



LOW CARBON ENTREPRENEURS: THE NEW ENGINES OF GROWTH



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Foreword from Tom Delay

CARBON TRUST CHIEF EXECUTIVE



Business has an essential role in tackling the environmental challenges the world faces. It has the resources, drive and discipline to make change real, not just a topic for debate. Mobilising the innovation, talent and productive capacities in companies will accelerate our move to a sustainable, low carbon economy. In the UK the low carbon economy is a success story. It accounts for more than £120 billion in annual sales and employs almost 1 million people. It has been growing and, despite the recession, contributed over a third of the UK's economic growth in 2011/12.

For over ten years the Carbon Trust has been working alongside, incubating and investing in the next generation of low carbon businesses. From this hands-on experience we know that taking a new idea and moving it through to commercial deployment is tough and requires not only a strong entrepreneurial spirit but a range of support along the way. This report not only recognises the critical role of low carbon entrepreneurs in the new green economy but it also sets out a series of recommendations to ensure the sector grows quickly to fulfil its potential.

I highlight three here: funding, collaboration and focus.

Addressing the funding gap for low carbon SMEs should be an urgent priority for the UK. For low carbon SMEs, this is the biggest barrier to business growth in the UK. The report outlines a number of potential options for consideration. One suggestion is to re-allocate £100 million of R&D tax credit funding that currently goes to large companies to an early stage venture capital fund. There are also other ways that funding could be made available for development and growth such as loan funding and contributions to crowd sourcing.

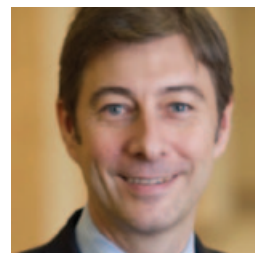
New collaborative models that engage a wider range of actors in the low carbon economy are also needed. In particular, corporates have a key role to play given their financial resources, technical expertise and global reach. New forms of collaboration that deliver benefits to corporates and SMEs could accelerate low carbon innovation and overcome the barriers that have made it challenging for these two groups to engage effectively. This research suggests that SMEs often do not find it easy to engage with corporates and vice versa. New models are emerging. For example, the Carbon Trust has a \$5 million incubation partnership with GE to find, assess and incubate start-ups across Europe. The Offshore Wind Accelerator is another example of a collaborative model and convenes nine of Europe's leading energy companies with 77% of the UK's licenced offshore wind capacity to drive down the cost of offshore wind by 10% by 2015. More is needed and at larger scale to accelerate the move to a low carbon economy.

Innovation support requires significant commitments of capital and resources. There is not enough of either to fund all the projects or ventures that apply. In order to deliver jobs, growth and environmental outcomes, the UK should consider focusing most of its innovation support in areas where the UK has a material advantage or a particular need to develop a technology option to ensure it benefits from the scarce resources available. The Carbon Trust has previously highlighted the need for this focus.

I would like to thank Shell Springboard for commissioning this important new report. It shines the spotlight on a critical element of our economic future and contributes to the continued success of the sector.

Tom Delay
Chief Executive

Foreword from Edward Daniels



SHELL UK CHAIRMAN AND EXECUTIVE VICE PRESIDENT DOWNSTREAM TECHNOLOGY

Some of the biggest breakthroughs come from small businesses. Bold, quick and nimble enough to reimagine the old ways of doing things – they are critical to driving the innovation required to tackle one of the greatest challenges of our time: meeting rising demand for energy while reducing CO₂.

This future energy challenge is an innovation challenge that Shell is embracing wholeheartedly. For example in the last five years we have invested \$2.2 billion in developing alternative energies, carbon capture and storage and other CO₂ related Research & Development.

But we also recognise that Shell is just one company. We don't have all the answers. That is why we believe it is so important to help small enterprises grow big ideas in low carbon innovation. Now in its eighth year, Shell Springboard offers businesses the chance to win up to £40,000 to help make their commercially viable ideas a reality. Since 2005, Shell has awarded £2.58 million to 71 UK companies at the cutting-edge of the low carbon economy – helping them to develop new ways of reducing carbon emissions. In 2013 a total of £330,000 has been awarded to nine businesses to help the growth and development of their low carbon business ideas.

As this report shows, this is an exciting time for low carbon enterprise. Supremely confident in their technology, this new breed of start-up is successfully chasing a global low carbon market expected to be worth £4 trillion by 2015. This is good news for the UK economy. Two-thirds of the UK's low carbon entrepreneurs are planning to create new jobs over the next 12 months, and over half already have. Whilst it's not without challenges, the strategic importance, achievement and future potential of this sector cannot be overlooked.

Thank you to the Carbon Trust and the Shell Springboard team for their work in putting this report together. A special thanks to everyone who participated in the research, particularly the Shell Springboard alumni and the Shell LiveWIRE* community.

I hope that the data and findings in this report will help organisations, policy makers, academic institutions and other interested parties support these entrepreneurs so that we continue to experience a healthy increase in new, low carbon start-up businesses in the UK.

Edward Daniels

Shell UK Chairman and Executive Vice President Downstream Technology

*Shell LiveWIRE is a Shell Social Investment programme supporting young entrepreneurs between the ages of 16 and 30 by providing independent online business advice, monthly start-up awards and an annual Shell LiveWIRE Young Entrepreneur of the Year Award.

Executive Summary

The low carbon economy is a UK success story. It accounts for more than £120 billion in annual sales and employs almost 1 million people. It has been growing despite the recession with “over a third of the UK’s economic growth in 2011/12 likely to have come from green business”.

The UK Government has put the low carbon economy at the heart of its strategy for growth. Its *Plan for Growth* identifies the low carbon economy as a priority theme which cuts across all sectors.

Given the size, growth and strategic importance of the low carbon economy, this research looks at the pivotal role played by small and medium size enterprises (SMEs). SMEs drive innovation, growth and job creation. They represent 60% of all UK private sector jobs. 9 out of 10 unemployed people who found work in the private sector since the economic downturn either started or joined an SME. Small businesses also account for more than 90% of the low carbon sector. SMEs are therefore critical to, and a key indicator for, the present success and future potential of the low carbon economy.

Low carbon enterprise: a bullish new breed of business

New analysis of the SMEs driving the low carbon economy reveals a bullish breed of business which is intent on pursuing a global low carbon sector forecast to be worth £4 trillion by 2015:

- Low carbon SMEs are almost twice as likely to have export customers as small businesses in other industries;
- Almost two in five low carbon SMEs are already exporting to a diverse set of countries and three quarters plan to enter or expand exports to a new market in the next two years;
- This ambition is matched by plans for growth
 - Three quarters of low carbon SMEs plan to raise funding in the next year;
 - Two thirds plan to recruit in the next year (more than half have created new jobs in the last year and 12% hired more than 4 new team members);
- However, the sector is not without its challenges. Chief among these are access to funding, technology demonstration opportunities and securing the right skills. The UK also remains a tough commercial nut to crack which is a contributing factor for low carbon SMEs seeking sales in overseas markets.

Low carbon innovation mainstreaming across the UK

Aside from the commercial landscape, a geographic analysis of enterprise by location reveals low carbon enterprise mainstreaming across the UK. Low carbon SMEs are found across the length and breadth of the country. Low carbon innovation hubs emerged in London, Oxford, Cambridge, Leeds and Southampton. Relative to population size, Derbyshire and Nottinghamshire also had high proportions of low carbon SMEs. Access to talent and regional funding sources are key reasons that drive business location after where company founders happen to live.

However, entrepreneurs in the low carbon sector are almost invariably male (more than 90%) and middle aged (more than 75% are over 40) highlighting the need to harness a broader UK talent base. This research also looked ahead to the next generation of low carbon innovators. Encouragingly, almost one third of entrepreneurs from a data set made up predominantly of 16 – 30 year olds say they would like to start a new low carbon business or get involved in the low carbon economy but don’t know how to go about it.

10 STEPS FOR SUCCESS

This report identifies ten steps to success for the low carbon SME sector:

1. Maintain clear, long term vision and ambition
2. Ensure funding is available for development and growth
3. Enable technology demonstrations through procurement
4. Provide sustained and tailored commercial advice
5. Help SMEs to access export opportunities
6. Address the skills gap
7. Develop new models to drive collaboration
8. Focus where the UK is well placed to lead
9. Recognise industry specific challenges
10. Celebrate success



Size, growth and strategic importance of the low carbon economy

1. The rise of the low carbon economy
2. SMEs: a key source of technology innovation and a driver of UK competitiveness

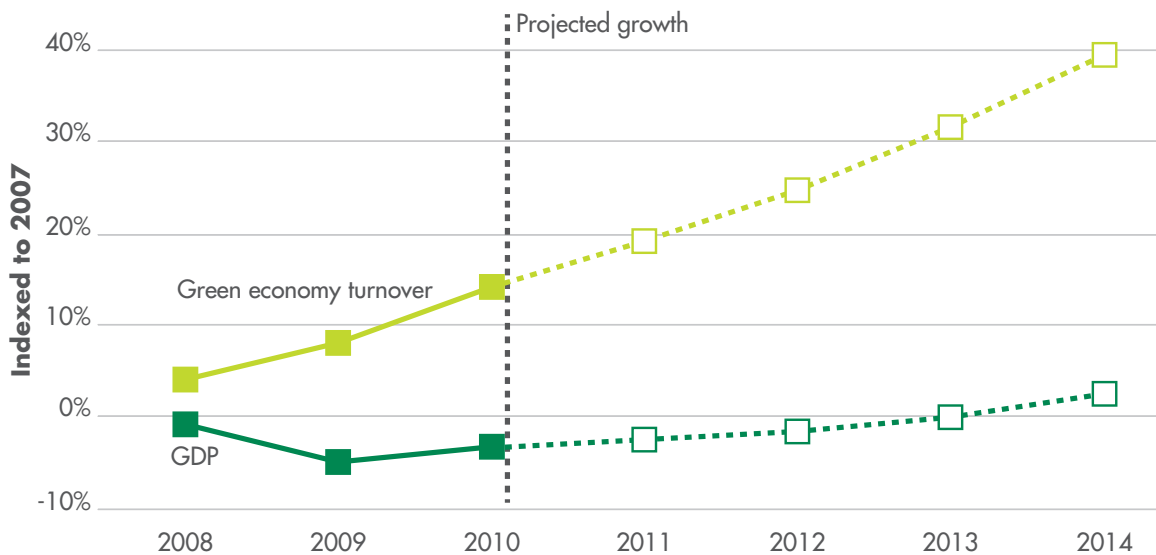
1 The rise of the low carbon economy

This report looks at the pivotal role small and medium sized enterprises (SMEs) are playing in driving the UK's low carbon economy and the economic opportunities that exist in both the UK and in increasing the UK's share of a global low carbon sector now worth more than £3 trillion and forecast to be worth £4 trillion by 2015¹.

Recent research on the low carbon economy by the CBI, the Green Alliance and the UK Government has highlighted the growth, size and employment provided by the low carbon and environmental goods sector in the UK. The sector is now estimated to be worth over £120 billion and employs 940,000 people². It has been growing despite the recession³ and "over a third of the UK's economic growth in 2011/12 is likely to have come from green business"⁴.

Figure 1: Indexed growth in green economy compared to overall economic growth

Indexed growth rate since the financial crisis¹



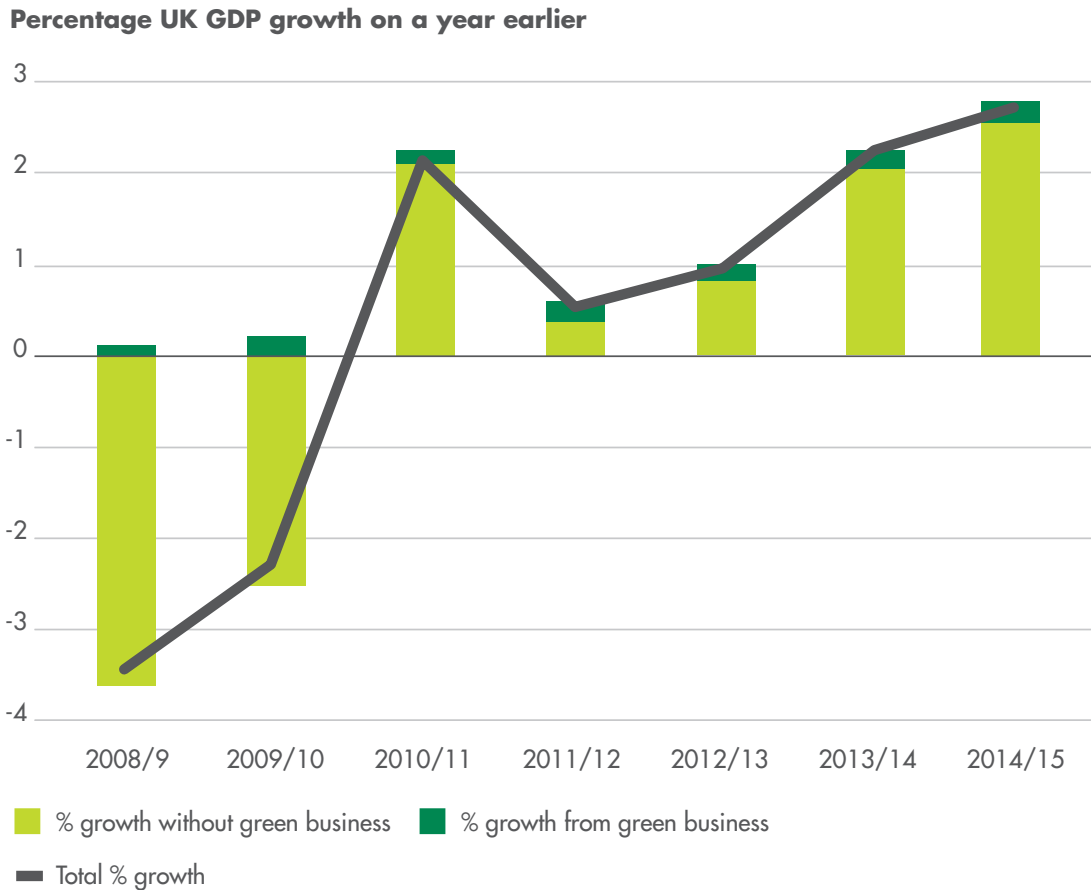
Source: Green Alliance, "Green economy: a UK success story", (Page 1)

The low carbon economy is one of the cross-cutting priority themes highlighted in the UK government's *Plan for Growth*⁵. The March 2013 update to this *Plan for Growth*⁶ highlighted progress against low carbon commitments in a number of areas. For example, the Government has introduced a Carbon Price Floor for electricity generation from 1 April 2013 to encourage investment in low carbon power and the Green Investment Bank has been operating independently since October 2012 and has already completed nine investments in the waste processing, energy efficiency, offshore wind, and biomass sectors.

The UK has introduced world leading, legally binding legislation with cross-party support in the form of the Climate Change Act 2008⁷. This legislation provides a long term vision for the low carbon economy and mandates at least an 80% reduction in the net UK carbon account for 2050 against a 1990 baseline.

Low carbon economy accounts for more than £120 billion in annual sales and employs almost 1 million people

Figure 2: Proportion of the OBR’s historical and projected UK GDP growth attributable to green business



Source: CBI, “The colour of growth”, (Page 9)

The low carbon economy is already a UK success story. Large companies have played an important part in this success. The CBI’s recent report included profiles of the role played by a number of large companies including Sainsbury’s, Kelda Group and Atkins which provides examples of the types of benefits large companies can deliver in this area⁸. The scale, resources and expertise of large companies enables them to solve difficult low carbon challenges and they will need to play an important role in accelerating the move to a sustainable, low carbon economy.

However, SMEs are also central to driving innovation, growth and job creation. Given the size, growth and strategic importance of the low carbon economy, this research focuses on the pivotal role played by SMEs. SMEs represent 60% of all UK private sector jobs and 9 out of 10 unemployed people who found work in the private sector since the economic downturn either started or joined an SME⁹. Small businesses also account for more than 90% (91.5%) of the low carbon sector¹⁰. SMEs are therefore critical to, and a key indicator for, the present success and future potential of the low carbon economy.

Global low carbon sector is forecast to be worth £4 trillion by 2015

2 SMEs: a key source of technology innovation and driver of UK competitiveness

SMEs are a key source of low carbon technology innovation and will be important to addressing the low carbon technology innovation challenge. For example, SMEs can identify unmet market needs that large companies may not have spotted, develop disruptive technologies to deliver step change improvements in performance without worrying about the effect this may have on an established business, and can operate in a more flexible, responsive manner than many large companies who are constrained by internal processes and decision making structures that make it hard to move quickly on risky innovations.

These characteristics are central to the Innovation required to achieve the UK's climate change commitments. Research carried out as part of the Technology Innovation Needs Assessments¹¹ across 10 low carbon technology areas has already highlighted the potential role that low carbon technologies could play in the energy system by 2050 as well as the challenges that innovation must address before they are viable and competitive. Cost reduction, at scale demonstrations, and the development of new technologies are all examples of important challenges that innovation needs to overcome for the potential of these low carbon technologies to be realised.

Innovation could deliver significant economic benefits both in terms of energy system cost savings and also international business development for UK based companies. Innovation across the 10 technology areas assessed so far as part of the Technology Innovation Needs Assessments could deliver energy system cost reductions of up to £403 billion to 2050 and generate UK based business activity contributing up to £153 billion to GDP over the same period¹². Innovation is also important to job creation with innovative firms found to grow twice as fast both in employment and sales as firms that fail to innovate¹³.



SMEs are a key source of low carbon technology innovation and will be important to addressing the low carbon technology innovation challenge.



Figure 3: Summary findings from Technology Innovation Needs Assessments for six low carbon technology areas

Technology	Potential energy role by 2050	Market Failures	Challenges that innovation must address before technology is viable and competitive	Potential energy system savings 2010-2050 (cumulative)	Potential global green growth opportunity 2010-2050	UK market potential 2010-2050 (cumulative contribution to UK GDP)
Bioenergy Energy crops and conversion to biofuels, biomethane, biopower and bioheat.	5% (Primary energy) 8% (Gas demand) 4% (Heat demand) 5% (Electricity demand) 10% (Transport fuel demand)	Access to capital Low investor appetite for high capex, high risk technologies. Uncoordinated supply chain Lack of existing infrastructure	Reduce costs Maximise yields sustainably Development of low-cost early conversion technologies	£4.2bn	£2-17bn	£19bn (5-10% of global market)
Carbon capture and storage	10-35% of total electricity generation	Uncertain demand Infrastructure needs Difficulty in insuring liabilities Uncertain environmental impacts and regulatory regime	Still unproven technology Reduce costs Demonstrate at full-scale, source to sink Development of lynch pin technologies Reduce component costs and address efficiency penalties	>>£100bn in system savings Reduce cost of CCS deployment by £10-45bn	£25-130bn	£3-16bn UK suppliers £150 - 750bn GVA (46% global market)
Energy networks and storage Enabling role for renewables, heat pumps, electric vehicles and other low carbon technologies	Enabler	Uncertain demand Infrastructure requirements Split incentives Potential for coordination failures	Cost reduction Integrate a diverse range of mutually-dependent technologies into one effective system	£9bn (4-19bn)	£0.3-1.6bn	£6-34bn (4% of global market)
Heat Heat pumps, heat networks and heat storage	33% of heat demand	Uncertain demand Infrastructure and planning Split incentives Coordination failures	Cost reduction and efficiency improvements Design, installation and system integration Demonstrations Improved components and advanced storage materials Heat store and extraction technologies	£14-66bn	£50bn-£300bn	£2-12bn (4-9% in some European markets)
Marine Tidal and wave energy generation	> 10% of total UK electricity generation	Uncertain role and demand – it is still a relatively early stage of technology development and demonstration	Cost and risk reduction Initial deployment of first array to demonstrate proof of value and cost reduction pathway Possible deployment of second generation technologies to prove technology in difficult conditions Cabling, multi-array deployment device interactions, foundations and installation systems Improved components and devices	£3-8bn		£1.4-4.3bn (15% of global market)
Offshore wind	20-50% of total UK electricity generation	Uncertain demand Lack of shared test facilities and other infrastructure requirements Insufficient payback on early stage R&D Insufficient coordination and sharing of data Limited competition in some areas Constraint on capital availability	Cost reduction Testing facilities to support the development of highyield/reliable turbines Novel designs and innovations for foundations, cabling as well as installation and maintenance techniques Measurement and sharing of test data	£18-89bn	£200-1,000bn	£7-35bn (5-10% of global market)

Source: EEF, "Tech for Growth: Delivering green growth through technology"¹⁴, (Page 8)

B

Low carbon enterprise: a bullish new breed of business

1. Low carbon enterprise mainstreaming across the UK
2. Exports almost twice as likely for low carbon SMEs
3. Ambitious plans for growth
4. Funding, demonstrations and skills are key challenges
5. Next generation of low carbon entrepreneurs

1 Low carbon enterprise mainstreaming across the UK

Profile

We received more than 200 responses to our online survey of low carbon entrepreneurs with 75% of the responses coming from people in executive level positions. A number of characteristics emerged from these survey results that give some indication of a typical profile for low carbon entrepreneurs and their businesses:

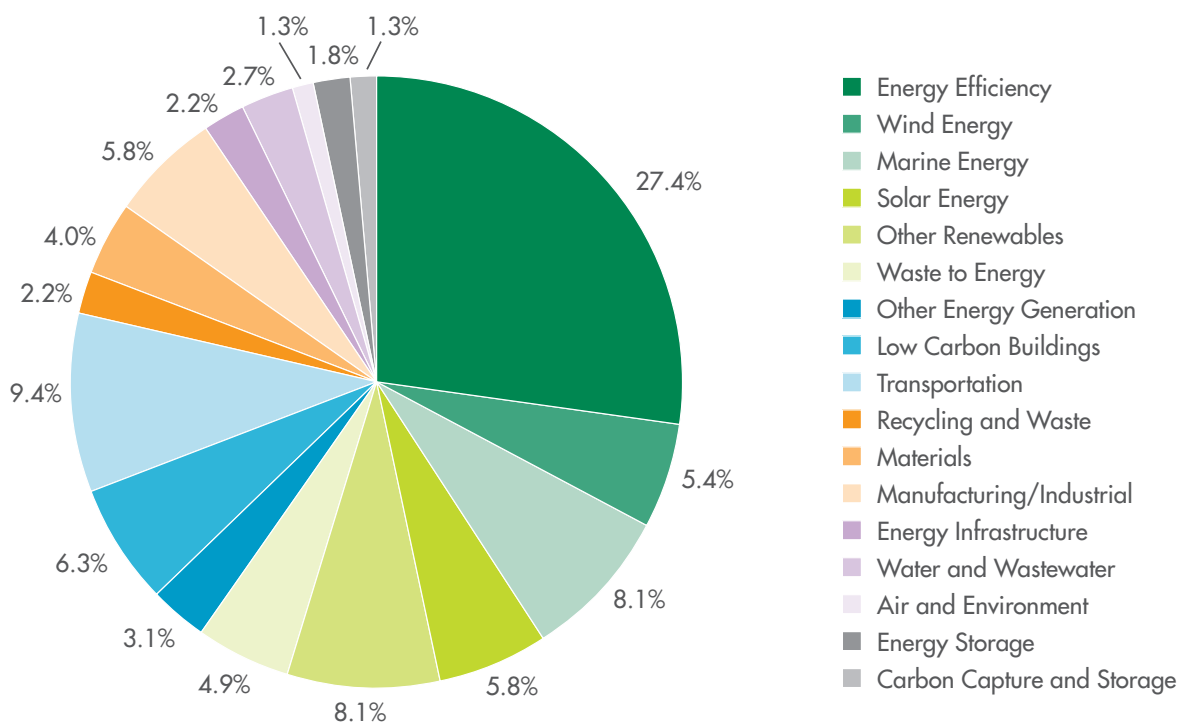
1. More than nine in ten (92%) of the respondents were male;
2. 85% of respondents were over 40 years of age;
3. More than half (52%) had been operating for five years or less;
4. 67% had 5 employees or less; and
5. 79% of the businesses we surveyed were either pre revenue or had revenues of less than £500,000.

Market and technology focus

The most common sector for a UK low carbon SME to focus on from our online survey is energy efficiency (27% of businesses). Transportation (9%), marine energy (8%) and other renewables (8%) are the next most common focus areas. This breakdown by technology type is broadly similar to previous Carbon Trust surveys of low carbon businesses (e.g. in 2011).

Figure 4: Main sector focus of low carbon SMEs in the UK

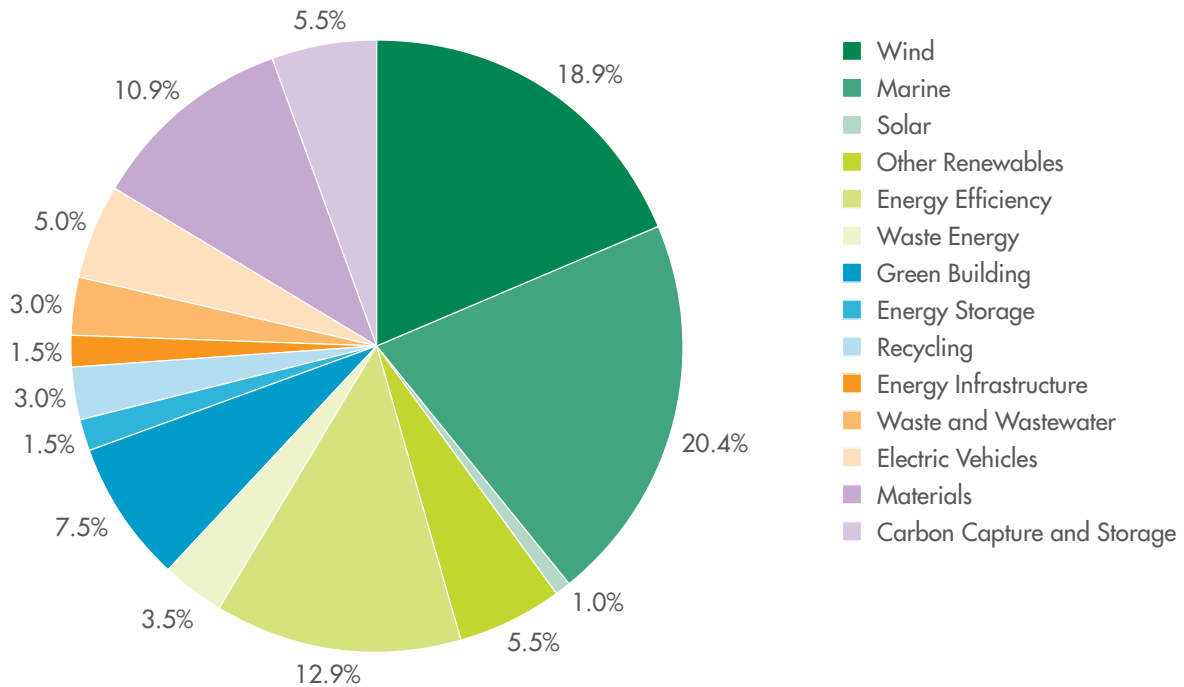
What sector is your main focus?



When low carbon SMEs are asked in which sectors the UK leads, there are similarities to the answers in an earlier 2011 Carbon Trust survey of low carbon SMEs. For example, wind and marine energy were also selected as the two leading sectors in that 2011 survey. However, in this study we see wind dropped from 28% to 19% and solar dropped from 12% to 1%, while energy efficiency has increased from 6% to 13% and materials has increased from 2% to 11%. These changes may be due to a range of factors. For example, the drop in solar may reflect broader challenges in the solar market as solar panel makers in particular face consolidations and a tough business environment.

Figure 5: Leading low carbon sectors in the UK as rated by UK low carbon SMEs

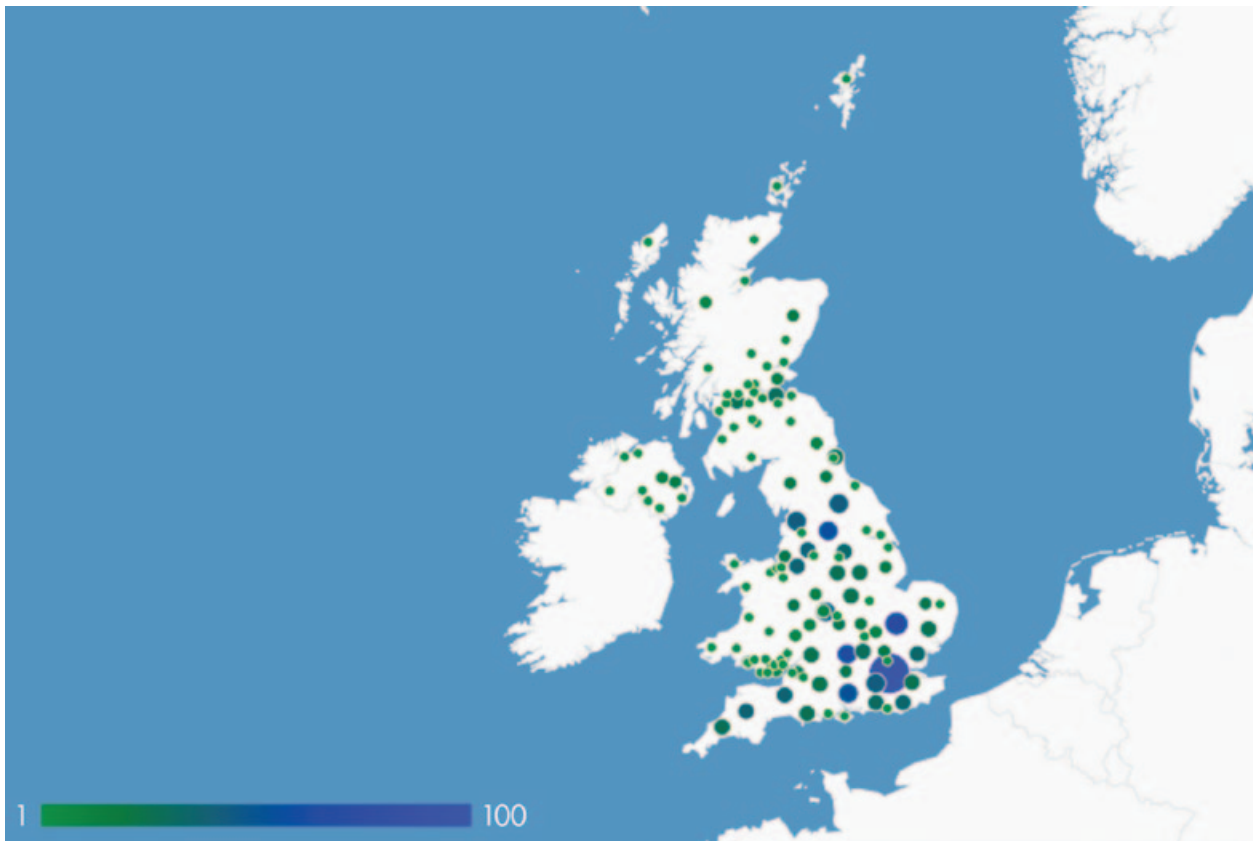
In your opinion, in which sectors is the UK leading?



Location

We also analysed the location of 1,855 low carbon SMEs to identify for the first time in detail at a national level where these businesses are located. The results are shown in the following map:

Figure 6: Location of low carbon SMEs in the UK (bubble size indicates the number of ventures in a particular location)



Perhaps the most striking aspect of the map is the way low carbon SMEs are distributed all over the UK from Cornwall to Scotland and the South East to Northern Ireland. This suggests that the low carbon economy and SMEs within it are mainstreaming and are not limited to small scale activities in small geographical areas.

The top five counties by total number of low carbon SMEs from our research (ordered by highest to lowest) were:

- London
- Cambridge
- Oxford
- West Yorkshire
- Hampshire

Perhaps the most striking aspect of the map is the way low carbon SMEs are distributed all over the UK from Cornwall to Scotland and the South East to Northern Ireland.

The London, Cambridge and Oxford results were expected. However, the West Yorkshire and Hampshire results were surprising. Further research highlighted hotspots of activity in Leeds in West Yorkshire and Southampton and Portsmouth in Hampshire. Half (51%) of the low carbon businesses in West Yorkshire had Leeds postcodes. 34% of the low carbon businesses in Hampshire had Southampton postcodes while 25% had Portsmouth postcodes.

The research also analysed the distribution of low carbon SMEs by technology type. These results showed some concentration of activity for some technologies. For example, the strongest concentrations of marine companies were around London, Cornwall and Belfast. However, there was no one dominant cluster for any of the 10 technology types assessed.

The research also analysed the concentration of ventures at a county level by normalising against county population statistics taken from Office of National Statistics (2010) data¹⁵. When we normalised for population in this way, some of the counties remained in the top five by concentration of ventures (e.g. Cambridge and Oxford) while other clusters emerged (e.g. Derbyshire and Nottinghamshire). Some qualitative interviewees suggested the Derbyshire cluster may have emerged as a hub around Rolls Royce's operations in the area. This report also interviewed and profiles a Nottinghamshire based venture, 4energy, as an example of an innovative low carbon SME that has achieved success by exporting to and growing in a range of markets.

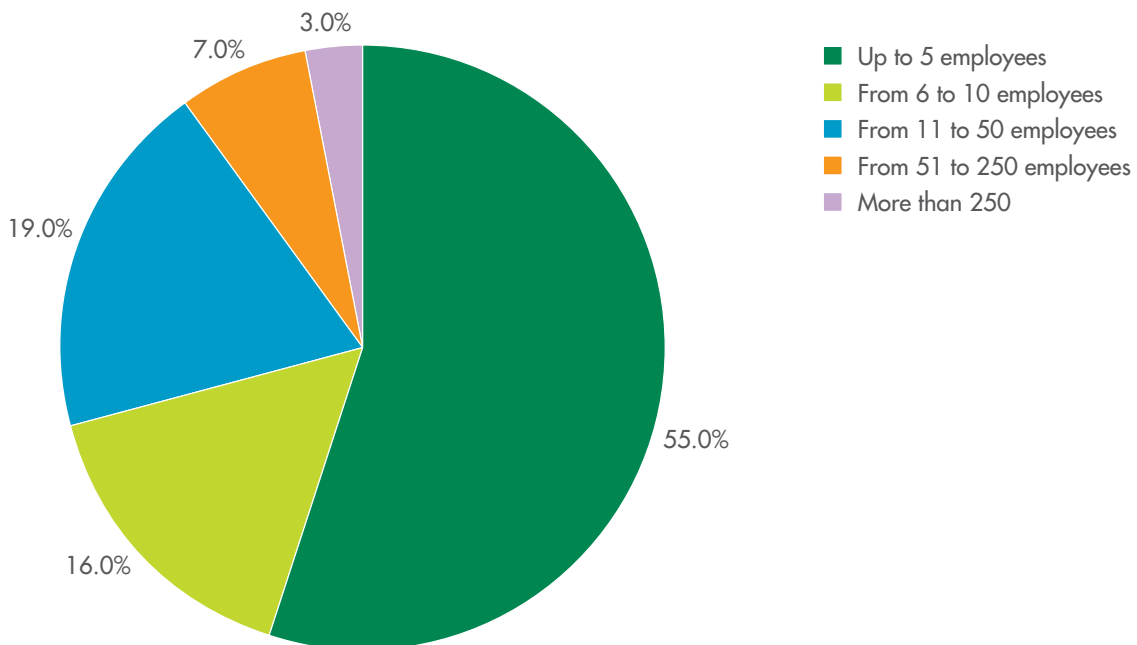
From our online survey results, aside from locating where their founders or senior managers live (77% of respondents), the most common reasons for a low carbon SME's current location were access to talented people (21%) and support from the local innovation network (20%). The most likely reason for a company to move location was to access regional funding (65% of respondents). Access to customers (30% of respondents) and access to talented people (26%) were the next two most commonly selected responses for why a company would move location.

A number of themes emerged from our qualitative interviews which are relevant to the location of low carbon SMEs. Firstly, many of these businesses have multiple bases that they operate from which complicates the analysis of their location. Secondly, some entrepreneurs who we interviewed felt that they operated in a low carbon cluster or a more general technology cluster and benefited from it. There are potential benefits to clustering (e.g. access to expertise, supply chain depth, improved information flow enabling the development of specialist services). However, most entrepreneurs we interviewed either didn't feel part of a low carbon cluster or felt they were part of a broader technology cluster that was not low carbon specific.

2 Exports almost twice as likely for low carbon SMEs

A surprising result that emerged from our online survey relates to exports. Almost two in five (37%) of the low carbon SMEs we analysed are already exporting despite most (71%) of the companies having revenues under £500k. By way of comparison, less than 25% of small businesses across all sectors export¹⁶. As it is not easy for SMEs to export, there must be strong drivers for UK low carbon SMEs to incorporate this in their growth plans from such an early stage.

Figures 7 and 8: Number of employees and age of low carbon SMEs in the UK that are exporting
Exporting ventures by number of employees, %



Exporting ventures by venture age, %

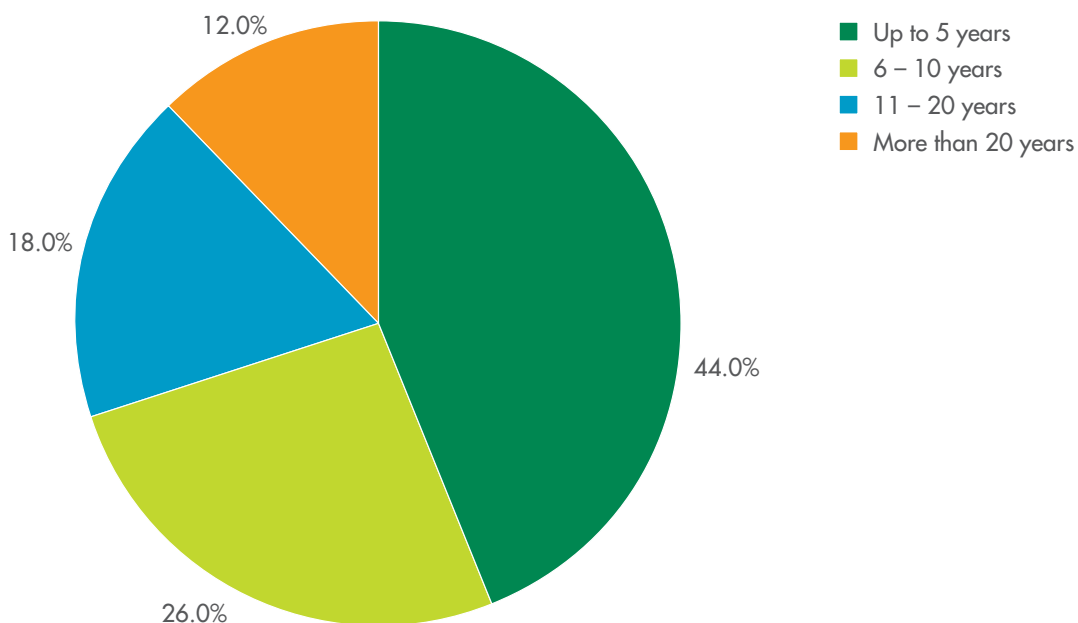
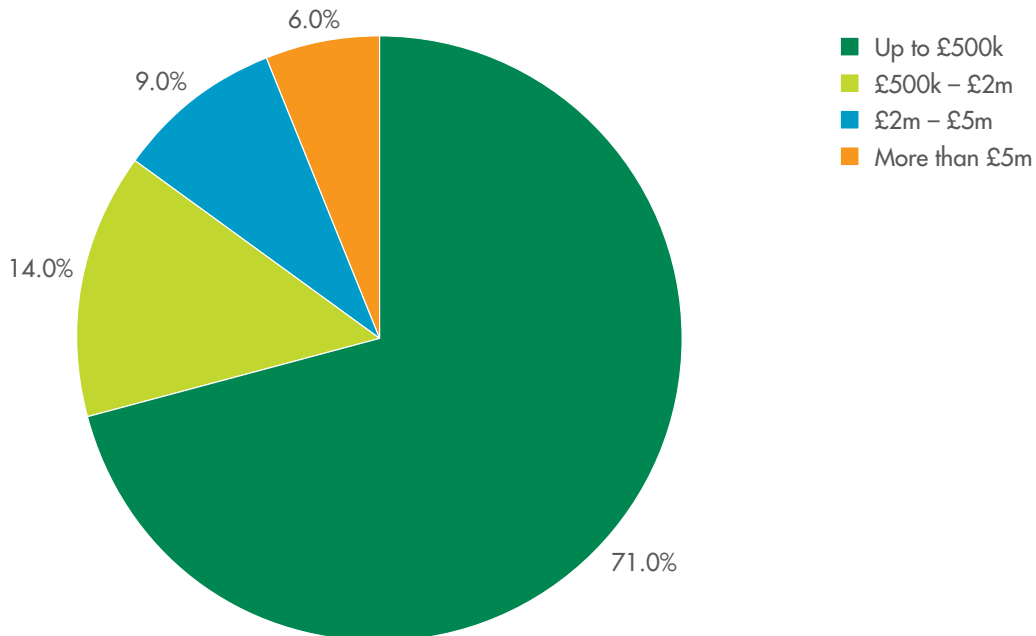


Figure 9: Revenue of low carbon SMEs in the UK that are exporting**Exporting ventures by revenue, %**

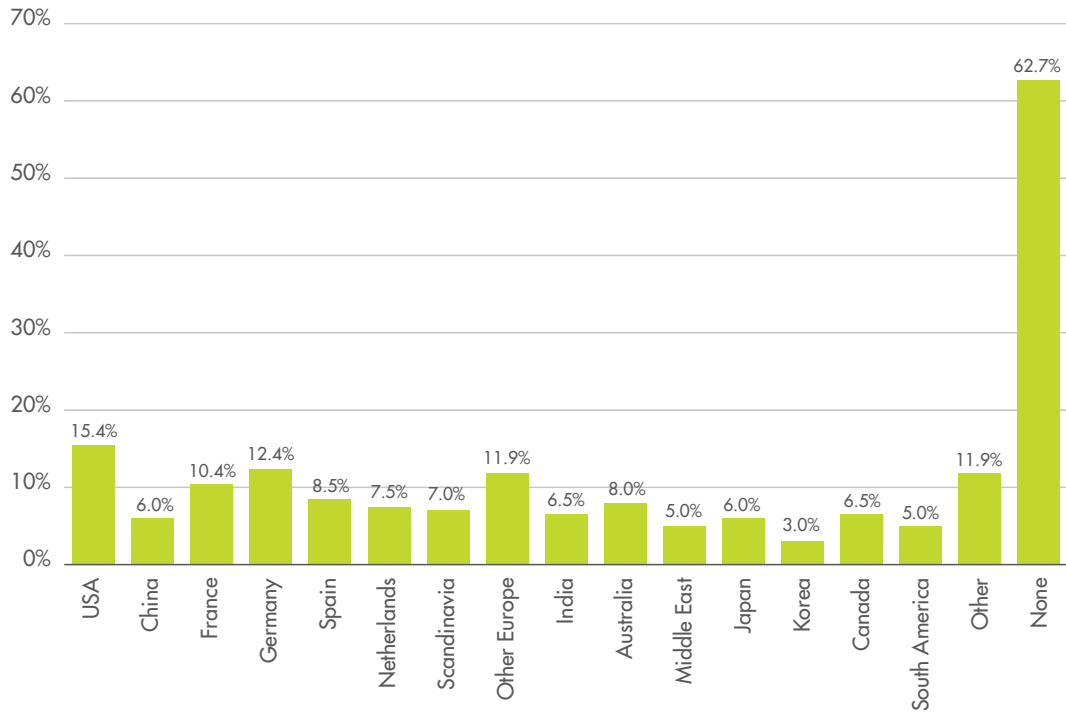
In addition, 76% of low carbon SMEs plan to enter/expand exports to a new market in the next two years. This is double the number of low carbon businesses (37%) that were planning to enter new export markets in a Carbon Trust survey in 2011. This suggests that exports have become more important to low carbon SMEs over the last two years.

Breaking the current export results down by country shows exports to a diverse range of countries. Developed countries were the most popular export markets in our research with the USA (15%) and Germany (12%) the two leading countries. Other recent analysis of the low carbon economy has shown emerging markets to be the most popular export destinations by volume of sales and have also shown exports from the UK being made to a wide range of countries¹⁷. Previous Carbon Trust survey results in 2011 showed the USA to be the preferred export market both in terms of current activity and future plans for low carbon businesses.

The projections of where UK low carbon SMEs are likely to export in the next two years is also similarly diverse. The USA, Europe, China, India, Australia, the Middle East, Canada and South America all score highly compared to current export activity to these countries. This suggests that low carbon SMEs are reasonably bullish about the breadth of export opportunities in the near future and about their ability to capture those opportunities.

Figure 10: Breakdown by country of exports from UK low carbon SMEs

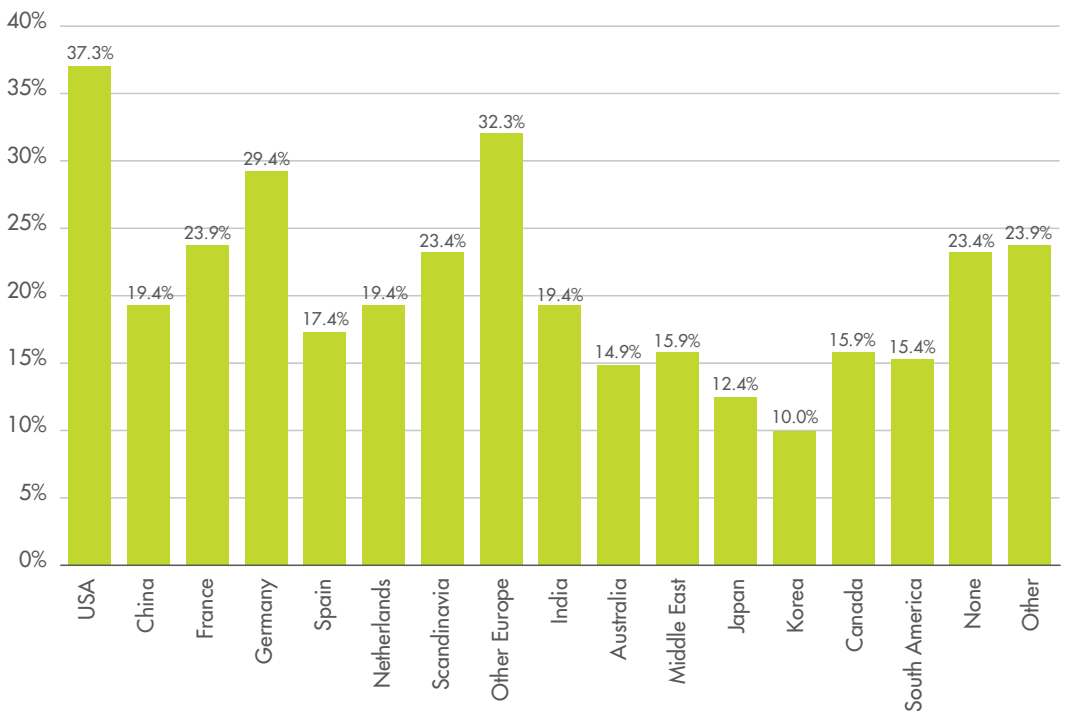
Do you currently export to any of the following countries?



Low carbon SMEs are almost twice as likely to have export customers as small businesses in other industries

Figure 11: Where are UK low carbon SMEs likely to export to in the next two years

Where are you likely to export in the next two years?



Three quarters of low carbon SMEs plan to enter or expand exports to a new market in the next two years

These results show the appetite for, and importance placed on, exports by low carbon entrepreneurs. This is partly due to the size of the global low carbon economy which is forecast to be worth £4 trillion by 2015¹⁸. This global opportunity creates new and exciting market opportunities outside the UK for low carbon SMEs based in the UK. It is also partly due to the UK low carbon market being difficult to crack with some interviewees suggesting that buyers in other countries may be more likely to try a new product (e.g. in the USA) or pay a premium for a more efficient, innovative, low carbon product (e.g. in Germany). In other countries the market opportunity will be bigger than in the UK making it a more attractive market (e.g. off grid products and applications can be a significant bigger market opportunity outside the UK).

Achieving export success is not easy. Finding the right local partner that you can work with effectively to break into an overseas market was identified as a key challenge. There are different ways to go about this (e.g. partner with a corporate to access their local network or leverage existing government contacts and support). Many of those who are exporting already acknowledged the support provided by organisations like UKTI and the Foreign and Commonwealth Office in helping them find and connect with potential partners.

Export revenues seem to be relatively more important from an early stage for low carbon SMEs in the UK than many other industries and form a core part of the business and growth plans for more than a third of these low carbon ventures. The case study on 4energy below is an example of how exports can form a core element of a low carbon SME's growth plans from an early stage.



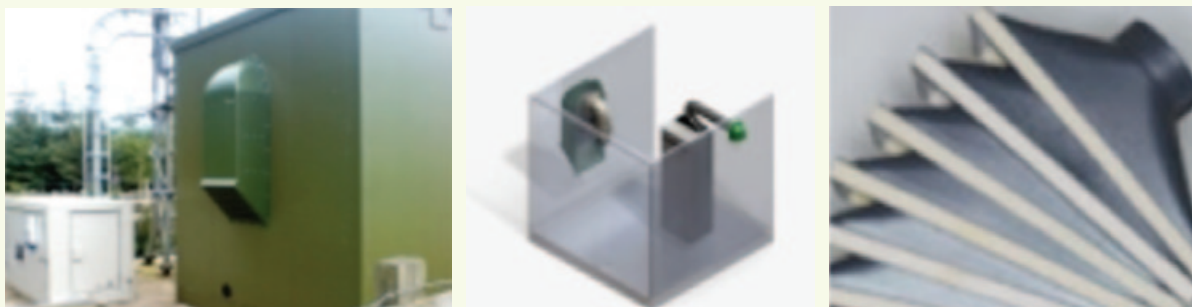
Finding the right local partner that you can work with effectively to break into an overseas market was identified as a key challenge.



CASE STUDY 1



How to achieve export success



4energy Ltd, a Nottingham-headquartered venture, develops low energy cooling hardware and software for building infrastructure in the ICT industry. These systems help protect sensitive electronic equipment from the detrimental effects of temperature whilst reducing the energy and costs used in air-conditioning.

4energy has been in existence for seven years and has successfully worked with corporate clients including Vodafone, Virgin Media, BT, D-Telekom, China Mobile and China Telecom delivering significant energy and cost savings in Data Centres, Telecom Base Stations and other equipment rooms.

In its early years, 4energy developed a solution for Vodafone with grant support from the Carbon Trust to eliminate the need for air-conditioning and filter maintenance in their base stations. The heat generated within a telecommunication base station can seriously affect the reliability and longevity of its equipment which represents a critical problem for the telecom industry. 4energy's CoolFlow system, which is developed around a unique maintenance-free air filter, has addressed Vodafone's base station energy costs with a solution that reduces the base stations' carbon footprint in the UK by over 90%, keeping the equipment temperature within a permitted range and lowering running and maintenance costs.

4energy now employs approximately 80 people, half of which operate from the UK and half from its global subsidiaries. Exporting is an essential part of 4energy's businesses as the majority of its revenues are generated from its presence outside of the UK in Germany, Egypt, and China.

Pat Tindale, CEO at 4Energy, commented that exporting is vital to their success and that the UKTI and UK Foreign and Commonwealth offices have been very helpful with introductions to potential foreign customers. Pat highlighted the importance of establishing relationships with UK clients and demonstrating the performance of new products in the UK to provide credibility for customers in other markets. This approach supported 4energy to establish contacts with the subsidiaries of these UK clients overseas as a route into the local market to deploy their solutions.

4energy is planning to recruit in the next year and to extend its export activities to new regions in India and SE Asia. 4energy has raised significant funding from both venture capital investors – Environmental Technology Fund, East Midlands Capital Venture Fund and CT Investment Partners - and most recently from a strategic partner, British Gas. Patrick noted that this external support has been crucial in the past and will be in the future when coupled with the commercial breakthroughs with customers that have come about from the efforts of individuals and teams from 'within' the business.

3 Ambitious plans for growth

The optimistic findings for exports highlighted above are matched by ambitious plans for business growth. Key findings that emerged from the online survey included:

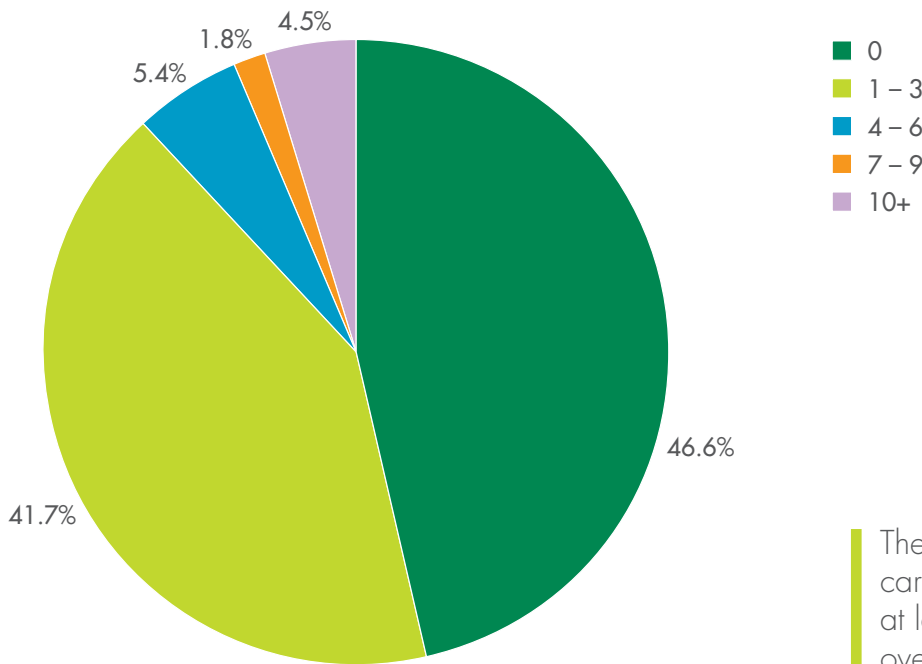
- Three quarters (75%) of low carbon businesses plan to raise funding in the next year (compared to 57% of low carbon businesses in 2011);
- Two thirds (66%) of low carbon SMEs are looking to recruit in the next 12 months (compared to 77% of low carbon businesses in 2011).

Three quarters of low carbon SMEs plan to raise funding in the next year

The majority of low carbon SMEs (53%) have also hired at least one employee over the last year and 12% of low carbon SMEs have hired 4 or more employees over this period which is positive given current economic challenges.

Figure 12: Number of new employees hired in the last 12 months by low carbon SMEs in the UK

Approximately how many new employees have joined your company in the past 12 months?



The majority of low carbon SMEs have hired at least one employee over the last year

Despite these ambitious growth plans, low carbon entrepreneurs are somewhat neutral about the business environment generally with a median score of 5 out of 10 (where 10 is the highest confidence). There has also been a shift in the aspect of business that entrepreneurs are most optimistic about with the company's technology rather than the company's growth the area of most optimism for low carbon entrepreneurs (company growth was the area low carbon entrepreneurs were most optimistic about in a similar 2011 Carbon Trust survey question). This may reflect that low carbon entrepreneurs now feel they have more control over their technology development relative to other aspects of their business including their growth given the tough economic and funding environment. It may also explain why so many low carbon entrepreneurs, confident in the commercial potential of their technologies, are pursuing opportunities in overseas markets.

Figure 13: Confidence of low carbon SMEs in the UK about the business environment generally

How confident are you currently feeling about the business environment generally?
(0=Lowest and 10=Highest)

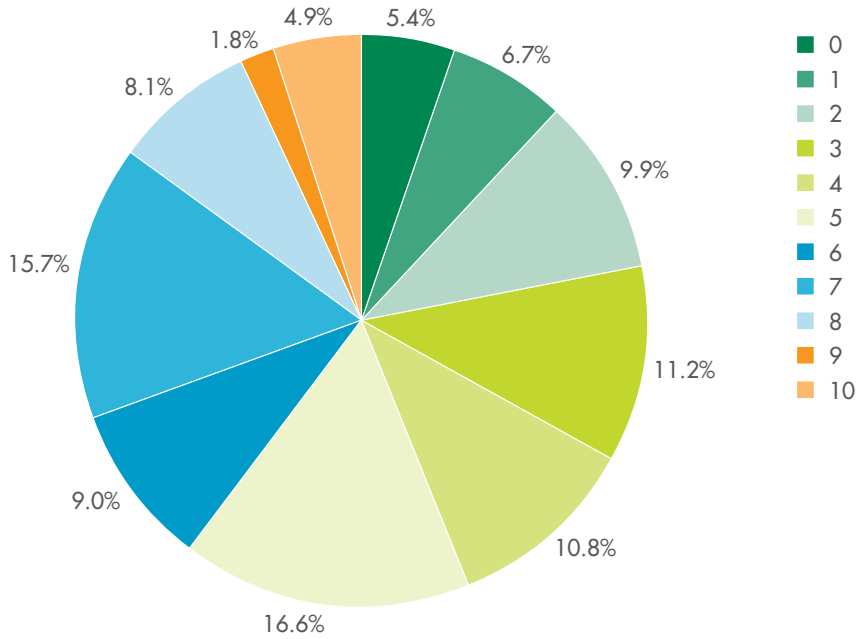
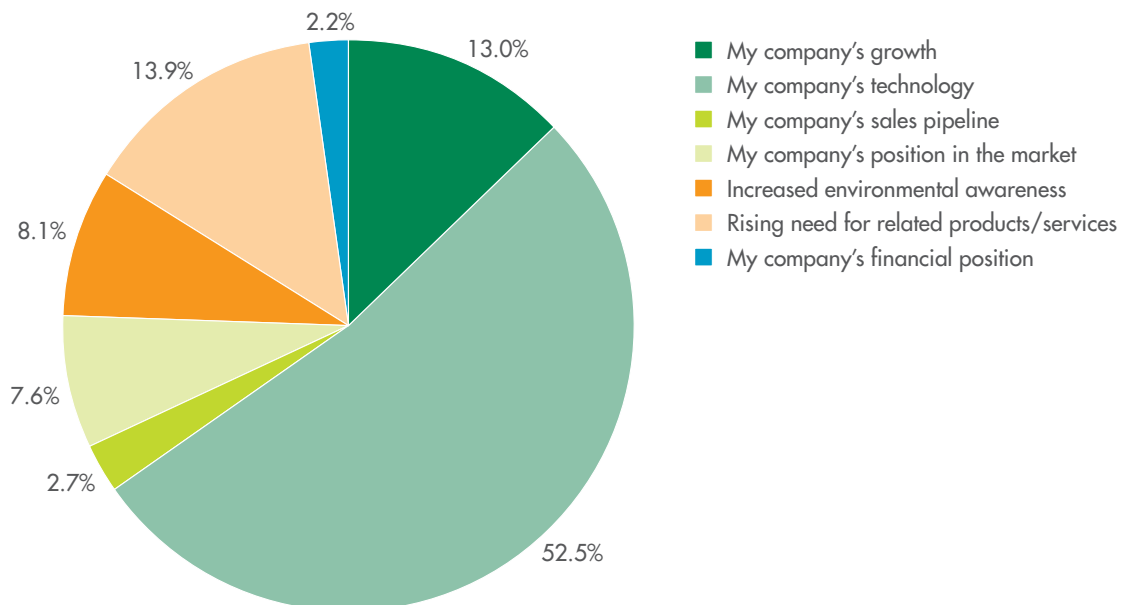


Figure 14: Aspects of business that low carbon SMEs in the UK are most optimistic about

What aspects of business are you most optimistic about?



CASE STUDY 2



The benefits of going global

The Cella Energy story began in earnest when Stephen Bennington and Neal Skipper from University College London were awarded a £300K grant to study the effects of nanostructure on hydrogen storage materials. Initially a pure research project, the venture took on commercial characteristics in 2010 when the pair filed a patent for their nanostructuring technique, electrospinning, which is used to make fine nanowires of polymer to hold hydrogen storage material. The technology's core application is in vehicle power, aiming to allow hydrogen to be safely and quickly deployed as a propellant. At this point, Stephen Bennington began to write business plans with Stephen Voller, an entrepreneur with several years' experience in start up fundraising in the low carbon space.

The company was formally incorporated in January 2011, and won the national Shell Springboard award only a month later. The two Stephens credit this prize with lending the young business credibility and expediting their access to funding – indeed, at this point their pre-existing conversations with Space Florida became concrete fundraising efforts, as Space Florida led their first round. By the end of 2011, Cella Energy were working with NASA on applying their innovation in the field of Space Radiation Shielding and with other partners to apply their technology to the field of battery replacement for Unmanned Aerial Vehicles (UAVs) as intermediate market applications..

In 2012 Cella had moved to improved premises in Oxford, as well as opening a new laboratory at the Kennedy Space Center, and by 2013 the company has swelled its staff numbers to 21. Several new patents have been filed, including one relating to the chemical regeneration of their materials that could potentially reduce their costs to that of gasoline. They are developing the first prototypes of a 1kW hydrogen supply system ready for testing. They have also settled on a specific form of the technology– similar in appearance to small pellets, the plastic-like material stores hydrogen in a stable state, rapidly releasing its latent energy when heated to 100 degrees Celsius. Cella hopes to complete initial testing of this material in an operational environment by the end of 2013, with a view to full scale vehicle fleet trial field testing in 2014.

Prof. Stephen Bennington, Chief Scientific Officer and co-founder at Cella Energy, highlighted that being located in a high technology and academic cluster in Oxford has allowed them to access the best people from the UK and international universities. Half of Cella's current employees came directly from universities, such as University College London and Oxford University, and this has injected fresh ideas, enthusiasm and capability into the company.

Stephen also identified how important it is been for their company to focus on both domestic and international markets in parallel. This has allowed them to develop their technology for intermediate applications like the battery replacement market for UAVs in the USA and emission abatement for diesel vehicles in the UK. The USA is the biggest market for UAVs while the UK has advanced diesel emissions regulations. Both applications represent nearer term market opportunities for Cella and provide a bridge which enables them to develop their technology for longer term zero emission vehicle applications running entirely on hydrogen. Cella has recently embarked on a new fundraising round for \$4m to enable the next stage in their commercialisation journey.

4 Funding, demonstrations and skills are key challenges

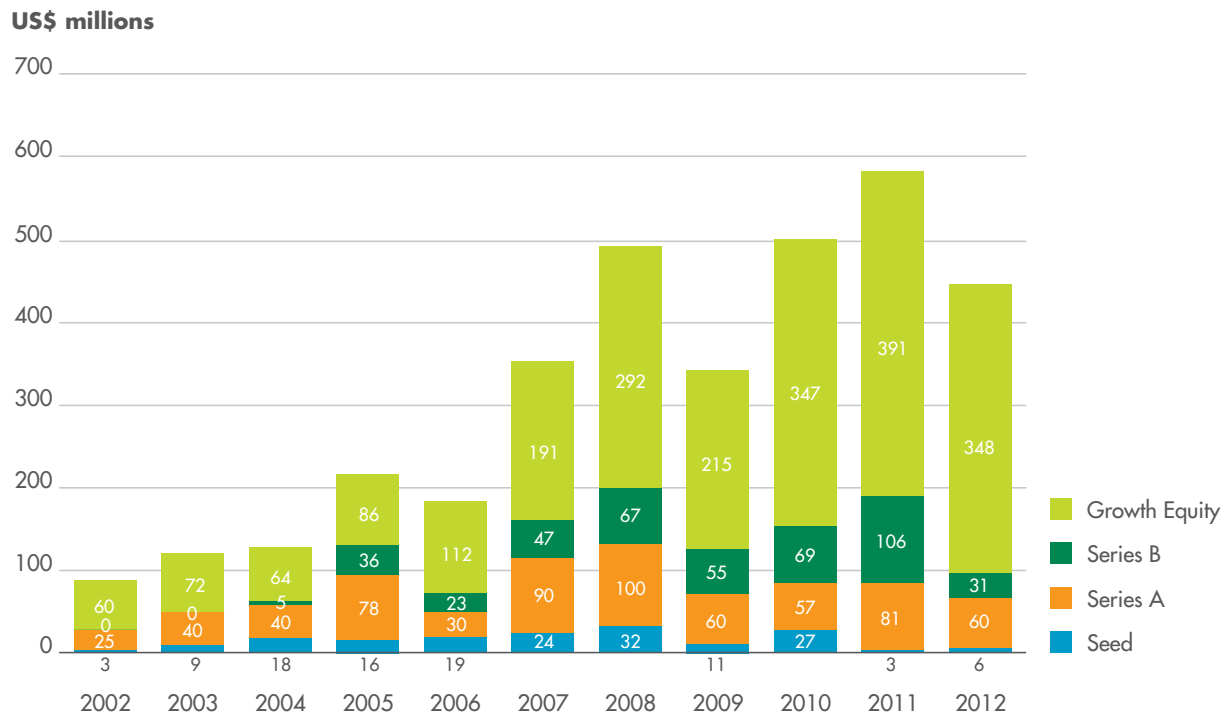
Funding, technology demonstrations and skills emerged as three key challenges for low carbon SMEs in the UK.

The funding challenge

The first challenge is access to funding. Low carbon SMEs see this as the biggest barrier to business growth in the UK by some margin (81% of businesses selected this as one of their three biggest barriers with the next highest score at 36%). Support on how to raise funding is an area that 43% of low carbon SMEs believe would help their business to grow.

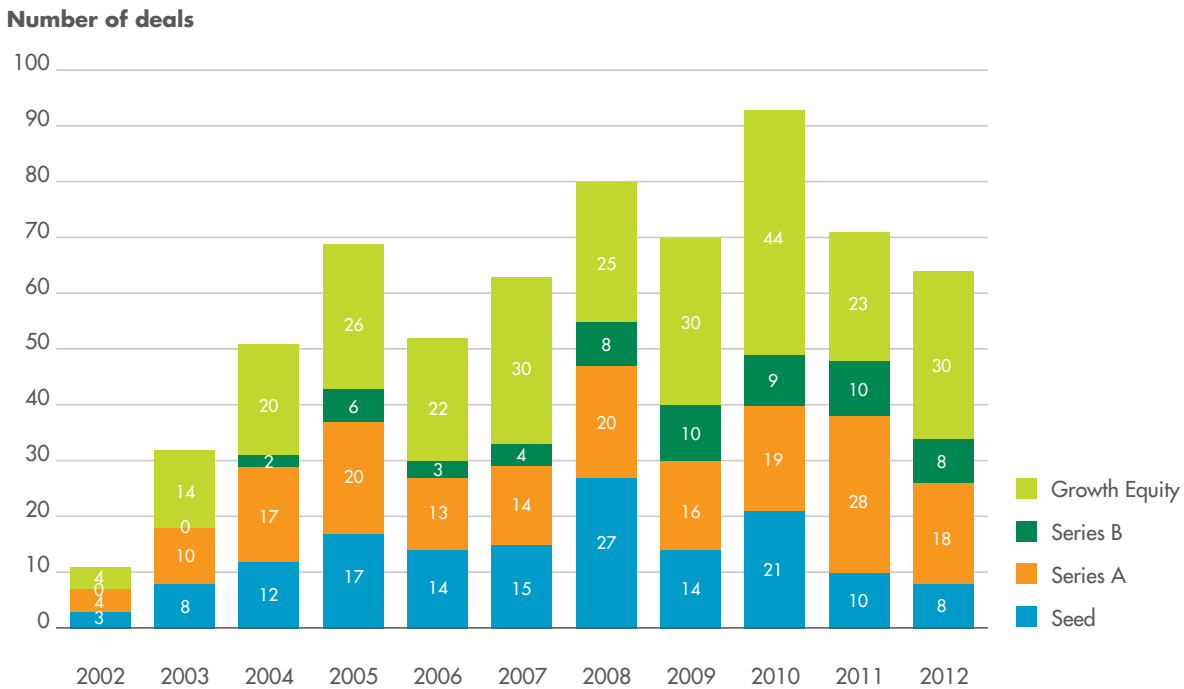
Early-stage (seed and Series A stage) venture capital investment activity has dropped in the UK since a peak in 2008. Both the total amount of funding invested and the number of deals are declining:

Figure 15: Venture Capital Investment, UK, \$ invested, 2002-2012



Source: Cleantech Group, i3 Platform, Carbon Trust analysis

Figure 16: Venture Capital Investment, UK, Number of deals, 2002-2012



Source: Cleantech Group, i3 Platform, Carbon Trust analysis

Carbon Trust’s experience is that early stage venture capital investment activity has been dropping for a number of reasons including:

- A trend towards later stage funding rounds as investors look to consolidate existing portfolios;
- Difficult macro-economic conditions in the UK and Europe that make it challenging to raise new funds;
- Downturn in exit opportunities to demonstrate profitable fund returns.

This puts pressure on low carbon SMEs to identify alternative sources of funding. However, most (79%) low carbon entrepreneurs in the UK are already putting their own money into their venture based on our online survey results and 29% are already raising funding from friends and family. The majority (54%) of low carbon SMEs have received government grants to help fund their business and more than one in five (21.5%) receive financial awards or prizes. Low carbon entrepreneurs value and appreciate these grants and prizes but generally need more funding than current prizes offer or need private funding to match public grants in order to progress to their next commercialisation stage which makes the access to other funding sources important.

Some ventures have also received corporate funding. This could be a significant new area of potential early stage investment for low carbon SMEs given the strength of corporate balance sheets and the potential synergies between SME innovation and corporate expertise, funding and global reach. However, corporate funding does not yet appear to be moving into the low carbon SME sector particularly in the early stages where it can address the lack of funding from other venture capital. Some of the interviewees who had previous contacts or established relationships with corporate partners acknowledged the challenges involved in working with big industrial partners particularly in terms of long timeframes but also praised the opportunities arising from such partnerships in terms of their route to market and access to customers. Feedback from qualitative interviewees also suggested that crowd funding, where the general public steps in to fill the equity or debt gap, and models such as stock finance, where capital is released against inventory that would otherwise be tied up as raw materials, work in progress or finished goods, would be alternative sources of finance that could become more significant for the low carbon sector over time.

The current situation suggests new models are required to unlock the funding challenge for low carbon SMEs to ensure they receive the funding they need to commercialise their technologies and enable other actors who could benefit from collaborative engagements with SMEs (e.g. corporates) to also access low carbon growth opportunities.

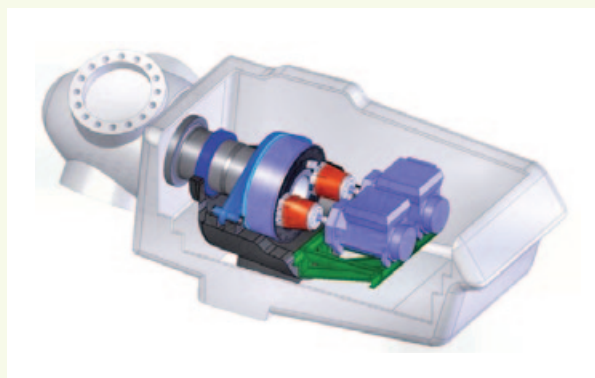
CASE STUDY 3

ARTEMIS

INTELLIGENT POWER LTD

How to succeed with corporates and avoid the need for institutional funding

Artemis Intelligent Power Ltd (Artemis) is a research, development and technology licensing company based at Loanhead (just outside Edinburgh) that is commercialising innovative hydraulic transmission technologies. Artemis was created at the University of Edinburgh in 1994 by Dr. Win Rampen and Professor Stephen Salter in response to a clear industry challenge for high performance multi-megawatt power-take-off systems for renewable energy devices and to bring hydraulics to smaller-scale applications that it had been previously locked out of (such as in transport and industry). It now employs 43 people.



From the outset, Artemis adopted a business model which saw them match public funding from agencies with income from technology licencing rather than raising funds from institutional investors. This model allowed Artemis to work closely with leading global companies, including Sauer-Danfoss, Bosch Rexroth and Mitsubishi, to develop Digital Displacement® systems and power transmissions for a wide range of energy-saving applications.

In 2010 the potential of Artemis's Digital Displacement® technology, particularly for transmissions in large offshore wind turbines, was recognised by Mitsubishi who agreed to acquire the whole of the company as part of a major push into the offshore wind sector. The Artemis technology forms a cornerstone of Mitsubishi's offshore wind strategy and Artemis is now working closely with Mitsubishi in Japan to develop a unique gearless power transmission for very large offshore wind turbines. The first prototype is expected to be shipped to a coastal test site in Hunterston (North Ayrshire, Scotland) in June 2013.

Jamie Taylor, Senior Project Manager at Artemis, stressed the importance of having a great team of international, young, dynamic and passionate engineers and leveraging the expertise and strong engineering ethos that Mitsubishi brings. Jamie also highlighted the importance of being located close to Edinburgh University and other Scottish universities as an excellent and vital source of knowledge and skills and a key element in Artemis's success.

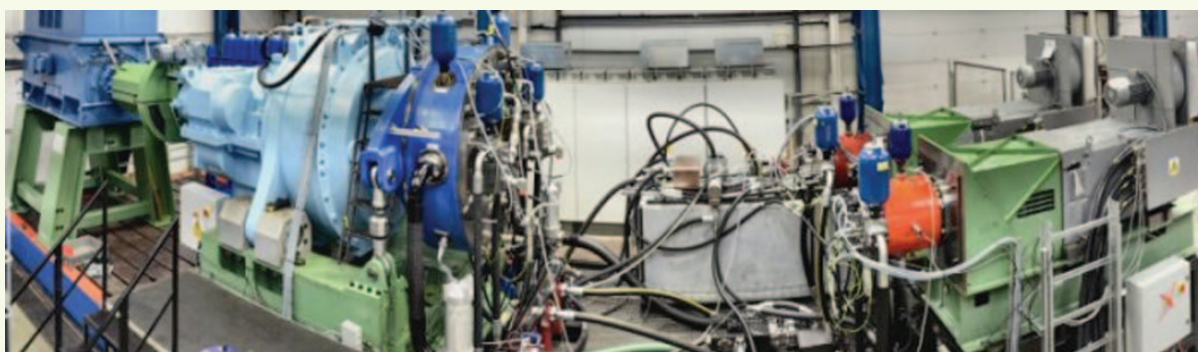
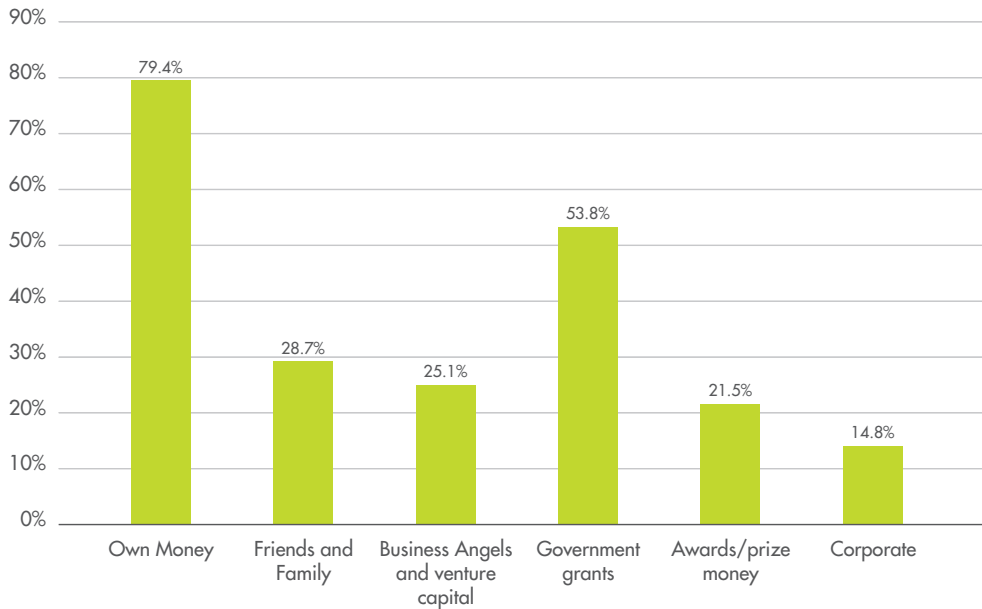


Figure 17: Sources of primary funding received by low carbon SMEs in the UK

What sources of primary funding has your business received?



The technology demonstration challenge

The second barrier that emerged is around technology demonstration opportunities. 40% of low carbon SMEs identified technology demonstrations as one of the three most valuable areas for support (fundraising was the only area that came out higher with 43%).

Figure 18: Barriers to business growth in the UK

In your view what are the biggest barriers to business growth in the UK?

(Select Top 3)

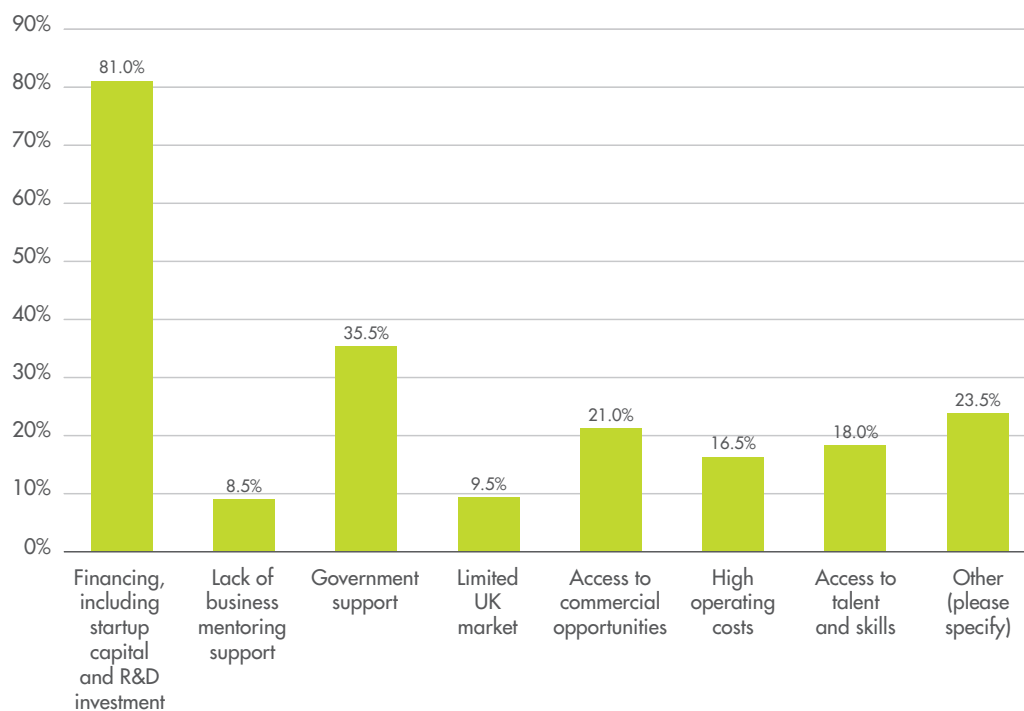
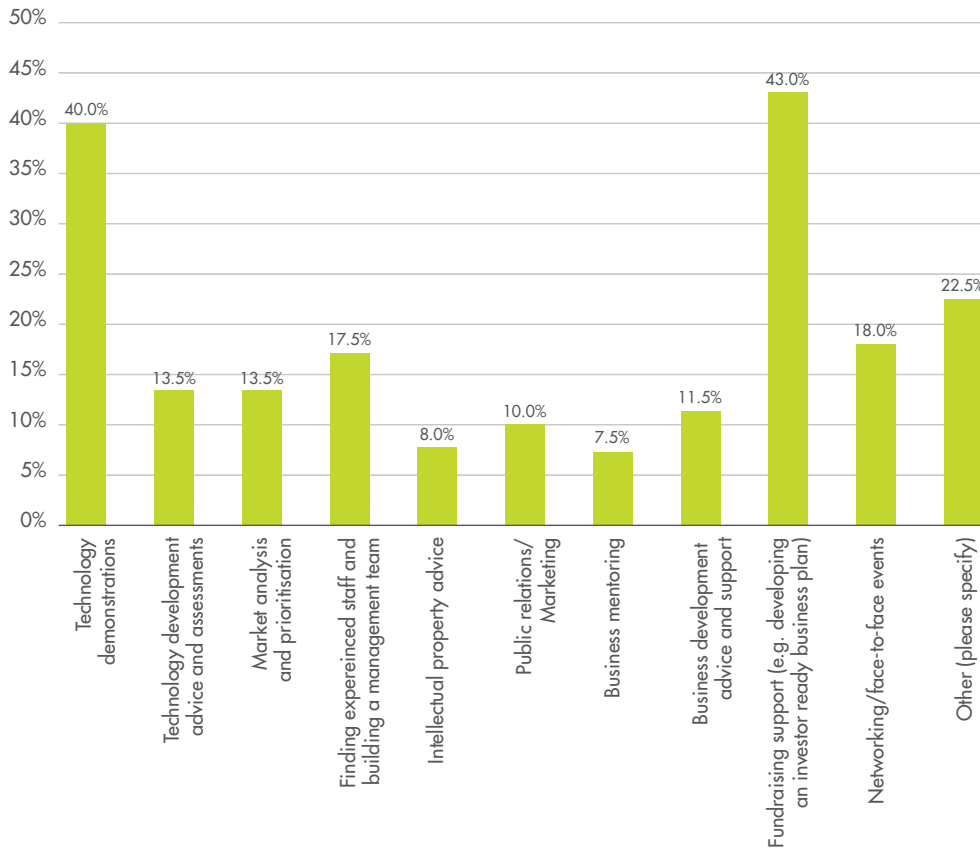


Figure 19: What support would help UK low carbon SMEs to grow

What support would help your business to develop and grow?



Feedback from interviewees was that technology demonstrations are crucial to proving the performance of an innovative low carbon technology. This is particularly the case where the demonstration is in a relevant operating environment that shows how a prototype performs under varying real world conditions. Technology demonstrations can also act as a valuable reference customer to give other potential customers the confidence that the low carbon SME is worth engaging with. Many interviewees reinforced the potential for UK government to play an active role by procuring low carbon products and services from UK SMEs to help demonstrate their technology and product potential.

The skills challenge

A third barrier that emerged from the qualitative interviews related to skills shortages. Finding the right people with the skills and experience a low carbon SME needs was highlighted in the interviews as a constant challenge. Many low carbon SME jobs require specific engineering knowledge for innovative technologies, as well as commercial awareness to be able to work in a start up environment. In addition to challenges finding the right technical candidates, some interviewees also highlighted finding the right candidates for senior commercial posts (e.g. CEO, Commercial Director etc) can be extremely challenging especially for CEOs who often need to be willing to take a significant pay cut in exchange for the opportunity to build their own company.

Other challenges

Many interviewees also highlighted:

- A lack of in depth, longer term, one-to-one mentoring support and commercial advice to help their ventures overcome commercialisation gaps that they do not have the resources or expertise to address on their own. These longer term engagements provide an opportunity to influence the strategic direction of the venture and build a detailed knowledge of the business which provides a platform for valuable support;
- Many ventures do not end up commercialising the product/business model/market segment that they first expected to so flexibility is required along with a recognition from potential supporters of the ventures, as well as those involved in the venture itself, that it takes time to get to market;
- Low carbon entrepreneurship is not for the faint hearted despite the potential emotional and financial rewards – it requires long hours, can be a stressful activity (particularly when funding is tight), has less security than most other jobs and normally requires you to invest your own money, which can make it challenging if you have other commitments (e.g. family commitments) or don't have the money to get started. This may partly help to explain why the typical low carbon entrepreneur is a male over 40.



Technology demonstrations are crucial to proving the performance of an innovative low carbon technology.



CASE STUDY 4



How to overcome the technology demonstration challenge

Lontra Ltd (Lontra) is an East Midlands-based start up developing energy saving compressors and engines. Its products include the Blade Compressor™, Blade Supercharger™, Blade Expander™ and the Lindsey Engine™. Lontra is developing products with world leading partners in major global markets with a focus on waste water aeration compressors, automotive superchargers and oil-free industrial air compressors.

Lontra has been operating for eight years, employs ten people and is looking to recruit in the next year. The company has successfully raised capital from institutional investors and won grants from the Carbon Trust, Technology Strategy Board and Regional Development Agencies since 2005. Lontra recently received the prestigious Water Industry Achievement Award as the most innovative technology of the year (2013). Steve Lindsey, Lontra's CEO, stressed it was important for his venture to be located in the East Midlands to access the local supply chain, good engineering skills, and regional funding opportunities in the area.

Lontra is an example of a company that has recently demonstrated an innovative low carbon technology in an operational environment. Steve stressed the importance of working with industrial partner Severn Trent Water with funding from the Carbon Trust to build and test an industry specific demonstration model of its Blade Compressor™ in the wastewater sector. Lontra prioritised this high energy consuming market segment having first proven its concept in smaller scale compressors. Its demonstration machine is being tested at Severn Trent Water's wastewater treatment site in Worcester and has already shown 20% efficiency gains over competing technologies with more than 5,000 hours of running time without issue. These demonstrated results provide a platform for Lontra to sell into the water sector and it has already received its first orders from water utilities impressed by both its efficiency and reliability. Lontra expects to start manufacturing its Blade Compressor™ at the end of this year and has been receiving worldwide requests about its product. Lontra plans to export in the next two years having established its sales and performance in the UK.



CASE STUDY 5

Ventive Limited

A breath of fresh air for the great indoors

The UK contains some of the poorest quality housing stock in Western Europe, despite numerous measures to enforce safety and improve energy efficiency. And without proper ventilation, efforts to increase energy efficiency through insulation can impact on air quality and lead to damp, structural damage, and a range of knock-on health problems.

Ventive has developed Passive Heat Recovery Ventilation technology to overcome these problems. Rising heat from outgoing stale air exits the home via a flexible duct stack and passes over an innovative, ultra-efficient aluminium heat exchanger as it leaves. Heat is recovered and transferred to incoming, pre-warmed fresh air, and then channelled naturally via an existing chimney into the home.



Active from very low wind speeds, Ventive's complete freedom from electrical connections means it can help home-owners reduce heat loss by up to 97%, save up to 800kg of CO₂/year, and save costs. And to boost its low carbon credentials, 95% of its totally British-made components are recyclable. The simple design means Ventive is scalable and well placed to help meet Government ambitions to revolutionise home energy efficiency.

Ventive is currently focussed on the UK market and has hired four people in the last year. It is planning to add further people to its team over the next 12 months and has already had interest in its technology from overseas. It is currently running a trial in Cyprus to test its system performance in a hotter, more humid climate and expects to start exporting within the next two years.

Rob Morrison, Managing Director of Ventive, highlighted that its London base gives Ventive access to stakeholders, forums and networks and said:

"We know that our technology moves air better, cheaper and for longer than mechanical systems while recovering most of the heat energy. This makes it the most viable, energy efficient and sustainable solution for a problem that affects indoor environments across the UK. Ventive could deliver good, fresh air not just to homes but schools, hospitals, offices and more."

5 Next generation of low carbon entrepreneurs

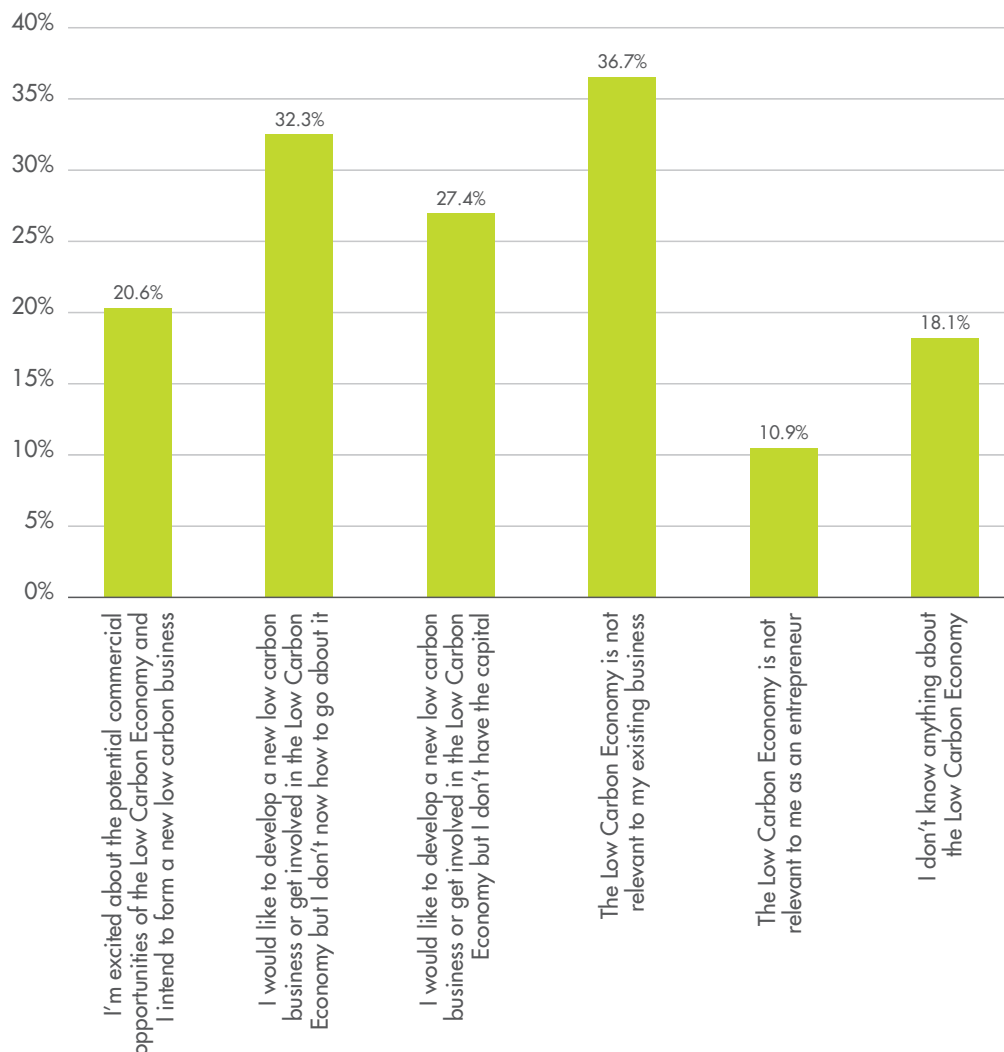
Entrepreneurs in the low carbon sector are almost invariably male (more than 90%) and middle aged (more than 75% are over 40) highlighting the need to harness a broader UK talent base. This research also looked ahead to the next generation of low carbon innovators.

The research explored this issue using an online survey of young entrepreneurs across a wide variety of sectors, who have applied to the Shell LiveWIRE programme. This programme is the UK's biggest online community for young entrepreneurs aged 16 – 30 and builds on a programme which has been running in the UK since 1982, when it was launched in the Strathclyde region of Scotland to combat the high level of youth unemployment.

Encouragingly, almost one third of entrepreneurs from this Shell LiveWIRE community say they would like to start a new low carbon business or get involved in the low carbon economy but don't know how to go about it.

Figure 20: Responses from Shell LiveWIRE survey regarding interest in low carbon economy

Still thinking about the Low Carbon Economy, which of the following statements do you agree with? (Tick all that apply)



Almost one third of young entrepreneurs would like to get involved in the low carbon economy but don't know how to go about it

The respondents to the LiveWIRE survey compared to the low carbon entrepreneurs’ survey were:

- More balanced in terms of gender: 58% male and 42% female;
- Younger by age of entrepreneurs: 88% of respondents under 40 years of age;
- Young by age of company: 87% of the businesses have been operating for 5 years or less;
- Small enterprises: 88% of businesses had no more than 5 employees;
- Early stage: 91.5% had no more than £500,000 of revenue.

The Shell LiveWIRE respondents feel more positive about the business environment generally (median 6 out of 10 score compared to 5 out of 10 for low carbon entrepreneurs) and are more confident about their businesses growth potential (low carbon entrepreneurs are more confident about their technology than their growth potential).

Figure 21: Responses from LiveWIRE survey regarding confidence about business environment generally

How confident are you currently feeling about the business environment generally?
(0=Lowest and 10=Highest)

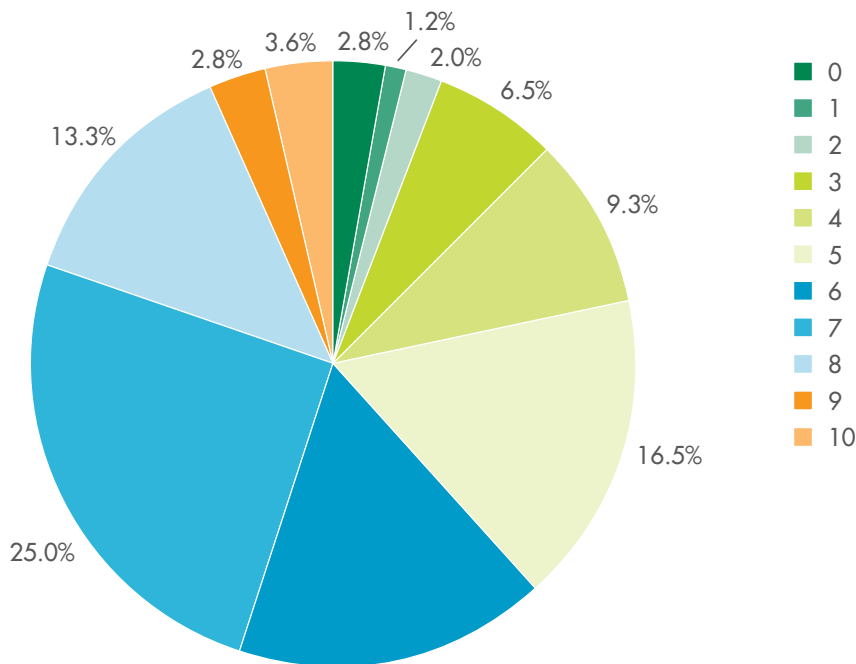
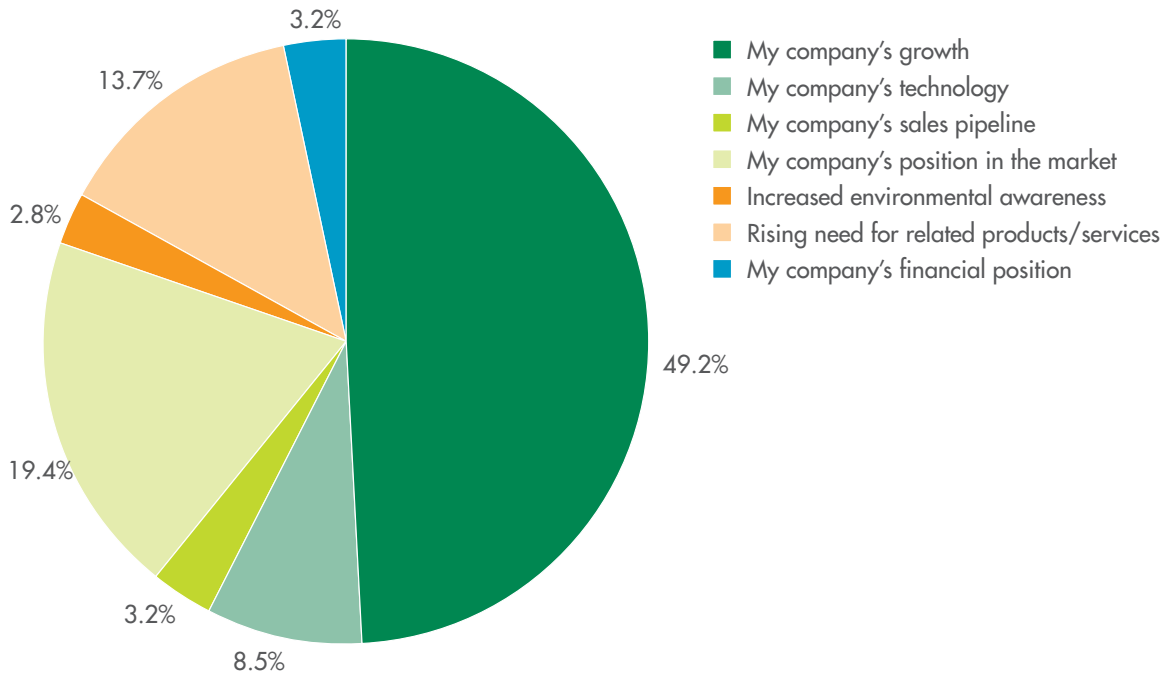


Figure 22: Responses from LiveWIRE survey regarding confidence about business environment generally

What aspects of business are you most optimistic about?



Similar results are observed between the two groups for location choice as proximity to home is the main criteria for LiveWIRE respondents. LiveWIRE respondents also give higher importance to factors such as costs and proximity to clients (that low carbon entrepreneurs seem to value less). When asked about what would incentivise them to move, low carbon entrepreneurs valued regional funding opportunities as a determining factor in their choice, whereas younger entrepreneurs indicated that proximity to their clients would be their key driver. The same key barriers were identified by both entrepreneur groups, with a higher emphasis on mentoring by younger entrepreneurs.



Low carbon entrepreneurs valued regional funding opportunities as a determining factor in their choice, whereas younger entrepreneurs indicated that proximity to their clients would be their key driver.



Figure 23: Responses from LiveWIRE survey regarding why company is located where it currently is

Why is your company located where it currently is?
(Select top 3 reasons)

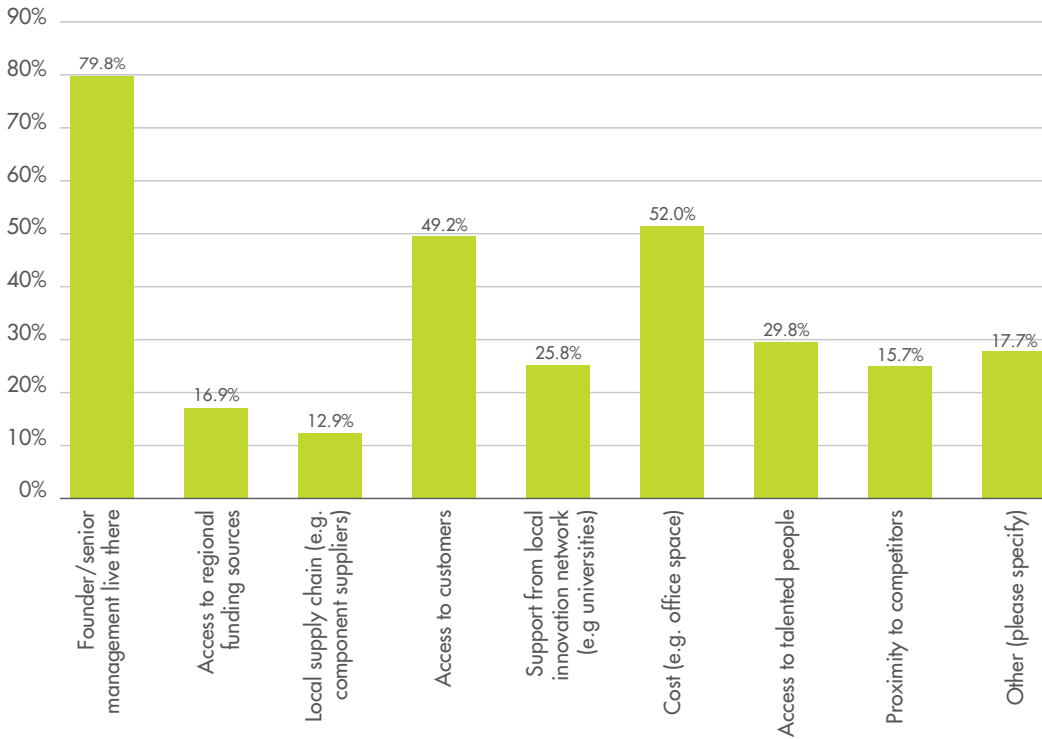
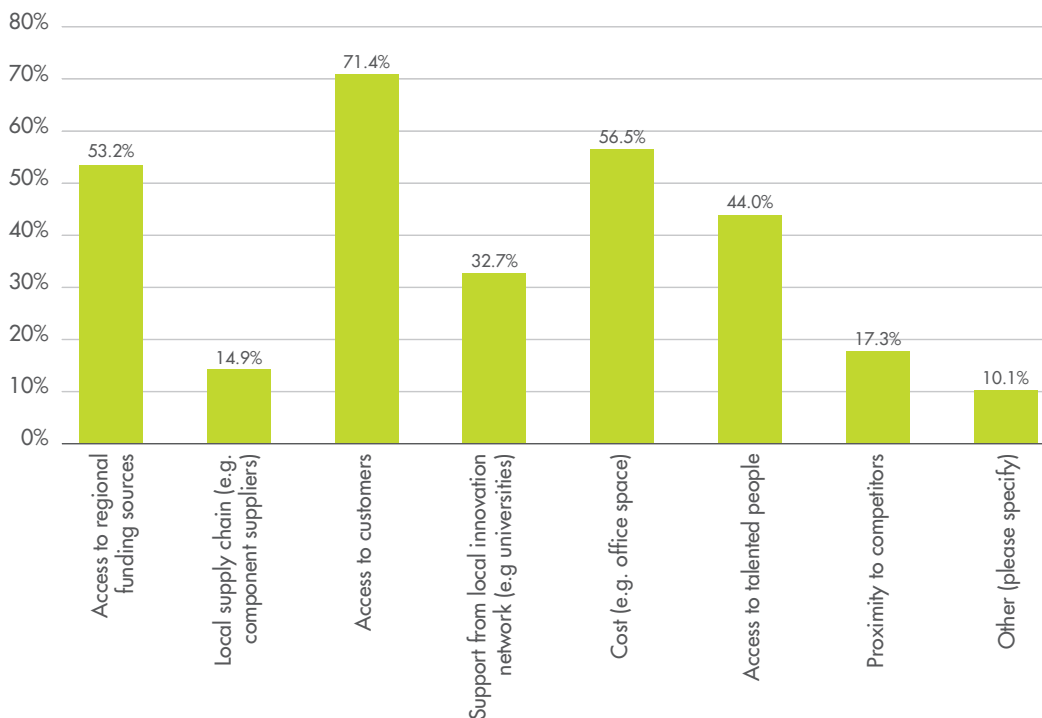


Figure 24: Responses from Livewire survey regarding what would incentivise their company to move

What would incentivise your company to move to another location?
(Select top 3 reasons)



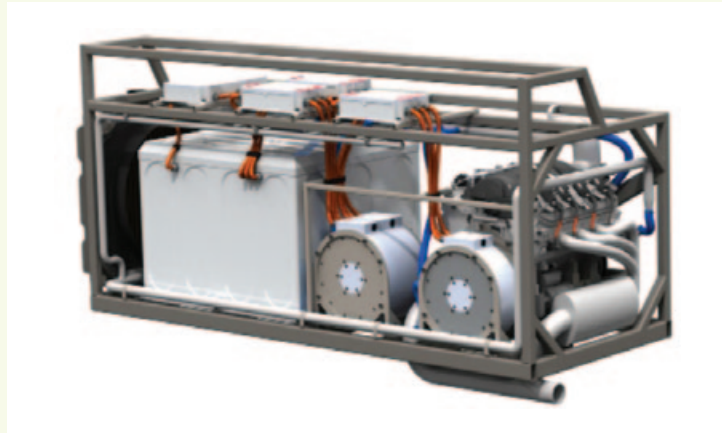
CASE STUDY 6

Vantage Power

Young entrepreneurs breaking into the low carbon economy

Alexander Schey and Toby Schulz like a challenge. After graduating from Imperial College, they set a world record for driving an electric sports car down the longest road in the world – the pan-American Highway. The project received global coverage on BBC World News and shortly after completing this adventure the two founded Vantage Power in January 2011.

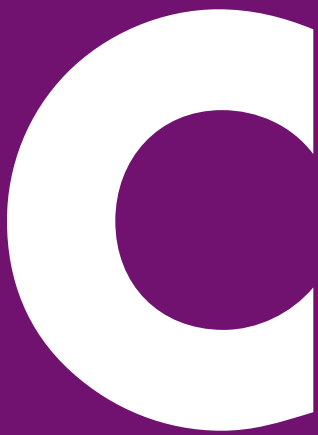
Vantage Power is an award winning company commercialising an innovative, retrofitable, hybrid system to substantially reduce fuel costs and emissions in buses.



Alex and Toby faced a tough start at Vantage Power as initial attempts to build the business floundered and optimism led to frustration. However, by late 2011 they had refocused and identified a clear problem for bus operators. Increasing fuel prices and falling rebates have squeezed bus operators' bottom lines, and are forcing them to seek out more fuel efficient solutions. Buses are also a significant source of carbon emissions which is driving regulatory pressure from governments to move to cleaner bus propulsion sources.

Hybrid buses have the potential to reduce both carbon emissions and fuel consumption by 40% but have not yet penetrated the market in significant number due to high costs and the large existing stock of diesel buses which would need replacing. Vantage Power aims to overcome these two challenges by reducing costs and delivering a system that can be retrofitted into existing diesel buses.

Vantage Power have already secured a strategic partnership with Ensign, the UK's largest used bus dealer and raised have raised over £600,000 of investment to date. They are now in the build phase and expect to begin testing in Q3 2013. They recently won the Oxford regional Shell Springboard event in April 2013 in recognition of the potential their venture has to be the next big idea in low carbon enterprise and innovation.



10 steps for success

1. Maintain clear, long term vision and ambition
2. Ensure funding is available for development and growth
3. Enable technology demonstrations through procurement
4. Provide sustained and tailored commercial advice
5. Help SMEs to access export opportunities
6. Address the skills gap
7. Develop new models to drive collaboration
8. Focus where the UK is well placed to lead
9. Recognise industry specific challenges
10. Celebrate success

We highlight 10 steps for success to help the UK's low carbon SMEs to grow, create jobs and deliver the innovation needed to realise the UK's environmental ambitions.

1 Maintain clear, long term vision and ambition

Clear long term vision and ambition is required to accelerate the move to a low carbon economy. This will provide the framework that enables low carbon SMEs to innovate, grow and create jobs and will enable investors to engage in the sector with confidence that the market will grow. The UK government has led the world in creating a long term legislative vision in the form of the Climate Change Act 2008. It has also signalled its intent to create new structures like the Green Investment Bank and mechanisms like the carbon price floor to help stimulate the low carbon economy. These measures provide a platform to build on to increase the scale of existing initiatives and develop new ways of catalysing the growth and potential of the low carbon economy.

2 Ensure funding is available for development and growth

The market for early stage funding has contracted since 2008 and is now stranding low carbon entrepreneurs with innovative technologies that could help to grow the low carbon economy. It is also challenging for private sector investors to raise new funds and these investors have limited dry powder in existing funds for new early stage investments. This research highlights the urgency of addressing the funding gap for low carbon SMEs and the opportunity for the government to correct a market failure. One suggestion for how to do this was put forward by the Green Alliance¹⁹ who outlined a measure to re-allocate £100 million of R&D tax credit funding that currently goes to large companies to an early stage venture capital fund. Although large companies would lose in the short term from this re-allocation, large companies in general are relatively well capitalised at present and the advantages of this type of approach are that it would require no new government funding. There are also other ways that funding could be made available for development and growth (e.g. loan funding, contributions to crowd sourcing). Consideration of the appropriate funding mechanism may include factors like: how established the routes to channel the money are, how well known the transaction costs are, what flexibility companies may gain compared to R&D tax credits from this funding and how involved the private sector is in helping to allocate this funding.

3 Enable demonstrations through procurement

One of the key areas where low carbon SMEs would benefit from support is in relation to demonstration opportunities to show whether their technology performs as they claim. Demonstration opportunities are pivotal for low carbon SMEs particularly where the demonstration enables them to gather reference data from a relevant operating environment. Reforming procurement rules provides one way to encourage more demonstration opportunities. This could include both government procurement reforms and also initiatives like the 'Access Pledge' which encourages large companies to reform their procurement rules to make it easier for small companies to bid in for opportunities. This model could be useful to a wide range of low carbon SMEs and could help to unblock a key barrier these SMEs face in getting to market.

4 Provide sustained and tailored commercial advice

There is a need for sustained and tailored mentoring and commercial advice to low carbon SMEs. This would complement existing initiatives (e.g. the Growth Accelerator and incubation support from the Energy Entrepreneurs Fund). The focus should be on the leading low carbon SMEs given, for example, job creation research which shows that a small minority of the fastest growing firms are responsible for a disproportionate share of the UK's job creation²⁰. The support should also be tailored to the gaps of each individual venture. This type of sustained, customised support has been demonstrated to deliver results. For example, the Carbon Trust's Entrepreneurs Fast Track catalysed £150 million of private sector investment and joint development agreements for low carbon SMEs in the UK within a year of support to the businesses.

5 Help SMEs access export opportunities

Exports are important to the current and future plans of low carbon SMEs. It is not easy for SMEs to export successfully and accessing the right local partner is particularly challenging. Existing initiatives run by the UKTI and the Foreign and Commonwealth Office were praised by many of the low carbon SMEs interviewed as part of this research. Given the scale and importance of exports to low carbon SMEs, there seems to be an opportunity to build on existing activities to help SMEs realise the export plans. This could involve further specific low carbon technology missions for SMEs (e.g. to build on the Clean and Cool Mission) or the inclusion of more low carbon technology SMEs as part of overseas trade missions.

6 Address the skills gap

Access to talented people is one of the top three reasons for the location of low carbon SMEs. The profile of current low carbon entrepreneurs is predominantly male and over 40 and that a new generation of entrepreneurs is keen to enter the sector. Other reports²¹ have highlighted the potential low carbon skills gap and various government responses have been written to highlight steps being taken to address this skills gap. These measures are a good start. More is likely to be needed right from early encouragement in secondary schools of science, technology, engineering and mathematics (STEM) subjects through to later qualifications to provide the engineering and technical skills needed to transition to a low carbon economy. In addition to the technical skills that are important, there may also be a skills gap at senior commercial levels (e.g. CEOs, Commercial Directors) for low carbon SMEs particularly at an early stage when salaries are either low or not paid and it can take time to generate the revenues that put the venture on a stronger footing. New ways need to be found to encourage senior commercial people into the sector to ensure technical developments are not held back by a lack of commercial expertise in low carbon SMEs. It would be useful to encourage more engagement with both young people and those who are considering becoming low carbon entrepreneurs to help them understand in a reasonably approachable, time efficient way what entrepreneurship involves, to help building entrepreneurial skills earlier and highlight some of the challenges that entrepreneurs face.

7 Develop new models to drive collaboration

New collaborative models that engage a wider range of actors in the low carbon economy are needed to drive collaboration. In particular, corporates have a key role to play given their financial resources, technical expertise and global reach. New collaborative models that deliver benefits to corporates and SMEs are needed to accelerate low carbon innovation and overcome the barriers that have made it challenging for these two groups to engage effectively. SMEs often do not find it easy to engage with corporates and vice versa but examples like Artemis demonstrate that it can be done successfully. New models are emerging for how to enable this type of collaboration to take place. For example, the Carbon Trust has a \$5 million incubation partnership with GE to find, assess and incubate start ups across Europe with the aim of driving the growth both of GE and start up partners that we engage with. The Offshore Wind Accelerator is another example of a collaborative model and convenes nine of Europe's leading energy companies with 77% of the UK's licenced offshore wind capacity to drive down the cost of offshore wind by 10% by 2015. The H2 mobility partnership is another example of collaborative partnerships involving corporates and SMEs to create a market and unlock innovation opportunities. More of these models are needed and at larger scale to accelerate the move to a low carbon economy.

8 Focus where the UK is well placed to lead

Innovation support requires significant commitments of capital and resources. There is not enough of either to fund all the projects or ventures that apply. In order to deliver jobs, growth and environmental outcomes, the UK should consider focusing most of its innovation support on areas where the UK has a material advantage or a particular need to develop a technology option to make sure it gets the most benefit from the scarce resources available. The Carbon Trust has previously highlighted the need for this focus. The Technology Innovation Needs Assessments that have now mostly been completed provide an evidence base to enable prioritisation to happen and this is something the Low Carbon Innovation Coordination Group is taking forward.

9 Recognise industry specific challenges

The low carbon economy is a UK success story. It is also an industry that faces a variety of difficult challenges compared to many other sectors. Low carbon technologies often require high amounts of capital and long timeframes to get to market at scale. It can be difficult to differentiate the outputs of low carbon technology product from the solutions they are trying to replace (e.g. electricity from low carbon versus high carbon generation). The sector is also particularly reliant on government regulation which creates uncertainty and risk for investors. Given these features of the low carbon economy, it seems important to recognise that targeted industrial policy for the sector can be justified to correct market failures that would otherwise limit its growth.

10 Celebrate success

The UK economy is a low carbon success story. There are a range of entrepreneurs who have achieved great success. This success needs to be celebrated both as a reward to those who have prevailed against the odds (most new businesses fail within 10 years) and to provide reference cases for aspiring entrepreneurs who are considering entering the sector to show them that it is possible to both succeed commercially and achieve environmentally. A core objective of Shell Springboard is to find the UK's next big idea in low carbon enterprise and innovation and celebrate the success of leading low carbon entrepreneurs in the UK. More programmes or initiatives like this could help to both reward those entrepreneurs who have worked so hard for their success and inspire the next generation of entrepreneurs to engage in the sector.

Appendix 1 – Methodology

This research uncovers new insights into the activities, outlook and challenges of low carbon SMEs in the UK. SMEs play an important role in driving low carbon innovation and growing the low carbon economy. By improving our understanding of these businesses, this research aims to contribute to discussions about how to ensure that the potential of these businesses and the wider low carbon economy can be realised.

This research analysed data from three main sources during April and early May 2013:

- (i) Applications to Shell Springboard and the Carbon Trust from low carbon SMEs
 - The location and technology focus of 1,855 low carbon SMEs was analysed;
 - The aims were to highlight for the first time in detail at a national level the distribution of low carbon businesses in the UK and analyse whether there were any trends in these locations across the dataset or in specific technology areas.
- (ii) Online surveys
 - This part of the research included two surveys:
 - (i) The first survey was of more than 200 low carbon SMEs who had applied to Shell Springboard or the Carbon Trust. The aim of this survey was to uncover the activities, outlook and challenges of low carbon SMEs in the UK;
 - (ii) The second survey was of more than 200 young entrepreneurs more than 88% of whom were aged below 40 who had applied to Shell's LiveWIRE programme to support entrepreneurs between 16-30 years of age. The aim of this survey was to identify how these young entrepreneurs thought about the low carbon economy and whether it was a sector they had an interest in participating in.
- (iii) Qualitative interviews
 - This involved in depth phone interviews (ranging from 20-90 minutes with typical interviews lasting around 60 minutes) with 22 low carbon entrepreneurs or technology commercialisation experts who have advised multiple low carbon SMEs on their businesses;
 - The aims of these interviews were to provide colour, depth and new insights that would not be uncovered from the first two data sources on entrepreneurs, their businesses and their challenges.

Appendix – 2 and 3

Full survey results for both the low carbon entrepreneurs survey (Appendix 2) and the Shell LiveWIRE survey (Appendix 3) are available from the Shell Springboard website: www.shellspringboard.org

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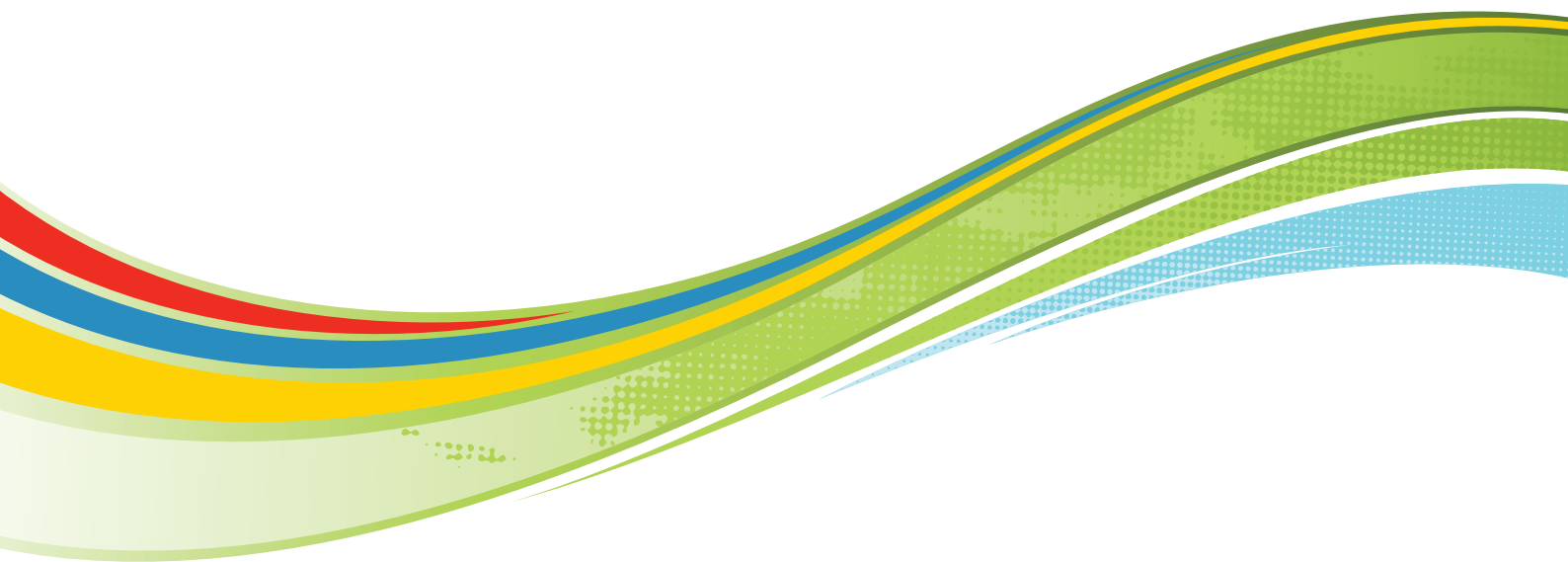
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