Regeneration, Culture and Environment Overview and Scrutiny Committee

BRIEFING NOTE – No. 6/24

Date: 30 September 2024

Briefing paper to: All Members of the Regeneration, Culture and Environment Overview & Scrutiny Committee

Purpose: Response to members query around the Rainham idling project

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Minutes from the RCE O&S meeting from Thursday 13 June 2024 recorded the following:

Air Quality Monitoring – *Members asked why the council were still putting up signs requesting drivers turn off their engines when research shows that drivers were being advised to turn off the stop/start function on vehicles due to the impact on vehicles. Officers committed to providing a briefing note regarding the advice they had been given on this issue.*

The full report containing the findings and recommendations of the Rainham idling project are attached.

Stop-start technology on vehicles has an important role to play in reducing harmful emissions and improving fuel consumption, helping to deliver cleaner air at the roadside. Many myths exist around the use of stop-start technology, including that it:

- Uses more fuel
- Damages the engine
- Wears out the battery
- Causes more pollution

The RAC have produced a myth busting article on their website which covers the above points, but specially says the following in relation to damaging the engine:

The argument that stop-start technology is damaging mostly comes from the fear of a cold engine – your engine must heat up lubricants when it starts. However, the technology doesn't come into use until your engine has warmed to an operational temperature.

If you're stuck in traffic for a minute and your engine switches off, the lubricants will not cool down to damaging levels.

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If you find yourself stationary for a longer period of time, the system is designed to start the engine automatically before lubricant temperatures drop too dramatically.

Another feature that protects your engine, prevents oil from returning to the oil pan. As a result, engines restart with a significant amount of fluid in the engine chamber.

While most engine parts such as your starter motor, ring gear, cambelt and flywheel have to work more frequently than a vehicle without stop-start, manufacturers ensure longevity and ability to operate more frequently through higher manufacturing specs.

Turbos aren't affected and build-up of soot (such as around the exhaust gas recirculation (EGR) valve) is minimised through precise engine management control features.

Further advances, such as dry lubricants on engine bearings and improvements to the durability of engine bearings, mean today's cars are designed to withstand these frequent engine restarts.

Read the full RAC article on stop-start engines.

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Medway Anti-Idling Project Report

Prof Tim Hopthrow, Zoe Horsham, Sarah Resanovich, Dr Fanny Lalot, Prof Dominic Abrams

Background

This Project was funded by DEFRA and Medway Council and conducted in partnership with the University of Kent.

1. Traffic and air pollution

Air pollution is a critical environmental concern, a significant risk to health and wellbeing. It is estimated by the World Health Organization (WHO) that seven million people die prematurely each year from air pollution exposure (WHO, 2023), approximately four million of which are due to ambient (outdoor) air pollution (WHO, 2022). Whilst ambient air pollution is highest in densely populated urban areas (e.g., cities), 99% of the global population live in places where air quality guidelines are not met as of 2019 (WHO, 2022). It is evident that the impacts of air pollution are widespread, affecting urbanised areas, suburban and rural regions.

Traffic emissions are amongst the biggest global contributors to air pollution (Defra, 2016), accounting for 37% of NO_2 emissions in EU countries in 2020 (EEA, 2018). Motor vehicles produce various air pollutants. Of these, nitrogen oxides (NO_X, including NO and NO_2) and particulate matter with a diameter ≤ 10μm (PM_{10}) and ≤ 2.5 μm ($PM_{2.5}$) pose the greatest concerns for health. Associated health risks include heart disease, strokes, cancer, and exacerbation of pre-existing respiratory diseases (OHID, 2022). Financial impacts of these health risks are extensive and rapidly growing. Between 2017-2025 in the UK alone, estimated health and social care costs to the NHS from $PM_{2.5}$ and NO_2 exposure are predicted to exceed £1.5 billion (Public Health England, 2018).

As such, the damaging effects of air pollution are not only environmental; they are a threat to human health and mortality rates as well as global economies and health services around the world. It is these factors which have led to the prioritisation of air quality improvement in environmental policy, with increased emphasis on the generation and implementation of practices to improve ambient air quality in urban and rural areas.

2. Practices to enhance air quality

Greater attention is being given in both academic and public policy to exploring strategies to increase sustainable and pro-environmental behaviours (Grilli & Curtis, 2021), and the UK is no exception to this. Many extant strategies have been directly informed by psychological theories of behaviour change. These theories propose a multitude of internal (e.g., attitudes, belief, knowledge) and external (e.g., social norms, governance) factors that influence the probability and strength of behavioural change.

Wallen and Daut (2018) propose a taxonomy of behaviour change intervention methods comprised of five categories: (i) education and awareness, (ii) outreach and relationship building, (iii) social influence, (iv) nudges and behavioural insights, and (v) incentives.

3. Air quality management in the UK

The Environment Act 2021 refined previous frameworks to guide targets, plans and policies to improve the natural environment of England. Air quality is cited as a priority area for improvement in this framework, in which regulations for the Secretary of State to provide the *$PM_{2.5}$ air quality target* by October 2022 were established. The Environmental Targets Regulations (Fine Particulate Matter) (England) Regulations 2023 provided two targets to be met by 2040, with interim targets set in the Environmental Improvement Plan 2023 (Defra, 2023): (i) Annual mean concentrations of $PM_{2.5}$ to be 10 µg m^{-3} or lower, with an interim target of 10 µg m^{-3} by 2028, and (ii) Population exposure to $PM_{2.5}$ to be reduced by 35% compared to 2018 levels, with interim target of 22% by 2028.

The air quality strategy for England (Defra, 2023) refined extant policies (Defra, 2015) for local authorities to meet these targets. The framework emphasizes the responsibility of local authorities to monitor and mitigate air pollution levels. Specifically, when these levels are exceeded (or predicted to exceed) limits set by the Air Quality (England) Regulations 2002, local authorities must declare the location an Air Quality Management Area (henceforth AQMA) and provide an Air Quality Action Plan (henceforth AQAP) with measures and deadlines to reduce concentrations.

Measures proposed within these AQAPs are determined by a multitude of factors, the greatest of which are resource availability and the main contributors to local emissions (e.g., freight volumes, congestion, volume of traffic, etc.) as determined by the local authority. In this section, we outline some primary examples of such measures within the UK, focusing on those that are both recent (i.e., introduced or expanded within the last 5 years) and target different elements of the intervention framework by Wallen and Daut (2018).

3.1. Low Emission Zones (LEZs)

LEZ schemes impose charges for vehicles that exceed set limits on emissions, designed as a disincentive (category four in Wallen & Daut's 2018 framework) to limit use of non-compliant vehicles in AQMAs. The first LEZ in the UK was introduced in Greater London in 2008. Charges were restricted to heavy-duty diesel vehicles only, accounting for approximately 13% of traffic in the AQMA. Outcome reports showed minimal improvements in ambient air quality, with reductions in particulate matter concentration of just 3% and non-significant changes in NO_X concentrations (Ellison et al., 2013). Projections suggested it would take almost 200 years to meet air quality targets in the LEZ (Ellison et al., 2013).

In 2019, the scheme was extended to introduce the ultra low emission zone (ULEZ). The ULEZ scheme made significant expansions to its criteria, imposing restrictions on all types of motorized vehicles. The scheme was predicted to directly reduce roadside NO_2 concentrations by 29% from July to September 2019. Early evidence reported limited impacts of ULEZ, with < 3% reduction in NO_2 and non-significant changes in $PM_{2.5}$ concentrations in the first nine months (Ma et al., 2021). More recent evidence suggests more substantial impacts, reducing NO_2 concentrations from traffic across inner London by 21% as of October 2022 (Cliff et al., 2023). These reductions still fall significantly short of the initial predictions for 2019, suggesting more needs to be done to meet national targets.

It is unlikely that (U)LEZ schemes will have sufficient impacts in isolation (Ma et al., 2023). Since restrictions are based only on NO_X and $PM_{2.5}$ emissions, many compliant vehicles continue to contribute to broader environmental issues, emitting large volumes of CO_2 associated with global warming (Smith, 2023). As such, even if national targets *are* met, it may not be enough to address the growing concerns around climate change. Continued expansion of ULEZ is anticipated, however critics have argued the intervention will cause significant hardship to the lowest income households who are unable to upgrade to newer, ULEZ-compliant vehicles (Clark, 2023). These economic barriers and perceived injustice may lead to negative attitudes towards air quality interventions in urban areas, reducing motivation to engage in pro-environmental behaviours.

3.2. Community Speedwatch

Community Speedwatch (CSW Online, 2020a) is a national initiative established in 2012 which various local police and council authorities have opted into across the country. Members of the local community volunteer to record vehicle registrations and speeds in targeted areas. Whilst primarily a road safety initiative, it is also an indirect strategy to improve ambient air quality. Maintaining a slower speed eases congestion at traffic lights, junctions and roundabouts, improving traffic flow. It also avoids rapid braking and acceleration cycles which are deemed one of the most significant contributors to NOx emissions in urban areas (Lujan et al., 2018; May et al., 2014), increasing fuel consumption by up to 40% and NOx emissions by as much as 255% (de Vleiger et al., 2000; Gallus et al., 2017).

Unlike LEZ schemes and other speed enforcement initiatives, CSW favours an educational approach to behaviour change over financial disincentive or punishment (category 1; Wallen & Daut, 2018), with first-time offenders being sent an educational letter about the importance of speed limits in the relevant area in lieu of a speeding ticket. The scheme's creators argue that punishment-led enforcement is generally ineffective due to its perceived random nature of targeting, which is more likely to catch first-time offenders rather than habitual speeders (CSW Online, 2020a). Feelings of injustice, paired with a lack of education about the importance of speed limits, is posed to foster negative attitudes towards speed regulations (CSW Online, 2020a), and reduce compliance.

CSW uses community volunteers to reduce perceptions of authoritative enforcement which can prime distrust from the public (CSW Online, 2020a). As community volunteers directly and visibly enact the scheme (recording vehicle speeds at roadside), salience of the community's social norm (Nolan et al., 2021; Reno et al., 1993) of adhering to speed limits, and the perceived importance of this norm to the community group (Jans, 2021; Nolan et al., 2021), increases. This in turn is claimed to increase likelihood of behavioural change, resulting in more individuals adhering to the speed limits in these areas. Consequently, CSW schemes serve as both a social influence- and education-based behavioral change intervention.

Evidence for the direct effects of CSWs on emissions has not been published, likely due to their primary focus on road safety. However, data from CSWs across Kent and Sussex show reoffending rates reduced from approximately 23% to just 6.5% between 2015-2019 (CSW Online, 2020b). These data suggest the scheme has far greater impacts than punishment-based approaches (e.g., speeding tickets) on reducing the speeding behaviours which contribute to vehicle emissions. Nonetheless, more research is needed to identify the direct effects of these schemes on roadside vehicle emissions and ambient air quality.

4. Air quality management in Medway

In compliance with the Local Air Quality Management framework, Medway currently has four AQMAs in place which exceed the annual objective for NO_2 concentrations (40ug/m^3): central Medway, Pier Road (Gillingham), High Street (Rainham), and Medway Four Elms Hill. The AQAP for the former three AQMAs was approved by Cabinet in 2015, with the latter approved in 2017 (Medway Council, 2022).

The Air Quality Action Plan 2015 (Medway Council, 2015) cited traffic congestion as a primary cause of high levels of air pollution in the Medway AQMAs. The Action Plan proposed 12 measures to reduce emissions in these areas by 10-20%. These measures underpin four broader targets, as summarised in Table 1: (i) reduction of traffic congestion and volumes, (ii) reduction of vehicle emissions, including regulation of high-emission licensed vehicles, (iii) education and promotion to local residents, and (iv) research and guidance for local authorities, developers and consultants.

Table 1. Summary of measures proposed by Air Quality Action Plan (Medway Council, 2015)

	Reduction of traffic volume and congestion	Reduction of vehicle emissions	Education and promotion to local residents	Research and guidance
Measure 1: Improving movement of freight	X			
Measure 2: Encouragement of Public Transport Use	X			
Measure 3: Improvement of Taxi Emissions		X		
Measure 4: Traffic Management	X			
Measure 5: Promotion of Cycling and Walking	X		X	
Measure 6: Eco-Driving		X	X	
Measure 7: Procurement			X	X
Measure 8: Travel Planning	X		X	
Measure 9: Car Sharing	X		X	
Measure 10: Development Planning				X
Measure 11: Promotion of health and air quality awareness			X	
Measure 12: Feasibility studies and funding				X

4.1. Rainham Highstreet Location

The Air Quality Action Plan (Medway Council, 2015) identifies a required reduction of NO_X in High Street (Rainham) of 35.5%, with a total NO_x of 71ug/m^{-3} of which road NO_x contributes a majority

(43.7ug/m^{-3}). The greatest contributor is congestion and slow-moving traffic around the traffic lights in this area (Medway Council, 2015). Consequently, the council seeks to address both infrastructure and behavioural strategies to reduce the volume and environmental impacts of congestion on this road.

Infrastructure changes to reduce congestion levels (Measure 4) are posed to significantly contribute to achieving the NO_X emission target in this AQMA (Medway Council, 2015), with a predicted impact of a further 10% reduction in emissions across the three AQMAs it targets. However, such interventions are resource-intensive, costly, and require extensive planning and development time. The local authority predict security of funding to be the greatest barrier to implementation (Medway Council, 2022), and it is possible that the required funding for many of these measures will not be obtained. Behavioural change interventions are significantly less time and resource-intensive, particularly communication-based strategies to influence pro-environmental behaviours (Allcott, 2011; Griskevicius et al., 2008). The current project thus poses a social influence-based behavioural change intervention to reduce engine idling at the traffic lights on the Rainham High Street (Measures 6 and 11), as a more immediate and efficient means of mitigating impacts of vehicle emissions on ambient air quality in this AQMA.

The current intervention is grounded in psychological theory and research, and explores the effects of different motivations to encourage drives to switch off their engines when sat at red traffic lights. Specifically, psychological theories of persuasion and behavioural change propose three types of influence: (i) *normative influence*- behavioural or attitudinal change driven by desire to fit in with a group; (ii) *informational influence*- change driven by information, such as statistics or evidence; and (iii) *identity-based* influence- perceived acceptance of the norm by group with which an individual highly identifies, triggering acceptance by the individual.

Previous research in Canterbury has demonstrated the feasibility of using persuasive messages targeting normative influence approaches on fixed road signs to reduce engine idling by up to 42% (Abrams et al., 2019; Abrams et al., 2021), significantly improving air quality measures. However, these interventions were tested at level crossings, where average waiting times are relatively long (two minutes on average; Abrams et al., 2019). Drivers may be more likely to switch off their engines during longer idling periods, as financial and environmental impacts of engine idling may become more salient when perceived to be higher. As such, it is not known whether the effects of persuasive messages on engine idling behaviour will generalise across different idling periods, such as at red traffic lights. Furthermore, previous research has focused on the short-term effects of persuasive message interventions, measuring their impact on engine idling over a single week (Abrams et al., 2019; Abrams et al., 2021). Since repeated exposure to persuasive messages can diminish the "novelty effects" that contribute to behavioural impacts (Rama & Kulmama, 2000, p. 93), reducing the depth at which they are processed (Shi & Smith, 2016), acceptance (Cacippo & Petty, 1979), and behavioural compliance (Skilbeck et al., 1977), it is possible that the impacts of these persuasive road sign messages on engine-idling will diminish over time, leading to temporary reductions in engine idling and associated air quality improvement.

To address these limitations, a longitudinal large-scale field-experiment was conducted to assess the efficacy of persuasive message interventions on road signs to reduce engine idling at red lights on Rainham High Steet over longer periods of exposure.

Method

Our sample consisted of 9,387 vehicles traveling through Rainham between March and July of 2023. There were two phases of testing periods.

Phase 1

The first testing period ran from second week of March to first week of May. The first week no signs were put up and baseline data was collected. Then in subsequent weeks three different signs were tested. Each sign was tested for a one-week period.

The signs were put up at the start of each week on Monday and then the testing period ran on Tuesdays and Thursdays: 9:30 am – 10:15 am, 12:00 pm – 12:45pm, and 4:00 pm – 4:45 pm. During the red light, researchers and volunteers manually recorded engine idling for all of vehicles in the queue. In addition to recording if the driver turned off their engine, we also recorded the type of vehicle (car, bus, lorry, motorbike, van/service vehicle, or taxi), if the vehicle was an electric or hybrid, the position in the queue the car was in, and the duration of the red light. There was a two week break in data collection between the first and second sign in early April as traffic patterns changed due a two-week school holiday. After the third sign was taken down there was a one week pause and then one final week of data collection with no sign up.

Phase 2: Longer term testing

The second testing period took place from the last week of May to the third week in July. The aim of the second testing period was to determine if there were longer term effects. Phase two testing used the most successful sign from phase one. Researchers and volunteers manually recorded the same data as in the previous testing period during the same time slots on Tuesdays and Thursdays.

Without the presence of signs baseline data was collected in the last week of May and then the sign went up the first week of June. The sign remained at the intersection for a month and data was collected at both the start of June and July. Finally, the sign was taken down in the second week of July and a final round of data collection was conducted a week later.

Location

The data was collected at the intersection of London Rd, Hight St, and Maidstone Rd in Rainham. There were two data collection locations one on London Road and one on High Street. Figure 1 shows specifically where the signs and data collection were located.

Figure 1: The intersection of London Rd, Hight St, and Maidstone Rd. The white boxes and red arrows indicate the two data collection points where volunteers would record data, and the purple circles indicate the location of the signs.

Intervention road signs

The intervention signs were printed on 1050 x 750 mm, with black text over yellow background. These signs were specifically designed to standout compared to white road signs. Three different intervention messages were printed on three different signs. Two signs were adopted from previous projects which demonstrated significant effects on engine idling behaviour and subsequent ambient air quality (Abrams et al., 2021). Extending on current research, the present intervention also tested the efficacy of a community-based persuasive message. This message generated as part of two community sign development workshops with local schools and the Rainham Ecohub community forum. For more details on the creation of the community sign, see below. All three messages are illustrated in Figure 2 and were the following:

Responsibility: this message encourages drivers to turn off their engines so they conform to norms set by others who are considered responsible (i.e. socially approved).

Join Rainham's responsible drivers Engines off when the lights are red

Effectiveness: this message highlights individuals' ability to exert control over the air quality by turning off their engine.

Turn off your engine at red lights to improve air quality in the area

Community: this message was developed and chosen by members of the Rainham community. By developing this message directly with the community, it aimed to combine normative theories of influence with messaging that is relevant and engaging to the local community.

Lights Red, Engines Dead. #BemoreRainham

Development of the Community Sign

Two community workshops were held in March. One was held at a local school with students between the ages of 13 and 17, the other was held in partnership with a local environmental group and consisted of group of community members from Rainham. In these two workshops researchers share information about the Canterbury Air Quality project and explained social psychological theories of influence. Then participants in the workshop were asked to create intervention messaging that would be tested alongside the messaging developed by social psychologists. All participants were given the following instructions to create signs that were:

- No more than 8-15 words.
- Designed to persuade drivers to switch off their engines when waiting at traffic lights.
- Reflect who you are as a community.

The participants created a wide range of messaging. The final message was then decided by an online poll where any member of the Rainham community could select which message they liked the best. As shown above the final message that was selected was "Lights Red, Engines Dead. #BemoreRainham".

These workshops not only increased community involvement with the project, but also the visibility of the scheme and awareness of air quality issues in the local area. Consequently, our strategy aligns with recommendations for behaviour change intervention design from a rapid review by Public Health England (2019), to prioritise involvement of stakeholders and local groups, provide clear and visible messages, encourage social norming of desired behaviours and communicate via trusted messengers.

Results

Descriptive results

During the observation period, 9387 vehicles were observed amongst which 7067 cars, 1291 vans, and smaller numbers of buses, lorries, motorcycles, etc. Overall, 83% of drivers left their engine running while waiting at the red light. Rates of engine running were slightly lower for cars (81%) than for other categories of vehicles (buses, lorries, and vans ranging 91%-97%). In preliminary analyses, we compared cars to all other vehicles; however, results showed that the effectiveness of the different messages were similar across categories of vehicles. We therefore present results considering all vehicles.

Phase 1

Phase 1 included 5903 vehicles over the course of several weeks encompassing: a pre-intervention baseline, Responsibility message intervention, Effectiveness message intervention, Community message intervention, and post-intervention baseline.

Results are summarised in Table 2 and illustrated in Figure 2. We found that the three intervention messages significantly reduced engine idling. Compared to 91.0% at baseline measurement, the proportion of idling engines when the messages were present was between 74.5-84.2%. Statistical tests confirmed that these effects were strong enough to be reliably attributed to the messages themselves, and not to random variations.

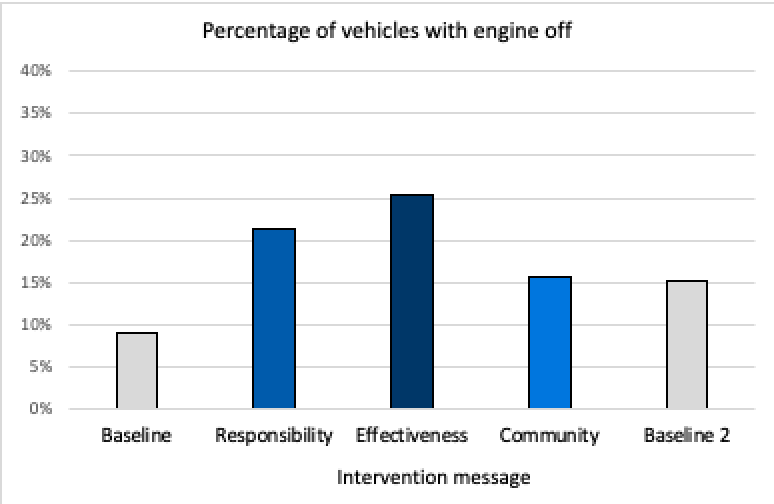
Comparisons between the three intervention messages revealed that the Effectiveness message, "Turn off your engine at red lights to improve air quality in the area" was the most effective.

Finally, observations in the post-intervention phase ("baseline 2") revealed a sustained effect of the intervention: while rates of engine idling had increased again compared to the most effective message, they remained significantly lower than the pre-intervention baseline (84.9% vs. 91.0%).

Table 2.
Percentage of observed engine idling behaviour as a function of the intervention message during Phase 1

Condition	Number of vehicles	Vehicles with engine off	Vehicles with engine on
Baseline	1852	9.0%	91.0%
Responsibility	1305	21.3%	78.7%
Effectiveness	815	25.4%	74.6%
Community	1090	15.7%	84.3%
Baseline post-intervention	841	15.1%	84.9%

Figure 2.
Percentage of vehicles with their engine off as a function of the intervention message.



Phase 2

Based on the results of Phase 1, the Effectiveness message was selected for continued testing in Phase 2. The second phase included 3045 vehicles over the course of several weeks encompassing: a first test of the Effectiveness message intervention, a second test of the same intervention, and a final post-intervention baseline.

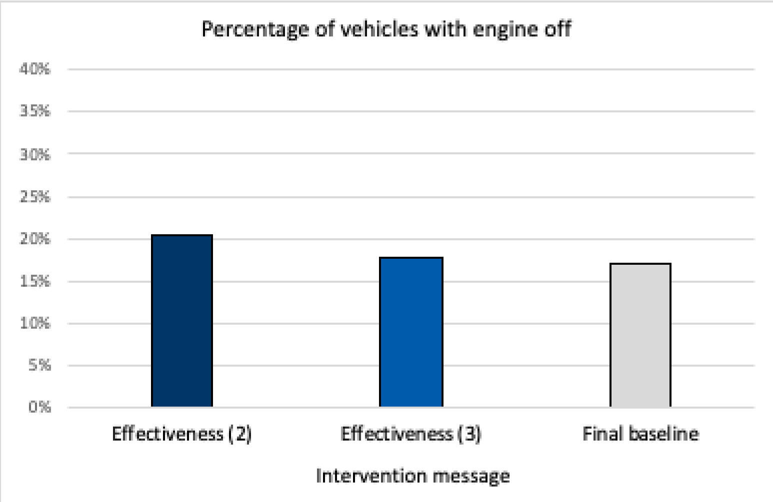
Results are summarised in Table 3 and illustrated in Figure 3. Compared to the first time the Effectiveness message was displayed in March (leading to 25.4% of engines being turned off), the second display of the same message led to a slightly lower rate of engines off (20.3%), suggesting a habituation effect reducing the effectiveness of the message. This trend continued with the third display of the message, leading to 17.9% of engines being turned off. However, all these figures remained statistically significantly larger than the rate of engines off pre-intervention (9.0%).

Remarkably, the final post-intervention baseline showed sustained rates of 17.1% of engine off. While lower than the rates of compliance observed at the peak of the intervention, this represents a rate of compliance almost twice as high as we could observed pre-intervention. This finding suggests that the intervention was successful in changing at least some of the habits of the regular drivers in the area.

Table 3.
Percentage of observed engine idling behaviour as a function of the intervention message during Phase 2

Condition	Number of vehicles	Vehicles with engine off	Vehicles with engine on
Effectiveness (2)	985	20.3%	79.7%
Effectiveness (3)	1315	17.9%	82.1%
Final baseline post-intervention	745	17.1%	82.9%

Figure 3.
Percentage of vehicles with their engine off as a function of the intervention message.



Conclusions

Improving air quality in AQMA areas is an important part of the Council's statutory duty. This involves several interventions that include infrastructure and traffic management projects. However, previous research suggests that improvements in air quality can be gained from reducing engine idling behaviour via in expensive behavioural change messaging. Many public authorities have employed community-level projects to increase awareness of environmental issues and encourage sustainable behaviours. However, the awareness of the efficacy of such projects on behaviour is limited due to an absence of systematic project success measures (Grill & Curtis, 2020).

The purposes of the Medway anti-idling project were to extend the findings from the Canterbury project and look at the impact Psychologically derived anti-idling messages at a short wait stop and the longevity of their effects. Findings show that idling behaviour was significantly reduced using anti-idling signage at a traffic light intersection on Rainham. Moreover, these effects continued to be above baseline both for a longer duration of sign display but also after the signs were removed.

Recommendations

1) To install signage, using tested messaging informed by Psychological evidence, to encourage drivers to switch off engines at long and short wait stops
2) Disseminate report and its findings, including talks etc.
3) Undergo periodic data collection to ensure continued effectiveness of signage
4) Continue to engage with community groups
5) Consider follow on projects
    a. In partnership with specific institutions eg. Schools, Hospitals.
    b. Extend messaging beyond fixed signs eg. Branding, bumper stickers, social media
    c. Incorporate evaluation into any extended projects.

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