Foreword

Climate change is a major challenge facing all nations, posing a threat to the very survival and development of humankind. The global average temperatures has increased nearly 1.2°C compared to pre-industrial levels, approaching the temperature rise control goals under the *Paris Agreement* at an alarming pace, bringing humanity to a make-or-break moment. UN Secretary-General António Guterres has called on all nations worldwide to declare a state of "climate emergency", and to make concerted, concrete efforts to advance carbon neutrality and address climate change. Carbon neutrality is fundamental to the path towards resolution of the climate and environment crisis. An important enabler of sustainable development, it will act as a strong driver of green transformation in the economy and society and of the building a community with a shared future for mankind.

Achieving carbon neutrality will be an extremely complex and arduous task. While over 120 nations have announced carbon neutrality goals, laying a solid foundation for achieving carbon neutrality by the middle of this century, and for implementing the targets of the *United Nations Framework Convention on Climate Change* (UNFCCC) and the *Paris Agreement*, to date nations' progress on mitigation has fallen short of what global carbon neutrality is meant to achieve. A key problem is the lack of feasible systematic solutions. To that end, related organizations and institutions have pursued in-depth research and extensive international cooperation to promote the formulation of climate policies and to mobilize mitigation measures worldwide.

Excessive use of fossil fuels constitutes the root cause of the climate crisis. Thus, in order to secure carbon neutrality, energy, the decisive factor driving climate change, must be addressed, and major efforts made to expedite the energy and electric power revolution and implement the "Two Replacements", namely, clean replacement in energy production and electricity replacement in energy consumption. Global Energy Interconnection (GEI) offers an innovative energy system characterized by clean energy production, extensive distribution of clean energy, and electrification of energy consumption, which will constitute an important platform for the development, transmission and use of clean energy on a global scale. It provides a technically advanced, cost-effective, systematic win-win solution permitting the achievement of the targets of the *Paris Agreement*, capable of facilitating the global efforts to achieve carbon neutrality by the middle of this century, resolving the climate and environmental crisis, promoting high-quality economic development, and advancing the sustainable development of humankind.

The Global Energy Interconnection Development and Cooperation Organization (GEIDCO) is dedicated to the promotion of the establishment of GEI, meeting global power needs in a clean, green way, and fulfilling humanity's need for sustainable development. Through ongoing research on the theories, technologies, schemes and mechanisms of carbon neutrality, GEIDCO has published books including *Resolving the Crisis* and *The Road to China Carbon Neutrality*, and released report series covering *Research and Outlook on Global and Continental Energy Interconnection*, and *Research on Global and Continental Renewable Energy Development and Investment.* These provide feasible, replicable, scalable and systematic climate change solutions, concerning which UN Secretary-General António Guterres has remarked "It is this global interconnectivity that allows for inclusivity for energy to reach everybody in need. And so, GEI is at the centre of the two central concepts (sustainability and inclusivity) of our commitment to Agenda 2030 and with our objectives in relation to climate change". What's more, the UNFCCC Secretariat deemed GEI an excellent tool for the realization of the goals of the *Paris Agreement*.

While adhering to green, low-carbon, sustainable development concepts and taking humanity's needs in terms of economic and social development into account, this book describes the current state of the climate and environmental crisis, analyzes the significance of challenges facing achieving carbon neutrality, and proposes a solution for achieving global carbon neutrality: GEI development based on "Two Replacements, One Increase, One Restore and One Conversion". It also provides a systematic exposition of net zero roadmaps in key sectors, and pathways towards carbon neutrality for each continent, identifies key needs in terms of technological innovation and market mechanism construction, and demonstrates the huge benefits of the GEI-based carbon neutral scheme in terms of the coordinated development of the economy, society and the environment.

This book comprises two volumes, a total of 17 chapters. Volume I consists of 8 chapters. Chapter 1 introduces the global climate change and explains the challenges facing and significance of achieving global carbon neutrality. Chapter 2 explains GEI's scientific mechanisms and conceptual system for achieving carbon neutrality. Chapter 3 analyzes the pattern, core features and major advantages offered by energy and power transition in the context of the GEI-based carbon neutrality pathway. Chapter 4 systematically analyzes the energy industry's net zero roadmap from three perspectives: fossil fuels, clean energy and energy allocation. Chapters 5-8 elaborate on net zero roadmaps for key sectors of industries, transportation, building, AFOLU (agriculture, forestry and other land use), and non-carbon dioxide greenhouse gases (Non-CO_2 GHGs).

Volume II is divided into 9 chapters. Chapter 9 describes the important role of electricity-carbon market development for carbon neutrality. Chapter 10 focuses on analysis of and prospects for key zero-carbon and carbon-negative technologies. Chapters 11-16 analyze mitigation pathways, energy transition patterns, and energy interconnection planning schemes for achieving carbon neutrality in Asia, Europe, Africa, North America, Central and South America, and Oceania, based on these regions' stages of development and other characteristics. Chapter 17 describes the comprehensive benefits and development framework for the GEI-based carbon neutrality pathway, and the outlook for infrastructure development in the direction of Energy, Transportation and Information Networks Integration (ETI Integration) and for sustainable development. Finally, the appendix introduces data, tools and models related to the research contained in this book.

This book proposes an innovative, systematic, strategic, scientific and feasible solution for the realization of global carbon neutrality which could be of great value in accelerating the green energy transition, coping with climate change, and achieving sustainable development for humankind. It is our hope that it can offer reference material useful to related international organizations and governments in their formulation of carbon neutral schemes for society as a whole, and of development plans and policies for energy and power industries, and can be of use to enterprises and institutions involved in global mitigation actions. GEIDCO is committed to making unremitting efforts to advance carbon neutrality in conjunction with all sectors of society, and to making a contribution to the realization of the targets of the *Paris Agreement* and the UN Sustainable Development Goals (SDGs).