Key skills and training needs of the D2N2 Low Carbon & Environmental Goods & Services (LCEGS) Sector

Study conducted by the Sustainable Business and Green Economy Research Cluster, Derby Business School, University of Derby

FINAL REPORT
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ABRIDGED VERSION - FINAL REPORT

A study conducted by the Sustainable Business and Green Economy Research Cluster, Derby Business School, University of Derby

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CONTENTS

LIST OF TABLES AND FIGURES

EXECUTIVE SUMMARY

Low Carbon is one of eight priority business sectors identified in the D2N2 Local Enterprise Partnership (LEP) Strategic Economic Plan (2014 – 2023). In January 2018, Learndirect (on behalf of the LEP) commissioned Derby Business School to research the key skills required by the Low Carbon and Environmental Goods and Services (LCEGS) sector in D2N2; map existing training provision for the sector and establish the needs of key sector supply chains.

The research:
 • Finds that many of the **key issues** and **challenges** for businesses that supply LCEGS identified in previous reports **remain**;
 • Suggests, surprisingly, that as many as 1 in 4 firms are doing business in the sector; with 1 in 20 firms deriving more than 80% of their turnover from LCEGS;
 • Estimates the number of LCEGS suppliers in **5 key sectors** to demonstrate where skills provision could be targeted;
 • Highlights the variety of **skills** needed in different sectors and some of the **issues**, **gaps** and **challenges** facing skills providers;
 • Proposes that pro-environmental **suppliers** and **innovators** should be identified in each priority sector and the current and future skills needs relevant to each sector established.

The report concludes that much of the business activity currently categorised as Low Carbon sector can be re-framed as *pro-environmental innovation* in existing traditional sectors. For example:

Sectors	Pro-environmental niches
Construction	green/energy efficient building; energy efficient products e.g. LED lights; energy control systems
Energy	renewable energy sources e.g. biomass, solar and wind
Transport & Logistics	ultra-low emission & autonomous vehicles; battery/fuel cell tech; charging infrastructure; intelligent mobility
Advanced Engineering & Manufacturing	cleantech; light-weight/composite material; internet of things; 3D printing

Our research shows that the skills and knowledge required to shift these niches of pro-environmental innovation into the mainstream vary across the sectors – and that more needs to be done to meet the needs of small and micro businesses that make up the vast majority of these innovators. Training in many traditional skills requires updating in the light of these fast-growing pro-environmental niches and training providers with an ambition to work in these niches need to be much more responsive to emerging new technologies as well as the needs of the many small businesses that supply new low carbon products and services.

The report finds that the demand for low carbon skills is being met by a variety of local and national Centres of Excellence although the most popular modes of learning are in house and on-the-job training provided by external providers as well as online learning. There are, however, significant gaps in provision at FE level and in Apprenticeship opportunities. The levels of workforce churn for traditionally defined LCEGS businesses were not significant, but there are skills shortages in programming and engineering skills. Although Universities play their part, several respondents wanted much more emphasis to be put on bringing renewable energy, sustainable engineering and other pro-environmental disciplines to the forefront of relevant undergraduate courses at local universities in order to ensure the supply of graduates into fast growing pro-environmental niches and priority sectors more widely.

The three most significant challenges facing pro-environmental SMEs were (1) keeping up with new technologies, (2) technical skills and (3) a range of leadership and management skills. Although managers were deemed to have the right expertise, two key areas of need were keeping up to date with innovation and awareness of the opportunities afforded by the growing Low Carbon Economy (LCE). References were also made to the need to better understand how to progress staff into higher skilled roles and supporting technical staff into managerial roles.

Whilst not the focus of this study, we note the range of business activity that is categorised as 'environmental' (waste collection and recycling, pollution and flood control for example) and argue that SMEs need more support with approaches to Environmental Management (EM). Environmental Management is important, not only because it supports the shift to a more sustainable economy by providing a common thread of awareness raising and skills development across sectors – but also because it supports access into the supply chains of larger private and public-sector organisations like international corporates, local councils and health trusts.

New skill provision will be required in the near future as demand rises, but this varies across sectors. For example, whilst skills supporting intelligent mobility and vehicle to grid technology will become increasingly important for the transport sector; in construction the skills needed will be in building retro-fit; Passivhaus design and pre-fabricated construction.

Finally, the report recommends that the various D2N2 LEP Sector and Skills Advisory Groups take responsibility for capturing the evidence of emerging skills needed and the training and development required to meet the needs of the Low Carbon Economy – but with support from other local stakeholders such as businesses, the Chamber of Commerce, Councils and Universities.

1.0   RESEARCH PROJECT AIMS, OBJECTIVES AND METHODOLOGY

The study set out to:

- Establish the key skills required by the Low Carbon and Environmental Goods and Services (LCEGS) sector in D2N2, now and in the future;
- Map existing training provision for the LCEGS sector, how the workforce is currently recruited, trained and what qualification are available locally;
- Establish the needs of key sector supply chains, what they need from SMEs and identify barriers to SMEs entering the sector;
- Identify any skills shortages, gaps in existing provision, barriers and risks for both smaller and larger businesses;
- Explore how apprenticeships can support the low carbon economy in the area; to help employers identify the right frameworks and standards; develop new standards; facilitate engagement and involvement and promote best practice.

To meet these aims, the research team conducted a robust desk-study of existing studies and labour market intelligence; interviews with key informants in relevant sectors to establish current practice, issues, barriers and future needs; and a survey of relevant employers and professionals to understand the skills needs and training provision in the D2N2 region.

In reality, there was an unprecedentedly low response to the online survey. In part this was because the survey coincided with the deadline for GDPR compliance and the resultant flurry of emails that everybody in the UK became so frustrated with. However, we argue that the more significant reason for the very disappointing response rate was that many people whose firms supply low carbon goods or services do not fully identify with the concept of (or at least do not feel they belong to) the low carbon sector.

Our analysis concludes that many of the businesses willing to engage in the survey were active in our Low Carbon Business Network and categorised themselves as offering 'low carbon', 'energy efficient', 'renewable' and other pro-environmental goods or services. These are the types of business that have traditionally been considered as forming the LCEGS sector – and for whom the survey data reveal useful insight into their demands for skills and where these skills are being accessed.

The Research Team have committed to reporting the study outcomes via multiple appropriate channels and collaborating with employers, SMEs and stakeholder groups to promote recommendations for commissioning and developing new programmes.

2.0   CONTEXT

We live in exciting times. Our economy is shifting from one dominated by fossil fuels to one that is driven by renewable energy. Companies are increasingly becoming aware of their impact upon the environment and the challenges of resource efficiency - and both national and international legislation are driving new approaches to business. Some would argue that this represents a fundamental shift in our economy that heralds a new industrial revolution and anticipates a new economic paradigm. There are terrific opportunities for business, public service and third sector organisations and a wealth of potential benefits for the general public.

Low Carbon is one of eight priority sectors of business and industry identified in the D2N2 Local Enterprise Partnership (LEP) Strategic Economic Plan (2014 – 2023). The D2N2 LEP established business-led Sector and Skills Advisory Groups for each of the key priority sectors, to inform, consult, and identify how the economic impact for their sector can be maximised through driving growth, workforce development, training and employment for local people. In November 2013, the D2N2 Local Enterprise Partnerhsip (LEP) published its Low Carbon Plan for Consultation with the primary focus on economic growth, innovation and the creation of 'green collar' jobs in the D2N2 LEP region and notes that: *"few if any significant clusters of low carbon businesses have yet developed in this embryonic sector within the UK, which is predicted to grow rapidly in coming years".*

In Autumn 2017/18 the LEP commissioned an Energy Strategy and when produced, this Skills Plan will be used alongside as an evidence base for the skills needs in the sector.

In December 2017, the D2N2 Science & Innovation Audit (SIA) was published, putting low carbon and energy high on the agenda as a "market priority". This skills plan shall feed into the wider SIA and refreshed Strategic Economic Plan (for 2019 – 2030) expected Autumn 2018 which will feed into our Local industrial Strategy.

In the five years since the original Low Carbon Plan was published, a number of other reports and action plans have monitored the progress and the challenges faced in this arena (D2N2 Local Enterprise Partnership, 2013, 2014b, 2014a; 2017). The latest version of the Low Carbon Sector Action Plan (2015) aims to provide a road map that shows how D2N2 will support business and create jobs and training opportunities in the emerging low carbon sector-economy. It sets out a series of actions which aim to help the sector achieve the greatest possible economic impact. These actions are centred around three key themes:

- Developing sustainable energy communities
- Low carbon transport technologies
- Support for SMEs providing low carbon goods and environmental services

In January 2017, a Low Carbon Sector and Skills Advisory Group published a Skills Needs report that updated the 2014 Low Carbon Sector Skills Action Plan. With the publication of a new UK Industrial Strategy and the associated Clean Growth Strategy the time is ripe to take stock of the skills landscape for the Low Carbon and Environmental Goods and Services (LCEGS) sector. These national strategies add new impetus to the robust growth that the LCEGS sector has seen over the last decade. So, in January 2018, Learndirect approached Derby Business School (DBS) to undertake robust research in order to better understand the

skills needs of the emerging low carbon sector and support the D2N2 LEP to plan and set delivery ambitions for the sector over the coming years. This study provides: a review of existing research, labour market intelligence; analysis of training provision in the sector; a survey of employers and SMEs and insight from interviews with more than 20 specially chosen informants.

Whilst this report offers a wealth of practical insight about current skills needs and provision that broadly concur with findings and recommendations from other recent local, national and international studies – it does present one more radical proposition that prompts a potentially different approach to the skills strategy for the local low carbon economy. Our study concludes that the supply of Low Carbon and Environmental Goods (LCEGS) is not a sector in itself. Rather, it reflects *pro-environmental innovation* in a number of niches that vary in nature across key sectors. Although varying in focus, these niches have a common focus on providing customers with products and services that balance economic value for money with the longer term needs of environmental sustainability. Whilst this requires new skills in some areas, more commonly it requires upskilling of current skills. More fundamentally, time and time again, our respondents talked about a 'shift in mind-set' and new 'ways of seeing' the purposes of business. In most business sectors the demand for low carbon products and services was still considered modest or emergent – although our data shows that nearly a quarter (24%) of businesses are deriving at least a small level of turnover from LCEGS; with more than 1 in 10 (12%) deriving 20% or more of their turnover from LCEGS and 1 in 20 (5%) deriving 80% or more of their turnover from LCEGS – with by far the most significant levels of LCEGS activity occurring in the Construction sector.

1 in 20 (5.2%) of SMEs derive more than 80% of their turnover from LCEGS

1 in 4 (24%) local businesses derive turnover from LCEGS

1 in 10 (12%) of SMEs derive more than 20% of their turnover from LCEGS
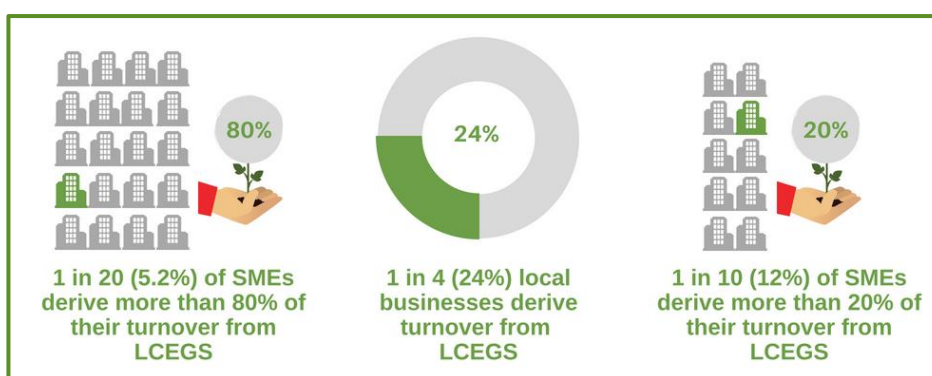
This reminds us that if we are to accelerate the shift to a low carbon and ultimately sustainable economy, the demand for new skills provision will follow demand for goods and services and so any skills strategy must work hand in hand with both local and national growth strategies for LCEGS. One of our recommendations is that each D2N2 Sector and Skills Advisory Group identify the current strengths and immediate growth opportunities for 'pro-environmental innovation' for each sector – and crucially what balance of new skills, upskilling, new awareness and leadership skills this requires.

2.1 What is the Low Carbon Sector?

The Office for National Statistics (ONS 2018) refer to the low carbon and renewable energy (LCRE) sector and define it as 'economic activities that deliver goods and services that generate significantly lower emissions of greenhouse gases; predominantly carbon dioxide'. The sector is also known as the green or clean-tech sector and the Department for Business,

Innovation and Skills (BIS 2013) recognised that in the strictest sense, LCEGS is not a "sector" but an "umbrella" term used to capture a range of activities spread across many existing sectors like transport, construction and energy that have the common purpose of reducing environmental impact. This early definition of the sector comprises supply, service and innovation in three broad categories - Environmental, Renewable Energy and Low Carbon which are further sub-divided into 24 markets (Level 2 markets), 119 sub-sectors (Level 3 markets) and 2800 activity headings that include both supply chain activities (componentry and assemblies) and value chain activities (R&D, Supply and Training) (see Table 1 below).

Environmental	Renewable Energy	Low Carbon
• Air pollution • Contaminated land • Environmental consultancy • Environmental monitoring • Marine pollution control • Noise and vibration control • Recovery and recycling • Waste management • Water supply and waste water treatment	• Biomass • Geothermal • Hydro • Photovoltaic • Wave and Tidal • Wind • Renewable Consulting	• Additional energy sources • Alternative fuel/vehicle • Alternative fuels • Building technologies • Energy management • Carbon capture and storage • Carbon finance • Nuclear power

Table 1: Low Carbon Sector (Reproduced from BIS 2013)

In 2015, BIS amended their definition of the LCEGS sector based upon several years' work with UK National and regional government and UK industry organisations:

> "... the low carbon economy is defined as the activities which generate products or services which themselves deliver low carbon outputs. It does not include the economic activity from the use of these goods and services, except where this represents the primary revenue stream of the operator. Only the portion of a firm's economic activity relating to low carbon goods and services is included, and double counting of economic variables across operating sectors is explicitly avoided." (BIS, 2015, p.8)

This broad definition is helpful and resonates with the analysis in this study that concurs with the notion that LCEGS is an 'umbrella' term that can be applied to activities in various sectors.

2.2 The LCEGS Sector across D2N2

There are some differences in emerging specialisms between Nottinghamshire and Derbyshire compared to the UK generally; with Nottinghamshire specialising in green buildings, manufacture of electrical equipment for green energy and power and energy infrastructure and Derbyshire specialising in alternative fuels and vehicles and manufacture of metal products and equipment for green energy (D2N2, 2014). The D2N2 report from January 2017 on Low Carbon Skills Need further develops the key industry specialisms within the locality (pp. 2-3):

- Strong low carbon vehicles and fuels sector, including Toyota and Rolls Royce and significant influence over the manufacturing supply chains and services they operate.
- Significant contributor to power generation in the UK, with the potential to exploit the move to more renewable sources of energy.

- Nottingham is recognised for its strengths in 'clean technology' and is home to world leading research centres of energy research and business development centres for clean tech, including the Energy Technologies Research Institute which specialises in Carbon Capture and Storage, Renewable Energy, Bioenergy and Low Energy Buildings.
- High quality research in the sector is also produced by the universities in D2N2, with the University of Nottingham becoming increasingly recognised as a centre for biomass and solar technology development alongside sustainable building design, photovoltaics, thermal systems and environmental alternatives to cement and concrete.
- Key companies in the LEP area include Romax Technologies, Chinook Sciences, Alkane Energy and E.ON.

In 2013, Employer First consulted with employers about the skills issues within the LCEGS sector (cited in D2N2, 2014) and concluded there were a range of issues. They identified that a rapidly evolving sector, comprised primarily from SME's with fluid skills requirements has resulted in the skills required by these businesses being poorly defined and supported. Employer First also argued that the approach to skill provision in this complex market was overly 'target-driven', which resulted in a focus on short term needs rather than the longer-term requirements of business in the LCEGS sector. They argued that the provision that did exist was complex and difficult to engage with and did not necessarily provide training in the right skills. A final concern was that there were not enough skilled workers in the sector which results in high recruitment costs and unfilled posts, with employers forced to recruit from outside the region. Their argue that this is unlikely to be resolved in the short term due to the confounding issues: of insufficient young people taking STEM subjects at GCSE; or considering careers related to LCEGS; and graduates that are attempting to move into LCEGS related careers lacking the appropriate experience.

2.3 Low Carbon Business framed as 'Pro-environmental Innovation'

As noted above, the LCEGS sector is tricky to pin down because it relates to economic activity across multiple sectors and supply chains - with many of the firms in this sector operating in several industry sectors, ranging from environmental services and pollution control to traditional energy generation, transport, construction and advanced manufacturing.

Activity in the low carbon economy (LCE) is therefore spread across a wide range of industries with many small but growing 'niches' based on many, often small, businesses for whom LCEGS activity is a secondary rather than primary function. For this reason, estimates of the number of businesses in this sector are particularly volatile. A more complete picture of how the LCE economy is changing over time will only be possible once better data and longer-term trends are available.

Although the most recent Government statistics differentiate between Low Carbon and Renewable Energy (LCRE) and the Environmental Goods and Services (EGSS), the term LCEGS (Low Carbon and Environmental Goods and Services) continues to be used widely as a 'catch all' category in industry and professional literature. However, whilst there are clear 'low carbon' subsectors such as renewable energy or low emission vehicles, our interviews suggest that sales of low carbon products and services are increasing in many other sectors. We make the case through this report that the LCEGS sector is better understood as a series of niches

within and across traditional sectors that are innovating or disrupting market behaviour by presenting customers with pro-environmental options that also offer economic value for money. Given time constraints, this study focused its attention on the Construction, Energy and Transport & Logistics sectors. This is not to diminish the significant contribution that Advanced Engineering, Food & Drink Manufacturing, Agriculture, Bio-tech & Life sciences, Creative & Digital, Retail and Visitor Economy sectors are making to the shift towards a more sustainable economy – indeed we recommend that further research should be done in these sectors to support the development of a pro-environmental skills strategy in those areas as well.

3.0 GROWTH IN PRO-ENVIRONMENTAL BUSINESS ACROSS D2N2

The vast majority of businesses operating in the Low Carbon sector are micro businesses which will impact on their ability to engage in training and development opportunities. NOMIS data implies that only 10 large organisations and 55 medium sized organisations operate in this sector. However, our analysis below suggests that these figures may significantly under estimate the level of business activity relating to low carbon goods and services. See Table 8, p.31.

LCE (2017)	D2N2	Derby	Derbyshire (exc. Derby)	Nottingham	Nottinghamshire (exc. Nottingham)
Micro (0-9)	5,510	530	2,435	405	2,140
Small (10-49)	405	50	155	50	155
Medium (50-249)	55	10	20	5	20
Large (250+)	10	0	5	0	5
Total	5,980	590	2,615	460	2,320

Table 2: LCEGS Enterprises by size (Reproduced from NOMIS)

In collaboration with the East Midlands Chamber of Commerce (EMCC), Derby Business School conducted surveys in 2015 and 2017 that asked about investment in resource efficiency; which can be seen as a marker of the emphasis firms place on environmental and energy performance within the organisation and the importance of this for their bottom line. Table 3 below highlights the significant commitment within the Construction sector to resource efficiency.

Sector	Significant decrease	Small decrease	No investment	No increase	Small increase	Significant increase	No answer
Construction	0%	0%	8%	25%	33%	25%	17%
Energy and water supply	0%	0%	20%	20%	20%	0%	40%
Engineering & Manufacturing	0%	1%	18%	24%	30%	8%	18%
Retail	0%	0%	22%	11%	28%	22%	17%
Professional services	0%	3%	31%	26%	25%	3%	12%
Transport and logistics	0%	0%	21%	21%	43%	7%	7%

Table 3: Investment in resource efficiency by sector, Q3 2017 (EMCC Survey)

The EMCC survey also asked businesses about the proportion of the company turnover generated from low carbon good and services. A comparative analysis of the survey responses is presented below. This shows that over this period the percentage of businesses deriving some turnover from LCEGS business increased from 16% to 24%, with 12% of businesses deriving more than 20% of their turnover from LCEGS in 2017, compared with 8% in 2015 (Figure 1). This is comparable to the picture nationally, where the LCEGS sector has been growing at around 5% year on year since 2007 (ONS 2018, CBI, 2012). Given that this data was collected as part of the regular quarterly survey by the EMCC that targets the whole range of businesses in the region, this trend reflects a positive shift towards low carbon goods and services over just two years.
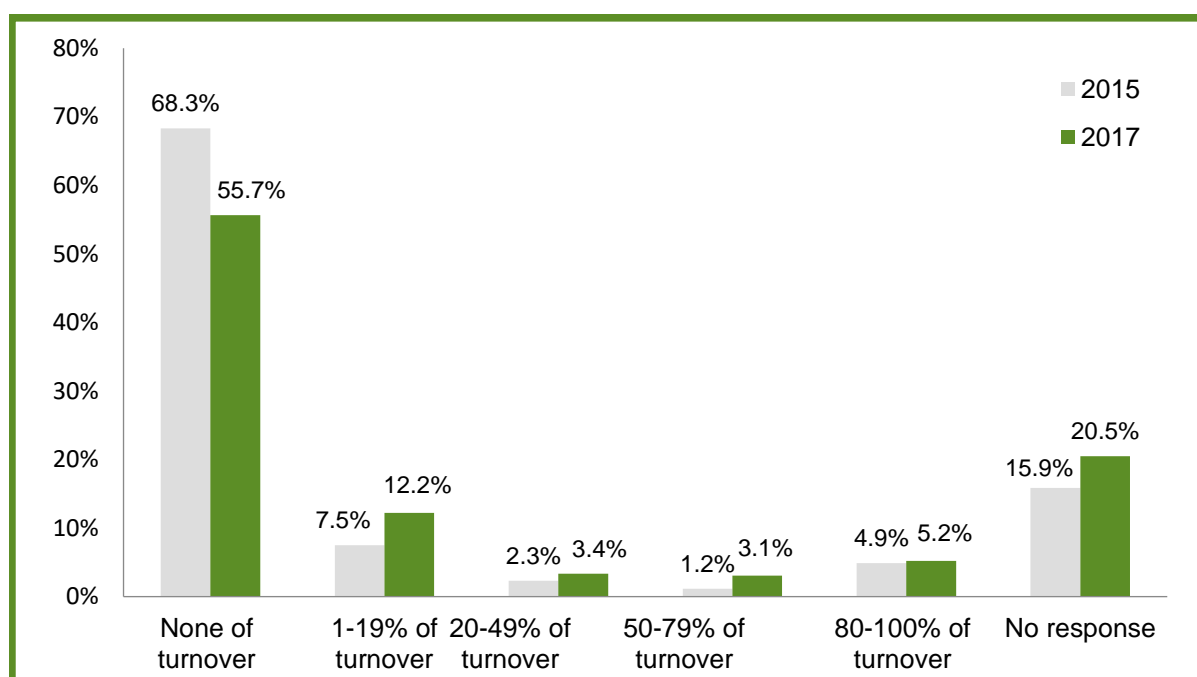
Figure 1: Turnover generated by supplying low carbon good and services

Although the response rate for this survey was strong (with over 300 responses to each survey) and reflected the balance of business size described above, the sample was skewed towards professional services and engineering and manufacturing sectors. Nevertheless, the analysis of business turnover by sector is revealing. Larger businesses are consolidating and increasing the proportion of turnover from the supply of LCEGS, with the Construction sector being by far the strongest performer.

Table 4 emphasises the significance of LCEGS for the Construction sector, with 79% of businesses deriving some form of turnover from low carbon environmental goods or services and with 29.2% of construction businesses deriving 80-100% of their turnover from LCEGS. Energy and water supply business also show a strong contribution with 60% of businesses supplying LCEGS in this sector.

	None of turnover	1-19% of turnover	20-49% of turnover	50-79% of turnover	80-100% of turnover
Construction	20.8%	29.2%	8.3%	12.5%	29.2%
Energy and water supply	40.0%	20.0%	0.0%	20.0%	20.0%
Engineering and Manufacturing	81.7%	11.3%	4.2%	0.0%	2.8%
Professional services	74.2%	13.4%	4.1%	1.0%	7.2%
Transport and logistics	79.0%	7.0%	7.0%	7.0%	0.0%
Retail	80.6%	12.9%	3.2%	3.2%	0.0%
Bio-tech & Life Sciences*	78.4%	8.1%	2.8%	1.4%	9.5%
LCEGS**	0%	27%	20%	13%	40%
				*Data from Rossiter et al (2018 forthcoming)	
				** Data from Skills study survey	

Table 4: LCEGS contribution to company turnover by sector, Q3 2017

In other sectors this trend is much weaker, with 74% or more of businesses deriving no turnover from low carbon environmental goods and services. The best of the rest is professional services which include, for example, firms providing environmental accreditation services, carbon accounting, carbon foot-printing and various types of consultancy services. Interestingly in the data emerging from the current study by Rossiter et al (2018 forthcoming), 9.5% of businesses operating in the Bio-tech & Life Science sector derive 80% or more of their turnover from LCEGS.

4.0   PRO-ENVIRONMENTAL SKILLS: SUPPLY AND DEMAND

In 2015, BIS estimated there were 1,556 LCEGS businesses in the D2N2 region employing nearly 29,000 people. In 2018, Nottingham City Council Economic Development team estimated that the pool of businesses potentially offering Low Carbon goods and services may be as large as 5,980 enterprises with LCEGS employment in the region exceeding 42,000 jobs. The range of these estimates reflects the weak reliability of the data available for LCEGS business activity.

Many more LCEGS sector companies could be categorised as providing energy efficient products or services and others still as 'green builders', 'low carbon consultants' and 'sustainable mobility' businesses – for which reliable economic data is unavailable.

4.1 Pro-environmental LCEGS SME 'innovators'

The quantitative data we collected for this study, however, does provide some well-grounded insight into the skills needs of SMEs that sit squarely within the LCEGS sector. As noted elsewhere in this report, there was a very disappointing response to our online survey but on close inspection, we found that 18 of the 20 businesses that had responded were active in, or known to, our Low Carbon Business Network, several of whom might easily be categorised as sector innovators or standard bearers for this emerging 'pro-environmental' way of doing business. Two businesses were discounted for incomplete responses or being out of the D2N2 area, resulting in data from 18 businesses being used in the analysis that follows.

It is important to note that the figures reported below only describe this group of businesses and are not meant to be generalisable to LCEGS SMEs more generally.

- Nearly half of the businesses operated in energy efficiency (e.g. energy-efficient lighting, domestic energy generating products, insulation, heat recovery and ventilation);
- Five businesses were involved in low carbon consultancy services (e.g. architectural and design services, EMS advice, accreditation schemes, financial advice, carbon accounting, environmental consultancy, sustainability training).
- Four were involved in low carbon energy generation
- Four in waste recovery
- Four in heat distribution.
- Three were in creative and digital
- Two were in low carbon transport
- The final two respondents were from bio-sciences, and hospitality, well-being and visitor economy sectors.

Sixteen of the 18 businesses were micro, employing less than 10 people, with two further small businesses employing between 11 and 50 people. Roles within businesses were varied; the majority had a mix of professional, managerial, technical (advanced), technical (skilled), semi-skilled and unskilled. Businesses reported that on average over 40% of their employees were technical with advanced skills. Twenty-seven percent on average were employed in

professional roles, 20.5% unskilled, 20.5% managerial, 18.3% technical (skilled) and 15% semi-skilled.

The majority of these pro-environmental businesses also reported that 80-100% of their turnover was from low carbon activities (see Figure 1, page 10) and that over the last year, demand for low carbon and environmental goods and services had predominantly stayed the same or increased (one reported it had increased significantly; only two reported it had decreased.

In 2015, BIS identified 1556 LCEGS businesses in the region. If we class firms with over 80% of their turnover delivered from LCEGS as Pro-environmental Innovators, our survey analysis shows that five of our sample could be categorised as Pro-environmental Innovators – with as many as 622 businesses of these businesses across the region.

> **622**
> **'Pro-environmental innovators' estimated across the D2N2 region.**

4.2 Demand for (New) Skills

Overall, interviewees reported that whilst demand for low carbon and environmental goods and services (LCEGS) remains modest in their respective sectors, graduate-level skills appear to be well-catered for, with the possible exception of specialist design skills in the Construction sector, mechanical, electrical and software engineers.

Survey respondents were asked to respond on a Likert type scale (from 'not true' for any roles to 'true' for all roles) to a number of statements regarding skills-based issues. Statements and responses are displayed in Figure 2. Reassuringly, managerial staff were perceived to have the right management skills and employees were not leaving regularly to work for competitors or leaving the sector completely, so the workforce appears to be stable. However, there appears to be a need for upskilling, with responses to a number of statements about technical skills in particular, suggesting that for some (but not all) roles, skills needs were not being met. The three skills that were reported to be in shortest supply were: electrical installation; software/programming skills and project management.

These needs were mirrored in some of the larger company representatives who talked about the difficulties in recruiting staff with electrical and digital expertise. One interviewee who worked in a large aerospace company talked about a: *"shortage of people understanding electrical and digital technology. This is relevant to low carbon as these types of technologies lower emissions and improve asset management. But then you are competing against the companies like Google and Apple for those kinds of technical skills so people have a lot more choice and aerospace is a little bit more challenging"*.

Focussing particularly on managers in their businesses, respondents were provided with a series of statements regarding their skills and asked to respond using a Likert type scale ('True' of all managers to 'Not true' of any managers). Figure 3 shows that for each skill, the majority of respondents felt all or most of their managers had the skills. Interestingly, the only skill where respondents had noted that none of their managers had the skills was for awareness of the opportunities afforded by the growing LCEGS market.
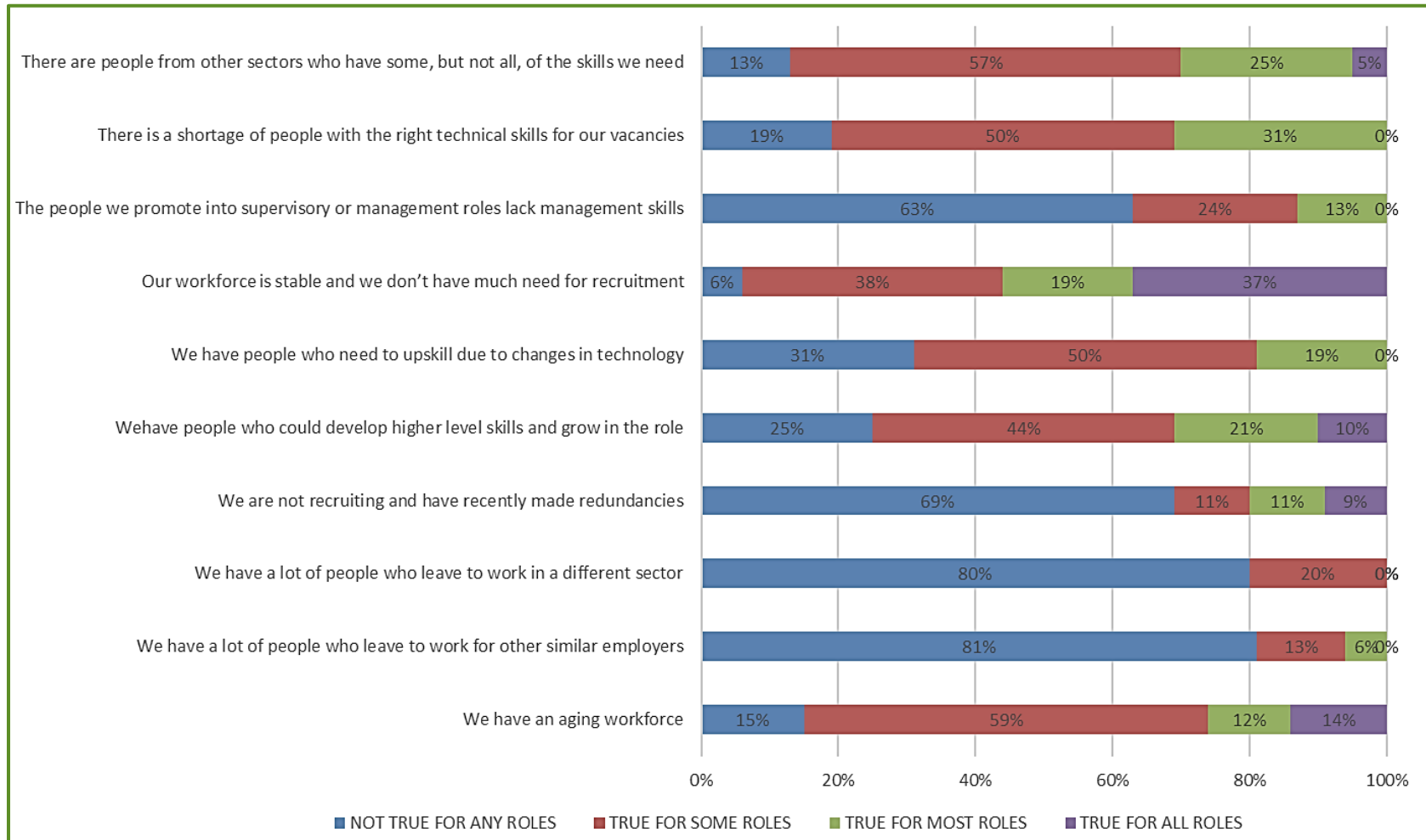
Figure 2: Skills based statements and responses as percentage

Chart data:

Statement	NOT TRUE FOR ANY ROLES	TRUE FOR SOME ROLES	TRUE FOR MOST ROLES	TRUE FOR ALL ROLES
There are people from other sectors who have some, but not all, of the skills we need	13%	57%	25%	5%
There is a shortage of people with the right technical skills for our vacancies	19%	50%	31%	0%
The people we promote into supervisory or management roles lack management skills	63%	24%	13%	0%
Our workforce is stable and we don't have much need for recruitment	6%	38%	19%	37%
We have people who need to upskill due to changes in technology	31%	50%	19%	0%
We have people who could develop higher level skills and grow in the role	25%	44%	21%	10%
We are not recruiting and have recently made redundancies	69%	11%	11%	9%
We have a lot of people who leave to work in a different sector	80%	20%	0%	
We have a lot of people who leave to work for other similar employers	81%	13%	6%	0%
We have an aging workforce	15%	59%	12%	14%

Figure 3: Managers skills

4.2.1   Recruitment

With respect to the roles that the businesses had problems recruiting for, there was little to no overlap amongst businesses; perhaps with the exception of roles that are concerned with **software** and **engineering** although with the engineer roles these were diverse; covering process, biomass, space, civil and renewable energy engineers. Given the reported modest demand for low carbon goods and services, our key respondents suggested that there is currently a good supply of graduates in the sectors represented. There appears to be greater demand for people with specific technical skills of relevance to sustainability practices in construction and engineering.

One sustainability consultant argued that the supply of graduate-level skills may outweigh demand - because "*there are more suitable qualified graduates floating around than there are good jobs for them to do*!" these people fill technical roles in the smaller LCEGS SMEs because these people can't secure graduate-level roles and will accept lower salaries.

4.2.2   Challenges

The three most significant issues facing respondents' skill base are listed in Table 5, with the top issues in the first column, second listed issues in the second column and third issues in the final column. Issues fall into a range of categories. The most prevalent concern was keeping up with **new developments in technology**. Second, were business and finance related issues; these range from **leadership & management** issues through budgetary, finance, accounting and cost issues as well as competition, adapting to new business models, understanding the market they are operating in and sales skills. A third category related to HR issues and includes failure to recruit, training/upskilling people and sustainable working. There were also concerns about being able to keep up to date with standards and guidelines (again three respondents reported this). **Technical skills** form another category (with two respondents noting this was an issue). The final two categories are risk management and product development.

	Most Significant	**Second Most Significant**	**Third Most Significant**
Technology	Increasing use of IoT technologies	Disruptive Technology	Understanding HVAC
	Learning new technologies	Technology skills	
	Keeping abreast of new technologies	Disruptive Technologies (Smart Contracts)	
	New technology		
	Good understanding of technology		
Finance	Sale skills	Fundraising skills	Accounting skills
	Leadership	Budgets	
	Competition	Understanding the market we are working in	
	Costs		
	Distributed, decentralised collaborative business models (Performance Contracts)		
HR	Difficult to find the time to upskill team members	On a one or two-decade time scale, key people retiring	Training in new installation methodologies
	We are a one-man band. Given up recruiting simply could not find staff with skills	Sustainable working	
Standards and Guidelines	Keeping up to date	Working to new standards and within new guidelines	
Technical	Technical Skills		Technical skills
Product development	Awareness of product development		
Risk management	Moving to a Low Net Energy economy (risk management)		

Table 5: Three most significant issues facing your skill base at the moment?

Insight from our interviews suggest that many of the skill-related issues facing businesses are related to LCEGS being an emerging sector and at the forefront of innovation; thus, there is a need to keep up with rapidly developing technology and advances, understand and operate effectively in new markets and find and develop people with the necessary knowledge and skills.

Several interview respondents agreed that demand for new skills relating specifically to 'low carbon' was modest and that we are still in the early days of the shift:

- From the internal combustion engine to low emission and autonomous vehicles
- From IT to the Internet of Things (IoT) that improve efficiency and user experience
- Towards 'net-zero' and 'net-positive' energy efficient buildings
- Towards sustainable supply chains

One respondent recognised that the public sector will be a significant procurer of low carbon goods and services but many public-sector officers lack awareness of the social and environmental benefits presented by whole life cycle procurement, ultra-low emission vehicles (ULEVs), net-zero/net-positive buildings and other sustainable innovations. Table 6 (overleaf) summarises current skills needs identified through the survey and by interviewees.

Large companies are much more likely to recruit graduates and train staff in house in the required technical expertise. One interview from an international advanced engineering company talked about the increasing importance of 'systems thinking'; horizon scanning (to understand what is changing in the requirements landscape) and responding to the expectations of external stakeholders. He explained that because the area of environmental sustainability is very dynamic, "*our understanding is increasingly changing all the time and that puts different expectations on company, people and stakeholders. We spend a lot of time talking to other people outside the company to understand what is going on and how it can impact the business*".

Representatives of larger companies referred to changing needs like those mentioned above - that sit within the arena of leadership skills – much more commonly than individuals from SMEs.

Our review of LCEGS provision highlighted the plethora of courses available on environmental auditing. There is clearly a substantial market for these courses; the vast majority of which support the implementation of major international standards such as ISO 14001. However, there appears to be a gap in the market for provision that supports smaller businesses to make good decisions about which accreditation scheme to subscribe to.

LCEGS	Construction	Engineering	Transport
• Skills for latest tech and new practices • Environmental audit, accreditation & compliance • Intelligent systems installation / IT • Sustainable software developers • Carbon accounting • Whole life costing procurement • Product life-cycle analysis	• Energy efficient M&E esp. HVAC • Electrical engineers • Renewable energy installation • Eco-renovation/ retro-fit • Smart cabling/lighting • Constructing pre-fabricated buildings • Higher standards of installation e.g. air tightness • Managing eco-friendly construction sites • Wooden structural design	• Renewable energy engineers • Electrical engineers • Digital engineers. • Process engineering including sensors and data handling • Circular design • Lightweight materials • Additive manufacture	• Charging infrastructure • Charge point installation • ULEV maintenance • ULEV fleet management • Transport planning (middle managers) • Battery/fuel cell innovation
• Awareness of opportunities presented by Low Carbon Economy • Environmental management • Leadership for sustainability			

Table 6: Current Skills Needs

4.3 Skills Supply Provision

In 2012, Employer First (D2N2 Local Enterprise Partnership, 2014b) concluded there was no dedicated Low Carbon skills infrastructure. As a result, the specific skill demands of these businesses, the majority of whom are SMEs operating in a rapidly evolving market, are insufficiently defined and met. They argued that the "*current system does not deliver the skills required by [LCEGS] SMEs who find engagement with providers prohibitive and time consuming due to the complexity of the market*". Our survey results and comments from interview respondents suggest that little has changed in the intervening six years.

One interviewee commented that provision would better respond to the needs of smaller businesses if it were delivered through modular or flexible units that build expertise over time to suit particular interests.

> "We need short snappy interventions that relate to business need"
>
> [MD, Engineering Company].

4.3.1 Centres of Excellence for Low Carbon and Renewable Energy

The major centres of excellence for low carbon and renewable energy are identified on a national level include: the Centre for Alternative Technology, Powys; Centre for Integrated Renewable Energy Generation and Supply, Cardiff; NSC Research and Development Centre of excellence for solar innovation in the UK, Watford; Centre for Advanced Materials for Renewable Energy Generation (CAMREG), Bedford and others across the UK. More locally, there is the Centre for Renewable Energy Systems Technology (CREST) at Loughborough.

The D2N2 region is well served by the presence of substantial expertise in Energy innovation at the Energy Technologies Research Institute and Creative Energy Homes Centre, both at the University of Nottingham. There are also local Centres of Excellence in both Construction (at the University of Derby) and Transport (in Nottingham) as well as Sustainable Engineering (again at the University of Derby).

4.3.2 Local University provision

Local University Provision in renewable energy is monopolised by the University of Nottingham with a variety of Masters level courses:

- Electrical Engineering for Sustainable and Renewable Energy MSc;
- Sustainable Energy Engineering MSc;
- Sustainable Energy and Entrepreneurship MSc;
- Renewable Energy and Architecture MSc;
- Energy Process Systems Engineering MSc;

Whilst there will undoubtedly be renewable energy options within undergraduate Modules - renewable energy is much less visible in undergraduate provision - even within the Centres of Excellence for Renewable Energy. A similar picture emerges for both Construction and Transport disciplines; with a dearth of undergraduate courses signalling any provision relating to pro-environmental practices. The University of Derby offers the majority of M-level courses in sustainable construction and, surprisingly given the region's focus on planes, trains and automobiles, few HE courses in sustainable transport.

Given the engineering skills shortages reported above, this suggests that more emphasis could be put on bringing pro-environmental aspects front and centre across the range of undergraduate engineering courses at all local Universities in order to ensure the supply of graduates into this sector.

Amongst our pro-environmental SME interviewees there was a strong view that provision needed to be highly responsive to the most up to date business interests – and as such, traditional providers such as Universities and Colleges may not be best placed to supply the training opportunities. It was clear that learners wanted:

- Flexible, online, easily accessible (video) content
- Case studies
- Access to industry speakers explaining cutting edge practice
- Opportunities to network

This would require a significant shift from current higher education (HE) and further education (FE) provision – and is more common amongst commercial training providers.

4.3.3 Internal vs External training opportunities

Respondents were asked about the availability of internal training opportunities on a range of subjects including, leadership/management, research/design/innovation, technical skills (adapting from other sectors), technical skills (upskilling) and technical skills (adapting to new technologies/working practices). There were some internal training opportunities for each subject with opportunities for training in leadership/management and technical skills for enabling sector crossover being most readily available. A number of businesses did not offer internal training opportunities in any subject and **research/design/innovation and training in technical skills was especially scarce.** However, given the micro-sized nature of the businesses who responded this is not surprising.
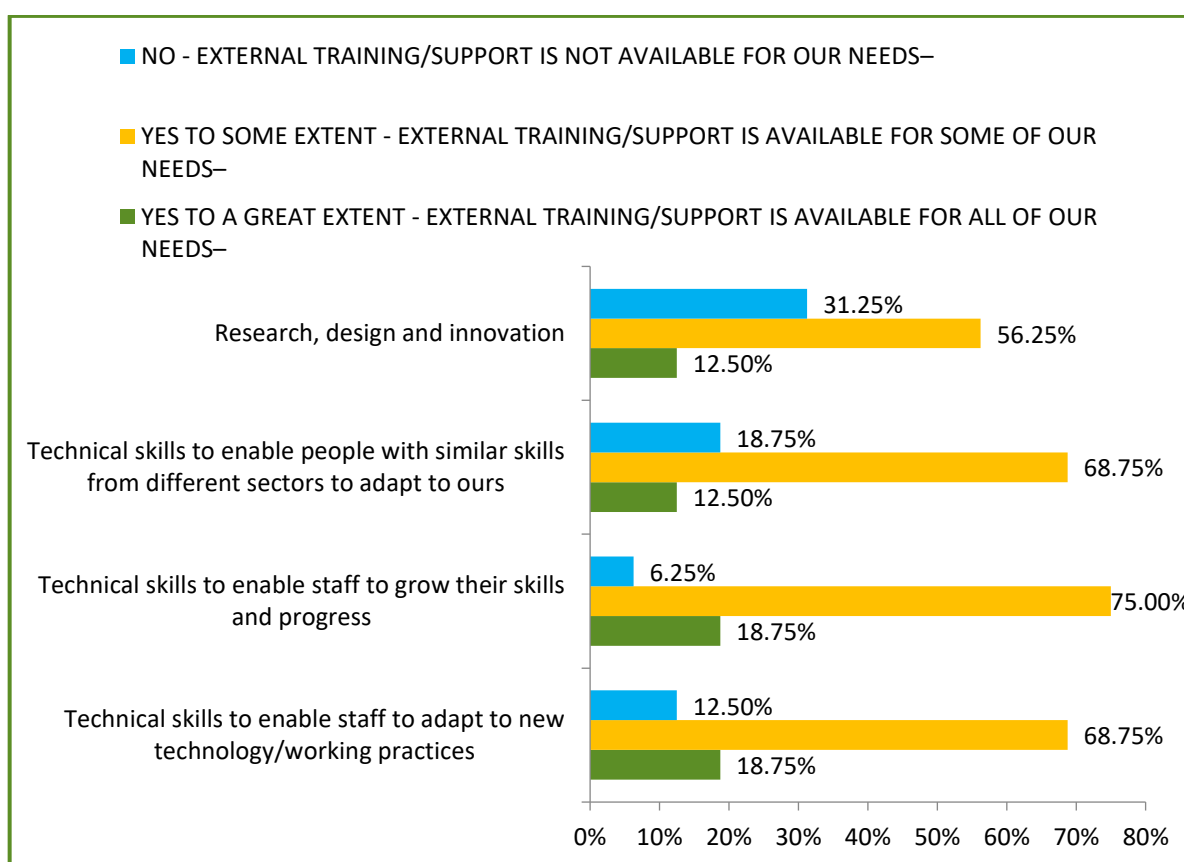

■ NO - EXTERNAL TRAINING/SUPPORT IS NOT AVAILABLE FOR OUR NEEDS–

■ YES TO SOME EXTENT - EXTERNAL TRAINING/SUPPORT IS AVAILABLE FOR SOME OF OUR NEEDS–

■ YES TO A GREAT EXTENT - EXTERNAL TRAINING/SUPPORT IS AVAILABLE FOR ALL OF OUR NEEDS–

Research, design and innovation: 31.25% / 56.25% / 12.50%

Technical skills to enable people with similar skills from different sectors to adapt to ours: 18.75% / 68.75% / 12.50%

Technical skills to enable staff to grow their skills and progress: 6.25% / 75.00% / 18.75%

Technical skills to enable staff to adapt to new technology/working practices: 12.50% / 68.75% / 18.75%

Figure 4: External training opportunities

Looking at the availability of external training (see Figure 4), the majority of businesses reported that external training was available to some extent and generally external training was more available than internal, although, once again research/design/innovation skills training was least well addressed by external training opportunities.

Respondents were also asked about the different forms of training they used (see Figure 5). The most popular options were internal in-house/on-the-job training, online learning available in the marketplace and training provided by private providers. Least often used were bespoke courses delivered by FE, followed by general FE courses, online courses specifically for staff and university courses.
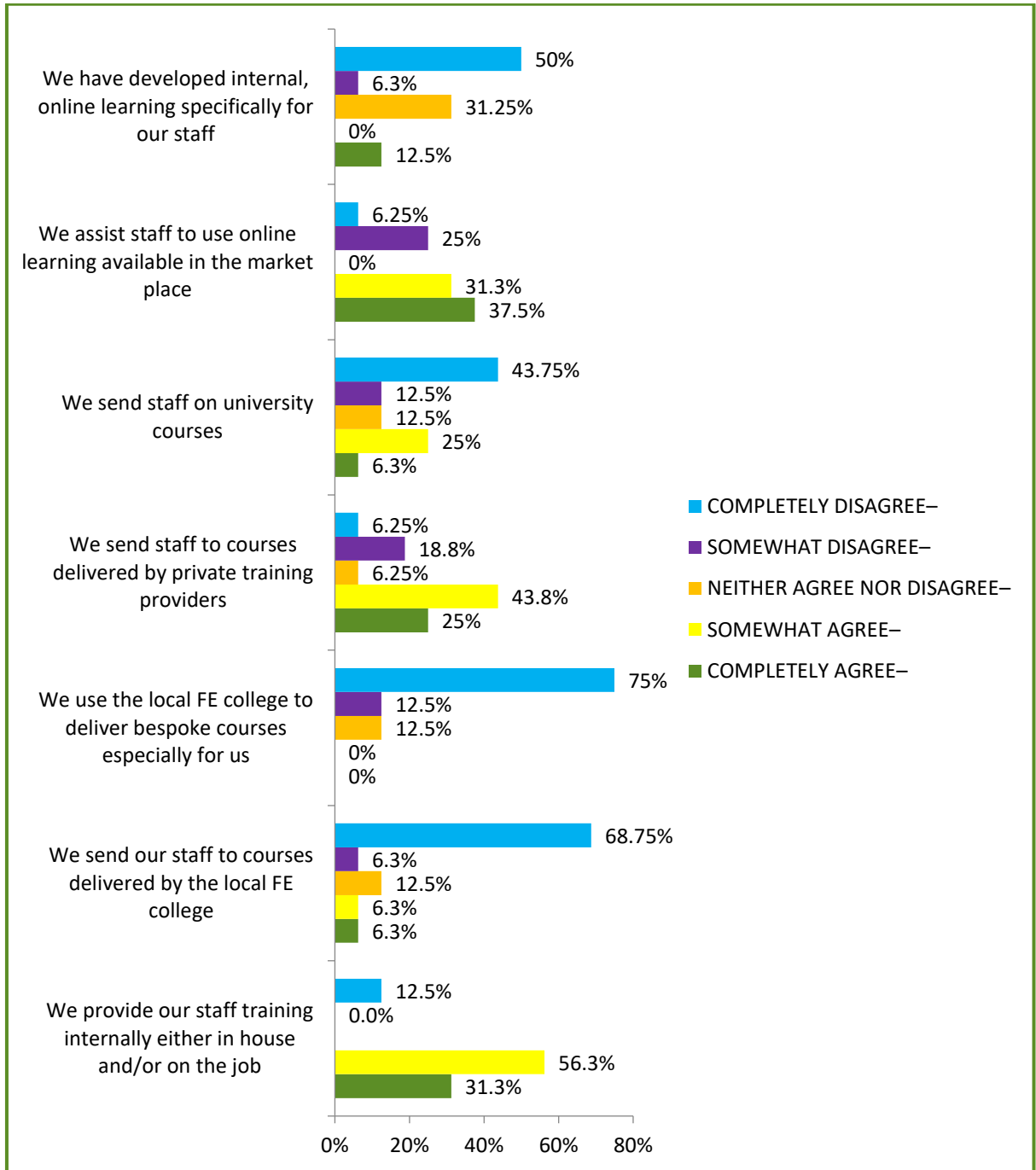
Figure 5: Training accessed

Preferred methods of receiving training are displayed in Figure 6. **The most popular methods were online, followed by in house by external providers**, internally by own staff, day release, by external providers in their location and then finally day release. Forty percent of respondents wanted courses that lead to qualifications.
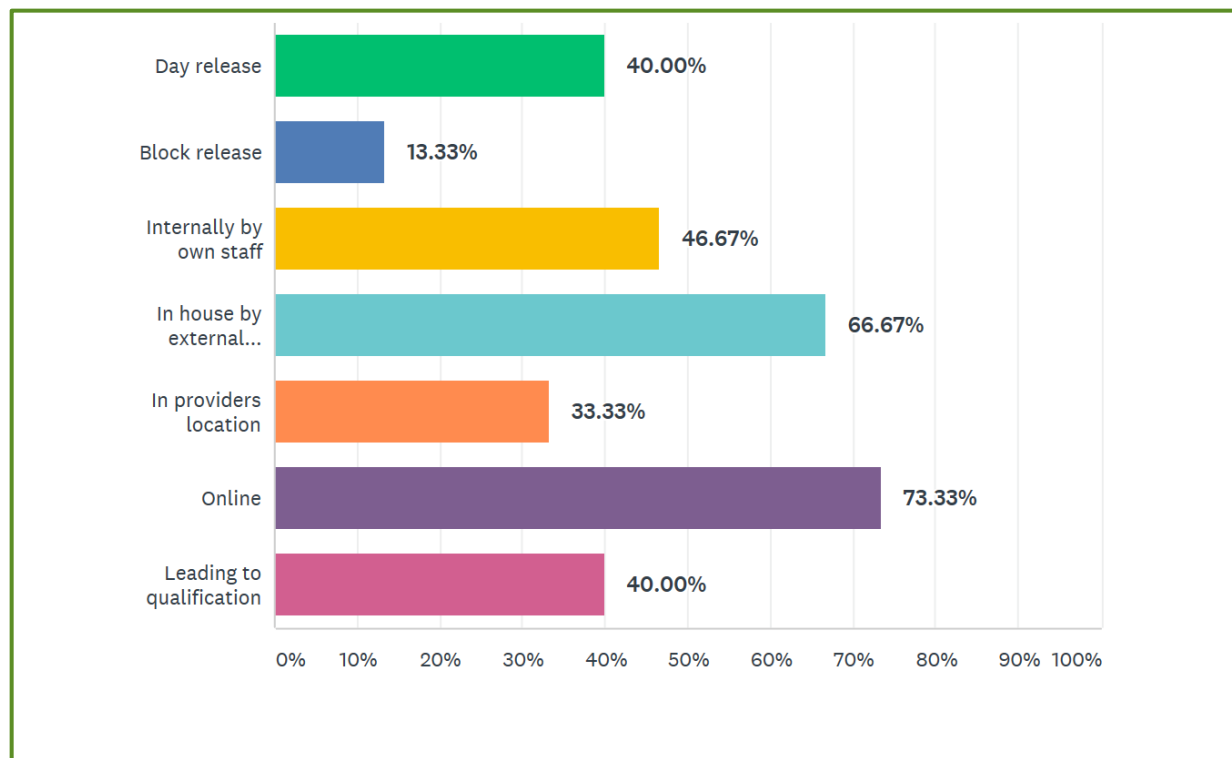

<div align="right">**Figure 6: Preferred methods of delivery**</div>

4.3.4   Apprenticeships & STEM

Our survey revealed that opinion was divided about whether apprenticeships provided a good route to building the skills needed in the LCEGS sector. Interestingly, 37.5% of respondents agreed or strongly agreed that apprenticeships were a good route and 38% disagreed or strongly disagreed it was. Twenty-five percent neither agreed nor disagreed.

Interviewees argued that current apprenticeship provision seems to be provider led rather than demand led. Engagement with Apprenticeships may be seen as risky by smaller employers until the national scheme is more clearly defined and a stronger demand for places established. For further discussion of Apprenticeships see Section 5.3.

4.3.5   Current Gaps and Future Skills Needs

Looking towards the future, our LCEGSs SME respondents typically felt that some roles would be filled easily by individuals with the right skills with several feeling confident that skills would be available or that they would not need to recruit. Only one respondent was worried that they might struggle to recruit individuals with the right skills. When asked about what would be beneficial to their business, respondents wanted provision on **policy and regulatory frameworks**, **management training to support technical staff moving into management positions**, support to **improve in house training and innovation, design and research**. Learning about the **effective commercialisation of new technologies, how to progress staff into higher skilled roles** and **project management** were also deemed useful.

A Business Advisor interviewee argued that awareness raising was the first hurdle to businesses entering the low carbon market. She said:

> "People need to understand that the future will be different and that green credentials will help them win business. They will need to show how they have integrated environmental awareness into their business model. It's a massive change"

She continued to suggest that case studies of successful LCEGS businesses will help others to see the benefits.

As noted above, skill needs vary across the key sectors. One interviewee wanted FE Colleges to develop hybrid courses for technical expertise that combined programming, electronics and mechanical engineering – "*Progra-mecha-tronics*" – in conjunction with groups of local SMEs with common interests.

Our interviews referred to the following future skills needs (Table 7):

LCEGS	Construction	Engineering	Transport
• Staying up to date with the latest tech and new practices • Adapting to new regulations • Sustainable supply chains	• Passivhaus /Net zero standards • Specialist installation • Eco-design/smart homes • Responsible sourcing & product transparency • Circularity & recycling	• Internet of Things • Sensors, software development and data analysis for intelligent (mobility) systems. • Hybrid progra-mecha-tronics skills • Hydrogen safety	• Intelligent mobility • Power-grid management/ • Vehicle to grid tech • Inductive charging of vehicles • Drone delivery

Table 7: Future Skills Needs

5.0   PRO-ENVIRONMENTAL SKILLS: PROVISION

A report undertaken by HM Government in 2010 identified five main skills challenges in the Low Carbon and Renewable Energy sector:

- Delivering significantly higher volumes of generic STEM skills at all levels.
- Developing and delivering rapidly the specialist skills solutions that will be needed for emerging sectors and technologies.
- Getting more young people and adults interested in low carbon careers, skills and qualifications.
- Stimulating employer demand for and investment in low carbon skills.
- Replicating good practice rapidly in each of the above, within and between emerging sectors.

The report argues that many of the skills needed to make the transition to a low carbon economy will not be new. For example, we already know that Science, Technology, Engineering and Mathematics (STEM) skills will be needed at all levels in key energy and advanced manufacturing sectors and more widely across the economy, to lower carbon emissions and make better use of all resources. In some sectors, much of what needs to be done will build upon existing STEM-based skill sets. However, there will be sectors in which completely new skills are needed, some in new combinations, and for which new qualifications will need to be developed. Our skills system needs to be able to respond rapidly and flexibly to these demands. Our research shows that these issues remain as pressing, if not more so, today.

5.1 University provision

As outlined earlier, the three major universities in the D2N2 are, the University of Nottingham, University of Derby, and Nottingham Trent University. With the exception of electrical and mechanical engineers and software design, the SMEs we spoke to generally felt there was currently a good supply of graduates in the sectors represented and over supply of Masters qualified people in some areas. There is greater demand for people with specific technical skills of relevance to sustainability practices in sustainable construction and engineering.

One sustainability consultancy specialist argued that the supply of graduate level skills may outweigh demand - because "*there are more suitable qualified graduates floating around than there are good jobs for them to do*!" these people fill technical roles in the smaller LCEGS SMEs because these people can't secure good graduate level roles and will accept lower salaries.

Whilst the lack of flexibility and inter-disciplinary provision was considered a gap in HE provision, Knowledge Transfer Partnerships (KTPs) were viewed positively as a channel to transfer skills between University staff and companies. One sustainable engineering SME Director argued that there is strong interest in University support/input – but he felt that "*Universities sometimes struggle to provide access to the right academic expertise*".

The challenges here may be, in part at least, related to the large differences in scale between small and micro SMEs and large corporate organisations like a University. There was undoubtedly a real desire to engage with University expertise from the pro-environmental

innovators we spoke to and Universities have much to gain through their interaction with innovative businesses often working at the leading of business practice. It is important therefore to forge these links in increasingly creative ways.

5.2 Further Education (FE) Colleges

Our review of courses provided by FE Colleges in the region showed that only a tiny handful of courses respond specifically to the interests expressed by pro-environmental business in our survey. Almost all of these courses related to environmental protection, management and regeneration. The majority were offered by Derby College; with the highest qualification being a level 3 diploma in Countryside management. Derby College also offer learner Academies (placement schemes) in conjunction with local pro-environmental SMEs (in waste management and low carbon engineering); with Nottingham College offering one course on ULEV maintenance.

Whilst there may indeed be other relevant courses that were not discovered, the dearth of pro-environmental courses seems at odds with the drive to engage the younger generation in science and engineering, given research that shows how engaging sustainability topics are for young people.

One respondent (MD, Engineering SME) argued that "*Colleges are fighting each other by churning out the same courses*". North Notts College was seen to be an exception with their Fluid Power specialism. "*Sector specialisms would be attractive – especially if this meant they could attract and retain appropriately qualified and experienced staff*".

There is a massive opportunity for FE Colleges to engage with some of the disciplines identified above, in order to enthuse and attract young adults into emerging new roles, such as off-grid electrician, smart tech installer or drone delivery.

5.3 Apprenticeships

Our review of the Apprenticeships database found various Environmental and Conservation focused apprenticeships across the UK, but the only apprenticeships offered in D2N2 were an intermediate and an advanced Apprenticeship in Environmental Conservation offered by Derby College. Given the enthusiasm of the younger generation for sustainability it seems strange that providers are not tapping into this 'zeitgeist' by promoting 'green' apprenticeship offers.

As noted above, our survey revealed that opinion was divided about whether apprenticeships provided a good route to building the skills needed in the LCEGS sector; with 37.5% of respondents 'agreeing' or 'strongly agreeing' that apprenticeships were a good route and 38% 'disagreeing' or 'strongly disagreeing'. Twenty five percent neither agreed nor disagreed.

For many employers, there was uncertainty about the new standards, which were considered to be coming through slowly. These are much lighter than the previous frameworks but this means that detail is thin. According to our interviewees, because the endpoint assessments can be defined in so many different ways – employers are holding back to see how things pan out. Currently, the rules allow apprentices to take the endpoint assessment (EPA) only twice. An SME might fund an apprentice who fails the EPA twice and is then left in the wilderness. Smaller employers want much more clarity before they commit to their supporting role. One

interviewee from an Engineering SME argued that more SMEs might be encouraged to get involved in Apprenticeships if a proportion of the fees were waived for every day of placement offered to an Apprentice.

Another interviewee from a micro LCEGS supplier argued that very small employers do not have enough work for a plumbing apprentice and an electrical apprentice, for example. For small companies, the "*existing syllabuses for current City & Guilds courses don't map onto skills that we use on a day to day basis*". If there was a modular approach for the LCEGS sector, apprentices could get something on thermal insulation one day, PV installation and ground source heating systems the next to build up a diverse body of experience.

> "It's crackers – but understandable why there hasn't been as good an (apprenticeship) uptake as expected – it hasn't been well thought through"
>
> [MD, Advanced Engineering].

One interviewee argued that more SMEs might be encouraged to get involved in Apprenticeships if a proportion of the fees were waived for every day of placement offered to an Apprentice.

Another Sustainable Systems contractor commented that very small employers don't have enough work for a plumbing apprentice and an electrical apprentice. For small companies, the "*existing syllabuses for current City & Guilds courses don't map onto skills that we use on a day to day basis*". If there was a modular approach for the LCEGS sector they could get something on thermal insulation one day, PV installation and ground source heating systems the next to build up a diverse body of experience. This interviewee explained that:

> "… (due to the) availability of very skilled and flexible workers with Masters level qualifications, there has been only a little incentive to consider the apprenticeship approach to recruitment. Where apprenticeships have been considered, it has not seemed to be a practical option because of the amount and degree of specialisation in the practical work that the apprenticeship requires. We could, for example, have an electrical apprentice, but we could not provide them with electrical work every day, and nearly all the work would be to do with renewable energy and energy storage rather than for example rewiring of buildings. We could also take on a plumbing apprentice to work on biomass, heat pump and solar thermal systems, but this is precluded as we don't do any natural gas installation work. The existing C&G courses are too inflexible and narrow in scope to work well with a company as small and diverse as ours. To work well, a more broadly based Sustainable Energy and Engineering course might be set up".

So, it seems that for Apprenticeships to work for the very large number of micro and small SMEs in Pro-environmental businesses significant changes are required that would mean large providers shifting away from solely a 'mass-market' approach that privileges larger employers who can take on groups of apprentices; to one which is more flexible and responsive to the needs of small innovative companies who have as great a need and as much to offer apprentices as the larger firms.

There were also significant challenges for larger organisations. An interviewee from a multi-national construction company with responsibility for Apprenticeships said:

"I have been asked to have a look at Apprenticeships in the area of sustainability. I have looked around and opportunities are very, very, very limited. I have tried to pull it on and it's not impossible, but you need to have quite a group of you working across the sector to be able to pull it together and its proving to be incredibly difficult. The opportunity is huge, but the actual practicalities … are very difficult. It is about cross company collaboration".

More generally, there is a mismatch between employers' skill needs and current learning provision and a wider lack of STEM learning. The skills required in some new technology areas will be specific and the number of learners potentially small. This makes it difficult in some cases to achieve economies of scale for learning provision. The national shortfall in achievement of students with Science Technology Engineering and Maths qualifications and skills will, as in other sectors, hold back the full potential of LCEGS business innovators, in particular within the renewable energy and nuclear sub-sectors.

5.4 Commercial independent provision

For adult and experienced learners, there appears to be strong appetite from Middle Managers in larger organisations for **practical, multi-discipline awareness raising development opportunities**. People recognise the need to step beyond their established or traditional disciplines and develop a broader/systems view. Learners wanted:

- Flexible, online, easily accessible (video) content
- Case studies
- Access to industry speakers explaining cutting edge practice
- Opportunity to network

Our key respondents wanted content that responds to the needs of smaller businesses, delivered through modular or flexible units that can build expertise over time to suit particular interests.

> "We need short snappy interventions that relate to business need".
>
> [MD, Advanced Engineering].

In the Construction sector especially, low carbon/energy efficient product suppliers are increasingly filling the gap in trade and craft guilds through free or low-cost YouTube and web-based 'how to' video tutorials. The benefit of easy/anytime access may be countered by the lack of critical scrutiny provided through independent face to face supervision.

In summary, there is great opportunity across the various modes of provision to do things radically differently in order to serve the exciting new roles and skills that are emerging from the breadth of innovation across multiple sectors in the rapidly growing sustainable economy.

6.0   LABOUR MARKET CHALLENGES

Pro-environmental skills needs reflect the pace at which sustainable innovation is developing. The data we have shown indicates that this innovation is moving more swiftly in Construction than in Advanced Engineering, for example. Figure 7, below, shows the classic diffusion of innovation curve – that depicts how the take up of any successful innovation moves through distinct phases as it moves towards market saturation.
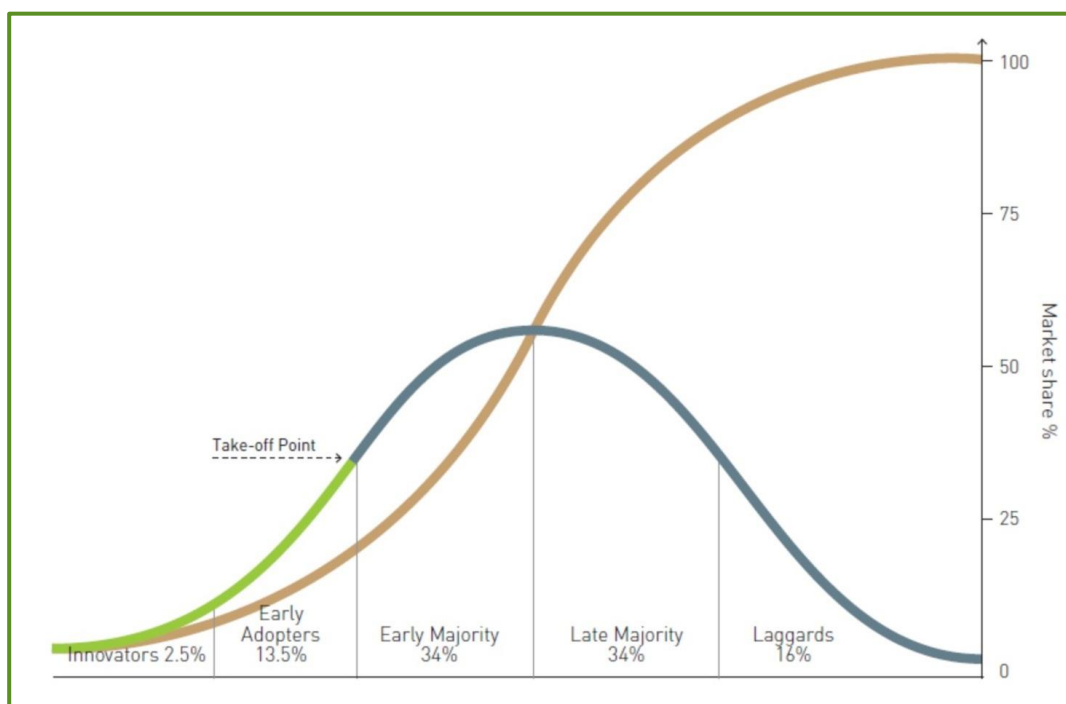

Figure 7: Diffusion of Innovation

This concept (Everett, 1962) is helpful as we look at how business activity in the emerging field of pro-environmental goods and services develops. The theory predicts that for an innovation to be successful and move closer to market saturation it needs to bridge the tipping point at around 16% of the market. This is when customers move from Early Adopters and forward-thinking Innovators, who will pay a premium just to be in the vanguard of consumers, to the Early Majority of buyers who make rational choices based on value comparison with other products or services.

Once this 'take-off point' has been bridged the innovation has 'proved it spurs' and is much more likely to reach market saturation. In our context, from an individual businesses perspective we might consider that getting past the 20% of turnover gained from pro-environmental products is the internal tipping point that determines whether this facet of the business will continue to grow. Not every firm will become a wholly pro-environmental business, of course – but neither does every innovation progress to market saturation. At the other end of this continuum, a business that is gaining 80% or more of its turnover from LCEGS can readily be considered as a 'pro-environmental standard bearer' within its broader sector.

	LCEGS*	Construction	Transport	Engineering	Biotech & life sciences	Waste recovery	Total
Firms in sector	1554	8,900	5,580	1000	2000	210	19,250
% of companies supplying LCEGS	100%	79%	21%	18%	21%	c. 40%	c. 50%
Estimated LCEGS	1554	7,000	1,100	180	440	c. 84	10,360
1-20% Turnover	420	2,580	390	11	160	c. 21	3,580
80%+ Turnover	620	2,580	110	30	200	c. 10	3,470
*Includes environmental management and energy efficient product and service suppliers							

Table 8: Estimate of Pro-environmental Innovators[1]

A similar argument can be made at the sector level. The data from the EMC Quarterly Business Review has been used to extrapolate the number of businesses in a number of the key sectors. Based on Table 8, this suggests that Construction - with 79% of firms deriving some turnover from LCEGS and 29% deriving 80% or more of their turnover from LCEGS – has moved passed its sector tipping point and is moving into a more mature development of its pro-environmental innovation. Clearly, for a sector to be fully mature we would expect to see very high percentages of firms with 80%+ or turnover from LCEGS – so there is some way yet to go for Construction! Our figures show that Advanced Engineering on the other hand only has 3% of firms gaining 80%+ of turnover from LCEGS and 82% of firms do not supply LCEGS at all.

It is important to emphasise here that although the figures from our EMC survey are based on a sample of 350 SMEs operating in the region, this analysis is indicative of a very complex business environment. However, the trends that it hints at have been reflected in comments from our interviewees, the results from our (small) survey and the challenges thrown up by the research process itself.

This analysis begs the strategic question about whether skills support and structural investment should be differentially targeted at niches that are already showing strong pro-environmental growth; or alternatively, that support should be targeted at sectors like Advanced Engineering that are showing much less pro-environmental business activity.

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[1] Note: Businesses with 80%+ LCEGS turnover

Unsurprisingly, our analysis has shown that current skills needs vary across sub-sectors and some of the differences between skills provision of some of our larger local companies who are much more likely to train people in-house.

As noted in 4.3.5, our research has highlighted a variety of current and future skills requirements in the local low carbon economy. Reassuringly, these mirror findings from a recent report by New Economy[2] that identified a number of skills gaps that have the potential to restrict growth. Challenges include: low carbon vehicle skills for mechanics; renewable energy and efficiency installation skills and specific technical skills relating to the design of new products.

Many of the skills needed to make the transition to a low carbon economy are not new. For example, we already know that Science, Technology, Engineering and Mathematics (STEM) skills will be needed at all levels, in key energy and advanced manufacturing sectors and more widely across the economy, to lower carbon emissions and make better use of all resources.

In some sectors, much of what needs to be done will be building upon existing STEM-based skill sets. However, there will be sectors in which completely new skills are needed, some in new combinations, and for which new qualifications will need to be developed (for example in the design and construction of smart buildings and infrastructure). Our skills system needs to be able to respond rapidly and flexibly to these demands.

We agree with our colleagues from Nottingham City Council[3] that the skills required in some of the technology areas will be very specific and the small number of learners in some areas will reduce the ability of providers to accommodate new areas of provision. We also concur that the key skill challenges going forward will include 'greening' the workforce, addressing labour and skills shortage, and ensuring adequate learning provision.

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[2] Deep Dive: Low Carbon and Environmental Goods and Services, New Economy, 2016
[3] Thanks and acknowledgement go to Nicola Stevens in the Employment & Skills section of Nottingham City Council for her support, encouragement and kind sharing of Nottingham City Council Skills Action Plan analysis – from which the latter part of this section is drawn.

'Greening' the workforce and skills development	• A significant amount of CPD will be required for existing professions especially in the areas of energy efficiency, renewable energy and refurbishment skills for domestic housing stock. • In many areas this will require 'upskilling' rather than new skills – although promoting a shift in awareness and mindset will be a fundamental foundation. • Management and leadership skills will be a pre-requisite to grow productivity and develop low carbon systems and opportunities for growth. • Environmental management learning is already in great demand and this is only likely to grow.
Labour and skills shortages	• Rapid growth in renewable energy, and re-development of nuclear energy plants in the UK (as well as decommissioning) will continue to drive significant demand for re-skilling. • In construction, an understanding and ability to fit appropriate retrofit technology, e.g. heat pumps, heat exchangers, solid wall insulation, CHP systems will be critical over the next two decades. • The rapid growth in Ultra Low Emission Vehicles will drive demand for charge point installation and new vehicle maintenance skills.
Mismatch between employer skill needs and current learning provision and wider lack of STEM learning	• HE and FE are significantly less popular options than online, in house and private training options. A major challenge for education and training providers will be to ensure that the content of courses provides students with the necessary skills in order to undertake work within a rapidly changing sector. • The skills required in some new technology areas will be specific and the number of learners potentially small. This will make it difficult in some cases to achieve economies of scale for learning provision. • The National shortfall in achievement of students with Science Technology Engineering and Maths qualifications and skills will, as in other sectors, hold back the LCEGS sector full potential, in particular within the renewables and nuclear sub-sectors.

Table 9: Key challenges

Each sector has specific challenges related to the shift to increasingly pro-environmental activity and outcomes:

- Decarbonising the **power industry** will require a major cross-sector effort to meet escalating demand for skills. The industry will need to recruit apprentices and graduates in large numbers, particularly those with STEM skills.
- In the **wind and nuclear energy** sectors, there is a clearly identified need for technician level skills.
- Decarbonising buildings and **construction** will create strong demand for skills to adapt existing housing stock, for renewable building methods and for the construction of zero carbon homes. The required skills will be mainly at graduate level to develop, manufacture and implement new technologies, and to enhance existing practical construction skills for installing new adaptation and mitigation technologies.
- In the **transport** sector – the transition to ultra-low carbon vehicles (ULEVs) and the development of new fuel-efficient aircraft will require the manufacturing and maintenance workforces to adapt their skill sets to the demands of changing technology. STEM graduates will be in high demand.
- In **advanced engineering**, skill needs will emerge around product development and design and manufacture. This will then follow through into services such as marketing, installation, maintenance and support. The main area of skills demand will be for high qualified staff in both product design and engineering.

As we shift from a focus on 'low carbon' and 'renewable energy' to pro-environmental business activity in any sector, it is important to acknowledge the important contribution being made by firms in the bio-sciences; environmental services; retail; agriculture and other sectors that have not been the focus of this particular study.

Nevertheless, Table 10 illustrates a key proposition that springs from this study. Namely that we should move away from the concept of a 'low carbon sector' and focus on the pro-environmental business activity we find in each sector. For example, with the help of colleagues at NTU we have established that there is a healthy degree of pro-environmental business done in the Biotech & Life Sciences with 22% of businesses deriving some turnover from LCEGS and 9.5% of businesses deriving more than 80% or their turnover from LCEGS. These figures are commensurate with the picture in other sectors and provide some validation of our proposition above.

It is difficult to be specific about numbers employed and enterprises engaged in this variety of activities because Standard Industry Classification codes do not reflect these 'pro-environmental' economic activities and partly because such activity is commonly a secondary aspect of business activity. Our approach to estimating the degree of pro-environmental business, therefore, provides a viable way to draw conclusions about the weight of this activity across the region; and in turn help inform regional skills strategy as a result. With that, we offer a number of conclusions and recommendations.

Traditional sector	Pro-environmental niches
Energy	• Renewable energy offshore wind, onshore wind, solar photovoltaic, hydropower, other renewable energy, bioenergy, alternative fuels, renewable heat, renewable combined heat and power, energy from waste, • Heat distribution geothermal, heat networks
Construction	• Green building sustainable architecture & design, eco-homes, Passivhaus, BREEAM, pre-fabrication • Energy efficient products & services insulation, renewable combined heat and power, energy efficient lighting, heat recovery, energy monitoring, saving or control systems, battery storage
Transport & Logistics	• Low Emission Vehicles charging infrastructure, vehicle to grid, battery & fuel cells, autonomous & shared vehicles • Fuel efficient logistics • Intelligent mobility travel planning, last mile logistics • Sustainable infrastructure smart highways, inductive charging
Advanced Engineering	• Cleantech, • Energy efficient products • Sustainable engineering, carbon capture and storage, • Process efficiency green LEEN, Sustainable 6 Sigma and related processes.
Environmental Services	• Environmental management EMS, accreditation schemes, carbon accounting, low carbon financial and advisory services. • Sustainable regeneration think tanks & NGOs, smart cities, SDGs • Recycling, material recovery • Water service efficiency • Pollution monitoring & control land regeneration, biodiversity
Bio-tech & Life Sciences	• Cleantech • Sustainable chemistry, bio plastics • Bio-energy
Retail	• Circular economy design, • Resource efficiency sustainable packaging • Energy efficient products

Table 10: LCEGS as pro-environmental innovation niches in traditional sectors

7.0   CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

This study set out to:

- Establish the key skills required by the Low Carbon and Environmental Goods and Services (LCEGS) sector in D2N2, now and in the future;
- Map existing training provision for the LCEGS sector, how the workforce is currently recruited, trained and what qualifications are available locally;
- Establish the needs of key sector supply chains, what they need from SMEs and identify barriers to SMEs entering the sector;
- Identify any skills shortages, gaps in existing provision, barriers and risks for both smaller and larger businesses;

Although we have talked with many passionate, engage and active 'innovators' and 'early adopter' businesses, one of the early lessons we learned, through the challenges of persuading enough individuals to contribute to the research, was that many people did not identify strongly enough with the issues and challenges of the 'Low Carbon Sector' to donate even a few minutes of their time to our 'worthy cause'. This issue also lies at the heart of the strategic challenge of supporting the shift towards a sustainable economy – many people still believe our climate change challenge "is someone else's job to deal with…".

In 2012, a strategic analysis by the Economic Strategy Research Bureau at NTU proposed that Low carbon should be viewed by the D2N2 LEP as '*a cross-cutting series of practices, technologies and opportunities*' rather than a sector in itself. This point is replayed again in the recent Low Carbon Sector Skills Needs report (D2N2, 2017). This document asks that the LCEGS Skills Action Plan is monitored and updated regularly by the Sector Task Group, who are similarly tasked to marshal local feedback on LCEGS. The same document makes the case for '*a local funding solution to support relevant bite-sized qualifications for emerging skill development areas*'; appropriate incentives to encourage employers to train their employees in the skills required in the Low Carbon sector; provision to support LCEGS start-up companies; bespoke access to expertise to support business growth; improved collaboration between Colleges and employers; courses for 14-19's on responsibility and ethics and a range of other plausible and worthwhile initiatives. Whilst progress has been made on some of these points, our analysis suggests that for many pro-environmental innovators there are still insufficient opportunities for skills development.

On the other hand, we were surprised by the level of pro-environmental business activity in certain quarters – notably in the construction sector. This gives us great cause for optimism but raises a strategic conundrum. Should our efforts and initiatives to boost demand for LCEGS and build the skill base to meet those demands be targeted at the pro-environmental niches that are already successful – and which may grow independently of any further support (such as energy efficient products for eco-construction or ULEVs). Or should our funding and energy be targeted at sectors that have real potential to promote LCEGS, but which appear to be lagging behind (advanced engineering in carbon capture and additive manufacture, for example). Or perhaps it will be most productive to identify niches that are currently struggling but have great potential to growth rapidly (local energy grids or heat distribution, for example).

So, whilst the research has identified some of the key skills required for pro-environmental innovation and how these vary across sector; where employers access training for these skills and some of the current and future gaps in the training provision – we conclude that the needs in each sector, as well as different geographical locations, vary enormously. This means that more research and evidence gathering is required from the sector and local perspectives in order to understand the skills needs and business practices associated with pro-environmental business growth.

Our research suggests that Apprenticeships, FE and undergraduate provision in particular have some ground to catch up and that this is as much to do with mode of delivery as it is to do with the lack of content/ courses that are offered (or at least signalled) for newly emerging roles and skills for a sustainable or pro-environmental economy.

7.2 Recommendations

With this in mind we offer ten recommendations which will link to the Science & Innovation Audit, Strategic Economic Plan (2019 – 2030) and forthcoming Local Industrial Strategy:

Recommendation 1: Invest in cross-sector opportunities to build local leadership capacity to accelerate the shift to a local low carbon economy.

Recommendation 2: Establish regular economic data capture and reporting protocols to monitor pro-environmental business activity and skills through collaboration of regional stakeholders. Namely, Growth Hub, LEP Sector Groups, East Midlands Chamber, Local Councils, Universities et al.

Recommendation 3: Sector Skills Groups to take responsibility for identifying and monitoring pro-environmental business activity and skills needs in each priority sector.

Recommendation 4: Sector Skills Groups review current and future skills needs to establish priority areas and make recommendations for skills provision in each priority sector.

Recommendation 5: Sector Skills Groups to identify at least one exciting new pro-environmental technical role/ skill need and 'sponsor' one FE College to develop a course aimed at attracting young adults.

Recommendation 6: FE Colleges coordinate on pro-environmental specialisms e.g. ULEV maintenance; renewable installation; smart lighting; 'progra-mecha-tronics' – to ensure access to provision and retention of appropriately skilled staff.

Recommendation 7: Set up an Apprenticeships initiative to support Pro-environmental business activity in SMEs, based on delivery methods identified in this report.

Recommendation 8: Provide awareness raising, training and development opportunities for public sector and corporate procurers on the long-term benefits of whole life cycle costing, future-fit procurement and tendering and sustainable supply chains.

Recommendation 9: Ensure that all the business advisors across the region are fully briefed on issues and opportunities related to pro-environmental business and workforce development.

Recommendation 10: Identify appropriate channels to raise awareness amongst other business support intermediaries – such as accountants, business development managers, advisors & mentors plus regional energy and low carbon advisors.

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