

The Irish Climate Tech Opportunity 2024



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PwC Foreword

The need to tackle climate change has never been more urgent. With global temperatures consistently rising and important carbon targets approaching, immediate and united action is crucial. Climate Tech innovation is key to this effort, offering solutions to help us reach our net zero goals. Irish entrepreneurs are making a big impact with their Climate Tech solutions, addressing both local and global issues.

This year's report builds on last year's progress, showing both our advancements and ongoing challenges. The report highlights the growing Climate Tech sector on the Island, with contributions from companies in both the Republic and Northern Ireland.

2024 is a critical year as we navigate geopolitical uncertainty and economic volatility. New regulations like the Corporate Sustainability Reporting Directive (CSRD) and its associated European Sustainability Reporting Standards (ESRS) are providing a

focus on carbon accountability, creating both challenges and opportunities. While Climate Tech continues to grow steadily, we must address funding gaps and capacity issues to speed up progress towards our net zero goals.

This report offers a snapshot of the Island of Ireland's Climate Tech sector, spotlighting key players and their work. It also stresses the need for a central hub on the Island of Ireland that brings together entrepreneurs, investors, researchers, government, and businesses. To lead in Climate Tech innovation, the time to act is now.

We are proud to continue working with SustainabilityWorks, whose expertise has been vital in advancing Ireland's Climate Tech sector. Special thanks to Aideen O'Hora for her significant contributions over the past decade. Together, we look forward to driving more progress and discovering new opportunities in Ireland's Climate Tech field.



David McGee,
PwC



Cat McCusker, PwC



SustainabilityWorks Foreword

As the world faces complex challenges and economic uncertainty, tackling climate change is more urgent than ever. The effects of climate change are clear and will far outweigh the costs of not acting, so we need strong action to meet our climate goals. Climate Tech is essential in this effort, helping us work towards net zero emissions.

This report provides a clear overview of Ireland's Climate Tech ecosystem, outlining the challenges and opportunities to move from a nascent to a mature ecosystem. It's inspiring to see how entrepreneurs on the island of Ireland are working together to fight climate change.

Climate Tech has experienced steady but slow growth over the past decade, but some countries and cities are taking significant strides to establish themselves as Climate Tech hot spots. They are successfully connecting the dots to address challenges around capacity building, access to funding and creating market confidence. Recent

regulations such as CSRD and the associated ESRS also bring greater emphasis to carbon accountability.

At SustainabilityWorks, we view the shift to a greener world as a significant opportunity, not just a problem. Ireland has quantified its greenhouse gas (GHG) emissions and developed a detailed plan to reduce them. While the plan concentrates on solving the issue, we aim to go beyond that by identifying and leveraging opportunities. We believe that Climate Tech investment should be a standard practice in a low-carbon economy.

We look forward to continuing our work with PwC and are excited about what we can achieve together. This report acknowledges progress and challenges, setting the stage for the future of Climate Tech in Ireland. We would also want to thank the Climate Tech entrepreneurs and the investor community for their contributions and insights.



Aideen O'Hora,
SustainabilityWorks



Laura Heuston,
SustainabilityWorks





Introduction





In this, our second Irish Climate Tech Opportunity Report, we are delighted to once again showcase the scale and diversity of the Climate Tech ecosystem across the Island of Ireland. It is incredibly encouraging to witness so many entrepreneurs driving innovation and creating value while tackling the greatest challenge of our time.

Our report acknowledges that Climate Technology plays a critical role in addressing the growing challenges of climate change. Science now recognises that we will fail to meet the Paris Accord targets of 1.5°C. Minimising global temperature rise and reversing the buildup of atmospheric emissions will demand a level of innovation and invention on a scale we have yet to witness.

Our report celebrates the wide diversity of the Climate Tech community on the island of Ireland. This year we have profiled 22 companies in the main body of the report. Despite this progress, a significant gap remains to be addressed. Ireland Inc has a genuine opportunity and a strong “right to win” in this space. In last year’s report, we called for consideration to be given to the Danish example of “State of Green”. We

acknowledge that nearly all companies featured in the report have benefited from some form of state support – whether through direct grants or funding, or through assistance from the university sector and early-stage incubators.

The State can—and should—do more. This is not only a climate imperative but also a compelling economic opportunity. It presents the Republic of Ireland with the opportunity to develop a new economic sector while simultaneously tackling the critical challenge of decarbonisation. To truly exploit the opportunity, we would urge the state to officially recognise Climate Tech as a distinct sector and to prioritise targeted funding, particularly for early-stage entrepreneurs.

Sustained commitment to Climate Tech innovation in uncertain times

We are falling short in our efforts to address climate change. The PwC Net Zero Economy Index 2023 highlights that globally we need to decarbonise at a 17.2% annual rate – despite having typically only achieved a 2.5% rate.¹ We are simply not decarbonising our economies quickly enough. In June 2024, the global average surface temperature was at or beyond 1.5°C pre-industrial levels for the twelfth consecutive month.²

In 2023, we recorded the hottest year on record, underscoring the urgent need for climate action. To address global warming, safeguard vulnerable populations, and manage the financial impacts of extreme climate change—both physical and transition risks—it is crucial to invest in adaptation measures. Surprisingly, only 3.6% of global Climate Tech funding between 2019 and 2023 went to adaptation finance, roughly equating to \$11.9 billion.³ The increasing occurrences of heatwaves, floods, and crop failures globally emphasise the critical need for increased investment in climate adaptation strategies. To put this into

perspective, “between 1980 and 2022, weather and climate-related extremes caused economic losses of assets estimated at EUR 650 billion in the EU Member States, of which EUR 59.4 billion and EUR 52.3 billion occurred in 2021 and in 2022 respectively.”⁴

We are already seeing the physical impact of climate change as well as the geopolitical impact. The science is colliding with economics and politics as the impending challenge of a global climate emergency causes stress on supply chains, population and migration patterns, and global security. Climate change, one of the greatest challenges of our era, is already underway. The impacts of climate change are increasingly evident, and the urgency to reduce greenhouse gas (GHG) emissions and adapt to a shifting climate is growing. Approximately 88% of global emissions are now covered by a net zero carbon target.⁵ The deadlines for meeting carbon targets—whether set for 2030 or 2050—are rapidly approaching. This reality is well understood by policymakers, innovators, investors, and society.

Achieving net zero goals will necessitate significant funding. Reengineering global value chains will be a costly endeavour, requiring investment on a scale comparable to several years of global GDP. However, many aspects of this challenge still lack clear technical solutions. The inventors, innovators, and entrepreneurs within the Climate Tech sector are bridging that gap, developing the solutions needed to help us meet and reverse our emissions.

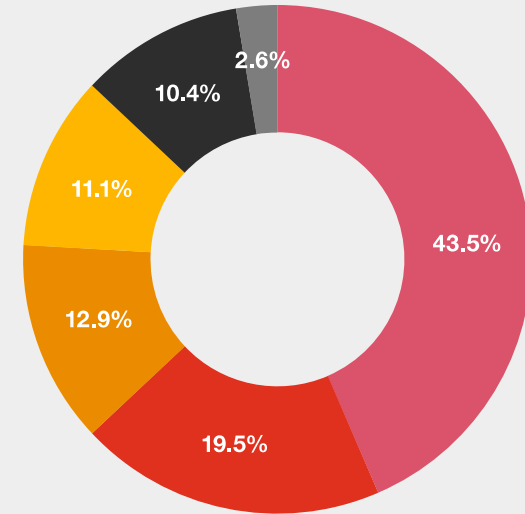
Republic of Ireland's GHG carbon emissions gap

Under the *Climate Action and Low Carbon Development (Amendment) Act 2021*, the Republic of Ireland is committed to reducing its GHG emissions by 51% by 2030 (relative to the 2018 baseline) and achieving net zero by 2050. These targets are aligned with the European Green Deal, which also commits to being climate-neutral by 2050. It further aligns with the agreement reached at COP28 to reduce emissions by 43% by 2030⁶ and to accelerate emissions reductions towards net zero by 2050.

The latest Climate Action Plan (2024) is the third annual update to the Climate Action Plan 2019, and it aligns with legally binding carbon budgets and sectoral emissions ceilings approved and agreed respectively by the Government in 2022. According to Ireland's most recent GHG emissions inventory, agriculture, transport, and energy are the sectors that emit the most greenhouse gases.

Ireland is nearing the 5-year mark to halve global climate emissions and faces a substantial challenge in meeting its legally binding net zero targets under the European

Ireland's 2023 greenhouse gas emissions by Climate Tech sector (%)



- FALU (Agriculture + Land Use, Land Use Change and Forestry)
- Mobility and Transport
- Energy
- Built (Residential, Commercial Services, Public Services)
- IMRM (Manufacturing + Industrial Processes)
- Other

Note the figures presented in this graph uses EPA 2023 data sets which have been analysed in a way that aligns to the sectors in this report.

Source: Environmental Protection Agency, Ireland's Provisional Greenhouse Gas Emissions, 1990-2023, July 2024



Green Deal. Based on implementation measures in the government's Climate Action Plan 2024, the EPA warns that the Republic of Ireland is set to reduce its total greenhouse gas (GHG) emissions by 29% in 2030 compared with its target of 51%.⁷

At the time of writing this report, the Northern Ireland Executive has recently published a draft Programme for Government, in which there is commitment to publish a new environment strategy, set carbon budgets and develop the region's first Climate Action Plan, which is welcomed.

We argue that fostering and supporting the Climate Tech sector will not only assist the state in meeting its legally binding targets but also provide economic benefits. Many of these companies will pursue international markets, enabling us to build a robust Climate Tech sector that drives GDP growth while advancing our climate goals.



Think local, go global

Ireland, a leading hub of innovation, continues to make an impact greater than its size. In the context of this global activity, we identified over 300 pure-play Climate Tech companies on the island of Ireland. Building on 2023 data, the energy sector continues to be the most popular with entrepreneurs and investors, but we are now beginning to see more Climate Tech companies emerge with solutions to tackle the decarbonisation of the Mobility & Transport and Industry, Manufacturing and Resource Management (IMRM) sectors.

A trend emerged as part of this report, that while Ireland's entrepreneurs innovate and hire on home soil, the reach of their products and services extend far beyond the island. Close business relationships with the UK and US continue, and the strength of presence in the European market, the Middle East, Australia, and Japan was apparent.

The perseverance and courage of Ireland's Climate Tech entrepreneurs to have a positive impact were obvious and should not be underestimated.

The creativity of the sector is leading to new software, new patents, new industrial techniques and new processes – all of which accumulate to a storehouse of knowledge. The State has previously targeted supports at the Fintech and Medtech sectors. We argue that further support for the recognition of the Climate Tech sector would be a massive boost to the nascent ecosystem.

“Climate Tech can drive Ireland's economy for the next 20-30 years. With its renewable energy and skilled workforce, Ireland is an ideal test bed for innovation. The government should prioritise this sector to make Ireland a global hub for Climate Tech, like California and Germany.”

Ali Lumsden, Temporis Capital

Investing in the green economy

While the current level of climate ambition from both government and corporate sectors is high, there remains a significant gap between ambition and action. Governments frequently encounter challenges in implementing climate policies, including misalignment between climate and planning legislation, higher costs for climate-friendly solutions compared to fossil fuel alternatives, and the strong influence of the fossil fuel industry. Even companies that have pledged to achieve net zero emissions often struggle to fully integrate sustainability into their core business models, cultures, and accountability systems. There is no single solution to address these complexities. The commitment from policymakers, corporations, investors, innovators, and society must remain steadfast and be harnessed to drive collaborative climate action.

The investment landscape for Climate Technology is evolving. While venture capital and private equity are important, they alone cannot provide the large-scale investment required to reduce greenhouse gas emissions and adapt to climate change. Government funding will continue to play a

crucial role in reducing emissions from industries that require significant capital expenditure. The recent announcement by the Irish Government of a €14 billion Infrastructure, Climate and Nature Fund, funded by a portion of corporate taxes and available for projects between 2026-2030, is encouraging⁸.

From an investor perspective, a volatile macroeconomic environment has slowed deal activity. However, this global fall in investment appears to reflect uncertain market conditions as opposed to a move away from Climate Tech⁹, which has had steady growth for over ten years. Overall, Climate Tech investment has been strong compared to other sectors, such as Fintech, and it is the second largest pool of investment after AI.

Global Climate Tech VC fundraising for H1 2024 looks stronger than that of 2023, with \$3.4 billion raised as of June, compared with \$3.9 billion in the whole of 2023¹⁰.

Achieving net zero emissions by 2050 will require a broad spectrum of innovations across all industries. While some of these technologies are already available, it is essential to nurture and commercialise a

pipeline of climate innovations to ensure progress in the years ahead. Irena Spazzapan of Systemiq Capital noted that *“Many of the innovations coming to market are first-of-a-kind (FOAK) solutions. Beyond initial research and seed funding, there are no large pools of capital with a mandate to take significant technology risks”*¹¹

This creates funding challenges for many early-stage entrepreneurs, particularly when transitioning from proof-of-concept to commercial deployment. The challenge—and opportunity—lies in identifying faster pathways to revenue for these companies, enabling them to scale and grow rapidly.

Two years ago, the US Inflation Reduction Act¹² boosted investment in Climate Tech and infrastructure. The CHIPS and Science Act, signed in 2022, directed new funding to semiconductor research and manufacturing. These Acts have generated over 100,000 jobs in the USA and supported key climate-aligned technologies like batteries, EVs, and solar, which are sectors in which the USA specialises. Investors are clear that many Climate Tech companies have been lured to set up in the USA due to these generous subsidies, grants, and tax breaks for climate, as well as the fact that many regions in the

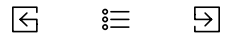
USA are now dynamic hubs for climate entrepreneurship. Equally, the EU’s Green Deal Industrial Plan presented in early 2023 aims to enhance the eurozone’s net zero industry competitiveness by scaling the manufacturing capacity for net zero technologies through simplified regulation and better access to finance, in order to meet the continent’s ambitious climate targets.¹³ Both examples demonstrate how aligning climate and industrial policy can drive economic growth by providing entrepreneurs and investors with long-term support.

The level of decarbonisation needed to meet EU legislation is unprecedented. Technology can help bridge the gap, but it requires adequate government support to ensure that scaling Climate Tech companies have access to adequate R&D and growth capital.

Tax Spotlight:

Tax policy is a critical lever available to the Irish Government to address the risks of climate change, to influence behavioural change and to mobilise private investment. The 2024 Climate Action Plan explicitly recognised the role that tax policy can play and there is now evidence (in particular in the US market as a direct result of the US Inflation Reduction Act) that tax policy can be used very successfully to mobilise the investment that is needed to develop and commercialise new climate technologies. It is clear that we need to accelerate investment in this area if we are to make meaningful progress towards our climate targets and Ireland must act now if we want to be successful in tapping into the significant economic opportunity that our energy transition presents. At PwC, as part of our pre-budget submission this year, we have identified a number of potential tax policy improvements and direct assistance (grants) which we believe could help the development and scaling of a climate tech hub in Ireland. The introduction of tax reliefs for corporates investing into companies setting up innovation hubs focused on the development of new green, clean-tech technologies is one example of a positive tax incentive, alongside a call to simplify and fast track access to grant funding, in particular for the SME sector.

Paraic Burke, PwC Ireland Tax Leader



A spotlight on Irish Climate Tech

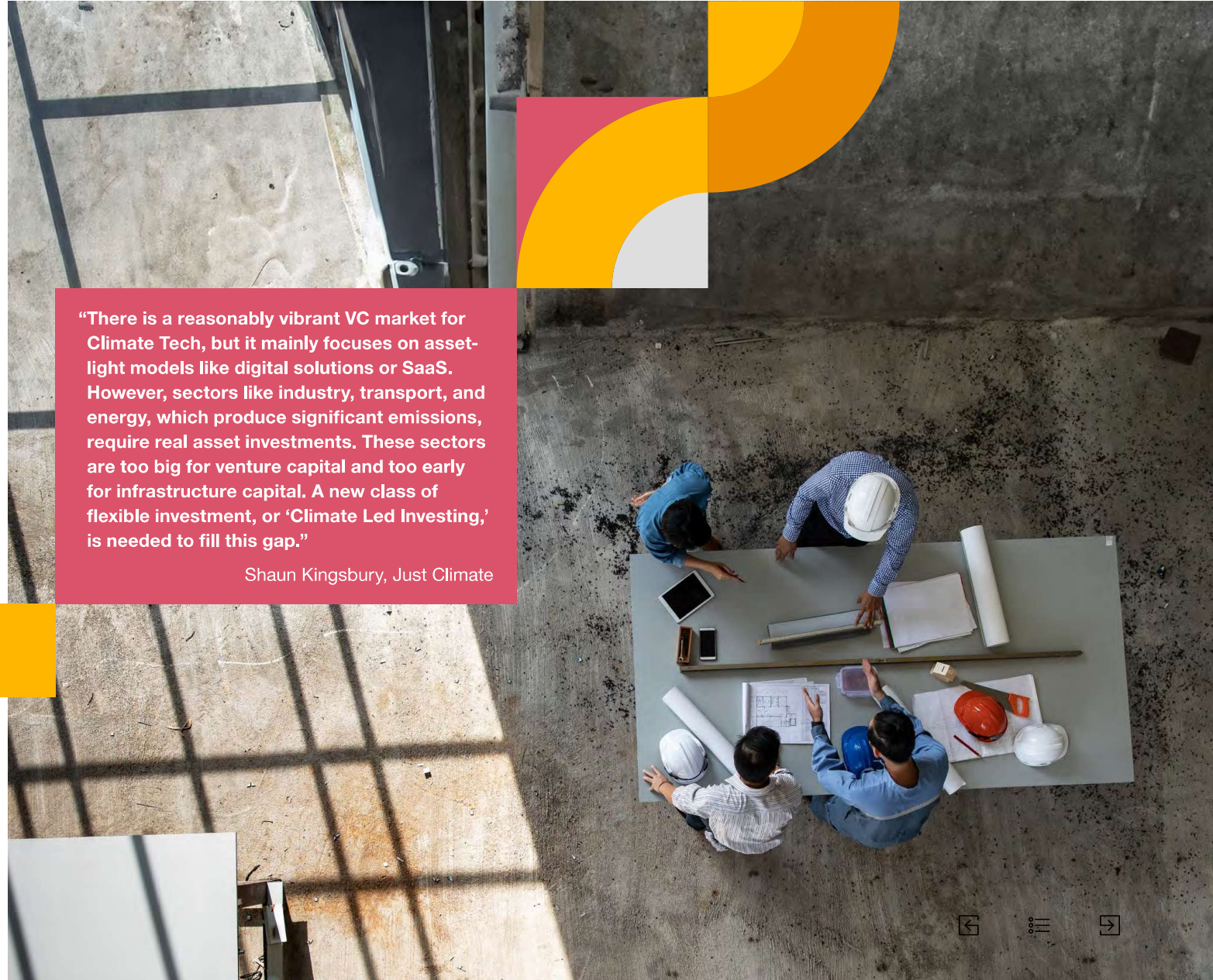
This report highlights some of the innovative Climate Tech entrepreneurs on the island of Ireland across key sectors who are creating unique solutions to address the impacts of climate change and advance the goal of net zero.

The report aims to draw attention to:

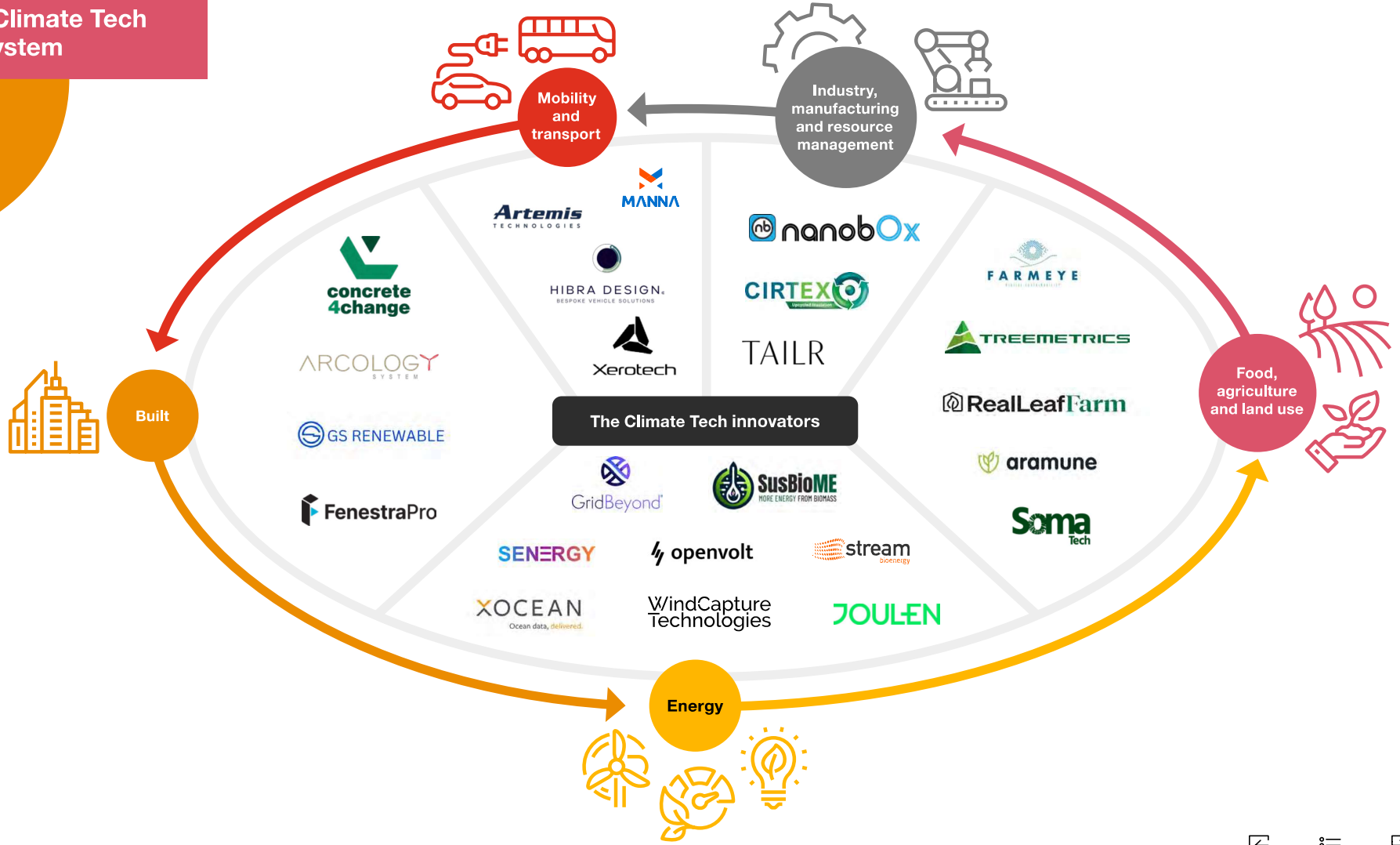
- The breadth and scale of the Climate Tech sector are remarkable, with over 300 companies developing innovative solutions to tackle climate change.
- While our first report highlighted the strength of the Climate Tech ecosystem, this report argues that the sector has developed largely without formal support. Recognising and offering targeted support could amplify the already strong foundation that exists.
- Investing in and supporting this sector will not only deliver economic returns for the state, but also advance the achievement of our national climate action plan.

“There is a reasonably vibrant VC market for Climate Tech, but it mainly focuses on asset-light models like digital solutions or SaaS. However, sectors like industry, transport, and energy, which produce significant emissions, require real asset investments. These sectors are too big for venture capital and too early for infrastructure capital. A new class of flexible investment, or ‘Climate Led Investing,’ is needed to fill this gap.”

Shaun Kingsbury, Just Climate



Irish Climate Tech Ecosystem



1. Energy

Today, the world invests almost twice as much in clean energy as it does in fossil fuels¹³



State of Play

The radical transformation of the energy landscape which powers the global economy is now underway. The world invests almost twice as much in clean energy as it does in fossil fuels¹⁴, as evidenced by the rapid expansion of renewable sources like wind and solar power worldwide. However, the challenge to decarbonise the sector is complex and affects every aspect of life, with every industry playing a crucial role. Heavy industries such as construction, logistics, and mining have vast power needs, and the world's global electricity demand is rising at its fastest rate in decades, with demand forecast to grow 4% in 2024.¹⁵ Moving towards greener energy sources and reducing demand will help create stable, affordable energy systems that provide equitable access for future generations.

As the third largest contributor to overall emissions in the Republic of Ireland, energy accounts for 12.9%¹⁶, yet it has made significant progress in reducing these emissions. According to the Environmental Protection Agency (EPA), the sector saw a 21.6% decrease in 2023 - the largest annual reduction ever recorded.¹⁷ This achievement was primarily driven by a higher share of renewable energy (mainly wind power), a 12-fold increase in imported electricity and a reduction in the use of coal, oil, and peat.¹⁸ These trends are essential for meeting climate targets, as they illustrate a shift from fossil fuels to cleaner energy sources. In addition, there is momentum on the use of carbon capture and storage, the power of hydrogen, and energy management for efficient and resilient systems. While commitments and actions by governments are growing, the pace and deployment of technologies required for decarbonisation is on a level never seen before. Harnessing renewable energy holds the key to unlocking the biggest challenge of our time.

INVESTMENT PERSPECTIVE

Continued investment and policy support for renewable energy and energy efficiency will be vital to maintaining and accelerating this progress. Some advancements in this can be seen across the sector, with small-scale renewable energy systems, including rooftop solar and battery storage, becoming more affordable. A current trend is that energy storage and demand responses are evolving and becoming more sophisticated. Climate Tech businesses that better match energy supply and demand in real-time and have the capability of adjusting economically show strong investment potential, so there is a focus on a wide range of grid technologies and services, including virtual power plants (VPPs), demand response and energy storage. The continued global decarbonisation of the electricity grid system underpins increased investment in EV technologies. Things to watch out for include locational pricing, bulk demand shifting, and technologies that alleviate grid constraints, intelligent EV charging, and the electrification of public transport.

Data centres in the Republic of Ireland use 21%¹⁹ of the country's power, while the global average is around 1%.²⁰ We live in an increasingly digitalised world, and so our reliance on data centres will increase. Rather than ignore the challenge, there is a unique opportunity for Ireland to lead the way in achieving net zero energy use in data centres and in shaping policy discussions on reducing the carbon footprint of big tech companies, going beyond Power Purchase Agreements, while ensuring continued alignment with the principles of the Science-Based Targets initiative (SBTi) and GHG Protocol. Investors Systemiq Capital and Wake-Up Capital suggested that Ireland has the potential to bring together key stakeholders to address challenges and find solutions transparently.

The recent launch of the Future Framework for Offshore Renewable Energy, the Republic of Ireland's offshore energy strategy, along with the establishment of the Marine Area Regulatory Authority (MARA) are positive steps towards accelerating offshore planning and progressing Ireland's offshore renewable energy sector.²¹ Many Irish companies are beginning to take charge of the development of offshore renewables, and one such company, **XOcean**, was featured in the 2023 report. XOcean is an ocean data measurement and reporting company which uses uncrewed surface vessels (USVs) to map the seabed and provide vital insights for the offshore wind industry to continue growing. XOcean is going from strength-to-strength, having doubled its workforce in the past year and secured €30m in their last funding round.²² This funding will accelerate the company's international growth and drive further technical innovation.

Alumni of the 2023 report, **My Gug**, a Cork-based food waste-to-energy start-up, raised €900,000 in seed funding from BVP and Enterprise Ireland. The funding builds on previous seed investment, and it will assist the firm's expansion into the UK and Europe.²³

Another notable mention from our 2023 Report is **Supernode**, which announced in mid-2023 that it was investing €40 million in research activities.²⁴

Wind Capture Technologies

University friends Aaron Boylan and Ronan Hearne co-founded Wind Capture Technologies in 2022, with a personal aim to contribute half a gigaton of carbon removal per year by 2050 using their technology. The start-up is developing retrofit proprietary wind turbine blades that capture carbon dioxide from the air that flows through the turbine. While the turbine continues to generate power from the wind, carbon dioxide is purified and regenerates the chemical used to capture it. They intend to utilise the existing wind farm infrastructure for rapid deployment. They are advocates of doing business in Ireland with the growing support they have received from Trinity College Dublin, Enterprise Ireland and other angel investors as a Climate Tech start-up. Aaron Boylan highlights that *"as a planet we need to remove colossal amounts of carbon dioxide from the air"*, and their technology which is still in development stages, aims to solve this by creating a self-powered carbon capture cyclical process.

SusBioMe

According to the EU Commission, bioenergy accounts for 59% of the EU's renewable energy consumption.²⁵ Biomethane is a purified version of biogas, produced from the breakdown of organic matter such as crops, livestock waste, forestry and food waste. The EU's biomethane production needs to reach 35 billion cubic metres (bcm) per year by 2030 to achieve energy security and transition away from fossil fuels. Dr. Ajay Menon of SusBioMe, an Enterprise Ireland UCD Commercialisation project, explains how his team is developing technology for use in the anaerobic digestion process to increase renewable gas yields by up to 30% from biomass. The university spin-out intends to launch in 2025. A major challenge with anaerobic digestion is that feedstock cannot be digested well, leading to unrealised gas yields. SusBioMe's technology breaks down the feedstock rapidly and efficiently to address this gap. The plug-in platform technology is also feedstock agnostic (e.g. grass, silage, water effluents) which is beneficial due to the variability and seasonality of organic feedstocks and wastes. This also harnesses the potential to leverage food waste for energy, given Ireland produces over 12% more waste than the EU average per capita.²⁶



Openvolt

Dublin-based Open Volt intends to unlock access to data from two hundred million existing smart meters across Europe and provide a holistic view of how we consume electricity. After launching in 2023 and raising €1.5m in pre-seed round funding supported by Berlin-based VC Cavalry Ventures,²⁷ founders Dave Curran and Don O’Leary are wasting no time in their mission of accelerating the next wave of energy innovation. Open Volt’s API software can be used in any commercial and residential buildings that have a smart meter installed, providing a range of businesses with rapid and accurate carbon emissions data and support property owners to decarbonise their buildings. It is expected that global electricity demand will rise at a faster rate over the next three years,²⁸ growing by an average of 3.4% annually through 2026 as the world races towards net zero. Open Volt can support the energy transition by providing access to granular data to inform and optimise energy use.

Stream Bio Energy

Stream Bio Energy is a leader in Biogas on the island of Ireland. Specialising in large-scale waste-based biomethane plants, the company utilises anaerobic digestion technology to convert organic materials into renewable energy. Founded in 2009, the company has developed several large biogas plants and is about to start constructing a new site in Little Island, Co. Cork, which will process 90,000 tonnes of food waste from Ireland’s brown bins. They are also processing poultry litter in their Northern Ireland plant and distillery waste in their Glasgow plant.

Founders Kevin Fitzduff and Simon Bessant have over 25 years in the renewable energy sector, which included wind farms, before shifting their focus to biomethane. They have experienced rapid growth over the past 18 months and intend to continue expansion across Ireland, the UK and potentially the US. As biomethane is chemically identical to natural gas, it can be injected into existing networks, offering a practical solution for reducing carbon emissions and securing a clean energy future. Kevin noted how policy is moving in the right direction but acknowledged that the speed of implementation remains the most significant barrier to change on the journey to net zero.

GridBeyond

GridBeyond's vision is to build a shared energy economy that supports the transition to a net zero future. They provide technological solutions to businesses to manage their energy resources, including demand-side response, which adjusts electricity use in real-time to help balance the electricity system. The platform has connected grid operators and leverages artificial intelligence (AI) for effective energy management, creating savings and driving sustainability and resilience.

Following a successful €52M Series C funding round in 2024, they continue to evolve their AI-powered Virtual Power Plant (VPP) platform, which provides a full suite of tools to manage, optimise, and monetise energy assets for energy price and carbon.

Unlike traditional solutions, the platform combines accurate forecasts, smart trading strategies, and real-time analysis to provide valuable insight and control. Following their acquisition of Denver-based software firm Veritone's Energy business,²⁹ this capital raise will also help expand their US market presence alongside operations in the UK, Ireland, Australia, and Japan's recently deregulated energy market. Blackouts are an increasing risk for Britain and many countries in Europe, highlighting the importance of digital infrastructure in electricity grids as our reliance on renewable energy sources soars. Grid Beyond helps to ensure a better match of supply and demand³⁰ in real-time and enables the energy transition to net zero.³¹

Senergy

In 2015, founder and CEO of Senergy Innovations Ltd, Christine Boyle, leveraged her commercial roofing experience to create affordable, eco-friendly, and integrable solar thermal panels. Christine identified polymers as an innovative material, leading to the development of the first thermally conductive polymer solar thermal panel. These patented panels reduce heating costs and carbon footprints and are digitally integrated for optimised use. They are aesthetically pleasing, easier to install, and fully digitally integrated, allowing consumers to understand and optimise their heating and hot water systems. Christine observed that *“Previously, people who had solar panels knew that from May to October they didn't have to put their immersion heater on, but*

they didn't know the actual cost and carbon savings the technology was bringing”. Each home fitted with the panels reduces 12 kW of heat demand from the grid, achievable with just 2-3 panels on a roof. Based in Carryduff, Northern Ireland, Senergy currently employs 10 people, with plans to double this number within the next year, expanding to the US and European markets. The development of thermally conductive polymers has opened new avenues beyond solar panels, including the automotive industry for EV cooling and in geothermal heat pipes for transferring heat from the ground into buildings. Senergy has secured approximately £3.5million in funding from the Department for Energy Security and Net Zero (DESNZ) under the Net Zero Innovation Portfolio (NETZIP), Invest NI and Innovate UK.



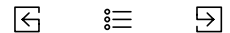
Joulen

Founded in 2016, Joulen (formerly known as the Electric Storage Company) is a cutting-edge technology and energy services firm headquartered in Belfast. With over 30 years of experience in the energy sector, founders Eddie McGoldrick and his wife Anne Marie identified a unique opportunity to enhance renewable energy generation through innovative battery storage solutions. Joulen's proprietary energy management software platform, PARIS, enables real-time analysis of energy generation and consumption patterns. This advanced system automatically determines whether energy should be used, stored, or traded, providing a comprehensive solution for both residential and commercial clients. Additionally, Joulen's technology maximises the revenue potential of grid-scale storage sites by optimising these flexible assets, thereby accelerating the energy transition. Unlike other competitors that require customers to bundle additional services to benefit from their platforms, Joulen offers more flexibility. Their PARIS system can be integrated as a white-label solution behind another brand name or can sit within an existing technology stack. This allows clients to access the same

high-quality services provided by other rivals without the necessity of purchasing associated services. With a strong presence in Ireland, Great Britain, and Germany, Joulen is poised for further expansion into Italy, Spain, and the United States. The company has received significant funding from Invest NI and Innovate UK, underscoring its innovative approach and growth potential.

“Europe is the place to grow Climate Tech right now. And the best place in Europe is Ireland.”

Po Bronson, SOSV



2. Built Environment

“Progress is positive with the residential sector on track to meet its sectoral emissions ceiling following a 7.1% reduction in emissions in 2023”

Climate Change Advisory Council

State of Play

The built environment, where we live, eat, and sleep, accounts for 21% of global greenhouse gas emissions.³² Emissions are primarily attributed to constructing, heating, cooling and lighting in homes and businesses. Global population growth and urbanisation mean worldwide construction is set to accelerate, which makes abatement of the sector challenging.

In 2023, the built environment in the Republic of Ireland contributed 11.1% of total GHGs, a reduction from 12.3% in 2021.³³ While headway has been made in the residential sector in Ireland due to high fuel costs, energy switching from coal and peat use and energy efficiency improvements, further measures are required to sustain reductions.

Commercial and public sector buildings will require a reduction in emissions of 2.9% per annum³⁴ to remain within the sectoral ceiling. Advances in policy are helping drive minimum performance standards in buildings. Still, behavioural changes and levers with high abatement potential that are cost-effective are needed to achieve a low-carbon economy. Irish Climate Tech entrepreneurs are spear-heading a rapid scale-up of effort and clean energy technological solutions to drive towards net zero. Low-carbon cement and concrete, energy optimisation, high-efficiency heating systems such as heat pumps and district heating, retrofitting and modular construction to minimise waste are innovative solutions emerging to decarbonise the sector.

INVESTMENT PERSPECTIVE

The UN Global Status Report for Buildings and Construction provides an annual snapshot of the global progress of the buildings and construction sector, including its impact on global climate change. The report outlines the sector's significant contribution to global GHG emissions and energy demand, as well as the gap between the current state and the desired decarbonisation path. It states that "about 60% of the buildings that will exist by 2050 have not been built yet, and 20 % of existing building stock needs to be renovated to zero-carbon-ready by 2030³⁵." Yet, data shows that only 50% of commercial buildings have pledged to be net zero by 2050³⁶. Therefore, there is a significant opportunity for more decarbonisation in commercial buildings.

The need to innovate is driven by a range of factors, including regulations such as The EU Carbon Border Adjustment Mechanism (CBAM), which imposes a carbon tariff or price on carbon-intensive products imported into the EU. As it applies to cement, iron, steel and aluminium, it has a direct cost and carbon accounting impact on the Irish and European construction sector.

Exciting opportunities exist to decarbonise the construction and built environment sector, driven by a demand for 'green' buildings, operational efficiencies for building users, and protection against climate risks, with 'green concrete' being one such innovation.

Concrete4Change, which was featured in last year's Climate Tech Report, is going from strength to strength, having recently closed a €3 million seed funding round. CEO Dr Sid Pourfalah and CCO Dalraj Nijjar are enthused at the fast growth of their company, which uses novel carbon sequestration technology to capture CO2 and mineralise it in concrete permanently. The International Energy Agency (IEA) states that an annual decline of 4% CO2 intensity in cement production is required for the construction sector to meet net zero targets. Concrete4Change is inspired to make a tangible impact as part of this effort.

Arcology System

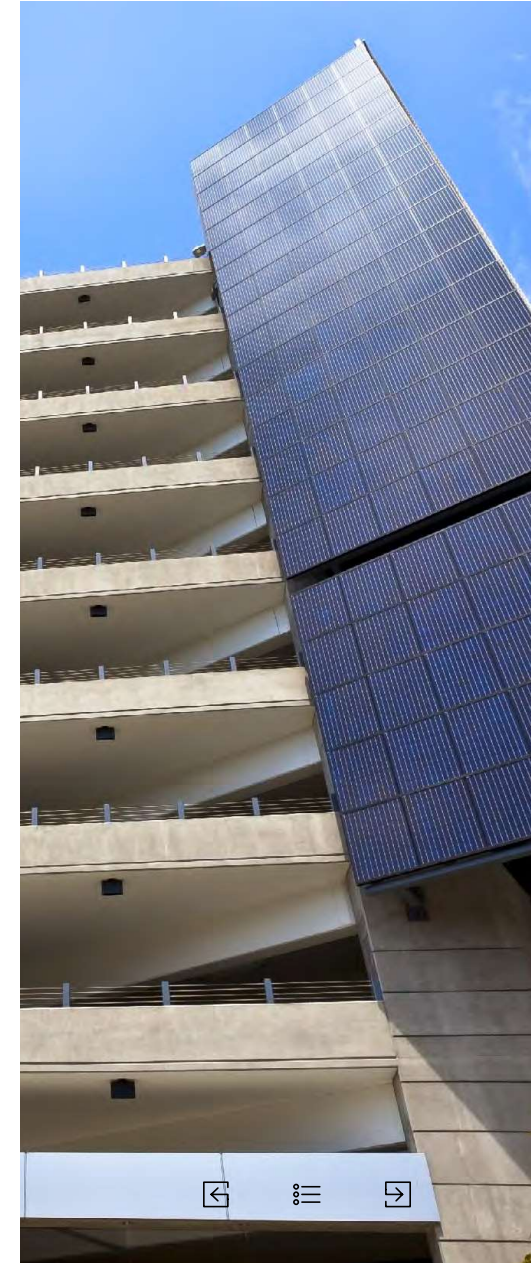
Colette van Jaarsveld and Keith Rose founded Arcology System in 2019 with a vision to reimagine the utilisation of commercial spaces, driving the circular economy in real estate. Traditional commercial fitouts are refitted every 5-7 years to adapt to evolving usage patterns, especially with the rise of hybrid working. Each time a space is refitted, vast amounts of materials are typically discarded as waste. Arcology System's innovative solutions are tailored to help buildings meet their 2050 net zero targets by fundamentally rethinking how commercial fitouts are financed, designed, procured, built, and managed. They continue to develop their reconfigurable construction system that preserves materials at their highest value, minimising waste and adapting to usage patterns. With a data-driven approach, Arcology integrates IoT sensors, Real Time Location System-asset tracking and platform to offer real-time modular and adaptable solutions that address user needs, enabling the creation of sustainable, future-proof interior spaces.

Fenestra Pro

Dublin-based Fenestra Pro's design-based platform identifies energy-reducing solutions for architects, designers and engineers. Architectural technologists David Palmer and Simon Whelan both had a desire to work within sustainability. They saw an opportunity to refine energy efficiency estimates in the early-stage design process of non-domestic buildings. David explained how the facade of a building controls more than half of a building's energy and acts as a moderator between external and internal environments, making the optimisation of the facade essential to reducing energy use and cost. The cloud-based software calculates thermal performance, daylighting, and glazing specifications in one user-friendly platform and can compare this data to regulatory requirements. Fenestra Pro's mission is to support sustainability in the built environment and 'Design beautiful, high performing buildings' - they see education of the market on energy efficient design as crucial to the transition to a low carbon economy.

GS Renewables

Family-owned GS Renewables was established over two decades ago by mechanical engineer Thomas Vaughan and has become a leader in integrated renewable technologies. The company designs and implements modular heat pumps for commercial and industrial applications. At the heart of their business is a lifelong passion for sustainability and the desire to make a difference. With operations in Ireland, the UK, Europe, and China, demand for their retrofit heat pump solutions are largely being driven by the energy transition and increasing regulatory reporting requirements, highlighting the need for efficient and sustainable energy use. They have commissioned over 2000 heat pump projects and saved over 47 million tonnes of carbon. One particular project of note was a listed building from 1720, where they successfully installed a modular district heating system across a number of buildings in the estate. Thomas' son Erik, who works alongside him, believes that large district heating schemes will be a key solution to meet future decarbonisation targets.



An aerial photograph of a farm. On the left, there is a large, long greenhouse with a white plastic covering. In the center, a cluster of farm buildings, including a barn and several smaller structures, are surrounded by trees. Several of the buildings have solar panels installed on their roofs. To the right of the buildings, a tall, white wind turbine stands prominently. The surrounding landscape consists of large, brown agricultural fields, likely plowed or harvested. A road or canal runs along the left side of the farm.

3. Food, Agriculture, and Land Use (FALU)

The current trajectory will exceed the 2030 carbon budgets. To avoid this, emissions need to drop by 8.3% each year for the next three years.

State of Play

Sustainable food production is one of the biggest challenges humanity faces. The UN estimates the world population will grow to nearly 10 billion by 2050, and how we feed ourselves currently is unsustainable. Food systems are vulnerable to external climate events, deforestation, water shortages and labour supply. However, securing the world's bioeconomy is possible through innovative technologies and the redesigning of supply chains.

Ireland's oldest and largest indigenous exporting sector,³⁷ agriculture, is a cornerstone of the nation's economy and an embedded part of Irish culture. However, FALU is also consistently responsible for the largest share of greenhouse gas (GHG) emissions in the Republic of Ireland at 43.5%³⁸ of the total. The value of Ireland's

agricultural sector is simultaneously growing, with seafood exports increasing and Ireland ranking as the 8th largest dairy exporter in the world.³⁹ Agri-food exports for the Republic of Ireland are in excess of €19 billion, highlighting the economic reliance on the sector and the importance of an orderly transition. The Common Agricultural Policy (CAP) insists that increases in production must be achieved sustainably.⁴⁰ This calls for radical changes to move towards greener, more sustainable practices and techniques.

Low GHG farming methods that reduce emissions, such as hydroponic farming, carbon farming, and precision agriculture, are on the rise. Technologies that minimise waste and improve food quality will revolutionise the sector, influencing consumer preferences for plant-based alternatives.

INVESTMENT PERSPECTIVE

As the 2023 Climate Tech Report shows, FALU is an Irish Climate Tech sector with the potential to grow and where Ireland could be a global leader in developing solutions to decarbonise agriculture while aligning with the principles of a Just Transition. A recent review by Ireland's Climate Change Advisory Council (CCAC) outlined a range of actions that Ireland needs to address to decarbonise its agricultural sector, ranging from the generation of biomethane from FALU wastes to feed additives for livestock that reduce methane production while also emphasising the need to invest in nature-based solutions that can act as a carbon sink as well as help adapt to physical climate risks such as flooding.⁴¹

The CCAC perspective echoes what we heard from investors, who identified food waste reduction, nature restoration, regenerative farming and ecosystem services, and the use of digital / AI as Climate Tech opportunities for the Irish FALU sector.

Featured in our 2023 report, food-tech start-up **Senoptica Technologies** received approval from the US Food and Drug Administration (FDA) to expand its technology to the US market. While not strictly a cash investment, this development is a significant milestone for Senoptica.⁴²



Real Leaf Farm

Over 80% of the fruit and vegetables consumed in Ireland are imported,⁴³ predominantly from mainland Europe. Many of these countries are increasingly climate-vulnerable, posing a threat to our food security. To ensure sustainable production of fruit and vegetables, Ireland needs to increase self-sufficiency and rethink our approach to farming and land use. Karen Hennessy of Real Leaf Farm shared with us that *“In an Irish context, less than 1% of land use is used for horticultural purposes, longer term we need to look at the land use”*.

Early-stage start-up Real Leaf Farm is Ireland’s first 100% hydroponic farm. As pioneers of smart farming, their mission is to grow fresh, nutritious, leafy greens for the local farming market by using a technique

that grows plants using water and nutrients, rather than soil. The plants will be grown hydroponically on a ‘mobile gutter system’ which facilitates separation as the crop grows, from planting and germination through to harvesting, which will improve the yield and scope for automation. Air and water sensors monitor temperature, humidity, CO2 and nutrient levels to optimise the growth environment. The approach has a lower environmental impact using less energy, land, and water, eliminates the use of chemical pesticides, and provides employment for the local community. Situated in large-scale glass houses under LED lights leveraging 100% green energy and recycled water, this next-generation farming method can be applied all year round.

Soma Tech

SomaTech's technology is helping the food sector transform for a circular and sustainable future. Their solid-state fermentation processes use fungal mycelium to improve nutrition and bring superior functionality and taste. This approach is more natural and cost-effective than liquid fermentation and produces less waste. The company decided to address the decrease in consumers' satisfaction with plant-based offerings which can lack texture & taste. They are doing this by fermenting a wide range of processing by-products and plant-based feedstocks, the output of which can be used as ingredients for food products such as breakfast cereals and bars, baked goods and meat analogues. While still early days, food biotechnologists and fungi experts Dr Tony Callaghan and Dr Alejandra Omarini are enthused about SomaTech's future. The technology proposition will be licensed to the industry, firstly in Ireland followed by plans to scale in the UK and Europe.

Aramune Technologies

Established as a Queen's University Belfast spin-out in 2021, Aramune Technologies Ltd (ATL) is innovating in climate change mitigation through its novel approach to infection prevention in livestock, companion animals, and humans. By enhancing the host's immune system, ATL's method reduces the reliance on antimicrobials, thereby preventing antimicrobial resistance (AMR) and promoting sustainable farming practices. Focusing initially on the animal feed sector, ATL's technology uniquely supports modern farming's dual goals of high-quality food production and environmental stewardship. ATL's products are sustainably produced from plants, including UK native wildflowers, which also support vital pollinator species such as bees and butterflies.⁴⁴ The cultivation of ATL's product on local farms in Down and Armagh further underscores its commitment to sustainability. The most promising opportunity for their technology also includes

“the ability to remove carbon intensive processes from agriculture and for the animal livestock sector to become more viable than it currently is”. ATL is advancing research aimed at reducing methane emissions from cattle, a significant contributor to greenhouse gases of the agriculture sector. Supported by Innovate UK with a £300k startup grant, ATL has also secured an £800k investment from a syndicate of institutional and private investors in Northern Ireland⁴⁵ and is currently in a Series A funding round. The company is at a critical stage of finalising research and development and engaging with various feed manufacturers, positioning itself as a key player in the transition to more sustainable and climate-friendly agricultural practices.

Cross-cutting: Climate Change Management and Reporting (CCMR)

Accurate and high-quality data is central to understanding environmental stressors and making informed decisions about land use. This can protect our forests and biodiversity as part of climate adaptation and mitigation.

Farm Eye

Founded in 2017 by Dr Eoghan Finneran, Joe Desbonnet and Brendan Allen, Farm Eye is a spin-out from a University of Galway research project. The company designed technology to measure and verify soil health and soil carbon to produce actionable insights for the agrifood sector and improve the lives of farmers. Understanding the soil profile is crucial for farmers to maximise yields and reduce the use of fertilisers as part of regenerative farming practices. Regulatory reporting requirements such as the Corporate Sustainability Reporting Directive (CSRD) and the Taskforce on Nature-related Financial Disclosures (TNFD) is also driving the need to report on the value chain and environmental footprint for companies in the agricultural sector.

They have grown rapidly since inception and are present across Ireland, the UK, and Europe. They hope to expand into Denmark's agricultural sector. With the belief that *"If it can be measured, it can be managed"*, Farmeye manages one of the largest geo-tagged soil health databases in the world, using both in-field verification and satellite data. They are currently engaged with the European Space Agency on a biodiversity project dedicated to exploring the vital role hedgerows play in Ireland's ecosystem and agricultural landscape.

TreeMetrics

Forests make up 31% of the earth's land area. Using satellite mapping, Cork based company Treemetrics provides innovative solutions to the global forest industry in over 40 countries. Founded by Enda Keane, he built the company based on decades of experience working in the forestry and tech industries. Using satellite monitoring systems with the support of the European Space Agency, Treemetrics provide data points for sustainable forest management (e.g. tree health, use of fertilisers) to adapt and mitigate for climate change. The Treemetrics team also helps project developers verify their carbon credits, ensuring credibility and accuracy. They recently developed a new forestry insurance product with AXA for fires and storms. The increasing focus on biodiversity and regulation, such as the EU's Deforestation Regulation (EUDR),⁴⁶ which applies from 30 December 2024, means that businesses will be required to conduct more extensive due diligence on their supply chains to limit the EU's contribution on global deforestation and reduce greenhouse gas emissions.

4. Mobility and Transport

Transport accounted for 19.5% of Ireland's national total emissions, second only to agriculture.

State of Play

The world's global ambition to electrify road transport and phase out internal combustion engines aims to unlock significant greenhouse gas emissions. However, electric vehicles alone won't be enough, and alternative fuels to reduce carbon emissions will be needed. Sustainable aviation fuel, hydrogen, ammonia and biofuels will be critical power sources in the mobility and transport sector in the future.

According to the Climate Action Plan 2024 ('CAP24'), transport and mobility represent one of the Republic of Ireland's most formidable challenges, necessitating transformative changes and rapid implementation. As the sector with the most rapidly increasing GHG emissions over the past 30 years, transport accounted for 19.5% of the Republic of Ireland's national total emissions, second only to agriculture. To meet the sectoral emission ceilings, CAP24 mandates a substantial reduction in transport emissions of 50% by 2030. However, transport, along with agriculture, has the furthest to go in achieving the set targets.⁴⁷ To drive decarbonisation, policy including financial incentives, as well as government investment in infrastructure, are key enablers for the net zero transition.

Additionally, a key driver of transport emissions is embedded in supply chains through freight logistics. Regulations such as the Corporate Sustainability Reporting Directive (CSRD) will compel companies to understand and disclose their Scope 3 emissions. Efficient transport through journey planning, load optimisation, and vehicle efficiency will receive greater emphasis. Finally, promoting alternative transport options through public and shared transportation and avoided journeys will be pivotal in accelerating the shift to a sustainable transport system.

INVESTMENT PERSPECTIVE

The emergence of drone-assisted delivery, battery technology to power the electrification of off-highway vehicles and green shipping are some of the inventive and talented solutions contributing to the successful decarbonisation of the transport sector.

In the USA, investment in transport and mobility solutions, such as EVs, has increased through the Inflation Reduction Act of 2022. Still, globally, there has been a decrease in the overall venture capital investment in transport and mobility.

That being said, investors have clearly identified that Ireland could play a leading role in the advancement of sustainable aviation fuels (SAF) and EV battery technology. The National Challenge Fund, part of Ireland's National Recovery and Resilience Plan, is a €65 million research fund that consists of eight research challenge streams, including the 2050 Challenge, which seeks to find solutions to current and future challenges in Ireland becoming climate-neutral and resilient by 2050. A total of 96 projects have received funding to date across all challenge streams, and funding has been given to transport-related research projects, including improving the efficiency of EV batteries.⁴⁸

As featured in our 2023 report, **City Swift**, a company that optimises public transport systems using data, raised €7 million to support its expansion. The funding round was led by Gresham House Ventures.⁴⁹

Hibra Design

Mike Keane of Hibra Design has over two decades of experience in automotive engineering. He spent his career leading vehicle programmes for major global companies such as Ford, Williams F1, Nissan, Aston Martin, Land Rover, Jaguar, Liebherr, and Magna. Mike spotted an opportunity in the off-highway vehicle market and founded Hibra Design in 2022. Based in Co. Cork with a global outreach extending to Europe, the Middle East, and South Africa, the start-up delivers innovative internal combustion, hybrid, electric and hydrogen fuel cell vehicle platforms. Hibra Design decarbonises industrial vehicles through engineering efficiency (e.g. drive time, fuel burn, power and battery capacity). They provide a bespoke service that is ‘vehicle-agnostic and operation-specific’. Hibra Design can re-engineer your speciality vehicles with clean-technology powertrain systems that ensure the highest level of safety and environmental regulatory compliance. Mike candidly spoke about the challenges of launching and scaling a hard-tech start-up in Ireland, which include securing the required CapEx and attracting talent with automotive engineering capability for a non-indigenous sector.

Xerotech

Xerotech, a technology company from the West of Ireland, is serving a niche market in the off-highway industry. CEO Barry Flannery, a University of Galway alumnus, designed a solution for battery packs to be stacked inside off-highway vehicles, avoiding the need for thousands of product variations and making it scalable and configurable. They are fast becoming a preferred battery supplier globally, producing “the safest battery pack” on the market, using patented liquid thermal management to create their Hibernium battery system. Xerotech can help some of the toughest industries - construction, mining, rail, and marine- reach a net zero destination. The company, which has a team of over 160 in Ireland, believes the electric motor is more reliable and efficient and requires less maintenance. An electrified excavator for example, is silent and has no exhaust fume emissions coming from the engine, while also saving on fuel and costs.



Manna Drone Delivery


Dublin 15 start-up Manna Drone Delivery is taking things to new heights by using flying robots to deliver your takeaway to your door. Their mission is to improve the world by making lightning-fast suburban deliveries affordable, green and safe. Founded in 2018, Bobby Healy's curiosity and background in self-taught coding and building software companies led him to launch the company. Standing at 120 FTE, Manna Drone Delivery is on track to carry out two million deliveries per year. Once an order is placed through the app, a custom-built Manna Drone takes off for delivery as the crow flies at an altitude of 70 metres and is with you in less than three minutes while abiding by European Aviation Safety Agency regulation (EASA).⁵⁰ As the unmanned aircraft is fully electric, it's cleaner and safer - so far, the company has taken 150,000 kilometres off Dublin roads, lowering carbon emissions. Manna Drone is the largest drone delivery company in Europe and has had VC funding of €60 million. Bobby Healy sees a huge opportunity in the ever-expanding home delivery market across the US and Europe. While unmanned aircraft system regulation in the US is currently a barrier to scale, that hasn't slowed ambition

to expand operations in Dublin, Helsinki, and other major European cities in the coming months.

Artemis Technologies

Based in Belfast, Artemis Technologies is a revolutionary clean maritime technology company specialising in 100% electric foiling commercial vessels. Established in 2017, the company originated from the America's Cup team, Artemis Racing, and has the mission to decarbonise high-speed maritime transport. Under CEO Iain Percy, an America's Cup veteran and multi-medal-winning Olympian, it developed the world's first commercially viable range of electric foiling vessels. The transformative Artemis eFoil® electric propulsion system generates zero emissions, reduces operational costs through substantial fuel savings and minimises wake to protect wildlife. The company also boasts one of the world's most advanced digital twin simulators. It is lead partner in Belfast Maritime Consortium, which received funding from UK Research & Innovation Strength in Places Fund to develop and launch the Artemis EF-24 Passenger ferry. In collaboration with Energia Group, Artemis Technologies will power this world's first

100% electric high-speed foiling passenger ferry with renewable electricity from a wind farm. It will reduce congestion, noise, and air pollution along the pilot scheme route connecting the cities of Belfast and Bangor in Northern Ireland. The company has also partnered in a number of collaborative industrial R&D projects funded by the UK Department for Transport UK SHORE programme, an initiative focused on developing the technology necessary to decarbonise the UK domestic maritime sector. Employing over 200 professionals from diverse sectors such as aerospace, maritime, and high-performance motor racing, Artemis Technologies is at the forefront of innovation within the maritime industry.



5. Industry, Manufacturing, and Resource Management (IMRM)

Green hydrogen can produce high-temperature heat to power enormous industrial processes, emit zero greenhouse gases and is produced using renewable energy and natural gas.



State of Play

The manufacturing and production sectors are key drivers of economic growth, accounting for nearly a fifth⁵¹ of global GDP. This productivity, however, is at the peril of our planet, contributing to pollution, environmental degradation, and depleted natural resources. Rethinking manufacturing processes and resource use is essential to reducing the burning of fossil fuels.

In 2023, the Republic of Ireland's industrial sector saw a modest change in its emissions profile, which made up 10.4% of the nation's total.⁵² Emissions from manufacturing reduced by 4.6%, while emissions from industrial processes saw a 5.8% reduction. These reductions were driven by significant declines in combustion emissions across key sub-sectors such as non-ferrous metals, chemicals, food processing, beverages, tobacco, and non-metallic minerals. Additionally, the sector achieved notable reductions in fossil fuel usage, reflecting a gradual shift towards more sustainable practices.⁵³

A challenge for this traditionally hard-to-abate sector is how to decarbonise industrial heat. One of the main solutions under consideration is green hydrogen. While its use is gaining traction, it will take significant policy and investment infrastructure changes, as well as customer buy-in. One of the main challenges is that green hydrogen is substantially more expensive than fossil fuel-derived hydrogen, and it is likely to remain as such until 2030 at least.⁵⁴

Climate change continues to disrupt global supply chains, limiting access to critical raw materials and key commodities, resulting in higher resource costs.⁵⁵ The shift to develop and deploy decarbonised technologies in the industry and manufacturing sector has been slow.

Globally, the circular economy is moving from niche to creating industrial symbiosis across value chains, largely driven by supply chain risks and access to raw materials. This is particularly evident in the mining value chain, where climate-tech companies are emerging with solutions to extract precious metals and minerals from waste electronics /

equipment. Additionally, the convergence of AI and Climate Tech is leading to a range of solutions that can reduce waste and create efficiencies, where SaaS is the business model. Still, Irish Climate Tech entrepreneurs are driving momentum to reimagine and deploy innovation for sustainable manufacturing and resource use.

Innovative technologies for circular business models that manage waste in manufacturing to 'reduce, reuse, recycle' are emerging, and water tech, ensuring clean access and optimal use of water, are advancing to protect the world's greatest natural resource.

INVESTMENT PERSPECTIVE

One approach to supporting Climate Tech companies in scaling and growing is to incentivise the industrial and manufacturing sectors to invest in decarbonisation solutions. Enterprise Ireland and IDA Ireland launched a €300 million fund to support their client firms in reducing their industrial emissions between now and 2030.⁵⁶

Limerick-based software company **AMCS**, featured in our 2023 report, has closed a deal with the Swiss private equity firm EQT, which has acquired a majority stake for an undisclosed amount.

Spotlight:

Women in Climate Tech

Of the companies featured in this year's report, four were female-founded - Shana Chu of Tailr, Karen Hennessy of Real Leaf Farm, Colette van Jaarsveld of Arcology Systems, and Christine Boyle of Senergy Innovations Ltd. Shana shared her experience and challenges starting as a female entrepreneur raising venture capital, reaffirming how only 2% of VC funding goes to female-founded companies.⁵⁷ Despite this, Tailr has still gained traction, raising €700,000 last year from Delta Partners, Haatch, other angel investors, and Enterprise Ireland, fuelling its growth to revolutionise the fashion industry. This representation highlights barriers to entry. Disrupting the status quo to empower women-led businesses and ensure equitable access to finance is an essential part of the green tech revolution.

Tailr

Founder Shana Chu created Tailr with a vision to redefine production for the fashion industry. She believes in leveraging technology to disrupt innovation and solve the sustainability challenge - the fashion industry is responsible for 10% of global carbon emissions.⁵⁸ Shana spent years developing her craft as a garment technologist, and this included working with companies to ensure employee PPE requirements were met and overseeing the production and quality assurance process. Shana described how this time spent on the factory floor exposed the flaws in the industry and highlighted the need for change, *"That's really why I started Tailr because I was tired of using technology that was never built for our industry"*. It was apparent that a move away from the analogue systems was required to reduce the volume of manual errors, which led to inconsistent sizing and waste. As the fashion industry is relatively unregulated, much of this waste goes unreported. British Vogue estimates that out of 150 billion garments produced each year, between 15 - 45 billion are never even sold.⁵⁹ The cloud-based software start-up gathers data points on fabric weight, colour fastness, and dimensional stability enabling real-time communication between designers, fabric mills, and manufacturers to refine the process and reduce supply chain waste.



Nanobox

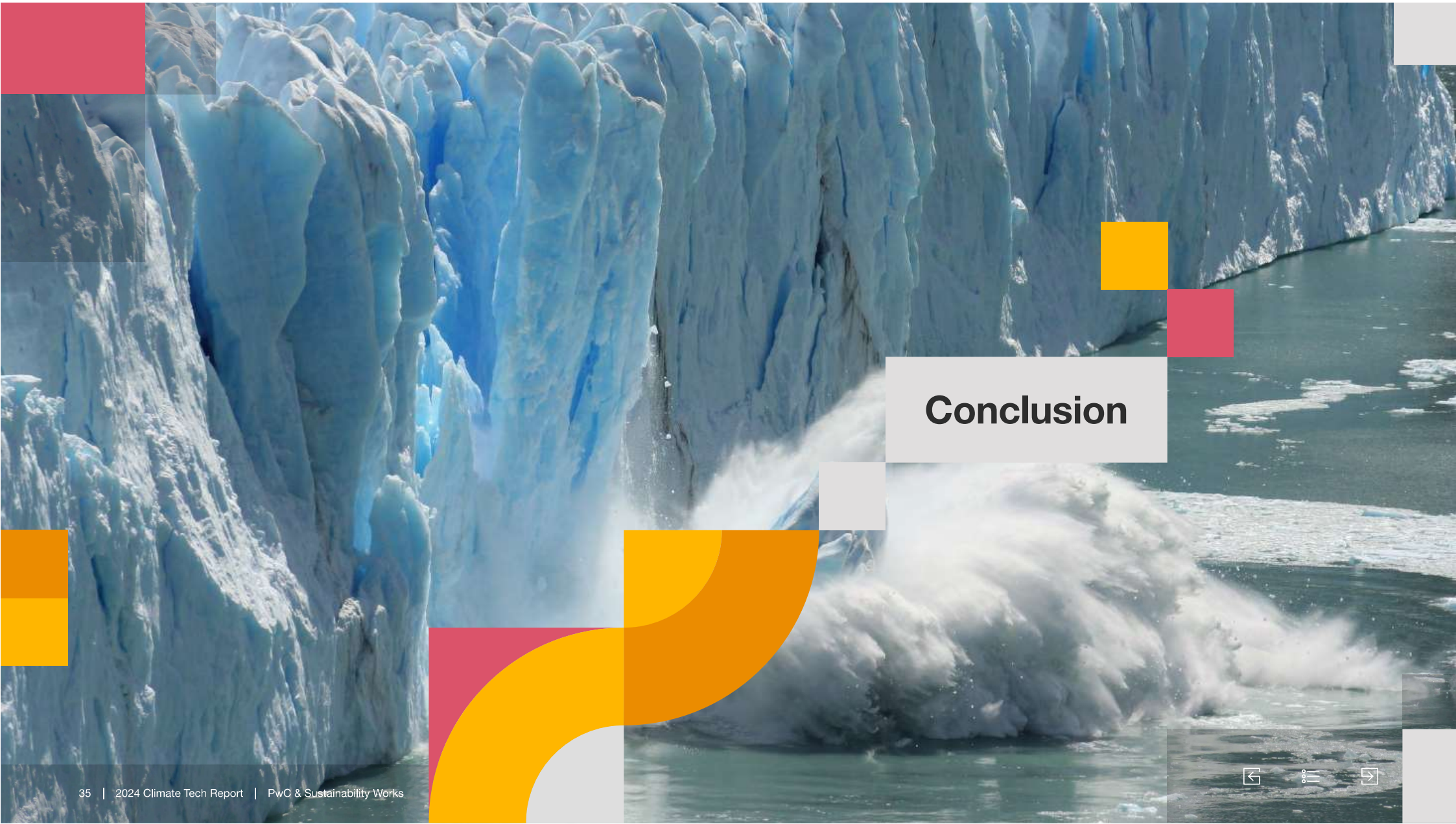
A nanobubble is 2000 times smaller than a grain of salt but can be used for highly energy-efficient, sustainable treatment of water. Dr John Favier and Dr Mohammad Reza Ghaani, both engineers, founded NanoBox in 2022. Their novel patented electric field nanobubble technology generates billions of nanobubbles per millilitre of water, while using low-voltage electric fields. Their mission is to increase the sustainability of bioprocesses to create lower energy costs, lower carbon footprint, and reduce the use of synthetic chemicals while increasing productivity. The technology is plug-and-play, making it easy to retrofit existing systems, acting as a process enhancement rather than replacement technology. The technology is plug-and-play, making it easy to retrofit existing systems,

acting as a process enhancement rather than replacement technology. By adding oxygen to the water, it acts as a battery. Nanobubbles will continue to give oxygen to the water for a longer time while also increasing the bioavailability of the oxygen to microorganisms, such as plants and animals. The chemical-free water sanitisation start-up has the unique ability to increase soil fertility as the nanobubbles nourish the microbes in the soil. This puts NanoBox in a position to have maximum impact and growth as EU policy is introduced to reduce nutrient losses in fertilisers significantly by 2030.⁶⁰ They raised €1 million last year with the support of Yield Lab and are also backed by Enterprise Ireland. They are continuing trials in advance of market entry in 2025, focusing on aquaculture and agriculture and envisioning being on every irrigation line in the world.

Cirtex

Cirtex, an innovative Irish upcycling textile company, is committed to transitioning to a circular economy. Founded in 2022 by experienced entrepreneur and businessman Rick Earley, Cirtex aims to make a difference by taking waste textiles from the bedding industry and upcycling them into finished products such as floor underlay and insulator pads for mattresses and furniture cushioning. This reduces greenhouse gas emissions and boosts the domestic economy. Based in Co. Longford, the company has seen immediate success and now has a headcount of over 20 employees. Rick credits this success to partnerships, including membership of the Irish Government Initiative Circuléire, a cross-sectoral industry network committed to accelerating the net zero carbon circular economy. Cirtex has access to 10% of

mattresses in Ireland. Regulation on an Extended Producer Responsibility (EPR)⁶¹ for mattresses would vastly open up the market. An attractive element of the company's proposition is that it manages both the collection of mattresses and their upcycling, meaning Cirtex provides an end-to-end solution for mattress disposal while reducing waste for an eco-friendly environment.



Conclusion

Climate change is an urgent threat to our planet's ecosystems, societies, and the global economy. Bold and swift action is needed. This report showcases groundbreaking technologies specifically designed to combat the climate emergency. Thanks to market demand, effective regulation, and ample capital, a strong ecosystem of innovation has emerged. However, further efforts are needed to build on our successes. Climate Tech goes beyond a single sector – it includes technologies focused on reducing greenhouse gas emissions or addressing the impacts of climate change.

These technologies fall into three broad, sector-agnostic categories:

1. **Emission reduction:** Technologies that directly mitigate or remove emissions.
2. **Adaptation:** Solutions that help us adapt to the impacts of climate change.
3. **Understanding:** Innovations that advance our understanding of the climate.

These Climate Tech applications span every sector, including hardware, software as a service, and various other services. It also intersects with foundational science and technologies such as electrification, AI, genomics, synthetic biology, and space tech. As the urgency of climate change intensifies, the demand for Climate Tech will continue to grow, and it will become mainstream.

The Republic of Ireland has achieved a modest decoupling of economic growth from GHG emissions, which is promising, but which has been described by commentators as a combination of good planning and good luck.⁶² However recent reports from the EPA indicate that nearly all sectors are likely to exceed their sectoral emissions limits for the 2025 and 2030 carbon budgets.

With just over 300 innovative Climate Tech companies on the island of Ireland, many of which are global climate innovation leaders. We must seize every opportunity to advance and support Ireland's Climate Tech entrepreneurs.

Call to Action

In our 2023 report, we spotlighted Denmark's 'State of Green Initiative', which has established a powerful brand and identity for Danish Climate Tech. Subsequently, we have witnessed other locations springing forth with equally robust support for their Climate Tech entrepreneurs. City examples include London and Stockholm, with emerging hot spots in Aachen and Tallinn. These cities have many common characteristics:

- a strong culture of supporting tech innovation
- access to talent
- numerous growth programmes and initiatives that spotlight climate, enabling it to grow
- access to investment opportunities across all funding classes i.e. venture, private equity and project / debt finance.

Ireland has many of these same attributes; based on our discussion with climate entrepreneurs and investors and our knowledge of the market, we have three calls to action.

1. The Republic of Ireland has set ambitious climate policies for every sector of the economy, with specific targets and actions outlined for implementation and Northern Ireland will now follow suit. The current challenge is to bridge the gap between Climate Tech innovations and national decarbonisation goals. We need a Climate Tech roadmap for Ireland that clearly aligns our decarbonisation targets with both existing and emerging Climate Tech solutions. Sectoral graphics similar to the MACC curve published by Teagasc⁶³ for the agricultural sector would help Climate Tech entrepreneurs understand where the demand for their solutions lies now and, in the future,
2. The Republic of Ireland should focus on areas where it has a competitive advantage instead of trying to address decarbonisation challenges across all economic sectors. There is an opportunity for Ireland to specialise in Climate Tech solutions that address its decarbonisation challenges as an island

nation. This could include developing new solutions to manage the energy and carbon challenges related to data centres, creating sustainable aviation fuels, and finding innovative ways to transition to decarbonise the food, agriculture, and land use sectors, using the principles of the Just Transition. This could include new methods of agricultural production, nature restoration, ecosystem services, regenerative farming and nature-based carbon removal and storage. The country has already shown leadership in decarbonising energy and the built environment sectors and should continue developing grid management technologies and products such as low-carbon cement. Additionally, emphasising adaptation technology is crucial for building resilience and managing risks amid the climate crisis, offering economic benefits such as stable agricultural production and reduced vulnerability to extreme weather.

3. The Republic of Ireland has successfully built a strong venture capital and innovation ecosystem for tech innovators, especially in Fintech and MedTech. This has been and continues to be achieved by connecting the dots within the respective sectors, starting with educational institutions offering specialised training programmes to develop the talent pool and the establishment of targeted support through dedicated research centres, incubators, and accelerators. Importantly, market demand existed, and Ireland's leadership was promoted to domestic and international buyers. Most of these same attributes exist within the Irish Climate Tech ecosystem, and now, with strong market demand domestically and internationally, let's refresh efforts to do what we have done to develop these sectors for Climate Tech. In turn, this will attract more pools of capital to Ireland and will provide innovators with greater confidence to establish HQs in Ireland and more options to scale their businesses. This is evident in other jurisdictions, where dedicated Climate Tech growth programmes have successfully bridged the gap between proof of concept and

scaling funding, showcasing and cohesively promoting leadership in Climate Tech.

Cross-border collaboration brings greater scale and momentum and the magnitude of what can be accomplished is significantly higher on an all-island basis. The island of Ireland stands on the cusp of a big opportunity in the Climate Tech sector. With the right focus and investments, Ireland can become a key player in this growing field. To do this, Ireland must act decisively and embrace sustainable innovation now.

“Ireland has a major opportunity in the Climate Tech sector but must act decisively to capitalise on it. While the country has set ambitious low-carbon targets, progress remains slow. Startup innovation in Climate Tech can play a critical role in driving this progress, but achieving Ireland's goals requires urgent action and strong investor support to ensure long-term economic and environmental success.”

Faye Walsh Drouillard,
Wake-Up Capital.

Methodology

The research methodology to identify entrepreneurs comprised of four stages of work:

1. Market scan

Using multiple sources, PwC Ireland and PwC UK's Northern Ireland practice scanned the market of the island of Ireland to identify companies that are delivering solutions across the key opportunity areas of decarbonisation, from grid management to precision agriculture.

2. Assessment

The identified company solutions and their impact, scalability, and maturity were reviewed to ensure that they aligned to the Climate Tech definitions.

3. Engagement

PwC Ireland and PwC UK's Northern Ireland practice connected with a number of companies to get an insight into their company, solution and journey to date. Meetings with company representatives were held during 2024.

4. Insights development

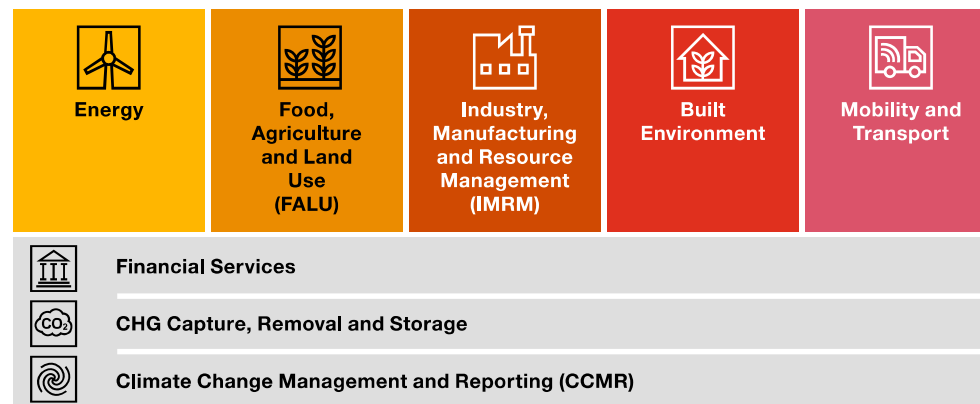
Insights were collated from global reports, including PwC publications, desk research on the Climate Tech industry and findings from interviews with Climate Tech innovators.

What is Climate Tech?

Climate tech is defined as technologies that are explicitly focused on reducing GHG emissions or addressing the impacts of climate change. Climate Tech applications can be grouped into three broad, sector-agnostic groups:

1. Those that directly mitigate or remove emissions.
2. Those that help us adapt to the impacts of climate change.
3. Those that enhance our understanding of the climate.

The term Climate Tech is purposely broad in order to incorporate the many technologies and innovations being used to address GHG emissions and the wide array of industries where they are being applied. This report considers Climate Tech in relation to opportunities for climate action within five sector vertices and three cross-cutting horizontals. These areas broadly follow the industry classifications set out by the IPCC, which are typically used when discussing emissions reduction.



The Climate Tech Landscape

The cross-cutting areas, whilst individually offering opportunity for innovation, can also play a role in driving innovation within each of the above five verticals. Examples of some of the cross-cutting growth areas are highlighted below:

Financial services

Net Zero and ESG agendas are becoming key deciding factors in where financial institutions allocate their capital. Growth areas for disruptive innovators exist across all financial markets' participants, including Lenders; Banking (business and retail); Funds and Investment Banking; Pensions; and Insurance.

GHG capture, removal and storage

Growth areas include Carbon Capture, Uptake and Storage (CCUS); Biomass Update of CO2 (excluding afforestation and land management); Geo-engineering.

Climate change management and reporting (CCMR)

Accessible and reliable open-source data is essential for climate modelling to get the true picture of climate conditions and enable informed decisions to be made. A well-known example where open data played a critical role was the IPCC reports – providing visibility into where we are today, where we're headed, the causes and the necessary actions. Growth areas for disruptive innovators include Emissions Data, Monitoring, Management and Reporting; Climate Risk and Resilience Management; Climate/Earth Data Generation.



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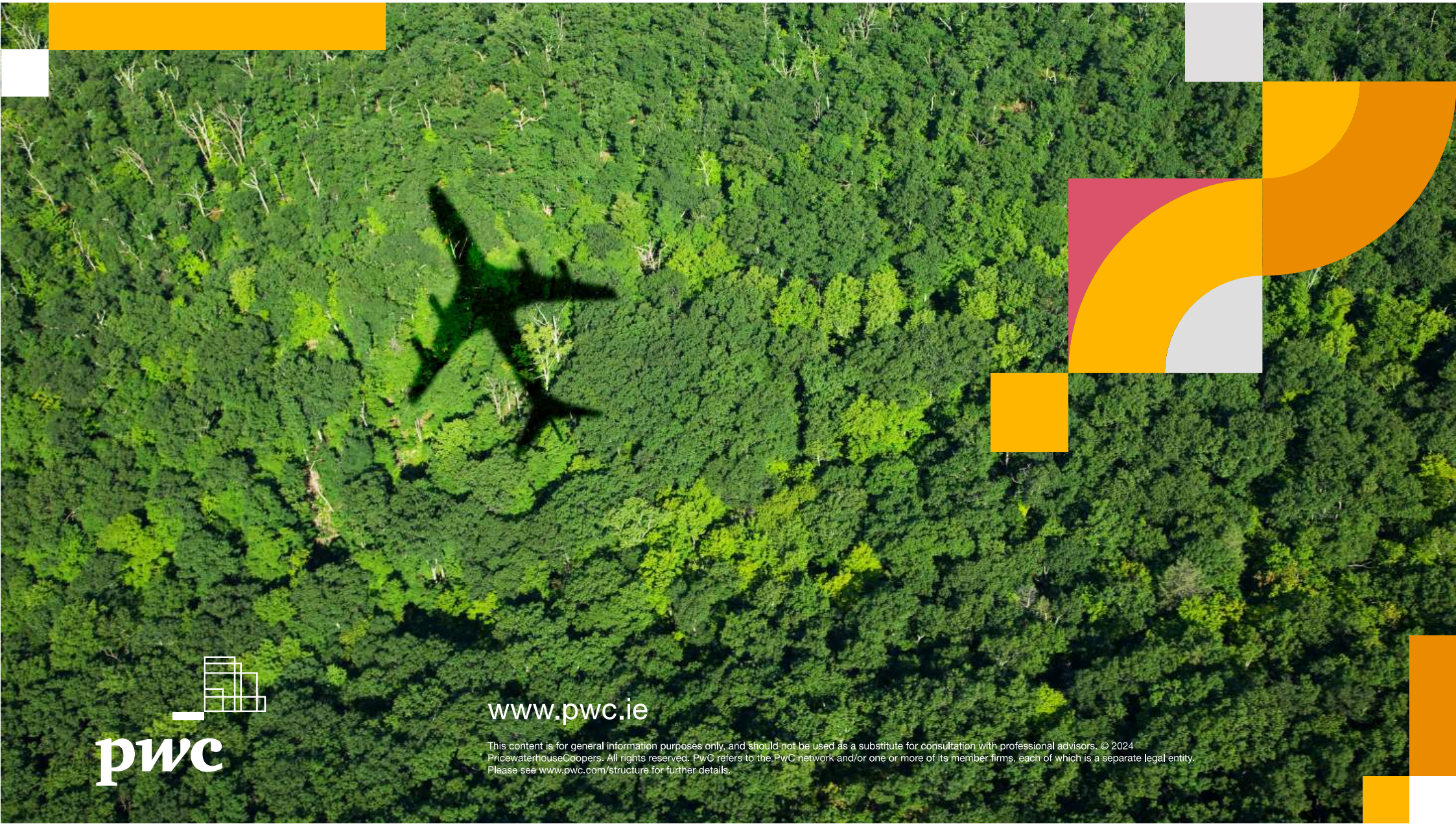
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Endnotes

- 1 <https://www.pwc.ie/issues/environmental-social-governance-esg/net-zero-economy-index.html>
- 2 Copernicus Climate Change Service, Monthly Climate Bulletin, 10 July 2024
- 3 Net zero Insights, State of Climate Tech 2023
- 4 European Environment Agency
- 5 United Nations <https://www.un.org/en/climatechange/net-zero-coalition>
- 6 UN COP28 key takeaways, December 2023
- 7 Environmental Protection Agency, 27 May 2024, *Ireland is projected to exceed its National and EU climate targets* [press release]
- 8 Department of Finance, August 2024
- 9 PwC, PwC 2023 State of Climate Tech
- 10 Pitchbook, PwC analysis
- 11 U.S. Department of the Treasury, Inflation Reduction Act
- 12 EU's response to the US Inflation Reduction Act (IRA), 2023
- 13 IEA, World Energy Investment 2024
- 14 IEA, World Energy Investment 2024
- 15 IEA, Global electricity demand set to rise strongly this year and next, reflecting its expanding role in energy systems around the world [press release], 19 July 2024
- 16 Environmental Protection Agency, Ireland's Provisional Greenhouse Gas Emissions, 1990-2023, July 2024
- 17 Environmental Protection Agency, Ireland's Provisional Greenhouse Gas Emissions, 1990-2023, July 2024
- 18 Environmental Protection Agency, Ireland's Provisional Greenhouse Gas Emissions, 1990-2023, July 2024
- 19 CSO: Data Centres Metered Electricity Consumption 2023
- 20 IEA: Data Centres and Data Transmission Networks
- 21 Department of the Environment, Climate and Communications
- 22 Irish Times, 11 June 2024
- 23 Irish Times, 25 March 2024
- 24 Irish Times, 18 July 2023
- 25 European Commission, 27 October 2023, Bioenergy report outlines progress being made across the EU [press release]
- 26 Environmental Protection Agency, 27 June 2024, Food Waste Statistics for Ireland
- 27 EU-Startups, 21 September 2023
- 28 IEA, Electricity 2024
- 29 Silicon Republic, 10 July 2023
- 30 IEA, August 2024
- 31 EU-Startups, 16 April 2024
- 32 UNEP: Global Status Report for Buildings and Construction
- 33 Environmental Protection Agency, Ireland's Provisional Greenhouse Gas Emissions, 1990-2023, July 2024
- 34 Climate Change Advisory Council, Annual Review 2024, Built Environment
- 35 UNEP: Global Status Report for Buildings and Construction
- 36 Silicon Valley Bank: The Future of Climate Tech 2024
- 37 Department of Agriculture, Food and the Marine, Annual Review and Outlook for Agriculture, Food and the Marine 2023
- 38 Environmental Protection Agency, Ireland's Provisional Greenhouse Gas Emissions, 1990-2023, July 2024
- 39 Department of Agriculture, Food and the Marine, Annual Review and Outlook for Agriculture, Food and the Marine 2023
- 40 Environmental Protection Agency, Ireland's Environment, An Integrated Assessment, 2020
- 41 Climate Change Advisory Council, 4 September 2024
- 42 Senoptica 27 June 2024
- 43 Agriland, 12 October 2023
- 44 Aramune Technologies Ltd
- 45 Aramune Technologies press release, 27 February 2022
- 46 Regulation on Deforestation-free products
- 47 Environment Protection Agency, Ireland's Provisional Greenhouse Gas Emissions, 1990-2023, July 2024
- 48 Science Foundation Ireland, National Challenge Fund
- 49 Irish Times, 1 Feb 2024.
- 50 European Union Aviation Safety Agency (EASA), July 2024
- 51 World Economic Forum, Reducing the carbon footprint of the manufacturing industry through data sharing, 5 October 2023
- 52 Environmental Protection Agency, Ireland's Provisional Greenhouse Gas Emissions, 1990-2023, July 2024
- 53 Environmental Protection Agency, Ireland's Provisional Greenhouse Gas Emissions, 1990-2023, July 2024
- 54 Bloomberg NEF, 9 Aug 2023
- 55 PwC, More than 70% of critical minerals key for the net zero energy transition at risk from climate disruption: PwC 2024 Climate Risks to Nine Key Commodities Report [press release], 30 April 2024
- 56 Irish Times 23 June 2024
- 57 World Economic Forum, 28 December 2023
- 58 European Parliament, 21 March 2024
- 59 British Vogue, 8 September 2023
- 60 European Commission
- 61 Department of the Environment, Climate and Communications, 14 August 2024
- 62 Paul Deane LinkedIn Post, Aug 2024
- 63 Teagasc Marginal Cost Abatement Curve





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