

FOREWORD



"Finally, the times have caught up with us." Knowing that this sounds arrogant, we the Institute of Advance Energy think this way. Fourteen years ago, in 2011, our Institute started a project recognized by the Minister of Education, Culture, Sports, Science and Technology for joint use and collaborative research. The project is named "Zero Emission Energy Research", and its mission is to research energy that minimizes emissions of harmful substances such as carbon dioxide. It is hard to imagine now, but at the time we started this project, there were quite a few skeptical opinions regarding the significance and importance of this mission. This project received high evaluations at the end of both the first phase from 2011 to 2015 and the second phase from 2016 to 2021. We believe this reflects the broad recognition of the significance and importance of our mission in society and the appreciation of the contributions our Institute has made toward achieving this mission. Following this, we are currently executing the third phase of the project from 2022 to 2027. While the times have caught up to us, to stay ahead and not just keep pace

with the times, we established the "Integrated Research Center for Carbon Negative Science (ICaNS)" in 2022 to research "Carbon Negative Energy," which further advances "Zero Emission Energy," and we continue and progress research that stays ahead of the times.

The Institute of Advance Energy was established in 1996 with the aim of exploring the nature of energy by returning to natural laws and principles and creating new energy theories to be carried on by the next generation, as well as developing cutting-edge technologies to lead and realize them. The Institute consists of three departments, each named after energy generation, transformation, and utilization, encompassing 14 research fields. Additionally, it includes the "Laboratory for Complex Energy Processes" that provides shared equipment for the aforementioned joint use and collaborative research project, and the previously mentioned ICaNS. The Institute has established two key interdisciplinary research areas as its cornerstone: one aimed at realizing nuclear fusion, called "Plasma and Quantum Energy," and the other aiming for efficient energy utilization and transformation based on biological energy utilization principles and material science, called "Soft Energy."

Each research field of this Institute serves as a cooperative course of the Graduate School of Energy Science, Kyoto University, with a considerable number of master's and doctoral students from that Graduate School assigned, doing education in a cutting-edge research environment. Additionally, we contribute to undergraduate education through the provision of university-wide common subjects at Kyoto University.

"Rather than asking what the Institute can do for you, I would like you to consider what you can do for the Institute." When I became the director last April, I made this greeting at a meeting of all faculty and staff of the Institute. This carries my sentiments based on the famous speech of the late President Kennedy. When I first heard his speech, I thought, "What a terrible demand to say, 'The country does nothing for you, but I want you to serve the country.'" However, as I encountered this phrase a few more times, I began to feel it was quite a good word. I came to understand that the country is not something to rely on and depend upon but is to be developed through the strength of each individual. Furthermore, this phrase seems to envision a country where each person can shine. An Institute where each member can shine is certainly a wonderful thing, isn't it? With this thought, I made the aforementioned greeting. Currently, Kyoto University is united in aiming to be selected as a University for International Research Excellence (Kokusai Takuetsu Kenkyu Daigaku). Shining members are expected to play important roles as significant pieces in that University.

This annual report summarizes the major research achievements of each of IAE's research divisions for FY2024 (April 2024-March 2025) to represent IAE's research activities. I hope you will enjoy our Institute's ongoing research in a wide range of scientific disciplines, which will surely provide innovative solutions to meet the demands of achieving carbon neutrality.

March 2025

A handwritten signature in dark ink that reads "M. KATAHIRA". The signature is fluid and cursive, with the first name "Masato" and the last name "KATAHIRA" clearly distinguishable.

Masato KATAHIRA
Director
Institute of Advanced Energy
Kyoto University