IFF Research

Non-agricultural use of red diesel for non-road mobile machinery

HM Revenue & Customs and HM Treasury Research Report 534

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Executive Summary

Background and research objectives

Red diesel is a marked gas oil used to power predominantly off-road vehicles and machinery and is subject to a lower rate of Fuel Duty. In industries such as construction, waste management, mining and quarrying, and airports, red diesel is commonly used in non-road mobile machinery. These machines are portable, engine-operated machinery such as wheeled excavators, dump trucks, drill rigs, aircraft tugs and mobile generators.

At Spring Budget 2017 the government announced a call for evidence on the use of red diesel in order to improve its understanding of how red diesel is used. The context behind the call for evidence was the Government's targets for reducing air pollutants (such as nitrogen oxides and fine particulate matter which are emitted during the combustion process of diesel) by 2020 and 2030.

To complement this call for evidence, HM Revenue & Customs (HMRC) and HM Treasury commissioned IFF Research to carry out a telephone survey of 500 UK businesses using non-road mobile machinery in industries other than agriculture, forestry and fishing, which were outside the scope of the research. The research also comprised 20 in-depth interviews with manufacturers of these machines – as well as those who lease and/or hire out such machinery to businesses – to better understand the availability of alternative technologies to red diesel fuelled machines.

The core objectives of the research were to:

- Understand the use of red diesel in non-road mobile machinery;
- Understand red diesel users' awareness of cleaner technologies; and
- Understand what could be done to accelerate the uptake of cleaner air technologies/engines amongst red diesel users.

There are no known population statistics on businesses that use non-road mobile machinery and so the survey data presented in this report is unweighted.

Key findings from the survey among businesses using non-road mobile machinery

Among the surveyed businesses using red diesel fuelled non-road mobile machinery, median total red diesel use in a typical year was 15,000 litres. This varied substantially by sector, with a median of 4,000 litres among construction businesses and 33,000 litres among those in other sectors (such as mining and quarrying and waste management). Unsurprisingly, the volume of red diesel used in a typical year was higher among large businesses compared with smaller ones (whether company size is measured in terms of number of employees or annual turnover).

The median annual total fuel spend was £30,000 across all businesses surveyed; £15,000 among construction firms and £73,000 among those in other sectors. As a proportion of total fuel spend in a typical year, spend on red diesel accounted for a median of 40% across all businesses surveyed (20% among construction and 65% among other sectors).

Where alternatives to red diesel were currently being used, it was most common among businesses using ground cutting, compaction and finishing machines. Around two thirds (67%) of businesses using these machines were using alternative fuels/technologies in at least some of their machines. Half (51%) of businesses using generators were using alternatives in at least some of these

machines, and 38% of businesses using material handlers had at least some of these machines running on alternatives to red diesel. Use of alternatives were least common for mining and quarrying machines where 98% of businesses using them reported that all their machines run exclusively on red diesel.

Where employers were using alternatives in at least some of their machines, the most common alternative fuels being used were petrol (used by 41% of businesses using alternatives) and electricity (37%).

Alongside use of alternatives to red diesel, the survey explored wider awareness of alternative technologies. Users of red diesel fuelled machines were most commonly aware of electrical alternatives for their machines. For instance, one third of businesses using material handlers (34%) and ground cutting, compaction and finishing machines (34%) were aware of electrical alternatives for at least some of these machines. Awareness of biodiesel/biofuel was highest for users of recycling and waste management machines (20%). Despite these levels of awareness of alternatives across different machine types, few businesses had considered switching to them in place of red diesel.

Looking more to the future, 17% of all businesses surveyed reported they were planning to switch to, or increase their use of, alternative technologies to red diesel in the next five years. This was higher among businesses in the construction sector compared with other sectors (20% compared with 12%, respectively). Of those with plans to increase their use of alternatives, most (58%) expected to increase their use of electric machines.

In addition to plans to increase use of alternatives, businesses were generally receptive to increasing their use of alternatives if the technology exists: a net of 64% of businesses agreed with the statement 'if the technology improves we would be prepared to switch to cleaner alternatives to red diesel.' However, this level of agreement reduced substantially if a switch to alternative technologies were to be accompanied with either a capital investment (net agreement of 10%) or higher running costs (net disagreement of -17%)[1].

Key findings from qualitative interviews with manufacturers and suppliers of non-road mobile machinery

The manufacturers of non-road mobile machinery – as well as those who lease and/or hire out such machinery to businesses – interviewed for this research generally felt that their end customers were aware of the emissions from their machines and aware of potential alternative technologies to red diesel. However, very few had experience of customers enquiring about the availability of alternatives to red diesel. This was largely due to end customers simply expecting that the machines they acquire will run on red diesel, alongside the general lack of viable alternative technologies, particularly for large machines. Where such enquiries had been received, this was typically for material handlers used on projects where they might need to operate indoors, as diesel emissions would pose a greater health risk to machine operators in confined environments.

Whilst awareness of electric alternatives to red diesel machines was highest among businesses in the quantitative survey, manufacturers and leasers of non-road mobile machinery felt that businesses would have health and safety concerns over using such machinery – perhaps indicating a disparity between what manufacturers and leasers think and what the users know. For example, the presence of high voltage cables on a construction site with other heavy, mobile machinery would cause

[1] Businesses with a higher net agree score demonstrate a greener/cleaner perspective.

concern. There were also concerns around the ease and/or economics of installing the necessary infrastructure – such as charging points – on construction sites.

Manufacturers of non-road mobile machinery also felt that resale value is a key consideration for businesses purchasing non-road mobile machinery. With the current limited market of other businesses using alternative technologies to red diesel it was felt that an inability to resell their machines after a few years' use would make acquiring such machines less desirable compared with those running on red diesel.

Among the manufacturers and plant hire companies interviewed, there were only a few examples of companies having plans to develop and/or expand their offering of machines which run on alternatives to red diesel. These included a manufacturer planning to develop hybrid excavators in the 14-20 tonne range. Among most of those interviewed, a greater focus was on ensuring the diesel machines they produce/supply are up-to-date and comply with the latest regulations regarding emission standards.

When asked if changes to the Fuel Duty associated with red diesel would change their plans to develop/supply non-diesel alternatives, manufactures and plant hire companies had mixed views. Most felt that it would simply lead to the increased running costs being passed on to end customers due to the lack of viable alternative technologies, though a few felt that it would help to make alternatives – such as hydrotreated vegetable oil (HVO) – more viable by reducing the cost differential between red diesel and alternative fuels.

1 Introduction

Background and research objectives

1.1 Red diesel is a marked gas oil used to power predominantly off-road vehicles and machinery in industries ranging from agriculture and construction to quarrying and waste management. With the same chemical composition as white (road) diesel, it is dyed red to distinguish it from white diesel as it is subject to a lower effective rate of Fuel Duty.[2]

1.2 The use of red diesel is approved for any purpose other than the propulsion of road vehicles[3] and is estimated to account for 15% of total diesel use in the UK.[4]

1.3 HMRC approves red diesel suppliers under the Registered Dealers in Controlled Oil (RDCO) scheme, meaning the Government has an understanding of the suppliers and distributors of red diesel.[5] Much less is known, however, about the end users of red diesel, including their motivations for using the fuel in preference to alternative technologies.

1.5 In May 2018, HM Treasury and the Department for Environment, Food & Rural Affairs (DEFRA) announced a call for evidence regarding the use of red diesel in a class of machinery known as non-road mobile machinery which is portable, engine-operated machinery. The context behind the call for evidence was the Government's targets for reducing air pollutants (such as nitrogen oxides and fine particulate matter which are emitted during the combustion process of diesel)[6] by 2020 and 2030.The call for evidence sought to explore the quantities of non-road mobile machinery and red diesel used across different sectors, the value of the fuel duty rebate to those industries which benefit, the reasons for red diesel use and the cleaner alternatives that currently or will soon exist. The use of red diesel in the context of farming, fishing, home heating and other stationary applications were outside the scope of this call for evidence.

1.4 To complement this call for evidence, HMRC and HM Treasury commissioned IFF Research to carry out a survey of businesses using non-road mobile machinery in several key industries (including construction, mining and quarrying, waste management and airports)[7] to gain further understanding on the use of red diesel in such industries, motivations for using red diesel and the availability of alternative technologies. To complement the quantitative survey, the research also included qualitative interviews with manufacturers of non-road mobile machinery and diesel engines – as well as those who lease and/or hire out such machinery to businesses − in order to better understand the availability of alternative technologies to red diesel.

1.5 In summary, the core objectives of the research were to:

[2] At the time of this report (November 2018) the effective rate of Fuel Duty (after rebate) was £0.1114 per litre for red diesel compared with £0.5795 per litre for white diesel.
[3] Vehicles constructed or adapted for use on roads, but not including any excepted vehicle as described in Schedule 1 of the Hydrocarbon Oil Duties Act (HODA) 1979.
[4] HM Treasury – Red diesel: call for evidence (https://www.gov.uk/government/consultations/red-diesel-call-for-evidence/red-diesel-call-for-evidence)
[5] https://www.gov.uk/government/publications/excise-notice-192-registered-dealers-in-controlled-oil
[6] https://consult.defra.gov.uk/airquality/non-road-mobile-machinery-and-red-diesel/supporting_documents/reddieselnrmmcallforevidence.pdf
[7] In line with the HM Treasury and DEFRA call for evidence, the use of red diesel in the context of farming, fishing, home heating and other stationary applications were outside the scope of this research.

- Understand the use of red diesel in non-road mobile machinery;
- Understand red diesel users' awareness of cleaner technologies; and
- Understand what could be done to accelerate the uptake of cleaner air technologies/engines amongst red diesel users.

1.6 Note that in this report non-road mobile machinery is sometimes referred to by the acronym 'NRMM' and that references to machines or machinery fall under this category, unless otherwise stated.

Methodology

1.7 The research comprised two core components:

- A quantitative telephone survey with 500 UK businesses using non-road mobile machinery; and
- 20 qualitative interviews with manufacturers of non-road mobile machinery and diesel engines, as well as those that lease and/or hire out these machines to businesses.

1.8 This chapter outlines the methodology used for carrying out the research. Further detail about the methodology, including the full profiles of participating businesses, is provided in Appendix A.

Quantitative survey

1.9 A total of 500 interviews were conducted with individuals with decision-making responsibility for (or those with oversight of) the machines used by their company.

1.10 The survey lasted an average of 20 minutes and fieldwork was conducted by IFF Research using Computer Assisted Telephone Interviewing (CATI) between 16 August and 10 September 2018.

1.11 A database of companies using non-road mobile machinery did not exist, therefore the sample needed to be screened to identify companies that used these machines. A starting sample was purchased from the commercial data supplier, Market Location. Sample was drawn from sectors that were in-scope for the research[8] and for who it was believed the use of relevant machinery would be common – i.e. construction, mining & quarrying, airports, waste management, mobile heating and mobile refrigeration.

1.12 A total of 9,200 records (5,200 of which were construction firms, reflecting the size of this sector relative to the others), with 6,300 called to achieve the 500 interviews. A large sample was required due to uncertainty over whether the businesses being called would be eligible for the research – i.e. whether they use non-road mobile machinery. At the end of fieldwork a large proportion (65%) of the records that had been called were still 'live' (i.e. a final call outcome had not been established) and their eligibility for the research was unknown. Due to this uncertainty it is difficulty to establish a response rate for this survey.

[8] i.e. Sectors outside of agriculture, horticulture, forestry and fishing.

1.13 Table 1.1 provides detail on the profile of the 500 interviews achieved by sector and use of red diesel. Additional tables in Appendix A provide further breakdowns by size, turnover and geography.

Table 1.1 Profile of achieved interviews

	Achieved interviews
Total	500
By sector	
Construction	316
Other	184
- *Mining & quarrying*	*74*
- *Waste management*	*46*
- *Mobile refrigeration*	*24*
- *Airports*	*22*
- *Mobile heating*	*18*
By red diesel use in non-road mobile machinery	
Any red diesel use	317 (63%)
No red diesel use	163 (33%)
Don't know	20 (4%)

Qualitative interviews

1.14 To gain insight into the current and future availability of alternatives to red diesel, as well as perspectives on what could accelerate the uptake of cleaner alternatives to red diesel, 20 qualitative interviews with manufacturers of non-road mobile machinery (13 of the 20 interviews) and those that lease and/or hire out such machinery to other businesses (seven of the 20 interviews) were carried out between 13 September and 18 October 2018. Interviews were conducted with senior individuals within these companies; typically the owner, managing director or (particularly for larger companies) the operations director, or other senior figure.

1.15 Sample for the interviews were compiled primarily through a 'free find' exercise, making use of trade association websites which list members, as well as some businesses identified as plant hire or manufacturers which were purchased from Market Location's database.

1.16 Interviews were carried out face-to-face, though telephone interviews were offered where it was more convenient for the respondent. The interviews were guided by a topic guide designed to last around 45 minutes.

Approach to analysis

Quantitative survey

1.17 It was not possible to weight the survey data due to there being no known population statistics on businesses that use non-road mobile machinery. Data presented in this report are therefore unweighted and reflects the experiences and opinions of the 500 businesses surveyed.

1.18 Sub-group analysis has been conducted on all data collected and is referred to in this report where statistically significant.[9] In a few cases, sub-group differences that are not statistically significant but which are potentially of interest are highlighted and clearly marked in the report.

1.19 Due to the small base size of many of the sectors outside of construction, reporting by sector in this report primarily focuses on construction compared with all other sectors as a single grouping. Where relevant, findings for the mining & quarrying sector (which forms part of the 'other' grouping of sectors but which itself has a base size of 74) has been presented. Any data with a base size of less than 35 has been omitted from this report.

1.20 'Don't know' or 'prefer not to say' responses have not been included in some tables and figures for simplicity, as the proportions were often negligible and did not add to the overall narrative. Consequently, not all figures shown in the tables and figures will necessarily sum to a total of 100%. Figures may also not add to a total of 100% if more than one response was possible. Where all responses have been included, figures may not sum to exactly 100% due to rounding.

Qualitative interviews

1.21 This strand aimed to get a range of perspectives across manufacturers and hirers of non-road mobile machinery and diesel engines. The qualitative nature and targeted 'free-find' sampling approach means that the findings presented in this report cannot be assumed to be representative of the wider population of such businesses.

Report structure

1.22 The findings in this report have been split into four core chapters which are broadly structured around the core research objectives:

- **Chapter 2** covers the types of machines used, the prevalence of red diesel use and the ways in which businesses tend to acquire their red diesel fuelled machines;
- **Chapter 3** explores current and past use of alternative technologies to red diesel in non-road mobile machinery;
- **Chapter 4** explores awareness of alternative technologies, even if businesses have not used them and the potential for machines to be replaced with alternative technologies; and
- **Chapter 5** explores future plans to switch to alternative technologies and general receptiveness to alternatives.

1.23 Each chapter is guided primarily by findings from the quantitative survey with insights from the qualitative strand introduced where appropriate.

[9] Any significant differences cited in the report have been tested using t-testing and are significant at a 95% confidence level.

2 Current use of red diesel in non-road mobile machinery

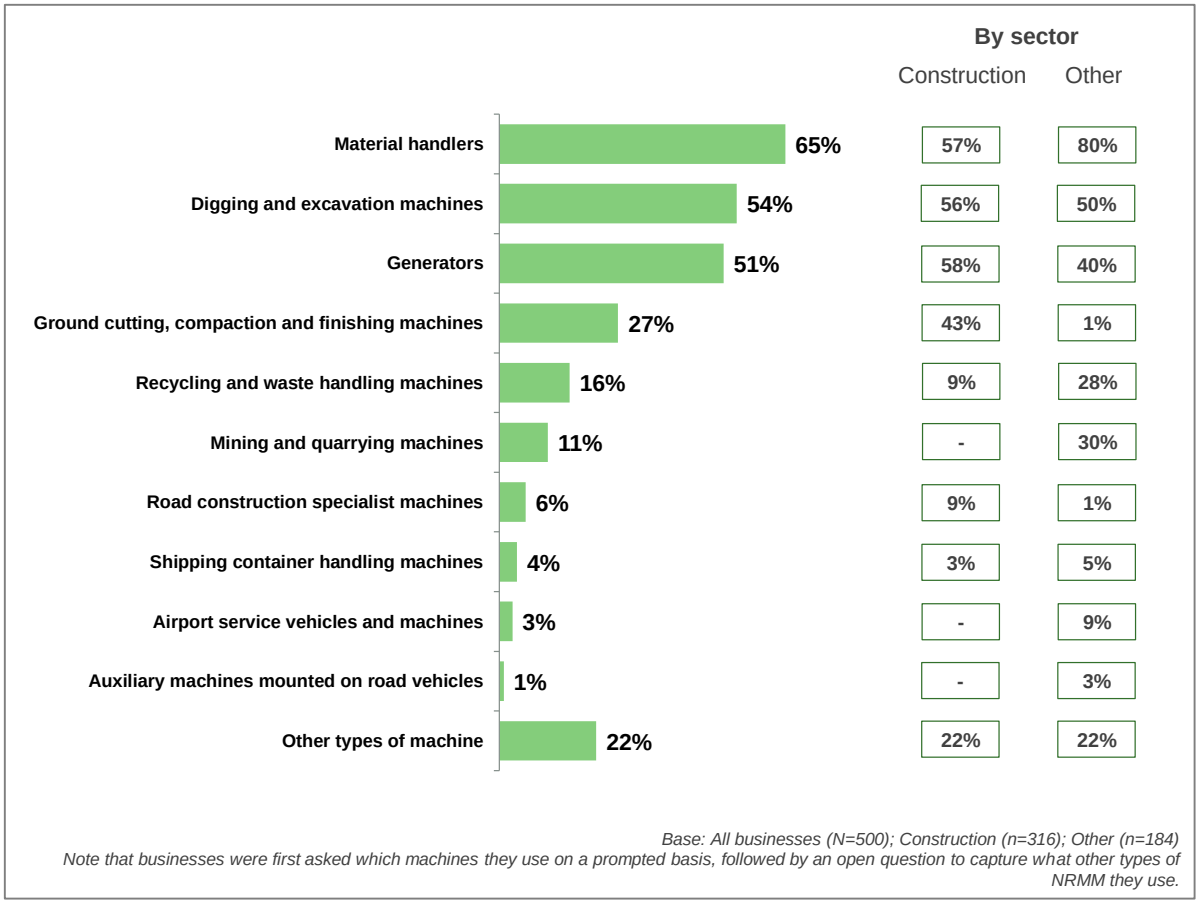
2.1 This chapter explores the types of non-road mobile machinery used by businesses, the extent to which businesses use red diesel (including spend on red diesel), the hiring of these machines and the relative importance businesses place on red diesel when deciding which machines to hire.

The types of non-road mobile machinery used

2.2 As detailed in Figure 2.1 there was a wide range of machines used by businesses and this varied according to the sector in which the business operated.[10] Material handlers were the most commonly used machine − used by 65% of all businesses surveyed – whereas auxiliary machines mounted on road vehicles were the least commonly used, with 1% of surveyed businesses using them.

2.3 On average, the businesses surveyed used three different classes of machinery.

Figure 2.1 The types of non-road mobile machinery used by businesses



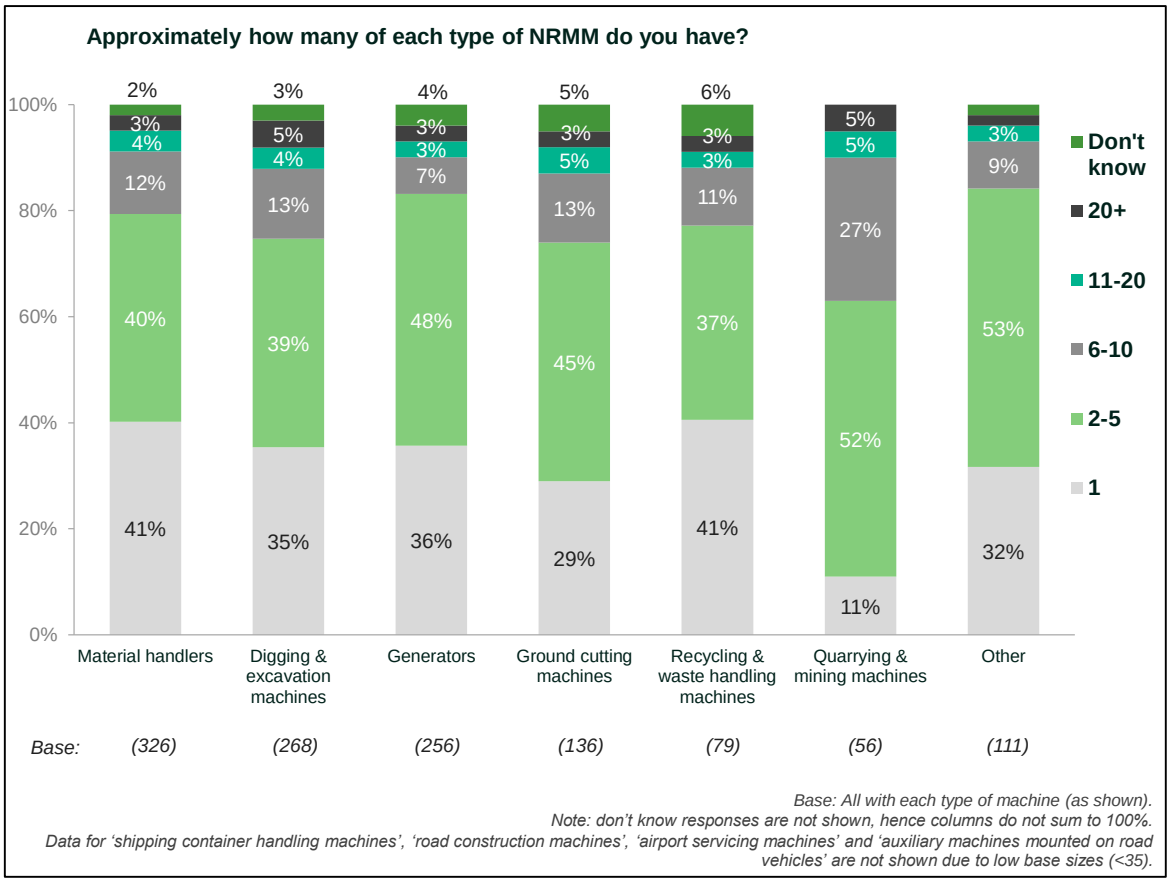
Base: All businesses (N=500); Construction (n=316); Other (n=184)
Note that businesses were first asked which machines they use on a prompted basis, followed by an open question to capture what other types of NRMM they use.

[10] In the survey businesses were first asked with a prompted list the types of NRMM they use. This was followed by an open question asking what other types of machines they use. Responses to these questions are combined and presented in Figure 2.1.

2.4 There was also variation in the number of each type of machine that businesses used. Whilst material handlers were the most common type of machine used, 41% of the businesses using these machines used only one material handler (see Figure 2.2). Very few businesses using material handlers used more than 10 such machines (7%).

2.5 Looking at machine type, businesses using quarrying and mining machines were more likely than any other type of business to use more than one of these machines. Most of these businesses (76%) were in the mining and quarrying sector.

Figure 2.2 Number of each type of machine used



Base: All with each type of machine (as shown).
Note: don't know responses are not shown, hence columns do not sum to 100%.
Data for 'shipping container handling machines', 'road construction machines', 'airport servicing machines' and 'auxiliary machines mounted on road vehicles' are not shown due to low base sizes (<35).

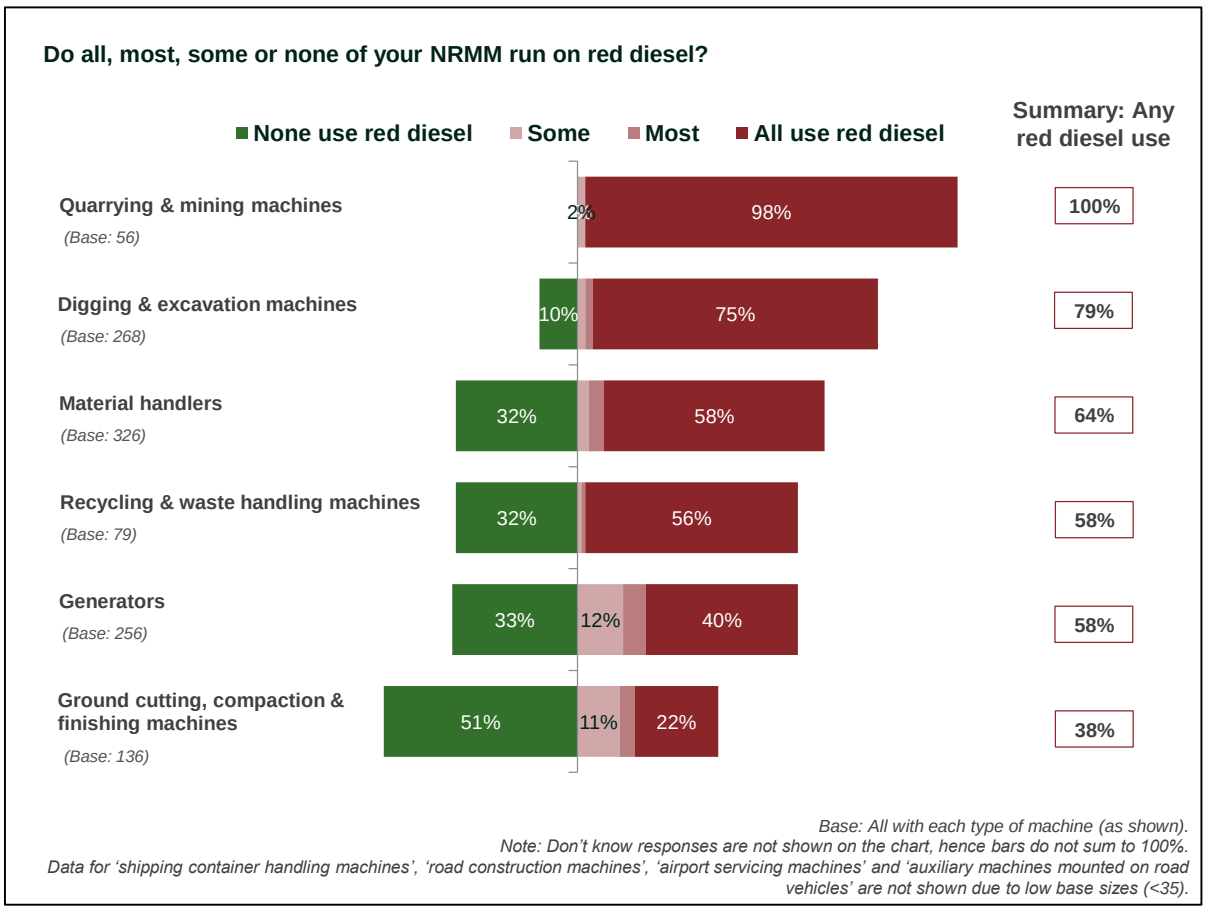
Use of red diesel

2.6 The previous section reported on the use of non-road mobile machinery overall, irrespective of the fuels they run on. In the survey, businesses were asked whether all, most, some or none of their machines ran on red diesel. As shown in Figure 2.3, the extent of red diesel usage varied considerably by machine.

2.7 Almost all (98%) of the businesses using quarrying and mining machines reported that all these machines ran on red diesel. In contrast, only 22% of businesses using ground cutting, compaction and finishing machines reported that all these machines used red diesel.

2.8 Across the different types of machinery few businesses reported that 'some' or 'most' of their machines use red diesel, thus for most businesses using each type of machine it was either the case that they all ran on red diesel or they all ran on alternative fuels. (Note that the alternative technologies/fuels used is discussed in Chapter 3.)

Figure 2.3 Use of red diesel by type of non-road mobile machinery



Total red diesel use in a typical year

2.9 Among all businesses using red diesel machines, total red diesel use in a typical year was a median[11] of 15,000 litres.[12] This varied substantially by sector, with a median of 4,000 litres among construction businesses and a median of 33,000 litres among businesses in other sectors. (Median red diesel use in a typical year was particularly high among mining and quarrying businesses at 80,000 litres).

2.10 Unsurprisingly, total red diesel use was lower among small businesses compared to larger ones (smaller businesses defined both in terms of the number of employees and size of turnover) (see Table 2.1).

[11] Median figures are reported as it is a measure of central tendency which is less susceptible to being skewed by outliers. In this case the data include some large companies using very large volumes of red diesel which would skew the mean.
[12] The base for this figure is 123 businesses (i.e. those that use any red diesel and were able to state in litres their total use of red diesel in a typical year).

Table 2.1 Total fuel spend in a typical year and the proportion of spend that red diesel accounts for

	Median total red diesel use in a typical year (litres)	Median total spend on all fuel in a typical year (£)	Median proportion of total fuel spend that red diesel accounts for (%)
All businesses using red diesel	15,000	30,000	40
By sector			
Construction	4,000	15,000	20
Other	33,000	73,000	65
By size (no. of employees)			
≤10 employees	4,000	7,000	20
11-50 employees	50,000	60,000	50
>50 employees	60,000	225,000	40
By annual turnover			
<£1 million	4,000	6,000	10
£1-5 million	30,000	48,000	60
≥£5 million	60,000	225,000	50

Base for first column: all businesses with red diesel fuelled machines (317); base for second column: all businesses using red diesel that were able to state their total fuel spend (155 at the total level); base for third column: all businesses using red diesel that were able to estimate the proportion of their total fuel costs that red diesel accounts for (248).

Red diesel spend in a typical year

2.11 In addition to total red diesel use, businesses were asked about their total spend on all fuel costs and what proportion of this is accounted for by spend on red diesel.

2.12 Among businesses that used red diesel, the median total fuel cost in a typical year was £30,000. This varied by sector, with a median spend of £15,000 among construction businesses and £73,000 among businesses in other sectors.

2.13 As detailed in Table 2.1, breaking down total fuel spend by business size and turnover shows a similar pattern to that reported for total red diesel use. Total fuel spend was higher among larger businesses.

2.14 Businesses were then asked what proportion of their total spend on fuel in a typical year was accounted for by spend on red diesel. As detailed in Table 2.1, businesses which used red diesel estimated that 40% of their total fuel spend in a typical year went towards red diesel. Similar to the sector and size differences outlined above, construction firms reported that a smaller proportion of their fuel spend went toward red diesel compared to those in other sectors, and smaller businesses reported that a smaller proportion of their total spend goes on red diesel compared with larger businesses.

Hiring of non-road mobile machinery

2.15 This section considers the ways in which businesses typically acquire their machines, the general condition of them and the relative importance placed on red diesel when choosing which machines to hire.

Typical method of acquiring non-road mobile machinery, length of hire and reasons for hiring machinery

2.16 Among all businesses using red diesel machinery, 35% tended to hire their machines whereas just under half (46%) tended to own them. (The remaining 19% tended to acquire their machines through a mix of ownership and hire.)

2.17 There was notable sectoral variation in how businesses tended to acquire their red diesel machines:

- Half (50%) of businesses in the construction sector tended to hire their red diesel machines, whereas only 30% tended to own them. (The remaining 20% tended to acquire their red diesel machines through a mix of ownership and hire).
- In contrast only 13% of businesses in other sectors tended to hire their red diesel machines and, instead, a much greater proportion (69%) tended to own their machines. (The remaining 17% tended to use a mix of ownership and hire.)

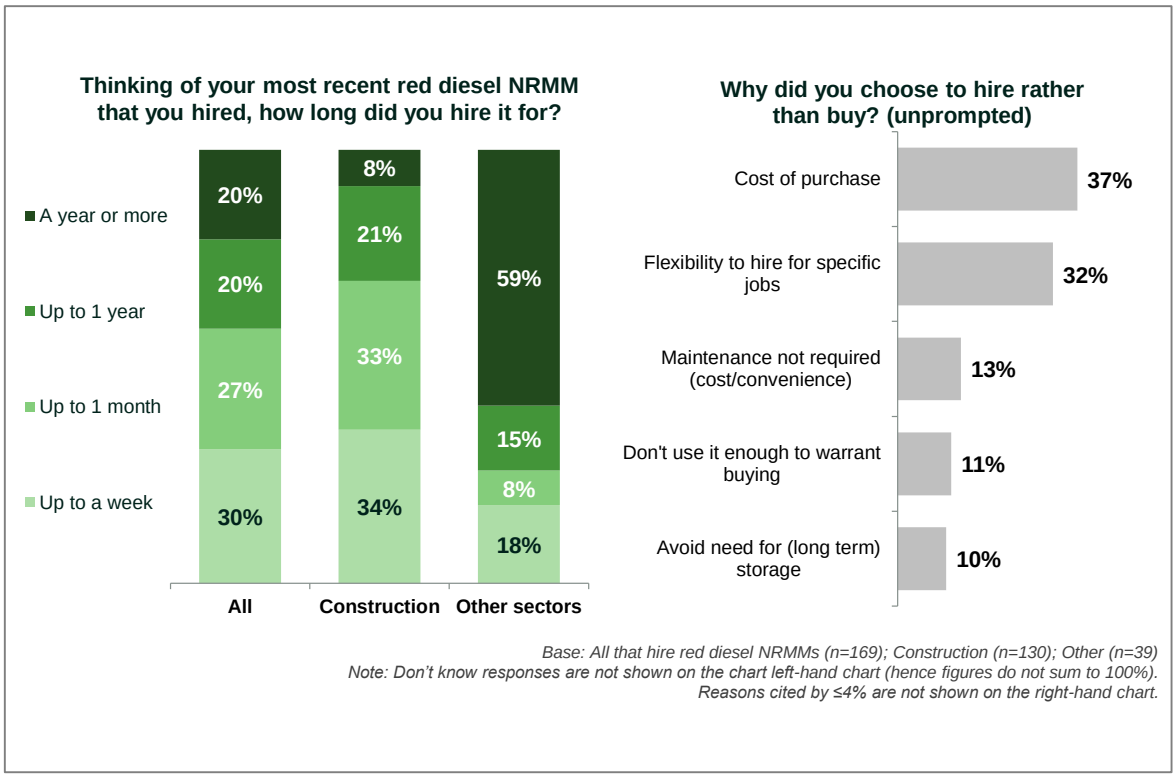
2.18 There was no significant variation by size or turnover in how businesses tended to acquire their red diesel machines.

2.19 As shown in Figure 2.4, the length of hire for red diesel machines varied considerably by sector. When asked about the last machine they had hired, a majority (67%) of construction firms had hired their last machine for either up to a week or up to a month, with very few (8%) hiring a machine for a year or more. On the other hand, just over half (59%) of businesses in other sectors reported hiring their last red diesel machine for a year or more.

2.20 The right-hand side of Figure 2.4 also shows the reasons why businesses chose to hire rather than buy their most recently acquired red diesel machines. The cost of purchase (37%) and a need for flexibility to hire for specific jobs (32%) were the two most common reasons for hiring.

2.21 This need for flexibility was mentioned by some of the plant hire companies interviewed in the qualitative stage. It was mentioned that construction firms typically hired equipment such as drilling/piling rigs which tended to be used at the early stages of a construction project for four to five weeks.

Figure 2.4 Typical length of hire for red diesel non-road mobile machinery and reasons for choosing to hire rather than buy



Base: All that hire red diesel NRMMs (n=169); Construction (n=130); Other (n=39)
Note: Don't know responses are not shown on the chart left-hand chart (hence figures do not sum to 100%).
Reasons cited by ≤4% are not shown on the right-hand chart.

2.22 Businesses that hired red diesel machines were asked what condition the hired machines tended to be in. Almost all (92%) reported that the machines were typically in a new condition (64% 'fairly new' and 28% 'very new').

Relative importance placed on red diesel when choosing which non-road mobile machinery to hire

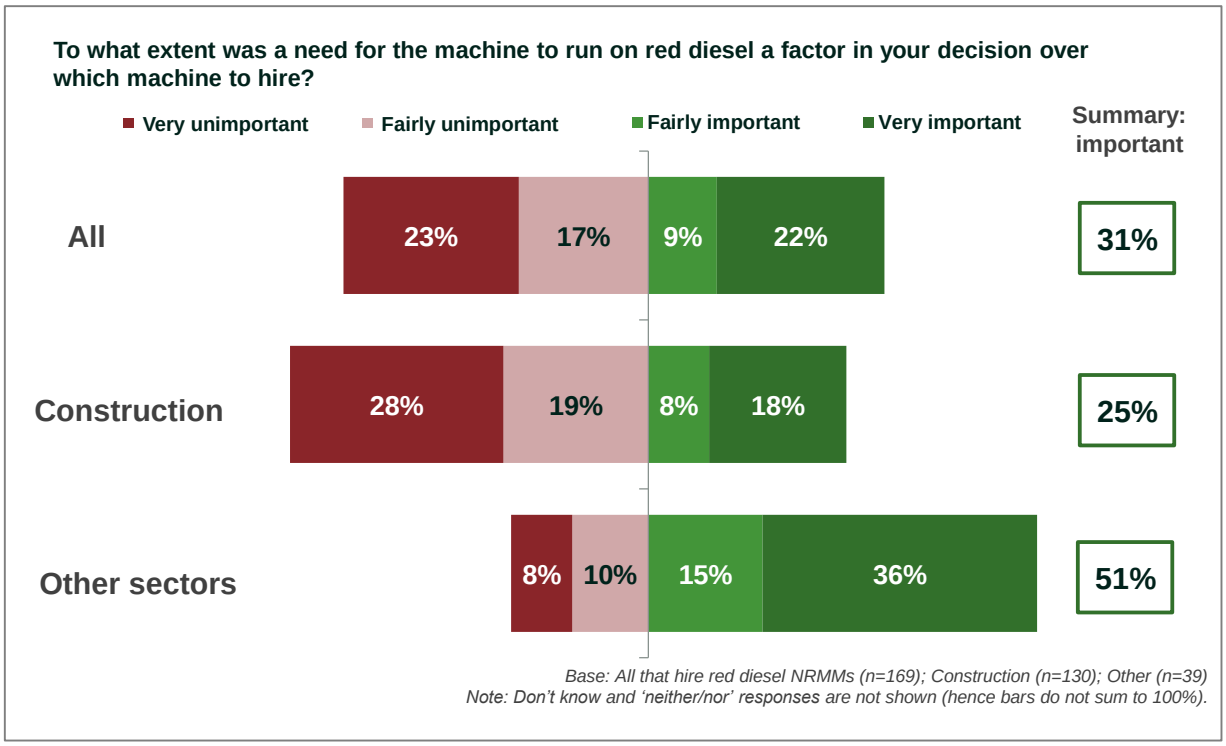
2.23 Figure 2.5 details the relative importance that businesses placed on the need for their most recently acquired machine to run on red diesel. Around a third (31%) of businesses hiring machines reported that the machine running on red diesel was an important factor in their decision (22% 'very' important and 9% 'fairly' important).

2.24 This varied by sector with only a quarter (25%) of construction businesses reporting that red diesel was an important factor in their decision, compared with half (51%) of businesses in other sectors.

2.25 There were also differences by size: larger employers tended to place greater importance on their hired machines running on red diesel compared with smaller employers:

- 33% of businesses with 11-50 employees and 47% of businesses with more than 50 employees placed importance on a need for their hired machines to run on red diesel, compared with 21% of employers with up to 10 employees.

Figure 2.5 The importance placed on red diesel when deciding which non-road mobile machinery to hire



Base: All that hire red diesel NRMMs (n=169); Construction (n=130); Other (n=39)
Note: Don't know and 'neither/nor' responses are not shown (hence bars do not sum to 100%).

3 Current and past use of alternatives to red diesel in non-road mobile machinery

3.1 This chapter explores businesses' current and past use of alternatives to red diesel in non-road mobile machinery. It explores which machines businesses have used alternatives to red diesel in and the types of alternatives used.

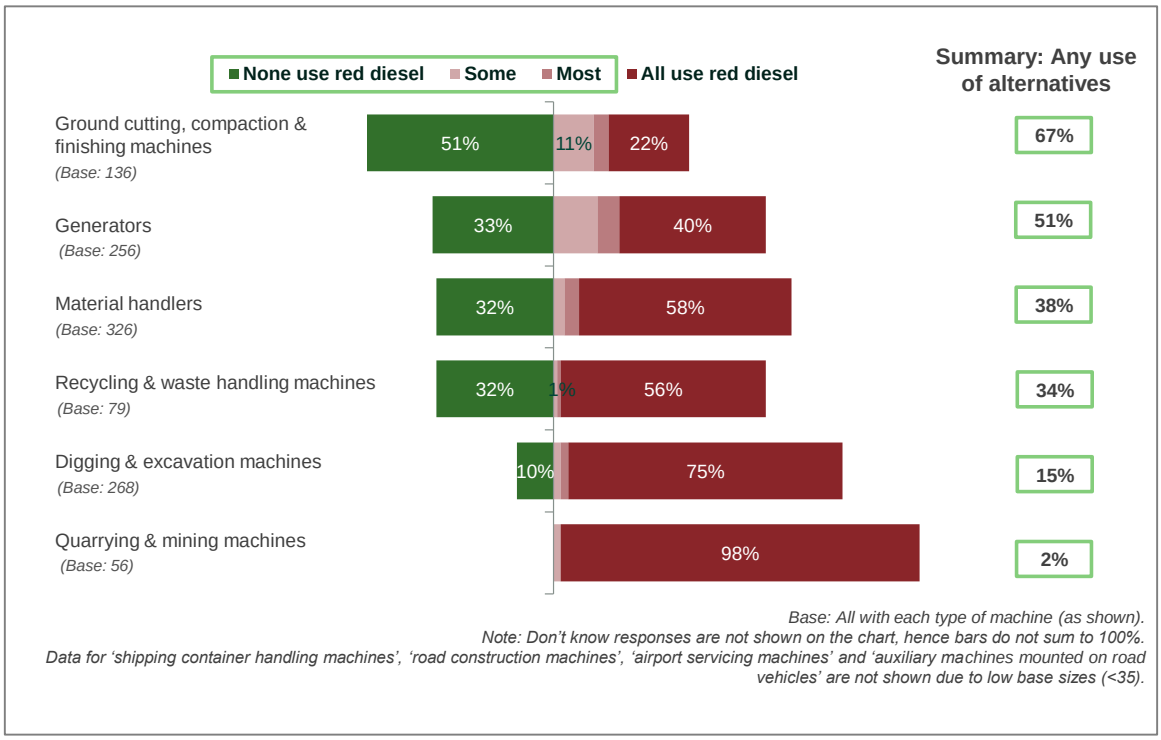
Proportion of non-road mobile machines that run on alternatives to red diesel

3.2 As part of the quantitative survey, businesses were asked what proportion of their machines ran on alternatives to red diesel. The data in Figure 3.1 is the same as shown in Figure 2.3 in the previous chapter, though with a different emphasis: this time on the proportion of businesses who have machines where at least some of them run on alternatives to red diesel.

3.3 Figure 3.1 shows that businesses using ground cutting, compaction and finishing machines were considerably more likely to be using alternatives to red diesel in at least some of their machines compared with businesses who use other types of machinery. Two-thirds (67%) of businesses using ground cutting, compaction and finishing machines had at least some of their machines running on alternatives to red diesel. This compares to just over half (51%) of businesses using generators, the next most common machine type in terms of the proportion of businesses who operated at least some of their machines with alternative fuels.

3.4 Unsurprisingly, ground cutting, compaction and finishing machines were used almost exclusively by businesses in the construction industry. This may suggest there is potential for alternatives to red diesel to be used by a large proportion of businesses, operating in this sector, who use this class of machinery.

Figure 3.1 Whether businesses' non-road mobile machines run on alternatives to red diesel



Base: All with each type of machine (as shown).
Note: Don't know responses are not shown on the chart, hence bars do not sum to 100%.
Data for 'shipping container handling machines', 'road construction machines', 'airport servicing machines' and 'auxiliary machines mounted on road vehicles' are not shown due to low base sizes (<35).

3.5 Material handlers were the third most common class of machinery where businesses reported using alternative technologies in at least some of their machines. This was supported by findings from the qualitative interviews where some manufacturers and leasers of non-road mobile machinery mentioned electric machines they supply, including forklifts, access platforms and wheel loaders (all of which fall under the 'material handlers' machine class). The manufacturers and leasers of the material handlers which ran on alternatives to red diesel said these machine types were predominantly used indoors and therefore needed to run on alternative fuels like electric power to protect the physical health of the operator.

"Electric engines are useful for businesses operating indoors as they are more efficient with less noise pollution and no vapour or particulate emission."

Plant Manufacturer

3.6 Quarrying and mining machines almost exclusively operated on red diesel. Use of alternatives in digging and excavation machines was the second least common with 15% of businesses using such machinery reporting that at least some of their machines operated on alternatives to red diesel. In the qualitative interviews, some manufacturers and leasers of excavation machines mentioned that excavators were a type of machine where it is possible to use electric / hybrid technologies due to their static nature when in operation.

"When you have a big bulldozer, or a dump truck, electric does not offer the torque or the power, but an excavator is static so you can use the electric and when you need a little extra power the hybrid can kick in."

Plant Hirer

3.7 The comparatively low usage of alternative fuels in digging and excavation machinery by the businesses surveyed may therefore either indicate a low take-up rate of these alternatives or reflect the type of jobs that these businesses were using excavation machines for.

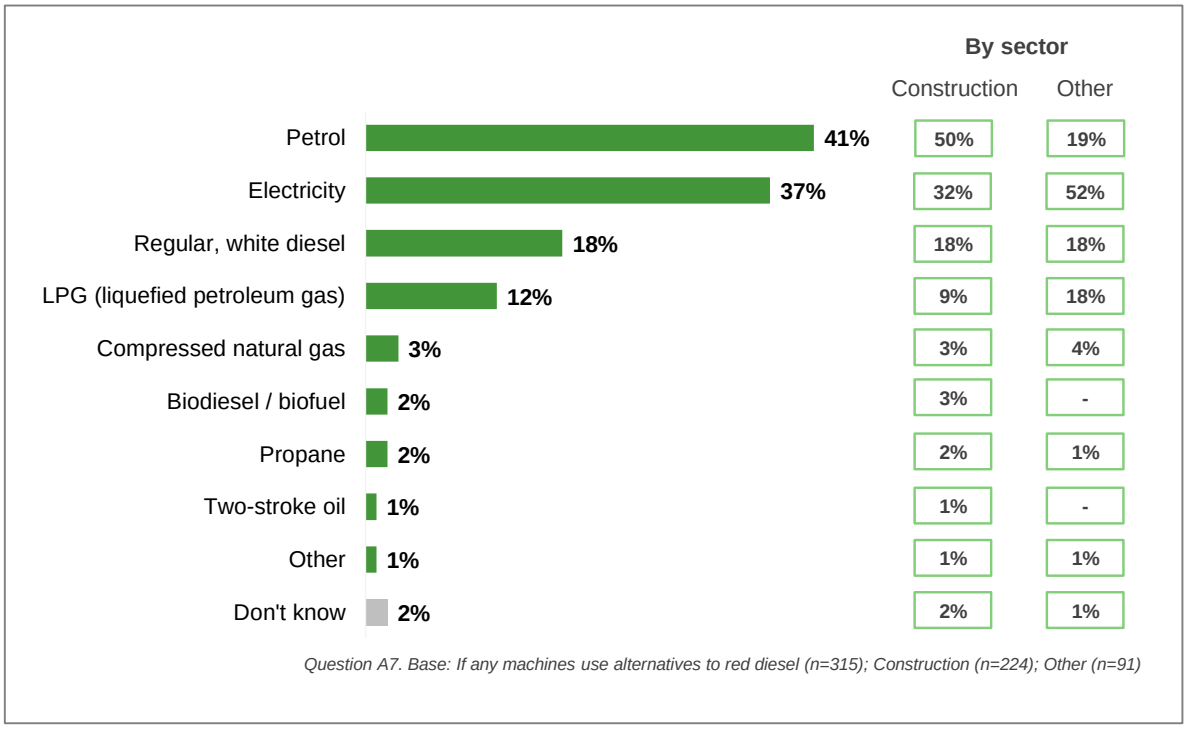
Type of alternative fuels currently used by businesses in their non-road mobile machinery

3.8 Overall, 63% of businesses were currently using alternatives to red diesel in at least some of their machines. As illustrated in Figure 3.2, the most common alternative fuels these businesses were using were petrol (41%) and electricity (37%). A comparatively small proportion of businesses were using compressed natural gas (3%) and biodiesel (2%).

3.9 The choice of alternative fuel used varied by sector.

- Businesses in construction were more than twice as likely as businesses in other sectors to use petrol as an alternative to red diesel (50% of construction businesses using alternatives were using petrol, compared with 19% among other sectors).
- Conversely, businesses outside construction were twice as likely to use liquefied petroleum gas (LPG) as those in the construction sector (18% compared with 9% respectively) and were also more likely to use electricity (52% compared with 32%).

Figure 3.2 Alternative fuels used by businesses in their non-road mobile machinery



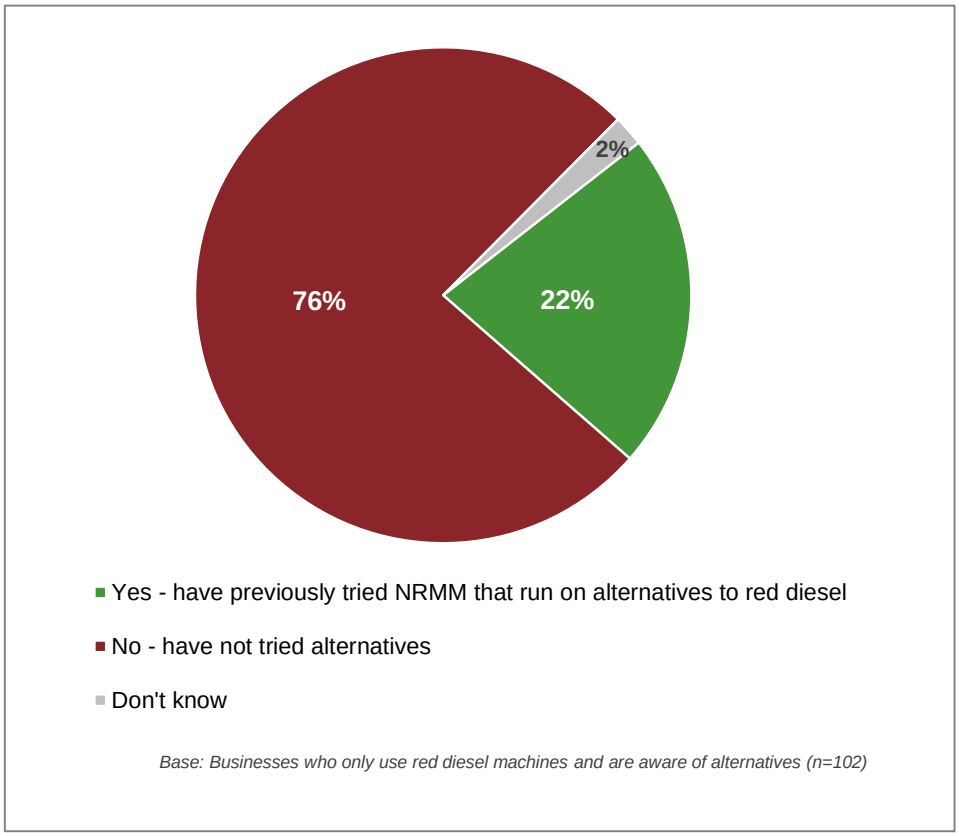
Question A7. Base: If any machines use alternatives to red diesel (n=315); Construction (n=224); Other (n=91)

Type of alternative fuels previously used by businesses in their non-road mobile machinery

3.10 Over half (62%) of the 164 businesses using only red diesel in their non-road mobile machinery were aware of alternative fuels they could use in their machines. Of this group, 22% had previously tried using machines that ran on alternatives to red diesel (see Figure 3.3), indicating that past use of alternative technologies was somewhat limited even when awareness of alternatives was relatively high.

3.11 Compared to businesses in other sectors, construction businesses were more likely to have previously attempted to use alternatives to red diesel in their machines (34% of businesses in construction compared with 13% of businesses in other sectors).

Figure 3.3 Businesses' prior use of alternative to red diesel and the types of alternative fuels used



3.12 These findings align with insights from the qualitative phase of the study. A high proportion of manufacturers and leasers of non-road mobile machinery felt their customers would be aware of the emissions from their machines and would be aware of the alternatives available to them. However, they had rarely experienced customers enquiring about cleaner technologies. In some cases this was because it was not a priority for them.

"If you spoke to end-user customers, they would probably complain, saying that in the bigger scheme of things, the amount of emissions that construction equipment put out into the atmosphere is minute in comparison to cars or cruise liners."

Plant Manufacturer

3.13 For others it was just expected that these machines would operate on red diesel and/or that in their view alternative technologies were not widely available or indeed viable for some machines, particularly large machines.

"Customers would embrace [cleaner alternatives] if there was a practical solution. Many of our customers would say "we'll look at anything if the manufacturers can make it." If you could be first in the market with an electrical digger that can be charged overnight and would last a full day of hard digging, I would have thought there would be a lot of interest."

Plant Hirer

"We have not had many enquiries [for alternatives]. It only really comes up when you are talking London where there is legislation [on emissions], but for those businesses it is a case of having to get the job done and they are not bothered about how they do it and, it is sad really in some ways, the person is not really interested in the environmental aspects."

Plant Hirer

3.14 Instead, manufacturers and leasers of machinery sensed that customers prioritise the resale value of their machines – diesel engines have greater resale value in the second-hand international market – and the more immediate health and safety concerns of their operators. The safety of worksites was considered to be a very important consideration for businesses in many of the industries that use non-road mobile machinery. Indeed, as detailed later in Chapter 5, almost half (48%) of businesses in the quantitative survey agreed with the statement: 'switching from red diesel to alternative technologies would be better for the health of our staff currently working with or near machines which use red diesel'.

"The more we have to meet higher emissions standards, in general, the performance of the machine reduces and the cost of ownership increases. Pretty much every time we [move to a higher engine tier] it is between 5-10% more added to the price of a machine. I am sure businesses using red diesel are aware of the alternatives but I do not think it is very high up their priorities list."

Plant Manufacturer

4 Awareness of alternatives to red diesel in non-road mobile machinery

4.1 The previous chapter focused on businesses that were using alternatives to red diesel in at least some of their machines, as well as those that had used alternatives in the past. This chapter focuses on the awareness of alternative technologies among all businesses, including those that had only used red diesel in their machines. It also details whether businesses have considered using alternative technologies in specific machines, reasons for not considering alternatives, as well as the expected lifecycle of their current machines.

Nature of users' awareness of alternatives to red diesel

4.2 A third of businesses surveyed (33%) only used machines that run on red diesel. These businesses were asked to describe their level of awareness of non-road mobile machinery that run on alternative fuels. Most (62%) were aware of alternatives to red diesel they could use in their machines, comprising those that were aware but had little (self-reported) knowledge of alternatives (20%), those aware and with some knowledge (27%), and those aware with a good knowledge of alternatives (15%).

4.3 This means that 84% of all businesses surveyed were in some way 'aware' of alternatives to red diesel, once factoring in the businesses discussed in the previous chapter that were already using alternative technologies in at least some of their machines. These businesses with awareness of alternatives were asked to identify the alternative fuels they were aware of that could be used to operate the machines they currently use and this is discussed in the next section.

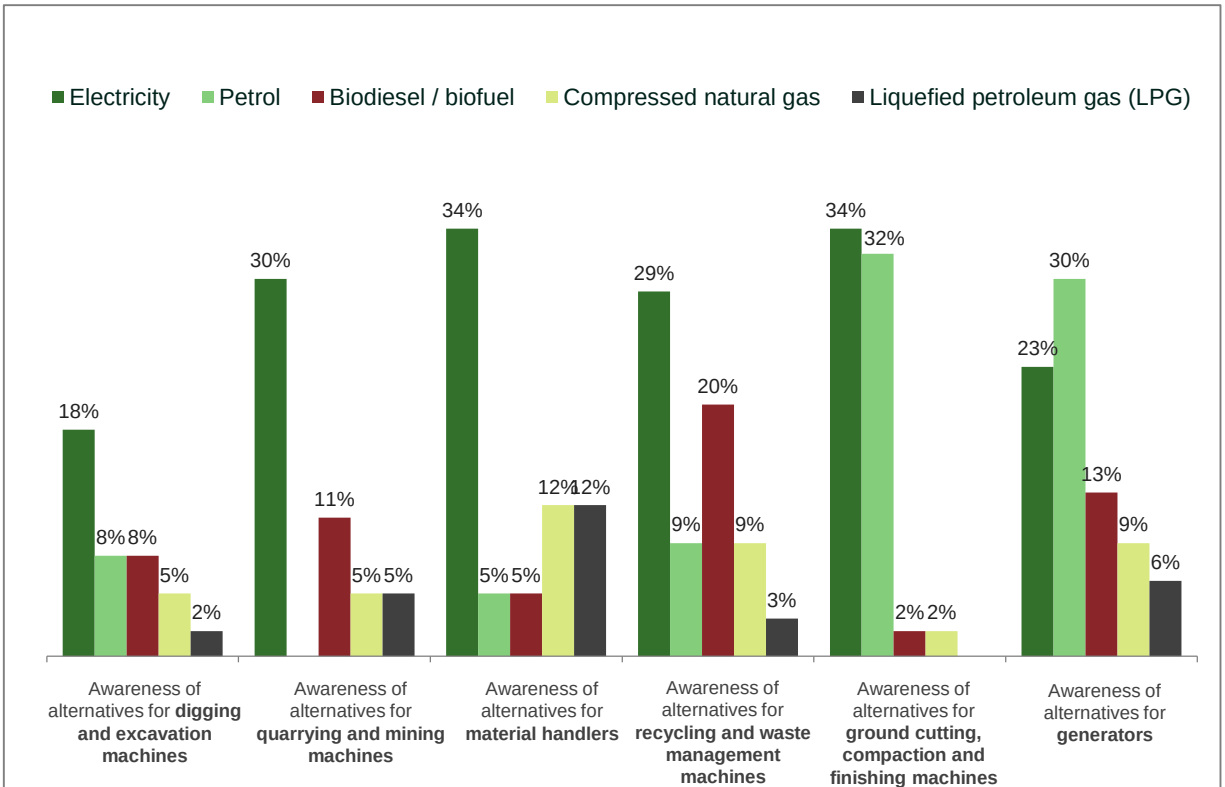
Awareness of specific alternative fuel types

4.4 As shown in Figure 4.1, users of red diesel-fuelled machinery were most commonly aware of electrical alternatives for their machines, with one third of businesses who used material handlers (34%) and ground cutting, compaction and finishing machines (34%) being aware of electric alternatives.

4.5 This finding aligns with insights from the qualitative discussions with manufacturers of non-road mobile machinery. When discussing potential alternatives to red diesel, many manufacturers mentioned electricity as a key alternative power source (either on the wider market, or those they manufactured themselves). They also cited liquefied petroleum gas (LPG) and biofuel (including Hydrotreated Vegetable Oil) as alternatives to red diesel. However, manufacturers also mentioned limitations with some of these fuels, specifically the relatively poor energy density of some of them in comparison to red diesel as well as the transportation and storage requirements of these alternatives. From these discussions, it became clear that these technologies were considered more 'high-maintenance' in terms of on-going servicing and associated costs than those which run on red diesel, and the infrastructure (such as charging points for electric machines) needed to support the use of these technologies was lacking.

4.6 Although businesses were most aware of electricity as an alternative fuel for four of the five classes of machinery shown in Figure 4.1, users of generators (30%) were most commonly aware of petrol as an alternative to red diesel for their machines. Additionally, awareness of biofuel and biodiesel was high amongst users of recycling and waste handling machines; 20% of users of these machines were aware of biofuel or biodiesel as alternatives to red diesel.

Figure 4.1 Awareness of alternative fuels by businesses who use red diesel-fuelled non-road mobile machinery



Base: All that use the red diesel fuelled machinery in questions and aware of alternatives (range from n=35 for 'recycling and waste management machines' to n=165 for 'digging and excavation machines'). Multiple responses were allowed.
Note: Don't know responses are not shown on the chart. Data for 'shipping container handling machines', 'airport servicing machines' 'road construction specialist machines' and 'auxiliary machines mounted on road vehicles' are not shown due to low base sizes (<35).

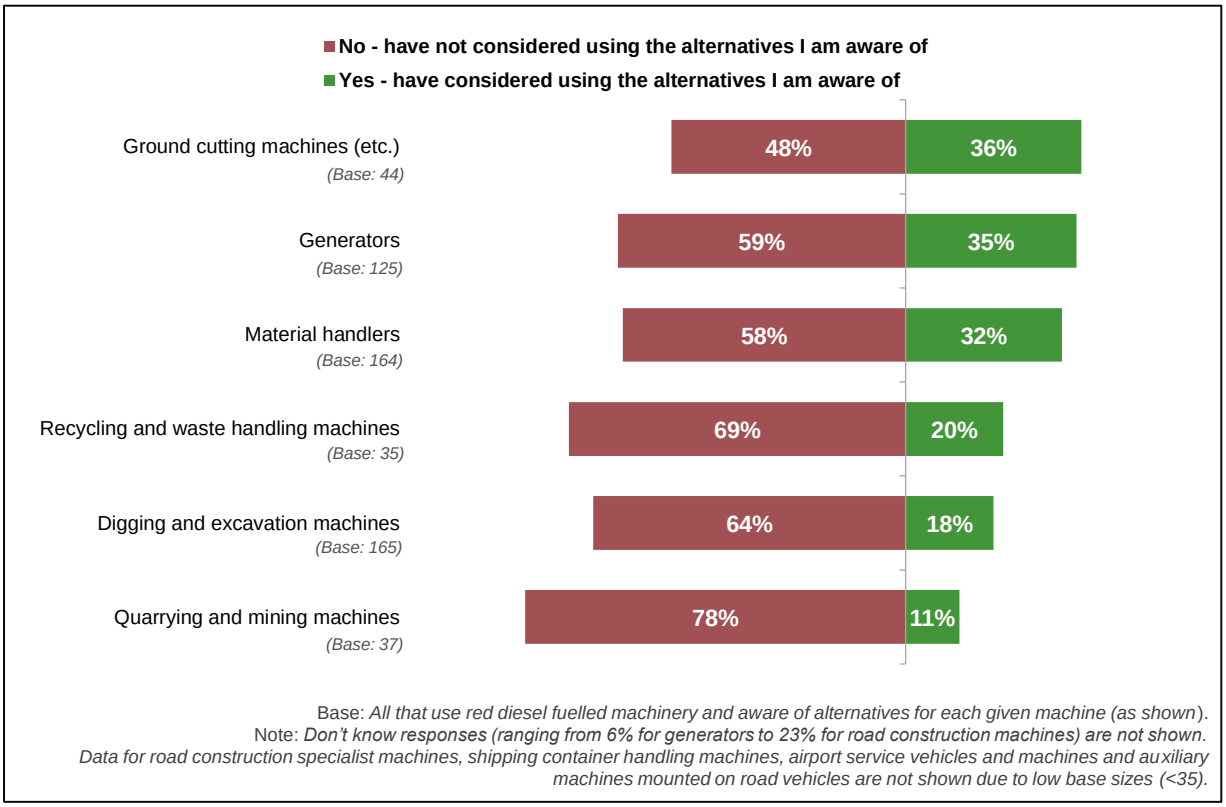
Whether businesses are considering using alternatives to red diesel

4.7 Businesses with awareness of alternatives to red diesel for particular classes of machinery were asked if they had considered using alternatives in their machines. As shown in Figure 4.2, in most cases businesses had not considered using alternatives to red diesel. The proportion of businesses that had not considered alternatives ranged from 48% of those using ground cutting, compaction and finishing machines, to 78% of businesses using quarrying and mining machines.

4.8 Irrespective of this broader finding, a significant proportion of businesses who used ground cutting, compaction and finishing machines (36%), generators (35%) and material handlers (32%) were considering using alternatives.

4.9 This again accords with earlier findings in the report that users of ground cutting, compaction and finishing machines were the most likely to be using alternatives to red diesel in at least some of their machines.

Figure 4.2 Whether businesses aware of alternative fuels have considered using them instead of red diesel



Base: *All that use red diesel fuelled machinery and aware of alternatives for each given machine (as shown).*
Note: *Don't know responses (ranging from 6% for generators to 23% for road construction machines) are not shown. Data for road construction specialist machines, shipping container handling machines, airport service vehicles and machines and auxiliary machines mounted on road vehicles are not shown due to low base sizes (<35).*

4.10 The fact that in most cases businesses had not considered using alternatives to red diesel also aligns with findings from the qualitative interviews. Although manufacturers and leasers of non-road mobile machinery asserted their customers' awareness of emissions from these machines was relatively high (due to regulatory demands and media coverage), and that environmental literacy around such machinery was generally improving, only a few had received enquiries for alternative technology from customers.

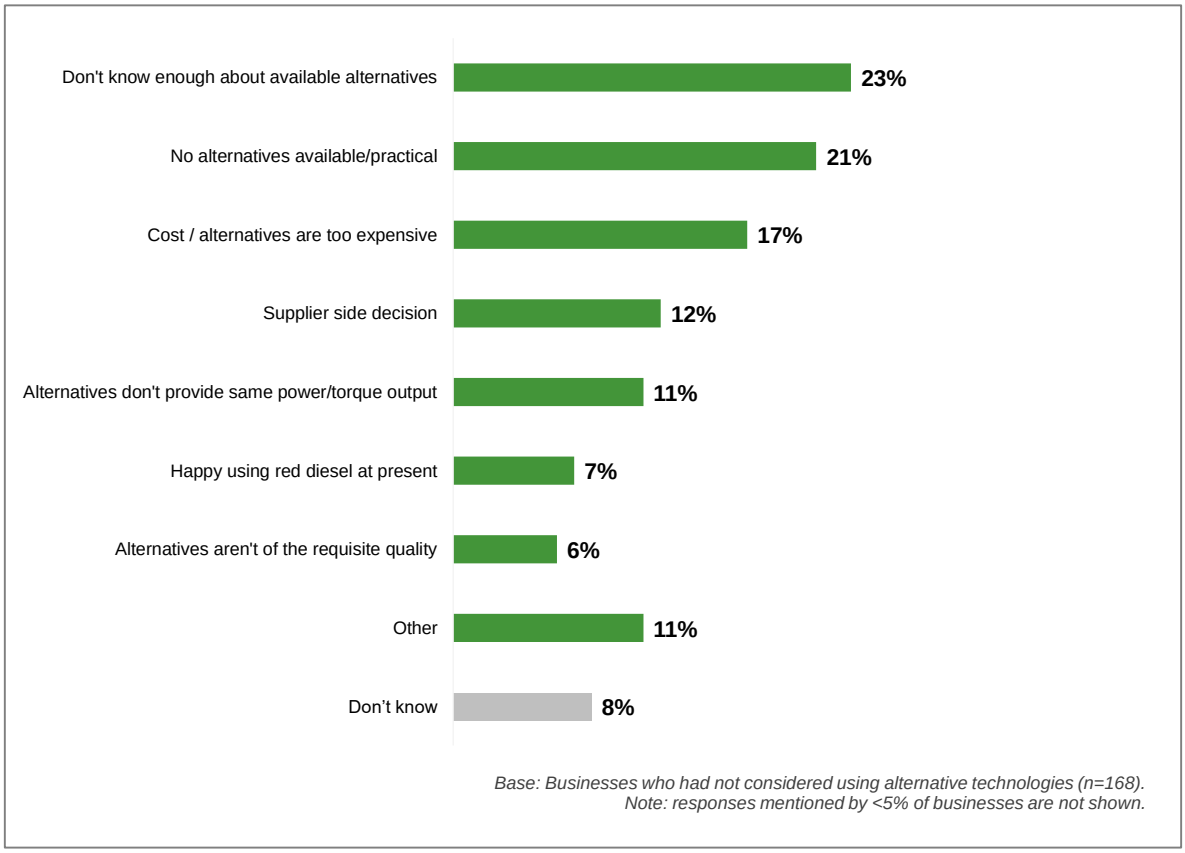
4.11 For the minority of manufacturers who had received enquiries for alternatives to red diesel, these enquiries were predominantly for electric machines – specifically diggers, wheel loaders and excavation machines – from waste management and utilities companies as well as construction firms.

Reasons businesses were not considering alternatives to red diesel

4.12 In order to identify factors that might encourage take-up of cleaner alternatives to red diesel, it may be useful to understand the reasons why some businesses had considered using alternative fuels for their non-road mobile machinery and then rejected it.

4.13 Two-thirds (66%) of businesses had not considered using alternative technologies for any of their machines and, as shown in Figure 4.3, the main reason for this was because they did not know enough about the alternatives available to them (23%). The next most common reason was a perceived lack of viable alternatives (21%) and the costs associated with switching (17%).

Figure 4.3 Reasons for not considering using alternatives to red diesel (unprompted)



Base: Businesses who had not considered using alternative technologies (n=168).
Note: responses mentioned by <5% of businesses are not shown.

4.14 Returning to respondents' broader reasons for not considering alternatives to red diesel, relatively few businesses reported limitations of alternative technologies in relation to power and torque (11%). For manufacturers and leasers of non-road mobile machinery, these limitations were prominent in their views of the barriers preventing uptake of cleaner technologies.

4.15 A number of manufacturers expressed concerns over the technological capabilities of machines that run on alternatives to red diesel. Some focused on the limitations of these technologies in terms of the responsiveness and reliability of the power output and others compared the relative effort needed to refuel machines that run on alternative technologies.

"If a diesel machine runs out of fuel it is easy to top it up. If an electric machine runs out it takes eight hours because you have to put it on charge or physically change the battery over and if you haven't got the equipment for that it is difficult to do."

Plant Manufacturer

"I think businesses are acutely aware of what needs to be done [to improve uptake of cleaner machines] but it comes at a price… the next generation of clean engines are an awful lot more expensive than the ones available at the moment."

Plant manufacturer

4.16 Nevertheless, the findings from the qualitative phase of the study do correlate with those from the quantitative survey in terms of the expense of engines that run on alternative technologies and the perceived lack of available alternatives. Respondents during the qualitative exercise said that new machines are expensive to run and maintain and tend to be more temperamental.

This may discourage consumers in industries that are contract-based and fundamentally shaped by the speed at which a particular job can be finished.

"You will have some people who will not mind about the cost because they want to be more environmentally friendly but there is a point where it is too expensive. For a building site, I don't know how much fuel they get through a week but at the moment the only incentive is the ethos of a company wanting to be more environmentally friendly because there is no financial incentive [to switch to alternatives]."

Plant Hirer

"If you have a company that wants to dig a hole or is in quarrying, for a 50 tonne machine you are looking at £350,000 for a modern machine, but if there is an older machine for £80,000 and it is way more reliable even though it is 10 years older and still costs you less to run it is difficult to justify the expense. There is an upside with modern machines with fuel consumption, but it just does not equate to the cost of repairs on modern machines and the cost of downtime."

Plant Hirer

4.17 Manufacturers and leasers of machines considered the resale value of machinery to be another key concern for their customers. Conversations with these groups revealed the importance of the international second-hand market for non-road mobile machinery, and due to the relative novelty of alternative technologies and their lack of use outside Europe, machines that runs on alternative technologies were considered less desirable for many customers.

4.18 It was also mentioned that there would be health and safety concerns related to using electrical alternatives on construction sites and a need for infrastructure to support the charging of such machines.

"Basically, there is not really a viable alternative [to red diesel]. In years past we looked at making electric rigs, but customers did not want them as it would cost 2.5 times as much. Also, one of the real problems is safety on site; having 450 volts capable of being run over by an excavator or a crane. Electric rigs will probably be more common in the future but probably not in my lifetime."

Plant Hirer

Replacing red diesel machines with those running on alternative technologies

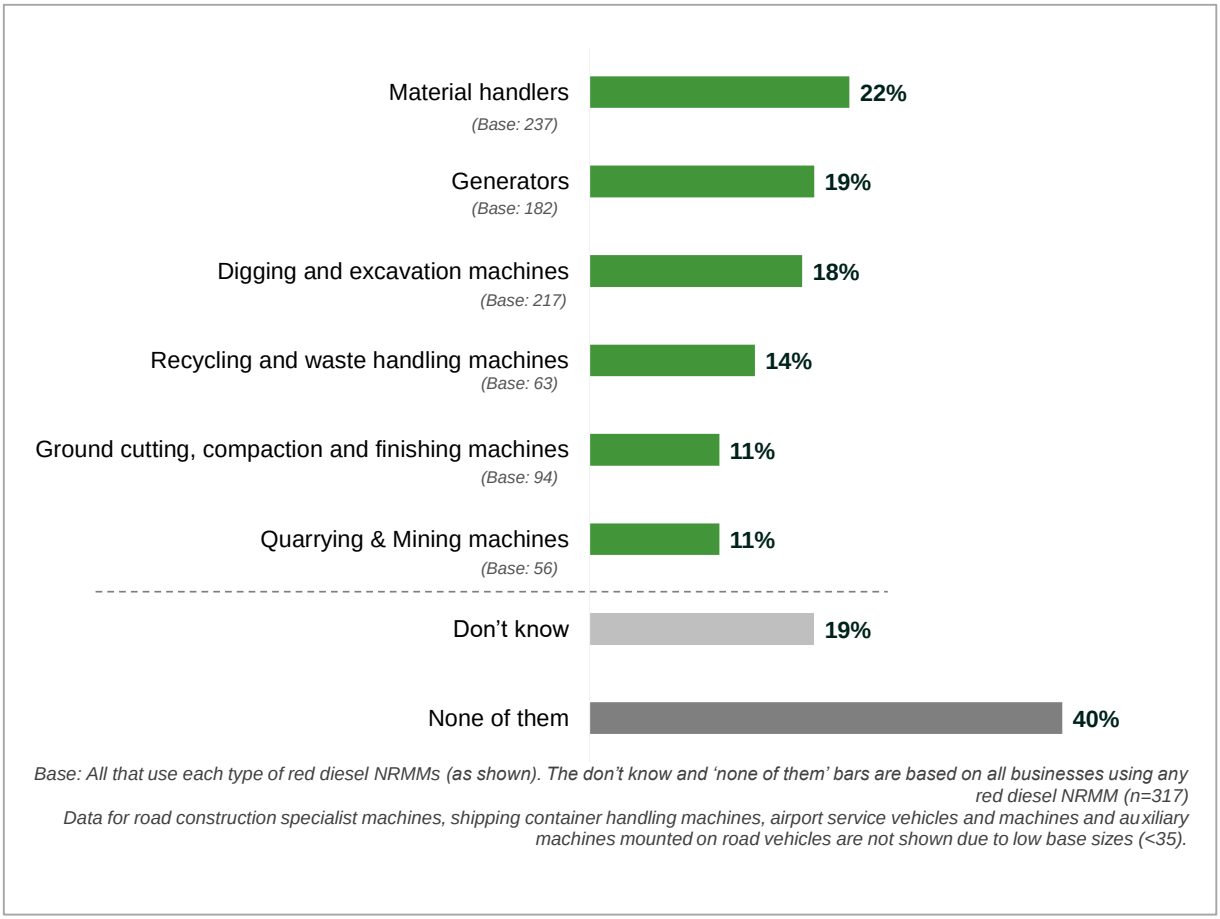
4.19 For the businesses who used red diesel in at least some of their machines, understanding whether these businesses felt there was potential to replace these machines with cleaner technology is necessary in order to ascertain the scale of opportunities for uptake of cleaner technologies.

4.20 Figure 4.4 shows the proportion of businesses using each type of red diesel machinery which felt that there was potential to replace their existing machines with cleaner alternatives. Material handlers, digging and excavation machines and generators were the machines most regularly cited by users as having the potential to be replaced with alternative technologies, but it was still only a minority of these businesses that felt their machines of this type could be replaced (22% of those with material handlers; 19% of those with digging and excavation machines; and 18% of those with generators).

4.21 This suggests that while some businesses see the potential for machines to be replaced with alternatives, the majority saw red diesel as the only viable fuel for *their* machinery. Two fifths

(40%) did not think there was potential to replace their machines with alternative technologies and a further 19% were unsure.

Figure 4.4 Potential to replace red diesel non-road mobile machinery with alternative technologies

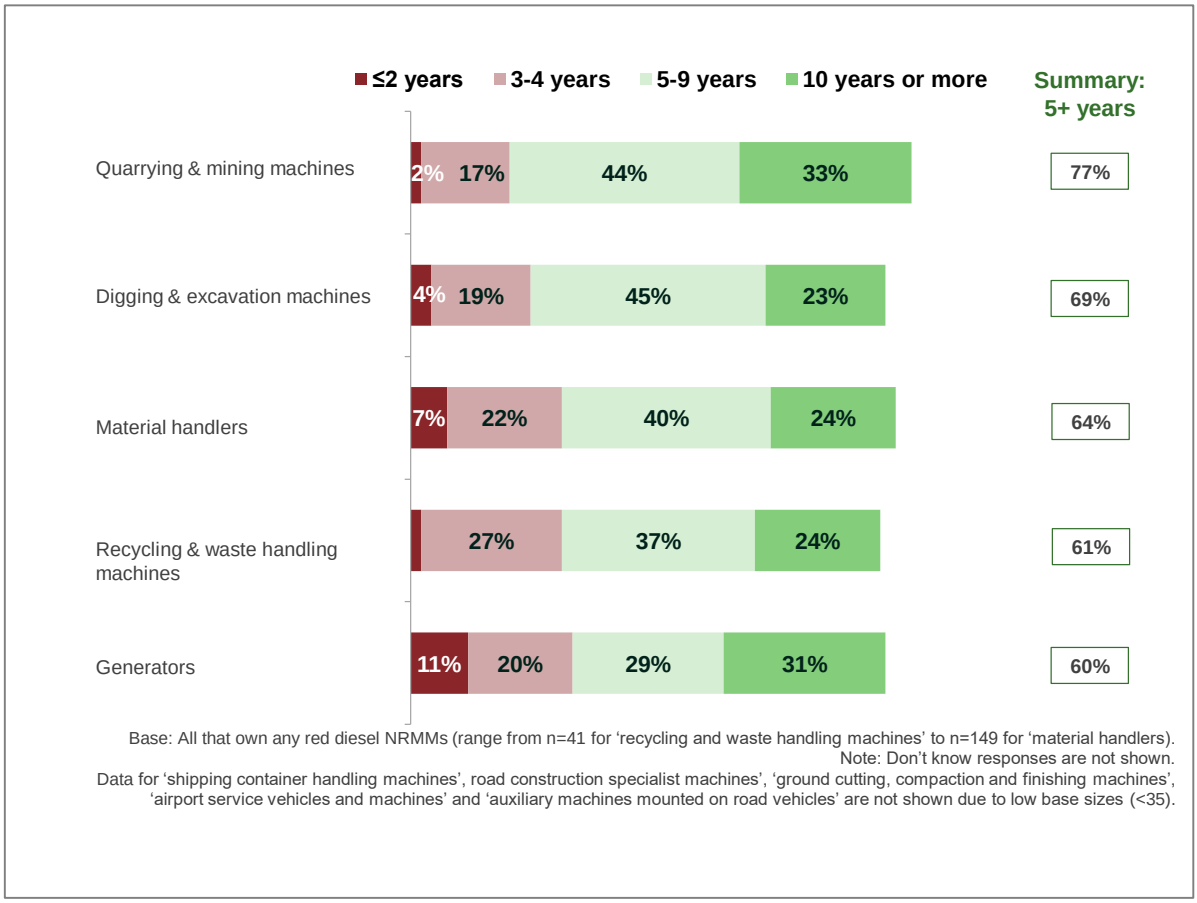


Base: All that use each type of red diesel NRMMs (as shown). The don't know and 'none of them' bars are based on all businesses using any red diesel NRMM (n=317)
Data for road construction specialist machines, shipping container handling machines, airport service vehicles and machines and auxiliary machines mounted on road vehicles are not shown due to low base sizes (<35).

4.22 Users of red diesel machinery were also asked to state how long they expected their current machines to last. This was to establish the perceived longevity of existing machines and to gain insight as to when businesses might be looking to replace their machines (and therefore the point at which most businesses might be receptive to replacing their machines with cleaner alternatives).

4.23 Most businesses expected their current stock of red diesel-fuelled machinery to last more than five years before requiring replacement. This ranged from 60% of businesses who owned generators to 77% among those who owned quarrying and mining machines (see Figure 4.5).

Figure 4.5 Length of time owners of non-road mobile machinery expect their machines to last



Base: All that own any red diesel NRMMs (range from n=41 for 'recycling and waste handling machines' to n=149 for 'material handlers').
Note: Don't know responses are not shown.
Data for 'shipping container handling machines', road construction specialist machines', 'ground cutting, compaction and finishing machines', 'airport service vehicles and machines' and 'auxiliary machines mounted on road vehicles' are not shown due to low base sizes (<35).

5 Receptiveness to using alternatives to red diesel in non-road mobile machinery

5.1 This chapter focuses on whether businesses had plans to move to using alternative technologies in the future, as well as exploring general attitudes to alternatives and views on any impact of a change to the effective rate of Fuel Duty for red diesel.

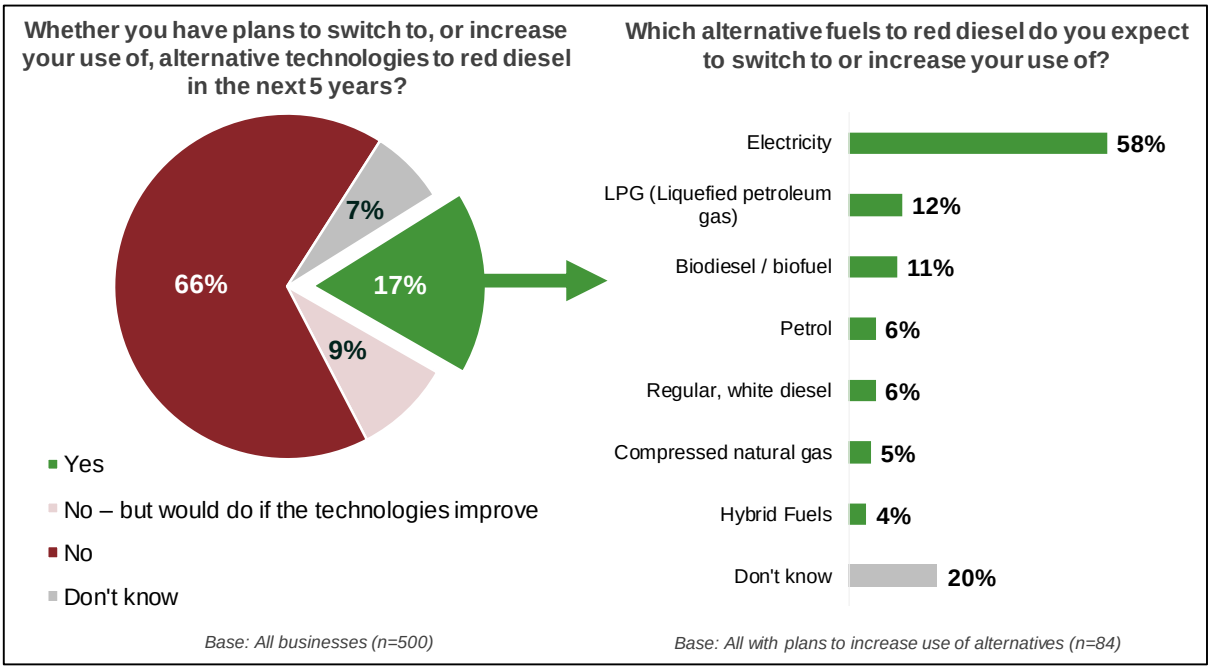
Plans to switch to alternatives

5.2 All businesses surveyed were asked whether they had plans to switch to, or increase their use of, alternative technologies to red diesel in the next five years. As Figure 5.1 illustrates, a minority (17%) said they had plans to and a further 9% said they would do if the technologies improved.

5.3 Businesses in the construction industry were more likely to have plans to switch to or increase their use of alternatives than those outside the industry (20% compared with 12% respectively). Larger businesses were more likely to have intentions to increase their use of alternatives (from 14% among those with fewer than ten employees to 26% among those with 50 or more employees).

5.4 Those in the mining and quarrying sector were more likely than average to state they would switch to or increase their use of alternatives if the technologies improve (16%), as were businesses who currently utilise both alternatives and red diesel (15%).

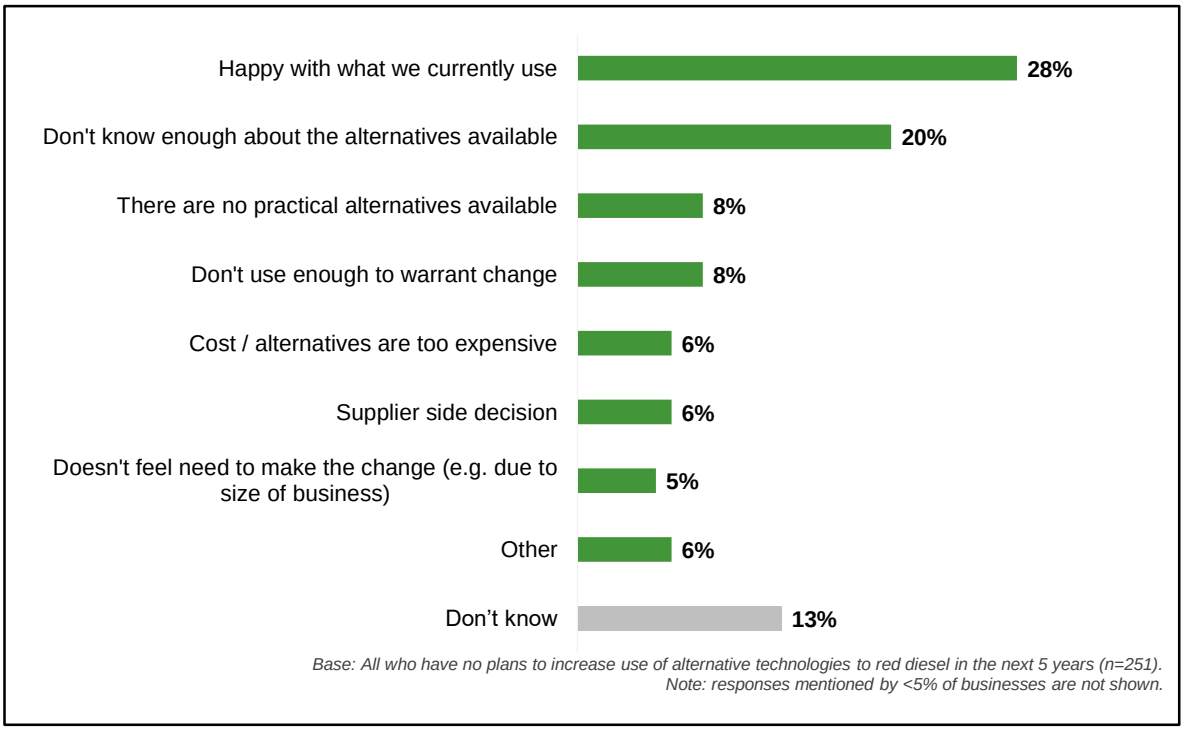
Figure 5.1 Whether businesses have plans to switch to, or increase use of, alternative technologies to red diesel in the next 5 years



5.5 Figure 5.1 also shows that among those with intentions to switch to or increase their use of alternatives, electricity was by far the most common alternative that businesses expect to increase their use of in future (58%).

5.6 Among businesses with no plans to switch to or increase their use of alternatives to red diesel in the next five years, the top two reasons for having no plans – as shown in Figure 5.2 – were that they were happy with what they currently use (28%) and that they did not know enough about alternatives technologies in order to have such plans (20%).

Figure 5.2 Main reasons businesses do not expect to switch to or increase their use of alternatives to red diesel in the next five years (unprompted)



Base: All who have no plans to increase use of alternative technologies to red diesel in the next 5 years (n=251).
Note: responses mentioned by <5% of businesses are not shown.

Plans to switch to alternatives among manufacturers and plant hire companies

5.7 Manufacturers and plant hire companies that took part in the qualitative research were asked what plans, if any, they had to develop or supply cleaner technologies, including discussion around any commercial pressures they might be under to do so. Some did not have any plans at present to supply cleaner technologies to the diesel-fuelled machines they currently supplied as there was not currently a market for it due to a lack of customer demand.

5.8 A number of manufacturers and hirers mentioned that their focus was on ensuring the machines they offered were up-to-date and comply with regulations around engine tiers and reported that the improvements in reducing emissions and particulate from diesel engines in recent years (with tier 3 and tier 4 engines) has been very significant. Others reported that they had other specific plans to develop cleaner technologies, examples of which are illustrated in the case examples below.

Case study 1: A plant hire company that advertises an alternative technology, however, it is yet to be taken up by the customer

A company that buys, hires and sells piling rigs of various sizes, all of which run on red diesel.

The business explained that they advertise an electric rig for sale on their website in case a customer is interested. However, the rigs are built in the Netherlands and is built to order, so has not been built as yet.

"No one has asked for it so it is one of those things we were floating out there if somebody wants it."

Case study 2: A plant hire company with plans to develop cleaner technologies and they believe the use of HVO is the way forward

A distributor of construction equipment including excavators, articulated haulers, wield loaders for material handling, and compaction equipment. All machines run on red diesel.

They have plans to develop cleaner technologies. Although they feel that most alternatives to diesel are not suited to larger machinery, they believe the use of hydrotreated vegetable oil (HVO) is the way forward.

The advantage to engines that run on alternatives to red diesel is the flexibility if they are able to run on a variety of different fuels, and there would not be a need to modify the engines.

"You could fill the engine with half a tank of diesel and half of HVO and would not have to worry about cross contamination."

However, the disadvantage to alternative technologies is the cost, as well as availability of the biofuels if everyone decided to switch to it.

Case study 3: A plant manufacturer with plans to develop a hybrid machine in order to be seen as a forward-thinking company

A manufacturer of construction equipment that supplies excavators that run on red diesel.

The business has plans to build a hybrid machine in the 14-20 tonne market, a response to their desire to adapt to the market and be seen as a forward-thinking company.

A couple of disadvantages were noted of engines that run on alternatives to diesel. Firstly, the impracticality in terms of the space needed to store batteries powerful enough to provide the same power as red diesel. Secondly, it was felt that operators do not understand how to use the technology.

5.9 Manufacturers and leasers of machines were asked if their plans to supply alternative technologies would change if there was a change to the Fuel Duty associated with red diesel, and this revealed some mixed views. Some did not think it would make a difference in encouraging moves to alternative technologies due to a lack of viable alternatives, so businesses would have to continue using red diesel regardless. It was also mentioned that any change in Fuel Duty would simply get passed on to the end customer. However, a couple felt it would make using alternatives more viable as it would lessen the difference in price between red diesel and alternative fuels. One example of this would be the utilisation of Hydrotreated Vegetable Oil (HVO), which was explained by one business as being able to provide the same energy density as red diesel, but is currently approximately twice the price.

"The cost impact to our customers would be phenomenal. For the articulated haulers alone on a large construction project would use in excess of 1 million litres of diesel per week and they will be running for a number of years. So, the cost to projects would be absolutely phenomenal."

Plant hire company

"You would really cost the UK economy a lot of money. You would get more tax but the cost of everything would go up enormously. These things don't use diesel like a car does; a tank in one of these things is 150 litres and in eight hours that is done. Ultimately the price of everything would go up… the prices of houses and roads would go up."

Plant manufacturer

5.10 A lack of viable alternatives was mentioned, with several manufacturers highlighting technical limitations of alternative technologies, most commonly reduced torque and practical implications such as storage and the presence of an alternative power supply. To accelerate the uptake of cleaner technologies, businesses felt improvements in technology were needed to make alternatives more viable.

"If they can get there with battery power then hybrid systems become very effective and red diesel consumption will drop considerably."

Diesel engine manufacturer

5.11 Following on from this, manufacturers and leasers of non-road mobile machinery were asked what commercial pressures, if any, are they under for providing and/or developing cleaner technologies for such machinery, and subsequently if they envisage any commercial pressures in the next five years. Several felt they were not under any commercial pressure related to cleaner technologies and some did not expect to be in the near future. These businesses explained that there does not seem to be a demand for cleaner technologies from customers, as mentioned previously in this report.

"I just don't think the customers are interested, that's certainly my impression."

Plant manufacturer

"I speak to a lot of people in my day to day life and it's amazing how many people have never heard of the likes of gas-to-liquid (GTL) and HVO. We are still in the infancy a little bit, and certainly we are pushing it. But I'd say there are more people who are not aware than are aware at this moment in time."

Plant hire company

5.12 However, many manufacturers cited government regulations as a source of current and future pressure – related to the European emission standards for engines used in non-road mobile machinery. They highlighted the need to comply with the regulation to remain competitive in the market, and that building and sourcing these cleaner engines costs more.

"There will be an effect on suppliers; the Italians have produced a Tier 5 engine which means there is a way; if they [suppliers] don't catch up soon they will miss out on market share."

Diesel engine manufacturer

5.13 When considering impacts on the wider industry, a few felt that the increase in cost could put smaller suppliers out of business and some manufacturers may look to other markets such as the Far East and Africa where there is less regulation so no need to develop alternatives. Some felt the impact on their customers will be an increase in price as they explained the cost increase would get passed on.

"Costs go up with all those [increases in engine tier] … we can feel the pressure already … piling would be more expensive in the end."

Plant hire company

5.14 When asked how these pressures will affect red diesel use in non-road mobile machinery, a few did not think it would have an impact as some of the cleaner alternatives still use red diesel in some way (e.g. hybrid machines and potentially diesel generators to support charging points), alongside the feeling that there are currently no widely available alternatives. However, a couple explained that the improved efficiency of the engines could result in a reduction in the volume of red diesel used.

5.15 One business that manufactures fork lift trucks and other material handlers expects that in five years' time they will be selling more electric machinery than diesel. Meanwhile, a couple of plant manufacturers reported the move towards hybrid vehicles – something that could result in a reduction of red diesel use if there is sufficient take-up.

"We believe that in the future there will be a higher demand for the hybrid over the standard excavator."

Plant manufacturer

General attitudes to alternative technologies

5.16 All businesses in the quantitative survey were asked a series of attitudinal statements to ascertain their views on alternative technologies using a scale where 1 meant strongly disagree and 5 meant strongly agree.

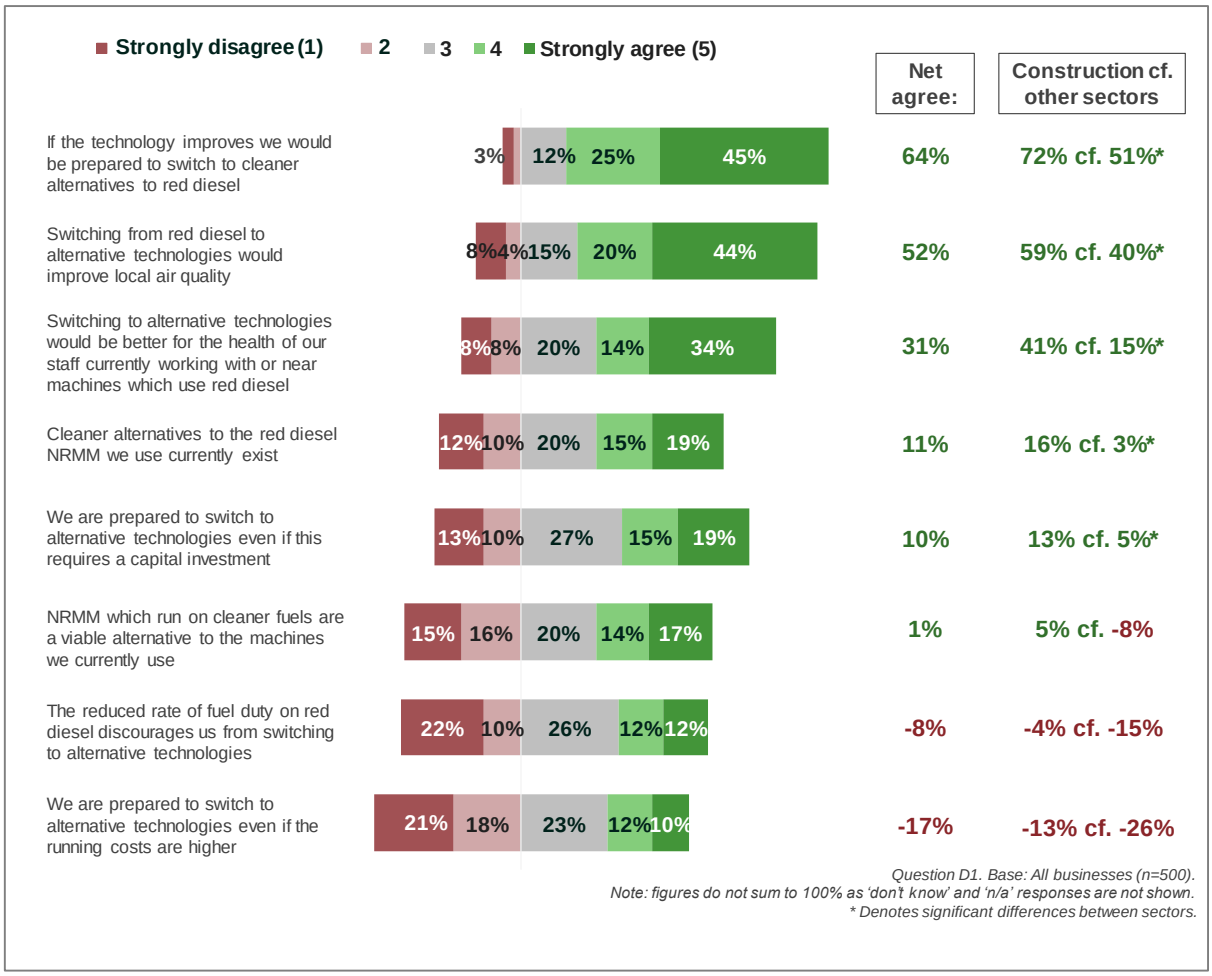
5.17 As detailed in Figure 5.3, businesses in the construction sector had a significantly higher net agree score[13] than those in other industries for a number of the statements.

5.18 Across a number of the statements, businesses' responses generally point toward green-friendly views. For instance, the largest net agreement (+64%) was in relation to the statement '*if the technology improves we would be prepared to switch to cleaner alternatives to red diesel'*.

[13] Subtracting those answering '1 (strong disagree), or '2' on the scale from those answering '4' or '5 (strongly agree)'.

The second highest net agree score was '*switching from red diesel to alternative technologies would improve local air quality'* highlighting that many businesses recognise the benefit of cleaner technologies. Moreover, the statement *'switching from red diesel to alternative technologies would be better for the health of our staff currently working with or near machines which use red diesel',* had a net agree score of +31%. Businesses that only used alternatives had a higher net agree score for this statement (+36%) compared with those that only use red diesel (+23%).

Figure 5.3 General attitudes to alternative technologies



Question D1. Base: All businesses (n=500).
Note: figures do not sum to 100% as 'don't know' and 'n/a' responses are not shown.
** Denotes significant differences between sectors.*

5.19 However, when factoring in the viability of switching to alternative technologies, or indeed if switching were to require a capital investment or increased running costs, businesses were less receptive to switching to alternatives. For instance:

- The statement '*NRMM which run on cleaner fuels are a viable alternative to the machinery we currently use'* had a neutral response with a net agree score of just +1%.
- The statement *'we are prepared to switch to alternative technologies even if this requires a capital investment'* had a net agree score of +10%. There was disparity in the net agreement with this statement depending on the size of businesses. Smaller employers with up to 10 employees had a negative net agree score of -3% compared with positive net agree scores of +16% among those with 11-50 employees and +30% among those with 50 or more employees.

- The lowest net agree score was for the statement '*we are prepared to switch from using red diesel to alternative technologies even if the running costs are higher'* at -17%, meaning that overall businesses are not willing to switch to alternative technologies if the running costs are higher than red diesel. This somewhat contradicts with the previous statement regarding whether the rebated rate of Fuel Duty would discourage businesses from switching to alternatives. It perhaps indicates uncertainty among businesses regarding the cost implication of any switch to alternatives.

5.20 The net agree score for the statement '*cleaner alternatives to the red diesel NRMM we use currently exist'* was +11%, highlighting a lack of awareness among many or perhaps a genuine lack of suitable alternatives.

5.21 The statement '*the reduced rate of fuel duty on red diesel discourages us from switching to alternative non-red diesel technologies'* had a negative net agreement score of -8%, meaning that, on balance, businesses do not feel that the rebated rate of Fuel Duty discourages them from switching to cleaner alternatives. This indicates that the rate may not be a central factor in preventing businesses switching to alternatives, but that other factors such as the viability of alternatives and associated capital costs may be of greater concern to businesses.

Appendix A: additional profile information on the businesses surveyed

The tables below provide information on the profile of businesses surveyed, by size, turnover and geography.

Table 5.1 Profile of achieved interviews

	Achieved interviews
Total	500
By size	
1-10 employees	225
11-50 employees	174
>50 employees	97
Don't know / prefer not to say	4
By gross turnover in the last financial year	
<£1 million	135
£1-5 million	138
≥£5 million	107
Don't know / prefer not to say	120
By geography	
East Midlands	41
East of England	58
London	48
North East	19
North West	36
South East	65
South West	68
West Midlands	33
Yorkshire and The Humber	34
Northern Ireland	22
Scotland	45
Wales	31

“

IFF Research illuminates the world for organisations businesses and individuals helping them to make better-informed decisions.”

Our Values:

1. Being human first:

Whether employer or employee, client or collaborator, we are all humans first and foremost. Recognising this essential humanity is central to how we conduct our business, and how we lead our lives. We respect and accommodate each individual’s way of thinking, working and communicating, mindful of the fact that each has their own story and means of telling it.

2. Impartiality and independence:

IFF is a research-led organisation which believes in letting the evidence do the talking. We don’t undertake projects with a preconception of what “the answer” is, and we don’t hide from the truths that research reveals. We are independent, in the research we conduct, of political flavour or dogma. We are open-minded, imaginative and intellectually rigorous.

3. Making a difference:

At IFF, we want to make a difference to the clients we work with, and we work with clients who share our ambition for positive change. We expect all IFF staff to take personal responsibility for everything they do at work, which should always be the best they can deliver.

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