

# Updated Star Rating Algorithms for Refrigerators

Energy Efficient Strategies (EES) for E3, 19 April 2018

## Background – current proposal for star ratings

The 2015 discussion paper *Household Refrigeration Appliances: New Star Rating Algorithm Proposal for the IEC Test Method* set out options for a new star rating algorithm under the International Electrotechnical Commission (IEC) test method.<sup>1</sup> Out of this paper, there was broad agreement to adopt Option 4, which set out how Projected Annual Energy Consumption (PAEC) was to be calculated and made estimates of the likely distribution of models and star ratings under a new star rating algorithm.

During 2017, the proposal was further refined as part of the Decision Regulation Impact Statement (RIS) for household refrigerators and freezers process. Several sets of small changes were made on the basis of improved data and also a change in the ambient indoor temperature from 21°C to 22°C. Other changes included defrost loading factors to take account of differences between laboratory measurements and field measurements based on recent field research. The latest proposal for the energy labelling algorithm is set out in the public comment draft (yet to be released) of *AS/NZS 4474 - Household Refrigerating Appliances - Energy Labelling and Minimum Energy Performance Standards Requirements*, Table 3.3. This is known as algorithm Option 6. Early indications from some suppliers suggest that the new star ratings under Option 6 are likely to fall by around 0.5 star on average. Additional analysis, modelling and refinement of estimates by EES indicates that that in general terms, star ratings under Option 6 would be somewhat lower than originally anticipated due to the many small changes and adjustments during the AS/NZS 4474 development process. This is in contrast to the broad objective stated in the RIS that this transition was not intended to be a label regrade in the traditional sense and that new star ratings should be broadly comparable to old star ratings on average. Of course this is impossible to guarantee in all cases as individual models respond differently to the IEC test method.

The following sections illustrate the current Option 6 in terms of actual old and estimated new star ratings for current approved model and estimated PAEC under the draft AS/NZS 4474 standard. This is followed by a revised algorithm called Option 8, which aims to address the current mismatch between old and new star ratings as far as possible to meet the stated objective in the RIS. Several alternative algorithms were examined under Option 7 but they had shortcomings that made them unsuitable.

Option 8 is therefore proposed for inclusion in the public comment draft of AS/NZS 4474. Below, each of the labelling meta-Groups is examined. Firstly, Groups 4, 5T, 5B and 5S were examined together because they these represent the vast majority of sales.

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<sup>1</sup> <http://www.energyrating.gov.au/document/report-household-refrigeration-appliances-new-star-rating-algorithm-proposal-iec-test>

## Groups 4, 5T, 5B and 5S

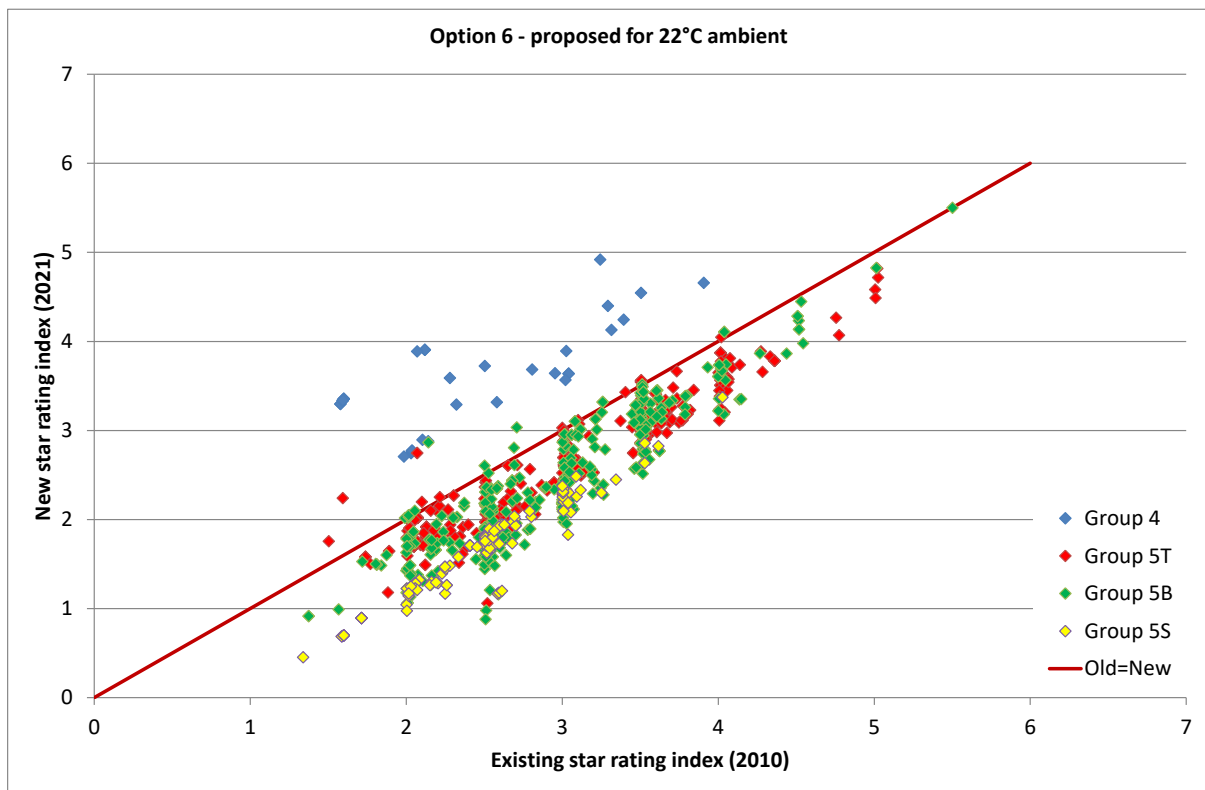


Figure 1: Star Rating 2010 versus proposed star rating Option 6 – INCLUDES MEPS 2021 failures

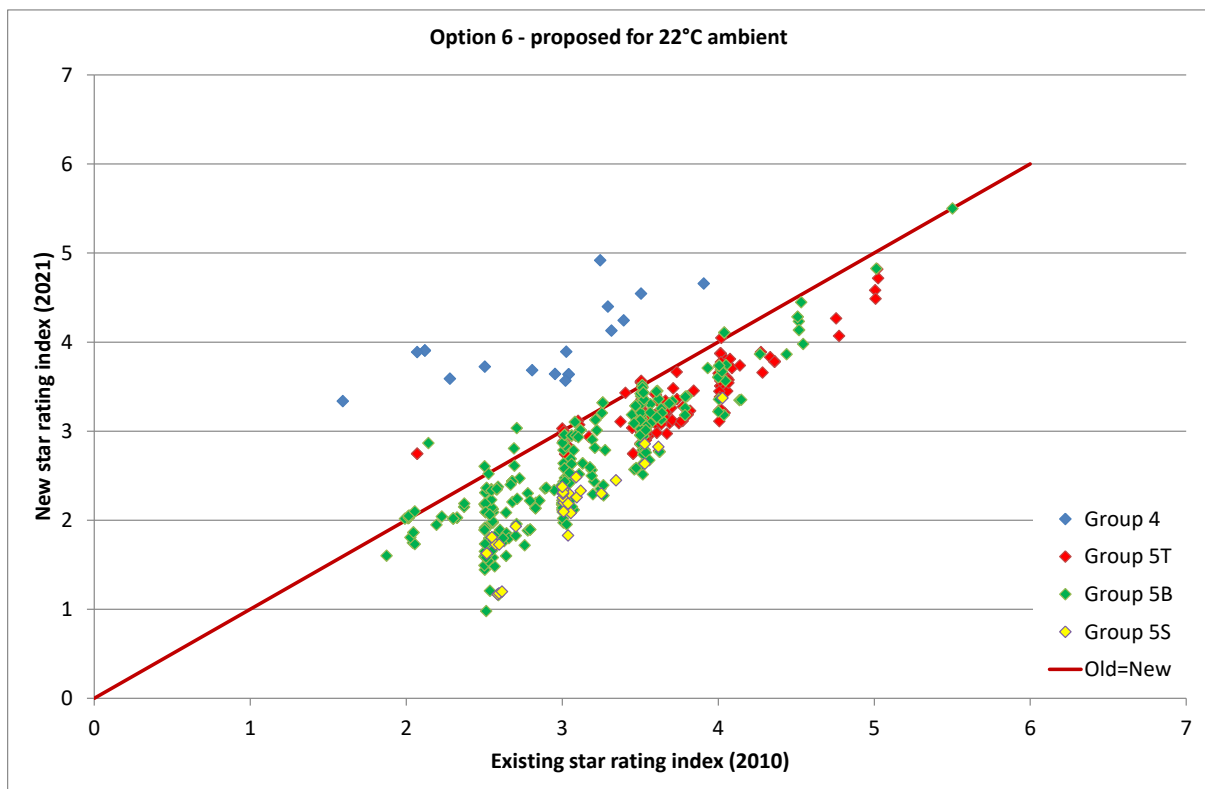


Figure 2: Star Rating 2010 versus proposed star rating Option 6 – EXCLUDES MEPS 2021 failures

Most of the Group 4 products are small (less than 200 litres) as indicated in the following figures.

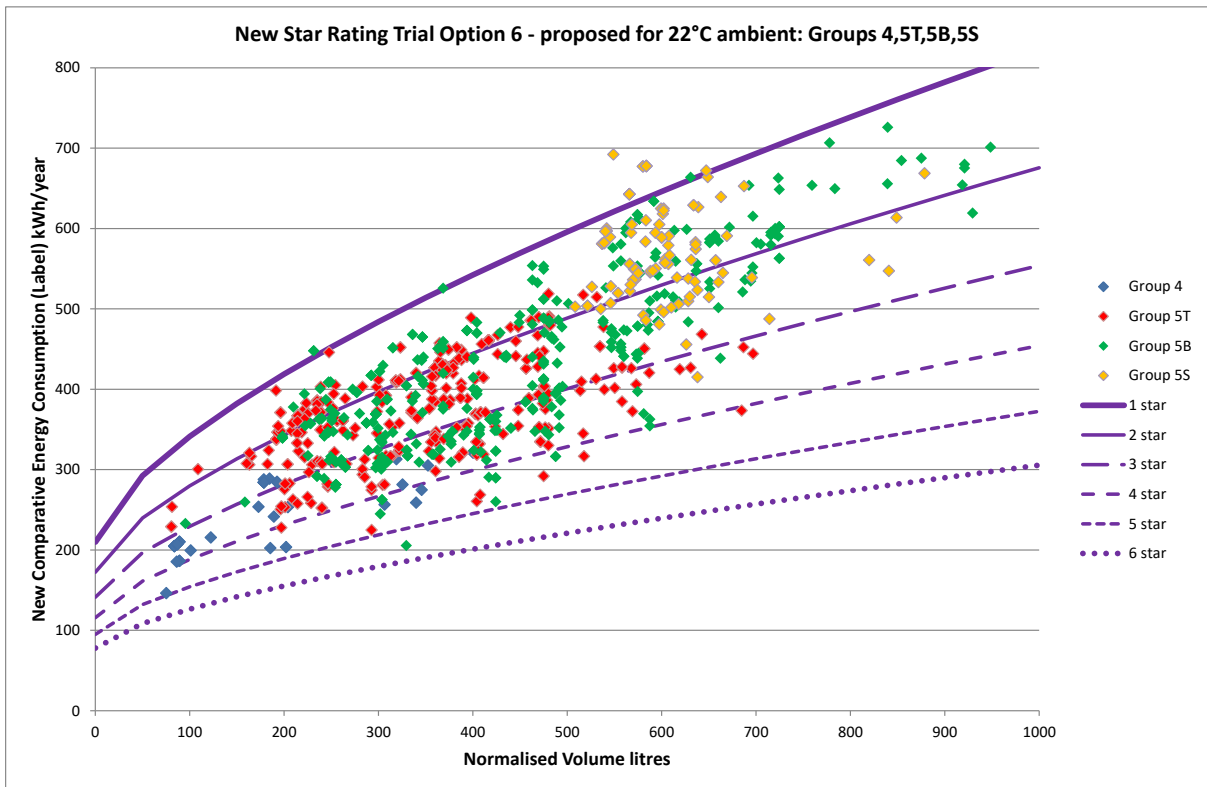


Figure 3: New label energy 2021 versus proposed star rating Option 6 – INCLUDES MEPS 2021 failures

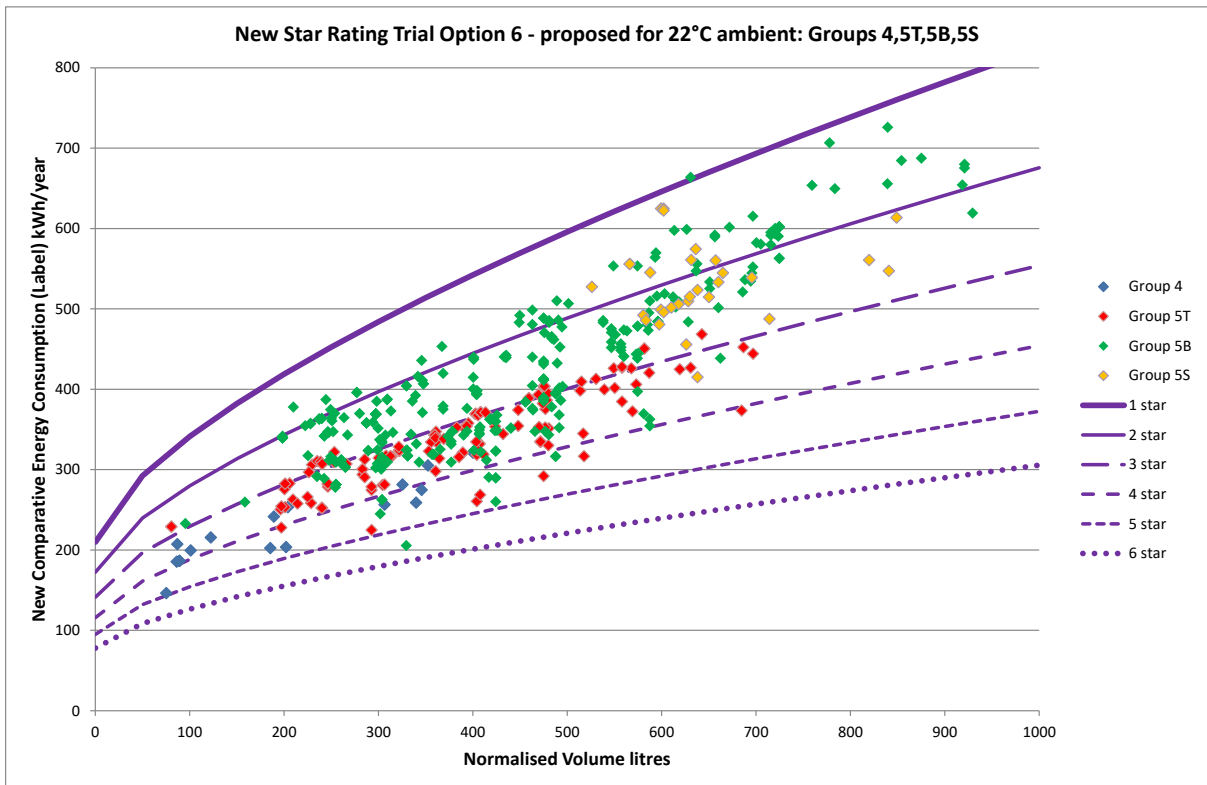


Figure 4: New label energy 2021 versus proposed star rating Option 6 – EXCLUDES MEPS 2021 failures

Several new possible algorithms were examined under Option 7 with the objective to keep star ratings for current middle ranking products similar while increasing the star ratings of more efficient products slightly. It was found that most options leave the 1 and 1.5 star bins fairly empty, after models that are expected to not meet new minimum energy performance standards (MEPS) levels,

due to commence in 2021, are removed. Almost any option will suffer this problem as MEPS naturally removes the lowest efficiency models currently on the market (noting that MEPS lines do not generally align well with star rating lines, especially for small products). If the mainstream models are to approximately maintain their old star rating, with the energy reduction factor (ERF) reduced to 0.18, there will naturally be some empty space below.

Option 8 has therefore been selected and it has a reduced fixed component and a higher variable component. The argument for this approach is that the normalised volume to the power of 0.67 should naturally track the changes in efficiency with size, so a smaller fixed component should be workable. Option 8 for Groups 4, 5T, 5B and 5S is as follows:

$$\text{BEC} = 55 + 10 \times (V_{\text{norm}})^{0.67}$$

Option 8 does manage to tilt the slope between old and new star rating so the lower star ratings achieve a bit less and higher star ratings achieve a bit more. Option 8 is recommended to be suitable for public discussion for Groups 4, 5T, 5B and 5S.

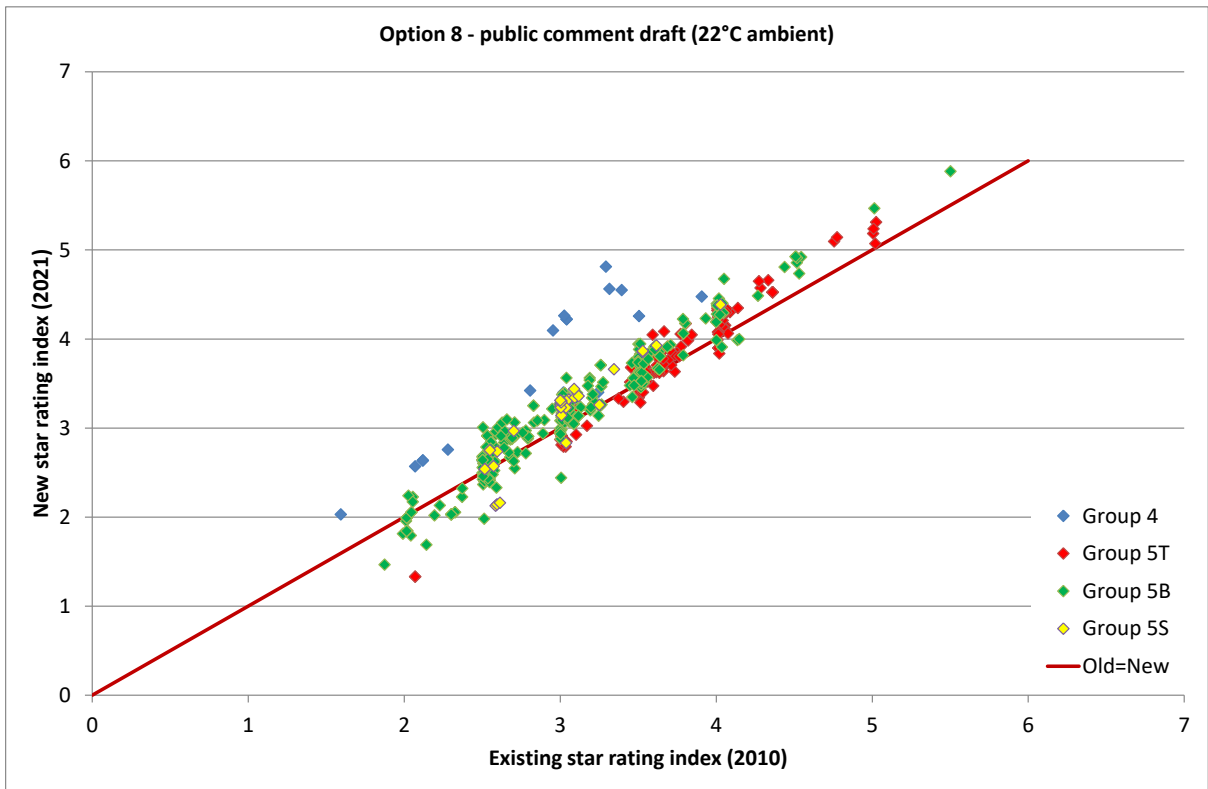


Figure 5: Star Rating 2010 versus proposed star rating Option 8 – EXCLUDES MEPS 2021 failures

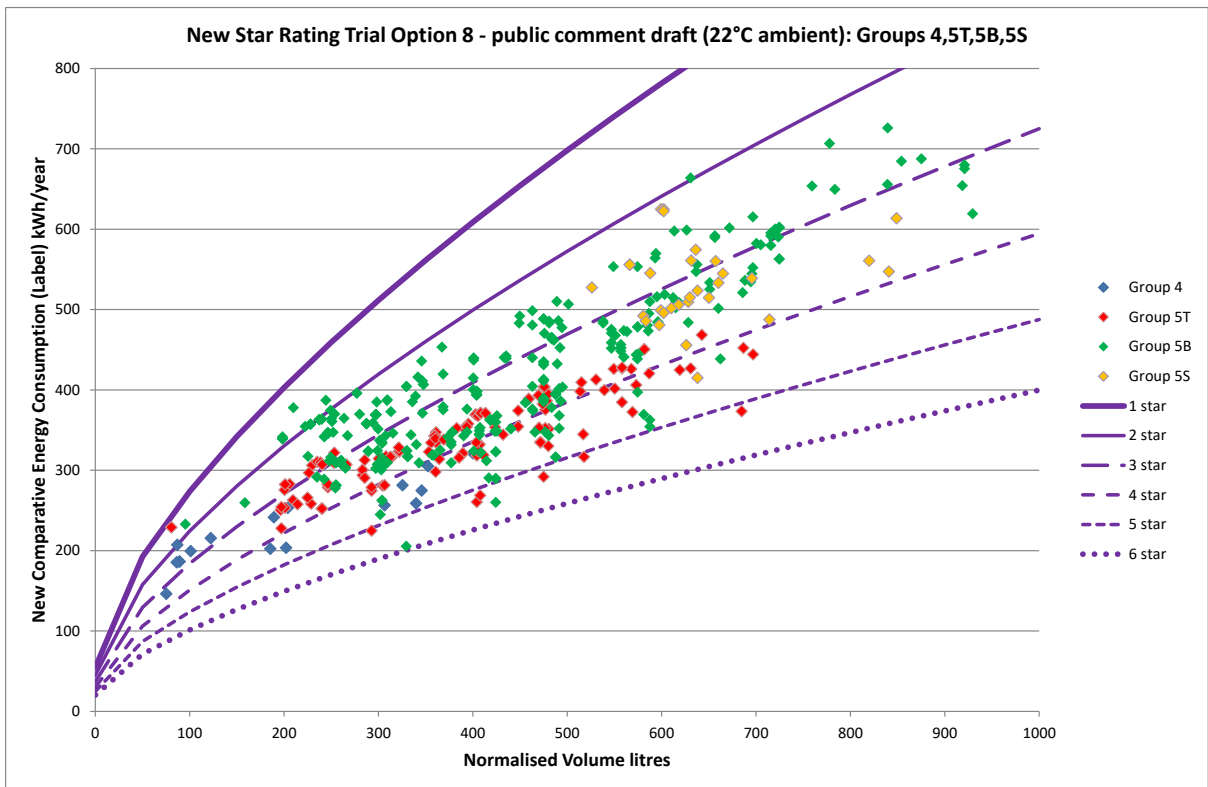


Figure 6: New label energy 2021 versus proposed star rating Option 8 – EXCLUDES MEPS 2021 failures

### Groups 1, 2 and 3

The current proposal for Groups 1, 2 and 3 under Option 6 is shown below. For this meta-group, Option 6 suffers the same issues as for the Groups 4 and 5 meta-group.

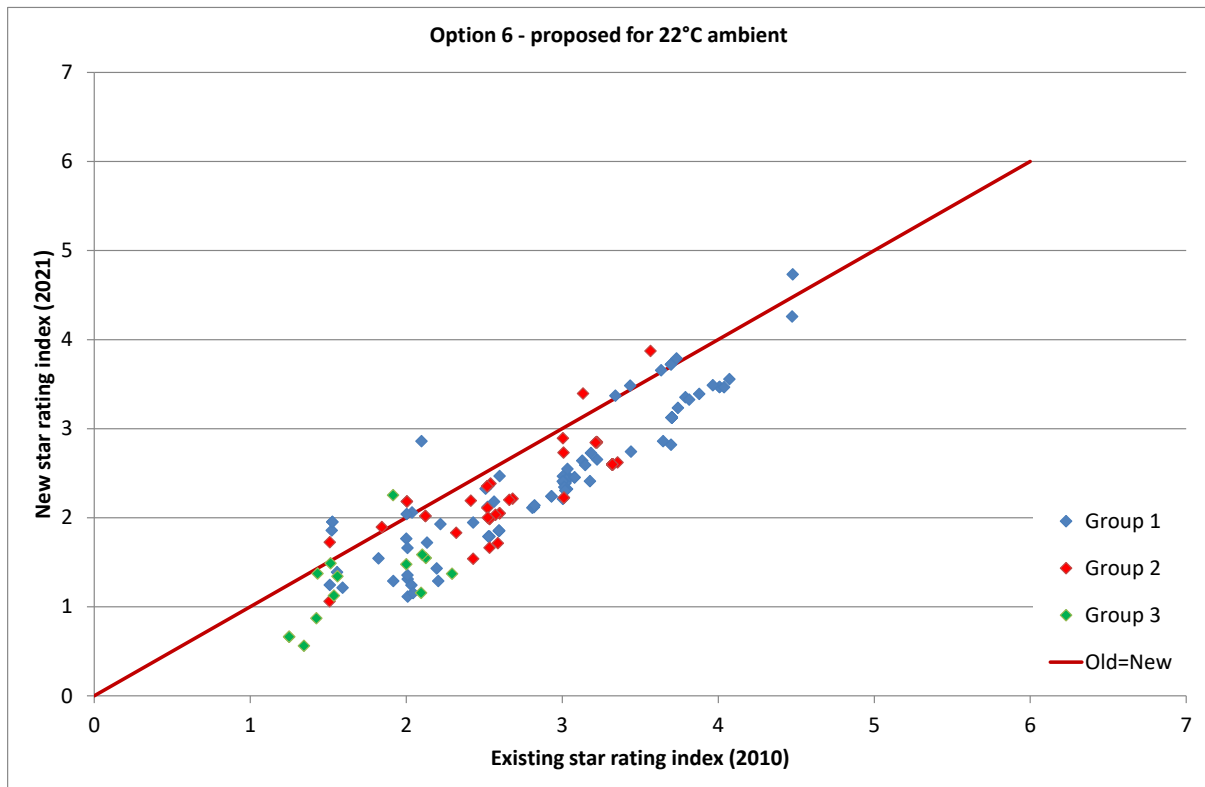


Figure 7: Star Rating 2010 versus proposed star rating Option 6 – EXCLUDES MEPS 2021 failures

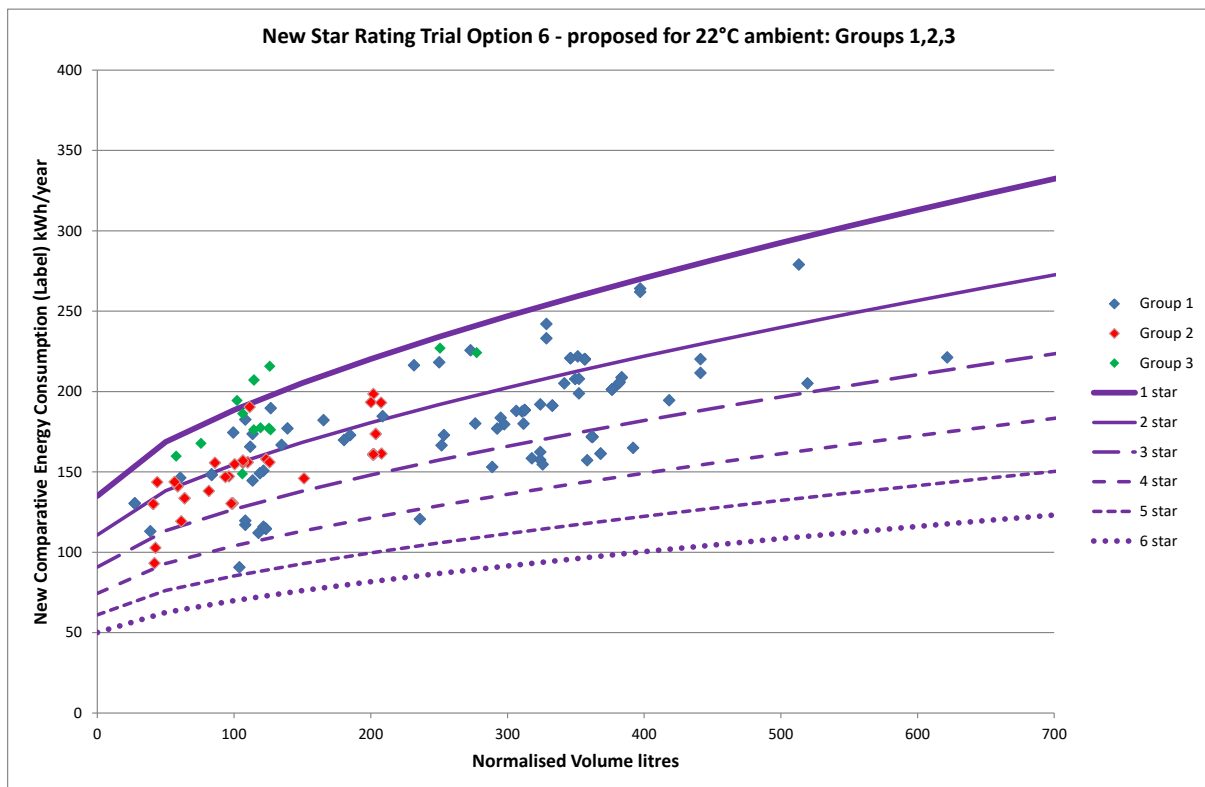


Figure 8: New label energy 2021 versus proposed star rating Option 6 – EXCLUDES MEPS 2021 failures

While Option 6 would be suitable for a label regrade, it does not meet the stated objective in the RIS. These Groups have a concentration of products in the small size range but there is a very wide spread of sizes. Option 8 for Groups 1, 2, and 3 is:  $BEC = 90 + 4.5 \times (V_{norm})^{0.67}$  This is recommended to be suitable for public discussion.

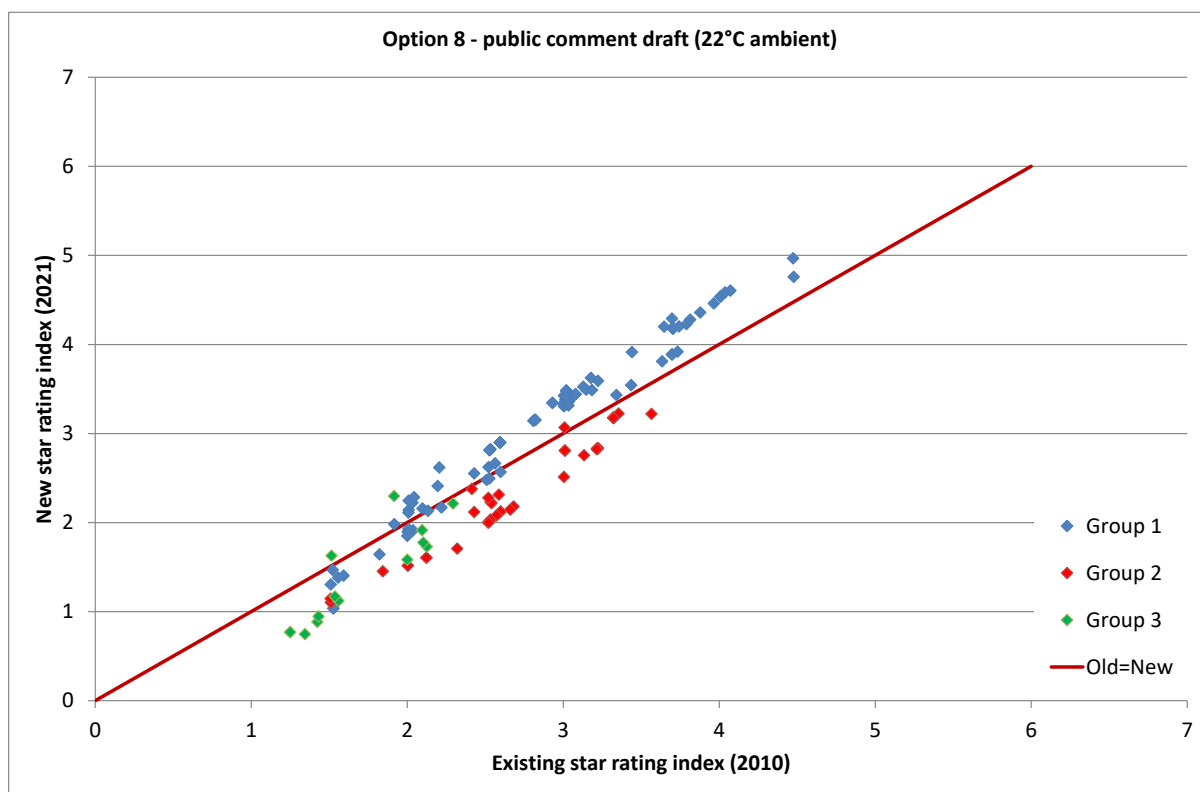


Figure 9: Star Rating 2010 versus proposed star rating Option 8 – EXCLUDES MEPS 2021 failures

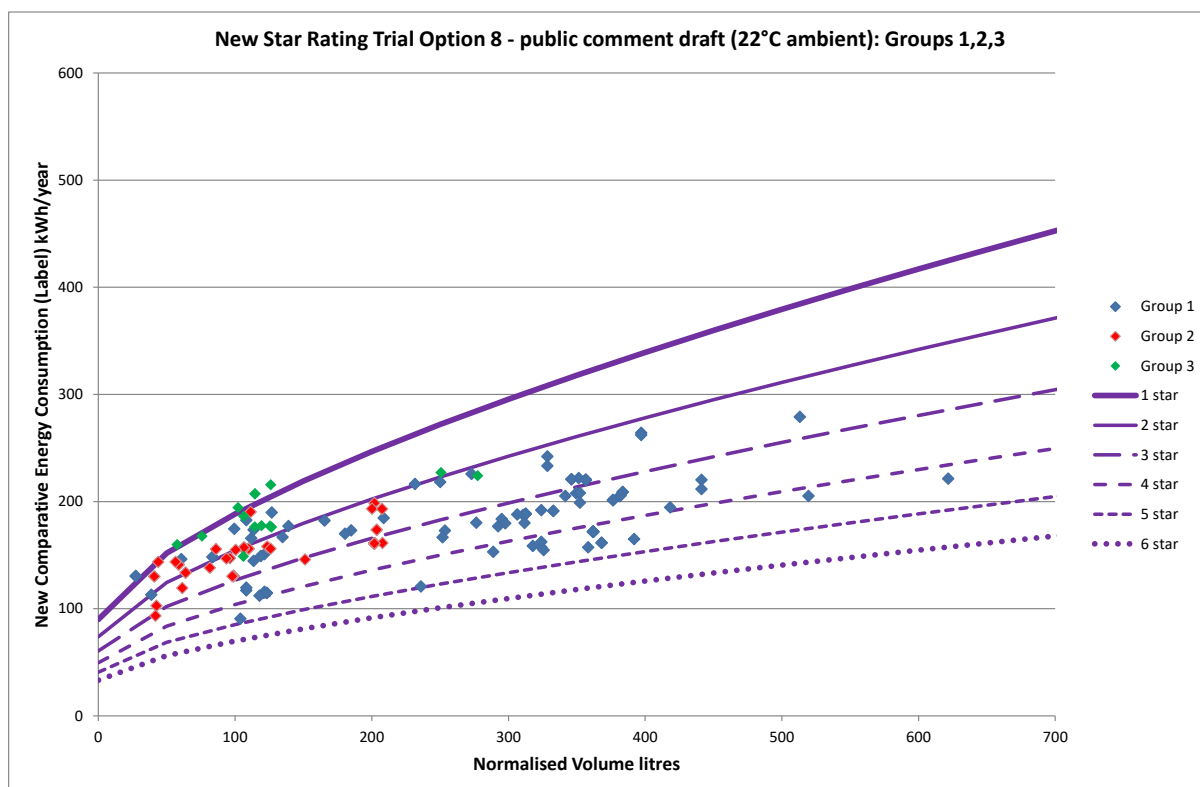


Figure 10: New label energy 2021 versus proposed star rating Option 8 – EXCLUDES MEPS 2021 failures

### Groups 6C, 6U and 7

The last batch of products to consider are freezers: Groups 6C, 6U and 7. Option 6 is shown below.

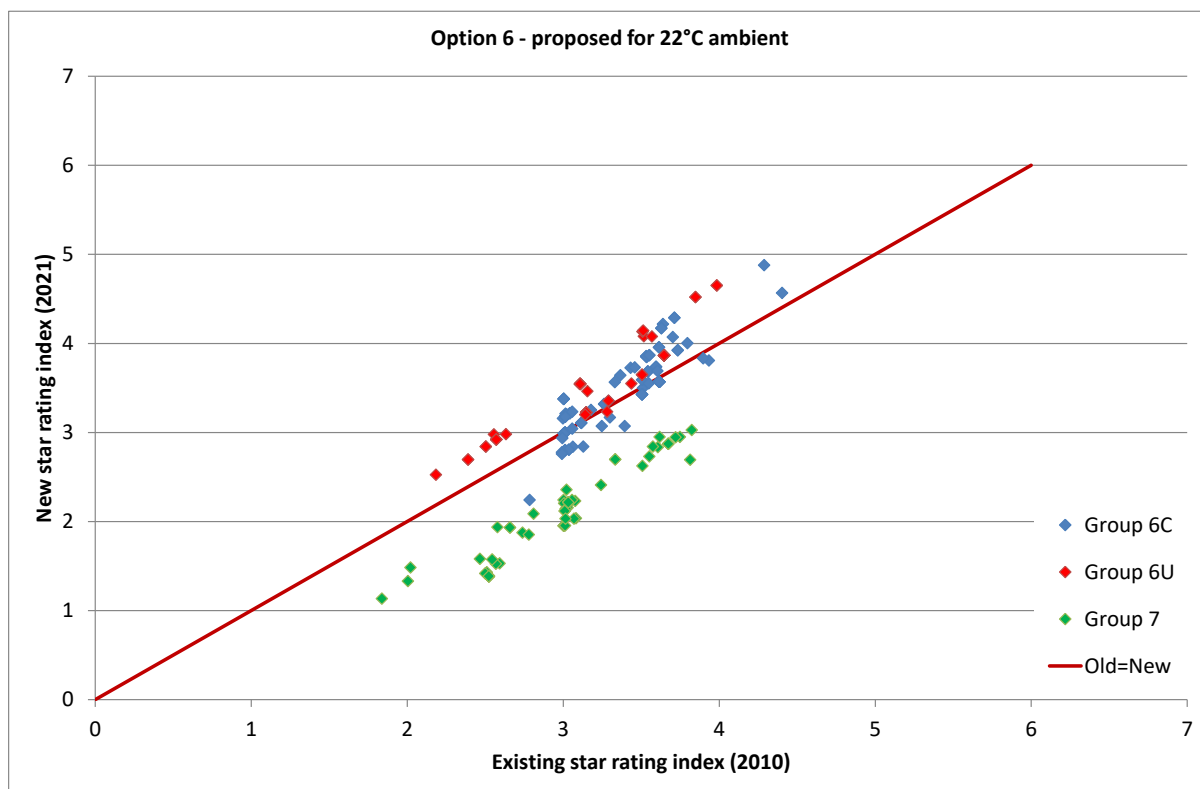


Figure 11: Star Rating 2010 versus proposed star rating Option 6 – EXCLUDES MEPS 2021 failures

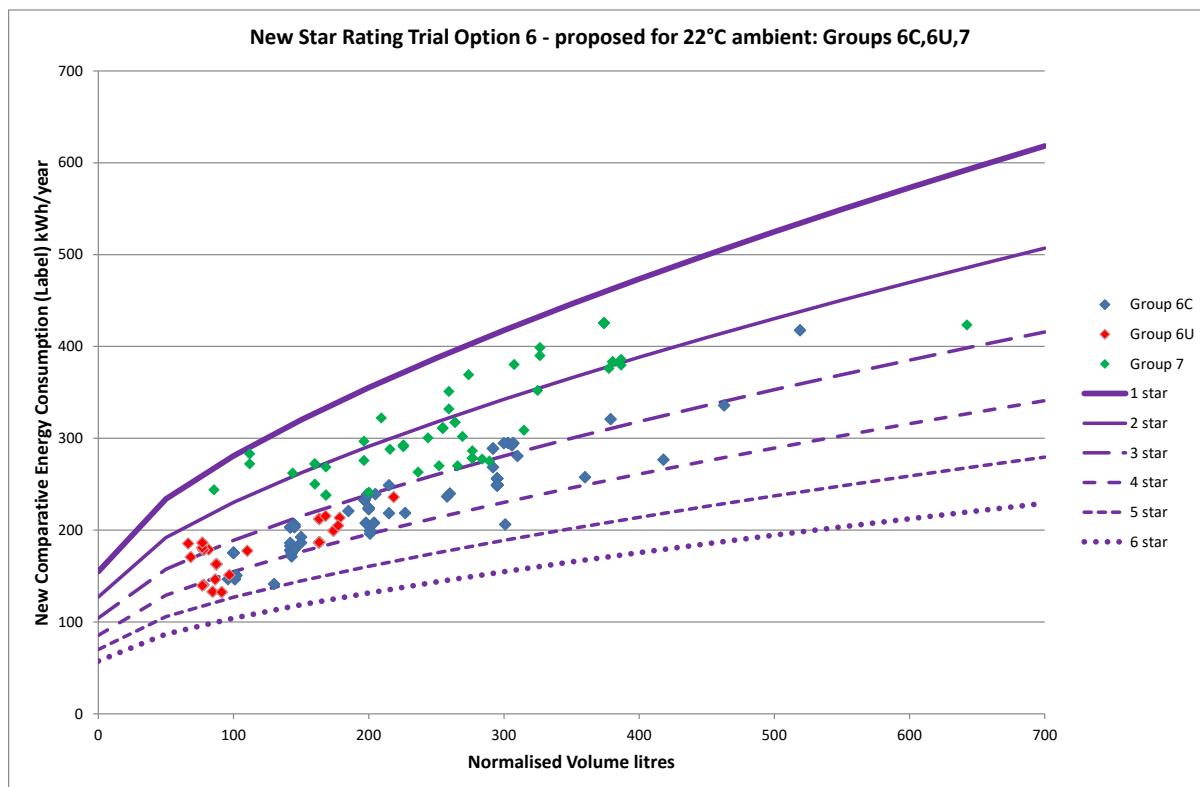


Figure 12: New label energy 2021 versus proposed star rating Option 6 – EXCLUDES MEPS 2021 failures



There appears to be a bias in Option 6 against Group 7 products. However, this bias is also evident in the existing star ratings as shown below, although not as pronounced. So it appears that Group 7 products generally have a higher energy for a comparable volume.

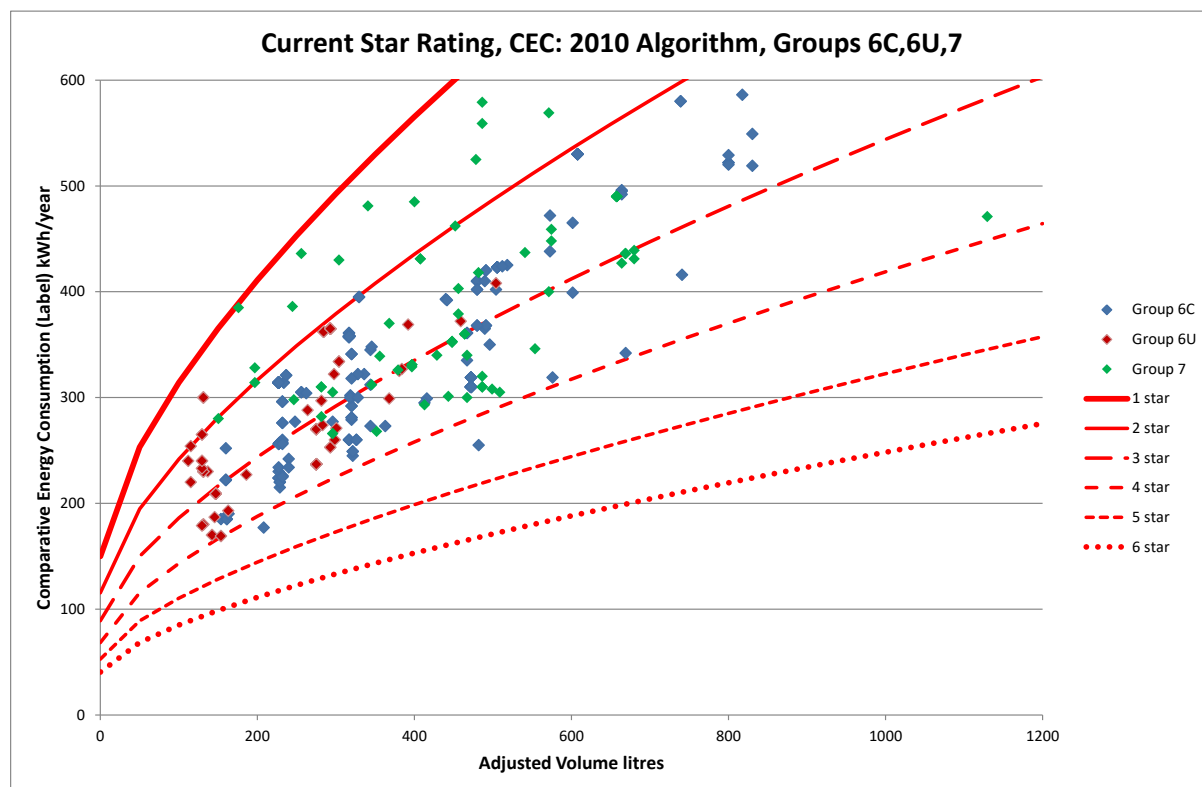


Figure 13: Current energy 2010 and current labelling algorithm – EXCLUDES MEPS 2021 failures

Option 8 was prepared to give a higher existing star rating to products under the new system. The new PAEC calculation appears to penalise Group 7 products. This is mostly as a result of the increased defrost in-use multiplier included in the draft of AS/NZS 4474 to reflect normal use. For these products, defrost energy makes up a significant share of the total energy. The user load (load processing) for separate freezers is quite low so this has a small effect overall. There is little that could be done about this apparent Group 7 bias as this is a reflection of likely differences in energy use that the consumer will see. As noted above, under the existing star rating scheme Group 7 products generally rate lower in a general sense in any case.

Option 8 for Groups 6C, 6U and 7 is as follows:  $BEC = 120 + 7.5 \times (V_{norm})^{0.67}$

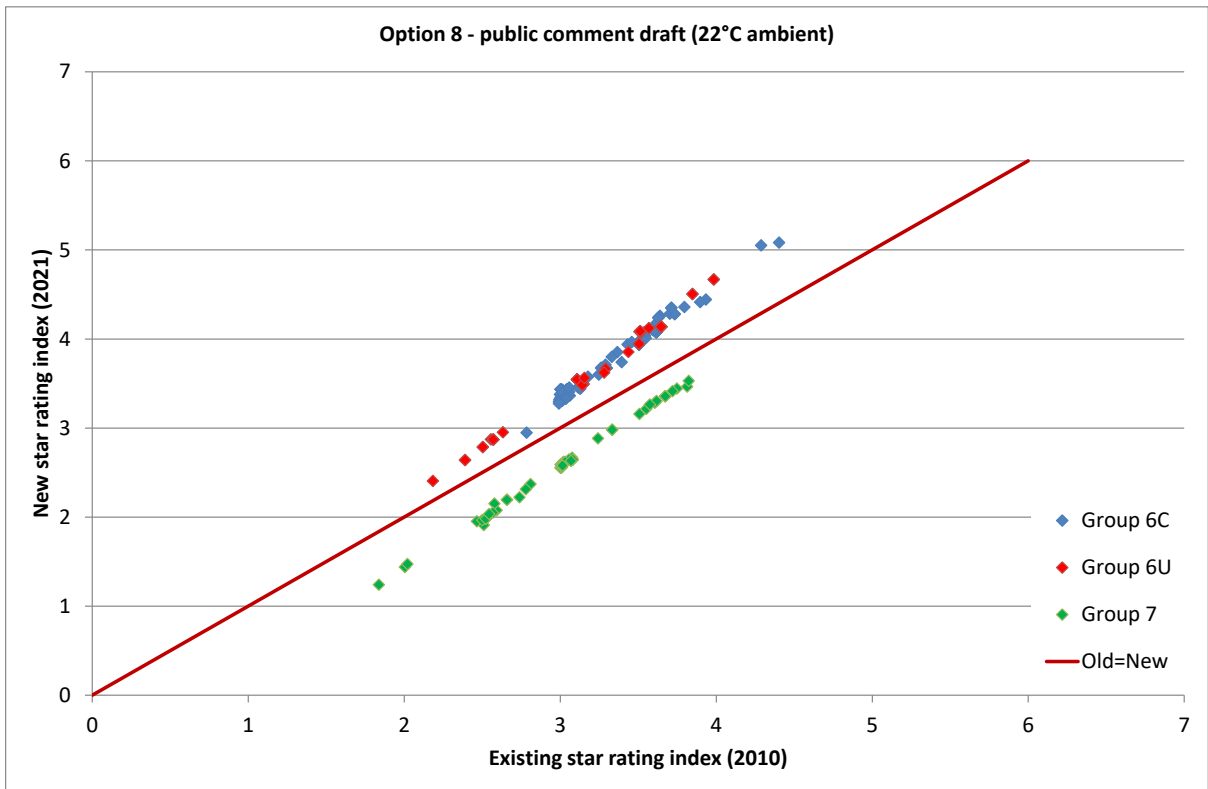


Figure 14: Star Rating 2010 versus proposed star rating Option 8 – EXCLUDES MEPS 2021 failures

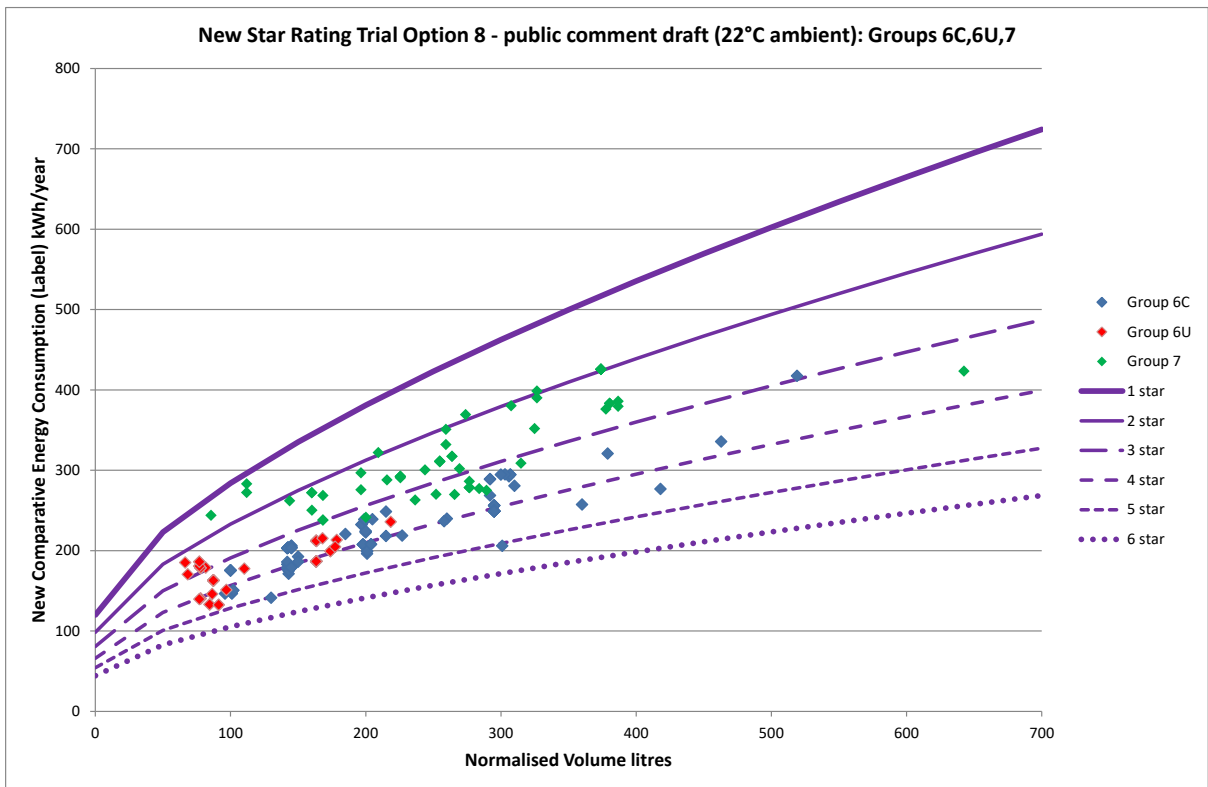


Figure 15: New label energy 2021 versus proposed star rating Option 8 – EXCLUDES MEPS 2021 failures

## Summary

The Option 8 developed for each meta-group appears to correct for many of the small changes progressively included in the AS/NZS 4474 draft over the past year. It should be noted that the energy consumption estimates for PAEC under the new draft AS/NZS 4474 are based on a wide range of typical data for different types of refrigerating appliances. The precise impact of the test method change will vary by product, so data in this report should be taken as indicative. It is recommended that the proposed Option 8 be included in the public comment draft. The new factors are summarised in Table 1. This should replace the current values in Table 3.3 of the AS/NZS 4474 public comment draft.

**Table 1: Summary of proposed labelling algorithm for AS/NZS4474 public comment**

Meta-Groups	Fixed Cf kWh/year	Variable Cv kWh/year/norm litre
1, 2, 3	90	4.5
4, 5T, 5B, 5S	55	10
6C, 6U, 7	120	7.5