Statement to the Gladman Appeal

My name is David Mayle & I have lived in Whiteditch Lane in Newport for 36 years.

> *I have degrees in Physics, in Systems & Social Psychology, and in Management & Artificial Intelligence, and hold professional membership of the Institute of Physics and the British Computer Society. After a career designing and developing High Technology Scientific Equipment, I spent over 20 years as an academic before retiring in 2013 from the position of Head of the Department of Innovation, Knowledge & Enterprise at the Open University Business School. I believe this qualifies me to analyse data and to interpret information.*

I'm currently watching my young grandchildren grow up, and I'm dreading the time when they come up to me and say "Hey Grumps, did you guys *really* not see all this coming?".

On that basis, the primary thrust of my argument is going to be about **Traffic** and, particularly, about **Air Quality (AQ)**. I would like to think that this month's decision in the High Court to uphold a refusal in Kent on air quality grounds[1] is the start of a long overdue recognition of the seriousness of the current situation.

As you will know, Newport has been subjected to a deluge of planning applications in the last few years, with permissions already granted for a 50+% increase in the number of dwellings since the 2011 census. At that point the single track byway where I live, beyond the agreed village development limits, had 12 houses scattered along its half-mile length out into the open countryside; today it has a total of 83 either built, under construction or about to be started. It is *still* a single-track byway.

How has such desecration been allowed to happen? The short answer is one step at a time. The 'each application on its own merits' ethos was interpreted by both the Local Planning Authority and the Local Highways Authority as obviating the need for any coherent cumulative impact assessment[2]. As a result of this, Newport's already creaking infrastructure has been stretched past breaking point. Local roads are perennially being closed and dug-up to effect band-aid fixes to water, sewage, electrical power, telecoms and so on as we continue to limp along. Health and Educational infrastructure is similarly overstretched.

Eventually, as part of the process of creating the Neighbourhood Plan, its Steering Group commissioned a professional **Transport Study** of their own[3]. The brief was to provide an overview of the road system in Newport, to establish its current performance, and to calculate the effect of permissions already granted but yet to become occupied. The results are entirely as expected. Since the vast majority of the 500+ new houses granted permission have been to the west of the village, two key junctions – that of the Wicken Road with the High Street and of Bury Water Lane with the High Street – are en-route to exceeding their practical capacity by the time the permissions *already granted* come fully on-line. (This notwithstanding that the modelling used has taken the developers' own understandably-conservative figures for trip-generation rates, and been shown to under-estimate queuing compared with the actual observations).

These two junctions are in theory straightforward, but in practice seriously compromised by a series of factors. The Wicken Road Junction, whilst aided in practice by the proximity of a zebra crossing on the High Street, is too narrow, and requires any long wheelbase vehicle to make an incursion onto the 'wrong side of the road (or even the pavement) to complete any of the turns involved in such a junction; it also features street-parking for local residents as near to the junction as the law permits. As a consequence of this latter, the junction generates not a single queue back along the Wicken Road, but at peak times a series of queues (ie in-between parked cars) stretching back as far as School Lane. This produces an incentive for traffic to use School Lane as a 'rat-run', leading between the two halves of the local secondary school to the Burywater Lane (BWL) junction.

Now this latter junction with the B1383 is even more of a stress case for standard traffic models. BWL is little more that 4.5m wide at that point. Around 50m back from the junction is the entrance to a school Car Park (used extensively for dropping off students in the am peak). A further 50m takes us to a zebra crossing between the two halves of the school. There is no pedestrian footpath on either side for the majority of this 100m. Beyond that is the bus stop where the buses queue to load/unload students. A further 50m brings us

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1 'Court of Appeal upholds housing planning refusal on air quality grounds'. https://airqualitynews.com/2019/09/13/court-of-appeal-upholds-housing-refusal-on-air-quality-grounds/

2 'In so far as it is a material factor, a local planning authority can consider the cumulative impact of development in reaching its decision on a planning application. Similarly, it can consider whether granting planning permission would create future pressures for further development, which taken as a whole, would be unacceptable in a particular location.' (Minister for Local Growth, to Newport Parish Council, 20Dec18.

3 Newport Transport Study, Railton TPC Ltd., July2019, as referenced in the Newport, Quendon & Rickling Neighbourhood Plan (Reg16) and as separately submitted to this appeal.

to the School's other vehicle entrance. Thereafter the south side represents the sole parking for a group of listed cottages (incidentally, the entire south side of BWL is part of a conservation area). The reason for offering this litany of compromising factors is to highlight that even if we accept developers' suggestions regarding trip generation, the theoretical modelling (which is seen to understate the queuing problem, and will necessarily understate the effect of these stressors) *still* shows the junctions will be working at or beyond their calculated capacity *with already committed development*[4]

Which brings us to **Air Quality**…

That Air Quality has failed to be a more effective voice in planning decisions relates to the mainstream AQ modelling community, which is struggling to keep pace with the technology involved in vehicle emissions. Current AQ modelling still assumes that the source of noxious emissions is volume of traffic. Now this is all very well if your sensors are alongside the A4, the A13, or some other major arterial routes into London, (where vehicle emission measurements were originally – & intuitively – targeted), because traffic here is a largely homogenous collection of vehicles. Gradually such modelling became refined to take account of fleet composition (Car vs. HGV, Petrol vs. Diesel) but there the evolution of the modelling has largely stalled; whereas the technology of the emitting vehicles has changed enormously, particularly in the last 20 years or so. Thus, all within the AQ fraternity will cheerfully admit that their modelling struggles to cope with the effects of queuing (although they will concede that it makes things worse), and does not really engage at all with stop/start technology (although the emerging consensus in the literature is that – perhaps counter-intuitively – this generally also makes things worse). However, the elephant in the AQ modelling room remains the Cold Start Problem.

Since the first glimmerings 50 or so years ago that vehicle emissions might be a Bad Thing (thankyou, California!), emission control devices have made quite remarkable progress, to the point that, *at equilibrium*, the Steady State emissions from a State-of-the-Art motor vehicle are actually very low indeed. Contrary to popular belief, motorways are far from the major contributor. The problem is really that, for the first mile or two of any journey, where the engine has not yet warmed up, most of these emission control devices don't actually work! Consider Figure 1

Figure 1 is a ***generic*** curve[5], one that plots rate of emission versus time since 'key-on' (industry jargon for the point at which the vehicle's engine is started). This form of curve applies to all the worrisome emissions, be they CO, NOx, or particulates. As you can see, immediately after key-on, emissions are effectively 'off the scale' (area A). The reason for this is the condition of the engine. The fuel/air mixture is typically enriched for starting, combustion is initially inefficient; internal frictional losses are high due in large measure to the temperature and distribution of the lubricating oil, and the catalyser is ineffective until it reaches its required operating temperature, typically in excess of 400ºC. Other palliative measures such as automatic stop/start functionality will also be inoperative until the vehicle has fully warmed up.

First the Good News; as can be seen from area B of Figure 1, once the engine has warmed up and the technology has fully come online, emissions drop to a very low level. The Bad News is that *until* the engine has warmed up, all the noxious emissions are running at many multiples of their low-level steady-state values. Which brings us back to area A of Figure 2

Excess Emissions due to Cold Starts (EECS) is now generally recognized by vehicle engineers as the major contributor to Air Quality…

> *"… researchers also found that almost all emissions in properly functioning, new vehicles came out immediately after starting the cars when their engines were cold.* ***But once new cars warmed up, they had to be driven 100 to 300 miles to match the levels that came out in the first 30 seconds of the engine turning on."***
>
> *[…]*

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[4] A valuable measure of the performance of a road junction is given by the Ratio of Flow to Capacity (RFC), expressed as a decimal with 1.00 being the theoretical limit and 0.85 being the rule of thumb for practical purposes. Whilst not being considered a deal-breaker on its own, an RFC > 0.85 takes a junction into a scenario where

> *… it becomes very sensitive to any increase in traffic, often providing excessive queuing results which do not correspond with the 'actual' additional traffic forecast through the junction itself.*

Italicised quote taken from Highways Assessment, Dover Road, Walmer, Kent. Iceni Projects for Gladman Developments, July17

[5] The brief literature study attached contains a plethora of specific curves, for all contaminants; all follow the generic form shown in Figure 1

Hot-stabilized emissions have varying importance depending on species and may require a driving distance of 200 miles to equal the emissions from a single cold start. Average commute distances in the U.S. suggest the majority of in-use vehicles have emissions dominated by cold starts. The distribution of vehicle ages in the U.S. suggests that within several years only a few percent of vehicles will have significant driving emissions compared to cold-start emissions.

Drozd et al., (2017)

If you take a small village with limited employment opportunities, bolt-on a residential development of this size in a position where the only egress for the vast majority of morning commuters is via restrictive junctions in the centre of the village, then cold-start emissions will generate a *massive* increase in noxious emissions compared with that predicted by conventional AQ modelling. If you'd like an aphorism, "Vehicles that start in Newport will leave their emissions in Newport".

This tends to explain the unedifying spectacle I witnessed at a recent planning appeal where the contending AQ Expert Witnesses were debating whose modelling was superior, based upon the magnitude of the factor they required to make their results match up with the actual measurements recorded at the site. The victor 'only' needed to multiply their outputs by just under four, whereas their opponent had to multiply by something rather more than four[6]. Such is sadly the reality with which we must contend.

Uttlesford's own emissions figures for the Wicken Road junction are particularly interesting. The raw data for monthly mean NO_2 readings suggests a figure of 39.62μg m^{-3} (the threshold for declaration of an Air Quality Management Area – AQMA – is 40). Two factors, however need to be borne in mind…

1 Unfortunately, due to a longstanding equipment malfunction, Uttlesford is currently unable to generate the DEFRA-preferred *local* 'bias adjustment', so instead of the historical factor for Uttlesford of 94% – which would have resulted in an annual mean value of 37.2 µg m^{-3} – we are forced to rely on the lesser option of a national factor of 74% and the resultant value of 30.1 µg m^{-3}. *This* is why official figures appear to show an improvement on previous years in respect of monthly means. We eagerly await the re-establishment of a local bias adjustment factor.

2 Of permissions *already granted* in Newport to the west of the B1383, more than 250 have yet to come online…

Thresholds for declaring an AQMA also feature a *hourly* mean limit. Unfortunately these are much more difficult (& expensive) to record and so are not routinely collected. Perhaps because of this(?), it remains DEFRA's contention (TG16[7]) that hourly means (where the threshold for required action is 200μg m^{-3}) can be inferred from monthly means. This is palpably Bad Science. DEFRA cite Laxen and Marner (2003)[8] as if it were a peer reviewed paper, rather a consultancy report that was commissioned by a group of local authorities to seek out just such an inter-dependence. The data and the paradigms involved in this work are at least 25 years out of date & make little or no allowance for the effects of emissions-control technology[9]. As a result, the wholly empirical and statistically low-level correlation the authors claim to have detected is no longer valid.

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6 DEFRA guidance does specify that such multiplicative factors should only be used as a 'last resort' when all avenues for incorporating the problem into the actual fabric of the model have been exhausted(!)

7 Local Air Quality Management – Technical Guidance (TG16), DEFRA Feb18. (Para 7.91) https://laqm.defra.gov.uk/documents/LAQM-TG16-February-18-v1.pdf

8 'Analysis of the relationship between 1-hour and annual mean nitrogen dioxide at UK roadside and kerbside monitoring sites', https://uk-air.defra.gov.uk/assets/documents/reports/cat06/1hr_NO2_rpt_Final_b.pdf

9 The work is problematic in our context for several reasons.

Consider Appendix A: 80+% of the data collection was carried out in the 20th century, incorporating fleets which would have comprised vehicles built 20 or 30 years ago. Emission control technology was necessarily more primitive at that point (witness the range of annual means observed, with few if any **less** than 40μg m^{-3}!). The operant world view was therefore that noxious emission are due to levels of **traffic** (witness the chosen site locations – M25, M4 M60, Marylebone Road, Purley Way, 'Tower Hamlets'!), rather than from **'vehicles'**, as I argue in my papers.

These site locations will likely feature few Cold Starts, so Cold Start contribution to NO2 levels will have been less both in terms of number of vehicles and – in the absence of effective emission control systems at that time –less in terms of its **relative** contribution to the overall problem at that time.

The conclusion to be drawn from this lack of hourly mean measurements is particularly instructive. I have heard it argued in cross-examination that 'peak period emissions would have to be enormous to have such a major effect on monthly means'. Indeed! And yet…

Orthodox AQ modellers already acknowledge that the output from their models may need to be multiplied by a factor of around four to match up with the measurements as recorded. So they're clearly missing something. They also acknowledge that they cannot model the cold-start problem, which will create emissions many multiples of steady-state levels, *particularly in the am peak*. We all need to 'do the math' – particularly in commuter villages such as Newport – and start measuring hourly means. The results will be truly shocking[10].

The effect of all this on Newport is being felt in two ways.

At the Wicken Road junction, the worsening of the queuing problem *due to already permitted development yet to come on line* will undeniably cause an exceedance that will formally trigger an AQMA. In a rural village!

Health England are currently lobbying for a ban on stationary cars with engines idling in the vicinity of a school site[11]. At the Burywater Lane junction, the worsening of the queuing problem due to already permitted development yet to come on line will generate large quantities *of newly started vehicles* which will dump massive quantities of Excess Emissions due to Cold Starts as they are forced to idle in a queue *in the middle of a school site*! Needless to say, any extra traffic using this route as a rat-run will further exacerbate the problem.

Summary

I am aware that despite my best efforts this paper has become – sadly but necessarily – more technical that I would have wished. For that I apologise.

If I might summarise:

> Newport has suffered a veritable explosion of largely speculative planning permissions, granted in no small part due to a lack of cumulative impact assessment – notwithstanding that such assessment should have been part of the determination process.
>
> The Traffic Study that neither the Planning Authority or the Highways Authority would commission has demonstrated, belatedly but quite clearly, that already-committed development will take the village's road network up to and beyond its practical capacity.
>
> Current Air Quality modelling orthodoxy has shown itself unable to address the major contributory factors that apply to our situation, where cold-started engines, queuing at sensitive junctions, are emitting at several multiples of their steady-state values.
>
> These EECSs will particularly stress the two junctions in the village which will – on completion of all the currently permitted development –be running at or beyond capacity, creating an AQMA in the first and enforcing a scenario in the second to which Health England are vehemently opposed.

Given the above, this application, entailing a significant additional traffic load – falls on the first criteria of policy GEN1 of the extant (2005) Local Plan, viz.:

> *Access to the main road network must be capable of carrying the traffic generated by the development* ***safely***

On its own, let alone added to already-permitted development yet to come on-line, this proposal must surrender any claim to sustainability and as such, any presumption in favour of approval – the so-called tilted balance – is similarly lost.

The science is clear, the policies are clear; this application should indeed have been refused and this appeal should not be allowed. Should anybody doubt my analysis, I attach a reading list of the primary references for their consideration.

Thankyou for your attention

David Mayle, 24Sept19

[redacted]

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[10] This is a considered professional judgment; I am more than happy for it to be challenged so as to advance our understanding of this issue.

[11] "Ban cars from idling near schools, says UK public health agency". The Guardian, 11Mar19. https://www.theguardian.com/environment/2019/mar/11/ban-cars-from-idling-near-schools-say-uk-public-health-chiefs

A Reading List

BBC: 'Electric cars not attractive for most people in the UK' (data from the Transport Research Laboratory). https://www.bbc.co.uk/news/business-48340202 (accessed 20Jun19)

Bielaczyc, P., Szczotka, A., & Woodburn, J. (2014). Cold Start Emissions of Spark-Ignition Engines at Low Ambient Temperatures as an Air Quality Risk, *Archives of Environmental Protection*, *40*(3), 87-100. doi: https://doi.org/10.2478/aep-2014-0026

Bogarra, Herreros, Hergueta, Tsolakis, York & Millington (2017). Influence of Three Way Catalyst on Gaseous and Particulate Matter Emissions during Gasoline Direct Injection Engine Cold-Start *Johnson Matthey Technology Review, **61,** 4, pp329-341*

Drozd et al. (2016), "Time Resolved Measurements of Speciated Tailpipe Emissions from Motor Vehicles: Trends with Emission Control Technology, Cold Start Effects, and Speciation", Environmental Science and Technology **50**(24)

Emissions Analytics Newsletter, July2017, "https://www.emissionsanalytics.com/news/can-driving-styles-prove-the-smarter-route-to-better-fuel-economy-and-emissions-lr5c2 [accessed 16Feb19

Hedinger, R.; Elbert, P.; Onder, C. Optimal Cold-Start Control of a Gasoline Engine. *Energies* **2017**, *10*, 1548.

Khalfan, A, Li, H and Andrews, G (2015) Cold Start SI Passenger Car Emissions from Real World Urban Congested Traffic. In: SAE technical paper series. SAE World Congress, 21-23 Apr 2015, Detroit, USA. Society of Automotive Engineers https://doi.org/10.4271/2015-01-1064

Rodriguez, J. Felipe and Cheng, Wai K. "Analysis of NOx Emissions During Crank-Start and Cold Fast-Idle in a GDI Engine." SAE International Journal of Engines 10, no. 2 (March 28, 2017): 646–655.

The Guardian: Air pollution: UK government loses third court case as plans ruled 'unlawful' https://www.theguardian.com/environment/2018/feb/21/high-court-rules-uk-air-pollution-plans-unlawful (accessed 22Jun19)

The Guardian: 'Ban cars from idling near schools, says UK public health agency' https://www.theguardian.com/environment/2019/mar/11/ban-cars-from-idling-near-schools-say-uk-public-health-chiefs (accessed 23Sept19)

Valverde, V.; Mora, B.A.; Clairotte, M.; Pavlovic, J.; Suarez-Bertoa, R.; Giechaskiel, B.; Astorga-LLorens, C.; Fontaras, G. Emission Factors Derived from 13 Euro 6b Light-Duty Vehicles Based on Laboratory and On-Road Measurements. *Atmosphere* **2019**, *10*, 243.

FIGURE 1

A generic emissions curve from a vehicle-based model

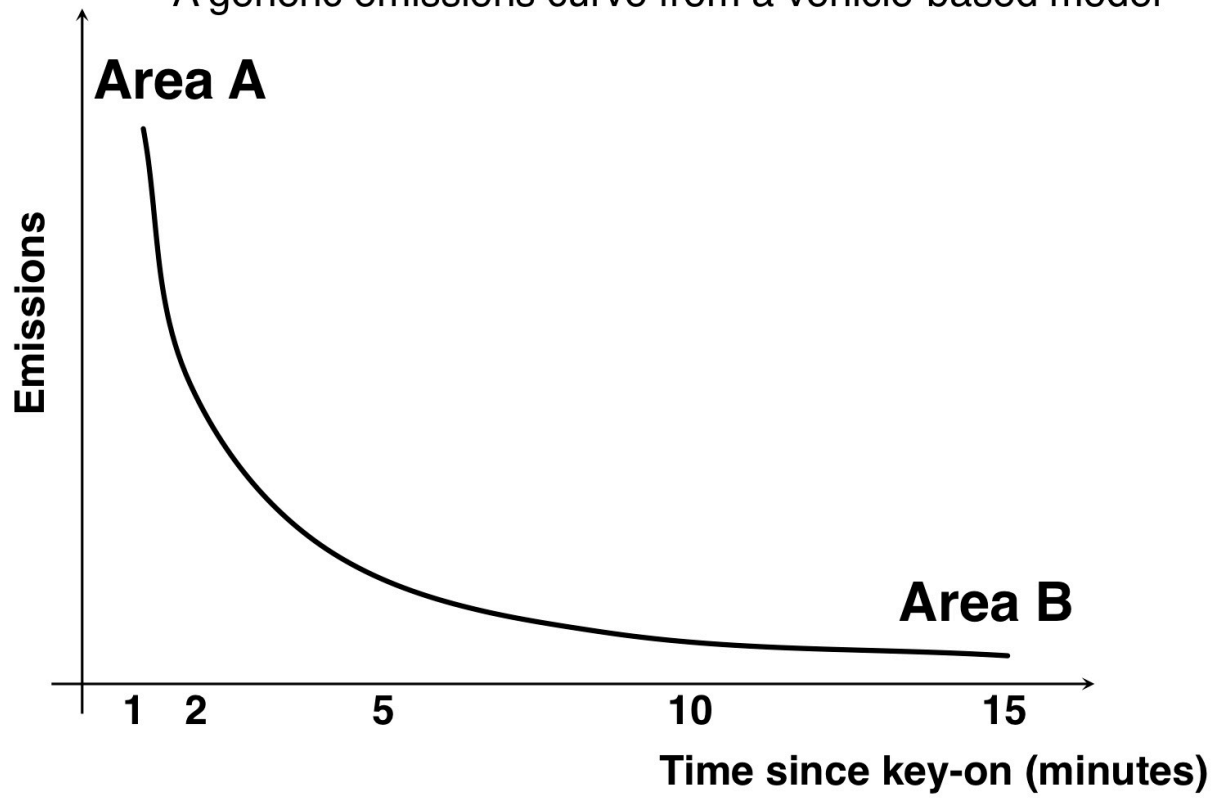

Figure 2 – The Wicken Road Junction

Picture taken at Tuesday 11:25, 08May18 (in term-time for the schools)

Selected Extracts from the cited articles

> *For the third time, the UK government has been slammed by the courts for failing to produce an adequate plan to tackle the growing problem of air pollution, in a landmark judgment that will force ministers back to the drawing board in their efforts to clean up dirty urban air.*
>
> *The high court ruled that the government's current policy on air pollution was "unlawful", and ordered changes. Air pollution has become a leading test case for environmental legal activism in the UK, as scientists have found as many as 40,000 people a year are dying from dirty air across the country.*
>
> *As a result of Wednesday's judgment, clean air in the UK will be overseen by the courts, rather than ministers, in a "wholly exceptional" ruling in which the government was roundly defeated.*

The Guardian: Air pollution: UK government loses third court case as plans ruled 'unlawful'

https://www.theguardian.com/environment/2018/feb/21/high-court-rules-uk-air-pollution-plans-unlawful

(accessed 22Jun19)

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> *The researchers also found that almost all emissions in properly functioning, new vehicles came out immediately after starting the cars when their engines were cold.* ***But once new cars warmed up, they had to be driven 100 to 300 miles to match the levels that came out in the first 30 seconds of the engine turning on.***
>
> *Hot-stabilized emissions have varying importance depending on species and may require a driving distance of 200 miles to equal the emissions from a single cold start. Average commute distances in the U.S. suggest the majority of in-use vehicles have emissions dominated by cold starts. The distribution of vehicle ages in the U.S. suggests that within several years only a few percent of vehicles will have significant driving emissions compared to cold-start emissions.*

Drozd et al. (2016), "Time Resolved Measurements of Speciated Tailpipe Emissions from Motor Vehicles: Trends with Emission Control Technology, Cold Start Effects, and Speciation", Environmental Science and Technology **50**(24)

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> *Engine cold-starts represent 50% of urban driving emissions and contribute to 80% of the total emissions for some species such as volatile organic compounds*

Bogarra, Herreros, Hergueta, Tsolakis, York & Millington (2017). Influence of Three Way Catalyst on Gaseous and Particulate Matter Emissions during Gasoline Direct Injection Engine Cold-Start *Johnson Matthey Technology Review,* ***61,*** *4, pp329-341*

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> *Gasoline engines can be used with a three-way catalytic converter (TWC) as the sole exhaust gas after-treatment system when operated at a stoichiometric air-to-fuel ratio. TWCs have proven to successfully cope with the ever more stringent emission limits, being able to convert more than 95% of the relevant raw engine-out emissions under nominal operating conditions [1]. However, as long as the temperature of the TWC is below the "light-off temperature" of around 250 °C, its conversion rate is significantly reduced. As a consequence, a large portion of the raw engine-out emissions are emitted into the atmosphere untreated.*
>
> *These unfavorable conditions occur during the first 40 to 100 s after the cold-start of an engine, that is, during the phase in which the temperature of the TWC is below light-off. Studies show that among all relevant emissions, namely carbon monoxide, nitric oxides and hydrocarbons, the total hydrocarbon emissions during a complete test procedure are affected most by this first phase of an engine start*

Hedinger, R.; Elbert, P.; Onder, C. (2017) Optimal Cold-Start Control of a Gasoline Engine. *Energies*, *10*, 1548.

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Cold start emissions behaviour represents perhaps the greatest single issue for emissions control regarding passenger cars […]

After treatment systems, such as a TWC, do not function properly during the first 20–100 seconds of engine operation following cold start, having not yet reached light-off, and this prevents effective mitigation of the increased tailpipe emissions of HC, CO and NOx.

Excesses were greatest following start-up, but persisted, even after several hundred seconds' driving

Bielaczyc, P., Szczotka, A., & Woodburn, J. (2014). Cold Start Emissions of Spark-Ignition Engines at Low Ambient Temperatures as an Air Quality Risk, *Archives of Environmental Protection*, *40*(3), 87-100. doi: https://doi.org/10.2478/aep-2014-0026

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Both in the laboratory and on the road, emission at cold start and emission at the low speed phases (urban) tend to be higher for all pollutants, which supports the rationales for urban emission limits applicable to RDE tests as does the fact that many trips in Europe are short trips in urban environments. Currently there are no specific limits for tailpipe emissions on short trips (where cold start emissions are large contributors). It might be an option to include such limits in future regulations to secure low emissions also on short city trips started with a cold engine.

Valverde, V.; Mora, B.A.; Clairotte, M.; Pavlovic, J.; Suarez-Bertoa, R.; Giechaskiel, B.; Astorga-LLorens, C.; Fontaras, G. Emission Factors Derived from 13 Euro 6b Light-Duty Vehicles Based on Laboratory and On-Road Measurements. *Atmosphere* **2019**, *10*, 243.

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Cars should be banned from idling near schools and congestioncharges imposed across the UK as part of measures recommended by the government public health agency.

In a report on Monday, Public Health England (PHE) said up to 36,000 people were dying each year from human-made air pollution.

It also pointed to emerging evidence of air pollution causing dementia, low birth weight and diabetes.

In a 263-page review of the options for improving air quality [pdf] the report calls on councils to introduce no-idling zones outside schools and hospitals; the imposition of more congestion charges and low emission zones; and the development of a vehicle-charging infrastructure to promote a "step-change" in the uptake of electric cars.

'Ban cars from idling near schools, says UK public health agency'. The Guardian, 11Mar19

Abbreviations common in the literature

CO	carbon monoxide
CO_2	carbon dioxide
CI	compression ignition (generally diesel)
DEFRA	UK body charged with, among other things, Air Quality
DISI	direct injection spark ignition
DPF	Diesel Particulate Filter
EECS	Excess Emissions due Cold Starts
EUDC	Extra Urban Driving Cycle
EPA	Environmental Protection Agency
FTP	Federal Test Procedure
Gasoline	What the US calls petrol
GDI	Gasoline Direct Injection
GPI	Gasoline Port Injection
HC	hydrocarbons
'Key on'	'The engine starts…'
LCV	Light Commercial Vehicle
'Light-out'	In car display to reveal when the catalyzer is up to working temperature (common in the US)
MPI	Multi-Point Injection
NEDC	New European Driving Cycle
NMHC	non-methane hydrocarbons
NMOG	non-methane organic gases
NO_x	oxides of nitrogen
PM	particle mass
PN	particle number
SI	spark ignition (generally gasoline)
TWC	three-way catalyst
UDC	Urban Driving Cycle
VOC	volatile organic compounds