Securing energy and conservation of the environment are the most important issues for the sustainable development of human beings. Until now, people have relied heavily on fossil fuels for their energy requirements and have released large amounts of greenhouse gases such as carbon dioxide (Here, we have abbreviated all greenhouse gases including carbon dioxide to “CO2.”). Emissions of CO2 have been regarded as the main factor in climate change in recent years, and how to control them is becoming a pressing issue in the world. The energy problem cannot simply be labeled a technological one, as it is also deeply involved with social and economic issues. It is necessary to establish “Low carbon Energy science” as an interdisciplinary field integrating social science and human science with the natural sciences.

From 2008, four departments of Kyoto University, Japan — the Graduate School of Energy Science, the Institute of Advanced Energy, the Department of Nuclear Engineering, and the Research Reactor Institute—have joined forces, and with the participation of the Institute of Economic Research, have been engaged in a program entitled “Energy Science in the Age of Global Warming — Toward a CO2 Zero-Emission Energy System” for a Global Center of Excellence (COE) Program of the Ministry of Education, Culture, Sports, Science and Technology of Japan, with the support of university faculty members. This program aims to establish an international education and research platform to foster educators, researchers, and policy makers who can develop technologies and propose policies for establishing a scenario toward a CO2 zero-emission society no longer dependent on fossil fuels by the year 2100.

In the course of implementing the Global COE, we placed the GCOE Unit for Energy Science Education at its center, and we are proceeding from the Scenario Planning Group and the Advanced Research Cluster to Evaluation, forming mutual associations as we progress. The Scenario Planning Group is setting out a CO2 zero-emission technology roadmap and establishing a CO2 zero-emission scenario. They will also conduct analyses from the standpoints of social values and human behavior. The Advanced Research Cluster, as an education platform based on research, promotes socio-economic study of energy, study of new technologies for renewable energies, and research for advanced nuclear energy by following the roadmap established by the Scenario Planning Group. Evaluation is conducted by exchanging ideas among advisors inside and outside the university, including those from abroad, to gather feedback on the scenario, education, and research.
For education, which is the central activity of the Global COE, we have established the GCOE Unit for Energy Science Education and have selected students from the doctoral course, and are fostering these human resources. The students, on their own initiative, are planning and conducting interdisciplinary group research combining social and human science with natural science, working toward CO2 zero emission. The students will acquire the ability to survey the whole energy system through participation in scenario planning and interaction with researchers from other fields, and will apply that experience to their own research. This approach is expected to become a major feature of human resources cultivation. We will strive to foster young researchers who will be able to employ their skills and knowledge with a broad international perspective and expertise in their field of study in order to respond to the needs of society in terms of various energy and environmental problems. Those new researchers also will become leaders in the twenty-first century, full of vitality and creativity and working toward harmony between the environment and mankind.

We held the First International Symposium of the Global COE titled “Zero-Carbon Energy, Kyoto 2009” on August 20–21, 2009, at Kyoto University Clock Tower in parallel with the First International Summer School on Energy Science for Young Generations (ISSES-YGN) on August 20–22, 2009, at Kyoto University Clock Tower and Kyodai Kaikan. There were many important lectures by invited speakers and members of the Global COE, with interesting presentations by students at the GCOE Unit for Energy Science Education. This book is a compilation of the lectures and presentations. We hope that it will provide the impetus for the establishment of Low carbon Energy science.

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