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Trade and Employment

# State Enterprise Agency Client Firms: Climate Change, Planning, and Investment

Working Paper

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**Authors:**

**Department of Enterprise, Trade and Employment:** Shannen Enright\*, Kate Newman and Dr Dermot P. Coates\*^

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\* Members of the Irish Government Economic and Evaluation Service (IGEES)

^ Corresponding author: [dermot.coates@enterprise.gov.ie](mailto:dermot.coates@enterprise.gov.ie)

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## Executive Summary

- This paper examines how Ireland is responding to the green transition. The paper utilises data collected through the Department’s Annual Business Survey of Economic Impact (ABSEI) on the climate response of agency client firms to act as a microcosm for the broader enterprise base. The paper also uses data from the Future Green Index by the MIT Technology Review to evaluate how Ireland is performing relative to other Small Advanced Economies.
- Whilst emissions have decreased overall, additional actions are required to meet our industrial targets set out in the carbon budgets.
- Emissions from manufacturing combustion decreased by 7.1 percent in 2022, while emissions from industrial processes decreased by 7.5 percent in 2022. Although emissions for the enterprise sector have fallen, they are not decreasing fast enough to achieve our targets. EPA projections indicate that the industrial sector is projected to exceed its first sectoral ceiling by 4.4MtCO<sub>2</sub> eq and its 2026–2030 sectoral ceiling by 9.5MtCO<sub>2</sub> eq.
- Cement and alumina account for the majority of industrial emissions, representing almost 60 percent of emissions. Modern manufacturing accounts for almost 80 percent of Gross Value added and 22 percent of employment and is the lowest emitter of all industrial sectors representing just 7 percent of emissions. Future policies to decarbonise industry should focus on cement, alumina, and traditional forms of manufacturing.
- Ireland currently ranks 15<sup>th</sup> out of 76 countries examined in the overall Future Green Index (FGI). Ireland performs the best on ‘green society’ which measures the efforts made by government, industry, and society to promote green practices, ranking first among all countries examined.
- Ireland ranks 18<sup>th</sup> in the climate policy pillar of the FGI, 21<sup>st</sup> on the carbon emissions pillar, and 38<sup>th</sup> in the energy transition pillar. However, Ireland is ranking 50<sup>th</sup> for clean innovation showing a poor performance in penetration of green patents, investment in cross-border clean energy, and investment in food technology. The findings suggest that further R&D may be required for private firms and the research system to increase the commercialisation of research.
- This paper shows that there have been positive changes in Enterprise Ireland and IDA client companies regarding climate action with both the measurement of emissions and development of climate response plans increasing since 2019. Overall, the proportion of clients with a climate response plan has increased between 2019 and 2021 with roughly a third of all agency client firms having a climate plan.
- The likelihood that a client company developed a climate plan increases considerably with size. Although the proportion is steadily increasing, micro enterprises (22 percent) are significantly less likely to have developed a climate plan in 2021 compared to SME’s (36 percent) or large enterprises (74 percent) for Enterprise Ireland clients. The same pattern holds for IDA clients with a quarter of SME and micro enterprises stating they have developed a climate plan in 2021 compared to three quarters of large firms.

- The likelihood that a company measures their emissions also increases with firm size. Two thirds of large IDA client companies measured their emissions in 2021 compared to one fifth of SME and micro clients. 65 percent of large Enterprise Ireland client firms measured their emissions in 2021 compared to 15 percent of SME and 6 percent of micro clients.
- Significant sectoral differences were also found in the development of a climate response plan. The manufacturing and industrial sector were significantly more likely to have a climate response plan than those in other sectors. These sectoral differences were present for both Enterprise Ireland and IDA client companies.
- Prioritisation(time) represents the biggest challenge for firms in developing a climate response plan followed by the availability of funding for such an investment.
- The findings suggest that funding, or possibly greater awareness of available funding, is required to alleviate the current challenges faced by enterprises in their development of a climate response plan. In addition, research should investigate the capacity issues which currently act as a barrier to greater climate action in smaller enterprises.

# 1. Introduction and context

## 1.1 Global Context

Addressing climate change is one of the biggest global challenges facing Governments today. Average global temperatures are rising due to increased carbon dioxide and other greenhouse gas (GHG) concentrations in the atmosphere. Without sustained intervention and policy targeted at reducing emissions, global temperatures will continue to rise at unsustainable rates, impacting future generations and causing irreversible damage to the environment. Hence, the 'Climate Issue' has risen to the forefront of the global policy agenda in recent years, amidst stark warnings from scientists and climate activists alike. Climate change is expected to have diverse and wide-ranging impacts on Ireland's environment, society, and economic development. These include managed and natural ecosystems, water resources, food security, human health, coastal zones, and infrastructure. Ireland has already experienced direct impacts of extreme weather events, including flooding and extreme snowfall.

The United Nations Framework Convention on Climate Change (UNFCCC), adopted in 1992, is the main international treaty on climate change. It provides a framework to combat climate change with the ultimate objective of stabilising GHG concentrations in the atmosphere at a level that will prevent "dangerous anthropogenic interference<sup>2</sup> with the climate system". The Kyoto Protocol, adopted in 1997, marked the first agreement to include binding commitments for developed countries to limit and reduce emissions. The successor to the Protocol, the 2015 Paris Agreement, represents the first legally binding, global agreement on climate change. It aims to keep the global temperature rise under 2°C (preferably 1.5°C) to prevent the worst effects of climate change. However, unlike the Kyoto Protocol, which established top-down legally binding reduction targets (and penalties for noncompliance) for developed nations, the Paris Agreement requires that all countries, developed and developing, cut GHG emissions.

Ireland is a party to the UNFCCC and signatory of the Paris Agreement, which together provide the international legal framework for addressing climate change. As an EU member state, Ireland also participates in the EU Emissions Trading System (ETS) and is committed to reaching national targets for reducing greenhouse gas emissions by 2030 under the EU Effort Sharing Decision and Regulation. Since the publication of its very first National Climate Change Strategy in 2000, Ireland has implemented a range of policies, bills, and frameworks to tackle climate issues, reduce emissions, and fulfil its public commitment to meet strict GHG reduction targets over the last few decades.

According to a paper published by the Department of Environment, Climate & Communications (DECC) on Estimating the Potential Cost of Compliance with 2030 Climate & Energy Targets, Ireland must make a significant effort to avoid compliance costs. The paper outlines the potential high costs of not meeting the targets associated with the Effort Sharing Regulation and Fit for 55 regulations which could be in the billions. While these costs are currently speculative and challenging to predict, they are likely to have a wide range of implications. These costs may be imposed on all government departments responsible for underachievement and not on DECC alone and would hinder Ireland's ability to invest further in climate policy if Ireland faces litigation fees. (Department of the Environment, Climate & Communications, 2023).

These compliance costs do not include the cost of transition or the cost of supports responding to extreme weather events resulting from climate change. Transition costs are estimated by IFAC to

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<sup>2</sup> Resulting from or produced by human activities (IPCC, 2018)

reduce Exchequer revenue by an annual rate of 0.9% which is about €1.5 billion in the period up to 2030. In terms of Government expenditure, and depending on the extent of private sector investment, the IFAC estimates that the Government may face annual costs of between €1.6 billion and €3 billion over the years 2026 to 2030. Ireland may also face additional costs associated with extreme weather events if the impact of climate change is not reversed. According to CAP 24, the cost of extreme weather events supports may cost up to €0.5 billion with an additional €0.1 billion needed per annum for flood defence mechanisms (Climate Action Plan, 2024).

## 1.2 Domestic Context

In 2016, Ireland established the Climate Change Advisory Council to assess and advise on how Ireland can achieve the transition to a low carbon, climate resilient and environmentally sustainable economy. Under the Climate Action and Low Carbon Development Act 2015, the Council is tasked with producing an on-going work programme that provides continuous input to and assessment of national climate change initiatives. This primarily centres around the publication of annual and periodic reviews and reports.

Looking at formal commitments to emission reductions, the Climate Action and Low Carbon Development (Amendment) Act 2021 formally commits Ireland to halving its GHG emissions by 2030<sup>3</sup> and reaching net zero by 2050. It has been designed to provide a clear signal to the economy that climate action will drive future investment and the objective of the bill is to embed energy efficiency, replacement of fossil fuels, management of resources and waste and carbon abatement across all enterprises and public service bodies.

Ireland's Climate Action Plans provide a roadmap to reduce GHG emissions and tackle the climate crisis, providing specific actions for Government Departments and public bodies. The Climate Action Plan 2024 is the third annual update to Ireland's Climate Action Plan 2019. Climate Action Plan 2024 is the second statutory update to the plan since the Climate Action and Low Carbon Development (Amendment) Act 2021 was signed into law, committing Ireland to 2030 and 2050 targets for reducing greenhouse gas (GHG) emissions. It builds on Climate Action Plan 2023 and outlines how Ireland will accelerate the action required to respond to the climate crisis, putting climate solutions at the centre of Ireland's social and economic development.

The plan sets out actions which include specific actions for industry. The actions recognise the important role Irish Enterprise will play in the transition to a climate neutral economy. The CAP 23 states that the IDA, Enterprise Ireland and the SEAI will work to decarbonise industry and align their grants and supports to align with emissions reduction. One of the actions taken will be to expand and enhance the supports from SEAI, IDA and EI with a focus on achieving energy demand reduction, electrification, and biomass adoption in industry.

## 1.3 White Paper on Enterprise

The need to reduce emissions is at the core of enterprise policy going forward. One of the seven priority enterprise policy objectives outlined in the White Paper on Enterprise 2022-2030 is the integration of decarbonisation and net zero commitments. Under this objective enterprise policy will be oriented to assist firms in meeting the costs associated with decarbonisation and allow them to exploit the opportunities of a green economy.

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<sup>3</sup> It sets out that the first two five-year carbon budgets produced by the Council must equate to an emissions reduction of 51 percent to 2030.

The two biggest challenges facing companies both in Ireland and internationally are climate change and the rapidly technological advancement in digitalisation, often referred to as the “twin transition”. These challenges often intersect as some digital advancements are energy intensive whereas others have the potential to reduce emissions through technological shifts or efficiency improvements (Kren and Lawless, 2023). In order to future proof our enterprise base, it is integral that both challenges are considered in tandem.

The ambition to decarbonise the enterprise sector will require significant investment and adoption of low carbon technologies. The White Paper sets out that sectoral agencies such as EI and IDA will incorporate carbon abatement as an equal objective to employment and value-added. This will necessitate significant changes to agency priorities including setting explicit emissions reduction targets for their clients and the incorporation of the cost of carbon into project evaluation. Investment in sustainable energy is integral not only to the achievement of Ireland’s climate targets but also to ensure energy security. The recent war in Ukraine has highlighted the vulnerability of becoming too reliant on finite energy sources controlled by other countries.

In line with the shifting focus in policy the Government has introduced a suite of supports to assist companies in achieving carbon reduction. Supports for businesses are delivered through Ireland’s State Enterprise Agencies, mainly Enterprise Ireland and IDA Ireland. The majority of funding for green investment is delivered under the Environmental Aid Scheme which is subject to provisions in the EU’s General Block Exemption Regulation (GBER). Amendments to GBER adopted in 2023 allow for higher grant thresholds and simplifies eligible cost calculations to improve the overall effectiveness of the scheme.

In 2022 the Government announced a new €55 million ‘Green Transition Fund’ to help businesses move away from fossil fuels and towards sustainable alternatives. The fund is targeted to contribute specifically to the Climate Action Plan. The fund is part of Ireland’s National Recovery and Resilience Plan (NRRP) which is funded by the European Union. The fund comprises a climate planning fund for business which gives businesses funding to create a plan to remove reliance on fossil fuels and further matched funding to go towards specific capacity building within the business, and the Enterprise Emissions Reduction Investment Fund (EERIF) which provides funding to businesses to invest in carbon neutral heating processes, energy monitoring and research and development. These funds are delivered through Enterprise Ireland for indigenous enterprise and IDA Ireland for Multi-National Corporations (MNCs) residing in Ireland.

Other EU Member States have established schemes under the Temporary Crisis and Transition Framework (TCTF) that allows for a focus on both environmental measures such as carbon abatement and developing the overall green economy. In January 2024, the European Commission approved two large TCTF aid measures in Germany, to build an advanced EV battery plant, and France, to support projects relating to solar panels, batteries, and wind turbines among others<sup>4</sup>.

#### **1.4 State Enterprise Agency Client Firms**

One of the main mechanisms through which the Government supports the enterprise sector is through targeted expenditure supports delivered by our enterprise agencies, Enterprise Ireland, and IDA Ireland. State intervention in the enterprise sector has been undertaken primarily through these agencies with a growing role for the private sector in recent years. The strategies and supports offered by these agencies are heavily informed and aligned with the policy focus of the Department of Enterprise, Trade and Employment (DETE).

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<sup>4</sup> See [Daily News 08 / 01 / 2024 \(europa.eu\)](https://europa.eu)

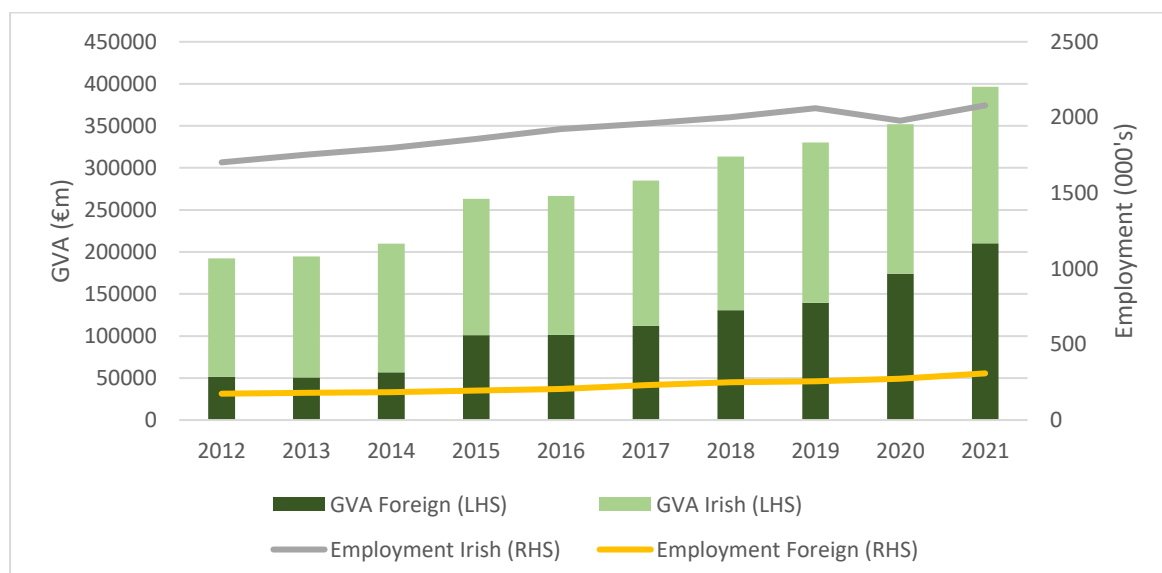


Enterprise Ireland (EI) is the State agency responsible for the development and growth of indigenous Irish enterprise. They work closely with Irish enterprises to get them established, grow, innovate, and expand into global markets. Their latest strategy “Leading in a Changing World” 2022-2024 contains five strategic objectives which include: accelerating the export growth and diversification of Irish enterprise, increasing the number of start-ups, and scaling existing enterprises, accelerate innovation and digitalization. Ambition 4 of the strategy focuses on transforming the sustainability performance of Irish enterprises and achieving our climate reduction targets.

IDA Ireland is the State agency responsible for the attraction and retention of Foreign Direct Investment (FDI) into Ireland. IDA has attracted thousands of multinationals to Ireland since its establishment, and partnered with these companies to ensure that they continually reinvest in Ireland. Whilst DETE oversees and monitors policies which improve Ireland’s overall attractiveness to FDI around key areas such as labour, taxation, education and skills, other aspects of achieving FDI investment are implemented by IDA Ireland, such as providing investment advice and support, targeted incentives, and property solutions through the Regional Property Programme. According to the CSO<sup>5</sup>, foreign-owned enterprises accounted for just 28 percent of employment but almost three quarters of total Gross Value Added (GVA). IDAs current strategy “Driving Recovery and Sustainable Growth 2021-2024” focuses on increased investment and job creation, innovation through R&D and advancing regional development. Aligned with departmental policy the strategy has a key focus on sustainability and supporting decarbonization of its client base.

Figure 1 shows GVA and employment by Foreign and Irish dominated sectors. GVA by firms in foreign dominated sectors has quadrupled between 2012 and 2021, overtaking Irish dominated firms in 2021. Whilst firms in foreign dominated sectors drive GVA they contribute significantly less to employment (roughly 309,000 in 2021) compared to those in Irish dominated firms (roughly 2.1 million in 2021). Employment in agency client companies is now at its highest level, accounting for over 529,144 jobs in 2022. Employment in 2022 had increased on 2021 levels by 6 percent for Irish-owned firms and 8.2 percent for foreign owned firms<sup>6</sup>.

**Figure 1: GVA and Employment by Foreign and Irish Dominated Sectors (CSO)**



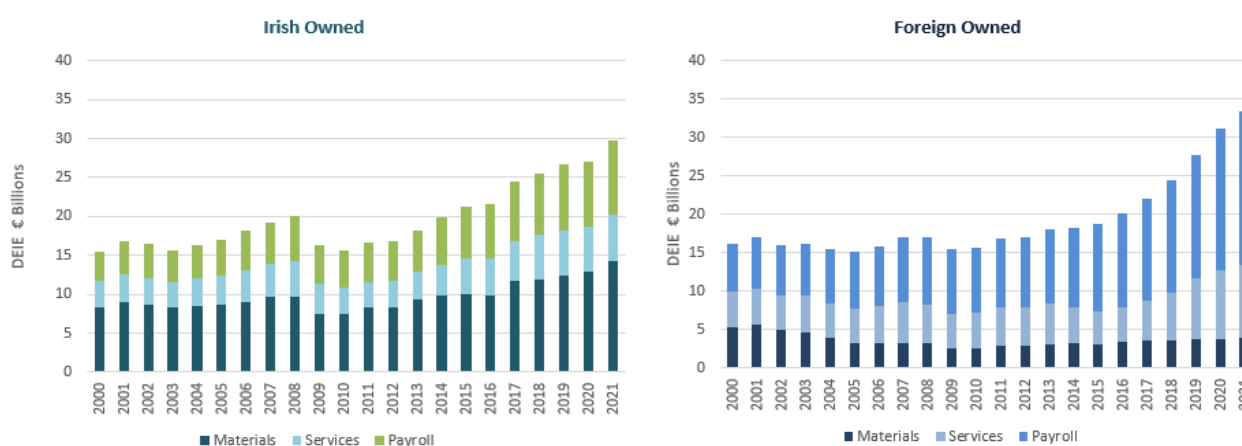
Source: PxStat PIA15.

<sup>5</sup> See [Irish-owned and Foreign-owned enterprises - CSO - Central Statistics Office](#)

<sup>6</sup> See [Annual Business Survey of Economic Impact 2021](#)

Looking at Direct Expenditure in the Irish Economy (DEIE) by agency assisted firms a similar trend appears for both Irish and Foreign owned agency clients' firms. DEIE increased steadily from 2000, dipping during the recession, and rising steeply between 2014 and 2021. Foreign and Irish owned client firms contribute roughly the same in terms of the total amount of expenditure with foreign owned firms overtaking slightly since 2018 however, the composition of their expenditure differs greatly. More than half of the DEIE contributed by foreign owned firms is accounted for by payroll expenses and their associated taxes whereas over two thirds of DEIE by Irish owned firms is spent on materials and services.

**Figure 2: DEIE by Irish Owned and Foreign Owned Agency Client Firms (ABSEI)**



Total sales by agency firms amounted to €383.5 billion in 2021 and exports totaled €345.8 billion. As the graphs above show, agency client firms represent a sizeable portion of the Irish economy. This paper uses data on these firms as a microcosm for the broader economy and to inform our understanding of the climate response of our enterprise base.

### 1.5 Data and Methodology

Data on the climate response of agency clients used for this paper comes from the 2019, 2020 and 2021 Annual Business Survey of Economic Impact (ABSEI) which is collected by this Department. This is a survey of the client companies of Enterprise Ireland, IDA Ireland and Údarás na Gaeltachta<sup>7</sup>. The survey is used to provide evidence for public policy and strategy development. An inter-agency group chaired by DETE and comprised of representatives from the participating agencies manages the implementation of the survey. The group decides on questionnaire content and questions can amended/ added in line with policy shifts to inform future Government and agency planning and strategy development. The ABSEI survey provides a vital resource to gain insight into how firms operate, their sales, exports, and the employment they provide. As the survey is conducted annually it allows for an examination of how firms develop and change over time. The recent addition of questions on the climate response of agency clients is an important resource for gaining insight into how enterprises in Ireland are considering their climate impact and working towards achieving Ireland's climate objectives.

<sup>7</sup> Údarás na Gaeltachta are excluded from the analysis due to small sample size.

Approximately 4,200 client companies were surveyed each year which comprises all agency client firms in manufacturing and services sectors in Ireland with 10 or more employees. A small number of High-Potential Start-Up companies are also included where there is an expectation that their employment will exceed 10 in future surveys. Therefore, the micro results presented may be less representative of this group than results from other size classes. Results are weighted to account for non-responses and are based on NACE sector, size, ownership, and region. The survey has a 60-70 percent response rate every year with a high response rate of over 90 percent for all climate-related questions (with the exception of type of plan and challenges (c.50-60 percent)). The analysis presented in this paper excludes clients who responded “don’t know” to the climate questions. As such, it is possible that more clients measure their emissions and have a climate plan than those reported here.

The paper draws on six climate questions from the ABSEI survey: whether clients have developed a climate response plan; the type of climate plan a client has developed; main challenges in developing a climate response plan; perceived importance of having a climate plan for a client’s business; whether clients measured CO2 emissions; and the energy resources that a client uses for their business (see Appendix Table A1). Questions differed according to year and whether the business was an Enterprise Ireland or IDA client (see Table 1).

**Table 1: Questions Asked by Year and Agency**

	2019		2020		2021	
	EI	IDA	EI	IDA	EI	IDA
<b>Climate Response Plan</b>	✓	✓	✓	✓	✓	✓
<b>Plan Importance</b>	✓		✓			
<b>Type of Plan</b>		✓				✓
<b>Challenges of Plan</b>	✓	✓				✓
<b>Energy Resources</b>			✓	✓	✓	✓
<b>Measurement of Emissions</b>			✓	✓	✓	✓

The authors also explore Ireland’s overall green response overall using the Future Green Index (FGI). The FGI was developed by the MIT Technology Review to compare the ranking of 76 territories and nations on their ability to create a low-carbon, sustainable future. It measures the degree to which economies are moving towards clean energy, industry, agriculture, and society through investment in renewable energy, innovation, and green policy. The scores were collated using primary and secondary sources. To collect primary data, in depth interviews were carried out with climate change scientists, research professionals, government policy makers and clean technology entrepreneurs. The secondary data comes from a large range of recent publications from sources such as the International Energy Agency (IEA), the International Monetary Fund (IMF) and the Organization for Economic Co-operation and Development (OECD).

The authors also endeavor to explore such themes as Economic Complexity, Green Complexity, and Green Potential using the Green Transition Navigator. Findings on complexity indicators can be found in the Appendix<sup>8</sup>.

<sup>8</sup> These findings are not presented in the main paper as although they are useful indicators, the data contains a number of caveats and may not be truly representative of Ireland’s advancements in the green transition due to the sectoral concentration in Ireland’s export basket.

## **1.6 Objectives and Structure of this paper**

This paper aims to examine the climate response of Enterprise Ireland and IDA client firms and inform future enterprise climate policy development. Chapter 2 sets out where Ireland currently stands in terms of its current emission levels and targets. It outlines the relevant EU frameworks and packages that can aid Ireland in its green transition. Chapter 3 explores Ireland's progress in the Future Green Index. Chapter 4 examines the climate response of IDA client firms. The climate response of Enterprise Ireland client firms is discussed in Chapter 5. Chapter 6 sets out the conclusions of the paper and provides recommendations for future data collection.

# 1. The Green Transition and Ireland's Economy

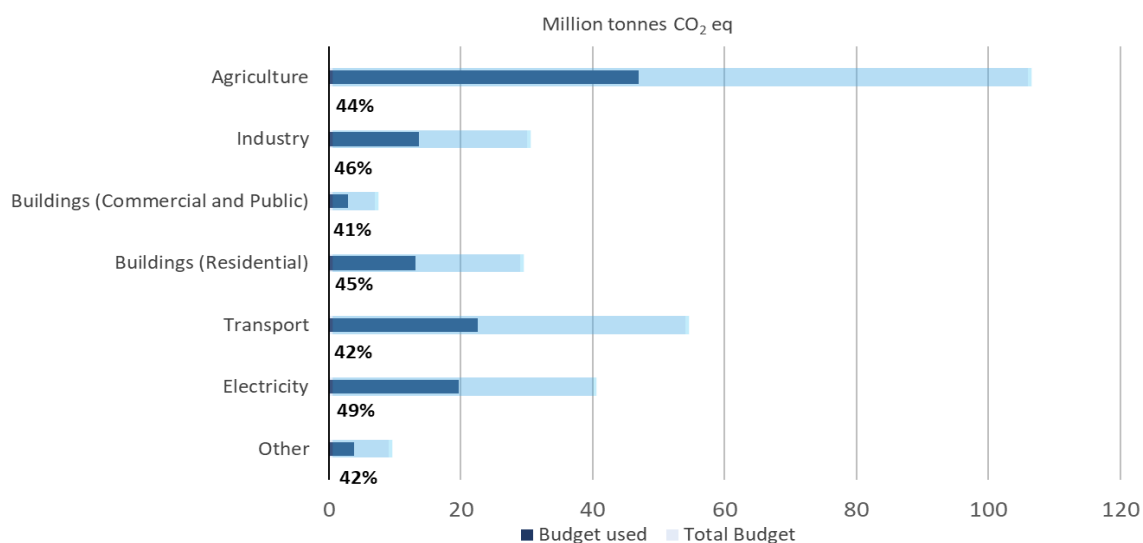
## 2.1 Emissions and Ireland's enterprise sector: current levels and targets

In order to meet our overall Climate objectives, carbon budgets were created to ensure compliance with emissions reduction. Three carbon budgets have been approved by the Oireachtas for the period of up to 2035 which came into effect in April 2022. Budget 1 from 2021-2025 has been set at 295 Mt CO<sub>2</sub> equivalent, budget 2 from 2026-2030 has been set at 200 Mt CO<sub>2</sub> equivalent, and budget 3 from 2031-2035 has been set at 151 Mt CO<sub>2</sub> equivalent.

Sectoral Emissions Ceilings (SECs) for the two carbon Budget periods (2021-2025 and 2026-2030) have been approved by the Government and are broken down by key emitting sectors. The sectoral ceilings for each sector were set with the expectation of achievement of specific emission reductions in 2030 compared to 2018 with an interim target set for 2025. The Climate Action and Low Carbon Development (Amendment) Act 2021 states that in the case that emissions ceiling is exceeded, the excess emissions are carried forward into the second budget period, reducing the second carbon budget. If this occurs, it will be substantially more difficult to achieve the second budget. The Government has agreed a SEC requiring a 35 percent reduction in emissions arising from the manufacturing sectors, but all businesses will need to reduce their environmental impact and emissions.

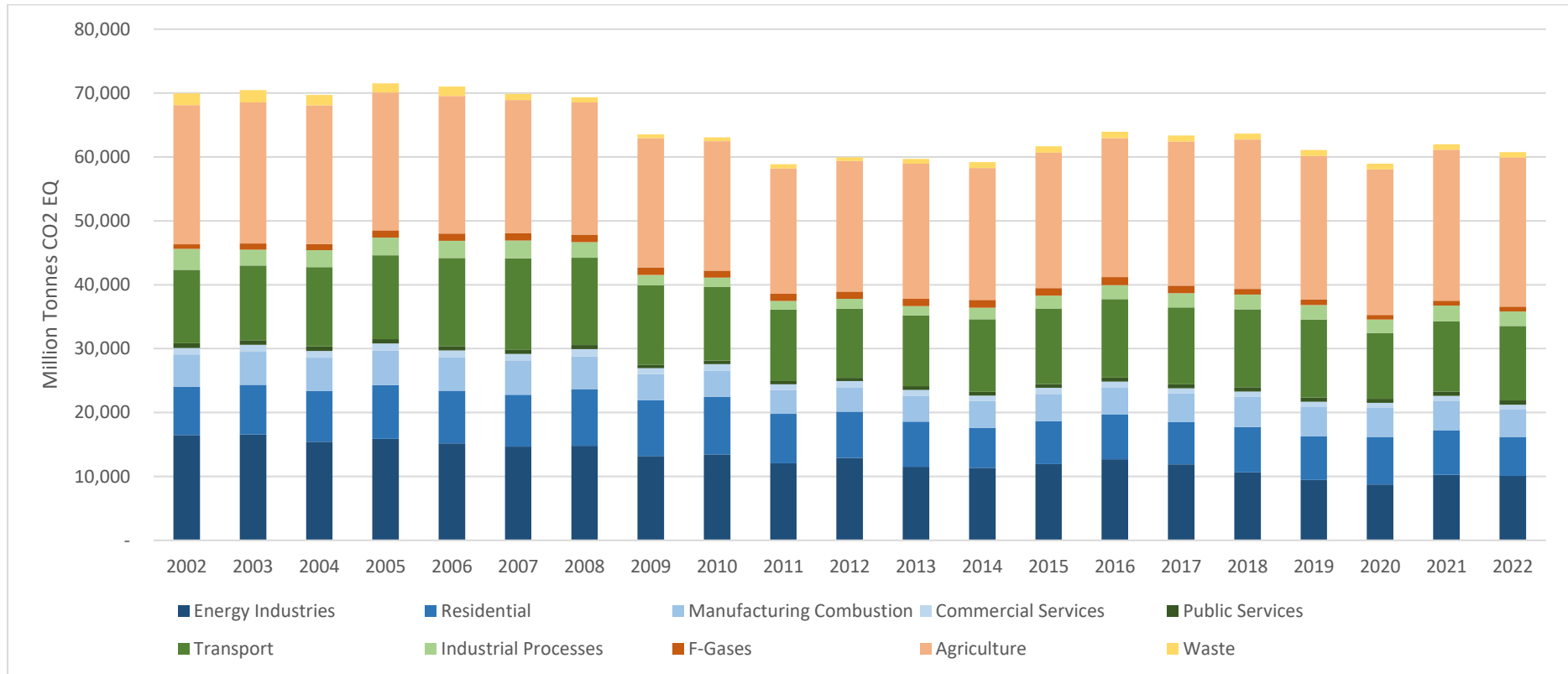
Figure 3 outlines the sectoral ceilings for 2021-2025 along with the amount used to date by sector. Overall, 47 percent of the total ceiling budget was used by the end of 2022. Ceiling usage varies from 42 percent (other and transport emissions) to 49 percent (electricity). Looking at industry, 46 percent of the total budget has been used by the end of 2022. The amount of the budget used significantly effects the level of emissions reduction required between 2023 and 2025 to stay within the budget. According to Figures from the EPA (2023), average annual emissions reduction of 12.4 percent is required to stay within our overall budget with 9.2 percent required for industry. Carbon abatement in industry will require significant improvements in energy efficiency, greater electrification of low to medium temperature heating and increased supply and use of biomethane and green hydrogen.

**Figure 3: Sectoral Ceiling Usage 2021-2025 by Sector**



Source: EPA GHG Provisional Estimates 1990-2022 data.

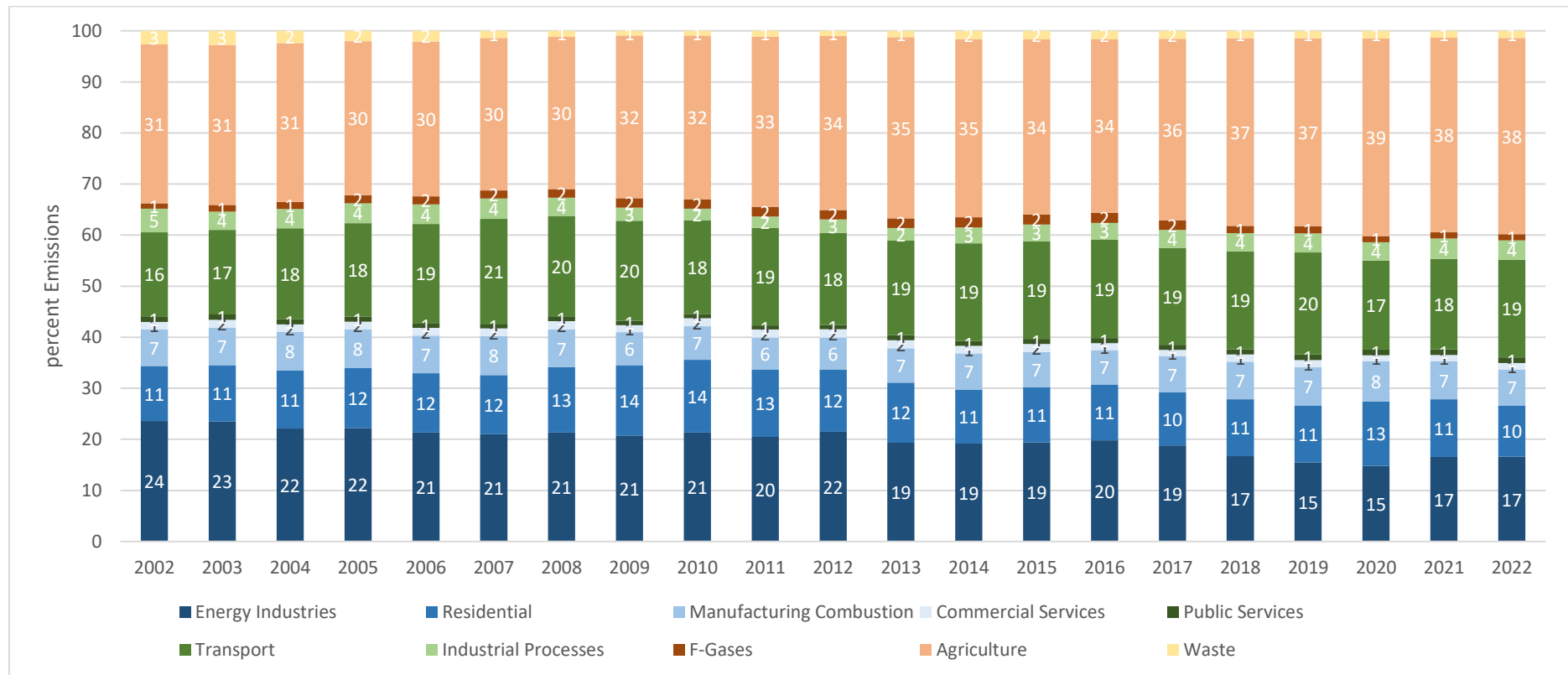
**Figure 4a: Emissions by Sector 2002-2022**



Source: EPA GHG Provisional Estimates 1990-2022 Data.

Note: F-Gases are fluorinated gases. F-gases can be emitted by any sector, but they are grouped here collectively as their emissions from any individual sector are usually not significant and measures to reduce their emissions are usually cross-sectoral in nature.

**Figure 4b: Proportion of Emissions by Sector 2002-2022**



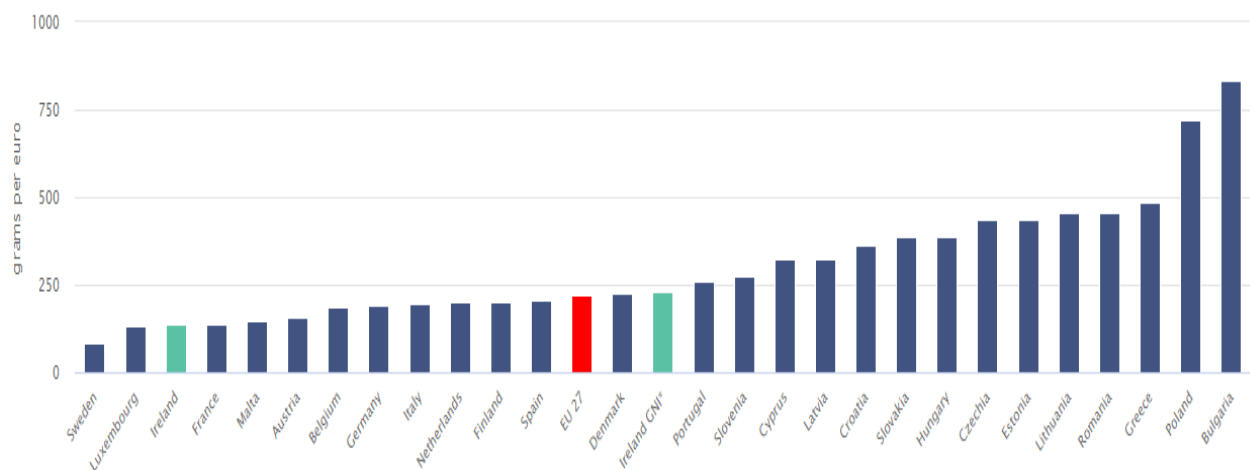
Source: EPA GHG Provisional Estimates 1990-2022 Data.

Note: F-Gases are fluorinated gases. F-gases can be emitted by any sector, but they are grouped here collectively as their emissions from any individual sector are usually not significant and measures to reduce their emissions are usually cross-sectoral in nature. Proportions exclude land use, land use change and forestry.

Figure 4a shows total emissions by sector between 2002 and 2022 and Figure 4b shows the percentage of total emissions accounted for by each sector. Whilst emissions have decreased over this period from roughly 70,000mt CO<sub>2</sub> to 60,000mt, emissions have fluctuated around 60,000mt since 2011. Emissions were at their lowest in 2011 at 59,000mt and fluctuated between 60,000-64,000 before dropping back to 59,000 in 2020 due to decreased activity during the COVID-19 pandemic. Agriculture is the highest emitting sector representing 38.4 percent of total emissions in 2022 followed by Transport (19.1 percent) and Energy (16.6 percent). The manufacturing combustion and industrial processes sectors accounted for 10.8 percent of emissions in 2022.

Figure 5 shows the estimated GHG emissions intensity per euro of output in EU Member States in 2021. Ireland has the third lowest GVA intensity at 135 grams per euro. Ireland’s modified GNI\* is also shown to exclude the globalisation effects that disproportionately effect the measurement of Ireland’s economy. Although it is not directly comparable with other countries, it provides insight into Ireland’s deglobalised position. When using GNI Ireland’s intensity increases to 232 grams per euro of GNI\*. The EU average in 2021 was 221 grams per euro of GVA. Bulgaria had the highest intensity (832 grams per euro of GVA) and Sweden performs the best on this measure (84 grams per euro of GVA).

**Figure 5: GHG Emission Intensities in Grams Per Euro of GVA in EU Member States, 2021.**



Source: CSO and Eurostat, see [EU Member State Comparisons - CSO - Central Statistics Office](#).

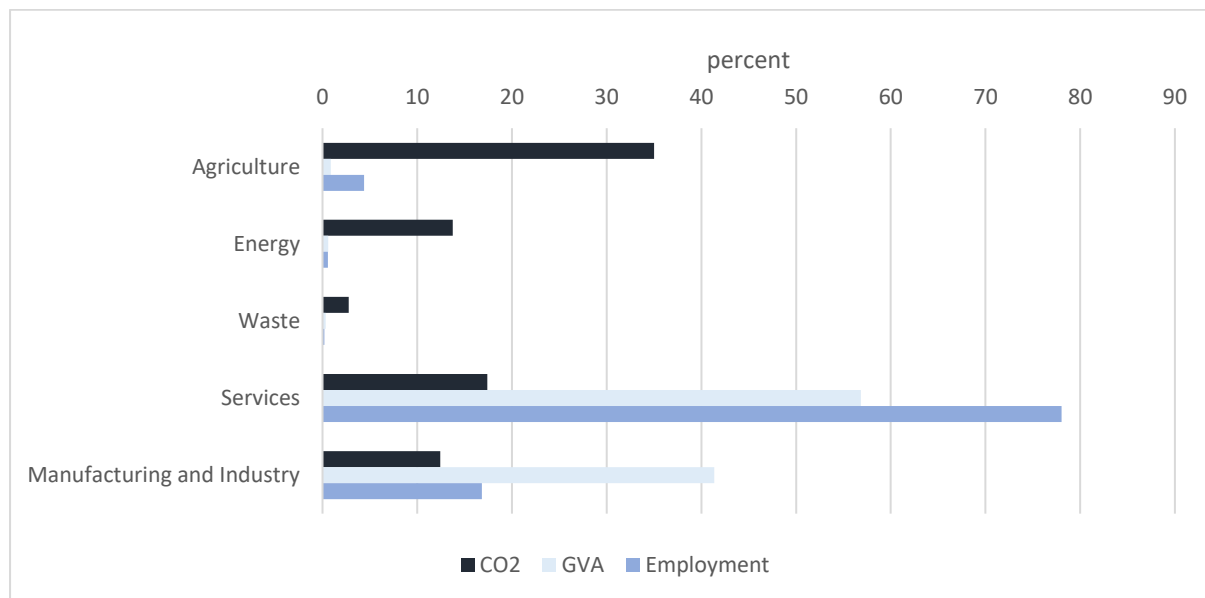
Figure 6 shows the distribution of emissions by sector versus the distribution of employment and Gross Value Added (GVA) in 2021. It should be noted that Figures presented will differ from those presented by the EPA as NACE codes are used to represent sectors to ensure comparability between GVA, employment and emissions indicators. The agricultural sector is emissions intensive and accounts for over a third of emissions (35 percent). It accounts for one percent of GVA and four percent of total employment, albeit that farmers are the custodians of our natural environment and ensure an ongoing supply of fresh, high-quality produce for Irish consumers.

The energy sector accounts for a high proportion of emissions (14 percent) compared to its employment (1 percent) and GVA (1 percent) contribution. The services sector contributes greatly to the Irish economy. The sector was responsible for over three quarters of employment in 2021 (78 percent) and 57 percent of GVA in the economy. Its emissions intensity is relatively low per employee, accounting for 17 percent of overall emissions. Manufacturing and industry are the second largest



contributors to GVA and Employment, representing 41 percent of GVA and 17 percent of employment. It falls just short of the energy sector in terms of its emission production at 12 percent.

**Figure 6: Proportion of Emissions, Employment and GVA by Sector 2021**



Source: GVA Figures retrieved from [Pxstat NA016](https://www.cso.ie/en/statistics/labourmarket/labourforcesurvey/fstimeseries/), Emissions data retrieved PxStat EAA15, employment data retrieved from <https://www.cso.ie/en/statistics/labourmarket/labourforcesurvey/fstimeseries/>. Author's Calculations.

Note: Proportions differ from sectoral emissions reported in Figures 4a as NACE codes are used to ensure comparison between the different indicators.

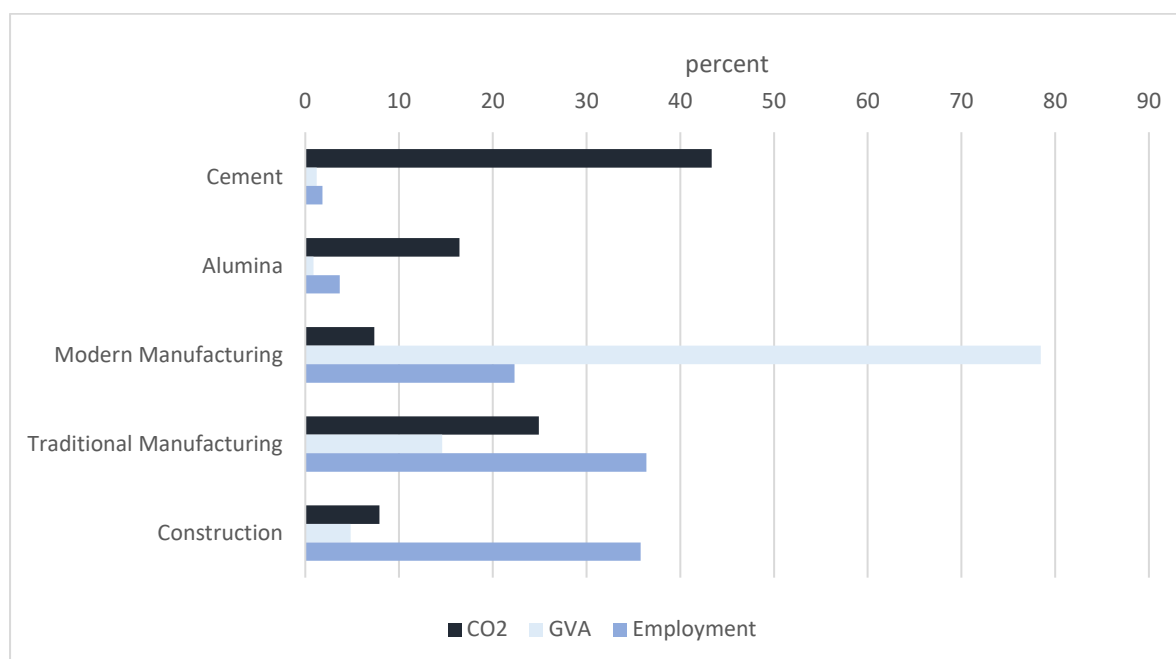
Figure 7 shows the breakdown of emissions, employment and GVA for the manufacturing and industrial sub sectors. Modern manufacturing includes the following NACE codes: Chemicals and Chemical Products; Basic Pharmaceutical Products and Preparations; Computer, Electrical Equipment<sup>9</sup>. Traditional manufacturing encompasses all other manufacturing NACE codes not included in another category such as food, wood and paper production and mining.

As expected, cement is the most emissions intensive sector followed by alumina which together account for almost 60 percent of industrial emissions. Modern manufacturing accounts for almost 80 percent of Gross Value added and 22 percent of employment and is the lowest emitter of all industrial sectors representing just 7 percent of emissions. Traditional manufacturing represents a significant portion of industrial employment (36 percent) and is the second largest contributor to GVA however, it also has a significant impact on industrial emissions representing a quarter of total industrial emissions.

The findings show that modern manufacturing contributes greatly to the economy in terms of value added and is not an emissions intensive industry. In order to ensure that the Department stays within the sectoral emissions budget, it is imperative that policies to decarbonise focus on the most intensive sub sectors such as cement, alumina and traditional manufacturing.

<sup>9</sup> Coke and refined petroleum products were included in modern manufacturing for GVA figures as this category was combined with chemicals and chemical products in the data.

**Figure 7: Proportion of Emissions, Employment and GVA by Sector 2021**



Source: GVA Figures retrieved from [Pxstat NA016](https://www.cso.ie/en/statistics/labourmarket/labourforcesurvey/fstimeseries/), Emissions data retrieved PxStat EAA15, employment data retrieved from <https://www.cso.ie/en/statistics/labourmarket/labourforcesurvey/fstimeseries/>. Author's Calculations.

Note: Proportions differ from sectoral emissions reported in Figures 4a as NACE codes are used to ensure comparison between the different indicators.

The Climate Change Advisory Council's (CCAC) Annual Review 2023 examines Ireland's climate performance in 2022 with regard to achieving the country's national climate targets. The review, which examines all sectors, states that Ireland will not meet the targets set out in the carbon budgets unless significant immediate action is taken to decrease emissions. According to both the Environmental Protection Agency and National Competitiveness and Production Council, Ireland is not reducing emissions at a pace which will allow Ireland to meet its 51 percent emissions reduction target (NCPC, 2023). The EPA have projected that Ireland will achieve a reduction of 29 percent in Greenhouse Gas (GHG) emissions by 2030. Almost all sectors are on a trajectory to exceed their national sectoral emissions ceilings for 2025 and 2030, including Agriculture, Electricity, Transport, and Industry. The first two carbon budgets (2021-2030) will also not be met, and by a significant margin (Environmental Protection Agency, 2023). Looking at the enterprise sector, the report notes that the biggest share of enterprise emissions come from a small number of large companies in the manufacturing sector mostly in alumina, food processing, beverages, and cement. These large companies are captured in the European Emissions Trading System. (ETS). Emissions from non-ETS sectors mainly arise from small and medium sized enterprises. It has also been noted in the Climate Action Plan 2024, that EPA's projections show that industry sector emissions are currently not aligned to Climate Action Plan 2023's (CAP23) pathways and targets. The EPA projections forecast an overshoot of the carbon budget of ~4.4 MtCO<sub>2</sub>eq. in the period 2021 to 2025, and ~9.5 MtCO<sub>2</sub>eq in the period 2026 to 2030. (Climate Action Plan, 2024).

The EPA (2023) finds that overall, emissions from manufacturing combustion decreased by 7.1 percent in 2022, while emissions from industrial processes decreased by 7.5 percent in 2022 due to a reduction in cement production. Although emissions for the enterprise sector have fallen, they are not decreasing fast enough to achieve our targets. EPA projections indicate that the industrial sector is projected to exceed its first sectoral ceiling by 4.4MtCO<sub>2</sub> eq and its 2026–2030 sectoral ceiling by 9.5MtCO<sub>2</sub> eq.

The CCAC (2023) make several recommendations to address enterprise emissions including the electrification of new and current manufacturing processes to remove the need for fossil fuels where possible. To accompany this, there must be a greater drive to provide businesses with the knowledge and skills to fuel switch. In order to ensure companies are facilitated to electrify their processes, we need to ensure security of supply and competitive pricing to support this transition. In 2023, the Government published “Energy Security in Ireland” (Department of the Environment, Climate and Communications, 2023). This new strategy, a first of its kind for energy security, balances energy risk and resilience against our binding climate commitments. One of the key conclusions of the paper is the need to transition to an electricity-led energy system. The plans for this system focus on the addition of renewable generation, demand-side flexibility and interconnection and storage.

The Council also recommends an intensified roll out of industrial scale heat pumps for medium temperature heating. In terms of industrial processes, there is a recommendation to specify low-carbon cement material as far as practical for publicly supported projects. A request has also been made for timber to be used in replacement of cement material where possible. Further to this, greater efforts to reduce the emissions intensity of cement and concrete used in construction are required. The paper also recommends that Small and Medium Enterprises (SMEs) are assisted by DETE, the SEAI and the national network of Local Enterprise Offices (LEOs) with regard to energy efficiency, industrial policy and broader cross-cutting policy mandates.

Achieving Ireland’s industrial emissions targets will need to be driven primarily by abatement among the top emitting companies. Reductions in emissions should be facilitated through a focus on innovation and R&D to develop new technologies and processes, as well as use of renewable energy, fuel switching, and more efficient use and recycling of materials. However, it is imperative that all companies are encouraged to reduce their emissions to assist in target delivery. In addition, a focus on decarbonisation for enterprise is needed to safeguard competitiveness, meet consumer demands, and secure funding from parent companies for MNC’s expanding in Ireland.

## **2.2 European Frameworks for Green Transition**

There are several European packages launched to aid EU countries in the green transition. This section outlines some of those most relevant to Ireland.

### **2.2.1 European Green Deal**

The European Green Deal was established in 2019 by the Commission as a package of policy initiatives to help the European Union achieve a green transition. The European Council has set a goal to reduce greenhouse gas emissions by 55 percent by 2030 with the overall objective being to reach climate neutrality by the year 2050. There are several initiatives included in this package. The Fit for 55 initiative enacts these climate ambitions into law. This means all European Union member states are legally required to enact and work towards these goals. The package aims to reform the current EU ETS with reformations including the extension of emissions from maritime transport, faster reduction of emissions allowances in the system and gradual phasing-out of free allowances for some sectors, increasing the funding for the modernisation fund and the innovation fund, and the revision of the market stability reserve. The carbon border adjustment mechanism (CBAM) was also implemented

to ensure emissions are not being redirected to countries outside the European Union by moving production to these countries. CBAM targets imports of products in carbon-intensive industries.<sup>10</sup>

The EU (2023) industrial plan to deliver the Green Deal “A Green Industrial Plan for the Net-Zero Age” aims to become an accelerator and enabler of change, innovation, and growth. For the enterprise sector, it targets the acceleration of the twin transition. The EU aims to create transition pathways in order to facilitate co-creation with industry and stakeholders and will identify actions needed for its successful implementation and provide a better understanding of the scale, benefits and conditions required in the twin transition. The Commission has proposed multi-country projects to develop green and digital capacities and maximise investments. Horizon Europe Partnerships will also be created to bring together private and public funding to finance research and innovation on low carbon technologies and processes. The commission will continue to work with member states to accelerate investments into renewable energy and grids and address the barriers to renewable energy.

The InvestEU programme is a fund of €26.2 billion which was established to boost net zero investments in the EU and deliver the goals set out in the Green Deal. This programme is the second pillar of the Just Transition Mechanism (JTM). The fund supports both private and public investments in four priority policy areas which include sustainable infrastructure, research, innovation, and digitalisation.

### **2.2.2 Just Transition Fund**

The Just Transition Fund is a fund of €17.5 billion to support economies most severely challenged by the climate neutral transition. It is the first pillar of the Just Transition Mechanism (JTM). The European Union has stated that all member states, regions and sectors must contribute to the transition towards a climate neutral economy. However, it recognises that this objective is more challenging for some member states than others as some regions are more dependent on fossil fuels or have more carbon intensive industries than others. This dependence will mean these regions will undergo a significant economic, environmental, and social transformation. To assist with this process, the European Union has created the Just Transition Fund to alleviate the socio-economic costs triggered by climate transition. The schemes main objectives include backing productive investments in small and medium-sized enterprises, creating new firms, promoting research and innovation, and aiding environmental rehabilitation. The scheme also aims to aid clean energy, reskill, and upskill workers, provide job-search assistance and promote active inclusion of jobseeker’s programmes.

### **2.2.3 Next Generation EU**

NextGenerationEU is the European Union’s €800 billion temporary recovery instrument to support the economic recovery from the coronavirus pandemic and to build a greener future. The largest element of this is the Recovery and Resistance Facility. This programme provides €338 billion in the form of grants and €385.8 billion in the form of loans to members of the European Union. The programme is used to enhance and reinforce other European Union initiatives.

Ireland has availed of this scheme through our Recovery and Resilience Plan (2021-2026) which was developed by the Government to direct funding under the EU’s Recovery and Resilience Facility. One element of the Recovery and Resilience plan is the Green Transition Fund which was announced in 2022 to support the decarbonisation of Irish enterprise. This plan directed €55 million to aid businesses in moving away from fossil fuels and towards sustainable and cheaper alternatives. The plan has two main components. The first is the Climate Planning Fund for businesses. This provides funding to develop a climate response plan and identify how best to remove reliance on fossil fuels in

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<sup>10</sup> <https://commission.europa.eu/strategy-and-policy/priorities-2019-20>

their business. A matched grant of up to €50,000 can also be availed of to go towards specific capacity building within an enterprise. The second component is the Enterprise Emissions Investment Reduction Fund. This provides a grant of up to €1 million euro for manufacturing businesses to invest in carbon neutral heating processes, smart metering and energy monitoring, and research and development.

### 2.3 The Twin Transition

Although the digital and green transition are two distinct concepts, they are often referred to as the 'Twin Transition' because the challenges intersect on several levels. The green transition focuses on how businesses can continue to operate and produce in a sustainable way. This is accompanied by the digital transition which allows the workforce to be fully equipped to work in the digital age. The digital transition requires policies that harness the benefits of technologies while reducing the negative impacts of technological change. The digital transition has the potential to be a driving factor in achieving the green transition (Muench et al., 2022).

There are several significant challenges associated with the successful implementation of the twin transition for the enterprise sector. These challenges include not being able to provide a business case for emerging green digital solutions and a risk of stranded assets and sunk costs. Smaller firms may be at a disadvantage as the increased technical capacity required may be difficult to manage with limited resources. For both smaller and larger firms, they are challenged by an overreliance on digital technologies leading to decreased knowledge and skill gaps.

Muench et al (2022) note that the creation of enabling markets and infrastructure can help new green-digital technologies compete with long established green technology which currently hold the competitive advantage. Enabling markets provide supportive market and regulatory conditions for the successful commercialisation of green-digital technologies. These must be created to facilitate business cases for green innovation, instead of only focusing on short-term profits. Markets must be designed in a way that reflect the green goals of the European Union. Companies also must be incentivised to change their production processes to become greener or diversify these if necessary. Diversity of players in the market is also crucial to ensure both small and large firms can compete. This is critical to ensure that markets are competitive, innovative and ensure local value creation. This can be achieved through providing support for SMEs to aid, develop, implement, and manage sophisticated green-digital solutions. Data ownership rules should also be introduced to minimise the risk of monopolies in the market. Lastly, the labour market should be equipped with the knowledge and skills to implement the twin transition. Upskilling, reskilling, and awareness-raising is needed in most sectors to implement green-digital solutions.

Kren and Lawless (2023) examine firm level attitudes and actions to the twin transition in Ireland. The paper finds that larger firms are less digitally prepared while smaller firms are reporting fully embedded digitalisation. This can be attributed to these smaller firms potentially being high-potential start-ups. There is also a varying degree of digital readiness among sectors. Half of the food, drink, primary sector, and traditional manufacturing sectors have no plans to introduce digitalisation whilst the ICT and business and professional services sectors are reporting higher levels of digitalisation. In terms of having a climate plan, micro firms were less likely to have a climate plan in comparison to macro firms. However, there is a positive attitude towards firms having a climate plan. Many respondents felt having a climate plan was very important or moderately important and are in favour of policy actions such as carbon tax. Finally, micro firms were increasingly less likely to monitor their CO2 emissions in comparison to larger firms. The link between the digital and green transition was

also evident in the papers findings with a considerable overlap found between having a climate and digital plan in place across all firms while controlling for other firm characteristics.

Kren and Lawless (2023) note some potential explanations for the delay in the progress of the twin transition. Firms may potentially be delaying investments in climate-friendly technologies as they await clarity on the evolution of the technologies, carbon prices, standards, and regulation. There is also a need for labour market investment to exploit the benefits from the twin transition and gain full productivity. They argue that more interventions may be required to bridge the gap between positive attitudes and concrete actions by providing more finance and certainty to businesses around climate change initiatives.

#### **2.4 Realising Opportunities: Green Transition and Competitive Advantage**

The green transition should not be seen as a threat to our competitiveness but rather an opportunity to expand into new sustainable markets. The White Paper on Enterprise highlights that consumers are becoming more conscious of the impacts of their purchases and for Irish businesses to remain competitive and resilient, they will need to respond to consumer preferences in support of more sustainable products and services. A review of the international literature provides a number of insights into the potential benefits for businesses from the green transition and the factors which effect green investment.

Muench et al (2022) outlines several benefits for a company adopting sustainable practices. A company may be able to achieve a competitive advantage through incorporating the protection of the environment into its business model. This competitive advantage can be achieved in different ways. Firms may be able to avail of a differentiation strategy; The product with the stronger environmental consideration may be able to differentiate from its competitors while also targeting a niche segment of consumers. These consumers may be willing to pay a higher price point for products that are environmentally friendly which can offset the costs of creating these products. In addition, firms can benefit from the receipt of label and certification. Consumers recognize the quality standard which therefore may increase willingness to pay and may boost overall firm reputation. A recognized certification also reduces the potential that a consumer may think a firm is “greenwashing”. This is when a firm exaggerates the extent to which it is environmentally friendly. Certifications and labels may also attract foreign investment and increase the possibility of exporting to countries with a higher value for environmentally friendly products or services (ibid).

The OECD (2019) outlines further opportunities which can arise from the growth of the green economy. As demand increases for low carbon products, there is the potential for opportunities along the supply chain to arise from technology providers to users of more energy-efficient technologies. There will also be significant opportunities for financial institutions, which will direct investment towards sustainable projects. The potential for knowledge spillovers is also high with the development of new technological fields in green industry. Labour productivity can also be improved due to less work absences caused by a reduction in illnesses associated with air pollution.

Research by Siedshchlag and Yan (2020) find that green investments have a positive effect on firms’ performance. Firm productivity is found to increase following green investment. The investments were found to have immediate and short-term impacts on some performance outcomes while other outcomes take longer to materialize. The authors highlight that GVA increases for the first three years post investment whereas the positive effects on energy intensity and employment growth only begin to appear from the second year after investment. These benefits were found to differ by firm size with

most differences in performance only significant for medium and large firms. Foreign owned firms also appeared to benefit more from these types of investments than indigenous enterprises.

There are several factors that contribute to whether a firm takes part in green investments. These factors vary depending on firm size and the time of which firms began to invest (Siedschlag and Yan, 2021). Research has shown that firms which began investing in environmental policies in 2008 are more likely to continue to do so in subsequent years. Larger firms are significantly more likely to invest in green technology in comparison to smaller firms. Interestingly, registration in the EU ETS did not have an impact on a firm's intention to invest in equipment for cleaner technologies and pollution control. Firms with a lower market concentration were also more likely to invest in green technologies. The reason for this could indicate that competition in industries incentivises firms to invest in green technologies. Firms with supply chain linkages are also more likely to invest in environmental protection. This correlates with evidence suggesting that firms with a larger corporate group have a higher probability to engage with environmental protection than firms who do not belong to a larger corporate group. In Ireland it has been shown that importing firms are more likely to invest in equipment for pollution control and cleaner technology equipment. This result may occur as Ireland's imports are from advanced economies such as UK, Netherlands, Germany, and the United States (Siedschlag and Yan, 2021).

Exporting companies' green technology investments also differ depending on which destination they are exporting to; this is because each country has different standards relating to their "green products". This is evident in the difference of standards between the UK and US which in turn is creating a gap between how invested the company is in green investments. Foreign-owned firms are less likely to invest in green technologies as they could potentially already be meeting the standards required and are not investing any further. This is evident in the United States as they typically use less energy per unit of output than local firms (Siedschlag and Yan, 2021).

Research by Clancy, Curtis and Ó Gallachóir (2017) describes further reasons companies may be discouraged from investing in energy saving options. The research finds a strong correlation between the likelihood of making energy saving decisions and tenure. Companies who own the building they operate from and where energy related decisions are made by local management are more likely to investigate an energy upgrade measure. Renting a premises was also found to be a barrier when making energy-saving responsible decisions. Similar to findings from Siedschlag and Yan (2021), companies with more than 10 employees are found to be more likely to investigate both energy upgrades and behavioural options. However, larger firms of over 100 hundred employees negatively impacts the likelihood of energy-saving decisions as decision making complexity increases. Finally, the empirical evidence shows that lack of capital, both internally within the company, and from external sources, are significant barriers to the uptake of energy efficiency measures. Further research may be required to determine what supports may be required to overcome these tenure barriers. (Clancy, Curtis and O'Gallachóir, 2017)

### 3. The Future Green Index

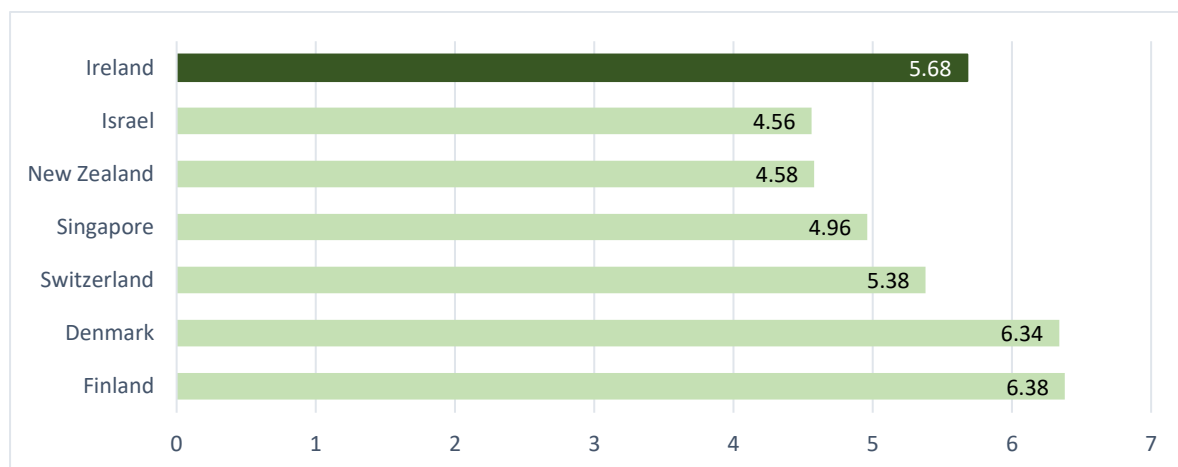
This Chapter<sup>11</sup> presents Ireland’s scores on the Future Green Index which ranks countries according to their ability to create a low-carbon, sustainable future. It measures the degree to which economies are moving towards clean energy, industry, agriculture, and society through investment in renewable energy, innovation, and green policy. The Index uses five pillars to measure different elements of climate change responses: carbon emissions, energy transition, green society, clean innovation, and climate policy.

The carbon emissions pillar examines how effective countries are at curbing their overall carbon emissions. This includes their total carbon emissions relative to GDP and the average annual change in carbon emissions between 2015 and 2023. The energy transition pillar assesses the contribution and growth rate of renewable and clean energy generation in each country. This pillar includes growth of renewable energy production and amount of nuclear energy generated. The Green Society pillar measures the efforts made by government, industry, and society to promote green practices. The clean innovation pillar examines the innovation environment for building a low-carbon future, such as the relative penetration of green patents, investment in cross-border clean energy, and investment in food technology.

Finally, the climate policy pillar, measures the ambition and effectiveness of climate policy, including carbon financing initiatives, sustainable agriculture policy, and the use of pandemic recovery spending to achieve a green economic recovery. The indicators include the evaluation and ranking of policy actions to reach stated climate goals in compliance with the Paris Agreement and the evaluation and ranking of the country’s policy and regulatory frameworks to promote Carbon Capture and Sequestration (CCS) efforts.

Iceland is currently ranked first on the overall index with Ireland ranked 15<sup>th</sup> out of the 76 countries examined. Ireland is currently ranked 1<sup>st</sup> in the green society pillar, 18<sup>th</sup> in the climate policy pillar, 21<sup>st</sup> on the carbon emissions pillar, 38<sup>th</sup> in the energy transition pillar, and 50<sup>th</sup> in the clean innovation pillar. Figure 8a shows overall FGI scores by country. Ireland scores higher than most SAE countries examined here with the exception of Finland and Denmark.

**Figure 8a: Overall Future Green Index Scores by Country**



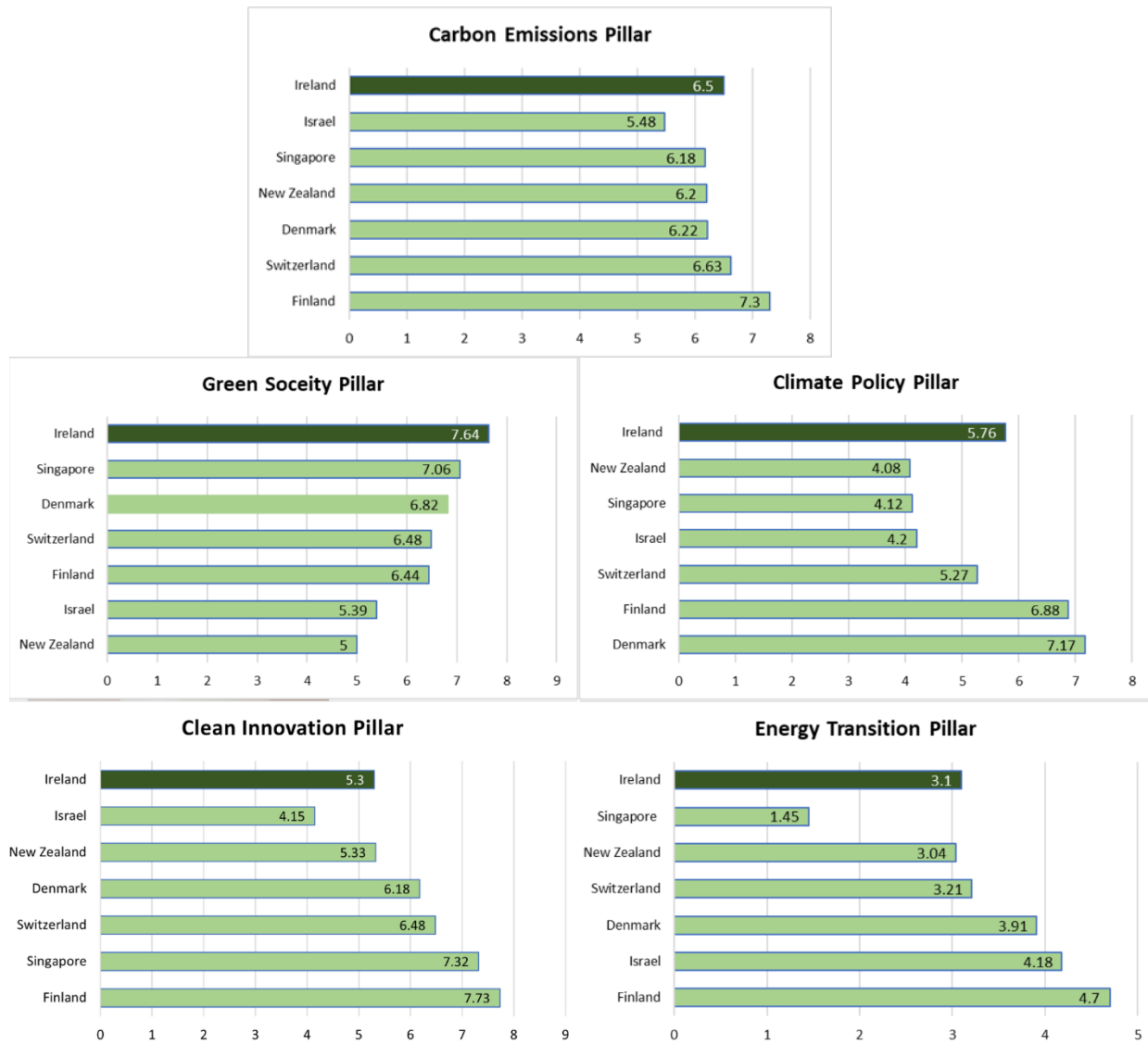
Source: Green Future Index -MIT Technology Review

<sup>11</sup> See Appendix for results on indicators relating to green complexity and potential.



According to the MIT review Ireland has made world-leading progress in the green society pillar ranking number 1. This pillar includes the Number of Leadership in Energy and Environmental Design (LEED) certified green buildings in 2020 per million urban population; the percentage of recycled solid waste in total waste managed; the net change in forestation between 2015 and 2020; and the stock of electric passenger vehicles per million urban population in 2021.

**Figure 8b: Future Green Index Scores by Country and Pillar**



Source: Green Future Index – MIT Technology Review

Ireland outperforms most SAE countries on the Climate Policy Pillar with the exception of Finland and Denmark. Ireland's ambitious climate targets are set out in the Climate Action Plan 2023 and updated in the Climate Action Plan 2024 which implements Ireland's carbon budgets and sectoral emissions ceilings. The government has emphasised the importance of reaching net zero and has introduced a wide range of initiatives to achieve its objectives.

The Climate Action Fund initiative has been set up to contribute to the achievement of Ireland's climate and energy targets in a cost-effective manner. This funding consists of €500 million in government funding up to 2027 towards this aim. This initiative will fund a wide range of sectors

including projects spanning the electricity, heat, transport, agriculture sectors, with both an urban and rural focus. These projects are projects which would not have been funded in the absence of this scheme. This scheme is managed by the Department of Environment, Climate and Communications.

The Department of Enterprise, Trade and Employment has also placed decarbonisation at the heart of enterprise policy. The Department has committed to a 35 percent reduction in industry by 2030 and a 45 percent reduction from the Commercial Built Environment. To assist with these goals, there are multiple interventions such as the Climate Toolkit 4 Business, the Green Transition Fund, the Grow Digital, and Digital Transition Fund to support businesses in the twin transition of the digital and climate environment.

Ireland is ranking 50<sup>th</sup> out of the 76 countries measured for clean innovation showing a poor performance in penetration of green patents, investment in cross-border clean energy, and investment in food technology. The indicators measured are growth in green intellectual property measured by the increase in patents registered for sustainable technologies or processes between 2017 and 2021, the amount of investment a country received and provided for clean energy efforts between 2016 and 2020 relative to GDP, and the number of food technology (food tech) startups per million of urban population as a percentage of GDP. It is important to note, however, that the use of GDP as a denominator here likely underestimates Ireland's actual performance in comparative global terms.

These findings suggest that further measures are needed to enhance Ireland's performance in clean innovation. According to Sbardella, patents have a positive impact on a country's ability to innovate. Typically, when a patent is created, there is a knowledge spillover which creates competitive advantages for products. (Sbardella, n.d) According to the Intellectual Property Office of Ireland Annual Report 2022, national patent applications filed in 2022 showed a decrease of over 9.6 percent. However, this could be a result of the Covid-19 pandemic. Nonetheless, to align with improvements in clean innovation, interventions may be required. Research by Popp (2020), suggests that in order to improve clean innovation, further R&D funding should be provided to private firms and universities and more policies should be developed to bridge the gap between laboratory research and commercial success.

## 4. IDA Ireland Client Firms

This chapter examines the climate response of IDA clients. It presents findings from the ABSEI survey on whether clients had a climate response plan, challenges faced in developing a plan, the type of plan developed, and whether a company currently measured their emissions.

### 4.1 Climate Plan

Table 2 lists the proportion of IDA clients with a climate response plan by sector and firm size. Looking at sector, companies in the manufacturing and other industry sector<sup>12</sup> were significantly more likely to have a climate response plan than those in the information, communications, and other services sector in 2019, 2020 and 2021. There was a temporary decrease in the proportion of clients with a climate response plan in 2020 before increasing again in 2021. The largest increase was seen for the manufacturing sector which increased 9 percent between 2019 and 2021. In contrast, the proportion of information services sector clients with a climate plan decreased slightly from 27 percent to 26 percent in the same time period.

**Table 2: Proportion of IDA Clients with a Climate Response Plan by Sector, Firm Size and Year (2019-2021)**

	2019		2020		2021	
	% Plan	% No plan	% Plan	% No plan	%Plan	%No plan
<b>Sector</b>						
<b>Manufacturing &amp; Other Industry incl. Energy</b>	37.0	63.0	35.2	64.8	45.0	55.0
<b>Information, Communications &amp; Other Services</b>	27.0*	73.0*	21.9*	78.2*	25.7*	74.3*
<b>Size of Firm</b>						
<b>SME and Micro</b>	24.6	75.4	19.3	80.7	24.6	75.4
<b>Large</b>	61.0*	39.0*	65.5*	34.5*	74.5*	25.5*

Source: Own Calculations from ABSEI data 2019, 2020, and 2021.

Notes: Percentages are weighted. \* Is to signal that the group value is significantly different from the Manufacturing & Other value for sector differences or SME and micro value for company size at  $p < 0.05$ . Energy sector has been combined with Manufacturing & Other Industry sector due to small  $n$ . Micro enterprises have been combined with SME's due to small  $n$ . Respondents who stated they didn't know were excluded from the analysis.

The biggest differences in the development of a climate plan are related to the size of a company. Large companies are significantly more likely to have a climate response plan compared to SME and micro enterprises with a quarter for SMEs and micro enterprises having developed plans compared to three quarters of large enterprises.

Table 3 examines a logistic regression model which looks at IDA Clients who have a climate response plan using 2021 data. The model includes the sector in which the company operates, the size of the firm and the region it is located. This allows us to determine if the significant effects seen previously remain if all other variables are held constant. A significant effect was found for sector with the odds of having a climate response plan significantly lower for those in the information, communication, and other services sector than the manufacturing and energy sectors.

Firm size was also found to have a significant effect after controlling for sector and region. The odds of having a climate response plan were 8.4 times higher for large firms than SME and micro

<sup>12</sup> The energy water waste and construction sector and manufacturing and other industry sector were amalgamated for IDA analysis due to small sample sizes in the energy sector.

enterprises. The marginal effects of sector and size of firm when controls were introduced did not differ substantially from the overall proportions reported above.

Looking at region we find that companies in the west of Ireland were 2.1 times more likely to have a climate response plan compared to those located in Dublin when sector and firm size were held constant.

**Table 3: Model Estimates Predicting Odds of Having a Climate Response Plan**

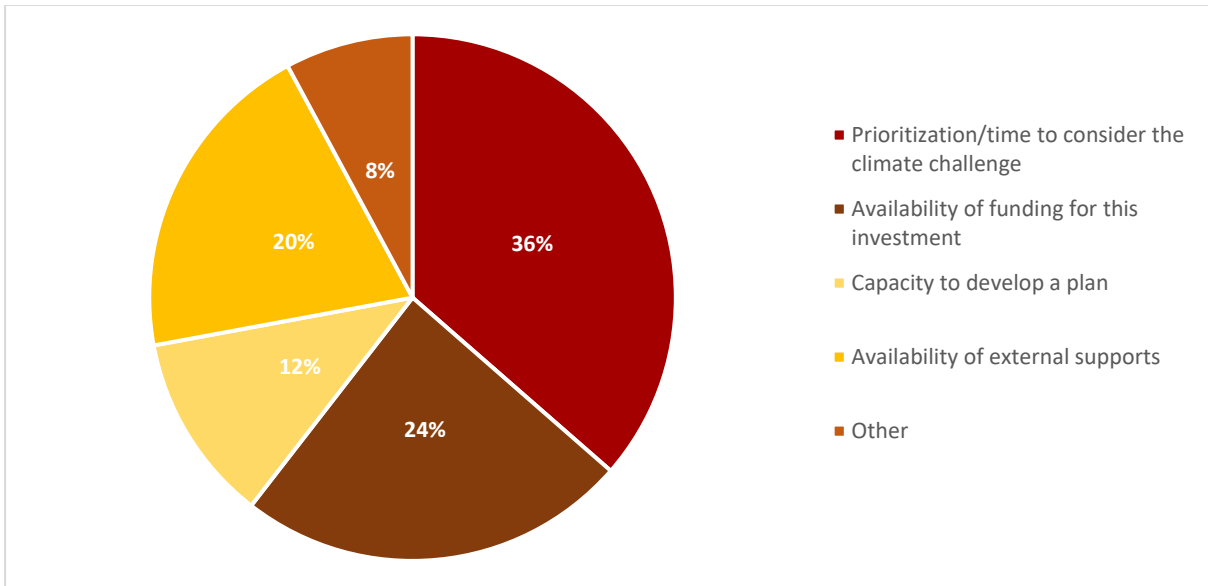
Climate Plan	
<b>Sector (Ref: Manufacturing &amp; Energy)</b>	
Information, Communications & Other Services	0.62*
<b>Firm Size (Ref: Micro and SME)</b>	
Large	8.41***
<b>Region (Ref: Dublin)</b>	
Border	0.93
Mid-East	2.27
Mid-West	0.82
Midlands	1.45
South-East	1.49
South-West	1.05
West	2.11*
<b>Pseudo R-squared</b>	
	0.15
<b>Observations</b>	
	513

Source: ABSEI (2021). Author's Calculations.

Notes: \*\*\*p<0.001, \*\* p<0.01, \*p<0.05. An odds ratio of less than one means that the variable is associated with a lower chance of having a climate response plan than the reference category. An odds ratio of greater than one means that the variable is associated with a higher chance of having a climate response plan than the reference category.

IDA clients report prioritization/time as their top ranked challenge in developing a climate plan (36 percent) followed by availability of funding (24 percent). This did not differ between 2019 and 2021. No significant differences were found in reported challenges by sector in 2021.

**Figure 9: Proportion of IDA Clients by Top Ranked Challenge in Developing Companies Climate Response Plan (2021)**



Source: Own Calculations from ABSEI data 2021.

Notes: Percentages are weighted. Respondents who ranked more than one challenge as their 1<sup>st</sup> priority were excluded from the analysis.

Prioritisation/time represents the biggest challenge for both SME/micro enterprises (38 percent) and large enterprises (31 percent) but of particular interest here is the reporting of funding difficulties (see Figure 10). In contrast to EI findings, large enterprises (29 percent) are significantly more likely to report funding as a challenge to the development of a climate plan than SME and micro enterprises (18 percent). The IDA currently have several available green funding options to assist clients in their climate response such as Green Start Grant which aims to help companies explore sustainability initiatives such as the development of a climate action plan or decarbonisation strategy.<sup>13</sup>

Looking at differences by sector again we see that prioritisation/time is the biggest challenge for both sectors. Significant differences were found in funding difficulties between sectors with over a quarter of clients in the manufacturing sector reporting this as their main challenge in developing a climate response plan compared to 17 percent of clients in the information, communications, and other services sector. All other sectoral differences were not found to be significant.

<sup>13</sup> See [SUPPORTING-YOUR-GREEN-GOALS.pdf \(idaireland.com\)](https://www.idaireland.com/SUPPORTING-YOUR-GREEN-GOALS.pdf) for more details.

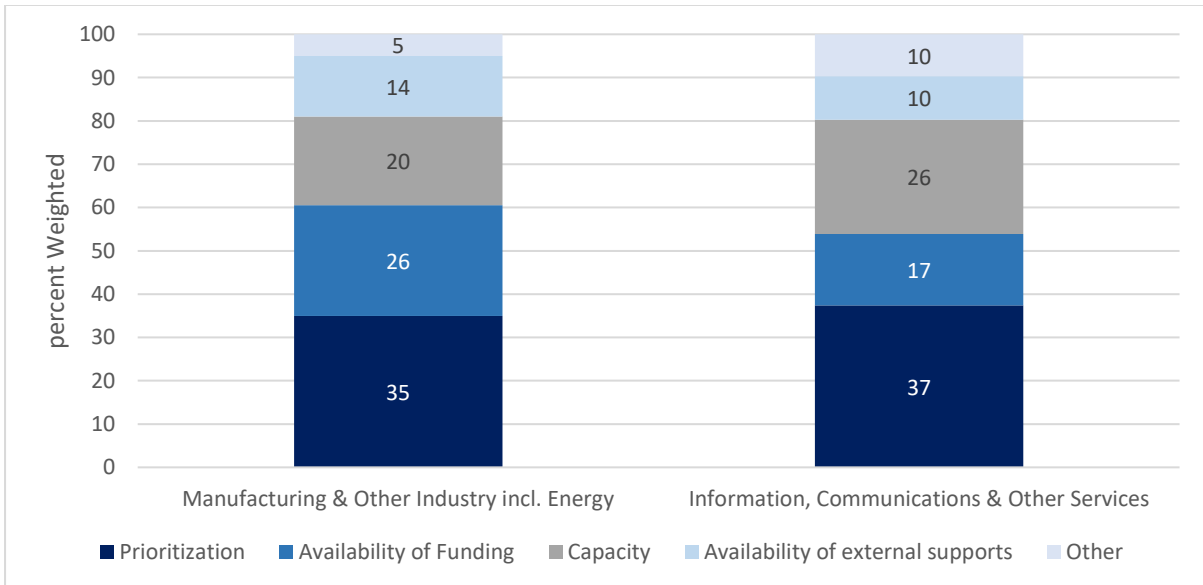
**Figure 10: Proportion of IDA Clients by Top Ranked Challenge in Developing Companies Climate Response Plan by Size of Firm (2021)**



Source: Own Calculations from ABSEI data 2021.

Notes: Percentages are weighted. Respondents who ranked more than one challenge as their 1<sup>st</sup> priority were excluded from the analysis.

**Figure 11: Proportion of IDA Clients by Top Ranked Challenge in Developing Companies Climate Response Plan by Sector (2021)**

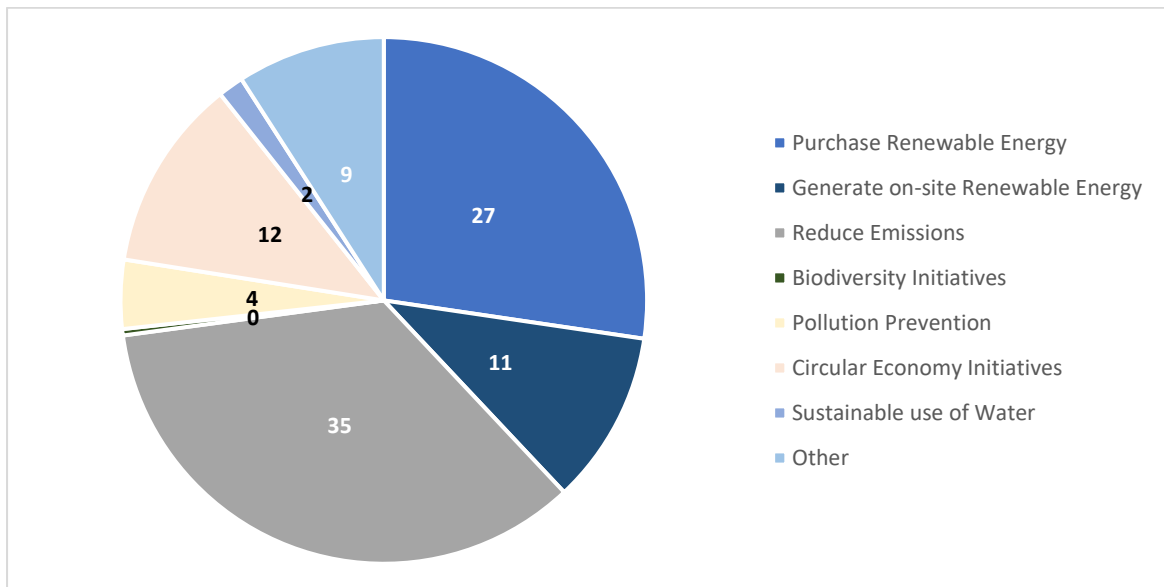


Source: Own Calculations from ABSEI data 2021.

Notes: Percentages are weighted. Respondents who ranked more than one challenge as their 1<sup>st</sup> priority were excluded from the analysis.

Over a third (35 percent) of IDA clients state that focusing on reducing emissions associated with operations, buildings, and transport/travel is the most relevant to their climate response plan (see Figure 12). Roughly a quarter (27 percent) of IDA clients’ climate response plans focused on purchasing and using more renewable energy. A similar proportion of clients’ state that circular economy initiatives (12 percent), generating on-site renewable energy for company use (11 percent), and other initiatives (9 percent) are the most relevant to their climate response plan. No significant sectoral or firm size differences were found in type of climate response plans.

**Figure 12: Proportion of IDA Clients by Climate Response Plan (2021)**



Source: Own Calculations from ABSEI data 2021.

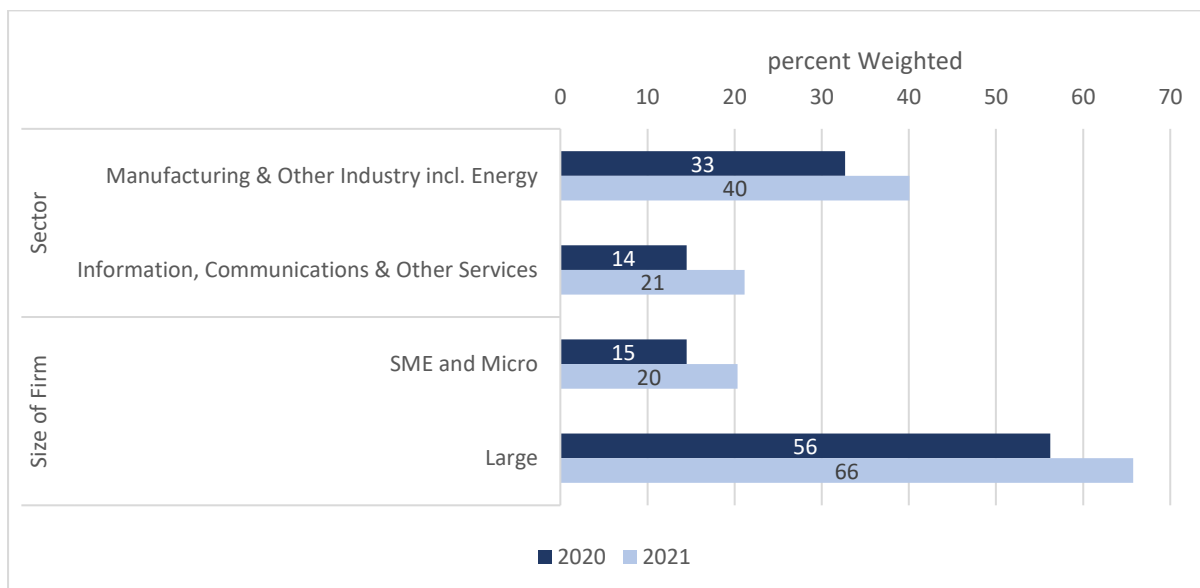
Notes: Percentages are weighted.

#### 4.2 Measurement of Emissions

Figure 13 outlines the proportion of IDA clients who measure emissions by sector and firm size. Overall, emissions measurement increased for both sectors between 2020 and 2021. The manufacturing sector (40 percent) were significantly more likely to measure their emissions than those in the information sector (21 percent). Size of firm is the most significant<sup>14</sup> predictor of whether a company measures their emissions. One fifth of SME and Micro firms measured their emissions in 2020 compared to two thirds of large firms. Again, this likely reflects the fact that large companies are more likely to have a larger impact on emissions than smaller companies. In addition, smaller companies are less likely to have the available resources to measure their emissions impact.

<sup>14</sup> Differences are significant at  $p < .05$ .

**Figure 13: Proportion of IDA Clients who Measure Emissions by Sector, Size of Firm, and Year (2020-2021)**



Source: Own Calculations from ABSEI data 2021.

Notes: Percentages are weighted.

Table 4 shows a logistic regression model for measurement of emissions. Model 1 includes region and sector; Model 2 includes size of firm, and the final model looks at climate response plans. In model one there is a significant effect for sector with the odds of measuring emissions significantly lower for the information, communications, and other services sector than the manufacturing and energy sector. This effect is also present in model two when controlling for firm size. No significant effect is found for sector in model 3 when we control for whether a company has a climate plan.

Size of firm was found to have a significant impact on whether a company measured their emissions. Large enterprises were significantly more likely to measure emissions than SME and micro enterprises. Although the odds of measuring emissions decreased for large enterprises when climate plans were added, large enterprises were still 3.4 times more likely to measure their emissions than SME and micro firms.

The odds of measuring emissions were significantly higher for companies who had a climate plan controlling for region, sector, and size of firm. Companies who had a climate response plan are 30 times more likely to measure their emissions than companies who had not developed such a plan.



**Table 4: Model Estimates Predicting Odds of a Company Measuring their Emissions.**

	Model 1	Model 2	Model 3
<b>Region (Ref. Dublin)</b>			
Border	0.55	0.57	0.36
Mid-East	1.42	1.53	0.91
Mid-West	1.14	1.00	2.04
Midlands	0.61	0.68	0.43
South-East	0.58	0.45	0.20
South-West	1.09	0.87	0.83
West	1.17	1.03	0.56
<b>Sector (Ref. Manufacturing &amp; Energy)</b>			
Information, Communications & Other Services	0.38***	0.46**	0.58
<b>Firm Size (Ref. Micro and SME)</b>			
Large		6.91***	3.43***
<b>Plan (Ref. No Plan)</b>			
Climate Plan			30.31***
<b>Pseudo R-squared</b>	0.04	0.14	0.43
<b>Observations</b>	534	534	486

Source: ABSEI (2021). Author's Calculations.

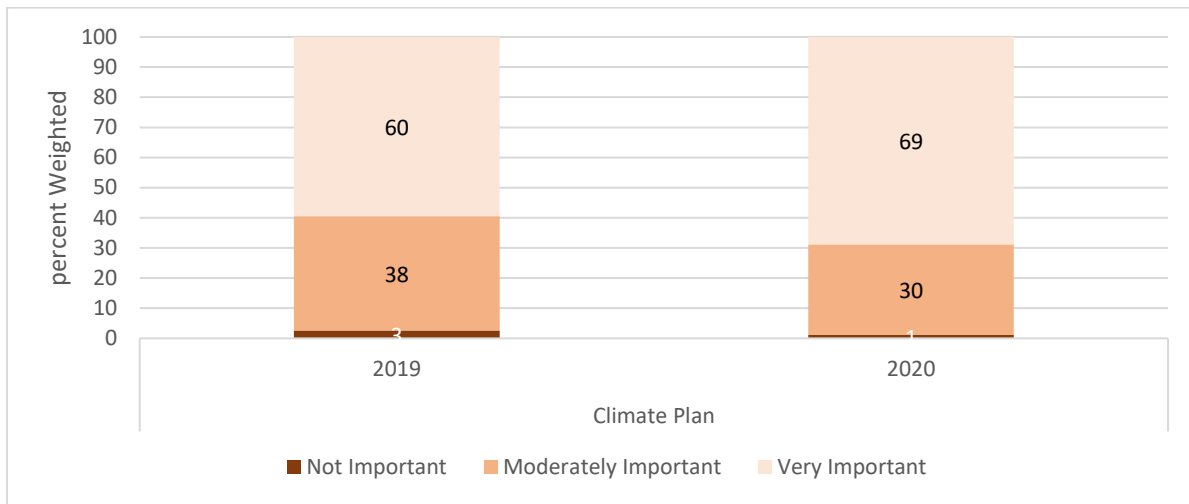
Notes: \*\*\*p<0.001, \*\* p<0.01, \*p<0.05. An odds ratio of less than one means that the variable is associated with a lower chance of a company measuring their emissions than the reference category. An odds ratio of greater than one means that the variable is associated with a higher chance of a company measuring their emissions than the reference category.

## 5. Enterprise Ireland Client Firms

### 5.1 Climate Response Plan

As expected, clients that state having a climate response is very important for their business are significantly<sup>15</sup> more likely to have a climate response plan in 2019 and 2020 than those who state it is not important or moderately important (see Figure 14). The proportion of clients who believe having a response plan is very important has increased from 60 percent in 2019 to 69 percent in 2020.

**Figure 14: Proportion of EI Clients with a Climate Response Plan by Perceived Importance of Having a Plan (2019-2020)**



Source: Own Calculations from ABSEI data 2019 and 2020

Notes: Percentages are weighted.

Table 5 examines the proportion of clients with a climate response plan by year and the sector in which the company operates. The proportion of clients with a climate response plan has increased substantially over the years for all sectors with the largest increases seen for those in the manufacturing sector (increased from 25 percent in 2019 to 39 percent in 2021). The proportion of clients with a response plan increased by roughly ten percent for those in the energy, water, waste, and construction, and information, communication, and other services sectors. There are significant<sup>16</sup> sectoral differences in the development of a climate plan with those in the manufacturing industry significantly more likely to have developed a plan than those in the information services sectors across all years examined.

<sup>15</sup> Differences in development of a climate plan between those who state that having a plan is very important and those who state it is moderately or not important are significant at  $p < .05$ .

<sup>16</sup> Differences are significant at  $p < .05$ .

**Table 5: Proportion of EI Clients with a Climate Response Plan by Sector and Year (2019-2021)**

Sector	2019		2020		2021	
	% Plan	% No Plan	% Plan	% No Plan	% Plan	% No Plan
<b>Manufacturing &amp; Other Industry</b>	24.6	75.4	23.7	76.3	39.0	61.0
<b>Energy, Water, Waste &amp; Construction</b>	25.5	74.5	26.3	73.7	35.6	64.4
<b>Information, Communications &amp; Other Services</b>	16.9*	83.1*	17.1*	82.9*	27.3*	72.7*

Source: Own Calculations from ABSEI data 2019, 2020, and 2021.

Notes: Percentages are weighted. \* Is to signal that the group value is significantly different from the Manufacturing & Other sector at  $p < 0.05$ . Respondents who stated they did not know were excluded from the analysis.

Looking at company size, the likelihood that a client company developed a climate plan increases considerably with size. Although the proportion is steadily increasing, micro enterprises (22 percent) are significantly<sup>17</sup> less likely to have developed a climate plan in 2021 compared to SME's (36 percent) or large enterprises (74 percent). These differences hold true across years and could be related to the resources available to firms as smaller firms may not possess sufficient staff, funding, or knowledge to develop a climate plan. The largest increase in plan development across years can be seen in large companies which increased from 42 percent in 2019 to almost three quarters in 2021.

**Table 6: Proportion of EI Clients with a Climate Response Plan by Size of Firm and Year (2019-2021)**

Size of Firm	2019		2020		2021	
	% Plan	% No Plan	% Plan	% No Plan	% Plan	% No Plan
<b>Micro</b>	16.0	84	13.2	86.7	21.7	78.3
<b>SME</b>	22.1*	77.9	22.3*	77.7	35.6*	64.4
<b>Large</b>	42.7*	57.3*	50.9*	49.1*	74.2*	25.8*

Source: Own Calculations from ABSEI data 2019, 2020, and 2021.

Notes: Percentages are weighted; Is to signal that the group value is significantly different from the micro value at  $p < 0.05$ . Respondents who stated they did not know were excluded from the analysis.

No significant effect was found for the region in which the company is located.

Table 7 examines a logistic regression model which looks at Enterprise Ireland Clients who have a climate response plan using 2021 data. The model includes the sector in which the company operates, the size of the firm and the region it is located. This allows us to determine if the significant effects seen previously remain if all other variables are held constant. A significant effect was found for sector with the odds of having a climate response significantly lower for those in the information, communication, and other services sector than the manufacturing sector. The odds of having a climate response plan were found to significantly increase in line with firm size with SMEs 1.8 times more likely and large firms over 9 times more likely to have a climate response plan than micro clients. The marginal effects of sector and size of firm when controls were introduced did not differ from the overall proportions reported above.

<sup>17</sup> Differences are significant at  $p < .05$ .

**Table 7: Model Estimates Predicting Odds of Having a Climate Response Plan**

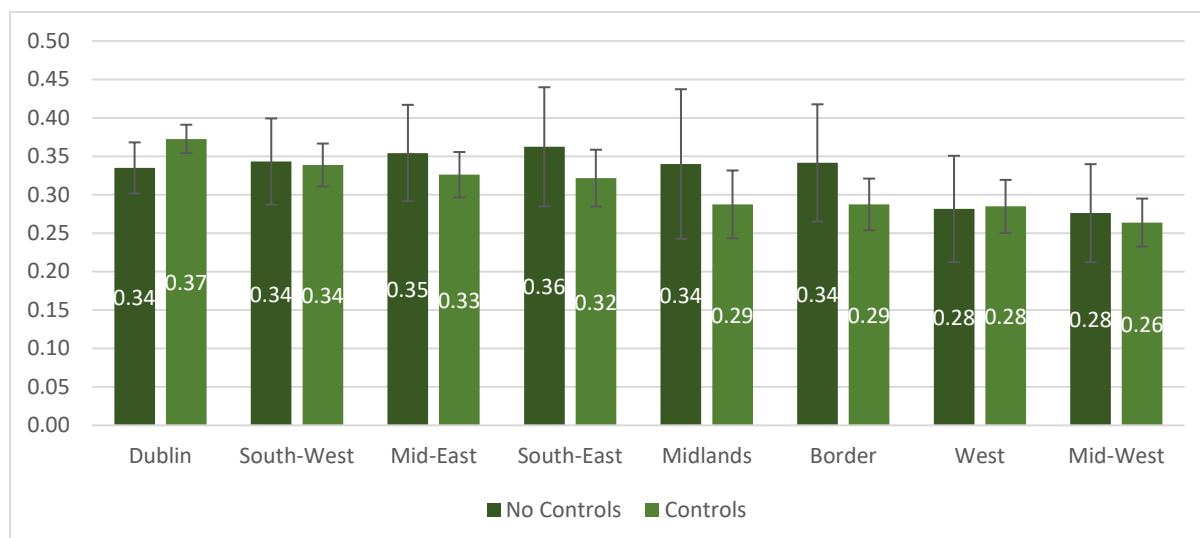
	Climate Plan
<b>Sector (Ref. Manufacturing &amp; Other Industry)</b>	
Energy, Water, Waste & Construction	0.76
Information, Communications & Other Services	0.59***
<b>Size of Firm (Ref. Micro)</b>	
SME	1.84*
Large	9.26**
<b>Region (Ref. Dublin)</b>	
Border	0.66*
Mid-East	0.80
Mid-West	0.59**
Midlands	0.66
South-East	0.79
South-West	0.85
West	0.65*
<b>Pseudo R-squared</b>	
	0.04
<b>Observations</b>	
	2062

Source: ABSEI (2021). Author's Calculations.

Notes: \*\*\* $p < 0.001$ , \*\*  $p < 0.01$ , \* $p < 0.05$ . An odds ratio of less than one means that the variable is associated with a lower chance of having a climate response plan than the reference category. An odds ratio of greater than one means that the variable is associated with a higher chance of having a climate response plan than the reference category.

The odds of having a climate response plan were significantly higher for those in Dublin compared to companies in the west, mid-west and border regions when controlling for sector and size of firm. Figure 15 shows the marginal effects of region on the probability that clients have a climate response plan. The probability of having a climate response plan increased for Dublin when the model controls for the size of firm and the sector in which the firm operates. When no controls are included in the model, the proportion of clients who have a climate response plan was the same for firms in Dublin and the border region however, when controls were introduced, there was a significant effect due to the increase seen in Dublin and the corresponding decrease seen in the border region.

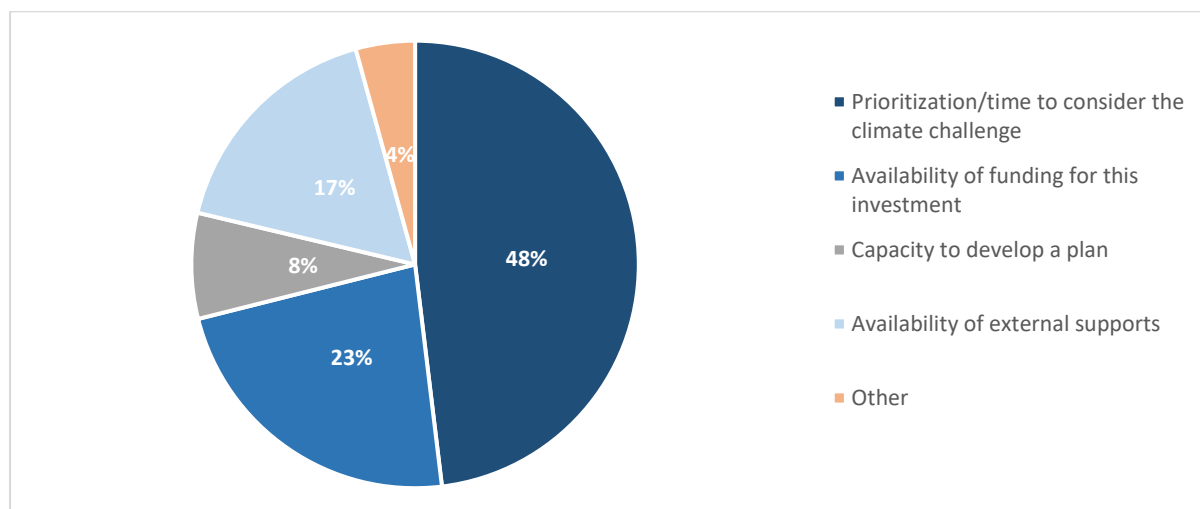
**Figure 15: Marginal Effects Showing Proportion of Clients Who Have a Climate Response Plan**



Source: ABSEI (2021). Author's Calculations.

Figure 16 shows the top ranked challenges in developing a climate response plan. Prioritization/time and availability of supports represented the largest challenges for EI clients in developing a climate plan. Almost half of EI clients reported that prioritisation/time to consider the climate challenge was their top difficulty and roughly a quarter of clients listed availability of funding as their top priority.

**Figure 16: Proportion of EI Clients by Top Ranked Challenge in Developing Climate Response Plan (2019)**



Source: Own Calculations from ABSEI data 2019

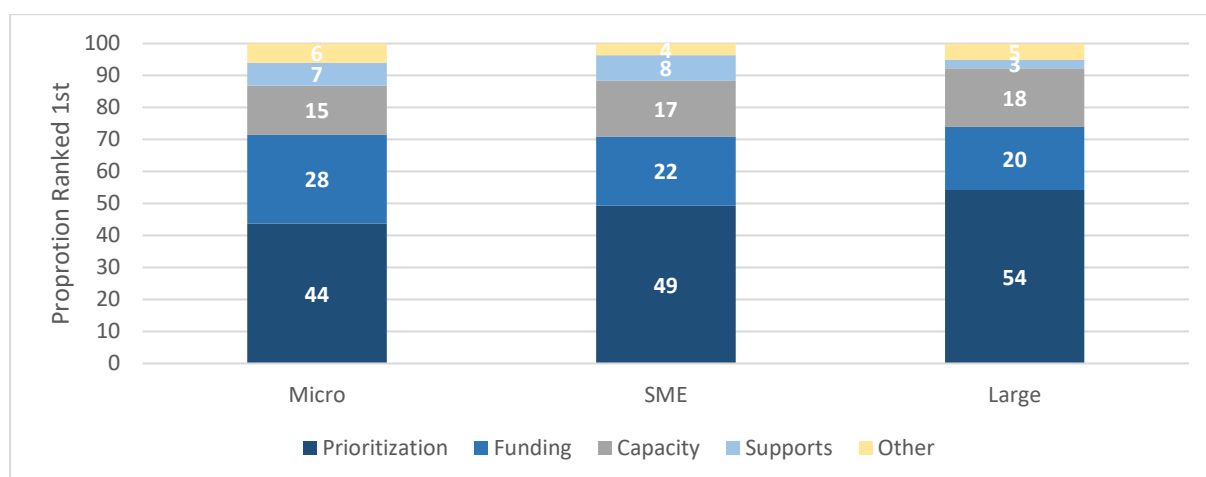
Notes: Percentages are weighted. N= 340 missing cases. Respondents who ranked more than one challenge as their 1<sup>st</sup> priority were excluded from the analysis.

Figure 17 shows differences in the challenges associated with developing a climate plan by company size. Although prioritisation/time represents the largest challenge for all firms, this challenge increases with firm size from 44 percent for micro firms to 54 percent for large firms. As anticipated, there are significant differences<sup>18</sup> in availability of funding between micro enterprises (28 percent) and SMEs

<sup>18</sup> Differences are significant at  $p < .05$ .

(22 percent). Differences are not significant between micro and large enterprises (20 percent) however, this is likely due to the small sample size for large enterprises. These findings suggests that funding (or greater awareness of available funding) may be needed in order to allow for the prioritisation of climate plan development and provide the capacity to develop such plans for enterprises. Currently, EI offers green funding for clients through the Green Transition Fund<sup>19</sup> such as the Climate Action Voucher which is a €1,800 grant available for all EI client firms that aims to “help companies prepare a plan for the low carbon, more resource efficient economy of the future”<sup>20</sup> and enables companies to develop an initial action plan.

**Figure 17: Top Ranked Challenge in Developing Companies Climate Response Plan for EI Clients by Size of Company (2019)**



Source: Own Calculations from ABSEI data 2019

Notes: Percentages are weighted. N= 340 missing cases. Respondents who ranked more than one challenge as their 1<sup>st</sup> priority were excluded from the analysis.

Challenges in developing a climate response plan did not differ significantly by the sector in which the company operated.

## 5.2 Measurement of Emissions

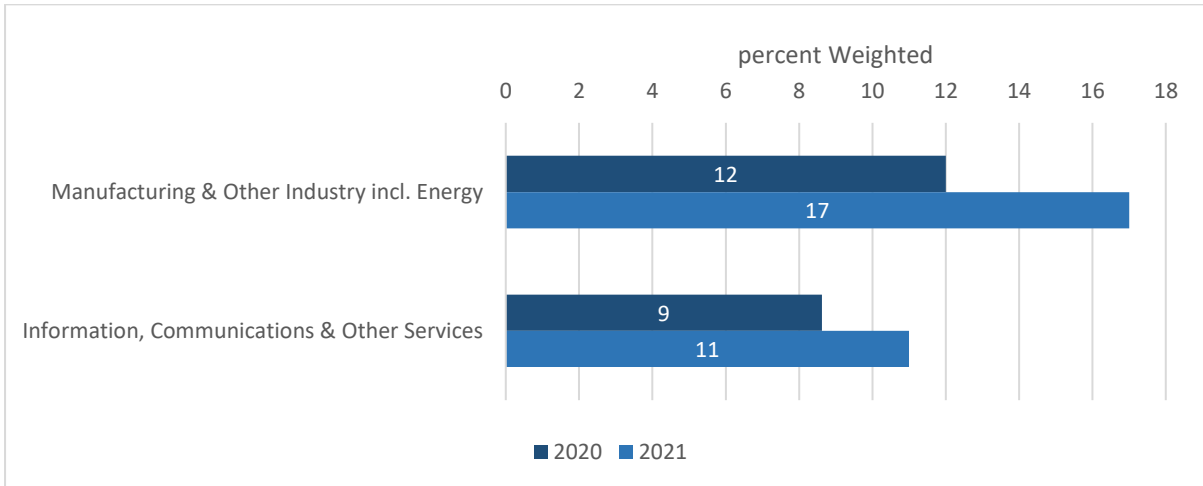
Figure 18 examines the proportion of Enterprise Ireland clients who measure their companies CO2 emissions in Ireland by sector and year. Note energy was amalgamated with the manufacturing sector due to small cell size for energy. In 2020 there were significant<sup>21</sup> albeit small sectoral differences in measurement of emissions. Clients in the manufacturing, industry, and energy sector (12 percent) were significantly more likely to measure emissions than those in the information, communications, and other services sector (9 percent). In 2021, the proportion of clients who measured their companies’ emissions had increased for both groups again with the manufacturing and industry sector significantly more likely to measure their emissions (17 percent) than those in the information and other services sector (11 percent).

<sup>19</sup> [Build a Green and Sustainable Business - Enterprise Ireland \(enterprise-ireland.com\)](https://www.enterprise-ireland.com/en/Build-a-Green-and-Sustainable-Business)

<sup>20</sup> See [Climate Action Voucher - Enterprise Ireland \(enterprise-ireland.com\)](https://www.enterprise-ireland.com/en/Climate-Action-Voucher) for more details.

<sup>21</sup> Differences are significant at  $p < .05$ .

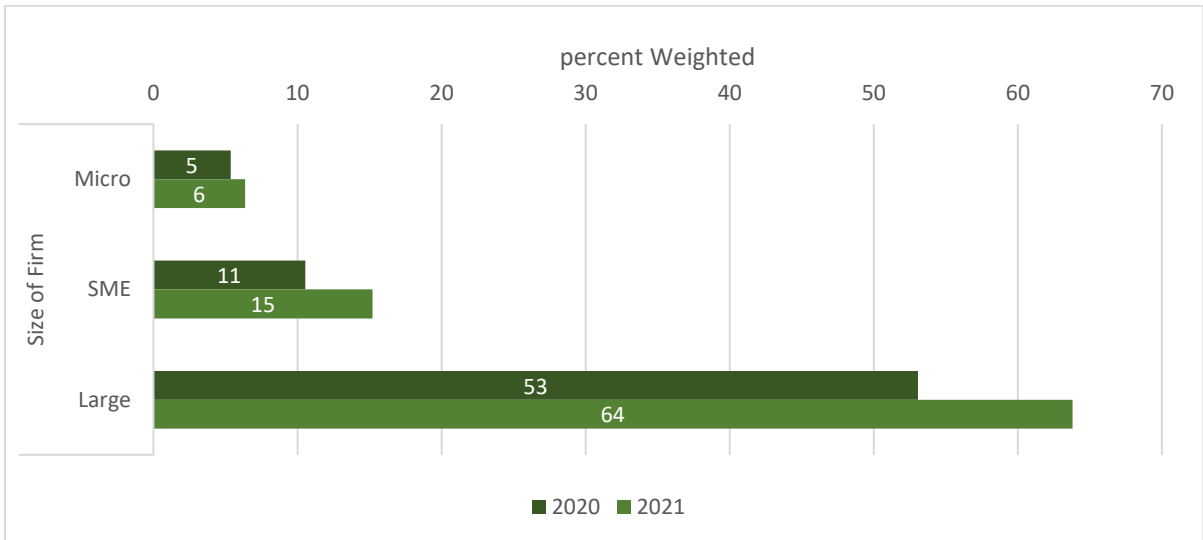
**Figure 18: Proportion of EI Clients who Measure Emissions by Sector and Year (2020-2021)**



Source: Own Calculations from ABSEI data 2020 and 2021.  
Notes: Percentages are weighted.

There is a large significant effect<sup>22</sup> of company size on the likelihood that a company measures its carbon emissions with the proportion increasing as firm size increases from just 6 percent for micro firm to 64 percent for large firms in 2021 (see Figure 19). This likely reflects the fact that large companies are more likely to have a larger impact on emissions than smaller companies. In addition, smaller companies are less likely to have the available resources to measure their emissions impact.

**Figure 19: Proportion of EI Clients who Measure Emissions by Firm Size and Year (2020-2021)**



Source: Own Calculations from ABSEI data 2020 and 2021.  
Notes: Percentages are weighted.

<sup>22</sup> Differences are significant at  $p < .05$ .

Table 8 shows a logistic regression model for measurement of emissions. Model 1 includes region and sector; Model 2 includes size of firm, and the final model looks at climate response plans. In Model 1, there is a significant effect for sector with the odds of measuring emissions significantly lower for the information, communications, and other services sector than the manufacturing and energy sector. This effect is not significant in model two when we control for the size of the firm. The odds of measuring emissions increased significantly as firm size increased with SME's 2.5 times more likely to measure emissions than micro enterprises and large enterprises almost 23 times more likely to measure their emissions than micro enterprises.

The odds of measuring emissions were significantly higher for companies who had a climate plan controlling for region, sector, and size of firm. Companies who had a climate response plan are almost 22 times more likely to measure their emissions than companies who had not developed such a plan. Although controlling for whether a company had a climate plan reduced the odds of measuring emissions for large companies, they were still 12.6 times more likely to measure than micro enterprises.

**Table 8: Model Estimates Predicting Odds of a Company Measuring Their Emissions**

	Model 1	Model 2	Model 3
<b>Region (Ref. Dublin)</b>			
Border	1.13	1.02	1.21
Mid-East	1.24	1.24	1.49
Mid-West	0.89	0.89	1.27
Midlands	1.15	1.07	1.38
South-East	1.11	0.97	1.04
South-West	0.77	0.74	0.80
West	0.54*	0.59	0.57
<b>Sector (Ref. Manufacturing &amp; Energy)</b>			
Information, Communications & Other Services	0.61***	0.77	1.03
<b>Size of firm (Ref. Micro)</b>			
SME		2.45***	2.02**
Large		22.72***	12.64***
<b>Plan (Ref. No Plan)</b>			
Climate Plan			21.85***
<b>Pseudo R-squared</b>	0.02	0.08	0.32
<b>Observations</b>	2098	2098	2098

Source: ABSEI (2021). Author's Calculations.

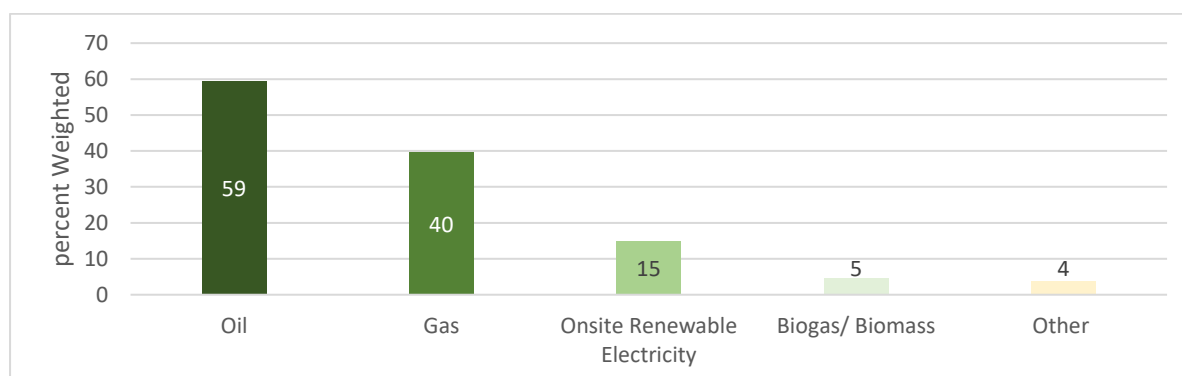
Notes: \*\*\*p<0.001, \*\* p<0.01, \*p<0.05. An odds ratio of less than one means that the variable is associated with a lower chance of a company measuring their emissions than the reference category. An odds ratio of greater than one means that the variable is associated with a higher chance of a company measuring their emissions than the reference category.



### 5.3 Energy Sources

Figure 20 shows the type of energy sources used by Enterprise Ireland Clients. It is important to note that non-renewable electricity was not listed as an option and clients could select more than one energy sources. Overall, oil (59 percent) is the most used energy source reported by clients followed by gas (40 percent) and onsite renewable energy (15 percent). Roughly 5 percent of EI companies used biogas or biomass (including renewable waste) or other fuels (coal, petroleum, coke). 2020 usage of energy was found to mirror that of the 2021 data.

**Figure 20: Type of Energy Sources Used by Enterprise Ireland Clients (2021)**



Source: Own Calculations from ABSEI data 2021.

Notes: Percentages are weighted.

Table 9 examines the types of energy used by Enterprise Ireland clients in 2020 and 2021. Energy usage appeared relatively consistent among sectors between 2020 and 2021. Overall, we see that oil is the most used energy source with roughly 85 percent usage among energy sector clients and 80 percent usage among those in the manufacturing industry. Those in the information, communications and other services sectors are significantly less likely to cite usage of all energy sources with the most notable difference seen in oil usage (just 33 percent in 2021). The energy, water, waste, and construction sector (31 percent) were significantly more likely to use onsite renewable electricity than the manufacturing sector (15 percent) and information sector (9 percent) in 2020. Differences between the energy and manufacturing sectors were not significant in 2021 due to a 5 percent drop in renewable energy usage for the energy sector in 2021 (decreased from 31 percent to 26 percent).

**Table 9: Energy Usage of EI Clients by Sector and Year (2020-2021)**

	Gas		Oil		Other		Biogas/Biomass		Onsite Renewable Electricity	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
<b>Energy, Water, Waste &amp; Construction</b>	44.5	42.6	85.6	85.3	7.5	8.1	8.6	10.8	30.9	25.7
<b>Manufacturing &amp; Other Industry</b>	46.0	46.3	79.9	80.7	5.4	4.9	7.2	7.2	14.4*	17.9
<b>Information, Communications &amp; Other Services</b>	35.1	32.5*	31.7*	32.6*	2.6*	2.2*	1.0*	1.6*	8.9*	10.8*

Source: Own Calculations from ABSEI data 2020, and 2021.

Notes: Percentages are weighted; \* is to signal that the group value is significantly different from the Energy, Water, Waste and Construction sector at  $p < 0.05$ .

The authors attempted to expand the analysis to examine whether the total volume of energy expended by companies has decreased for companies with climate response plans but due to the structure of the ABSEI questions, it is not possible to conduct this type of analysis at present. Therefore, the authors have made a number of recommendations for the addition of questions into the ABSEI survey in Chapter 6.

## 6. Concluding Comments

The report finds that although Ireland's emissions are decreasing, they are not decreasing at a rapid enough rate to meet our domestic targets. Almost half of the 2021-2025 carbon budget for industry had been used by the end of 2022. Unless significant immediate action is taken it is likely that we will exceed our initial carbon budget. Any roll over of excess emissions into the second budget period, will make it substantially more difficult to achieve the second budget.

Ireland could potentially be met with a high cost of compliance in the event of not reaching the legally binding targets set out by the European Union such as the Fit for 55 regulation and the Effort Sharing Regulation. The extent of these costs is currently unknown but is believed to be significant. It is reliant on several factors. As the Effort Sharing Regulation allows for credits to be transferred or stored for future use in the event of a country exceeding or meeting targets, it cannot be forecasted how many credits, if any, will be available to be acquired. It is also unknown what the price will be for purchasing credits or completing statistical transfers.

DECC has stated that the likelihood of there being excess credits to trade is unlikely and the cost of these credits will potentially rise in the future. In the event where Ireland does not meet its targets and cannot purchase credits, the country will face infringement proceedings. This is detrimental for Ireland's investment in climate policy as the investment which would have been used for climate policy will be subsequently used on the cost of compliance. This accompanied with the cost of purchasing credits would be significant. While at this time, the cost is speculative and complex to predict, it must be assumed that it will have a high cost to the Exchequer and will be spread across all Government Departments.

To avoid this, it is essential to ensure that this cost is kept to a minimum by ensuring that Ireland meets its climate targets rather than depend on the performance of other EU member states (Department of the Environment, Climate & Communications, 2023) These costs also do not include the cost of responding to extreme weather events or the cost of transition which will put an additional burden on the Exchequer.

Compared to other countries Ireland is found to be strong on promoting green practices. Ireland ranks first in the Future Green Index for green society which considers the efforts made by Government, industry, and society to promote green practices. However, Ireland ranks poorly for clean innovation with a poor performance in penetration of green patents, investment in cross-border clean energy, and investment in food technology. The findings suggest that further R&D may be required for private firms and universities and policies should be developed to bridge the gap between laboratory research and commercial success.

Policies and incentives targeting the climate response of enterprise should consider the twin transition to ensure that the green and digital transitions reinforce each other. Technological advances in digitalisation could bring additional environmental burdens with them however considering advancements through a climate lens will allow us to ensure that digital technologies support the green transition rather than hinder it.

This paper shows that there have been positive changes in Enterprise Ireland and IDA client companies regarding climate action with both the measurement of emissions and development of climate response plans increasing since 2019. Overall, the proportion of clients with a climate response plan has increased between 2019 and 2021. In 2019 and 2020, IDA clients were significantly more likely to have developed a climate response plan than Enterprise Ireland (EI) clients however, in 2021 EI clients

had a dramatic increase in plan development with roughly a third of EI and IDA clients reportedly having developed climate response plans.

**Table 10: Proportion of Agency Clients with a Climate Response Plan by Year (2019-2021)**

	2019		2020		2021	
	% Plan	Count Plan	% Plan	Count Plan	% Plan	Count Plan
<b>Enterprise Ireland</b>	21.1	455	20.7	336	33.2	698
<b>IDA</b>	30.6*	181	26.5*	152	33.3	202
<b>Total</b>	23.3	636	21.9	488	33.2	900

Source: Own Calculations from ABSEI data 2019, 2020, and 2021

Notes: Percentages are weighted; N of cases are unweighted. \* Is to signal that the group value is significantly different from the Enterprise Ireland value at  $p < 0.05$ .

Although industrial targets will primarily be achieved through the decarbonisation of our large high emitters, all enterprises should work towards decarbonisation to both help Ireland achieve its targets and ensure its future competitiveness. It is evident that more work needs to be done among SME and micro enterprises to ensure that they are facilitated to establish climate response plans and reduce their emissions. As a climate plan is integral to ensuring businesses are considering and mitigating their environmental impact, placing a requirement on businesses to develop a climate plan as a prerequisite condition for funding in the future (with the exception of green funding to develop such plans) could boost adoption of climate plans for agency clients. The Agencies should also consider placing a requirement to complete the ABSEI survey as a condition for funding.

The findings suggest that funding, or possibly greater awareness of available funding, is required to alleviate the current challenges faced by enterprises in their development of a climate response plan. In addition, research should investigate the capacity issues which currently act as a barrier to greater climate action in smaller enterprises.

The data collected through ABSEI is an important resource for gaining insight into the how EI and IDA clients are considering their climate impact and working towards achieving Ireland’s climate objectives. However, in order to utilise this data to the fullest, questions relating to climate response must be collected consistently across years. Plan importance, the type of plan implemented, related challenges, and emissions measurement are not measured every year or only measured for one type of agency client. Future iterations of the ABSEI survey should ensure all questions are asked for both EI and IDA clients. Table 11 sets out proposed changes to the ABSEI survey questions. There are no changes proposed to the first four questions.

We propose that an additional question, subject to feasibility considerations, is asked under energy resources which asks respondents for the total amount spent on each energy source. This will allow for a rough calculation of emissions for companies that cannot supply emissions data. Related to this we propose asking companies who measure their emissions to state their total yearly emissions. This data will provide an extremely valuable resource which will allow for the tracking of emissions year on year and could be a useful proxy indicator to measure the Department’s progress towards decarbonising the enterprise base.

**Table 11: Proposed Changes to Questions on ABSEI Survey**

<b>Questions</b>	<b>Changes</b>
<b>Climate Response Plan</b>	No Changes
<b>Plan Importance</b>	No Changes
<b>Type of Plan</b>	No Changes
<b>Challenges of Plan</b>	No Changes
<b>Energy Resources</b>	Add question on total amount spent on each resource
<b>Measurement of Emissions</b>	Requirement for those who measure emissions to state total emissions.

## Bibliography

- Andres, P and Mealy, P (2023) *Green Transition Navigator*. Retrieved from [www.green-transition-navigator.org](http://www.green-transition-navigator.org).
- Backlund, B. and Rahimo, M. (2010). Power Semiconductor Technologies for Renewable Energy Sources Issue 4 2010 Power Electronics Europe [www.power-mag.com](http://www.power-mag.com). [online] Available at: [http://www.power-mag.com/pdf/feature\\_pdf/1276871989\\_ABB\\_Feature\\_Layout\\_1.pdf](http://www.power-mag.com/pdf/feature_pdf/1276871989_ABB_Feature_Layout_1.pdf) [Accessed 2023].
- Clancy, J.M., Curtis, J. and O’Gallachóir, B.P. (2017). What are the factors that discourage companies in the Irish commercial sector from investigating energy saving options? *Energy and Buildings*, 146, pp.243–256. doi:<https://doi.org/10.1016/j.enbuild.2017.04.077>.
- CSO (2023). Goods Exports and Imports July 2023 - CSO - Central Statistics Office. [online] [www.cso.ie](http://www.cso.ie). Available at: <https://www.cso.ie/en/releasesandpublications/ep/p-gei/goodsexportsandimportsJuly2023/> [Accessed 2023]. Department of the Environment, Climate & Communications (2023). Estimating the Potential Cost of Compliance with 2030 Climate & Energy Targets. Irish Government Economic and Evaluation Service , pp.1–20. [Accessed 2023]
- Department of Environment, Climate and Communications (2024). Climate Action Plan 2024. [online] Gov.ie, pp.1–414. Available at: <https://www.gov.ie/pdf/?file=https://assets.gov.ie/279555/25df7bb5-1488-4ba1-9711-e058d578371b.pdf#page=null> [Accessed 2024].
- Department of Environment, Climate and Communications (2023) *Energy Security in Ireland to 2030: Energy Security Package*. rep. DECC. Available at: <https://www.gov.ie/pdf/?file=https://assets.gov.ie/278473/4919d4e2-44ea-454a-855a-0229eeda4f4f.pdf#page=null> (Accessed: 11 January 2024).
- Department of Enterprise Trade and Employment (2022). Annual Employment Survey 2022. [online] Department of Enterprise, Trade and Employment, pp.1–61. Available at: <https://enterprise.gov.ie/en/publications/publication-files/annual-employment-survey-2022.pdf> [Accessed 2023].
- Department of Public Expenditure NDP Delivery and Reform (2020). Briefing Note: Compliance Cost Associated with 2020 & 2030 Climate & Energy Targets. [Accessed 2023]
- Enterprise Ireland (2022). Leading in a Changing World Strategy 2022-2024. [online] Enterprise Ireland. Available at: <https://www.enterpriseireland.com/en/Publications/Reports-Published-Strategies/Leading-in-a-changing-world-Strategy-2022-2024.pdf> [Accessed 2023].
- Environmental Protection Agency (2023). Ireland’s Provisional Greenhouse Gas Emissions 1990-2022. [online] Environmental Protection Agency, pp.1–31. Available at: [https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/2023-EPA-Provisional-GHG-Report\\_Final\\_v3.pdf](https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/2023-EPA-Provisional-GHG-Report_Final_v3.pdf) [Accessed 2023].
- Environmental Protection Agency (2023). News Releases 2023. [online] [www.epa.ie](http://www.epa.ie). Available at: <https://www.epa.ie/news-releases/news-releases-2023/ireland-projected-to-fall-well-short-of-climate-targets-says-epa.php#:~:text=Irelandpercent20willpercent20achievepercent20apercent20reduction> [Accessed 2023].

- EPA (2023) Ireland's Provisional Greenhouse Gas Emissions: 1990-2022. rep. EPA. Available at: [https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/2023-EPA-Provisional-GHG-Report\\_Final\\_v3.pdf](https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/2023-EPA-Provisional-GHG-Report_Final_v3.pdf) (Accessed: 2023).
- European Commission (2023). A Green Deal Industrial Plan for the Net-Zero Age. [online] European Commission. Available at: [https://commission.europa.eu/system/files/2023-02/COM\\_2023\\_62\\_2\\_EN\\_ACT\\_Apercent20Greenpercent20Dealpercent20Industrialpercent20Planpercent20forpercent20thepercent20Net-Zeropercent20Age.pdf](https://commission.europa.eu/system/files/2023-02/COM_2023_62_2_EN_ACT_Apercent20Greenpercent20Dealpercent20Industrialpercent20Planpercent20forpercent20thepercent20Net-Zeropercent20Age.pdf) [Accessed 2023].
- Hidalgo C, Balland PA, Boschma R, Delgado M, Feldman M, Frenken K, Glaeser E, He C, Kogler DF, Morrison A, Neffke F (2018) *The principle of relatedness. In: International conference on complex systems*. Cham: Springer, pp. 451-457.
- Hidalgo C, Klinger B, Barabási AL, Hausmann R (2007) The product space conditions the development of nations. *Science*, 317(5837), pp.482-48
- IDA Ireland (2021). Driving Recovery and Sustainable Growth 2021-2024. [online] IDA Ireland. Available at: [https://www.idaireland.com/getmedia/69a2499c-ac2b-45b7-a342-e57bfb42a2de/IDA\\_STRATEGY\\_Draft\\_15.pdf?ext=.pdf](https://www.idaireland.com/getmedia/69a2499c-ac2b-45b7-a342-e57bfb42a2de/IDA_STRATEGY_Draft_15.pdf?ext=.pdf) [Accessed 2023].
- Intellectual Property Office of Ireland (2022). Intellectual Property Office of Ireland Annual Report 2022. [online] Gov.ie, pp.1–44. Available at: <https://www.ipoi.gov.ie/en/about-us/ipoi-publications/annual-reports/intellectual-property-office-annual-report-a4-english-2022-digital.pdf> [Accessed 2023].
- Kren, J. Lawless, M (2023). Firm-level attitudes and actions to the 'Twin Transition' challenges of digitalisation and climate change. [online] Papers. Available at: <https://www.esri.ie/publications/firm-level-attitudes-and-actions-to-the-twin-transition-challenges-of-digitalisation> [Accessed 2023].
- Mealy, P. and Teytelboym, A. (2017) 'Economic complexity and the Green Economy', *SSRN Electronic Journal* [Preprint]. doi:10.2139/ssrn.3111644.
- Mealy, P. and Teytelboym, A. (2022) 'Economic complexity and the Green Economy', *Research Policy*, 51(8), p. 103948. doi: 10.1016/j.respol.2020.103948.
- MIT Technology Review (2023). The Green Future Index 2023. [online] MIT Technology Review. Available at: <https://www.technologyreview.com/2023/04/05/1070581/the-green-future-index-2023/> [Accessed 2023].
- Muench, S., Stoermer, E., Jensen, K., Asikainen, T., Salvi, M. and Scapolo, F. (2022). Towards a green & digital future. [online] JRC Publications Repository. Available at: <https://publications.jrc.ec.europa.eu/repository/handle/JRC129319> [Accessed 2023]. München, München, Vol. 17, Iss. 04, pp. 30-35
- National Competitiveness & Productivity Council (2023). Ireland's Competitiveness Challenge 2023. [online] pp.1–128. Available at: <http://www.competitiveness.ie/publications/2023/irelandpercent20competitive-nesspercent20challengepercent202023.pdf> [Accessed 2023].
- Nurlaela Arief, N., Gustomo, A., Rahman Roestan, M., Putri, A.N.A. and Islamiaty, M. (2022). Pharma 4.0: Analysis on Core Competence and Digital Levelling Implementation in Pharmaceutical Industry in Indonesia. *Heliyon*, [online] 8(8), p.e10347. doi: <https://doi.org/10.1016/j.heliyon.2022.e10347>.

- O’Clery, N. (2015) ‘A tale of two clusters: The evolution of Ireland’s economic complexity since 1995’, *Journal of the Statistical and Social Inquiry Society of Ireland*, 45.
- OEC (2021a). Ireland (IRL) Exports, Imports, and Trade Partners. [online] oec. world. Available at: <https://oec.world/en/profile/country/irl> [Accessed 2023].
- OEC (2021b). Denmark (DNK) Exports, Imports, and Trade Partners. [online] oec. world. Available at: <https://oec.world/en/profile/country/dnk> [Accessed 2023].
- OEC (2021c). Switzerland (CHE) Exports, Imports, and Trade Partners. [online] oec. world. Available at: <https://oec.world/en/profile/country/che> [Accessed 2023].
- OEC (2021d). Finland (FIN) Exports, Imports, and Trade Partners. [online] oec. world. Available at: <https://oec.world/en/profile/country/fin> [Accessed 2023].
- OECD (2019). Innovation and Business/Market Opportunities Associated with Energy Transitions and a Cleaner Global Environment Issue Paper Prepared by the OECD as Input for the 2019 G20 Ministerial Meeting on Energy Transitions and Global Environment for Sustainable Growth. [online] Available at: [https://www.oecd.org/g20/summits/osaka/OECD-](https://www.oecd.org/g20/summits/osaka/OECD-G20-Paper-Innovation-and-Green-Transition.pdf)
- [G20-Paper-Innovation-and-Green-Transition.pdf](https://www.oecd.org/g20/summits/osaka/OECD-G20-Paper-Innovation-and-Green-Transition.pdf) [Accessed 2023].
- Popp, D (2019): Promoting Clean Energy Innovation, ifo DICE Report, ISSN 2511-7823, ifo Institut – Leibniz-Institut für Wirtschaftsforschung an der Universität.
- Sbardella, A. (n.d.). Assessing EU green technological potential through Economic Complexity. [https://iri.jrc.ec.europa.eu/sites/default/files/2021-03/Sbardella\\_Policy\\_Brief\\_JRC\\_Green\\_Technologies\\_Economic\\_Complexitypercent20percentt28002percent29.pdf](https://iri.jrc.ec.europa.eu/sites/default/files/2021-03/Sbardella_Policy_Brief_JRC_Green_Technologies_Economic_Complexitypercent20percentt28002percent29.pdf), *Economics of Industrial Research and Innovation*, pp.1–14.
- Siedschlag, I, and Yan, W. (2021). Firms’ green investments: What factors matter? *Journal of Cleaner Production*, 310, p.127554. doi: <https://doi.org/10.1016/j.jclepro.2021.127554>.
- Siedschlag, I, and Yan, W. (2020): Green investments and firm performance, ESRI Working Paper, No. 672, The Economic and Social Research Institute (ESRI), Dublin
- Skilling, D. (2020) Frontier firms: An international small, advanced economy perspective. rep. Landfall Strategy Group, pp. 1–28.
- The Observatory of Economic Complexity (2021). The Observatory of Economic Complexity. [online] oec. world. Available at: <https://oec.world/en/profile/bilateral-product/semiconductor-devices/reporter/irl> [Accessed 2023].



## Appendix: Economic and Green Complexity

Measures of economic and green complexity have been used internationally to compare how countries are faring in the green transition. This section explores how Ireland compares to other countries in our current green productivity and our potential to diversify into green industry. We benchmark Ireland's complexity against the EU average and members of the Small Advanced Economies initiative (Denmark, Finland, Ireland, Israel, New Zealand, Singapore, and Switzerland). These countries are advanced economies by International Monetary Fund standards and have similar population sizes with roughly 5 to 10 million inhabitants. Small Advanced Economies (SAEs) have distinctive characteristics in their economic behaviour and performance and are more comparable to Ireland's performance on these indicators than larger economies.

The performance of internationally oriented sectors is central to each SAEs productivity performance as the domestic sector is constrained with a small market size limiting competitiveness as well as opportunities for scale and specialisation. Firms in internationally oriented sectors that expand into international markets drive productivity growth in SAEs. Many SAEs have a high number of large internationally engaged firms that have played a significant role in driving global engagement and productivity growth (Skilling, 2020).

### Economic and Green Complexity Data Limitations

Data presented in this chapter on Economic and Green Complexity indicators was retrieved from the [Green Transition Navigator](#). This data is among the only comparable data on green products and potential and allows us to examine how Ireland is faring compared to other similar countries. However, it should be noted that the data has a number of limitations.

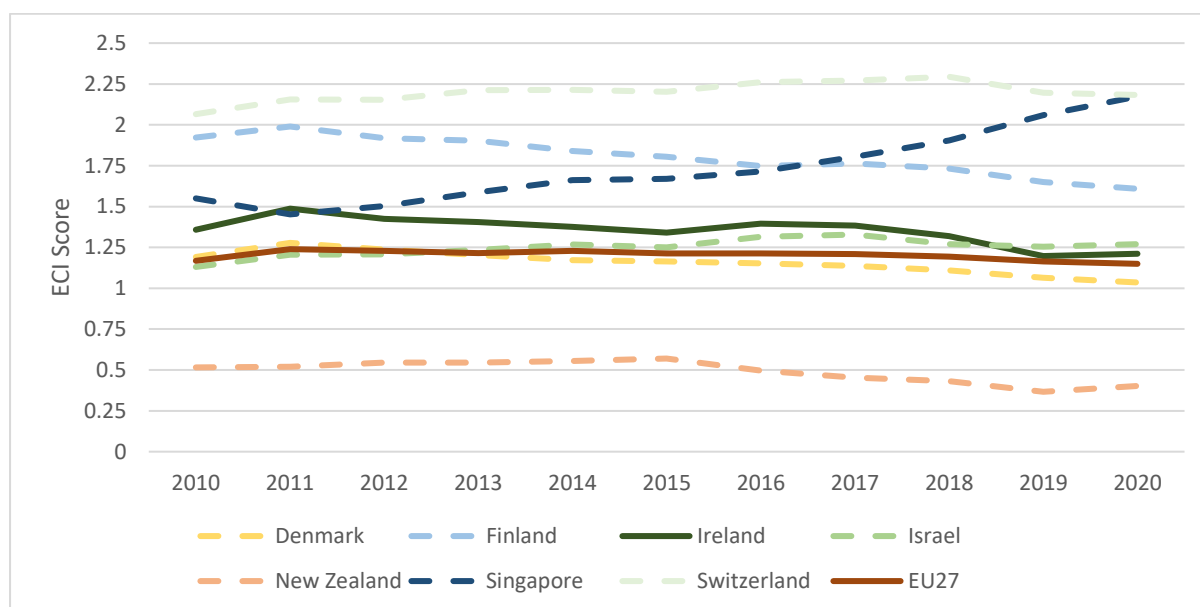
The data on trade in green products draws on existing lists from OECD, WTO, and APEC as an internationally accepted list of products with environmental benefits does not exist. Due to the structure of the associated classification systems some green products cannot be precisely specified. In addition, as some products are 'dual use', meaning they can have both environmental and non-environmental purposes, the analysis tends to somewhat over-estimate environmental trade volumes. The data also doesn't allow for an examination of the environmental impact of product production and use.

Finally, the data presented here only covers goods and does not represent the export of services by countries. This could potentially distort Ireland's ranking under these measures given the significant contribution of the services sector to Ireland's export performance.

### A.1 Economic Complexity

Figure A1 shows the Economic Complexity Index (ECI) score by country between 2010 and 2020. The ECI ranks countries according to the similarity of the products they are competitive in. The ECI estimates the productive knowledge of a country by looking at the diversity and ubiquity of the products it exports and how this relates to the diversity and ubiquity of products from other countries. Countries with a high ECI have strengths which are similar to other countries with a high ECI. High ECI countries tend to be advanced economies that are able to export technologically sophisticated products competitively.

**Figure A1: Economic Complexity Index by Country 2010-2020**



Source: Andres, P and Mealy, P (2023) Green Transition Navigator. Retrieved from [www.green-transition-navigator.org](http://www.green-transition-navigator.org).

Notes: Yearly Figures are based on 5-year averages.

Overall, Ireland’s performance has decreased on the ECI. In 2003 Ireland ranked 9th on ECI compared to other countries, in 2019 and 2020 Ireland ranked 27th out of over 220 countries. Ireland’s performance on the ECI ranks around the middle of the SAE’s. The ECI has decreased from a high of 1.5 in 2011 to just 1.2 in 2020. Ireland performs better than Denmark, New Zealand on ECI between 2010 and 2020. Ireland has a higher ECI than the EU average, albeit that due to Ireland’s decreasing performance, the gap between the two has narrowed considerably with just a .05 difference by 2020. Israel’s performance on the ECI had been on an upward trajectory with Ireland outperforming Israel on this measure until 2019. Ireland’s decreasing ECI suggests that we are either losing high complexity products or gaining low complexity products (or some combination of these factors). It is, however, important to note that the measures of complexity presented here are only concerned with exported goods and therefore do not capture Ireland’s large service sector (i.e., ICT).

The high performing countries as seen above include Denmark, Switzerland, and Finland. Finland is producing many complex products which include chemical wafers doped with elements to produce semiconductors. These products score highly on the Product Complexity Index (PCI) of 1.91. (OEC, 2021d) Denmark are also producing a high volume of complex goods with a large emphasis on metalworking machinery. This machinery is used to make other goods and has a PCI of 1.88. (OEC,2021b) Finally, Switzerland, has a large focus on exporting Metalworking Transfer Machines. These machines have a PCI of 2.18 and rank 2<sup>nd</sup> on the PCI out of 1024 goods. (OEC, 2021c) Some of Ireland’s most complex products include Blank Audio Media for the recording of sound and chemical analysis instruments. The Blank Audio Media has a PCI of 1.79 and the Chemical Analysis Instruments has a PCI of 1.65. (OEC,2021a)

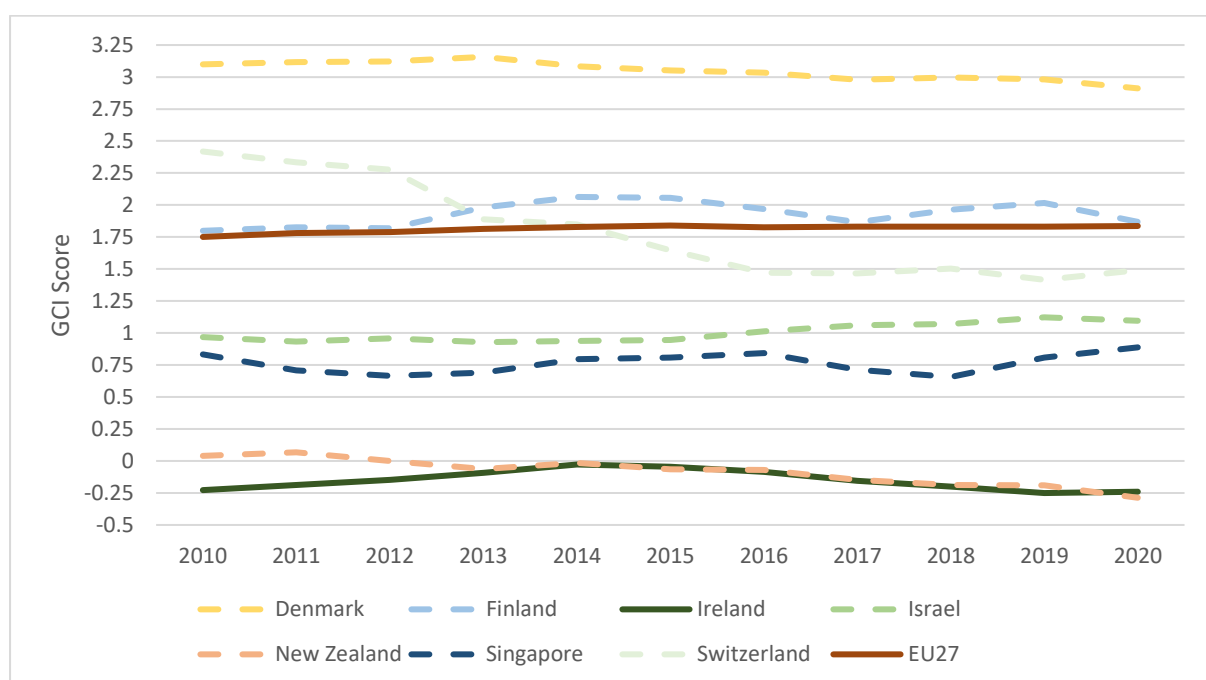
## A.2 Green Complexity

The Green Complexity Index (GCI) aims to estimate a country’s green production capabilities based on the number and the product complexity index of green products they are competitive in. GCI has been found to be correlated with GDP and captures variation in different environmentally relevant variables (Mealy & Teytelboym, 2017). Countries that rank highly on the GCI have been shown to have higher

rates of environmental patenting, lower CO2 emissions and more stringent environmental policies (ibid). However, it is important to note that while GDP and GCI are correlated, GDP is not a factor in the calculation of GCI and therefore has no effect on how a country performs in the GCI.

Despite ranking 27th in ECI in 2020, Ireland ranked 82nd in the Green Complexity Index. Looking at Figure A2 we see that Ireland performs the poorest of SAE countries alongside New Zealand. Denmark performs significantly better than other SAE countries and ranks 8th in all countries overall. GCI scores remain relatively static between 2010 and 2020 except for Switzerland which has seen a sharp decline from 2.4 in 2010 to 1.5 in 2020. The findings suggest that although Ireland can export technologically sophisticated products, its exports are generally not perceived as ‘green’ products. However, as DETE did not have access to the microdata associated with this analysis we do not have a record of the exact types of ‘green’ products included in the analysis.

**Figure A2: Green Complexity Index by Country 2010-2020**



Source: Andres, P and Mealy, P (2023) Green Transition Navigator. Retrieved from [www.green-transition-navigator.org](http://www.green-transition-navigator.org).  
Notes: Yearly Figures are calculated based on rolling five-year averages.

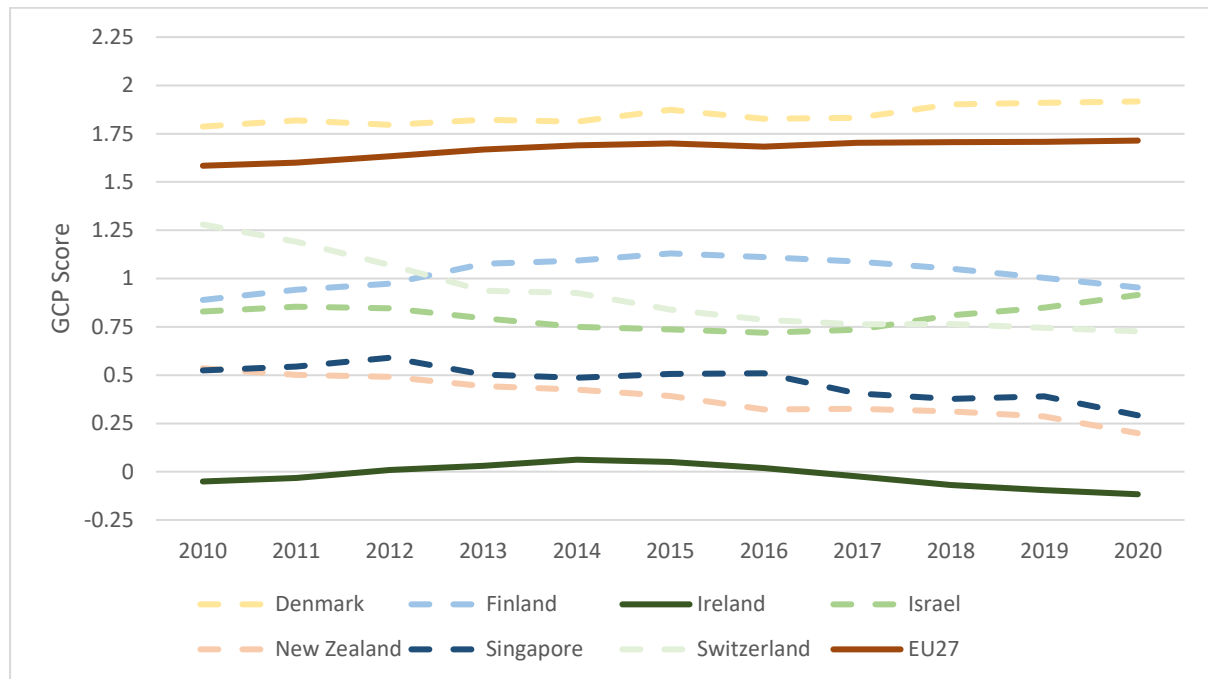
### A.3 Green Potential

A major concern for Irish policymakers is not just Ireland’s competitiveness in the green economy but also its future potential to diversify and become competitive in green technologies and products. We next consider the Green Complexity Potential (GCP) of countries to examine the potential a country has to diversify into green complex products in the future based on the proximity and complexity of the products it is not yet competitive in. Previous research has shown that it is easier for countries to transition into new products and industries that involve skills and capabilities that are like those they already possess (Hidalgo et al., 2007; Hidalgo et al., 2017).

Countries with a high GCP have a wide number of complex green exports that they can diversify into in the future relatively easily. GCP has also been shown to predict future increases in a country’s GCI, green export share, and green competitiveness, even after controlling for GDP. Ireland ranks the poorest of all SAE countries and has had a negative score since 2017. Overall Ireland ranked 94<sup>th</sup> in

GCP in 2020. There is a large difference between the GCP for Ireland and the EU average suggesting that Ireland may be an outlier in a European context.

**Figure A.3: Green Complexity Potential by Country 2010-2020**



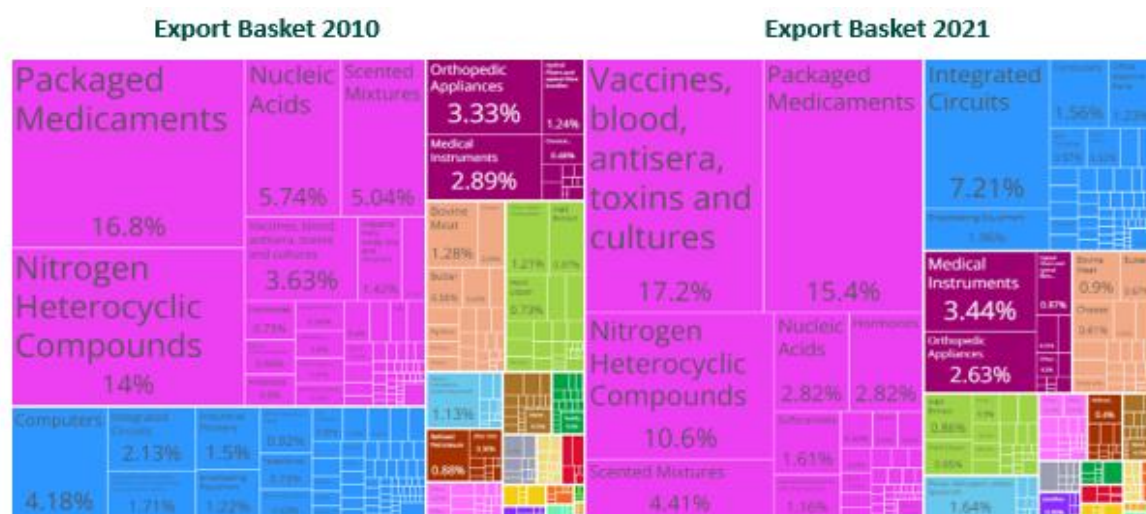
Source: Andres, P and Mealy, P (2023) Green Transition Navigator. Retrieved from [www.green-transition-navigator.org](http://www.green-transition-navigator.org).

Notes: Yearly Figures are calculated based on rolling five-year averages.

The findings on GCI and GCP suggest that Ireland is currently at a relative disadvantage compared to other countries in relation to the green transition. However, in order to ensure scores are comparable across countries, the green complexity measured included here only included products which are said to have a Revealed Comparative Advantage. A product is exported with RCA when the relative share of a country's exports in the product exceeds the global share of exports in that product. Ireland has become increasingly specialized in its exports, exporting fewer and fewer products with RCA over the years (O' Clery, 2015). This behaviour contrasts that which is typically observed for developed countries which tend to be highly diversified. Ireland's level of diversification is extremely low compared to its level of GDP. O' Clery (2015) notes that Ireland's level of specialization is increasing due to the expansion of the pharmaceutical industry and is now approaching countries with highly specialized exports such as Norway whose main export is petroleum.

Figure A.4 shows Ireland's export baskets in 2010 and 2021. Whilst Ireland's export basket has consistently relied on electronics, pharmaceuticals and food and agriculture produce, a shift in the composition of our export baskets is evident in recent years with a huge growth in the share of pharmaceuticals and a decline in electronics and food.

Figure A.4: Ireland's Export Baskets (2010 & 2021)



Source: [OEC Ireland Profile](#) (accessed December 2023).

In 2022, Chemicals & Related Products accounted for 64 percent of total exports with Medicinal & Pharmaceutical Products making up 38 percent of our total exports (CSO, 2023). Machinery and Transport equipment were Ireland's second largest export accounting for roughly 14 percent of exports. Due to the highly specialized nature of Irish exports the diversity of the products we export with revealed comparative advantage is low. The current products Ireland is producing and exporting likely have a specialised or narrow skill set which cannot be easily transferred. It has been reported by (Nurlaela Arief et al., 2022) that the pharmaceutical sector requires many technical and soft skills which are specific to the sector. As the pharmaceutical sector is one of Ireland's main export sectors, these skill sets, or infrastructure used for this may not be transferable to create green products. As microdata was not available for this paper, it is challenging to determine which skills and abilities high performing countries have which Ireland does not.

However, it must be acknowledged that green products are challenging to identify. Green products can be described as products which consist of activities which produce goods and services to measure, prevent, limit, minimize or correct environmental damage to water, air, and soil, as well as problems related to waste, noise, and eco-systems. In addition, products which can be considered as green can also be used for non-environmental protection purposes. (Mealy and Teytelboym, 2022). Ireland currently exports a large proportion of technically sophisticated semiconductors which accounted for \$139 million in semiconductor devices in 2021 (The Observatory of Economic Complexity, 2021). These semiconductor devices are not typically considered as green products but are an essential component in the network of renewable energy sources such as wind-turbines and photovoltaic cells (Backlund and Rahimo, 2010). While semiconductor production is a highly resource intensive process, they could potentially be considered one of Ireland's green products in the future. This further highlights the gap between what may or may not be considered green products. The concentration in Ireland's enterprise mix is one of the risks outlined in the 2023 National Risk Assessment.

The report highlights how the lack of diversification among our enterprise base could expose the country to risks associated with macroeconomic trends in trade and investment and policy changes in other countries. The findings on GCI and GCP suggest that the concentration of our enterprise base also has negative consequences on our ability to expand into a green economy. Future investment

into the green economy should focus not only on developing new green sectors but also 'greening' our existing sectors.