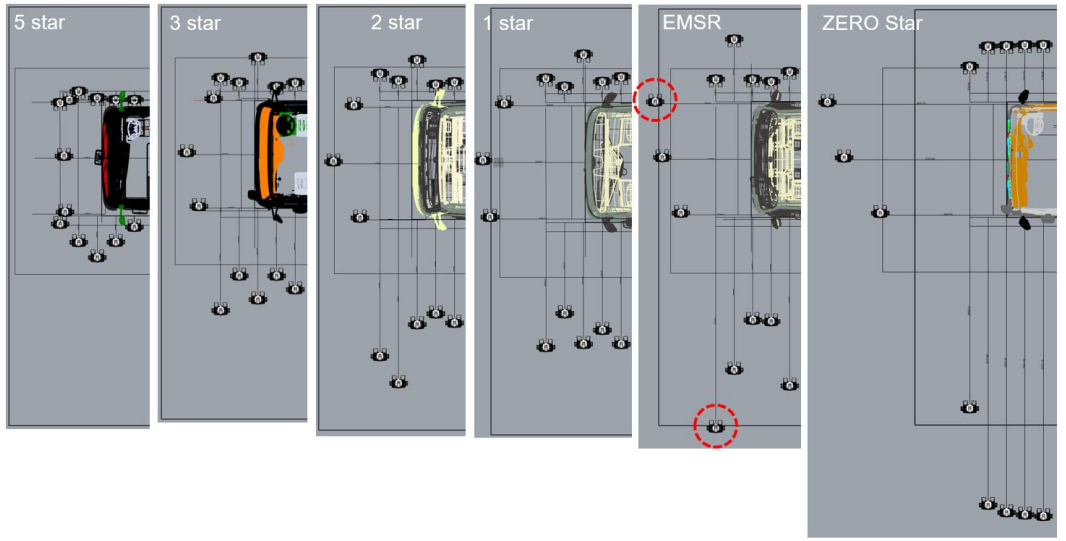
- Examples have been provided of the overall volume that will required to be seen for the VRU values at the edge of the assessment volume, and VRU values suggested by the contracting parties

- Overall volume that is required to be visible for the VRU values at the edge of the assessment volume **= 4.36m^3**

  - **This is equivalent to a zero star vehicle in the TfL DVS system**
  - **This is because the TfL system uses the combined approach**
  - **In the TfL system one vehicle is identified that just passes the average VRU distance test to each side**
  - **A passing level of direct vision is more difficult to achieve to the front of the vehicle, so a TfL 1 star vehicle that passes to the front performs relatively well to the sides.**
  - **This is why the separated passing scores at the edge of the assessment volume appear to be low in comparison to the combined approach, the separated approach at maximum VRU distance to the sides of the vehicle requires little of the assessment volume to be seen.**

TfL 1 star vehicle





How to select appropriate limits?

- Overall volume that is required to be visible for the VRU values suggested at the 13th meeting **= 11m³ using the combined approach**
- The reality of the situation is that the **absolute minimum** requirement for all trucks should be above the **4.36m³** value because this value assumes that all truck mirrors are perfectly adjusted as discussed in previous meetings.
- Using **4.36m³** also makes an assumption that indirect vision through mirrors is effective which goes against the evidence from accident data for accidents with pedestrians when pulling off.
- The aim here is to **improve direct vision** in the **area of greatest risk.**
- The volumetric limits that are selected will depend upon whether a separated or combined approach is taken, and whether differentiation between vehicle types can be agreed.
- However they are determined by the VRU distances, in the first instance **we should agree the VRU distances** to each side
- **It is our suggestion that if the separated approach is taken then the combined approach EMSR limit should be used (8m³)**

How to select appropriate limits?

- If we the assume the following

1. The separated approach is selected
2. That there are two categories, A and B, where urban delivery vehicles are in category A and larger trucks such as Long Haul are in category B and then we can suggest minimum requirements for each category
3. For the urban Category A we would suggest the minimum requirement proposed by the contracting parties in the 13th meeting, i.e. **11.0m^3**
4. For the Rural Category B we would suggest the minimum requirement proposed as the EMSR at the 13th meeting previously which is **8m^3**
5. In this case all vehicles would need to pass a minimum requirement as follows with the total figure equalling 8m^3
    1. 1.8m^3 to the front minimum = to an average VRU distance of **1.9m**
    2. 3.4m^3 to the passenger side = to an average VRU distance of **3m**
    3. 2.8m^3 to the driver's side = to the average VRU distance of **0.930m**
6. **We are happy to consider different proposals from manufacturers or contracting parties and have supplied the spreadsheet to allow the values to be calculated**

Using a combined approach, can a vehicle pass and still have blind spots to the front?

Yes. Evidence follows

- We have removed the mirrors and wipers (on the premise that they can be designed to have a resting position below the windscreen) for 14 vehicles across the range of the full sample
- The following results show how this can improve the rating of a vehicle

Showing effects of removing mirrors and wipers on the star rating

Dennis Eagle, 5star

Volvo Fl (L) improves from 3 star to 4 star

Volvo FM (L) improves from 1 star to 4 star

Merc Atego (L) improves from 2 star to 4 star

Volvo FH (L) improves from 1 star to 2 star

Ren C 2.3 (L) improves from EMSR star to 1 star

Ren T (L) improves from Zero star to 1 star

Merc Atego (H) improves from Zero star to EMSR

Volvo FH (H), zero star

Ren T (H), Zero star

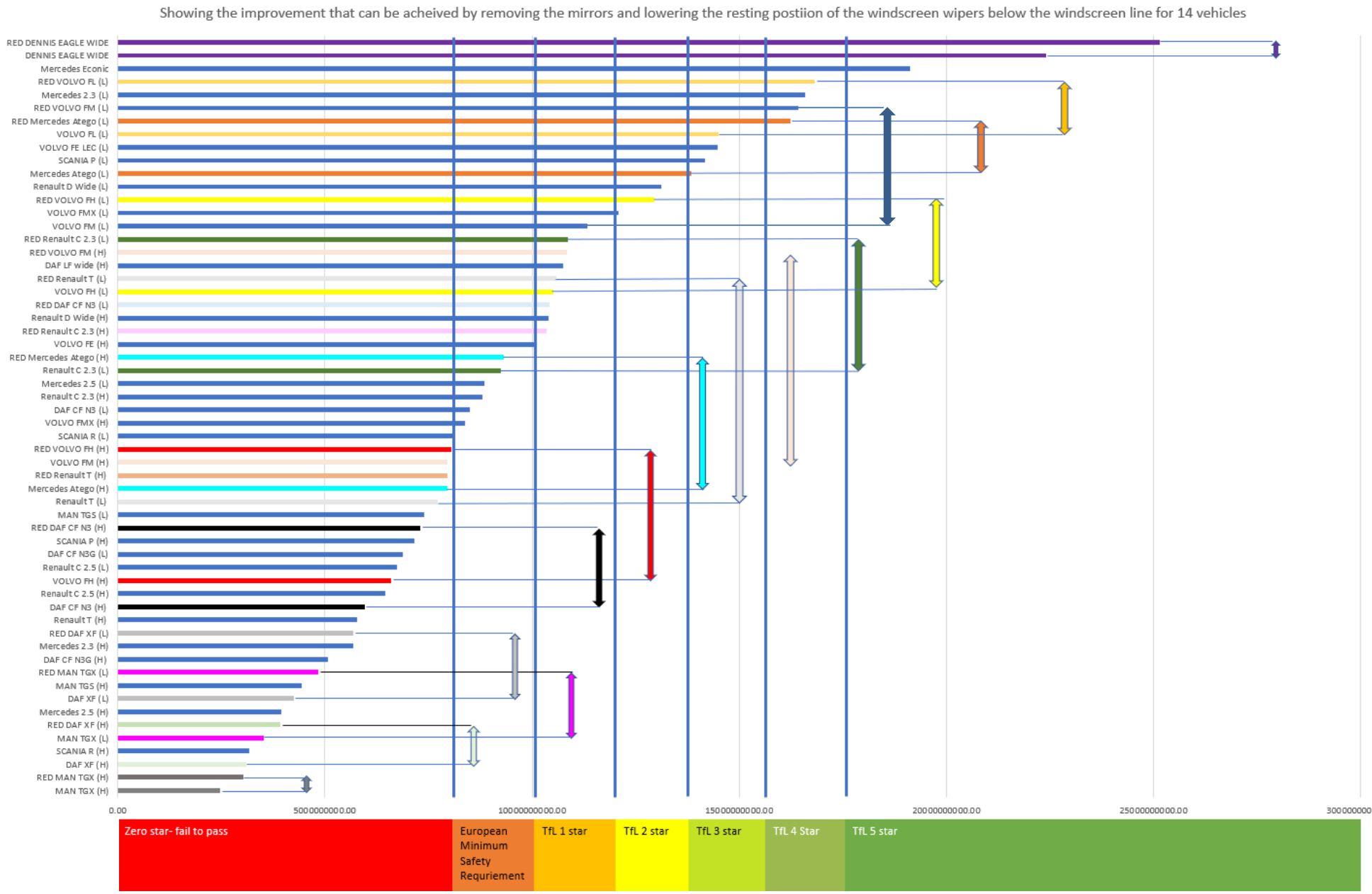
DAF CF N3 (H), Zero star

DAF XF (L), Zero star

MAN TGX (L), Zero Star

DAF XF (H), Zero Star

MAN TGX (H), Zero Star



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Summary for removing mirrors and lowering wipers where required.

- It is clear that removing mirrors and lowering wipers improves direct vision.
- The biggest improvement is for the Volvo FM (L) which improves from TfL 1 star to TfL 4 star.
- The largest improving effect is found by removing the mirrors, and so it is clearly possible for a vehicle to improve performance to the sides without improving performance to the front, especially in a case where the wipers are already set below the windscreen.
- This is demonstrated by the Mercedes Atego (H) which moves from zero star to a higher star rating by removing mirrors but fails to pass the test to the front of the vehicle with an Average VRU distance to the front of 2.12m
- So, if a **combined approach is used**, it is possible that a vehicle such as the highest possible Mercedes Atego could pass the new rating scheme by removing the mirrors, and yet it would have a **potential blind spot** to the front of the vehicle
- Therefore the separate approach is recommended in order to reduce the possibility of vehicles passing the minimum requirement in a combined approach whilst having a vehicle which does not meet the minimum requirement to the front.

Moving forward

- It has been demonstrated that the combined approach could lead to vehicles passing the UNECE DVS minimum requirement which still has blind spot to the front of the vehicle
- **Is this acceptable to the contracting parties?**
- If not the separated approach is recommended
- We have provided ACEA/OICA with dynamic graphs that allow the calculation of volumes for different VRU distance values separately to each side
- We expected a counter proposal at this meeting
- We are happy to define a set of proposals for manufacturers to consider and have made one such proposal below

Final summary

- It has been shown that a combined approach can lead to vehicle designs which potentially pass but with **inherent blind spots** to the front of the vehicle
- Therefore the separated approach is recommended as per the summary in the 14th meeting
- It is our opinion that this analysis highlights that a Differentiated approach to the application of DVS limits to different vehicles types would improve the effectiveness of the DVS as opposed to a ‘one size fits all’ minimum requirement.
- We have suggested minimum limit requirements for the suggested category A (Urban) and category B (rural) vehicles.
- **We have not had a response from manufacturers with regard to the information presented at the last meeting.**
- We hope that our initial proposal is beneficial in moving things forward.