Towards a Low Carbon Manufacturing Region

A report prepared for *emda*

TWI

December 2010

This document forms part of the *emda* Knowledge Bank

east midlands development agency

Project 19636

December 2010

Towards a Low Carbon Manufacturing Region

for

east midlands development agency

Towards a Low Carbon Manufacturing Region

TWI Project 19636

December 2010

Prepared for:	East Midlands Development Agency (***emda***) Apex Court, City Link Nottingham, NG2 4LA
Contact:	Catherine Jew Principal Low Carbon Policy Advisor
Authors:	Nee Joo Teh, Gilles Bortuzzo, Guillaume Goujon, Paul Jones

TWI Endorsement

This report has been reviewed in accordance with TWI policy.

Lead Author .... Dr Nee Joo Teh Manager Business Process Service	Approved by .... Sayee Raghunathan Technology Group Manager Manufacturing Support Group
Approved by .... Peter Oakley Associate Director	Secretary .... Jackie Brand

About this study

This study was conducted independently by TWI Ltd on behalf of the East Midlands Development Agency (*emda*).

The report is based on extensive analyses of more than 95,000 registered businesses in East Midlands and complemented with independent technical and market knowledge.

The content of this report does not constitute a solicitation, advice or recommendation by *emda* or TWI Ltd to purchase or sell any products, services or any interests described herein.

The report is for guidance only. Readers must make their own independent assessment of the analysis and recommendations.

None of the directors, employees, affiliates or advisers of *emda* or TWI Ltd shall be liable for any direct, indirect or consequential loss or damage suffered by any parties as a result of relying on any statement in, or alleged omission from, this document.

Table of Contents

Executive Summary

Background

The global drive towards a low-carbon economy is a major challenge for world leaders striving to deliver economic growth while reducing the climate impact. This transition can only be achieved through radical changes in government policies, population lifestyles, industrial practices, as well as the implementation of new financial mechanisms and novel technologies.

Implicit in these challenges are major opportunities for businesses willing to make the transition to emerging low carbon manufacturing markets, such as wind power and carbon capture and storage. The East Midlands region is home to many manufacturing companies with the capabilities to be successful in these markets. Consequently the East Midlands Development Agency (*emda*) commissioned this **Towards a Low Carbon Manufacturing Region** programme to orientate the region's companies and economic growth towards low carbon markets, building upon its strong manufacturing base, world class R&D capabilities and position in global supply chains.

Objectives

The objectives of the study were consistent with the *emda* business support objective and were:

- To map regional manufacturing companies in a Relational Database and, through supply chain and value chain analyses, to identify low carbon opportunities and associated risks for companies in making the transition to new markets.
- To review low carbon manufacturing market trends for the period 2010-2020 and map these against regional capabilities in order to quantify growth and innovation potential.
- To develop intervention mechanisms and undertake a pilot programme with a selection of companies capable of exploiting low carbon manufacturing opportunities.

Approach

The programme comprised six phases:

1. Through an analytical mapping process based on two commercial databases comprising 95,000 businesses in East Midlands, a Manufacturing Companies Database of 7,008 relevant businesses was constructed. This formed the basis of the regional manufacturing competencies analysis.
2. The anticipated trends and structures of ten low carbon sector supply chains were investigated. Each sector's value chains were investigated to identify future value propositions for UK businesses within each supply chain.

3. The above analysis was evaluated by industry experts in order to validate the results and to identify the anticipated market opportunities for the 2010-2020 periods.

4. Manufacturing processes associated with market opportunities were mapped to current regional business products and services in the Manufacturing Companies Database. The relevance of the opportunities for each business was assessed and all data was compiled in a Low Carbon Relational Database, which correlated industry knowledge and business capabilities.

5. A further analysis was made of the transition and non-transition risks for businesses considering the emerging low carbon sectors. The identified risks were captured in a Low Carbon Transition Risk Radar™. The companies in the database were surveyed to establish their stance on the opportunities offered in manufacturing for the low carbon sectors. The survey also validated the results of the analysis performed in earlier phases.

6. A Low Carbon Transition Intervention scheme was developed to support businesses in making the transition to the new markets. The intervention support was piloted with a diverse group of companies to facilitate their transition.

Key Findings

The following key findings were highlighted in this study:

- The supply chain and value chain analyses identified 3,142 regional manufacturing and related businesses from the Low Carbon Relational Database as having high potential to exploit opportunities in emerging low carbon industries, with over 80% of these being SMEs. A further 4,413 companies were found to have competencies for the medium potential categories.
- The East Midlands has strong manufacturing competencies for sectors such as low carbon transport, fuel cells and carbon capture and storage (CCS). This is partly because the supply chains in these sectors are relatively new, and technology and components are still being developed, hence more opportunities exist. Wave and tidal was found to offer the lowest potential for the region's businesses, and this could be attributed to the relatively limited inherent offshore competencies in the region.
- The distribution of 'high potential' and 'medium potential' companies for each low carbon sector is as follows:

Sector	No. of 'High Potential' Companies	No. of 'Medium Potential' Companies
Low carbon transport	1,248	246
Fuel cells	1,168	221
CCS	1,060	465
PV solar	918	162
Nuclear	747	603
Geothermal	688	599
Wind	573	511
Biomass	400	144
Low carbon construction	305	147
Wave and tidal	199	242

The detailed manufacturing opportunities in individual supply chain and breakdown of potential companies are discussed in Chapter 4.

- The industry survey with companies from the Low Carbon Relational Database found that the primary manufacturing capabilities are in the following descending order:
    1. Materials Supply
    2. Component Manufacture
    3. Engineering Services
    4. Mechanical Systems Development
    5. Electrical Systems Development
    6. Manufacturing of Large Structures
- With respect to the significance of perceived business opportunities within the next five years, surveyed businesses indicated wind, nuclear and low carbon transport as the primary sectors, followed by wave and tidal, biomass and low carbon construction. Geothermal was deemed to offer the least significant opportunity by the businesses. However, the survey also found that the majority of respondents currently have limited experience in supplying low carbon markets.
- The pilot companies found that the intervention pilot scheme informed them of the structure and operation of new target market(s), helped to gain a clear and independent overview of their competencies against associated transition risks and provided advice and increased confidence on supply chain development strategies. All companies recognised that the work undertaken in the pilot scheme was a starting point, in as much as it was intended to initiate access to new markets.

Recommendations

This study has set the benchmark for the availability of opportunities for the East Midland's manufacturing businesses in the emerging low carbon industry, and should be viewed as a springboard to a more proactive initiative to support the businesses in fulfilling the potential opportunities. The report offers the following recommendations by addressing the key challenges in enabling businesses to make a risk-mitigated transition to a low carbon industry:

1. The level of manufacturing opportunities identified in the low carbon industry represents a significant prospect for a considerable number of companies in the region. However, the majority of these companies have limited experience in supplying to low carbon sectors, and therefore a business support programme would increase the visibility of potential opportunities for the companies as well as providing guidance in managing any arising transition risks.
2. The Low Carbon Transition Intervention pilot scheme achieved its objective and received positive feedback from pilot companies. However with businesses strongly focused on tangible opportunities adjacent to their existing competencies, significant technical and industry knowledge were sought by the businesses. Therefore, the future implementation of transition support would need to be delivered by a team of market/technology experts with extensive breadth and depth of knowledge (i.e. multi sector) in order to add value to businesses.
3. The Low Carbon Relational Database developed in this programme provides *emda* with a dynamic tool to map existing supply chain needs for ten low carbon sectors to the competencies of its regional businesses. It can be updated on a regular basis where new industry opportunities and companies can be added over time. It would enable companies matching specific market needs to be identified for a more customised business support to be provided.

The recommendations outlined above were developed based on the assumption of a regional landscape with potential for continued investment by *emda*. Whilst the Coalition Government remains committed to the low carbon agenda, they are also committed to localism, and as such will replace the Regional Development Agencies with Local Enterprise Partnerships. The report and recommendations remain applicable and relevant and can be adapted to suit the new delivery landscape.

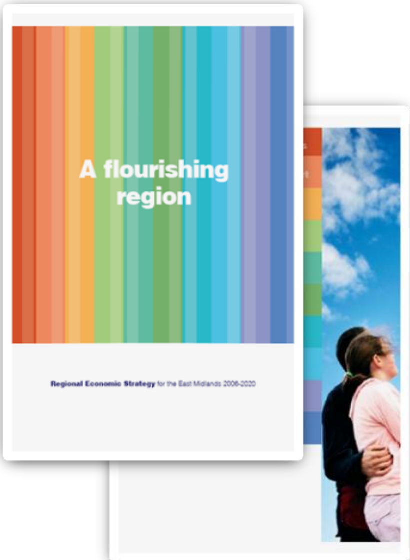
1 Introduction

The vision of a low-carbon economy in the UK is an economy where the standard of living keeps on improving while green-house gases (GHG) emissions are drastically cut in order to reach an acceptable level of sustainability. This global drive toward future sustainability is a major challenge for world leaders striving to meet economic growth while reducing the climatic impacts. This shift in international paradigm to a low carbon economy can only be achieved through changes in governmental policies, population lifestyle, industrial practices, new technological transformations and strategic financial mechanisms.

In July 2009 the Government set out its low carbon strategies through **the UK Low Carbon Transition Plan (LCTP) White Paper**[1] to deliver a 34% reduction in carbon emissions by 2020 and 80% by 2050, as embodied in the Climate Change Act (2008). Three additional strategies supported the LCTP:

- *Low Carbon Industrial Strategy (LCIS)* on the transition to a low carbon economy whilst maximising the UK's share of the global low carbon marketplace expected to be worth £4.3 trillion by 2015.
- *UK Renewable Energy Strategy*: setting out how the Government will achieve 15% of energy production from renewables by 2020.
- *Low Carbon Transport – A Greener Future*: a national carbon reduction strategy on reducing the 21% of national carbon emissions from transport.

At the regional development level, *emda*'s third Regional Economic Strategy for East Midlands 2006-2020 **(RES 2006-2020)**, published in July 2006[2], – **"A Flourishing Region"**- provides a shared vision and the route map for the region's sustainable economic success up to 2020. The vision of a flourishing region is underpinned by three themes of:



- Raising productivity
- Ensuring sustainability
- Achieving equality

Aligning with the UK LCIS, *emda*'s **Economic Exploitation of Low Carbon Markets** framework aimed at exploiting the economic opportunities from new and emerging low carbon/energy

[1] http://berr.gov.uk/files/file52002.pdf
[2] http://www.emda.org.uk/res/

technologies, processes and services. With significant manufacturing capacity cutting across most of the markets/sectors, East Midlands businesses are well placed to benefit from new low carbon supply chain opportunities.

Accordingly, this **Towards a Low Carbon Manufacturing Region** programme was commissioned to create a springboard for *emda* to energise the East Midlands economic growth towards a sustainable transition to a low carbon economy that is built on its strong and diverse manufacturing base and underpinned by world class R&D capabilities and global supply chains.

This study, as illustrated in Figure 1, mapped the producer (manufacturing) companies in the region to identify relevant opportunities in emerging low carbon industry, outlined the associated manufacturing value chain and potential risks for businesses making transition into the new high growth market. A pilot intervention programme was also undertaken with a selection of companies to trial a support mechanism while managing their transition risks.

Figure 1 Overall study vision and key activities in Towards a Low Carbon Manufacturing Region programme

2 Study Approach

Working in consultation with the Low Carbon Advisory team at *emda*, a six-stage model was developed to ensure a comprehensive approach was undertaken for both the perspectives of East Midlands manufacturing competencies and low carbon supply chain opportunities. An overview of this model is shown in Figure 2 with the individual processes briefly described below.

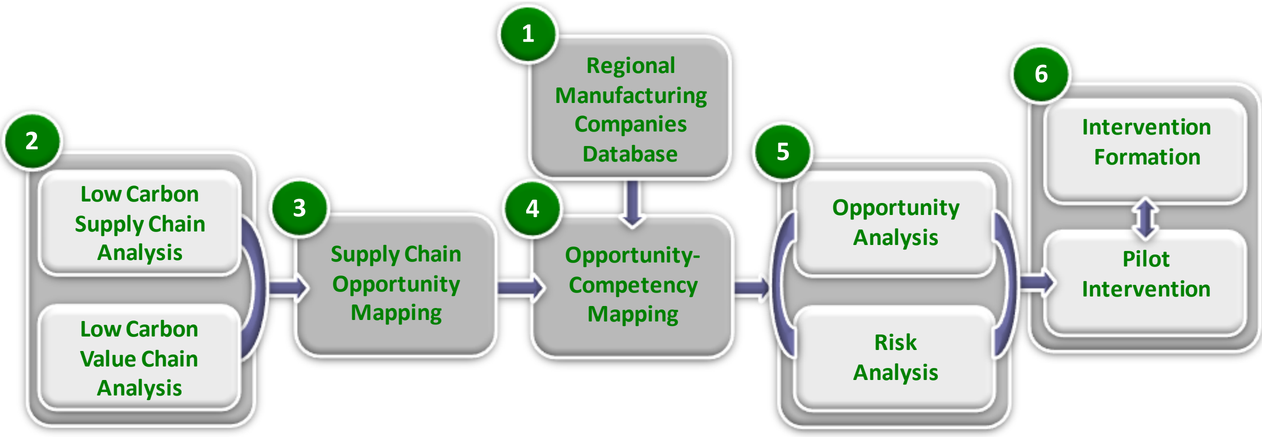


Figure 2 Overall model for the Towards a Low Carbon Manufacturing Region study

Phase 1 Development of East Midlands Manufacturing Companies Database

The study combined two commercial databases that consisted of more than 95,000 registered businesses in the East Midlands region. Following an iterative analytical mapping process, a Manufacturing Companies Database of 7,008 businesses was constructed and formed the basis of the regional manufacturing competencies base.

Phase 2 Low Carbon Supply and Value Chain Analyses

An analysis of the manufacturing supply chains for a total of ten low carbon sectors was carried out, with a particular emphasis on the UK's potential market trends and structures for the 2010-2020 period. A further analysis of the respective value chains was performed to identify potential value propositions for UK businesses within each supply chain. The overall scope of this study is shown in Figure 3 below, noting that the supply and value chains focused primarily on manufacturing activities (i.e. goods producing) whilst taking into account the R&D and services activities in sectors with a very early-stage supply chain (e.g. wave & tidal and Carbon Capture & Storage (CCS)).

Phase 3 Low Carbon Supply Chain Opportunity Mapping

The supply chain and value chain analytical results were evaluated by industry experts for each of the low carbon sectors, in order to validate them as well as to identify the perceived market opportunities for the 2010-2020 periods.

Phase 4 Opportunity-Competency Mapping

Firstly, the various manufacturing processes in each of the low carbon supply chains were analysed in order to map them to the related business activities in the Manufacturing Companies Database. Therefore, manufacturing business activities in the database were mapped to the identified business opportunities, and the degree of relevance was assessed.

One of the main outcomes from Phases 1-4 was the development of a **Low Carbon Relational Database**, which links each of the manufacturing business in the database to manufacturing supply chain opportunities in ten low carbon sectors.

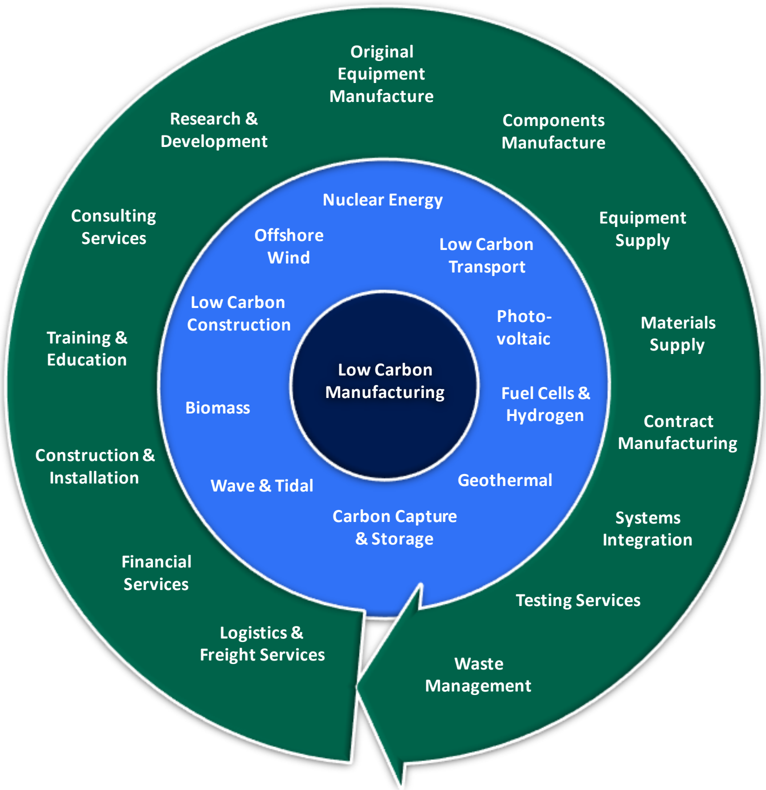


Figure 3 The scope of low carbon sectors and supply chains covered in this study

Phase 5 Risk and Opportunity Analyses

This was the second step in the creation of the relational database. Combining industry knowledge and business competencies, each company in the database was assessed to determine their potential to supply one or more of the low carbon industries. A further analysis on the risks for businesses in both scenarios of making transition and non-transition (i.e. business as usual) to the emerging low carbon sectors was carried out. The identified risks were captured in a Low Carbon Transition Risk Radar™, as illustrated in Figure 4 below, to enable a level of quantification during the pilot interventions.

An industry survey was conducted amongst the manufacturing companies in the database to establish the opportunities offered by in manufacturing for the low carbon sectors. The survey also enabled the analytical results from the risk analysis and opportunity mapping work to be tested and validated by the businesses. The potential opportunities and associated risks for the businesses were captured in a Potential/Risk Matrix illustrated in Figure 5.

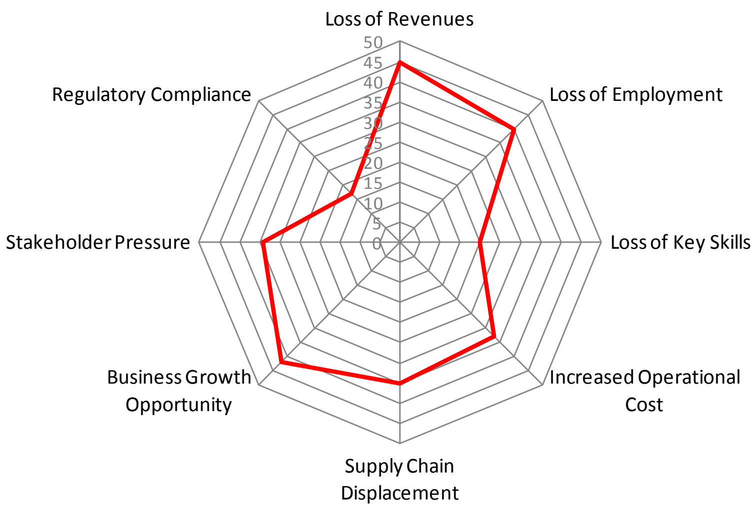


Figure 4 Low Carbon Transition Risk Radar™

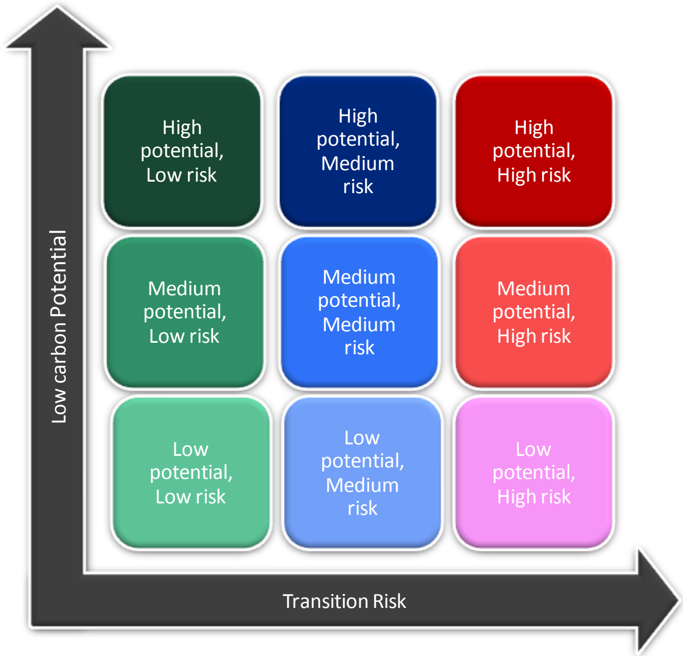


Figure 5 Potential/Risk Matrix

Phase 6 Low Carbon Transition Pilot Intervention

The outputs from the supply and value chain analyses and industry survey culminated in the development of a Low Carbon Transition intervention support framework for the manufacturing businesses in the region. A selection of companies was shortlisted based on their opportunity-risk profiles and consulted. The intervention support was piloted to facilitate the transition to low carbon market(s) targeted by the individual businesses.

3 Regional Opportunities in Low Carbon Manufacturing

3.1 Supply Chain and Value Chain Analysis Model

In accordance with *emda*'s policy and the strength of the region, the following ten emerging low-carbon sectors were selected for this study:

- Off-shore wind power generation
- Low carbon transportation
- Low carbon construction
- Biomass
- Carbon capture and storage (CCS)
- Nuclear power generation
- Fuel cells
- Solar photovoltaic
- Wave and tidal
- Geothermal

It must be noted that, whilst sectors such as low carbon construction, offshore wind and nuclear have a relatively mature supply chain structure globally, most of the sectors are in their infancy in the UK, but with emerging worldwide interest that requires the UK to be ready when the supply chains are being established. For example, CCS and wave & tidal attract worldwide interest, but are not economically viable and are limited to large scale pilot projects. In geothermal, some major projects are planned in the UK which, if successful, could lead to a number of follow-up large scale deployments.

A coherent three-step approach, shown in Figure 6, was designed and undertaken to analyse each low carbon sector. This ensured that future projections of manufacturing supply chain are aligned with current market knowledge, industry trend forecasts and key policies to derive the market opportunities as well as the value chain for East Midlands businesses.

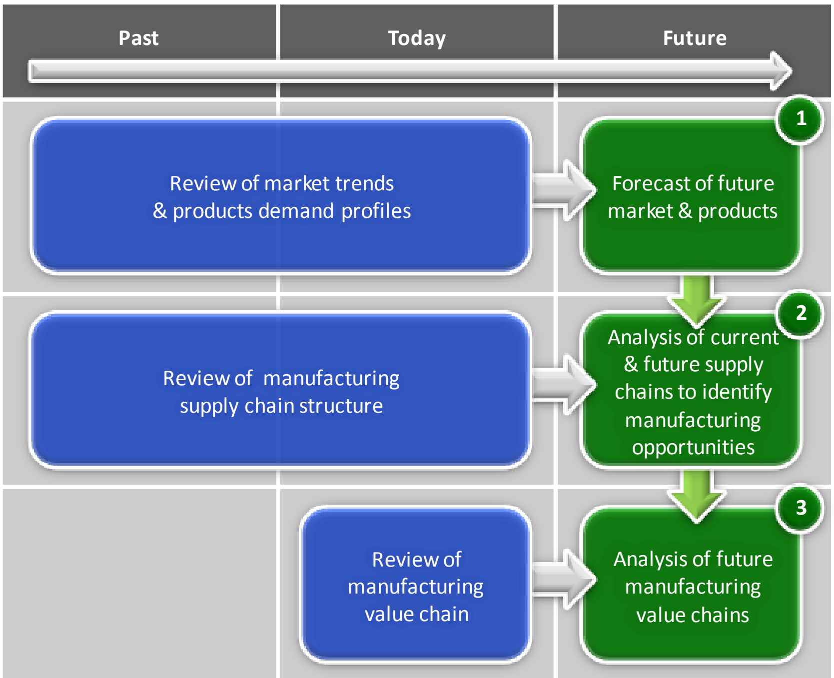


Figure 6 Industry supply and value chains analysis model

The key steps illustrated in Figure 6 are briefly described as follows:

1. **Analysis of Industry Development**. This involved analysing the market trends and product demand profiles for each individual low carbon sector through market and policy studies and industry insights. The focus was to highlight the key drivers and conditions that will enable the industry's emergence over the next decade and identifying current manufacturing capability gaps that could present opportunities for manufacturing businesses in the East Midlands region. Four key areas affecting each sector were investigated in this study:

   a) Current status of industry development
   b) Government support: The policy framework that is shaping each industry
   c) Market requirements: The products and services required by each industry, currently and in the future
   d) Market opportunities for UK manufacturing businesses

   This analysis identified the potential manufacturing gaps and supply chain trends that may represent business opportunities for manufacturers over a 5-10 years horizon.

2. **Supply Chain Analysis**. For the purposes of this report a supply chain is defined as a system of organisations and activities involved in moving a manufactured product from the suppliers to the customers. Based on industry knowledge and supplier-buyer transactions in each industry (e.g. using the Bills of Materials where available), the existing manufacturing supply chain for each sector was constructed. Building on the analysis of industry development above, anticipated future supply chains were then forecast to identify manufacturing opportunities that may exist. Figure 7 shows an illustrated high level supply chain.

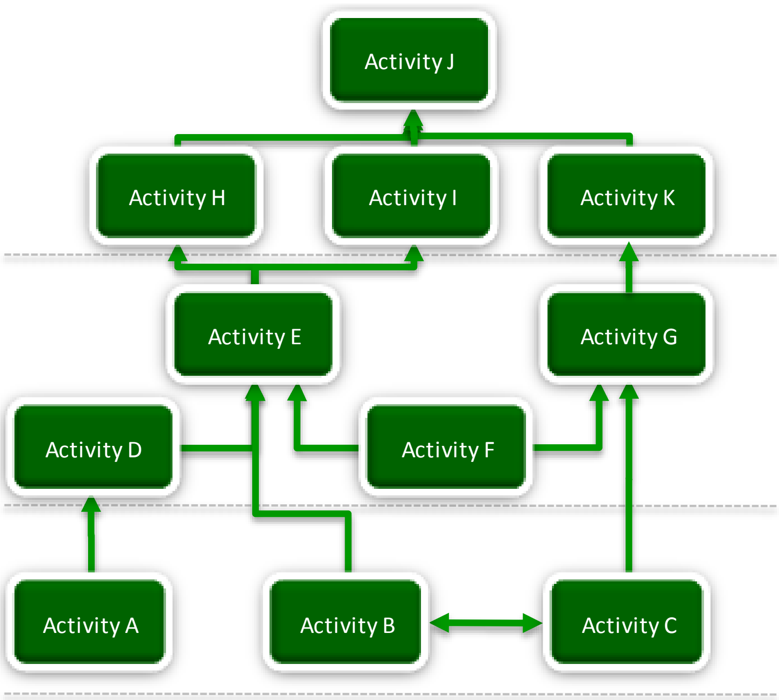


Figure 7 Illustration of a supply chain structure

3. **Value Chain Analysis**. Building on an understanding of the industry structure and main players, and defining the main steps of value creation. For the purposes of this report, a value chain is defined as a network of companies consisting of one or two primary product or service suppliers and many other companies that add value to a product or service that is ultimately delivered to the end customer, such as illustrated in Figure 8.

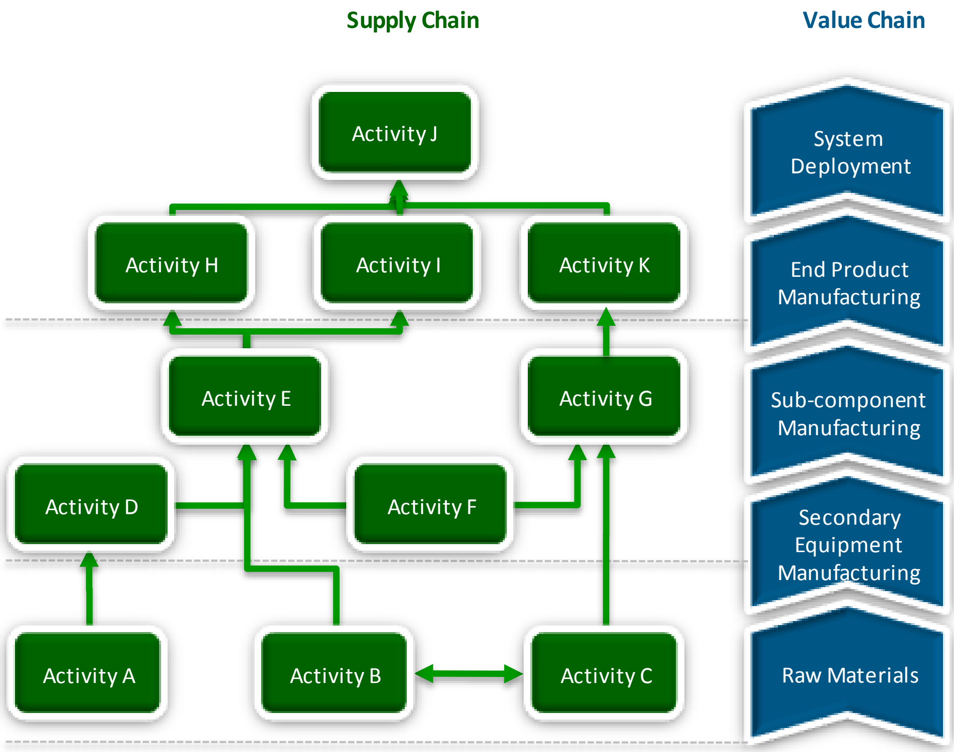


Figure 8 Example of value chain analysis for a supply chain

The identified business opportunities formed the basis of competency mapping, by feeding the output into the Relational Database to segregate relevant low carbon manufacturing opportunities.

3.2 Overview of Regional Opportunities

The supply chain and value chain analyses identified 3,142 regional manufacturing and related businesses from the Relational Database (comprising 7,008 companies) as having high potential to exploit opportunities in emerging low carbon industries. A further 4,413 companies found to have competencies for the medium potential categories[3]. A multitude of companies were mapped against opportunities in more than one individual sector. The breakdown of high potential companies for each low carbon sector is shown in Figure 9.

Chapter 4 will present the mapping output for each low carbon sector in greater details. However, the overview of the results in Figure 9 shows that East Midlands has the strongest potential manufacturing competencies for sectors such as low carbon transport, fuel cells and CCS. This is partly because the supply chains in these sectors are relatively new, and technology and components are still being developed, hence more opportunities exist. In contrast, a concrete analysis could be carried out for more mature sectors (such as PV solar, nuclear, wind, low carbon construction and geothermal) where supply chain opportunities for specific technologies could be mapped more firmly. Wave and tidal was found to offer the lowest opportunities to match the region's businesses, and this could be attributed to the relatively limited inherent offshore competencies in the region.

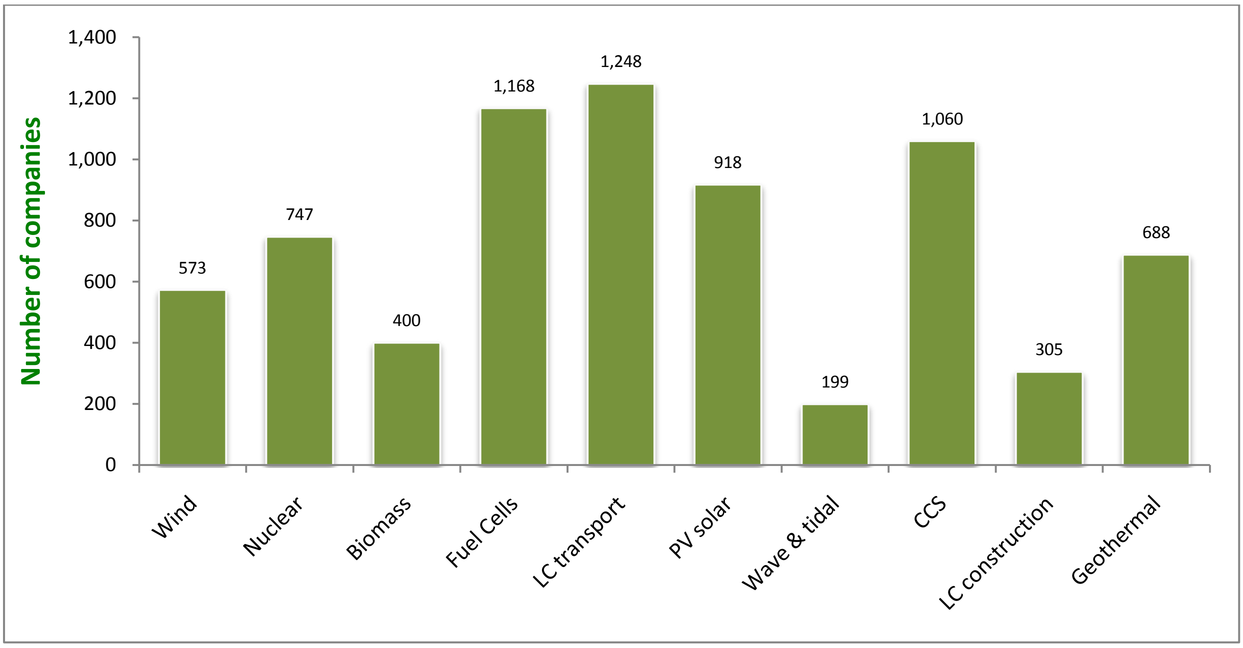


Figure 9 Distribution of the identified manufacturing businesses in East Midlands with high potential for the low carbon sectors

[3] Further breakdown of high and medium potential opportunities for the individual sectors are discussed in Chapter 4.

As early economic indicators for the region, existing employment and turnover data for the high potential companies, where available, were collated and analysed.

The estimated existing employment numbers of companies mapped for the ten low carbon industry sectors studied were compared in Figure 10 below. The distribution across all the sectors was dominated by SMEs, in particular by businesses with less than 50 employees who collectively represent just over 80% of the identified companies (as shown in Figure 13(a)). The sector-based breakdown of the estimated minimum and maximum existing employment by the identified companies is shown in Figure 11.

The data for estimated turnovers of the identified companies were less readily available. However the distribution across the ten sectors (for a total of 3,142 companies) in Figure 12 showed a similar trend, in that it is dominated by businesses with less than £5m turnovers. Figure 13(b) further shows the distribution of 1,777 companies with known turnover data, which confirms that businesses with less than £5m and with £5m-100m represented nearly 74% and 24% respectively amongst these high potential companies.

Therefore it is clear that among the 7,008 businesses in the Relational Database, manufacturing for emerging low carbon industries offers an important opportunity for some 3,142 manufacturing businesses in East Midlands, with over 80% of these being SMEs. The risks involved in making the transition or staying in a 'business as usual' scenario would need to take into account issues such as:

- Limited resources and market exposure in developing new business opportunities
- Limited investment for new capital equipment and skills training
- Challenges in meeting supply chain quality compliance or manufacturing standard requirements
- Critical loss of investment if low carbon markets fail to materialise

The intervention support piloted under this study was subsequently developed with a transition/non-transition risk assessment at its heart, and was geared to the specific needs of regional SMEs in the region (see Chapter 6).

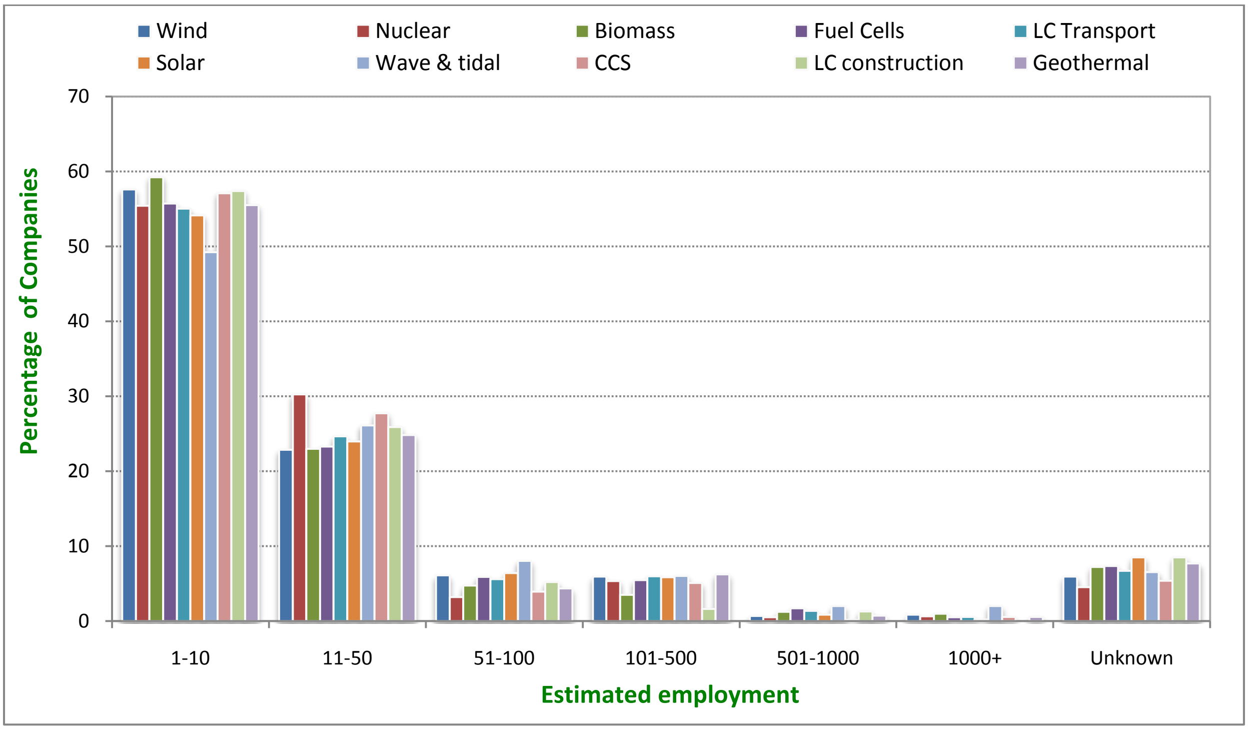


Figure 10 Distribution of compounded estimate of existing employment for manufacturing businesses in East Midlands that could benefit from low carbon industry opportunities

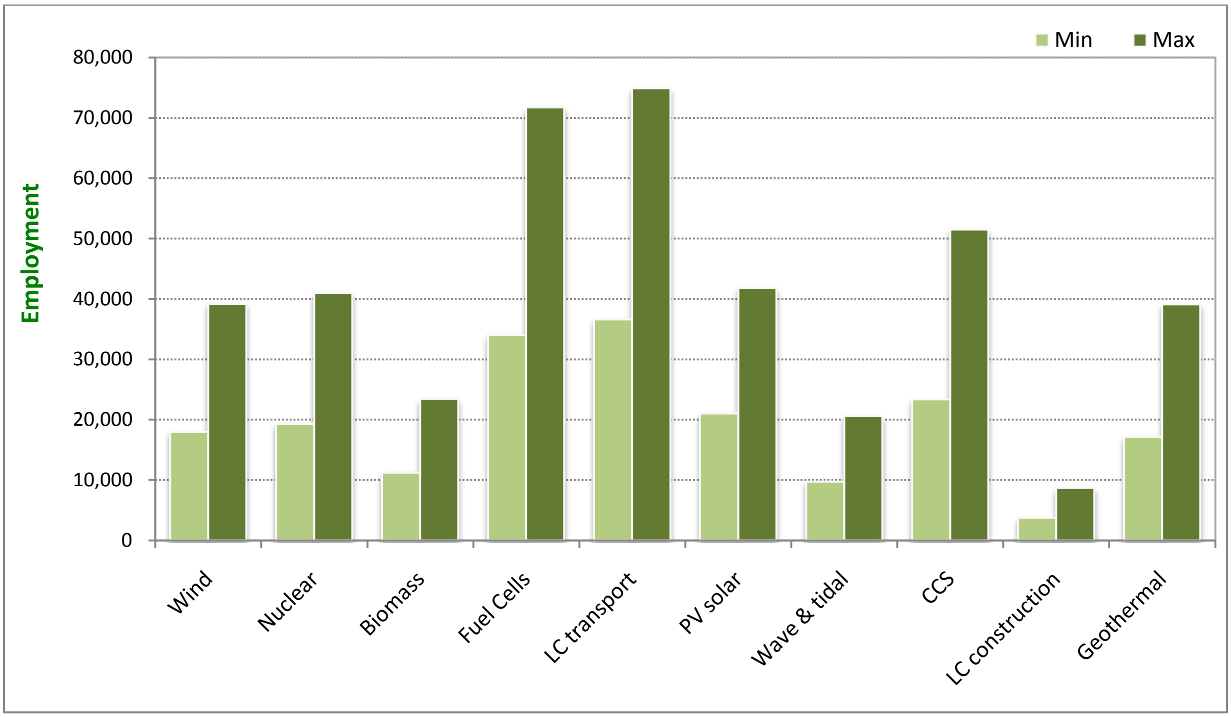


Figure 11 Compounded estimate of existing employment of potential manufacturing businesses in East Midlands that could benefit from low-carbon industry opportunities

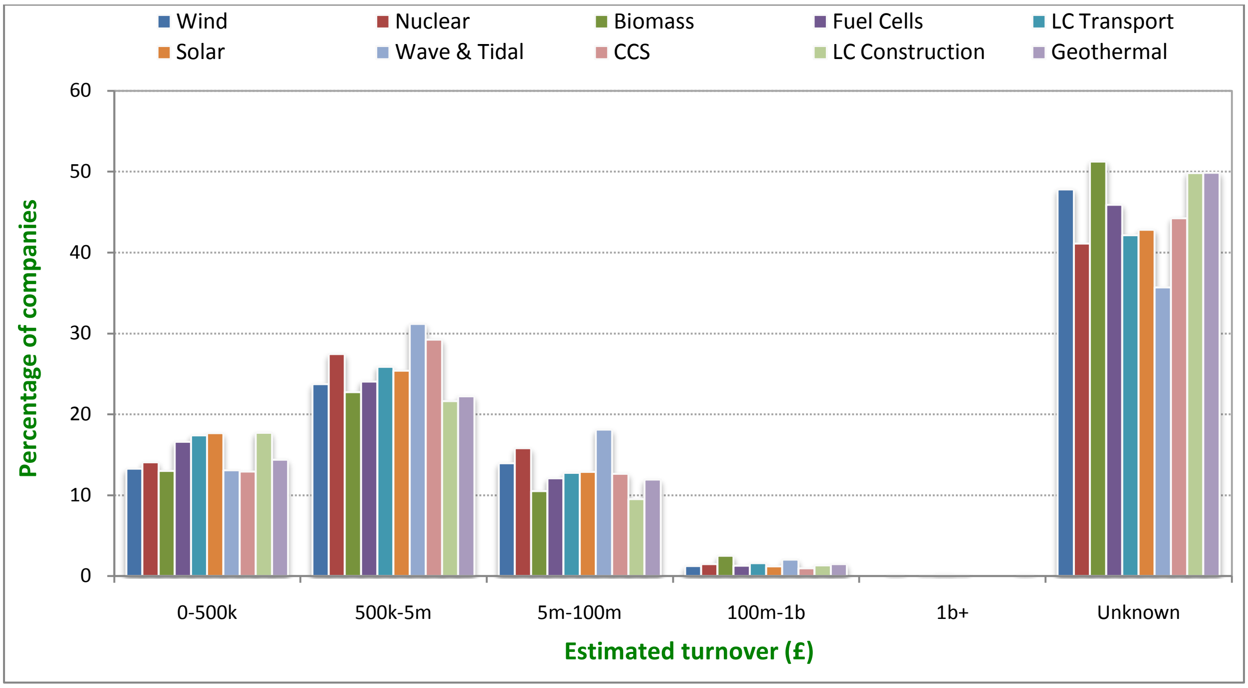


Figure 12 Distribution of estimate of turnover for potential manufacturing businesses in East Midlands that could benefit from low-carbon industry opportunities

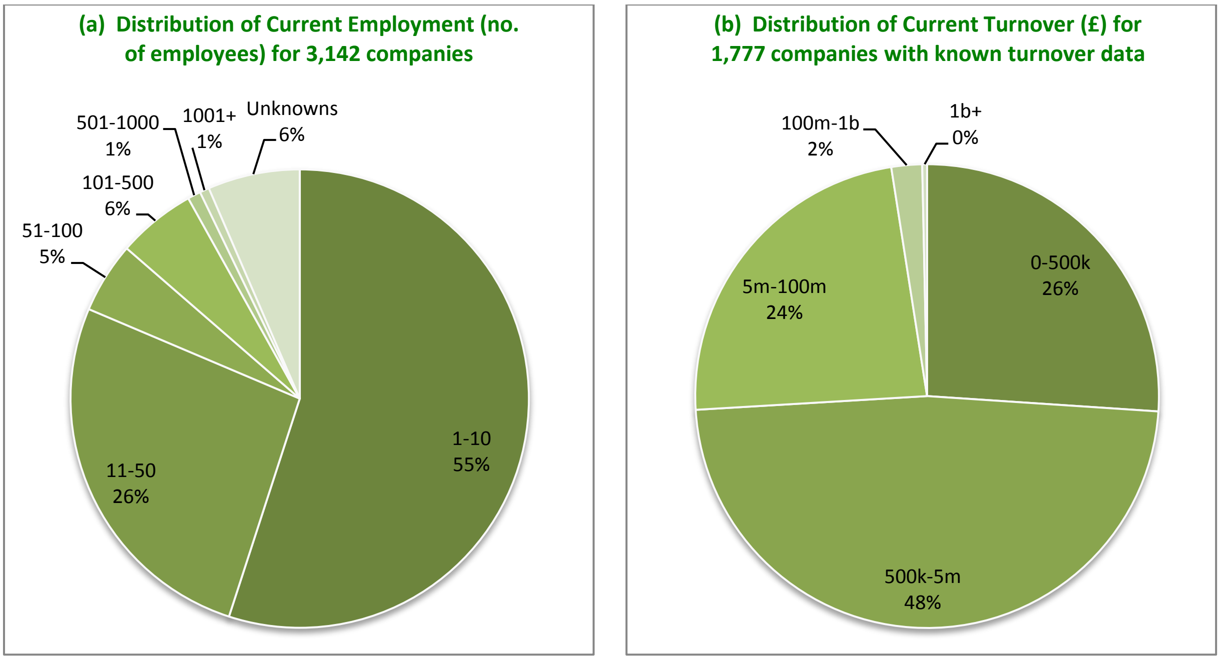


Figure 13 Overall distribution of estimate of existing employment for potential manufacturing businesses in East Midlands that could benefit from ten low carbon industry opportunities

4 Low Carbon Industry Analyses

Manufacturing and related opportunities in the low carbon sectors investigated in this study indicated differing levels of matching competencies for East Midlands businesses, partly influenced by the maturity of the respective supply chain. This chapter discusses the analytical findings of the ten sectors investigated.

4.1 Offshore Wind

4.1.1 Industry Development

Offshore wind is expected to make the single biggest contribution towards the UK government's legally-binding target of generating 15% of our energy from renewable sources by 2020[4]. Following the Rounds 1, 2 and 3 as well as the Scottish Territorial Waters (STW) leasing rounds awarded by The Crown Estate by May 2010, the combined total of all UK planned installation is now over 48GW[5]. This puts the UK in the forefront of offshore wind as the single biggest market in the world.

The scale of the technical, logistical and economic challenges posed in delivering this capacity is very significant, but at the same time represents a major supply chain opportunity for manufacturing industry. The momentum created by Round 3, in particular, will see multi billion pounds of investment into the UK economy. With a long standing engineering and manufacturing capabilities for aerospace, power generation, automotive and construction industries, East Midlands may be well placed to supply wind turbine components for the offshore wind supply chain.

Offshore wind technology essentially consists of five key elements: (1) the wind turbine, (2) the foundation, (3) the electrical connection, (4) the installation, and (5) operation and maintenance (O&M). These are currently all based on existing technologies proven in other industries, and an offshore wind turbine is essentially a scaled-up marinised onshore turbine. However, offshore turbines have genuine advantages over onshore turbines, such as greater generation efficiencies as a result of higher and more constant wind speeds. The main components in a typical wind turbine are shown in Figure 14.

---

[4] "The UK Renewable Energy Strategy", HM Government, July 2000
[5] More details on http://www.thecrownestate.co.uk/offshore_wind_energy

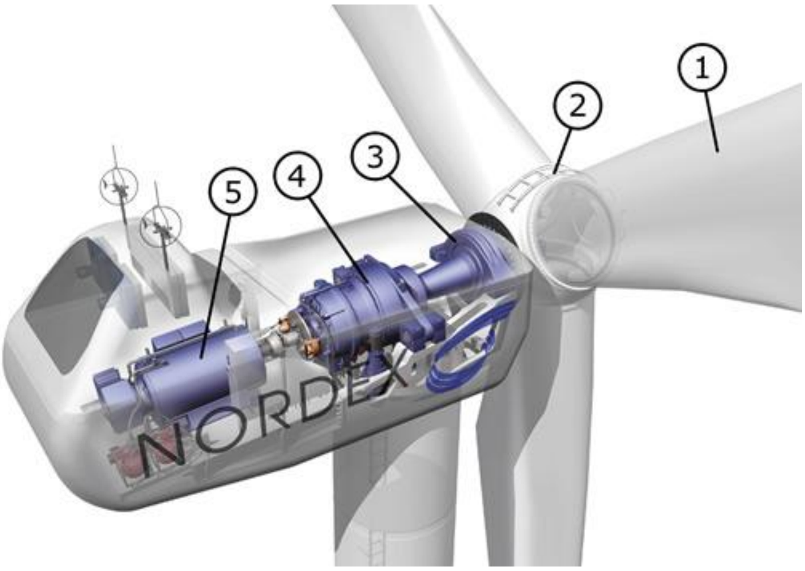


Figure 14 A conventional commercial-scale wind turbine (1 – blade, 2 –hub, 3 – rotor bearing, 4 – gearbox, 5 – generator) (Copyright © 2008 Nordex GmbH)

4.1.2 Supply Chain Opportunity

Whilst there are global models for offshore wind supply chains, the Round 3 leasing programme will establish a more local, UK-based, supplier market.

The supply chain framework in Figure 15 encapsulates the longer term manufacturing supply opportunities for the UK businesses. The immediate and medium term market will be created through the deployment and initial installation of the remaining Round 2 and planned Round 3 and STW leasing programmes.

However by maintaining the O&M activities in the country, the turbine manufacturers, Tier 1, Tier 2 and subsequent sub-component suppliers will be able to take advantage of supply chain opportunities required for the long term operational services of the large-scale installed wind farms. There will also be a repowering programme for the installed wind farms, which could require full-scale replacement of turbines and sub-components. This will help to create a more long term and sustainable market and revenue streams for any UK based manufacturing businesses, which the East Midlands manufacturers could potentially benefit from.

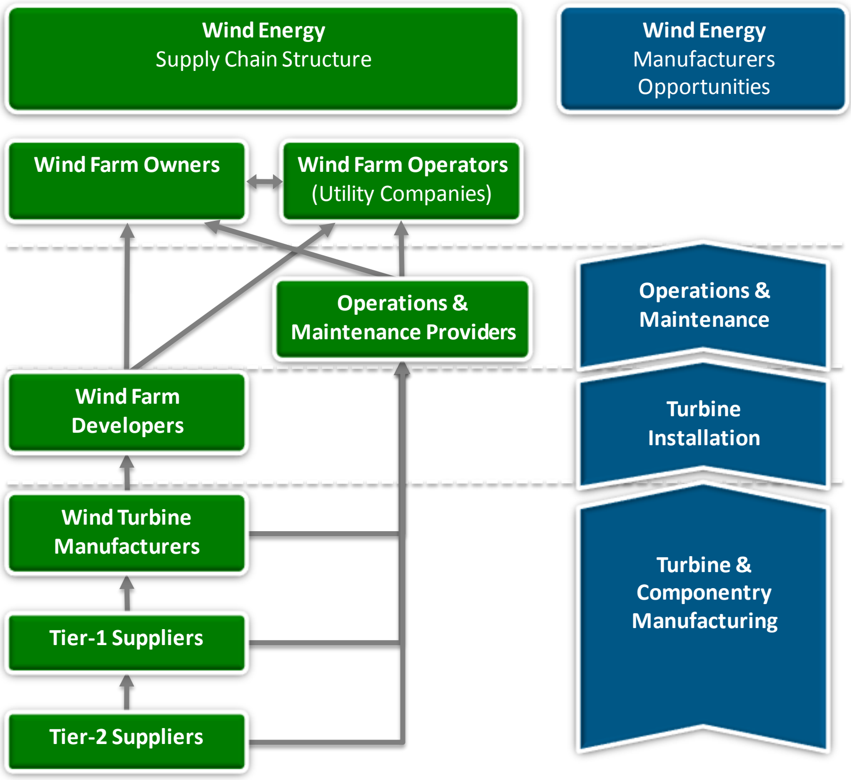


Figure 15 Manufacturing supply chain and value chain for offshore wind industry

Taking into account the analysis of the supply and value chains in line with the manufacturing competencies in the East Midlands, the following opportunities in the UK offshore wind sector were identified:

1. Large structural components, e.g. fabrication of tower and foundation
2. Large castings & forgings – these items include the hub, main shaft, main frame (in some cases), gearbox castings and bearing forged rings
3. Composite material supply
4. Gear boxes supply
5. Bearings supply
6. Operation and maintenance (O&M)
7. Corrosion prevention and protection

A total of 573 companies with 'high potential', and 511 with 'medium potential' were mapped against these opportunity gaps. Figure 16 shows the distribution of these companies by their primary business activities. Figure 17 to Figure 22 show the breakdown of the 'high potential' companies (by primary business activities) that could have the relevant competencies to take the opportunities identified.

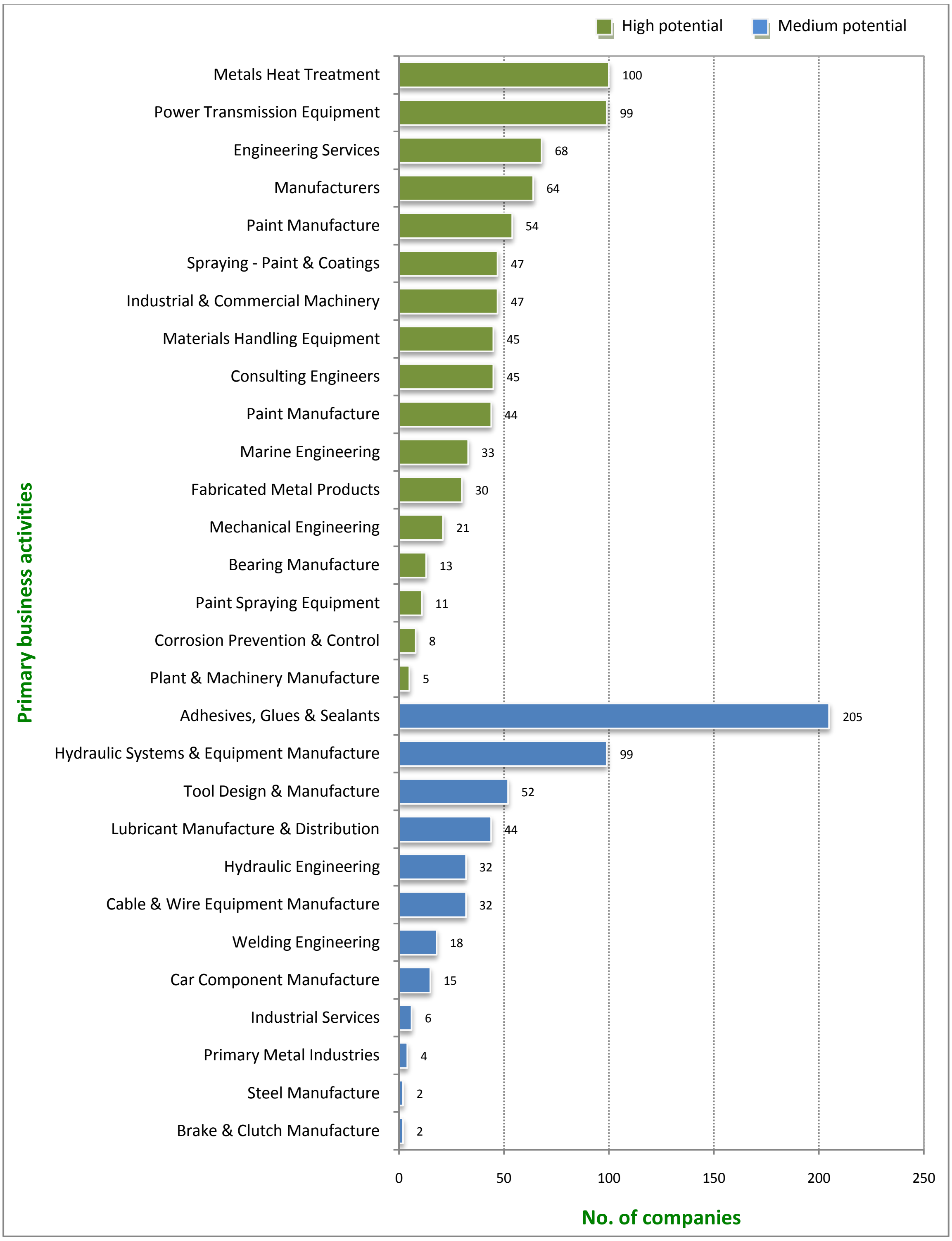


Figure 16 Distribution by primary business activity of 573 'high potential' and 511 'medium potential' companies for offshore wind manufacturing

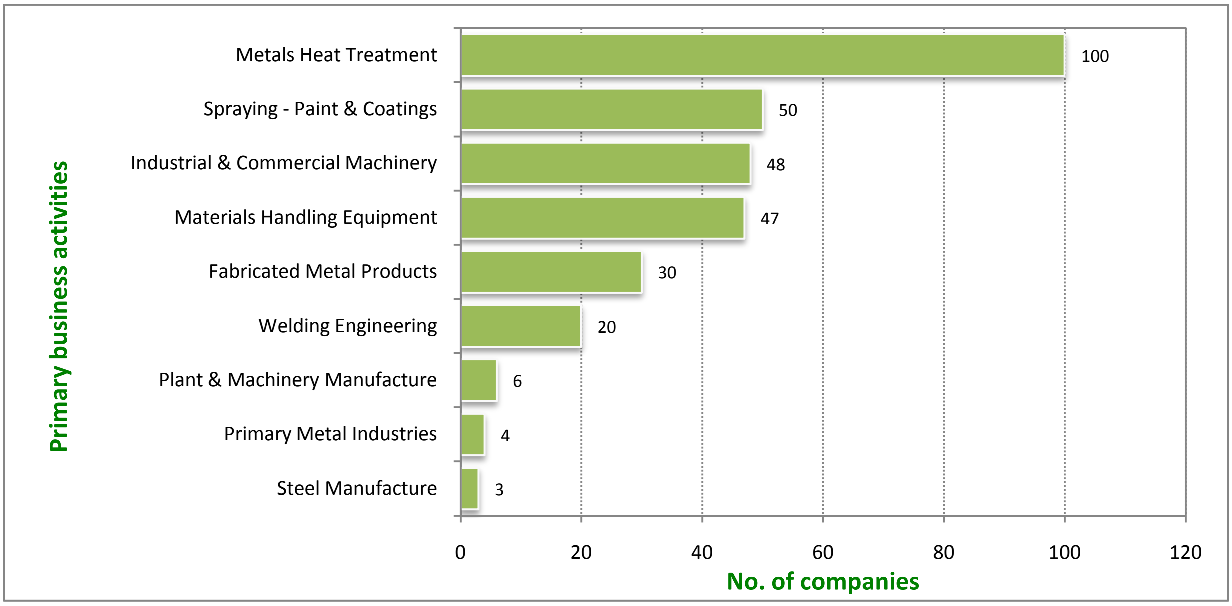


Figure 17 Distribution by primary business activity of 308 'high potential' companies for supply of **large structural components** and **forgings and castings** for offshore wind

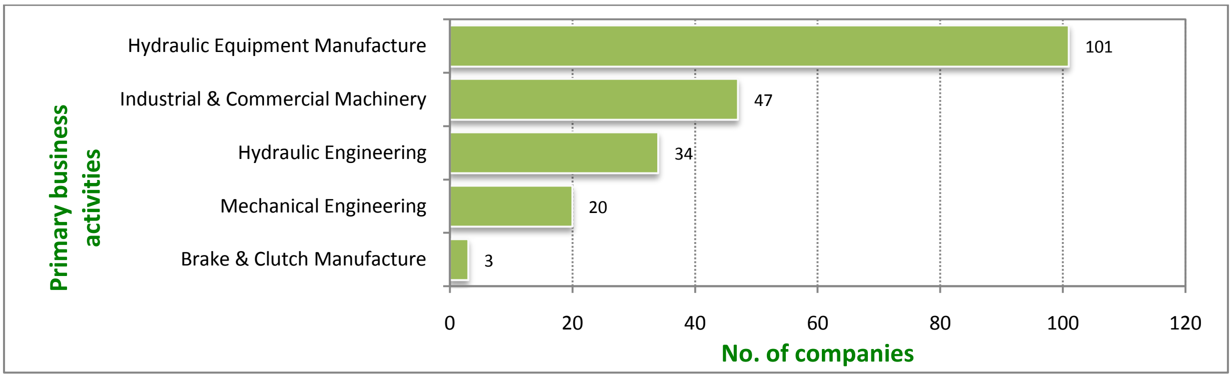


Figure 18 Distribution by primary business activity of 205 'high potential' companies for supply of **gear boxes** for offshore wind

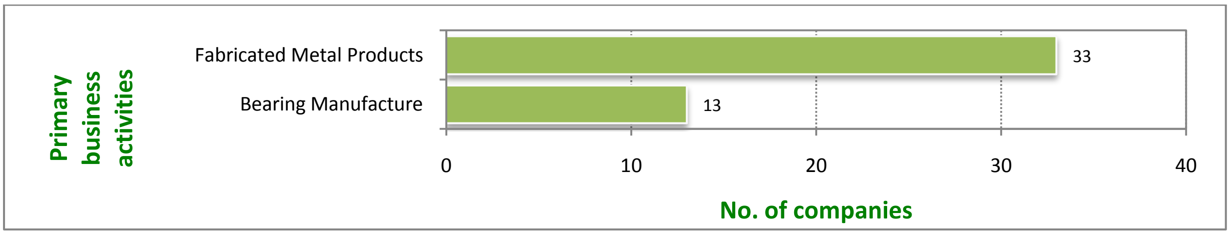


Figure 19 Distribution by primary business activity of 46 'high potential' companies for supply of **bearings** for offshore wind

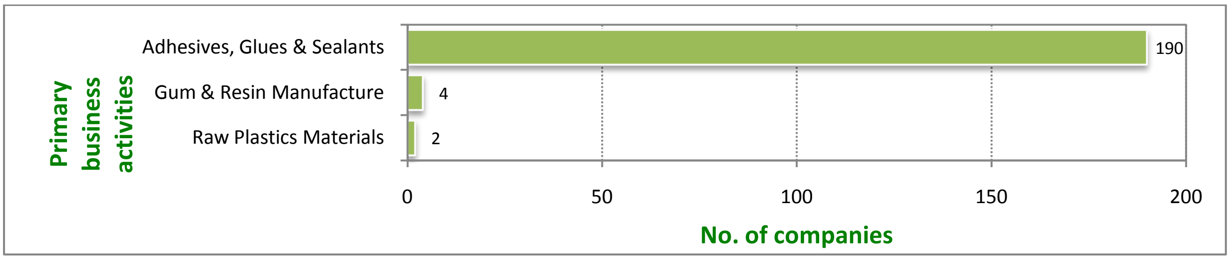


Figure 20 Distribution by primary business activity of 196 ‘high potential’ companies for supply of **composite materials** for offshore wind

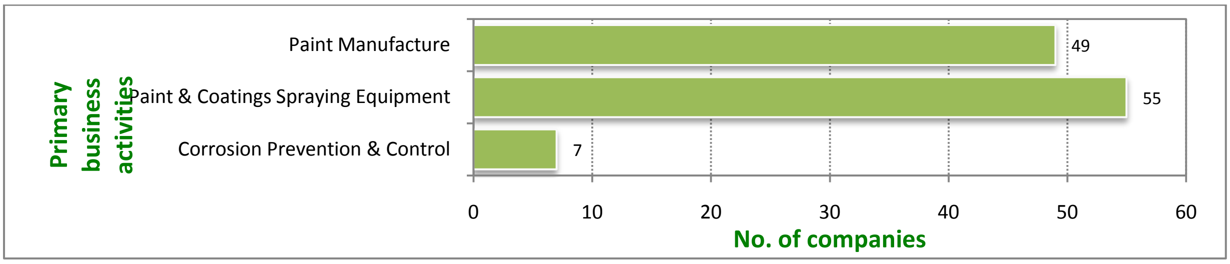


Figure 21 Distribution by primary business activity of 111 ‘high potential’ companies for supply of **corrosion prevention and protection** for offshore wind

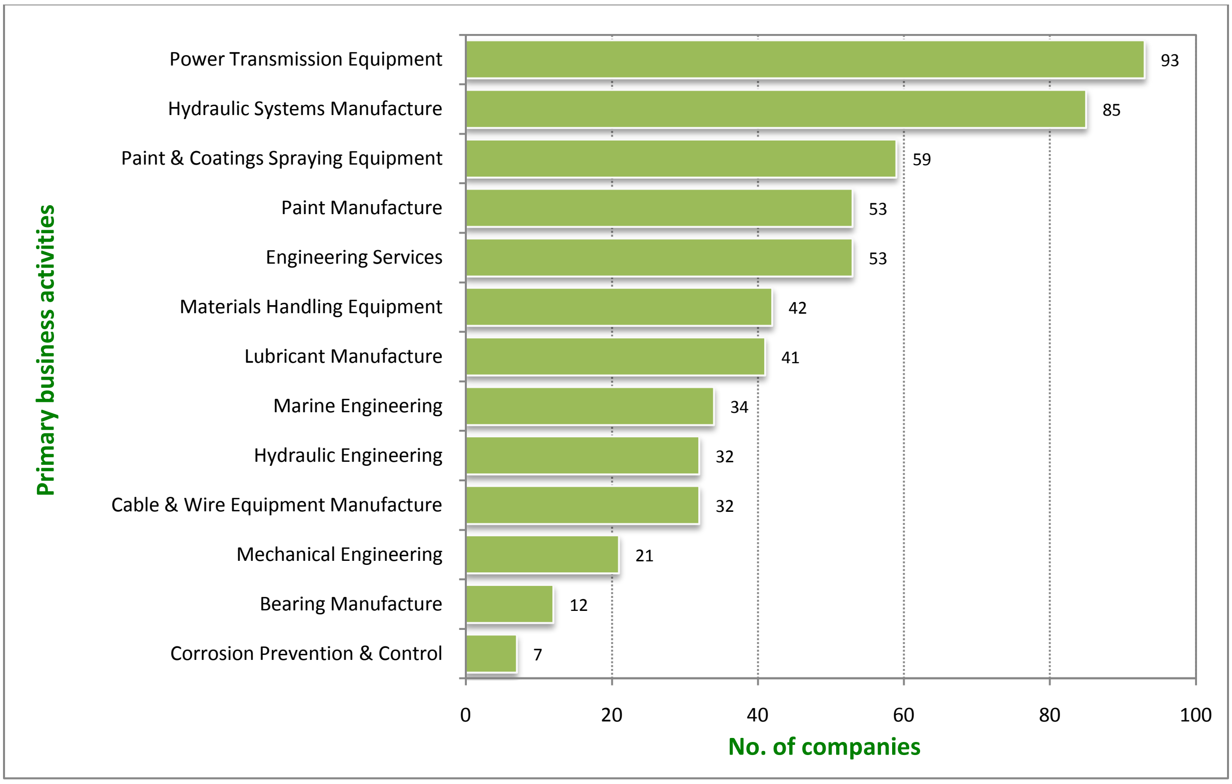


Figure 22 Distribution by primary business activity of 564 ‘high potential’ companies for **operation & maintenance (O&M)** for offshore wind

4.2 Nuclear New Build

4.2.1 Industry Development

Over the last few years, the nuclear industry has seen a revival worldwide. One of the main reasons for this increased interest from governments is the very low CO_2 emissions associated with nuclear energy production. Up to 130 new nuclear reactors are being planned for the next 10 years. China accounts for 50 of these reactors, India for up to 30. By the end of 2009, 50 reactors were under construction in the world[6].

In the UK, there are currently 19 reactors totalling 11 GWe capacity, accounting for around 18% of the country's energy production. All but one of these reactors will be retired by 2023[7], which means there are significant business opportunities in nuclear decommissioning over the next decades.

In addition, about 3% of UK electricity demand is met by imports of nuclear power from France, so overall nuclear total in UK consumption is normally about 22%. Because of planned decommissioning of the Magnox and AGR reactors, and old coal-fired plants, the energy bought from France is likely to rise further in the future. The increasing reliance on foreign countries to supply the UK with fossil fuels for power generation is an important argument to return to nuclear energy. Some industry bodies estimate that nuclear capacity in the UK could reach 40% by 2040.

In 2008, the UK government invited power utilities to come forward with plans for the development of new nuclear power stations. EDF Energy and Horizon Nuclear Power are foremost among them with EDF intending to build new stations at Hinkley Point in Somerset and Sizewell in Suffolk, and Horizon announcing similar plans at Wylfa on Angelsey and Oldbury in Gloucestershire. A third utility, a joint venture of Iberdrola, GDF Suez and Scottish and Southern Energy, has acquired land near Sellafield in Cumbria for development. The indicative timeline for new build is shown in Figure 23. Construction of the first new nuclear power station in the UK will be at Hinkley C, which is expected to start in 2013, with commissioning in 2017, and SME suppliers, incumbents and new entrants, need to begin preparations for the market now.

The market for nuclear new build represents a significant opportunity for the current nuclear supply chain and particularly for new entrants. Many opportunities will be similar to those of any major civil engineering project with additional opportunities associated with specialised nuclear plant involved.

[6] World Nuclear Association, 2009; "The Nuclear Renaissance", http://www.world-nuclear.org/info/inf104.html

[7] World Nuclear Association, 2010; "Nuclear Power in the United Kingdom", http://www.world-nuclear.org/info/inf84.html

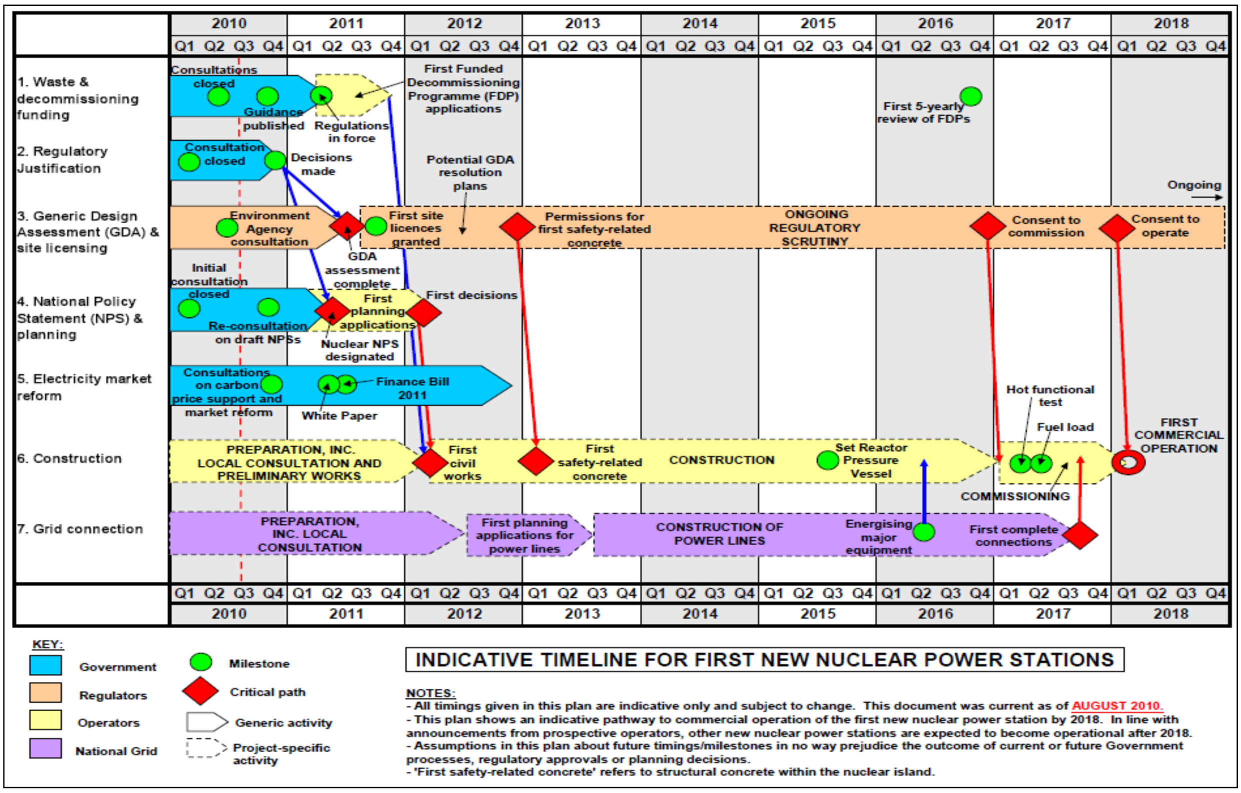


Figure 23 Indicative timeline for first new nuclear power stations (© DECC[8], 2010).

4.2.2 Supply Chain Opportunity

The UK civil nuclear power market can be broken down into three segments of (1) power generation at existing sites, (2) decommissioning/waste management, and (3) new build programme. Whilst opportunities exist in operation/maintenance of the current fleet of nuclear power stations (i.e. the Advanced Gas Cooled reactors and plant owned and operated by EDF) the market size is limited and the mature supply chain will be challenging for new entrants. Therefore, this study focussed primarily on the new build programme as it offers the greatest level and diversity of opportunities to supply chain companies.

The supply chain for the UK new build programme is expected to have the structure shown in Figure 24.

---

[8] http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/nuclear/new/new.aspx

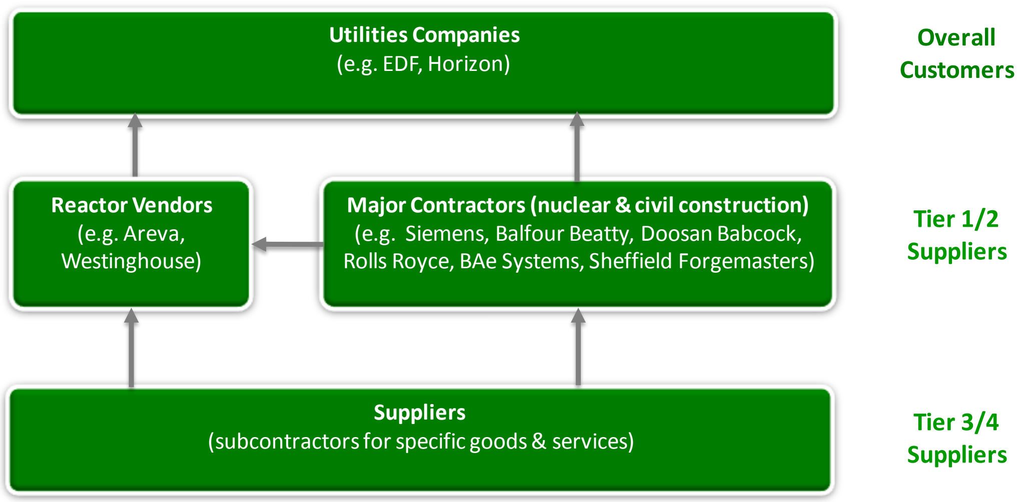


Figure 24 The expected supply chain structure of the UK nuclear new build programme

Goods and services required for nuclear new build

Goods and services for the new build programme fall into four categories:

- Pre-build activities associated with planning and licensing
- Construction
- Operation
- Decommissioning

Of most interest in terms of immediacy and number of opportunities for manufacturing business is the construction phase. As yet, detailed information on precise opportunities is unavailable, but they will broadly be in the following areas:

- Project management
- Civil building and construction
- Plant and equipment (for both the nuclear and civil areas of each plant)
- Onsite fabrication and erection of components
- Nuclear fuel supply
- Plant commissioning

Health and safety and Quality requirements for new build

The standards of health and safety and quality will be proposed by the utilities, reactor vendors and project integrators (Architect Engineers) and to be agreed by the Nuclear Directorate of HSE. For example, EDF is seeking agreement by September 2010 and Horizon Nuclear Energy in 2011.

All SMEs intending to operate at the Tier 3/4 levels will be expected to hold ISO 9000, ISO 14001 and ISO 18001. Additionally, all suppliers will need to be open to audit by Tier 2 customers, the NII or a third party; have arrangements for auditing their own suppliers; and systems for full materials traceability.

Currently, no construction contracts are flowing in nuclear new build but commercial relationships and supply chain structures are being established. However, it is important for SMEs to take action now in order to position themselves for future opportunities in manufacturing of plant and equipment of the

UK nuclear new build programme. This can be done in two ways: getting in touch with major contractors or reactor vendors or attending industry events run by the utilities, reactor vendors and commercial events companies.

It is recognised that procurement of equipment and services must be competitive and reliable and that procurers will have no obligation to use UK suppliers. It is also clear that there has been a dramatic downsizing and redirection of manufacturing capability in the UK for large power stations of all types, including nuclear, since the mid 1990's. However, there are still numerous companies with considerable manufacturing facilities and experience capable of supplying many of the other parts of a nuclear power station. Some UK companies are amongst world leaders and are currently exporting their equipment and skills to overseas nuclear nations.

Manufacturing opportunities for East Midlands manufacturing and related businesses to supply the emerging UK nuclear new build programme were identified as follows:

1. Structural design of foundations
2. Reactor protection system
3. Heat exchangers, generators and turbine components
4. Pressurized tanks and accumulators
5. Switchgear and cabling
6. Secondary pipe works
7. Specialised decommissioning
8. Control room equipment

A total of 747 manufacturing and related companies perceived with 'high potential' and 603 with 'medium potential' were mapped to these opportunities gaps. Figure 25 shows the distribution of these companies by their primary business activity. Figure 26 to Figure 33 show the breakdown of the 'high potential' companies (by primary business activity) that could have the relevant competencies to take the identified opportunities.

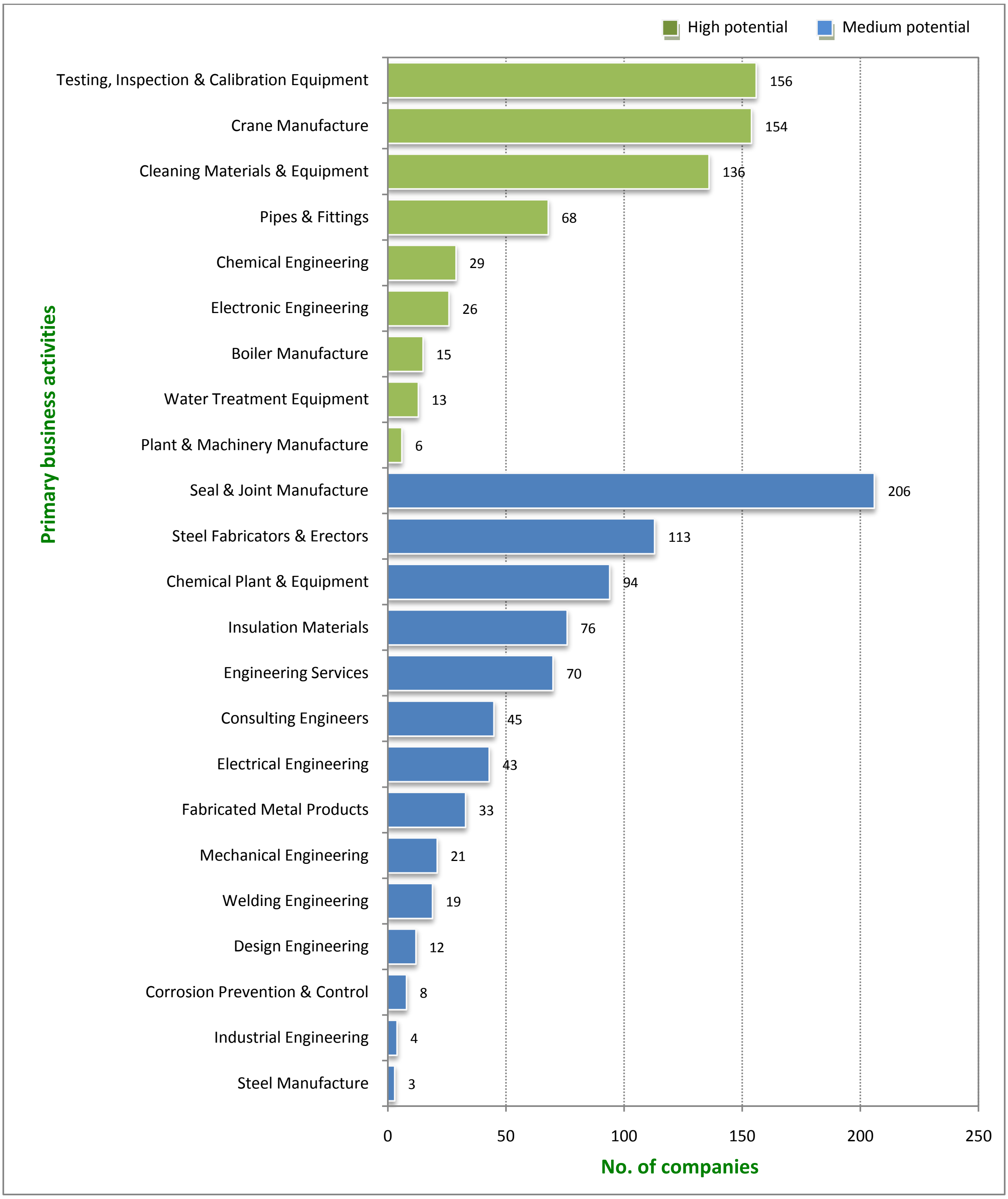


Figure 25 Distribution by primary business activity of 747 'high potential' and 603 'medium potential' companies in manufacturing for nuclear new build programme

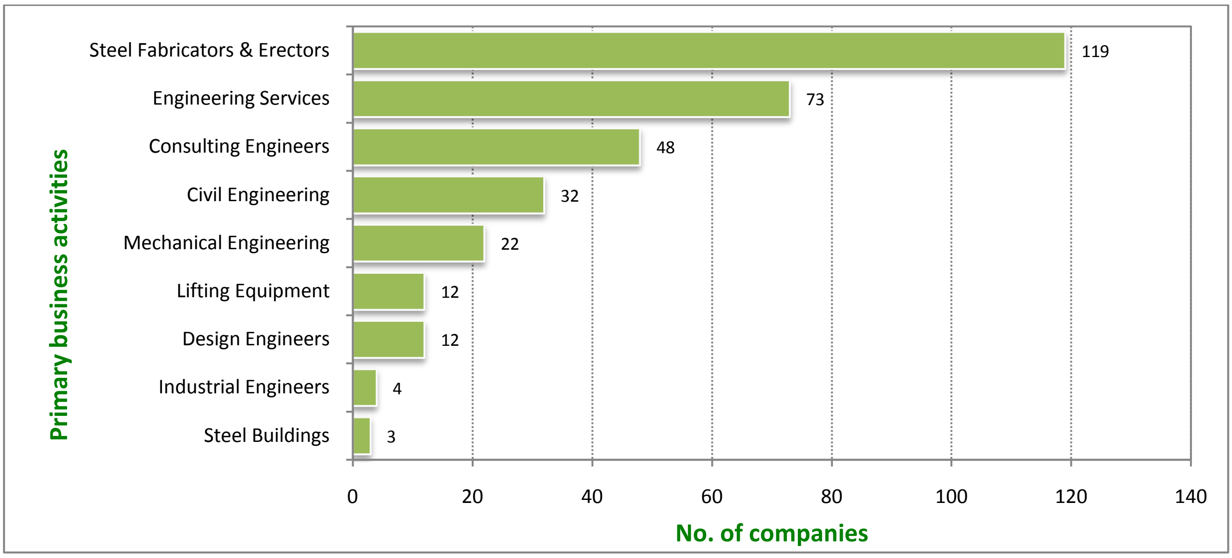


Figure 26 Distribution by primary business activity of 325 'high potential' companies in **structural design of foundations** for nuclear new build

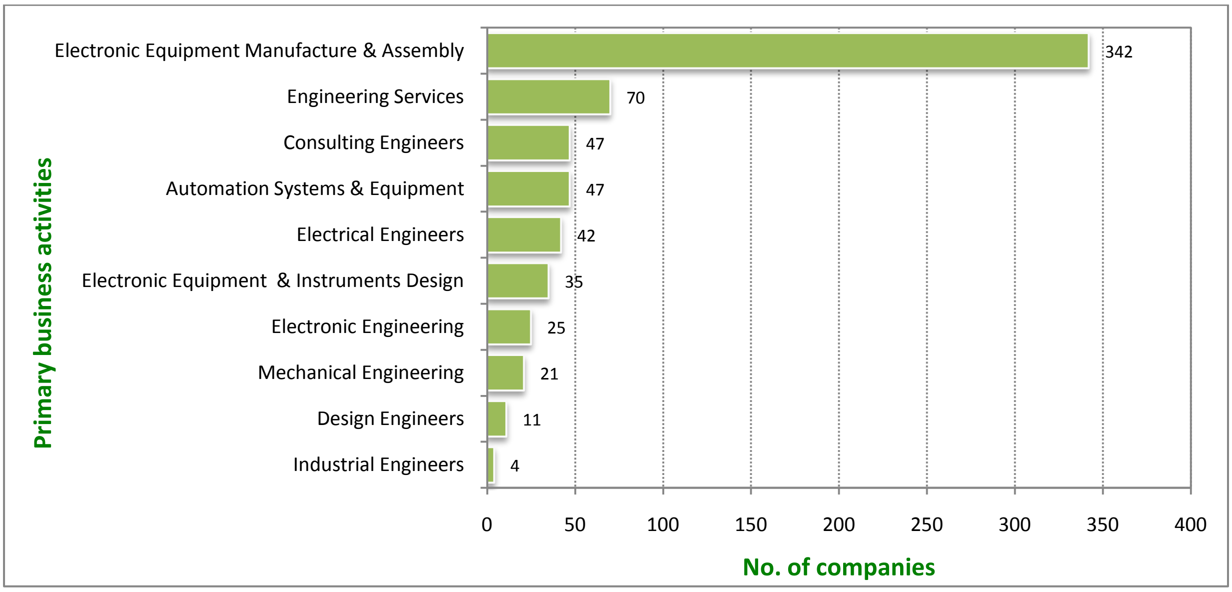


Figure 27 Distribution by primary business activity of 644 'high potential' companies in **reactor protection systems** for nuclear new build

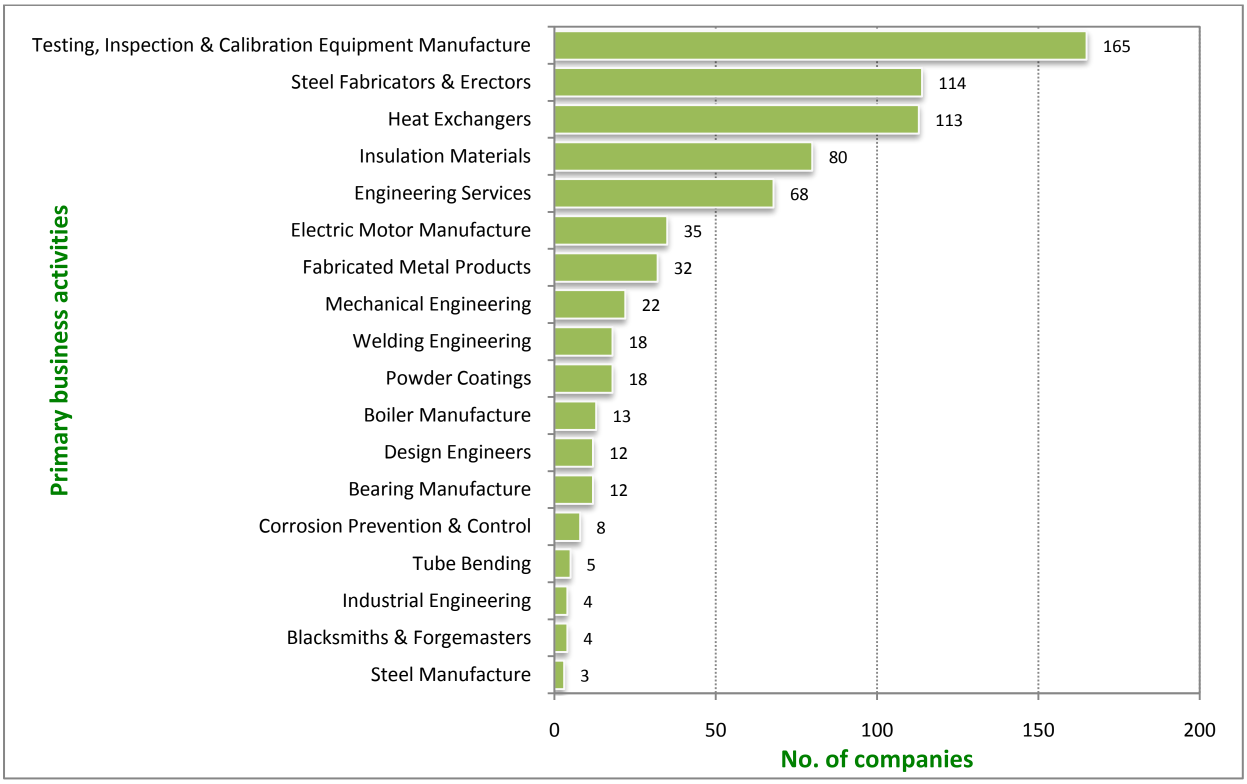


Figure 28 Distribution by primary business activity of 726 'high potential' companies in **heat exchangers, generators and turbine components** for nuclear new build

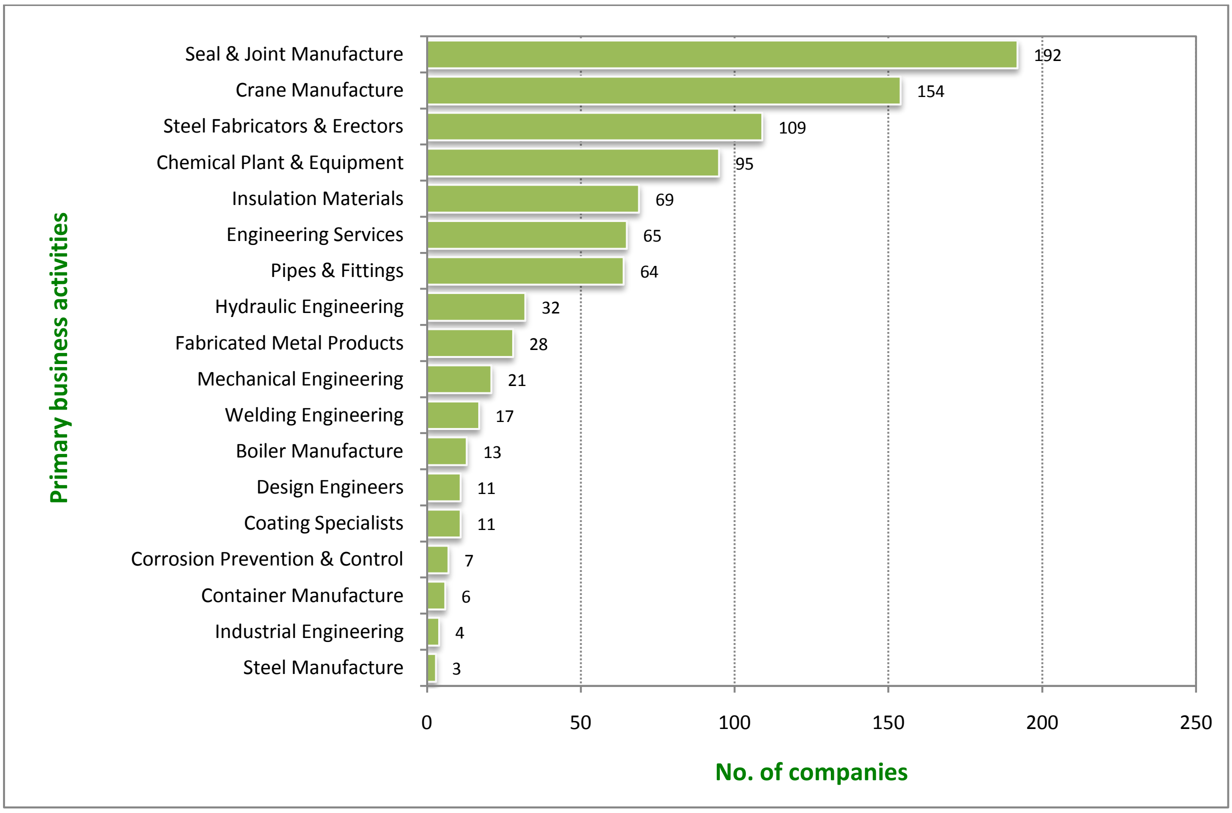


Figure 29 Distribution by primary business activity of 901 'high potential' companies for supplying **pressurized tanks and accumulators** for nuclear new build

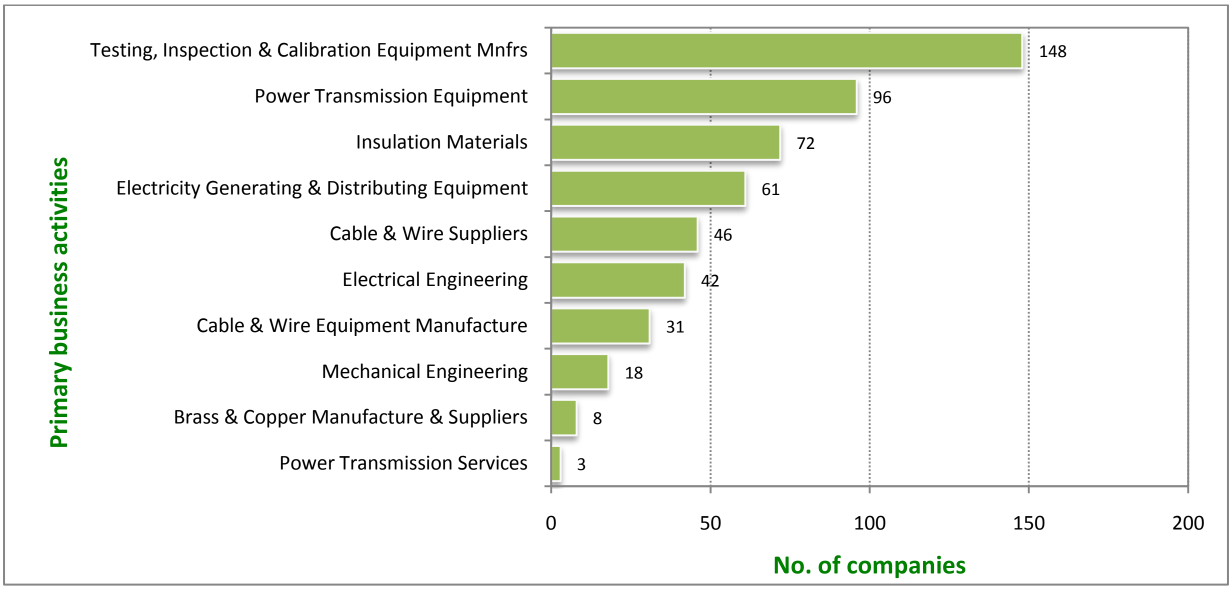


Figure 30 Distribution by primary business activity of 525 'high potential' companies for supplying **switchgear and cabling** for nuclear new build

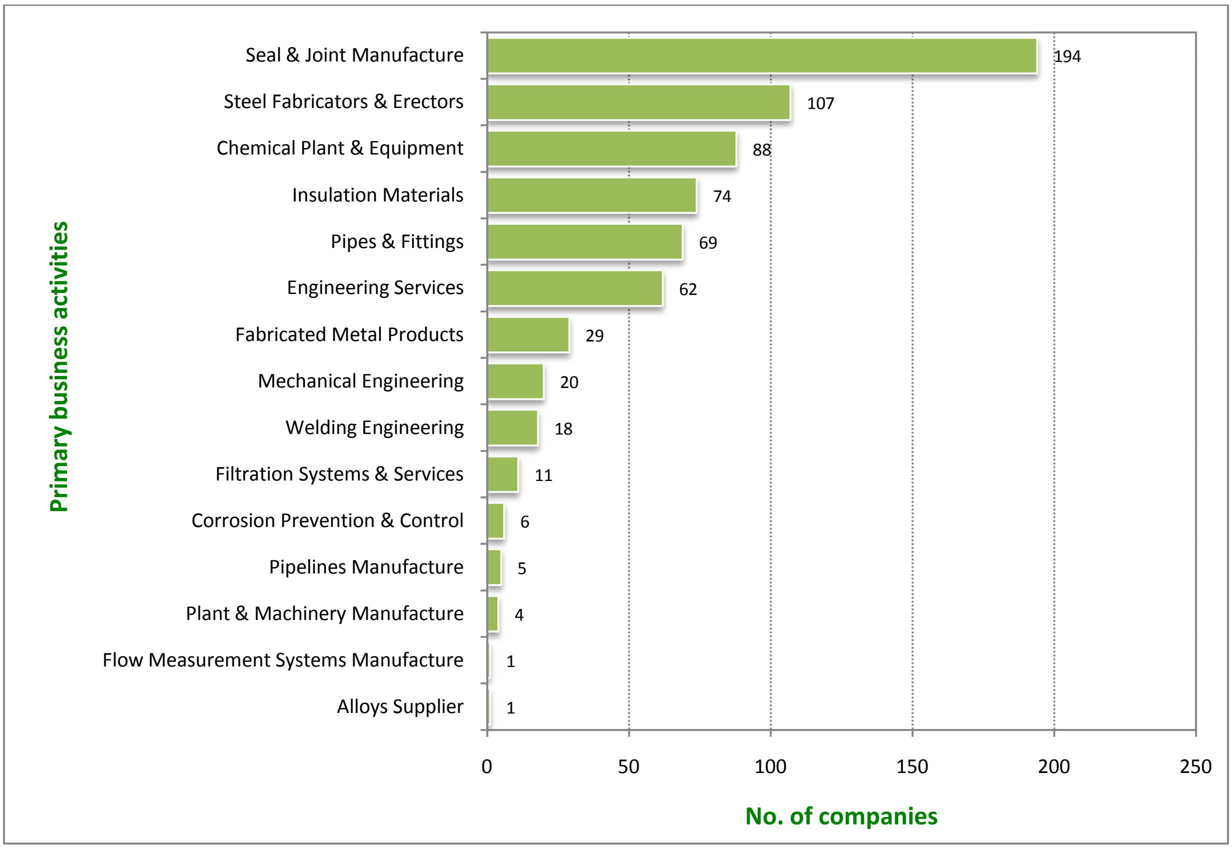


Figure 31 Distribution by primary business activity of 689 'high potential' companies for supplying **secondary pipework** for nuclear new build

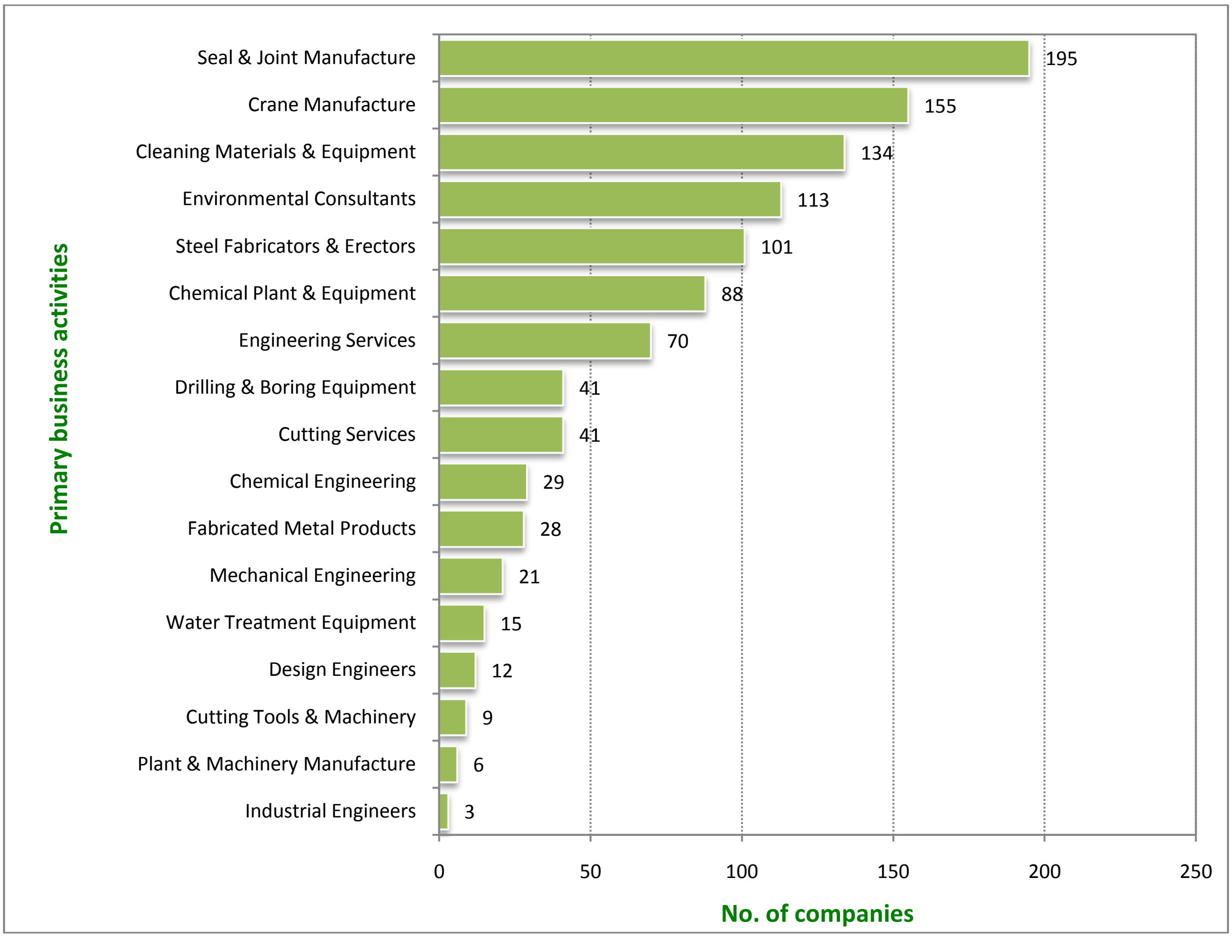


Figure 32 Distribution by primary business activity of 1,061 'high potential' companies for supplying specialised **decommissioning** for nuclear new build

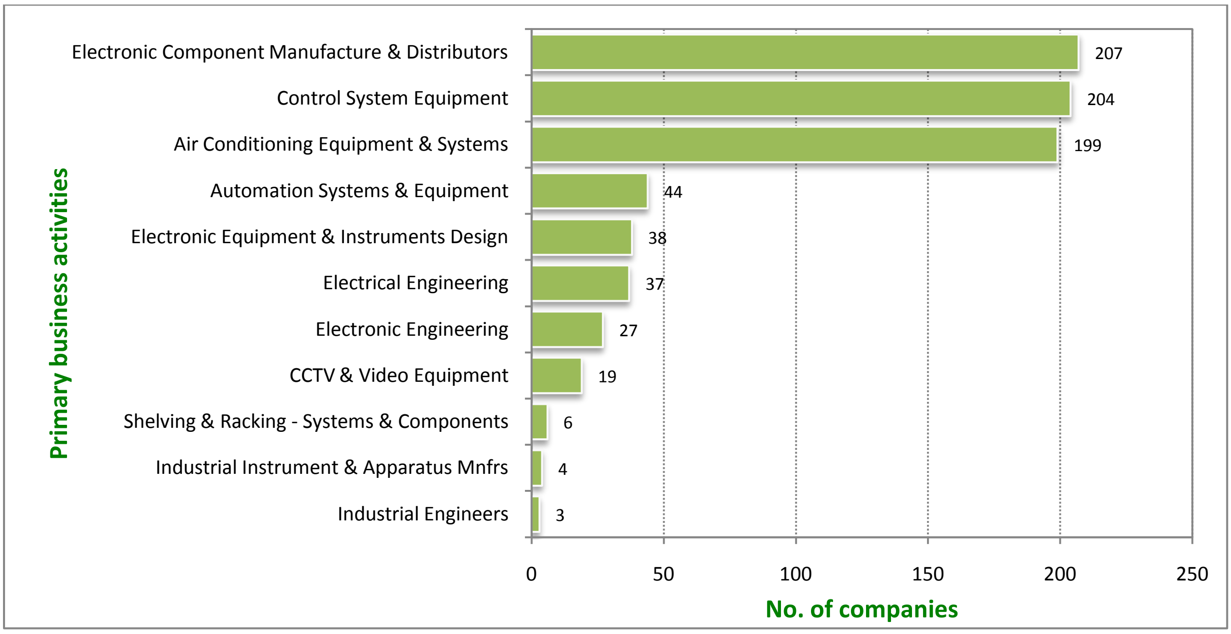


Figure 33 Distribution by primary business activity of 788 'high potential' companies for supplying **control room equipment** for nuclear new build

4.3 Carbon Capture and Storage

4.3.1 Industry Development

Carbon capture and storage (CCS) is a key technology to mitigate greenhouse gas (GHG) emissions from large-scale fossil fuel usage, such as coal power plants. This is established by the International Energy Agency (IEA) (see Figure 34) in achieving the balanced portfolio of low carbon initiatives that should be developed and implemented throughout the world in order to achieve by 2050 a 50% reduction of yearly CO_2 emissions (compared to 2010 level of emissions).

However, CCS is more than a strategy for “clean coal”. In the long run CCS technology could also be adopted in biomass and gas power plants; in the fuel transformation and gas processing sectors; and in emissions-intensive industrial sectors like cement, iron and steel production, chemicals, and pulp and paper. Beyond GHG emissions mitigation, another important driver for the deployment of CCS is that CO_2 injection in oil reservoirs can improve the recovery of oil. This technique is referred to as enhanced oil recovery (EOR).

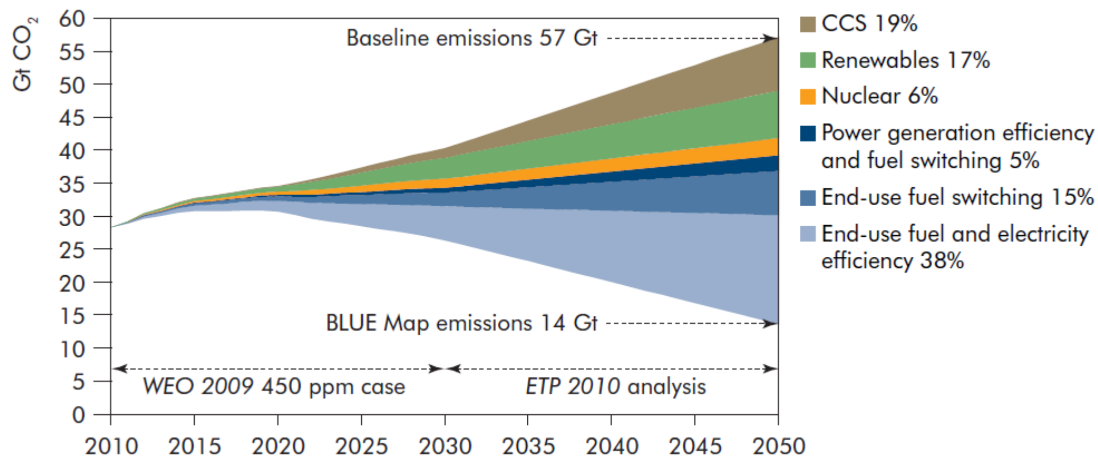


Figure 34 Key technologies for reducing CO2 emissions by 2050 and expected impact of CCS (© IEA[9], 2010)

The European Commission has made a commitment to developing CCS, firstly, by the Commission's announcement to contribute up to €50m to help China build a test facility, and secondly, by having a dozen or so demonstration plants running by 2015 on the continent. The UK is also following suit, with a commitment from the government to provide financial support for up to four commercial scale CCS projects, and if the technology is proven, to be prepared for a nationwide roll out. However, developing CCS is a costly exercise and the current economic conditions do not help the financial

[9] IEA (2010) ; ‘Energy Technology Perspectives 2010’, page 55, http://www.iea.org/Textbase/npsum/ETP2010SUM.pdf

obstacles that the EU and Britain face in funding demonstration projects, with reports that there is a potential funding shortfall for the dozen or so pilot projects.

The UK is in a good geographical position to exploit CCS opportunities since a number of suitable offshore CO_2 reservoirs (or 'sinks') have been identified in the North and Irish Seas for EOR, or simply for storage. There are currently three main CO_2 capture pilot projects in the UK, all testing Coal Pre-Combustion Capture technologies (IGCC):

- Centrica is planning to invest about £1 billion on building the power plant to be developed by Coastal Energy Ltd, provided the company gets approval and planning permission. The construction is planned to enable the station to start operation in 2012 or 2013. The project will also include the development of a CO_2 pipeline that will transport the CO_2 to the North Sea. The pipeline development will be owned by Coots Ltd.
- E.ON has announced it will commission a single IGCC module with CCS, to be built at their Killingholme site in Lincolnshire. The CO_2 will be stored in a depleted gas field in the southern North Sea. The total investment cost is about £1 billion. The feasibility study was completed in September 2006.
- PowerFuel plant at Hatfield with CCS technology to be used to enable EOR at the Brent Oil Field (North Sea). The project requires an investment of £800 million and is currently at the feasibility study stage.

A list of UK projects being planned can be found on website of the Carbon Capture and Storage Association[10].

4.3.2 Supply Chain Opportunity

Carbon capture and storage (CCS) consists of three stages of: (1) CO_2 capture, (2) transportation and (3) geological storage (e.g. in saline formations, oil and gas reservoirs, or deep un-minable coal seams). Currently, there is no full scale deployment of CCS as the feasibility of associated technologies needs to be demonstrated at each stage of the value chain. The industry is thus at an early stage of development. This study based its analysis on the expected future supply chain published by the IEA, as shown in Figure 35 below.

The current challenges to the full-scale implementation of CCS include:

- **CO_2 capture technology** is commercially available today, and several solutions are competing such as pre-combustion separation, post-combustion separation, advanced pulverised coal combustion or natural capture. However, costs need to be lowered and the technology still needs to be demonstrated at a commercial scale.

---

10 http://www.ccsassociation.org/ccs_projects/uk_projects.html

- **CO_2 transport** has been used for over 30 years in North America with over 30 metric tonnes (Mt) of CO_2 transported per year through 6,200 km of CO_2 pipelines in USA and Canada. However, the transport of supercritical CO_2 has never been achieved at a commercial scale and presents a number of technical challenges. Furthermore, the construction of high-pressure pipeline networks presents a number of regulatory, access, public acceptance and planning challenges for different regions.
- **CO_2 storage** through injection in off-shore geological sites is well known. However, more work is needed to improve predictions of CO_2 behaviour at the commercial scale. Exploration programmes are also needed to locate and characterise suitable storage sites, particularly in deep saline formations.

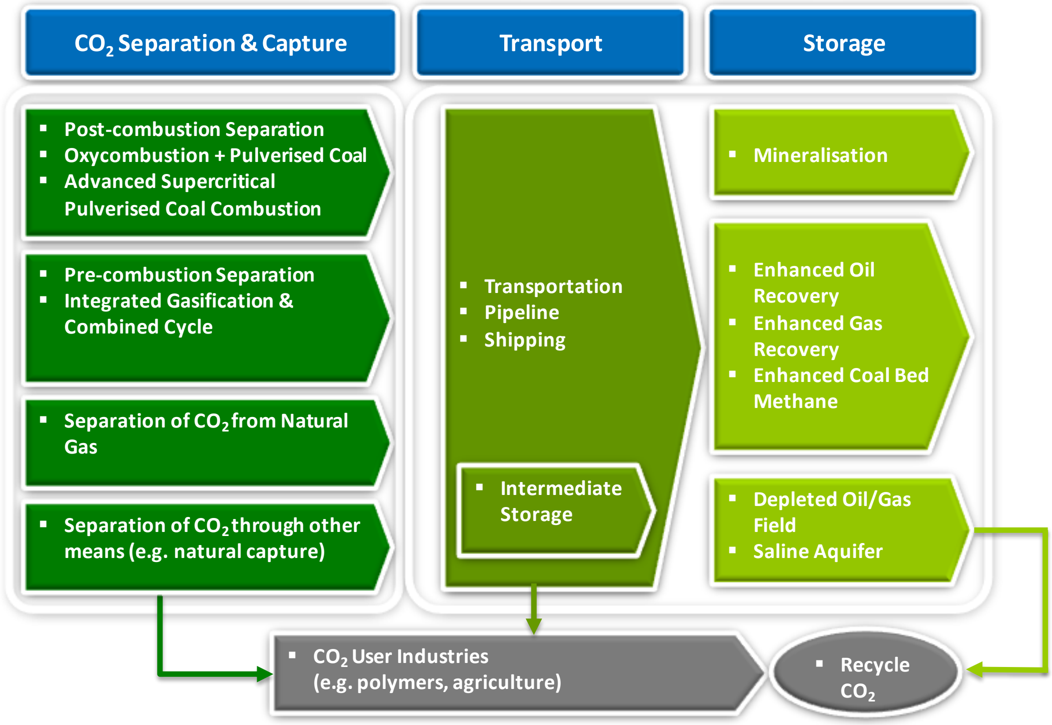


Figure 35 The expected supply chain for the emerging Carbon Capture and Storage industry (© IEA[11], 2009).

Whilst there is a lot of confidence that CCS plants can be effectively deployed at a commercial scale in the future, there is currently no practical experience of operating such a facility[12]. The big issue with the adoption of CCS is that it adds significant costs to production processes. In the current economic climate, CCS is not commercially interesting to companies. The incentive has to be created through regulations and government support.

---

[11] International Energy Agency, 2009; "Technology Roadmap: Carbon capture and storage" http://www.iea.org/papers/2009/CCS_Roadmap.pdf
[12] BERR, 2008; "Towards Carbon capture and Storage", A Consultation Document, June 2008

The value chain analysis of CCS for East Midlands based technical competencies led to the following opportunities for the region's businesses:

1. Machinery and valves
2. Plant automation and control systems
3. Sensors and monitoring systems
4. Structural steel fabrication and CO_2 transport pipelines (long term)

A total of 1,060 manufacturing and related companies with 'high potential' and 465 with 'medium potential' were mapped to these opportunities gaps. Figure 36 shows the distribution of these companies by their primary business activity. Figure 37 to Figure 40 show the breakdown of the 'high potential' companies (by primary business activity) that could have the relevant competencies to take the identified opportunities.

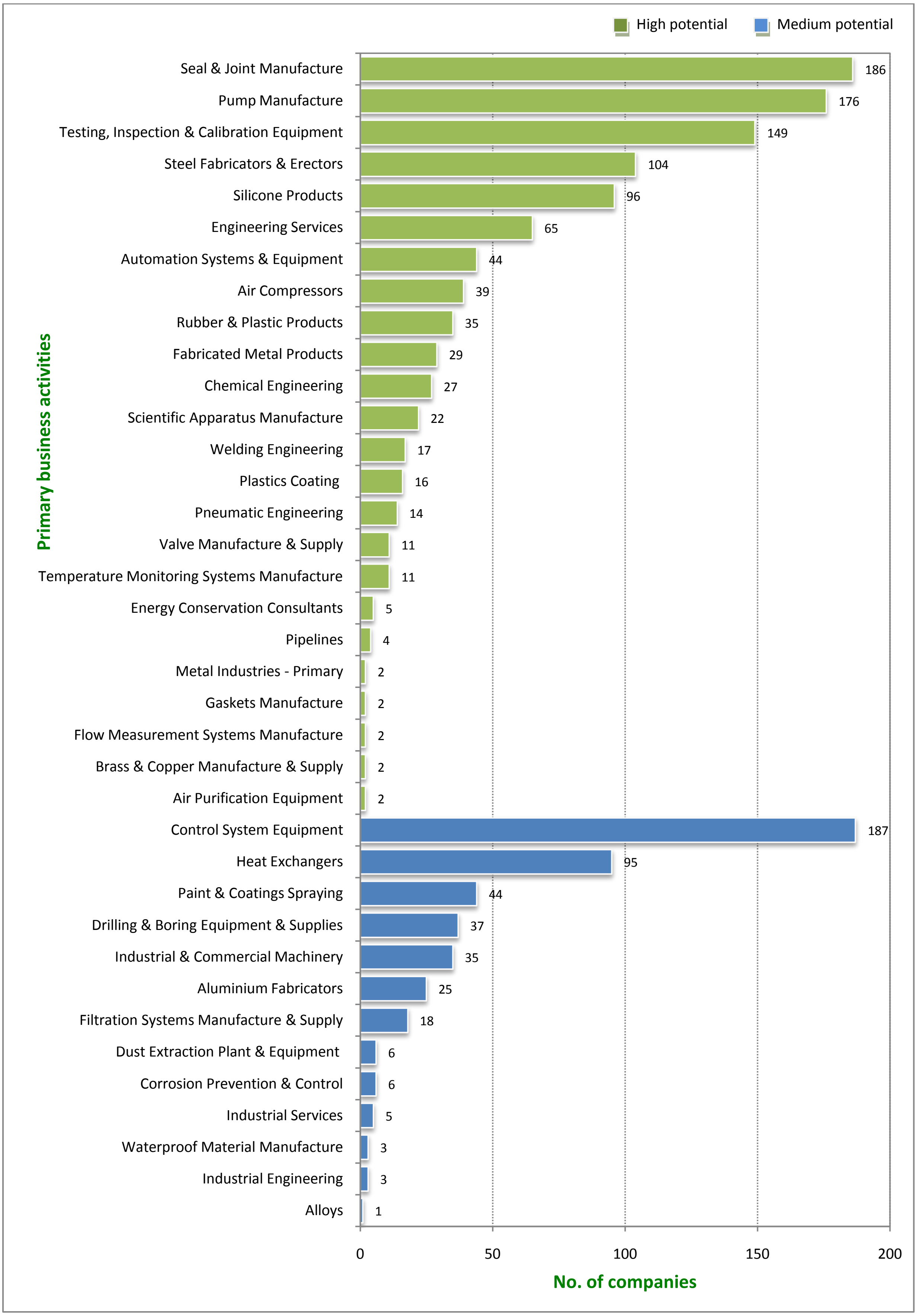


Figure 36 Distribution by primary business activity of 1,060 'high potential' and 465 'medium potential' companies in manufacturing for CCS

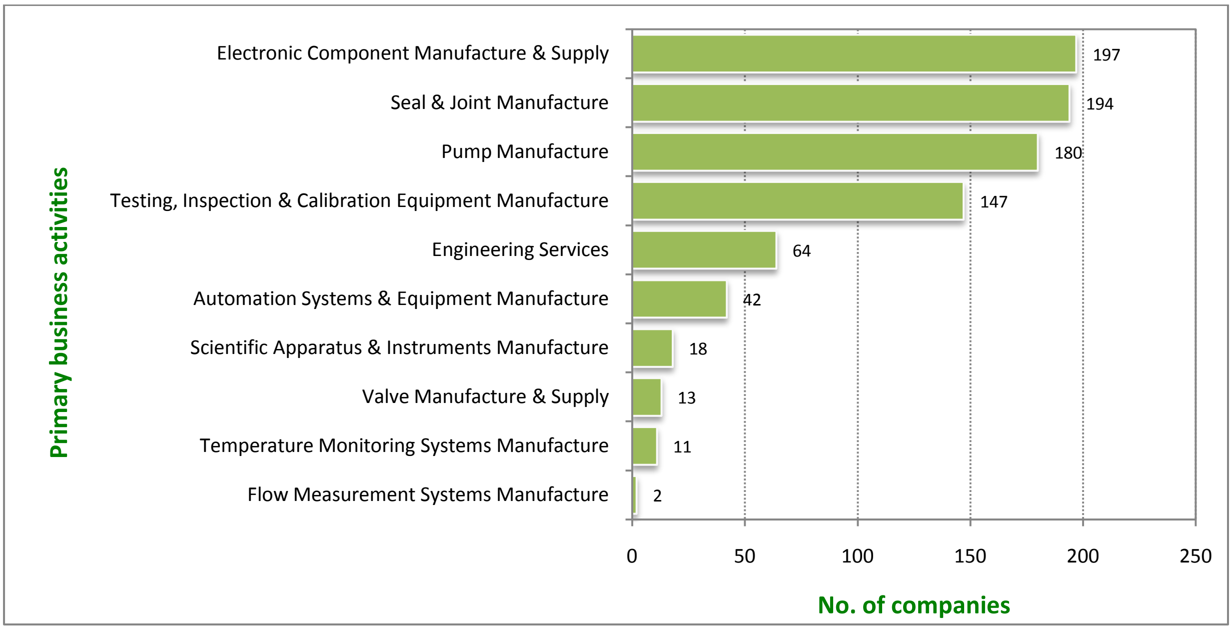


Figure 37 Distribution by primary business activity of 868 'high potential' companies for supplying **plant automation and control systems** for CCS

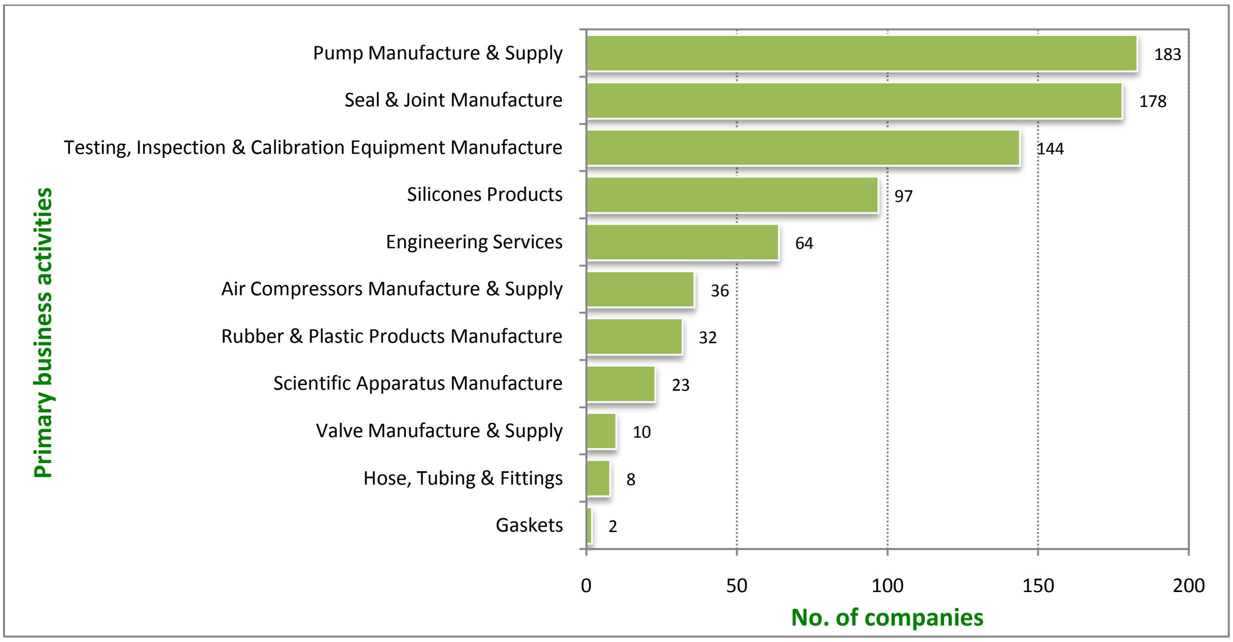


Figure 38 Distribution by primary business activity of 777 'high potential' companies for supplying **machinery, and valves** for CCS

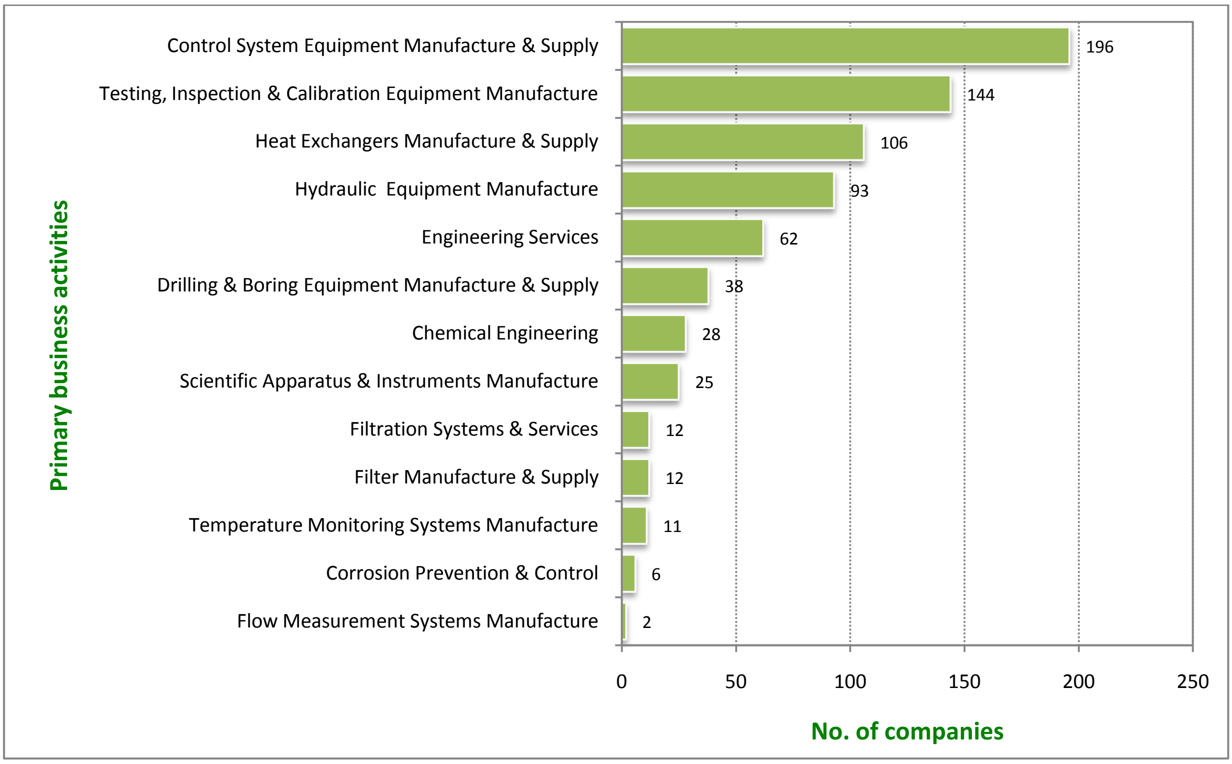


Figure 39 Distribution by primary business activity of 735 ‘high potential’ companies for supplying **sensor and monitoring systems** for CCS

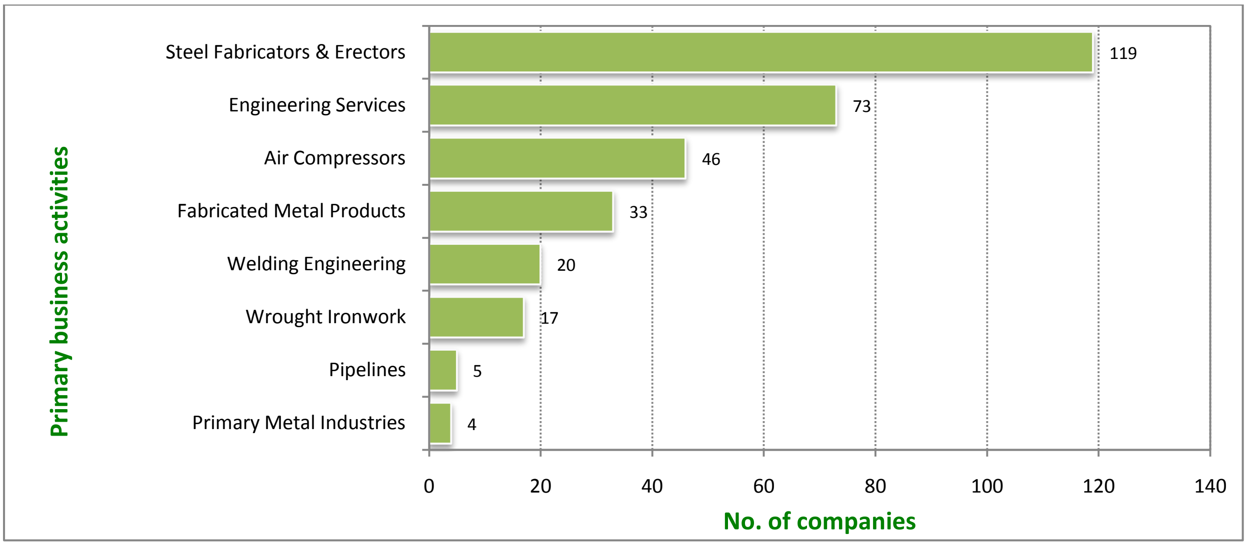


Figure 40 Distribution by primary business activity of 317 ‘high potential’ companies for supplying **structural steel fabrication and CO_2 transport pipelines** for CCS

4.4 Low Carbon Transport

4.4.1 Industry Development

The UK benefits from a good production volume for internal combustion engines manufacture but does not have a critical production volume for vehicles (e.g. it does not compare with manufacturing volumes of France, Germany and Japan). Indeed, there is no global volume vehicle manufacturer headquartered in the UK, and for most automotive suppliers operating in the UK, strategic decisions on future products are mostly taken by the foreign parent company.

However, with low-carbon vehicles the UK benefits from globally competitive R&D capabilities in vehicles and power trains. Radical innovation will not necessarily come from major vehicle manufacturers because of the disruptive nature of low-carbon vehicles. Ultimately, the large-scale deployment of low-carbon vehicles will fundamentally change where and how businesses realise benefit from the manufacture and use of vehicles. To date, the lack of full scale demonstration to test the potential business models makes this area an unproven proposition for investors.

4.4.2 Supply Chain Opportunity

Both electric and fuel-cell powered vehicles have not yet fully demonstrated technological viability and a number of scientific breakthroughs are required before they can become the dominant design on the roads. The industry is thus at an early stage of development, between scientific and technological demonstration.

Work in research and development is still required to enable technological breakthroughs in areas such as battery energy storage, fuel cell stack and hydrogen storage. Currently, low-carbon design improvements focus on vehicle weight and drag reduction, and internal combustion engine and transmission. Current opportunities identified in the low carbon transport supply chain include:

1. Lightweight/low-cost materials
2. Recharging/refilling infrastructure
3. Energy storage for hydrogen and batteries
4. Energy management
5. Emission control

A total of 1,243 manufacturing and related companies with 'high potential' and 246 with 'medium potential' companies in the region were mapped to these opportunities gaps. Figure 41 shows the distribution of these companies by their primary business activity. Figure 42 to Figure 46 show the breakdown of the 'high potential' companies (by primary business activity) that could have the relevant competencies to take the identified opportunities.

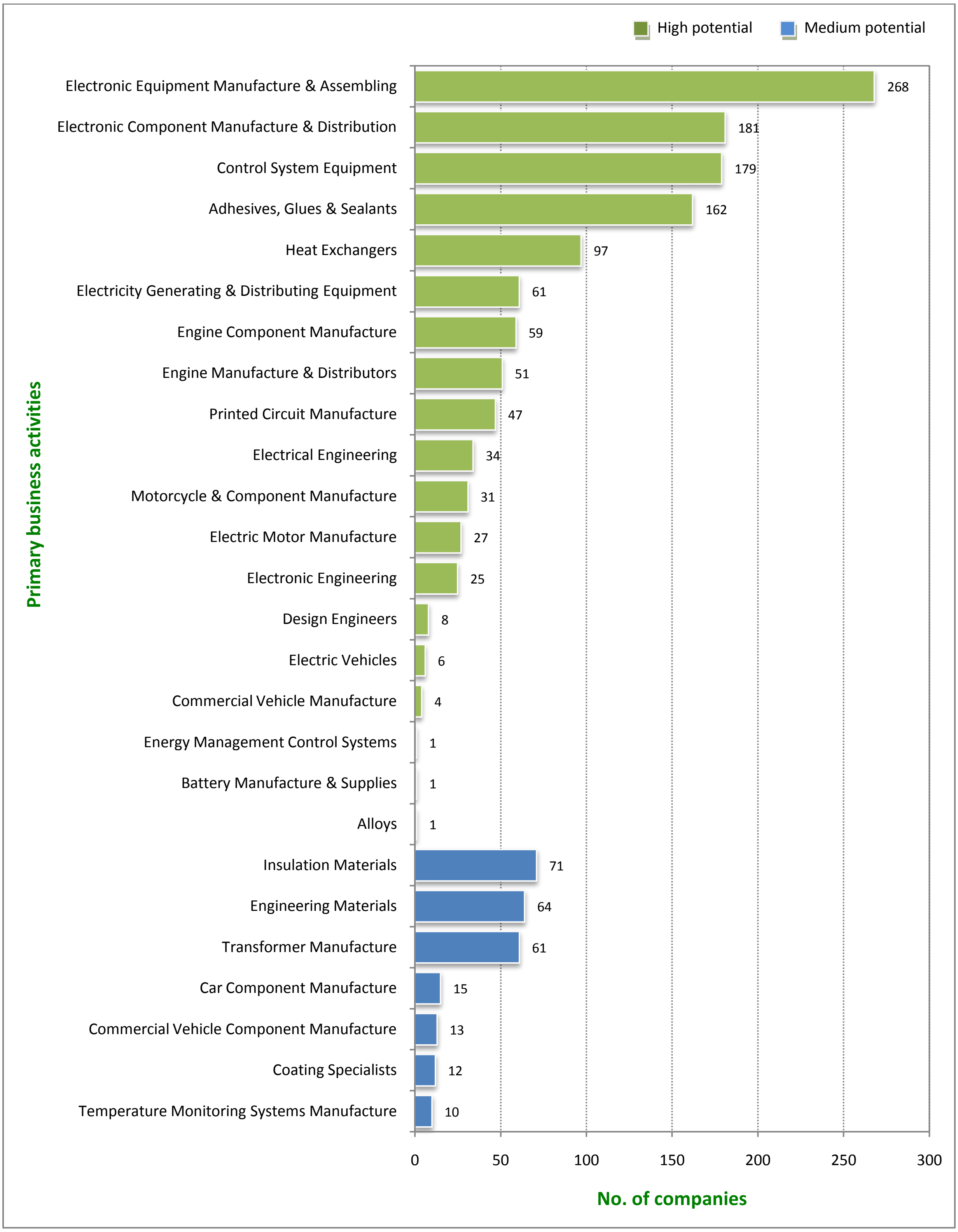


Figure 41 Distribution by primary business activity of 1,243 'high potential' and 246 'medium potential' companies in manufacturing for low carbon transport

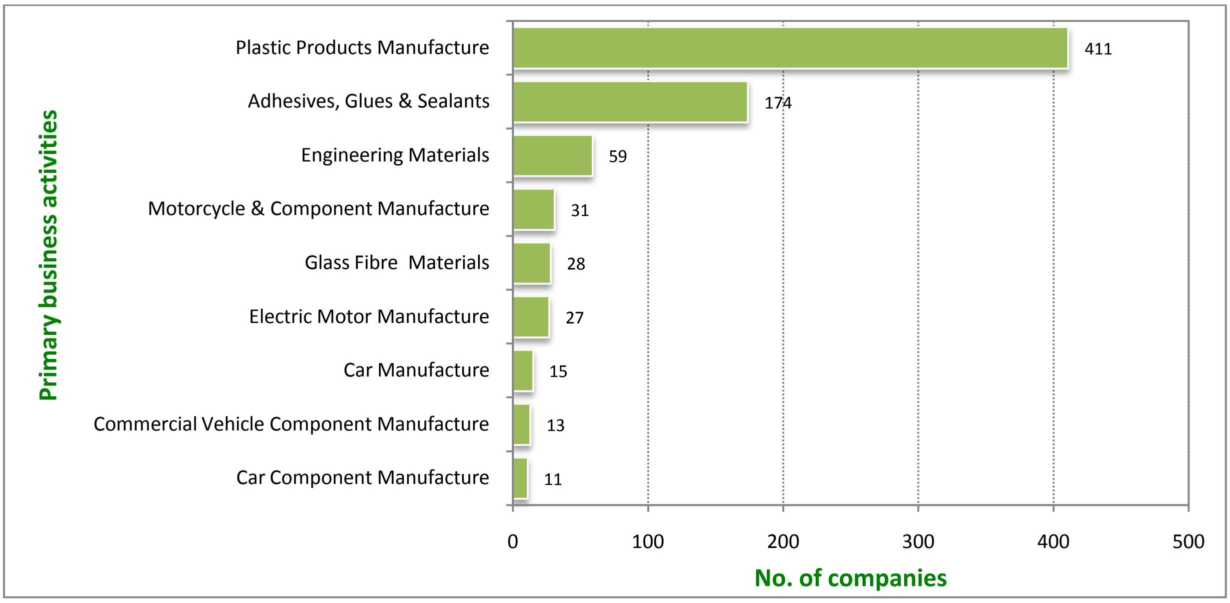


Figure 42 Distribution by primary business activity of 769 'high potential' companies in **lightweight/low-cost materials** for low carbon transport

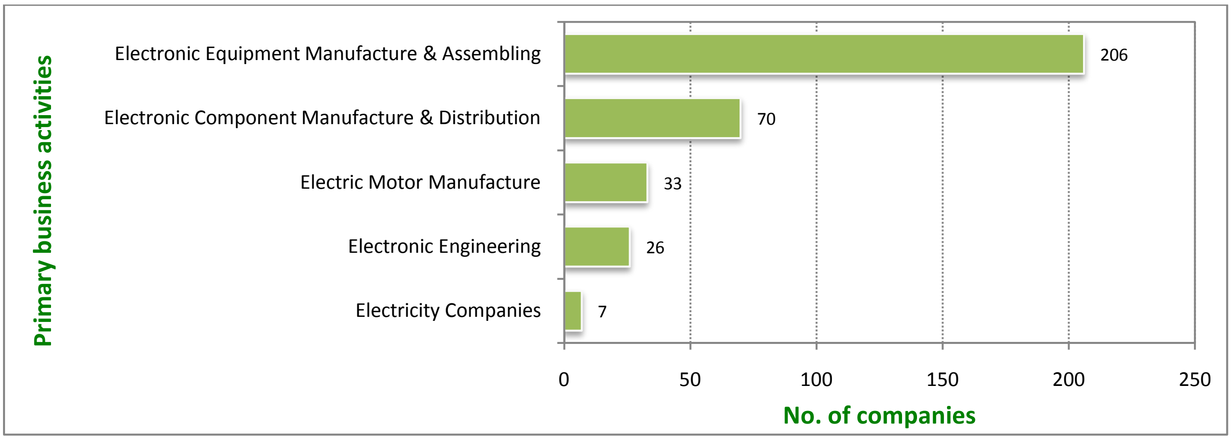


Figure 43 Distribution by primary business activity of 769 'high potential' companies in **recharging/refilling infrastructure** for low carbon transport

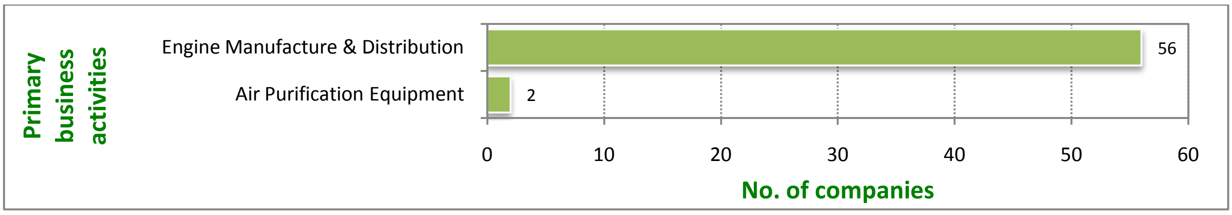


Figure 44 Distribution by primary business activity of 58 'high potential' companies in **emission control** for low carbon transport

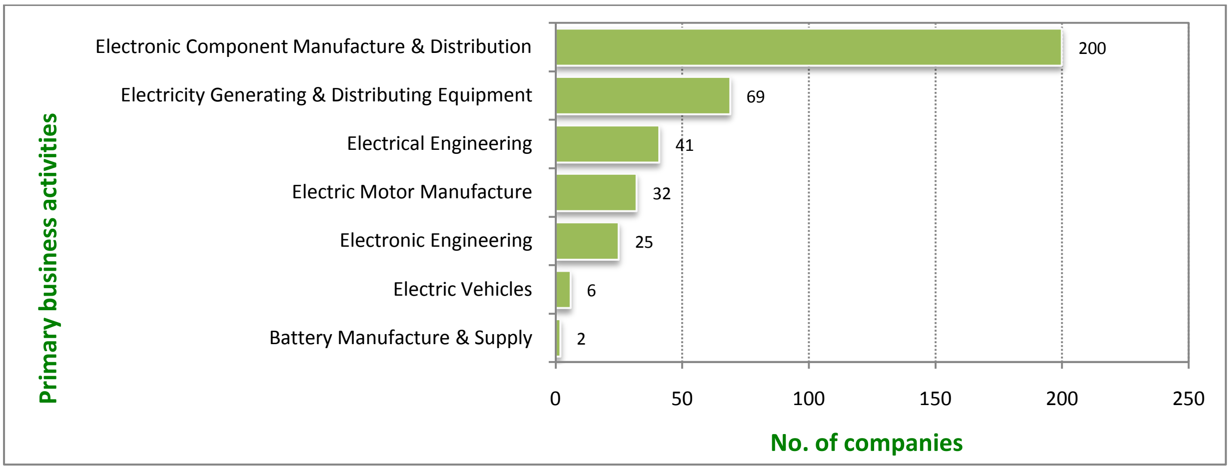


Figure 45 Distribution by primary business activity of 375 'high potential' companies in **energy storage for hydrogen and batteries** for low carbon transport

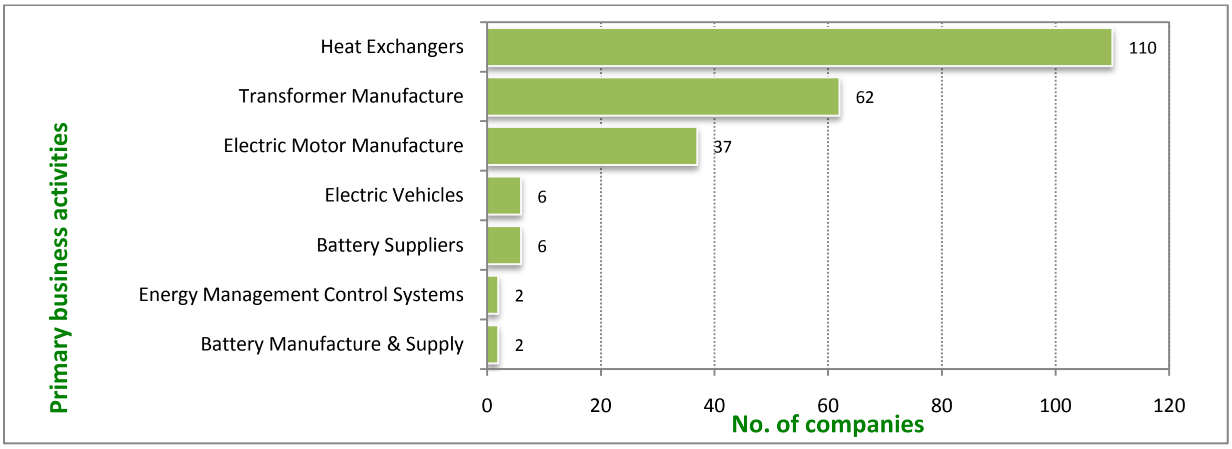


Figure 46 Distribution by primary business activity of 225 'high potential' companies in **energy management** for low carbon transport

4.5 Fuel Cells

4.5.1 Industry Development

With a volume of $570 million in 2009, the world fuel cell industry is still a niche market with a range of technologies competing for the future market. However, rapid market growth in both stationary and portable applications is expected over the next decade. According to Freedonia in May 2009[13], global commercial fuel cell demand will triple through 2013 in dollar terms. Portable fuel cell systems will remain the dominant application by unit, while electric power generation will continue as the top use in value terms. Polymer Electrolyte Membrane (PEM) chemistry fuel cells will strengthen their dominant position over the next decade.

Future products and services associated with fuel cells are expected to include the following:

- **Products** - Stationary (backup and larger scale primary power, combined heat & power), transport (automotive, marine) and mobile power (replacement of batteries and portable generators).
- **Services** - Control systems, system integration, design of components, hydrogen infrastructure support.

The UK government has provided funding support and initiatives to create a 'market pull' by embedding fuel cell technology in the transport industry through building a hydrogen fuelling infrastructure. To this end, the following initiatives have been launched:

- A refuelling station at Birmingham University where a number of university-based hydrogen vehicles can be refuelled[14].
- A Midlands hydrogen ring is planned consisting of hydrogen stations built at the University of Nottingham, East Midlands Airport, Snibston Discovery Park, the vehicle research and testing centres at MIRA, Millbrook and a number of refuelling stations for fuel cell forklift deployments (20 refuelling stations are planned until 2020).
- A Hydrogen Corridor linking Aberdeen to Inverness, some 150 miles, will consist of 5 stations at Aberdeen, Ellon, Peterhead, Findhorn, and Inverurie by 2020.
- Transport for London announced that it will be introducing five hydrogen fuel cell buses to its fleet in 2010. The Olympic Delivery Authority has granted planning permission for a new hydrogen refuelling facility in east London, where the buses will be fuelled and maintained[15].
- Riversimple and Leicester council will collaborate on setting up a hydrogen refuelling point in the city for the first large scale trial of fuel cell powered cars with 30 vehicles participating[16].

---

[13] World Fuel Cells to 2013 - Demand and Sales Forecasts, Market Share, Market Size, Market Leaders, published by Freedonia in May 2009
[14] http://www.fuelcelltoday.com/media/pdf/surveys/2009-Infrastructure-Survey-Free.pdf
[15] http://www.ukinvest.gov.uk/Feature/4052675/en-GB.html
[16] http://www.ft.com/cms/s/0/5a85a828-73eb-11df-87f5-00144feabdc0,dwp_uuid=6a1a3010-8800-11de-82e4-00144feabdc0.html

4.5.2 Supply Chain Opportunity

The fuel cell industry is trying to bridge the gap between successful pilot projects and commercial application. The challenges that the industry is addressing can be summarised as follows[17]:

- **Cost**: The cost of fuel cell power systems must be reduced before they can compete with conventional technologies.
- **Durability and Reliability**: The durability of fuel cell systems has not been demonstrated.
- **System Size**: The size and weight of current fuel cell systems must be further reduced to meet the packaging requirements for automobiles. This applies not only to the fuel cell stack, but also to the ancillary components and major subsystems (i.e., fuel processor, compressor/expander, and sensors) making up the balance of power system.
- **Air, Thermal and Water Management**: Air management for fuel cell systems is a challenge because today's compressor technologies are not suitable for automotive fuel cell applications.
- **Improved Heat Recovery Systems**: The low operating temperature of PEM fuel cells limits the amount of heat that can be effectively utilized in combined heat and power (CHP) applications. Technologies need to be developed that will allow higher operating temperatures and/or more-effective heat recovery systems and improved system designs that will enable CHP efficiencies exceeding 80%.

The UK has over 100 companies involved in the different worldwide fuel cell supply chains. A detailed analysis of strengths and weaknesses of the UK fuel cell industry is available in: The UK Fuel Cell Development and Deployment Roadmap 2005[18]. The main points of the roadmap are:

The UK capabilities in fuel cells are mostly clustered in two groups:

- Solid Oxide Fuel Cells (SOFC) aimed at the market of stationary power generation.
- Proton Exchange Membrane Fuel Cells (PEMFC) targeting the mass market of fuel cell powered cars.

The key issues hindering the fast adoption of technology and the development of a stronger fuel cell community in the UK are:

- Missing clear government policy supporting the fuel cell industry (e.g. extension of feed-in-tariffs to support de-centralised fuel cell power generation).
- Lack of obvious, economical, low-volume, low price-sensitivity early applications.
- Lack of incentives to establish fuel cell supply chain companies in the UK.
- Shortage of advanced skills to foster development of the industry in the UK.

[17] U.S. Department of Energy; Fuel Cell Technology Challenges
http://www1.eere.energy.gov/hydrogenandfuelcells/fuelcells/fc_challenges.html
[18] http://www.fuelcellsuk.org/wp-content/uploads/2009/04/uk-fuel-cell-roadmap.pdf

- Lack of recognition of UK strengths amongst potential international partners.

The structure of the future fuel cell industry is not yet fully defined as there is no mass market. This is due to differences in commercial approaches between system integrators, and suppliers of electrical and materials components. Some system integrators have a vertically integrated business model and cover all processes from design to final product manufacturing, while other companies specialise in one aspect of design or production.

Although there are ongoing development activities across the whole value chain, some products are too early for the market. The biggest obstacle is the route to market for refuelling infrastructure for fuel cell powered transport applications as well as technology readiness and consumer acceptance for portable devices.

The value chain analysis for current fuel cell sector for East Midlands based technical competencies led the following potential opportunities for the region's businesses:

1. CHP and inverters
2. Thermal management systems
3. Adhesives and sealants
4. Ceramic powder manufacturing
5. Press forming plastics, machined graphite

A total of 1,168 companies perceived with 'high potential' and 221 with 'medium potential' were mapped to these opportunity gaps. Figure 47 shows the distribution of these companies by their primary business activity. Figure 48 and Figure 49 show the breakdown of the 'high potential' companies (by primary business activity) that could have the relevant competencies to supply CHP and inverters as well as thermal management systems respectively. Furthermore, the study found 213 adhesive and sealant companies and 190 ceramic manufacture and supply companies that could potentially take the above opportunities.

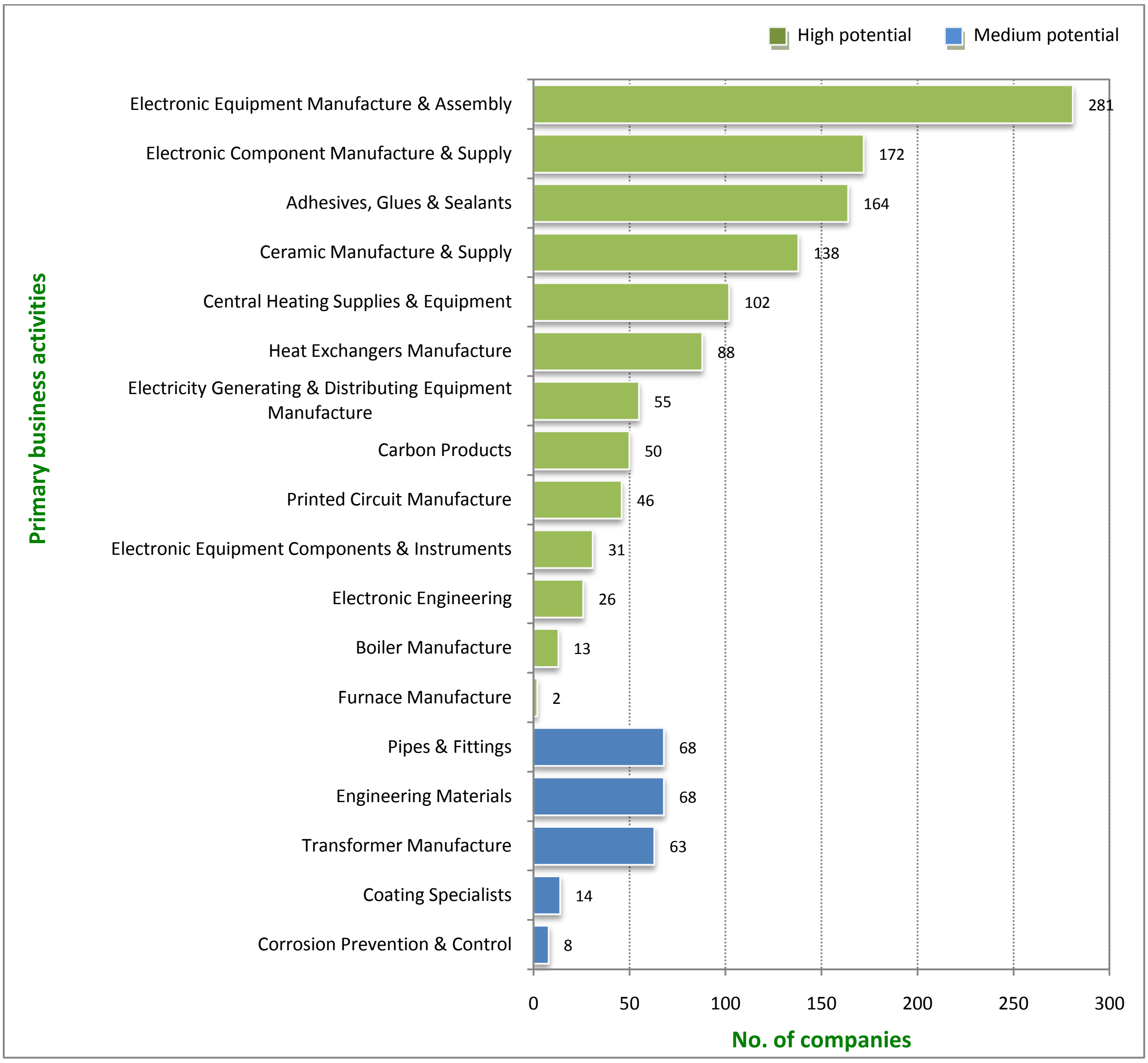


Figure 47 Distribution by primary business activity of 1,168 ‘high potential’ and 221 ‘medium potential’ companies for fuel cells

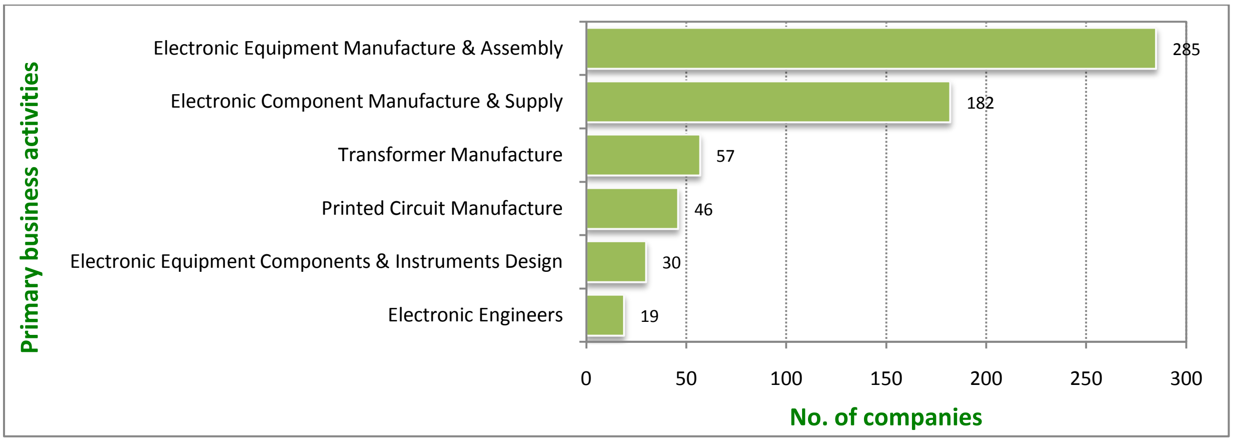


Figure 48 Distribution by primary business activity of 619 ‘high potential’ companies in **CHP and inverter** for fuel cells

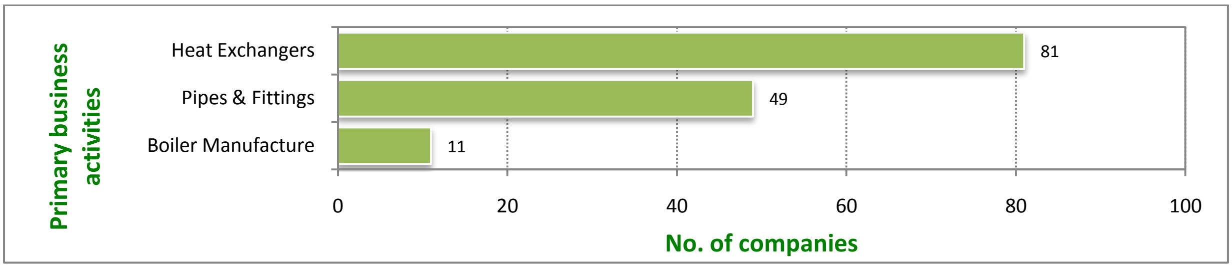


Figure 49 Distribution by primary business activity of 141 'high potential' companies in **thermal management systems** for fuel cells

4.6 Low Carbon Construction

4.6.1 Industry Development

Low carbon construction refers to a range of low-carbon solutions that could be adopted in order to reduce energy losses and the overall carbon footprint of buildings, whether commercial, public, or private. Thus, low-carbon construction is not an industry per se but a grouping of different technologies and products, each of which has a different maturity and readiness for market. For instance, energy-efficient lighting is quite mature, while domestic micro-Combined Heat and Power systems need to be further developed. Reduction of energy consumption and carbon emissions from buildings needs to be delivered by two complementary routes; improved designs for new buildings and retrofitting of existing buildings (e.g. through improved insulation).

Overall, there are a lot of proven technologies that can be readily manufactured and are ready for full market deployment. There are also a number of secondary options that require further demonstration before they can be seriously considered by the construction industry.

Technical know-how for energy-efficient building has been developed over the last twenty to thirty years. For instance, "Passivhaus" is an ultra low-energy construction standard first developed over a decade ago by Dr Wolfgang Feist of the Passivhaus Institut Germany. Today there are approximately 17,000 buildings constructed to the PassivHaus principles worldwide. Those buildings consume 90% less energy than average houses and 75% less than current UK regulations for energy consumption.

However, the UK construction industry struggles to meet current regulations, which are far from zero-carbon standards. A pilot project at Stamford Brook involving the construction of 700 homes was quite revealing. The project was unable to consistently achieve a 25 to 30% improvement on current UK regulations for energy consumption. In some houses, the heat loss, which accounts for the largest part of energy inefficiency, was 100% higher than expected.

4.6.2 Supply Chain Opportunity

The analysis undertaken in this study found that the main barrier to the construction of low-carbon new build is a lack of skills and knowledge about low carbon solutions within the industry, at every step of the value chain. The lack of skills extends through all parts of the construction value chain and to all players from architects to contractors and low-skilled workers.

Capability gaps and opportunities in low carbon construction fall into two categories; new build and retrofitting. Retrofitting solutions are easier to implement since the owner can act independently to improve the energy efficiency of an existing building. As such, change seems easier to implement here than in new buildings, for which a range of stakeholders have to be convinced of the need to adopt disruptive change, from architects to workers.

Challenges for low carbon construction remain, such as:

- Attractive low-carbon solutions need to be fully available for building owners (e.g. efficient lighting, effective insulation, small wind turbines, and photovoltaic panels)
- Low-carbon building options will need to be underpinned by government incentives; at least as long as they are not as cost-efficient as the "business-as-usual" option. This would enable sales volume to increase gradually and hence lead to the generation of manufacturing cost reductions, over time. Many schemes and funding opportunities are already available for private and public building projects to help reduce carbon emissions. Current coalition government deficit reduction measures could call some of these schemes into question.

The value chain analysis for East Midlands based technical competencies revealed the following potential opportunities for the region's businesses:

1. Ultra low-carbon cement/concrete
2. Insulation solutions
3. Advanced boilers, plumbing systems and heat control systems
4. Products to assist building life extension and decarbonisation

A total of 305 manufacturing and related companies with 'high potential' and 221 with 'medium potential' were mapped to these opportunities gaps. Figure 50 shows the distribution of these companies by their primary business activities. Figure 51 to Figure 53 show the breakdown of the 'high potential' companies (by primary business activities) that could have the relevant competencies to take these supply chain opportunities.

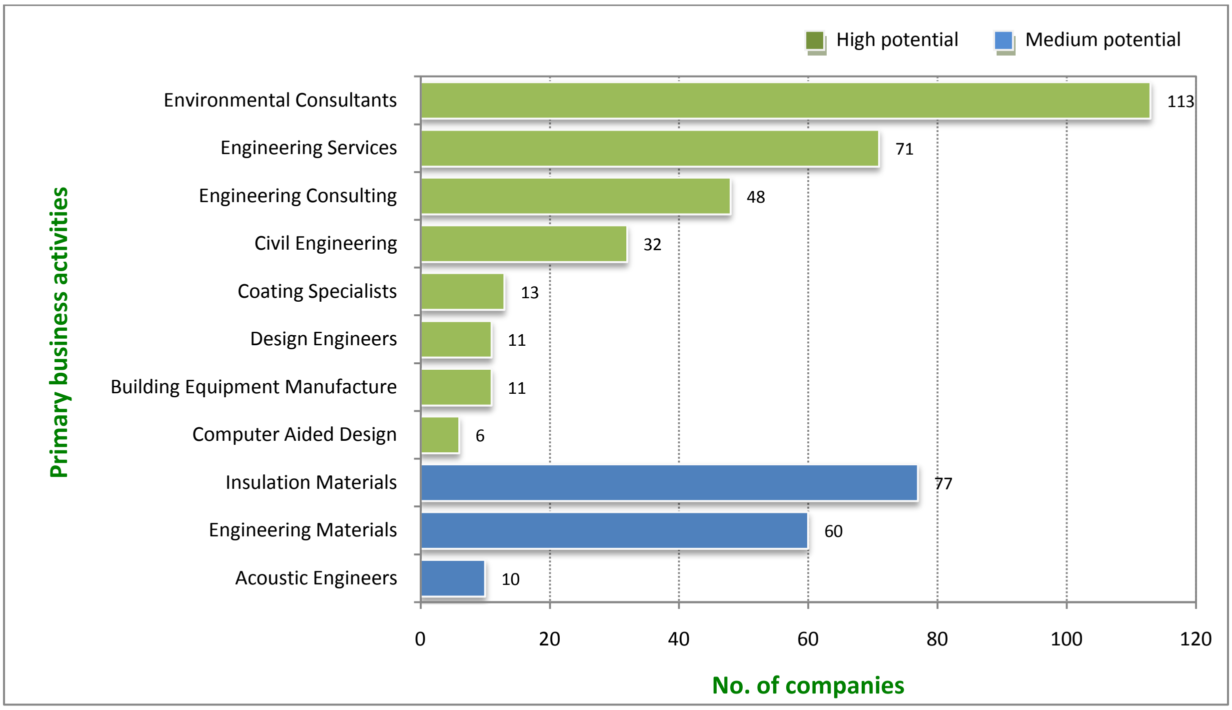


Figure 50 Distribution by primary business activity of 305 'high potential' and 147 'medium potential' companies for low carbon construction

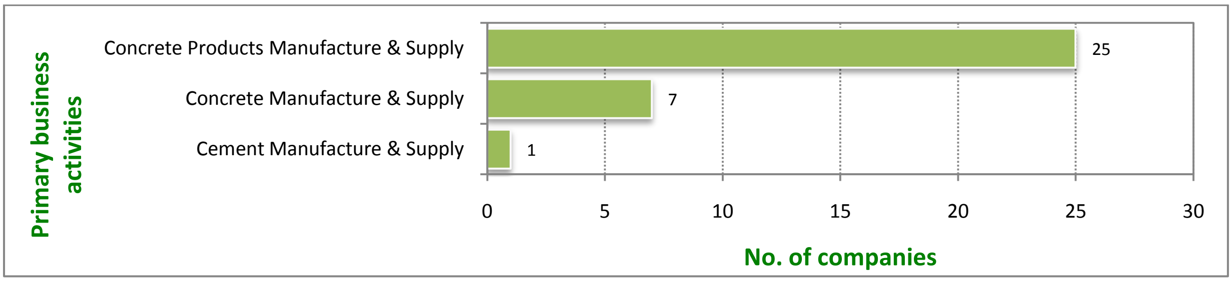


Figure 51 Distribution by primary business activity of 33 'high potential' companies in supplying **ultra low carbon cement/concrete** for low carbon construction

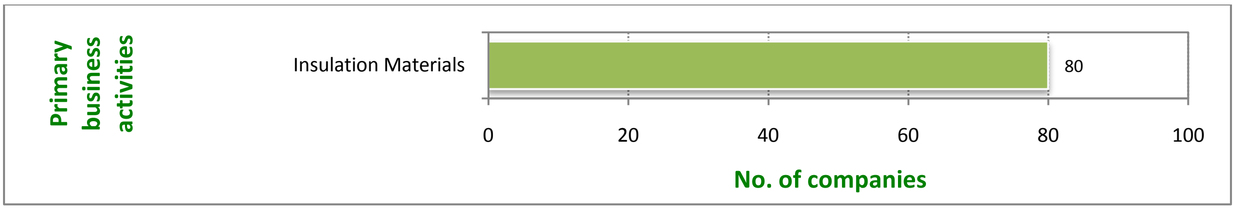


Figure 52 Distribution by primary business activity of 33 'high potential' companies in supplying **insulation solutions** for low carbon construction

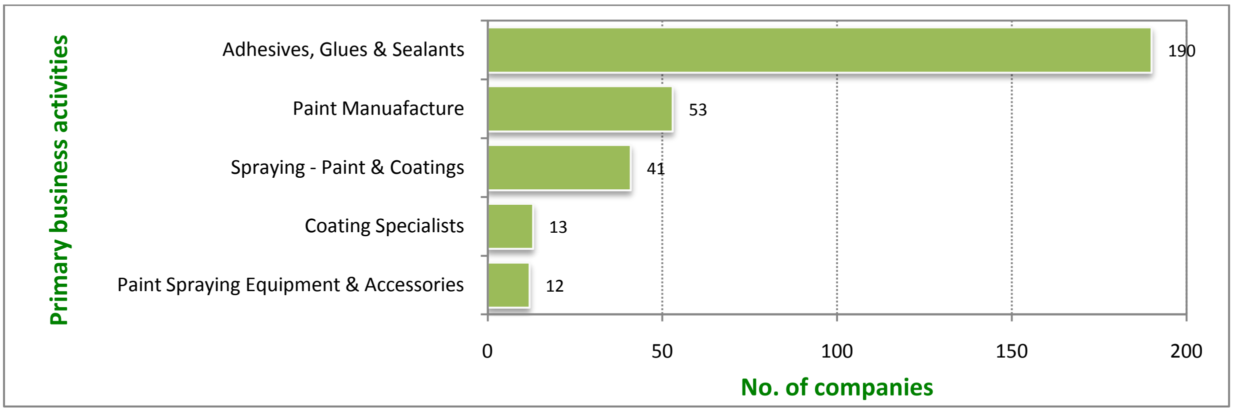


Figure 53 Distribution by primary business activity of 33 'high potential' companies in **building life extension and decarbonisation** for low carbon construction

4.7 Biomass

4.7.1 Industry Development

The increased use of biomass could reduce CO2 emissions but its impact is likely to be minor. Indeed, growth in renewable energy use in the non-OECD nations will come mostly from hydro power and wind power, while in the OECD countries wind power will be the predominant source of renewable energy with biomass playing a relatively lesser role.

In the UK, by far the most commonly used form of bioenergy is in large scale power plants. Over the last decade, the bioenergy industry has been mainly driven by government support for renewable energy rather than by genuine market forces. The most prominent use of bioenergy in the UK is through co-firing biomass in coal power plants[19].

Biomass is a renewable source of energy and is therefore part of the strategy to reduce CO_2 emissions over the next few decades. Two different conversion processes are used to extract energy from biomass:

- Thermo-chemical conversion, which consists of breaking down biomass into intermediates using heat and upgrading these intermediates to fuels using a combination of heat and with catalysts.
- Biochemical conversion, which consists of breaking down biomass into sugars using either enzymatic or chemical processes and then converting them to ethanol via fermentation.

The products and processes for both markets are relatively well-understood, although technical challenges remain. Biomass combustion has been used commercially for decades and biofuel

[19] "Recent trends and future opportunities in UK bioenergy: Maximising biomass penetration in a centralised energy system", Imperial College London, 2008

production was developed on a large scale in Brazil in the 1970s and is increasingly being introduced in Western economies. The industry is thus at full deployment.

4.7.2 Supply Chain Opportunity

Bioenergy includes energy obtained from municipal waste. In 2008, 81 plants were operational in England. It is estimated that between 100 and 500 new operational plants would be needed to deal with England's residual waste, requiring an investment of about £10billion[20].

The Carbon Trust estimates that about 49% of the UK carbon emissions are related to heating. To meet its carbon reduction target, the UK government proposes that renewable sources may need to provide 14% of the heating energy by 2020 (currently less than 1%). The main portion of this will be provided by biomass[21]. In Teesside, a bioenergy plant will produce 24,000 tonnes of road transport fuel out of 100,000 tonnes of biodegradable household and commercial waste. This £52m project will also provide 3MW of electricity[22].

Biomass qualifies for lower subsidies than other forms of renewables and limitations are imposed on co-firing. Over-complexity and indecision by Government make large investments a tough sell to investors, who, despite the proven efficacy of the technology, prefer the less risky and more established coal plants[23].

The economic viability of biomass in developed countries does not compare with oil and gas. While the biomass industry is quite mature, in terms of underpinning technology and required production capabilities, the sourcing of high-energy-density biomass is a major issue. For instance in the UK, biomass supply chains are not yet established and only a small proportion of the required supply of raw materials is sourced through UK suppliers. The price of the raw material is a determining factor and the long term availability of cheap biomass is essential for the survival and development of the industry.

The value chain analysis for the current biomass sector for East Midlands based technical competencies identified the following potential opportunities for the region's businesses:

1. Corrosion control
2. Gas clean up and heat exchangers
3. Emission control

---

[20] Trends and Developments in the UK Waste Management Industry http://www.ebw-uk.com/uk_waste_industry_market_info.pdf

[21] Carbon Trust calls for massive switch to biomass heating, Carbon Trust, http://www.carbontrust.co.uk/news/news/press-centre/2009/Pages/biomass-heating-guide.aspx

[22] Teesside poised for first bioenergy plant in Europe Financial Times, June 2010, http://www.ft.com/cms/s/0/ff2c3df6-821e-11df-938f-00144feabdc0,dwp_uuid=6a1a3010-8800-11de-82e4-00144feabdc0.html

[23] 'Drax to convert boiler to use biomass fuel', Financial Times, July 2010, http://www.ft.com/cms/s/0/55298c26-8478-11df-9cbb-00144feabdc0,dwp_uuid=6a1a3010-8800-11de-82e4-00144feabdc0.html

4. Pre-treatment before co-firing
5. Pelletisation technology

A total of 400 manufacturing and related companies with 'high potential' and 144 with 'medium potential' were mapped against these opportunities. Figure 54 shows the distribution of these companies by their primary business activity. Figure 55 to Figure 59 show the breakdown of the 'high potential' companies (by primary business activity) that could have the relevant competencies to take these opportunities.

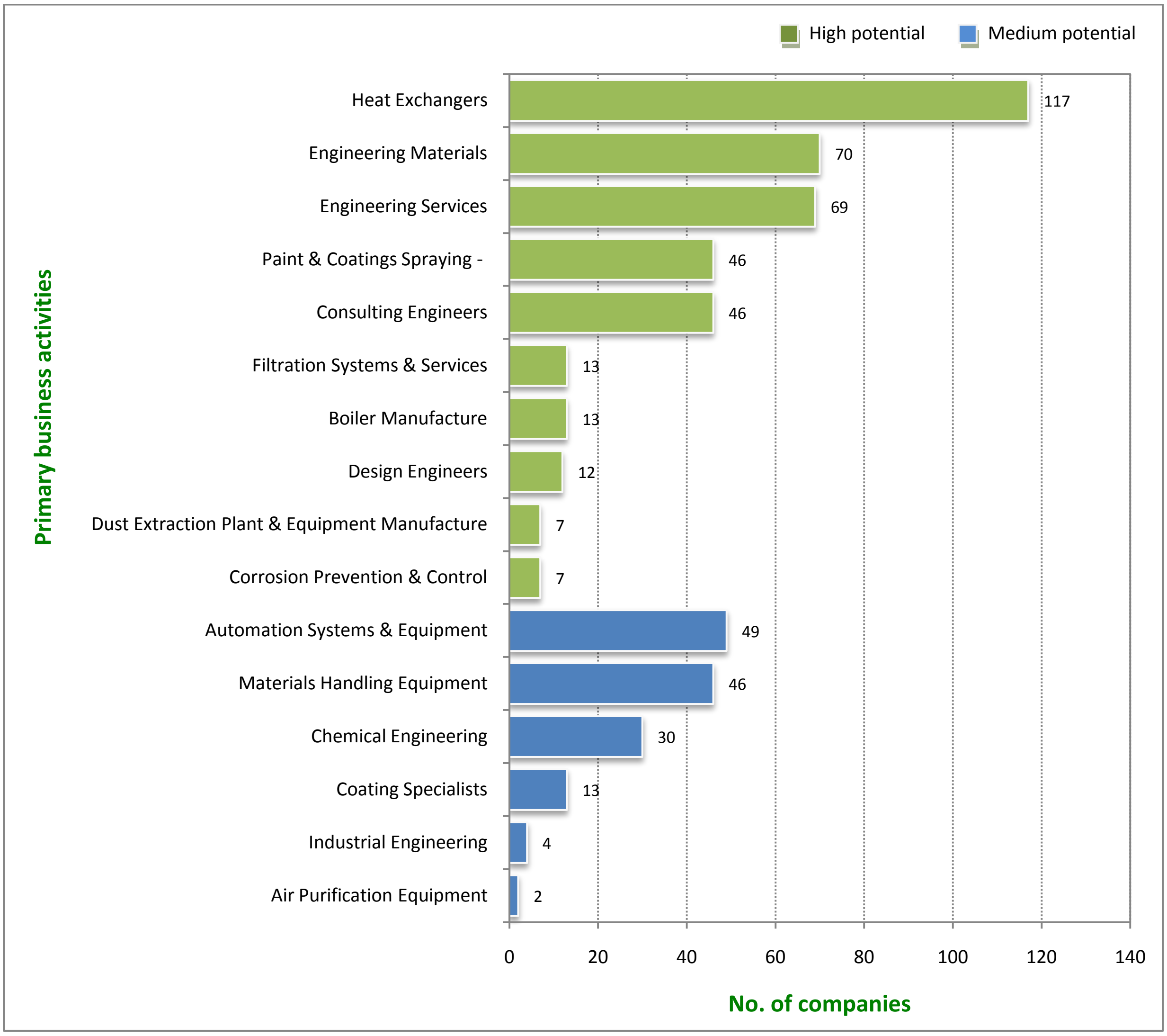


Figure 54 Distribution by primary business activity of 400 'high potential' and 144 'medium potential' companies for the biomass sector

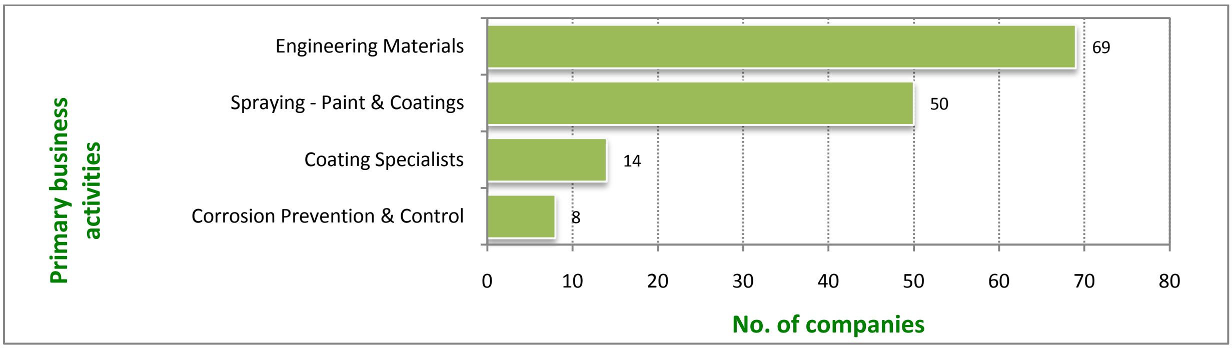


Figure 55 Distribution by primary business activity of 141 'high potential' companies in supplying **corrosion control** for the biomass sector

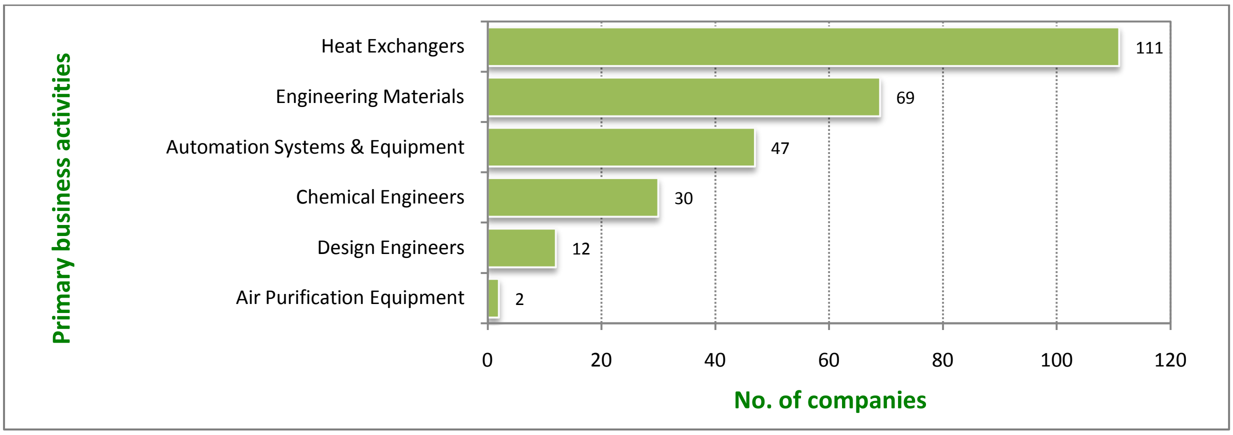


Figure 56 Distribution by primary business activity of 271 'high potential' companies in supplying **gas clean up and heat exchangers** for the biomass sector

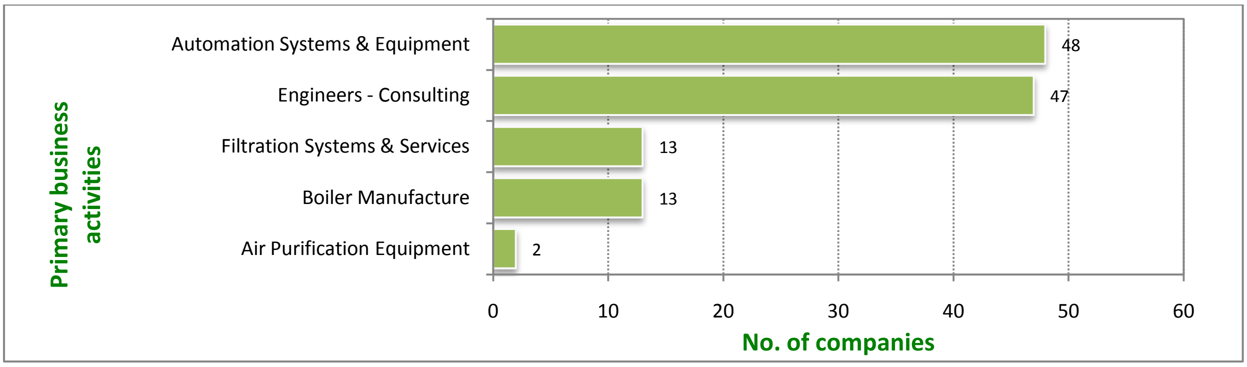


Figure 57 Distribution by primary business activity of 123 'high potential' companies in supplying **emission control** for the biomass sector

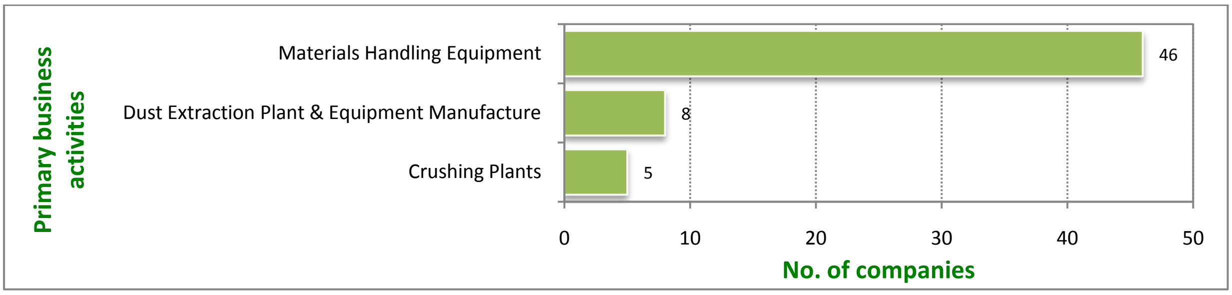


Figure 58 Distribution by primary business activity of 59 'high potential' companies in supplying **pre-treatment before cofiring** for the biomass sector

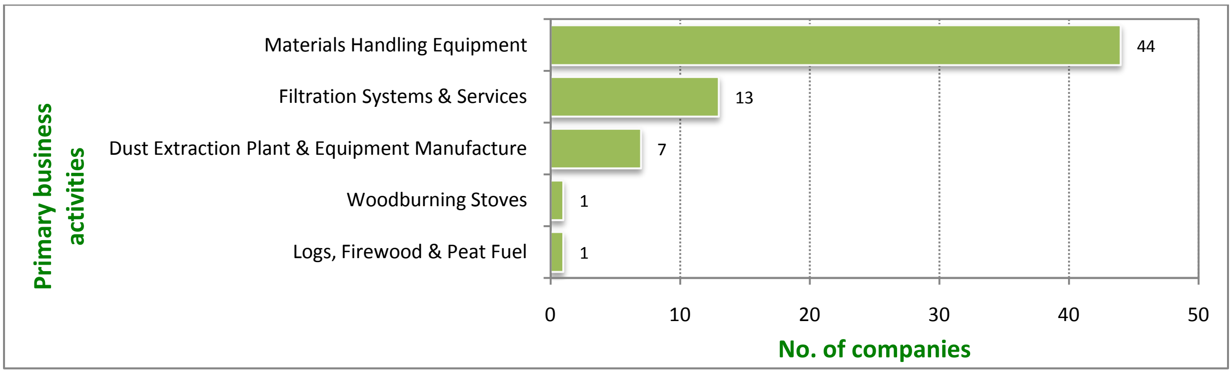


Figure 59 Distribution by primary business activity of 59 'high potential' companies in supplying **pelletisation technology** for the biomass sector

4.8 Solar Photovoltaic

4.8.1 Industry Development

According to a publication by Pike Research in 2010[24], the solar industry is going through a phase of restructuring, triggered by a shift from supply constricted to demand-driven market conditions. Some of the consequences of the economic downturn are listed below[24]:

- Strong growth of crystalline silicon cells and module production commensurate with rapidly increasing availability of polysilicon at plunging prices
- Limited availability of credit and financial resources restricting project financing
- Spain's dramatic demand decline after extremely generous feed-in-tariffs (FITs)[25] were capped in October 2008
- Cost per watt ($/W) and return on investment becoming the dominant drivers in the market

In 2009, Photovoltaic (PV) modules experienced a significant dip in prices, caused by the shift from high demand that could not be met by the companies, to oversupply of products.

Manufacturing costs are being forced down and are estimated to drop to $1.50/W during the first quarter of 2010 and hover around $1.30/W by the end of 2010. The "grid-parity" (the cost of producing electricity from renewables equals the cost of producing electricity from conventional power plants) is estimated at about $1/W[24]. The massive capacities built up by the market are estimated to reach 30GW by the end of 2010; for a demand of merely 10GW worldwide. It is therefore expected that consolidation of the market is inevitable to stabilise the industry.

In the UK, feed-in-tariffs came into effect in April 2010. In all the main European markets, it took the industry three years to develop a substantial market share and it is expected that the full effect of the feed-in-tariffs will only become apparent after about three years. This time period is needed to get acceptance from the general public, develop installation and maintenance skills as well as production and assembly of PV modules.[26]

The Photonics Knowledge Transfer Network recommended[27] that the UK considers a number of options to support its solar industry development:

---

[24] "The New Solar Market: Implications of the Shift to a Demand-Driven Market; Key Differentiators to Watch in 2010 and Beyond", 2010, Pike Research

[25] "A FIT is a payment for energy. It is likely to be a payment greater than the standard power price that is paid to generators using 'emerging technologies' and often from renewable sources.", Feed-in Tariffs for the UK, Good Energy Ltd, March 2009

[26] http://www.energyportal.eu/latest-solar-energy-news/8808-experts-predict-dazzling-solar-future-for-uk.html

[27] UK Photovoltaic Solar Energy Road Map, January 2009, prepared by Anne Stafford and Stuart Irvine, OpTIC Technium/Glyndŵr University in association with Photonics KTN

- Establish a strong PV industry or sector body, able to provide support to companies and advise decision makers as well as consumers. In Germany, the solar industry has a well established and strong lobby to represent its interests among the decision makers.
- Build a comprehensive database of current UK manufacturers, businesses and other support organisations that contribute to the PV value chain.
- Develop a proper marketing strategy for the PV industry.
- Establish a UK test laboratory.

4.8.2 Supply Chain Opportunity

The worldwide photovoltaic market is volatile and competition is keen. Significant shifts have occurred recently, with First Solar establishing itself as the market leader in 2009. The market leader from 2008, Q-Cells, ended 2009 in a difficult financial situation and had to adopt a drastic restructuring programme to survive. Globally, the industry has changed dramatically over the last few years. China and Europe overtook Japan as the major producers of solar cells and China has become the major manufacturing location in just five years.

Although solar panel modules are expected to become competitive with conventional power generation options ("grid-parity") in the UK in the future, the time span required depends to a great extent on the technology's economic viability. The cost of power output has to fall to around $1/W. This requires cost savings that will have to be delivered through technology advances and moving production to countries with lower labour costs.

Because of the current high cost-per-power-output the adoption of solar technology and the build up of installation and maintenance capabilities depends to a large extent on feed-in-tariffs (FIT) and other government subsidies. FITs create a strong market necessary to support home-grown industry development and inward investment.

The value chain analysis for current solar PV technical competencies based in the East Midlands revealed the following potential opportunities for the region's businesses in the following areas:

1. Batteries and electricity storage
2. Electronic interconnects
3. Plastics thin film reel to reel printing
4. Lightweight materials
5. Glass Panels
6. Specialised coatings for glass panels

A total of 918 manufacturing and related companies with 'high potential' and 162 with 'medium potential' were mapped to these opportunity gaps. Figure 60 shows the distribution of these companies by their primary business activity. Figure 62 to Figure 64 show the breakdown of the 'high potential' companies (by primary business activity) that could have the required competencies to meet these supply chain opportunities. Furthermore, the study found 213 adhesive and sealant companies, 190 ceramic manufacture and supply companies and 14 specialist coating companies that could potentially meet the needs for the other opportunities above.

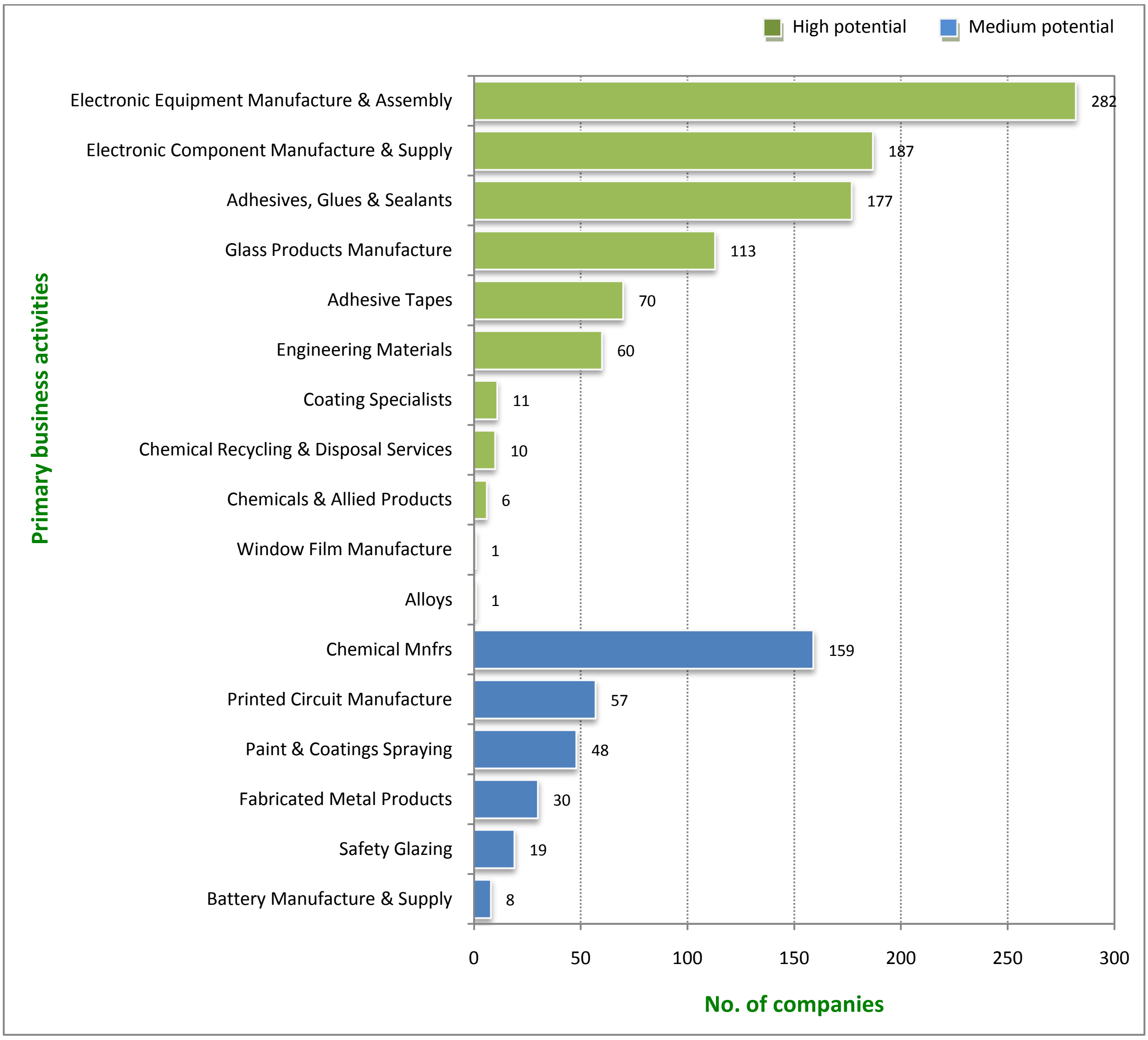


Figure 60 Distribution by primary business activity of 918 'high potential' and 162 'medium potential' companies for solar PV

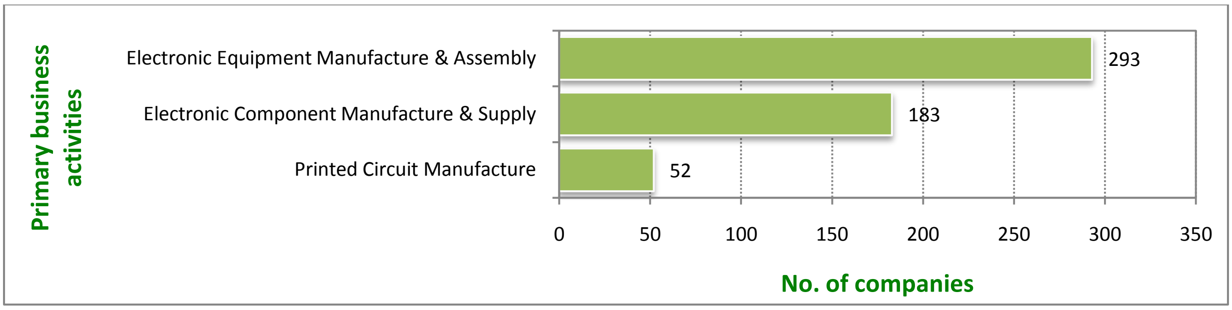


Figure 61 Distribution by primary business activity of 26 'high potential' companies in **electronic interconnects** for solar PV

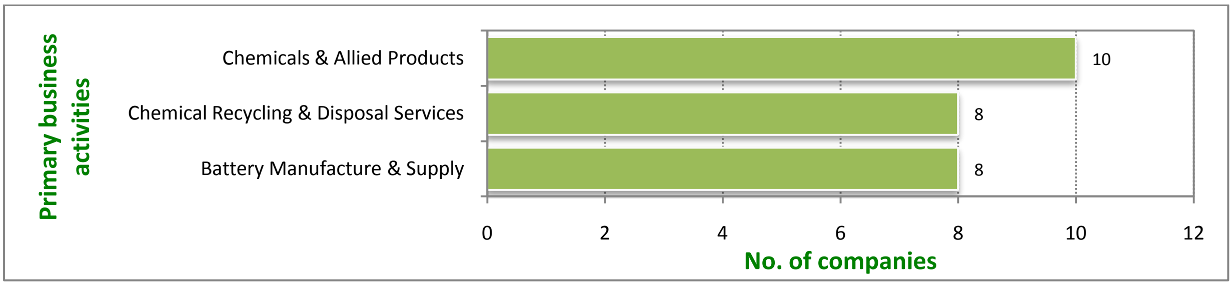


Figure 62 Distribution by primary business activity of 26 'high potential' companies in **batteries and electricity storage** for solar PV

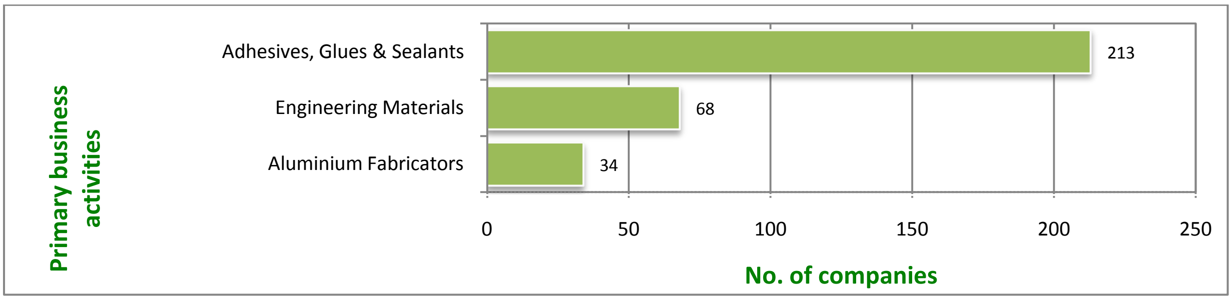


Figure 63 Distribution by primary business activity of 26 'high potential' companies in **lightweight materials** for solar PV

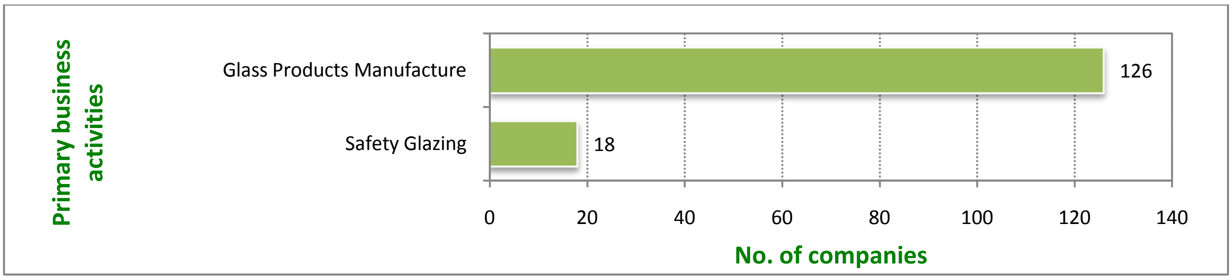


Figure 64 Distribution by primary business activity of 26 'high potential' companies in supplying **glass panels** for solar PV

4.9 Wave and Tidal

4.9.1 Industry Development

The emerging wave and tidal industry is strongly supported by the UK government as well as the EC. Even though wave and tidal power technology has not been fully demonstrated and the various competing concepts have yet to show complete economic and technological viability, 2009 and 2010 has witnessed a flurry of UK government support initiatives for wave energy:

- The Carbon Trust publicly announced[28] in September 2009 the creation of the "Marine Renewables Proving Fund". This £22.5m initiative aims to accelerate the leading marine devices to the point where they can qualify for the Government's existing Marine Renewables Deployment Fund (MRDF).
- The Crown Estate announced[29] in March 2010 the names of the successful bidders for the world's first commercial wave and tidal leasing round, for ten sites in Scotland's Pentland Firth and Orkney waters. Energy developers proposed to install 1.2 GW of wave and tidal capacity for 2020, 600 MW each from wave and tidal.
- The Wave Hub[30] is a groundbreaking renewable energy project to create the UK's first offshore facility to demonstrate the operation of arrays of wave energy generation devices. The project is funded by the EC and the UK government. Installation was launched in the summer of 2010.

Current challenges concern the whole-life reliability of designs and materials, which means that operation and maintenance costs cannot be accurately predicted. Furthermore, the costs of connecting wave and tidal farms to the distribution grid are expected to be high. While the scientific and technological principles of wave and tidal power are proven, the technologies and thus manufacturing systems are not fully demonstrated.

4.9.2 Supply Chain Opportunity

The emerging wave and tidal industry structure will be similar to that of offshore wind. Currently, opportunities are available for designers, as the UK government is allocating funding for proof-of-concept programmes. This indicates that the bottleneck to value creation in this industry is at the R&D and design stages as different UK players are competing to define the dominant design of marine energy structures.

The biggest UK companies in the wave and tidal energy industry include Wave Dragon, Pelamis Wave Power, Ocean Power Technologies, Wavebob, and Aquamarine Power. They all promote different

[28] http://www.carbontrust.co.uk/news/news/press-centre/2009/Pages/marine-energy-prototypes.aspx
[29] http://www.thecrownestate.co.uk/newscontent/92-pentland-firth-developers.htm
[30] http://www.businesscornwall.co.uk/wp-content/uploads/2010/03/RDA-WAVE-HUB-GRAPHIC.jpg

engineering concepts to generate electricity and have working prototypes being tested in real conditions.

If the UK is able to maintain its leading position in design for wave and tidal energy structures there will be increased future opportunities for UK manufacturers through partnerships and networks enabling the transition from the design phase to the high volume manufacturing phase.

Future opportunities will be dependent on the emergence of dominant design for wave and tidal energy structures as well as the confirmation of government-led contracts. It is thought that UK manufacturers will be able to take advantage of these opportunities using technologies and capabilities developed for other industries such as hydrodynamic capabilities, marine design and construction capabilities and mechanical engineering capabilities.

Manufacturing opportunities identified in this study include:

1. Fabrication of wave and tidal structures (although large volumes are unlikely before 2020)
2. Corrosion protection
3. Ruggedness of electrical and electronic components
4. Design of wave and tidal structures

A total of 199 manufacturing and related companies with ‘high potential’ and 242 with ‘medium potential’ were mapped to these opportunities. Figure 65 shows the distribution of these companies by primary business activities. Figure 66 to Figure 69 show the breakdown of the ‘high potential’ companies (by primary business activity) that could have the relevant competencies to take these opportunities.

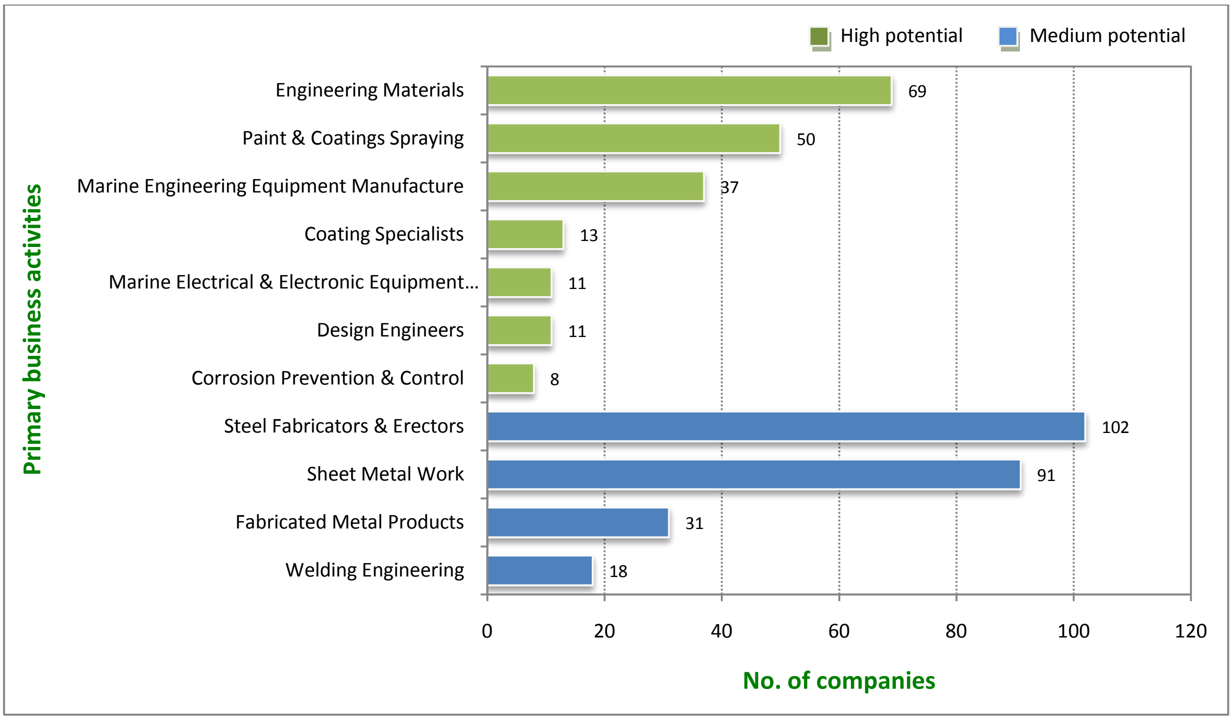


Figure 65 Distribution by primary business activity of 199 ‘high potential’ and 242 ‘medium potential’ companies for wave and tidal

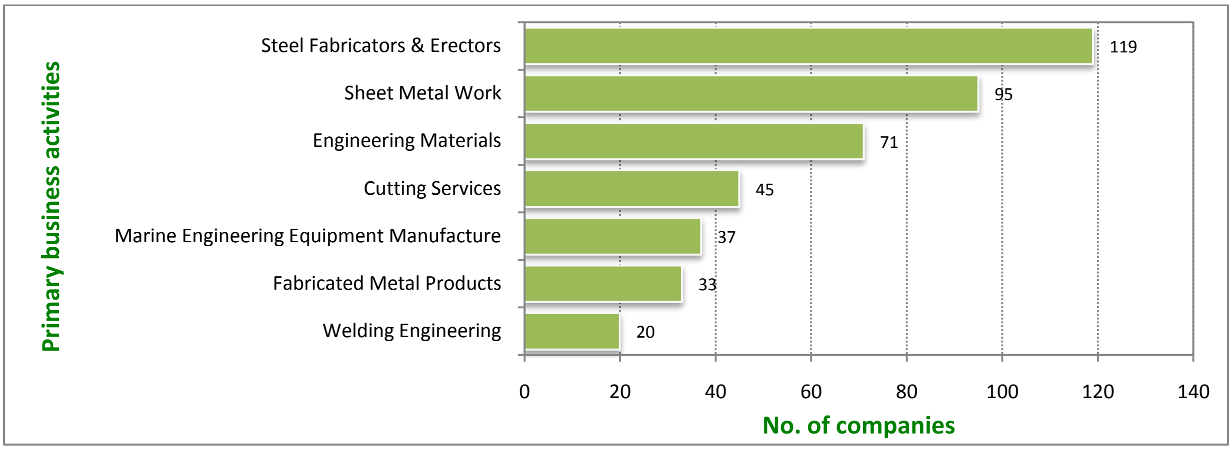


Figure 66 Distribution by primary business activity of 420 'high potential' companies in **fabrication** for wave and tidal

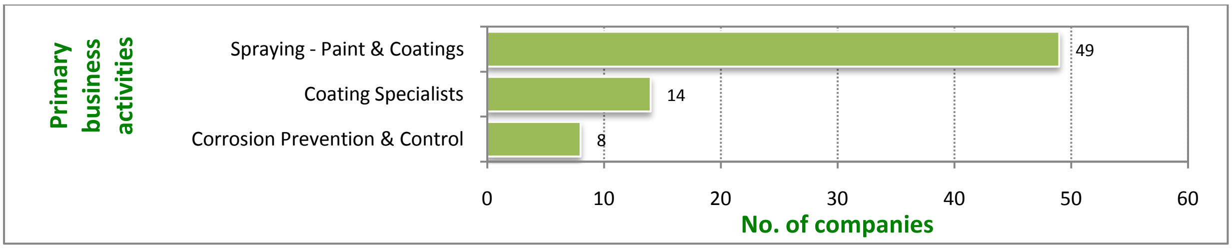


Figure 67 Distribution by primary business activity of 71 'high potential' companies in **corrosion protection** for wave and tidal

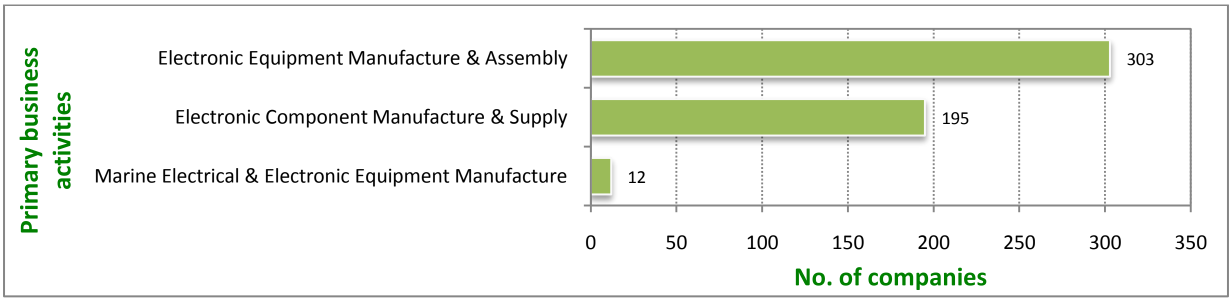


Figure 68 Distribution by primary business activity of 71 'high potential' companies in **rugged electrical and electronic components** for wave and tidal

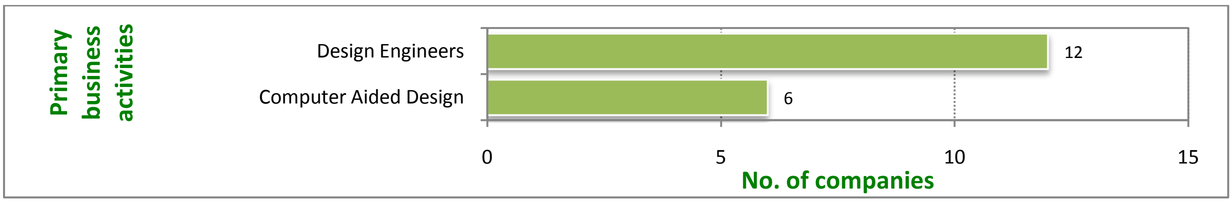


Figure 69 Distribution by primary business activity of 18 'high potential' companies **in design of wave and tidal structures**

4.10 Geothermal

4.10.1 Industry Development

Geothermal energy is defined as energy extracted from natural heat stored in the earth. This heat comes from two sources:

- From the earth's internal heat, originating from the radioactive decay of deep minerals (i.e. earth's inner core) and diffusing to the surface by material conduction.
- From solar energy accumulated in the top ten meters of the ground during summer, and released during winter.

Two types of geothermal energy power generation are currently being investigated:

- Large scale energy and heat generation on the Megawatt scale (deep geothermal energy).
- Ground heat usage for building heating.

Geothermal energy is renewable and virtually carbon-free. As such, geothermal could be included in the carbon mitigation portfolio. However, government interest in this energy has been limited to date and no estimates are available with regard to the expected impact of the emerging geothermal industry for the reduction of CO_2 emissions by 2050.

It is difficult to determine exactly how much geothermal energy is accessible with current technology, or would be accessible with enhanced technology. Some experts estimate that up to 72 GW worldwide could be produced with current technology at known hydrothermal sites. With enhanced technology, these estimates increase to 138 GW[31].

The regions in Europe that are most appropriate to the exploitation of deep geothermal energy are indicated in the map in Figure 70. It can be seen that the UK regions that are best suited to exploit geothermal power are parts of Cornwall, the East Midlands and the North East of England. UK efforts in the geothermal industry have been focused mostly in Cornwall and Newcastle.

Currently, the main markets are the US, Iceland and Indonesia, due to geological conditions that make geothermal heat relatively easy to access. The size of the future geothermal market in the UK is unknown to date, but several initiatives are exploring its potential. In December 2009 DECC announced that three projects had been awarded capital grants under the Deep Geothermal Challenge Fund, launched earlier this year. They were:

- £2.011 million to EGS Energy Limited, to purchase capital items associated with their exploratory borehole at the Eden Centre, Cornwall.
- £1.475 million to Geothermal Engineering Ltd, to purchase capital items associated with their exploratory borehole at Redruth, Cornwall.

---

[31] http://www.geo.tu-freiberg.de/oberseminar/os06_07/Wei%DFflog.pdf

- £461,000 to Newcastle University (supported by engineers Parsons-Brinckerhoff) for recasing an existing 1km deep borehole and boring a new 410m borehole with the intention of providing heat to the proposed Eastgate eco-village, County Durham.

When looking at the energy production cost, geothermal is reasonably competitive. According to the data from the U.S. Department of Energy a geothermal power plant built today would probably have an energy generation cost of about $0.05 per kWh[32], which is nearly comparable to coal and gas power plants. While geothermal energy has higher start-up costs, operational and maintenance costs are lower than for coal power plants (e.g. no fuel costs). Hence, geothermal power plants can be a reasonably competitive investment, even more so if there are government incentives. Factors that keep geothermal costs down are as follows:

- Less land need than for solar or wind
- No fuel cost needed for the operation of the plant
- No CCS needed
- Fewer permits needed than for nuclear and coal plants
- High load factor (90% compared to lower than 40% for solar and wind).

However, there are technology issues and uncertainties concerning geological behaviour over long time periods. Pilot and commercial plants have highlighted the risks of geothermal projects. Those issues currently deter larger investments from the private sector.

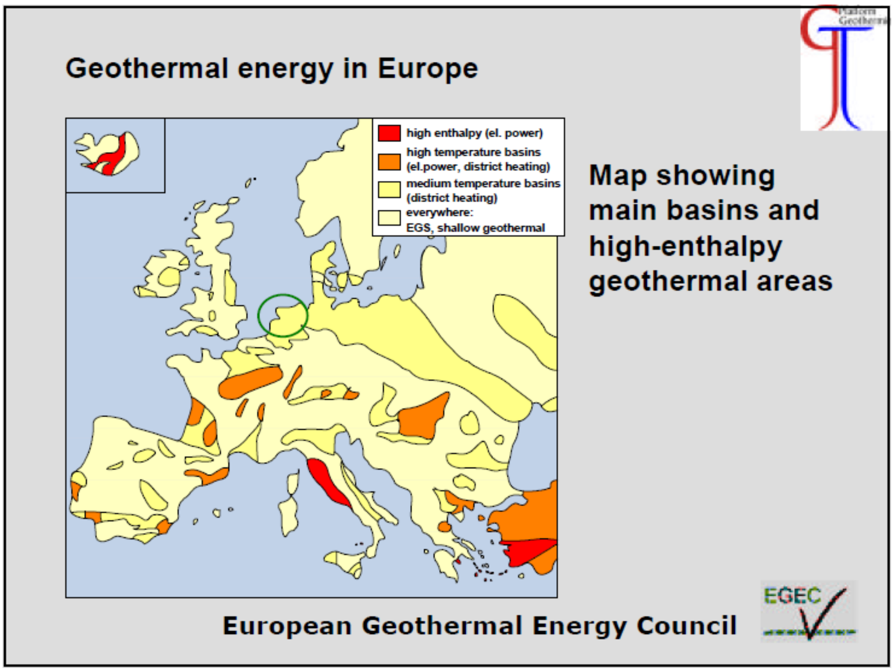


Figure 70 European map of geothermal energy best locations (© European Geothermal Energy Council[33], 2008).

[32] http://renewableenergyarticles.blogspot.com/2010/03/geothermal-energy-costs-things-to-know.html
[33] European Geothermal Energy Council, “Symposium”, Brussels, Assen, 2008

4.10.2 Supply Chain Opportunity

The supply chain for the large-scale geothermal industry is not fully established since projects are treated as one-offs. An International Partnership for Geothermal Technology[34] (IPGT) was set up between Australia, Iceland and the United States. The purpose of the IPGT is to accelerate the development of geothermal technology through international cooperation. EGS Energy Ltd is in an early stage of development and groups throughout the world are working to develop effective methodologies and practices. The main areas of interest of the international consortium are the following[34]:

- Lower cost drilling
- Zonal isolation/packers
- High temperature tools
- Stimulation procedures
- Modelling
- Exploration technologies.

Currently, there are no major UK players in the deep geothermal power plant market, but that could change with the recent government support to some large-scale projects, which include.

- The power plant at the **Eden Centre** would consist of a two borehole system – one injection well and one production well, both around 3-4km deep. Water would be circulated between the bottoms of the two wells, with it being heated by the hot rocks in the process and returning to the surface at approximately 150ºC. There it would drive a binary turbine to create electricity, at a planned capacity of 3MWe. It is intended that further development of the power plant would see the hot water being used for other purposes such as community heating, before it is returned into the reservoir.[35]
- **Geothermal Engineering** was granted building permission in August 2010 for the first UK geothermal plant which should provide enough electricity to power 20,000 homes. The plant is expected to start operating in 2013[36].
- Concerning the **Newcastle University** work, a major breakthrough was achieved in June 2010; after more than six years of research and development, water at a temperature of 40 degrees Celsius was pumped to the surface.[37]

The uptake of geothermal energy usage for heating buildings is becoming popular and wide-spread in countries like Germany, Austria and Switzerland. Geothermal heat pumps offer high efficiency and low

[34] http://internationalgeothermal.org/IPGT.html
[35] http://www.edenproject.com/media/geothermal-announcement-pr.php
[36] http://www.ft.com/cms/s/0/ecc4b012-a898-11df-86dd-00144feabdc0.html
[37] http://www.ft.com/cms/s/0/438db28e-7ede-11df-8398-00144feabdc0.htm

operating cost. According to the EPA[38], geothermal heat pumps can save homeowners 30 to 70 percent on heating and 20 to 50 percent on cooling costs over conventional systems.

In the UK several companies are established producers of heat pumps extracting ground heat, but no major industry champions have emerged yet and the market is immature. Several reasons inhibit growth, as follows[39]:

- Until recently, there were no major government incentives in the UK to install heat pumps. Fortunately, heat pumps are now included as suitable technology under the Energy Efficiency Commitment, Low Carbon Buildings Programme (Phase 2), and the Scottish Community and Householder Renewables Initiative (SCHRI) funding schemes
- The majority of UK R&D is focusing on cooling, not heating technology
- Low awareness of the saving potential that heat pumps offer among the UK public. This is mostly caused by the lack of direct marketing from authorities and companies to demonstrate the potential of this technology
- The systems used by the companies vary significantly, thus confusing consumers. No heat pump technology has managed to establish itself as the "industry standard" yet.
- No independent test centre exists in the UK to check the quality of the products on the market. An accreditation system similar to those found in Europe (i.e. the D-A-CH label) would give customers added reassurance and help to allay fears regarding investing in a new technology.

The supply chain for geothermal energy for power generation is not fully established as projects occur as one-offs. The bottleneck lies in the technology challenges of exploiting geothermal heat sources at several hundred meters depth. Moreover, the economic viability and technology risks of geothermal projects deter the private sector from investing. Indeed, technology issues and uncertainties concerning geological behaviour over long time periods have highlighted the risks of geothermal associated with the large scale adoption of this method of energy generation.

The manufacturing opportunities in the geothermal industry identified in this study include:

1. Heat pump technology adaptation to UK market
2. Directed lower-cost drilling
3. Corrosion and scaling resistance for tubing and turbines
4. High temperature tools
5. Incremental generators improvements

A total of 688 companies with 'high potential' and 599 with 'medium potential' were mapped to these opportunities. Figure 71 shows the distribution of these companies by primary business activity. Figure

---

[38] http://www.articlesbase.com/technology-articles/geothermal-heating-versus-air-source-heating-pumps-investment-and-operational-costs-349622.html

[39] "An Investigation into Ground Source Heat Pump Technology, its UK Market and Best Practice in System Design" MSc Thesis, 2007, Pharoah le Feuvre

72 to Figure 76 show the breakdown of the 'high potential' companies (by primary business activity) that could have the relevant competencies to meet these opportunities.

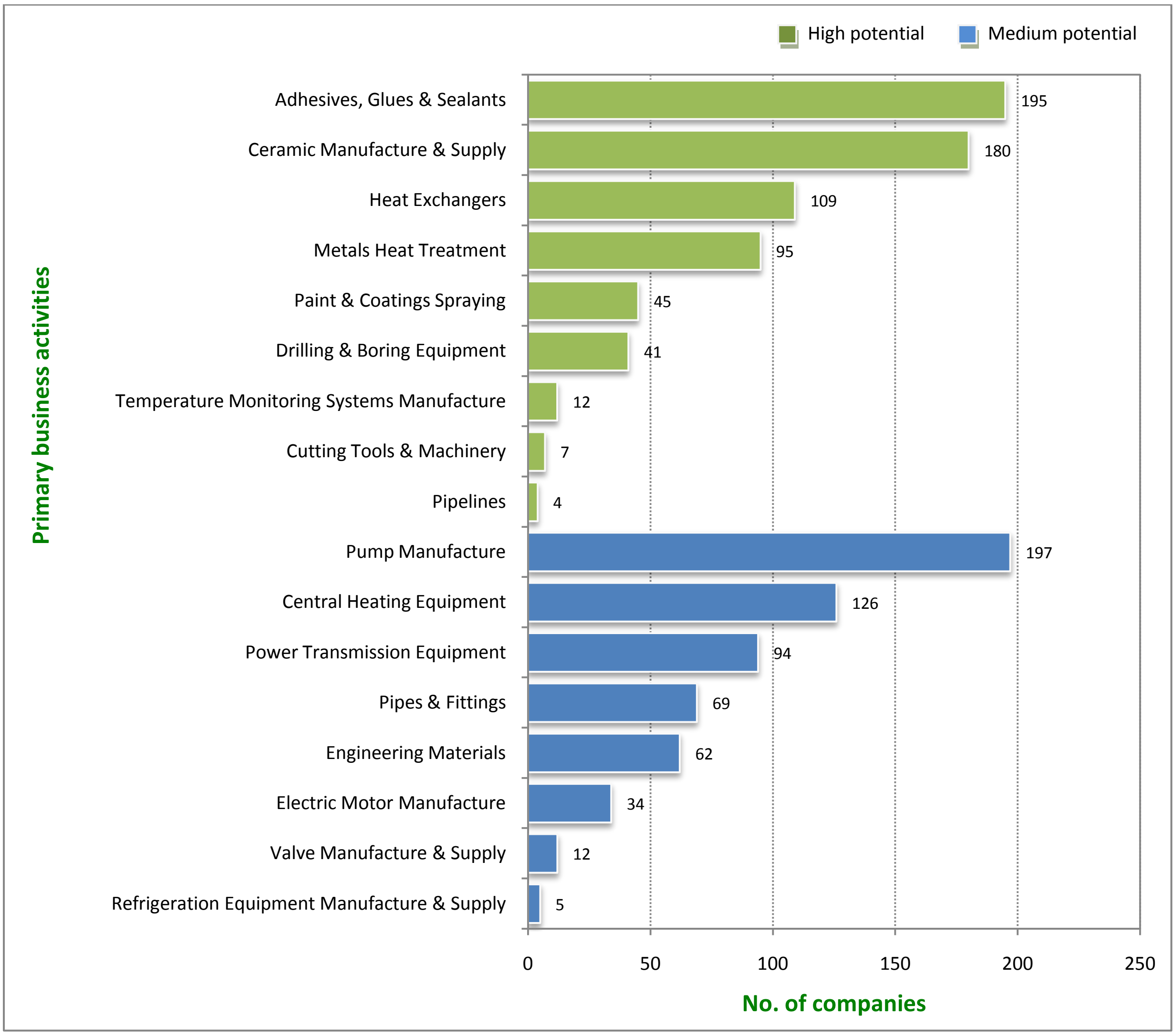


Figure 71 Distribution by primary business activity of 688 'high potential' and 599 'medium potential' companies for the geothermal sector

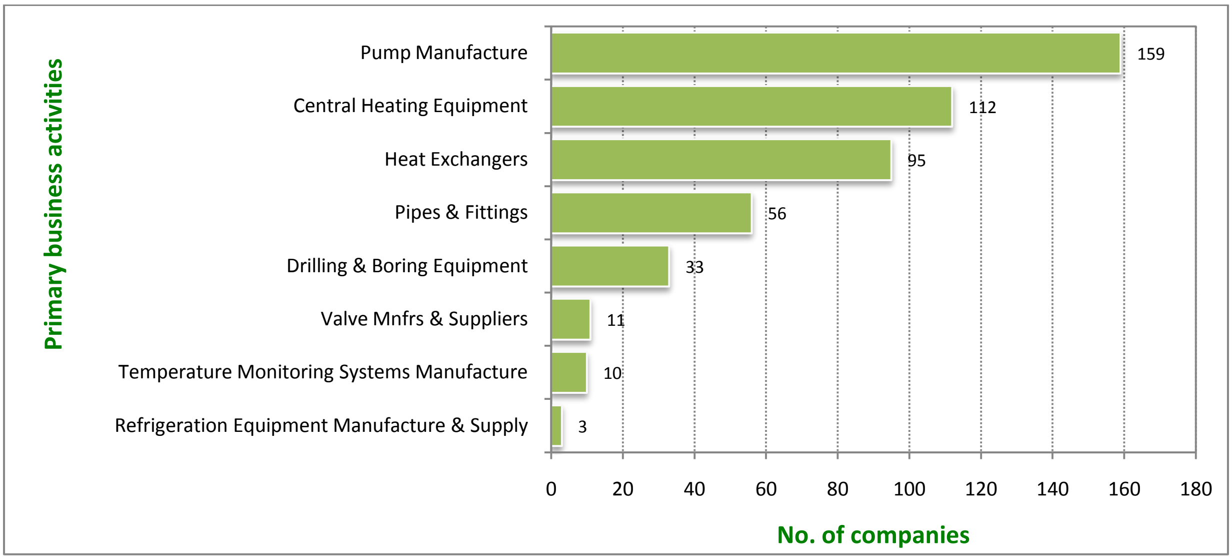


Figure 72 Distribution by primary business activity of 479 'high potential' companies in **heat pump technology adaptation** for geothermal

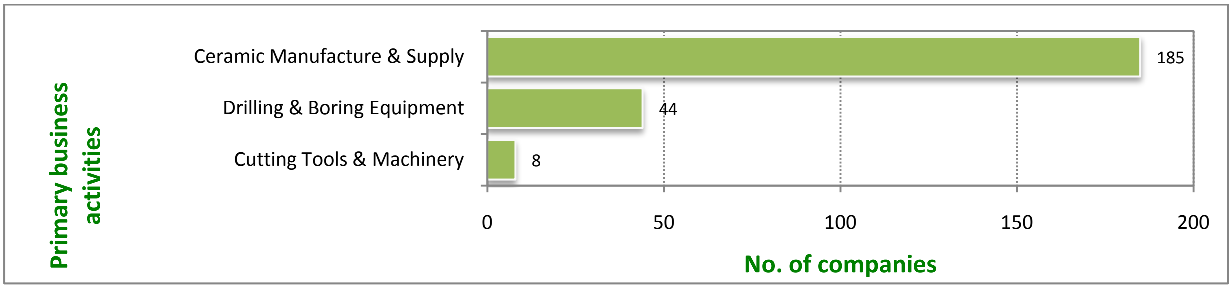


Figure 73 Distribution by primary business activity of 479 'high potential' companies in **directed lower-cost drilling** for geothermal

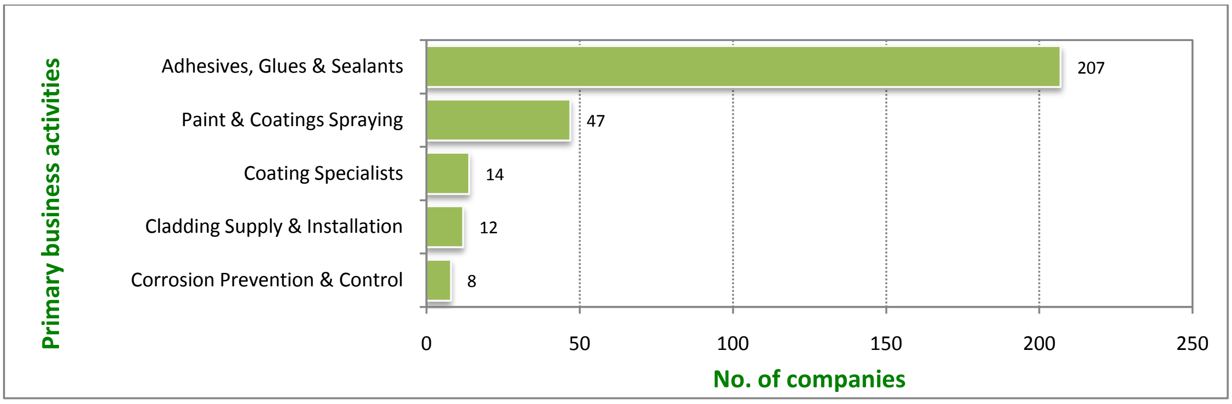


Figure 74 Distribution by primary business activity of 288 'high potential' companies in **corrosion and scaling resistance** for geothermal

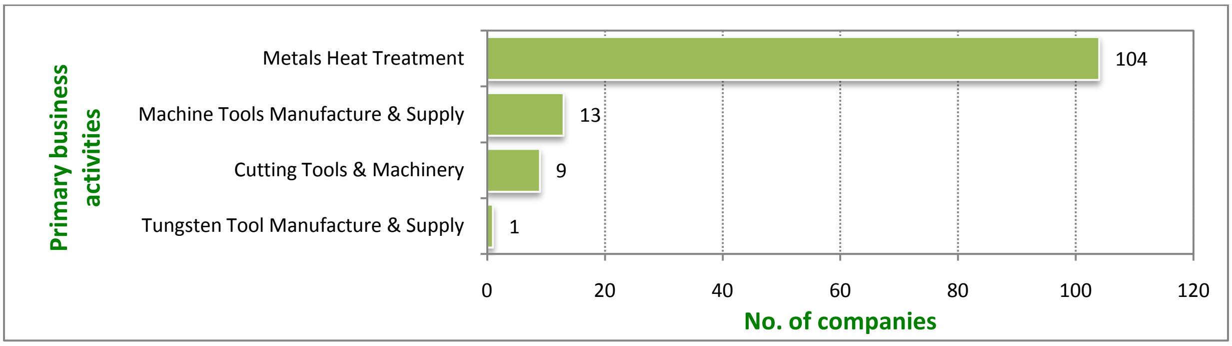


Figure 75 Distribution by primary business activity of 127 'high potential' companies in **high temperature tools** for geothermal

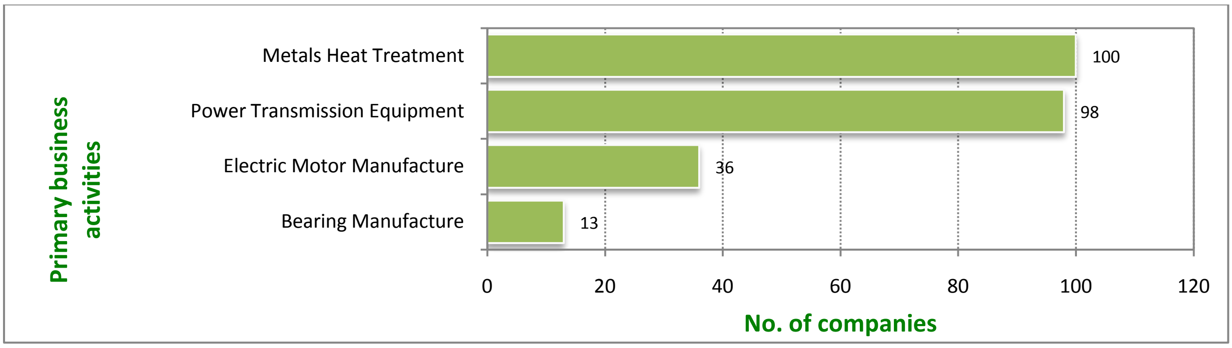


Figure 76 Distribution by primary business activity of 247 'high potential' companies in **incremental generators improvements** for geothermal

5 Industry Survey

Following the analysis of supply and value chains, an industry survey was conducted with 4,178 companies with contact details in the Low Carbon Relational Database to obtain their views as stakeholders in the region's transition to low carbon manufacturing as well as validating the programme's analytical results.

The survey received responses from a relatively small number of 55 companies from region. It could be due to the timing of the survey which coincided with the General Election period in May 2010, during which there was a lack of clarity with regards to policy direction and business support. The results documented in this chapter must therefore be interpreted with this statistic in mind.

A diverse range of business types in East Midlands were covered in the survey, with original equipment manufacturers, engineering service providers, component manufacturers and consultancy providers representing more than 80% of respondents. All respondents were SMEs, with more than 80% having less than fifty employees. These are detailed in Figure 77.

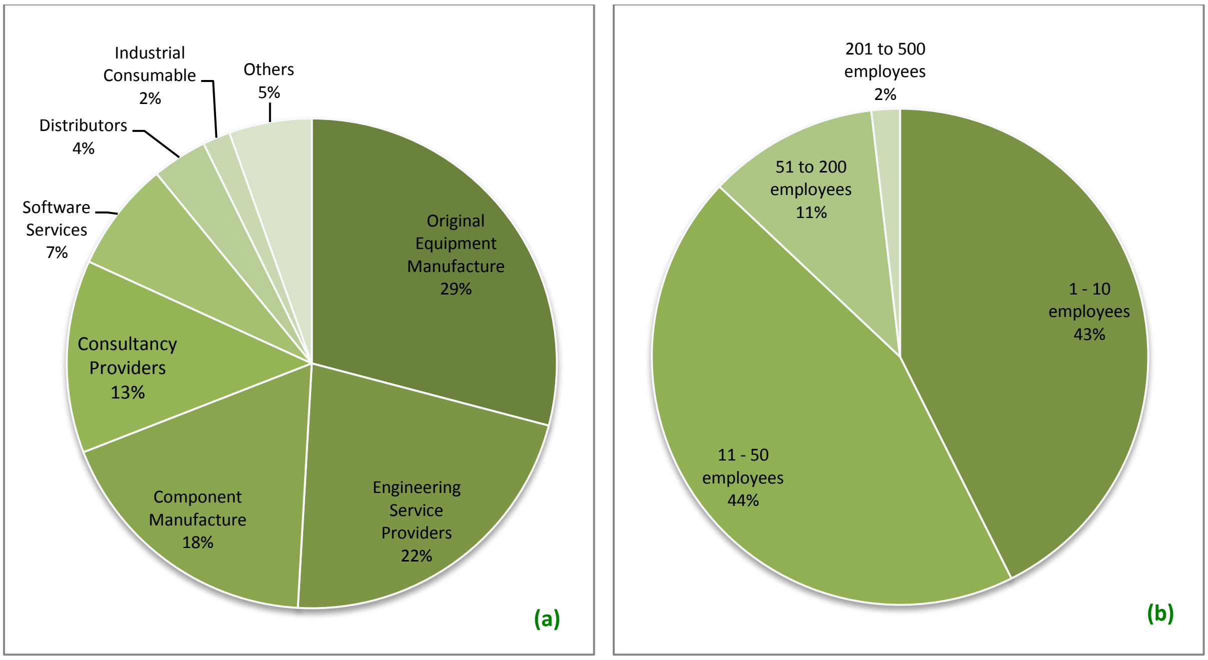


Figure 77 Distribution of survey respondents by (a) business types and (b) by size of companies

When asked to rate their company's primary manufacturing capabilities, the results are shown in Figure 78. Materials Supply was the most common among respondents, with 47% and 27% indicating 'high' and 'medium'. This was, followed by Component Manufacture (41% 'high' and 22% 'medium'), Engineering Services (38% 'high' and 28% 'medium') and Electrical Systems Development (38% 'high' and 10% ‘medium’). Only 7% and 15% of the respondents rated themselves as having respectively ‘high’ and ‘medium’ capability in the Manufacturing of Large Structures.

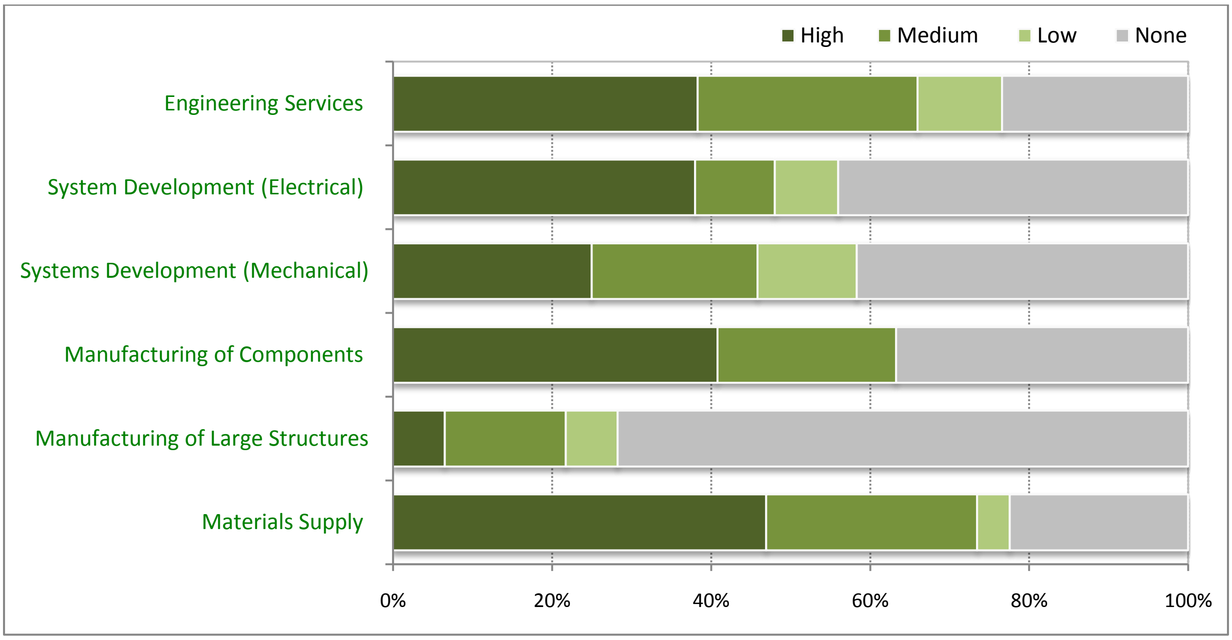


Figure 78 Manufacturing competencies of survey respondents

As illustrated in Figure 79, below, the carbon risks associated with making the transition to a low carbon economy, high CO_2 emissions were perceived as the least significant risk (with responses of 9% ‘high’, 18% ’medium’, 37% ‘low’ and 36% ‘insignificant’), while high energy consumption (14% ‘high’ and 28% for ’medium’, ‘low’ and ‘insignificant’) and changes in the supply chain (11% ‘high’ and 38% ‘medium’, 24% ‘low’ and 27% ‘insignificant’) were deemed the most relevant risks.

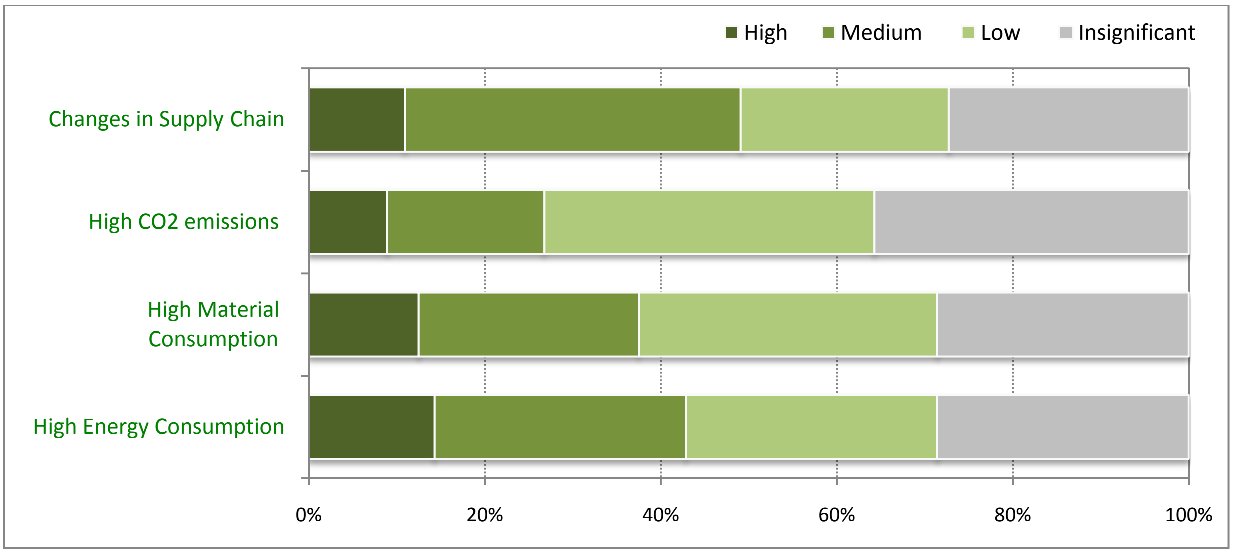


Figure 79 Perceived impact of risks linked with the transition to a low carbon economy

In order to measure the need for business change, respondents were asked to assess how sustainable their business strategy would be in the next five years if their company did not engage with the emerging low carbon industries, i.e. defined as the *'business-as-usual'* risks. The results are illustrated in Figure 80. 'Missed business opportunities' was perceived as most important, with over 70% of respondents rating it as 'high' or 'medium'. Concerns over 'failure to meet new carbon legislation' and 'displacement or loss of business in current supply chains' were rated as other significant business-as-usual risks by the region's businesses. On the other hand, 'shareholder/investor pressure' and 'loss of skilled employees to low carbon sectors' were perceived as relatively lowest business-as-usual risks by the respondents.

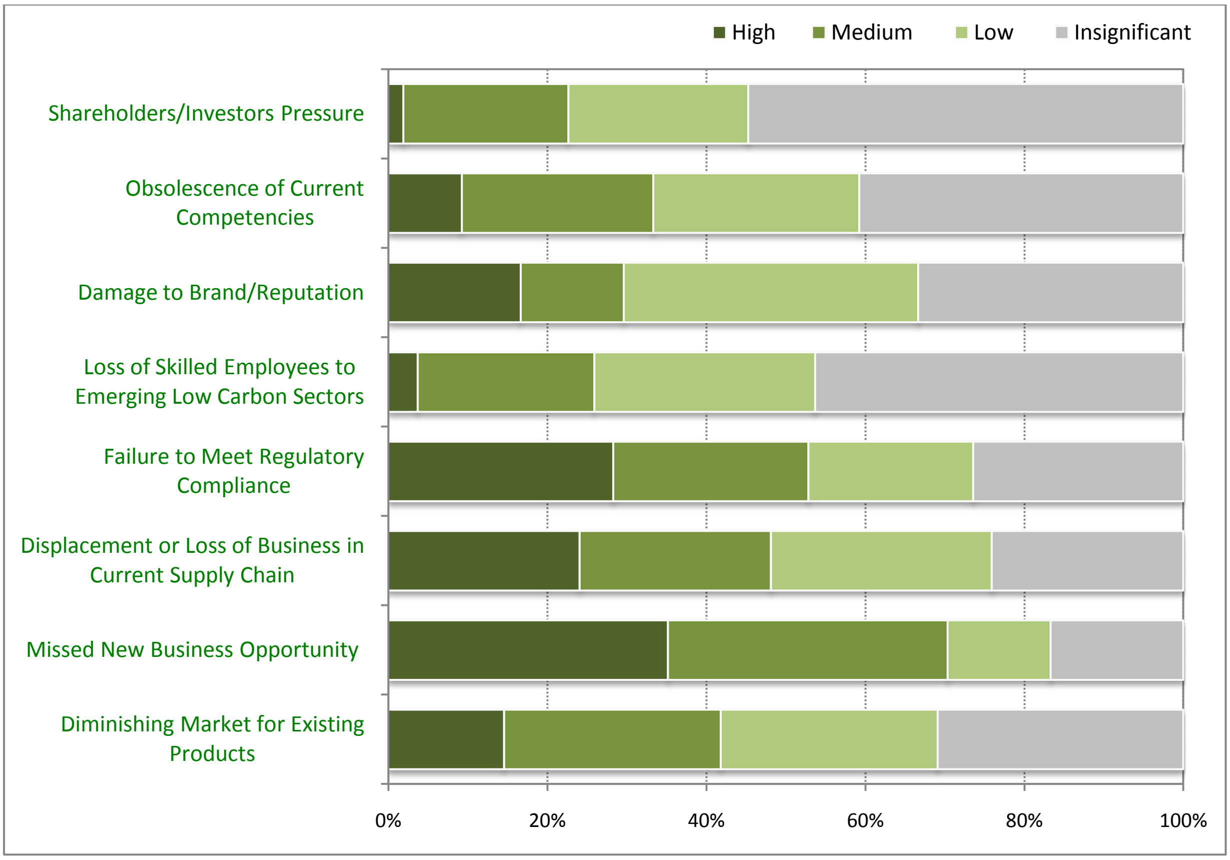


Figure 80 Perceived impact of risks linked with a 'business-as-usual" strategy within the next five years

Respondents then identified the significance of perceived business opportunities within the next five years for their respective business. As the results in Figure 81 suggest, the surveyed businesses perceived wind, nuclear and low carbon transports as the primary sectors, followed by wave and tidal, biomass and low carbon construction. Geothermal was deemed to offer the least significant opportunity by the businesses.

However, when assessing the experience in supplying the low carbon market, the survey found that the majority of surveyed businesses currently have a limited experience in supplying low carbon markets. As shown in Figure 82 below, the respondents collectively have the most experience in the nuclear sector (10% with more than 3 years and 31% with 1-3 years experience). This was followed by biomass (28%) and wind (20%), whilst solar has the lowest response at 8% of the businesses with 1-3 years experience.

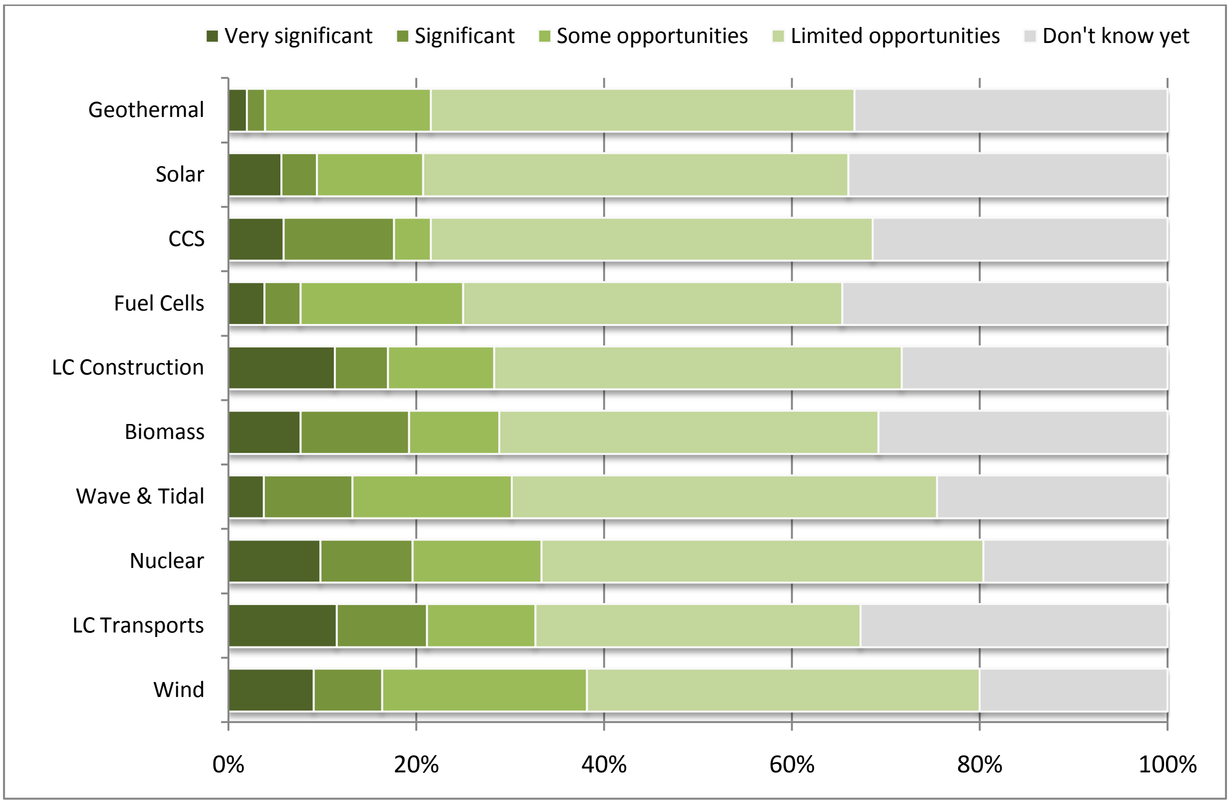


Figure 81 Perceived opportunities for business diversification in emerging low carbon industries

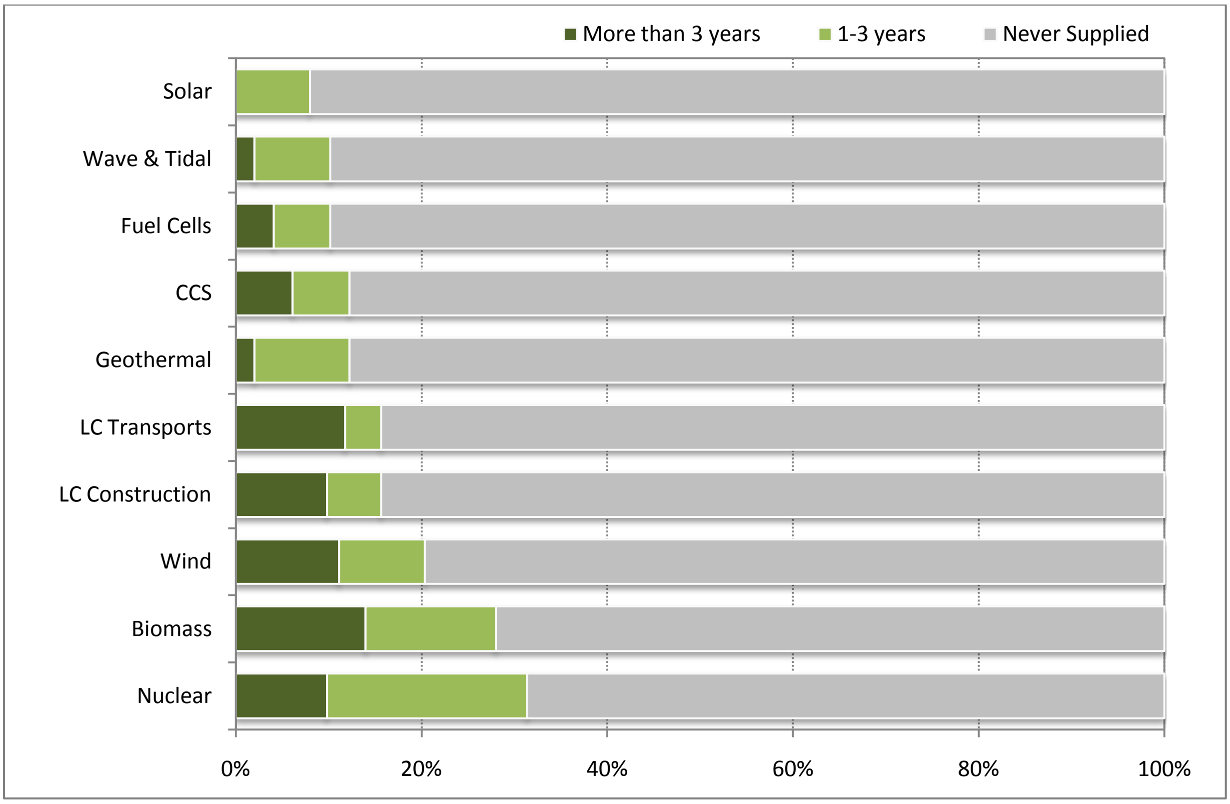


Figure 82 Distribution of the experience levels in supplying low carbon sectors by surveyed companies

6 Pilot Intervention for Low Carbon Transition

The outputs from the supply and value chain analyses and industry survey culminated in the development of a Low Carbon Transition intervention support framework for the manufacturing businesses in the region. A selection of companies was consulted and shortlisted based on their opportunity-risk profiles. The intervention support was piloted to facilitate the transition to low carbon market(s) targeted by the individual businesses.

6.1 Low Carbon Transition Intervention Pilot Scheme

Building on the principle that both the risks and business support (intervention) has an impact on a company's decision in transition into a new market, the impact of the risk factors has to be individually evaluated and addressed if the value of the intervention is to be maximised.

The pilot intervention model was therefore designed with a specific focus on addressing the risks perceived by businesses in assessing a transition into chosen low carbon sector(s). It subsequently mapped the specific risks to the company's current competencies and going concerns in terms of its existing market status and manufacturing capabilities with respect to entering an emerging market opportunity. The appropriate action plan was then drawn up with a company piloting the scheme based on a 'toolbox' that was developed from a combination of analytical findings, survey outcome and policy support strategy. An Intervention Report would be produced and a mini workshop held with each pilot company at the end of the scheme. The overall model is illustrated in Figure 83.

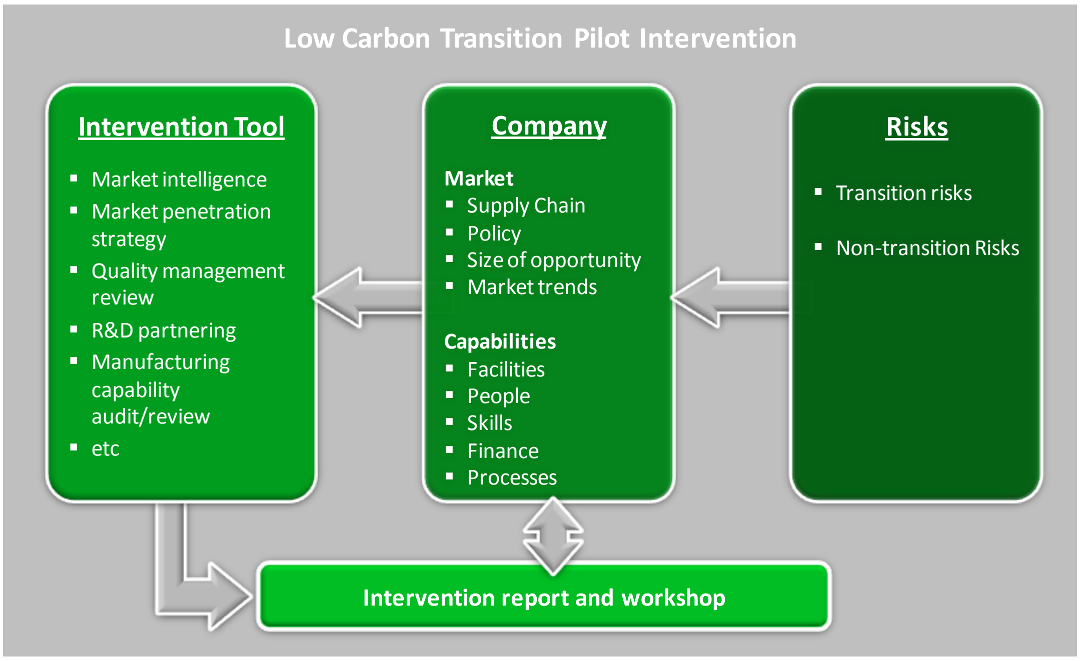


Figure 83 Illustration of the Low Carbon Transition Intervention Pilot Scheme

Based on the survey findings, twelve companies in the region were initially selected for interviews, leading to four companies recruited for the pilot scheme. The main selection criteria were to provide a representative cross-section of the regional manufacturing industry and a variety of potential/risk profiles. The companies were assessed on the following areas:

- Current company products and manufacturing capabilities
- The future conditions of existing markets
- The potential of existing technologies, products and competencies against opportunities in specific low carbon sector(s)
- The associated transition and/or non-transition risk factors and impacts on business
- Relevance of options from the intervention toolbox in tangible assistance to business

The potential/risk profile and respective low carbon sector(s) identified for the four pilot companies are shown in Figure 84.

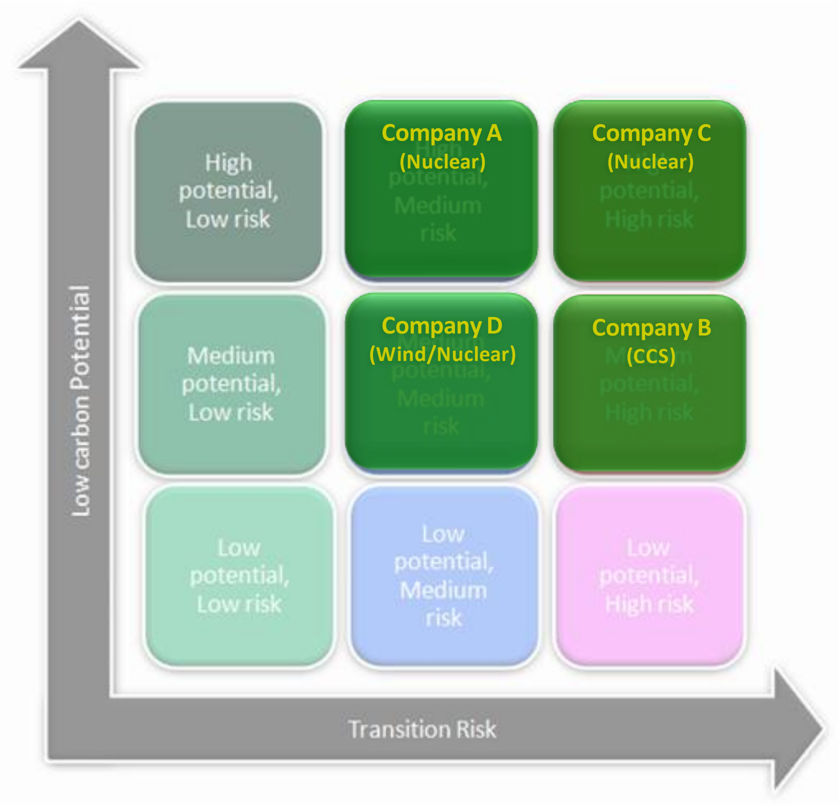


Figure 84 Low carbon potential/ risk profiles of the four pilot intervention companies

With the exception of *Company D* (where significant barriers to the nuclear and wind markets were identified for its high integrity aluminium fabrication technology, thus providing a strategic view for the company not to pursue its effort further), the pilot scheme produced industry insights and transition advice for Companies A, B and C. In particular, the companies found the pilot scheme to have informed them of the structure and operation of new target market(s), helped to gain a clear and independent overview on their competencies against associated transition risks, as well as provided advice on supply chain development strategies. All companies recognised that the work undertaken in the pilot scheme was a starting point, in as much as it was intended to initiate access to new markets.

6.2 Pilot Case Studies

6.2.1 Case Study 1 - Company A

Background

Founded in 1985, *Company A* is a SME supplier of bespoke components to heavy industry, primarily for coal mining. As the UK coal industry declined, the company diversified into pre-stressed concrete and hydraulic control systems. Its core capabilities include design, fabrication and installation of mechanical and electrical systems. The company has a strong portfolio of successful projects completed for a wide range of industries, including power generation, construction and rail.

During the pilot scheme, the company identified a strong interest in supplying components to the decommissioning projects and new build programme for the nuclear sector. The company has most of the quality certification relevant to nuclear industry requirement and was seen to have few technical and compliance issues. However, *Company A* had limited knowledge of the nuclear industry, particularly in terms of supply chain structure, immediate customers for its products and the timescale of the UK nuclear programme. Therefore, the company wished to obtain support in understanding the decommissioning and new build supply chains, the relevant requirements for goods and services and key supply chain companies, as well as recommendations on accessing the opportunity for its products.

Intervention Outcome

The nuclear supply chain is inherently conservative due to stringent safety and quality requirements. Following detailed consultation with nuclear market specialists, the intervention scheme concluded that *Company A*'s products and services were potentially applicable across a wide range of nuclear applications in decommissioning and particularly new build. The company has a recognised track record in fabricating batch and bespoke products for a range of customers in industry sectors such as civil engineering, power generation, water utilities and railway. These industries have similar quality and safety requirements to nuclear and thus *Company A* should be capable of making the transition to this sector.

The intervention report also provided *Company A* with the supply chain breakdown of goods and services opportunities specific to its competencies, key market contacts, transition advice and its potential risks.

Risk Analysis and Feedback

The Risk Radar in Figure 85 shows the analysis of the transition risks to the nuclear sector for *Company A*. The pilot intervention allowed the company to gain a concise overview of the risk factors that it would need to manage. The pilot scheme helped to reduce a number of the risks, however as an SME, Company A would benefit from longer-term intervention support to increase the likelihood and speed of a successful transition.

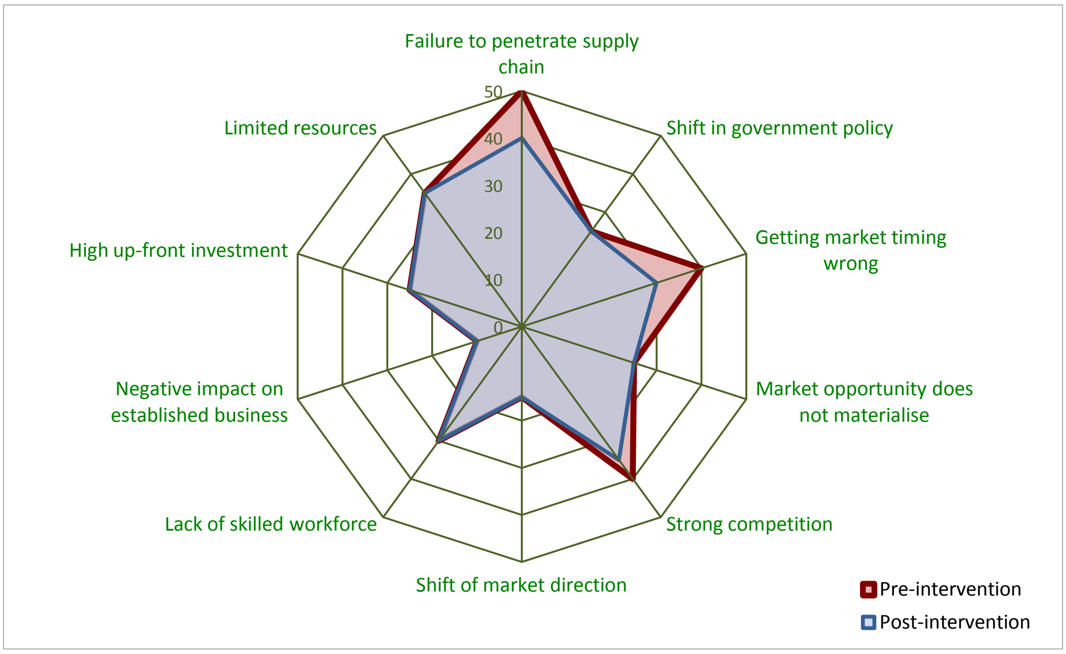


Figure 85 Analysis of low carbon transition risks for *Company A*

> *"We have been able to quickly assess the current state of the nuclear market, identify possible places we could fit in and whom we should be talking to at this stage. Without the assistance, this would have taken considerable resource and time. We can proceed with far more confidence now."*
>
> Managing Director, *Company A*

6.2.2 Case Study 2 - Company B

Background

Company B has been established in the UK for more than 40 years and manufactures a range of phenolic glass reinforced plastic (GRP) pipes and ducting, polyurethane products, GRP rockbolts and ventilation ducting products. The company's main markets are tunnelling and mining for its ventilation and ducting equipment as well as specialised electrical equipment for collision avoidance and gas detection.

With its international track record in supplying GRP pipes for harsh environments, the pilot intervention scheme helped *Company B* to investigate the viability of existing or new GRP pipes that it could be potentially supply to the emerging CCS applications.

Intervention Outcome

Following a detailed market and technical investigation, the intervention scheme recommended that *Company B*'s existing GRP products did not currently meet the technical and legislative requirements for the transport of supercritical CO_2. However, with further R&D to enhance the GRP characteristics matching those of steel, GRP pipes could potentially be used in dense-phase CO_2 pipelines.

In addition to providing Company B with the expected CCS industry development and the technical and regulatory compliance requirements for CO_2 pipelines, the pilot intervention scheme also recommended various low risk actions for Company B to make a strategic assessment on the attractiveness of the new opportunity as well as to leverage public R&D funding to ascertain the viability of its GRP products for CCS.

Risk Analysis and Feedback

The market opportunity for *Company B* in CCS was seen as a long term business prospect which would require further R&D investment. However, as a relatively well funded business, *Company B* acknowledged that it was now better positioned to exploit the opportunity. Through the pilot intervention scheme, three key transition risks for the company were marginally reduced (as shown in Figure 86).

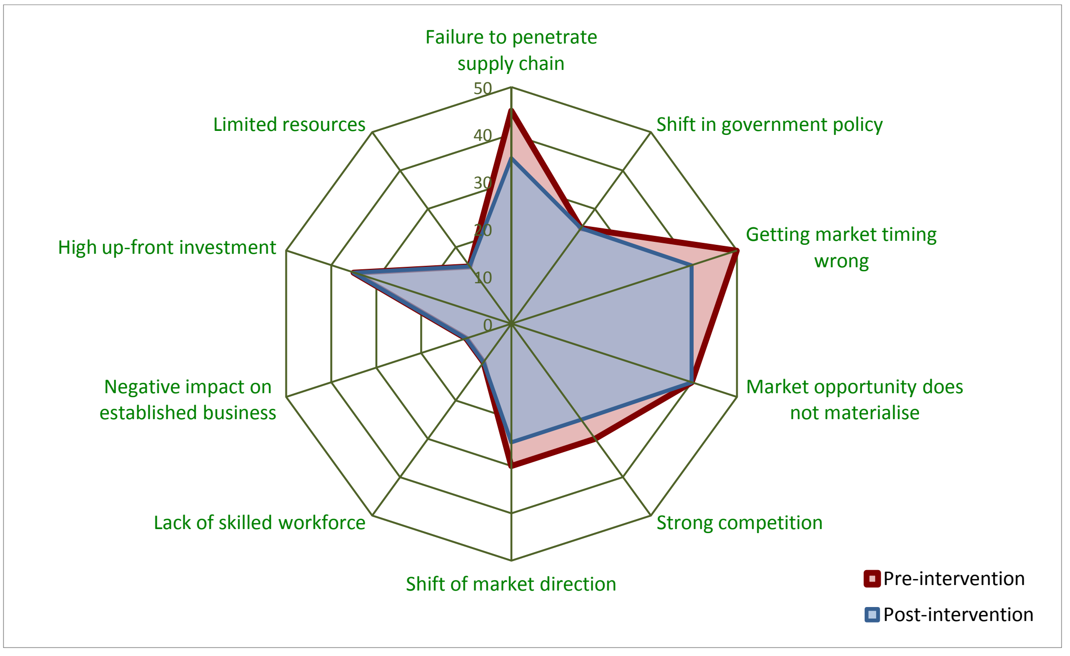


Figure 86 Analysis of low carbon transition risks for *Company B*

> *"(The pilot intervention has given us) an insight into the potential markets of CCS and in particular the transport of captured CO_2. Also potential contacts and networking opportunities to help in the potential development of a new CO_2 transport infrastructure. It has certainly given us the confidence to further investigate the opportunities in the low carbon sector, an area we may otherwise have ignored. There are issues with the use of GRP in high pressure situations but it has a proven track record for durability and ease of handling."*
>
> Operations Manager, *Company B*

6.2.3 Case Study 3 - Company C

Background

Founded in 2002 as a spin-out from a UK university, *Company C* specialises in 3-dimensional optical inspection solutions. From 2002 to 2008, it produced bespoke products only, but since 2008, it has developed a range of standard products. *Company C*'s products offer very precise measurements around 100 times faster than the equivalent laser technology. Most of the company's current efforts are focussed on increasing the applications for its technology. Current applications include measuring aerofoils, piston dimensions, air channels in turbine blades and performing sheet metal dimensional checks in aerospace and automotive industries.

The company is already investigating whether its product could tap into the niche market of dimensional checks of storage vessels of intermediate level radioactive waste arising from nuclear power operations. Although it had established several contacts in the decommissioning industry, it had not managed to build the critical link with the appropriate supply chain players.

The intervention scheme therefore focussed on helping *Company C* to firstly understand the decommissioning sector, investigate the requirements for the niche application of its high-speed 3D optical system and advise on any suitable transition route.

Intervention Outcome

Following consultation with nuclear industry specialists, it was found that *Company C*'s 3D optical technology was potentially applicable for performing dimensional checks in nuclear decommissioning applications, such as process pipe work and waste containment vessels. This corroborated the company's own preliminary investigations into the nuclear market.

As *Company C* was developing niche inspection solutions there is potential for them to operate as a Tier 2 or 3 supplier in the decommissioning market (i.e. working directly for Sellafield Ltd or indirectly via a Tier 2 contractor). The intervention scheme recommended that it needed to collaborate with both levels of the supply chain and provided a number of key industry contacts.

On the technical front, the intervention scheme investigated the operational and safety considerations for such an optical system in a nuclear facility, where radiation could cause degrading damages to polymeric materials, electronic and optical components. Moreover, nuclear radiation may interfere with the equipment's accuracy. Advice on shielding and compliance with testing and safety requirements was provided to *Company C*.

Given that *Company C*'s technology would need to undergo a rigorous process to be qualified for operation in a nuclear environment, it is estimated that it will take it up to 5 years to penetrate the market.

Risk Analysis and Feedback

For a small start-up company seeking to introduce a novel technology into nuclear industry which is highly driven by health and safety, it is inherent that the risks associated with market penetration and equipment qualification are relatively high. Furthermore, limited resources and investment may also be a limiting factor. This was the case for *Company D*, as shown in Figure 87. The pilot scheme managed to help reduce a number of the transition risks, however the company would need to have a medium-term mitigation plan in order to utilise its limited resources without adverse implication on existing business.

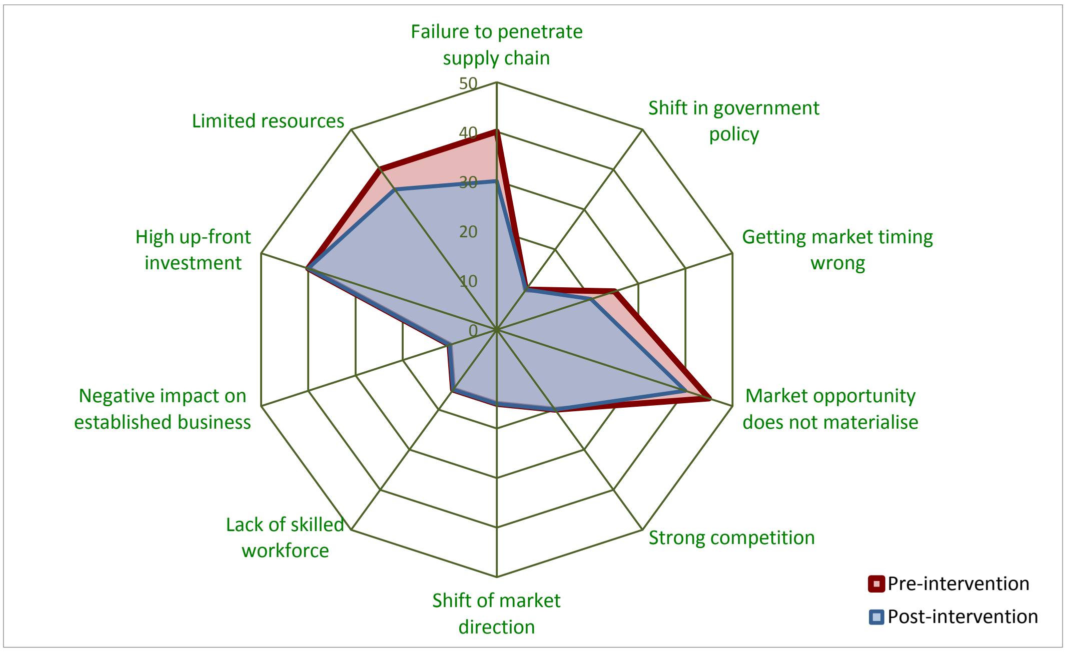


Figure 87 Analysis of low carbon transition risks for *Company C*

> *"(The pilot intervention has given us) a better understanding of the overall UK nuclear market & supply chain, including the tier structure and contacts."*
>
> *On confidence to enter the target low carbon sector – "Yes, but the rather long-term nature of developing business in this area suggests making only a limited investment of time/resources at this early stage of our company development."*
>
> CEO, *Company C*

6.2.4 Case Study 4: Company D

Background

Established in 1958, *Company D* is a world leader in designing, calibrating and manufacturing high quality powertrain components, used in domestic cars, commercial vehicles and racing cars. It employs about 500 employees in several UK locations. Whilst its core business and competencies are in advanced powertrain technology, the company has a novel fabrication technology for high integrity aluminium components which could potentially be supplied into the wind and nuclear sectors.

Company D has requested that the details of the pilot intervention scheme be kept confidential to protect its commercial interest.

7 Conclusion and Recommendation

7.1 Conclusion

Aligning with the UK LCIS, *emda*'s **Economic Exploitation of Low Carbon Markets** framework is aimed at exploiting the economic opportunities from new and emerging low carbon/energy technologies, processes and services. With significant manufacturing capability cutting across most of the markets/sectors, East Midlands businesses are well placed to benefit from new low carbon supply chain opportunities. In support of the objective above, this study has successfully achieved the following aims:

1. Developing a Low Carbon Relational Database comprising 7,008 businesses involved in manufacturing and related activities. This was constructed from two commercial databases with a combined total of 95,000 registered businesses in the East Midlands.
2. Undertaking an extensive analysis of the supply chain and value chain of ten low carbon sectors to identify manufacturing opportunities in low carbon market for the period 2010-2020 and map these against regional competencies.
3. Identifying the transition and non-transition risks associated with regional businesses moving into the emerging markets.
4. Validating the analytical findings and obtaining the views of business with respect to a transition to low carbon industry.
5. To develop intervention mechanisms and undertake a pilot scheme with a selection of companies capable of exploiting low carbon manufacturing opportunities.

The following key findings were highlighted in this study:

- The supply chain and value chain analyses identified 3,142 regional manufacturing and related businesses from the Low Carbon Relational Database as having high potential to exploit opportunities in emerging low carbon industries, with over 80% of these being SMEs. A further 4,413 companies found to have competencies for the medium potential categories.
- East Midlands has the strongest potential manufacturing competencies for sectors such as low carbon transport, fuel cells and CCS. This is partly because the supply chains in these sectors are relatively new, and technology and components are still being developed, hence more opportunities exist. Wave and tidal was found to offer the lowest opportunities to match the region's businesses, and this could be attributed to the relatively limited inherent offshore competencies in the region.
- The distribution of 'high potential' and 'medium potential' companies for each low carbon sector is as follows:

Sector	No. of 'High Potential' Companies	No. of 'Medium Potential' Companies
Low carbon transport	1,248	246
Fuel cells	1,168	221
CCS	1,060	465
PV solar	918	162
Nuclear	747	603
Geothermal	688	599
Wind	573	511
Biomass	400	144
Low carbon construction	305	147
Wave and tidal	199	242

The detailed manufacturing opportunities in individual supply chain and breakdown of potential companies are discussed in Chapter 4.

- The industry survey with companies on the Low Carbon Relational Database found that the primary manufacturing capabilities are in the following descending order:,
  1. Materials Supply
  2. Component Manufacture
  3. Engineering Services
  4. Mechanical Systems Development
  5. Electrical Systems Development
  6. Manufacturing of Large Structures

- With respect to the significance of perceived business opportunities within the next five years, surveyed businesses indicated wind, nuclear and low carbon transports as the primary sectors, followed by wave and tidal, biomass and low carbon construction. Geothermal was deemed to offer the least significant opportunity by the businesses. However, the survey also found that the majority of respondents currently have a limited of experience of supplying low carbon markets.

- The four pilot companies found that the intervention pilot scheme informed them of the structure and operation of new target market(s), helped to gain a clear and independent overview of their competencies against associated transition risks and provided advice and increased confidence on supply chain development strategies. All companies recognised that the work undertaken in the pilot scheme was a starting point, in as much as it was intended to initiate access to new markets.

7.2 Recommendations

This study has set the benchmark for the availability of opportunities for the East Midland's manufacturing businesses in the emerging low carbon industry, and should be viewed as a springboard to a more proactive initiative to support the businesses in fulfilling these potentials. It is clear that the region has a strong technological, manufacturing, R&D and service capabilities that would meet the supply chain opportunity and create tangible economic and employment benefits to the region.

The report offers the following recommendations by addressing the key challenges in enabling businesses to make a risk-mitigated transition to a low carbon industry:

1. The level of manufacturing opportunities in the low carbon industry identified represents a significant prospect for a considerable number of companies in the region. However, the majority of these companies have limited experience in supplying to low carbon sectors, and therefore a business support programme would increase the visibility of potential opportunities for the companies as well as providing guidance in managing any arising transition risks.
2. The Low Carbon Transition Intervention pilot scheme achieved its objective and received positive feedback from pilot companies. However with businesses strongly focused on tangible opportunities adjacent to their existing competencies, significant technical and industry knowledge were sought by the businesses. Therefore, the future implementation of a transition support would need to be delivered by a team of market/technology experts with extensive breadth and depth of knowledge (i.e. multi sector) in order to add value to businesses.
3. The Low Carbon Relational Database developed in this programme provides *emda* with a dynamic tool to map existing supply chain needs for ten low carbon sectors to the competencies of its regional businesses. It can be updated on a regular basis where new industry opportunities and companies can be added over time. It would enable companies matching specific market needs to be identified for a more customised business support to be provided.

The recommendations outlined above were developed based on the assumption of a regional landscape with potential for continued investment by *emda*. Whilst the Coalition Government remains committed to the low carbon agenda, they are also committed to localism, and as such will replace the Regional Development Agencies with Local Enterprise Partnerships. The report and recommendations remain applicable and relevant and can be adapted to suit the new delivery landscape.