MAG
Motorcycle Action Group

Motorcycle Carbon Emissions

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Introduction

The question of Green House Gas (GHG) emissions from the transport sector is a point of much discussion and scrutiny in the current climate. The UK Government has committed to achieving 'net zero' GHG emissions by 2050.

The transport sector is now the largest contributor to UK domestic GHG emissions, contributing 28% of UK domestic emissions in 2018.

Motorcycles form a small but vital part of the transport mix in the UK. The Motorcycle Action Group promotes modal shift from cars to motorcycles as part of the solution for many transport challenges, from congestion to air quality. It is therefore incumbent upon us to consider emissions contribution from motorcycles, and to explore the potential impact of modal shift from cars to motorcycles in terms of GHG emissions.

Discussions of GHG emissions from transport focus primarily on direct “tailpipe” emissions generated whilst vehicles are in service. This document will consider tailpipe emissions only. The average weight of a motorcycle is less than 20% of the average weight of a car. Consequently, environmental manufacturing costs are anticipated to show significant benefits during this phase of the vehicle’s lifecycle. We hope to address this issue in more detail in future.

Executive Summary

Our analysis of tailpipe carbon emissions from cars and motorcycles on a distance travelled basis reveals that, kilometre for kilometre, the average motorcycle on the road emits around 30% less CO2 than the average car on the road. This is a comparison of all cars and motorcycles, and thus includes zero emission as well as conventionally powered vehicles. Time series analysis shows that emissions from both vehicle types have reduced at a broadly comparable rate over the last 20 years.

Since the economic crash of 2008, the overall distance travelled by motorcycle has decreased slightly whilst car use has shown a continuation of its strong upward trend. Average trip lengths by car have remained broadly static throughout the last 30 years, but average motorcycle trip length has shown an increase in recent years. In 2018 the average motorcycle trip distance was 60% higher than average car trip distance.

From a purely commuting perspective, numbers of motorcycle commuters have reduced by around 35% in the 15-year period 2002 – 2017 whilst car commuters increased by over 11%.

Our estimations of the emissions cost of motorcycle commuters taking up the car as an alternative mode show that an excess of 130.2 Kilotonnes of Carbon was emitted to the atmosphere purely as a result of commuter trips made by car that would have otherwise been completed by motorcycle. Further estimation shows that a modest policy to promote modal shift from cars to motorcycles for commuting trips - yielding a tiny 1% total modal shift over a period of 15 years - would have resulted in a cumulative saving of 294.3 Kilotonnes of Carbon emissions over the period.

Carbon savings across trips for all purposes as a result of modal shift from cars to motorcycles would be far higher. Based on Carbon emissions savings calculated by TM Leuven in 2011, the UK carbon emission saving of a 10% modal shift from cars to motorcycles would have equated to a saving of 8.85 million tonnes of Carbon in 2017 alone. The likelihood of achieving a 10% modal shift from cars to motorcycles may be small, but the potential for Carbon emission savings from even modest levels of modal shift to motorcycles is indisputable.

Comparison of real-world Carbon emissions from motorcycles and cars.

MAG has undertaken similar analysis to that done for NO2 emissions in our paper "Powered Two Wheelers: An Air Quality Solution"

Our analysis (figure 1) of data from the National Atmospheric Emissions Inventory table of emissions by vehicle type and the DfT statistics for Vehicle Kilometres by Vehicle Type confirms that motorcycle carbon emissions are much lower than those for cars on a mile-for mile-basis. This calculation is based on modelling of current real-world performance, meaning modal shift to motorcycles as a solution for reducing overall carbon emissions with the current vehicle fleet is entirely legitimate. The choice for road users to switch a proportion of their journeys from cars to motorcycles will reduce overall carbon emissions.

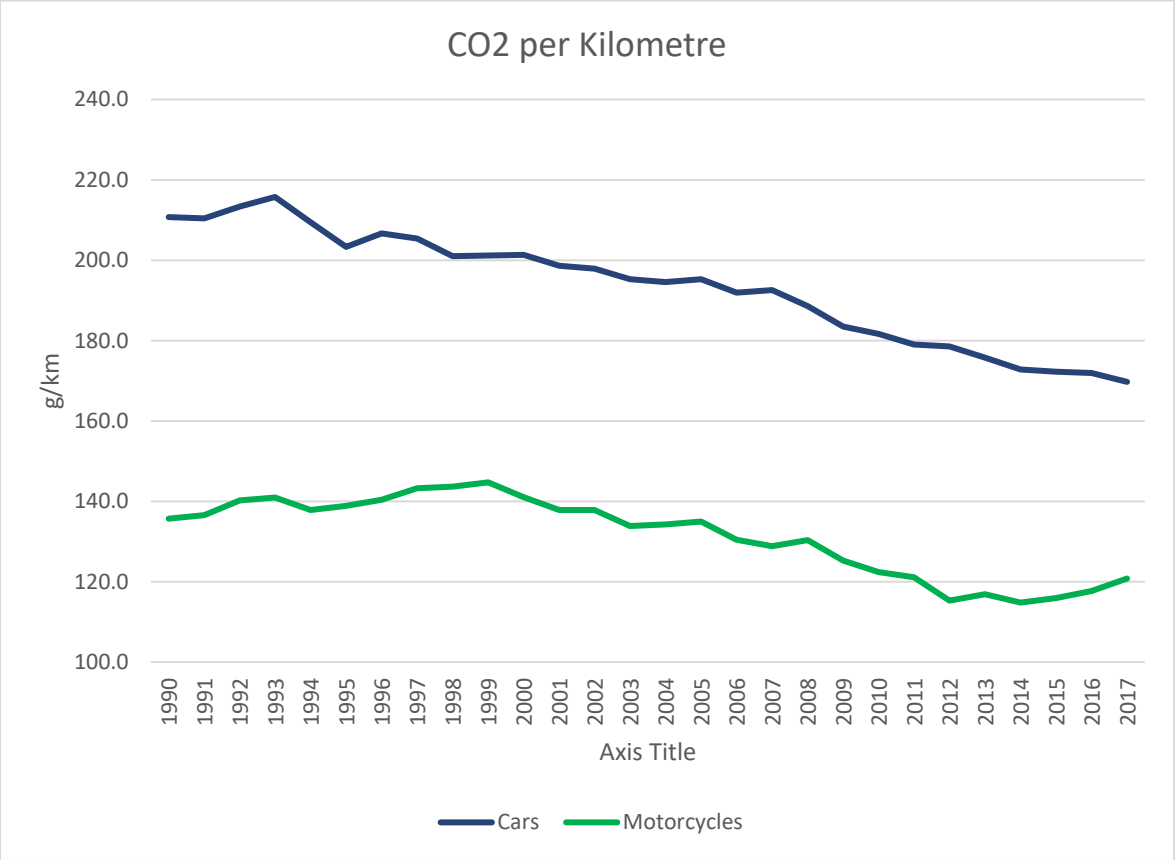

Figure 1: CO2 emissions per kilometre travelled 1990 – 2017. Data Sources NAEI; DfT

Comparison of car and motorcycle usage

It is clear from DfT statistics that the overall usage of motorcycles in the UK has been in a slight decline since the early 2000's (Figure 2), whilst car usage showed a slight decline and then plateaued between 2007 and 2013 before resuming its previous strong upward trend (Figure 3).

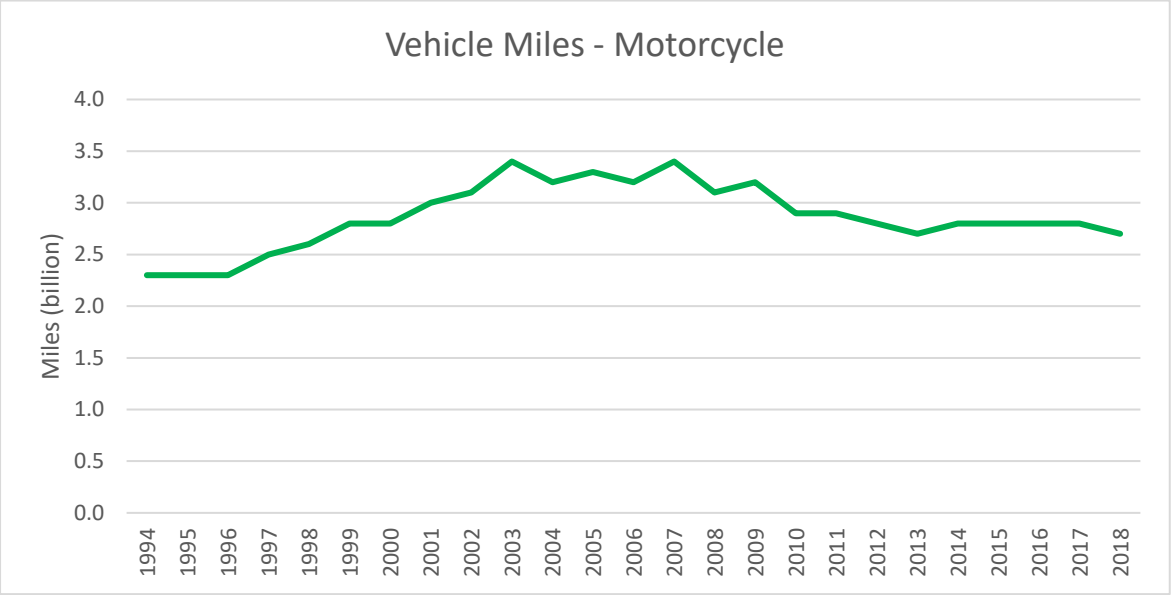

Figure 2: Motorcycle miles travelled 1994 – 2018. Source DfT

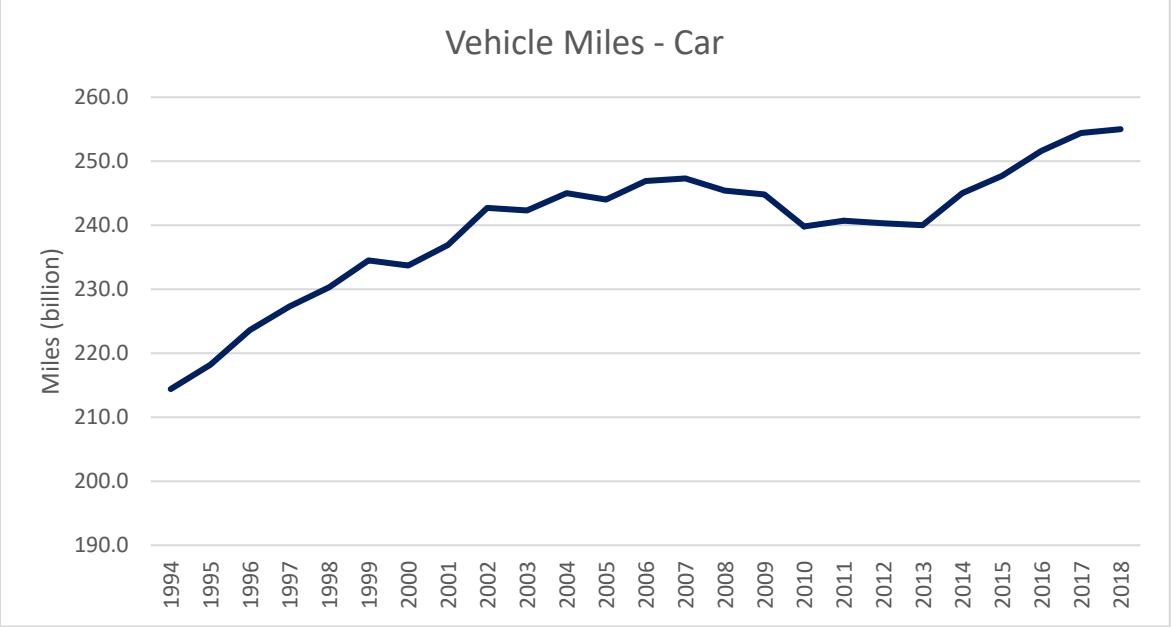

Figure 3: Car miles travelled 1994 – 2018. Source DfT

Arriving at specific data for the average distance of motorcycle commutes is more problematic. Commuting distances data are generally published as distance per person, but does not equate to the numbers of people using each transport mode. There is, however, mode-specific distance data published for average trips for all purposes. Figure 4 below shows average trip distances for cars and motorcycles taken from Table NTS0303

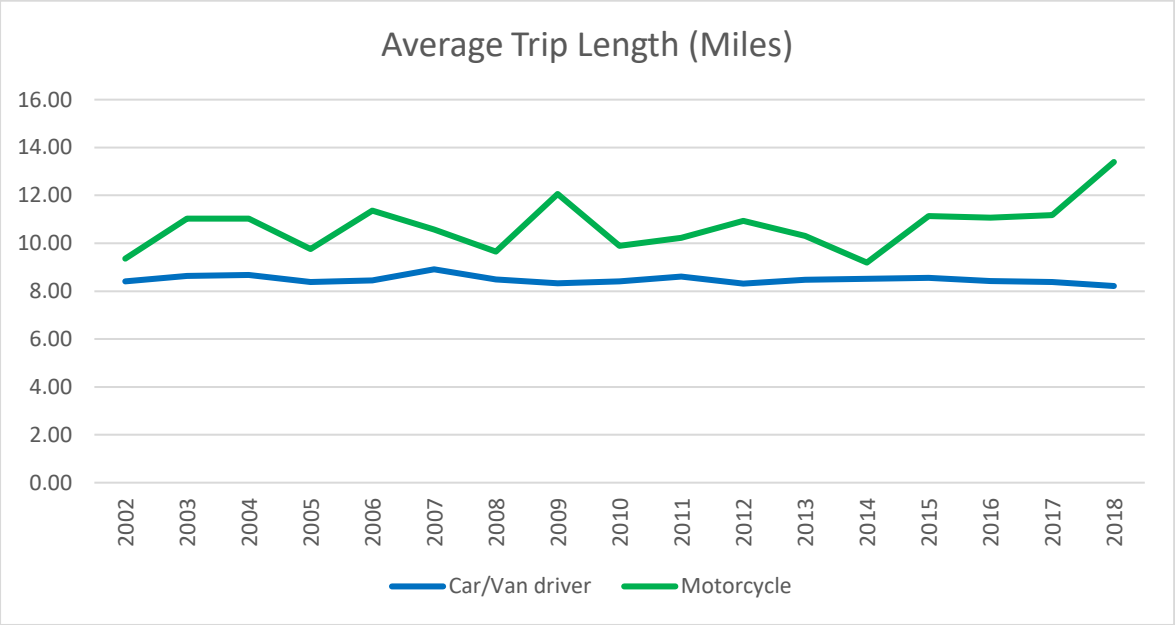

Figure 4: Average trip lengths (miles) Source: DfT

The National Travel Survey also provides us with useful data for the percentage of commuter trips made by transport mode. By combining the percentage of commuters naming each transport mode as their regular commuting mode (table TSG0108) with the numbers in employment (table TSG0108) we can ascertain an estimate for the numbers of regular commuters using cars and motorcycles as their regular mode of transport. Analysis of this data shows that numbers of regular car commuters has grown at a significant rate across the entire period 2002 – 2018 (Figure 5), whilst regular motorcycle commuters have drastically reduced over the same period (Figure 6).

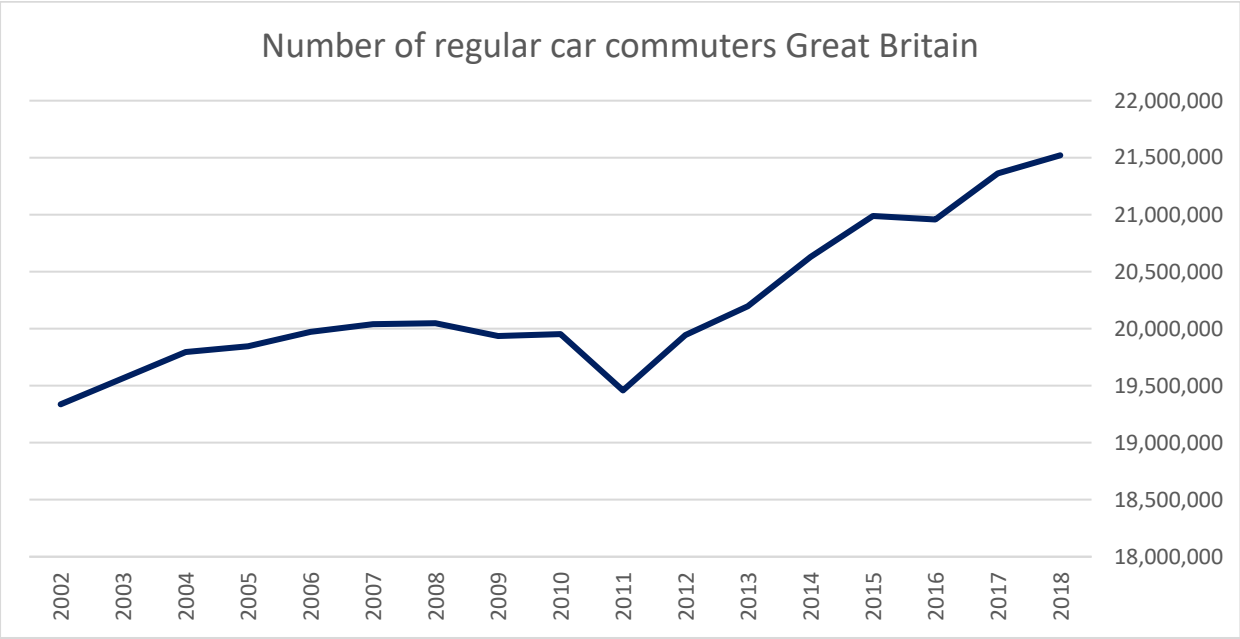

Figure 5: Number of commuters citing car as their normal mode of transport for commuting 2002 - 2018. Source DfT

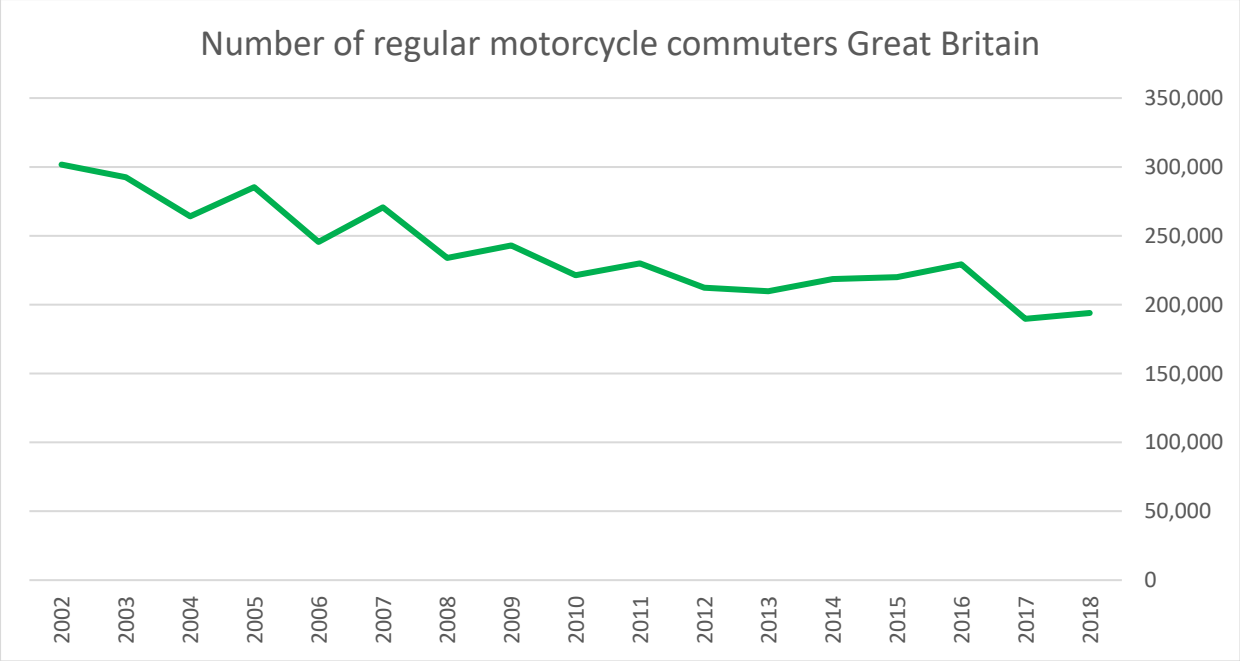

Figure 6: Number of commuters citing motorcycle as their normal mode of transport for commuting 2002 - 2018. Source DfT

In purely percentage terms, the number of car commuters has declined slightly indicating the impact of factors such as home working, and modal shift to active travel and public transport.

In seeking an understanding the decline in motorcycle commuters and, more importantly, what mode of transport the lost motorcycle commuters switched to we can only speculate. It would seem reasonable to assume that modal shift to active travel and public transport would be of a similar proportion to that total in car commuters. This, however, does not account for the majority of the shift in numbers. We believe that it is reasonable to assume that the majority will have switched to an alternative form of motorised transport: i.e. the car.

Emissions impact of modal shift from motorcycles to cars.

MAG has estimated the potential Carbon emission savings that would have been achieved had the level of motorcycle commuters remained at the initial 2002 level over the proceeding 15 years to 2017.

In arriving at this estimate we have factored in a decrease in proportion of motorcycle commuters equivalent to that for cars, but have assumed that all other decrease is accounted for by a shift from motorcycle to car commuting. The assumed motorcycle commute length is calculated as twice the average trip distance for motorcycles. The commute distance after mode change is assumed to be unchanged.

Here we show the annual saving in emissions of Carbon Dioxide as Carbon in alignment with the NAEI reporting standard.

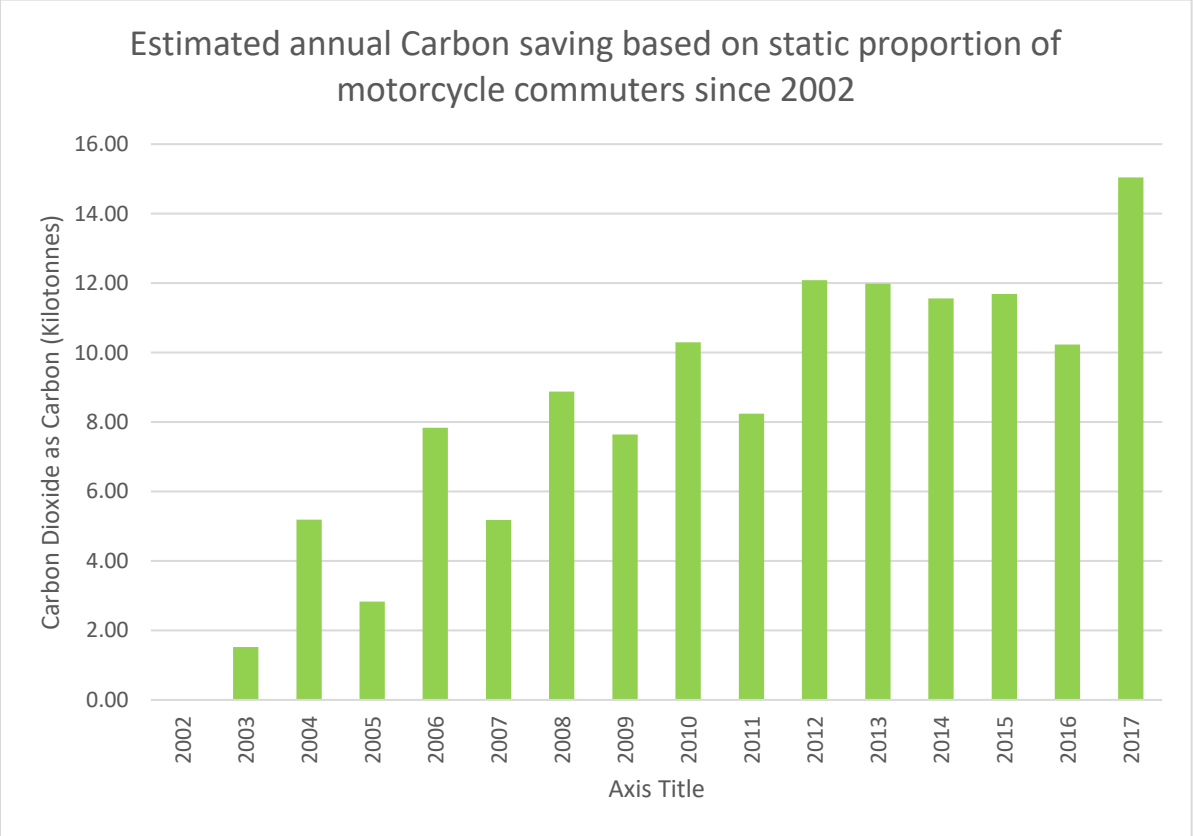

Figure 7: Estimated Carbon saving if proportion of motorcycle commuters remained static since 2002. Sources NAEI, DfT

The total cumulative estimated cost of the decrease in motorcycle commuters between 2002 and 2017 is 130.2 Kilotonnes of Carbon; an average of 8.68 Kilotonnes per year.

It is also possible to estimate the Carbon saving that would be achieved by a relatively modest modal shift from cars to motorcycles, were policy incentives introduced to encourage such behaviour change. We have estimated the effect of a policy encouraging a modest 1% modal shift over the same 15 year period.

The assumptions made for commute distance for commuters switching from cars to motorcycles is, again, that commute distance is unaffected by the transport mode choice. Thus the commute distance calculated for those switching from car to motorcycle is assumed to be 2 x the average trip distance for cars.

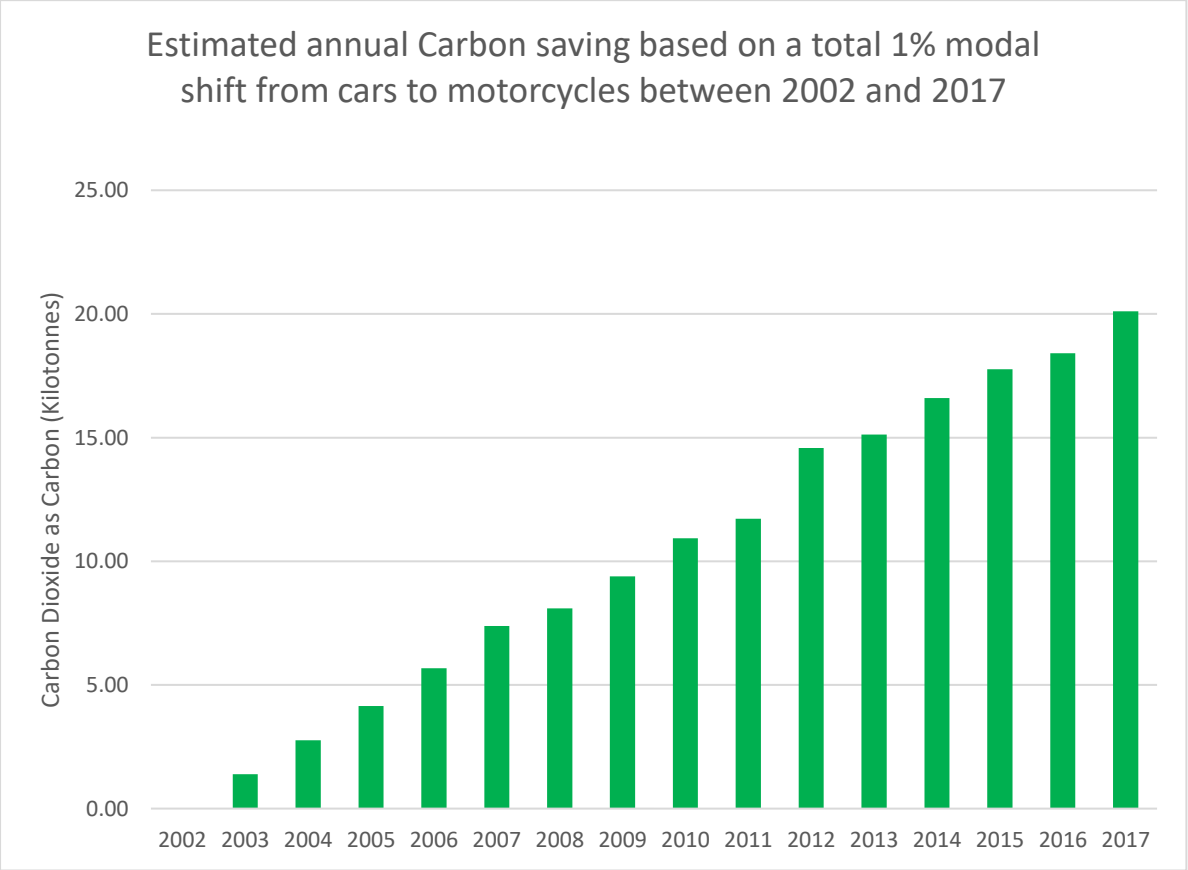

Figure 8: Estimated commuting Carbon emission saving as a result of the linear modal shift from cars to motorcycles achieving 1% total shift after 15 years. Sources NAEI, DfT

Combining the CO2 emissions savings provides an estimate for total carbon savings from a mildly pro-motorcycling policy stance. The total cumulative estimated Carbon emission saving achieved by promoting this policy between 2002 and 2017 is 294.3 Kilotonnes of Carbon; an average of 19.6 Kilotonnes per year.

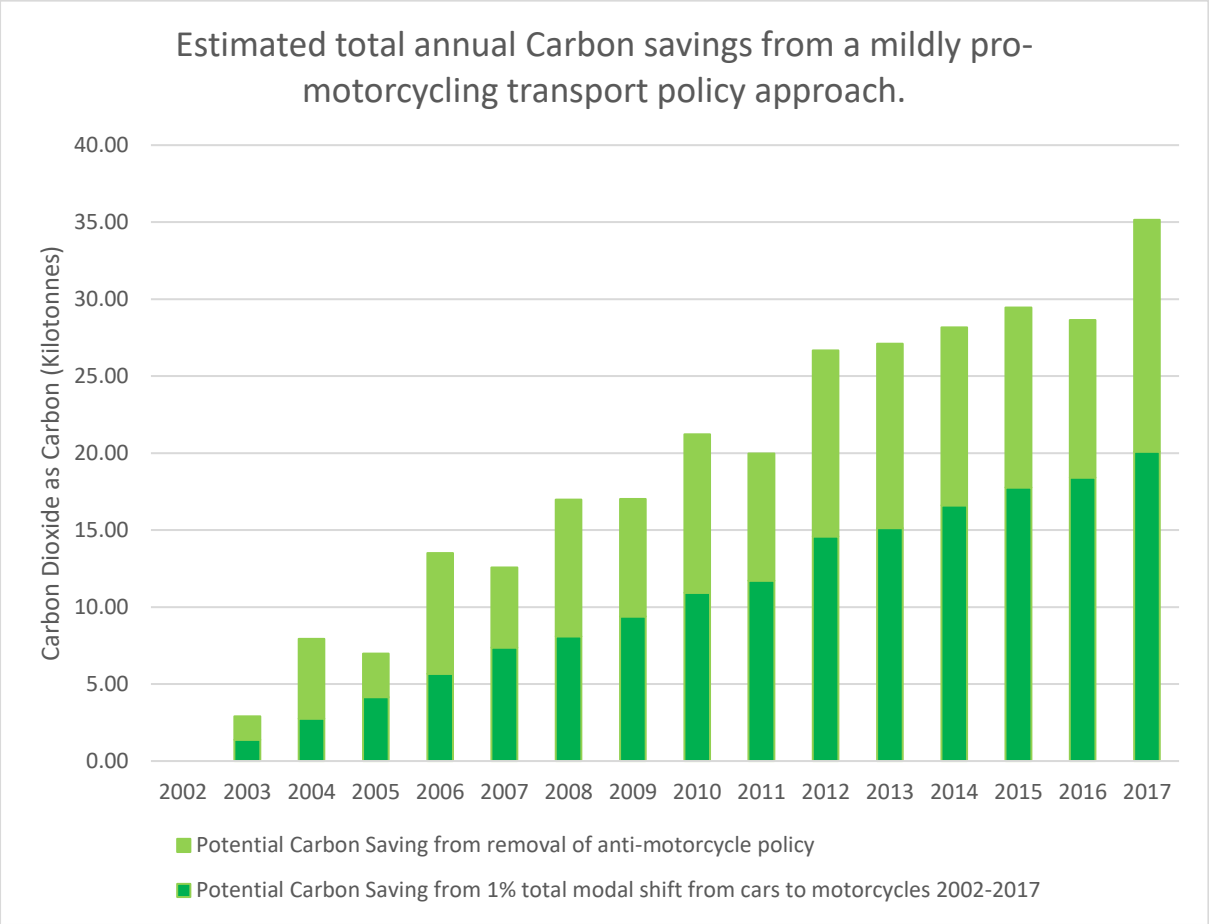

Figure 9: Total estimated commuting Carbon emission saving resulting from a mildly pro-motorcycling policy

Discussion

Our estimate for Carbon emissions cost is based purely on regular motorcycle commutes and does not include use of motorcycles for other journey purposes.

MAG has previously demonstrated that the COPERT modelling system used to generate NAEI emission figures for motorcycles is likely to over-estimate the mode's contribution. This is due to an accepted lack of accurate empirical evidence for motorcycle emissions and real-world fuel efficiency, combined with an inability of the modelling to account for the behaviour of motorcycles in congested environments. The ability for motorcycles to filter through stationary and slow-moving vehicles is not reflected in the modelling techniques.

It should not, therefore, be overlooked in any review of transport Carbon emissions that for every car replaced by a motorcycle there is a reduction in congestion. The footprint of a motorcycle is smaller than that of a car, resulting in less road space use. Motorcycles enable better traffic flow, and more capacity through junctions thus creating much higher movement of people through the road network. The congestion savings benefit all road users, including those who are not able to make the switch to motorcycles. MAG's paper "Pathways for Progress" discusses the wider aspects and benefits that motorcycles deliver to the transport network.

Reports such as the TM Leuven "Commuting By Motorcycle: Impact Analysis" published in 2011 suggest that a 10% modal shift from single occupancy cars to motorcycles would result in a 7.5% reduction in CO2 emissions for all transport. This would equate to 8.85 million tonnes of Carbon in 2017. Assuming a 10% modal shift to motorcycles may be viewed as optimistic, but MAG demonstrates that simply reversing the contraction of the modal share of motorcycles and introducing a limited stretch target for modal shift from cars to motorcycles could have a significant role to play in meeting the net zero target set by the Government. Introducing a genuine ambition to support the mode in a way that reflects its positive contribution should form the basis of a modal shift target which reflects goals for modal shift to other sustainable transport modes.

The UK Government's "plug-in" grant to incentivise the switch to electric cars introduced in 2011 was not extended to motorcycles until 6 years later. The provision of charging infrastructure for electric vehicles uniformly ignores the specific requirements and benefits of electric motorcycles. Despite this, there is a move towards increasing numbers of electric motorcycles. Emerging models of smaller electric motorcycles feature removable batteries, reducing the requirement for charging infrastructure in parking locations, but the need for charging points for larger electric motorcycles is unlikely to change in the foreseeable future.

Growth of electric motorcycles is currently slow, but with better incentive schemes and adequate consideration of motorcyclists' needs when it comes to charging infrastructure, there is no reason why growth in zero emission motorcycles cannot match that of cars.

MAG concludes that both national and local transport policy - which has failed to encourage and support the use of motorcycles - has cost the nation a significant saving in Carbon emissions, well in excess of our estimated 294 Kilotonnes of Carbon in 15 years. Motorcycles provide an effective solution to reducing Carbon emissions both in the present, mid- and long-term future.