

EDITORIAL

The Climate-Neutral Future

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As the globe grapples with the accelerating shifts in climate patterns, the clarion call to address its repercussions resonates with newfound urgency [1]. Now, at this pivotal moment in our shared history, humanity confronts unparalleled challenges. There has never been an urgent need for the world to come together on a sustainable, climate-neutral path. "Rolling Out a Climate-Neutral Future: Materials and Sustainable Innovations" which shed light on the topic and provided directions for building a greener tomorrow (Fig. 1) [2]. Smart materials and ground-breaking breakthroughs are important in the journey towards this climate-neutral future [3]. This book explores the many ways in which modern sustainable technology and materials science can be powerful tools to achieve the Sustainable Development Goals (SDGs), build a more resilient and equitable world, and mitigate the effects of climate change.

Against the backdrop of a world plagued by climate change and its associated problems, finding sustainable green solutions has never been more important [3,4]. At the Centre of this effort is climate neutral material and a circular future combined with sustainable production methods. Materials that are climate neutral Materials without an impact on the greenhouse gas budget of our planet over their entire life cycle [5]. Making something carbon-neutral refers to ensuring that as much CO₂ or other greenhouse gases are put into the manufacture, use and disposal of a product is taken out again. It is possible by using renewables, efficient manufacturing processes and balancing emissions with e.g. carbon sequestration or compensating CO₂ credits. For industries, as well as consumers these materials hold a special promise — to get further away from the traditional linear economy of take-make-dispose and create a sustainable future where emissions are not just reduced but also neutral [6]. It is impossible to emphasize the importance of these things enough. Industries are one of the main contributors to greenhouse gas emissions throughout the world for a long time in history. Taking the rate at which climate change continues to be alarming, it is obvious that incremental adjustments or gentle emissions cuts are not enough.

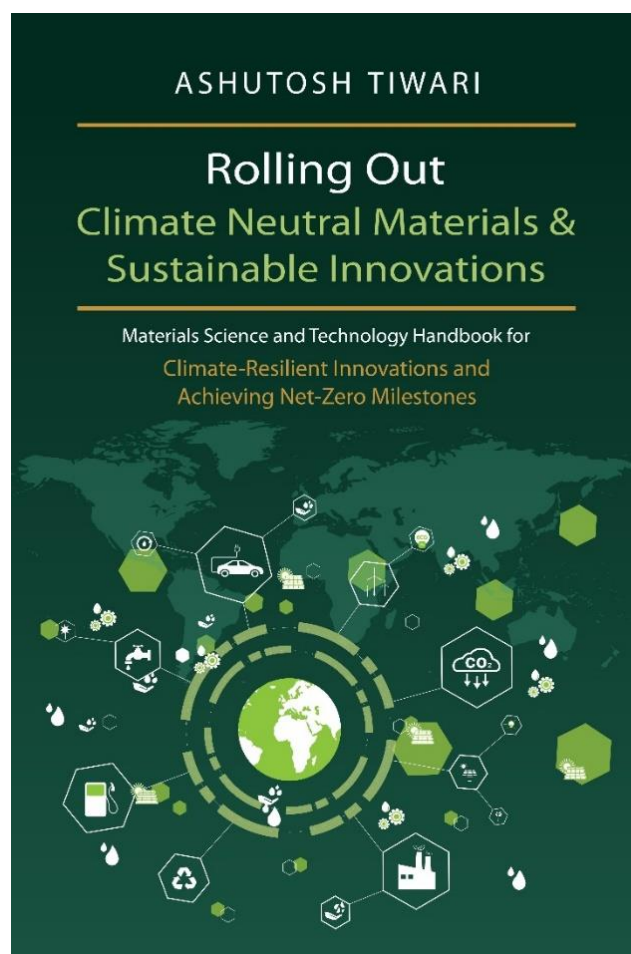


Fig. 1. Cover of the book "Rolling Out a Climate-Neutral Future: Materials and Sustainable Innovations" published by the International Association of Advanced Materials. Observers in the yellow and green zones play a crucial role in advancing discussions and initiatives related to climate change. It emphasizes sustainable practices, energy reform, and a unified strategy to improve both human and environmental health. The chapters highlight a steadfast dedication to collaborative net-zero innovation and the pursuit of global sustainability goals.

Industries can radically reduce their carbon footprint by switching to climate-neutral materials [7]. Such materials also carry the promise of greater economic

upside. Among consumers, there is a growing demand for sustainable products; and with impending stricter environmental regulations becoming ever more probable in the future, industries focusing on climate-neutral materials potentially wield a significant advantage. The notion of a circular future and climate-neutral materials are interwoven. In a circular economy, resources are repeatedly re-used and then either recycled or composted at the end of life. Its potential testifies to a new, non-mainstream linear model that assumes "everything needs to go somewhere" which is based on the concept of respect for all objects and disdain for waste [8].

Climate-neutral materials, when put into a circular system, can be recycled and repurposed over and over without adding to climate change [9]. This means stuff made from these materials can last longer, get fixed up, and when they're done, the materials can be used to make new stuff. Take a climate-neutral polymer in packaging, for example. In a circular future, this polymer wouldn't just be tossed out after being used. Instead, it could be taken apart and turned into new packaging or something else entirely while still climate neutral [10]. Thinking about a future where climate-neutral materials drive a circular system is cool but comes with its fair share of challenges too. Making new discoveries in material science, changing how things are made, shifts in how consumers act, and having rules to support it all are needed.

Developing and scaling these materials requires a lot of R&D [11]. Transitioning to a circular economy also needs infrastructure for collection, recycling and repurposing. But the opportunities are huge. Beyond the environmental benefits, industries will save costs in the long run, reduce dependency on volatile raw materials and get positive brand positioning in a market that's getting more and more sustainable. As we stand at the crossroads of a climate crisis, the time to act is now. Climate neutral materials and the circular future are not goals, they are the way to a sustainable future [12]. By embracing this vision, we can have a world where resources are valued, emissions are neutral, and the planet is preserved for future generations.

The following chapters are a collection of many different conversations that cover all our challenges. We start by looking at the importance of materials research in getting to net zero. As we get into the conversation on research and development practices, the need for long term and multi-faceted partnerships becomes clear. In a world where climate change is an imminent threat, net zero is top of mind for businesses, governments and societies around the world [13]. Net zero innovation combined with green tech is not a trend, it's a necessity and a game changer to stop environmental degradation. These are changing the landscape of many industries and getting us to a sustainable future [14].

Net zero means the balance where the amount of greenhouse gases you produce is equal to the amount you take out of the atmosphere. In short net zero innovation is about minimising carbon footprints so we reduce the impact of human activity on global warming. This can be achieved by reducing emissions, increasing energy efficiency and carbon capture and storage. Green tech, also known as clean tech, is about creating products, practices and innovations that have no impact on the environment.

From renewable energy to sustainable agriculture, this technology is about protecting and conserving the planet's resources, so they are available for future generations.

Renewable Energy: Wind, solar and hydroelectric have changed the way we produce electricity. The cost of solar panels and wind turbines is dropping, and efficiency is increasing making these more accessible and viable. Electric vehicles powered by renewable energy are becoming the norm rather than the exception [15].

Waste Management and Recycling: Innovations in waste processing allow us to recycle more than ever before. Advanced sorting, ecofriendly packaging and techniques to convert waste to energy have changed the waste management technique [16].

Water Conservation: Green tech solutions for water management go from simple rainwater harvesting to advanced desalination plants. The focus has moved from just water purification to use, recycle and sustain [17].

Net-zero and green tech are converging to create whole-of-life solutions to climate [18]. The implementation of green tech ensures that industries can function without over-exploiting natural resources, thus aiding in the transition to net-zero emissions [19]. For example, the construction sector is embracing green building designs that rely on energy-efficient appliances, waste minimization, and sustainable materials. These structures often produce as much energy as they consume, achieving a net-zero energy balance. Therefore, we are not just reducing emissions we are also driving inherent sustainability. Industries like aviation and agriculture which have big carbon footprints are going green. Biofuels, precision agriculture, and digital solutions that optimize resources are a few examples. While the promises of net-zero innovation and green technology are profound, challenges remain.

Financial constraints, especially in developing countries, can slow down the adoption of these technologies. And the initial investment in green infrastructure can be huge. But as more industries realize the economic, social and environmental benefits of going green, the investment will increase. Public awareness and government policies can speed up this transition. For real change to happen, we need a collective effort from policymakers, industry leaders, scientists and the general public. The combination of net-zero innovation and green

technology is a hope in a time of environmental challenges [20]. The road to a fully sustainable world is long and tough but with collective effort and relentless innovation, we can have a balanced and harmonious coexistence with nature.

It is up to us, the global community, to support and nurture these technologies for a better world for ourselves and for generations to come. Our story revolves around the pioneering advances in materials for a climate-neutral world. From the breakthroughs in energy domains, hydrogen fuels and electric mobility to the fusion of artificial intelligence with healthcare – each chapter is a window to the future. Here we see a world transformed by innovations like wearable tech, nanomedicine and cloud-integrated medical solutions. Embedded in this narrative is a steadfast belief in global solidarity and the spirit of climate diplomacy.

A climate-neutral world is not the task of a few but the collective mission of all. It mandates a symphony of nations, harmonizing in their quest for a shared, eco-balanced destiny [20, 21]. For academics, policymakers, industrial torchbearers, and inquisitive students, this book hopes to be both a beacon and a compendium. By weaving together rich insights, compelling narratives, and vanguard trends, we aim to not just educate but to galvanize action. The journey to a climate-neutral realm is fraught with complexities. Yet, with unyielding resolve, ceaseless innovation, and a shared ethos, these challenges metamorphose into opportunities.



Fig. 2. Unveiling of 'Rolling Out a Climate-Neutral Future: Materials and Sustainable Innovations' at COP28 – A significant event at the 28th Conference of the Parties in Dubai, showcasing IAAM's commitment to climate resilience. This handbook has 14 chapters on climate neutrality. IAAM's mission is to strengthen materials ecosystems against climate change. Sustainable development and global warming reduction. Climate management, biodiversity conservation and technological innovation. COP28 for a cleaner, greener and more sustainable future.

COP28, UAE Outcomes and IAAM's Role in Advancing Climate Action – A detailed overview of IAAM's key highlights at COP28 in Dubai, on how we are

building material ecosystems to fight climate change for sustainable development and global warming [8]. COP28's clean energy, climate finance, natural and human well-being and IAAM's climate management, biodiversity conservation and integration of technology and policy for a sustainable future.

IAAM held a meeting across four continents to discuss the agenda and climate action plans for a more resilient Earth. With the goal of promoting advanced materials for global excellence, IAAM is making a geographical impact worldwide. Representatives of the International Association of Advanced Materials convened in a multi-continental meeting to deliberate on agendas and climate action plans aimed at fostering a more resilient Earth. Demonstrating a commitment to leveraging climate-efficient materials for a circular economy, IAAM showcases its dedication to sustainable development across the globe.

COP 28 was an important event since it was the first 'global stocktake' of the Paris Agreement climate change initiatives [22]. The official launch of the book "Rolling Out a Climate-Neutral Future: Materials and Sustainable Innovations" during the United Nations Climate Change Conference in 2023 turned out to be an extremely remarkable event, given the platform that was provided (Fig. 2). This book adopts a holistic lens, emphasizing the significance of material R&D in a climate-neutral vision. It traverses various domains from sustainable materials and energy solutions to the crossroads of healthcare and sustainability.

At the end of COP 28, a deal was reached that marks the "beginning of the end" of the fossil fuel era. It establishes a framework for a fair and rapid transition supported by severe reductions in emissions and increased opportunities for further research [8]. COP 29, the 29th Conference of the Parties on Climate Change, is scheduled to take place in Baku, Azerbaijan, from November 11 to 22, 2024. The COP29 Presidency has devised a plan consisting of two interconnected pillars to promote ambition and facilitate action, to ensure a transparent, unbiased, and inclusive process [23]. Looking ahead, the IAAM climate delegation for COP29 is now open. Our members are encouraged to contribute to climate action.

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