Examining Net Zero

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Examining Net Zero: Creating Solutions for A Greener Society and Sustainable Economic Growth

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Emerald Publishing Limited
Emerald Publishing, Floor 5, Northspring, 21–23 Wellington Street, Leeds LS1 4DL.

First edition 2025

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN: 978-1-83608-575-1 (Print)
ISBN: 978-1-83608-574-4 (Online)
ISBN: 978-1-83608-576-8 (Epub)

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About the Editors

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Steven McCabe is Professor and Pro Vice Chancellor, DoctorateHub. Previously, he spent 35 years as an academic at Birmingham City University where he taught management, business, economics and strategy to undergraduate and postgraduate students. He also supervised PhD students and taught research methods as part of their development.

Steven regularly writes and comments regularly in the national and international media on politics and the economy and has published ten texts on quality management, benchmarking, 'Brexit' and its economic and social impact, the green economy and manufacturing, house prices and India's progress since independence. Additionally, He has written extensively for edited texts examining economics and politics.

Beverley Nielsen is Visiting Professor at the Centre for Brexit Studies, Birmingham City University, having worked for the past decade as Executive Director at the Institute for Design, Economic Acceleration and Sustainability (IDEAS), a think tank based at the University. She has published books on diverse themes including Redesigning Manufacturing, Brexit Negotiations After Article 50, English

Regions After Brexit, Exploring the Green Economy, Green Manufacturing and India at 75. For the past decade Beverley has conducted economic analysis of the Birmingham Jewellery Quarter and has provided consultancy covering a wide range of specialised industrial clusters. She has served as an Expert Commissioner on the All-Party Manufacturing Group at the House of Commons, working for many years at the CBI in London, Brussels, Manchester and Birmingham. As a councillor in Worcestershire, she is focused on supporting local businesses and retains a strong interest in entrepreneurship having started community companies in outdoor activities and sustainable transport. Whilst working in industry, she was a Director of Aga Rangemaster plc and MD of Fired Earth.

About the Contributors

Carl Arntzen, Mechanical Engineering, joined Worcester Bosch in 1984 where he worked in Product Development for several years before moving into commercially oriented roles in Product Management and Marketing Management. Following national and international roles throughout the sales, marketing and service organisation, he was appointed as Managing Director in October 2011 and CEO for the whole Bosch Thermotechnology operations in the UK and Ireland in 2015. This includes the residential business operating under the Worcester Bosch brand. He is a Board Member of the Construction Product Association (CPA), the Energy Utilities Alliance (EUA) and the CBI Heat Commission.

Tom Bedford is Place Based Decarbonisation Manager for the Globe CIC. He's been driven for many years by the desire to make a positive impact on people and the planet, pursuing two sustainability degrees. Throughout, he focused on climate change and the net zero transition. Since completing these, he has worked on research, delivery and teaching to support the net zero transition. This has included overseeing the role out of major clean energy projects, completing research on the net zero governance landscape and training and supporting organisations across the West Midlands to decarbonise. Alongside his paid employment, he has several voluntary roles supporting communities to take positive action on the climate emergency.

Conall Boyle is Independent Researcher, formerly at Birmingham (UK) City University, and Lecturer in Economics and Statistics. Originally qualified as a Mechanical Engineer, his interests focus on the mechanisms for achieving social and political goals. In 2022, he co-authored *Stop House Prices Rising* with Steve McCabe.

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Michael Butler is Professor in Management, Head of Subject Group for Business, Management and Marketing, Lead of Organisational Behaviour Research Group and Member of Rhanbarth Management Board at Bangor Business School, Bangor University. He is on the Editorial Board of Complexity, Governance and Networks and *Asia Pacific Journal of Business Administration*. He publishes in leading management and organisation journals (*British Journal of Management, Human Relations, International Journal of Operations and Production Management, Journal of Management, Journal of Management Studies, The Leadership Quarterly, Organization Science* and *Public Management Review*). He is Founder/Director of The TRANSFORMATION Project (www.thetransformationproject.co.uk). His engaged scholarship (funded to c£1.5m) has been recognised (CMI and ESRC), and the OECD used his research to evaluate international policy implementation. In 2023, he was part of a CMI policy paper titled 'West Midlands Future Prosperity' which sets out how management skills can boost growth.

Kate Copeland-Rhodes is the Founder and Managing Director of The Globe Group CIC a non-profit dedicated to tackling climate change, which encompasses running The Globe Foundation, a community eco centre to establishing events such as the Midlands Climate Expo and Green Action Planning programmes. A passionate environmentalist with over 20 years of experience in project management, communications and environmental behavioural change programmes. As well as Globe, she helped establish and is Deputy Chair of Staffordshire & Stoke-on-Trent Climate Commission; she also sits as Deputy Chair on IEMA Midlands Regional Board.

Sharon Cronin, MSc in Marketing from the Technological University Dublin, has built on wide ranging experience in digital business transformation, energy management, information technology and the services industry to become Head of Marketing for Schneider Electric in Ireland before being promoted to Head of

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David Horsfall is Director of Property and Sustainability at Tyseley Energy Park. As a Chartered Surveyor, he qualified in Planning and Development and is passionate about creating high-quality sustainable places. He is currently delivering the development in Central Birmingham known as Tyseley Energy Park (TEP). Through collaborative partnerships with experts from academia, government and industry, Tyseley Energy Park will shape the way the City of Birmingham develops infrastructure for renewable heat and power, energy storage, clean transport fuels and advanced waste processing.

Holly Johnson has worked at Amtico for almost a decade and for the last three and a half as Marketing Director where she is responsible for a team of 35 design, marketing and brand professionals. Her role has a wide and interesting scope managing and implementing the product and marketing strategy globally for both the residential and commercial markets. Prior to that, she spent over a decade working for Midlands-based manufacturing brand, Aga Rangemaster, in marketing and brand management. She completed her degree in Marketing Management from the University of Derby where she also successfully attained her Chartered Institute of Marketing post-graduate diploma in Marketing and Management.

Mike Leonard is Visiting Professor, Manufacturing and the Built Environment, Birmingham City University (BCU), and has extensive senior leadership experience in building products manufacturing and housing. He is currently delivering primary research to support the transition to net zero, ensuring resilience in the built environment and frequently speaks at conferences and publishes material to shape future policy. A leader in the Birmingham City University "Centre for Future Homes" researching the Future Homes Standard through active Demonstrators, preventing overheating, enhancing indoor air quality, addressing the fire

risk, reducing the use of single-life plastics, decarbonising the built environment and embracing the skills gap. In a period of unprecedented change, he believes that it is critical that we put customers at the heart of the journey and avoid unintended consequences.

Monica Mateo-Garcia is Senior Lecturer in Sustainable Built Environment and Lead of REFUoA13 at Birmingham City University. Architect by background, she has led and managed industry and publicly funded applied research projects related to zero-carbon homes, low-carbon refurbishment in buildings and healthy indoor environments. She is currently leading research in Future Homes Standard and post-occupancy evaluation. She co-leads the Centre for Future Homes at Birmingham City University.

Tony McNally is the Managing Director of Climate Change Solutions Ltd (est.2003). He jointly organised the first Midlands Environmental Business Conference NEC 1990 from which it was established and continues to date as the MEBC (Club). He was involved in organising the Pledge to the Planet and Tree of Life campaign, with John Talbot, David Middleton Jonathon Porritt, leading to and featuring in the UN Earth Summit Rio 1992. He is an Ambassador for the National Forest in the Midlands and co-founding detector HECE.

Julian Morgan is MD Founder and Technical Lead for KPM Marine and Scotseat KPM marine. He has an ONC in engineering, an Honours degree in Manufacturing from Brunel University (1987), an NSF scholarship in intelligent robotics and AI from URI/MIT (1985) and an MBA from Warwick Business (1989) where he specialised in Product development and future energy trends.

KPM Marine won the Queen's award for Innovation (2022), the SeaWork spirit of Innovation marine award three times for safety design and FSB international business of the year. He holds the world speed endurance record for 1, 2 and 3 hours S850 power boat, inspiring much of the design concepts used by the business. He is a Member of the Royal Institute of Naval Architects and a Fellow of the Lunar society. He also works with the West Midland Lieutenancy promoting the Kings award for Enterprise specialising in Sustainability and Innovation.

For over 30 years, he has specialised in the design and manufacture of safety critical products for the marine and automotive industries. He has worked for Phillips Research Laboratories medical division and consulted with organisations including Apple Computers, BAE Systems, Hewlett Packard and Psion to name a few in high technology and manufacturing.

Robyn Owen is Professor of Entrepreneurship and Sustainable Finance, Founder of GreenFin research cluster and Deputy Director of the Centre for Enterprise, Environment and Development Research (CEEDR), Middlesex University. Her research focus is green innovation finance and developing finance solutions for early-stage investment markets. She currently leads Middlesex University's Natural Environment Research Council Integrated Finance and Biodiversity research programme on SME Nature Positive Finance.

Rashmi Prakash is Experienced Educator with over 19 years of teaching prowess, catering to a diverse range of student-learners from ages 3 to 60. She equipped with a unique educational background – holding a Bachelor's in Accounting, MBA and a Masters in Interdisciplinary Studies focused on Education and Mathematics from UTD, Richardson, Texas. She recently earned a Doctorate in Educational Administration and Leadership Management from European International University, Paris.

Her journey involves a heartfelt commitment to community service, from constructing homes with Habitat for Humanity to supporting foster children, aiding animals at shelters and caring for seniors in old age homes. She is passionate about music, trekking and travel and totally invested in unearthing profound stories from history. She is an actively engaged educator imparting soft skills training to educational institutions and corporate sectors. Her notable achievements include earning award at Kalakari Film Festival for the best documentary on women empowerment & well-being, guiding a Special Education School to secure funds via the CSR Initiative at IIM/IIT Indore's i5 Summit and collaborating with India's Ministry of Women and Child Development for Professional Development initiatives for the field officers on site. She is always passionate about learning with avid learners, facilitating learning and nurturing a healthy mindset geared towards growth.

Vicky Pryce is Chief Economic Adviser at the Centre for Economics and Business Research (CEBR) and a Visiting Professor at BCU and King's College, London. She was previously Senior Managing Director at FTI Consulting, Director General for Economics at the Department for Business, Innovation and Skills (BIS) and Joint Head of the UK Government Economic Service. Before that she was Partner and Chief Economist at KPMG after senior economic positions in banking and the energy sector. She is a Fellow of the UK Academy of Social Sciences, a Fellow of the Society of Professional Economists, a Companion of the British Academy of Management, Chair of the Economic Advisory Council of the British Chambers of Commerce, and on the Advisory Group of the Better Statistics CIC. Her recent books include '*Greekonomics*: The Euro crisis and Why Politicians Don't Get It'; '*It's the Economy, Stupid*- Economics for Voters', with Ross and Urwin; '*Redesigning Manufacturing*' with Nielsen and Beverland and '*Women vs Capitalism*'.

Al Rainnie, Professor, has held Chairs at Monash, Leicester and Curtin Universities. He has researched in the area of work and employment for about 40 years and has published over 100 books, book chapters, journal articles and research reports. He was the founding Director of the Monash Institute for Regional Studies and Director of Research at both the Centre for Labour Market Studies at the University of Leicester and the Curtin Graduate School of Business in Perth, Western Australia. He has recently co-authored a report on skill and innovation commissioned by the Federal Chief Scientist for the Australian Council of Learned Academies.

Darryn Snell is an Associate Professor in the School of Management and Coordinator of the Work in Transition Research Group of the Business and Human Rights Centre and co-coordinator the Skills, Training and Industry Research Network at RMIT University, Melbourne. Forthcoming book Rainnie, A., Snell, D., & Dean, M. *Australia's regional and industrial future: Issues of militarization, manufacturing and climate change*. Taylor and Francis.

John Stott is a Chartered Member of the Energy Institute and worked in the electricity generation industry. He is very interested in finding ways of minimising climate change, and renewable energy is an important part of the solution.

He has invested in over 50 renewable energy projects and is well informed about renewable energy and, in particular, the technicalities of solar power. He has helped a community solar project with technical advice and helped a local business to purchase a solar power system. For 10 years, he promoted the low-carbon message by writing the green column in a local electronic newspaper.

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Foreword

As Chair of the Carbon Trust, a member of the UK Climate Change Committee since it was formed in 2008 and the UK's former Low Carbon Business Ambassador, I look back over the last 20 or so years of climate action in the UK with some satisfaction, given the progress in monitoring emissions, in establishing legally binding targets to reach both Net Zero by 2050 and in addressing biodiversity depletion through Net Gain. However, I am conscious of Lord Stern's warning that climate change is the greatest and widest-ranging market failure ever seen and a unique challenge for all our economies. And we have just experienced the hottest year on record, the 12 months up to May 2024, with global air temperatures 1.63° above pre-industrial levels. As I look ahead to the UK's Seventh Carbon Budget, which will set legal limits for net emissions of greenhouse gases in the period 2038–2042, I cannot help but be anxious about our current trajectory and the need for significant acceleration of action.

In 2023, wrong kind of records were broken – the highest global average temperatures, the hottest month on record and daily global temperatures briefly surpassing pre-industrial levels by more than 2 °C. Extreme weather events have become more frequent with consequences including forced migration and mass extinction. A recent survey of 10,000 young people conducted by universities across 10 countries showed that more than half of the respondents think humanity is doomed, three-quarters are frightened for their future and 4 out of 10 are reluctant to have children of their own. It is hard not to feel gloomy, but that won't help, we have to use this (almost literally) burning platform to motivate an urgent response.

The good news is that we can fix this, especially with the concerted efforts of global leadership and politicians working nationally and locally to deliver shared net zero goals. In the past, fossil fuels fuelled our progress, but at an increasing cost to our environment; we're now able to harness innovative technologies to power future progress through clean renewable energy. And whereas the Climate Change Committee previously highlighted that the costs of cutting greenhouse gas emissions by 80% by 2050 could reduce UK GDP by 1.5%, it's now considered that 100% emissions savings could have little impact on living standards and, indeed, could increase GDP through a growing green economy.

This book offers a lively and at times controversial commentary. Insightful analysis and a range of practical case studies demonstrate the ambition and commitment of many in business to reaching net zero and to passing on a more sustainable system to future generations.

Julia Elizabeth King,
Baroness Brown of Cambridge

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Chapter 1

Introduction: What This Book Consists of

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Abstract

Climate change caused by an increase in greenhouse gas emissions poses a threat to species on earth. Such emissions have been caused by activities that have increased the rate at which greenhouse emissions have occurred due to the burning of fossil fuels and industrial processes in recent decades. Without urgent intervention, the ability of earth's citizens will be irrevocably altered. Hundreds of millions of people's lives will effectively become extremely challenging. Deaths due to starvation, lack of water, storms and flooding will increase. The magnitude of the crisis confronting humanity has resulted in means the formation of what's known as the 'Net Zero' target set by The Intergovernmental Panel on Climate Change (IPCC, 2024), a United Nations body consisting of global experts on climate change in 1994. This chapter explains why climate change has occurred, what its impact may be and how intervention by governments as well as all organisations and individuals catastrophe can be avoided. There is an overview of subsequent chapters contained in this book.

Keywords: Climate change; emissions; environmental threat; net zero; intervention; economic benefit

What's Causing Climate Change?

Climate change, defined by the United Nations Group (2024) for Climate Action as consisting of 'long-term shifts in temperatures and weather patterns', is almost universally acknowledged to be the result of human activity. In particular, the

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doi:10.1108/978-1-83608-574-420251001

burning of fossil fuels (coal, oil and gas) is the major reason for a noted increase in the average temperature of the earth following the industrial revolution which commenced, in Britain in the latter half of the 18th century, coal, a readily available resource, was used to heat water to produce steam. Producing steam provided a reliable supply of power to operate rapidly developing machines capable of producing goods at greater speed and reduced costs than hitherto possible. Mass production became the basis of the modern world we continue to enjoy over two and a half centuries later.

Burning non-renewable fossil fuels to produce energy, currently accounting for 80% of the world's requirements, and regarded as utterly essential to the effective functioning of every society has, in recent decades, contributed to an alarmingly rapid increase in what's are known as 'greenhouse' gases (Saplakoglu, 2019). Coal, oil and gas – created millions of years ago when dead plant matter was converted by heat and pressure – when burned produce over 75% of global emissions. Largely consisting of carbon dioxide (CO_2), representing around 90%, methane (CH_4) and nitrous oxide (N_2O) are also emitted by burning these fossil fuels. Notably, methane, produced by 'intensive' agricultural practices, waste management, energy use and biomass burning, though less prevalent than carbon dioxide, is 34 times more harmful.

Anyone who's been in a greenhouse when the sun shines will know it can be hot and uncomfortable. Unless cooler air is introduced, the heat will become increasingly oppressive. This is the effect increased greenhouse gas emissions are having on the earth. Heat from the sun is being trapped in the atmosphere. The result is global temperatures are increasing which disrupts the earth's complex interactive weather and ecosystems. As the earth becomes warmer, more water vapour is contained in the atmosphere. In turn, water vapour acts as a greenhouse gas creating a vicious circle by contributing to further warming.

The Impact of Climate Change

Though human beings are believed to have emerged around 800,000 years ago, the level of damage earth has suffered in the last 70 years is so great as to warrant an alternative era. What's known as the Anthropocene (human-centred) Epoch is characterised by the increase in greenhouse gases which, as we've experienced in the last 35–40 years, has resulted in extreme temperatures and weather patterns across the globe. Human activity in the Anthropocene Epoch, as well as increasing CO_2 levels to the highest level in 66 million years increased extinction rates, now running at well above the long-term average (Carrington, 2016). Levels of plastic and microplastic particles in waterways and the sea are 'now virtually ubiquitous' with attendant risks to long-term health (Carrington, 2016). The developing catastrophe that is climate crisis is cited as a major reason for a notable fall in oxygen levels in lakes across the world that's suffocating wildlife and creating a threat to drinking water supplies (Carrington, 2021).

The world's population has risen dramatically in the last 200 years from 1 billion to over 7.8 billion. As a direct consequence, there's been a corresponding rise in use of fossil fuel and consumption of the earth's resources. Growth in

population, requiring prolific consumption of energy, food and a vast range of minerals essential in everything we do each day, is destructive to planet earth. Humanity's 'success' in survival and multiplication is, ironically, leading to the destruction of the only known planet in the universe capable of supporting life. Global warming, if allowed to continue unchecked, will make life considerably more difficult for many hundreds of millions of people who will be affected by rising temperature. Climate change will irrevocably alter ecosystems and natural habitats potentially affecting all life on earth.

Why Climate Change Poses Such an Existential Risk to Humanity

Earth is over 1°C warmer than it was prior to the industrial revolution and warmer than at any point in the last 100,000 years. If the production of greenhouse gases does not decline, the rise in the average temperature of earth will continue. What this will mean is a destabilisation of the delicate balance of the interconnected ecosystems that operate on earth IPCC (2014). Any alteration in one system influences all others. The consequence of climate change manifested by rising temperature will be a combination of outcomes potentially devastating to hundreds of millions of earth's citizens as the environment becomes increasingly inhospitable (Carrington, 2019). As we've seen in recent years, wildfires are more prevalent and spread more rapidly. Temperatures in the Arctic have warmed at least twice as fast as the global average meaning ice caps may eventually disappear (Milman, 2021).

Rising temperature increases heat-related illnesses and makes working outdoors more difficult. An increase in the incidence of 'wet bulb thermometer' readings has been experienced in many parts of the world. When a wet bulb reaches 35°C, humans are no longer able to cool themselves by sweating. Death from overheating can occur within hours, even among the fittest, but especially among the old, infirm and disabled. Currently, extreme temperatures are estimated to result in 5 million premature deaths each year. According to the United Nations, 'environmental factors' account for the deaths of some 13 million people annually. Altered weather will mean more diseases, place even greater strain on health care systems that, for the world's poorest, are inadequate at present. However, things could get a great deal worse.

A study led by the London School of Hygiene & Tropical Medicine (LSHTM) and published in The Lancet suggests that should the emission of greenhouse gases continue to rise at current rates, the effect on global temperatures could lengthen transmission seasons by more than a month for malaria and four months for dengue over the next 50 years (Zhao et al., 2021). Without action to reduce greenhouse gas emissions, the research carried out by LSHTM predicts up to 8 billion people could be at risk of malaria and dengue fever by 2080 (Dehghan, 2021). According to the United Nations, weather-related events have resulted in over 23 million people being forced to move every year (Dehghan, 2021). Such migration will only increase should the earth's average temperature continue to rise. Climate change will increase hunger and result in nutrition among the world's

poorest, already insufficient, being undermined. Fisheries, crops and livestock are likely to be less productive. Increased temperature will reduce land available for grass to feed livestock and reduce yields of crops vital for food. Raised temperatures make external work, especially in agriculture, especially challenging.

It's not only humanity that will suffer from the impact of climate change. The rate of decline of species is one thousand times greater than at any time in recorded human history. It's believed that as many as a million species could become extinct within coming decades. The threat of forest fires, storms and more extreme weather coupled with a rise in invasive pests and disease will intensify such decline. Any increase in the average temperature of the earth will, according to the United Nations (Dehghan, 2021), cause a number of other devastatingly dire consequences.

Earth's weather patterns have altered in recent years and severe 'topical' storms have become more commonplace in many regions. Raised temperatures allow more moisture to be held in the atmosphere leading to extreme rainfall and flooding. Oceans that have become warmer increase the likelihood of intense dangerous cyclones, hurricanes and typhoons that may be potentially fatal and deadly to those affected. As oceans become warmer because of global warming and combined with melting ice from polar caps, their volume increases leading to sea levels rising. This means that many millions are forced inland. As well as the trauma induced, additional stress is placed on communities that must provide accommodation, feed them and provide water that may already be scarce. Moreover, as ocean absorbs greater levels of carbon dioxide, they will become more acidic which will threaten marine life and coral reefs.

However, while increased temperature and raised moisture in the atmosphere may cause storms and flooding in some parts of the world, water becomes scarcer elsewhere. Water shortages in already water-stressed regions result in a higher risk of drought. Water is, of course, essential to life and causes people to migrate with inevitable disruption (Harvey, 2020). Drought undermines crops yields leading to food shortages and starvation. It also causes ecological drought and increased vulnerability of ecosystems. Destructive sand and dust storms shift billions of tons of sand resulting in expanding deserts with reduced potential to cultivate land for food.

The IPCC and Emergence of Net Zero

The IPCC, formed in 1988 by the United Nations (UN) and the World Meteorological Organization, and currently consisting of 195 member countries, is a direct response to climate change. As its own website explains, it was 'created to provide policymakers with regular scientific assessments on climate change, its implications and potential future risks, as well as to put forward adaptation and mitigation options' (IPCC, 2021). Consisting of thousands of scientific experts from across the globe, its explicit purpose is reviewing all published research examining the likely consequences of 'human-induced climate change'.

Based on what amounts to an extremely rigorous review of extant research, the IPCC produces, every five or six years, 'Assessment Reports'. These reports

contain a 'Summary for Policymakers' intended to guide thinking and, crucially, recommend collaborative and coordinated policymaking by all governments. To this end, and coinciding with the Assessment Reports, a Conference of Parties (COP) is held attended by delegates from participating countries that have signed the UN Framework Convention on Climate Change, an international treaty agreed in 1994. Significantly, in 1994, the IPCC identified immediate actions essential to arrest the rate at which emissions, particularly carbon, are produced.

As the IPCC reasoned, concerted and coordinated action by all countries needed to be implemented to reduce greenhouse gases required to limit the increase in average global temperature level to 1.5°C. This proclamation is standardly referred to as 'Net Zero' developed by the IPCC in Paris, the Paris Agreement. Critically, the IPCC (2024) has stressed with unerring consistency ever since – and with increasing alarm at the need for urgent action – cutting carbon emissions and other emissions is essential to ensure the earth's atmosphere can be protected and, eventually, allowed to recover. What was critical, the IPCC stresses, is that 'in order to avert the worst impacts of climate change and preserve a livable [sic] planet' a reduction of greenhouse gases, particularly carbon, must occur. Accordingly, the proclamation made in 1994 was that action to reduce greenhouse gas emissions would achieve a 45% reduction by 2030 and become net zero by 2050. As Oxford University's *Net Zero Climate* (2024) website explains, 'To "go net zero" is to reduce greenhouse gas emissions and/or to ensure that any ongoing emissions are balanced by removals'.

How Can Net Zero Be Achieved?

Faced with impending catastrophe, action is urgently required. It's utterly imperative that radical reduction in emissions of greenhouse gases occurs with as much urgency as possible. Though action by every individual is to be applauded, unless matched by collective endeavour across the globe, halting climate change will not succeed. Importantly, though CO_2 is emitted in every part of the globe, some countries produce a greater proportion, relative to population than others. Collective action is essential. Though not easy or cheap, the scale of the catastrophe means immediate intervention is not optional. Delay will merely ensure the likelihood of even greater catastrophe more likely. All governments, organisations, businesses and every individual must play their part.

In terms of activities and processes undertaken in any country, there will, of course, be variations in levels of contribution to greenhouse emissions. PCC (2024) data collected in 2010 present averages for global emission of greenhouse gas for six key activities:

- Electricity and heat production (25%)
- Agriculture, forestry and other land use (24%)
- Industry (21%)
- Transportation (14%)
- Other energy (10%)
- Buildings (6%)

The largest contributory sector, electricity and heat production, should be achieved using alternative sources which, as much as possible, are free from emission. The development of renewable energy by harnessing power from wind, solar and waves allows 'green' energy to be produced. Renewable energy is also possible through, for example, biomethane gas produced from organic waste.

Agriculture, forestry and other land use, producing 24% of greenhouse gases, marginally less than electricity and heat production, must be carried out using methods of production that do not rely on the use of nitrogen-based fertilisers. Reducing consumption of meat and dairy products, which require vast amounts of land to feed livestock, is regarded as essential.

Industry, which significantly contributes to emissions, must aim to produce, using green energy, goods that are free from waste. This requires all of those engaged in industry (manufacturing) across the globe, in all parts of the supply chain, to redesign processes utilised. Such redesign will include the extraction of raw materials and minerals through distribution and delivery. It is incumbent on consumers to demand goods made using green production methods. This is the central tenet of the 'Circular Economy'.

Transportation, accounting for 14% of global greenhouse gas emissions, includes all aspects of the way in which everything, both people and goods, moves from one place to another. It is estimated that 90% of energy used for transport regularly used, which includes cars, motorcycles, vans, lorries, buses, trains, trains, airplanes and shipping, currently uses fossil fuel. As such, this sector represents an immediate opportunity for change. International trade and tourism is currently carried out with an environmental cost. Collective action is needed to find ways to reduce the harm to the planet caused by transportation.

Other energy, representing 10% of the greenhouse gases emitted, though not directly associated with electricity or heat production, incorporates fuel extraction, refining, processing and transportation. Coordinated effort by all countries should seek ways to reduce the emission of greenhouse gases resulting from these activities.

Finally, buildings, essential for shelter and activities conducted under cover, account for 6% of global greenhouse gas emissions through the burning of energy, that is natural gas, to produce heat as well from cooking. Achieving a reduction in greenhouse gas emissions from newly constructed buildings through improved design and alternative fuels is already underway. However, in any mature economy, such as the United Kingdom, the overwhelming majority of the 'built environment' already exists. Consequently, an ambitious programme known as 'retrofitting' and adaption is urgently required.

An Economic and Societal Rationale for Action

According to the UN Environmental Programme (2021), a green economy is defined as a 'low carbon, resource efficient and socially inclusive'. Such an economy is based on the desire to achieve growth in employment, as well as income, through investment by the public and public sectors. It is explicitly based on ensuring future investment in all aspects of economic activity is achieved without

any further increase in greenhouse gases and with, correspondingly, reduced waste in activities carried out. Additionally, decreased pollution, enhanced energy and resource efficiency, as well as prevention of degradation of biodiversity and ecosystems, are regarded as fundamental to achieving a green economy that will ensure the planet supports life for future generations. A greener economy achieved through a range of initiatives including Net Zero is not intended to replace sustainable development but, rather, to deliberately focus on the economic opportunities possible. As such there are three strands, 'Policy Mainstreaming', 'Economic Instruments' and 'Capability Building'.

At the time of writing, a report describes research showing that economic damage from climate change is calculated to be six times greater than previously believed (Bilal & Känzigcal, 2024). Crucially, the report's authors state every additional 1°C average increase in global temperature leads to a 12% decline in world gross domestic product. Given the collective output of all countries, gross domestic product (GDP), is estimated by the International Monetary Fund (2024) and published in its 2023 World Economic Outlook report, to be $105 trillion, this represents a phenomenal benefit that would accrue by proactively dealing with, and investing in, climate change.

A report published in *Nature* on the economic impact of climate change, 'The economic commitment of climate change', provides equally stark warning of the consequences of failure to act by governments in dealing with the threat (Kotz et al., 2024). Based on research carried out, the authors assert that average incomes across the globe will decrease by almost a 5th within the next 26 years compared with the level they'd reach in the absence of the effects of global warming. Though this report suggests that should net zero fall in line with accepted targets, the decline will be around 20%; if emissions continue to rise without action, the fall in income could be as high as 60% by 2010.

According to the OECD (Organisation for Economic Co-operation and Development) in *Towards green growth, A summary for policy makers* (2011), any framework to achieve a greener economy should be explicitly based on growth strategies that include two key objectives. Firstly, improving resource management and boosting productivity. Secondly, encouraging economic activity to take place where it is of best advantage to society over the long term. These should be achieved through innovation and collaboration. This will require economic growth which will be based on institutional and individual investment decisions informed by the desire to produce a future that is green. As OECD recognise, 'Advanced, emerging, and developing countries face different challenges and opportunities in greening growth, as will countries with differing economic and political circumstances'. Creating a greener future, in which Net Zero is fundamental to success, is only possible by the combination of policies implemented by government and incentives (financial or otherwise) provided to motivate a change in attitudes and behaviour.

Critically, as the OECD stresses, there is a clear connection between increased GDP used to measure economic progress generally enhancing the importance of 'natural assets to wealth, health and wellbeing'. Growth must be beneficial to the health, wealth and welfare of all citizens in all parts of the world.

This must include those who, traditionally, suffer the greatest inequality and poverty in, most especially, developing countries. The location of natural assets, largely in low-income countries, means that growth policies must be cognisant of the need to reduce local citizens' vulnerability to environmental risks and to increase their economic prospects.

Consistent with the attainment of Millennium Development Goals, the OECD contends a number of vital outputs should be achieved. This would include far effective and efficient methods of use of water, transport and, of course, production of energy which, as well as vastly improve poor health experienced by the world's poorest resulting from environmental degradation, would improve productivity and reduce the causes of climate change. In summary, implementing initiatives as part of Net Zero in pursuit of improving the earth's environment will immeasurably improve the quality of life for current and future citizens of this planet.

An Overview of This Book

Examining Net Zero – Creating Solutions for a Greener Society and Sustainable Economic Growth consists of three parts:

- Part One – Challenges/Opportunities and Issues Overview
- Part Two – Empirical Examples of Practice (Case Studies)
- Part Three – Moving Forward

The five chapters presented in the first part of this book provide a brief overview of theoretical perspectives of net zero. So, in Chapter 2, 'Circularity in Producing a Green Economy', BCU's Dr Steven McCabe examines what circularity means and what's required to successfully achieve the significant social, economic and environmental benefits offered by implementing net zero. In Chapter 3, Al Rainnie from Unisa/Curtin University and Darryn Snell of RMIT University in 'The Australian Net Zero Economy Authority: Limits and Possibilities' explore how the transition from an economy reliant on carbon is being achieved through the activities of a newly created Net Zero Authority. In particular, they describe the tensions that transition has engendered and how the aspiration of achieving Net Zero is being achieved. In Chapter 4, Dr Rashmi Prakash from Bengaluru City University, 'The Challenge of Net Zero: Evidence from the Indian Automotive Sector', explains the methods being used to achieve how net zero in the automobile industry in India. Emissions and the benefits of cleaner air for citizens are examined in Chapter 5, 'Unveiling the Interplay of Air Pollution, Genetics and Epigenetics' by BCU's Professor Loukia G. Tsaprouni. In an extensive examination of air quality based on her research, Loukia describes how by the advancement of preventive and therapeutic strategies, it's entirely possible to protect public health and achieve the promotion of sustainable environmental practices aligned with the objective of net zero. Finally, the last chapter in Part One, BCU's Professor Alex de Ruyter, Michael Butler and Rowan Crozier in 'Towards Net Zero: A Practical Transformative Leadership