Decarbonisation of SMEs And Supply Chains

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1 INTRODUCTION

1.1 Project overview

In March 2021, the Welsh Government committed to a Net Zero target for 2050, following advice given by the Climate Change Committee. In recognition of its unique position to influence emission reductions in the private sector, the Welsh Government engaged Ricardo Plc (hereafter Ricardo) to investigate effective decarbonisation measures targeting Small and Medium Enterprises (SMEs). Decarbonising SMEs and their supply chains will be a critical step in decarbonising the Welsh economy – as of 2021, 99.4% of enterprises in Wales are SMEs, accounting for 62% of jobs in the country, and employing around 1.2 million people. Typically, SMEs require additional support in understanding and addressing carbon reductions due to lack of resources, limited knowledge, and budgets to implement changes.

This report provides outputs of desk-based research, workshops and modelling to support the methodology for decarbonising Welsh SMEs and their supply chains.

1.2 Objectives

The main objective of this project is to perform and present the findings of robust analysis that can inform policymakers and stakeholders in their development of Carbon Budget 3. This work aims to highlight where interventions are most needed and effective to support the decarbonisation of SMEs. The outputs of this project are designed to be used in the development of targeted, evidence-based policies and initiatives to meet carbon reduction targets. As part of the wider work, the Welsh Government are preparing a business decarbonisation brochure that will serve as a source document for policy makers and as a live document for providing access support to Welsh SMEs. Ricardo's work will feed into this brochure as an important source of evidence and data.

2 APPROACH

There are two main phases that form the basis of the deliverable for this work, these are:

1. Desk-based secondary research, and
2. Primary research, stakeholder consultation and recommendations

The below provides detail on the approach taken within each phase.

2.1 Phase 1 approach

In phase 1, Ricardo undertook detailed analysis and review of the existing strategies and policies relating to the decarbonisation of SMEs and supply chains. Research on key questions provided by the Welsh Government was carried out to understand where efficiency improvements could be made, including the potential for energy efficiency improvements to buildings and opportunities to improve sustainability within SME supply chains. In addition to setting out the strategic and policy context of the work, this phase involved calculating baseline emissions from SMEs and their non-territorial supply chains.

2.2 Phase 2 approach

In phase 2, Ricardo engaged Welsh SME representatives from organisations including Industry Wales and the Development Bank of Wales to gain an understanding of measures and policies that could be introduced to support SMEs to decarbonise. Following this, a net zero pathway scenario analysis was undertaken to calculate projected emissions from different levels of effort in implementing the decarbonisation measures identified both in phase 1 and through the phase 2 stakeholder engagement.

3 PHASE 1: DESK BASED RESEARCH

During the desk-based research phase, Ricardo provided a response to a list of research questions and output to baseline modelling. These deliverables are provided in the following sections and include a background of strategic and policy context, baseline SME carbon emissions, business premise energy use, adaptation and procurement.

3.1 Overarching legislation, strategies and policies

3.1.1 Overview

Since 2015, Wales has implemented several legal initiatives and policy frameworks aimed at reducing carbon emissions and reaching net zero by 2050. Wales has also acted in response to the advice from the UK Climate Change Committee (UKCCC) since 2019. As a result, Wales has developed a series of five-year carbon budgets (and interim emission targets). These budgets provide a clear roadmap for achieving emissions reduction goals whilst simultaneously delivering on the well-being objectives outlined in the Well-Being of Future Generations (Wales) Act 2015[1]. The Act sets out seven well-being goals including a focus on creating a more prosperous and equal society, fostering vibrant culture and language, ensuring a resilient economy and promoting environmental sustainability. Under this Act, the Welsh Government and other public bodies are required to integrate these goals into their decision-making process, taking into account the potential impacts on social, cultural, economic and environmental aspects to create a more holistic and sustainable future.

The Environment (Wales) Act 2016[2] imposed additional obligations on the Welsh Government with regard to reducing emissions. These obligations included establishing a maximum total amount for net Welsh emissions (carbon budgets) for a series of five-year budgetary periods. Initially, the target was to achieve at least an 80% reduction by 2050 compared to the baseline, but this was updated in 2021 to a more ambitious goal of 100% reduction. The budgetary periods considered included the first budgetary period (2016-2020), and then each succeeding period of five years until 2050. The baseline year considered for emissions reduction varies between 1990 and 1995, based on the greenhouse gas.

In 2021, the Net Zero Wales Plan was also published as the first all-Wales plan to tackle the climate emergency and has net zero as its guiding ambition. The plan aims to build synergies with others to policy areas and develop new plans to apply downward pressure on emissions. For the budgetary period 2021-2025, the Net Zero Wales Carbon Budget 2[3] set out Wales' commitment to reducing greenhouse gas emissions for that period with the overall goal of reaching net zero by 2050. The Climate Change (Wales) Regulations 2018[4], and the amended objectives included in Climate Change (Wales) Regulations 2021, provide for a maximum total amount for the interim net Welsh emissions account (carbon budget) for the first two budgetary periods, 2016-2020 and 2021-2025. Two reports have been published so far on these Climate Change Regulations (2018 and 2021), providing insights on the achievement of the targets, as well as recommendations for the next period.

In addition to these, Prosperity for All: A Low Carbon Wales (2016-2020)[5] set the foundations for Wales to transition to a low carbon country and has been underpinned by the Prosperity for All: Economic Action Plan. The Low Carbon Wales Plan details how policies and proposals contribute to meeting sector emission reduction pathways. The relevant sectors considered are power, buildings, transport, industry, land use, agriculture, waste, and sources of fluorinated gases, which align with the UKCCC sector emission pathways. The Prosperity for All: Economic Action Plan, set out a vision for inclusive growth, built on strong foundations,

1 Well-being of Future Generations (Wales) Act 2015 (Welsh Government, 2015)
2 Environment (Wales) Act 2016 (Welsh Government, 2016)
3 Net Zero Wales - Carbon Budget 2 (2021-2025).
4 Climate Change (Carbon Budgets) (Wales) Regulations 2018.
5 Prosperity for All: A Low Carbon Wales.

supercharged industries of the future and productive regions. The plan drives the twin goals of growing the economy, largely characterised by microbusinesses and Small and Medium-sized Enterprises (SMEs), while also reducing inequality. In this context, the Prosperity for All: A Low Carbon Wales Plan, supported by sectoral strategies and analytical studies, will help to deliver the decarbonisation of products manufactured in Wales. The aim is to move towards a more resource efficient, circular economy that reduces the energy and GHG emissions used in manufacturing. The plan also aims to reduce the overall carbon footprint of Welsh products.

More recently, the Economic Resilience and Reconstruction Mission and the Renewed Economic Mission: Priorities for a Stronger Economy have sought to build on these foundations considering the growing global and domestic challenges which disrupt businesses, damage growth, create uncertainty and, at times, require emergency responses. In this regard, the Welsh Government has sought to provide an even stronger assistance framework for businesses and, in particular, for SMEs to grow and diversify, invest in people's skills, speed up business decarbonisation and invest in climate resilient infrastructure.

3.1.2 Overarching Legislation, Strategies and Policies

3.1.2.1 Wellbeing of Future Generations Act

The **Well-being of Future Generations (Wales) Act 2015**[6] is aimed at improving the social, economic, environmental and cultural well-being of Wales, and provides a legally binding common purpose through seven well-being goals, for national government, local government, local health boards, and other specified public bodies. The act aims to give current and future generations a good quality of life based on the long-term impact of decisions taken. The seven well-being goals include a focus on creating a more prosperous and equal society, fostering vibrant culture and language, ensuring a resilient economy and promoting environmental sustainability.

The act details the ways in which specified public bodies must function to improve the well-being of Wales. Under this act, the Welsh Government and other public bodies are required to integrate these goals into their decision-making process, taking into account the potential impacts on social, cultural, economic and environmental aspects to create a more holistic and sustainable future. To ensure progress towards achieving the well-being goals, Welsh Ministers must set national indicators and milestones to show expectations of what should be outlined at certain points in the future. The act enables Ministers to review and amend the national indicators and milestones to ensure they remain relevant. At the start of each financial year, Ministers must publish an annual progress report setting out the progress made over the previous year. Within twelve months after a Welsh Parliament election, Ministers must also publish a **Future Trends Report**[7] containing predictions of likely future trends in socio-economic, environmental and cultural trends, and related analytical data and information that the Welsh Ministers consider appropriate. This contextual analysis must take account of the United Nations' sustainable development goals and the impact of climate change on Wales.

3.1.2.2 Environment (Wales) Act 2016

The **Environment (Wales) Act 2016**[8] placed additional obligations on the Welsh Government with regard to reducing emissions. These obligations included establishing a maximum total amount for net Welsh emissions (**carbon budgets**) for a series of five-year budgetary periods. Initially, the target was to achieve at least an 80% reduction by 2050 compared to the baseline, but this was updated in 2021 to a more ambitious goal of 100% reduction.

The budgetary periods considered included the first budgetary period (2016-2020), and then each succeeding period of five years until 2050. The baseline year considered for emissions reductions varies for 1990 (carbon dioxide, methane and nitrous oxide) and 1995 (hydrofluorocarbons, perfluorocarbon, sulphur hexafluoride, and nitrogen fluoride). By the end of 2018, the Welsh Government must set interim emissions targets for 2020, 2030 and 2040. The Welsh Government must consider international agreements to limit increases in global

[6] Well-being of Future Generations (Wales) Act 2015 (Welsh Government, 2015)

[7] Future Trends: 2021, Part of the Well-being of Future Generations (Welsh Government, 2021)

[8] Environment (Wales) Act 2016 (Welsh Government, 2016)

average temperatures. For each budgetary period, the Welsh Government must publish a **Decarbonisation Delivery Plan** setting out its proposals and policies for meeting that carbon budget. The act requires the first Decarbonisation Delivery Plan to be published as soon as is reasonably practicable following the setting of the first carbon budget.

The act provides an iterative framework that ensures that managing natural resources sustainably will be a core consideration in decision-making:

- **State of Natural Resources Report** – Natural Resources Wales (NRW) must produce a report that gives an assessment of natural resources and that measures the progress in managing them in a sustainable way.
- **National Natural Resources Policy** – The Welsh Government must produce a national policy that sets out the priorities, risks and opportunities for managing natural resources sustainably. The policy will take into account the findings of the State of Natural Resources Report.
- **Area statements** – NRW must produce a local evidence base, which helps to implement the priorities, risks and opportunities identified in the National Policy and how NRW intends to address these.

A set of five regulations have been established by the Welsh Government to give effect to some of the commitments arising from the act:

- Climate Change (Interim Emissions Targets) (Wales) Regulations 2018[9]
- Climate Change (Carbon Budgets) (Wales) Regulations 2018[10]
- Climate Change (International Aviation and International Shipping) (Wales) Regulations 2018[11]
- Climate Change (Credit Limit) (Wales) Regulations 2018[12]
- Carbon Accounting (Wales) Regulations 2018[13]

Financial mechanisms and policies are also highlighted to support the decarbonisation of the economy. This involves investments in green technologies, research and development, and incentives for businesses and individuals to adopt sustainable practices. Furthermore, the carbon budget emphasises the need for regular monitoring and assessment of progress, with transparent reporting to track the effectiveness of measures implemented. To monitor the delivery of the plan, Wales has developed a comprehensive system including:

- Legislation – ensuring an assessment against the carbon budgets is undertaken every five years.
- Indicators – annually tracking general progress and publishing a Wellbeing of Wales report.
- A monitoring and reporting system – specifically to analyse Welsh policies within the plan by assessing the implementation and effectiveness of the policies.
- Independent progress reports from the Climate Change Committee
- Scrutiny from Welsh Parliament and its committees

In this framework, the **Climate Change Committee Report**[14] required under the Environment (Wales) Act 2016, analyses the progress made and assesses whether Wales is on track to meet its currently legislated emissions reductions targets.

[9] Climate Change (Interim Emissions Targets) (Wales) Regulations (Welsh Government, 2018)

[10] Climate Change (Carbon Budgets) (Wales) Regulations (Welsh Government, 2018)

[11] Climate Change (International Aviation and International Shipping) (Wales) Regulations (Welsh Government, 2018)

[12] Climate Change (Credit Limit) (Wales) Regulations (Welsh Government, 2018)

[13] Carbon Accounting (Wales) Regulations (Welsh Government, 2018)

[14] Progress report: Reducing emissions in Wales (Climate Change Committee, 2023)

3.1.2.3 Net Zero Target and Carbon Budgets

The **Climate Change (Carbon Budgets) (Wales) Regulations 2018**[15] established a system of interim emissions targets and carbon budgeting to create an emissions reduction trajectory towards the 2050 goal. The regulations also set out how the Welsh Ministers can utilise international carbon credits. The **First Carbon Budget** (2016-2020) which required a 23% reduction in gas emissions below 1990 levels was achieved as Welsh greenhouse gas emissions decreased by an average of 28% during the first period[16].

The **Climate Change (Carbon Budgets) (Wales) (Amendment) Regulations 2021**[17] revised the maximum total amount for net Welsh emissions for each of the five-year budgetary periods. Initially, the target was to achieve at least an 80% reduction by 2050 compared to the baseline, but through the 2021 regulations, this was updated to a more ambitious goal of 100% reduction by 2050. In 2021, the **Net Zero Wales Plan**[18] was published as the first all-Wales plan to tackle the climate emergency and has net zero as its guiding ambition.

The plan aims to build synergies with others to policy areas and develop new plans to apply downward pressure on emissions. For the budgetary period 2021-2025, the **Net Zero Wales Carbon Budget 2**[19] set out Wales' commitment to reducing greenhouse gas emissions for that period with the overall goal of reaching net zero by 2050. The budget outlines the policies and proposals that are put in place to achieve an average reduction of 37% of greenhouse emissions by 2025. This is relative to the baseline year, as detailed within the Environment (Wales) Act 2016. Key elements of the Net Zero Wales Carbon Budget 2 involve transitioning to renewable energy sources and reducing reliance on fossil fuels whilst also enhancing energy efficiency. The emission sector chapters set out how emission sector policies and proposals contribute to the carbon budget and concerns by targeting:

- Electricity and Heat Generation
- Transport
- Residential buildings
- Industry and business
- Agriculture
- Land Use, Land Use Change and Forestry (LULUCF)
- Waste Management
- Public Sector

The budget emphasises the importance of engaging stakeholders, encouraging collaboration between the government, industries, and communities, and to motivate individuals to adopt sustainable practices. The budget details the concept of a socially 'Just Transition' ensuring that the costs of change do not impact those least able to pay. Two reports have been published so far on these Climate Change Regulations (2018[20] and 2021[21]), providing insights on the achievement of the targets, as well as recommendations for the next period. According to the June 2023 Climate Change Committee progress report[22], while the first carbon budget has been achieved, Wales is not yet on track to meet its targets for the second half of this decade and beyond.

For the coming period, **Carbon Budget 3** (2026-2030) requires an average reduction of 58% of carbon emissions by 2030 which is a large step relative to Carbon Budget 2. To achieve the Carbon Budget 3 goals,

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15 Climate Change (Carbon Budgets) (Wales) Regulations (Welsh Government, 2018)

16 Greenhouse Gas Inventories for England, Scotland, Wales & Northern Ireland: 1990-2021 (National Atmospheric Emissions Inventory, 2023)

17 Climate Change (Carbon Budgets) (Wales) (Amendment) Regulations (Welsh Government, 2021)

18 Net Zero Wales (Welsh Government, 2021)

19 Net Zero Wales - Carbon Budget 2 (2021-2025) (Welsh Government, 2021)

20 Report on the Climate Change (Wales) Regulations 2018 (National Assembly for Wales, 2018).

21 Report on the Climate Change (Wales) Regulations 2021 (Welsh Parliament, 2021).

22 Progress report: Reducing emissions in Wales (Climate Change Committee, 2023)

precise data regarding current emission levels and trends from the current period will enable policymakers and stakeholders to focus on where interventions are most needed to aid in the development of targeted, evidence-based policies and initiatives. This data will also allow for more informed decision-making and efficient resource allocation towards **Carbon Budget 4** (2031-2035) which is set to enter into law in 2025, and the Net Zero Plan for Wales which is planned to be published in 2026.

3.1.2.4 Economic Mission

The **Prosperity for All: A Low Carbon Wales Plan** (2016-2020)[23], which set the foundations for Wales to transition to a low carbon economy, details how policies and proposals contribute to meeting sector emission reduction pathways. The reduction in emissions and the moving towards a low carbon economy is expected to bring opportunities around clean growth for business, as well as wider benefits for people and the environment. The plan outlined the actions Wales has been undertaking to support the growth of a low carbon economy in a way that maximises the wider benefits for Wales, ensuring a fairer and healthier society. The plan also shows how Wales is at the forefront of international developments, contributing to the challenge of global climate change and sharing learnings with others. The relevant sectors considered are power, buildings, transport, industry, land use, agriculture, waste and sources of fluorinated gases, which align with the UKCCC sector emission pathways. The contribution of the emission reduction pathway for each sector was modelled relating to Wales' 2020 target and the First Carbon Budget (2016 to 2020), which have also been derived from the UKCCC's recommended emission pathway. For each sector pathway, a policy framework was developed, consisting of a Policy Outcome, Policies and Proposals.

The **Prosperity for All: Economic Action Plan**[24], which was launched to support delivery of the National Strategy for Wales, set out a vision for inclusive growth, built on strong foundations, supercharged industries of the future and productive regions. The plan drives the twin goals of growing the economy and reducing inequality. In this context, the Prosperity for All: A Low Carbon Wales Plan is also being supported by the Economic Action Plan to help deliver the decarbonisation of products manufactured in Wales. The aim is to move towards a more resource efficient circular economy that reduces the energy and GHG emissions used in manufacturing. The plan also aims to reduce the overall carbon footprint of Welsh products. Actions to support these plans have included the Waste and Resources Action Programme (WRAP) and Fareshare on circular economy and resource efficiency activity through involvement as a partner in the Interreg funded Circular Economy SMEs (CESME) project. To achieve wider impacts from interventions, the Welsh Government has proposed a new Economic Contract between business, government and partners in Wales.

The approach is expected to increase the availability of better jobs closer to home that meets the decarbonisation ambitions and ensures that businesses are optimising the potential of new and emerging technologies. The Development Bank of Wales also has a critical role in ensuring SMEs and micro businesses have access to streamlined finance packaging that will enable them to grow. Business finance is therefore also dedicated to innovative and thriving social businesses, including cooperatives, non-profit organisations and social enterprises.

The Economic Resilience and Reconstruction Mission[25] and the renewed **Economic Mission: Priorities for a Stronger Economy**[26] seek to build on the Prosperity for All: Economic Action Plan, to strengthen the values and priorities that shape the Welsh Government's decisions given more recent socio-economic challenges. The Economic Resilience and Reconstruction Mission established how the Welsh Government has been planning to rebuild Wales' post COVID-19 economy in a manner that prioritises wellbeing, drives prosperity, values environmental sustainability, and helps every person in Wales to realise their potential. There is also a focus on supporting firms to innovate and diversify, speeding up business decarbonisation and investing in climate resilient infrastructure. In this regard, the Welsh Government has announced additional funds for the Development Bank of Wales' Flexible Investment Fund to improve the supply of long-term,

[23] Prosperity for All: A Low Carbon Wales (Welsh Government, 2019)

[24] Prosperity for All: Economic Action Plan (Welsh Government, 2019).

[25] Economic Resilience and Reconstruction Mission (Welsh Government, 2021).

[26] Economic Mission: Priorities for a Stronger Economy - Our priorities for building a more prosperous, equal, and greener economy (Welsh Government, 2023)

accessible business finance and help more firms, including SMEs, to grow and expand. The Economic Mission: Priorities for a Stronger Economy seeks to provide a more robust assistance framework for businesses, especially SMEs, considering further complex global and domestic events. The Welsh Government is seeking to invest as much as possible to tackle the skills divide while putting rapid support in place to help those facing redundancy to find new employment. This is being prioritised by investing in long-term partnerships capable of linking innovation and skills to better pay and wellbeing.

The Welsh Government intends to establish Wales as a global leader both in technologies that will power the future, and in global responsibility. In this regard, to meet the highly ambitious target for Net Zero Wales Plans by 2050, the Welsh Government has set a path to re-examine the infrastructure needed to deliver a rapid and effective change, and to ensure the infrastructure can address future needs. For many micro-businesses and SMEs in Wales, a key barrier to decarbonising their heat will be a lack of expertise or finances to invest in low carbon solutions. Larger businesses are also not necessarily currently incentivised to invest given the way the current electricity price is determined. While there is undoubtedly a commitment from businesses to support net zero ambitions, for many, the financial case for the required investment is not strong. The draft **Heat Strategy for Wales**[27] consultation document, which was published in 2023, outlines the heat strategy for Wales with the aim of developing a decarbonised heat system that delivers an enabling framework to supporting a just transition across all sectors. This strategy takes a comprehensive approach to address the future of heat, encompassing all sectors, from low-temperature home heating to high-temperature industrial heat. It recognises that low carbon and affordable heat is not only a technical challenge, but also a human one.

The **Future Energy Grids** technical report[28] and insights report[29] for Future energy grids for Wales (FAW) project aim to ensure a net zero compliant, Welsh future energy system pathway to 2050 by consolidating a broad view, across the network companies operating in Wales. The reports also identify the key implications for electricity and gas network operators and steps needed to develop energy networks in Wales as part of the wider UK energy system. As part of the analysis, the reports develop recommendations for the Welsh Government to take forward, consistent with its ambitions to accelerate decarbonisation and play a role in the energy governance landscape.

Manufacturing is the largest contributor in terms of Gross Value Added (GVA) to the Welsh economy. Manufacturing can be defined as a sector in itself but is, in fact, composed of several SMEs in the food and drink, information and communications technology, chemicals, electronics, life sciences, construction, metals, paper and pulp, energy, mobility, and defence and security sub-sectors. The framework outlining a manufacturing future for Wales[30] outlines the **Manufacturing Action Plan (MAP)** to ensure that our manufacturing community is fit for the future. The MAP has identified six over-arching issues that need to be addressed and a further ten themes that have emerged from the consultation process along with the Welsh Government co-ordinating the partnership needed to achieve the economic goals. Actions have been prioritised in terms of immediate (the next 12 months), medium (up to 5 years) and long term (up to 10 years and beyond). The MAP also protects and promotes growth in existing added value manufacturing capabilities, especially through its Small and Medium-sized Enterprises (SMEs), by sharing best practice and collaboration.

The updated version of the plan, **A Manufacturing Future for Wales - Our Journey to 'Wales 4.0'**[31] aims to decarbonise industry and is underpinned by the **Net Zero Skills Action Plan**[32]. The updated version of the MAP establishes six strategic objectives which set the long-term approach to delivering against this vision. Businesses, particularly SMEs, are also offered support to incorporate energy efficiency, resource efficiency and new low carbon technologies into their workspaces and manufacturing facilities while developing new ways of working. The Net Zero Skills Action Plan sets out the current net zero skills position in Wales, against the eight emission sectors as identified in Net Zero Wales Plan. The Net Zero Wales Plan also narrows the

27 Draft Heat Strategy for Wales - The path to net zero heat in Wales by 2050 across all sectors (Welsh Government, 2023)

28 Future Energy Grids for Wales – Technical Report (Welsh Government and Catapult Energy Systems, 2023)

29 Future Energy Grids for Wales – Insights Report (Welsh Government and Catapult Energy Systems, 2023)

30 Manufacturing Future for Wales: A Framework - How we will improve manufacturing across Wales (Welsh Government, 2021)

31 A Manufacturing Future for Wales - Our Journey to 'Wales 4.0' (Welsh Government, 2023)

32 Stronger, Fairer, Greener Wales: Net Zero Skills Action Plan. Welsh Government, 2023.

definition and helps gain a common understanding of the jobs and skills that will be required. In this context, the Welsh Government remains committed to upskill the net zero skills by investing in people, skills, and talent, to drive Wales towards a greener economy.

3.2 Small and medium enterprises: An overview

3.2.1 Emissions baseline

To understand the quantity of emissions that SMEs' activities generate, a baseline needs to be calculated. This includes emissions categorised as scopes 1, 2 and 3:

- Scope 1: Direct emissions. This refers to emissions from activities owned or controlled by the SMEs, such as combustion in owned or controlled boilers and vehicles.
- Scope 2: Indirect energy emissions. This refers to emissions associated with consumption of electricity, heat, steam, and cooling purchased by companies. This work considers only Scope 2 emissions from electricity as not all companies purchase heat, steam, and cooling, so these emissions could not be reasonably apportioned to SMEs.
- Scope 3: Other indirect emissions. This refers to emissions that occur at sources that companies do not own or control and are not classed as Scope 2 emissions.

This section (3.2.1) outlines the methodology used in calculating the baseline emissions for scopes 1, 2 and 3 for SMEs in Wales. The results of this baseline can be found in section 3.2.2

3.2.1.1 Scope 1

When creating a plan for net zero, the essential first step is to have a clear and thorough understanding of current emissions. A baseline year is selected, then emissions calculated for that year to determine the baseline emissions.

For this project, a carbon baseline for scopes 1 and 2 has been developed using data from the 2023 National Atmospheric Emissions Inventory (NAEI) produced by Ricardo on behalf of the Welsh Government. The 2023 publication used in this work (the most recently published at the time of analysis) provides data for the 2021 calendar year. Emissions in the Welsh Greenhouse Gas Inventory are provided in kilotons of carbon dioxide equivalent ($ktCO_2e$) and disaggregated first by NCFormat industries (National Communications nomenclature for sectors), and then further by IPCC categories. The Inventories team within Ricardo, who compile the NAEI, advised that the NCFormat categorisation is based on policy-areas. For example, refrigerant leakage within IPCC category "2F2a_Closed_foam_blowing_agents" is not typically carried out by traditional heavy industries, so this is considered to fall under the scope of "Business" instead of "Industrial Processes" for the purpose of policy making. IPCC categories within national inventories define activities that produce emissions with significant influence on a region's total inventory of greenhouse gases (GHGs). Therefore, IPCC categories should be understood to refer to processes, while NCFormats describe the policy-areas under which this process would be targeted.

NCFormat industries in the NAEI:

- Transport
- Residential
- Public
- Industrial Processes
- Energy Supply
- Business
- Agriculture
- Land use, land use change and forestry

- Waste Management
- Exports.

Due to the nature of this work investigating SME emissions, all emission sources within the NCFormat industries “Residential”, “Energy Supply” and “Public” have been excluded, as these do not relate to the activity of SMEs. Agricultural emissions have also been omitted from this work, as advised by the Welsh Government, as pathways are being modelled using the Welsh Government's 2050 calculator for this sector.

Emissions from IPCC categories have been excluded from calculations where these categories relate to activities undertaken by large corporations only, for example 1A2a_Iron_and_steel, relating to production of iron and steel. These exclusions were made following consultation with Ricardo colleagues who compiled the NAEI and the point source document[33] detailing the companies from which emissions for different activity types were recorded.

Once relevant exclusions had been made to remove activities only carried out by large enterprises, the remaining IPCC categories accounted for emissions from businesses of all sizes, in activities that are carried out by both SMEs and large enterprises. As the NAEI cannot be disaggregated by enterprise size, the next step was to apportion the emissions from included IPCC categories to SMEs only. The report Size Analysis of Active Businesses in Wales[34] provided a key dataset, quantifying the percentage of businesses in Wales in each size-band and industry, split by turnover. The proportion of SMEs (businesses with up to 250 employees) out of total enterprises is shown in Table 1. By mapping IPCC categories to one of these industries, the emissions for each category could be multiplied by the relevant SME proportion to estimate SME emissions for a given activity type.

In order to minimise subjectivity in this mapping process, each IPCC category has been mapped to a SIC03 code, so that it can be tagged with an industry from the report ‘Size Analysis of Active Businesses in Wales’, as the methodology defines that these industries represent aggregations of SIC03 codes, as shown in Table 2. This mapping of one IPCC category to one SIC03 code is a simplification, as an activity represented by one IPCC category could be undertaken by enterprises within a range of SIC03 codes. However, the purpose of this mapping is not to use the SIC03 codes to calculate emissions, but to apportion the emissions already calculated within the NAEI to SMEs using a reasonable assumption of the size of businesses undertaking a given activity within an IPCC category.

Table 1: Proportion of Welsh businesses by industry with 250 employees or fewer, split by turnover (2021).

Business size-band	Agriculture	Production	Construction	Distribution, Hotels, Restaurants and Transport	Financial and business services	Public Administration, Health, and Education	Other services
SME Proportion	86%	25%	76%	48%	N/A[35]	61%	72%

[33] Emissions from NAEI large point sources (BEIS, 2023)

[34] Size Analysis of Active Businesses in Wales, 2022 (Welsh Government, 2023)

[35] Data not available for Financial and business services. As enterprises in this industry do not have significant Scope 1 emissions, there were not any IPCC categories which linked only to the business activities of enterprises in SIC03 codes J or K, so this missing data has not affected the results. Although there will be emissions in the NAEI from enterprises in this industry, the mapped industries are used only to apportion emissions to SMEs, so these emissions have not been excluded, rather apportioned according to the SME proportion of another industry.

Table 2: Industries in the report 'Size Analysis of Active Businesses in Wales' and relevant SIC03 codes

SIC03 codes	Industries
AB	Agriculture
CDE	Production
F	Construction
GHI	Distribution, Hotels, Restaurants and Transport
JK	Financial and Business Services
LMN	Public Administration, Health, and Education
OPQ	Other Services

It can be seen in Table 1 that production is the industry with the lowest proportion of SMEs. Agriculture is the industry with the largest proportion of SMEs.

3.2.1.2 Scope 2

Electricity generation is accounted for under dedicated IPCC categories (Table 2) with end-user scope 2 electricity consumption reported by NCFormat. To ensure that electricity consumption for excluded IPCC categories was not included in the baseline, the proportion of end-user emissions for each NCFormat sector has been found against aggregated scope 1 emissions for the respective NCFormat. Therefore, estimation of scope 2 emissions considers the typical ratio between scope 1 and 2 emissions for each industry. Estimates of location-based scope 2 electricity emissions for IPCC categories included in the baseline were found by multiplying scope 1 emissions by the scope 2 proportions in Table 3 according to the NCFormat that each IPCC category belongs to. These emissions were then apportioned to SMEs only, using the same method as for scope 1. This method of estimation uses the assumption that emissions for all IPCC categories in an NCFormat will be scaled by the same factor between scope 1 origination and scope 2.

Table 3: Proportion of Scope 2 emissions against Scope 1 emissions by NCFormat (2021).

NCFormat	Scope 2 ($ktCO_2e$)	Scope 1 ($ktCO_2e$)	Scope 2 proportion
Transport	10	5421	0.2%
Industrial processes	1	2273	0.04%
Business	1866	8808	21.2%

IPCC categories within NCFormats Land use, land use change and forestry (LULUCF) and Waste Management have been included in this work, as these include activities that are controlled by SMEs. Whilst these groups have high scope 1 emissions, there are no associated scope 2 emissions. This is due to the nature of the emissions activities, which are largely produced by non-fuel combustion. For Waste Management this includes methane and carbon accumulation in landfills, biological treatment, and open burning of waste, and for LULUCF these are carbon stock change emissions from land use changes and controlled burning of biomass as forest land is converted to other land types.

3.2.1.3 Scope 3

Scope 3 emissions are defined in this work as the non-territorial emissions associated with Welsh SMEs. This reflects an area-wide approach to calculating GHG emissions, where scope 3 refers to the emissions from activities that occur outside of Wales as a result of demand from within Wales. Emissions from exports (non-territorial emissions associated with the use of and disposal of Wales' sold products in countries that are importing them) have not been accounted for, as these are beyond the scope of this work. Inclusion of these emissions would require an understanding of quantities of goods that have been exported by Wales broken down by country, parameters for products including kW ratings, usage frequency (x number of days per year), lifespan of products and the material constituent types and masses.

Upstream cradle-to-gate emissions associated with Wales' imports (including emissions associated with the extraction of raw material, transport to manufacturing site, manufacturing processes) have been calculated. The key data sources for these calculations were the Welsh International Goods trade: Interactive Dashboard,[36] used to provide Wales' £ spend on EU and non-EU imported goods for the 2022 calendar year. Use of data from 2022 was selected as this was the most recent publication of this dataset at the time of analysis and reflects an economy less affected by COVID than the equivalent 2021 data. 2022 was selected over 2019 as a non-COVID baseline as any decarbonisation measures based on 5-year-old data would not be representative of the emissions landscape that has evolved since the pandemic. As was done for scopes 1 and 2, the report 'Size Analysis of Active businesses in Wales[37]' was used to apportion spend to SMEs.

Emissions were estimated from this spend-based import data using the Ricardo spend-based emissions calculator. Spend values (£) for each import item have been assigned an emissions factor ($kgCO_2e$/£ spend) spend description based on SIC/COICOP categorisation[38].These emission factors were developed using a multi-regional input output model (MRIO), which accounts for the flow of products from abroad to the UK[39]. Spend values were adjusted to account for VAT (if COICOP factors were used) and for inflation, as the most updated SIC and COICOP factors are for 2020.

Results

3.2.1.4 Overview

Section 3.2.2 of this text provides the results for the baseline emissions for Welsh SMEs. This allows for the identification of the largest emission contributors, which can help provide focus on where action should be targeted.

The calculated emissions baseline for Welsh SMEs is shown as follows:

- Figure 1: Scope 1 and 2 baseline by NCFormat.
- Figure 2: Scope 1 emissions by fuel.
- Figure 3: Scope 3 emissions by import item.
- Figure 4: Baseline emissions by scope.

[36] International goods trade: interactive dashboard (Welsh Government, 2023)

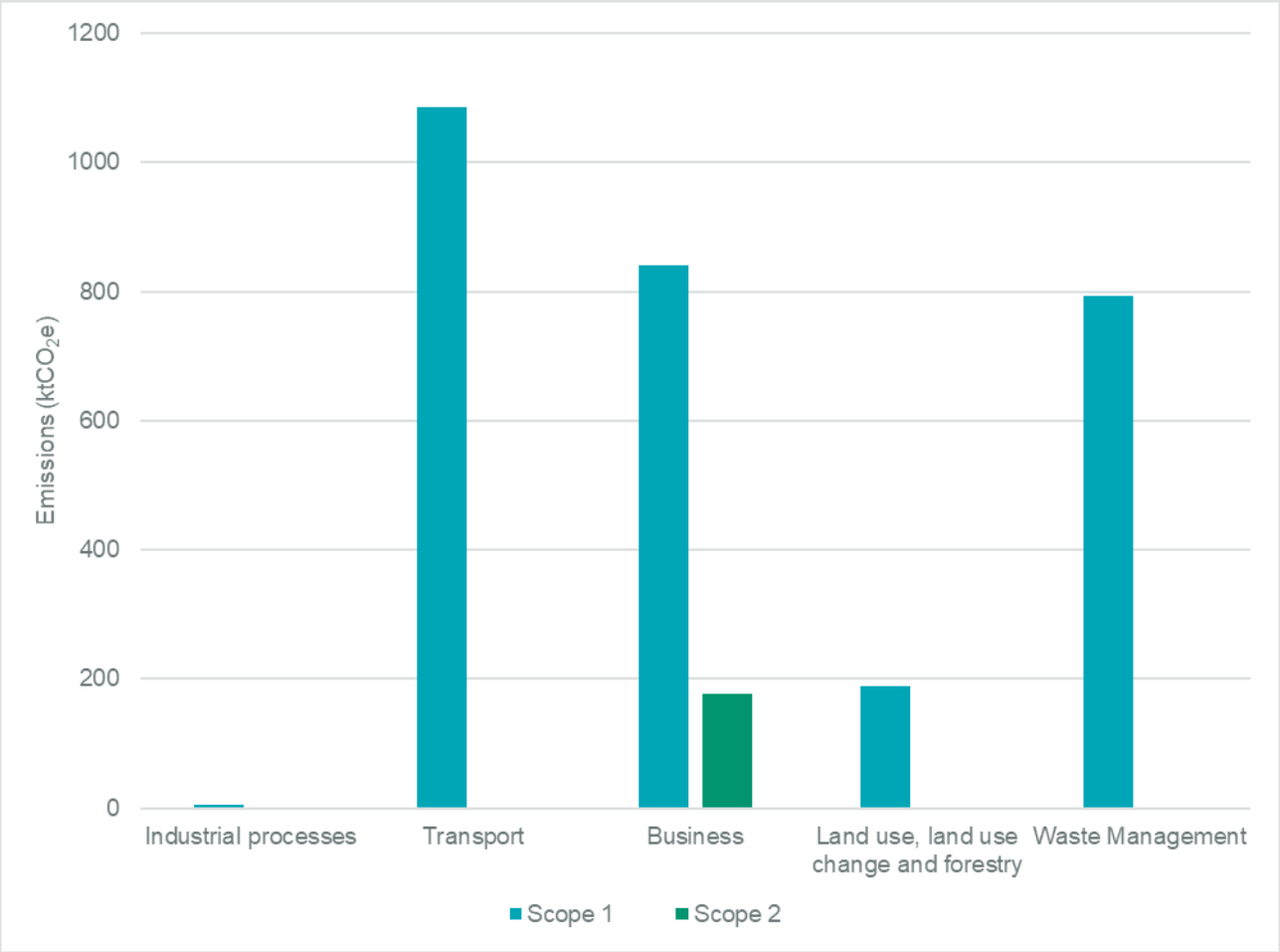
[37] Size Analysis of Active Businesses in Wales, 2022 (Welsh Government, 2023)

[38] SIC (standard industry classification) and COICOP (consumer goods and services) factors convert spend into emissions ($kgCO_2e$), accounting for the emissions intensities of given industries or consumer goods and services, respectively.

Source: UK and England's carbon footprint to 2021 (UK Government, 2024)

[39] 'Abroad' refers to the UK, Brazil, Russia, India, China, South Africa, the USA, Japan, the rest of the EU, the rest of Europe, the rest of the OECD, the rest of Africa, the rest of Americas, the rest of Asia and Oceania and the Middle East. Variance in production efficiencies means that the impact per pound spent may be larger for a product from country A than from country B. Including the UK's most significant trade partners in the MRIO model means that emissions factors account for the countries from which items are imported.

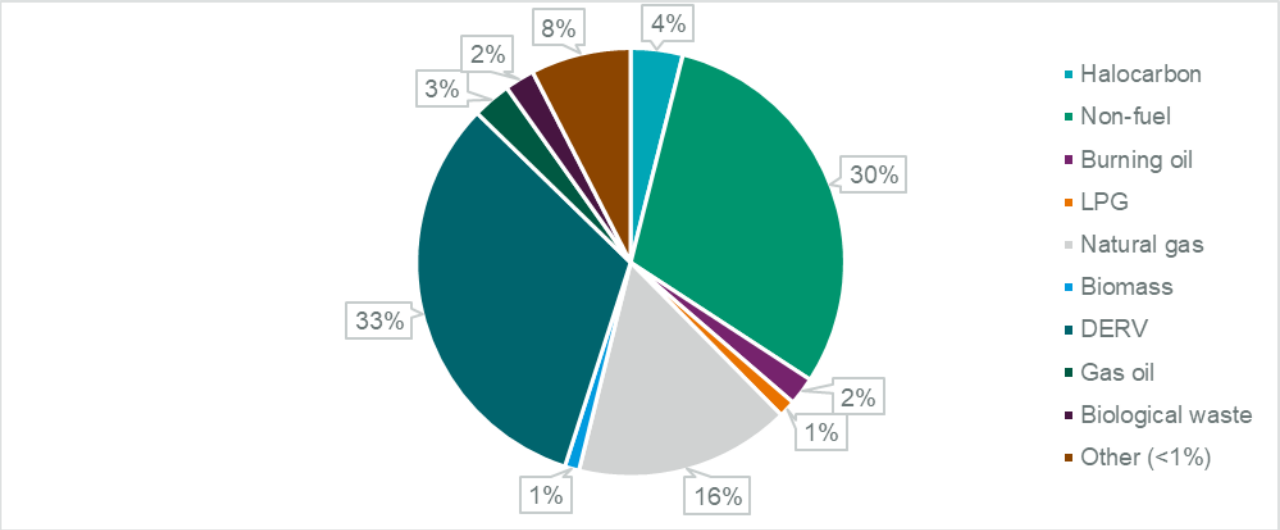
Figure 1: Scope 1 and 2 baseline by NCFormat (2021)



Transport emissions account for the greatest proportion of scope 1 emissions, whilst industrial processes account for the least. Many IPCC categories within NCFormat Industrial Processes are large scale industrial processes, such as the manufacture of steel. As a result, Industrial Processes largely does not reflect the activities of SMEs, and so many of its constituent IPCC categories have been excluded, resulting in the emissions for this group being relatively small. NCFormat Business encompasses manufacturing processes taking place on a smaller scale. Therefore, most manufacturing emissions from SMEs sit within Business.

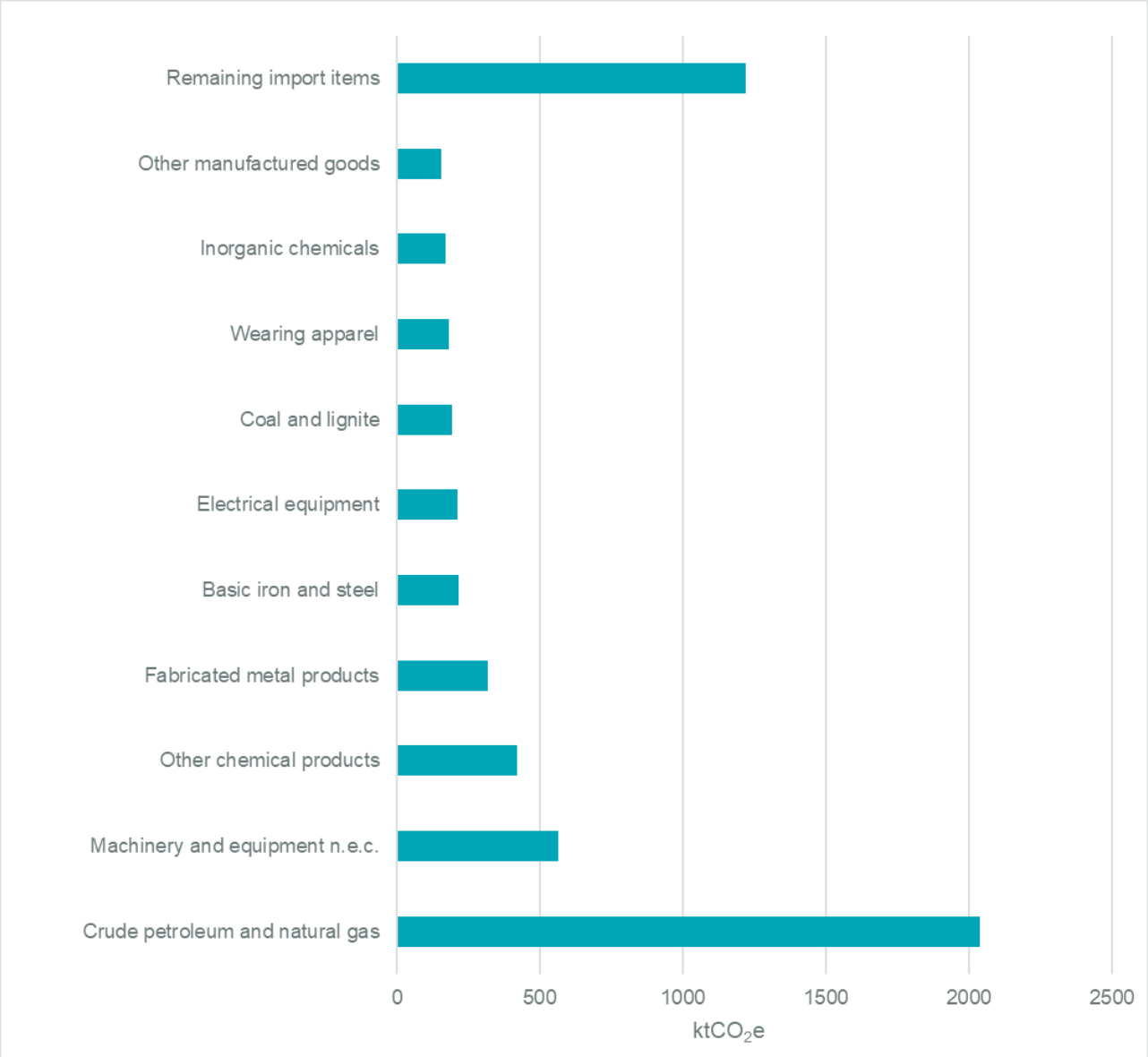
Most scope 2 electricity consumption emissions are within NCFormat Business. This is due to the types of enterprises whose activities fall under ‘Business’, as these end-users consume electricity as a greater proportion of scope 1 emissions than other groups. Transport scope 2 emissions are small despite this being the most significant scope 1 category as the vast majority of fuels used for transport generate carbon emissions through fossil fuel combustion. Whilst there is electricity consumption corresponding to these scope 1 activities, this is much less carbon intensive and relates to a much smaller proportion of activities in this NCFormat.

Figure 2: Scope 1 emissions by fuel ($ktCO_2e$) (2021)



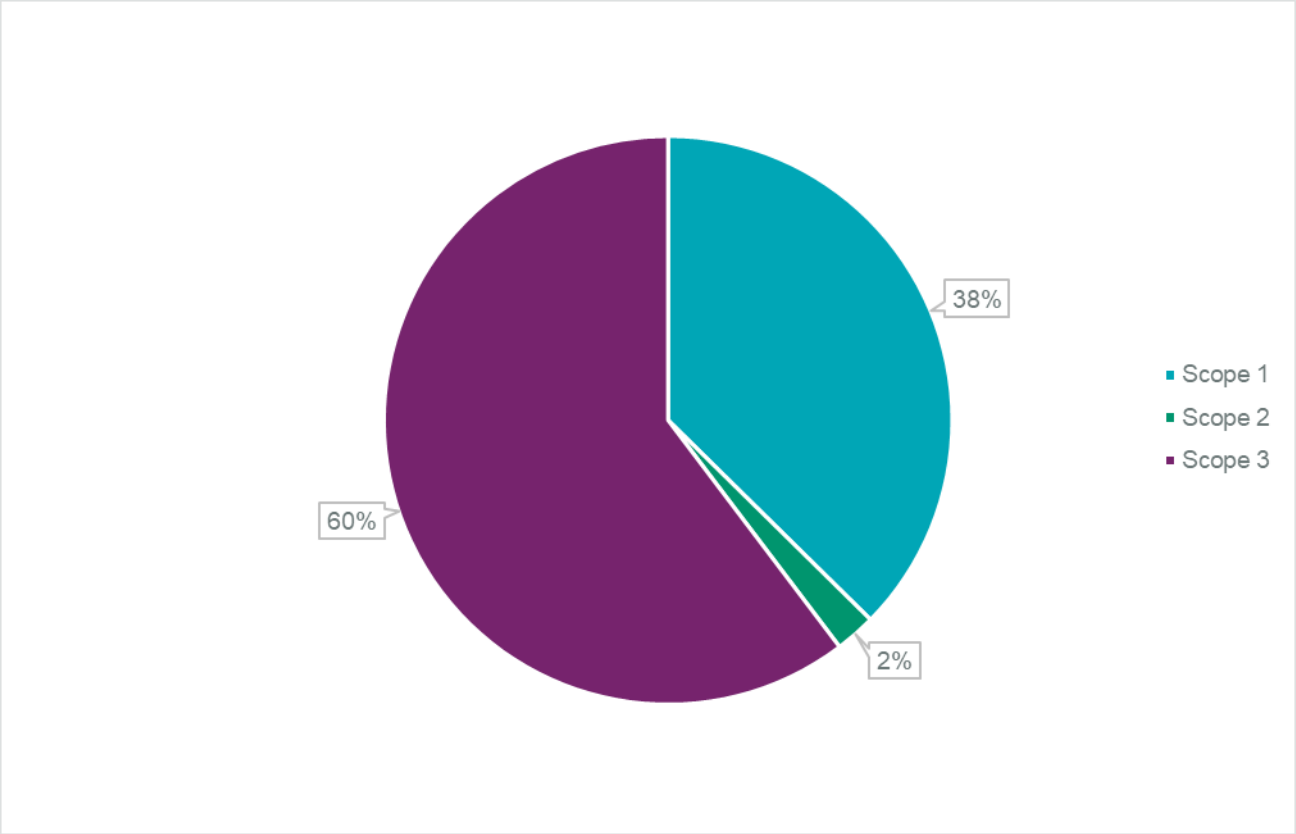
The fuels with the most significant emissions are DERV (33%), natural gas (16%) and non-fuel (30%), relating to LULUCF emissions from carbon stock exchange from land use change and waste emissions from landfill, sewage decomposition and waste-water treatment. The prevalence of carbon intensive fuels DERV and natural gas demonstrate a clear need to focus future actions on activities that will reduce the emissions from fossil fuel sources.

Figure 3: Scope 3 emissions by import item (2021)



The import item accounting for the most significant emissions is crude petroleum and natural gas, accounting for 36% of emissions from import items. This shows Wales' dependence on imported fossil fuels and highlights an opportunity for improved national fuel security by switching to domestic renewable fuel sources, operated by and for Wales.

Figure 4: Baseline emissions by scope ($ktCO_2e$) (2021)



This area-wide assessment of GHG emissions, following the GHG protocol for cities[40], shows that scope 3 emissions are the most significant, followed by scope 1, with scope 2 representing only 2% of overall emissions for Welsh SMEs. This is reflective of the broad nature of activities carried out by SMEs across the economy, including scope 1 emissions in NCFormats LULUCF and Waste Management, which have significant emissions with no associated electricity consumption. In this assessment of carbon emissions, scope 3 emissions account for 60% of total emissions for Welsh SMEs. Under the Corporate GHG Protocol[41], scope 3 emissions typically account for over 80% of an individual company's carbon footprint. An assessment of Welsh SMEs following this framework would likely result in a larger emissions result for scope 3, as this study has considered only non-territorial GHG emissions to fall within scope 3. An aggregation of all corporate GHG emissions inventories for SMEs in Wales would re-count emissions reported here under scope 1, as businesses will count supply chain emissions within Wales in their scope 3. Whilst an organisation will have limited control over scope 3, there is the potential to influence it and thereby encourage those responsible to reduce the emissions (one company's scope 3 is another's scope 1 and 2).

3.3 Climate resilience

This section provides an introductory overview of the changing climate in Wales and some guidance on adaptation for SMEs and their supply chains. Climate adaptation for SMEs is a particularly challenging topic as (i) the future climate of Wales and its regions is highly uncertain, (ii) the vulnerability of an SME to particular climate hazards (including rising sea levels, hotter weather and more intense rainfall) is *context specific* (where "context" includes, *at a minimum*, the type of business operations undertaken, and the local terrain, hydrology and building stock) which, taken together, mean that (iii) the costs of adaptation measures cannot be modelled for individual businesses, and even with state-of-the-art climate data, benefits are hard to quantify. This section

[40] GHG Protocol for Cities | GHG Protocol
[41] Corporate Standard | GHG Protocol

is, therefore, necessarily high level and provides only generic advice. Further assessment of adaptation needs, costs and benefits, for SMEs and supply chains is recommended. Such an assessment would use business specific information on assets, operations, people and geography to build a fuller picture of climate risks, and specific steps that could be taken to tackle these.

This overview covers three topics:

1. Changing weather patterns in Wales.
2. Costs and benefits of adaptation.
3. Legal requirements associated with adaptation.

Specifically, this is a high-level starting point in support of the following questions:

- **How do Welsh SMEs and supply chains need to adapt to the consequences of climate change? With regards to: heatwaves; rising sea levels; coastal erosion; flooding; and drought/water supplies.**
- **What are the costs/benefits of adapting to the consequences of climate change?**

3.3.1 Changing weather patterns in Wales

3.3.1.1 Overview

The UK Climate Projections (UKCP)[42] provide insight into how the climate in Wales is projected to change under a range of different scenarios. The most readily accessible climate data for Wales is provided in the UKCP document "Key Results Spreadsheet" which is available online[43]. Data taken from this spreadsheet is reproduced in Table 4, showing changes, relative to a 1981 – 2000 baseline, in mean annual temperature, mean summer temperature and mean summer rainfall in Wales. Projections are provided under four IPCC climate scenarios, called "Representative Concentration Pathways" (RCPs), that UKCP used to derive projections. These scenarios are not forecasts, but rather provide insight into different possible futures. For example, for future emissions to follow RCP2.6, significantly more mitigation efforts would be needed globally than are being undertaken today. Whereas, while RCP8.5 has been subject to criticism for having "unrealistically high emissions" to the end of the century, global emissions are still increasing and track most closely to RCP8.5, at least over the short-term. Therefore, preparing for the 'worst case' scenario, i.e., RCP8.5, may be an appropriate strategy for companies exposed to climate risks who wish to be prepared for all potential futures.

Within a given scenario, different model runs (which are generated by varying the initial climate parameters from which the model starts its calculations) give different results, which is why Table 4 provides a *range* of numbers rather than a specific value for the change 'forecast'. A number of model runs are used to generate each range, and, for a given scenario, 90% of all model runs gave outputs which sit within the range presented.

Given the uncertainty in climate projections, particularly for changes in precipitation, more granular regional climate data for Wales is not provided. Such information, including the extremely useful "maximum air temperature anomaly" (which projects changes in maximum temperature, a proxy for the extremity of future heatwaves) can be extracted from UKCP[44] at a regional (Wales) and 25 km^2 grid level of disaggregation.

[42] UK Climate Projections (UKCP) (Met Office, 2022)

[43] UKCP headline findings (Met Office, 2022)

[44] UKCP Product Selection (Met Office, 2023)

Table 4 Overview of climate projections in Wales

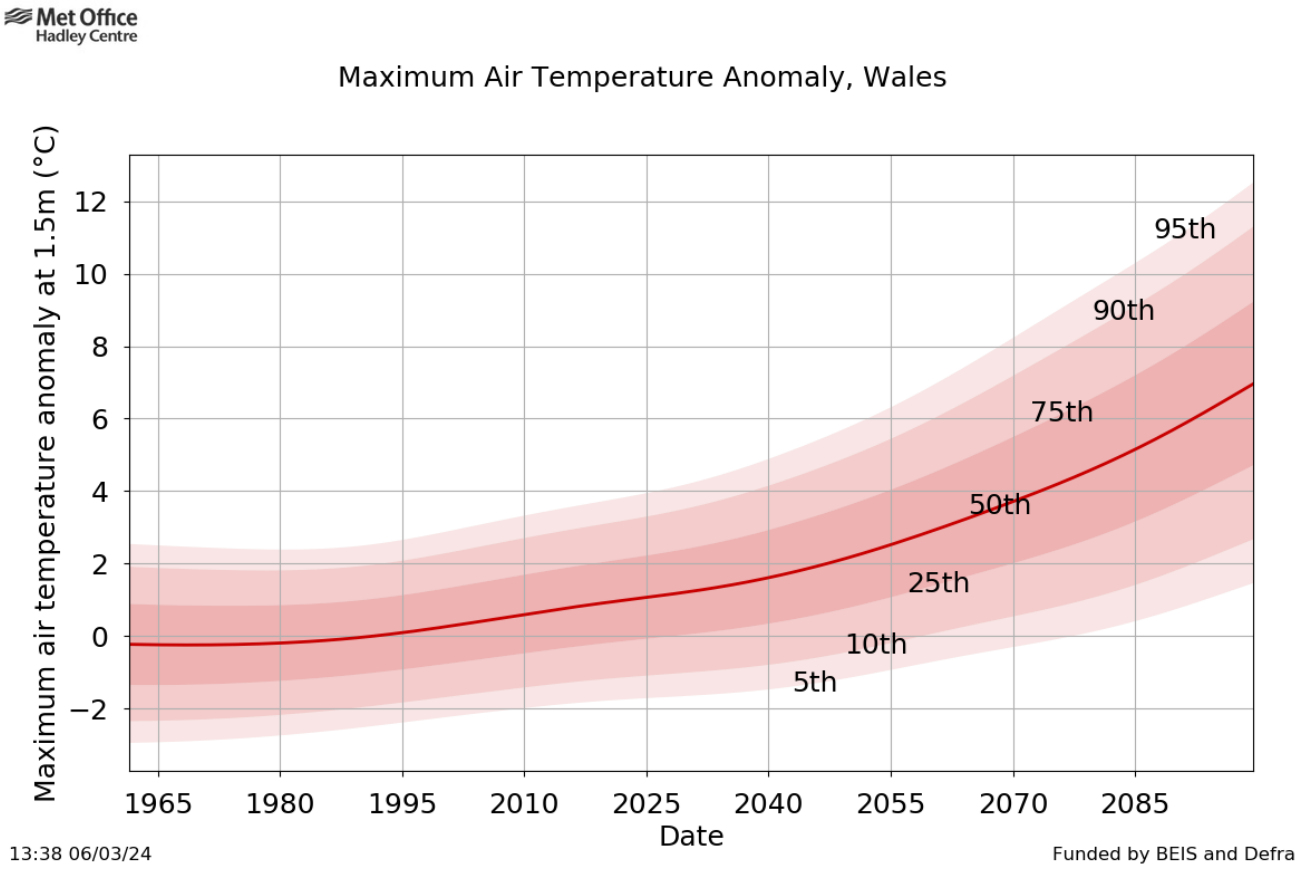
Variable	Scenario				
	RCP2.6	**RCP4.5**	**RCP6.0**	**RCP8.5**	**Full range**
Increase in mean annual temperature, short term (to 2030) / °C	0.2 – 1.4	0 – 1.3	0 – 1.3	0.1 – 1.4	0 – 1.4
Increase in mean annual temperature, medium term (to 2040) / °C	0.2 – 1.7	0.1 – 1.5	0.1 – 1.4	0.2 – 1.7	0.1 – 1.7
Increase in mean annual temperature, longer term (to 2050) / °C	0.2 – 1.7	0.1 – 1.5	0.1 – 1.4	0.2 – 1.7	0.1 – 1.7
Increase in mean *summer* temperature, short term (to 2030) / °C	0.3 – 1.9	0.1 – 1.7	0.1 – 1.7	0.2 – 1.8	0.1 – 1.9
Increase in mean *summer* temperature, medium term (to 2040) / °C	0.1 – 2.3	-0.2 – 2	-0.2 – 1.9	0 – 2.2	0 – 2.3
Increase in mean *summer* temperature, longer term (to 2050) / °C	0.1 – 2.7	-0.2 – 2.4	-0.3 – 2.3	0 – 2.8	0 – 2.8
Change in mean *summer* rainfall, short term (to 2030)	-28% – +17%	-25% – +17%	-24% – +17%	-25% – +17%	-28% – +17%
Change in mean *summer* rainfall, medium term (to 2040)	-30% – +14%	-27% – +17%	-26% – +18%	-29% – +17%	-30% – +18%
Change in mean *summer* rainfall, medium term (to 2050)	-32% – +11%	-30% – +16%	-29% – +17%	-34% – +16%	-34% – +17%

3.3.1.2 Temperature and heatwaves

Under all scenarios, UKCP points to significantly warmer temperatures in Wales, as shown in Table 4, particularly during summer. Under the full range of scenarios, the summer is likely to be up to 2.8°C warmer, *on average*, by 2050 than it was in the period 1981 – 2000.

To determine temperature extremes further analysis of the UKCP data is needed, via the web portal[44]. Figure 55 shows how maximum summer (Jun – Jul – Aug) temperatures are projected to increase under the worst-case emissions scenario (RCP8.5). In this scenario the hottest days of the year are projected to be ~6 degrees Celsius hotter than at present.

Figure 5: Change in Summer Maximum Air Temperatures in Wales under RCP8.5. UKCP18 data.



Companies already exposed to heat-related weather risks (e.g. overheating in buildings, heat stress to employees working outside, overheating of machinery or IT infrastructure) should consider measures to monitor the temperatures staff and assets are being exposed to, understand how these temperatures are changing over time, and take steps to address risks that overheating poses before they become issues.

Low-cost measures to address overheating may include changing working conditions on the hottest days to avoid overheating, and steps to reduce solar gain in buildings (using blinds and/or increasing albedo). Medium cost measures may include ensuring that new infrastructure is designed to withstand peak temperatures 6°C or more (see Figure 5) hotter than today. Appropriately specified passive and active cooling technologies in new buildings should be carefully considered at design phase. Nature-based solutions, particularly increasing tree-cover, can be used to reduce local temperatures. Higher cost measures may include retrofitting cooling systems to existing buildings. Cooling costs may be offset by investing in onsite renewable generation, particularly solar PV where electricity generation correlates with cooling demand.

3.3.1.3 Rainfall, flooding, and water supplies

The challenges faced by SMEs in understanding the impacts of changing rainfall patterns on assets and operations is significantly more complex as Table 4 shows. While climate models tend to suggest drier summers, some model runs (which, similar to climate scenarios, are not forecasts but rather explore different possible futures) show wetter summers. For example, under scenario RCP6.0, for the period 2040 – 2050, 90% of model runs calculate a change in summer rainfall volume of between -29% (drier) and +17% (wetter) in Wales. This finding is taken from the final row of Table 4 in the central column.

However, even with this uncertainty, two robust findings can be drawn. Firstly, extended periods of hot, dry weather may increase over land in a warmer world. This means that SMEs for whom drought would be a significant issue (e.g. companies relying on water for cooling, agricultural companies relying on water for irrigation) should consider what contingencies can be put in place. At the same time, warmer summers can

lead to more intense downpours (even if average summer rainfall decreases). Therefore, risks associated with surface water flooding and localised river flooding may also increase.

Low-cost measures to reduce flood risk may include something as simple as regularly cleaning drains and guttering. Low-cost measures to tackle drought likely include investing in water capture and re-use, and reduction of leaks, where the cost of implementation can be offset by reduced costs from water bills. Medium-cost measures to tackle flood risk may include ensuring that new infrastructure is designed to withstand prolonged periods of intense rainfall through enhanced drainage, use of nature-based solutions to absorb rainwater, and appropriate siting, particularly avoiding flood plains and areas at risk of coastal inundation. Higher cost measures may include investment on flood barriers and retrofitting draining systems, and construction of water storage systems and reservoirs, to provide buffers in times of drought.

3.3.1.4 Sea-level rise

Sea-levels are projected by UKCP to rise in Cardiff[45] by up to 39cm by mid-century and potentially more than 1m by the end of the century. More detailed data, including projections on storm surges, and spatially disaggregated data, can be downloaded from the UKCP data archive[44]. However, projections of the rate and scale of sea-level rise are subject to frequent revision as the science evolves.

According to Adapting to Climate Change - Progress in Wales[46], a report by the UKCCC from 2023, 2% more non-residential properties in Wales could be at risk of coastal flooding under a 2°C current levels of adaptation scenario by 2050. This means that only a small number of SMEs in Wales are likely to be at an increased risk of coastal flooding. However, since such flooding could be catastrophic for business organisations, and could potentially lead to risk to life, it is essential that those SMEs in coastal areas undertake a more detailed risk assessment. This underlines the context dependent nature of climate adaptation. For the majority of SMEs coastal flooding is not a risk, but for those where it is a risk, steps must be taken to understand whether increasing sea levels mean that the risk increases in significance and – where the risk becomes significant – steps must be taken to adapt.

The single easiest action any SME in a coastal area can take is to collect data on the proximity of seawater to their site(s) as a function of tide data[47] for Wales, to understand how the risk of a 50cm increase in sea-level might lead to inundation.

3.3.1.5 Coastal erosion

Like coastal flooding, coastal erosion is highly location specific and therefore will not apply to most SMEs. However, where it does apply, the impacts can be very serious. The Welsh Government runs a Flood and Coastal Erosion Risk Management Programme (the current iteration of which covers the period 2023 to 2024[48]) which sets out areas in which work to address coastal erosion is being undertaken.

For any SME in an area prone to coastal erosion, the first step should be to communicate with the relevant Risk Management Authorities (RMA) – the Local Authority, Water Company and Natural Resources Wales – to find out what assessment of local erosion risk has been undertaken, and what works will be undertaken to adapt. The SME would then need to assess whether the RMA response was sufficient to address risk to its operations and, if not, what steps the SME itself might take to build resilience. Clearly in the worst-case scenario, relocating to a different site may be the only option, but this is likely to be a high-cost measure for many SMEs.

45 UKCP Marine Report (Met Office, 2018)

46 Adapting to Climate Change - Progress in Wales (UKCCC, 2023)

47 River levels, rainfall, and sea data (Natural Resources Wales, 2024)

48 Flood and Coastal Erosion Risk Management Programme 2023 to 2024 (Welsh Government, 2023)

3.3.2 Costs and benefits of adaptation

Understanding potential climate risks, the need for adaptation, and hence planning for adaptation is highly context specific. As a result, the potential costs and benefits of adaptation are also highly context specific. Adaptation needs for SMEs are dependent on factors such as: the location and size of assets and operations in comparison to the location of physical climatic changes and extreme weather events; the susceptibility of these assets and operations to be affected by the climate; the existing and potential capacity for each enterprise to prepare for such changes/events in terms of knowledge, technology, funding; etc.

Guidance on undertaking a climate change risk assessment and developing an adaptation plan is available from a range of sources. For example, Natural Resources Wales have provided guidance[49] which sets out how sites with an environmental permit should take steps to ensure that climate risks are managed.

3.3.2.1 Understanding climate risks and the need for adaptation

Planning for climate risks for SMEs should be considered in a contextual manner. This could include conducting a high-level risk assessment specific to each, or a group of, SME(s) and/or supply chain(s) to understand the context that is being planned for. This could include identifying:

- The key assets and operations that may be at risk e.g., staff, IT infrastructure, transport infrastructure, etc.,
- The projected frequency, magnitude, and location of relevant physical climatic events and changes that may put the assets at risk e.g., flooding, drought, coastal erosion etc.,
- The susceptibility of the key assets and operations to these climatic changes/events,
- The capacity/potential to be prepared for climatic changes/events.

This would help to determine adaptation actions necessary to address direct needs, to reduce susceptibility, and improve capacity/preparedness.

Understanding context-specific risks could also consist of a high-level assessment of the CCRA results for Wales and cross-checking these risks with the location and potential susceptibility and capacity of key assets and operations of the SMEs and supply chains in question.

No matter how high-level, the approach taken to understand climate risks and adaptation should be systematic, in order to gain an understanding of the specific context being planned for, to ensure the benefits of adaptation are successfully achieved and the costs are efficiently allocated to target adaptation needs.

3.3.2.2 Identifying costs and benefits of adaptation

The financial impact of a particular extreme weather event on a particular SME is similarly highly context dependent. As a result, a quantitative analysis on the benefits of adaptation would require a detailed set of workshops or interviews to understand current weather-related financial losses and project how these might change over time, across a representative set of companies. Similarly, the costs associated with adaptation will be context dependent. One clear recommendation is that retrofit costs are higher than building in appropriate measures at the outset, which means that new infrastructure should be built to withstand future warmer temperatures and more intense rainfall, and water capture/recycling technology should be considered where future periods of drought would have a negative impact on operations.

Climate impacts on staff, and the costs/benefits of adaptation interventions, are also context specific. While physical interventions – particularly air conditioning – may be appropriate in some contexts, for those working outdoors or in spaces where air conditioning cannot easily be installed, other measures such as restricting working when temperatures exceed a particular level, increasing rest/break periods and/or adjusting dress

[49] Climate change: risk assessment and adaptation planning in your management system (UK Government, 2023)

codes may be considered. 'Soft' interventions of this type can be more effective than 'hard' ones, particularly where severe, disruptive heat or rainfall events may be relatively short term and infrequent.

Table 5 gives some examples of steps which might be taken by SMEs to adapt to climate change. These are provided as prompts to stimulate thinking and enable SMEs to use these a starting point to identify measures which they could take, given their location and business model.

Table 5: Examples of steps that may be taken by SMEs to adapt to climate change

Risk	Lower cost actions	Medium cost actions	Higher cost actions
Overheating to buildings and staff	Changing working conditions and working hours. Reduce solar gain.	Design new infrastructure for higher peak temperatures. Increasing tree-cover, can be used to reduce local temperatures.	Retrofitting cooling systems to existing buildings.
Flooding	Invest in ongoing maintenance of existing drainage systems	Design new infrastructure for higher rainfall. Appropriate siting of new buildings and assets.	Flood barriers. Retrofit better draining systems. Abandon buildings / sites.
Water shortages	Water use efficiency investment (e.g. tackle leaks, waste).	Rainfall collection and water re-use.	Significant investment in water storage, e.g. reservoirs.

3.3.2.3 Monitoring losses, costs and benefits

Effective monitoring of losses and disruption due to weather events is essential. By tracking how particular types of event impact on business activities over an extended time period, and seeking to observe any trends in frequency, duration and disruption/impact, businesses can gain a better understanding of the context specific conditions in which they are working and make decisions about thresholds above which hard or soft interventions should be considered. All SMEs are currently exposed to risks from extreme weather, even in the absence of climate change, so a first step should be to understand this baseline. This will help to establish which cost effective measures are available to reduce weather impacts on business operations today.

3.3.2.4 Contingency

Significant risks are associated with climate disruption to supply chains. Since SMEs may not be resourced to conduct any sort of assessment of these risks, particularly where they source products or services from outside of Wales, putting in place contingencies to supply from different regions should be considered to reduce risk and, where possible, requiring suppliers to report on their approach to climate risk and how they will keep supplies flowing, should both be considered.

3.3.3 Legal requirements

Welsh businesses which have a written Management System[50] in place as part of their environmental permit from Natural Resources Wales (NRW) must integrate climate change adaptation into this system[51]. As set out in the guidance, this involves identifying potential climate impacts, conducting a risk assessment, and putting in place control measures to mitigate any risks identified. Clear and transparent documentation of these steps is required.

[50] Develop a management system: environmental permits (UK Government, 2023)

[51] Climate change: risk assessment and adaptation planning in your management system (UK Government, 2023)

While the Financial Conduct Authority (FCA) regulations on issuers of standard listed shares, or equity shares represented by certificates[52] and FCA-regulated asset managers and asset owners[53] are unlikely to apply to SMEs, investors are increasingly seeking climate risk disclosures in order to understand the financial risk climate change poses to their investments. In practice this means that investors who use the ISSB S2 standard to disclose climate-related financial risks may require SMEs in which they invest to provide them with this information. The good news is that while the S2 standard can look rather daunting, the fundamentals are simple. Companies should seek to understand how changing weather might impact on their operations, assets and supply chains (physical risk) and also think about whether the products and services they sell are likely to see a significant increase or decrease in demand as their customers adopt net zero strategies (transition opportunity, and risk).

If an assessment of how well set-up Welsh SMEs are to respond to these new standards, and what would be done to support this were needed, it would be possible to run a series of stakeholder workshops to establish familiarity with standards, their applicability in a Welsh SME context and what might be done to provide support.

3.4 Business premises

3.4.1 SME business premises: An overview

This section discusses some potential benefits to aiding SMEs in carrying out energy-saving improvements to their premises, in addition to the barriers that may be faced in implementing such improvements. Energy efficiency in buildings is classified using Energy Performance Certificates (EPCs). Properties are rated from A (best) to G (worst) to give an indication of a property's energy use and typical energy costs[54].

3.4.2 Improvements through building measures

Energy savings can be achieved through energy-efficient building measures, such as improved lighting, heating, and cooling systems. Where the business premises are not owned by the business itself, optimising the relationship between tenants and landlords will be an important factor in delivering this decarbonisation plan. One potential route for ensuring an efficient transition is a 'green lease'[55]. These are contractual agreements between a landlord and a tenant that incorporates environmentally sustainable practices into the running of a property. It aims to reduce environmental impact, lower costs, and promote responsible resource usage. In addition to involving energy-efficient measures, green leases often include agreements for ongoing monitoring and maintenance of sustainability measures, ensuring that environmental benefits are sustained over the long term.

However, it is likely these landlords may not see the benefits of allowing or funding these decarbonisation measures unless leases are long-term. This is where regulation and policy set by the Welsh government will have to be strict enough to ensure compliance. Both tenant and landlord must be considered to encourage decarbonisation plans. Green home grants (replaced by local insulation schemes) in England covered up to two-thirds of the cost of eligible energy efficiency measures which were available to both landlord and tenant[56].

The Welsh government could consider similar schemes tailored towards commercial properties. Landlords can benefit from improvements to energy efficiency and on-site generation which lead to higher rents, greater tenant satisfaction resulting in fewer turnover periods and legal/regulatory compliance.

52 PS21/23: Enhancing climate-related disclosures by standard listed companies (FCA, 2021)

53 PS21/24: Enhancing climate-related disclosures by asset managers, life insurers and FCA-regulated pension providers (FCA, 2021)

54 Selling a home: Energy Performance Certificates (UK Government, 2024)

55 Green leases and Minimum Energy Efficiency Standards (The Law Society, 2023).

56 Green Homes Grant (UK Government, 2021)

3.4.3 Fuel switching

Switching from carbon intensive to low carbon fuels has been identified as a key priority for innovation in the UK's energy system[57]. Fuel switching has the potential to reduce carbon emissions and operational costs across a range of industries.

3.4.3.1 Barriers to fuel switching

Existing infrastructure constraints pose the main barrier to fuel switching. Tackling these constraints can be costly and require significant changes to the site. The costs of this when not split evenly between landlord and tenant can cause unwillingness by either party to invest. For example, if the costs of changing technology are fronted by the landlord but the benefits in fuel costs are claimed by the tenants.

3.4.4 Self-generation

On-site generation can provide energy security and long-term energy savings as well as mitigating potential future exposure to fluctuating energy prices and carbon pricing[58]. For sites that are constrained by or are not able to access site grid connectivity, on-site generation also presents an effective way to generate electricity, moving away from high carbon intensive generation technologies such as oil/diesel generators.

3.4.4.1 Barriers to on-site generation of renewable energy

Investment payback time periods can vary depending on the size and type of onsite generation. Like with EPC improvements, these payback periods combined with high initial costs may deter both landlords and tenants from such projects.

Additionally, several technological factors may influence the ability for SMEs to uptake renewables onsite. With alternatives like heat pumps creating more electricity demand there may be potential issues around site supply and delays with contacting and working with the Distribution Network Operator (DNO). Solar PV, heat pumps, EV charging points and battery storage technologies all require DNO notification. The ENA Distributed Generation and Storage Connection Guides provide examples on the necessary contact required with DNOs depending on technology or system size[59]. This additional requirement poses another barrier to the uptake of on-site generation as it falls to the landlord or tenant to complete.

3.4.5 Barriers for improving energy efficiency of business premises

The barriers to improving EPC ratings, fuel switching, and on-site generation is a multi-faceted issue with various financial and technological restraints.

One financial barrier will be the knock-on effect of disruptions to business operations with transition periods as it is likely operations will either have to pause or operate at a lower efficiency whilst decarbonisation measures are implemented/installed. To be able to support all businesses through this transition could prove to be costly.

Any funding made available will benefit from contingency assurances made at the planning stage and should be in place to show potential risks have been assessed and sufficient additional funds are in place should any issues arise during the project delivery.

External funding and initiatives are important funding routes for SMEs, helping to navigate capital expenses, however, they can be complex and often lengthy processes. Efficient funding routes along with clear policy and guidance will need to be established to aid these decarbonisation projects.

The Welsh government should consider ensuring that, with this shift in energy generation to renewable sources, there is enough skilled labour for installation and maintenance. This could be through funding training programmes and apprenticeships to also upskill the existing workforce. Progress can be seen already with the

[57] Energy Innovation Needs Assessment: overview report (Vivid Economics / UK Government, 2019)

[58] Is your business missing out on the benefits of onsite generation? (Inenco, 2019)

[59] How to register energy devices in homes or small businesses (UK Government, 2021)

Welsh government publishing the Net Zero Sector Skills Consultation in 2023, along with the Net Zero Skills Action Plan[60], evaluating the current support requirements for upskilling workforces in key areas to reach net zero by 2050 in Wales.

Regulatory pressure is the most effective way to overcome the influence and relationship between tenant and landlord and the unwillingness of either party to invest in decarbonisation measures. Usually, the main capital costs are fronted by the landlord.

Specifically for improving EPC ratings, there are financial barriers such as high upfront costs and funding availability. Material, installation and retrofitting costs pose significant upfront capital requirements. This is complicated further due to uncertainties surrounding return on investment and payback periods, which are often important metrics in decision-making and communicating projects with stakeholders. With building fabric measures there is a discrepancy with the cost vs performance, initial upfront costs may prove unappealing for smaller SME's, especially those on short term leases.

The policy should also be reviewed to ensure it is robust enough to deter a 'just enough' attitude to building upgrades i.e., landlords only just meeting an EPC E rating. A strict EPC regulatory framework would ensure certain criteria are met or that renovations and implementation work is done as efficiently as possible. This should be aligned to the Welsh government's current policy framework for commercial properties, which by 2030 will require a minimum EPC grade of 'B' or above for all rented properties[61].

3.4.6 Benefits

Increasing the uptake and demand of new technologies could stimulate investment to create new jobs and businesses to help supply this demand. Through government and third-party support, businesses are better placed to handle transitions to low carbon power alternatives. This is because they are better positioned to mitigate potential future stranded assets such as gas boilers[62]. One example is the Green Business Fund, which closed in 2019, but provided SMEs support to improve energy efficiency and reduce energy costs. Despite the scheme closing, many of the guides and regulatory support is still available[63].

3.5 Supply chains

This section provides an overview of procurement for SMEs and associated supply chains. This considers the barriers to implementation, public sector procurement, incentives, risks and relocation of supply chains.

The section answers three main questions:

1. To what extent might public sector procurement be used to incentivise new SMEs/supply chains in Wales?
2. Could SMEs be encouraged to locate and grow in Wales through Welsh public sector anchor contracts?
3. To what extent might supply chains in renewable technologies be encouraged to locate in Wales?

3.5.1 Incentivising public sector procurement for SMEs and supply chains

3.5.1.1 Appropriate Sectors for Public Sector Procurement

There are several SME sectors which would be appropriate for public sector procurement. The technology sector has been identified to be a major sectoral area in which many SMEs tend to thrive. A 2020 report[64] on procurement in the UK EdTech market established that SMEs were awarded almost half of the public sector

60 Net zero skills action plan (Welsh Government, 2023)
61 What impact will new minimum EPC requirements have? (RICS, 2023)
62 How retrofitting minimises risk of stranded property assets (CIBSE Journal, 2023)
63 The Carbon Trust Green Business Fund | SME energy efficiency support (Carbon Trust, 2019)
64 Procurement in the UK EdTech market (Tussell, 2020)

education technology contracts between 2015 and 2020, with the most popular services relating to virtual learning and data management systems. The report also outlined that SMEs have also managed to achieve success in undertaking public contracts in the healthcare services sector. In fact, between 2015 and 2020 public healthcare services ranked second in terms of the highest contract services undertaken by SMEs through public contracts in the UK. Success by SMEs has also been identified in the award of public sector food contracts. A 2023 report[65] identified that 74% of public sector food contracts in the UK were awarded to SMEs in the agricultural and food production sector. The key to SMEs' success is likely to be based on their local agricultural and food production knowledge since SMEs often have greater area-based knowledge than larger companies.

There are other sectors which would be appropriate for public sector procurement but have not managed to achieve the same level of success when in public procurement contracts. For example, SMEs in the construction sector, which make up 52% of the construction industry, are typically responsible for the majority of the apprenticeship training in local areas. SMEs in the construction sector also often have good local knowledge of sourcing local materials and are not required to travel long distances to provide their services. Notwithstanding, when bidding for public sector contracts, 41% of SMEs in the construction sector are only successful 10% of the time or less due to several barriers such as eliminatory pre-qualification criteria, established framework arrangements, and the limited visibility of public sector contracts suitable for SMEs[66].

3.5.1.2 Incentive Schemes

To incentivise these sectors to become more involved within public sector procurement and to increase SME's success rates, several schemes can be considered. These schemes can be particularly effective given that SMEs are typically at a disadvantage when competing for public tenders due to higher resources being at the disposal of larger businesses. SMEs typically also find it more difficult to consider such opportunities given that participation in procurement activities would entail the allocation of their already limited resources. Therefore, to encourage wider participation, governments could introduce set-aside programmes and bidding preferences which would benefit SMEs. Such set-asides programmes and bidding preferences could include ensuring a certain percentage of public contracts to be reserved exclusively for SMEs, or the implementation of a local purchasing policy which gives preference to locally produced goods and services. The Agricultural Diversification Scheme, which provides funding to support establishing new agricultural enterprises on farms, and which Wales has already implemented, is another scheme which can be emulated across other sectors. Such schemes could encourage and facilitate the development of new SMEs.

Governments can also help reduce the consumption of SME resources when competing for public tenders by simplifying public procurement processes and by making them more transparent. For example, the Crown Commercial Service (CSS) has published guidance[67] for SMEs when bidding for public sector contracts. The dissemination and/or the production of similar materials on how to respond to opportunities and application processes can help SMEs build their capacities to become engaged in public sector contracts.

Several national and international governments have action plans which aim to increase opportunities for SMEs whilst also incentivising decarbonisation. For example, in 2014 the European Commission adopted the Green Action Plan[68] for SMEs which aims to convert environmental challenges into business opportunities. The objectives within the Green Action Plan include:

- A societal change towards a low carbon economy and preventing environmental damage to open new opportunities for businesses that offer green products and services.
- A greener and more circular value chain which would promote re-manufacturing, repair, maintenance, recycling and eco-design thus creating more opportunities for SMEs which specialise in these services.

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65 Can regional food systems feed the public plate (Manchester Metropolitan University / Aurora Trust / Food for Life - Soil Association, 2023)

66 Improving public procurement for construction SMEs (Federation of Master Builders, 2013)

67 Information for buyers and suppliers (Crown Commercial Service, 2024)

68 Green Action Plan for SMEs (European Commission, 2014)

- Improving resource efficiency in SMEs to reduce production costs.

The planned adoption of the EU's Net Zero Industry Act (NZIA)[69] also seeks to ensure that the EU's decarbonisation policy is not hampered by skill mismatches and shortages. In this regard, SMEs and micro enterprises must be given the necessary support for training schemes in the respective EU Member States.

In terms of incentivising the decarbonisation process, Germany's 'Energiewende' (energy transition) policy covers SMEs' planned transition to a low-carbon economy. Given that SMEs make up more than 99% of all businesses in Germany[70], the policy's success has resulted in an increase in small and medium renewable energy companies with specific growth in the solar and wind sectors[71]. This policy could be replicated or serve as the basis for a similar policy in the Welsh context due to the high number of SMEs. In Denmark, where SMEs also make up approximately 99% of all businesses[72], companies have implemented energy-saving measures under the country's Energy Efficiency Obligation Scheme[73]. This scheme requires energy companies to achieve annual energy savings through efficiency measures and therefore creates a demand for energy-saving measures which subsequently benefit SMEs who are in the process or have already decarbonised. Similarly, other SMEs are encouraged to accelerate their decarbonisation plans.

Within the UK context, the Energy Saving Trust published a study[74] which identified policies to support SMEs in the pathway to reaching net zero. The key recommendations were as follows:

- Establish a clear regulatory timetable which identifies firm dates for future low carbon standards so SMEs can invest/plan in accordance with the timeline.
- Establish a joined-up support framework which includes a single contact point for SMEs which provides access to financing support, information on regulations, audit services and peer learning networks.
- Ensure effective financing to support SME decarbonisation as upfront costs are a key barrier for SMEs.
- Ensure the government plan for SME decarbonisation includes cross-departmental policies addressing common net zero challenges and good coordination of activity through regional development funding.

A report by the British Business Bank[75] outlined that energy efficiency measures are among the most widely adopted measures that can help SMEs reduce their emissions. Such measures are likely to be adopted due to the associated reduced costs that SMEs will achieve because of reduced energy consumption. Measures relating to reducing business vehicles, travel and employee commuting are also widely adopted by SMEs but are not as prevalent as energy efficiency measures. The least adopted option was a change in SMEs' production processes, likely due to the disruption and costs associated with altering production processes.

3.5.2 Growth and relocation to Wales for SME supply chains through public sector anchor contracts

3.5.2.1 Biggest risks to SME businesses

There are several risks to SMEs, particularly as they remain vulnerable to several external factors. A survey that included 750 SMEs across the UK[76] established that between 2020-2021, SMEs perceived supply chain disruptions to be among the biggest risks to their businesses. This is particularly true as SMEs are often reliant

69 The Net zero Industry Act (European Commission, 2023)
70 The German Mittelstand as a model for success (German Federal Ministry for Economic Affairs and Climate Action, 2020)
71 Key stakeholders in Germany's Energiewende (Clean Energy Wire, 2017)
72 Denmark | Financing SMEs and Entrepreneurs (OECD, 2024)
73 Energy Efficiency Obligation Scheme in Denmark (BEACON, 2019)
74 How can policy better support SMEs in the pathway to Net Zero? (UKCCC / Energy Saving Trust, 2022)
75 Smaller businesses and the transition to net zero (British Business Bank, 2023)
76 Threats to Small Businesses and Their Impact (Towergate Insurance, 2022)

on a limited number of suppliers which are not immune to global shortages of materials, staff shortages, and transport delays.

Another significant risk SMEs often encounter relates to their size given that industries are often dominated by established businesses which can often outprice SMEs. Given their size, SMEs also often face high financial risks as a result of inflation or when seeking private financing. Changing consumer demands, as well as the lack of resources to adapt and innovate, have also been identified as risks that can significantly undermine SMEs' competitiveness.

On an infrastructural level, another risk that was commonly identified by SMEs includes cyber threats as small businesses do not often have an internal IT department or the necessary financing available to implement security measures.

3.5.2.2 Relocation through Anchor Contracts

Whilst some of the risks SMEs face can be addressed with public sector anchor contracts, there are several factors that need to be considered when relocating. For example, the demand for the services that an SME offers can vary between locations. Therefore, SMEs would need to assess the market opportunities for the products or services they would offer at that new location. Additionally, the availability of employees will need to be considered given that the relocation of the business could result in the loss of current employers who would be unable to relocate. SMEs would therefore need to assess whether they would need to recruit new employees and if the necessary skills would be readily available in the new location. Wales is seeing growth in the manufacturing sector, with innovation and investment across the entire industry with small local manufacturers becoming more technology driven[77]. Wales can reflect on the growth of this industry across other SME businesses to encourage relocation and supply chains.

Similarly, consideration would have to be given to whether SMEs would be able to find suppliers which would enable them to continue operating without significant disruptions. The relocation of SMEs could also result in higher costs as some locations command higher rental costs and salaries. Other risks that SMEs face when relocating include downtime disruptions, different legislative contexts and regulations, as well as quality-of-life considerations for both employees and SME owners. SMEs would therefore ideally undertake a cost-benefit analysis to ensure that the benefits of relocating outweigh the envisaged costs and risks.

Public sector contracts can help SMEs mitigate such risks by providing a reliable and consistent source of income which would facilitate SMEs' decision to relocate. This would also mitigate the risk associated with the demand for services or products that SMEs would offer. Other government incentives can include grants to help SMEs cover the relocation costs. The provision of tax breaks would also give SMEs time to build up their reputation in a new location and could be applied in a similar way to the research and development tax reliefs that SMEs in Wales can currently apply for. Additionally, many SMEs have social values relating to environmental sustainability, good employment welfare and community engagement. Therefore, should the Welsh public sector contracts incorporate these values, this could incentivise SMEs to consider relocating and participate in local contracts. In this context, the use of anchor contracts to support SMEs could encourage them to relocate and grow in Wales while mitigating the identified relocation risks.

3.5.3 Encouraging new renewable technology supply chains in Wales

To encourage new renewable technology supply chains in Wales, the Welsh government should consider the following measures to support the green sector.

- Incentives – financial incentives are a straightforward way to aid the profitability of startups and businesses moving to Wales, as well as scaling up existing businesses and supply chains. These include, but are not restricted to, tax breaks, grants or subsidies for companies willing to establish manufacturing, services or supply networks. An example of this is the Carmarthenshire Business

[77] Why Wales is a hotspot for manufacturing technology (UKTN, 2024)

Renewable Energy Fund, which rewards up to £25,000 to businesses within Carmarthenshire for renewable energy systems e.g. solar PV[78].

- Infrastructure developments – investing in support and supply chains required by these renewable technology companies. This could include transport links and industrial parks/locations such as the 2023 brownfield site development of Merthyr Tydfil into a business park with investment from the Welsh Government and Development bank of Wales[79].
- Policy and regulation – adopting policy and regulation that prioritise renewable energy development and restrict barriers. Strong regulation can help minimise the environmental and social impact of supply chain developments through regulation of life cycle carbon emissions, shifting production to less carbon-intensive grids, robust environmental and social standards, and enforcing higher supply chain traceability[80].
- Collaborations – this might include creating partnerships between local government and municipalities with industry stakeholders. This might also include demonstrating the governments' commitment to these partnerships or incentives through setting ambitious targets. Examples can be seen already in this regard, through the Climate Change Welsh Government Engagement Approach 2022-2026[81] aimed at stakeholder engagement to tackle climate change.

To understand what might be plausible, a report by Scottish Renewables[82] on the Scottish renewable industries growth found that the Scottish renewables sector supports more than 27,000 jobs and is worth £5.6 billion to the economy, as of 2022. This is largely due to a close relationship with industrial partners, fostering innovation and supporting the development of specific areas, mainly Aberdeen and the central belt. The process of rejuvenating existing industrial areas like Aberdeen should be regarded as a potential opportunity for the Welsh government.

The Welsh government has already drawn on influences from Scottish policy through the Small Business Rate Relief scheme. This scheme allows relief to renewable energy projects and encourages participation in renewable energy schemes[83].

The Welsh government should also draw on its own expertise and existing industrial partnerships, especially Wales' expertise in the manufacturing sector, such as Industry Wales[84], in implementing developments in the building sector. Experience and lessons can also be learnt from previous implementation of low carbon technologies in new builds[85]. An evaluation of the existing supply chains they utilised for these projects will allow for further development of these supply chains and implementation routes.

3.5.3.1 A Selective SWOT Analysis

A SWOT analysis has been taken into consideration as part of this response to identify key internal and external factors and is shown in Figure 6.

78 Business Renewable Energy Fund (Carmarthenshire County Council, 2024)

79 Development Bank backs £4.1 million investment to transform brownfield site into vibrant business park (Development Bank of Wales, 2023)

80 Clean energy technology supply chains must get better, faster, cleaner (Energy Transitions Commission, 2023)

81 Climate Change Welsh Government Engagement Approach 2022-2026 (Welsh Government, 2022)

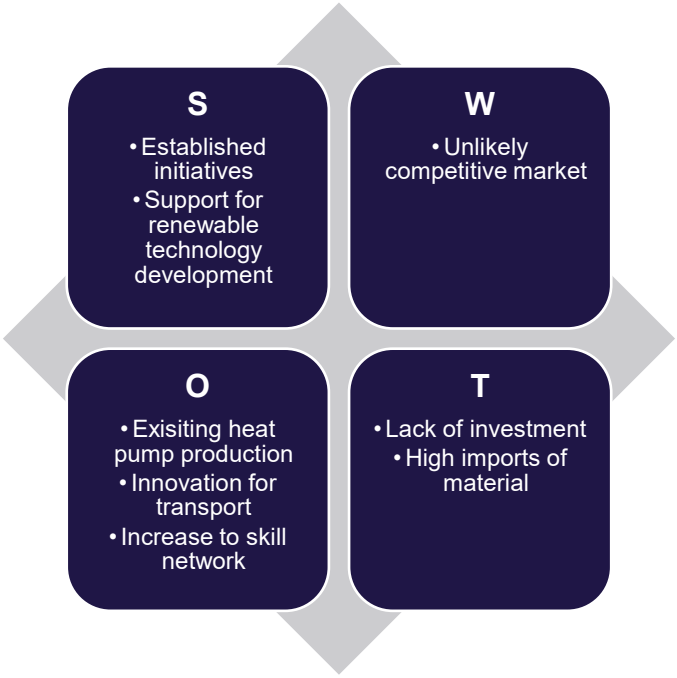
82 Scotland's Renewable Energy Industry: Supply Chain Impact Statement (Scottish Renewables, 2022)

83 Funding renewable energy projects government response (Welsh Government, 2019)

84 A manufacturing future for Wales: our journey to Wales 4.0 (Welsh Government, 2023)

85 Renewable and low carbon energy in buildings: case studies (Welsh Government, 2019)

Figure 6: Summary of SWOT analysis



3.5.3.2 Strengths

There are already several research initiatives in Wales such as the Centre for Low Carbon Built Environment and Low Carbon Energy & Environment Research Network Wales which are all supporting the development of renewable energy technology deployment[86,87].

3.5.3.3 Weaknesses

Energy intensive businesses such as the processing and production of raw materials to produce the key inputs for renewable technologies such as polysilicon, rare earth elements, copper, aluminium and steel (where available), are unlikely to be competitive. This is because industrial competitiveness is closely linked to gas and electricity costs, as well as other costs. As a result, the higher cost of energy in Europe compared to that of the US and China has resulted in European mineral refiners historically struggling to compete[88].

3.5.3.4 Opportunities

There is already existing heat pump production in the UK with strong local demand forecasted[89]. Heat pumps are relatively bulky, making them costly to transport. They also require adaption to the local regional conditions and legal requirement concerning recyclability, efficiency, voltage, safety and refrigerants. Hence, global competition for supplying heat pumps is not as strong as other renewable energy technologies and Wales may be in a position to explore this opportunity[88].

A shortage of heat pump engineers has already been identified in the UK, which may hinder the deployment of heat pumps to meet net zero goals, hence there could be a significant opportunity for businesses involved in providing a higher number of trained heat pump engineers[90].

86 Centre for Low Carbon Built Environment (Cardiff University,2024)
87 Low Carbon Energy &Environment Research Network Wales (2023)
88 Energy Technology Perspectives 2023 – Analysis - (IEA, 2023)
89 Heat Pump Investment Roadmap (UK Government, 2023)
90 Shortage of trained heat pump installers could set back net zero (Nesta, 2022)

The UK has had a local manufacturing industry for small wind turbines for over 40 years to supply both the domestic and global market[91]. Being already world-leading there is an opportunity for UK small wind manufacturing to continue to grow to meet local and global demand.

Businesses which provide services that are less dependent on access to low-cost energy and materials supply such as research & development, design, installation and maintenance of renewable technologies have a greater potential for being competitive.

3.5.3.5 Threats

A lack of historical investment, especially when compared to other countries, has contributed to both a lack of resource extraction industry and a lack of the required manufacturing capacity for local production of renewable energy technologies in Europe. Local political, economic, and environmental factors also affect the extent to which resource extraction industries can be established. Overall, this has resulted in a current dependence on imports, particularly solar PV and batteries, to meet domestic demand[88].

3.6 Transport

As of the end of September 2022, Wales had 20,872 registered plug-in electric vehicles, which include both battery electric vehicles (BEVs) and plug-in hybrid vehicles (PHEVs). This number represents a significant increase, having more than doubled since the beginning of 2021. The growth rate is around 10-15% each quarter, highlighting the rising adoption of electric vehicles in the region [92]. The country has approximately 1,600 public charge points installed, approximately 1 charge point for every six electric vehicles on the road[93].

Wales have set ambitious plan to invest in infrastructure and work with private sectors to encourage the switch to electric vehicles, to both public and private sectors, some of this is evident from the above numbers. These plans include Llwybr Newydd: The Wales Transport Strategy 2021[94] and Sustainable Development Plan 2022-27[95]. Both these policies collectively aim to create a transport system that supports economic growth, reduces environmental impact, and enhances accessibility, directly benefitting SMEs across Wales.

For SMEs to embed these policies into their businesses, there requires support and acknowledgement for the costs and emphasise on benefits of electrifying their fleet.

3.6.1 Benefits of electrifying fleets

There are several positives that SMEs can benefits from in electrifying their fleet. The below provides an overview of benefits such as cost saving, environmental impact, operational efficiency and government incentives. The associated supply chains for SMEs could also see benefits from enhances marketing to this sector.

3.6.1.1 Cost saving

A number of cost saving can be applied to SMEs transitioning to EVs.

EVs typically have lower energy costs compared to diesel or petrol vehicles and can reduce fuel costs by more than half compared to conventional vehicles due to the higher efficiency of motors and lower cost of electricity compared to oil-based fuels[96].

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91 Wind Energy (RenewableUK, 2018)

92 Plug-in Electric Vehicle Landscape in Wales (eva.cymru, 2022)

93 Increase to EV charge points in Wales (gov.wales, 2023)

94 Llwybr Newydd: the Wales transport strategy 2021 (gov.wales, 2021)

95 Sustainable Development Plan 2022-27 (TFW, 2022)

96 Electric vehicles vs petrol/diesel/hybrid (Drive Electric, 2023)

Additionally, electricity prices are generally more stable than fossil fuel prices which make energy costs more predictable. This is especially key for budgeting SMEs and can protect businesses from the volatility of global oil markets.

There are known maintenance savings experiences from owning EVs. This is due to fewer moving parts and longer lifespan of brakes. Fewer moving parts compared to internal combustion engine vehicles reduces the likelihood of mechanical failures and lowers maintenance costs. Components such as oil filters, spark plugs and exhaust systems are absent in EVs. EVs also use regenerative breaking which reduces the wear and tear on brake components and can extend vehicle lifespan which contributes to lower maintenance costs[97].

The UK Government offers grants and subsidies to offset the higher initial cost of EVs which can be attractive to Welsh SMEs eager to make a transition towards greener energy use. The Electric vehicle infrastructure grant for staff and Fleets[98] opened in 2022 with current end date of 3 March 2025 and specifically supports ESMES in installing EVs and associated infrastructure. The grant can cover 75% of installation costs and businesses can claim up to £350 per charge point socket and up to £500 for each parking space equipped with the necessary infrastructure. An eligible business can make claims across five different locations, up to £15,000 per site.

Finally, Businesses can also benefit from lower company car tax rates and enhanced capital allowances for EVs. These tax incentives may reduce the overall cost of ownership and improve the financial feasibility of transitioning to EVs.

3.6.1.2 Environmental Impact

The transition to EVs can provide environmental stability to Welsh SMEs, these include reductions to greenhouse gas emissions, improvements in air quality and contributions to broader sustainability goals.

EVs produce zero tailpipe emissions which substantially reduces the amount of CO_2 and other greenhouse gases emitted compared to internal combustion engine vehicles. When comparing this in urban areas, this is a major contributor to improving air pollution[99]. And while EVs do generate some emissions during the productions and electricity generation phases, studies have shown that their overall lifecycle emissions are significantly lower than those of conventional vehicles. In particular, this is pronounced when electricity used to charge EVs comes from renewable sources.

Unlike combustion engines, EVs do not emit nitrogen oxides or particulate matter, both harmful pollutants to humans and the atmosphere. By using EVs, this will significantly reduce these emissions and improve air quality. Improved air quality has direct health benefits including reduction of respiratory and cardiovascular diseases among the population. This, in turn, can lead to lower healthcare costs and improved public health, which benefits employees, employers and the community.

On a wider scale, the adoption of EVs provides support for sustainability goals. In support of the Welsh Government target to achieve net zero carbon emissions by 2050, SMEs transitioning to EVs aligns with this goal and helps SMEs contribute to national and regional sustainability targets. Additionally, SMEs can enhance their Corporate Social Responsibility profiles by demonstrating a commitment to environmental stewardship. This can improve their reputation and strengthen relationships with customers, partners, and stakeholders who value sustainability[100]

3.6.2 Costs of electrifying fleets

While the above provides a list of benefits in transitioning to EVs, there are also significant costs that Welsh SMEs should be aware of in considering a switch to electric vehicles. These costs can impact initial investment, infrastructure requirements, and long-term financial planning.

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97 A guide to regenerative braking (SupaQuick, 2024)

98 Electric vehicle infrastructure grant for staff and fleets (Gov.Uk, 2022)

99 Llwybr Newydd: the Wales transport strategy 2021 (gov.wales, 2021)

100 Sustainable Development Plan 2022-27 (TFW, 2022)

3.6.2.1 *Investment costs*

EVs generally have a higher purchase price compared to traditional internal combustion engine vehicles. This is usually due to the expensive battery technically used in EVs. In comparison, a typical electric van could have a 40% higher cost compared to a diesel of similar specification[101]. Additionally, higher end models such as Tesla, may have a significantly higher cost difference which could increase financial burden to SMEs.

While EVs have lower maintenance and operational costs, they tend to depreciate faster than combustion engine vehicles due to concerns about battery life and rapid technological advancements. This could impact the long-term value of the investment. This also results in unknowns to the resale market for EVs as this is still a developing area. The concerns about battery degradation can lower resale value and impact the return on investment.

When transitioning to EVs, considerations to the infrastructure to charge is important. This is particularly important for SMEs wishing to make their businesses attractive to a variety of audiences and encourage employee use of EVs. Setting up charging infrastructure is a major expense as relies not only on purchasing of the charging stations but the space to be able to install them. This may result in the need to upgrade the electrical components of the site. An average cost of commercial charging points can be between £500 and £1000 for basic models, with up to £5000 for fast chargers- an attractive feature for most EV owners. Furthermore, an SME may require more than one EV and considerations need to be made for fleet needs such as infrastructure costs for usage patterns and charging speeds.

As mentioned, the electrical upgrades for infrastructure associated with EV charging can be significant. For example, upgrades for a fleet of 10EVs could cost between £10,000 and £20,000 dependent on current capacity and required upgrades[102]. This is a significant investment cost for SMEs, in particular.

3.6.3 Sector considerations

The above sections provide a general overview of costs and befits to SMEs as a whole. There are specific considerations required for different sectors within SMEs.

For the retail and hospitality sectors, procurement of EVs would typically be via cars or small van for transport of light goods. It is very likely that charging infrastructure would need to be agreed with site owners such as those in retail parks or small BnBs which could limit the number of vehicles that can be procured. On the other hand, it is also likely that infrastructure is already being installed at larger retail venues.

The construction sector would require electric trucks and heavy-duty vehicles as part of their transition to EVs. These may cost in excess of 50-100% more than a diesel equivalent. These types of vehicles also require robust charging infrastructure which likely results in upgrades to electrical supply at construction sites. This may not be applicable for short term sites which requires a separate static compound for charging. Positives to the transition within this sector can see immediate effect to air quality around sites as well as reduced noise which may have positive health impacts.

In the transport and logistics sector, it is highly likely that a fleet of EVs is required which would result in a significantly large upfront investment and recommendations would be to transition as each combustion engine vehicle comes to end of life. In particular for long-haul transport, fast-charging infrastructure is essential to support logistic operations and variable shift patterns. There also may be concerns about the range and longevity of EV batteries for long-distance travel. EVs for long-haul will have a significant impact on the reduction of greenhouse gases to the atmosphere and supports regulatory compliance. This sector would particularly benefit from government incentives and grant schemes.

[101] The Big Questions: Economy (Institute of Wales, 2021)

[102] Importance of charging infrastructure to the electric vehicle revolution (Faraday Institution 2022)

3.6.4 Vehicle Type Analysis

The following section provides a snapshot overview of vehicle types such as vans and buses. This analysis highlights the difference in emissions generated between battery powered and petrol-fuelled vehicles.

3.6.4.1 Buses

In 2016-17, the Office for Low Emission Vehicles (OLEV) announced a competitive project to support the purchase of Low Emission Buses (LEB) and fund infrastructure by local authorities and transport operators across England and Wales[103]. The scheme saw £30 million awarded to 13 projects where 326 buses were trialled using four differing LEB technologies; Battery Electric, Diesel Hybrid, Compressed Natural gas (CNG) and Hydrogen Fuel Cell (HFC). Monitoring was undertaken over a 12-month period where operators recorded refuelling and recharging, and distance travelled. This was done so that their energy consumption could be measured in accordance with their total GHG consumption. At the end of the trial process the results showed that:

- Battery electric buses were the most energy efficient, using up to 70% less energy than Diesel buses and reduced GHG emissions by up to 70%. Fully renewable electricity would reduce emissions by close to 100%.
- CNG buses used more energy than diesel buses and increased GHG emissions by up to 7% when using natural gas. However, when using biomethane (renewable natural gas), they reduced GHG emissions by 80%.
- Diesel hybrid buses were 15% to 37% more efficient than non-hybrid diesels, depending on type, reducing GHG emissions in the same proportion.
- The HFC buses used up to 58% less energy than diesel, reducing GHG emissions by up to 30% with hydrogen made using UK ‘grid-average’ electricity.

3.6.4.2 Heavy Good Vehicles – Trucks

A similar study was conducted by the International Council on Clean Transportation (ICCT), investigating the life cycle emissions of battery electric trucks compared to diesel trucks. The study focused not only on emissions generated from tailpipe sources, but across the vehicle’s entire life, from manufacturing, fuel production and operation. The study showed that over the entire lifetime of a battery-electric 40-tonne truck entering service in 2021, these vehicles produced at least 63% lower emissions compared to diesel powered trucks[104]. As the electricity grid continues to decarbonise, the emissions generated by battery electric trucks are projected to fall further, with an estimated 84% reduction in emissions when using only renewable electricity. The study also revealed that fuel cell electric trucks using hydrogen produced from fossil fuels were found to have 15% less GHG emissions compared to their diesel counterparts, although this figure is relatively low compared to battery electric trucks as hydrogen production relied on fossil natural gas.

3.6.5 Supply chain benefits

Implementation of more EVs within SMEs in Wales can yield significant benefits to supply chains. Many of the above points such as cost saving and infrastructure installation also directly impact the supply chain. The below points provide further insight to direct benefits to the supply chain.

Supply chains can benefit from the operational efficiencies offered by EVs. Reduced downtime due to fewer mechanical issues increases the reliability of supply chain operations. EVs also have advanced telematics and route optimisation software which can provide better delivery routes based on real-time data. This, in turn, reduces travel times and energy consumption[105].

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[103] Low Emission Bus Scheme monitoring programme (Department for Transport, 2022)

[104] Battery electric trucks emit 63% less GHG emissions than diesel (International Council on Clean Transportation, 2023)

[105] Llwybr Newydd: the Wales transport strategy 2021 (gov.wales, 2021)

Furthermore, there can be an enhancement to supply chain resilience due to energy independence. Where EVs can be charged using renewable energy, this reduces dependency on fossil fuels and enhances energy security for supply chain operations. EV batteries can also be used for energy storage which can provide backup power and further contribute to grid stability. This can ensure uninterrupted supply chain operations.

The supply chain can therefore benefit from a variety of positives from EV transition and can be an enabling factor in supporting SMEs in their transition to a greener transport option.

4 PHASE 2: STAKEHOLDER CONSULTATION & PATHWAYS

Following the desk-based research, Ricardo held four workshops with relevant sector leads to further understand the SME landscape, their challenges and recommendations. Feedback from these sessions and the desk-based research enabled Ricardo to provide net zero pathways for the decarbonisation of SMEs in Wales.

4.1 Workshop

Four workshops were held by Ricardo on behalf of the Welsh Government. Key stakeholders, both internal and external to the Welsh Government, were invited to join. The purpose of these workshops was to share an overview of the work being undertaken and to gain feedback from stakeholders on what the Welsh Government can do to support SMEs in Wales to decarbonise.

The dates and attendees at these workshops were:

Workshop 1: 18th March 2024

- Manufacturing sector stakeholders
- Welsh Government stakeholders
- Ricardo facilitators

Workshop 2: 19th March 2024

- Business member organisations stakeholders
- Welsh Government stakeholders
- Ricardo facilitators

Workshop 3: 25th March 2024

- Industry Wales stakeholders
- Welsh Government stakeholders
- Ricardo facilitators

Workshop 4: 8th April 2024

- Development Bank of Wales stakeholders
- Welsh Government stakeholders
- Ricardo facilitators

4.1.1 Workshop discussions

4.1.1.1 Climate considerations

The topic of climate considerations covers the need for future proofing against a changing climate and more extreme weather events. The attendees were asked about potential support that could be provided to SMEs to address climate considerations however it was not a topic that generated significant comments as it was reported that climate considerations are not a significant concern for most SMEs.

4.1.1.2 Access to fuel

Access to low-carbon fuels is a key step towards decarbonisation and important to SMEs in de-risking their transition to a low-carbon business model. To help SMEs decarbonise, fuel switching from fossil fuels to renewables and other low-carbon energy sources will need to take place across all types of SMEs. However, SMEs are already facing high energy costs and the switch to electricity or hydrogen is intimidating as these

energy sources come with significant investment costs as well as uncertainties around future operating costs, fuel availability, reliability of the equipment, operating requirements, maintenance and repair costs and supply chain capacity and availability.

Across workshops, participants voiced concerns about electrifying business operations:

- It was noted that the high price of electricity compared with oil and gas is preventing businesses from investing in decarbonisation measures which involve fuel switching. This is true even where there are loans available to support with capital costs as the additional operational expense from using electricity instead of fossil fuels are deemed too high. Moving taxation from electricity to oil/gas was suggested as a good incentive to electrify, although this may be unrealistic as it would create a diminishing tax source.
- Lack of grid connectivity across Wales is making it difficult for some businesses to decarbonise. Participants reported that Wales has been losing out on business opportunities that rely on good connectivity to the grid. This is especially important for future fuel switching from fossil fuel to electricity as, for many SMEs, this additional demand will exceed their existing grid supply capacity. Increasing the grid capacity would require upgrades which can take considerable amounts of time and money.
- There is interest from businesses in installing solar PV, but frustration that excess electricity can't be sold into the grid at a good price. This is preventing businesses from investing in solar PV infrastructure which is large enough to cover a significant proportion of their operations as the payback is too long if the majority of the generated electricity is not being used by the business. If a good export rate could be agreed, then it could generate additional revenue opportunities to SMEs that are operating 5-day or 4-day weeks as the excess electricity could be sold back to the grid on non-operating days.

Issues relating to fleet decarbonisation were also raised.

- Switching to hydrogen fuelled HGVs will not be feasible for most businesses until there is a comprehensive and reliable hydrogen refuelling network across the country. Currently using hydrogen-fuelled HGVs is not viable for operators unless the fleet return to the depot every night. So fleets that could potentially switch to hydrogen include waste collection vehicles or local bus operators.
- Investing in hydrogen-fuelled vehicles also presents a risk to the operator because maintenance provision requires training and investment in new facilities. Also, resale values of the vehicles is very uncertain.
- Switching to electric vehicles for company small vans and cars is a potential solution for some SMEs provided the range requirements can be met by the vehicles and there are back-to base or home-charging facilities in place. For this reason, electrification is the preferred decarbonisation route however these vehicles cost more to purchase so financial support (possibly in the form of interest-free loans) can help to enable this transition as the operating and maintenance costs should, generally, be lower than petrol or diesel vehicles.

4.1.1.3 Financial support

Financial support was the next policy aspect discussed as this will be important to SMEs that require assistance in investing in decarbonisation measures.

- Participants shared that SMEs often identify the lack of financial support as a major barrier in implementing decarbonisation measures however that is partly because it is an answer which is easy to give in response to the question. Experience in Scotland was that the introduction of grants alongside interest free loans didn't have a significant impact on the proportion of identified savings that went on to be implemented. This was because the decision to implement was made on the strength of the business case for its implementation and creating the business case was supported through free expert consultancy support.
- The availability of grants was very good at generating interest from SMEs however, while it does lead to implementation, it is a very expensive way to encourage engagement and implementation of energy efficiency, resource efficiency and renewable measures.

- Where grants can be beneficial in positively influencing implementation that wouldn't happen through other, cheaper forms of support is where the aim is to encourage the implementation of measures which are not attractive financially due to high CAPEX or OPEX costs or where the measures are not seen as mature and are perceived as having higher risks associated with their installation and/or use.
- The availability of unsecured, interest-free loans in Scotland was a useful sales tool in supporting engagement. The interest-free loan was also a successful way of de-risking investment in assets for energy efficiency or decarbonising however a significant proportion of SMEs preferred to pay for the measures from cash savings to avoid taking on more debt even where that debt was unsecured.
- Many SMEs have reported that future planning and decarbonisation strategies have been deprioritised. These businesses are primarily concerned with the survival of their business and staying afloat during the current period of high inflation, which acts as a major barrier to forward planning and incorporating decarbonisation into their operations.

There were also concerns voiced around the difficulties SMEs face even when support mechanisms are available:

- Participants were concerned that the current support mechanisms in place from the government will not be sufficient to help SMEs in the decarbonisation of their operations. More free advice and financial support for energy efficiency and decarbonising measures would be welcomed by SMEs.
- Where business loans for decarbonisation measures have been made available, it was reported that solar PV is a popular choice. This trend is quite surprising given the relatively long paybacks for most solar PV installations compared with other measures such as LED lighting, heating and lighting controls or draught proofing however it was believed that this demand has been generated by high energy prices, proactive marketing by installers and the salience of PV as a decarbonisation measure. It was noted that SMEs will often apply for loans for PV without conducting an energy audit that could help them to explore other options or size the PV at the most appropriate level. As a result, they may be overlooking more cost-effective measures with respect to their business operations and investing in PV which is not sized most appropriately to their business.
- Many of the support mechanisms on offer are centred around decarbonising or reducing a businesses' energy consumption. For many SMEs, energy costs are a small percentage of their total operating spend so they are not incentivised to make changes even when these will reduce their energy costs, as the overall saving is small. This perception potentially doesn't appreciate that energy and resource savings directly impact the bottom line and investment in these areas can reap long term benefits for many years. Not appreciating the value of energy and resource efficiency highlights a low level of understanding which can be countered by an investment in marketing this important message. "Straight to the bottom line" was a message consistently utilised in the Scottish programmes promoting energy and resource efficiency over the last 20+ years which has helped to generate good levels of engagement from SMEs.
- It was suggested that Government investment in new technologies that would reduce operational energy use and create faster return on investment (ROI) would be very valuable however it was also noted that there are significant benefits already available to most SMEs from installing proven energy efficiency technologies and that would directly lead to reduced carbon emissions. Similarly, there are low-carbon solutions already at market such as LED lighting, heating and lighting controls and efficient boilers which are already cost beneficial to implement. There are also other measures such as heat pumps, solar PV and batteries which can significantly reduce carbon emissions which can be financially attractive if supported by government programmes.
- Many SMEs do not know what financial support is available, or where to look for it and so centralised guidance from the Welsh Government would be valuable. That central support should also promote local financial schemes which may also provide useful support to SMEs.
- Care should be taken when developing financial support mechanisms so that they are accessible to SMEs. For example, at one point the Scottish SME loan scheme applied a bespoke SME definition which was not aligned with the EU-based definition which was applied for the preceding advice service.

This led to a number of SMEs accessing the advice but then not being able to access the loan scheme. The loan assessment process should also be configured so that it is willing to risk investing in SMEs that have got low financial stability. Investing in energy efficiency and appropriate low-carbon technologies can be transformational for SMEs that are struggling to survive and can help to keep them in business. The costs to a government arising from a small number of loan defaults is still very small compared to the costs associated with running a grant scheme or the indirect costs associated with the business failing.

4.1.1.4 Supplier and equipment availability

This topic referred to the supply chain for decarbonisation solutions to help SMEs implement energy efficiency and low-carbon technologies, systems, and processes. This includes the provision of equipment, as well as the installation and maintenance of that equipment.

Participants discussed that the availability of energy efficient and low-carbon equipment can slow down the transition:

- There was a surge in demand for heat pumps and electric vehicle charging stations within the last five years and the rate of installations was slowed because of limited availability. Demand for heat pumps and EV charging stations is expected to continue to increase as the need for decarbonisation solutions becomes more urgent so this supply issue is likely to continue to be a challenge.
- The futureproofing fund removed double glazing as a measure due to concerns that it may create too much demand and supply chains may not be able to manage. That said, double and triple glazing are important energy efficiency measures which can reduce energy consumption, increase comfort levels and reduce noise disturbance so, while the measure has a relatively long payback in most instances, it is an important step in retrofitting buildings and should be encouraged and supported. The Scottish SME loan scheme funded double, triple and secondary glazing measures and the level of uptake was not disproportionate.
- It was suggested that mechanisms to incentivise the uptake of equipment should be accompanied by an increase in stock of this equipment however governments can't force installers to increase stock levels. It was suggested that the best way to influence installers and manufacturers to invest in the manufacturing, distribution, training and installation of energy efficient and low-carbon technologies is through stable, long-term policy commitments which support this manufacturer and supplier investment.

Businesses should have access to impartial advice on the equipment into which they should be investing:

- Participants suggested that advice on whether businesses should invest in certain equipment should come from those who don't stand to make a profit and are impartial. Some suppliers may encourage sales of certain equipment even when it is not the most suitable solution or does not fit well with a business's operations.
- Some businesses are investing in heat pumps without first insulating their building premises, and so efficiency gains from the heat pump are significantly reduced. If these businesses had access to advice on this equipment from an impartial body, they would first focus on upgrading the building fabric where possible before investing in a heat pump.
- Some business facilities are old and have poor building fabric which makes them less suitable for retrofitting energy efficiency or low-carbon measures. It would be useful to have access to advice to understand what options are available in these situations.

4.1.1.5 Policy/ legislation

This topic provided an overview of the current landscape of Welsh policy related to decarbonising SMEs and the history of legislation evolution. Participants discussed that legislation to support decarbonisation measures should be created with SMEs in mind:

It was suggested that it would be important that government schemes aimed at developing decarbonisation technologies consider the requirements and processes of different businesses so that all SMEs can access support that is relevant to their operations. For example, heat pumps will not be suitable for the heat demands of all business. So government funding targeting only heat pumps will leave some SMEs without access to relevant support.

- There is currently a skills gap as many SMEs do not have any employees with the knowledge to lead on identifying and implementing decarbonisation measures. A government-backed apprentice scheme was suggested to ensure there are people in businesses who can lead on energy management although most SMEs would not have the capacity to employ an energy manager. For most SMEs, energy management would be one of many management responsibilities that the general manager or owner would have.
- An alternative to an apprentice scheme would be to support the development of a supplier base of local energy and low-carbon consultancies so that one person with expert knowledge and experience can effectively support multiple SMEs. The Welsh government providing a free advice service which utilises a pool of local consultants can help to develop that supply chain.
- Implementing an apprentice scheme for installers of energy and resource efficiency measures and low-carbon technologies could help to develop the supply chain needed to install the high numbers of measures that will be needed to meet government targets for domestic and business properties.

Participants reported that there is a lack of certainty around support mechanisms:

- There is a fear that policy that comes through to support businesses may not be around for long enough to be useful. Businesses, and particularly manufacturers and installers of energy efficiency and low-carbon equipment want long-term strategies from the government so that they feel comfortable investing the time and money to take advantage of schemes being offered.
- Support mechanisms are currently offered by both the Welsh Government and local authorities but many businesses report uncertainty around what is available to them. It would be useful to have a centralised advice service targeted at SMEs that could act as a guide to local and national schemes. Where there are also local schemes operating then the national and local schemes should be encouraged to cross-refer in order to give the best advice to the SMEs rather than try and close down local schemes. This was implemented successfully in Scotland where it was found that there was consistently more demand for all the support available than capacity to deliver. One single, national scheme would be easier for SMEs to navigate but it is always hard to prevent local schemes being funded which seek to address local issues. A collaborative, integrated approach is likely to be the better compromise which still presents a joined-up approach for the SMEs.
- Some businesses have reported looking towards the UK government more than the Welsh government for guidance. Alignment in messaging between the two would provide a clear guide to businesses on what they should be doing however implementing a long-term strategy which is aligned with the UK government may be challenging at least in the short term. In Scotland, SME business advice along with the SME loan has been delivered consistently (although with small variations in name and scope) for around 20 years. That scheme successfully adapted over the first 10 years to changing criteria that was applied by a UK scheme run by the Carbon Trust in order to present a clear offering to the SME audience.

4.1.1.6 Other

Following discussion of the key areas of support, participants were asked to discuss and raise any other issues of relevance to SMEs.

- Participants raised concerns around the difficulties that SMEs in rented buildings face in implementing energy efficiency measures such as upgrades to building fabric. This is due to the tenant businesses not having an incentive to invest in these measures if the length of their tenancy agreement is short. Where they have a long lease and want to invest in the building, some tenancy agreements do not support that agreement and require the building to be returned at the end of the lease in the same

condition as it was started. Equally, landlords often don't have an incentive to invest in these measures as the lower energy bills or increased comfort levels only benefit the tenant. Interestingly, the UK scheme, Green Deal, which was being developed around 2010 included the possibility of supporting SMEs as well as domestic properties. It involved installing measures into buildings and the costs of the measures being repaid through a charge which was added to the energy bill and managed by the energy suppliers. The beauty of that proposed scheme was that the energy bill payer would make savings which resulted from the installed measures. Those savings would repay the cost of the measure so that the bill payer didn't experience a higher bill. For tenants and landlords, it meant that the bill payer (the tenant) benefitted from the measures and paid back the cost through their energy bill but if the tenant left then the next tenant that moved in would continue to pay off the improvements (As well as benefiting from them). Unfortunately, the scheme floundered due to excessive bureaucracy built in to minimise risk combined with expensive loan terms.

- There were concerns around the burden and cost that will be imposed when reporting requirements such as Energy Savings Opportunity Scheme (ESOS) extend beyond large enterprises to include SMEs. This is understandable as schemes like ESOS are fairly inflexible and relatively expensive however a steady long-term plan to restrict the selling and renting of commercial properties based on EPC ratings for smaller sites will be an effective, low-cost approach to driving change to buildings which, for most SMEs, is the most significant emissions associated with their business (compared with process and transport emissions).

4.2 Workshop recommendations

4.2.1 Welsh Government support

Based on the discussions held during the workshops, key support mechanisms that could be offered by the Welsh Government to support the decarbonisation of SMEs are:

- Improved grid connectivity across Wales to enable electrification of business operations.
- A favourable export rate for businesses to sell excess electricity generated on-site back to the grid. This would incentivise businesses to install sufficient solar PV to cover all their operations without the risk that they would be inefficiently generating more than they can use on non-operating days.
- Free advice on energy efficiency and decarbonising measures. This would support businesses in identifying the most cost-effective measures with respect to their business operations, without relying on advice from suppliers who stand to make a profit by promoting investments that are not well suited to a business's operations. This advice service could utilise local energy and low-carbon consultancies.
- Government investment in new technologies that would reduce operational energy use and create faster return on investment. This can be supported with stable, long-term policy commitments which support manufacturers and suppliers to make investments into these technologies.
- Centralised guidance from the Welsh Government, local authorities and the UK government would provide a clear guide to businesses on what they should be doing. Long term strategies should be offered so that businesses feel comfortable investing the time and money required to take advantage of schemes being offered.
- A centralised action plan targeted at SMEs that could act as a guide. Where there are also local schemes operating then the national and local schemes should be encouraged to cross-refer in order to give the best advice to the SMEs rather than try and close down local schemes.
- A government-backed apprentice scheme to ensure there are people in businesses who can lead on energy management in businesses who have the capacity to employ someone in this position, or to develop the supply chain needed to install the volume of low-carbon measures that will be needed to meet government targets for domestic and business properties.

- A steady long-term plan to restrict the selling and renting of commercial properties based on EPC ratings for smaller sites would be an effective, low-cost approach to driving change to buildings. For most SMEs, this is the most significant emissions associated with their business (compared with process and transport emissions).

4.2.2 Financial support

Financial support is likely to be a critical element of the Welsh Government's SME decarbonisation strategy – many SMEs have reported that future planning and decarbonisation strategies have been deprioritised during the current period of high inflation. Financial support mechanisms throughout the workshops are:

- Interest-free loans to help businesses to electrify their fleets, as the higher cost of these vehicles is a key barrier for SMEs. The operating costs of EVs once they have been procured should, generally, be lower than petrol or diesel vehicles.
- Interest-free loans have been identified through work in Scotland as a successful way of de-risking investment in assets for energy efficiency and decarbonisation.
- Loans should be designed to be accessible to SMEs. The loan assessment process should also be configured so that it is willing to risk investing in SMEs that have got low financial stability.
- Subsidies on low-carbon solutions such as heat pumps, solar PV and batteries to reduce the financial barrier for SMEs looking to invest in these technologies.

4.3 Net Zero Scenarios and Decarbonisation Pathways

4.3.1 Pathways overview

For SMEs in Wales to achieve Net Zero, success will be determined by a variety of factors. Whilst there will be factors that SMEs will be able to directly control and influence, such as individual businesses incorporating decarbonisation and Net Zero initiatives into their overarching strategies, there are several external factors that could hinder or enhance the ability of SMEs to meet Net Zero targets. For example, a changing political landscape and its impact on policies and support mechanisms could lead to increasing subsidies and guidance, or alternatively lead to fragmentation, isolation, and a lack of support. The availability of technology and its upscaling to market will also be crucial, such as hydrogen fuel and its feasibility to become a key renewable fuel stock.

It is therefore necessary to consider several decarbonisation pathways and trajectories to Net Zero, to account for scenarios where businesses will experience accelerated progress towards their goals, inhibited progress towards their goals and a scenario that falls between the two extremes, combining enabling and restrictive elements.. Net Zero projections and decarbonisation pathways have therefore included the following scenarios:

- High effort
- Central effort
- Low effort

The high, central and low effort scenarios each project emissions to reduce by the same quantity by 2050. The key difference between the scenarios is the speed at which measures are adopted and implemented by Welsh SMEs. For each of these scenarios, the following process was undertaken to model a decarbonisation pathway and trajectory to Net Zero.

The 2021 Scopes 1 & 2 emissions baseline (section 3.2.1) was entered into Ricardo's Net Zero Projections Tool, aggregated by NCFormat industry and emissions source (diesel, natural gas, LPG, etc.). Emissions reductions measures were formulated, consisting of efficiency (e.g., sub-metering) and fuel switching (e.g., electrification) initiatives. The energy savings from these initiatives were calculated and imported to the Net Zero Projections Tool. Timescales (year of initiative implementation and years to implement initiative) were factored into the modelling, using available literature and published documentation to best inform the model

inputs (section 4.3.2). The financial impact of implementing these initiatives was also quantified and imported into the model figures, factoring in trajectories for operational expenditure (OPEX), such as changing fuel prices, and capital expenditure (CAPEX), such as investment into fuel saving technologies and assets (section 4.3.6).

Figure 7 and Figure 8 show the emissions trajectory for each scenario, with the three scenarios reaching a common residual figure in 2050. For simplicity, Figure 8 has removed the waste sector emissions.

Figure 7: Net Zero projections to 2050 from a 2021 baseline, for high, central and low effort scenarios

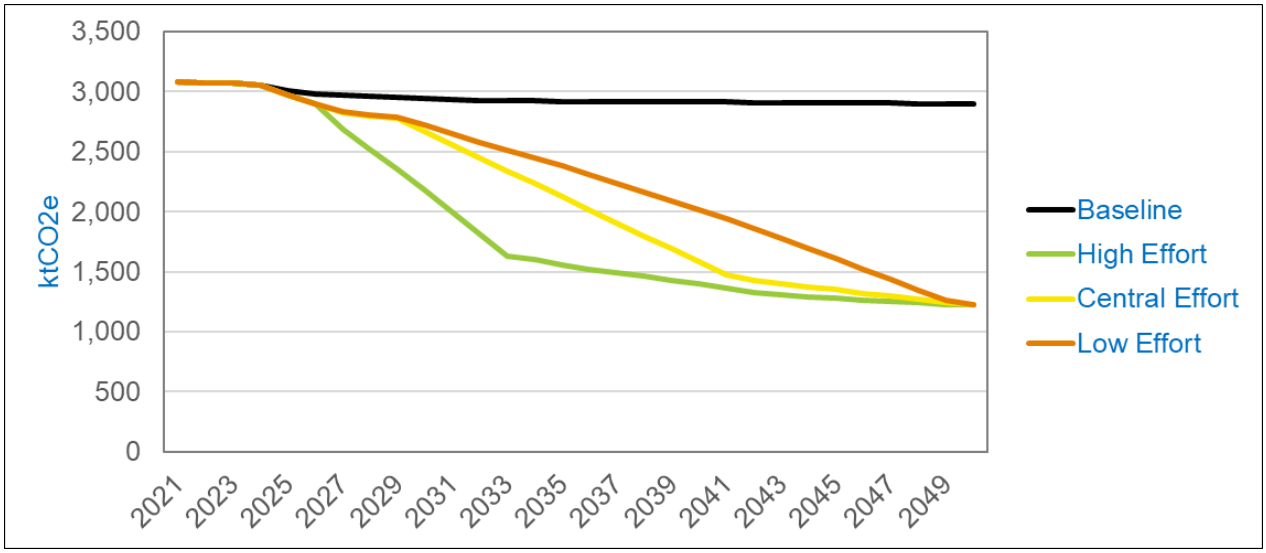
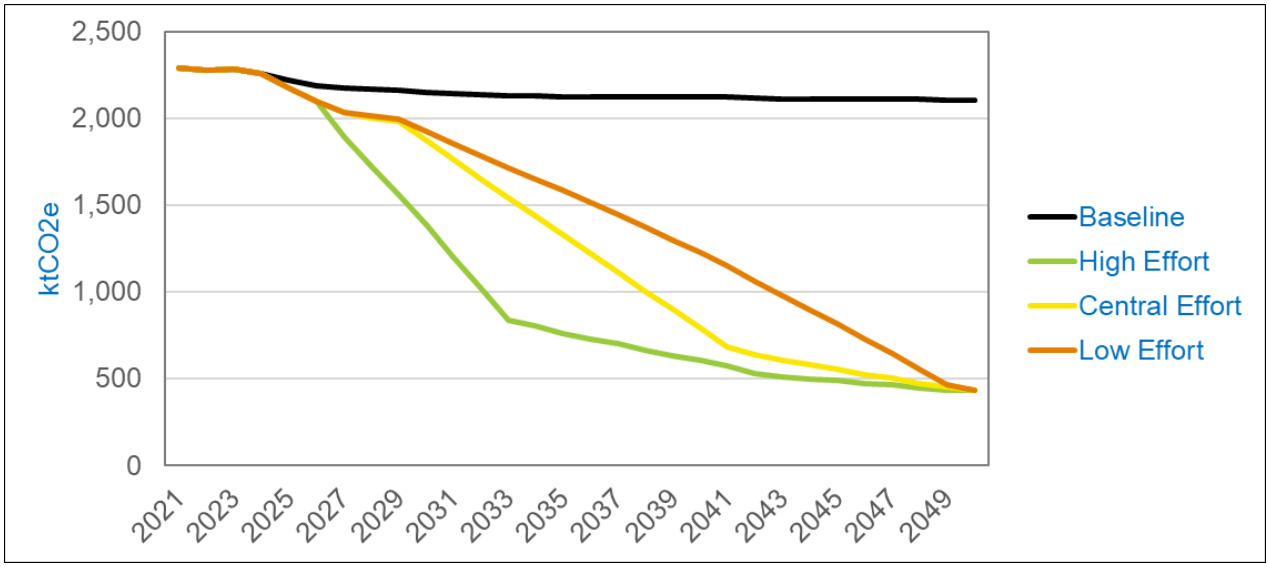


Figure 8: Net Zero projections to 2050 from a 2021 baseline, for high, central and low effort scenarios (without waste)



It can be seen in Figure 7 and Figure 8 the high effort scenario shows the fastest rate of decarbonisation, with over 50% of emissions being removed before 2035. All three scenarios reach a common residual emissions figure in 2050 of 1,228 $ktCO_2e$, when waste is not included in the baseline and three scenarios (Figure 8), the residual emissions in 2050 are 435 $ktCO_2e$.

Table 6 shows the residual emissions for each NCFormat in the SME baseline, with land use and waste included. These residual emissions are applicable to all three modelled scenarios in 2050, and show what emissions would still remain following the implementation of recommended mitigation measures.

Table 6: Residual emissions by source in 2050 (tCO_2e)

Emissions Source	Emissions (tCO_2e)
Active Aircraft	621
Biogas: 2021	1
Biomass	1,869
Colliery methane	221
Halocarbon Bank	136,036
Halocarbon in products at disposal	64,003
Halocarbon use	209
Halocarbon use in manufacturing	2,752
Lubricants	5,417
Gaseous fuels: Natural gas: 2021	69
Non-fuel combustion	1,387
Population	15,788
Waste solvent	771
Wood chips: 2021	198
UK electricity: Electricity generated: Electricity: UK: 2021	8,499
Dolomite	675
Ethylene	20
Glass-making additives	55
Limestone	1,075
Process emission	559
Soda ash	1,825
Sodium Bicarbonate	198
UK electricity: Electricity generated: Electricity: UK: 2021	3,653
Biological waste	65,640
Chemical waste	90
Clinical waste	2,413
Non-fuel combustion	650,948
Non-fuel domestic	73,175
Sewage sludge combustion	655
Biomass	31,837
Non-fuel combustion	156,854

The residual emissions in 2050 are estimated to be around 1,228 $ktCO_2e$. The decarbonisation measures implemented for the three scenarios focus on reducing emissions arising from traditional fossil fuel sources (natural gas, diesel, coal, etc.). Included in the Scopes 1 and 2 emissions baseline are additional emissions sources such as waste and halocarbons, the decarbonisation of which is not calculated by the model. Emissions from these sources therefore remain constant and do not decrease to 2050. These are more complex sources of emissions to decarbonise and cannot by addressed via conventional fuel switching measures. Examples of these are discussed in greater detail in the following sections.

With the commencement of The Waste Separation Requirements (Wales) Regulations 2023; The Prohibition on the Incineration, or the Deposit in Landfill, of Specified Waste (Wales) Regulations 2023; and The

Prohibition on Disposal of Food Waste to Sewer (Civil Sanctions) (Wales) Order 2023, it is expected that emissions associated with waste management will decrease as Wales progress towards 2050.

Switching F-gas systems and substituting halocarbons with high global warming potentials (GWPs) for low GWP alternatives would be an effective approach to reducing emissions associated with F-gas use. These could include Carbon Dioxide, Ammonia, low GWP hydrofluorocarbons (HFCs) such as R32 and low GWP hydrofluoroolefins (HFOs) such as R-1234yf. SMEs and landlords of sites occupied by SMEs should consider replacing existing systems with newer using more environmentally friendly working fluids and the Welsh government can engage stakeholders to encourage this and raise awareness. Similarly, in the baseline there are emissions associated with halocarbon disposal, which are still present in the current 2050 residual emissions. When replacing aged systems, there needs to be careful management to ensure these emissions do not occur at landfill sites i.e. intercepting systems before landfill, ensuring suitable capture and treatment of halocarbons.

For further study of each scenario, the periodic emission values are shown in Table 7.

Table 7: Periodic Emissions Values to 2050 from 2021 baseline, for high, low and baseline scenarios

	$ktCO_2e$						
Scenario	**2021**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
High effort	3,089	2,968	2,181	1,556	1,397	1,284	1,228
Central effort	3,089	2,968	2,669	2,126	1,584	1,349	1,228
Low effort	3,089	2,968	2,722	2,379	2,020	1,609	1,228

It can be seen in Table 7 that in the periods 2035-2045, the high effort scenario shows the lowest emissions total each year due to the faster implementation of measures.

4.3.2 Emissions reduction measures overview

4.3.2.1 EPC Ratings

For this project, Ricardo was asked by the Welsh government to research EPC statistics and recommendations to estimate the number of SMEs that could benefit from EPC improvement measures such as lighting controls, insulation etc, and quantify the carbon savings. Ricardo obtained the results for 2023 of Non-Domestic Properties in Wales[106] and these are shown in Table 8.

Table 8: EPC Rating bands 2023

Year	Number Lodgements	Total Floor Area (m^2)	A	A+	B	C	D	E	Below E
2023	6,458	4,216,630	300	19	1,665	2,338	1,437	606	93

Table 8 shows as of 2023 the most common EPC rating was “C”, with “A+” being the least common. “A+” is the highest achievable rating band and indicates optimum energy performance. “E” is the lowest rating band.

To help understand what measures are recommended to non-domestic properties; Ricardo downloaded the data set for all EPCs issued in Wales and analysed the recommendations. This data set goes back to 2008 and for a total of 58,532 certificates there were 596,186 recommendations. The top 20 categories of recommendations are shown Table 9.

[106] Source: Energy Performance Certificates for Buildings Register for England and Wales

Table 9: Top 20 categories of EPC Recommendations

Recommendation Category	Example recommendation	% of total
Air leakage	Carry out a pressure test, identify and treat identified air leakage. Enter result in EPC calculation.	5.9
Air source heat pump	Consider installing an air source heat pump.	3.1
Boiler replacement	Consider replacing heating boiler plant with a condensing type.	2.8
Cavity wall insulation	Some walls have uninsulated cavities - introduce cavity wall insulation.	3.5
Chiller system setup	The default chiller efficiency is chosen. It is recommended that the chiller system be investigated to gain an understanding of its efficiency and possible improvements.	0.8
Glazing	Some glazing is poorly insulated. Replace/improve glazing and/or frames.	4.5
Ground source heat pump	Consider installing a ground source heat pump.	1.7
Heating controls	Add optimum start/stop to the heating system.	20.5
Heating system investigation	The default heat generator efficiency is chosen. It is recommended that the heat generator system be investigated to gain an understanding of its efficiency and possible improvements.	2.7
Install efficient water heater	Install more efficient water heater.	1.4
Internal wall insulation	Some solid walls are poorly insulated - introduce or improve internal wall insulation.	1.9
Lighting	Replace tungsten GLS lamps with CFLs: Payback period dependent on hours of use.	18.0
Loft insulation	Some loft spaces are poorly insulated - install/improve insulation.	1.7
Point of use HWS	Consider replacing hot water system (HWS) with point of use system.	0.8
Roof insulation	Roof is poorly insulated. Install or improve insulation of roof.	1.3
Secondary glazing	Some windows have high U-values - consider installing secondary glazing.	5.7
Solar control measures (coating/shading)	Some spaces have a significant risk of overheating. Consider solar control measures such as the application of reflective coating or shading devices to windows.	4.5
Solar PV	Consider installing photovoltaic (PV).	4.9
Solar water heating	Consider installing solar water heating.	5.8
Wind turbine	Consider installing building mounted wind turbine(s).	5.7

It can be seen in Table 9 that "Heating Controls" is the most frequently occurring recommendation, with >20% of all recommendations. From the example shown, the recommendation refers to the heating system having a programme enabled that starts heating so it will reach the desired setpoint by the time specified, calculating when to begin preheating. "Lighting" is the second most frequently occurring recommendation, and this will often be for sites to upgrade to more efficient, LED lights.

4.3.2.2 *Efficiency measures and fuel switching*

To identify the applicability of each measure and estimate carbon savings, the end use of fuels is needed. ECUK statistics[107] were used to obtain an understanding of the fuel quantities in the SME baseline that are being consumed for the purpose of space heating and therefore could be reduced by a measure such as heating controls. The energy use by fuel is shown for industry and services in Table 10 and Table 11 respectively.

Table 10: End Use by Fuel – Industry 2021 Table U2

End use	Natural Gas	Oil	Solid Fuel	Electricity
Space heating	12%	17%	7%	8%
High temperature process	24%	26%	56%	10%
Low temperature process	41%	36%	18%	18%
Drying/separation	12%	11%	9%	6%
Other	12%	11%	10%	5%
Motors	0%	0%	0%	35%
Compressed air	0%	0%	0%	10%
Lighting	0%	0%	0%	3%
Refrigeration	0%	0%	0%	6%
Unknown (heat)	0%	0%	0%	0%
Overall total	**100%**	**100%**	**100%**	**100%**

Table 11: End Use by Fuel – Services 2021 Table U2

End use	Natural Gas	Oil	Electricity
Space heating	75%	58%	10%
Water heating	10%	9%	2%
Cooking/catering	7%	29%	10%
Computing	0%	0%	10%
Cooling and ventilation	0%	2%	13%
Lighting	0%	0%	23%
Other	8%	2%	32%
Overall total	**100%**	**100%**	**100%**

Table 10 and Table 11 show the different end uses of fuel in the categories industry and services. Industry will apply to manufacturing SMEs such as food and drink, semi-conductor, etc. Due to the need for different grades of heat and processes in industry, the end uses include high temperature processes, low temperature, and drying/ separation as well as space heating. For services, there are fewer end uses and the most common use is space heating.

The following fuels and their relevant contributions from the SME baseline developed for this study were mapped to the ECUK statistics.

[107] UK Government - Energy Consumption in the UK, 2021

Table 12: SME Baseline fuel totals

Fuel	$ktCO_2e$
Natural Gas	474
Burning Oil	62
Fuel Oil	7
Gas Oil	4
Coal	23
Electricity	180

With burning oil, fuel oil, and gas oil being grouped together as “oil” that is referenced in Table 10 and Table 11. The baseline totals were converted to kWh and then assigned to industry and services end uses in Table 10 and Table 11. It should be noted that while EPC rating improvements can achieve energy savings and the EPC rating scheme allows for comparison between business premises, additional energy reduction measures can help SMEs achieve significant savings and act as enabling measures on the way to decarbonisation. A study by the Investment Property Forum[108] supports this, referring to the importance of energy management and tenant engagement to enable decarbonisation to be achieved. Furthermore, research carried out by the Better Buildings Partnership[109] found very weak correlation between energy intensity of offices and EPC ratings, meaning properties with a high-performance band may still operate with a higher energy intensity (e.g. kWh/ m^2) than a low-performance band property.

Ricardo therefore recommends the following measures to be targeted at SMEs alongside EPC improvements.

Energy management: Energy management involves identifying a champion on site and assigning them with responsibility for identifying measures. A committee (governance) should be set up to regularly review data and oversee energy performance. This ensures that there is a centralised, coordinated, and systematic approach to energy management and decarbonisation across the organisation. An energy management programme centralises the organisation’s approach to decarbonisation. The programme will include formal site policies coupled with a framework through which they will be delivered, and this will include senior management engagement, the setting of objectives and targets, and systematic programmes and mechanisms to report and account for energy performance at a local level, e.g., processes, procedures and reporting systems. These will need to be sustained in a systematic manner in order that savings are sustained over the long term. Energy management can typically save organisations 5-10% in energy consumption.

Sub metering: Sub metering involves installing additional utility meters within a site to monitor and measure energy consumption from significant energy users (SEU). By analysing this data, it is possible to identify the source of any inefficiencies more precisely than it would be using a single meter, wastage, or excessive consumption. This allows for stakeholders to optimise their resource usage more effectively. Sub meters can be used to measure electricity, water, natural gas, or other utilities. The data obtained helps inform building owners and property managers where energy savings can be made. For example, sub meters can help identify the energy usage of idle equipment, helping to lower expenses and waste. Analysis of sub metered data (profiling, regressions etc.) can also give insights into energy performance by developing metrics such as energy vs. weather conditions. Sub metering can achieve energy savings of typically 5% for organisations.

Heat recovery: Heat recovery is an efficient energy saving measure, particularly at manufacturing SMEs where there may be waste heat available to recover through a heat exchanger and use elsewhere, for instance boiler feedwater preheating to reduce fuel consumption. Typical industrial sources of waste heat are boiler flues, air compressors, refrigerant and chiller compressors, and boiler blowdown. An economiser installed on a boiler flue can increase boiler net efficiency by as much as 9%[110].

[108] Costing Energy Efficiency Improvements in Existing Commercial Property, Investment Property Forum 2024

[109] Real Estate Environmental Benchmark: 2022 Insights Report, Better Buildings Partnership

[110] Boilers: controls and heat recovery, Department for Business, Energy and Industrial Strategy (BEIS) UK

Building Management Systems Control Improvements: This will depend on the controls in place at each SME's workplace. Optimising set points and building management systems can lead to notable savings for organisations. The simplest implementation will be a review of operating times against workplace occupancy hours and aligning temperature set points with IEA guidance such as 18°C maximum for heating, 24° C for cooling[111].

For SMEs with a controls system in place such as Building Management System (BMS), the control system may be aged, need updating, or have scope for controls improvement enabling SMEs to improve energy performance. SMEs should be encouraged to review the functionality and performance of existing BMS against the classes of BS EN 15232 and determine if improvements can be made.

BS EN 15232 is a European standard that provides a framework for assessing and improving the energy performance of buildings, ranking from Class D to A:

- Class D describes non-energy efficient controls,
- Class C describes environmental Zone Controls,
- Class B describes a pre-programmed Building Management System (BMS) with fixed functions,
- Class A describes programmable Building and Energy Management System (BEMS) with greater functionality.

It has been estimated that upgrading from controls at BS EN 15232 Class D to Class A, a programmable BEMS, can provide energy savings of 54% for offices[112].

Refrigeration system improvements: Refrigeration systems and cold storage areas can be significant energy users for certain SMEs. To ensure the efficiency of a site's cooling systems and industrial refrigeration, there should be suitable isolation for chilled and frozen areas so that minimum heat enters the system. If there is heat ingress into refrigerated areas, the system must work harder to expel this heat, meaning more energy is required. Excessive humidity in cold storage areas can also impact the system's efficiency and should be avoided. SMEs can be engaged and made aware of good management techniques which will help improve the efficiency of their cooling systems. These include staff training to ensure doors are not left open in key areas, this can be extended to include door alarms alerting staff of doors left open, air curtains to reduce heat ingress, managing humidity, and efficient use of controls.

VFDs and motor upgrades: There will be opportunities to improve the efficiency of electric motors and their drives in both industrial and commercial applications at SMEs. There are two main ways to achieve this, by installing variable frequency drives (VFDs) and ensuring optimal sizing of motors for the load required. VFDs are most commonly used on fans, compressors, and pumps to improve energy performance. Installing VFDs allows for accurate control of motor speeds by adjusting the power supplied to the motor. This is especially beneficial in applications where motor speeds may vary such as in HVAC systems. Over-sized motors are also a key source of wasted energy and can adversely affect motor performance. Matching motor and drive specifications to meet requirements improves overall efficiency. SMEs should be encouraged to comparing current performance of fans, pumps, compressors against the operating curve and identify if the machinery is locating at close to maximum efficiency or if it is incorrectly sized.

The Welsh Government should consider if financial assistance or training materials can be provided to help SMEs incorporate these measures and achieve energy reductions.

It would be recommended to implement these measures before switching fuels and installing air source heat pumps, ground source heat pumps, solar PV, and electric resistive systems at SME premises to reduce carbon. As this will optimise energy consumption on site and reduce the size of the heating system required. Following theoretical implementation of the above measures, and other recommended energy saving measures such as energy management, sub metering, the remaining fuel totals from the SME baseline could be used to model carbon savings from SMEs switching to low carbon heating. An industrial fuel switching market engagement

[111] Residential behaviour changes lead to a reduction in heating and cooling energy use by 2030, International Energy Agency

[112] Energy management and building controls, BRE group

study[113] was used as a guide for suitable fuel-switching options for the non-space heating end uses in Table 10, these are shown in Table 13. For space heating, heat pumps were modelled as the preferred option.

Table 13: Fuel switching options for end uses

End Use	Suitable fuel switching options
High temperature process	Electric heaters, hydrogen
Low temperature process	Electric boilers, electric heaters, hydrogen, heat pumps (up to 25% substitution)
Drying/separation	Electric boilers, electric heaters, heat pumps (up to 25% substitution)
Other	Electric boilers, electric heaters

Through the use of Ricardo's modelling tool, the fuel switching measures have been applied to the baseline fuel quantities after the implementation of energy efficiency and reduction measures discussed in this section.

4.3.2.3 Solar PV

- For offices and manufacturing sites, the floor space and number of properties in Wales in 2017 was taken from the UK government publication 'NDR: stock of properties including business floorspace' [114]. The 2017 values were used because the latest figures available for stock of properties was 2017, so the 2017 floorspace values were also used for consistency.
- The floor space and number of properties in Wales was attributed to SMEs using employment numbers broken down by size band and industry[115]. For manufacturing sites, employment numbers for micro, small and medium production enterprises were taken as a proportion of employment numbers for all production enterprises. For office sites, employment numbers for micro, small and medium financial and business enterprises were taken as a proportion of employment numbers for all financial and business enterprises. These percentage proportions were then used to attribute building stock and floor space to SMEs in Wales. Employment number was selected as a proxy as it was deemed to best represent the space occupied by enterprises.
- After attributing floor space and number of properties to SMEs, these figures were adjusted to account for the fact that as of 2023, 69.3% of properties were rated EPC B or lower and therefore eligible for Solar PV implementation[116]
- For offices and manufacturing sites, the average floor space per building was calculated by dividing the apportioned floor space values by the building stock values. For offices, this was then converted to available roof space by assuming the average number of storeys per office building[117]. For manufacturing sites, this was then converted to available roof space by assuming 25% of the roof area will be available for Solar PV implementation, allowing for architectural and design constraints such as pitching, existing equipment etc.

The size of solar panels was then researched to determine on average how many solar panels could be placed per building for office and manufacturing sites:

- An average solar panel size was obtained by averaging the measurements for small and large solar panel designs[118]

[113] Industrial Fuel Switching Market Engagement Study for BEIS, 2018
[114] UK Government, Non-Domestic rating: stock of properties including business floorspace, 2020
[115] Welsh Government, Employment by industry (SIC2007), size-band and area, 2023
[116] Energy Performance Certificates for Buildings Register for England and Wales, 2023
[117] SteelConstruction.Info, Multi-Storey Office Buildings, 2023
[118] Skills Training Group, Solar Photovoltaic Panel Sizes: A Complete Guide, 2024

- The average available roof space for office and manufacturing sites was divided by the average solar panel size to provide the average number of solar panels per office site and manufacturing site.

The kWh of electricity generation of solar panels was then researched, to determine the kWh of energy that could be generated by the office and manufacturing building stock of SMEs in Wales:

- The average kWh/m^2/year electricity generation of solar panels was obtained by averaging the minimum and maximum generation values of solar panels[119]
- For office and manufacturing sites, the average kWh/m^2/year for a single solar panel was multiplied by the estimated number of solar panels per building stock type to provide the kWh generation per building per year.

The kWh generation values per building per year were then multiplied by the SME apportioned number of offices and manufacturing buildings that were eligible for Solar PV implementation, to provide total annual kWh generation from Solar PV.

4.3.3 Decarbonisation measures timelines

An overview of the timeline for the decarbonisation measures discussed in section 4.3.2 is presented in Table 14.

Table 14: Pathway Modelling Measures Timeline

Measure overview	Emission source impacted	End use	High Effort	Central Effort	Low Effort
Reduction measures e.g. energy management, transport fuel efficiency	Natural gas, gas oil, fuel oil, coal, electricity	All	2025-2027	2025-2027	2025-2027
Fuel switching – heat pumps	Natural gas , Gas oil, burning oil, fuel oil, LPG , coal	Industry – space heating, low temperature processes (25%), drying/ separation (25%)	2027-2050	2027-2050	2027-2050
Fuel switching - hydrogen	Natural gas, Coal , Gas oil, burning oil, fuel oil, LPG	Industry – high temperature processes	2035-2042	2035-2047	2037-2050
Fuel switching – direct electric	Natural gas, Natural gas, Coal, Gas oil, burning oil, fuel oil, LPG	Industry – other, low temperature processes (75%), drying/ separation (75%)	2027-2050	2027-2050	2027-2050
Fuel switching – heat pumps	Natural gas, Gas oil, burning oil, fuel oil, LPG	Services – space heating, water heating	2027-2050	2027-2050	2027-2050
Fuel switching – direct electric	Natural gas , Gas oil, burning oil, fuel oil, LPG	Services - cooking/ catering, other	2027-2050	2027-2050	2027-2050
Fuel switching – electric vehicles	DERV, fuel oil, gas oil, LPG, petrol , natural gas	Transport – vehicles	2027-2034	2030-2042	2030-2050
Renewable electricity generation	N/A	All	2025-2050	2025-2050	2025-2050

The timeline of decarbonisation measures is shown in Table 14. The high effort scenario differs from the low effort scenario in that hydrogen is to be fully rolled out by 2042 in the high effort scenario, but 2050 in the low effort and renewable electricity generation such as solar PV is completed by 2035 in the high effort scenario.

[119] Richardson. J, Gardiner. R.B., How Much Space Do I need for Solar Panels, 2024

4.3.4 Emissions Impact of Measures

The impact on emissions per year by measure is shown in Table 15. For simplicity, different baseline fuels have been grouped into a single measure. Financial results for each measure are shown in section 4.3.6.

Table 15: Emissions impact of measures

Measure title	Emission reduction ($ktCO_2e$)
Industry reduction measures	26.4
Fuel switching – heat pumps, industry SMEs	90.7
Fuel switching – hydrogen, industry SMEs	81.6
Fuel switching – direct electric, industry SMEs	133.1
Services SMEs reduction measures	24.6
Fuel switching – heat pumps, services SMEs	208.3
Fuel switching – direct electric, services SMEs	46.3
Transport reduction measures	80.5
Fuel switching, electric vehicles	988.4
Solar PV installations	24.3

Table 15 shows the emission reductions per year that can be achieved by each measure. The measure to reduce fossil fuels by switching to electric vehicles has the highest emission reduction. This is due to diesel (DERV) being the largest fuel in the baseline.

The cumulative emission savings of each measure are shown in

Table 16, Table 17 and Table 18 for the high, central and low effort scenarios respectively.

Table 16: High effort scenario measure cumulative emission savings

	tCO_2e				
	2030	2035	2040	2045	2050
Industry reduction measures	131	311	462	778	522
Heat pumps Manufacturing SMEs	51	247	553	946	1,388
Hydrogen Manufacturing SMEs	-	12	245	653	1,061
Direct Electric Manufacturing SMEs	59	324	749	1,310	1,957
Service SMEs reduction measures	121	233	342	449	385
Heat pumps General SMEs	115	564	1,267	2,168	3,183
Electrification General SMEs	21	114	263	459	684
Fuel switching, electric vehicles	1,318	5,699	10,537	15,428	20,361
Transport reduction measures	403	805	1,207	1,609	2,011
Solar PV installations	112	213	311	373	399

Table 17: Central effort scenario measure cumulative emission savings

	tCO_2e				
	2030	2035	2040	2045	2050
Industry reduction measures	131	311	462	778	522
Heat pumps Manufacturing SMEs	34	168	399	723	1,140
Hydrogen Manufacturing SMEs	-	7	143	449	857

	tCO2e				
Direct Electric Manufacturing SMEs	40	221	542	1,004	1,613
Service SMEs reduction measures	121	233	342	449	385
Heat pumps General SMEs	79	385	915	1,656	2,613
Electrification General SMEs	14	78	190	352	564
Fuel switching, electric vehicles	78	1,677	5,307	10,198	15,131
Transport reduction measures	403	805	1,207	1,609	2,011
Solar PV installations	75	142	214	266	291

Table 18: Low effort scenario measure cumulative emission savings

	tCO2e				
	2030	2035	2040	2045	2050
Industry reduction measures	131	311	462	778	522
Heat pumps Manufacturing SMEs	24	116	288	558	959
Hydrogen Manufacturing SMEs	-	-	58	262	612
Direct Electric Manufacturing SMEs	28	153	392	778	1,363
Service SMEs reduction measures	121	233	342	449	385
Heat pumps General SMEs	54	266	660	1,280	2,200
Electrification General SMEs	10	54	138	272	476
Fuel switching, electric vehicles	47	1,006	3,184	6,609	11,247
Transport reduction measures	403	805	1,207	1,609	2,011
Solar PV installations	14	74	168	233	260

Implementing measures earlier will increase the amount of carbon emissions that are avoided or prevented by 2050. This is important when considering the next carbon budget and overall allowance for cumulative carbon emissions over time. It can be seen when comparing

Table 16, Table 17, and Table 18 that the high effort scenario shows the greatest cumulative carbon savings, and the low effort scenario the lowest.

It is crucial to not only focus on the net zero target year, but also total carbon emissions released into the atmosphere. A key concept behind net zero is to minimise total cumulative emissions, thereby helping to keep the national/global carbon budget under a particular threshold, as emphasised in the recently released Science Based Targets initiative (SBTi) Net Zero Standard[120].

Despite each decarbonisation pathway reaching a similar residual emission threshold in 2050, there is substantial variation in the total cumulative emissions, as can be seen in Figure 9. When the Welsh Government considers which pathway is best suited to its goals and resources, this aspect of net zero should be given just as much weight as the target year.

[120] Science Based Targets Initiative (SBTi), Corporate Net Zero Standard, 2021

Figure 9: Cumulative emission savings comparison for scenarios with baseline

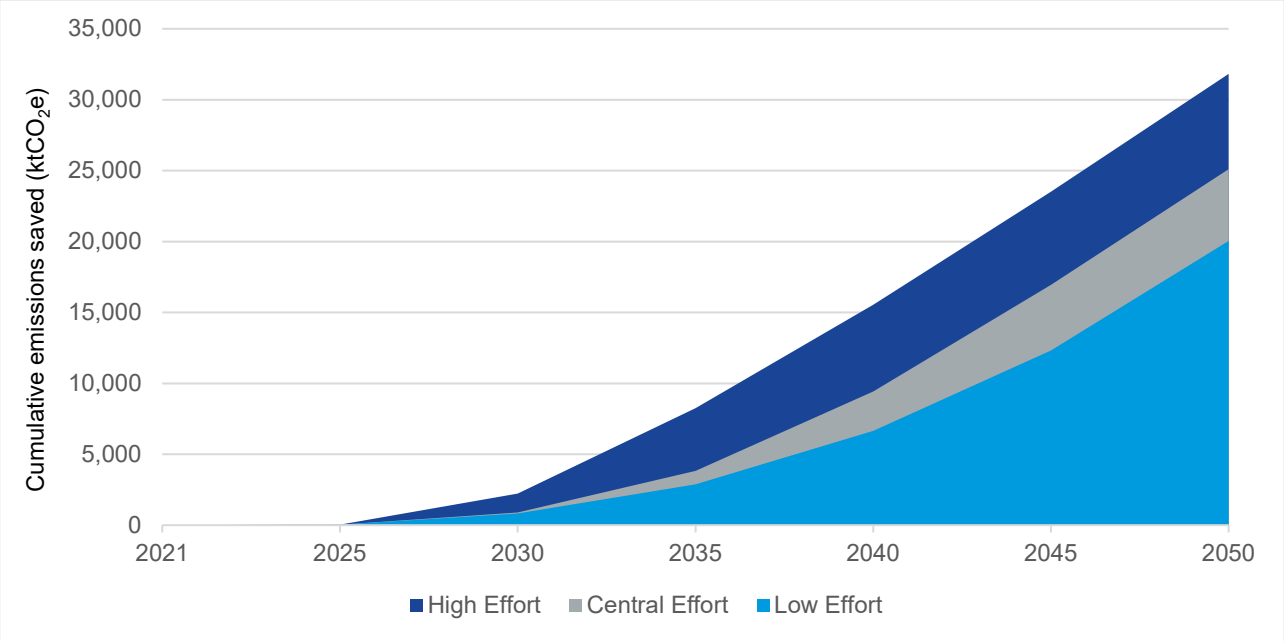


Figure 9 shows the cumulative emissions saving for each scenario. The cumulative emissions saved are in comparison with the baseline scenario in which minimal decarbonisation initiatives are implemented. As a result of implementing the various decarbonisation initiatives fastest in the high effort scenario, over 10,000 $ktCO_2e$ are saved in the period to 2050, compared with the low effort scenario. The cumulative emission savings are further presented in Table 19.

Table 19: Cumulative emissions savings per scenario to 2050

ktCO2e	2030	2035	2040	2045	2050
High Effort Scenario	2,219	8,253	15,543	23,522	31,821
Central Effort Scenario	901	3,829	9,423	16,939	25,103
Low Effort Scenario	817	2,888	6,648	12,317	20,043

The cumulative emission savings of each scenario can be seen in Table 19. As a result of faster implementation of EVs, fuel switching, and renewable electricity the high effort scenario shows the highest cumulative emission savings throughout the timeline to the 2050 target.

4.3.5 Scenario parameters

The scenarios presented as part of this pathway modelling study are described in Table 20.

Table 20: Parameters and assumptions used in the high, central and low effort scenarios

Scenario	Parameters
High effort	An ambitious scenario, where there are efforts to implement decarbonisation measures at a faster rate (focusing on fuel switching measures – heat pumps, electrification and hydrogen): **Heat pumps:** • 60% of old fuel quantities are switched a faster rate (implemented in 2027 and over 9 years) • 30% of old fuel quantities are switched between 2036 and 2044. • Remaining 10% switched between 2044 and 2050.

Scenario	Parameters
	Electrification: • 60% of old fuel quantities are switched a faster rate (implemented in 2027 and over 9 years) • 30% of old fuel quantities are switched between 2036 to 2044. • Remaining 10% switched between 2044 and 2050. **Hydrogen:** • Fuel switching implemented in 2035 (aligning to the UK's Hydrogen Strategy) and completed by 2042. **Electric Vehicles:** Starting in 2027 and completed by 2034.
Central effort	A scenario that combines certain optimistic parameters of the high effort scenario, with certain pessimistic parameters of the low effort scenario: **Heat pumps:** • 50% of old fuel quantities are switched between 2027 and 2038. • Remaining 50% of old fuel quantities are switched between 2038 and 2050. **Electrification:** • 50% of old fuel quantities are switched between 2027 and 2038. • Remaining 50% of old fuel quantities are switched between 2038 and 2050. **Hydrogen:** • Fuel switching implemented in 2035 (aligning to the UK's Hydrogen Strategy) and completed by 2047. **Electric Vehicles:** • Starting in 2030 and completed by 2042.
Low effort	A less ambitious scenario, where there is some earlier uptake of decarbonisation measures, but the majority of these measures are implemented at a slower rate (focusing on fuel switching measures – heat pumps, electrification and hydrogen): **Heat pumps:** • 25% of old fuel quantities are switched a faster rate (implemented in 2027 and over 8 years). • 30% of old fuel quantities are switched between 2035 and 2043. • Remaining 45% switched between 2043 and 2050. **Electrification:** • 25% of old fuel quantities are switched a faster rate (implemented in 2027 and over 8 years). • 30% of old fuel quantities are switched between 2035 and 2043. • Remaining 45% switched between 2043 and 2050. **Hydrogen:** • Fuel switching implemented in 2037 (aligning to the UK's Hydrogen Strategy) and completed by 2050. **Electric Vehicles:** • Starting in 2030 and completed by 2050.

The parameters shown in Table 20 for each scenario influence the rate at which decarbonisation measures are implemented and the timescales for their completion (with a specific focus on fuel switching measures – hydrogen boilers, electric boilers and heat pumps).

The high, central and low effort scenarios show equal emissions reductions by 2050, with the key difference being the trajectory up until this end point. The high effort scenario represents a pathway where fuel switching measures are adopted at an accelerated rate, leading to larger quantities of baseline fuels being substituted earlier. Comparatively, the low effort scenario represents a pathway where fuel switching measures are

adopted at a delayed rate, leading to larger quantities of baseline fuels being substituted in later years. The central efforts falls between the two extremes, representing a scenario that combines optimistic parameters of the high effort scenario with pessimistic parameters of the low effort scenario.

For hydrogen fuel switching, both the high and central effort scenarios implement this initiative in 2035. The low effort scenario assumes a slightly delayed implementation, not occurring until 2037. This has been informed by the UK Government's UK Hydrogen Strategy[121], which proposes that by 2030, the UK will have 5GW of low carbon hydrogen production capacity. This places the UK hydrogen economy in a strong position for the required scale-up to market by the mid-2030s, which is required to meet the UK's sixth carbon budget and Net Zero by 2050. The low effort scenario adopts a pessimistic outlook on the availability and uptake of hydrogen switching technology, with full implementation not being complete until 2050. The high effort scenario adopts an optimistic outlook on the availability and uptake of hydrogen switching technology, with SMEs having the necessary means and capacity to complete implementation by 2042. In this study, as recommended in Table 13, hydrogen has been targeted at high temperature processes only.

For heat pump switching and electrification, the high, central and low effort scenarios all implement these initiatives in 2027. This reflects the need for rapid uptake of heat pumps identified by the UK government, and the UK ambition for heat pumps to be no more expensive than gas boilers by 2030[122]. Additionally, the Welsh government has expressed the ambition to target heating systems consuming non-gas fossil fuels at an accelerated rate as these will have a higher carbon reduction impact.

In the high effort scenario, 60% of baseline fuels are switched via heat pumps and electrification from 2027 to 2036, 30% of old fuels are switched from 2036 to 2044 and the remaining 10% of old fuels are switched from 2044 to 2050. These assumptions have been guided by Ricardo's review of literature and project experience, where consideration has been given to ensure the timescales of implementation are ambitious but also realistic and achievable. Comparatively, the low effort scenario sees 25% of fuels switched from 2027 to 2035, 30% of old fuels switched from 2035 to 2043 and the remaining 45% switched from 2043 to 2050.

4.3.6 Financial quantification of scenarios

For the high, central and low effort scenarios, the required capital expenditure (CAPEX) investment for the proposed fuel switching initiatives was calculated (heat pumps, electric boilers, hydrogen boilers, solar PV and DERV vehicle switching). Details of these calculations are outlined in sections 4.3.6.1 to 4.3.6.4.

4.3.6.1 Heat pumps, electrification, and hydrogen boilers

The parameters for costing heat pumps, electric boilers, and hydrogen boilers are shown in Table 21. These costs are high level and include a 50% addition for installation, preliminaries, and contingency following the cost metric shown in Table 21. The costs should be taken as averages for equipment only and will vary per site.

[121] Department for Business, Energy and Industrial Strategy, UK Hydrogen Strategy, 2021

[122] Department for Business, Energy and Industrial Strategy, Heat and Building Strategy, 2021

Table 21: Parameters used in CAPEX costing calculations for heat pumps, electric boilers and hydrogen boilers

Fuel switching initiative	Days use per year	Hours use per day	£/kW
Heat pumps	Manufacturing SMEs – 350 days[123] General SMEs – 200 days[124]	24[125]	£1300[126]
Electric boilers/ heaters	Manufacturing SMEs – 350 days General SMEs – 200 days	24	Manufacturing SMEs - £368[126] General SMEs - £110[126]
Hydrogen boilers	Manufacturing SMEs – 350 days	24	£610[126]

For each of the initiatives Table 21, assumptions were made regarding the days use per year of the new fuel asset and hours use per day (refer to footnotes regarding the sources of these assumptions). This provided an annual hours usage value, which when used in accordance with the calculated kWh of the new fuel initiative (section 4.3.2), provided an estimated kW for costing purposes. Using the £/kW values in Table 21, the estimated CAPEX cost was calculated.

4.3.6.2 DERV vehicle fuel switching

The 2021 Scopes 1 and 2 emissions baseline highlights how light-duty and heavy-duty DERV trucks are the largest emission source from the 'Transport' NCFormat industry. The cost to convert the vans and HGVs of SMEs in Wales to electric alternatives has been calculated using the following approach:

- The total annual kilometres of vans and HGVs in Wales was obtained from Welsh Government road traffic publications[127]
- The annual kilometres for a single van[128] and single HGV[129] were obtained from online sources.
- The total annual kilometres of vans and HGVs in Wales were divided by the annual kilometres of a single van and a single HGV to provide an estimate of the number of vans and HGVs in Wales.
- The estimated numbers of vans and HGVs in Wales were apportioned to SMEs using the 'Size Analysis of Active Businesses in Wales' report[29], using the same method based on revenue and size bands as mentioned in section 3.2.1.
- The average costs of electric vans[130] and electric HGVs[131] were obtained from published sources and multiplied by the estimated number of SME vans and HGVs in Wales, to provide a CAPEX cost.

4.3.6.3 Solar PV

The methodology for quantifying available roof space for solar installations is explained in section 4.3.2.3. From Ricardo's project experience, a cost per kW of £239 per m^2 of installation is a suitable indicative cost and was used to calculate CAPEX for theoretical installations with SMEs.

[123] Ricardo assumption that manufacturing SMEs will be operating their energy generating assets for 350 days of the year.
[124] Ricardo assumption that general SMEs will be operating their energy generating assets for 200 days of the year.
[125] Ricardo assumption that energy generating assets will be in operation for 24 hours each day they are in use.
[126] Ricardo has compiled these cost estimates from literature and project experience
[127] Welsh Government, Road Traffic: 2019, 2019
[128] Department for Transport, Final Van Statistics April 2019 – March 2020, 2021
[129] Webfleet, What is the diesel consumption per mile of trucks, 2020
[130] Webster. T, Best Electric Vans 2024 – Our Expert Guide, 2024
[131] Zero Emission Truck Taskforce, Total Cost of Ownership, 2023

4.3.6.4 Costing outputs

The cost calculations described in section4.3.6.1 to 4.3.6.3 were imported into the Net Zero Projections Tool for the high and low effort scenarios. The outputs of this financial quantification are shown per year in Figure 10.

Figure 10: High effort scenario cost of implementation and fuel savings

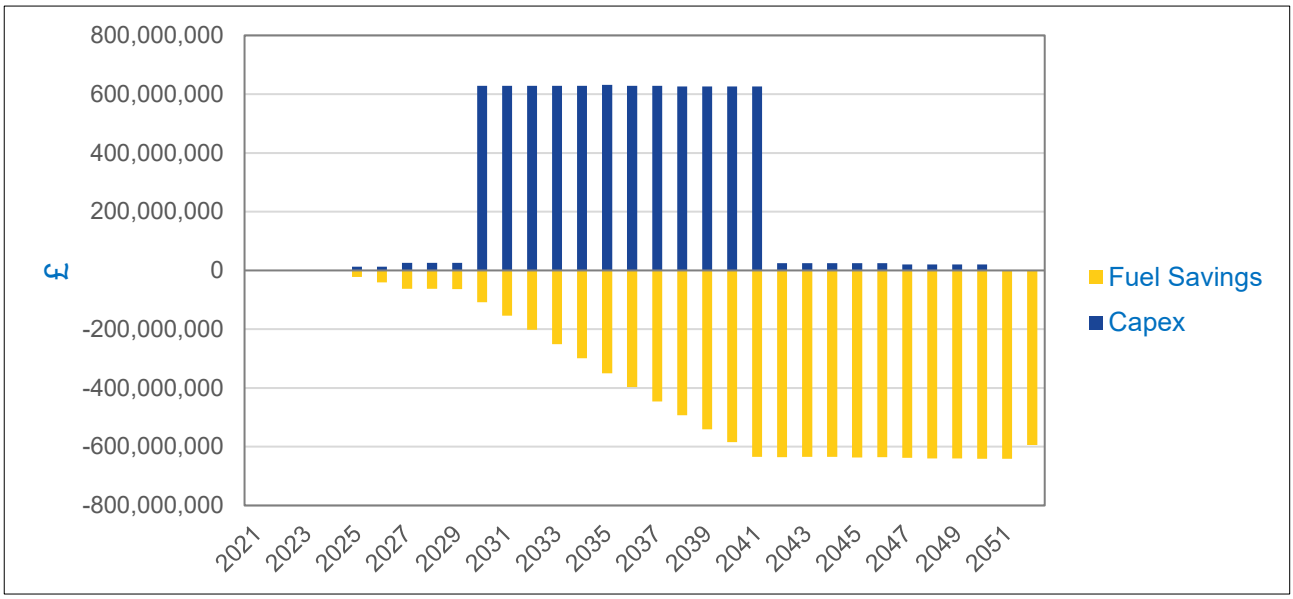


Figure 10 shows significant investment is needed to decarbonise the scope 1 and 2 emissions of Welsh SMEs. The highest period of CAPEX is in the years 2027 to 2033 due to the investment in electric vehicles. The negative values in the chart show savings in fuel costs by the decarbonisation initiatives combined and reach above £0.6 billion beyond 2044, indicating the positive financial implications of decarbonising SMEs. The maximum annual investment in the trajectory is over £1 billion. The monetary fuel savings and CAPEX have been used to calculate the net present value (NPV) using the discounted cash flow method.

The NPV has been determined from the Ricardo modelling tool for each measure. This considers the relative cost in baseline and new fuel as a result of the measure, for instance in a heat pump installation the cost that would have been spent on natural gas (baseline fuel) versus the new cost of electricity (new fuel) over the time period to 2050. The NPV results should be treated with caution as a lot of the equipment being installed has a capital cost but is expected to last 15-20 years and as such there will be life-cycle costs for many SMEs. The NPV results for each measure in the different pathways are shown in Table 22. A negative NPV will indicate an unfavourable cash flow over the time period.

Table 22: NPV per measure for each scenario

Measure overview	High Effort NPV (£)	Central Effort NPV (£)	Low Effort NPV (£)
Fuel switching – heat pumps, industry SMEs	416,504,276	328,280,935	264,678,646
Fuel switching – hydrogen, industry SMEs	45,319,595	35,321,229	22,209,605
Fuel switching – direct electric, industry SMEs	-276,761,792	-224,271,117	-186,422,494
Fuel switching – heat pumps, services SMEs	-252,126,733	-214,499,860	-187,384,751
Fuel switching – direct electric, services SMEs	-82,171,009	-66,123,958	-54,559,059
Fuel switching, electric vehicles	915,268,269	-192,533,598	-864,632,860
Solar PV installations	-174,560,684	-155,188,256	-149,559,501

Table 22 shows mixed financial results for the decarbonisation measures. Heat pumps to be used in industry, for example, show positive financial results to 2050 in all three scenarios. This will be due to the lower consumption of energy through heat pump use and more expensive fuel mix that is used in industry (such as coal and fuel oils alongside natural gas). On the other hand, in services, heat pumps are not seen as financially favourable to 2050 due to the displacement of lower cost natural gas. Additionally, a faster rollout of heat pumps in the period 2025-2035 can be financially punitive due to the higher cost of electricity in this time period and low forecast value of natural gas. Ricardo has used price profiles for fuels as found in UK Treasury Green Book Dataset.

For measures with a negative NPV, additional financial means will be required to make the measure profitable to 2050, such as carbon pricing or reduced capital expenditure through subsidies.

The vehicle fuel switching measure shown in Table 22 has the biggest financial and carbon impact, with the high effort scenario being the only scenario where this measure is profitable.

The NPV results for each scenario at discrete time intervals are shown in Table 23.

Table 23: NPV for high, low and central scenarios

Year	High Effort NPV (£)	Central Effort NPV (£)	Low Effort NPV (£)
2030	-2,771,610,503	-508,054,267	-282,055,227
2035	-3,356,164,087	-1,985,990,285	-1,241,779,182
2040	-1,833,398,251	-2,556,593,462	-1,617,901,303
2045	-529,222,682	-1,580,076,954	-1,595,143,532
2050	591,471,923	-489,014,625	-1,155,670,413

The NPV shown in Table 23 in the central and low effort scenarios is negative all the way to 2050. However, the high effort scenario shows a positive NPV is achieved by 2050, indicating faster action to decarbonise can deliver positive financial results.

Alongside financial results, the wider environmental and societal benefits of SME decarbonisation should be considered when viewing these results, such as reduced dependence on imported fuels, preserved environment, and the jobs created by the net zero transition. The model also predicts savings in fuel costs (as shown in Figure 10), and these are compared for the scenarios in Table 24.

Table 24: Cumulative savings for high effort, low effort, and central scenarios

Year	High Effort (£)	Central Effort (£)	Low Effort (£)
2030	752,770,748	47,842,587	30,478,321
2035	3,287,044,355	977,716,824	589,505,159
2040	6,131,377,335	3,107,342,339	1,866,364,041
2045	8,988,440,667	5,951,906,507	3,856,043,525
2050	11,853,950,972	8,817,891,009	6,544,501,254

Table 24 shows the positive financial benefits of faster decarbonisation of energy and transport for SMEs, with the high effort scenario having the highest amount of cumulative savings by 2050.

5 FINAL REMARKS

A study of Welsh SMEs has been performed by Ricardo to help the Welsh Government understand the estimated baseline of scope 1, 2, and 3 emissions for SMEs in Wales, and understand what work is required to decarbonise this key demographic. Throughout this report, recommendations for the Welsh Government have been made in regard to specific questions being answered.

A high-level summary of results and recommendations are provided as follows:

- **Baseline:** The baseline for Welsh SMEs was 7,790 $ktCO_2e$ in total. With 2,912 $ktCO_2e$ scope 180 $ktCO_2e$ scope 2, and 4,698 $ktCO_2e$ scope 3.
- **Climate resilience:** Changing weather patterns in Wales and unpredictability of future forecasts mean SMEs need to be adaptable to their requirements in the event of significant climate changes. Support from the Welsh Government to support adaptation infrastructure could be key in enabling consideration to the unpredictable nature of climate change.
- **Business premises:** SME businesses require focus on fabric-frits implementation to their sites to enable incorporation of on-site renewables. Renewables are a fast-track method of reducing energy consumption and reducing carbon emissions. However, without enabling the property to be receptive to a change in energy source, the building may not achieve the energy savings calculated. A combination of fabric measures and onsite renewables will be key in SMEs achieving EPC targets for their premises.
- **Procurement:** Incentivising public sector procurement would enable an increase of SMEs engaged in the public sector, enhancing the supply chains and providing stability to Wales' economy. There has seen a positive shift in encouraging public sector procurement through Green Action Plan and Wales would benefit from adopting some of the key recommendations such as improving resource efficiency in SMEs to reduce production costs and upskill for circular value chains.
- **Supply chain engagement:** An encouragement of new renewable technology supply chains in Wales can be supported by the Welsh Government offering incentives for startups, training grants for upskilling on technologies, adopting policies and regulations that prioritise renewable energy development and collaborations on regional and local scales with key stakeholders.
- **Transport:** A transition to EVs for SMEs can result in high upfront costs for both the vehicles and the infrastructure, however, there are benefits to EVs such as lower maintenance costs, reduced environmental impacts and greater market visibility. Supply chains benefit from reduced pressures on energy demands and better logistical operations to fleets. The Welsh government could further encourage EVs by supporting infrastructure challenges such as within the construction sector and smaller hospitality venues.
- **Stakeholder engagement:** From the workshops, targeted actions to help Welsh SMEs decarbonise include support mechanisms such as free advice and financial support to enable knowledge transfer of needs and requirements within SME businesses. It was suggested that government investment into new technologies could create a faster return on investment and encourage an increase to supply chains in Wales. Support for both SMEs and their supply chains is needed to upskill on technologies required to shift towards a sustainable future. Suggestions for this included apprentice schemes and college courses.
- **Net Zero pathway:** A pathways study for decarbonising energy and transport in Welsh SMEs was performed, predicting 1,859 $ktCO_2e$ can be removed from the baseline through targeted efforts. It is recommended to target measures wherever possible to align with the high effort decarbonisation scenario as this scenario is the most beneficial in terms of financial impacts and cumulative emission savings.