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Drivers and Performance Outcomes of Net Zero practices: Evidence from UK SMEs

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Drivers and Performance Outcomes of Net Zero practices: Evidence from UK SMEs

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ABSTRACT

This report examines the environmental practices that small and medium enterprises (SMEs) adopt in order to meet the net zero emission targets set by the UK government. Up to now scholars have focused most of their attention on large corporations and new start-ups. Hence, we know very little about the approaches taken by existing SMEs with regards to net zero. Here, our focus is threefold: (a) we examine a large range of net zero practices, which span across technological and organisational business domains; (b) we investigate the external and internal [to the business] drivers of net zero practices; and (c) we analyse the performance outcomes of net zero practices. We employ a novel dataset of 1019 SMEs, which was collected during the COVID-19 crisis in the UK. The results of the econometric estimations have important policy and managerial implications. We find that *environmental regulations/taxes* and *customer demand for low-carbon products/services* are the key external drivers of inducing SMEs to commit to net zero. Furthermore, we demonstrate that the internal firms' motivation to *improve their image and reputation* is a significant driver for adopting net zero practices. We also provide new insights into the performance outcomes of net zero practices in general, pointing out in particular that, technological net zero practices improve the environmental performance of SMEs, whilst organisational practices affect environmental performance indirectly by complementing technological changes in the during the production process or the introduction of low carbon products/services. Finally, even in the context of the COVID-19 pandemic, our results indicate a strong statistically significant relationship between both technological and organisational net zero practices and business performance, proxied by employment growth.

Keywords: net zero practices; SMEs; firm performance; carbon reduction; Covid-19

CONTENTS

1.INTRODUCTION

The Net Zero Emissions Law was passed by the UK government in 2019. It refers to a radical decrease in carbon footprint[1] – effectively, after accounting for removed greenhouse gas emissions (GHG), it expects that net emissions should be reduced to zero by 2050. Although this is an ambitious target, climate emergency is driving several other economically advanced countries to commit to deep reductions in GHG[2]. The growing interest by academics and policy makers in understanding net zero practices is even more acute since the COVID-19 crisis. A recent environmental policy report by BEIS outlines the government's vision of a green recovery that would restore the economy from the COVID-19 crisis (BEIS, 2020).

Prior literature has paid attention mostly to environmental practices of large corporations and new start-ups, mainly because large firms, rather than SMEs, are the prime polluters. Large firms typically operate in GHG intensive industries[3] (ONS, 2019). Additionally, most of the research on SMEs focused on new start-ups rather than existing SMEs, as start-ups are more prone to generate green product innovations (Hockerts and Wüstenhagen, 2010; Hofmann et al., 2012). As a result, our knowledge about how existing SMEs are approaching net zero is quite limited. Correcting these shortcomings is crucial, since SMEs will also be called upon to conform to net zero regulations, either directly (due to government policy) or indirectly (due to consumer or supply chain pressures). Here, we focus on the environmental practices that existing SMEs pursue in order to meet the net zero emission targets set by the UK government (hereafter *net zero practices*). In this context, we are guided by two research questions: *RQ1 - Which are the drivers of net zero practices? RQ2 - Which are the performance outcomes of net zero practices?*

We employ recent data of 1019 SMEs based on a novel survey – that was collected during the COVID-19 crisis[4] in the UK. The econometric analysis addresses the research questions we raised as follows: First, we examine an extensive range of net zero practices, which span across technological and organisational business domains. Second, we investigate the external (such as regulatory push) and internal [to the business] drivers of net zero practices.

[1] Carbon footprint refers to the total amount of GHG produced directly and indirectly by human activities. It is calculated in tons, as the sum of all emissions of carbon dioxide (CO2).
[2] Besides the UK, five nations have introduced net zero legislation, namely, Sweden and Scotland by 2045, and Denmark, France, and New Zealand by 2050 (Institute for Government, 2020).
[3] The most GHG intensive industries in the UK are energy supply, agriculture, water supply, mining, transport, and manufacturing (ONS,2019).
[4] The data collection took place between September 2020 and November 2020.

Third, we analyse the performance outcomes of net zero practices by identifying the environmental practices that reduce carbon emissions and those that stimulate firm growth.

2.LITERATURE REVIEW

2.1 Net zero practices

The UK green recovery plan on net zero is seeking to tackle climate change by focusing on clean energy, transport, and vehicles as well as, investments on carbon capture, smart technologies, and infrastructure investment on buildings insulation (BEIS, 2020). Firms typically implement a portfolio of net zero practices across different business domains – from changes in production processes and distribution systems, to organisational changes and employees training, as well investments on environmental research and development (R&D), green product innovation, and market research.

The OECD (2018) provides a more subtle understanding of net zero practices by highlighting that the development and diffusion of low-carbon practices requires accelerating not only technological investments (e.g. renewable energy or battery energy storage), but also non-technological investments (e.g. changes in institutions or organisations that lead to consumer behavioural changes such as circular economy business models). Accordingly, in this research we recognise that net zero practices include new or improved low-carbon technologies as well significant changes in organisational routines, processes, and systems. Crucially, low-carbon organisational investments can complement low-carbon technological solutions, as the adoption of a net zero technology may depend on behavioural or organisational changes (OECD, 2018; Ozusaglam et al., 2018; García-Quevedo et al., 2020).

2.1.1 Technological net zero practices

Previous research on environmental and energy economics, largely focused on technological net zero practices (Popp, 2006). Production processes can become net zero by either introducing integrated cleaner production technologies or end-of-pipeline pollution control technologies (OECD, 2009; Demirel and Kesidou, 2011). Integrated cleaner production technologies refer to the introduction of clean or more efficient production technologies that transform the *production process*. For instance, the European Commission has paid particular attention to changes in the production process that contribute to the circular economy, when businesses install technologies that seek to re-plan the way water and/or gas is used to minimise usage or maximise re-usage (e.g. closed loop manufacturing systems) (EC, 2010). Radical transformation in the production process can also be achieved by substituting inputs

in the production process (e.g. fossil fuel) with cleaner alternatives, such as *use of renewable energy* (Fischedick et al., 2014). On the other hand, end-of-pipeline pollution control technologies refer to incremental changes at the final stage of the production process that reduce emissions without changing the production process (DEFRA, 2006; Fischedick et al., 2014). A typical example of this type of net zero practice is *improved pollution filtering*.

Whilst the path towards net zero involves the diffusion of existing net zero practices (technological and non-technological), it also requires the development of new green technologies. Thus, e*ngaging in environmental R&D* is of paramount importance as it leads to the accumulation of an increasing stock of knowledge on net zero technologies and increases the probability of innovation in general and the introduction of *new low carbon products and services to the market* in particular (Kesidou and Wu, 2020).

2.1.2 Organisational net zero practices

Environmental reporting is a net zero organisational practice that allows businesses across sectors to reduce their carbon emissions (García-Quevedo et al., 2020). This practice improves environmental performance by changing organisational structures and by introducing appropriate procedures and routines. Additionally, *training on environmental matters* aims to increase the environmental awareness of employees as well as to enhance the core environmental skills and expertise within the organisation (Renwick et al., 2013; Pham et al. 2020). Investing on training, with an explicit focus on net zero, allows businesses to adopt a systematic approach in building, updating, and enhancing the knowledge and capabilities of employees on environmental matters (Jabbour et al 2020; Jabour, 2015).

Conducting market research related to low carbon products/services allows businesses to build “market sensing” net zero capabilities, which are crucial in allowing SMEs to gain a better understanding of current and future changes in consumer tastes and demand (Demirel and Kesidou, 2019). The commercial success of new low carbon products and services might be higher when businesses invest on market research as weak understanding of consumer trends impedes the viability of new low carbon products (Dangelico and Vocalelli, 2017).

Developing net zero strategies that focus on re-organising *distribution processes* across the supply chain can reduce carbon emissions. Existing research on green operations management and sustainable procurement has paid attention to organisational net zero practices (Hsueh et al., 2020). Sarkis et al (2011) provide an insightful review into the different ways via which the distribution process can integrate net zero concerns into inter-

organisational practices by looking at best practices applied in sustainable supply network management, green purchasing and procurement, environmental purchasing, green logistics, and sustainable supply chains (Laari et al., 2006; Large and Gimenez, 2011)

2.2 Drivers of net zero practices

The uptake of net zero practices is driven by both external and internal (business-level) factors. External factors entail government policies, voluntary regulations, external finance, and customer demand, whereas internal business-level factors include the motivation of businesses to improve their image and reputation and to reduce costs (Kesidou and Demirel, 2012).

2.2.1. External drivers of net zero practices

Government policies, either via command-and-control instruments or through price incentives can induce businesses to commit to net zero (Kesidou & Wu, 2020; Porter & van der Linde, 1995). Earlier works on environmental economics indicate that government policy plays a central role in accelerating investments into low-carbon practices, whereby *environmental regulations* could restrict or limit the use of GHG intensive technologies and *environmental taxes* increase the cost of operating pollution-intensive technologies or processes (Johnstone and Labonne, 2006). For example, Emission Trading System (ETS) is the core policy tool used in the EU for reducing greenhouse gas emissions in Europe[5] (European Commission, 2010). However, 99.8% of EU27s non-financial business are SMEs, the majority of which are not covered by ETS, as ETS covers GHG intensive sectors.

Recent evidence points out that policies need to be implemented coherently across different sectors and a mix of policies seems to be more relevant than before (Committee on Climate Change, 2019; Edmondson et al., 2019). In the same vein, studies in the literature on eco-innovation advocate the importance of government innovation policies that provide incentives in the form of *government grants or subsidies*, so that they increase or shift investments towards green R&D that allows them to transition to net zero and become leaders in current or future growing markets of green innovative products (Fabrizi et al., 2018). Such incentives are highly relevant to SMEs as prior literature indicates that they are more prone to generate

[5] The ETS in EU includes more than 11,000 installations in the following high polluting sectors such as aviation, energy, minerals, production and processing of ferrous metals, pulp from timber, paper and board (over 20 tonnes/day capacity) (European Commission, 2010).

radical green innovations compared to incumbent large corporation; although the latter play a pivotal role in scaling up green innovations (Hockerts and Wüstenhagen 2010; Hofmann et al. 2012). For instance, the UK government has only recently announced that will provide £90 million funding on green technologies, such as energy storage, floating offshore wind and biomass production (BEIS, 2021).[6]

Besides state regulation, self-regulation or voluntary regulation may play a role in stimulating the adoption of net zero practices (Prakash and Potoski, 2013). For example, *voluntary agreements within the sectors or across the supply chain* could be instrumental in indirectly inducing businesses to commit to net zero practices in order to sustain their legitimacy within their sectors and/or gain entry to global supply chains (Aravind and Christmann, 2011; Iatridis and Kesidou, 2018). Moreover, voluntary regulations might be more relevant for SMEs, such as GHG reporting, as they can be effective in motivating businesses across all sectors to measure and eventually reduce their GHG emissions (European Commission, 2010).

Additionally, access to finance such as the *availability of external funding from banks* is required for the uptake of more capital-intensive net zero practices. The UK established the Green Investment Bank in 2012, which played a pivotal role in financing renewable energy projects (Committee on Climate Change, 2019), but was later on privatised. Recently the UK government announced the creation of the first infrastructure bank, whose purpose is to attract private investment and to liaise with local authorities in order to finance the transition to net zero in general and capital-intensive projects on energy, water, waste, transport and digital technologies, in particular (Financial Times, 2021[7]). The rational and need for government financing and coordination, as opposed to solely private finance such as venture capital, is that transition to net zero requires stable and sustained levels of finance over the long run, which mitigates the high risk and uncertainty of new green technologies and addresses affectively coordination failures (Mazzucato and Semieniuk, 2018).

Finally, the road map towards net zero can be swayed by consumers as *customer demand for low-carbon products or services* could be a key driver of net zero practices (Kesidou and Demirel, 2011). This is because consumer behavior and societal choices may shift demand away from GHG-intensive activities, for example by reducing demand of beef, lamb, and dairy

[6] https://www.gov.uk/government/news/over-90-million-government-funding-to-power-green-technologies
[7] https://www.ft.com/content/94317e23-8729-42cb-9e62-4b398eb49144

products (Committee on Climate Change, 2019). Yet, consumer demand and behaviour is still not well understood as evidence suggests that consumers may have climate concerns, but they might not always follow up with a purchasing decision due to low willingness to pay for a price premium (Young et al, 2010; Devinney et al., 2010), or even because of non-economic barriers such as culture or customs that may need to change so that we accelerate the shift to healthier diets.

2.2.2. Internal business-level drivers of net zero practices

Internal business-level factors are also crucial in driving business to invest on net zero practices (Horbach et al. 2012). Here, we focus on businesses' motivation to improve their image and reputation and to reduce costs.

Prior research indicates that businesses are seeking to adopt low-carbon practices in order to *improve their image and reputation*. Businesses invest on image and reputation as they are considered valuable intangible assets that affect positively business performance (Deephouse, 2000; King & Whetten, 2008). Rindova et al. (2005) define reputation as an intangible asset that reflects a broad public recognition of the capability of the firm to deliver high quality products and services. Pfarrer et al. (2010) have shown that firms with high reputation received higher rewards for upwards deviations of predicted profits and lower penalties for downward deviations of profits. This positive performance outcome occurs because image and reputation reflect the social approval of the firm. In a similar vein, SMEs even if they are not requested to comply with national net zero regulations, they will seek to invest on net zero practices in order to legitimise their business activities and gain public approval by various national and international stakeholders. Specifically, there is a growing global pressure to combat emissions in order to meet the UN Sustainable Development Goals (SDGs)[8]. The SDGs includes 17 targets, many of which are directly (e.g. goal 13 on climate action) or indirectly (e.g. goal 7 affordable and clean energy) interrelated with climate change, thus, driving businesses to reduce faster and deeper GHGs.

Also, a crucial factor underpinning investments on environmental practices are motivations to *reducing costs*. For example, a more efficient production process may decrease costs (Hitchens et al., 2003). However, not all net zero practices lead to a significant decline in business costs. For instance, pollution abatement technologies could lead to reductions in

[8] United Nations (2015) *Sustainable Development Goals*, https://sustainabledevelopment.un.org/?menu=1300

pollution, without necessarily reducing costs - they actually increase costs (Rexhäuser and Rammer, 2014). This is oftentimes the case of end-of-pipeline pollution control technologies such as air pollution monitoring and filtering (Ashford, 1994), which reduce environmental externalities, but are costly. However, integrated cleaner production technologies typically lead to both reduction of pollution (as they modify the production or distribution process) and costs reductions (by either replacing inputs or increasing energy, production, or distribution efficiency).

The configuration of internal and external factors that stimulate the adoption of carbon reducing practices may change during times of crisis. For instance, during the Great Financial Crisis (GFC), companies with strong internal motivations, seeking to reduce costs, were more likely to adopt and implement ISO14001 in a substantive manner, instead of just greenwashing and symbolic implementation (Iatridis and Kesidou, 2018). Likewise, due to the advent of Covid-19 and the subsequent economic crisis that followed, we anticipate that internal drivers (i.e. businesses' motivation to improve their image and reputation and to reduce costs) might explain the uptake of net zero practices amongst SMEs.

2.3. Performance outcomes of net zero practices

2.3.1. Environmental and business performance

Net zero practices vary in their effects upon environmental and business performance in that several net zero practices can reduce carbon emissions (with diverse effectiveness levels), but a few can boost firm performance (Johnstone, 2007; Palmer et al., 1995). Identifying those net zero practices that do both – the so-called 'win-win scenario' (Porter, 1991; Porter and Van Der Linde, 1995a,b) – is pivotal in order to ease the trade-offs between environmental and firm performance.

Prior literature indicates that whilst some types of net zero technologies decrease environmental externalities (e.g. carbon capture filters), they do not necessarily improve firm growth (Hitchens et al., 2003; Ashford (1994). Evidence from Germany indicates that only those net zero practices that alter the production process significantly, increasing production efficiency, are able to boost business performance (Rexhäuser and Rammer, 2014). In the same vein, recent evidence of 36,645 firms from eight European Countries shows that the cost-offsets of net zero technologies that solely reduce environmental externalities are trivial (Ozusaglam et al. 2018). As a result, such technologies shrink business turnover compared

to net zero technologies that increase efficiency, which lead to turnover growth (Ozusaglam et al. 2018).

In the same vein, the literature on organisational environmental practices shows a growing consensus of the positive impact that such practices exert upon environmental performance (Arimura et al. 2016); yet, the benefits of non-technological net zero practices (such as environmental reporting, market search, or training) are not always clear when it comes to business performance (Darnall et al. 2008). For example, research environmental reporting and environmental management systems indicates that environmental management systems reduce pollution, but only certified ones are able to positively affect operational performance (Melnyk et al., 2003).

3. DATA AND METHODS

Our analysis is based on the Business Futures Survey, a new major survey of UK SMEs launched by the ERC in 2020. The survey aimed to understand current net-zero practices of the UK SMEs and to gather insights into SMEs' experiences during the challenging times of the COVID-19 pandemic. The survey was undertaken by telephone using a CATI system between September and November 2020 and collected data from 1,019 SMEs. The sample focused on businesses employing between 7 and 250 employees and was representative of the main economic sectors and nations.[9]

Small businesses of less than 50 employees accounted for about 86 per cent of the sample. The other 14 per cent were medium-sized businesses, employing between 50 and 249 employees. Well established businesses, which started trading more than 10 years ago made up to 80 per cent of interviewed SMEs. Young businesses, of 5 years old or less, accounted for just over 5 per cent and businesses, between 6 and 10 years old, made up to about 15 per cent. About 74 per cent of businesses were the unique site organisations, while 26 per cent of businesses operated more than one site.

[9] Northern Ireland SMEs were overrepresented in the sample. Thus, in order to provide results which are representative of the UK population of SMEs, observations from Northern Ireland were weighted.

3.1. Model variables

3.1.1.Net zero practices

In the survey, firms were asked if they had taken any steps to minimise the environmental impact over the past year, and if they did, what were these steps. Table 1 shows that the most widely diffused net zero practice was *changes in the production and/or distribution processes* (i.e. transport/logistics). 38 per cent of all businesses in the sample reported that they had changed their production and/or distribution processes in order to reduce carbon emissions. The second most diffused net zero practice is the use of *renewable energy* (almost 30 per cent of all businesses). This is closely followed by offering *training on environmental matters* (26 per cent), *introducing new low carbon products/services* to the market (25 per cent), and undertaking of *environmental reports* (22 per cent). Just over 19 per cent of the surveyed firms reported that they improved *pollution filtering*, around 16 per cent conducted *market research related to low carbon products/services*, and 14 per cent were engaged in *environmental R&D*.

Our net zero practices variables are binary variables reflecting whether firms adopted each of the eight net zero practice or not.

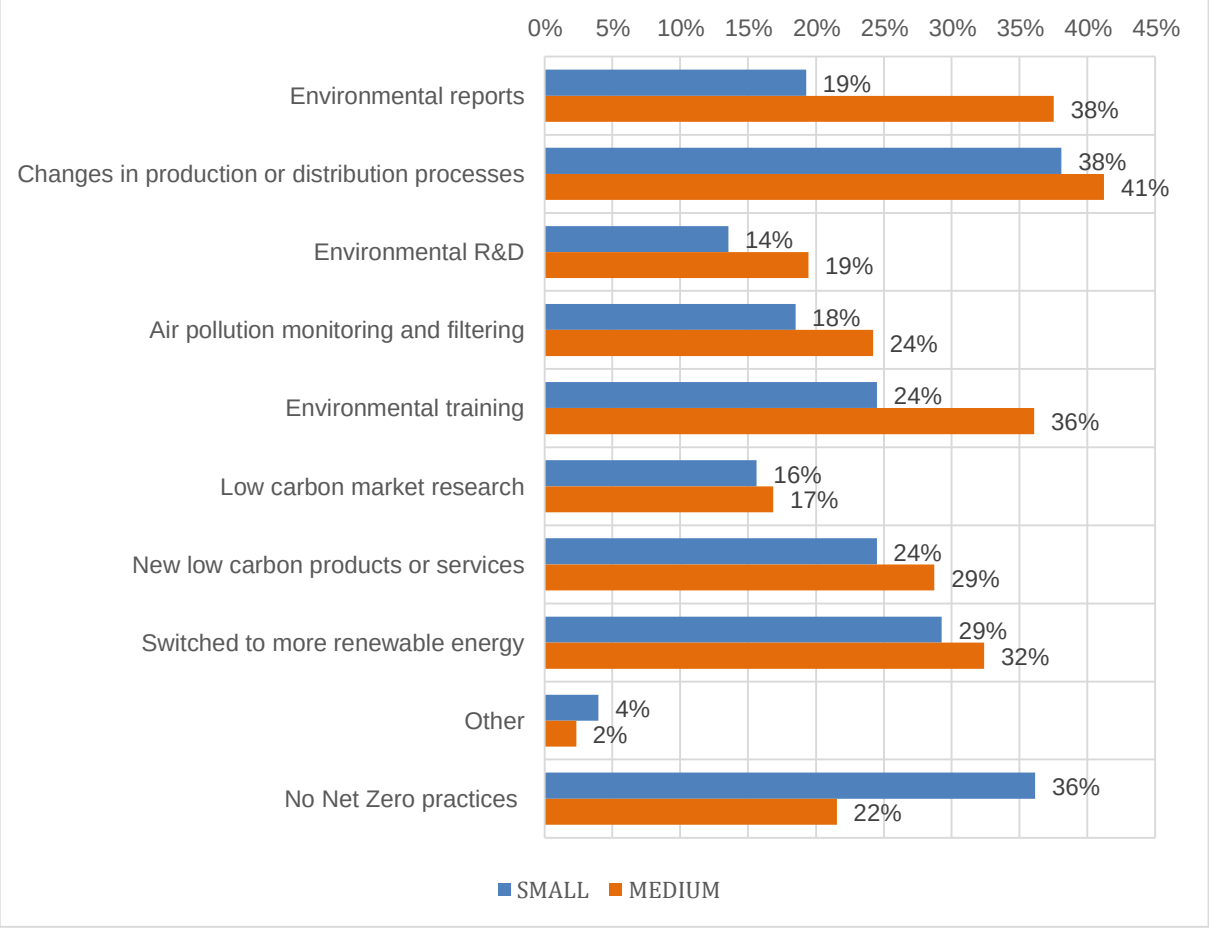
Figure 1 illustrates differences in net zero practices by firm size. Medium sized businesses are more likely to be engaged in environmental reports, environmental R&D, environmental training compared to small-sized businesses (statistically significant differences). For other practices there are no major differences: although the results show higher percentages for medium-sized businesses, the difference is not statistically significant. The results show that 36 per cent of small firms are not engaged in any net zero practice to minimise their environmental impact. This is significantly higher than among medium-sized businesses (22 per cent).

Table 1. Descriptive statistics

Variables			
Net zero practices	**Sample**	**Mean**	**Std. Dev.**
Environmental reports (1/0)	N=1019	0.219	0.414
Changes in production or distribution processes (1/0)	N=1019	0.385	0.487
Environmental R&D (1/0)	N=1019	0.144	0.351
Air pollution monitoring and filtering (1/0)	N=1019	0.193	0.395
Environmental training (1/0)	N=1019	0.261	0.440
Low carbon market research (1/0)	N=1019	0.158	0.365
New low carbon products or services (1/0)	N=1019	0.251	0.434
Switched to more renewable energy (1/0)	N=1019	0.297	0.457
Drivers			
Environmental regulations or taxes	N=694	2.794	1.296
Government grants or subsidies	N=688	2.741	1.447
Customer demand for low-carbon products or services	N=686	2.502	1.337
Voluntary agreements within the sector or supply chain	N=675	2.512	1.307
External funding from banks	N=681	2.352	1.386
Improving your image and reputation	N=714	3.322	1.277
Reducing costs	N=719	3.441	1.248
Performance outcomes			
Employment growth (0/1)	N=1015	0.171	0.377
Carbon reduction (0/1)	N=1019	0.505	0.500
Controls			
Size: small	N=1018	0.857	0.350
Size: medium	N=1018	0.143	0.350
Size: log(Employment)	N=981	3.306	0.880
Age: 0 to 5 years	N=1013	0.053	0.224
Age: 6 to 10 years	N=1013	0.146	0.353
Age: 11 to 20 years	N=1013	0.315	0.465
Age: More than 20 years	N=1013	0.486	0.500
Exporter (0/1)	N=1015	0.308	0.462
Product innovation objective (0/1)	N=1019	0.517	0.500
Process innovation objective (0/1)	N=1019	0.628	0.484
Nation: England	N=1019	0.861	0.346
Nation: Northern Ireland	N=1019	0.027	0.162
Nation: Scotland	N=1019	0.073	0.259
Nation: Wales	N=1019	0.039	0.195
Sector: Primary ABDE	N=1005	0.025	0.156
Sector: Manufacturing C	N=1005	0.111	0.314
Sector: Construction F	N=1005	0.077	0.266
Sector: Transport, retail and distribution GHI	N=1005	0.347	0.476
Sector: Business services JKLMN	N=1005	0.274	0.446
Sector: Other services PQRS	N=1005	0.167	0.373

Source: ERC Business Futures survey 2020

Figure 1: Net zero practices by Size

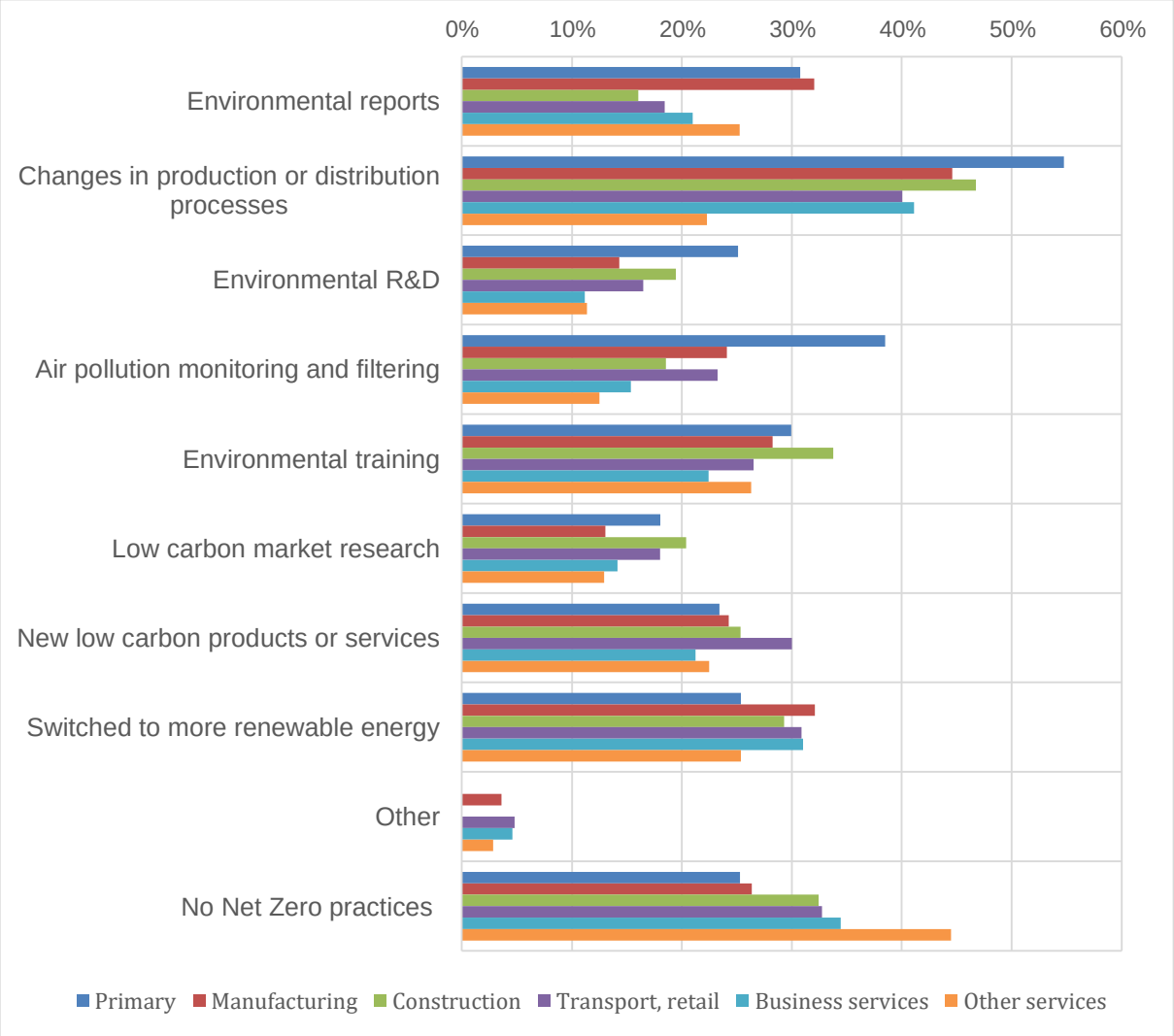


Source: ERC Business Futures survey 2020

As it may be expected there are also some sectoral differences in the level of adoption of *technological* and *organisational net zero practices*. Figure 2 shows that among technological net zero practices *changes in the production and/or distribution processes* were adopted by more than a half of firms in primary sector (55 per cent), by 47 per cent of firms in construction and 45 per cent of SMEs in manufacturing, but only by 22 per cent of firms in other services. On the contrary, *use of renewable energy* is more even across sectors varying from 25 per cent of firms in primary sector and other services, to 31 per cent in transport and retail, and

32 per cent in manufacturing. *Improving pollution filtering* was more largely diffused among SMEs in primary sector (39 per cent)[10] than in other sectors.

Figure 2. Net zero practices by sector



Source: ERC Business Futures survey 2020

As it should be expected *Environmental R&D* were more largely reported by firms in production sectors (25 per cent of firms in private sector followed by 19 per cent of firms in construction, 17 per cent in transport, distribution and retail and 14 per cent in manufacturing) than in

[10] However, the number of firms representing primary sector in the sample is low. Thus, these figures should be considered with some degree of cautiousness.

services (11 per cent). The highest use of *new low carbon products and services* was reordered in transport, retail and distribution (30 per cent).

Among organisational net zero practices, the most important sectoral differences concern *environmental reports* which are more often undertaken by firms in manufacturing (32 per cent) and primary sectors (31 per cent), and less so by firms in construction (16 per cent) and transport and distribution (18 per cent) sectors. As for *environmental training* and *low carbon market research*, these practices demonstrate the highest adoption rates in construction.

Services sectors, business and professional services and other services, have the highest percentage of firms who reported that they had not undertaken any steps to minimise their environmental impact (34 and 44 per cent of firms). This is to compare with only one in four firms in primary and manufacturing sectors to report none of net zero practices.

3.1.2 Drivers of net zero practices

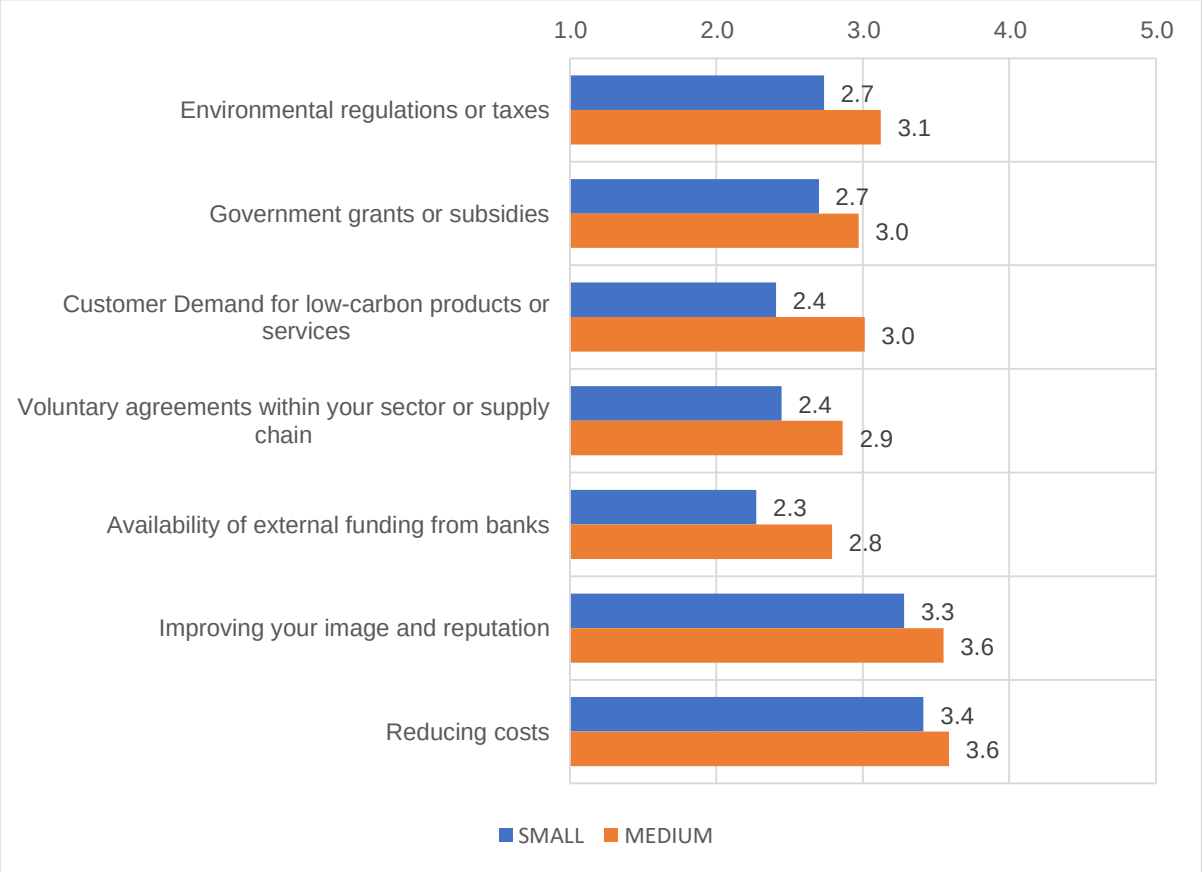
In the survey firms who had undertaken any of the steps to minimise their environmental impact were also asked how important each of the seven factors (*environmental regulations or taxes*, *government grants and subsidies*, *customer demand for low-carbon products or services*, *voluntary agreements within the sector or supply chain*, *availability of external funding from banks*, *image and reputation*, and *cost reduction*) was in influencing their efforts to reduce carbon emissions on a scale from 1 (not at all important) to 5 (extremely important). Our 'drivers' variables are categorical variables taking values from 1 to 5. Answers 'don't know' and 'refused' were treated as missing observations.

Descriptive statistics (Table 1) show that in the context of the COVID-19 crisis, firms were committing to reduce their carbon emissions largely due to internal factors. With an average value of 3.4, *reducing costs* appears as the most important factor. Typically, respondents considered this factor as very important[11] in driving their efforts to reduce carbon emissions. For about half of the firms, improving their *image and reputation* was extremely or very important (average score of 3.3). *Government policies, grants or subsidies* (2.7) and *environmental regulations and taxes* (2.8), were the key external drivers of adoption of net zero practices amongst firms in the UK. This is in line with prior research. Sectoral pressures

[11] Median value for this variable is 4 - 'Very important'.

to comply with *voluntary agreements* and *customer demand* for low carbon products and services were almost equally important (2.5), followed by *availability of external funding* (2.35).

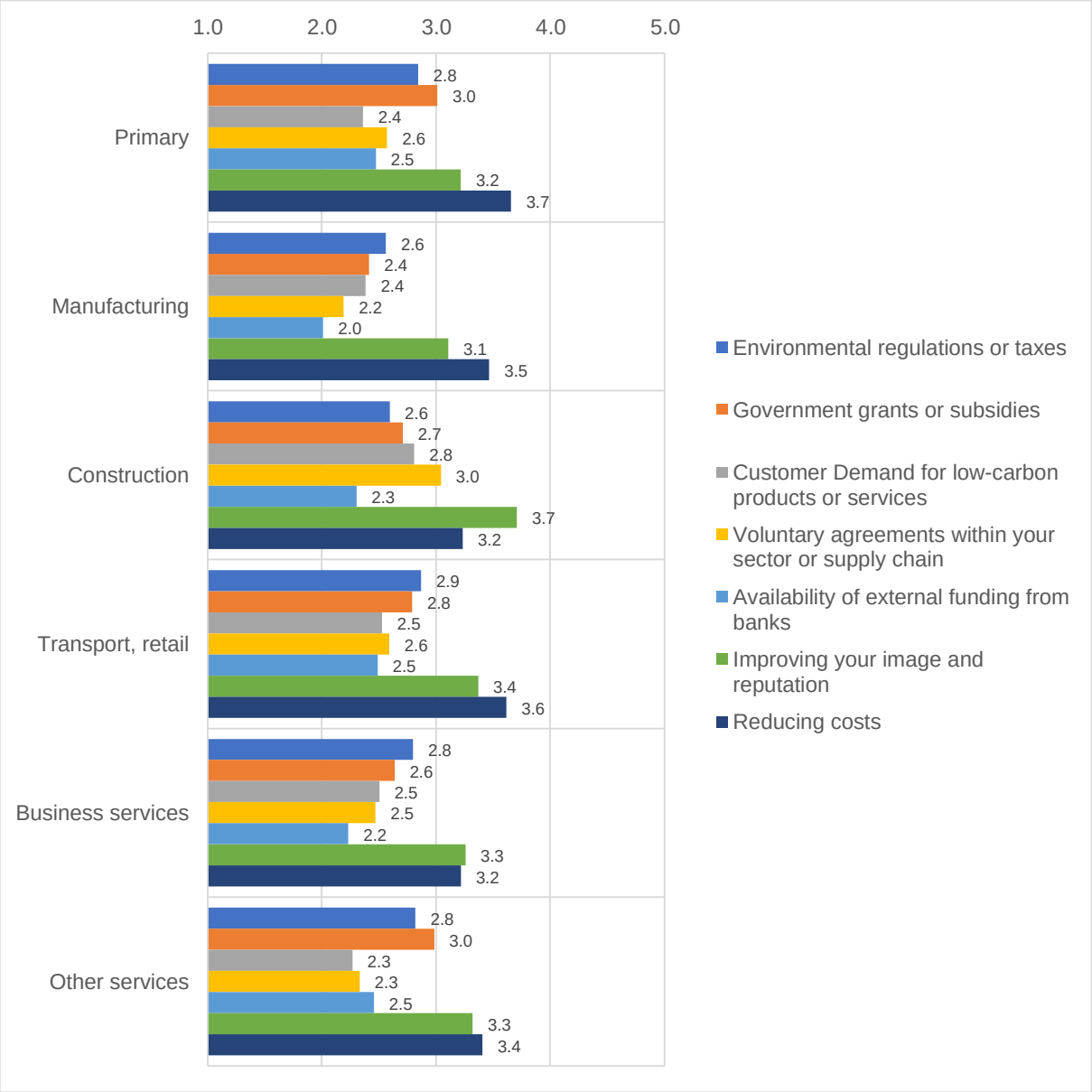
Figure 3. Drivers of net zero practices by size



Source: ERC Business Futures survey 2020

When comparing drivers of net zero practices by size, medium-sized firms typically give more importance to all seven factors than smaller firms (Figure 3). Except for *reducing costs* driver, all differences are statistically significant. The largest difference is observed for *customer demand* which is on average much more important in driving steps to minimise environmental impact for medium firms (3.0 on scale from 1 to 5) than it is for small firms (2.4).

Figure 4. Drivers of net zero practices by sector



Source: ERC Business Futures survey 2020

Figure 4 shows that across all sectors *reducing costs* and *improving image and reputation* have the highest average level of importance. *Image and reputation* are particularly important in construction (3.7 on as scale from 1 to 5), which is significantly different from other sectors. *Voluntary agreements* within the sector or supply chain and *customer demand* also appear as more important in construction than in other sectors. *Government grants or subsidies* are more important for primary sector and other services.

3.1.3. Performance Outcomes

To measure environmental performance of net zero practices we use a binary variable of *carbon emissions reduction*: it takes value of 1 if businesses' carbon emissions decreased over the past 12 months and 0 otherwise. More than 50 per cent of businesses in the sample reported some reduction in carbon emissions.

As a proxy for business performance, we use a binary outcome variable of *employment growth* taking value of 1 if the number of employees increased over the last 12 months, and of 0 otherwise. Considering the timing of the survey fieldwork (autumn 2020) this period includes pre-pandemic months of late 2019 and early 2020, as well as the first and second lockdowns of 2020. In this analysis, we cannot make a distinction between business performance prior and during the Covid-19 pandemic. It is likely that some businesses may have postponed their plans for increasing labour force when the pandemic struck. In this context, we argue that any relationship that we may identify between introduction of net zero practices and business performance could have been even stronger during the 'normal' times.

Table A1 in the Appendix shows the correlation matrix for all variables of interest. It provides some indication of potential relationships between net zero practices, factors that may be driving them, and possible outcomes of their implementation. For example, customer demand is positively and significantly correlated with all eight net zero practices, while government grants and subsidies are correlated with environmental R&D, improving pollution filtering, and low carbon market research. We explore these possible relationships below by applying econometric methods to analyse the data.

3.2 Estimation strategy

3.2.1 What drives adoption of net zero practices?

To analyse what drives the uptake of net zero practices, we estimate a following univariate probit model for each of eight net zero practices separately:

$$NZ_i^j = \alpha_0 + \alpha_1 Drivers_i + \alpha_2 Z_i + \varepsilon^j, \quad j = (1, \dots, 8) \qquad (1)$$

Where NZ_i^j is a binary variable equal to one if a firm *i* introduced net zero practice *j* and zero otherwise[12]. $Drivers_i$ are a series of variables that capture the external and internal factors that induce firms to invest in diverse net zero practices[13], and Z_i are a set of controls.

For the standard firm level controls, we use a categorical variable for the size of the firm to distinguish between small and medium-sized businesses and another categorical variable for the age of the firm (0 to 5 years, 6 to 10 years, 11 to 20 years and more than 20 years since starting trading). We also allow for sectoral and geographical heterogeneity by including sector and nation variables.

3.2.2 What are the performance outcomes of net zero practices?

3.2.2.1 Environmental performance: Carbon emission reduction

We explore the effects of different net zero practices upon the environmental performance of UK SMEs by estimating the following bivariate model for each of eight net zero practices:

$$CE_i = \alpha_0 + \alpha_1 NZ_i^j + \alpha_2 NZ_i^{k \neq j} + \alpha_3 Z_i + \varepsilon_a \quad (2a)$$

$$NZ_i^j = \beta_0 + \beta_1 NZ_i^{k \neq j} + \beta_2 Drivers_i + \beta_3 Z_i + \varepsilon_b \quad (2b)$$

$$\varepsilon_a, \varepsilon_b \sim N_2[(0,0),(1,1,\rho)]$$

where CE_i is a binary variable equal to one if a firm *i* reported a reduction in its carbon emissions and zero otherwise, NZ_i^j is a binary variable equal to one if a firm *i* introduced net zero practice *j* and zero otherwise, $NZ_i^{k \neq j}$ is a vector of all other net zero variables which are not *j*, $Drivers_i$ is a vector of variables relating to potential drivers of net zero practices as previously defined and Z_i are a set of controls. As previously, we control for size, age, sector and geography.

The first equation (2a) is structural and expresses the probability of carbon emissions reduction dependent on the adoption of net zero practices. The second question (2b) measures the probability that a firm undertakes net zero practice *j* due to complementarities arising from the adoption of other net zero practices (other than *j*) and external and internal

[12] Net zero practices are discussed in detail in sections 2.1 and 3.1.1.
[13] The drivers of net zero practices are discussed in detail in sections 2.2 and 3.1.2.

drivers. In line with prior research, our model specification assumes that firm's use of one net zero practice may not only be driven by external and internal factors as discussed above, but also by other net zero practices that it has already in place (Ozusaglam et al., 2018). In other words, there might be some complementarities between different net zero practices.

The choice of the model is driven by potential endogeneity of net zero practices in which case univariate probit models might produce biased and inconsistent results. Therefore, we use a modelling strategy which simultaneously estimates the probability of carbon emission reduction reported by a firm *i* (CE_i) and the probability that firm *i* undertakes net zero practice *j*.

The correlation coefficient between two error terms ($\varepsilon_a, \varepsilon_b$) accounts for all possible omitted or unobservable factors that drive both the probability of carbon emission reduction and the likelihood of net zero practice use. If estimated correlation coefficient ρ is not significantly different from zero, then the error terms are not correlated, and the model can be consistently estimated using two separate univariate probit models. If, on the contrary, ρ is significantly different from zero, then the estimates of separate univariate models are inconsistent, and it is necessary to estimate two equations simultaneously.

3.2.2.2 Business performance: Firm growth

To analyse the relationship between net zero practices and business performance, we estimate the following bivariate recursive model for each of eight net zero practices, which allows for reversed causality:

$$Growth_i = \alpha_0 + \alpha_1 NZ_i^j + \alpha_2 NZ_i^{k \neq j} + \alpha_3 Z_i + \varepsilon_a \quad (3a)$$

$$NZ_i^j = \beta_0 + \beta_1 Growth_i + \beta_2 NZ_i^{k \neq j} + \beta_3 Drivers_i + \beta_4 Z_i + \varepsilon_b \quad (3b)$$

$$\varepsilon_a, \varepsilon_b \sim N_2[(0,0),(1,1,\rho)]$$

where $Growth_i$ is a binary variable equal to one if a firm *i* reported employment growth over the past 12 months and zero otherwise, NZ_i^j is a binary variable equal to one if a firm *i* introduced net zero practice *j* and zero otherwise, $NZ_i^{k \neq j}$ is a vector of all other net zero binary variables which are not *j*, $Drivers_i$ is a vector of variables relating to external and internal drivers of net zero practices as previously defined, and Z_i are a set of controls. To control for firm size, we use here the (log) employment to reflect the scale of firm's resources. We also control for firm age, sector, and geography.

The model is closely similar to the one used for analysing environmental performance with one important difference: it allows for reversed causality. There is a reason to believe that the relationship goes in both ways: (a) net zero practices by altering the production process and increasing efficiency may affect business performance; (b) more efficient and better performing organisations may have better capabilities and resources to undertake net zero practices.

As discussed previously, the significance of estimated correlation coefficient ρ represents an indicator of the goodness of this approach. If ρ is not significant, the model can be consistently estimated using two separate univariate models. Models are implemented using CMP module in Stata 16 (Roodman, 2011).

4. RESULTS

4.1. Drivers of net zero practices

In table 2, we summarise the findings resulting from the estimation of models of net zero practices driven by a set of external and internal factors (1). The average marginal effects are reported in Table A2 in the Appendix. The sample is restricted to those firms who undertake steps to minimise the environmental impact of their business and excludes those who do nothing in this domain. With this analysis we aim to identify what types of drivers stimulate or constrain each type of net zero practice.

External drivers of net zero practices

The results of the econometric analysis show that *environmental regulations or taxes* drive SMEs to commit to organisational net zero practices. Specifically, they increase the probability that firms undertake environmental reports by 5.2 percentage points. Additionally, *environmental regulations or taxes* induce investments on technological net zero practices. In particular, they increase the probability of investing on environmental R&D by 4.4 percentage points.

Furthermore, our results indicate that *government grants or subsidies* are constraining organisational net zero practices. First, they reduce the probability for undertaking environmental reports by 4.3 percentage points. Second, *government grants or subsidies* are

associated with 4.1 percentage points lower probability that SMEs will engage with environmental training.

Table 2. Effects of net zero drivers on the probability of net zero practices

Net zero drivers \ *Net zero practices*	Environmental Reports	Changes in production / distribution	Environmental R&D	Pollution filtering	Environmental training	Market research	Low carbon product/services	Renewable energy
Environmental regulations or taxes	+		+					-
Government grants or subsidies	-				-			
Customer demand for low-carbon products or services	+	+	+		+	+	+	+
Voluntary agreements within sector or supply chain					+			
External funding from banks		-						
Improving image and reputation	+	+				+		
Reducing costs								

Note: only results significant at 10% or lower are reported here; full results are reported in Appendix Table A2.

The results of the analysis show that *customer demand for low-carbon products/services* is the most important driver of both technological and organisational net zero practices. Customer demand is positively and significantly associated with higher probability of all net zero practices (with the exception of pollution filtering). For instance, customer demand increases the probability to switch to renewable energy by 7.2 percentage points.

We find little evidence that *voluntary agreements within sector or supply chain* affect net zero practices. Sectoral agreements encourage only organisational net zero investments. Specifically, firms reporting voluntary agreements within sector are 3.8 percentage points more likely to introduce environmental training.

Finally, our results suggest that *external funding* constrains investments in technological net zero practices. In particular, financially constrained firms are 5.8 percentage points less likely to undertaking changes in production and distribution processes.

Internal drivers of net zero practices

Despite the fact that *reducing costs* was the most frequently cited reason to implement environmentally friendly activities, we do not find statistically significant evidence that cost reduction drives net zero practices.

The second most cited reason – *improving image and reputation* – is positively associated with changes in production or distribution processes. Specifically, firms looking to improve their image and reputation are 3.8 percentage points more likely to undertake changes in production/distribution processes than those who do not. This driver is also positively and significantly associated with two organisational net zero practices, environmental reports and low carbon market research.

4.2 Performance outcomes

4.2.1 Environmental performance: Carbon emission reduction

In Table 3 we report the average marginal effects of net zero practices undertaken by UK SMEs on the probability of carbon emissions reduction. Full estimation results containing probit coefficients are reported in Appendix Table A3. For four net zero practices models – *environmental reports*, *changes in production/distribution*, *new low carbon products and services* and *renewable energy* – correlation coefficient ρ is significant suggesting correlations between error terms and necessity of simultaneous estimations of equations (2a) and (2b). For *environmental R&D*, *pollution filtering*, *environmental training* and *low carbon market research*, ρ is not significant indicating that the two equations can be estimated separately as univariate probit models. Last column in Table 3 reports average marginal effects of net zero practices on the probability of carbon emissions reduction resulting from the estimation of univariate probit model of carbon emissions reduction[14].

Technological net zero practices

Regarding technological net zero practices, we find evidence that *changes in production or distribution processes* have a strong and significant impact upon carbon emissions. When a

[14] As we are interested here in the effect of net zero practices on carbon emissions, we report only estimates of the first equation (2a) estimated separately as univariate probit model.

firm introduces changes in production or distribution processes this increases the probability of carbon emissions reduction by 43.7 percentage points (column 3).

Furthermore, we find evidence that *new low carbon products and services* help to improve environmental performance of SMEs. Indeed, this net zero practice increases the probability of carbon emissions reduction by 45.2 percentage points (column 13).

Switching to *renewable energy* also improves the environmental performance of SMEs by increasing the probability of carbon emissions reduction by 43.1 percentage points (column 15).

We do not find evidence in support of a positive direct effect of *environmental R&D* on carbon emissions reduction. However, we demonstrate that this effect is indirect: undertaking environmental R&D increases the probability of introducing *new low carbon products or services* by 11.6 percentage points (column 14), which in turn improves the environmental performance of SMEs.

Regarding *pollution filtering*, the results of univariate probit model (column 0), suggest a positive and significant at 5% effect on carbon emissions (increase the probability by 10.1 percentage points). At the same time, we also find that *pollution filtering* affects carbon emissions indirectly via *changes* in *production or distribution processes;* the probability to introduce such changes increases by 13.7 percentage points when a firm also undertakes steps to improve air pollution monitoring and filtering (column 4).

Organisational net zero practices

We do not find evidence that *environmental reports* and *low carbon market research* affect environmental performance directly. Instead, our results suggest that *low carbon market research* exerts an indirect effect upon environmental performance via *new low carbon products and services* and *renewable energy*. Specifically, we find that SMEs that invest on *low carbon market research* are more likely (by 18 percentage points) to introduce a *new low carbon product or service* (column 14) and to invest on *renewable energy* (column 16). In turn, we already mentioned that SMEs that introduce *new low carbon product or service* or invest on *renewable energy* are more likely to reduce carbon emissions (columns 13 and 15).

Regarding *environmental training*, the estimation results of univariate probit model of carbon emissions provides weak evidence (column 0), suggesting that it increases the probability of reduction of carbon emissions by 7.4 percentage points (significant only at 10 per cent).

Table 3. Average marginal effect of net zero practices on the probability of carbon emissions reduction

	Environmental reports		Changes in production or distribution		Environmental R&D		Pollution filtering		Uni-variate probit
	CE (1)	*NZ*[1] (2)	*CE* (3)	*NZ*[2] (4)	*CE* (5)	*NZ*[3] (6)	*CE* (7)	*NZ*[4] (8)	*CE* (0)
Net Zero practices									
Environmental reports	0.137		-0.014	0.069	0.002	0.020	0.011	0.040	0.012
	(0.092)		(0.031)	(0.049)	(0.044)	(0.039)	(0.043)	(0.048)	(0.042)
Changes in production / distribution processes	0.252***	0.036	0.437***		0.258***	0.055	0.260***	0.113***	0.265***
	(0.030)	(0.039)	(0.016)		(0.029)	(0.038)	(0.033)	(0.043)	(0.028)
Environmental R&D	0.027	0.022	0.003	0.068	0.153		0.041	0.026	0.043
	(0.057)	(0.047)	(0.038)	(0.054)	(0.127)		(0.056)	(0.048)	(0.055)
Pollution filtering	0.098**	0.030	0.028	0.137***	0.094**	0.011	0.140		0.101**
	(0.046)	(0.042)	(0.036)	(0.048)	(0.047)	(0.036)	(0.132)		(0.046)
Environmental training	0.037	0.245***	0.014	0.060	0.067	0.039	0.071*	0.047	0.074*
	(0.050)	(0.034)	(0.033)	(0.048)	(0.042)	(0.037)	(0.041)	(0.046)	(0.040)
Low carbon market research	0.031	0.098**	0.041	-0.037	0.017	0.221***	0.045	0.083*	0.048
	(0.057)	(0.046)	(0.040)	(0.058)	(0.066)	(0.038)	(0.057)	(0.049)	(0.056)
New low carbon products and services	0.181***	-0.010	0.096***	0.015	0.176***	0.069*	0.178***	0.132***	0.183***
	(0.038)	(0.040)	(0.034)	(0.046)	(0.040)	(0.038)	(0.043)	(0.041)	(0.038)
Renewable energy	0.153***	0.044	0.087***	-0.017	0.167***	-0.086**	0.163***	0.034	0.166***
	(0.035)	(0.040)	(0.029)	(0.044)	(0.035)	(0.043)	(0.036)	(0.048)	(0.034)
Other steps	0.003	0.100	-0.005	0.022	0.009	0.135*	0.017	-0.012	0.017
	(0.093)	(0.105)	(0.075)	(0.106)	(0.095)	(0.074)	(0.092)	(0.121)	(0.093)
Drivers									
Environmental regulations or taxes		0.054***		-0.028*		0.043**		0.027	
		(0.018)		(0.017)		(0.017)		(0.020)	
Government grants or subsidies		-0.035*		0.001		-0.007		-0.018	
		(0.018)		(0.018)		(0.016)		(0.019)	
Customer demand for low-carbon products or services		0.003		0.044**		0.024		-0.013	
		(0.016)		(0.018)		(0.015)		(0.018)	
Voluntary agreements within sector or supply chain		-0.011		0.021		-0.021		0.029	
		(0.018)		(0.017)		(0.016)		(0.021)	
Availability of external funding from banks		-0.001		-0.046***		0.035**		0.026	
		(0.017)		(0.016)		(0.015)		(0.018)	
Improving image and reputation		0.031		0.027		-0.029*		0.012	
		(0.019)		(0.018)		(0.017)		(0.020)	
Reducing costs		-0.017		0.013		0.014		-0.001	
		(0.018)		(0.019)		(0.017)		(0.019)	
Atanhrho	-0.383*		-1.625***		-0.310		-0.106		
	(0.231)		(0.560)		(0.277)		(0.296)		
Number of obs.	597		597		597		597		

Note: standard errors in parenthesis *** p<0.01, ** p<0.05, * p<0.1. Observations are weighted to give representative results. Here, number of observations for computing marginal effects; full estimation results reporting probit coefficients are in Annex Table A3.

Table 3 (suite). Average marginal effect of net zero practices on the probability of carbon emissions reduction

	Environmental training		Low carbon market research		New low carbon products and services		Renewable energy		Uni-variate probit
	CE	*NZ*[5]	*CE*	*NZ*[6]	*CE*	*NZ*[7]	*CE*	*NZ*[8]	*CE*
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(0)
Net Zero practices									
Environmental reports	-0.036	0.282***	0.016	0.071**	0.017	-0.019	-0.022	0.055	0.012
	(0.063)	(0.038)	(0.042)	(0.033)	(0.035)	(0.051)	(0.037)	(0.053)	(0.042)
Changes in production / distribution processes	0.241***	0.045	0.265***	-0.032	0.188***	-0.004	0.175***	-0.024	0.265***
	(0.038)	(0.046)	(0.028)	(0.038)	(0.032)	(0.047)	(0.031)	(0.048)	(0.028)
Environmental R&D	0.029	0.070	0.055	0.186***	0.008	0.116**	0.052	-0.088	0.043
	(0.057)	(0.050)	(0.063)	(0.032)	(0.047)	(0.057)	(0.047)	(0.060)	(0.055)
Pollution filtering	0.082*	0.057	0.103**	0.048	0.032	0.141***	0.048	0.043	0.101**
	(0.049)	(0.045)	(0.046)	(0.030)	(0.045)	(0.048)	(0.042)	(0.053)	(0.046)
Environmental training	0.221		0.078*	0.078**	0.025	0.059	0.048	-0.000	0.074*
	(0.140)		(0.042)	(0.033)	(0.036)	(0.050)	(0.035)	(0.051)	(0.040)
Low carbon market research	0.028	0.115**	0.004		-0.032	0.180***	-0.040	0.186***	0.048
	(0.061)	(0.054)	(0.137)		(0.051)	(0.056)	(0.051)	(0.061)	(0.056)
New low carbon products and services	0.162***	0.047	0.190***	0.113***	0.452***		0.103***	0.047	0.183***
	(0.045)	(0.046)	(0.040)	(0.029)	(0.043)		(0.037)	(0.049)	(0.038)
Renewable energy	0.158***	-0.014	0.172***	0.096***	0.105***	0.019	0.431***		0.166***
	(0.036)	(0.049)	(0.036)	(0.032)	(0.034)	(0.047)	(0.027)		(0.034)
Other steps	0.013	0.034	0.018	0.003	0.042	-0.177	0.059	-0.189*	0.017
	(0.091)	(0.090)	(0.093)	(0.063)	(0.085)	(0.109)	(0.074)	(0.111)	(0.093)
Drivers									
Environmental regulations or taxes		-0.007		-0.020		-0.002		-0.015	
		(0.019)		(0.015)		(0.019)		(0.019)	
Government grants or subsidies		-0.028		0.014		-0.022		-0.002	
		(0.019)		(0.014)		(0.018)		(0.020)	
Customer demand for low-carbon products or services		0.020		0.034***		0.031*		0.044**	
		(0.018)		(0.012)		(0.017)		(0.019)	
Voluntary agreements within sector or supply chain		0.037*		0.003		0.014		0.002	
		(0.019)		(0.015)		(0.019)		(0.018)	
Availability of external funding from banks		-0.007		-0.004		-0.041**		-0.004	
		(0.018)		(0.013)		(0.017)		(0.018)	
Improving image and reputation		-0.006		0.033**		0.023		0.011	
		(0.019)		(0.016)		(0.020)		(0.020)	
Reducing costs		0.032*		-0.007		0.013		0.005	
		(0.018)		(0.013)		(0.018)		(0.018)	
Atanhrho	-0.453		0.128		-1.380***		-1.453***		
	(0.418)		(0.314)		(0.525)		(0.343)		
Number of obs.	597		597		597		597		

Note: standard errors in parenthesis *** p<0.01, ** p<0.05, * p<0.1. Observations are weighted to give representative results. Here, number of observations for computing marginal effects; full estimation results reporting probit coefficients are in Annex Table A3.

4.2.2 Business performance: Firm growth

In Table 4 we report the average marginal effects of net zero practices undertaken by UK SMEs on the probability of employment growth. Full estimation results containing probit coefficients are reported in Appendix Table A4.

The results of joint estimation of equations (3a) and (3b) confirm the presence of reversed causality between net zero practices and employment growth. Correlation coefficients of error terms are significant in all models indicating that univariate probit estimators would be inconsistent and simultaneous estimation should be preferred.

The overall results indicate that even in the context of the COVID-19 pandemic, there is a strong statistically significant relationship between both technological and organisational net zero practices and business performance, proxied by employment growth.

Technological net zero practices

Regarding technological net zero practices, we find evidence of significant relationship between these practices and employment growth in our sample of SMEs. Specifically, having introduced *changes in production or distribution processes* increased the probability (by 40.8 percentage points) that a firm experienced employment growth (column 3).

Additionally, SMEs which invested in *environmental R&D* were more likely (by 40.2 percentage points) to have grown over the past 12 months (column 5). Also, SMEs switching to *renewable energy* and those introducing *pollution filtering* were more likely (by 39.7. and 37.9 percentage points respectively) to grow (columns 15 and 7 respectively).

Significantly, our results indicate that SMEs that introduced *new low carbon products and services* were less likely to experience employment growth (column 13). Yet, investing on *new low carbon products and services* exerts an indirect positive effect upon growth, by playing a complementary role when SMEs introduced *changes in production or distribution processes* (columns 4).

Organisational net zero practices

On average, undertaking *environmental reports* and *conducting low carbon market research* increases the probability of employment growth by 36.2 (column 1) and 32.3 percentage points (column 11) respectively.

Environmental training exerts a negative direct effect on employment growth: SMEs who engaged in environmental training were 37.2 percentage points less likely to experience employment growth over the past 12 months. Yet, our results suggest that investments on *environmental training* affect employment growth indirectly by complementing several other net zero practices, such as *environmental reports* (column 2), *changes in production or distribution processes* (column 4), *low carbon market research* (column 12), and *new low carbon products and services* (column 14).

Table 4. Average marginal effects of net zero practices on the probability of employment growth

	Environmental reports		Changes in production or distribution		Environmental R&D		Pollution filtering	
	Growth (1)	*NZ*[1] (2)	*Growth* (3)	*NZ*[2] (4)	*Growth* (5)	*NZ*[3] (6)	*Growth* (7)	*NZ*[4] (8)
Employment growth		0.439*** (0.043)		0.505*** (0.030)		0.405*** (0.034)		0.455*** (0.021)
Net zero practices								
Environmental reports	0.362*** (0.029)		-0.018** (0.008)	0.043** (0.017)	-0.010 (0.024)	0.001 (0.025)	-0.003 (0.030)	0.013 (0.039)
Changes in production or distribution processes	0.029 (0.025)	0.019 (0.029)	0.408*** (0.003)		0.043 (0.031)	0.035 (0.033)	0.036 (0.023)	0.074** (0.029)
Environmental R&D	0.028 (0.020)	-0.026 (0.032)	0.033*** (0.010)	-0.003 (0.034)	0.402*** (0.025)		0.045* (0.026)	-0.023 (0.036)
Pollution filtering	0.004 (0.028)	0.026 (0.031)	-0.055*** (0.005)	0.099*** (0.021)	0.010 (0.030)	0.013 (0.031)	0.379*** (0.016)	
Environmental training	-0.099*** (0.037)	0.206*** (0.031)	-0.056*** (0.005)	0.071*** (0.024)	-0.024 (0.027)	0.044 (0.030)	-0.031 (0.024)	0.042 (0.033)
Low carbon market research	-0.027 (0.029)	0.070* (0.037)	0.003 (0.004)	-0.018 (0.024)	-0.083** (0.032)	0.165*** (0.034)	-0.034 (0.022)	0.067** (0.030)
New low carbon products and services	0.000 (0.021)	0.002 (0.033)	-0.042*** (0.010)	0.039** (0.019)	-0.033 (0.031)	0.039 (0.032)	-0.049*** (0.018)	0.102*** (0.028)
Switched to more renewable energy	-0.004 (0.029)	0.046 (0.030)	-0.023*** (0.005)	0.031* (0.018)	0.020 (0.028)	-0.061** (0.027)	-0.016 (0.022)	0.012 (0.026)
Other steps	-0.066 (0.078)	0.116 (0.117)	-0.062* (0.037)	0.074 (0.069)	-0.071* (0.040)	0.123** (0.054)	-0.003 (0.045)	0.023 (0.070)
Drivers								
Environmental regulations or taxes		0.029* (0.017)		-0.017 (0.015)		0.030** (0.013)		0.012 (0.016)
Government grants or subsidies		-0.014 (0.015)		0.007 (0.008)		0.002 (0.013)		-0.014 (0.010)
Customer demand for low-carbon products or services		-0.004 (0.015)		0.018*** (0.007)		0.011 (0.012)		-0.004 (0.014)
Voluntary agreements within sector or supply chain		-0.010 (0.014)		0.010 (0.013)		-0.027** (0.014)		0.019 (0.014)
Availability of external funding from banks		0.001 (0.015)		-0.021* (0.011)		0.025* (0.013)		0.014 (0.011)
Improving image and reputation		0.015 (0.013)		0.014 (0.012)		-0.018 (0.015)		0.005 (0.014)
Reducing costs		-0.019 (0.015)		-0.011 (0.011)		0.005 (0.014)		0.003 (0.014)
atanhrho	-13.187*** (0.325)		-14.290*** (0.237)		-14.574*** (0.363)		-14.005*** (0.200)	
Number of observations	580		596		580		580	

Note: standard errors in parenthesis *** p<0.01, ** p<0.05, * p<0.1. Observations are weighted to give representative results. Here, number of observations for computing marginal effects; full estimation results reporting probit coefficients are in Annex Table A4.

Table 4 (suite). Average marginal effects of net zero practices on the probability of employment growth

	Environmental training		Low carbon market research		New low carbon products and services		Renewable energy	
	Growth (9)	*NZ*[5] (10)	*Growth* (11)	*NZ*[6] (12)	*Growth* (13)	*NZ*[7] (14)	*Growth* (15)	*NZ*[8] (16)
Employment growth		-0.434*** (0.023)		0.386*** (0.029)		-0.442*** (0.005)		0.497*** (0.024)
Net zero practices								
Environmental reports	0.163*** (0.007)	0.226*** (0.028)	-0.000 (0.029)	0.050 (0.030)	0.020 (0.046)	0.016*** (0.000)	-0.021 (0.018)	0.048 (0.034)
Changes in production or distribution processes	0.098*** (0.003)	0.104*** (0.015)	0.060** (0.030)	-0.037 (0.029)	0.100*** (0.031)	0.097*** (0.009)	0.017 (0.028)	0.002 (0.034)
Environmental R&D	0.107*** (0.006)	0.099*** (0.016)	-0.027 (0.034)	0.120*** (0.030)	0.104*** (0.007)	0.114*** (0.001)	0.082*** (0.019)	-0.117*** (0.033)
Pollution filtering	0.049*** (0.003)	0.065*** (0.020)	-0.017 (0.030)	0.041 (0.027)	0.079** (0.032)	0.118*** (0.014)	-0.022 (0.022)	0.028 (0.030)
Environmental training	-0.372*** (0.008)		-0.037 (0.030)	0.068** (0.032)	0.054*** (0.011)	0.076*** (0.025)	-0.021 (0.034)	0.029 (0.042)
Low carbon market research	0.048** (0.019)	0.094*** (0.035)	0.323*** (0.030)		0.083** (0.033)	0.139*** (0.001)	-0.094*** (0.023)	0.142*** (0.032)
New low carbon products and services	0.048*** (0.003)	0.062** (0.024)	-0.034 (0.024)	0.101*** (0.026)	-0.371*** (0.008)		-0.053** (0.024)	0.067** (0.033)
Switched to more renewable energy	0.042*** (0.005)	0.039*** (0.013)	-0.034 (0.029)	0.064** (0.028)	0.072** (0.030)	0.082*** (0.015)	0.397*** (0.017)	
Other steps	0.015* (0.009)	0.022 (0.024)	0.007 (0.070)	-0.006 (0.069)	-0.035 (0.024)	-0.083*** (0.001)	0.031 (0.080)	-0.050 (0.106)
Drivers								
Environmental regulations or taxes		-0.003 (0.007)		-0.011 (0.015)		0.001 (0.005)		-0.018 (0.014)
Government grants or subsidies		-0.005 (0.004)		0.012 (0.013)		-0.005 (0.015)		-0.003 (0.010)
Customer demand for low-carbon products or services		0.003 (0.007)		0.027** (0.011)		0.006 (0.006)		0.017 (0.012)
Voluntary agreements within sector or supply chain		0.010 (0.009)		-0.007 (0.015)		0.002 (0.007)		-0.002 (0.015)
Availability of external funding from banks		-0.004 (0.007)		-0.000 (0.013)		-0.014*** (0.000)		0.004 (0.016)
Improving image and reputation		-0.004 (0.003)		0.023* (0.013)		0.004 (0.008)		0.010 (0.015)
Reducing costs		0.008 (0.011)		-0.008 (0.013)		0.003 (0.008)		-0.001 (0.014)
atanhrho	14.287*** (0.236)		-13.433*** (0.257)		13.911*** (0.174)		-14.138*** (0.222)	
Number of observations	580		580		580		580	

Note: standard errors in parenthesis *** p<0.01, ** p<0.05, * p<0.1. Observations are weighted to give representative results. Here, number of observations for computing marginal effects; full estimation results reporting probit coefficients are in Annex Table A4.

5.CONCLUSIONS

In this report we have conducted an econometric analysis that employs novel data from the Business Futures Survey. We have raised a policy-relevant question - *which are the drivers of net zero practices?* - and tackled a question with significant implications for owners and/or managers of SMEs in the UK- w*hich are the performance outcomes of net zero practices?* Below, we summarise the answers to these questions, and draw the relevant implications.

First, the results of the econometric analysis show that external drivers such as *environmental regulations or taxes* and *customer demand for low-carbon products or services* induce SMEs to commit to technological and organisational net zero practices. Additionally, our findings stress the importance of internal motivations, whereby SMEs adopt net zero practices in order to *improve their image and reputation.* By contrast, our evidence indicates that *government grants or subsidies* and the *availability of external funding from banks* are constraining organisational and technological net zero practices respectively.

Second, we provide new insights into the performance outcomes of net zero practices in general, pointing out in particular that, technological net zero practices improve the environmental performance of SMEs, whilst organisational net zero practices affect environmental performance indirectly. For instance, we show that investments on *low carbon market research* play a complementary role by facilitating technological changes such as the introduction of *new low carbon products and services* and appropriate investments on *renewable energy*, thus improving environmental performance indirectly.

Third, our results indicate that even in the context of the COVID-19 pandemic, there is a strong statistically significant relationship between both technological and organisational net zero practices and business performance, proxied by employment growth. Specifically, SMEs that introduced *changes in production or distribution processes,* invested in *environmental R&D*, switched to *renewable energy,* and those introducing *pollution filtering* were more likely to grow. Alike SMEs that adopted organisational net zero practices such as undertaking *environmental reports* and *conducting low carbon market research* were more likely to experience employment growth.

Our results are relevant to policy makers, as the current conditions provide an opportunity to introduce a mix of policies that may support businesses to transition towards net zero. Policy mix refers to adopting a holistic approach to net zero, by implementing different types of policies (e.g. environmental policies, innovation policies) at different levels (e.g. business level, city level). Our results point out two priorities of a net zero policy mix: First, environmental regulations and taxes induce investments on net zero practices (Kesidou and Wu, 2020). Low private investments on net zero practices are partly due to due to market failures[15] associated with pollution. Our results show that environmental policies are able to solve market failures associated with pollution, and in turn drive the transition of SMEs to net zero. Second, our findings point out that consumer demand for low carbon products/services drives the uptake of net zero practices. However, consumers are not always willing to pay the premium associated with low carbon products or services. Green/sustainable procurement (at the national or city/region level) could boost demand for net zero products and services and provide the opportunity for green SMEs to scale-up (Darnall et al., 2017).

Finally, our research can inform owners or managers of SMEs as our results provide strong evidence that a 'win-win scenario' (Porter, 1991; Porter and Van Der Linde, 1995a,b) is feasible in the UK: SMEs can adopt net zero practices that ease the trade-offs between environmental and business performance. Specifically, technological net zero practices (such as *changes in production or distribution processes*) are able to reduce carbon emissions and to stimulate firm growth. Organisational net zero practices do not seem to affect environmental performance directly, yet, we highlight their significance as we detected indirect mechanisms, whereby synergies amongst technological and organisational net zero practices drive performance.

[15] Government policy is required because markets fails in the case of pollution due to negative environmental externalities. *Negative* refers to the fact that industrial pollution imposes a burden upon society and the environment, whilst *externality* refers to the fact that firms do not compensate society for the harmful environmental impact.

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APPENDICES

Table A1. Correlation matrix

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
1	Environmental reports	1																				
2	Changes in production/distribution processes	0.10*	1																			
3	Environmental R&D	0.17*	0.09*	1																		
4	Air pollution monitoring & filtering	0.17*	0.19*	0.14*	1																	
5	Environmental training	0.37*	0.12*	0.19*	0.19*	1																
6	Low carbon market research	0.21*	0.11*	0.33*	0.21*	0.25*	1															
7	New low carbon products/services	0.14*	0.13*	0.18*	0.21*	0.18*	0.29*	1														
8	Switched to more renewable energy	0.13*	0.10*	0.07	0.12*	0.13*	0.23*	0.15*	1													
9	Other	0.05	0.00	0.03	-0.03	0.05	0.05	-0.01	-0.02	1												
10	Environmental regulations/taxes	0.16*	0.04	0.21*	0.14*	0.14*	0.15*	0.08*	0.04	0.04	1											
11	Government grants/subsidies	0.03	0.04	0.11*	0.08*	0.04	0.15*	0.01	0.05	0.01	0.51*	1										
12	Customer demand	0.16*	0.14*	0.22*	0.14*	0.20*	0.28*	0.16*	0.14*	0.04	0.49*	0.40*	1									
13	Voluntary agreements within sector / sc	0.12*	0.12*	0.12*	0.13*	0.20*	0.19*	0.11*	0.08	0.05	0.53*	0.48*	0.51*	1								
14	Availability of external funding	0.05	-0.04	0.18*	0.09*	0.05	0.13*	0.01	0.06	-0.07	0.44*	0.59*	0.43*	0.47*	1							
15	Image and reputation	0.16*	0.08*	0.12*	0.15*	0.17*	0.25*	0.14*	0.07	0.06	0.47*	0.49*	0.47*	0.51*	0.42*	1						
16	Reducing costs	0.04	-0.01	0.12*	0.05	0.10*	0.11*	0.07	0.00	0.03	0.42*	0.46*	0.31*	0.39*	0.39*	0.44*	1					
17	Employment growth	0.09*	0.08	0.05	0.03	0.05	0.09*	0.04	0.03	0.04	0.10*	0.07	0.09*	0.09*	0.01	0.07	-0.03	1				
18	Turnover growth	-0.03	-0.05	-0.01	0.00	0.00	-0.05	-0.05	-0.04	-0.04	0.02	-0.03	-0.06	-0.02	0.00	-0.10*	0.36*	1				
19	Carbon reduction	0.12*	0.27*	0.13*	0.17*	0.16*	0.13*	0.18*	0.13*	-0.05	0.14*	0.04	0.21*	0.17*	0.04	0.13*	0.10*	0.10*	-0.06	1		
20	Product innovation objective	0.00	0.10*	0.06	-0.01	0.08	0.14*	0.14*	0.08*	-0.01	0.05	0.03	0.05	0.06	0.01	0.13*	0.04	0.17*	0.15	0.01*	1	
21	Process innovation objective	0.05	0.13*	0.08*	0.04	0.10*	0.05	0.12*	0.05	0.01	0.05	0.02	-0.02	0.05	0.00	0.08*	0.00	0.10*	0.06	-0.05	0.29*	1

Note: Spearman nonparametric correlation; * correlation coefficients significant at the 5% level

Table A2. Average marginal effects of net zero drivers on the probability of net zero practices

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Env Reports	Changes in production / distribution	Env R&D	Pollution filtering	Env training	Market research	Low carbon product/ services	Renewable energy
Environmental regulations or taxes	0.052*** (0.019)	-0.031 (0.022)	0.044** (0.018)	0.025 (0.020)	0.007 (0.021)	-0.013 (0.017)	-0.002 (0.023)	-0.036* (0.022)
Government grants or subsidies	-0.043** (0.019)	0.013 (0.020)	-0.005 (0.016)	-0.025 (0.019)	-0.041** (0.020)	0.002 (0.017)	-0.029 (0.020)	-0.013 (0.021)
Customer demand for low-carbon products or services	0.038** (0.018)	0.069*** (0.019)	0.054*** (0.015)	0.021 (0.019)	0.053*** (0.019)	0.075*** (0.015)	0.063*** (0.020)	0.072*** (0.020)
Voluntary agreements within sector or supply chain	-0.001 (0.019)	0.029 (0.022)	-0.019 (0.017)	0.032 (0.021)	0.038* (0.021)	0.006 (0.018)	0.016 (0.023)	0.003 (0.023)
Availability of external funding from banks	-0.008 (0.018)	-0.058*** (0.020)	0.020 (0.016)	0.012 (0.019)	-0.013 (0.020)	-0.003 (0.016)	-0.033 (0.020)	0.005 (0.021)
Improving image and reputation	0.048** (0.020)	0.038* (0.022)	-0.009 (0.018)	0.033 (0.021)	0.023 (0.021)	0.048*** (0.018)	0.031 (0.022)	0.025 (0.022)
Reducing costs	-0.021 (0.019)	-0.015 (0.022)	0.010 (0.018)	-0.004 (0.019)	0.018 (0.020)	-0.006 (0.017)	0.003 (0.021)	-0.007 (0.021)
Size (Benchmark - small)								
Size: Medium-sized businesses	0.200*** (0.048)	-0.047 (0.049)	0.026 (0.041)	0.016 (0.044)	0.106** (0.049)	-0.035 (0.038)	0.036 (0.050)	-0.010 (0.050)
Age (Benchmark: 0-5 years old)								
Age: 6 to 10 years old	-0.157 (0.107)	-0.206* (0.108)	-0.075 (0.104)	0.000 (0.097)	0.073 (0.112)	0.054 (0.095)	0.018 (0.113)	-0.093 (0.121)
Age: 11 to 20 years old	-0.133 (0.098)	-0.094 (0.095)	-0.088 (0.096)	0.026 (0.087)	0.052 (0.100)	-0.012 (0.085)	-0.020 (0.102)	-0.031 (0.110)
Age: More than 20 years	-0.191** (0.095)	-0.107 (0.093)	-0.115 (0.094)	0.065 (0.085)	-0.055 (0.097)	-0.045 (0.082)	-0.070 (0.099)	-0.125 (0.108)
Sector (Benchmark - Manufacturing)								
Primary	-0.117 (0.123)	0.149 (0.121)	0.076 (0.132)	0.140 (0.140)	-0.146 (0.130)	0.070 (0.147)	0.039 (0.153)	-0.039 (0.153)
Construction	-0.284*** (0.081)	0.103 (0.100)	0.054 (0.087)	-0.074 (0.099)	0.085 (0.107)	0.003 (0.083)	-0.025 (0.101)	-0.050 (0.107)
Transport, retail and distribution	-0.226*** (0.060)	-0.062 (0.063)	0.011 (0.053)	-0.046 (0.062)	-0.073 (0.063)	0.003 (0.053)	0.048 (0.063)	-0.019 (0.066)
Business services	-0.181*** (0.061)	0.004 (0.065)	-0.044 (0.052)	-0.123** (0.062)	-0.107* (0.062)	-0.023 (0.055)	-0.035 (0.064)	0.003 (0.068)
Other services	-0.021 (0.081)	-0.181** (0.084)	-0.010 (0.072)	-0.114 (0.077)	0.023 (0.083)	-0.038 (0.066)	0.058 (0.084)	-0.042 (0.085)

Country (Benchmark - England)								
Northern Ireland	0.138**	-0.022	0.028	0.085	0.095*	0.062	-0.005	0.113*
	(0.059)	(0.057)	(0.050)	(0.054)	(0.057)	(0.056)	(0.057)	(0.059)
Scotland	0.101	-0.025	-0.023	-0.053	0.106	0.080	-0.020	-0.035
	(0.077)	(0.079)	(0.060)	(0.066)	(0.078)	(0.066)	(0.078)	(0.080)
Wales	0.225**	-0.056	0.089	0.044	0.035	0.116	0.034	0.015
	(0.098)	(0.108)	(0.097)	(0.095)	(0.108)	(0.101)	(0.111)	(0.107)
Observations	597	597	597	597	597	597	597	597
LR χ^2	89.36	46.94	47.41	41	60.82	65.97	28.16	27.77
Prob >χ^2	0.000	0.000	0.000	0.002	0.000	0.000	0.080	0.088
Log likelihood	-315.2	-371.7	-272	-329.9	-352.4	-269.7	-369.9	-386
Pseudo R-squared	0.131	0.0765	0.102	0.0588	0.0903	0.136	0.0453	0.0399

Note: Standard errors in parenthesis *** p<0.01, ** p<0.05, * p<0.1
Observations are weighted to give representative results.

Table A3. The probability of carbon emissions reduction: bivariate recursive probit models

	Environmental reports		Changes in production or distribution		Environmental R&D		Pollution filtering	
	CE (1)	*NZ*[1] (2)	*CE* (3)	*NZ*[2] (4)	*Growth* (5)	*NZ*[3] (6)	*Growth* (7)	*NZ*[4] (8)
Net Zero practices								
Environmental reports	0.496 (0.331)		-0.060 (0.134)	0.198 (0.141)	0.006 (0.159)	0.089 (0.171)	0.041 (0.155)	0.138 (0.162)
Changes in production / distribution processes	0.913*** (0.126)	0.134 (0.149)	1.896*** (0.121)		0.936*** (0.125)	0.243 (0.169)	0.946*** (0.136)	0.385** (0.159)
Environmental R&D	0.099 (0.207)	0.083 (0.179)	0.014 (0.166)	0.196 (0.156)	0.554 (0.457)		0.148 (0.205)	0.090 (0.164)
Pollution filtering	0.355** (0.171)	0.112 (0.158)	0.119 (0.156)	0.393*** (0.141)	0.341** (0.173)	0.048 (0.158)	0.508 (0.481)	
Environmental training	0.134 (0.183)	0.922*** (0.144)	0.062 (0.141)	0.171 (0.138)	0.244 (0.152)	0.170 (0.165)	0.257* (0.149)	0.159 (0.159)
Low carbon market research	0.111 (0.206)	0.368** (0.176)	0.180 (0.175)	-0.107 (0.167)	0.060 (0.240)	0.970*** (0.175)	0.165 (0.210)	0.282* (0.168)
New low carbon products and services	0.655*** (0.146)	-0.038 (0.149)	0.416*** (0.147)	0.044 (0.131)	0.640*** (0.156)	0.301* (0.171)	0.648*** (0.166)	0.450*** (0.151)
Renewable energy	0.554*** (0.134)	0.164 (0.153)	0.379*** (0.127)	-0.048 (0.126)	0.607*** (0.131)	-0.378** (0.176)	0.594*** (0.137)	0.116 (0.168)
Other steps	0.010 (0.336)	0.377 (0.400)	-0.023 (0.325)	0.063 (0.304)	0.032 (0.343)	0.589* (0.333)	0.062 (0.335)	-0.040 (0.412)
Drivers								
Environmental regulations or taxes		0.203*** (0.069)		-0.082* (0.049)		0.190** (0.076)		0.093 (0.068)
Government grants or subsidies		-0.133* (0.069)		0.004 (0.051)		-0.032 (0.070)		-0.062 (0.063)
Customer demand for low-carbon products or services		0.011 (0.060)		0.128** (0.054)		0.105 (0.065)		-0.045 (0.063)
Voluntary agreements within sector or supply chain		-0.043 (0.069)		0.061 (0.050)		-0.093 (0.072)		0.098 (0.070)
Availability of external funding from banks		-0.003 (0.064)		-0.131*** (0.048)		0.152** (0.068)		0.088 (0.061)
Improving image and reputation		0.116 (0.073)		0.077 (0.052)		-0.126* (0.075)		0.041 (0.069)

Reducing costs		-0.065 (0.068)		0.037 (0.053)		0.059 (0.073)		-0.005 (0.064)
Size (Benchmark: small)								
Medium	0.325*** (0.120)	0.616*** (0.149)	0.340*** (0.107)	-0.249** (0.126)	0.379*** (0.115)	0.173 (0.161)	0.388*** (0.114)	0.031 (0.146)
Age (Benchmark: 0-5 years old)								
6 to 10 years old	-0.091 (0.257)	-0.672** (0.333)	0.104 (0.238)	-0.462 (0.282)	-0.105 (0.255)	-0.406 (0.356)	-0.124 (0.255)	0.117 (0.361)
11 to 20 years old	-0.188 (0.225)	-0.507* (0.279)	-0.079 (0.206)	-0.270 (0.248)	-0.197 (0.226)	-0.270 (0.306)	-0.209 (0.224)	0.210 (0.317)
More than 20 years	-0.086 (0.215)	-0.609** (0.274)	0.004 (0.197)	-0.294 (0.239)	-0.091 (0.216)	-0.373 (0.305)	-0.117 (0.215)	0.411 (0.319)
Sector (Benchmark - Manufacturing)								
Primary	0.528 (0.398)	-0.275 (0.383)	0.406 (0.426)	0.536 (0.371)	0.471 (0.425)	0.215 (0.374)	0.499 (0.420)	0.363 (0.388)
Construction	0.127 (0.265)	-1.140*** (0.319)	-0.018 (0.268)	0.622** (0.280)	0.037 (0.262)	0.193 (0.310)	0.068 (0.261)	-0.234 (0.347)
Transport, retail and distribution	0.214 (0.158)	-0.776*** (0.203)	0.231 (0.143)	-0.130 (0.165)	0.157 (0.157)	0.012 (0.222)	0.162 (0.159)	-0.127 (0.192)
Business services	0.161 (0.153)	-0.463** (0.199)	0.108 (0.144)	0.163 (0.165)	0.131 (0.155)	-0.185 (0.224)	0.132 (0.158)	-0.356* (0.193)
Other services	-0.319* (0.183)	-0.002 (0.249)	-0.023 (0.169)	-0.270 (0.217)	-0.315* (0.182)	0.022 (0.287)	-0.308* (0.187)	-0.292 (0.248)
Country (Benchmark - England)								
Northern Ireland	-0.022 (0.123)	0.357* (0.189)	0.074 (0.121)	-0.102 (0.159)	-0.014 (0.121)	0.057 (0.191)	-0.014 (0.122)	0.196 (0.165)
Scotland	0.139 (0.196)	0.173 (0.236)	0.178 (0.175)	-0.101 (0.205)	0.170 (0.190)	-0.428 (0.267)	0.155 (0.191)	-0.236 (0.243)
Wales	0.049 (0.317)	0.681** (0.274)	0.144 (0.275)	-0.101 (0.283)	0.036 (0.328)	0.254 (0.288)	0.065 (0.318)	0.090 (0.316)
Constant	-0.906*** (0.258)	-0.580 (0.377)	-1.228*** (0.238)	0.053 (0.299)	-0.866*** (0.257)	-1.658*** (0.438)	-0.853*** (0.259)	-1.896*** (0.453)
Atanrho	-0.383* (0.231)		-1.625*** (0.560)		-0.310 (0.277)		-0.106 (0.296)	
Observations	999		999		999		999	
LR chi2	329.8		530.2		328		282.7	
Prob > chi2	0.0000		0.0000		0.0000		0.0000	

Notes: Probit coefficients, Standard errors in parenthesis, *** p<0.01, ** p<0.05, * p<0.1
Observations are weighted to give representative results.

Table A3 (suite). The probability of carbon emissions reduction: bivariate recursive probit models

	Environmental training		Low carbon market research		New low carbon products and services		Renewable energy		Univariate probit
	CE (9)	*NZ*[5] (10)	*CE* (11)	*NZ*[6] (12)	*CE* (13)	*NZ*[7] (14)	*CE* (15)	*NZ*[8] (16)	*CE* (0)
Net Zero practices									
Environmental reports	-0.132 (0.231)	0.946*** (0.148)	0.058 (0.151)	0.364** (0.177)	0.065 (0.134)	-0.055 (0.148)	-0.085 (0.141)	0.148 (0.144)	0.042 (0.154)
Changes in production / distribution processes	0.883*** (0.152)	0.153 (0.159)	0.964*** (0.121)	-0.162 (0.187)	0.715*** (0.132)	-0.011 (0.137)	0.665*** (0.125)	-0.064 (0.129)	0.966*** (0.120)
Environmental R&D	0.107 (0.207)	0.235 (0.170)	0.199 (0.230)	0.950*** (0.170)	0.032 (0.180)	0.338** (0.166)	0.198 (0.180)	-0.237 (0.163)	0.157 (0.203)
Pollution filtering	0.300* (0.182)	0.193 (0.152)	0.374** (0.172)	0.245 (0.159)	0.121 (0.174)	0.411*** (0.144)	0.181 (0.159)	0.116 (0.144)	0.368** (0.172)
Environmental training	0.809 (0.516)		0.284* (0.154)	0.399** (0.168)	0.096 (0.138)	0.171 (0.145)	0.182 (0.132)	-0.001 (0.137)	0.272* (0.148)
Low carbon market research	0.104 (0.222)	0.387** (0.182)	0.014 (0.501)		-0.120 (0.195)	0.523*** (0.171)	-0.153 (0.192)	0.499*** (0.170)	0.177 (0.204)
New low carbon products and services	0.593*** (0.170)	0.157 (0.156)	0.692*** (0.151)	0.579*** (0.161)	1.719*** (0.177)		0.393*** (0.141)	0.126 (0.131)	0.670*** (0.146)
Renewable energy	0.578*** (0.136)	-0.048 (0.165)	0.625*** (0.135)	0.491*** (0.182)	0.400*** (0.131)	0.056 (0.137)	1.639*** (0.124)		0.605*** (0.131)
Other steps	0.047 (0.333)	0.115 (0.305)	0.066 (0.340)	0.013 (0.324)	0.160 (0.325)	-0.516 (0.318)	0.223 (0.283)	-0.508* (0.299)	0.061 (0.339)
Drivers									
Environmental regulations or taxes		-0.023 (0.065)		-0.103 (0.077)		-0.007 (0.055)		-0.039 (0.050)	
Government grants or subsidies		-0.093 (0.063)		0.071 (0.075)		-0.064 (0.054)		-0.006 (0.053)	
Customer demand for low-carbon products or services		0.068 (0.060)		0.175*** (0.063)		0.090* (0.050)		0.118** (0.052)	
Voluntary agreements within sector or supply chain		0.125* (0.066)		0.014 (0.076)		0.042 (0.055)		0.004 (0.048)	
Availability of external funding from banks		-0.024 (0.061)		-0.021 (0.066)		-0.118** (0.051)		-0.011 (0.049)	
Improving image and reputation		-0.020 (0.064)		0.168** (0.078)		0.067 (0.057)		0.030 (0.053)	
Reducing costs		0.108* (0.060)		-0.034 (0.069)		0.037 (0.052)		0.014 (0.048)	
Size (Benchmark: small) Medium	0.350*** (0.123)	0.119 (0.147)	0.385*** (0.114)	-0.348** (0.174)	0.299*** (0.109)	0.066 (0.134)	0.318*** (0.105)	-0.084 (0.126)	0.390*** (0.114)
Age (Benchmark: 0-5 years old)									

6 to 10 years old	-0.176 (0.253)	0.413 (0.318)	-0.123 (0.254)	0.465 (0.378)	-0.135 (0.250)	0.048 (0.312)	-0.080 (0.246)	-0.261 (0.287)	-0.132 (0.256)
11 to 20 years old	-0.267 (0.224)	0.334 (0.285)	-0.212 (0.227)	0.200 (0.339)	-0.202 (0.219)	-0.137 (0.279)	-0.179 (0.223)	-0.121 (0.249)	-0.215 (0.226)
More than 20 years	-0.121 (0.211)	0.039 (0.283)	-0.115 (0.217)	0.236 (0.338)	-0.098 (0.210)	-0.252 (0.274)	-0.012 (0.214)	-0.360 (0.244)	-0.115 (0.216)
Sector (Benchmark - Manufacturing)									
Primary	0.474 (0.414)	-0.461 (0.418)	0.512 (0.420)	0.303 (0.515)	0.520 (0.372)	0.022 (0.428)	0.583 (0.427)	-0.108 (0.380)	0.512 (0.418)
Construction	0.010 (0.274)	0.608** (0.301)	0.066 (0.257)	0.059 (0.327)	0.049 (0.228)	-0.123 (0.274)	0.075 (0.228)	-0.035 (0.259)	0.056 (0.260)
Transport, retail and distribution	0.150 (0.158)	-0.016 (0.192)	0.168 (0.157)	0.054 (0.229)	0.085 (0.152)	0.121 (0.172)	0.187 (0.144)	-0.096 (0.166)	0.160 (0.158)
Business services	0.129 (0.155)	-0.098 (0.192)	0.129 (0.156)	0.100 (0.247)	0.107 (0.149)	0.033 (0.182)	0.098 (0.142)	0.052 (0.167)	0.123 (0.156)
Other services	-0.330* (0.183)	0.231 (0.256)	-0.317* (0.184)	-0.195 (0.273)	-0.338* (0.174)	0.312 (0.223)	-0.232 (0.184)	0.022 (0.219)	-0.320* (0.184)
Country (Benchmark - England)									
Northern Ireland	-0.012 (0.118)	0.140 (0.178)	-0.012 (0.121)	0.027 (0.219)	0.011 (0.117)	-0.086 (0.157)	-0.123 (0.118)	0.235 (0.152)	-0.009 (0.121)
Scotland	0.127 (0.194)	0.139 (0.234)	0.167 (0.194)	0.362 (0.246)	0.120 (0.173)	-0.275 (0.225)	0.119 (0.163)	-0.193 (0.213)	0.155 (0.192)
Wales	0.063 (0.323)	-0.161 (0.295)	0.081 (0.321)	0.232 (0.425)	0.122 (0.289)	0.066 (0.310)	0.105 (0.282)	0.036 (0.268)	0.078 (0.320)
Constant	- 0.825*** (0.256)	- 1.568*** (0.416)	- 0.851*** (0.258)	- 2.943*** (0.535)	- 0.836*** (0.254)	-0.689* (0.355)	- 1.011*** (0.250)	-0.175 (0.319)	-0.843*** (0.259)
Atanrho	-0.453 (0.418)		0.128 (0.314)		-1.380*** (0.525)		-1.453*** (0.343)		
Observations	999		999		999		999		999
LR chi2	393		383.8		420.8		428		186.2
Prob > chi2	0.0000		0.0000		0.0000		0.0000		0.0000

Notes: Probit coefficients, Standard errors in parenthesis, *** p<0.01, ** p<0.05, * p<0.1
Observations are weighted to give representative results.

Table A4. The probability of employment growth: bivariate recursive probit models with reversed causality

	Environmental reports		Changes in production or distribution		Environmental R&D		Pollution filtering	
	Growth eq. (1)	NZ eq. (2)	Growth eq. (3)	NZ eq. (4)	Growth eq. (5)	NZ eq. (6)	Growth eq. (7)	NZ eq. (8)
Employment growth		1.688*** (0.216)		1.527*** (0.024)		1.842*** (0.195)		1.630*** (0.094)
Net Zero practices								
Environmental reports	1.373*** (0.137)		-0.062** (0.029)	0.129*** (0.020)	-0.039 (0.096)	0.006 (0.113)	-0.012 (0.117)	0.048 (0.140)
Changes in production or distribution processes	0.112 (0.095)	0.073 (0.113)	1.424*** (0.016)		0.172 (0.124)	0.159 (0.150)	0.140 (0.090)	0.265** (0.109)
Environmental R&D	0.107 (0.073)	-0.099 (0.122)	0.115*** (0.034)	-0.009 (0.000)	1.623*** (0.129)		0.174* (0.102)	-0.082 (0.130)
Pollution filtering	0.013 (0.106)	0.099 (0.120)	-0.193*** (0.017)	0.298*** (0.016)	0.042 (0.121)	0.059 (0.140)	1.476*** (0.072)	
Environmental training	-0.375*** (0.144)	0.792*** (0.125)	-0.196*** (0.020)	0.216*** (0.006)	-0.096 (0.112)	0.201 (0.136)	-0.121 (0.094)	0.149 (0.120)
Low carbon market research	-0.101 (0.111)	0.270* (0.145)	0.012 (0.018)	-0.054 (0.041)	-0.334*** (0.126)	0.752*** (0.150)	-0.134 (0.087)	0.240** (0.111)
New low carbon products and services	0.001 (0.081)	0.009 (0.127)	-0.148*** (0.034)	0.116*** (0.008)	-0.131 (0.125)	0.176 (0.147)	-0.192*** (0.069)	0.364*** (0.104)
Switched to more renewable energy	-0.015 (0.109)	0.178 (0.114)	-0.079*** (0.017)	0.095*** (0.014)	0.082 (0.113)	-0.276** (0.125)	-0.061 (0.087)	0.045 (0.092)
Other steps	-0.251 (0.293)	0.446 (0.454)	-0.216* (0.127)	0.224 (0.000)	-0.287* (0.164)	0.558** (0.250)	-0.012 (0.174)	0.083 (0.250)
Drivers								
Environmental regulations or taxes		0.112* (0.066)		-0.051* (0.027)		0.135** (0.061)		0.044 (0.057)
Government grants or subsidies		-0.054 (0.057)		0.020*** (0.005)		0.009 (0.057)		-0.049 (0.036)
Customer demand for low-carbon products or services		-0.016 (0.058)		0.053*** (0.012)		0.052 (0.053)		-0.016 (0.052)
Voluntary agreements within sector or supply chain		-0.037 (0.054)		0.029 (0.032)		-0.122* (0.062)		0.068 (0.050)
Availability of external funding from banks		0.005 (0.059)		-0.064*** (0.014)		0.114* (0.060)		0.051 (0.039)

Improving image and reputation		0.057 (0.051)		0.042** (0.018)		-0.081 (0.070)		0.017 (0.049)
Reducing costs		-0.074 (0.057)		-0.035*** (0.010)		0.023 (0.064)		0.011 (0.050)
Employment (log)[1]	0.021 (0.059)	0.199*** (0.072)	0.229*** (0.036)	-0.243 (0.000)	0.055 (0.064)	0.116 (0.083)	0.061 (0.045)	-0.006 (0.064)
Age (Benchmark: 0-5 years old)								
6 to 10 years old	-0.002 (0.169)	-0.540** (0.235)	0.152*** (0.046)	-0.325 (0.000)	-0.001 (0.132)	-0.362* (0.201)	-0.004 (0.106)	0.050 (0.154)
11 to 20 years old	-0.403*** (0.129)	-0.122 (0.184)	-0.310*** (0.061)	0.138 (0.000)	-0.438*** (0.166)	-0.031 (0.202)	-0.391*** (0.106)	0.469*** (0.150)
More than 20 years	-0.330** (0.151)	-0.233 (0.202)	-0.222*** (0.041)	0.070*** (0.005)	-0.334** (0.139)	-0.127 (0.201)	-0.375*** (0.078)	0.538*** (0.153)
Sector (Benchmark - Manufacturing)								
Primary		0.025 (0.351)		0.621* (0.374)		0.351 (0.369)		0.510 (0.356)
Construction	0.655** (0.267)	-0.991*** (0.334)	0.256*** (0.021)	-0.121*** (0.014)	0.403 (0.280)	-0.092 (0.367)	0.493*** (0.126)	-0.373* (0.199)
Transport, retail and distribution	0.291** (0.136)	-0.525*** (0.153)	0.133*** (0.029)	-0.144 (0.000)	0.106 (0.160)	-0.000 (0.193)	0.115 (0.121)	-0.156 (0.151)
Business services	0.437*** (0.136)	-0.528*** (0.149)	0.252*** (0.041)	-0.153*** (0.021)	0.383** (0.157)	-0.308 (0.201)	0.436*** (0.093)	-0.433*** (0.156)
Other services	-0.058 (0.199)	-0.006 (0.240)	0.142*** (0.052)	-0.371 (0.000)	-0.057 (0.180)	-0.055 (0.239)	0.005 (0.084)	-0.187 (0.165)
Country (Benchmark - England)								
Northern Ireland	-0.036 (0.154)	0.180 (0.209)	0.182*** (0.023)	-0.147*** (0.004)	0.038 (0.147)	0.021 (0.211)	-0.043 (0.086)	0.122 (0.150)
Scotland	-0.099 (0.161)	0.235 (0.192)	-0.032 (0.043)	-0.118 (0.111)	0.026 (0.145)	-0.292 (0.188)	-0.024 (0.109)	-0.145 (0.142)
Wales	-0.069 (0.125)	0.439** (0.177)	0.124 (0.080)	-0.237 (0.000)	0.049 (0.290)	0.163 (0.328)	-0.018 (0.277)	0.046 (0.323)
Constant	-1.149*** (0.253)	-1.301*** (0.308)	-1.238*** (0.028)	-0.211 (0.000)	-1.143*** (0.283)	-1.913*** (0.418)	-1.182*** (0.253)	-1.732*** (0.399)
atanhrho	-13.187*** (0.325)		-14.290*** (0.237)		-14.574*** (0.363)		-14.005*** (0.200)	
Prob>chi2	0.0000		0.0000		0.0000		0.0000	
Number of obs.	952		987		952		952	

Notes: Probit coefficients, Standard errors in parenthesis, *** p<0.01, ** p<0.05, * p<0.1
Observations are weighted to give representative results.
1Categorical size variable in changes in production or distribution model as convergence could not been achieved when using continuous employment.

Table A4 (suite). The probability of employment growth: reversed causality models

	Environmental training		Low carbon market research		New low carbon products and services		Switched to more renewable energy	
	Growth eq.	NZ eq.	Growth eq.	NZ eq.	Growth eq.	NZ eq.	Growth eq.	NZ eq.
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Employment growth		-1.485***		1.811***		-1.432		1.524***
		(0.082)		(0.155)		(0.000)		(0.096)
Net Zero practices Environmental reports	0.585***	0.773***	-0.000	0.233	0.073	0.052	-0.076	0.146
	(0.024)	(0.099)	(0.112)	(0.143)	(0.167)	(0.000)	(0.065)	(0.105)
Changes in production of distribution processes	0.352***	0.356***	0.236**	-0.175	0.358***	0.313***	0.064	0.006
	(0.012)	(0.051)	(0.116)	(0.136)	(0.096)	(0.025)	(0.102)	(0.106)
Environmental R&D	0.384***	0.340***	-0.107	0.564***	0.373***	0.368	0.303***	-0.360***
	(0.023)	(0.053)	(0.134)	(0.147)	(0.037)	(0.000)	(0.071)	(0.102)
Pollution filtering	0.175***	0.221***	-0.067	0.194	0.284***	0.383***	-0.080	0.085
	(0.012)	(0.072)	(0.116)	(0.127)	(0.103)	(0.048)	(0.082)	(0.092)
Environmental training	-1.340***		-0.143	0.319**	0.193***	0.248***	-0.076	0.088
	(0.025)		(0.116)	(0.145)	(0.032)	(0.083)	(0.125)	(0.129)
Low carbon market research	0.175**	0.321***	1.261***		0.299***	0.449	-0.345***	0.435***
	(0.069)	(0.121)	(0.128)		(0.105)	(0.000)	(0.087)	(0.103)
New low carbon products and services	0.173***	0.212***	-0.134	0.476***	-1.332***		-0.194**	0.204**
	(0.011)	(0.082)	(0.093)	(0.122)	(0.079)		(0.087)	(0.100)
Switched to more renewable energy	0.151***	0.134***	-0.131	0.301**	0.260**	0.266***	1.459***	
	(0.017)	(0.044)	(0.116)	(0.133)	(0.117)	(0.050)	(0.071)	
Other steps	0.056*	0.074	0.029	-0.030	-0.127	-0.270	0.113	-0.153
	(0.033)	(0.083)	(0.274)	(0.325)	(0.090)	(0.000)	(0.293)	(0.324)
Drivers Environmental regulations or taxes		-0.012		-0.053		0.002		-0.057
		(0.026)		(0.069)		(0.016)		(0.043)
Government grants or subsidies		-0.015		0.057		-0.016		-0.010
		(0.015)		(0.062)		(0.049)		(0.032)
Customer demand for low-carbon products or services		0.011		0.127**		0.018		0.053
		(0.024)		(0.052)		(0.019)		(0.035)
Voluntary agreements within sector or supply chain		0.035		-0.031		0.006		-0.007
		(0.032)		(0.070)		(0.022)		(0.047)
Availability of external funding from banks		-0.014		-0.002		-0.045		0.013
		(0.023)		(0.059)		(0.000)		(0.050)
Improving image and reputation		-0.014		0.106*		0.012		0.029

		(0.010)		(0.064)		(0.026)		(0.047)
Reducing costs		0.026		-0.037		0.011		-0.003
		(0.037)		(0.063)		(0.024)		(0.042)
Employment (log)	0.109***	0.108***	0.116**	-0.110*	0.099***	0.069***	0.043	-0.002
	(0.007)	(0.034)	(0.052)	(0.066)	(0.014)	(0.012)	(0.054)	(0.068)
Age (Benchmark: 0-5 years old)								
Age: 6 to 10 years old	0.031	0.188	-0.191	0.371	-0.018	0.046***	-0.004	-0.085
	(0.032)	(0.141)	(0.195)	(0.285)	(0.216)	(0.011)	(0.160)	(0.205)
Age: 11 to 20 years old	-0.295***	-0.082	-0.546***	0.396*	-0.373	-0.281	-0.427***	0.306
	(0.016)	(0.143)	(0.163)	(0.231)	(0.280)	(0.000)	(0.131)	(0.192)
Age: More than 20 years	-0.306***	-0.193*	-0.421**	0.338	-0.290	-0.257***	-0.237*	0.064
	(0.013)	(0.102)	(0.178)	(0.248)	(0.000)	(0.012)	(0.132)	(0.174)
Sector (Benchmark - Manufacturing)								
Primary		-0.655		0.379		-0.236		0.005
		(0.408)		(0.456)		(0.430)		(0.397)
Construction	0.589***	0.636***	0.411	-0.220	0.367***	0.275	0.449***	-0.293
	(0.010)	(0.087)	(0.260)	(0.386)	(0.047)	(0.000)	(0.147)	(0.193)
Transport, retail and distribution	0.120***	0.129	0.089	0.028	0.185	0.191***	0.087	-0.025
	(0.008)	(0.091)	(0.135)	(0.200)	(0.226)	(0.008)	(0.083)	(0.129)
Business services	0.283***	0.220**	0.307**	-0.118	0.276	0.214*	0.269***	-0.139
	(0.021)	(0.091)	(0.119)	(0.185)	(0.266)	(0.116)	(0.080)	(0.134)
Other services	-0.006	0.158	-0.075	-0.193	-0.026	0.073	-0.080	-0.009
	(0.159)	(0.192)	(0.201)	(0.254)	(0.000)	(0.000)	(0.178)	(0.202)
Country (Benchmark - England)								
Northern Ireland	0.035	0.090	0.062	0.019	-0.061	-0.078	-0.058	0.170
	(0.045)	(0.137)	(0.131)	(0.190)	(0.089)	(0.000)	(0.122)	(0.165)
Scotland	0.011	0.069	-0.146	0.388**	-0.059	-0.089	-0.034	-0.078
	(0.020)	(0.103)	(0.122)	(0.176)	(0.117)	(0.000)	(0.124)	(0.172)
Wales	-0.028	-0.143	-0.056	0.395	0.012	-0.046	0.125	-0.139
	(0.099)	(0.153)	(0.184)	(0.245)	(0.022)	(0.000)	(0.125)	(0.148)
Constant	-1.218***	-1.373***	-1.150***	-2.174***	-1.097***	-0.958	-1.187***	-0.648**
	(0.053)	(0.281)	(0.283)	(0.415)	(0.039)	(0.000)	(0.206)	(0.321)
atanhrho	14.287*** (0.236)		-13.433*** (0.257)		13.911*** (0.174)		-14.138*** (0.222)	
Prob>chi2	0.0000		0.0000		0.0000		0.0000	
Number of obs	971		952		952		952	

Notes: Probit coefficients, Standard errors in parenthesis, *** p<0.01, ** p<0.05, * p<0.1
Observations are weighted to give representative results.

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