



Good Practice Guide

# Reducing Emissions from Idling Diesel Trains

2022-SUS-012

Written by

**Tim Barlow**, Aether Limited

**Mark Gibbs**, Aether Limited

**Neil Grennan-Heaven**, Carrickarory Consulting Limited

March 2025

# Copyright

© Rail Safety and Standards Board Ltd, 2025. All rights reserved.

This publication may be reproduced free of charge for research, private study or for internal circulation within an organisation. This is subject to it being reproduced and referenced accurately and not being used in a misleading context. The material must be acknowledged as the copyright of the Rail Safety and Standards Board. The title of the publication shall be specified as written.

For any other use of the material please apply for permission to the Director of Research at the Rail Safety and Standards Board. Any additional queries can be directed to our [customer service portal](#). This publication can be accessed by authorised audiences, via the [RSSB research catalogue](#).

## Executive summary

When diesel trains are not generating tractive power, they have one or more idle modes. All diesel trains spend a substantial part of the drive cycle in idle. When such trains are stationary, engines can be required to produce power for hotel loads and auxiliaries, and to prepare for departure. For a variety of reasons, engines may be left idling for longer than operationally necessary, which incurs fuel costs and impacts air quality.

When diesel trains are in enclosed stations or depots, emissions of air pollutants are not well dispersed. This is a particular issue in stations with a high degree of terminating/reversing/laying-over traffic. As a result, passengers and staff can be exposed to high levels of air pollution.

Unavoidable idling occurs for a variety of reasons: warming up the engine; building air pressure so that the brake system will operate; providing interior lights for passengers; and creating a comfortable temperature for staff and passengers. Also, while waiting at a stop signal, the engines need to be kept running to ensure that the train can move off promptly. Avoidable idling can occur during long stops at terminating stations and while stabling when engines are sometimes left running for long periods. These periods can last for several hours. The idling time in stations can also be reduced by tackling the causes of departure delays.

This guide is aimed at helping train operating companies (TOCs) that operate diesel-powered passenger rolling stock to reduce avoidable idling. It is of relevance to engineering, maintenance, and operational staff (for example, drivers and managers), and to those involved in environmental and sustainability issues relating to train operations. It provides information on why idling occurs, the cost and impacts of idling, and how it can be reduced to save money and improve the station and depot environments.

Due to high variability across rolling stock, routes, and operations, it is impossible to prescribe a single solution to reduce avoidable idling. TOCs must understand their own situation to determine where and why idling happens and how much is avoidable. With this information, TOCs will be able to assess the most practical, effective solutions that will address the biggest issues.

TOCs are encouraged to develop idling reduction strategies or include them in air quality improvement plans. The recommended approach is:

1. **develop data analysis capability** to ensure that engine running data and train speed and location data are available to help develop solutions
2. **identify potential avoidable idling** by analysing locations and durations of idling
3. **understand the causes**; these could be because of behavioural, operational or technical issues
4. **develop effective idling reduction approaches** that are class and route specific
5. **target interventions** by considering sensitive locations and cost-effective interventions
6. **develop idling key performance indicators (KPIs)** against which improvement can be tracked
7. **track progress** to enable wider implementation of interventions or development of new approaches.

## Contents

<b>1</b>	<b>Introduction .....</b>	<b>4</b>
1.1	Structure of this document .....	6
<b>2</b>	<b>Train idling .....</b>	<b>7</b>
2.1	Why do diesel trains idle? .....	7
2.2	Why do we need to reduce idling? .....	9
2.3	Potential avoidable idling .....	10
2.4	Potential benefits of reducing idling .....	11
<b>3</b>	<b>Identifying and quantifying avoidable idling .....</b>	<b>13</b>
3.1	Data collection systems .....	13
3.2	Data analysis systems .....	14
<b>4</b>	<b>Understanding specific causes of avoidable idling .....</b>	<b>16</b>
<b>5</b>	<b>Techniques to reduce idling .....</b>	<b>18</b>
<b>5.1</b>	<b>Behavioural changes .....</b>	<b>18</b>
5.1.1	Staff education .....	18
5.1.2	Signage .....	18
5.1.3	Train crew notices .....	18
<b>5.2</b>	<b>Operational changes .....</b>	<b>19</b>
5.2.1	Driver diagrams .....	19
5.2.2	Timetable adherence and timetable changes .....	19
5.2.3	Location management .....	20
<b>5.3</b>	<b>Engineering changes .....</b>	<b>20</b>
5.3.1	Shore supplies .....	20
5.3.2	Automatic engine stop/start .....	20
5.3.3	Improve restart reliability .....	21
5.3.4	Improve air systems .....	21
5.3.5	Air compressors .....	21
5.3.6	Cross feeding of auxiliary supply .....	21

5.3.7	Heaters .....	22
<b>6</b>	<b>Developing idling reduction strategies.....</b>	<b>23</b>
6.1	Develop data analysis capability .....	23
6.2	Identify potential avoidable idling .....	23
6.3	Understand the causes .....	26
6.4	Develop effective reduction approaches .....	26
6.5	Target interventions.....	26
6.6	Develop idling key performance indicators .....	26
6.7	Track progress.....	27

# 1 Introduction

When diesel trains are not generating tractive power, they have one or more idle modes where the engine operates at a relatively low engine speed (revolutions per minute (rpm)). All such trains spend a substantial part of the drive cycle in idle. A diesel train will idle when coasting or braking and when stationary. This occurs in stations, stabling locations or depots, when idling may be necessary to produce power for hotel loads and auxiliaries and/or to prepare for departure.

Emissions of the key air pollutants oxides of nitrogen (NO<sub>x</sub>) and particulate matter (PM) are highest on a power basis (g/kWh) in idle but lower on a time basis (g/h) than other engine notches. Consequently, idling emissions can have a disproportionately higher impact on air quality compared to other parts of the drive cycle. Some trains can have more than one type of idle mode that have different emissions profiles. These may be referred to as low idle, high idle or traction ready.

When diesel trains are in enclosed stations or depots, emissions of air pollutants are not well dispersed, especially when a train is not moving. This is a particular issue in stations with a high degree of terminating/reversing/laying-over traffic. As a result, passengers and staff can be exposed to high levels of air pollution. The need to address idling emissions is recognised in the rail industry Air Quality Strategic Framework<sup>1</sup> and Sustainable Rail Blueprint<sup>2</sup>. It is also included in the 2022 Chief Medical Officer's annual report<sup>3</sup>.

Diesel trains cannot operate without some stationary idling time. As such, idling can be considered either unavoidable or avoidable:

- **Unavoidable idling:** When a train arrives at a terminating stop, the engine may need to run for a few minutes to allow passengers to disembark and for the driver to go through the shutdown procedures. This period of idling is unavoidable. Prior to departure, the engine will need to run for a few minutes to prepare the train for departure. This builds up air pressure so that the brake system will operate and heats or cools the compartment carriages to a comfortable temperature. This period of idling is also unavoidable. Another example of unavoidable idling occurs while waiting at a stop signal: engines need to be kept running to ensure the train can move off as soon as it is allowed to proceed. In addition, there is little benefit in shutting down engines for stops that are less than 10 minutes. During extreme cold, it may also be necessary to run the engines during stabling to prevent engine damage.
- **Avoidable idling:** during long stops at terminating stations and while stabling, engines are sometimes left running for long periods that can last for several hours. Between the two unavoidable idling periods when a train is being shut down after arrival and when it is being prepared for departure, there is a period of potentially avoidable idling when the engines could be shut down.

---

<sup>1</sup> <https://www.rssb.co.uk/sustainability/clean-air/air-quality-strategic-framework>

<sup>2</sup> <https://www.rssb.co.uk/sustainability/sustainable-rail-blueprint>

<sup>3</sup> <https://assets.publishing.service.gov.uk/media/639aeb81e90e0721889bbf2f/chief-medical-officers-annual-report-air-pollution-dec-2022.pdf>

Reducing idling has numerous benefits:

- It reduces the amount of diesel fuel used and saves money.
- It reduces exhaust emissions, which improves the air quality in the local area and reduces the societal costs of air pollution and carbon emissions.
- It reduces the impact of noise on staff and neighbours.
- It can lead to a reduction in maintenance costs as engines are running less, which may allow for longer time periods between servicing. However, this benefit could be offset with a greater number of engine restarts, which could lead to additional wear on the engine and starter motor.

Emissions during idling may only be a small part of the total mass of emissions generated throughout the overall drive cycle of a train. However, they may be particularly important at key locations with existing air quality issues where concentrations of air quality pollutants are close to breaching an existing ambient air quality objective or potential rail air quality target. Idling reduction initiatives may therefore be justified at such locations. There is a need to identify, quantify, and potentially monitor the location and extent of avoidable idling to facilitate its reduction by industry stakeholders.

The aim of this document is to help TOCs to understand where and when idling is occurring across their operations. This will enable them to identify where realistic measures can be implemented to reduce the amount of avoidable idling practically and tractably. Measures that would eliminate idling in key locations, such as enclosed stations, include:

- deployment of new bi-mode rolling stock that can take exploit existing electrification infrastructure
- hybridisation of existing rolling stock, for example, retrofitting a new transmission and/or batteries
- full electrification.

However, such measures would require significant planning, investment, and a long lead time. This document discusses other practical and tractable actions that could reduce idling by existing diesel rolling stock.

## 1.1 Structure of this document

- **Section 2. Train idling:** why diesel trains idle, why this needs to be reduced, and the benefits that can result from reducing idling.
- **Section 3. Identifying and quantifying avoidable idling:** the data and tools available to quantify where and when idling is occurring.
- **Section 4. Understanding specific causes of potential avoidable idling:** investigating causes and opportunities to reduce avoidable idling.
- **Section 5. Techniques to reduce idling:** various changes that can reduce idling.
- **Section 6. Developing idling reduction strategies:** how to understand where potentially avoidable idling is occurring, consider effective approaches to reduce idling, and monitor the progress in reducing idling.

## 2 Train idling

### 2.1 Why do diesel trains idle?

Idling refers to when the train engines are running but not producing tractive power. The engines are still under load to generate electrical power for lighting, HVAC (heating, ventilation, and air conditioning), and train control systems. They also provide compressed air for the brake system, which, on some older trains, will be used for opening and closing doors and operating windscreen wipers. The air compressors may be driven directly by the engines or electrically driven. Under these idle loads, engines will consume diesel and produce NOx and particulate emissions. Engines can produce 40 kW or more of power at idle on some trains.

Diesel train engines may be left idling for prolonged periods when stationary to:

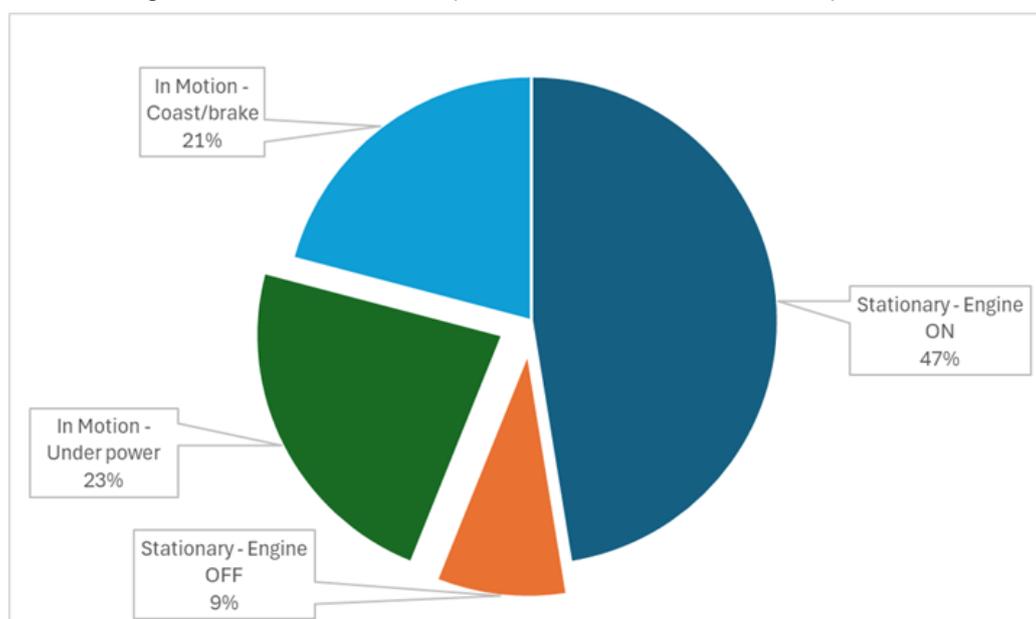
- warm up the engine before the first operation of the day.
- power HVAC systems to provide a suitable environment for passengers and staff. Engines may idle to power HVAC systems:
  - to prepare the train before its first operation of the day
  - during long stops at reversing stations where passengers remain on the train
  - during overnight stabling (to provide a comfortable environment for cleaning and technical staff)
  - to reduce the temperature in the passenger cabin on hot days.
    - On some older trains, this may be achieved through recovering heat from the engine's cooling system. Modern trains will also include air conditioning to cool the carriages.
- power interior lights for passengers while the train is stopped, especially during the hours of darkness.
- build up air pressure that powers the brake system prior to departure. Trains are generally unable to release their brakes and move until a certain air pressure level is reached. In some cases, door and windscreen wiper operation on older trains are also operated in this way.
- ensure operation. Engines may be difficult to start due to worn starter motors or poor battery performance. In these cases, they may be left running to avoid missing a scheduled departure due to delays starting the engines.
- keep engines warm and protect them from engine damage during periods of extreme cold, for example, keeping parts of the cooling system from freezing.
- await a delayed scheduled departure due to, for example, a blocked path or passenger movement issue.
- provide interior lights and electricity supply for train cleaners' vacuum cleaners.
- complete performance checks, testing, and some types of maintenance during maintenance activities.

The amount of idling will vary across the year, for example, there will be a larger energy demand for heating and lighting in the winter and a larger demand for the air conditioning in the summer. There will also be daily variations due to the local weather conditions.

Figure 1 shows an illustrative example of data collected from two diesel multiple units (DMUs) in routine operation for about a month. This included running scheduled timetables, overnight stabling, and time in depots. The data has been analysed to determine the amount of time in four different modes:

- Stationary – Engine OFF: the train is stationary (speed = 0) and all its engines have been shut down.
- In Motion – Under power: the train is in motion (speed > 0) and traction power is applied to the wheels (i.e. notch position is greater than zero).
- In Motion – Coast/brake: the train is in motion (speed > 0) and either coasting or braking. No traction power is applied to the wheels (i.e. notch is in the zero position).
- Stationary – Engine ON: the train is stationary (speed = 0) and the engines are running.

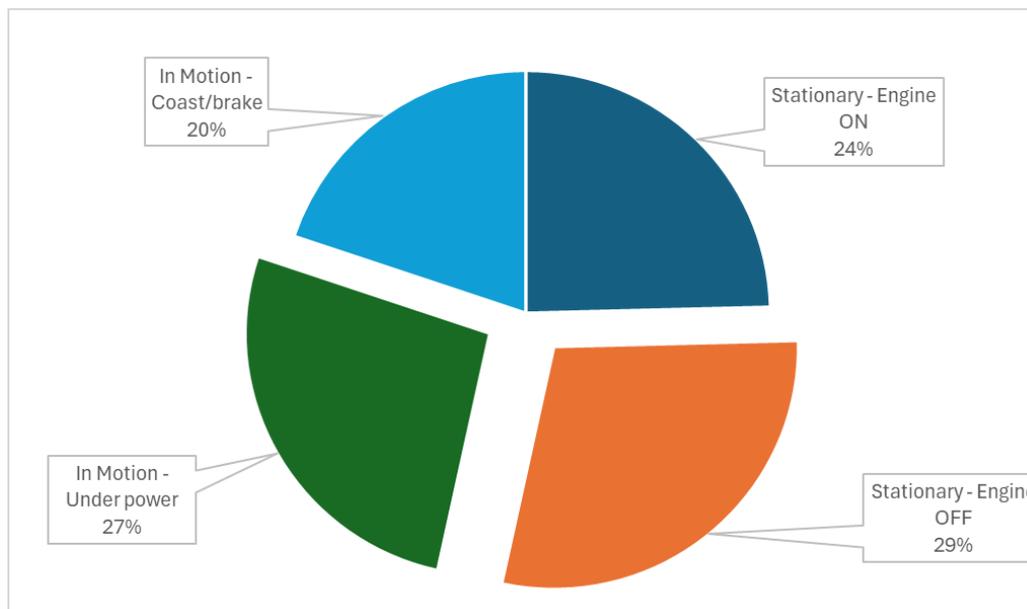
**Figure 1** Share of time spent in different modes – Example 1



In Figure 1, the trains are spending almost half of their time stationary with the engines idling. Including coasting/braking, the trains spend 68% (over two thirds) of all their time with their engines idling. Although it might not be possible to shut down the engine while in motion without engineering changes (for example, selective engine shutdown), there are likely to be practical opportunities to reduce idling while stationary.

Figure 2 presents similar data for another two DMUs but for a different train class and TOC. Although a similar proportion of the day is spent in motion, less than a quarter of the time (24%) is spent stationary with the engines running. This illustrates the variability in idling durations that occurs across the industry.

**Figure 2** Share of time spent in different modes – Example 2



Prolonged stops can occur at stations, depots, siding or elsewhere on the network. During some of these stops, the engines are left running. Data shows that some of these idling events exceed 12 hours. Idling is of greatest concern when it occurs at stations, where passengers and staff are exposed to the exhaust emissions. It is also important in depots and sidings, where staff and neighbours can also be affected.

## 2.2 Why do we need to reduce idling?

Engines consume diesel fuel while they are idling, resulting in exhaust emissions and noise pollution. Exhaust emissions affect local air quality, which has an impact on passengers and train staff, train despatchers, and those working at station retail and catering units. This is especially important at sensitive locations – typically enclosed stations served by a high number of diesel trains or stations where a high number of diesel trains terminate or reverse. RSSB provides data from the Air Quality Monitoring Network (AQMN) to help TOCs identify the locations with high pollution levels.

Proactive management of the amount of idling that occurs will reduce:

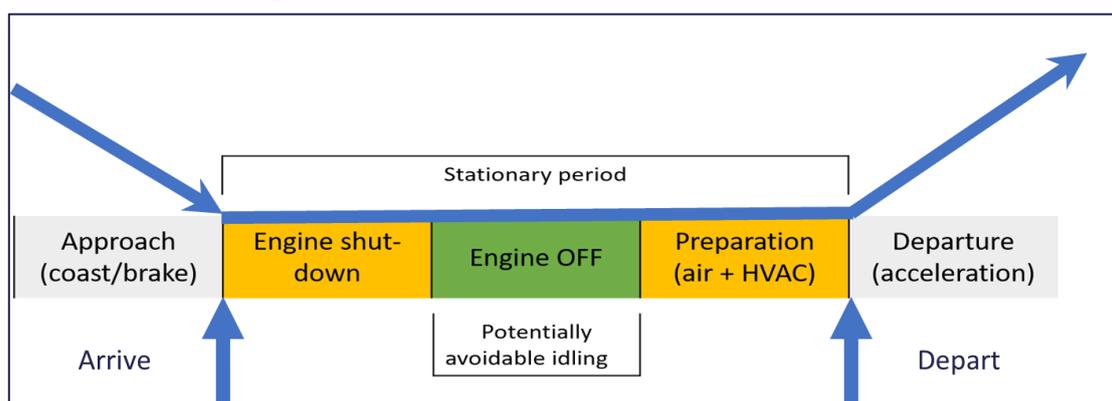
- the overall fuel costs. Analysis of data across the diesel fleet indicates that there is a potential to reduce the fuel consumed by up to 10%.
- exhaust emissions leading to improvements in the air quality experienced by passengers and staff in and around stations and depots.
- the amount of noise generated to benefit staff and passengers at stations and neighbouring residents. This may also reduce complaints from neighbours about excessive noise.

## 2.3 Potential avoidable idling

Some idling is necessary, but there are prolonged periods of time when the engines could be shut down. This is illustrated in Figure 3. There is limited benefit to shutting down the engines if a service stop at a station is very short or at a red signal when a train must be ready for a prompt departure. Furthermore, any benefit gained in reduced fuel consumption and emissions during a short stop will be lost by the restart penalties, that is the extra fuel needed to recharge the air systems and batteries after starting the engines and the excess emissions that occur during restarts, especially if the engines and emission control devices have cooled down.

Given the need for time to prepare trains for departure, stops with short dwell times are unlikely to be good opportunities to reduce stationary idling. Each fleet of trains has a particular requirement for preparation time that TOCs should seek to define. For the analysis conducted during the preparation of this document, stops over 10 minutes were considered as a conservative but reasonable threshold for identifying potential avoidable idling across multiple fleets. These longer stops would provide the opportunity to shut down the engines for a realistic period of time and allow time for the engines to be restarted prior to departure.

Figure 3 Potentially avoidable idling at a stop



Opportunities to shut down the engines include:

- at stations where a train terminates, reverses or otherwise has a prolonged planned dwell time
- while stabled overnight in stations, depots or sidings.

TOCs should decide what minimum stationary period durations to consider on the basis of their fleet characteristics and circumstances. For instance, the exact threshold may be affected by the time:

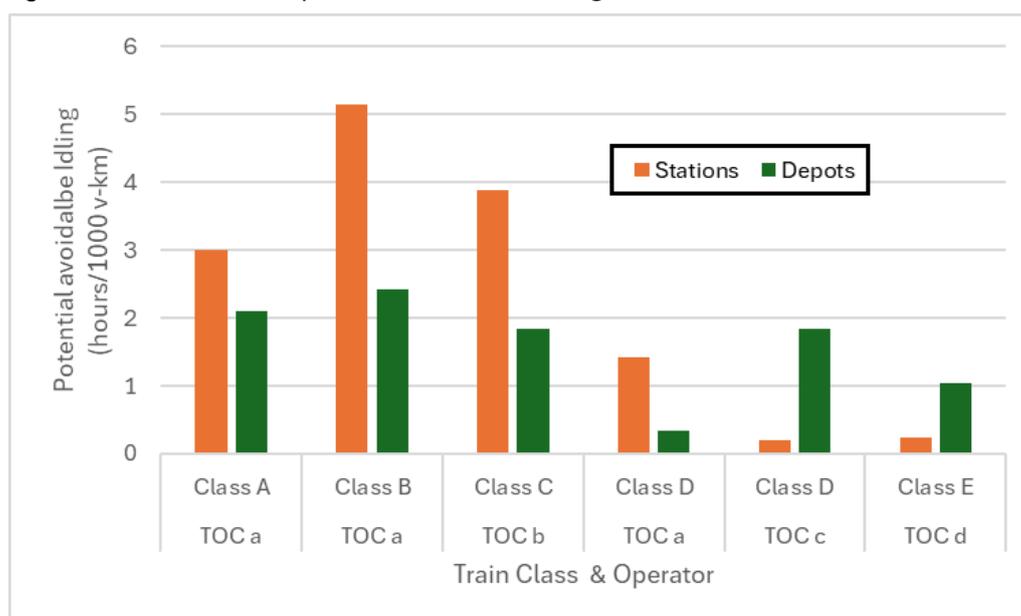
- that engines need to be running after arriving at a stop (for example, demands on the coolant system, shutdown routine)
- for a driver to change ends
- needed to prepare for departure, ensuring sufficient air pressure and a suitable passenger cabin environment.

Analysis of data from a sample of trains has shown that there are opportunities to reduce idling across the working day. **Error! Reference source not found.** shows the potential avoidable idling from a number of train classes (designated A-E) operated by different TOCs (designated a-d). These have been derived by analysing the distribution of stop durations and idling durations in the data, calculating the number of prolonged stops per 1,000 vehicle-km, and combining this with the observed distribution of idling events to derive a typical idling period in minutes. The amount of avoidable idle (assuming 2 minutes for engine shutdown and 5 minutes warm-up before departure) was used to derive the potential avoidable idling rates for different fleets. This analysis was done separately for stops at terminating stations and stops at depots.

For some TOCs, there is a larger amount of idle time that can be avoided at stations, typically due to trains that are stabled overnight at stations. For other TOCs, the biggest contributor is depots where the overnight stabling occurs.

The analysis illustrates both the amount of idling that can potentially be avoided and the variability in idling that occurs across the industry. There is not one simple solution to reduce idling. Each TOC must understand their daily operations, which may vary by train class, route and season.

**Figure 4** Variation in potential avoidable idling between TOCs and train classes



## 2.4 Potential benefits of reducing idling

Reducing idling can provide a number of financial and societal benefits, including:

- reduced diesel fuel costs:** leaving the engines idling for a long time uses a significant amount of diesel. The potential avoidable idling rates shown in Figure 4 was combined with data on annual vehicle-kilometres for all DMUs to estimate this national impact. Analysis carried out for the preparation of this document indicates that up to 8.5% of annual fuel usage of the GB DMU fleet

relates to potentially avoidable idling. As an illustrative example, at a cost for diesel of £0.60 per litre (excluding VAT and duty), this equates to more than £20m per year nationally.

- **improved air quality in stations and depots:** reducing emissions from avoidable idling will reduce air pollution, particularly in terminating and enclosed stations. This will lower passenger and staff exposure to air pollution and may help to improve customer perception of rail. Being seen as a clean transport mode could boost rail travel and, as a result, revenue.
- **reduced noise levels around depots and stabling locations:** this will support community wellbeing and rail's reputation as a good neighbour.
- **reduced air quality damage costs and carbon costs:** the emissions of NO<sub>x</sub> and PM have a damage cost associated with them, which represents the societal costs of their impact on human health. There is also a cost associated with the carbon emissions. Using central £/tonne values, national emissions from potentially avoidable idling are associated with total costs of over £45m per year. These costs are not a direct cost for TOCs, but they do have an indirect impact and reducing idling would reduce them. Enhancing operational efficiency and environmental sustainability would contribute to the rail industry's environmental and social value credentials.
- **reduced maintenance:** if engines are running less, there would be the potential for longer time periods between routine maintenance. This may result in lower annual maintenance costs. In addition, leaving the engine running for long periods can damage the engine, for example, glazed bores, sticky valves, or dropped pushrods. Glazing can result in diesel fuel diluting the engine oil, requiring additional oil changes. There is limited time available during servicing, so adding urgent additional items can mean that other issues are left until another time. Reduced engine running times would have to be offset with the additional number of engine restarts required. Restarts may cause additional wear on the engine (most engine wear occurs when cold) and on auxiliary components (for example, the starter motor), as well as a greater stress on the batteries.

## 3 Identifying and quantifying avoidable idling

Our research shows that there is a significant difference in the idling that occurs between different TOCs, train classes, and routes. There will also be variations in the overnight stabling locations, which may be depots, sidings on the network or stations.

Before avoidable idling can be addressed, it is vital that TOCs understand the amount of idling that occurs across their operations. This should include differences between scheduled services and routes, overnight stabling locations, and depots. TOCs could then focus first on the situations that will have the most impact for the most effective use of resources. However, a certain amount of knowledge and effort is needed to quantify the amount and location of idling that occurs across a fleet.

### 3.1 Data collection systems

The first step is to understand what data is available from the existing data systems and whether this can determine the on/off status of the engines. Sustainability staff and engineering staff should discuss what is available. Systems that could be used to analyse idling may already have been installed for other purposes, for example monitoring the condition of components such as engine temperature and turbocharger performance.

Data is available from on-train monitoring and recording (OTMR) and remote condition monitoring (RCM) systems. These systems track and store information on various operating parameters, which can vary substantially in number and scope. OTMR requires manual download of data from each train, whereas RCM allows remote access. Core parameters include train speed (mph or km/h) and command notch position. RCM systems typically include GPS data to identify the train location. This might not be available from older OTMR systems, though it might be available from a driver advisory system.

However, a typical issue is that data systems may not include the on/off status of the engines. Some RCM systems include engine speed, while others do not. This indicator is unlikely to be included in standard OTMR systems. There may be other parameters that can be used to derive the engine on/off status accurately, such as the battery voltage or the logging rate.

If TOCs install new or adapt existing monitoring systems to consider idling, it is important that the systems record:

- engine on/off status
- engine speed
- train speed
- train location.

A suitable data analysis system would show the time and location in various modes:

1. stationary (speed = 0), all engines off
2. stationary (speed = 0), engine(s) on, idling (notch position = 0)

3. moving (speed > 0), engine(s) on, under power (notch position > 0)
4. moving (speed > 0), engine(s) on, no power (notch position = 0).

This will enable the following conclusions to be drawn for each fleet/route combination:

- Identify locations where long periods of idling occurs, possibly set for sensitive locations (for example, enclosed terminating stations).
- Identify seasonal effects within the data, which may help identify the reasons for idling.
- Generate overall statistics, for example, the percentage of time idling, and trend analysis to show the impact of any idling reduction initiatives.
- Quantify the amount of time the train is moving but the engines are not applying power to the wheels (coasting and braking events). Note that one or more engine(s) may still be needed to provide compressed air and electricity. This would illustrate the opportunities for selective engine shutdown. For trains where selective engine shutdown is not possible, it will show the benefits of upgrading the train to allow some engines to be selectively shut down.

## 3.2 Data analysis systems

Analysing raw OTMR/RCM data can be challenging because:

- just gaining access to the data can be challenging. Most OTMR data requires manual downloads from the train, unless the recorder is new or retrofitted in the last few years. Plus, it is unlikely to be practical, due to high staff effort, to download the data regularly and then process and analyse it.
- raw OTMR and RCM data is typically in a native format, needing specific software to access or export the data.
- there can be issues and errors in the data that need careful examination and filtering.
- the data frequency changes depending on the status of the train, for example, operational or stabling.
- file sizes can be large, especially with RCM data, meaning large storage areas are needed to store and share the data.
- there may be multiple systems within a fleet that provide different details of operational data.
- TOCs may not have the capacity to analyse the raw data for their entire fleet.

To help solve these challenges, software solutions can be used to aggregate, process, and store the relevant raw data from the various trains in the fleet. User-friendly dashboards can enable TOCs to identify where and when idling occurs quickly. Alarms can also be set up to flag when long engine idling events occur at particular locations.

Care would be needed if such systems identify individual drivers—even indirectly, for example, through location, date, and time—as this may require clear communication and engagement with staff.

Data services to collect, hold, and process the data relating to idling are available commercially. Relevant suppliers would need to be approached to determine exact costs. These would depend on what equipment has already been installed and whether data collection and analysis systems are already in place, for example, for predictive maintenance alerts, operational analysis, delay investigation, or wheel-slip protection. Data systems also need to ensure that the status (on/off) of each engine can be determined, which is not always the case, even with some installations of RCM.

An indicative price may be £20-£30,000 per month for the aggregation, presentation, and easy access of the data for a particular fleet. Larger investments would be needed to install the RCM equipment and to transmit, handle and process the data.

## 4 Understanding specific causes of avoidable idling

To effectively address avoidable idling TOCs need to understand why engines are left running. As a first step, it is necessary to understand which systems need to run while a train is stationary and which are powered by the engines. The inability to shut down engines while stationary stems from the requirement to be able to power auxiliary and hotel loads that cannot be supplied by existing battery capabilities.

Electricity is consumed by various auxiliaries, including:

- the train control and signalling systems
- OTMR
- internal and external lights
- passenger information systems
- HVAC, though on many DMUs heat is recovered from the diesel engine on the vehicles
- door operation
- electrically powered air compressors.

However, batteries cannot be used for some purposes because:

- key items may be powered mechanically, not electrically; air compressors, for example, are not electrically powered on almost all DMUs.
- batteries may not be large enough or efficient enough to supply all systems.
- heating that is provided through heat recovery from the engine cooling system or an independent heat source (for instance, a Webasto heater) may cease functioning or lack the capacity to provide sufficient heat in the coldest weather conditions.

TOCs should study these systems as they apply to each of their fleets. A key consideration is how long each system needs to run to achieve a particular objective. For instance:

- For HVAC systems: how long does it take to increase or decrease passenger cabin temperature to a target temperature for a given ambient temperature? This should be considered when the vehicle doors are open and closed.
- For vehicle air systems: what is the time needed for an air compressor to run to achieve and maintain sufficient pressure in the main air brake reservoir?
- For battery recharging: how long after an engine is shut down does it need to be run again to recharge batteries? The discharge rate of battery systems due either to vehicle system loads while the engine is shut down, which will itself need detailed investigation, or the battery health and self-discharge rates.

- A better understanding of existing electrical loads and how they can vary on DMUs is required: can the existing battery meet these loads and for how long? Would the current battery be able to handle larger electrical hotel loads?

This analysis will yield the rate at which a system must operate to achieve a necessary condition or status. The rate will vary both by rolling stock class and within rolling stock class. An individual unit not being able to perform in line with these expectations would indicate a requirement for maintenance on that particular unit. For example, air conditioning struggling to cool the passenger cabin, high air leakage rates, or batteries not being able to maintain charge.

By considering realistic start and end points, the window of 'on time' required for a particular system, and the associated power requirements, can be defined. This becomes a key starting point to investigate potential changes to systems and equipment. For example:

- a bigger compressor and an air system with fewer leaks could reach and maintain the required air pressure quicker than a current system, shortening the time before a train would be ready for departure.
- additionally, if an electrically powered compressor is installed, then whether the batteries have sufficient capacity to enable the required air pressure to be achieved needs to be determined. In some cases, it may be that a battery system with a higher capacity would be beneficial.

This enhanced understanding can assist in defining minimum sensible recommendations for specifications for these systems to enable greater engine shutdown. The [Key Train Requirements \(KTR\)](#) document sets out requirements for systems for new and refurbished rolling stock.

To develop effective measures to reduce avoidable idling, it is necessary to gather relevant information to understand the current situation and to identify opportunities. It is important to continue to monitor relevant indicators and parameters after implementation. This is to ensure that new measures (covered in Section 5) are effective at reducing idling, while other requirements (for example, air pressure, hotel loads) continue to be met.

## 5 Techniques to reduce idling

Techniques to reduce idling are split into three categories:

1. behavioural changes
2. operational changes
3. engineering changes.

This categorisation generally progresses from the simplest techniques to more complex and expensive techniques. Applicability, effectiveness, and the time to realise the benefits of individual techniques will depend on the particular circumstances of the TOC (for example, service types, routes and rolling stock).

### 5.1 Behavioural changes

#### 5.1.1 Staff education

All relevant staff, including drivers, driver managers, controllers, maintenance staff, and platform staff, should be educated on the problems associated with idling. This should cover the impacts of idling, for instance, air quality pollution and noise pollution and their effects on staff, passengers, and neighbours. The expected actions and responsibilities of each staff role to implement a TOC's idling reduction policy should be clearly communicated.

Education could take the form of training sessions (face-to-face or remote) or be added to existing communications to drivers and other staff. Clear communication and explanation of the issues should be a priority. Priority locations on particular services and routes can be identified based on TOC-specific data analysis (see Section 3). Regular newsletters could include updates on idling statistics, locations where idling occurs, and locations where improvements have been made.

Drivers are typically assessed two or three times a year. The assessments could include compliance with idling reduction policies, eco-driving, and other professional driving policies that are already driven by data analysis.

Spot checks during shifts could also be carried out. Station staff could be encouraged to identify instances of excessive idling and discuss with drivers whether engines could be shut down. An escalation procedure could draw attention to persistent occurrences.

#### 5.1.2 Signage

Signs could be placed in the cab to encourage the driver to shut down the engines on arrival at stations, when appropriate, where there will be a lengthy stationary period (for example, over 10 minutes). Additionally, signs on platforms at key terminating stations could remind drivers to shut down the engines.

#### 5.1.3 Train crew notices

Notices could be issued to remind drivers of requirements at known problem areas along the route. Drivers are required to check for notices and noticeboards when they are booking on for duty.

## 5.2 Operational changes

### 5.2.1 Driver diagrams

The Rule Book mandates that a train must be left in a safe condition when unstaffed. This leads to different requirements for engine shutdown and air system discharge depending on the particular staffing circumstances. For instance, these requirements may vary for a crew changing ends, for a crew handover, or for leaving a train unattended, depending on the location (for example, depots or stations).

The driver diagrams and the instructions they contain are developed by TOCs to align with their operational requirements for the service, which must also align with the requirements of the Rule Book. With differing procedures required at stations and depots, there is significant complexity, and specific situations need to be considered carefully.

Instructions to shut down the engines could be included in the driver diagrams. This may require additional time to be allocated to the drivers for restarting the engines and preparing the train ahead of departure. An automatic engine stop/start system could help reduce the impact on driver workload. Any operational changes would need engagement with relevant stakeholders.

### 5.2.2 Timetable adherence and timetable changes

Drivers could also be discouraged from arriving early at stations to reduce the amount of time that the train is stationary. DAS could be used to inform where it would be appropriate to reduce speed in order to arrive at the next stop just on time. These aspects should be included in eco-driving and professional driving policies.

It is also important to highlight the impact of delayed departures. Whilst a delayed departure is not considered as avoidable idling in this guide, the data analysis shows that a considerable proportion of the time diesel trains spend idling in stations is caused by delayed departure. This can be caused by:

- lost path because of other late trains
- late arrival of drivers or crew
- slow closing of the doors at departure time
- passenger overcrowding causing slow alighting and boarding.

TOCs can investigate the reasons for delayed departure using the [Quartz station dashboard](#), which uses data sourced from the Network Rail open data feeds. A time and motion study could improve understanding of the underlying reasons for delays.

Timetable changes could reduce the amount of time that trains are stationary at terminating and reversing stations and thus reduce the amount of idling in sensitive locations such as enclosed stations. Where possible more use could be made of stabling and reversing sidings outside stations.

### 5.2.3 Location management

Some locations have proactive management, with special conditions imposed on diesel trains. For example, at Stansted Airport, station diesel trains are required to stop outside of the area covered by the station roof to enable dispersion of pollutants. Electric trains can stop under cover at this location. This approach would need a careful consideration of passenger movements through stations where such an approach may be applicable.

## 5.3 Engineering changes

A number of technical engineering changes could be implemented to reduce idling. Their applicability varies by TOC fleet, and this requires TOCs to have a deep understanding of their current fleet functionality.

### 5.3.1 Shore supplies

Shore supplies could be provided at major terminating stations, especially at high-risk locations where there would be the greatest benefit, for example, enclosed stations. Trains that are scheduled to be stationary for a significant amount of time could be plugged into the shore supply and the engines shut down. This would require an appropriately trained staff member to connect and disconnect the shore supply. Bear in mind, qualified roles and training for shore supply vary across TOCs, which already actively use shore supply.

The shore supply would need to provide electrical power to the train to support interior lighting and, ideally, the HVAC. The shore supply should also support the compressed air system by either providing compressed air or electricity to drive on-board compressors. Safety locks would prevent the train from departing while still connected to the shore supply. This could be a driver console and brakes lock on while connected to the shore supply.

Shore supply may not be suitable for all trains. In some cases modifications may be needed to the rolling stock. Furthermore, there is range of connectors in use, which varies between, and sometimes within, train classes. This issue could be overcome by developing suitable adaptors. Availability of a suitable power supply at the location will be another consideration.

### 5.3.2 Automatic engine stop/start

Automatic or remote engine stop/start would allow engines to be shut down on arrival at a terminating station or depot. Many DMUs have automatic engine stop systems, though usage varies, and they can often be overridden. In some cases, engines can be automatically restarted in time to prepare for the scheduled departure or in time for scheduled servicing/cleaning. A safety lock/system would need to be included to ensure that the engines are not restarted while technicians are working on them. Remote start/stop systems would appear to be feasible in many cases, although it requires ongoing good battery health to maintain auxiliary systems.

### 5.3.3 Improve restart reliability

Poor restart reliability of older rolling stock can discourage drivers from shutting down engines. The restart reliability could be improved by investigating the cause of the poor reliability. Causes include, in order of importance:

- insufficient electrical power from the battery pack, due to its limited capacity, low state of charge or its health
- poorly performing starter motor, for example worn starter motor bearings/gear
- issues with the fuelling system, such as leaky or blocked injectors, and faulty glow plugs.

Improvements could include upgrading starter motors, a campaign to improve existing battery health, and increasing the capacity of the batteries. A battery status monitoring system could address reliability. This would inform the driver whether the battery systems would be capable of restarting the engines before the driver shuts down the engines. The monitoring system would also indicate to maintenance providers when batteries are due for replacement because they can no longer sustain required charge levels.

### 5.3.4 Improve air systems

Some drivers leave the engines running to maintain the air pressure while stopped and prevent delays when departing. Air leaks cause the air pressure in the system to drop while the engines are off when mechanically powered compressors are used. A campaign of maintenance could be undertaken to find the leaks in the system and fix them. However, finding these leaks can take a considerable amount of time and effort.

### 5.3.5 Air compressors

Some systems take a long time to build up air pressure from zero, even if the system is healthy. However, if the vehicle is parked up fully pressurised, then even after a 1-hour layover, it should only take 3 or 4 minutes to restore the air pressure. Drivers are likely to allow for the preparation time needed, based on the worst performing unit they have experienced. It is therefore important to understand the performance of the air compressors in the fleet, especially the worst performing ones. The compressors of these trains could be upgraded to improve the pressure build up and reduce the time needed, for instance, larger capacity. Alternatively, electricity-driven compressors could replace engine-driven ones, although this would be a significant modification.

### 5.3.6 Cross feeding of auxiliary supply

Adjacent cars can cross-feed auxiliary power. However, issues will arise if a compressor is inoperable and the adjacent car shuts down. An engine, or even two engines, can be shut down or rendered inoperable, and the train can still be run, depending on which engine or engines are lost within the consist. Not being able to cross feed electrical power between vehicles means engines must be running for the vehicle they are mounted on.

### 5.3.7 Heaters

Small diesel heaters (for example, Webasto heaters) can be used to provide heating instead of running the engines. These can be used to preheat the engines prior to starting and to maintain temperature in the cab and the passenger compartments. Given challenges of low reliability with some examples of this equipment, it will be important to ensure such heaters function as anticipated. These heaters may be worth considering for retrospective introduction to other fleets.

## 6 Developing idling reduction strategies

To be able to reduce idling, there is a need to identify where avoidable idling occurs, identify the biggest wins and develop an action plan to reduce idling. A systematic approach is required. This can be developed as a standalone idling reduction strategy or included in an [air quality improvement plan](#). The process followed should be documented in accordance with the AQIP template. The recommended approach is:

1. develop data analysis capability
2. identify potential avoidable idling
3. understand the causes
4. develop effective idling reduction approaches
5. target interventions
6. develop idling KPIs
7. track progress.

### 6.1 Develop data analysis capability

TOCs should work to improve the understanding of how their diesel fleets operate. Where possible, engine monitoring systems to consider idling should be installed. The systems should record:

- engine on/off status
- engine speed
- train speed
- train location.

Some money and effort will need to be invested initially in data systems to understand the scope, extent, and cause of avoidable idling before the cost of any solutions can be assessed. Improving data collection and analysis is an important step. It will also enable monitoring of the effectiveness of any initiatives that are subsequently implemented. Capable staff members, with knowledge and/or experience of relevant operations and departments, will be needed to make effective use of the data collected.

### 6.2 Identify potential avoidable idling

The next step in the process is to identify where and when idling is occurring, especially potentially avoidable idling. Idling at stop signals is unavoidable, as the train would need to move off promptly once it receives the proceed signal. Short stops at intermediate stations on a route are unlikely to be long enough to be a target for idling reduction. However, TOCs should consider if there are consistent delays in departure resulting in longer dwell times than timetabled. The [Quartz station dashboard](#) is a useful resource. Improved on-time departure rates would have wider performance benefits.

Idling analysis should concentrate on terminating stations, stations with prolonged dwell times for timetable resilience, stabling locations (station, depot or sidings), and maintenance depots. The analysis should consider the total time stationary with the engines idling, as well as the number of events and time spent at long stops (for example, over 10 minutes). An example template used to track idling is shown in Table 1. It could be modified as needed.

For trains where selective engine shutdown is possible, the number of engines running and the number of engines shut down also need to be captured. This template can also be used to document the operational patterns of different rolling stock

Once the data has been analysed, the locations and the train classes with the highest amount of idling can be identified. The data needs to be collected first before assessing the effectiveness of particular solutions.

Table 1 Example template for tracking idling

Observation period	Train class	Route		Stabling location	Maintenance location	Maintenance location managed by?	Terminating stations or depots	Sensitive location?	Quantification of idling				
		From	To						Number of instances	Minimum duration	Average duration	Maximum duration	Total duration
xxx	xxx	xxx	xxx	xxx	xxx	xxx	Station A	Yes					
							Station B	No					
							Depot C	Yes					
							Station D	No					

### 6.3 Understand the causes

Once avoidable idling has been identified, the reasons can be identified. Is this simply normal practice or abnormal operating circumstances, such as a signalling fault? Or are there technical reasons for leaving the engine idling, such as poor restart reliability, leaky air system, or maintaining comfortable temperature in the compartments?

In some cases, the drivers might default to the worst possible case; for example, if one train in a particular fleet takes 30 minutes to build air pressure, then the driver might leave all such trains running for at least 30 minutes before departure, even though most would only take 5 minutes to build up the required air pressure.

### 6.4 Develop effective reduction approaches

Knowing the causes of the idling gives an indication of the best procedures to reduce idling. This could include operational changes; for example, giving instructions to drivers to shut down the engine on arrival at specific locations. In some cases, technical solutions might be required; for example, upgrading battery systems to improve restart reliability. It should be possible to introduce combinations of solutions in parallel with each other, although in some cases there may be overlap in the impacts of some measures.

Idling reduction policies should be updated in accordance with the approaches developed. The policies should contain specific timings and clear instructions for when and where engines should be shutdown, as per the TOC's particular circumstances and the extent, location and causes of avoidable idling. The policies should be well publicised within the TOC so that all staff understand their responsibilities.

### 6.5 Target interventions

From the initial analysis, idling reduction should initially be focused on the areas that would provide the biggest gains with the smallest effort, that is the largest, most tractable situations. This approach might target high-risk locations, such as enclosed stations or depots and sidings near residential areas, where there are air quality or noise issues. Subsequently, other areas can be targeted; these could be prioritised according to their impact/effort ratio. This information can then be used to produce an action plan to reduce idling across the fleet that is specific to a TOC's particular circumstances.

Costs of implementing solutions can only be assessed once the particular suite of solutions determined to have the most impact has been identified. Exact net costs and overall benefits will be specific to a TOC's situation and rolling stock.

### 6.6 Develop idling key performance indicators

TOCs need to consider reasonable aims, approaches and effective interventions, and then to develop KPIs appropriately tailored to their particular operations and their particular idling reduction solutions. A

fundamental prerequisite to develop and then track KPIs will be an effective data system to monitor and analyse the scope and extent of idling on an ongoing and continuous basis.

Certain metrics could be considered that may become KPIs, though these may need to be tailored for a particular fleet and operations. The following are metrics that could be considered:

- TOC based: total diesel used per vehicle-km
- Train based: minutes of prolonged idling per 1,000 vehicle-km
- Location based: minutes of prolonged idling per day
- Amount of idling at terminating stations versus depots
- Amount of idling while stabled (station or depot)
- Amount of idling within a driver diagram (i.e. between trips)
- Amount of idling between driver diagrams (i.e. at driver changeover).

These metrics could be generated from the data in completed copies of the template discussed above. It should be possible to set up a system that calculates the KPIs once the templates are filled in with the latest data. It is important to ensure that improvements in idling are maintained by regularly updating the data and refining the KPIs. Tractable targets should be set to reduce idling and the highest priority locations identified.

## 6.7 Track progress

Once any changes are put in place, it is important to monitor changes to see if the campaign has been successful. This may also need to consider seasonal effects; for example, comparing idling in December to idling in June could be influenced by the ambient temperature. It is therefore important to compare similar operating conditions and routes. Timetable changes may also affect any comparisons, which will need to be considered.

Depending on the cost of monitoring, TOCs may wish to finish engine monitoring after a change has been implemented and avoidable idling has been reduced as far as practicable. The TOC will just need to maintain any new systems installed and ensure that correct procedures are followed. It may be that monitoring systems are retained for other purposes, for example, condition-based maintenance, so periodic checks on data relating to idling can be made.



**Contact:** <https://customer-portal.rssb.co.uk/>  
**Web:** [www.rssb.co.uk](http://www.rssb.co.uk)

RSSB  
25 Fenchurch Avenue  
London  
EC3M 5AD