Decarbonisation in the East of England: Industry efforts and linking with academic research

Project Report

31 August 2023

Report commissioned by the University of Cambridge Decarbonisation Network

UNIVERSITY OF CAMBRIDGE
Department of Engineering

IfM Engage

Decarbonisation in the East of England: Industry efforts and linking with academic research

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The Decarbonisation Network connects the University of Cambridge academics with external industry leaders working towards decarbonisation through three Special Interest Groups (SIGs): Light Harvesting, the Built Environment, and Hard to Decarbonise Technologies. Website: https://www.decarbnetwork.hub.cam.ac.uk

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Additional files linked to the report (for internal use only):

- Companies List 31 08 2023.xlsx
- Interview Data 31 08 2023.xlsx
- Interview Outputs 31 08 2023.pptx

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1 Executive Summary

The project aims to explore collaborative ties between academia and industry in the East of England region, particularly focusing on the shared objectives of decarbonisation and sustainable growth. The project's core objectives involve consensus-building among academic leaders on priority industry sectors, identifying companies and startups within these sectors, and gauging their willingness to collaborate with research groups at the University of Cambridge. This alignment of academic expertise and industry needs is envisioned to expedite the region's transition to a net-zero future.

A multi-step methodology was employed to understand the landscape of companies' decarbonisation efforts, principally through case study interviews with key industry leaders. An initial scoping meeting was conducted with the Decarbonisation Network to define the project's scope, including the industrial sectors and types of businesses to be targeted. Companies like energy, engineering, and the public sector linked to decarbonisation were identified through existing networks and public information, resulting in a curated list of companies for prospective interviews. 105 companies in the East of England were identified out of 472 nationally identified companies, all based on a selection criterion developed by the Decarbonisation Network. 27 companies and public sector organisations were prioritised, out of which 10 interviews were conducted with the leaders.

The study is designed to build a comprehensive database that could act as a resource for future research collaborations by the Decarbonisation Network, including strategic proposals and large grants. Interviews were designed to be focussed on technology and processes, diving into the specific challenges companies face in decarbonisation and how academic linkage could be supportive. The outcome includes a list of areas companies are keen on exploring collaboratively with the University of Cambridge.

While the project does not currently include the development of new service offerings or participation in academic publications, its primary aim remains to broaden the network and establish meaningful collaborations. This may involve organising networking events, and collaborations in research, strategic proposals and grants. University-industry collaborations are integral to meeting the larger objectives of facilitating the East of England region's pathway to achieving net-zero carbon emissions. Following is a summary of key outputs from the interviews:

The main categories of business activities of companies/organisations linked to decarbonisation

- *Decarbonisation management and strategies:* Companies in sectors like construction, energy, and transportation are intensifying their efforts toward a low-carbon economy, with initiatives ranging from energy-efficient construction technologies to renewable energy adoption and infrastructural upgrades.
- *Technologies in decarbonisation:* In the realm of technology, advancements in clean and climate tech, including energy transition technologies like battery and grid services, are at the forefront of decarbonisation strategies.
- *Collaboration within the ecosystem:* Collaborative efforts across industries are key to accelerating decarbonisation, with companies engaging in a variety of partnerships, consultancies, and member-based models that focus on climate tech, ecosystem development, and innovation, often in conjunction with universities and cross-sector collaborations.

Barriers and challenges faced by companies/organisations in their decarbonisation efforts:

- *Developing and integrating new technologies / innovations:* Companies face systemic barriers and technology-specific challenges in adopting new technologies in supply chains, exacerbated by risk aversion, skills gaps, and difficulties in forming effective partnerships and data gathering.
- *Impediments to decarbonisation and adoption of renewable energy:* Obstacles to the integration of renewable energy and decarbonisation range from grid capacity and unclear policies to skills shortages and funding limitations, posing significant barriers to meeting sustainability goals.
- *Skills gap, education, and expertise in advanced technologies:* The fast pace of technological change highlights a skills gap in areas like design thinking and systems leadership, prompting organisations to seek talent from niche sectors and forge collaborations to mitigate challenges.
- *Operational and regulatory challenges in sustainability and decarbonisation initiatives:* Operational and regulatory hurdles, including misconceptions about costs and complex planning regulations, make the implementation of sustainability and decarbonisation initiatives difficult, compounded by challenges in building a business case and navigating fluctuating supply chain conditions.

Actions companies are taking or intend to take to address decarbonisation challenges:

- *Collaboration, communication, and ecosystem development:* Strategic partnerships among companies, governments, and academia create a symbiotic ecosystem that propels mutual understanding and innovative solutions in decarbonisation.
- *Energy efficiency and technological innovations:* Companies are driving tangible innovations in energy efficiency, supported by data analytics and standardisation, addressing shared challenges through initiatives like the Climate Tech Supercluster.
- *Workforce development and organisational changes:* A multi-faceted approach to workforce development and internal restructuring aligns corporate focus with the evolving demands of sustainability and decarbonisation.
- *Business development, funding, and market development:* Companies are leveraging innovative funding and business models, as well as high-level discussions, to accelerate market penetration and align with sustainability objectives.
- *Business operations, including regulatory compliance: Business* operations are being optimised to meet the evolving landscape of regulations, combining quality control, energy audits, and policy advocacy.

Academic linkages as desired by companies/organisations for accelerating decarbonisation efforts:

- *Innovation and system-level change:* Academic research serves as a multi-disciplinary catalyst, enriching both technological innovations and social dynamics in the push towards decarbonisation.
- *Policy evaluation and improvement:* Particularly instrumental in shaping and assessing local policies, shedding light on their effectiveness and areas for improvement.
- *Skill development, education support, and community outreach:* Focused educational outreach and skill development initiatives lay the foundation for future advancements in sustainable technologies.
- *Networking and partnerships:* Academic and industry collaborations extend beyond traditional bounds, creating diverse networks that amplify impact and broaden reach.
- *Core technologies and their applications:* Academic research is pivotal in advancing both the technological and social aspects of decarbonisation, from fuel alternatives to public engagement.

2 Introduction

2.1 Background

The Decarbonisation Network[1] connects the University of Cambridge academics with external industry leaders working towards decarbonisation through three Special Interest Groups (SIGs): Light Harvesting, the Built Environment, and Hard to Decarbonise Technologies.

The East of England industrial cluster has a significant number of companies that are engaged in decarbonisation activities. However, it has become evident that most of the activities are not as closely aligned with academic research and practice as they could be. The Decarbonisation Network believes that through active participation by academics and researchers in the decarbonisation activities of the Cambridge cluster, both academia and industry can benefit significantly. This can contribute to achieving decarbonisation outcomes and put the regional industry on a sustainable path towards a net-zero future.

To achieve these objectives, it was suggested to build capabilities within the Decarbonisation Network to provide academic research leadership in decarbonisation by connecting industry and academia. Capabilities within the network will be built to put decarbonisation efforts on a sustainable path in the region while contributing to academic and research excellence. As a first step, a study was done to understand various business related activities in the East of England region that contribute to the decarbonisation and Net Zero strategy and gauge the decarbonisation interests of the industry in collaborating with the University of Cambridge.

The Decarbonisation Network has sought support from IfM Engage[2] for a scoping study to understand the industry's decarbonisation efforts in the East of England and academic collaborations.

2.2 Objectives

The main objectives of the project were:

- Achieving an agreement on the industry sectors in focus among academic leaders
- For these industry sectors, identifying companies and startups across the value chain within the East of England
- Understand areas of work of companies and their topics of interest related to decarbonisation.

[1] https://www.decarbnetwork.hub.cam.ac.uk
[2] https://engage.ifm.eng.cam.ac.uk

- Understanding the level of engagement companies/organisations might be interested in collaborating with the research groups at the University of Cambridge.

3 Approach

The method to investigate companies' decarbonisation efforts and determine the need for academic collaboration is done through interviews with company representatives. Figure 1 shows the process steps in the project, including activities and outputs. The time scale of the project is given in Annex – I. A total of 13 workdays were spent on the whole project.

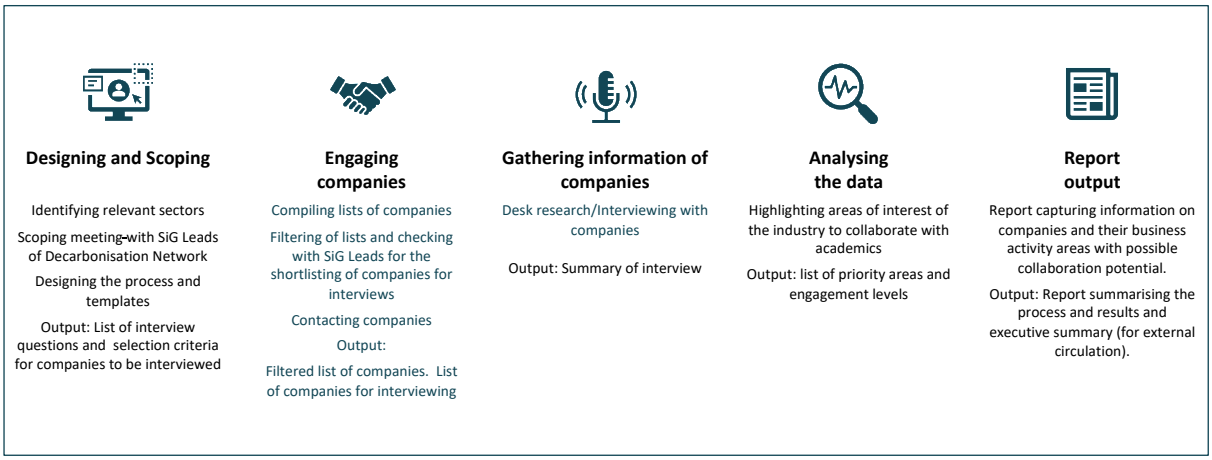


Figure 1: Process steps

3.1 Designing and Scoping

A scoping meeting was held with the academic leaders within the Decarbonisation Network on 9 May 2023 to specify the focus of the study and, specifically, what industrial sectors and types of businesses should be included in the study.

Further, a set of criteria was elaborated and agreed upon for prioritising the companies interviewed in the subsequent stage of the process. An interview protocol was developed, serving as a structured guide to the interviews.

The Decarbonisation Network was engaged to design the project process and interview templates. The scope and process were carefully crafted, and sectors were identified with selection criteria developed. Additionally, key information to be collected from companies during interviews was confirmed.

The decarbonisation Network identified the purpose of the study. One of the primary goals of the study was to support strategic proposals and large grants. Additionally, a comprehensive database of companies detailing their product, services and expertise should be compiled to facilitate future grant applications and research proposals. Another goal was to find partners who are a good fit for mutually

beneficial collaborations. This was not merely about enlarging the network but about forging meaningful connections that could add value to the Decarbonisation Network objectives. In parallel, there was an effort to stay abreast of new developments in the decarbonisation field, positioning the Decarbonisation network at the forefront of innovation and policy in decarbonisation and achieving net zero.

Furthermore, it is also aimed at seeking companies willing to collaborate on student projects, offering undergraduate and graduate research sponsorships. This fostered a synergistic relationship between academia and industry, enriching the educational experience for students. Finally, the project was also considered to align interests and projects with the infrastructure and expertise available in Cambridge. This included activities such as device testing and leveraging local resources.

Following were the key strategies for applying the outcomes of the study:

- Enriching teaching and research through study findings
- Securing large grants through strategic proposals in various energy areas such as Ammonia, Hydrogen, and Solar
- Facilitating early engagement with corporate entities for collaborative grant applications
- Recruiting industry partners for the launch of new initiatives and project proposals
- Providing opportunities for MPhil students to engage in short-term, industry-focused projects
- Investing in the development and enhancement of departmental resources and specialised equipment to better serve industrial needs, including testing and characterisation capabilities
- Compiling a comprehensive database of industry companies that can be tapped for future departmental initiatives

Exclusions from the current project scope include the creation of a brand-new service offering at the university and the involvement in hosting or attending academic conferences or publishing in scholarly journals.

In establishing the companies to be given priority for interview selection, several pivotal criteria were taken into consideration. Particular attention was directed towards identifying companies involved in technology and science-focused activities that resonate with the prevailing scope of proposals. Additionally, the selection process encompassed companies whose insights would hold significance within the present scope and in shaping directions for future project directions.

The following are the categories of companies targeted for interviews:

- Startups in the Energy Sector
- Engineering/Supply Services
- Grid Companies
- Oil and Gas (including Bio-Gas Companies)
- Large Energy Supplier
- Engineering/Supply/Support Services
- Companies in Wind Energy
- Public sector organisations (including Councils)
- Companies in Electrochemistry
- Companies in Solar Energy
- Energy Storage Companies

Exclusions include automotive, short-term energy storage (grid balancing), companies manufacturing batteries, and companies involved in nuclear and fusion.

The scope of the study involved companies with business representation in the East of England region. Additionally, national companies with active business representation in this region were also considered. The proposed interviews were intended to be conducted with either C-level individuals having strategic oversight of the business or individuals responsible for sustainability and decarbonisation.

Several companies were also considered that are already collaborating with the Decarbonisation Network, involved in participating in networking events and engaging in other research/study-related activities. The investigation also factored in companies that typically participate in joint research grant applications.

During the process, a few other criteria were also identified that can help in prioritising the companies by Academics. This includes companies in the East of England that exhibited research potential. This was determined by statements or research collaborations, and the required information was collected from sources such as company websites, industry reports, and academic publications. Companies were analysed based on whether they were designers, manufacturers, or service providers. An analysis of their technologies, products, and processes determined if they were at the forefront of technology.

Before approaching the companies, it was also important to understand the specific strength of the Decarbonisation Network that it can offer external partners and stakeholders. Some of these are:

- Research and development support
- Access to laboratory equipment for testing, coupled with expertise and consultancy
- Opportunities for mutual partnerships with access to expert knowledge
- Engagement in student projects involving both undergraduates and graduates (MPhil, PhDs)

It is important to note that while the Decarbonisation Network offers the above advantages for stakeholders, guaranteeing immediate collaboration in the current project was out of scope.

3.2 Engaging Prospective Companies

The initial stage involved identifying companies situated within the East of England region. Publicly available information about companies was used in the study, building a research list. A Master list was produced, adding companies suggested by the Decarbonisation Network and other academic collaborations developed through strategic and large grants. After compiling the master list, selection criteria were applied to develop companies in the east of England. Companies were prioritised based on a set of criteria. In the end, a list of 27 companies was developed through prioritisation by academics from the Special Interest Group within the Decarbonisation Network. Prioritised companies and organisations were approached for interviews, out of which 10 responded. Figure 1 shows the selection process with the number of companies in red.

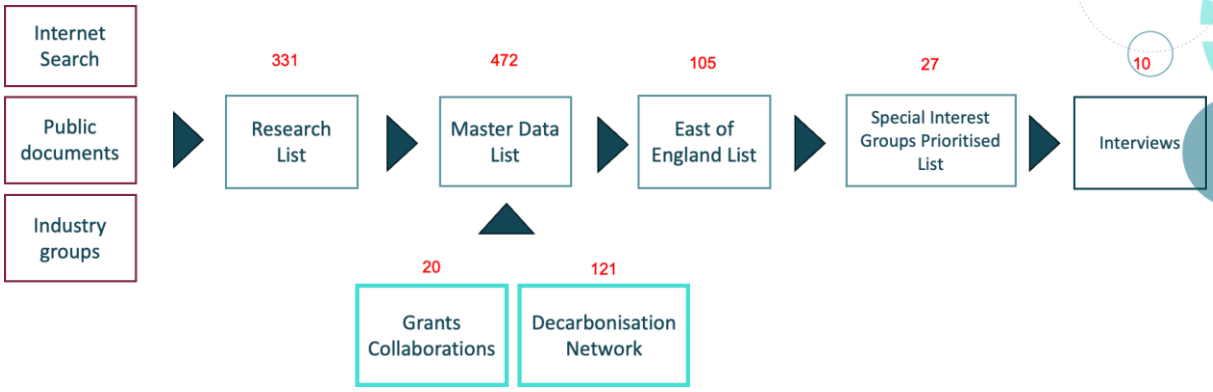


Figure 2: Companies' selections

4 Case study interviews

4.1 Interview protocol

Interviews were conducted using an online platform, MSTeams, each lasting 30 minutes. The immediate interview output includes a response summary captured in a pre-designed template and an interview audio recording upon permission. The interviews will aim to gain insights into the company's challenges and actions concerning decarbonisation, their line of business, and potential bottlenecks in technology and science. Interview questions are designed to be science and technology-focused. They cover areas such as barriers and challenges faced in decarbonisation, planned or executed actions to overcome such challenges, and ways academic linkage could offer support. The following are the main interview questions:

- Can you tell us about your business activities, including technologies you deal with related to decarbonisation?
- What significant barriers and challenges do you face in your business regarding decarbonisation?
- What actions have you taken or intend to take to address these challenges?
- How can academic linkage and research support you in your actions or challenges?

It was an open-ended interview that included follow-up questions if needed.

4.2 Conducting interviews

A template was designed to capture the summarised responses from each company. Interviews were recorded with due permission, and participants were informed of this in advance. In cases where people preferred not to be recorded, interviews proceeded without voice recording, but summary notes were taken after obtaining permission.

Several companies unable to schedule interviews in the given timeframe were requested to submit responses online. In total, up to 8 interviews were conducted, while 2 companies submitted responses online in the given time. The outcome was a list of topics related to decarbonisation that companies are interested in collaborating on with the University of Cambridge.

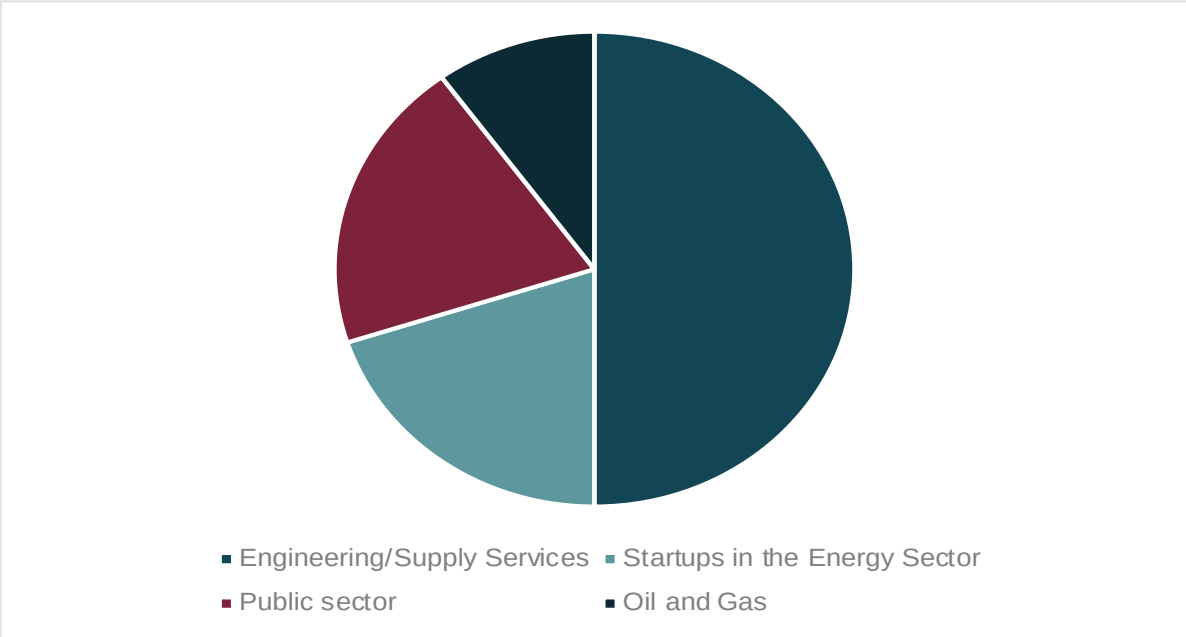


Figure 3: Companies interviewed

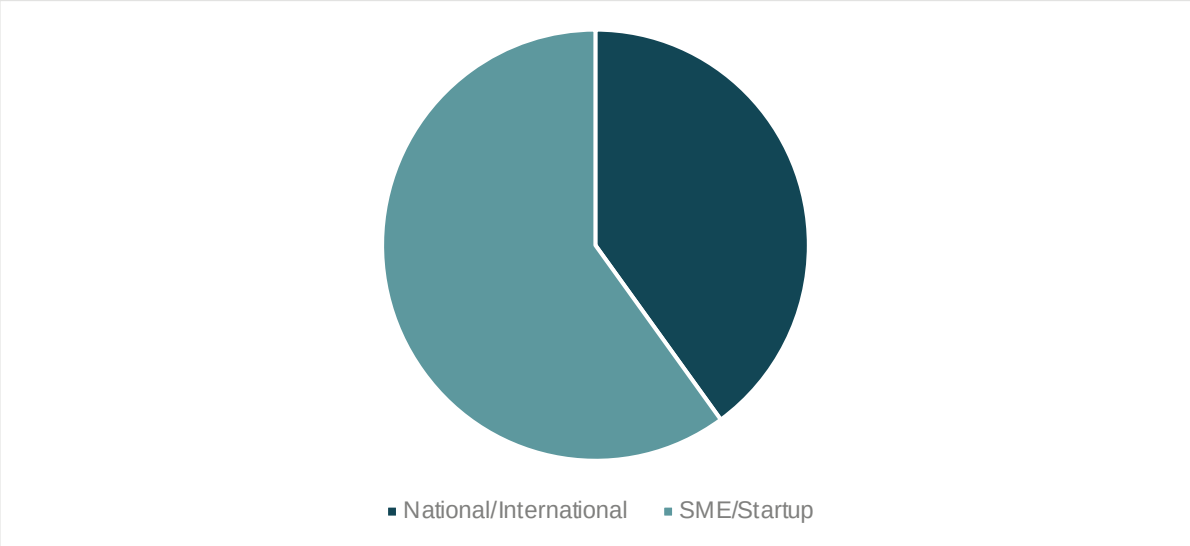


Figure 4: Companies interviewed (National/International or SME/Startup)

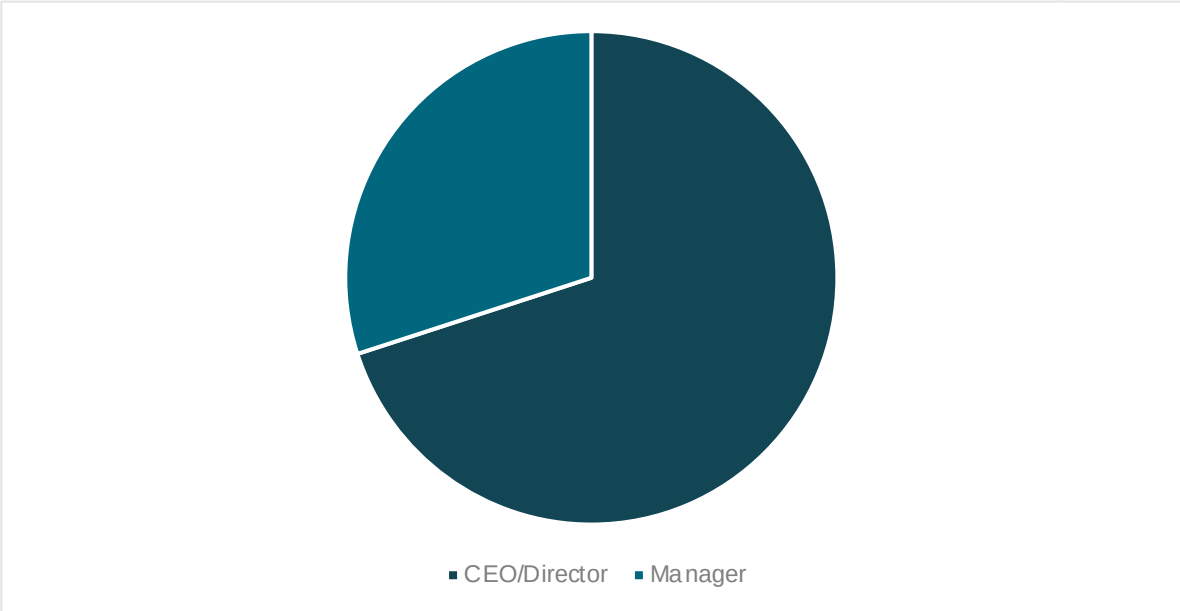
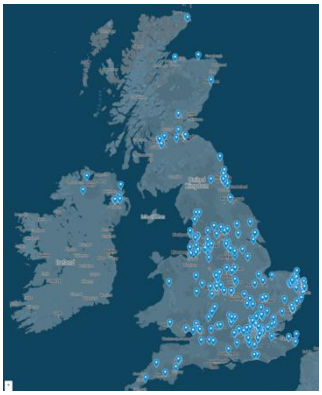
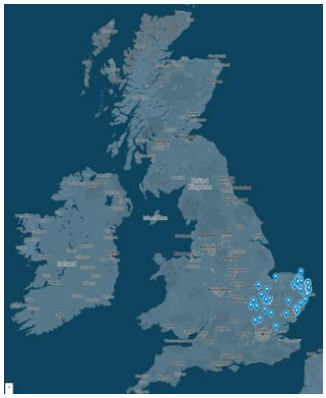


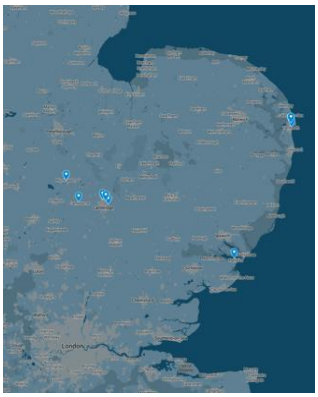
Figure 5: Companies personnel interviewed (CEO/Director, Manager)



Research List across the UK



Companies in the East of England



Companies Interviewed in the East of England

Figure 6: Companies selction map

5 Discussions

The interview data was captured in templates and also recorded with the interviewee's permission. The data was then analysed through segments based on interview questions such as Business Activities, Barriers and Challenges, Actions, and Academic Linkages. Sub-clusters were created within these segments based on analysing interview responses. Figure 7 shows the clustering map.

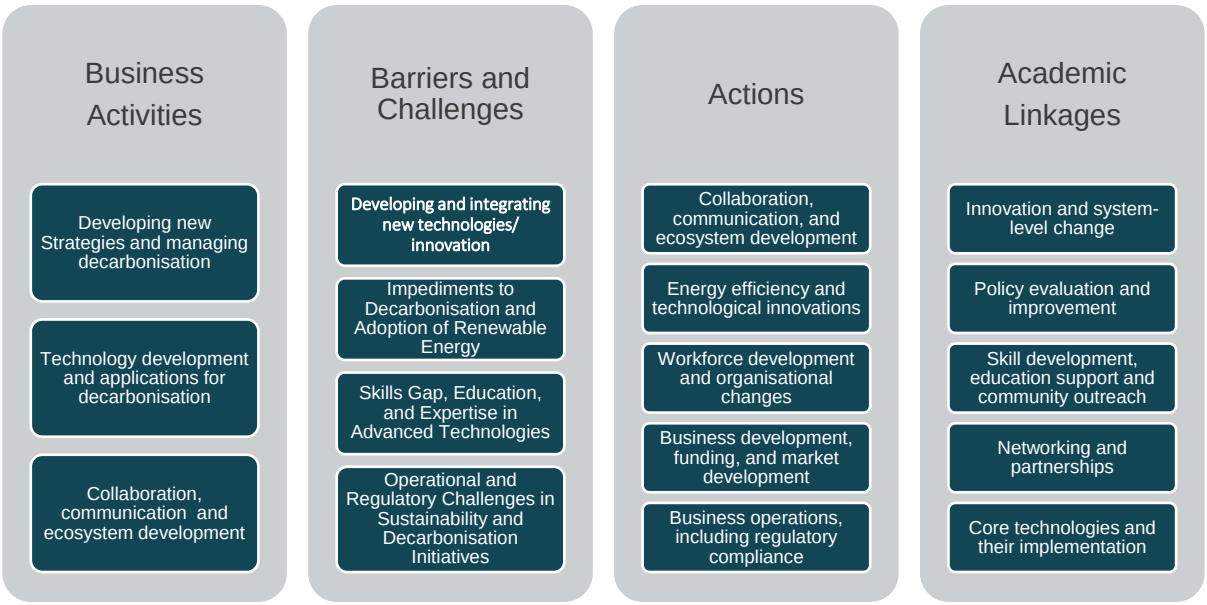


Figure 7: Interview data segment and clusters

A summary of the interview data is provided in the following sections, organised by segments and clusters.

5.1 Business activities

This includes key business activities, and areas companies are involved in regarding decarbonisation.

5.1.1 Developing new strategies and managing decarbonisation

Companies across different sectors are committed to facilitating a swift transition to a low-carbon economy, predominantly within construction, energy, and transportation. One primary focus area is the construction industry, especially technologies tied to new, energy-efficient buildings. Renewable energy technologies, such as photovoltaic panels and heat pumps, are being adopted in buildings for decarbonising. Simultaneously, a more comprehensive focus is shifting towards infrastructural changes supporting decarbonisation, such as upgrading the electricity grid.

In the public sector, most UK councils are implementing an ambitious climate strategy to reach net-zero carbon emissions by 2040. Major initiatives among councils that were interviewed include electrifying the council's vehicle fleet, implementing EV charging points, and installing solar installations at public access buildings such as leisure centres. Moreover, there's an ongoing transition to HBO fuels for vehicles, underpinned by the external review of the fleet to formulate a decarbonisation plan. Councils are also embracing a sustainable procurement approach inclusive of carbon budgeting.

5.1.2 Technology development and applications for decarbonisation

An area of significant interest lies in clean and climate tech, with particular attention paid to energy transition technologies. These include battery and grid services, demand-side management, and hydrogen supply chain, among others. The recent completion of a European battery storage pilot project represents one such technological advancement.

Similarly, companies in the East of England, particularly in the Norfolk area, are deploying a combination of technologies, such as wind and solar energy, batteries, and heat pumps, to devise the most fitting energy solutions. Other innovative technologies being explored include gravity energy and 'black box' technologies, which employ a magnetic field to generate energy.

Companies are also undertaking large-scale commercial installations under their solar energy divisions, utilising Building Integrated Photovoltaics (BIPV) with thin-film technologies. In addition, new decarbonisation technologies focus on emissions quantification and surveying, with camera and sensor systems able to monitor a range of emissions in the energy sector.

Collaboration, communication and ecosystem development

Collaboration is integral to the acceleration of decarbonisation, evident in a number of partnerships, consultancies, and member-based models. Companies are partnering with technology developers, providers, and innovators, majorly concentrating on climate tech and key tech solutions. Moreover, through consultancies, these companies are helping in ecosystem development and innovation while also fostering collaboration through member-based models.

Several companies partner with universities on certain projects, and cross-sector collaborations are common. For instance, a business offering emission monitoring technology has a partnership agreement with a European technology provider. Another company collaborates with a Scottish engineering company specialising in water wheels and funnels.

Collaborations extend to commercial operations as well, with entities like TW Solar serving as a partner in selling solar panels in the UK. There are also ongoing collaborations with manufacturers on design and technology proposals. Collectively, these collaborations foster an innovative environment for exploring and implementing diverse decarbonisation strategies.

5.2 Barriers and challenges

The following are the key barriers and challenges to decarbonisation as identified by companies during interviews:

5.2.1 Developing and integrating new technologies / innovations

Companies have expressed difficulties at both systemic and system levels when integrating new technologies into supply chains and procurement. There is a risk aversion at a system level, coupled with a lack of willingness to implement small-scale pilot initiatives, hindering innovation. Moreover, the over-reliance on high-level strategy development, which often fails to percolate through the system, further compounds this issue. Technology-specific barriers, such as noise associated with air source heat pumps and the high carbon footprint of hydrogen, exemplify challenges in incorporating innovative solutions. On top of that, securing partnerships and assembling the right individuals for projects, understanding current and future demand, and gathering comprehensive data on energy consumption present significant barriers.

5.2.2 Impediments to decarbonisation and adoption of renewable energy

The integration of renewable energy and decarbonisation efforts faces unique challenges, with issues ranging from grid capacity and policy uncertainty to a lack of trained professionals and funding limitations. A consistent concern is the lack of clarity in policy areas; the UK Government's stance on the hydrogen economy is a prime example. The skills gap, particularly in installing new technologies like air source heat pumps, impedes building construction that meets low energy requirements. Struggling manufacturers and suppliers prioritise survival over decarbonisation, leading to a lower focus on sustainable practices. The lack of UK-based solar technology manufacturing has led to a reliance on imports, causing supply chain issues. Overcoming regulatory hurdles, keeping abreast of the rapidly changing landscape of decarbonisation, and understanding government and local objectives amidst these challenges pose further obstacles.

5.2.3 Skills gap, education, and expertise in advanced technologies

A recurring issue across sectors is the existing skills gap, particularly in design thinking, systems thinking, and systems leadership. The rapid pace of technological advancements necessitates a dynamic, agile process to replace the dominant teaching and delivery paradigm. Despite the advancements, human factors are seen as posing significant barriers. There is a challenge in finding individuals trained to handle advanced technologies. The unstable market for decarbonisation technologies, with high prices and limited capacity, compounds the problem. Specific niches like hydrogen-related machinery and material science for hydrogen storage further exacerbate the skills gap. The search for appropriate talent often leads organisations to small university spinouts or branches within larger organisations. Collaborations for funding, partnerships, subcontracting, and investing are pursued to circumvent some of these challenges.

5.2.4 Operational and regulatory challenges in sustainability and decarbonisation initiatives

Companies face numerous operational and regulatory challenges in implementing sustainability and decarbonisation initiatives. The misconception that these practices invariably increase costs leads to resistance. Regulatory hurdles, particularly in the utility and power sectors, along with navigating planning regulations, can obstruct progress. Simultaneously, staying updated with the shifting targets in the changing landscape of decarbonisation is challenging. Building a business case for decarbonisation investments and demonstrating potential return on investment is challenging, as is the task of convincing businesses of the need for decarbonisation. Supply chain issues, price fluctuations, obtaining clearance for grid access for power export, and the accuracy of modelling software predictions against real-world results form additional barriers to decarbonisation initiatives.

5.3 Actions

These include actions companies are undertaking or plan to undertake to address challenges and barriers.

5.3.1 Collaboration, communication, and ecosystem development

The efforts for decarbonisation promote an ecosystem of collaboration, communication, and mutual development among diverse stakeholders. Companies recognise that decarbonisation requires collective action. Most of the companies that were interviewed work with governments to develop an understanding of a wider decarbonisation landscape and collaboration among organisations, emphasising negotiation and compromise. Effective communication is crucial for collaboration. Companies engage with stakeholders and partners to build trust. They also work with universities and corporations to pilot emerging technologies, creating a more sustainable innovation ecosystem.

In addition to forging ties with governmental and academic institutions, companies are keen on developing local partnerships for calculating carbon footprints and advancing home energy solutions. Company representatives attend conferences and leverage personal, often academic, networks to gather and share vital information. The focus on local collaborations is also evident, whether it is working with local and regional councils due to their advanced understanding of society trends/choices or collaborating with renewable energy firms in specific regions like in the East of England. This approach extends to seeking expertise beyond their organisation, often relying on word-of-mouth or engaging in strategic partnerships and investments to access niche skills and technologies. Firms are even collaborating with specialised agencies like Innovate UK, NPL, STFC, and Newton Gateway for decarbonisation.

5.3.2 Energy efficiency and technological innovations

To address the challenges and barriers to decarbonisation, companies are making notable strides in energy efficiency and technological innovations. Establishing the Climate Tech Supercluster[3] is a prime example; it encompasses most of the UK and significant parts of Northern Europe, aiming to address shared challenges and promote emerging technologies. Companies are also working closely with building developers to monitor real-world applications of technologies such as source heat pumps, thereby moving away from lab-based conditions. A robust standardisation process, such as utilising the British PAS 2035 standard for retrofitting and energy efficiency, is being followed to ensure consistent quality. Further, instead of simply offsetting carbon emissions, companies are opting for a more structured hierarchy of actions that often includes consultation with experts to evaluate fleet management and carbon trajectory. Technological innovation isn't just a buzzword for companies dealing with the automotive sector; they are actively developing electric vehicle (EV) strategies and researching next-generation materials. Other company initiatives include:

- Advancements in automating energy consumption calculations for real-time scenarios to inform building retrofit projects.
- Resolving legacy issues like non-intelligent meters and developing real-time dashboards for energy utilisation.
- Exploring innovative applications of photovoltaic (PV) technology in various settings, such as semi-transparent roof sections and bus stops.
- Development of unique technologies like SF6 quantification to overcome current limitations.
- Open mindset towards further research and development, especially for technological improvements in the oil and gas sector.
- Focus on developing practical, on-the-ground solutions that are simple but effective in achieving energy efficiency and sustainability.

5.3.3 Workforce development and organisational changes

Workforce development in decarbonisation technologies and related organisational changes is crucial to overcoming most of the challenges in decarbonisation. One shift is the increasing practice of hiring outside the traditional Oil and Gas sector to bring in fresh perspectives and skill sets. Collaborations are not limited to just industry players; companies are also working with regional authorities, such as the Cambridgeshire and Peterborough Combined Authority, to address specific skills shortages. Furthermore, they are engaging with local educational institutions, e.g. Technical and Further education institutions, to explore apprenticeships and other avenues for skills enhancement. This is part of a broader effort to build a well-rounded workforce equipped with the necessary tools to drive sustainability goals, including transitioning to independent carbon calculation within the second year and promoting carbon literacy training among staff. Other skill-related interventions include:

- Companies are fine-tuning their organisational structures in addition to focusing on the external academic and research landscape.

[3] https://www.climatetechsupercluster.com

- Acknowledgement of the need for specialised skills, particularly in areas like marketing.
- Companies are subcontracting technical tasks to external professionals, allowing internal resources to focus on core competencies related to decarbonisation.

5.3.4 Business development, funding, and market development

New contract structures are being devised to better align with sustainability goals, and there is a concerted effort to develop the Clean Tech and Climate Tech ecosystem in the UK and Northern Europe. Rather than focusing innovation in specific geographical areas, companies advocate for a more distributed innovation model. They see opportunities in using pension funds for investment in new developments, considering this a way to take a long-term view and encourage higher construction standards that facilitate decarbonisation. Businesses are also preparing plans for potential investors in decarbonisation projects, detailing project viability, expected rate of return, and cost structures to attract funding. Leveraging information platforms, they are keen on staying updated on energy networks, innovation, and funding opportunities, often working on multiple business plans concurrently.

On the funding side, companies are actively seeking grants from various bodies, such as Innovate UK, the Automotive Propulsion Centre, and API. To increase their chances, they focus on crafting a coherent narrative when applying for grants, specifying the technology delivery process, partnership roles, and areas of expertise. Several companies invest in academic research and product development, covering various technology areas like architectural design and basic photovoltaic components. Interestingly, some companies allocate at least a third of their revenue for such investment purposes. To further penetrate markets and secure funding, they are elevating discussions to ministry levels and leveraging contacts within sectors like oil and gas.

5.3.5 Business operations, including regulatory compliance

Companies are making concerted efforts to align their business operations with regulatory compliance as part of their decarbonisation initiatives. A prominent step taken by councils is establishing a retrofit framework for residents in partnership with various companies skilled in delivering retrofit solutions. Quality control is a key focus, promoting certified retrofit coordinators and accredited systems to guard against unqualified contractors. While some aspects, like the UK's overall regulatory stance, may be outside the immediate control of smaller companies, lobbying efforts through local politicians are being undertaken to influence policy. Companies also stay abreast of regulatory changes affecting the energy and decarbonisation sectors. Comprehensive energy audits are being conducted for clients to identify potential savings and provide an in-depth overview of energy usage. Before embarking on larger projects, clients are advised to focus on optimising their existing operations. This holistic approach also includes a periodic review of business practices for efficiency, adaptable engagement methods based on specific tasks, and navigating complexities such as procurement procedures when advancing business propositions.

5.4 Academic linkages

Following are the main areas where companies would like to collaborate with academia to accelerate decarbonisation efforts.

5.4.1 Innovation and system-level change

Defining key metrics and aligning them with academic research enables small-scale cluster development and supports larger-scale innovations. The focus on systems leadership and design thinking allows for cross-border impact, amplifying regional economic activation, especially in climate tech innovation. Companies believe in tailoring innovations based on the regional context, integrating techno-economic analysis, ecosystem development, and human behaviour as areas where academic insight is invaluable. Case studies, in particular, serve as real-world templates for overcoming challenges, while research into financial mechanisms can expedite the decarbonisation process.

Academic involvement extends beyond technical aspects to the social dynamics of decarbonisation. Research supports funding applications by providing the necessary expertise and even helps inform local council decisions on infrastructure investments related to decarbonisation. Academic inquiries in this context are often multi-disciplinary, incorporating science, engineering, humanities, and social sciences for a holistic view of technology adoption and decarbonisation. Companies also see potential collaboration in data analytics, given their limited capabilities despite having access to large data sets. As larger players leave the market in sectors like oil and gas, smaller companies display an increased push toward renewables, with academic research playing a pivotal role in opening new avenues, such as finding replacements for environmentally harmful substances like SF6.

5.4.2 Policy evaluation and improvement

In the realm of policy evaluation and improvement concerning decarbonisation, academic research plays a pivotal role. This is particularly true at the local level, where authorities such as county councils often lack the capacity for in-depth research. Academic contributions are viewed as crucial in forming policies, supporting lobbying efforts, and even enhancing public health through insights into sustainable lifestyles. Overall, there's a resounding call for a scholarly investigation to not only validate the effectiveness of government interventions and market changes but also to identify the shortcomings of complex schemes that fail to meet the needs of vulnerable populations. Other policy-related academic linkages include:

- Academic research is essential for providing an evidence base for health improvements and efficient policy schemes.
- Research aids in identifying the efficacy of government interventions, illuminating both successes and failures.
- Academic insights can illustrate why certain programs, like ECO-4 and HUG-2, are inaccessible to vulnerable individuals.

- There's a debate on whether the academic focus should be confined to emissions testing or encompass a broader service provider sector in the decarbonisation area.

5.4.3 Skill development, education support and community outreach

The emphasis is on broadening systems thinking and design thinking skills, which could lead to meaningful advances in decarbonisation efforts. Research also underscores the importance of educational outreach, including engagement with schools to identify potential cost savings and fund reallocation. There is a notable social drive to involve younger generations in the sustainable energy sector, offering hands-on experiences like solar panel projects to spark interest and understanding. Furthermore, apprenticeships are highlighted as an essential avenue for entry into the sector, addressing a pressing need for more opportunities in this domain.

5.4.4 Networking and partnerships

Research on alliancing models and active support for trade associations like Renewable UK set the stage for collaborative efforts. Inter-regional collaborations, as exemplified by an accelerator in Ireland, underscore the potential for shared knowledge and mutual benefits. Engagements with academic institutions, such as CUSPE at Cambridge University, lead to invaluable research insights, including those on carbon offsetting. Networking extends beyond academia, incorporating city leaders and local councils, like Cambridge County Council, in projects that explore financial flows and non-technical barriers to net-zero objectives. These multi-stakeholder interactions amplify the industry's reach and credibility while mitigating challenges, such as setting contractual terms for collaboration.

- Interests lies in broadening the network to commercial outlets not directly affiliated with universities.
- Challenges persist in identifying less visible potential partners, like startups or specific university departments, emphasising the need for a comprehensive catalogue.
- The visibility of ongoing projects is crucial for enhancing collaboration opportunities.
- Existing relationships with academic institutions in specialised fields, like hydrogen absorption materials, show the robustness of these connections.
- Academic publishing is both a promotional tool and a scientific contribution, strengthening the symbiosis between industry and academia.

5.4.5 Core technologies and their applications

Companies have shown a keen interest in the role of academic research in developing and applying core technologies for decarbonisation. Areas of technological focus span from sustainable aviation fuels to second-tier hydrogen applications in road freight, marine, and medium-scale industries. Academic support has been pivotal in progressing solar and storage projects and specialised research, like ARU's work on local carbon calculators and fleet management. Furthermore, large-scale initiatives like transforming the Golden Mile at Great Yarmouth into a

"green mile" are contingent upon academic research that involves liaising with numerous organisations.

Another dimension where academic research proves invaluable is examining the secondary effects of new infrastructural elements, such as PV windows, on building interiors and energy usage. Advances in modelling techniques, like digital twins, are also aiding in energy use analysis. Beyond the technological aspects, studies focusing on the social acceptance of new systems, like carports, are vital for gauging public engagement.

Long-term academic research on these systems' sociological and economic impacts can provide invaluable insights. For example, collaborative fundamental research with Greenwich University has advanced understanding of agricultural issues like plant growth under solar glass. Attention is also being paid to emerging markets in the renewable sector, specifically the replacement of SF6 gas, a known pollutant under investigation by research groups in Cambridge.

6 Conclusion

The project aims to bridge the knowledge gap between academia and industry in the East of England region, focusing on decarbonisation and sustainable growth. Key objectives include reaching a consensus among academic leaders on priority industry sectors, identifying relevant companies and startups within these sectors, and understanding their specific interests related to decarbonisation. Additionally, the project seeks to assess the willingness of these companies to collaborate with research groups at the University of Cambridge. By aligning academic resources with industrial needs, the objectives lay the groundwork for an effective industry-academic partnership that accelerates the region's journey towards a net-zero future.

The approach to investigating companies' decarbonisation efforts involved a multi-step methodology centred on interviews with company representatives. The project began with a scoping meeting to define its focus, specifically which industrial sectors and types of businesses would be included. This meeting resulted in an interview protocol and a structured guide to facilitate the interviews. Targeted companies spanned various sectors, such as energy, engineering, and the public sector, based in the East of England region. These companies were identified through a list provided by the Decarbonisation Network and publicly available information, resulting in a prioritised list of companies to be considered for interviews.

The research further aimed to deliver a comprehensive database, facilitating future grant applications and research collaborations. Interview questions were designed to be science and technology-focused, exploring barriers and challenges in decarbonisation and ways in which academic research could offer support. Up to 10 interviews were conducted, yielding a list of topics related to decarbonisation that companies are interested in collaborating on with the University of Cambridge. Exclusions from the current scope included the creation of a new service offering and participation in academic conferences or scholarly publications. Overall, the approach was designed to extend the network and forge meaningful connections that add value to the objectives of achieving net-zero implementation.

Companies across various sectors, such as construction, energy, and transportation, adopt comprehensive strategies to decarbonise their operations. These efforts often include energy-efficient construction technologies, renewable energy adoption, and infrastructural improvements. Alongside these measures, technological innovations are emerging as significant contributors to decarbonisation goals. Advancements in clean energy, battery technologies, and smart grid solutions underscore the evolving landscape of corporate sustainability. To accelerate these efforts, companies also recognise the importance of collaboration, engaging in various partnerships and consultancies that focus on climate tech and ecosystem development.

However, the path to decarbonisation isn't without its challenges. Companies often grapple with integrating new technologies into their supply chains, facing hurdles like risk aversion and skills gaps. Additionally, unclear policies and funding limitations significantly hinder renewable energy adoption. Skills shortages in emerging technologies exacerbate these issues, compelling companies to seek specialised talent and collaborate to address these gaps. Operational and regulatory complexities, such as misconceptions about costs and planning regulations, further hinder sustainability initiatives, often demanding re-evaluating the business case behind such efforts.

To overcome these challenges, companies are adopting a multi-pronged approach. Strategic collaborations with governments and academia create a mutually beneficial ecosystem that fosters innovative solutions. Concurrently, efforts are underway to drive technological innovations in energy efficiency, supported by robust data analytics and standardisation practices. Companies are also prioritising workforce development and restructuring internal processes to align with the escalating demands of sustainability. Furthermore, innovative funding models and business development strategies are leveraged to accelerate market penetration and align with broader sustainability objectives.

The role of academia, particularly research institutions, is becoming increasingly pivotal in this context. Academic research catalyses innovation and system-level changes, influencing both technological advancements and social dynamics. Universities also contribute to policy evaluation and improvement, providing insights into the effectiveness of local policies related to decarbonisation. Skill development and educational outreach initiatives by academic institutions are laying the groundwork for future advancements in sustainable technologies. This collaborative approach extends beyond traditional academic-industry partnerships, creating diverse networks that amplify impact and broaden the scope of collective efforts towards decarbonisation.

Annex – I: Project timescale

Tasks	Week 2023															
	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Designing and Scoping	■	■	■	■	■	■	■	■									
Engaging prospective companies							■	■	■								
Conducting interviews								■	■	■	■	■					
Analysing interviews												■	■	■	■		
Report output																■	■

Total contracted project workdays = 13

Annex – II: Companies interviewed

Category	Company Name	Company Representative		Interview date
		Name	Title	
Engineering/Supply Services	Cambridge Cleantech	Sam Goodall	Chief Executive	10/07/2023
Public sector	Greater Cambridge Shared Planning Service	Emma Davies	Joint Director of Planning and Economic Development	10/07/2023
Public sector	Huntington District Council	Neil Slopper	Assistant Director	14/07/2023
Supply Services	JBJ Associates	Robert David Haslam	Director	11/07/2023
Engineering	Marshall-Futureworx	Piotr Zulawski	Solution Architect	04/07/2023
Startups in the Energy Sector	Polysolar	Martyn Rush	R&D Manager	29/06/2023
Startups in the Energy Sector	Polysolar	Hamish Watson	CEO and Founder	07/07/2023
Engineering	Vectur Energy Ltd	Tim Gardiner	Founder	03/07/2023
Engineering	Aker Solutions*	Stephen Bull	Executive Vice President, Strategy, Portfolio & Sustainability	21/07/2023
Oil and Gas (Refinery)	Haltermann Carless UK*	Keith Mead	Sustainability Manager	21/07/2023

* Information gathered electronically

Annex – III: Interview capture templates

- Cambridge Cleantech
- Greater Cambridge Shared Planning
- Huntingdonshire District Council
- JBJ Associates
- Marshall-Futureworx
- Polysolar (A)
- Polysolar (B)
- Vectur Energy
- Aker Solutions*
- Haltermann Carless*

* Information gathered electronically

Company
Cambridge Cleantech

Respondent
Sam Goodall (CEO)

Business Activities

- Engages in the facilitation and representation of technology developers, providers, and innovators, mainly focusing on climate tech and key tech solutions.
- Fields of operation include water, energy, transport, smart mobility, and smart cities.
- Works with multinational companies looking for emerging technologies.
- Organises clean tech investment events to connect investors and tech companies.
- Assists in acceleration work for international companies aiming to enter the UK market.
- Involved in project development and initiation, working with different stakeholders to align objectives.
- Recently completed a four-year European project on battery storage pilots.
- Technologies of interest span across clean and climate tech, with a special focus on energy transition technologies such as battery and grid services, flexibility, demand-side management, and hydrogen supply chain.
- Participates in the advancement of green hydrogen production and carbon capture utilisation storage.
- Involvement extends to mobility and smart city projects.
- Offers technology scouting services for corporate partners, a paid service aimed at identifying emerging technologies.
- Operates a membership model for partners, particularly SMEs and innovators, providing them with information and opportunities to collaborate with corporate partners.

Barrier and Challenges

- Systemic and system level challenges for technology companies in incorporating new technologies into supply chains and procurement.
- Risk aversion at a systems level, often managed by high level strategies, obstructs innovation.
- A lack of willingness to take risks, learn by doing and implement more pilot, small scale initiatives.
- The need for skills development, particularly in systems thinking, design thinking, and systems leadership across public, private and academic sectors.
- Over-reliance on high level strategy development, which fails to effectively cascade through the system.
- The necessity for a more dynamic, agile process to challenge the dominant teaching and delivery paradigm.
- Existing skills gap in design thinking, leadership ideas, systems thinking, risk management and agile approaches.
- Despite technological advancements, human factors often pose more significant barriers.
- Uncertainty in policy areas, for example, a lack of clarity from the UK Government regarding the hydrogen economy.

Actions

- Acting as a coordinating entity to foster understanding amongst organisations of their interdependencies.
- Encouraging organisations to not work in isolation and emphasise the importance of negotiation, compromise, and collaboration.
- Advocating for organisations to work with other policies and be conscious of the entire ecosystem's interaction and function rather than just their part.
- Maintaining constant communication with collaborators and stakeholder partners.
- Actively developing the UK Clean Tech and Climate Tech ecosystem, including Northern Europe, to promote the technology in these regions.
- Initiating the Climate Tech Supercluster, covering most of the UK and significant parts of Northern Europe, to address shared challenges and promote emerging technologies.
- Fostering better collaboration between universities and corporates to create more opportunities for pilots and emergent technologies.
- Promoting the narrative of distributed innovation rather than concentrating on singular geographic locations.

Academic Linkages

- Academic research has potential for supporting larger scale innovation test systems, not just smaller scale cluster development.
- There is interest in exploring how stakeholders, such as multinationals and universities, can contribute positively to these ecosystems.
- A focus on systems leadership and design thinking can facilitate system level changes beyond national boundaries.
- There's potential to create multiplier effects in areas of regional economic activation, specifically relating to climate tech innovation.
- There is a need to approach innovations based on regional opportunities and benefits derived from different definitions of 'place'.
- Sharing of knowledge between regions can encourage mutual benefit and success.
- There is potential for inter-regional collaboration, as illustrated by the example of an accelerator in Ireland.
- Specific technologies of interest include sustainable aviation fuel and second-tier hydrogen use cases like road freight, marine, and medium scale industry.
- Techno-economic analysis, ecosystem and cluster development from both economic and social perspectives, and human behaviour are all interesting areas for academic support.
- Development of systems thinking and design thinking skills across a wider scale could potentially lead to significant improvements.

Company
Greater Cambridge Shared Planning (Cambridge City Council and South Cambridgeshire District Council)

Respondent
Emma Davies (Principal Environmental Officer)

Business Activities

- Primary focus lies within the construction industry, specifically on technologies associated with new, low-energy buildings.
- Utilisation of renewable energy technologies such as photovoltaic panels and heat pumps, with a noticeable uptake of air source heat pumps.
- Consideration is being given to decarbonising construction processes, including reducing carbon locked into building materials – an emerging area of focus.
- Transition is observed from building-scale solutions to a concentration on infrastructure supporting decarbonisation, like the electricity grid.
- A county-wide local area energy plan in Cambridgeshire is underway to examine the necessary infrastructure to support broader scale decarbonisation.
- Acknowledging the impact of increased infrastructure demands owing to a focus on electrification.
- Projects related to the electrification of transport are being undertaken, leading to additional pressure on energy infrastructure.
- Exploration of solutions for decarbonising heat includes district heating systems.
- Collaboration with universities, specifically with estates departments, on certain projects is underway.
- Emphasis on the usage of solar panels on individual buildings, alongside a potential project facilitating residents with bulk purchasing of solar panels for discounts.

Barrier and Challenges

- Grid capacity for renewable energy is a challenge, with projects facing delays or extra costs due to necessary power grid reinforcement.
- There is a skills gap in installing new technologies, such as air source heat pump engineers.
- Constructing buildings that meet low energy requirements is hindered by the same skills gap.
- There are technology-specific barriers to overcome, including the noise associated with air source heat pumps, particularly in compact cities.
- More work is required from manufacturers to reduce potential noise impacts.
- Barriers exist for the integration of newer technologies, such as hydrogen, which currently has a high carbon footprint.
- There may be an overemphasis on exploring newer solutions like hydrogen in sectors where existing technologies are sufficient, and these newer solutions may be more appropriate for harder-to-treat industries.

Actions

- Collaborating with developers to monitor the use of source heat pumps in real-world settings rather than lab-based conditions.
- Working alongside Cambridgeshire and Peterborough combined authority on specific work streams to address skills shortages.
- Established a retrofit framework for residents, partnering with various companies that can deliver retrofit solutions.
- Promoting the use of certified retrofit coordinators and accredited systems to ensure quality control and to prevent rogue contractors from exploiting customers.
- Recommend utilising the British standard for retrofit and energy efficiency, PAS 2035, to maintain standards in the retrofit process.
- Engaging with local education institutions, such as Cambridge Regional College, to explore apprenticeships and other skill-enhancing opportunities.
- Viewing the use of pension funds for investment in new developments as an opportunity to take a long-term view and consider lifecycle costs, thereby promoting the cause of higher standards in construction and facilitating decarbonisation.

Academic Linkages

- Research, particularly case studies, can provide real-world examples of how challenges have been overcome.
- Collaborations with departments such as CUSPE at Cambridge University have led to valuable research on topics like carbon offsetting.
- Research has been instrumental in forming decisions and approaches adopted by local authorities, such as the County Council.
- Often, local authorities lack capacity to conduct necessary research, further emphasising the importance of academic linkage.
- Potential research areas include embodied carbon and how to reduce it in the construction of new buildings while meeting all the necessary regulations.
- Financial mechanisms for speeding up decarbonisation could be another area of academic focus.
- A County Council Team have been leading on numerous projects related to decarbonisation, potentially providing useful insights.
- Academic support could be beneficial in delivering solar projects, storage projects and other such initiatives.
- The City Leaders Climate Change Group, includes various organisations, demonstrating another form of academic linkage.

Company
Huntingdonshire District Council

Respondent
Neil Sloper (Assistant Director)

Business Activities

- Management of various direct service responsibilities such as parks, open spaces and off-street car parks.
- Management of the Council's delivery team, including major projects, programmes, and project office.
- Operation of a data team providing insights, supporting bids, corporate planning and delivery.
- Cross-cutting responsibilities in climate and environment, leading the Council's climate strategy and action plan.
- Committed to achieving Net Zero Carbon Council by 2040, including measures to encourage the wider Huntingdonshire region.
- Engagement in broader projects around sustainable transport and sports development.
- Major emissions sources include energy consumption from leisure centre facilities, offices, and vehicle fleet.
- Management of refuse collection service in Huntingdonshire, including running own vehicles.
- Implementation of EV charging points in off-street car parks, alongside the development of an EV strategy.
- Management of solar installations at leisure centres and exploring further decarbonisation initiatives.
- Considering transition to HBO fuels for vehicles and keeping a review of the viability of electric refuse vehicles.
- External review of fleet to devise a decarbonisation plan for it.
- Implementation of an energy strategy for Council buildings, focusing on procurement and usage.
- Development of sustainable procurement approach, including carbon budgeting.
- Support for transport initiatives, especially EV charging infrastructure, with an upgrade to 22 KW chargers.

Barrier and Challenges

- Insufficient funding and difficulties securing investments for decarbonisation efforts.
- Return on investment for decarbonisation technology, such as EV charging points, is often poor.
- Funding streams are often dependent on match funding, requiring capital to be set aside beforehand.
- Decarbonisation not being a top priority for struggling manufacturers and suppliers, who focus more on survival.
- Barriers to household decarbonisation due to limitations in the electricity network
- Constant need for consultants to keep up with rapid advancements and changes in decarbonisation technology.
- Disconnect between charger products and network products, causing issues in infrastructure.
- Rural areas present unique and increased challenges for decarbonisation
- Technical expertise is needed for tasks such as fleet decarbonisation due to the rapidly evolving nature of the technology.
- Lack of clarity regarding the future of hydrogen as an energy source for heavy goods vehicles
- Difficulty in finding trained individuals with the required skills for handling these advanced technologies.
- Inadequate education in the field of decarbonisation technologies, leading to reliance on consultants.
- An unstable market for decarbonisation technologies, with high prices, limited capacity, and companies failing.
- Lack of UK-based solar technology manufacturing, leading to reliance on imports and supply chain issues.

Actions

- Implementing a clear hierarchy of actions to replace technologies rather than offsetting.
- Engaging professional consultants to examine options for fleet and carbon trajectory.
- Collaborating with local partnerships to calculate carbon footprints.
- Transitioning to independent carbon calculation by the second year, enhancing staff skills and promoting carbon literacy training.
- Developing an EV strategy through a learning by doing approach.
- Seeking to automate ways of calculating energy consumption in real time for building retrofit projects.
- Exploring real-time dashboards to make informed decisions on energy utilisations instead of relying on quarterly billing cycles.
- Working on resolving issues with manual assessments, such as non-intelligent meters and disconnected legacy systems.
- Collaborating with the County Council on home energy matters due to their advanced understanding of the technology and market knowledge.

Academic Linkages

- Reframe and solve problems using students, with projects including climate options and fuel consumption solutions such as energy efficient tyres.
- Academic studies at ARU supported research into local carbon calculators and fleet issues.
- Research played a role in understanding system benefits from changes in broader study.
- Collaborated with Cambridge County Council on Energy for UK Innovate project, investigating non-technical barriers and financial flows for net-zero.
- Identified need for academic research to provide evidence on effectiveness of government interventions and market changes.
- Identified failures of complex schemes such as ECO-4 and HUG-2 which present difficulty for vulnerable individuals to access and utilise.
- Academic research suggested as a tool to illustrate why certain schemes are not working, not coordinated, and not easily accessible.
- Academic research seen as a way to provide evidence against ineffective and sporadic small-scale grant schemes.
- Call for academic research to be used to highlight failures and success of schemes and provide insights into interventions.
- Highlighted the role of academia in the intersection of technical and social aspects related to decarbonisation.
- Academic research seen as valuable in providing an evidence base for improving the population's health through decreased fossil fuel consumption, increased active travel, and dietary improvements.
- Overall, there is a strong call for academic research to provide evidence and learning, enabling the creation of more efficient, beneficial schemes.

Company
JBJ Associates

Respondent
Rob Haslam (Director)

Business Activities

- The business has been engaged in sustainable and green energy projects for the past four to five years.
- The focus has shifted to the East of England, particularly in the Norfolk area, fostering relationships with local partnerships and associations.
- The company operates as an independent energy and technology consultancy, tailoring their advice to the specific needs of each client.
- Multiple technologies are utilised, often in combination, to provide the most suitable energy solution.
- Technologies employed include wind and solar energy, batteries, ground source and air source heat pumps.
- Additionally, there's interest in hydrogen desalinisation, especially due to the proximity to water and demand for decentralisation.
- Other emerging technologies under investigation include gravity energy and 'black box' technologies, one of which uses a magnetic field to generate energy.
- Hydrogen energy is being explored through smaller, portable units rather than large-scale facilities.
- Hydro energy sources, such as wave energy and water wheels, are also considered.
- The company collaborates with a Scottish engineering company specialising in water wheels and funnels.
- Emphasis is placed on keeping abreast of commercial developments in emerging energy technologies.
- The business perceives the East of England as a region full of opportunity, creativity, and innovation in the green energy sector.

Barrier and Challenges

- Funding is a significant barrier; sourcing different types of energy funding is challenging.
- It's difficult to assemble the right partners and individuals for projects, given everyone's hectic schedules.
- Developing an accurate business plan is tough, particularly when attempting to understand current and future demand.
- Gathering comprehensive data on energy consumption is challenging.
- There is nervousness about the direction of energy trends, specifically concerning sustainability and decarbonization.
- A misconception exists that decarbonisation and sustainability invariably increase costs, causing resistance.
- There is a distinction between making a business more sustainable through green energy and decarbonisation, with the latter potentially adding costs.
- Regulatory hurdles, particularly in the utility and power sectors, pose a challenge.
- Navigating planning regulations and general awareness issues can be difficult.
- Staying updated with current, relevant information and wider targets in the changing landscape of decarbonisation is challenging.
- Understanding government and local objectives can be tough amidst these moving parts.

Actions

- Creating high level business plans for potential investors showcasing viability, expected rate of return, cost structure, and benefits of projects.
- Working on several different business plans concurrently.
- Engaging larger, established partners within the industry.
- Keeping collaborations local where possible.
- Fostering relationships with international partners.
- Implementing on-the-ground solutions that prove to be simpler than expected.
- Conducting comprehensive energy audits for clients, identifying savings and providing a complete overview of energy usage.
- Encouraging clients to focus on getting their 'housekeeping' right before embarking on larger projects.
- Regularly reviewing and adjusting business operations to ensure they are efficient.
- Keeping abreast of current technologies and wider targets related to the energy sector.
- Leveraging LinkedIn and other organisations to receive updates on heat, energy networks, innovation, and funding opportunities.
- Keeping informed of regulatory changes affecting the energy and decarbonisation sectors.
- Collaborating with partners knowledgeable about industry details to fill in any regulatory gaps.

Academic Linkages

- Academics can support funding applications, particularly through providing expertise in making applications.
- Research is needed for large-scale projects, like turning the Golden Mile at Great Yarmouth into a green mile, which involves contacting numerous organisations.
- Research also supports outreach to schools, to identify potential savings and diversion of funds.
- Networking is seen as essential; learning from all individuals, regardless of their position, is highly valued.
- A strong social drive is present, with an emphasis on involving younger people for the continuous development of the energy sector.
- Hands-on experiences, such as involving school children in solar panel projects, are believed to help understanding and promote interest in the sector.
- There is a focus on apprenticeships as a viable pathway into the sector, with a pressing need for opportunities in this area.
- The overall objective is to develop industry-academic linkages to enhance and promote the energy sector.

Company
Marshall-Futureworx

Respondent
Piotr Zulawski
(Solutions Architect)

Business Activities

- The division is a technology incubator within a larger corporate group. This incubator acts as a task force of scientists and engineers working on diversifying and creating new business and technology ideas.
- The larger group operates mature businesses in areas such as airspace maintenance, repair, and overhaul (MRO), manufacturing of specialist composite elements, and fleet services and logistics.
- The key focus is exploring future states and facilitating transitions to those states, primarily in the energy sector, also investigating potential value from new products and business models.
- An autonomous drone infrastructure project for offshore wind farms. This project aims to remotely monitor the health and structural integrity of the wind turbines.
- A liquid hydrogen fuel system for aviation in partnership with industry partners.
- A solar-powered substitute for diesel units in refrigeration machinery on vehicles, which is not powered by hydrogen. The system uses solar panels installed on the rooftop of the trailer, feeding a battery that runs the refrigeration unit when sunlight is available.

Barrier and Challenges

- Small size of the organisation poses a challenge in conducting testing, integrating, and developing concepts.
- Requires specific and niche skill sets, which can be difficult to find.
- Difficulty in establishing partnerships, collaborations, and acquiring funding.
- The search for appropriate talent is often a tedious process, with niche expertise often found in small university spinouts or branches within larger organisations.
- Technology scouting is a challenge, particularly with regards to niche technology.
- There is a lack of expertise in specific areas, such as hydrogen-related machinery and material science for hydrogen storage.
- Difficulty in identifying key players in the market.
- Relies on personal networks, word of mouth, and networking at conferences to find relevant expertise.
- Requires various niche skill sets, often resorting to collaborations for funding.
- The requirement for a coherent story or roadmap to apply for large grants poses a challenge.
- Limitations in in-house capability for developing niche technologies.
- Engages in partnerships, subcontracting, and investing to overcome some of the challenges.
- Funds academic research and student projects to foster the development of required skills and technologies.

Actions

- Attending conferences and networking events for understanding and connecting with diverse individuals in relevant fields.
- Leveraging personal networks, particularly academic ones, to gather and share information.
- Relying heavily on word-of-mouth for finding relevant expertise.
- Demonstrating willingness to form partnerships to access niche skill sets.
- Actively seeking out grant opportunities from various funding bodies such as Innovate UK, the Automotive Propulsion Centre, and API.
- Forming a coherent story when applying for grants, detailing the technology delivery process, partnership roles, and contribution of expertise.
- Leaning on larger groups for support, particularly for a route to market.
- Engaging in partnerships, investments, and subcontracting to develop niche technologies, such as drones, machinery, science, and software.
- Funding academic research and student projects.
- Adapting engagement method depending on the specifics of the task at hand.

Academic Linkages

- Like to maintain strong academic linkages, particularly with the University of Cambridge, due to their proximity and existing network.
- Interest in exploring commercial outlets not affiliated with the university due to their harder reach.
- Challenges arise in identifying potential university and startup partners due to their less visibility, rather than the actual partnering process.
- There's a need for a catalogue or overview of university involvement in idea generation and product/business development.
- A well-networked system and clear visibility of ongoing projects can enhance the opportunity for collaboration and innovation.
- The company is already working with university academics in the area of hydrogen absorption materials, indicating a robust connection in this particular field.
- The process of setting contractual terms and other collaboration prerequisites has largely been resolved, reducing hurdles for future academic-industry collaborations.

Company
Polysolar (A)

Respondent
Martyn Rush (R&D Manager)

Business Activities

- Focuses on creating next-gen photovoltaic materials using organic polymer in research and development sector.
- Deploys low-cost spray deposition for printing on various materials, turning any surface into a solar panel.
- Specialises in architectural Building Integrated Photovoltaics (BIPV) with thin-film technologies, used in structures like office buildings, market stalls, and bus shelters.
- Undertakes large-scale commercial installations including car parks, car ports, battery storage, and Agrivoltaics under solar energies division.
- Produces domestic canopies and carports featuring transparent photovoltaics in the roof.
- Collaborates with TW Solar for selling panels in the UK.
- Manages direct manufacturing for organic photovoltaics, contract manufacturing in Europe and Asia, and local manufacturing in Cambridge for other technologies like curtain walling systems, canopy systems, and glazing bar systems.

Barrier and Challenges

- Challenges around carbon emissions reduction are faced more by the organisation's partners than the organisation itself.
- Attainment of low carbon status is not a primary goal for the organisation, though efforts are made to reduce carbon emissions where possible.
- International trade, particularly with Europe, is difficult due to customs duties and transport costs, which impact profitability.
- Quality control issues exist due to a significant amount of manufacturing being done in Asia.
- Recruiting qualified individuals is an issue
- Challenges to remain competitive due to the rapidly falling price of solar technology.
- Operating in UK, an expensive part of the world, the cost of hiring qualified electricians, poses additional challenges.
- Collaborating with universities on research and development projects can be expensive and complex due to financial contribution restrictions and costs.
- Supply chain issues were a problem earlier in the year but have since largely dissipated.
- Thin film technologies are being overtaken by the falling price and improving performance of crystalline silicon, causing a risk of the product becoming outdated.

Actions

- Developing proprietary technology to overcome limitations of current technologies.
- Investing significant sums in product development, encompassing various areas such as architectural design and basic photovoltaic components.
- Allocating at least a third of revenue for investment purposes.
- Possessing in-house architectural design capabilities for building projects.
- Maintaining external capabilities through partnerships with other companies.

Academic Linkages

- Collaborates closely with various academic research institutions based on their respective skills and capabilities.
- Engages in fundamental research, particularly with Greenwich University, on agricultural issues related to plant growth under solar glass.
- Academic research aids in understanding the impact of various factors on plant photosynthesis, yields, and pathogens.
- Collaboration with universities lends credibility to company operations and assists in development work.
- Universities aid in the practical application of materials in various settings and sectors.
- Utilises universities for testing products such as solar PV glass in windows, measuring their impact on reducing heat gain into buildings.
- Benefits from academic publishing as a promotional tool as well as for its scientific contributions.
- Engages in university networking activities, facilitated by being active within the academic community.

Company
Polysolar (B)

Respondent
Hamish Watson (CEO)

Business Activities

- Deals with architectural solar glazing, specifically photovoltaics.
- Installs facades on buildings and roofs incorporating photovoltaic technology.
- Develops solar carports and roof lights.
- Provides battery storage solutions and general electrical design for solar output.
- Conducts research into next-generation printed photovoltaics, emphasising transparency or semi-transparency.
- Utilises both current technologies and designs, including standard silicon on roofs and curved structures.
- Collaborates with manufacturers on design and technology proposals.
- Aims to manufacture printed photovoltaic technology on glass.
- Sells products designed in-house, which are now fairly available.
- Maintains links with silicon manufacturers to procure glass with slight transparency but retaining power.
- Predominantly uses Chinese-made solar products due to lack of current manufacturing capabilities.
- Acts as the principal contractor on tenders, including council tenders.
- Undertakes project management for both small and large infrastructure projects, owing to inherent expertise.
- Also performs design work for carports, building structures, curtain walls, and facades.

Barrier and Challenges

- Perceptions surrounding PV and their return on investment can act as a barrier to uptake.
- Supply chain issues and price fluctuations can inhibit timely procurement and project execution.
- Obtaining DNO clearance for grid access for power export can be time-consuming and complex.
- Hesitation about switching from standard silicon PV technology to new materials and structures can limit the potential for energy innovation.
- Uncertainty about the functional impacts of semi-transparent PV materials in building environments can stall implementation.
- Explaining the lower energy output of alternative PV materials compared to silicon can be challenging.
- Public perception and acceptance of new PV technology can be difficult to establish.
- The need to understand complex system modelling for non-standard surfaces and angles is a technical challenge.
- Designing new applications that can utilise flexible PV technology, such as polytunnels for dual land use, can pose implementation barriers.
- The accuracy of modelling software predictions for energy output against real-world results needs to be improved.
- Maintaining a balance between pursuing advanced aesthetic PV solutions and sustaining business with standard silicon technology is a commercial challenge.
- Securing and maintaining research grants for continued material and application development is a constant business necessity.
- Scouting for new PV material developments is an ongoing task requiring dedicated research resources.

Actions

- Developing various applications of PV technology, including semi-transparent roof sections and bus stops.
- Demonstrating how PV can be integrated into architecture and daily life for public engagement.
- Investigating new uses for flexible PV technology, such as over polytunnels, allowing for dual land use.
- Working with Innovate UK, NPL, STFC, and Newton Gateway on analysing the complex systems of these new applications, to provide accurate output estimates to customers.
- Establishing projects involving carports and standard silicon PV to maintain business continuity and support other technologies.
- Offering two types of products: standard and more aesthetically advanced PV solutions.
- Collaborating with private enterprises interested in these advanced PV solutions.
- Securing research grants and maintaining a network of collaboration to continuously explore potential new applications and materials.
- Running a research department to scout for and focus on the next generation of materials, with a particular interest in direct-to-glass manufacturing.

Academic Linkages

- Lifecycle analysis and information are crucial for council decisions about infrastructure investments, particularly in decarbonisation.
- Examining secondary effects of infrastructural elements, like PD windows, includes assessing impacts on building interiors, air conditioning use, heating needs, and lighting.
- Research on new materials can inform their potential implementation at larger scales.
- New modelling and measuring techniques, like digital twins, are valuable for energy use analysis.
- Studies on social acceptance of new systems, such as carports, aid in understanding public engagement with renewable energy and new technologies.
- Long-term, in-depth studies on sociological and economic impacts of such systems in various areas can provide valuable insights.
- Studies can extend beyond science and engineering, incorporating insights from humanities and social sciences, for a comprehensive understanding of new technology adoption and decarbonisation efforts.

Company
Vectur Energy

Respondent
Tim Gardiner (CEO)

Business Activities
- Offers decarbonisation technology focused on emissions quantification and surveying.
- Utilises camera system to monitor emissions in energy sectors, predominantly methane and CO2.
- Ability to detect up to 400 organic compounds.
- In the renewable sector, detects, monitors, and quantifies SF6 emissions, common in this field.
- Assists companies in reducing both carbon and non-carbon emissions.
- Reduces carbon utilised for mobilising people offshore, leading to fewer shipping requirements.
- Has partnership agreement with technology provider based in Europe.
- Specifically identified a need in the renewable sector to monitor SF6 emissions and collaboratively developed a product with collaborator for this purpose.
- Offers installation of systems for 24/7 data monitoring and transmission back to onshore or data centres.
- Able to capture and analyse emission data or transmit the data to clients for their own analysis.

Barrier and Challenges
- Convincing businesses of the need for decarbonisation presents a significant barrier, as acknowledgement of their emissions would necessitate investment to rectify.
- Building the business case for decarbonisation investments and demonstrating potential return on investment is challenging.
- Technological limitations do not present challenges; the technology to quantify gas emissions is advanced and effective.
- Building relationships and trust with businesses to promote decarbonisation requires time and effort.
- Proving the effectiveness of decarbonisation technology demands persistent demonstrations and presentations.
- The comprehensive nature of the service, including equipment and monitoring, leads to costs that can form a barrier.
- Costs are bespoke, depending on the client's needs, adding another layer to the convincing process.
- Most of the current operations are within the oil and gas sector.
- Efforts are being made to lobby the renewable sector and international markets, such as Iraq and Libya, towards decarbonisation.

Actions
- Engaging in dialogue with national oil companies, particularly in regions like Iraq and Libya.
- Identifying the right person or decision maker within those companies.
- Elevating discussions to a ministry level to secure funding and budget approvals.
- Using personal and partner contacts within the oil and gas sector for market penetration in areas like Iraq and Libya.
- In the local market, working with renewable energy companies in regions like offshore East Anglia.
- Addressing the challenge of finding the right decision maker within organisations.
- Navigating situations where contact persons may not be the actual decision makers.
- Dealing with complexities while taking the business proposition to the next stage such as discussions with procurement departments.
- Acknowledging the need for professional marketing assistance and considering subcontracting these tasks.
- Developing unique technology, for example, SF6 quantification.
- Recognising room for technological improvements and openness to enhancements via further research and development.
- Emphasising that improvements could particularly be made on the oil and gas side of the technology.

Academic Linkages
- The study in question will be scrutinised by various academics who will understand the research or development requirements and work together, possibly with government or other funding.
- The areas of improvement and suggestions are of interest to these academics.
- There is a focus on the renewable sector as the biggest emerging market, specifically the replacement of SF6 gas.
- Oil and gas companies are smaller now due to larger players leaving the market. Hence, there's a greater push towards renewables.
- SF6, a known pollutant, is being replaced by a new, currently unnamed gas. More research is required to determine whether this new gas is environmentally damaging or inert.
- The technological development involved in this gas replacement is of interest, with research groups in Cambridge working on renewable gas research.
- The replacement for SF6 could open up other avenues in the renewable sector.
- The company is interested in receiving academic support in oil and gas areas, particularly the development of new gas and research around it.
- It is uncertain whether the focus should be solely on emissions testing or if it should extend to the entire service provider sector.
- The company has several engineering ideas for tools to be used on a wellhead that could be pushed forward with academic support.
- There is potential interest in the data transmission, data acquisition, or analytics space, as the company has access to numerous data sources. While they can monitor this data, their analytics capability is limited. Therefore, there may be opportunities for academic collaboration in this area.

Company
Aker Solutions

Respondent
Stephen Bull
(Executive Vice President)

Business Activities
- Offshore Wind
- CCS injection
- Subsea Power

Barrier and Challenges
- Profitability
- People
- O&G solutions and way of thinking
- Regulatory

Actions
- New contract structures
- Hiring outside O&G sector
- New benchmarks and standards
- Working closely with governments

Academic Linkages
- Research on alliancing models
- Skills assessments
- Define key metrics
- Support trade association like Renewable UK

Company
Haltermann Carless

Respondent
Keith Mead (Sustainability Manager)

Business Activities
- Energy use
- Bioliquids
- Hydrogen as a fuel
- Hydrogen as a process

Barrier and Challenges
- Cost
- Availability of equipment
- Long term stability/policy from government
- Pricing mechanism that brings costs close to existing

Actions
- Monitor UK position
- Outside our control - larger organisations may have influence
- Lobbying through local PM
- Lobbying

Academic Linkages
- Regular updates from UK v EU v US policy developments
- Publish key suppliers index and listings
- Support lobbying through academic research

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