Initial Comparison of EFT v9 with EFT v8 and CURED v3A

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Experts in air quality management & assessment

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1 Introduction

1.1 In December 2017, Defra issued its Emissions Factors Toolkit (EFT) V8.0.1 and Air Quality Consultants issued its Calculator Using Realistic Emissions for Diesels (CURED) V3A. In May 2019, Defra issued EFT V9.0. This note provides an initial, and cursory, comparison of how these three emissions models compare in different areas. All of the emissions calculations are based on a road carrying 76,342 vehicles per day (AADT) with 5.19% HDV[1] and have been run using the "basic fleet split" option common to all three models. The gradient and HDV-load functionality of EFT V9.0 have not been used.

1.2 Figure 1 to Figure 10 show the evolution of NOx emissions over time (assuming no change in AADT or %HDV) for the fleet categories: 'central London'; 'inner London'; 'outer London'; and 'England (not London) urban', and for average speeds of: 10kph; 50kph; and 90kph where considered appropriate.

2 Discussion

2.1 For central London, the accelerated effect of the ULEZ is evident when comparing EFT V9 with either of the other models. Similarly, there is a clear effect on the predicted emissions centred on the year 2020 in inner and outer London, which is driven by assumptions regarding the London bus fleet. For the 'England (not London) urban' fleet category, there is very little difference between the predictions made using EFT V8 and EFT V9[2].

2.2 Because dispersion model results are always verified, and most often calibrated, against recent measurements, it is the rate of change over time, rather than the absolute predicted emissions, which determines which model will predict higher concentrations in the future. At the present time, most modelling studies are verified against measurements made in either 2017 or 2018. Figure 11 to Figure 20 show how each model predicts the rate of change in emissions from a 2017 base year, while Figure 21 to Figure 30 show the change from a 2018 base year.

2017 Verification

2.3 In central London, a dispersion model calibrated against 2017 measurements and using EFT V9 is likely to predict marginally higher concentrations in 2018 and 2020 than a model using either CURED V3A or EFT V8. From 2021 onward, a model using EFT V9 would predict

[1] Which was the measured traffic flow on the road which happened to form the basis of these tests.

[2] EFT V9 continues to assume that battery electric vehicles only use urban roads, and that these vehicles make up a relatively small proportion of the projected future vehicle fleet. For example, by 2030, electric cars are predicted to make up 2.1% of the urban car fleet outside London (and 2.6% of the outer London car fleet). Similarly, diesel cars are predicted to make up approximately the same proportion of the urban (outside London) car fleet (40%) in 2030 as in 2013.

higher concentrations than one using EFT V8, but lower concentrations than one using CURED V3A.

2.4 In inner London, CURED V3A would give the highest concentrations from 2019 onward, with the 2018 predictions essentially the same for all three emissions models. EFT V8 and EFT V9 would predict similar concentrations to one another, with a general tendency for EFT V8 to be associated with the higher values in most, but not all, years.

2.5 For outer London and England outside of London, CURED V3A gives higher predictions than either EFT V8 or EFT V9 for each year beyond 2020. EFT V9 would tend to predict lower concentrations than EFT V8 in outer London between 2019 and ca. 2027 (depending on speed). For England outside of London, EFT V9 would tend to predict higher concentrations than EFT V8.

2018 Verification

2.6 For a 2018-based verification, the observations are essentially the same as those for a 2017-based verification. In central London, a dispersion model calibrated against 2018 measurements and using EFT V9 is likely to predict marginally higher concentrations in 2020 than a model using either CURED V3A or EFT V8. From 2021 onward, a model using EFT V9 would predict higher concentrations than one using EFT V8, but lower concentrations than a model using CURED V3A.

2.7 In inner London, CURED V3A would give the highest concentrations from 2019 onward. EFT V8 and EFT V9 would predict similar concentrations, with a general tendency for EFT V8 to be associated with the higher values in most, but not all, years.

2.8 For outer London and England outside of London, CURED V3A gives higher predictions than either EFT V8 or EFT V9 for each year beyond 2020. EFT V9 would tend to predict lower concentrations than EFT V8 in outer London between 2019 and ca. 2027 (depending on speed). For England outside of London, EFT V9 would tend to predict higher concentrations than EFT V8.

2019 Verification

2.9 Since a full calendar year of 2019 measurements is not yet available, models are unlikely to be verified against 2019 measurements for some time to come. It is nevertheless useful to see how the patterns change if 2019 is the calibration year. Figure 31 to Figure 40 show the rates of change from 2019. In central London, because of the large improvements predicted between 2018 and 2019, EFT V9 is associated with higher predictions in most subsequent years. This pattern does not, however, occur in the other areas. In each of the other areas, a model using CURED V3A and verified against 2019 measurements would predict the highest concentrations in each future year.

Conclusion

2.10 While different fleet compositions will result in different results, for most modelling studies verified against annual mean measurements made in 2017 or 2018, CURED V3A will predict higher concentrations than EFT V9 from 2021 onward. CURED V3A may thus continue to provide a helpful sensitivity test in these situations for assessments against the nitrogen dioxide objectives.

Observations

2.11 This note has shown that, under the conditions specified, CURED V3A will predict higher emissions than EFT V9. This is the basis for concluding that CURED V3A may continue to provide a helpful sensitivity test. No fresh validation of CURED V3A against measured trends has been presented. All three models predict very rapid reductions in fleet-average emissions over the period 2017 to 2020; particularly in London. It will soon be apparent whether these predictions are accurate; particularly for the very large changes predicted by EFT V9 for central London. Similarly, further work is required to reconcile the predictions made using EFT V8 and CURED V3A with measured trends up to 2018 in different settings.

3 Calculated NOx Emissions

Central London

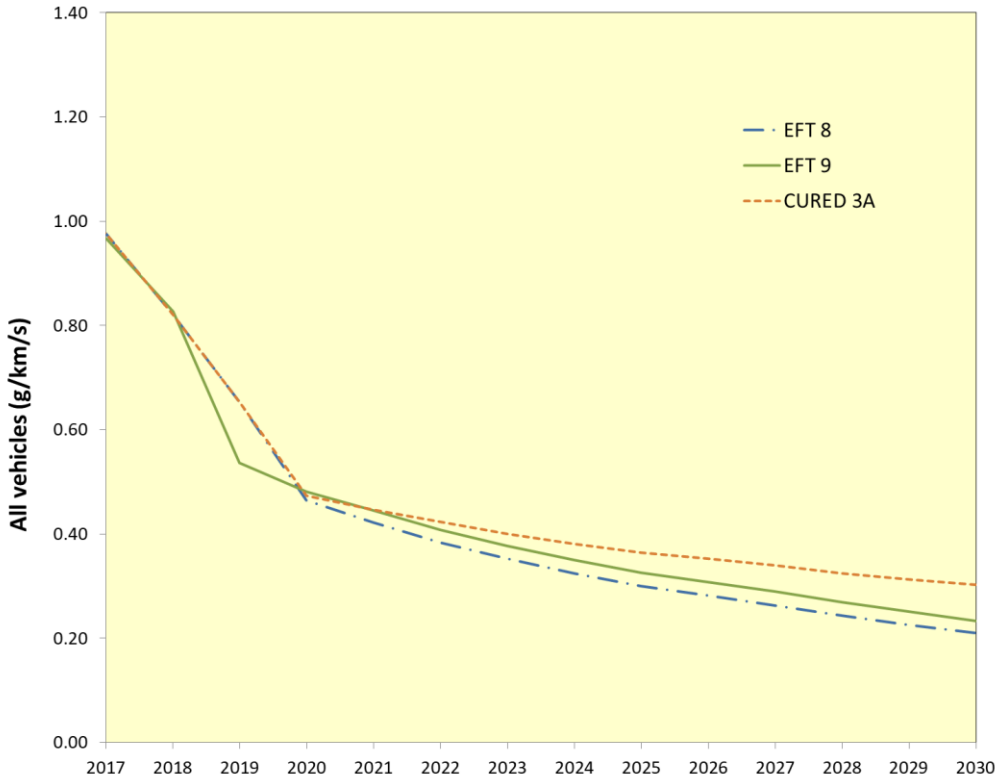

Figure 1: NO_x Emissions over Time - Central London at 10 kph.

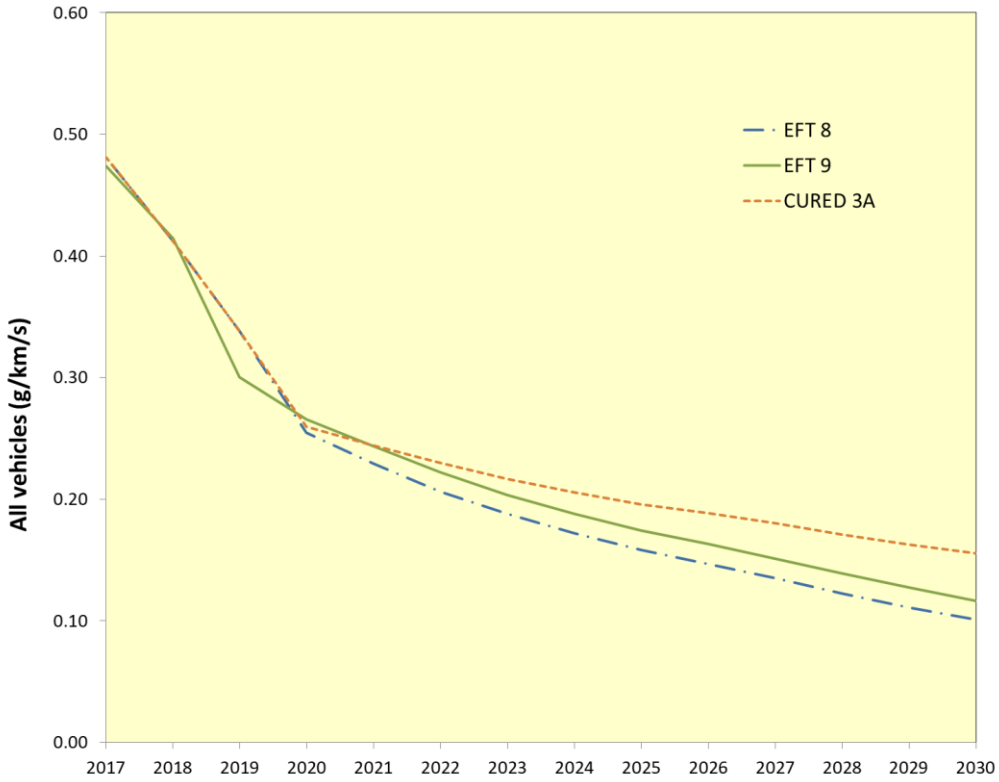

Figure 2: NO_x Emissions over Time - Central London at 50 kph.

Inner London

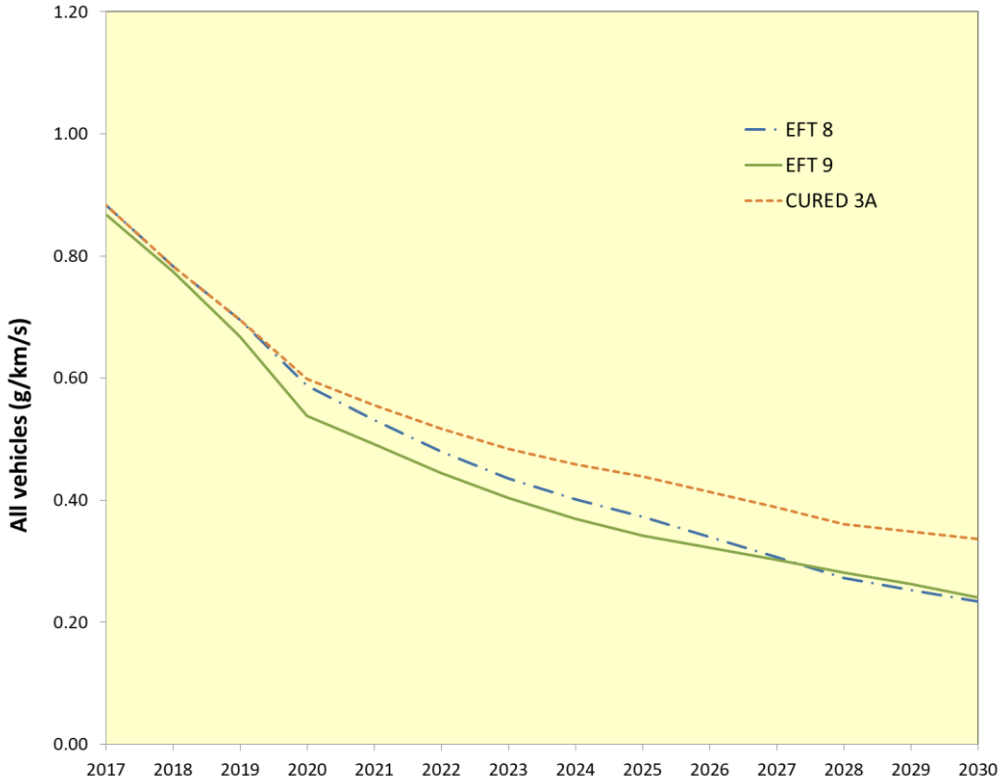

Figure 3: NO_x Emissions over Time – Inner London at 10 kph.

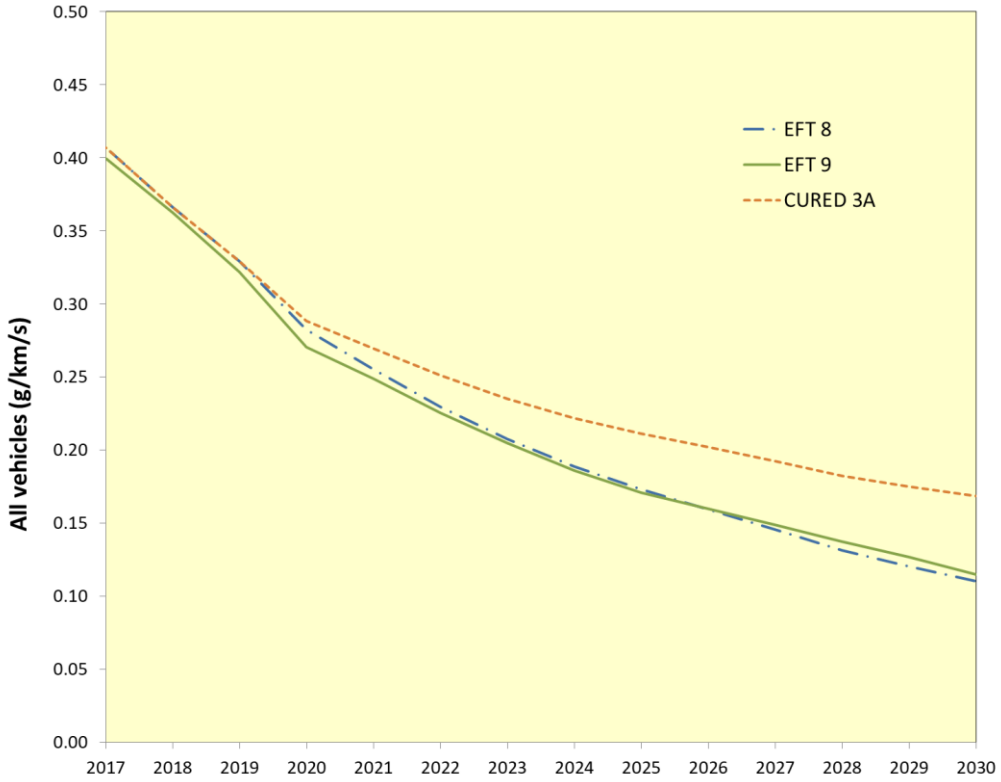

Figure 4: NO_x Emissions over Time - Inner London at 50 kph.

Outer London

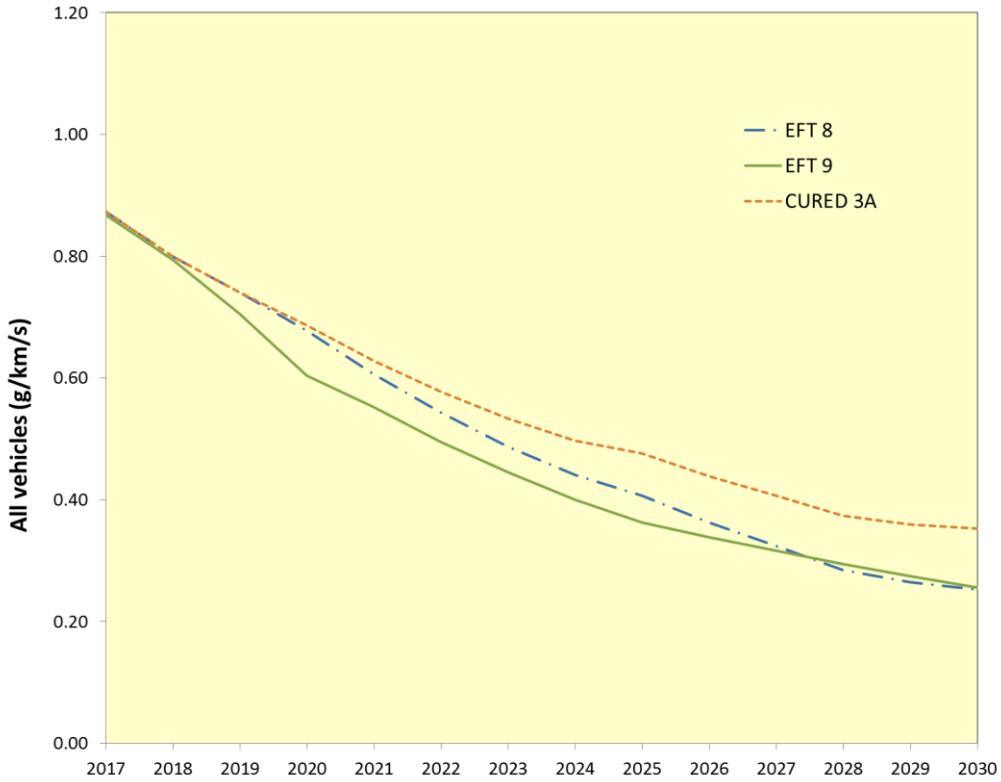

Figure 5: NOx Emissions Over Time – Outer London at 10 kph.

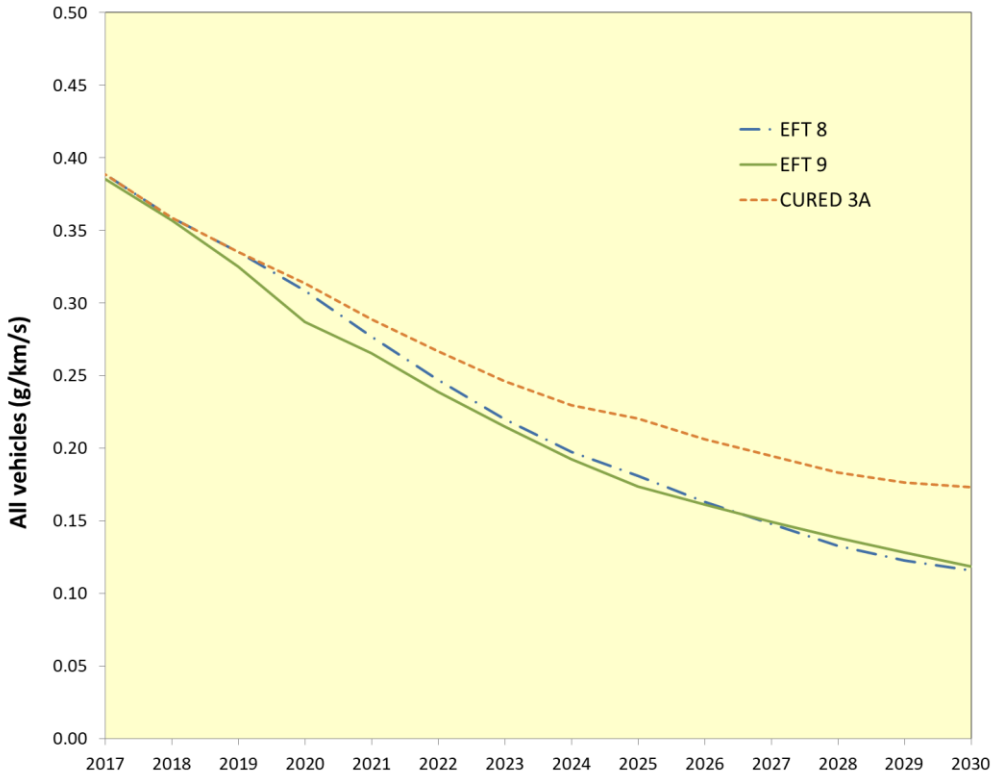

Figure 6: NOx Emissions over Time – Outer London at 50 kph.

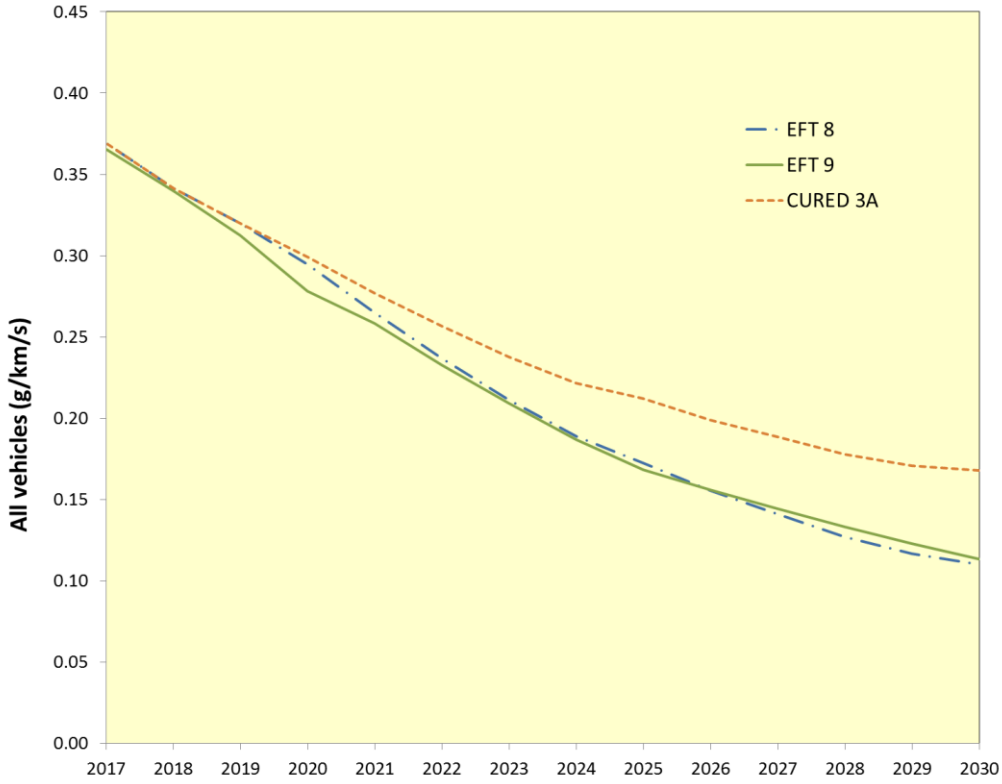

Figure 7: NOx Emissions over Time – Outer London at 90 kph.

England (not London) Urban

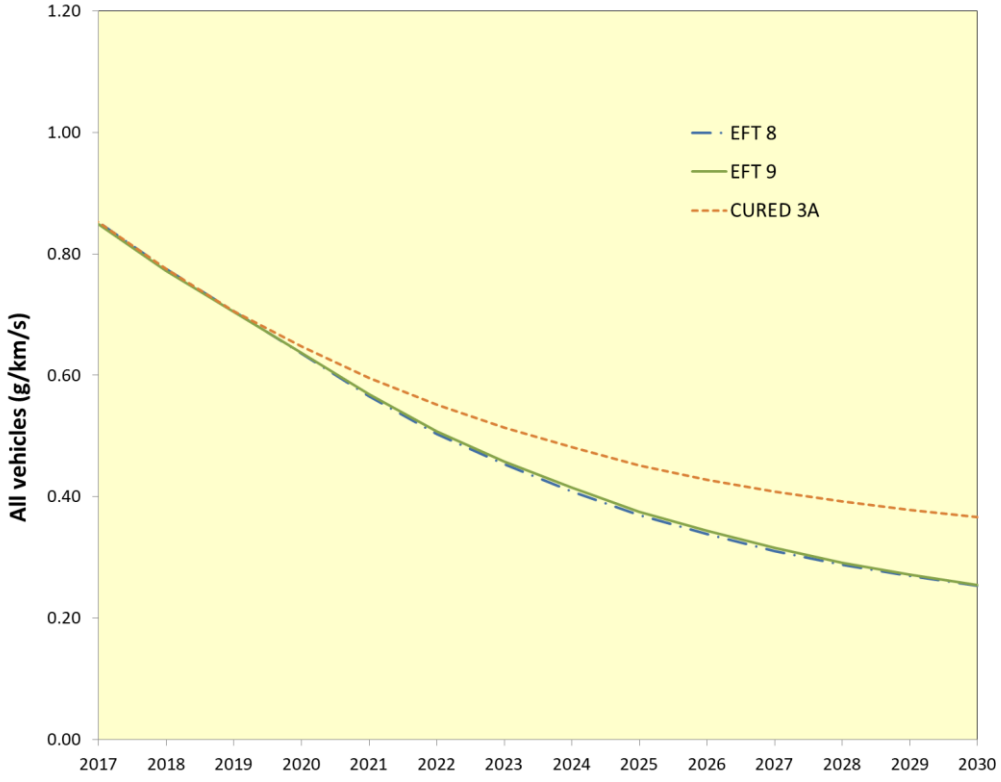

Figure 8: NO_x Emissions over Time – England (not London) Urban at 10 kph.

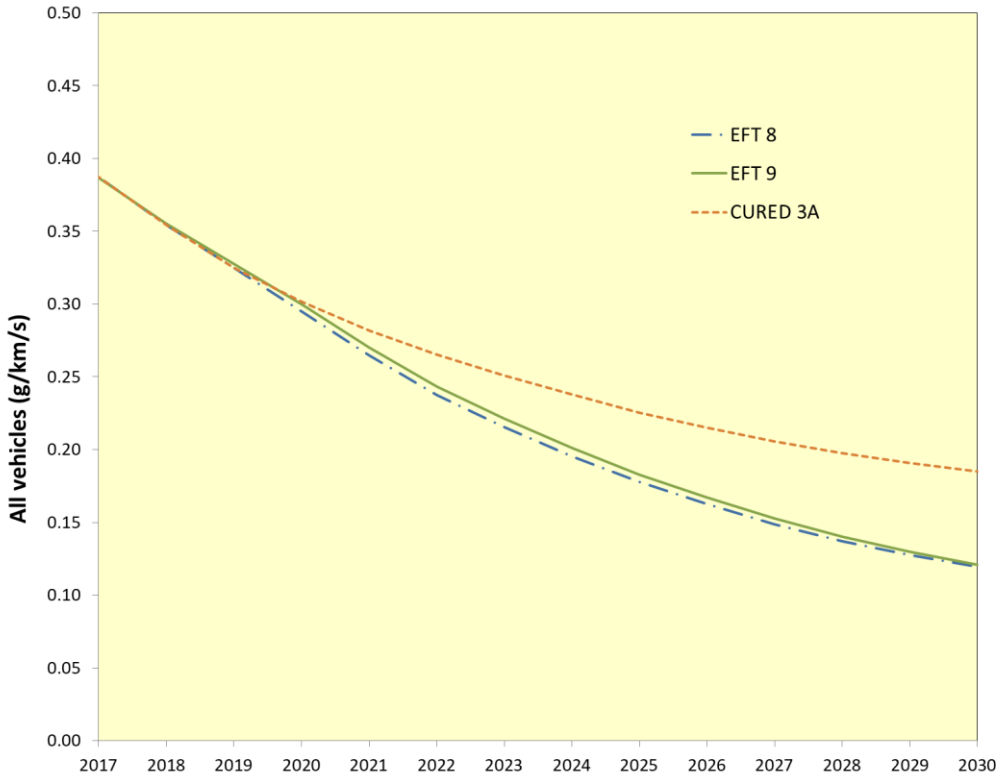

Figure 9: NO_x Emissions over Time - England (not London) Urban at 50 kph.

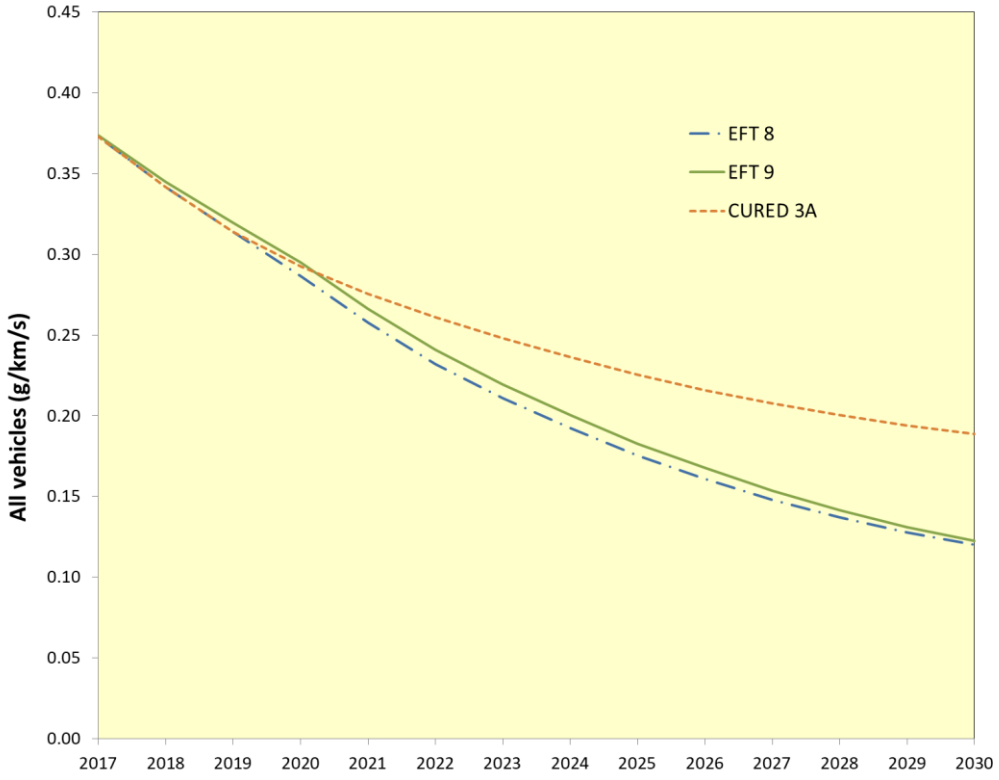

Figure 10: NO_x Emissions over Time - England (not London) Urban at 90 kph.

4 Rates of Change from 2017 Base

Central London

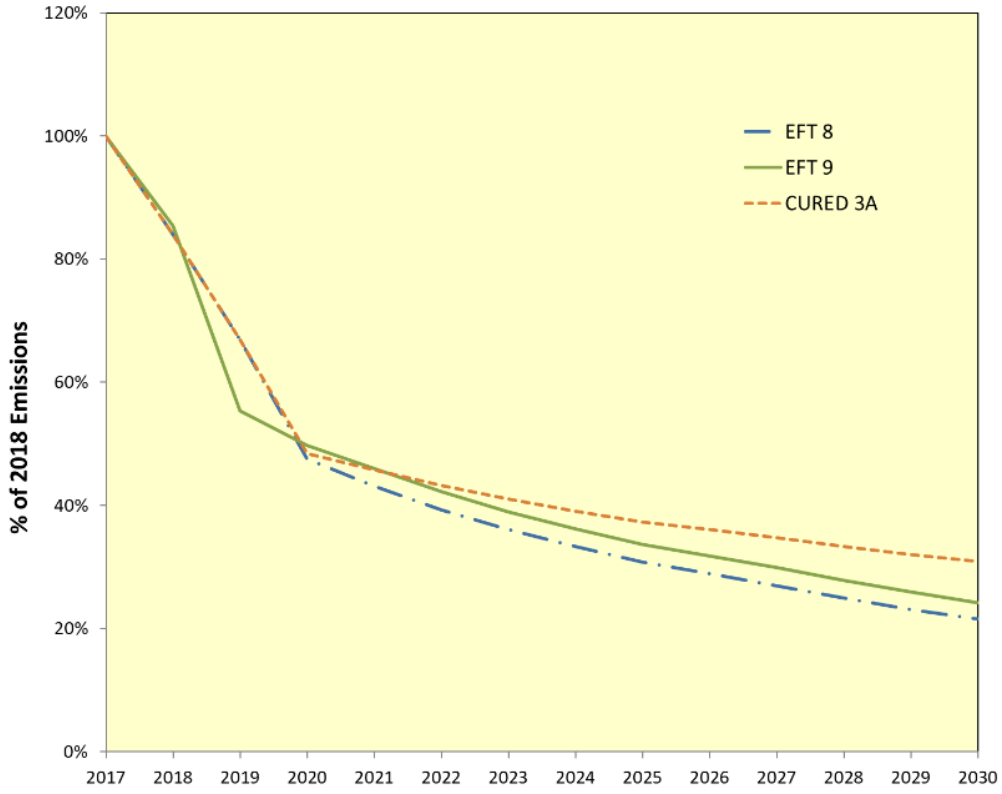

Figure 11: % Change in NO_x Emissions from 2017 - Central London at 10 kph.

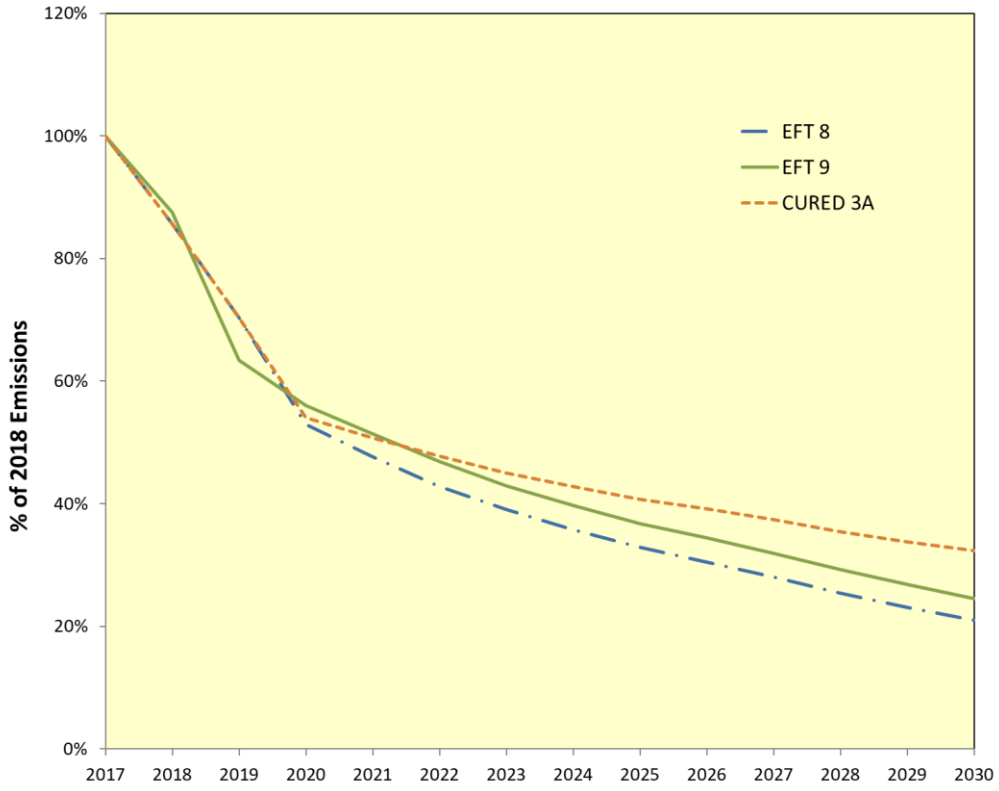

Figure 12: % Change in NO_x Emissions from 2017- Central London at 50 kph.

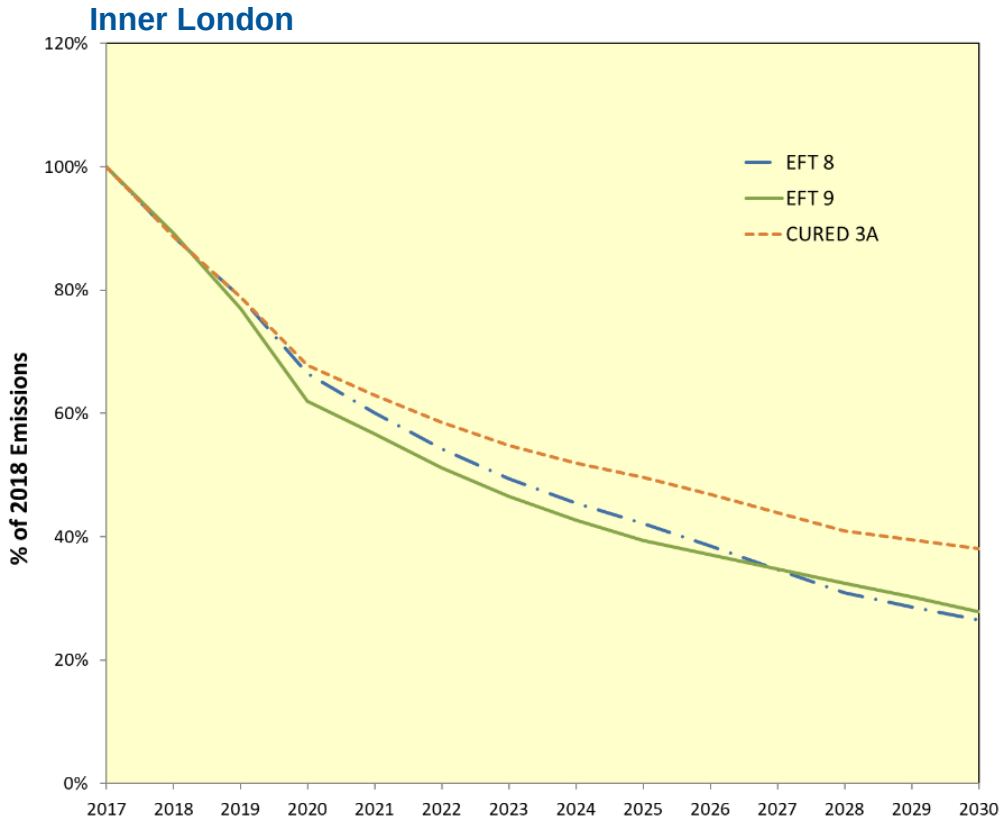

Figure 13: % Change in NO_x Emissions from 2017– Inner London at 10 kph.

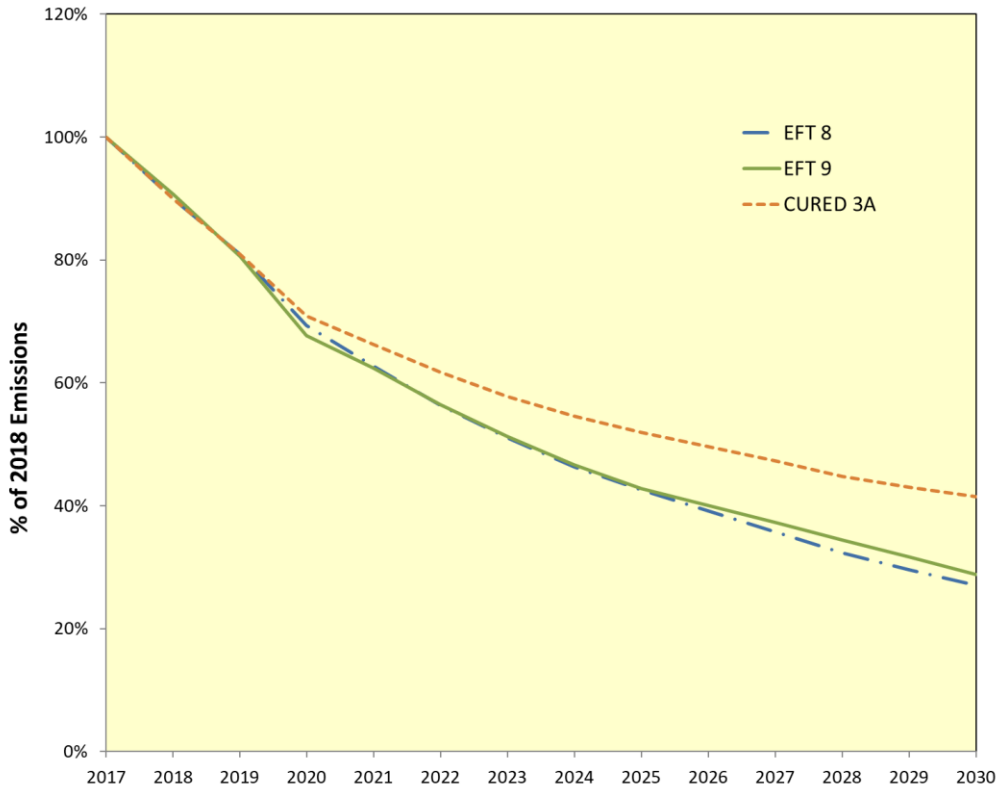

Figure 14: % Change in NO_x Emissions from 2017- Inner London at 50 kph.

Outer London

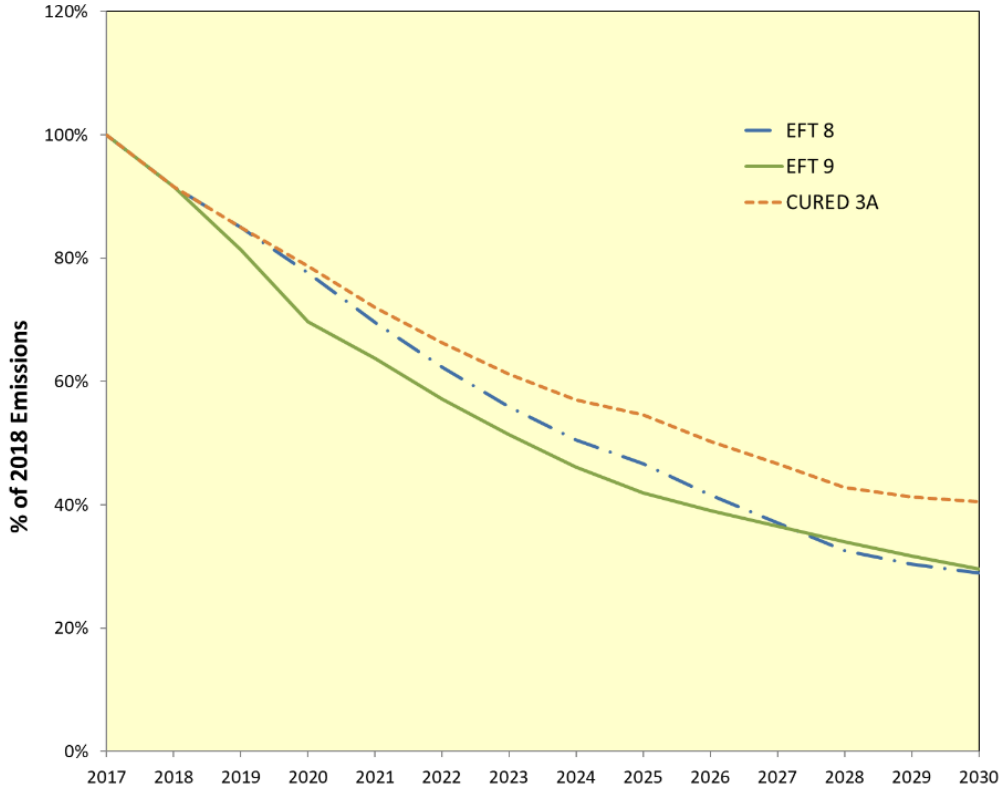

Figure 15: % Change in NO_x Emissions from 2017– Outer London at 10 kph.

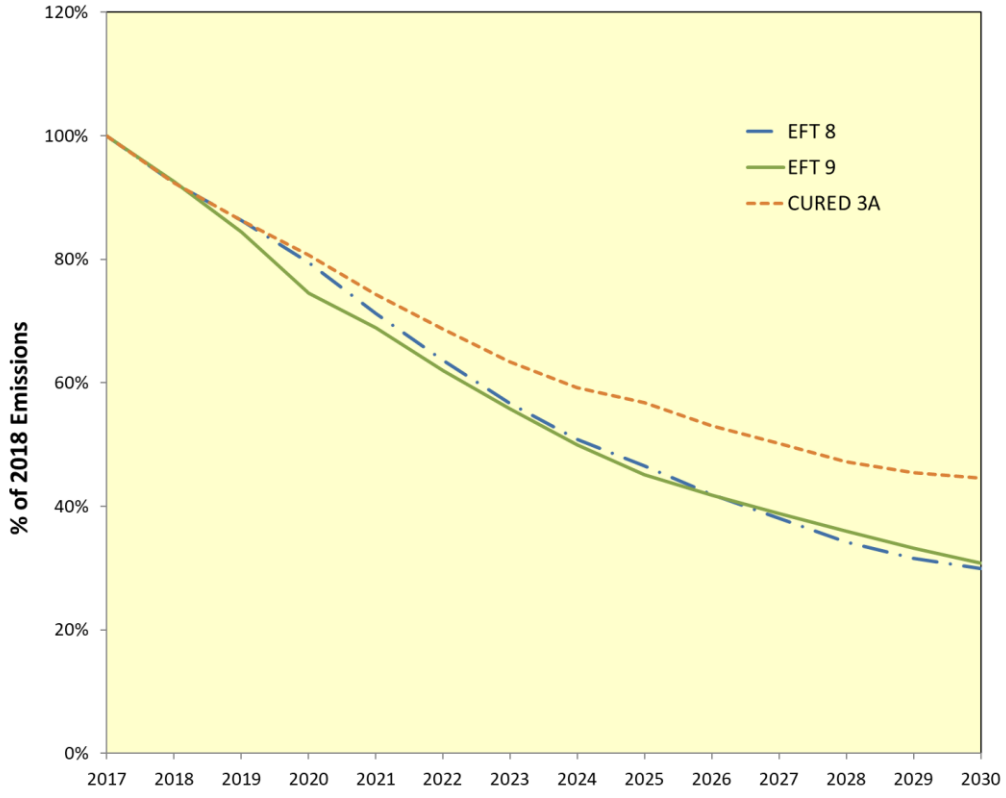

Figure 16: % Change in NO_x Emissions from 2017– Outer London at 50 kph.

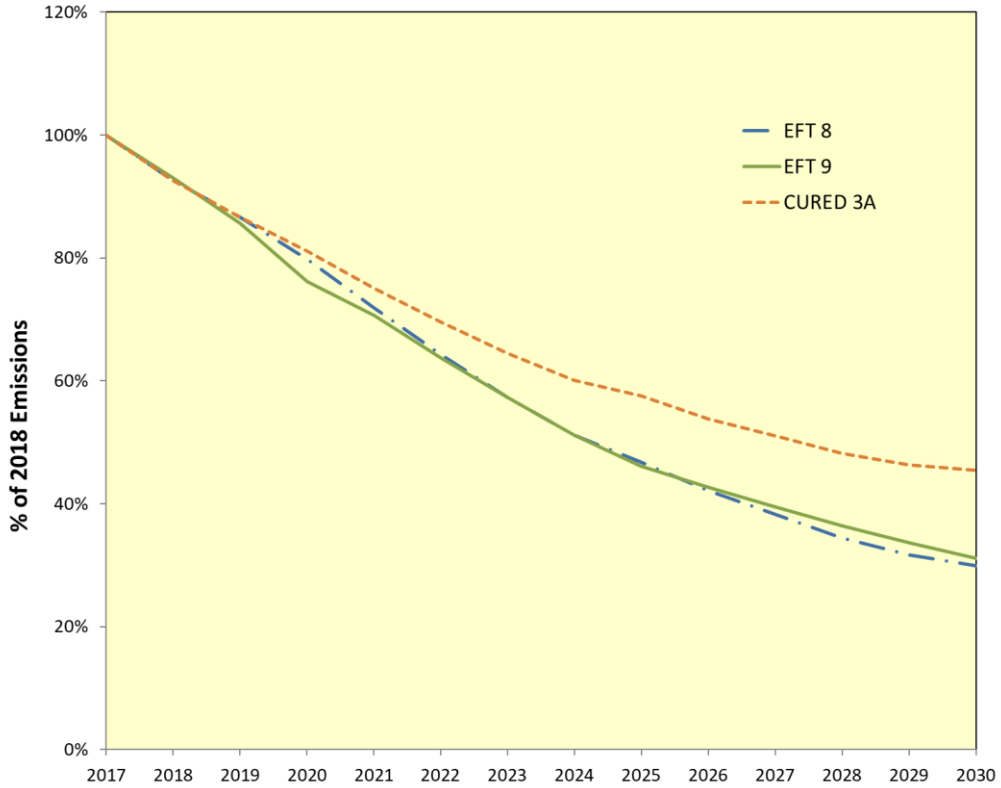

Figure 17: % Change in NO_x Emissions from 2017– Outer London at 90 kph.

England (not London) Urban

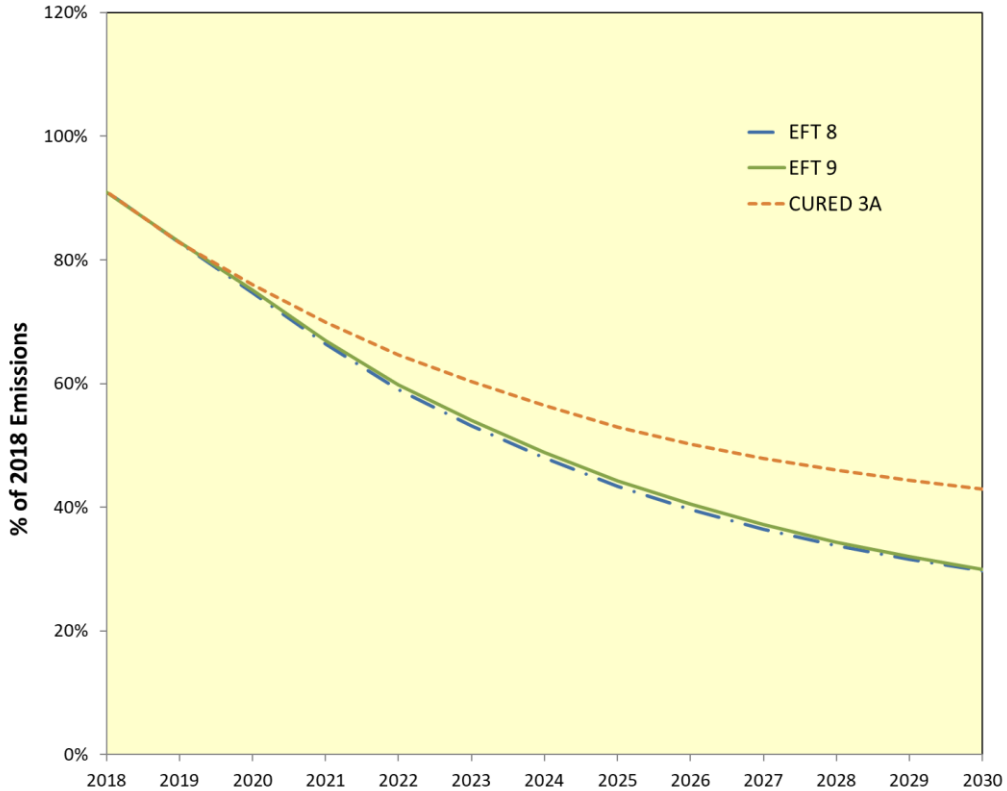

Figure 18: % Change in NO_x Emissions from 2017– England (not London) Urban at 10 kph.

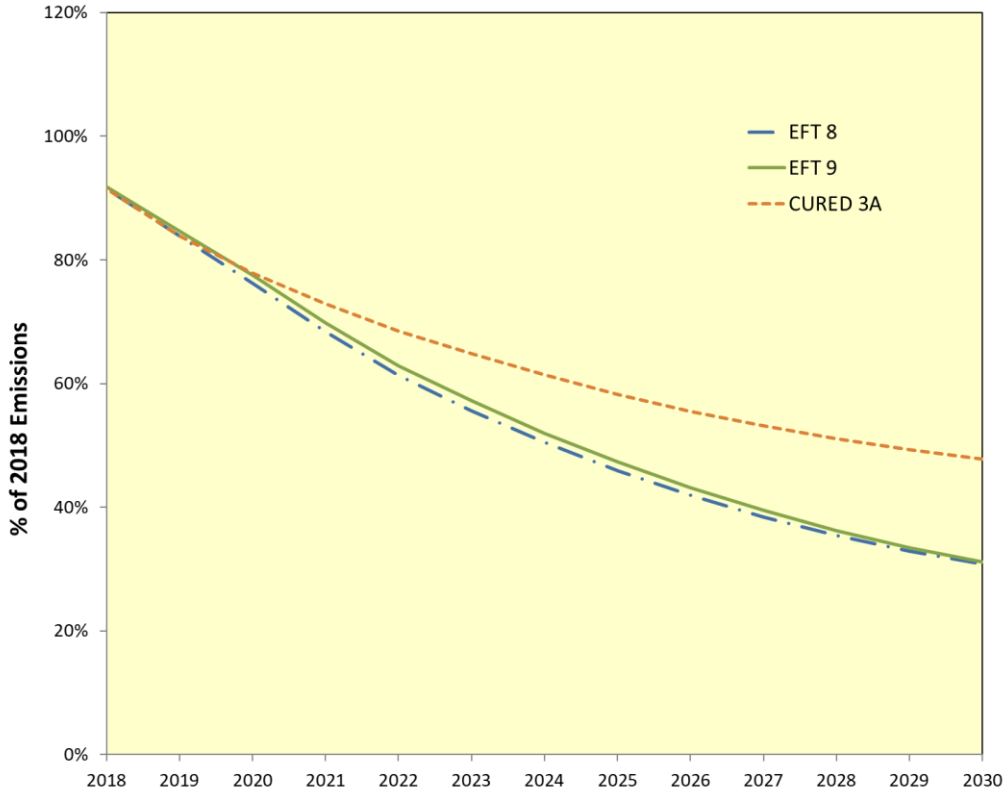

Figure 19: % Change in NO_x Emissions from 2017- England (not London) Urban at 50 kph.

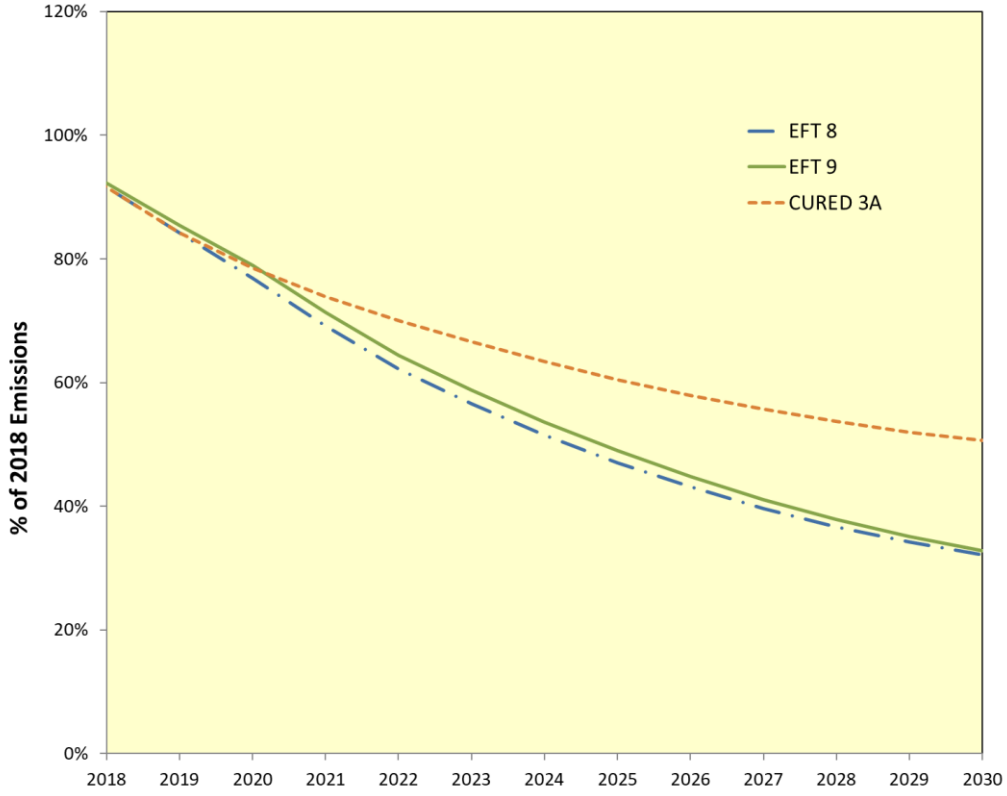

Figure 20: % Change in NO_x Emissions from 2017- England (not London) Urban at 90 kph.

5 Rates of Change from 2018 Base

Central London

Figure 21: % Change in NO_x Emissions from 2018 - Central London at 10 kph.

Figure 22: % Change in NO_x Emissions from 2018 - Central London at 50 kph.

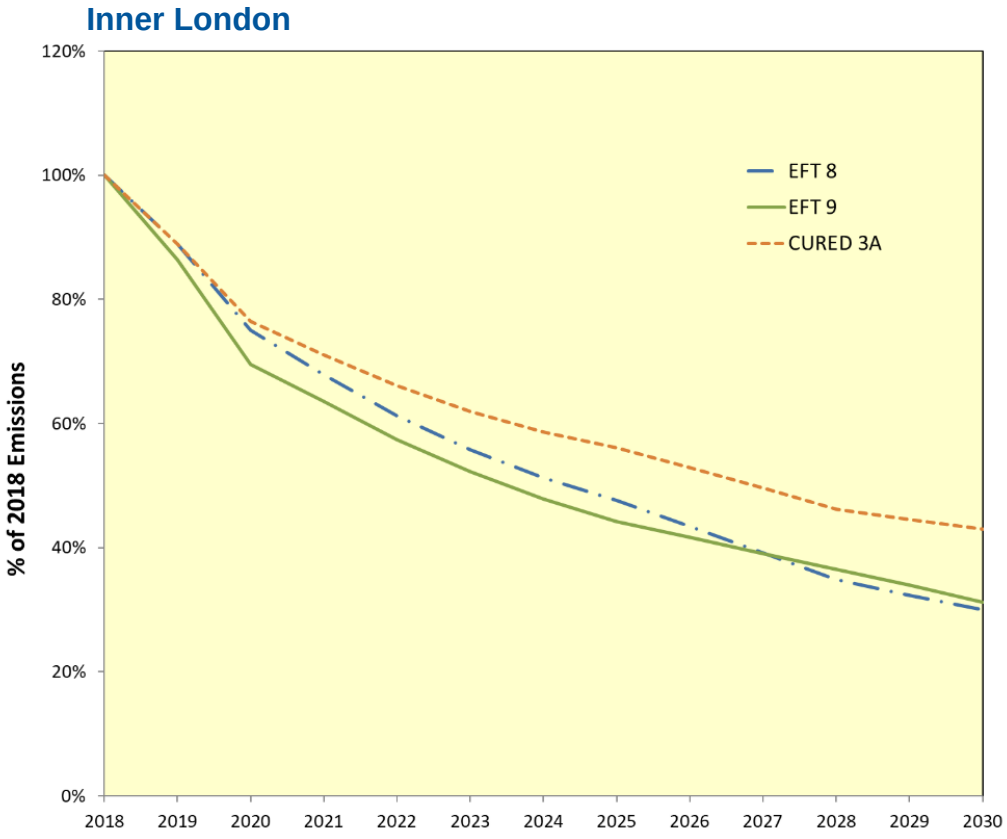

Figure 23: % Change in NO_x Emissions from 2018 – Inner London at 10 kph.

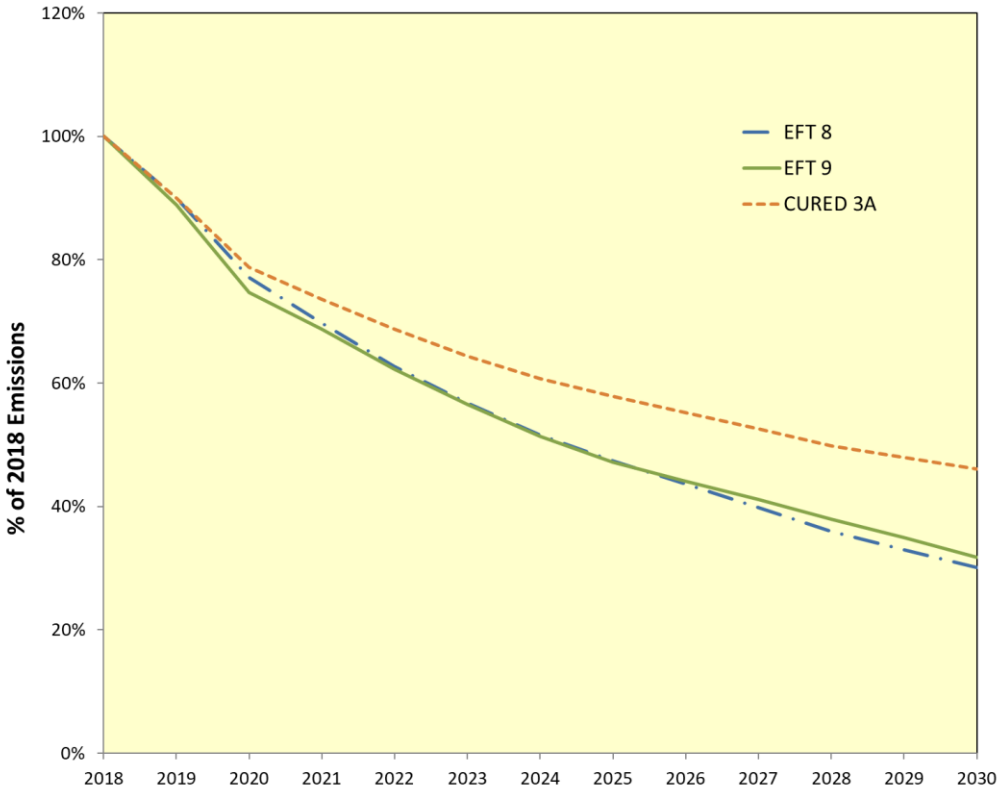

Figure 24: % Change in NO_x Emissions from 2018 - Inner London at 50 kph.

Outer London

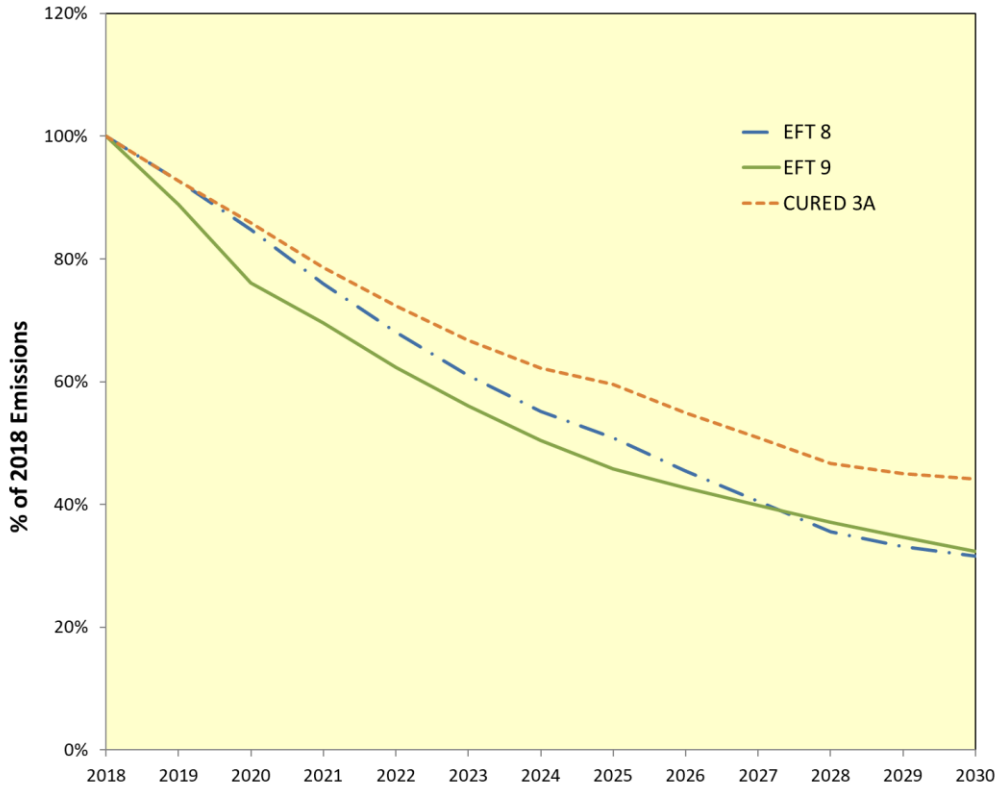

Figure 25: % Change in NO_x Emissions from 2018 – Outer London at 10 kph.

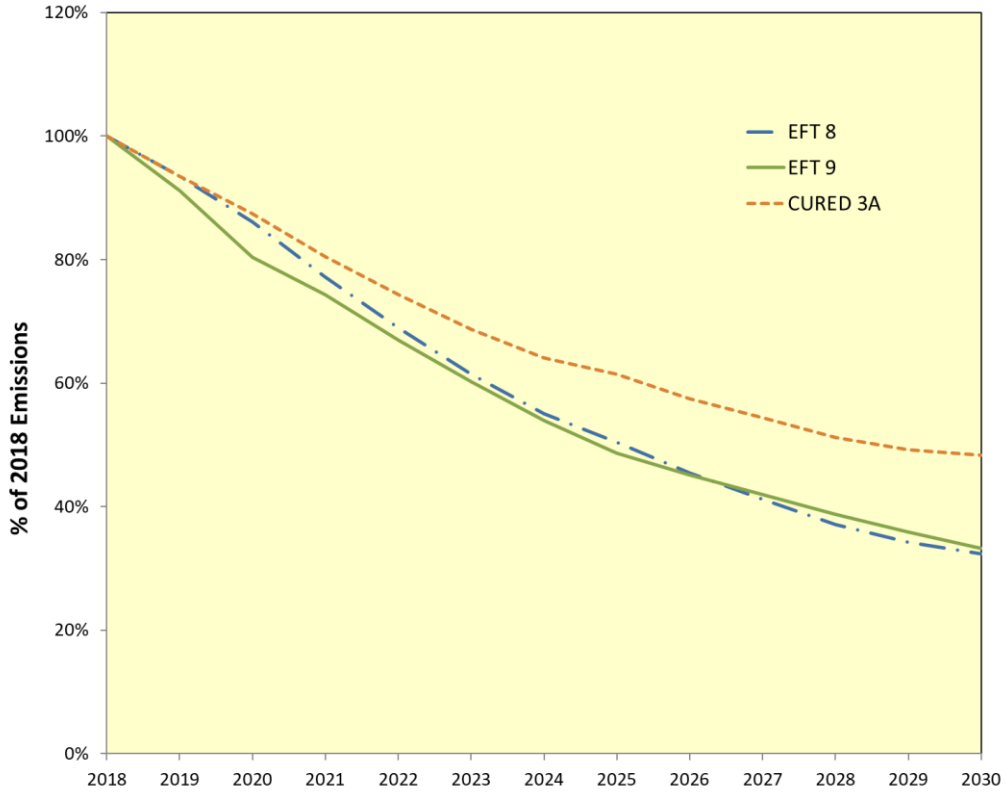

Figure 26: % Change in NO_x Emissions from 2018 – Outer London at 50 kph.

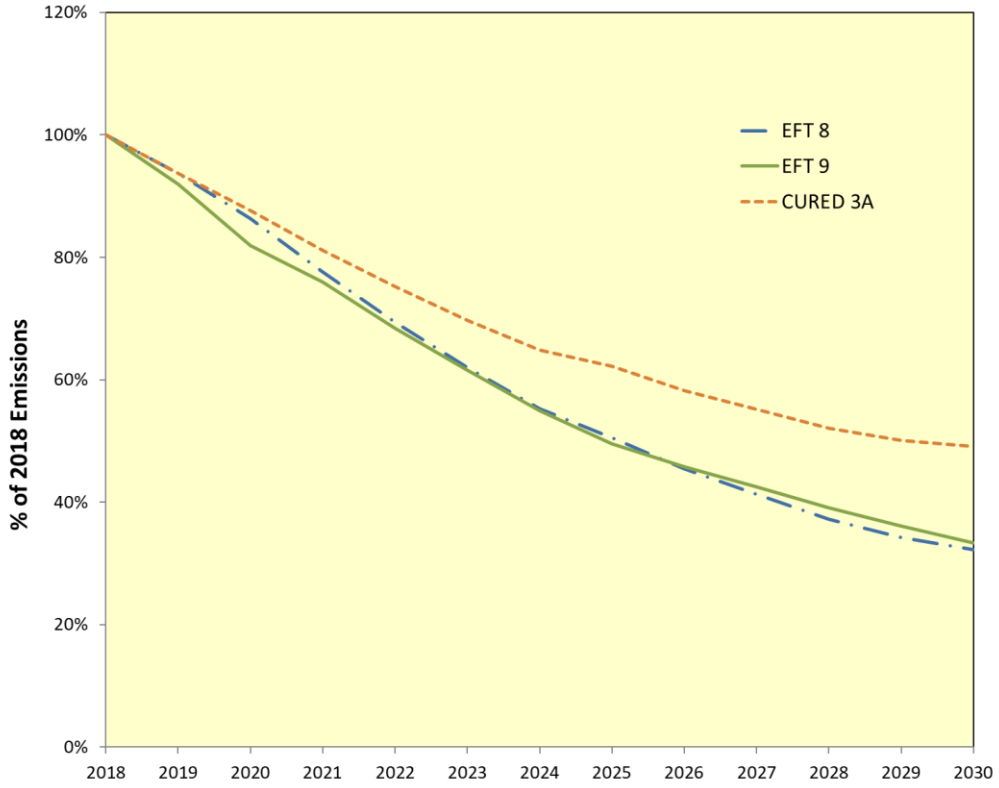

Figure 27: % Change in NO_x Emissions from 2018 – Outer London at 90 kph.

England (not London) Urban

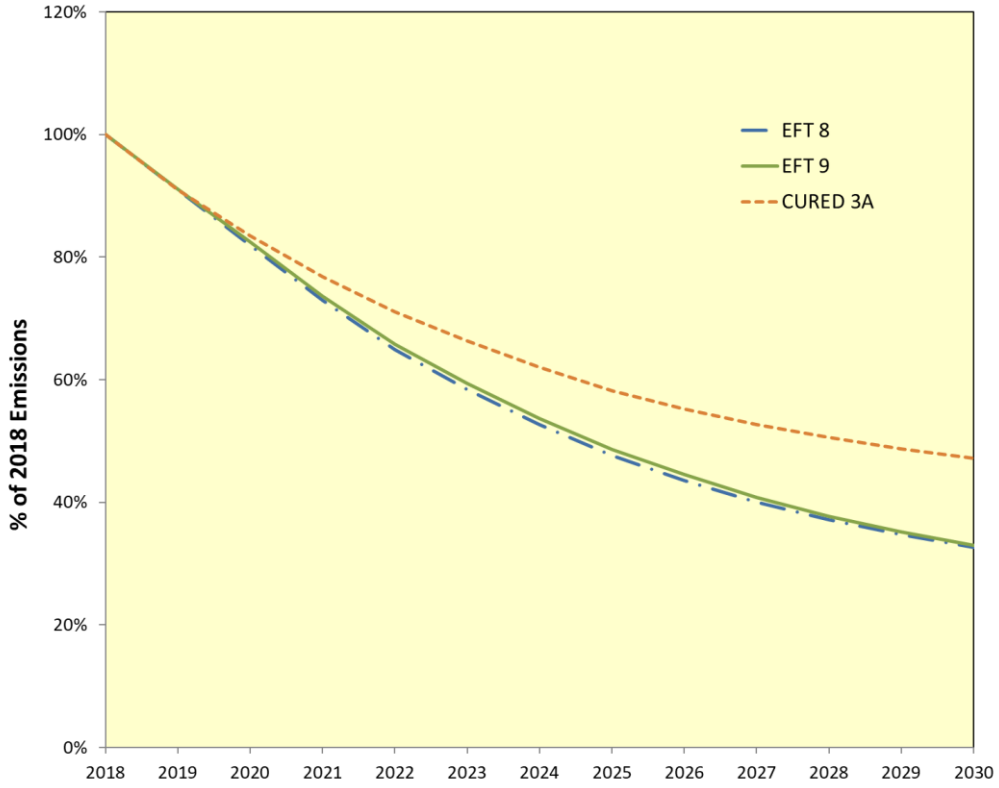

Figure 28: % Change in NO_x Emissions from 2018 – England (not London) Urban at 10 kph.

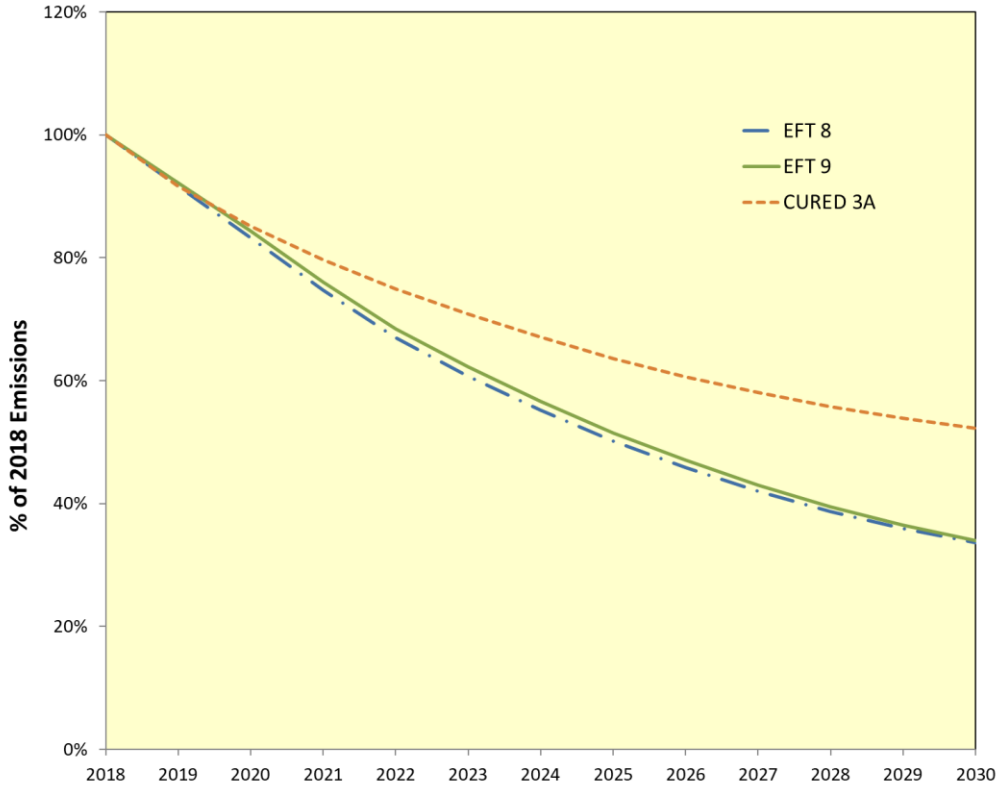

Figure 29: % Change in NO_x Emissions from 2018 - England (not London) Urban at 50 kph.

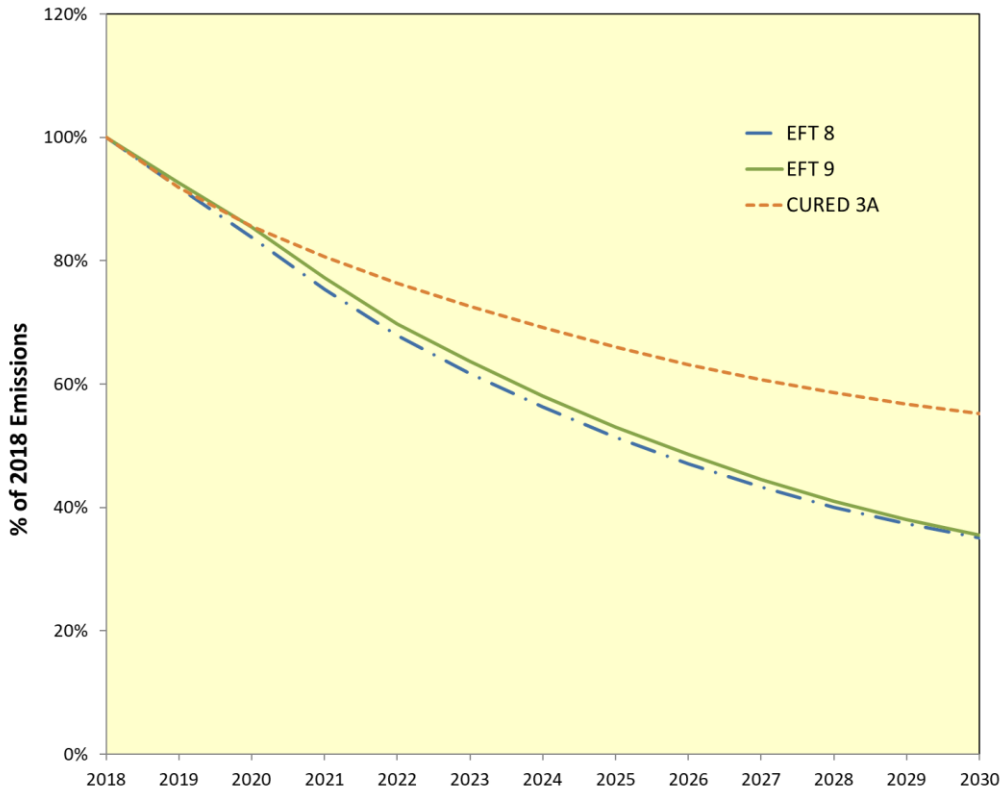

Figure 30: % Change in NO_x Emissions from 2018 - England (not London) Urban at 90 kph.

6 Rates of Change from 2019 Base

Central London

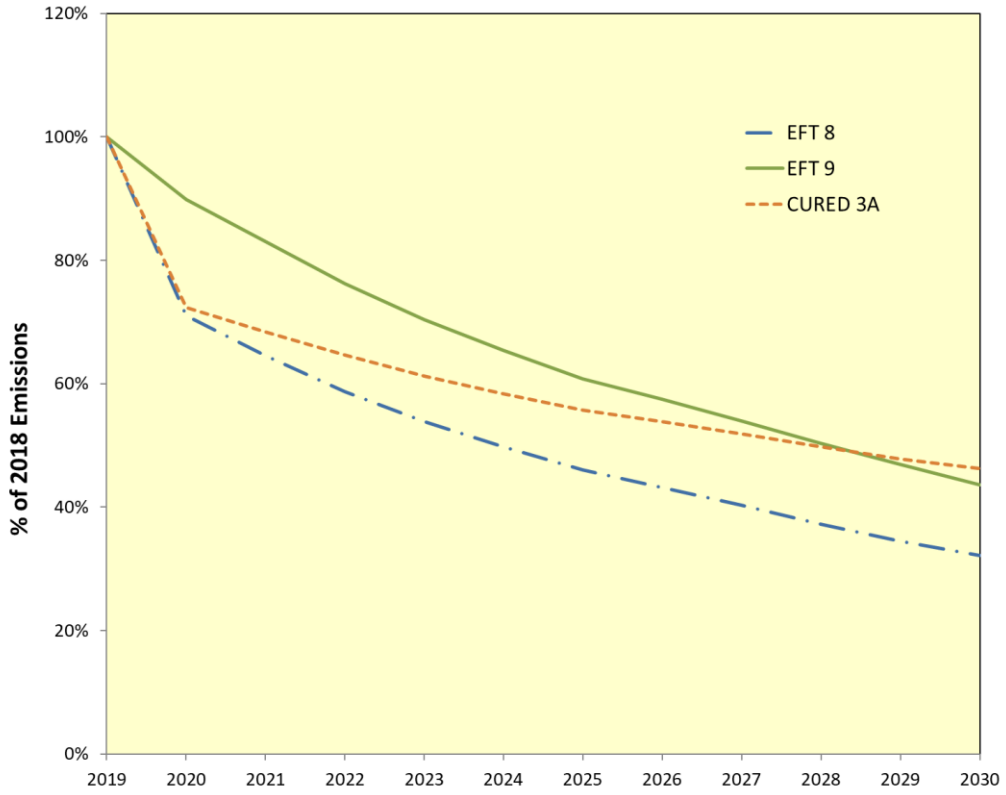

Figure 31: % Change in NO_x Emissions from 2019 - Central London at 10 kph.

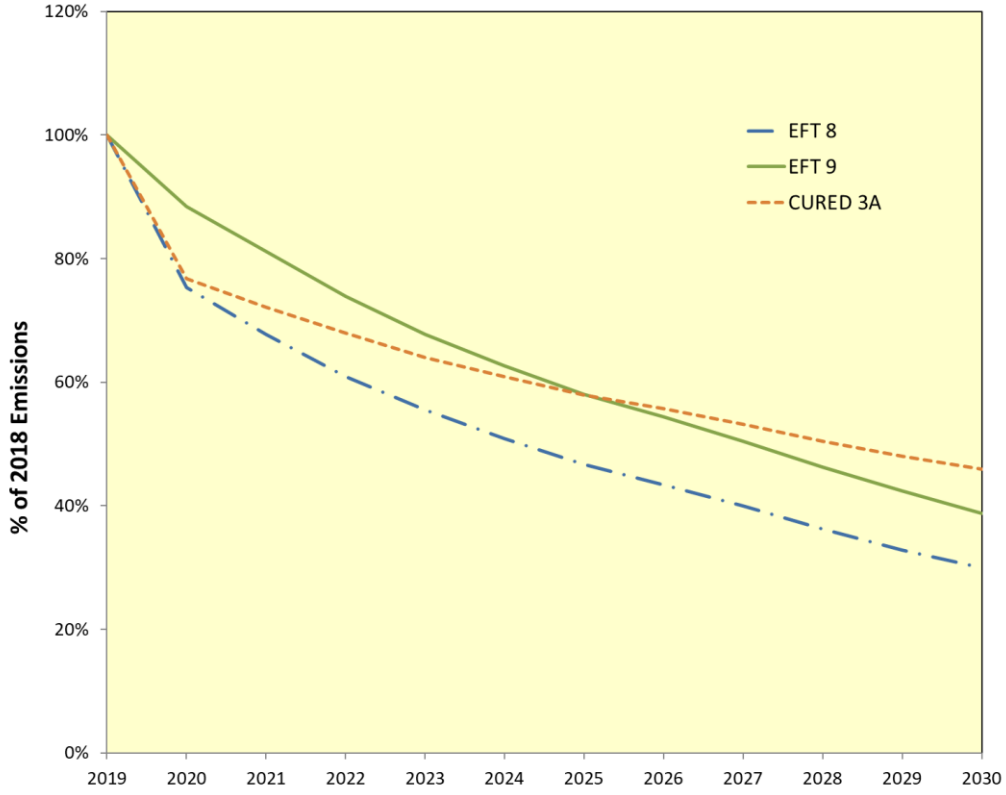

Figure 32: % Change in NO_x Emissions from 2019 - Central London at 50 kph.

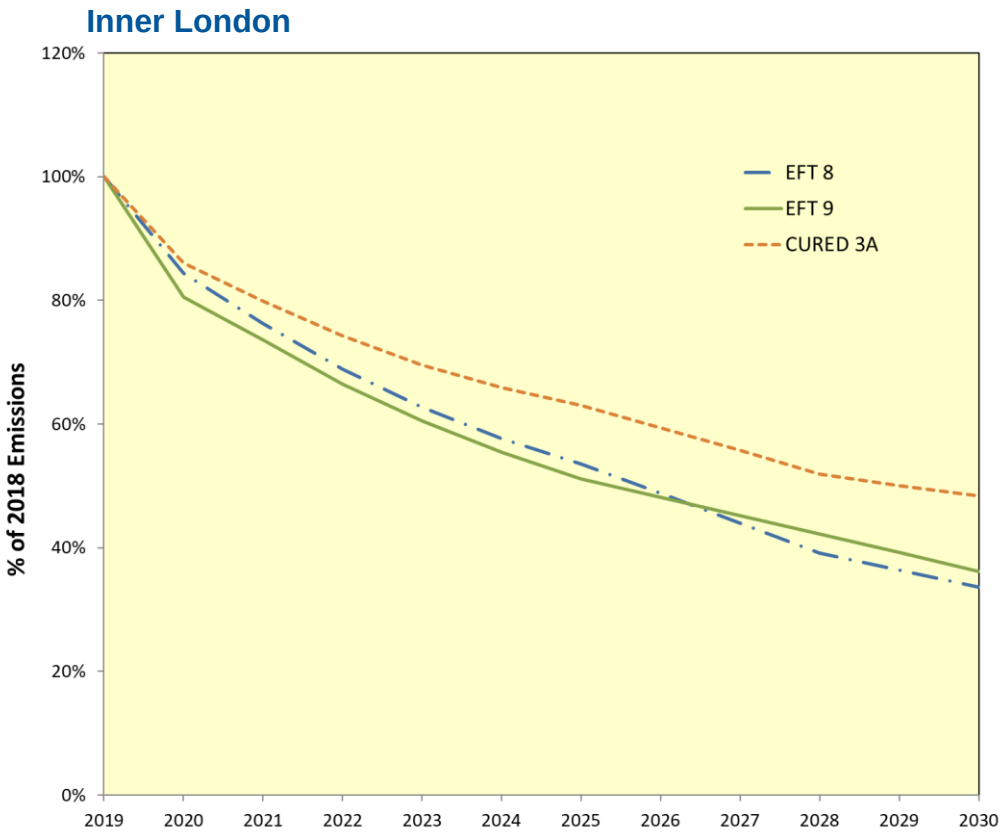

Figure 33: % Change in NO_x Emissions from 2019 – Inner London at 10 kph.

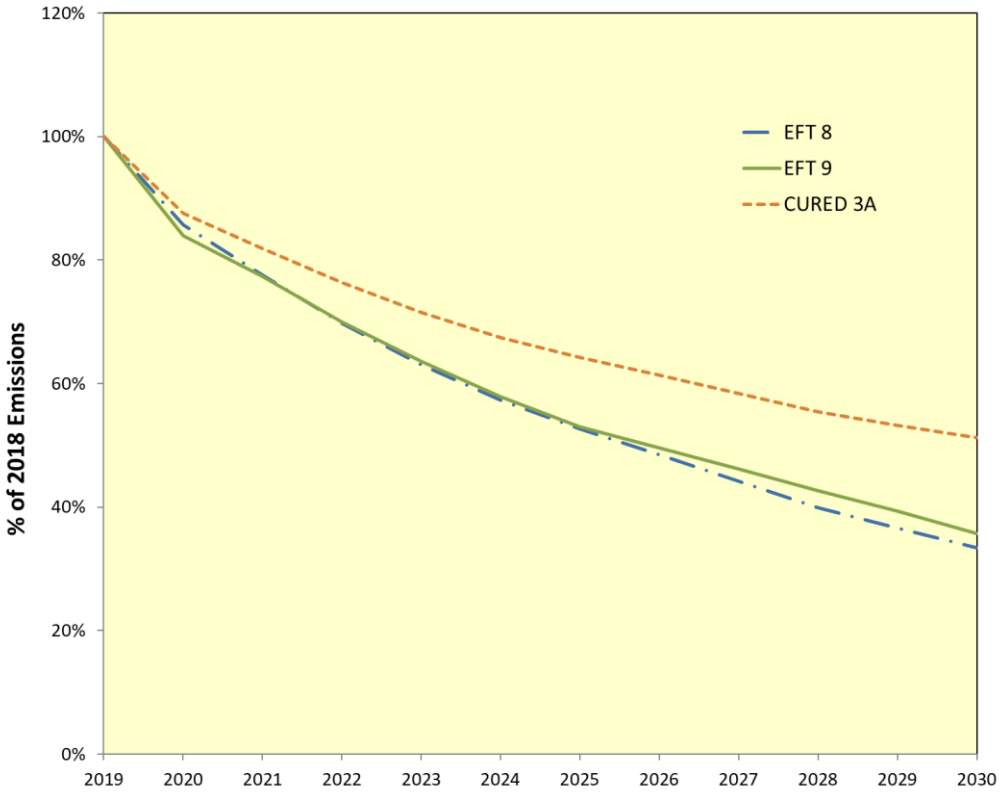

Figure 34: % Change in NO_x Emissions from 2019 - Inner London at 50 kph.

Outer London

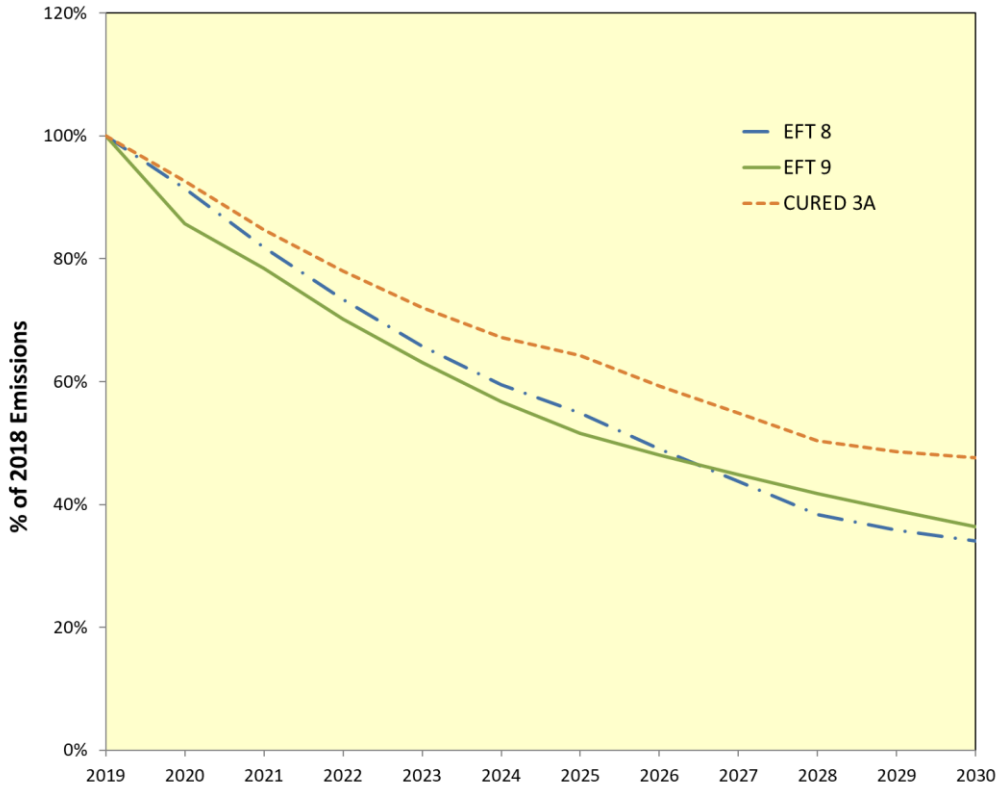

Figure 35: % Change in NO_x Emissions from 2019 – Outer London at 10 kph.

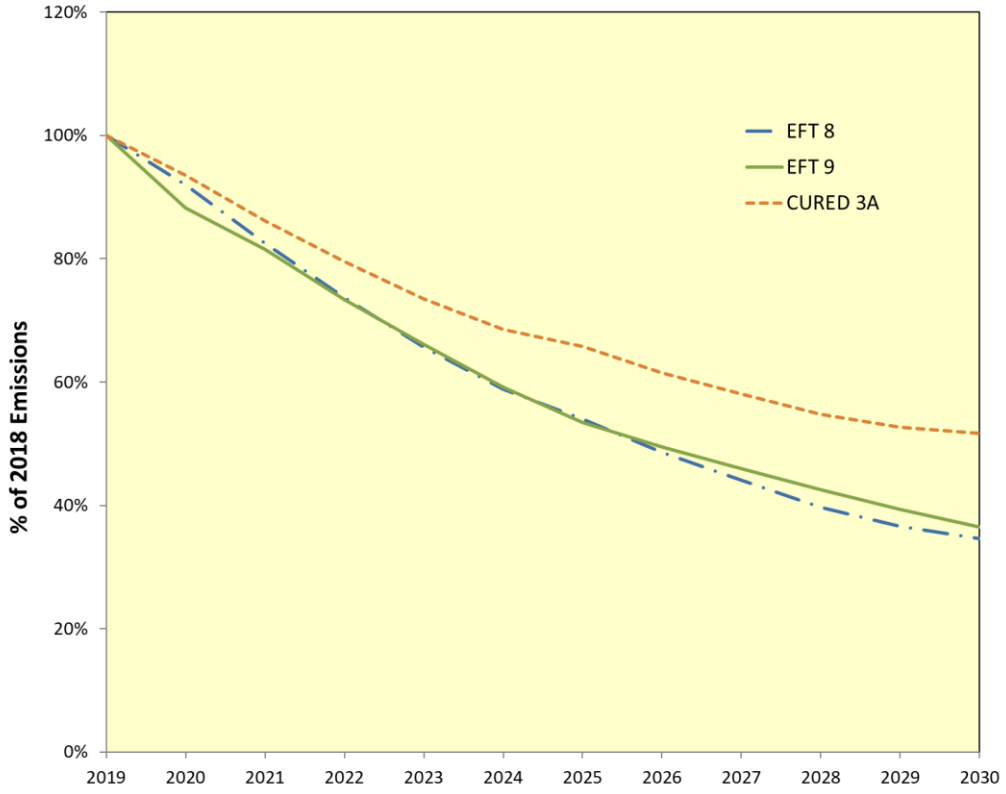

Figure 36: % Change in NO_x Emissions from 2019 – Outer London at 50 kph.

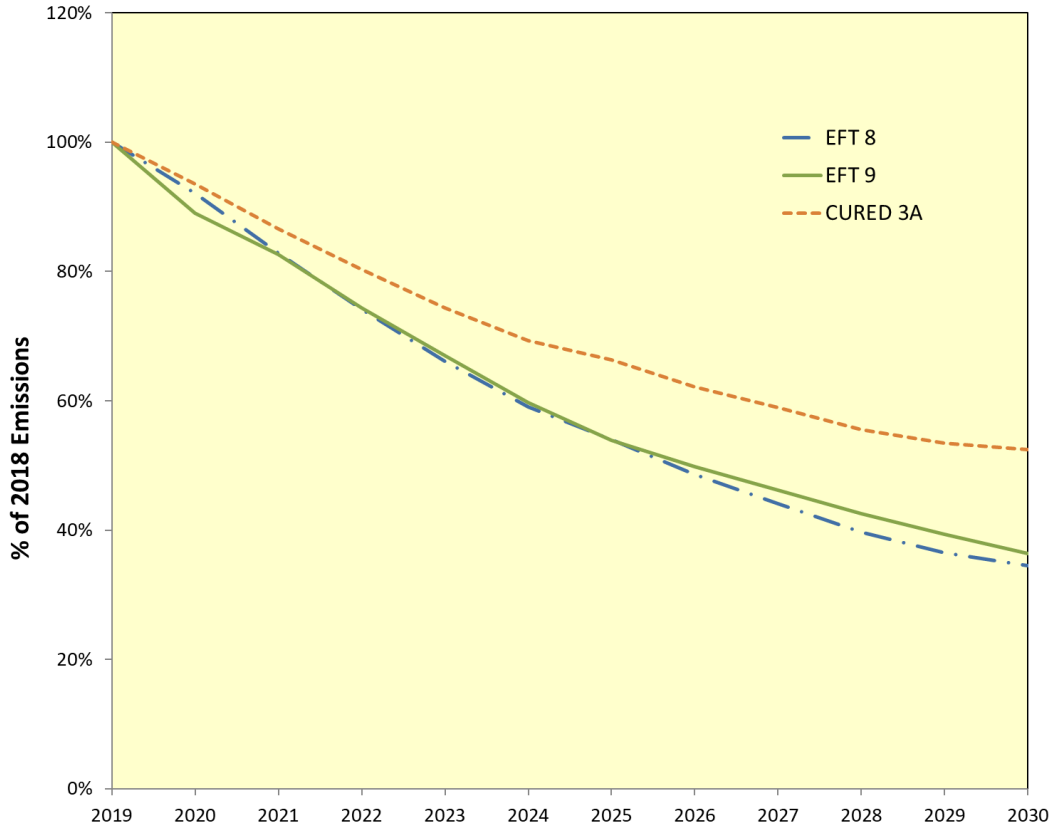

Figure 37: % Change in NO_x Emissions from 2019 – Outer London at 90 kph.

England (not London) Urban

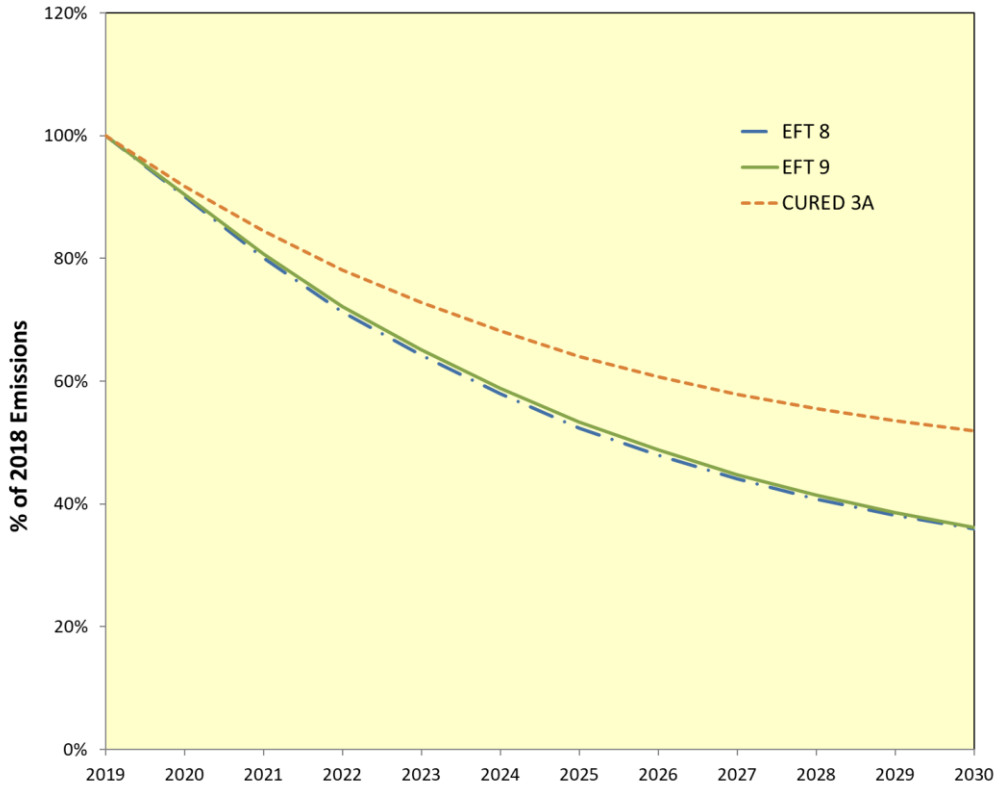

Figure 38: % Change in NO_x Emissions from 2019 – England (not London) Urban at 10 kph.

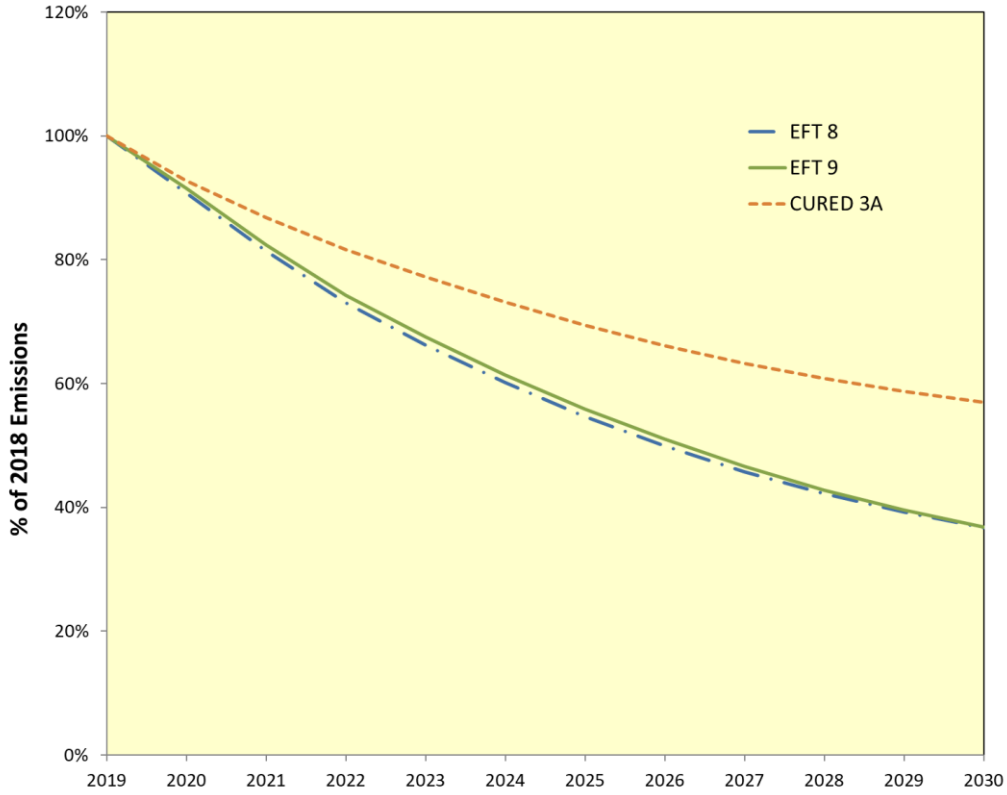

Figure 39: % Change in NO_x Emissions from 2019 - England (not London) Urban at 50 kph.

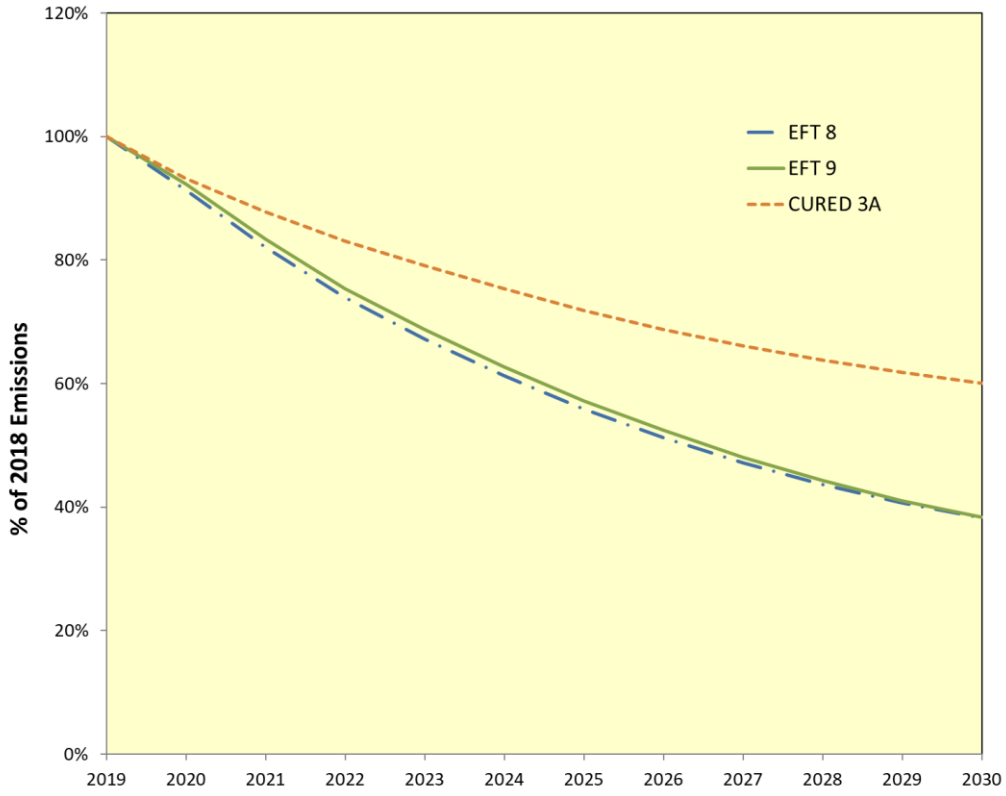

Figure 40: % Change in NO_x Emissions from 2019 - England (not London) Urban at 90 kph.