Kyoto University Global COE Program
京都大学グローバルCOEプログラム

Energy Science in the Age of Global Warming

地球温暖化時代のエネルギー科学拠点

— Toward a CO2 Zero-emission Energy System —
— CO2ゼロエミッションをめざして —

Self-Inspection and Evaluation Report 2008

平成20年度 自己点検・評価報告書

Kyoto University Global COE Program

Energy Science in the Age of Global Warming

– Toward a CO2 Zero-emission Energy System-

Self-Inspection and Evaluation Report

2008

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1. Introduction

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 (abbreviated to CO2 below). CO2 have been regarded as the main factor in climate change in recent years. It is becoming a pressing issue in the world how to control over the CO2 release. The energy problem cannot be simply labeled as a technological one, as it is also deeply involved with social and economic elements. It is necessary to establish the “Low carbon energy science” in the interdisciplinary field adding the social science and the human science to the natural science.

In FY2008, the four departments of Kyoto University, Graduate School of Energy Science, Institute of Advanced Energy, Department of Nuclear Engineering, Research Reactor Institute have joined together, and also with the participation from Institute of Economic Research have been engaging in "Energy Science in the Age of Global Warming - Toward a CO2 Zero-emission Energy System " for a Global COE Program of the Ministry of Education, Culture, Sports, Science and Technology under the full faculty support taking advantage of characteristics of university. 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 the center, and we proceed from the Scenario Planning Group, the Advanced Research Cluster to the Evaluation, forming mutual associations as we progress. The Scenario Planning Group sets out a CO2 zero emission technology roadmap and establishes a CO2 zero emission scenario. They will also conduct analysis from the society values and human behavior aspect. The Advanced Research Cluster, as an education platform based on research, promotes the socio-economic study of energy, study of new technologies for solar energy and biomass energy, and research for advanced nuclear energy by following the road map established by the Scenario Planning Group. Evaluation is conducted by exchanging ideas among advisors inside and outside of the university and from abroad, to gather feedback on the scenario, education, and research.

For education, which is the central activity of the Global COE, we establish “the GCOE Unit for Energy Science Education” and select students from the doctoral course, and foster these human resources. The students plan and conduct interdisciplinary group research containing both the social and the human science and the natural science toward CO2 zero emission at the initiative of the students themselves. The students will acquire the faculty to survey the whole “energy system” through participation in scenario planning and interaction with researchers from other fields, and apply it to their own research. This approach is expected to become a major feature of human resources cultivation. We will strive to foster young researchers not only who will be able to employ their skills and knowledge with a wide international perspective as well as expertise in their field of study in order to respond to the needs of the society in terms of the variety of energy and environmental problems, but who will also lead people to a 21st century full of vitality and creativity, working towards harmony between the environment and mankind.

There was only about a half-year period for the Global COE actual activities in FY2008, however, we had energetic activities such as quick setting up the organization, recruiting program-specific assistant professors through an international open recruitment, implementing the student's interdisciplinary group research, implementing the scenario planning research and the advanced research, establishing the advisory committee, organizing the kick-off symposium, hosting or co-hosting the related seminars and symposiums, and preparing the GCOE education unit curriculum.

We present here the self-inspection and evaluation report.

Program Leader Takeshi Yao

2. Purposes of the Program

Greenhouse gas emission (hereinafter called CO2 emission) is regarded as the main factor in global warming as stated in the IPCC report in 2007. A shortage of fossil fuels by the end of this century is also predicted. Consequently, showing possible paths to achieving a worldwide zero CO2 emission system independent of fossil fuels is not only a pressing issue for the world but also a research topic that should be initiatively pursued by Japan, as a developed country but poor in terms of energy resources. In energy issues, not only the natural science, but also the social science that seek new social systems and human science that consider social way are also deeply related. It is necessary to establish the “Low carbon energy science” in the interdisciplinary field adding the social science and the human science to the natural science.

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 year2100. The students will acquire the faculty to survey the whole “energy system” through participation in scenario planning and interaction with researchers from other fields, and apply it to their own research. This approach is expected to become a major feature of human resources cultivation.

In the course of implementing the Global COE, we placed the GCOE Unit for Energy Science Education at the center, and we proceed from the Scenario Planning Group, the Advanced Research Cluster to the Evaluation, forming mutual associations as we progress. The Scenario Planning Group sets out a CO2 zero emission technology roadmap and establishes a CO2 zero emission scenario. They will also conduct analysis from the society values and human behavior aspect. This task is provided as an education platform, and is made useful for human resources development. The Advanced Research Cluster, as an education platform based on research, promotes the studies by following the road map established by the Scenario Planning Group. As Energy Science Research for no CO2 emission, from the point of view that the main cock should be turned off first, we targeted at Renewable Energy (Solar Energy and Biomass Energy), Advanced Nuclear Energy (Fission and Fusion), and Socio-economic Study of Energy because the energy issues cannot be simply considered as a technological problem, but it is deeply related to the social and economic elements. Evaluation is conducted by exchanging ideas among advisors inside and outside of the university and from abroad, through the establishment of an advisory committee consisted of external experts, implementation of external evaluation by external evaluating committee, implementation of self-inspection and evaluation and so on, to manage the platform by gathering feedback on the scenario, education, and research.

For education, which is the central activity of the Global COE, we establish “the GCOE Unit for Energy Science Education” and select students from the doctoral course, and we foster core human resources by making the students of the Unit participate in the Scenario Planning Group and the Advanced Research Cluster and receive a practical education.

The fundamental principle of the GCOE Unit for Energy Science Education is to foster a human resource:

(1) Who has comprehensive ability to have a profound knowledge regarding the energy and environmental issues, to understand both the social and human scientist and the natural scientist, and to carry out collaborative work,

and

(2) Who has independence to organize a research group for the intended research, and to perform the research cooperating with other researchers,

and

(3) Who has internationality to have an international perspective, communication ability, and world-class standard research ability,

and

(4) Who has potential to contribute in solving the energy and environmental issues which relate deeply to the sustainable development of human beings.

The "CO2 zero emission education program"

provided by this unit has made the following compulsory subjects:

(1) "Open recruitment group research" to plan and conduct interdisciplinary group research containing both the social and the human science and the natural science toward CO2 zero emission at the initiative of the students themselves.
(2) "Advanced research" to participate in the Advanced Research Cluster as an independent researcher and to master creativity and independence.
(3) "Field training" to visit field site such as nuclear power plant or waste power plant or etc. and to make practical learning.
(4) "Research presentation" to make research presentation at an international congress or an industry-academia cooperate symposium or an international workshop.

Furthermore, the following subjects are also provided:

(5) International education through classes in English, invitation of researchers and strategists from abroad.
(6) Long-term overseas education and acceptance of foreign students.

And also, students in this unit are recruited as research assistants to provide adequate economic support. Annual wage system program-specific educators and researchers are recruited by international open recruitment, then are joined the scenario planning or advanced research as independent researchers, and are fostered as practical researchers. They also instruct the students' research, are cultivated their instructing skills, and are fostered as researchers who inherit the human resources cultivation to the next generation.

Furthermore, in order to transmit the achievement of this platform to public, we will promote,

(1) Information transmission through website,
(2) Publication of quarterly newsletters in English and Japanese,
(3) Hosting domestic and international symposiums and activity report meetings,
(4) Co-hosting related meetings domestic and international such as SEE (Sustainable Energy and Environment) forum and so on,
(5) Hosting of an industry-government-academia collaboration symposium and citizen lectures.

Based on the above-said activities, we foster every year academic researchers who will inherit the human resources cultivation, industrial researchers who will put the research achievements into practice, policy makers, and strategist who will support an international organization as becoming government representatives of the future COP.

And the followings are expected as the social value and the pervasive effect,

(1) Contribution toward realizing CO2 zero-emission, and policy proposal coordinated with government and autonomy, domestic or abroad, and international agencies,
(2) Spread of Energy Science as an interdisciplinary academic field and provide of new approach for the education and the research,
(3) Establishment of information channel, human exchange path and education system to solve the energy issues,
(4) Contribution to utilization of nuclear power with improved social acceptance,
(5) Contribution to prevention of global warming and energy security
(6) Spread of the effective achievements to the south-east Asian Nations through international cooperation such as the SEE forum, activities at platform universities and so on.

In FY2008, while setting up the organization and, at the same time, making an effort to implement the program promptly, the following activities were carried out.

1. GCOE Unit for Energy Science Education
   (1) Forming the unit and establishing the education program and curriculum
   (2) Open recruitment, detailed checking and grant for the group research
   (3) Hearing and evaluation for the achievement of the open recruitment group research by the Scenario Planning Group
   (4) Recruiting research assistants (RA) and accepting foreign students

2. Scenario Planning Group

(1) Construction of a CO2 zero-emission technology roadmap
(2) Planning of a CO2 zero-emission scenario
(3) Establishment of the Group of Energy Scenario and Strategy Study as a place where information and ideas exchange between Global COE scenario research committee and industry for issue of energy and environment.
(4) Promoting the open recruitment group research at the GCOE Unit for Energy Science Education

3. Advanced Research Cluster
(1) Study of essential improvement of productivity for energy utilization including production, consumption and waste
(2) Survey of existing technology for solar energy utilization and development of novel solar energy utilization method.
(3) Development of new production method of bio-fuel and bio-materials.
(4) Concept formation of a safe and advanced nuclear energy (accelerator driven subcritical reactor, nuclear fusion, nuclear power and radiation) and construction of research infrastructure.

4. Transmission to the public
(1) Start-up of the website
(2) Publication of newsletters in English and Japanese
(3) Hosting the kick-off symposium
(4) Co-hosting related research meetings domestic and international
(5) Hosting of an industry-government-academia collaboration symposium

3. Organization Setup

3.1 Organization and Education/Research Program

Objective of this program is to formulate international center of education and research to foster distinguished researchers and policy-makers who can, respectively, invent new technologies and propose new policies to realize the scenario toward the zero CO2 emission energy system without utilizing fossil fuels. From the following viewpoints:

1) To prescribe energy supply and demand scenarios toward a zero CO2 emission system required for the latter half of the 21st century reflecting the results from advanced research clusters
2) To promote research tasks of socio-economic energy research, renewable energy research, and advanced nuclear energy research, in cooperation with the Scenario Planning
3) To give doctoral students an experience of mutual interaction with researchers in other fields through their own participation into scenario planning, to acquire the ability of globally looking down at entire energy system and to foster young researchers

GCOE Unit for Energy Science Education (GCOE Unit) comprising 30 selected doctoral students per academic year from the Graduate School of Energy Science and the Department of Nuclear Engineering is set up in the center of this program as shown in Fig. 3-1 and a unique curriculum is formulated. Students belonging to the *Unit* participate in international internships and research workshops outside Japan. In addition, they belong to research group of scenario planning to draw up a road map toward a zero CO2 emission energy system as well as advanced research cluster which aims to conduct globally-advanced research in the system. The *GCOE Education Unit* allows the students to develop practical real-world skills.

Fig. 3-1. Entire picture of this program.

In order to promote the project in Fig. 3-1, governing organization was set up as shown in Fig. 3-2. *Steering Committee of GCOE Unit for Energy Science Education* formulates the basic policies in not only the management of the GCOE Unit but also all organizations, controls the overall program, handles budget control and carries out decision-making. It is called as *Program Headquarters Committee* (PHC). PHC consists of the representatives from each working committee involved in this program except *Advisory Committee* as shown in Fig. 3-2 and academic staffs of four faculties (Graduate School of Energy Science, Institute of Advanced Energy, Department of Nuclear Engineering and Research Reactor Institute) take part in the committee. Secretariat performs administrative matters of this program and responds to all other inquiries according to the policy of PHC.

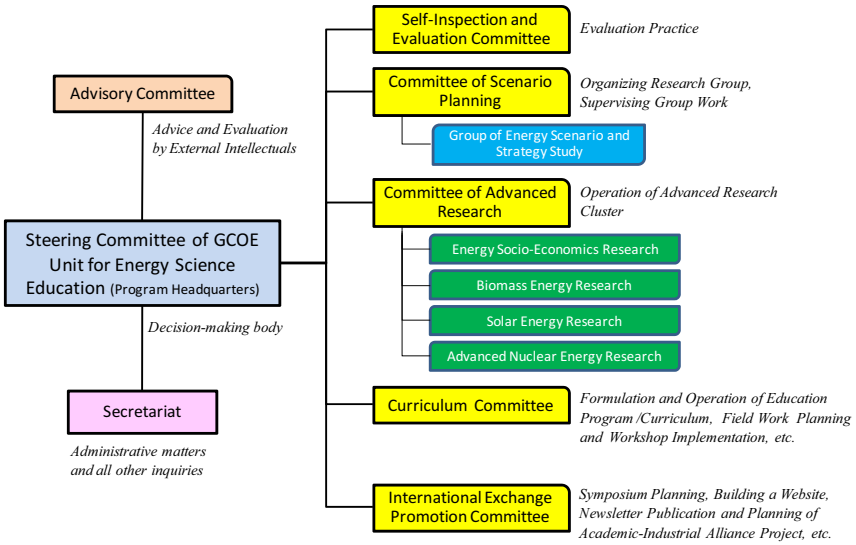


Fig. 3-2. Organization of this program.

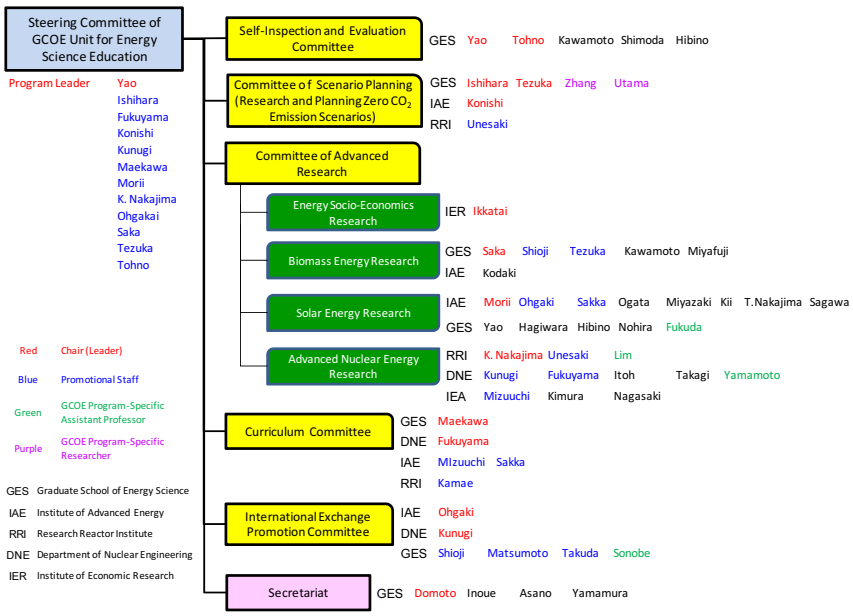


Fig. 3-3. Committee Composition as of March 31, 2009.

Curriculum Committee formulates a unique curriculum that includes basic energy science and advanced research results. The Committee also plans and implements other education programs such as field work or internship. Interdisciplinary group work of doctoral students in the GCOE Unit on a voluntary basis is managed by *Committee of Scenario Planning*. *International Exchange Promotion Committee* disseminates information by hosting international and domestic Japanese symposiums to promote communications with other countries regarding research results and international exchange among students and researchers.

Committee *of Scenario Planning* and *Committee of Advanced Research* perform the actual operation of research activities. *Committee of Advanced Research* consists of four research groups of Energy Socio-Economics, Biomass Energy, Solar Energy and Advanced Nuclear Energy. The two committees operate in close coordination and cooperation with each other such as the holding of joint workshops.

Self-Inspection *and Evaluation Committee* inspects and evaluates the above mentioned activities, and issues the report every year to pursue the continuous improvement of the program. Furthermore, *Advisory Committee* comprising external intellectuals is established to assess the development of the GCOE Program and offer the recommendations that will enhance quality of outcomes of the program. According to the recommendations, PHC makes some corrections if necessary to accomplish the goal.

In addition to *twenty* academic staffs in charge, a number of other academic staffs, GCOE researchers and graduate students in the four faculties participate in this program. Fig. 3-3 indicates the personnel distribution of academic staff and GCOE researcher who belongs to each committee.

3.2 Establishing the GCOE Secretariat

The GCOE secretariat was established on October 1, 2008. The staff consists of a Chief of the Administrative Office of the Graduate School of Energy Science (double post), a Chief of the Academic Administration Affairs Division (double post) and two newly recruited temporary staff. The main duties are budget management and administration of the cost involved with each committee (steering, self-inspection and evaluation, scenario planning, advanced research, curriculum, and international exchange promotion), application procedure, management and administration of young researchers expenses, completion of performance reports, etc., communications and coordination with the administrative headquarters of Kyoto University, and budget management and administration of the in-direct expenses.

3.3 Budget and Allocation Status for FY2008

In FY2008, the direct expense was 268,600,000 Yen, in-direct expense was 80,580,000 Yen, totaling to 349,180,000 Yen. The allocation by committees and departments are as follows. Additionally, Table 3-1 shows the expense breakdown for each committee.

✧ **Direct expenses allocation status**

・Graduate School of Energy Science	261,600,000 Yen	
Breakdown		
Program Headquarters	93,440,000 Yen	
Self-Inspection and Evaluation	0 Yen	
Scenario Planning	73,992,000 Yen	(66,000,000 Yen for Young Researchers)
Advanced Research	74,668,000 Yen	
Curriculum	0 Yen	
International Exchange Promotion	19,500,000 Yen	
・Department of Nuclear Engineering	3,500,000 Yen	
・Reactor Research Institute	3,500,000 Yen	
Direct expenses Total	268,600,000 Yen	

✧ **In-direct expenses allocation status**

・Graduate School of Energy Science	11,064,000 Yen
・Institute of Advanced Energy	16,372,000 Yen
・Department of Nuclear Engineering	6,267,000 Yen
・Research Reactor Institute	6,587,000 Yen
Subtotal	40,290,000 Yen
・Administration Headquarters	40,290,000 Yen
In-direct expenses Total	80,580,000 Yen

Table 3-1 Final Budget and Allocationi n FY2008

(1,000 Yen)

Expense Category	Direct Expenses						Sub-total	In-direct expenses	Total
	Program Headquarters	Scenario Planning	Advanced Research	Curriculum	International Exchange Promotion	Self-Inspection and Evaluation			
Equipment and facilities	36,355	195	49,092	0	778	0	86,420		
Domestic travelling	4,384	181	92	0	967	0	5,624		
Overseas travelling	6,903	0	0	0	4,578	0	11,481		
Salary									
Program-specific assistant professor	11,413	0	0	0	0	0	11,413		
Researchers	1,794	0	0	0	0	0	1,794		
RA	9,000	0	0	0	0	0	9,000		
Administrative support	2,101	0	0	0	0	0	2,101		
Rewards	175	36	0	0	2,755	0	2,966		
Program promotion	31,494	8,306	25,048	447	6,783	0	72,078		
Young Researchers Group research	0	65,723	0	0	0	0	65,723		
Total	103,619	74,441	74,232	447	15,861	0	268,600	80,580	349.180
Budget Amount	100,440	73,992	74,668	0	19,500	0	268,600	80,580	349,180

1. The 3,500,000 Yen each allocated to Department of Nuclear Engineering and Reactor Research Institute were included in the Steering Committee (Program Headquarters) budget.
2. Budget incurred for the Secretariat is included in the Steering Committee (Program Headquarters).

4. Activities of Steering Committee of GCOE Unit for Energy Science Education

4.1 Outline

The committee consists of a program leader and the representatives of five committees (*Scenario Planning, Advanced Research, Curriculum, International Exchanger Promotion*, and *Self-Inspection and Evaluation*) and secretariat. Policies and planning of this program are deliberated in the committee meeting and the activities of the above five committees are confirmed and modified. The committee meeting has been regularly held once a month since this program started as follows:

The 1st Committee Meeting: August 28, 2008
The 2nd Committee Meeting: September 29, 2008
The 3rd Committee Meeting: October 28, 2008
The 4th Committee Meeting: November 26, 2008
The 5th Committee Meeting: December 22, 2008
The 6th Committee Meeting: January 14, 2009
The 7th Committee Meeting: February 24, 2009
The 8th Committee Meeting: March 18, 2009

4.2 Selection and Adoption of Program-Specific Fixed-Term Assistant Professors and Researchers

In order to promote the program, application invitations for GCOE assistant professors and GCOE researchers were advertised in international publication of Nature as well as the websites of Graduate School of Energy Science (GES) and our GCOE program in September, 2008. One GCOE assistant professor was adopted on October 1, 2008 and three GCOE assistant professors were adopted on November 1, 2008. In December, 2008, the recruitment advertising was published in Nature as well as the websites of Kyoto University, GES and our GCOE program. Total of two GCOE researchers were adopted on January 1, 2009 and March 1, 2009. Four GCOE assistant professors and two GCOE researchers are staffed as of March 31, 2009. Application invitations are shown below.

Recruitment article in Nature (September 25, 2008)

Kyoto University Global COE Program
"Energy Science in the Age of Global Warming"
6 Faculty Positions at the Assistant Professor Level

Kyoto University Global COE Program "Energy Science in the Age of Global Warming" invites applications for full-time appointments at the Assistant Professor level as a Program-Specific Fixed-Term Faculty member in energy science. Kyoto University Global COE Program "Energy Science in the Age of Global Warming" is in part supported by a five-year Fund (September 2008 to March 2013) from the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT).

1. The number of positions available 6

2. Research Fields
The Global COE Program entitled "Energy Science in the Age of Global Warming" is seeking applicants for Program-Specific-Fixed-Term Assistant Professor positions in the research fields of Energy Science for the Zero CO2 Emission.
   1) Evaluation of Sustainable Energy System
   2) Scenario Planning for the Zero CO2 Emission Energy System
   3) International Survey on the Zero CO2 Emission Energy System
   4) Thermofluid Research on Advanced Nuclear Energy
   5) Biomass Energy Research
   6) Solar Energy Research

3. Conditions of application and employment:
   1) **Requirements for applicants:** Applicants must have a Ph.D.
   2) **Nature of employment:** Assistant Professor in Kyoto University Global COE Program.
   3) **Term of the appointment:** The appointment will be renewed every year up to March 31, 2013 according to the rules of employment in Kyoto University. Note that the first year is up to March 31, 2009, which is the end of the Japanese academic year for 2008.
   4) **Salary:** Salary will be paid monthly in accordance with the rules of Kyoto University by the annual salary system.
   5) **Insurances:** National Public Servant Mutual Aid Association and Unemployment Insurance (compulsory).

4. The starting date of employment: November 1, 2008 (negotiable)

5. Procedure of the application:
   1) **Required documents:**
      a. Application Form (specify your research field and Subject Keywords)
      b. Curriculum Vitae (Academic and research backgrounds after high school and a color photo taken within 3 months (3 cmx4 cm))
      c. Letters of recommendation or the names of references
      d. List of publications and copies of three representative publications
      e. Short description of research plan in about 1000 words
      f. Any other pertinent information such as a list of patents and research funds.
      Note that application packages will not be returned.
   2) **The application deadline:** September 30, 2008
   3) **Mailing address:**
      Office of Global COE, Graduate School of Energy Science, Kyoto University
      Yoshida, Sakyo-ku, Kyoto, Kyoto 606-8501, Japan
      Phone: +81-75-753-4871
      Fax: +81-75-753-4745
      E-mail: soumu@energy.kyoto-u.ac.jp
      * Please indicate "Application for Assistant Professor at Global COE, Energy Science" in red on the envelope. You may also hand deliver the application to the office.
      * For more information, please send us an e-mail to soumu@energy.kyoto-u.ac.jp
      Make sure to use the following in the subject of your e-mails:
      "Application for Assistant Professor at Global COE, Energy Science"

6. Homepages:
   Kyoto University: http://www.kyoto-u.ac.jp/
   Global COE Program " Energy Science in the Age of Global Warming":
   http://www.energy.kyoto-u.ac.jp/gcoe/index.html
   Supporting Faculties of Kyoto University Global COE Program "Energy Science in the Age of Global Warming":
   http://www.rpd.gcoe.kyoto-u.ac.jp/recruit/recruit_080919_kyouin.html
   Graduate School of Energy Science:
   http://www.energy.kyoto-u.ac.jp/english/
   Institute of Advanced Energy:
   http://www.iae.kyoto-u.ac.jp/eng/iae/e_index/e_index.html
   Department of Nuclear Engineering, Graduate School of Engineering:
   http://www-e.gs.kogaku.kyoto-u.ac.jp/
   Research Reactor Institute:
   http://www.rri.kyoto-u.ac.jp/en/

Kyoto University Global COE Program
"Energy Science in the Age of Global Warming"
6 Faculty Positions at the Assistant Professor Level

Kyoto University Global COE Program "Energy Science in the Age of Global Warming" invites applications for full-time appointments at the Assistant Professor level as a Program-Specific Fixed-Term Faculty member in energy science. Kyoto University Global COE Program "Energy Science in the Age of Global Warming" is in part supported by a five-year Fund (September 2008 to March 2013) from the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT).

1. The number of positions available : 6

2. Research Fields :
The Global COE Program entitled “Energy Science in the Age of Global Warming” is seeking applicants for Program-Specific-Fixed-Term Assistant Professor positions in the research fields of "Energy Science for the Zero CO_2 Emission.

Category	Research Fields	Subject Keywords
1	Evaluation of Sustainable Energy System	CO_2 Inventory, Energy Supply and Demand Analysis, Management of Resources, Environmental Impact Assessment for CO2 Emission, Modeling of Energy System
2	Scenario Planning for the Zero CO_2 Emission Energy System	Evaluation of Technical Innovation, Futurology, Social Engineering, Energy Philosophy
3	International Survey on the Zero CO2 Emission Energy System	World Energy Supply and Demand, International Trends and Networking in Energy Research and Development, Energy Policy Trends
4	Thermofluid Research on Advanced Nuclear Energy	Thermofluid Engineering, Turbulent Heat & Mass Transfer, Energy Conversion, Fast Breeder Reactors, Advanced Light Water Reactors, High Temperature Gas-cooled Reactor, Fusion Reactors
5	Biomass Energy Research	Bio-materials from the Biomass, Biofuels from the Biomass
6	Solar Energy Research	Utilizing the Solar Energy in the Chemical Form, Artificial Photosynthesis

3. Conditions of application and employment:
   1) Requirements for applicants: Applicants must have a Ph.D.
   2) Nature of employment: Assistant Professor in Kyoto University Global COE Program.
   3) Term of the appointment: The appointment will be renewed every year up to March 31, 2013 according to the rules of employment in Kyoto University. Note that the first year is up to March 31, 2009, which is the end of the Japanese academic year for 2008.
   4) Salary: Salary will be paid monthly in accordance with the rules of Kyoto University by the annual salary system.
   5) Insurances: National Public Servant Mutual Aid Association and Unemployment Insurance (compulsory).

4. The starting date of employment: November 1, 2008 (negotiable)

5. Procedure of the application:
   1) Required documents:
      a. Application Form (specify your research field and Subject Keywords)
      b. Curriculum Vitae (Academic and research backgrounds after high school and a color

photo taken within 3 months (3 cm×4 cm)).
c. Letters of recommendation or the names of references
d. List of publications and copies of three representative publications
e. Short description of research plan in about1000 words
f. Any other pertinent information such as a list of patents and research funds.
Note that application packages will not be returned.
2) The application deadline: September 30, 2008
3) Mailing address:
Office of Global COE, Graduate School of Energy Science, Kyoto University
Yoshida, Sakyo-ku, Kyoto, Kyoto 606-8501, Japan
Phone: +81-75-753-4871
Fax: +81-75-753-4745
E-mail: soumu@energy.kyoto-u.ac.jp
* Please indicate "Application for Assistant Professor at Global COE, Energy Science" in red on the envelope. You may also hand deliver the application to the office.

* For more information, please send us an e-mail to soumu@energy.kyoto-u.ac.jp
Make sure to use the following in the subject of your e-mails: "Application for Assistant Professor at Global COE, Energy Science"

6. Homepages:
Kyoto University: http://www.kyoto-u.ac.jp/
Global COE Program "Energy Science in the Age of Global Warming":
http:// www.energy.kyoto-u.ac.jp/gcoe/index.html

Supporting Faculties of Kyoto University Global COE Program "Energy Science in the Age of Global Warming":

Graduate School of Energy Science:
http://www.energy.kyoto-u.ac.jp/english/
Institute of Advanced Energy:
http://www.iae.kyoto-u.ac.jp/english/e_index/e_index.html
Department of Nuclear Engineering, Graduate School of Engineering:
http://www-e-gs.kogaku.kyoto-u.ac.jp/
Research Reactor Institute:
http://www.rri.kyoto-u.ac.jp/en

5. Committee of Scenario Planning (Research and Planning Zero CO2 Emission Scenarios)

5.1 Target (Plan) and Achievement in FY2008

As the starting year of the Program, the objective was to construct a base where research can be developed. Specifically, to set up a room for the Committee of Scenario Planning, to assign program-specific researchers, and to operate "Group Research" are included.

- **Set up of a Room for the Committee of Scenario Planning**

The committee room was scheduled to be available from October 2008, but it was finally opened in January, 2009 at the same time with the appointment of program-specific researchers after a three-month delay from its initial schedule. The reason was that the open recruitment of GCOE researchers was not allowed to begin in August. The committee room is at Room 352 in Engineering Building No.6 of main campus. It can ensure the space where 4 researchers and an administrative support staff can work, a meeting space for 6 people, and a space to store books and documents.

- **Program-Specific Researchers Assignment**

The document screening and interviews with applicants after the international open recruitment was conducted. Two researchers were appointed in FY2008, one rsearcher is scheduled to be appointed in FY2009 and the total of 3 researchers was selected. In response

to the second Nature advertisement and homepage recruitment, there were many inquiries from all over the world. Then, the recruitment was generally suucessful. The two researchers recruited this year were a Chinese national and an Indonesian national, and the researcher appointed in 2009 is Japanese. Internationalization of academic staff was pormoted.

- **Group Research**

Actual start of "Group Research" was in December, 2008 because it took much time to set up research support system. The research support funds were granted to students and were used effectively in their respective research. Students' evaluation for group work is specified in 5.4 and the system worked smoothly without any major problems. Additionally, regardless of the short period, the accounting process was smoothly carried out.

Furthermore, Energy Scenario and Strategic Research meeting was launched, and extramural collaborative framework with companies was established.

5.2 Scenario Strategic Committee

Energy Scenario Planning is required to seek opinions from wide and various fields. Therefore, the Energy Scenario and Strategic Research Committee (Scenario Strategic Committee) was setup and those who are active mainly in industries were invited to be members in the committee.

The first Energy Scenario and Strategic Research Committee meeting was held on January 28, 2009, and together with explaining the objective of the committee, the future management policy was also confirmed. Hereafter, this meeting is scheduled to be held twice a year.

Table 5-1 Scenario Strategic Committee Member List as of May 29, 2009

Name	Organization	Post/Occupation
Yoshikazu Nishikawa	Research Institute for Applied Sciences Professor Emeritus at Kyoto University	Chairman
Yoshinobu Iwaki	the Kansai Electric Power Co., Inc.	General Manager, Research and Development Department
Yasuhito Nakagawa	Sharp Corporation	Division General Manager, Energy Technologies Development Center, Solar Systems Development Group
Shigeki Isojima	Sumitomo Electric Industries, Ltd.	Chief Engineer, Materials and Process Technology R&D Unit
Fumio Tanaka	West Japan Railway Company	Senior Engineer of Technical Research and Development Department Railway Operation Headquarters
Yasuhiro Fujii	Panasonic Electric Works Co., Ltd	Director, Corporate R&D Planning Office
Hirofumi Fujioka	Mitsubishi Electric Corporation	Manager, Energy Device Technology Department, Advanced Technology R&D Center
Yoshihiko Nagasato	Asahi Research Center Co., Ltd.	President
Shigeki Hirano	Osaka Gas Co., Ltd.	Managing Director, CTO, Head of Technology Division
Yuji Sano	Toshiba Corporation Power Systems Company	Senior Fellow, Power and Industrial Systems Research and Development Center
Takeshi Yao	Kyoto University	Dean, Graduate School of Energy Science
Keiichi Ishihara	Kyoto University	Professor, Graduate School of Energy Science
Tetsuo Tezuka	Kyoto University	Professor, Graduate School of Energy Science
Satoshi Konishi	Kyoto University	Professor, Institute of Advanced Energy
Hideaki Ohgaki	Kyoto University	Professor, Institute of Advanced Energy
Hironobu Unesaki	Kyoto University	Professor, Research Reactor Institute

5.3 Committee Meeting Status

As noted below, a total of 15 committee meetings were held to discuss about the "Group Research" progress and the details of scenario research. In addition, the video conference system through the internet for communicating with academic staffs in remote places was introduced and it can start operating from FY2009.

- 2008
  - 1st meeting September 1, 13:00－
  - 2nd meeting October 7, 15:00－
  - 3rd meeting December 22, 9:30－

- 2009 Meeting Status of the Committee of Scenario Planning
  - 1st meeting January 13, 10:30－
  - 2nd meeting January 20, 10:30－
  - 3rd meeting January 27, 10:30－
  - 4th meeting February 3, 10:30－
  - 5th meeting February, 10, 10:30－
  - 6th meeting February 17, 15:00－
  - 7th meeting February 24, 13:30－
  - 8th meeting March 3, 10:30－
  - 9th meeting March 10, 10:30－
  - 10th meeting March 16, 10:30－
  - 11th meeting March 24, 10:30－
  - 12th meeting March 31, 10:30－

5.4 Open Recruitment and Grant for Group Research

As for "Group Research", the guidance for doctoral students was conducted and they were requested to submit reports on their contribution to GCOE research objectives. Based on the research contents submitted by 70 students, 62 were selected as research grant recipients, and then they were divided into 8 groups. Additionally, a leader was appointed in each group. Meetings and discussions about topic determined in each group were carried out in English under guidance of the leader, and poster presentation in the kick-off symposium and report submission by the end of March, 2009 were demanded.

Table 5-2 Grouping and Grant Amount List

Group	Grant Amount	
	500,000 Yen	1500,000 Yen
A	3 Students	5 Students
B	2 Students	5 Students
C	3 Students	5 Students
D	2 Students	5 students
E	3 Students	5 Students
F	3 Students	5 Students
G	3 Students	4 Students
H	3 Students	5 Students

- Questionnaire and its results for the students joined in "Group Research"

Since "Group Research", as mentioned above, is aiming at fostering advanced research driving abilities such as finding problems, communication ability, multifaceted viewpoints and discussion ability, it is impossible to evaluate the effectiveness of the improvement by a simple paper test. Accordingly, a questionnaire survey was conducted for the students joined in the "Group Research" in order to subjectively evaluate the effectiveness. Considering the educational purposes of the "Group Research", the questionnaire investigated the effectiveness of the improvement for research driving abilities as the answering format of 5 grade scales from "Very effective" to "Not effective at all". Fig. 5-1 shows the questionnaire results. In addition to the above, "good points" and "points to be improved" were also asked as free description. Table 5-3 shows the descriptions of "good points" by the students who gave high evaluations for the "Group Research", while Table 5-4 shows those of "points to be improved" by the students who gave low evaluations.

As shown in Fig. 5-1, "Ability for cooperation in group research" and "Multifaceted viewpoints" got high evaluation. This is because the students from various research fields cooperated to conduct the group research and it was effective to improve the abilities necessary to solve energy and environmental problems which have various viewpoints. On the other hand, "Motivation and interest for research work" got low evaluation comparing with other factors. It is supposed that they did not have enough time to deeply quest the research theme in this group research and the interest in the theme could not be fostered.

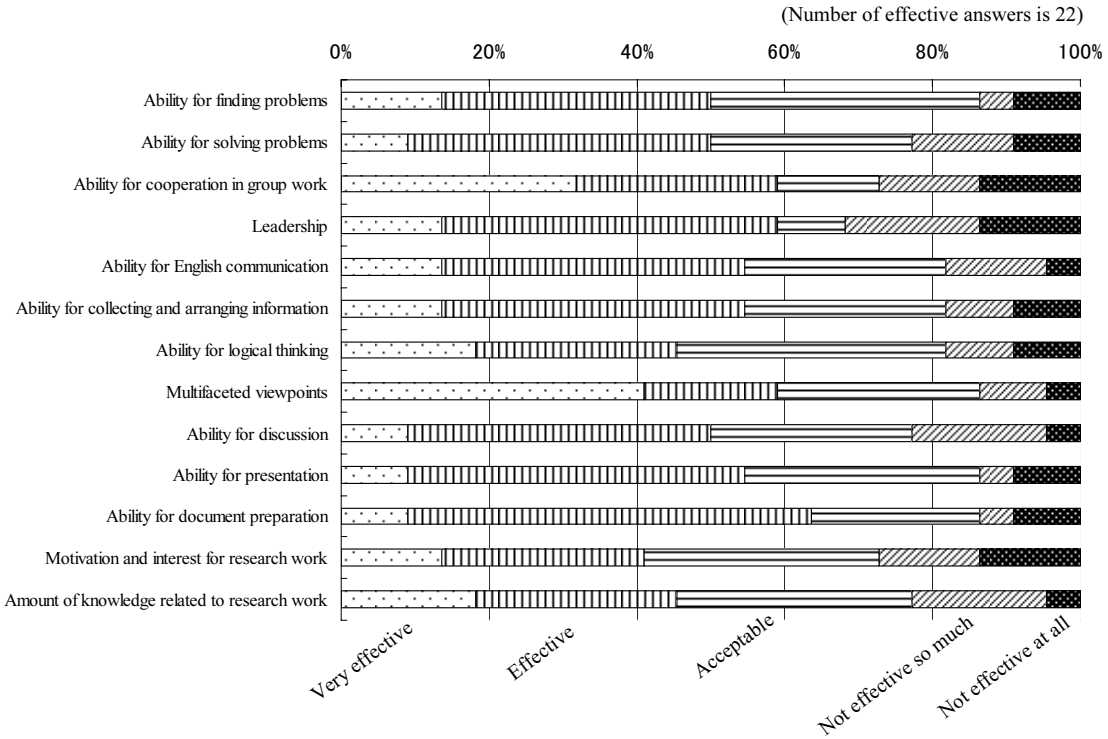


Fig.5-1. Questionnaire results of effectiveness for fostering abilities.

Table 5-3 "Good points" described by the students who gave high evaluations

・ I could improve the abilities having meeting and discussion in English (especially, expediting the meeting). ・ I could communicate and discuss with other Ph.D. candidates who have different research fields with common interests such as global environment, natural resource and energy problems. *(Translated from Japanese)*
It was a fascinating chance to see and learn to achieve zero CO2 emission by different ways which means that targeting same goal but other major knowledge. Having communication and discussion make us feel that we are doing really important things which is inevitable for new upcoming centuries. In the future, these connections will be a really important infra-structure to us to deal with spontaneous environment problems. The financial support for buying the necessary equipment and attending international community make us not only spread our thoughts to reality but also having chances to learn and see high-end technologies. There is also a huge potential to meet famous world-wide scholars and also receiving comments from them. ・ Fascinating opportunity to understand various way of reduce CO2 emission ・ Building future infra-structure for zero CO2 emission society ・ Strong support to sustain current research and study ・ Feedback from famous scholars
"Group Work" program of GCOE total system is very effective and knowledge related.
I think that this is a chance to communicate with the students from different research fields and obtain various knowledge. I could also learn the importance of mutual cooperation, collaboration method and abilities to promote a research theme as a leader throughout this group work. In conclusion, I could broaden my international horizons by meeting the students with various nationalities. *(Translated from Japanese)*
1-Work as group. 2-Cooperation between students works in different subjects and has deferent minds.

3-Practice the work in very work from our subjects.
GCOE program is very good for post-graduate students. We can not only learn our own research which we know well, but also are able to learn the group research which we didn't know before. So, it can widen our knowledges and learn how to teamwork with other members. The financial support for each student is also helpful to our own research; we can buy something which necessary for experiments using that budget.
It was good for me to discuss a common theme with the students from other laboratories. I could find out my poor English ability through communication in English. *(Translated from Japanese)*
1. Good targets of the GCOE program. 2. Many types of activities that students can take part in. 3. Group working give students and researchers good opportunity to communicate, discuss and share knowledge, etc.

Table 5-4 "Points to be improved" described by the students who gave low evaluation

・ Signature should not be necessary in the report because it is difficult for us to gather. ・ It is difficult to set up and promote the research theme because of the limitation by our different research field and difficult situation of gathering. ・ Because of the above reasons, it is not expected for each student to improve their abilities through the group work. (I am sorry but I cannot give a better proposal. In my case, it is difficult to propose a research theme which does not need experiment. It is better for the secretariat to give the candidates of the research themes.) *(Translated from Japanese)*
・ Considering the relationship with my supervisor, I could not give my own research outcome in the cooperation with other students. I cannot spare time for the work which is not my research work. Considering this situation and that all the members could contribute to the group work, the theme has to be the one in social engineering and its content has to be shallow. ・ There is no incentive (award, competitive budget, etc.) to actively join the group work. Considering the above problems, I cannot feel the merit to join the group work. ・ I feel that the motivation got lower especially in the case of foreign students. (I could not contact with a student until 31st of March.) If foreign students could not cooperate, one important meaning of this program is lost. ・ I cannot feel the meaning of the cooperation with the students from different field in such way. If they like to make the students broaden their horizons, I think it is enough to have interprofessional communication or poster session of their own research work. *(Translated from Japanese)*

As shown in Table 5-4, on the other hand, it was found that the group works could not be conducted smoothly because of the difficulty to conduct the "Group Research" with the students from different research fields, difficulty to set up the research theme and less incentive to join the "Group Research". These problems should be solved in the future.

The questionnaire sheet for the evaluation is shown below ("Group Work" is used instead of "Group Research" in the questionnaire).

1, April 2009

To: the students who join “Group Work” program.

Self-inspection and Evaluation Committee of GCOE

Questionnaire for “Group Work” program of GCOE

The self-evaluation committee of GCOE is conducting a questionnaire survey of “Group Work” program to evaluate and improve educational programs of GCOE.

The results of the survey will be processed statistically so that no individual student is identified or they do not affect the evaluation of your group work. Even though we are asking you to write your name on the face sheet of this questionnaire, it is used only for a follow-up survey and your name is not identified. The questionnaire results will be reported as a proposal for the improvement of “Group Work” program. We would like to ask you to cooperate for this questionnaire survey.

Your name			Sex	Male Female
Graduate School, Department	Year of entrance	Age	Date of questionnaire	
			, April 2009	

Please answer whether “Group Work” program is effective in improving the following abilities.
(Check “✓” mark in the following boxes as your answers.)

Items for questionnaire survey	Not effective at all	Not effective so much	Acceptable	Effective	Very effective
Ability for finding problems					
Ability for solving problems					
Ability for cooperation in group work					
Leadership					
Ability for English communication					
Ability for collecting and arranging information					
Ability for logical thinking					
Multifaceted viewpoints					
Ability for discussion					
Ability for presentation					
Ability for document preparation					
Motivation and interest for research work					
Amount of knowledge related to research work					

Please describe good points and the points necessary to be improved for “Group Work” program.

Good points;

Points necessary to be improved;

Please submit this questionnaire sheet to GCOE office (Room 103 in the Engineering Building No.2) no later than the 15th of April, 2009.

Thank you for your cooperation.

Please contact us at the following address if you have any questions concerning this questionnaire.
Prof. Susumu Tohno, Graduate School of Energy Science, E-mail: tohno@energy.kyoto-u.ac.jp

5.5 Global COE Researchers Activities

The Global COE researchers were selected from international recruitment. In FY2008, two researchers were recruited. One researcher was appointed in January, 2009 and played an active part as “Group Research” advisor along with conducting the scenario model research. Another was appointed in March, 2009 and is conducting a research on energy saving in residences along with collecting information on South-East Asia energy scenarios.

6. Committee of Advanced Research

6.1 Energy Socio-Economics Research

6.1.1 Drastic Improvement Measures of Energy Efficiency Incorporating Production, Consumption and Waste Cycle

Seiji Ikkatai (Institute of Economic Research)

- Target (Plan) and Achievement in FY2008

Implementation Plan

Preliminary study of the drastic improvement measures of energy efficiency that included the cycle of production, consumption and waste

Outcome summary

For a preliminary study in the first year, the Institute of Energy Economics, Japan was requested to summarize the following three fields as "An Investigation Related to the Possibility of Drastic Improvement of Resource and Energy Efficiency'":

(1) organization of the existing investigative researches on the concept of drastic energy efficiency improvement,
(2) case studies on the existing investigative researches on the possibility of the drastic improvement of energy efficiency through the cycle of production, consumption and waste,
(3) case studies on "Efficiency Improvement Barriers and its Remedies".

Outcome

[1] Organizing the Existing Investigative Researches on the Concept of Drastic Energy Efficiency Improvement

In this section, the following publications were identified as references that compiled existing researches, and while organizing these summaries, the evaluation was tried from the viewpoint of energy efficiency improvement possibility concept.

1) "The First Global Revolution" (Roma Club Report), Alexander King, Bertrand Schneider, Hiroshi Tasogawa (Translator), Asahi Shimbun Publicaions, 1992 Publication,
2) "Factor 10" (Realizing Ecology Revolution) F. Schmidt-Bleek, Ken Sasaki (Translator), Springer Verlag Tokyo Co., Ltd., 1997 Publication,
3) "Factor 4" (Doubled the Prosperity, Halved the Consumption), Ernst Ulrich von Weizsäcker, Amory B. Lovins, and L. Hunter Lovins, Ken Sasaki (Translator), Energy Conservation Center, Japan, 1998 Publication,
4) "Natural Capitalism", Paul Hawken, Amory Lovins, Hunter Lovins, Takamitsu Sawa (Translator), Nihon Keizai Shinbun Co., 1999 Publication
5) "Japan Low Carbon Society Scenario" Shuzo Nishioka (Editor), Nikkan Kogyo Shinbun Co., 2008 Publication.

Additionally, while referring to these authors, the research progress status up until now on

1) Internal and external environmental accounting system,
2) Lifestyle and energy utilization efficiency,
3) Emphasis on end use approach

were compiled.

[2] Case Studies on the Existing Investigative Researches on the Possibility of the Drastic Improvement of Energy Efficiency through the Cycle of Production, Consumption and Waste

In this section, case study on researches involved in the method of energy efficiency improvement and alternative method comparison related to various human activities such as transportation, food supply, lighting and hot water supply, and services were conducted. Specifically, summaries on methods such as

1) Eco Rucksack,
2) Food mileage,
3) Wood mileage,
4) Ecological footprint,

were compiled and the methods and indicators were studied in order to grasp the improvement of resources and energy efficiency. Additionally, concerning the substantial decrease of greenhouse effect gas to handle the climate changes problem, the concept and calculation methods of the "Carbon Productivity" presented by McKinsey & Co., in June 2008 were identified, including analysis from the cost aspect on the significant rise of the energy

productivity. Furthermore, existing research summary on energy consumption comparison between each type of alternate behavior in daily life, such as "how to dry hands", "to fax or to mail", "microwave or gas stove", "how to boil water", and "e-mail energy consumption", were compiled.

[3] Case Studies on "Efficiency Improvement Barriers and its Remedies"

In this section, "Negawatt" (Next Generation Energy Born from a Switch in the Way of Thinking), Peter Hennicke, Dieter Sifried, Park Seung-Joon (Translator), Energy Conservation Center, Japan, 2001 Publication was referred to, and introduced examples where the minimum cost plan was not endorsed because the people way of thinking is hard to change regardless of the fact that there are examples showing that the cost required to conserve energy is lower than the cost for assuring the supply increase, and from that experience, showed the conditions for realizing the "Efficiency Revolution". Additionally, the concept on "Supply Curve", a method where new energy is evaluated on the same scene was applied to energy saving technology. Furthermore, by referring to the "Learning Curve", a method where the possibility of reducing the cost by mass production is studied, it has shown the possibilities for technologies considered as high cost and not feasible to be applicable by introducing measures, such as in the example of solar battery learning curve where the cost is reduced to 82% when the cumulative production capacity is doubled. In addition, concerning the popularity of the bulb-type fluorescent lamp said to be economically proven, along with organizing the technical problems faced at its beginning, its solution status and its popularity status afterward were compiled. Furthermore, the study on solar water heater popularity holdup and the study on hybrid car popularity and its evolved form of plug-in hybrid car was shown.

6.1.2 Research Presentation and Workshop

Research results of Energy Socio-Economic Group are presented in domestic conferences. The presentation numbers in FY2008 are as follows:

	Scholarly Journal, etc.	International Conference	Domestic Conference	Workshop	Patent
Number	0	0	2	0	0

6.2 Solar Energy Research

6.2.1 Highly Efficient Solar Cells Research

[1] Improvement of Efficiencies of Organic Solar Cells: Development of Materials and Novel Design of Device Structure

Takashi Sagawa (Institute of Advanced Energy)

- Target (Plan) and Achievement in FY2008

We firstly made guidelines for development of novel donors, acceptors, and electrodes for organic photovoltaic devices and tried to optimize and evaluate the fabrication process of single cell with commercially available materials. Followings are main research achievements in the year of 2008. In order to develop novel materials with highly efficient light-harvesting properties and/or electron transporting properties, we started to synthesize novel compounds and investigated the self-assembling behavior and appropriate semi-micro phase-separated state. Particularly, we focused on the synthesis of porphyrin lipid as a donor and fullerene C_{60} lipid as an acceptor and confirmed the formation of fibrous assemblies, induced circular dichroism, and so on. Photovoltaic properties such as the extent of photoinduced current, carrier density, lifetime, and so on under the various conditions are investigated underway.

[2] Development and Evaluation of Novel Materials for the Future Solar Cells

Hideaki Ohgaki (Institute of Advanced Energy)
Taro Sonobe (Graduate School of Energy Science)

- Target (Plan) and Achievement in FY2008

Our research group objectives are to create the next generation solar battery material by using microwave thermal process method and controlling the wide-gap semiconductor energy band structure, and to develop a new semiconductor material and an

evaluation method by using mid-infrared tunable laser (KU-FEL). Specifically, our overall target is to conduct direct measurement of middle and sub-band energy, life time and band width by observing the photoluminescence (PL) characteristics based on simultaneous bombardment of FEL, and visible and ultraviolet lasers synchronized to it, elucidating the correlation factor of surface structure and its middle and sub-band energy from the optical characteristics.

For that purpose, in 2008, we developed and applied for patent for semiconductor surface structure control method by microwave thermal in collaboration with Research Institute for Sustainable Humanosphere for titanium dioxide, zinc oxide, etc., and successful in introducing middle band structure by microwave thermal surface carbon modification and in introducing the sub-band structure by surface reduction. Additionally, by adopting the thermionic cathode RF gun as electron source and introducing a unique RF control system, the mid-infrared free electron laser device: KU-FEL was completed. In March 2008, FEL oscillation was observed with 12.4 μm wavelength, and in May 2008, FEL saturation was achieved with 13.6 μm wavelength. Furthermore, optical transport system for FEL users was constructed. Concurrently, the PL measuring system was introduced with He-Cd laser (325 nm/442 nm) as the light source, and PL measurement for semiconductor test materials was made possible. Next year, we schedule to implement the photoluminescence (PL) characteristics measurement method development by simultaneous bombardment of FEL light and He-Cd laser synchronized to it, and aiming to establish the high performance materials and their evaluation method toward creating a high efficiency solar cell.

6.2.2 Artificial Photosynthesis Research

[1] Development of Biomaterials that Mediate Electron Transfer

Takashi Morii (Institute of Advanced Energy)

- Target (Plan) and Achievement in FY2008

Toward sustainable society, chemical conversion of solar energy as artificial photosynthesis is potentially promising for efficient utilization of renewable energy sources in addition to the well-established thermal and electrical utilization of solar energy. Before the development of the photo-driven oxidase, which was designed by mimicking the material conversion process in photosynthesis, we aimed at the construction of photoelectric transducers consist of light-harvesting antenna and charge transporter in this year.

DNA scaffold would be suitable for hole transporter because double stranded DNA forms highly organized self-assembly and mechanism for hole transfer in DNA have been studied extensively. Ruthenium(II) complex was an attractive candidate for light-harvesting antenna because Ru(II) complex was utilized as oxidant to probe DNA charge transfer both spectroscopically and biochemically, and the absorption spectra of Ru(II) complex extends over visible region. Accordingly, DNA-modified films tethering Ru(II) complex as a photoelectric transducer were constructed by the hybridization of thiolated DNA immobilized on a Au surface with Ru(II) complex-labelled complementary DNA. A stable cathodic photocurrent appeared immediately under the photoirradiation of the modified gold electrode at 436 nm. In contrast, the photocurrent dropped instantly when the illumination ceased. Additionally, the cathodic photocurrent increased sharply with increasing negative bias on the gold electrode. This indicates that the photocurrent generation was controlled by a positive charge transport, i.e., hole transport between the gold electrode and the DNA. The photocurrent process is mainly divided into four processes, that is, charge injection, charge recombination, charge conduction along the DNA, and charge hopping to the Au electrode. In conclusion, we succeeded in the construction of the appropriate photoelectric transducer consist of Ru(II) complex and DNA scaffold because DNA-modified films tethering Ru(II) complex exhibited cathodic photocurrent under visible light irradiation due to photoinitiated hole transport through DNA duplexes.

[2] Design of the Artificial Photosynthetic Enzyme Driven by Solar Energy

Masatora Fukuda
(Graduate School of Energy Science)

➢ Target (Plan) and Achievement in FY2008

In order to establish the CO2 zero emission energy system that does not depend on the fossil fuel, it is necessary to develop the new energy and environmental technology which solar energy is utilized as chemical energy based on the biomolecules. Aiming toward the construction of the new energy production and utilization system that can contribute to the society, in the global COE Advanced Research Clusters, I am developing the methodology of constructing the artificial photosynthetic complex that possesses high efficiency of energy conversion. In fiscal 2008, the photo-driven artificial reductase that is as a component of the artificial photosynthesis complex was designed by using the RNA and the peptide complex (RNP). As the basic methodology of constructing the functional RNPs, the following two methods were developed. One is the strategy for creating a fluorescent RNP sensor for dopamine detection and, another is stabilizing a RNP complex by introducing a covalent linkage between RNA subunit and peptide subunit. A basic technology for constructing the artificial photo-driven reductase was prepared by the development of these methodologies.

6.2.3 Materials for Sustainable Energy Systems Research

[1] Electrode Materials for Lithium-Ion Battery with High Energy Density and High Power Density

Mitsuhiro Hibino, Takeshi Yao
(Graduate School of Energy Science)

➢ Target (Plan) and Achievement in FY2008

Lithium-ion batteries have already gained a large market share in the field of small-scale batteries and are becoming increasingly important as an essential energy storage medium, in particular for utilization of solar energy and other “new energies”, and further for any types of electric vehicles including hybrid and plug-in hybrid ones. Our group has targeted to develop electrode materials for lithium-ion batteries in terms of syntheses of new electrode materials and investigations of their basic electrochemical properties. In our recent studies, we succeeded to fabricate a composite material of ferric oxide and carbon that was applicable to cathodes for rapidly chargeable and dischargeable lithium ion batteries. In this study, we develop new electrode materials and examine them from a standpoint of the practical application in which lithium-ion batteries are incorporated in photovoltaic power generation system in the form of power storage device. To this, this year we have intended to establish the fabrication method of a practical electrode sheet in the 2032-type cell using our newly developed materials. Also we have continued to conduct a basic study on new materials in terms of synthesis, characterization, and evaluation of electrochemical property. These results are described in detail below.

For the establishment of fabrication of electrode sheet for 2032-type cell: Using the (ferric oxide)/carbon composite as an active material, mixing ratio of a conducting additive and a binder material to the active material, thickness of electrode mixture and current collector foil, coating conditions (speed of applicator, viscosity of coating paste) and drying condition of coated paste were investigated and optimized. Finally we succeeded to construct the cell containing the electrode sheet of the (ferric oxide)/carbon composite, whose discharge-charge performance was as high as expected from the result measured beforehand using a test cell for electrode performance evaluation.

For basic research on the electrode material: The lithium intercalation property of cobalt vanadium oxide CoV_3O_8 having tunnel space along the c-axis of the crystal structure was investigated. Lithiated samples, $Li_xCoV_3O_8$, were structurally analyzed by the Rietveld analysis. From the linear variation in the lattice parameters during lithiation, it was found that lithium was intercalated in the host compound CoV_3O_8 for $0.125 < x < 0.5$ in $Li_xCoV_3O_8$. For $x > 0.5$, no change in the lattice parameters was observed, and an amorphous substance was formed. On the basis of the variation in the interatomic distances between oxide ions, the cavity size and molar ratio Li/CoV_3O_8, the site suitable for lithium intercalation was determined.

[2] Preparation and Evaluation of Semiconductor Thin Films by Spray Layer-By-Layer Method

Yoshikazu Suzuki (Institute of Advanced Energy)

➢ Target (Plan) and Achievement in FY2008

For dye-sensitized solar cells and quantum dot-sensitized solar cells, thin film processing on conducting glass substrate for wide-area, low cost and low environmental impact have been required. Homogeneity and good mechanical properties of thin films are also important for such a thin film. Furthermore, low (ambient) temperature process is favored to apply the plastic conducting films.

In FY2009, we have studied on the preparation and evaluation of semiconductor thin films by spray layer-by-layer (LbL) method. Titanate nanowire thin film was successfully coated on glass substrate by using spray LbL method with controlling the thickness of tens of nanometers. (*J. Ceram. Soc. Jpn*., **117**, 381 (2009)).

6.2.4 Solar Energy Conversion Research

[1] Nanoprocessing with Femtosecond Laser Pulses for the Development of Efficient Solar Cells

Kenzo Miyazaki, Godai Miyaji
(Institute of Advanced Energy)

➢ Target (Plan) in FY2008

The purpose of this research is to develop a new technology of nanoprocessing with femtosecond (fs) laser pulses, for the purposes of achieving a high efficiency of thin-film solar cells. The study in 2009 was concerned with the following objectives: (1) one was to understand the physical mechanism of periodic nanostrcuture formation on thin film targets that we observed for the first time with fs laser pulses. It has been found in our previous experiment that the nanoscale ablation is initiated with the generation of near field (local field) around small surface roughness. We intended to make clear its subsequent interaction process for periodic nanostructure formation to develop a theoretical model. The experiment was designed to observe the most initial stage of nanostructuring on diamond-like carbon (DLC) film with linearly and circularly polarized femtosecond (fs) laser pulses. Based on the results, we tried to control the nanostructure; (2) the other was to demonstrate the validity of a quantum mechanical theory for high-order harmonic generation from coherently rotating molecules, which we have recently developed. Especially, we have shown that HHG from aligned molecules is able to provide us with a new method for accurate measurement of degree of molecular alignment and rotational temperature.

➢ Achievement in 2008

1) We have successfully made clear the following physical process for nanostructuring of hard thin films, which consists of the bonding structure change and resulting surface swelling, the generation of near field on the swelled surface, the initiation of nano-scale ablation, and the excitation of surface plasmon polaritons (SPPs). This model accounts well for the characteristic properties of observed nanostructure and provides a good agreement between the calculated nanostructure period and the observed.
2) Based on the physical model, we have demonstrated that the nanostructured surface can be controlled so as to have a sawlike shape with obliquely incident *p*-polarized pulses.
3) In order to apply the present model to semiconductor materials, an experiment of fs-laser ablation has been made for silicon (Si) substrate. The results have demonstrated possible formation of periodic nanostructures on Si surface under some specific experimental conditions for ablation. The nanostructuring process for Si was almost the same as for DLC or dielectric materials, while additional competing processes were inevitably induced to restrict the nanostructuring.
4) On the other hand, high-order harmonic generation from coherently rotating N_2 and O_2 molecules has been observed for different alignment angles in a pump and probe experiment using fs laser pulses. The results obtained are in excellent agreement with those calculated using a recently developed theory. It is shown that the polarization geometry and the alignment

distribution play essential roles in potential applications to probe electronic structure and dynamics of molecular systems.

5) It has been demonstrated that HHG can be used for sensitive measurements of molecular rotational temperature in a thin supersonic gas beam. The results show the versatile applicability of this new method.

[2] Evaluation of Interfaces for Solar Energy Conversion

Tetsuo Sakka, Kazuhiro Fukami, Yukio H. Ogata
(Institute of Advanced Energy)

➢ Target (Plan) in FY2008

Efficiency of solar energy conversion by a solid surface depends on microstructure and chemical component of the surface. Evaluation of the interface in situ in the fabrication process or under actual use is important for monitoring the processes and controlling the process parameters. In the present work we aim at the establishment of micro-LIBS (laser induced breakdown spectroscopy) for in situ elemental mapping of photo-electrodes. In this fiscal year, we tried to clarify the reason of the pulse-to-pulse fluctuation of the spectral intensity, especially focusing on the instability observed in the analysis of an alloy in water.

We investigate the timing of the bubble formation by shadowgraph measurement under the irradiation, and the pulse-to-pulse fluctuation of the emission intensity. Also, we measure emission spectra of the species ablated from Cu-Zn alloy under water, and obtain calibration curve for the Cu/Zn ratio. Finally we investigate the error and fluctuation in the resultant composition ratio obtained by using the calibration curve.

➢ Achievement in FY2008

The cause of the pulse-to-pulse fluctuation of the spectral intensity was clarified by the observation of shadowgraph. The bubble observed in the shadowgraph showed fluctuation in its size and also in its shape after consecutive irradiations. The laser breakdown in the bulk water or the fluctuation of the position where the ablation initiates were observed. On the other hand, Cu-Zn alloy was employed to investigate the pulse-to-pulse fluctuation of the component analysis in water. The model calculation assuming the Boltzmann distribution for the population between the levels involved in the transition improved the pulse-to-pulse fluctuation. This is probably because the fluctuation caused by the temperature instability is compensated.

[3] Frequency-Conversion of Mid-Infrared Laser Pulses

Takashi Nakajima (Institute of Advanced Energy)

➢ Target (Plan) and Achievement in FY2008

To synthesize new efficient materials for solar cells it is often useful to utilize a mid-infrared laser with short pulse duration for the analysis, since the mid-infrared “photon” energy corresponds to the “phonon” energy of the materials. It is, however, desired that the laser is available at more than a single wavelength: If perfectly synchronized laser pulses are simultaneously available at different wavelengths such as the mid-infrared, near-infrared, and perhaps to the visible region, the usefulness of a polychromatic light source is out of doubt.

One way to realize a polychromatic light source is to use frequency-conversion techniques such as second harmonic generation (SHG), third harmonic generation (THG), and fourth harmonic generation (FHG) processes, etc. If we initially have mid-infrared laser pulses at the wavelength of ~12 μm, even the FHG is at 3 μm and still in the infrared region. To produce shorter wavelength pulses, we have to utilize high-order harmonic generation (HHG), which is possible if the initial mid-infrared pulses have sufficient pulse energies.

In this work we investigate the interaction of alkali-metal (potassium) atoms with mid-infrared laser pulses, the purpose of which is to clarify at what mid-infrared laser intensity the high-order harmonic photons are produced up to which order with what signal intensity.

6.2.5 Research Presentation and Workshop

Research results of Solar Energy Group are presented in domestic and international conferences,

and published in scholarly journals. The presentation numbers in FY2008 are as follows:

	Scholarly Journal, etc.	International Conference	Domestic Conference	Workshop	Patent
Number	21	33	39	8	2

6.2.6 Major Equipment

① Electrochemical Analyzer (ALS, model 660C, BAS)
② High-pressure Hg Lamp (REX-250, Asahi Bunko)
③ A Package for DNA Sequence Analysis (GENETYX)
④ Gel Electrophoresis Apparatus (ATTO)
⑤ A machine for coin type lithium ion battery (2032-type assembly system, Hosen)
⑥ Multichannel battery tester (HJ1001SD8, Hokuto Denko)
⑦ Electrochemical measurement system for rapid discharge-charge (4A current booster for VMP3, (Bio-Logic)
⑧ Applicator system for electrode sheet (Minicoater MC-11, Hosewn)
⑨ Scanning Electron Microscope (VE-8800, Keyence)

6.3 Biomass Energy Research

6.3.1 Characterization of Biomass Resources for Biofuel Production

[1] Characterization and Potential Evaluation of Various Biomass Resources for Biofuel Production

Shiro Saka (Graduate School of Energy Science)

➢ Target (Plan) and Achievement in FY2008

Although various biomass resources are available for biofuels production, their characteristics affect the properties of produced biofuels. Therefore in this study, basic characteristics of biomass resources were investigated and their potentials were planned to be evaluated. In this year, chemical constituents of various biomass resources such as cellulose, hemicelluloses, lignin, extractives and inorganic constituents were quantitatively studied and their chemical characteristics were elucidated.

6.3.2 Bioethanol

[1] Ecoethanol Production by Acetic Acid Fermentation with Hydrogenolysis from Lignocellulosics

Shiro Saka, Haruo Kawamoto, Hisashi Miyafuji
(Graduate School of Energy Science)

➢ Target (Plan) and Achievement in FY2008

Compared to starch and molasses, lignocellulosics are difficult to convert to ethanol by yeast. Therefore, innovative technology for ethanol production is widely anticipated for lignocellulosics. A two-step hot-compressed water treatment process was, therefore, studied in this work to obtain a high yield of pentose, hexose, oligosaccharides, uronic acid and fragmented products etc. from lignocellulosics. The obtained saccharides and fragmented products etc. were studied to be fermented to acetic acid, which is further converted to ethanol by hydrogenolysis. Consequently, a highly-convertible eco-ethanol production system can be expected to be established with highly-effective CO2 reduction, compare with conventional concentrated sulfuric acid process. In a study with buna wood, hot-compressed water treatment resulted in 72wt% yield of sacchrides. Additionally, lignin was found to de decomposed to a lower-molecular weight substance. In acetic acid fermentation, hot-compressed water-treated products can be effectively converted to acetic acid by the co-culture of *Clostridium. thermoaceticum* and *C. thermocellum.* In hydrogenolysis, ethyl acetate was found to be converted to ethanol effectively. Based on these results, our proposed process would be better, compared with conventional method by yeast in bioethanol production.

[2] Prospect of Nipa Palm for Bioethanol Production

Shiro Saka (Graduate School of Energy Science)

➢ Target (Plan) and Achievement in FY2008

The global bioethanol supply is produced mainly

from sugar and starch feedstock. Sugarcane in the form of molasses and starchy materials in corn and cassava contain high levels of glucose, fructose and sucrose, are the easiest to convert to ethanol. Similarly, nipa (*Nypa fruticans*) is a non-threatened and underutilized sugar yielding palm which produces rich sugar sap from its inflorescence continuously for up to 50 years. We are currently focusing on comparative study of nipa sap produced in Thailand and Philippines with sugarcane sap mainly on chemical compositions and bioethanol production. Nipa sap was found to have higher total recoverable dry mass (17wt%) compared to sugarcane sap (15wt%). Ash analysis showed a group of different dominating salts such as Na^+ and K^+ for nipa and K^+, Mg^{2+} and Ca^{2+} for sugarcane. Fermentation trend of nipa sap was similar to sugarcane sap with high yields of bioethanol (above 90% conversion). However, the presence of inorganic elements in nipa sap is now being studied for its role in the fermentation to bioethanol.

[3] Development of Highly Efficient Bioethanol Production Yeast Using Protein Engineering

Tsutomu Kodaki (Institute of Advanced Energy)

➢ Target (Plan) and Achievement in FY2008

Xylose is one of the major fermentable sugars present in lignocellulosic biomass. The efficient fermentation of xylose is required to develop economically viable processes for producing bioethanol. Although a few xylose fermenting yeasts are found in nature, *Saccharomyces cerevisiae* is used universally for industrial ethanol production because of its ability to produce high concentrations of ethanol and high inherent ethanol tolerance. However, native *S. cerevisiae* can not ferment xylose, so engineering *S. cerevisiae* for xylose utilization has focused on adapting the xylose metabolic pathway from the xylose-utilizing yeast such as *Pichia stipitis*. Although *S. cerevisiae* transformed with native XR and XDH genes from *P. stipitis* can ferment xylose, its ethanol production was not sufficient for application in the industrial bioprocess. One of the main reasons is the unfavorable excretion of xylitol caused by the different coenzyme specificity between XR and XDH. In this study, we at first developed the mutated XR and XDH by protein engineering and then the effects of mutation were examined by transforming the mutated enzymes into *S. cerevisiae*. The change of coenzyme specificities of XR and XDH by protein engineering has been shown to have the positive effects on the production of bioethanol from xylose.

6.3.3 Biodiesel

[1] High Quality Biodiesel as Prepared by Non-Catalytic Supercritical Methanol Method

Shiro Saka (Graduate School of Energy Science)

➢ Target (Plan) and Achievement in FY2008

Properties of biodiesel as prepared by supercritical methanol method were determined. It was found that most of the fuel properties can meet the standard specifications except for oxidation stability of biodiesel from oil/fat resources with high unsaturated fatty acid content. To evaluate oxidation stability of biodiesel, biodiesel produced by alkali-catalyzed method was exposed to supercritical methanol. As a result, it was found that after supercritical methanol treatment, hydroperoxides were greatly reduced for biodiesel with initially high in peroxide value, while the natural antioxidant slightly decreased in its content. Therefore, supercritical methanol method can produce biodiesel with better oxidation stability especially waste oils/fats. In order to improve the oxidation stability of biodiesel, lignin was subjected to supercritical methanol treatment during preparing biodiesel. It was found that lignin was decomposed to small molecular substances that have very good antioxidation effect. Thus, the study proved that lignin addition provides an inexpensive and technically acceptable way to improve the oxidation stability of biodiesel as prepared by supercritical methanol method with satisfactory fuel properties.

[2] New Biodiesel Production Process from Oils/Fats by Supercritical Carboxylate Esters and Neutral Esters

Shiro Saka (Graduate School of Energy Science)

➢ Target (Plan) and Achievement in FY2008

The current commercial biodiesel production

called the alkali-catalyzed method, transesterifies triglycerides in the presence of alkaline catalyst with methanol to produce fatty acid methyl esters (FAME) and glycerol as by-product. As biodiesel production becomes rapid in years to come, the overproduction of glycerol lower its economical value and available applications are not likely to be align with its abrupt increase. Thus, new production methods of biodiesel without the production of glycerol are therefore worth to be explored. In this line of study, an additional new supercritical process utilizing other potential reactants such as carboxylate esters and neutral esters have been explored. The supercritical methyl acetate method; a non-catalytic transesterification reaction between methyl acetate and triglycerides, evidently succeeded in producing high yield of fatty acid methyl esters and triacin. Since triacin has very similar fuel properties as biodiesel, a mixture of fatty acid methyl ester and triacin was demonstrated to be used efficiently as biodiesel. In addition, the supercritical dimethyl carbonate method has also demonstrated that, without any catalyst applied, converted triglycerides to fatty acid methyl esters with glycerol carbonate and citramalic acid as by-products. The by-products from this process which are glycerol carbonate and citramalic acid are much higher in value than glycerol produced by the conventional process. Without doubt, these studies could charter the path towards exploration of novel and alternative biodiesel production processes for the future.

[3] Ignition and Combustion Characteristics in Various Kinds of Biodiesel Fuels

Masahiro Shioji
(Graduate School of Energy Science)

- Target (Plan) and Achievement in FY2008

Among various alternative fuels available for the conventional diesel engine, biodiesel fuel (BDF) is the most attractive. This research aims to provide the fundamental data of ignition delay and combustion characteristics of BDF spray. Experiments were carried out in a constant-volume vessel under diesel-engine conditions to investigate the spray developments, ignition delays and heat-release rates using several kinds of BDF from the edible oil with different properties, together with the standard gas-oil for comparison. Although penetration lengths of both fuels are almost same, physical properties such as higher density and lower vaporization may retard the mixture formation of BDF at spray tip. Experimental results at ambient temperature lower than 800 K show that the fresh BDF has a longer ignition delay compared with the gas-oil, whereas the aged one has the almost same delay, and that a small amount of IPA may promote the ignition. Those results may contribute for consideration the optimal condition of design and operation in diesel engines fuelled by BDF.

6.3.4 Biomass Conversion to Liquid Biofuels and Useful Biomaterials

[1] Biomass Conversion to Liquid Biofuels and Useful Biomaterials by Supercritical Fluid Technologies

Shiro Saka (Graduate School of Energy Science)

- Target (Plan) and Achievement in FY2008

In this study, liquefaction of wood is being studied to produce liquid biofuels by supercritical (or subcritical) alcohol technology. In liquefaction of woody biomass by supercritical alcohol, there exist characteristics such as i) the obtained liquefied products can be directly utilized together with alcohol which is itself a kind of fuels, and ii) various alcohols such as methanol, ethanol,1-butanol and 1-octanol can be produced from biomass resources. Therefore, by liquefying biomass with these alcohols, 100% biomass-based liquid biofuels can be achieved. In this study, therefore, phenol species as a solvent were also used to liquefy the biomass resources and its optimum treatment conditions were studied and clarified.

[2] Production of Biofuels and Biomaterials by Pyrolysis

Haruo Kawamoto, Shiro Saka
(Graduate School of Energy Science)

- Target (Plan) and Achievement in FY2008

In this study, pyrolysis and gasification mechanisms of woody biomass are studied at the molecular level, aiming at the development of effective conversion methods to liquid biofuels and useful biomaterials. The following results are obtained in this year. Wood gasification is a two-stage process which includes the primary pyrolysis to form volatile and carbonized products and their secondary reactions. Softwood and hardwood are expected to exhibit different reaction behaviors in this process, since chemical structures of hemicelluloses and lignins in these species are different. With sugi (*Cryptomeria japonica*) and buna (*Fagus crenata*) woods as a softwood and a hardwood, respectively, their different pyrolysis and gasification behaviors were clarified, which include the greater gasification reactivity of buna primary char than sugi char, and different influences of deionization [ex: gasification reactivity: sugi (increase), buna (not influenced)]. As for cellulose pyrolysis, the reducing end-groups were found to have higher reactivities than other parts and cause color formation and transglycosylation (depolymerization) of the glycosidic linkages even at such low pyrolysis temperatures as 200-240^{o}C. Furthermore, by using model dimers, radical chain-reactions were suggested to play an important role in pyrolysis of lignin in wood. Wood polysaccharides were also found to affect the chain-reactions very much and their influences were significantly different depending on their chemical structures.

[3] Biofuel and Biomaterial Production by Ionic Liquid Treatment

Hisashi Miyafuji, Shiro Saka
(Graduate School of Energy Science)

➢ Target (Plan) and Achievement in FY2008

For production of biofuel and biomaterial, the treatment of wood with ionic liquid was studied. Wood was found to be liquefied around 100°C by the 1-ethyl-3-methylimidazoriumchloride.Cellulose, hemi-celluloses and lignin which are components of wood could be liquefied. It was also clarified that these components were depolymerized and monosaccharide could be produced from cellulose and hemicelluloses. From the study on the effect of reaction atmosphere on ionic liquid treatment of wood, oxygen was found to accelerate the liquefaction of wood. Ionic liquid is thought to work as a solvent for chemical conversion of wood with liquefaction and depolymerization.

[4] Oil Palm (*Elaeis guineensis*) Chemical Characteristics for Its Efficient Utilization

Shiro Saka, Haruo Kawamoto
(Graduate School of Energy Science)

➢ Target (Plan) and Achievement in FY2008

Oil palm plantation is rapidly growing especially in south-east Asian countries such as Malaysia and Indonesia to produce palm oil. With this trend, huge amount of oil palm wastes are produced, which include trunk and frond from the plantation site and mesocarp, shell, kernel cake and empty fruit bunch (EFB) from the palm oil production. Efficient utilization of these various kinds of oil palm wastes is expected. In this study, chemical compositions of cellulose, hemicelluloses, lignin and other minor inorganic cell wall components were clarified first for these oil palm wastes. Furthermore, the products obtained by supercritical water treatment of these materials were characterized chemically as compared with those from wood samples.

6.3.5 Framework Design for Biomass Utilization

[1] Modeling of Biomass Utilization in a Region and Framework Design of Autonomous Decentralized Energy Supply-demand System with Biomass Use

Tetsuo Tezuka (Graduate School of Energy Science)

➢ Target (Plan) and Achievement in FY2008

This study aims to investigate the possible biomass-utilization system in a region, and to design the framework for realizing the desirable system in future. Concretely speaking, the microscopic information about energy and biomass utilization in a region is investigated by taking Kyoto City as a study area. And the information about biomass utilization

technology is also surveyed with the collaboration of the research groups of GCOE project. The biomass utilization model is developed based on the information obtained through the investigation. The important characteristics about the modeling is to include the microscopic and macroscopic viewpoints about the energy and biomass utilization.ina region The robust framework design procedure will be applied to the framework design for biomass utilization system in Kyoto City. In 2008, the concept of model-based analysis was developed for renewable energy use, and the basic survey of biomass use in Kyoto City was started.

6.3.6 Research Presentation and Workshop

Research results of Biomass Energy Group are presented in domestic and international conferences, and published in scholarly journals. The presentation numbers in FY2008 are as follows:

	Scholarly Journal, etc.	International Conference	Domestic Conference	Workshop	Patent
Number	15	6	11	0	1

6.3.7 Major Equipment

①Kjeldahl analyzer (Actac・Super Kjel 1400)
②High-performance liquid chromatograph (Shimadzu・LC-20)
③MALDI plate spotter (Shimadzu・AccuSpot)
④Visualization device for unsteady flames (Photoron)

6.4 Advanced Nuclear Energy Research

6.4.1 Research on New-Type Nuclear Reactors and Accelerator Driven Subcritical Reactors

[1] Development of New-Type Nuclear Reactors

Tomoaki Kunugi, Zensaku Kawara
(Graduate School of Engineering)

➢ Target (Plan) and Achievement in FY2008

In order to realize high efficiency and safety for new-type nuclear reactors as promising advanced nuclear energy source, precise knowledge is essential on the coolant flow, which is gas-liquid two-phase flow in complex system. Measurement and analytical technology for multi-phase flow are needed as the fundamental technology. In this study, measurements are taken for the temporal-spatial behavior of gas-liquid interface at various two-phase flow regime by using two-phase flow experiment loop, and its experimental database are used for development of high-accurate and high-speed analytical technology on multiphase flow. In this year, experimental loop of large cross-sectional rectangular flow channel were set up for three-dimensional behavior of bubbles, and measurement system for multiphase flow were sophisticated by introducing optical probe system, flow visualization system with high resolution, etc. Numerical technology combining multiphase flow and structure were being developed, and speeding up of numerical analysis for multiphase flow were also investigated.

[2] Research on Reactor Physics of Accelerator Driven Subcritical Reactors

Tsuyoshi Misawa, Hironobu Unesaki, Ken Nakajima
(Research Reactor Institute)

➢ Target (Plan) and Achievement in FY2008

An Accelerator Driven Subcritical system (ADS) is expected to be a safety and innovative energy resource for the future. In order to evaluate the feasibility and establish the technology bases on ADS, a series of experiments have been conducted using a proton accelerator, FFAG, combined with a subcritical core of Kyoto University Critical Assembly (KUCA). In the ADS reactor physics experiments, high-energy neutrons generated from FFAG proton beam injected to tungsten target have been introduced to subcritical core constructed at KUCA. High-energy neutron spectrum measurement by foil activation method, reaction rate measurement and spectrum measurement by foil activation method, reactor response measurement at beam trip / beam injection and sudden insertion of negative reactivity, subcriticality measurement by pulse neutron method and source multiplication method and reactor kinetics parameter measurement using noise method have been performed.

[3] Development of FFAG Proton Accelerator

Yoshiharu Mori, Yoshihiro Ishi
(Research Reactor Institute)

➢ Target (Plan) and Achievement in FY2008

The FFAG proton accelerator at KURRI is a chain of three FFAG rings; injector, booster and main ring. The injector is eight-sector spiral focusing type of FFAG accelerator and the field gradient of each sector magnet can be changed precisely for varying the maximum attainable beam energy of this system. The booster and the main ring are eight-sector and twelve-sector radial focusing FFAG accelerators, respectively. In the first ADS experiment with the FFAG accelerator, the proton beam energy was 100 MeV and the beam was transported to KUCA cores through the MCBT line which consists of many dipole and quadrupole magnets. The beam intensity and quality at the KUCA core, which affect the ADS experimental results, depend largely on the tuning of the MCBT line. In this study, a power supply system for the MCBT magnets has been improved to increase the magnetic field stability. In order to increase the beam intensity of the FFAG accelerator in future, development of charge-exchange beam injection with negative hydrogen ions has been also started in this study, where beam optics for this scheme was designed, and some of the vacuum chambers and beam ducts were fabricated.

[4] Development of Materials for Accelerator Driven Subcritical Reactors

Toshimasa Yoshiie, Qiu Xu
(Research Reactor Institute)

➢ Target (Plan) and Achievement in FY2008

In order to ensure the safety of accelerator driven subcritical reactor, it is necessary to develop the materials which withstand the irradiation of protons with high energy. In addition to the displacement damage, material degradation is also induced by helium and hydrogen produced by high energy protons. The purpose of this study is to investigate the materials degradation mechanism experimentally. In this year, materials irradiation system using the proton accelerator of FFAG in the Research Reactor Institute was developed.

6.4.2 Research on Nuclear Fusion Reactors

[1] Research on Plasma Confinement with Heliotron J

Tohru Mizuuchi (Institute of Advanced Energy)

➢ Target (Plan) and Achievement in FY2008

New diagnostic systems in the magnetically confined high-temperature plasma have been developed for (a) electron density profile by introducing a microwave reflectometer and (b) impurity ion temperature and the rotation velocity profiles by introducing charge exchange recombination spectroscopy (CXRS) system. A newly installed power amplifier for the reflectometer increases the injected microwaves power from 10dBm to 20dBm, resulting that the detection sensitivity can be improved for 200MHz amplitude-modulated microwaves of 33-56 GHz frequencies. This makes the phase detection accurate, expecting that the electron density measurement is more reliable. By using a high sensitive and time-resolved CCD camera the CXRS system has a capability to improve the resolution of the rotation velocity more than several times higher than the conventional one, aiming at precise estimation of the radial electric field being a key factor in fusion reactor design.

On the other hand, to develop modules of an integrated code which is capable of performing hierarchical simulation for plasmas in a non- axisymmetric fusion reactor, a workstation with eight cores has been introduced. At present, we are developing several simulation modules for analyzing the neoclassical transport and detailed MHD equilibrium of helical plasmas.

[2] Development of Integral Tokamak Simulation Code

Atsushi Fukuyama
(Graduate School of Engineering)

➢ Target (Plan) and Achievement in FY2008

In order to predict plasma performance and

optimize operation scenario of magnetic fusion core plasmas, self-consistent simulation of ion cyclotron heating and electron cyclotron current drive was carried out by developing a numerical code which describes the time evolution of multi-species momentum distribution functions precisely including the effects of Coulomb collisions between the particles species, and the install of more main memory of the integrated simulation server has enabled simulations with higher resolution.

[3] Development of Compact Tokamak Fusion Reactor

Takashi Maekawa
(Graduate School of Energy Science)

➢ Target (Plan) and Achievement in FY2008

As a proof of principle study for realization of compact tokamak fusion reactor with no central solenoid, an experiment to produce a spherical plasma torus by using microwave power has been conducted in the Low Aspect ratio Torus Experiment (LATE) device. In addition, characteristics of the plasma have been studied by un-isotropic pressure model parallel and perpendicular to the magnetic field.

[4] Fusion Reactor System Design

Satoshi Konishi (Institute of Advanced Energy)

➢ Target (Plan) and Achievement in FY2008

Plan:

The research plan in the fiscal year 2008 in the fusion reactor system design area intended the establishment of design concept of energy system, and the preparation for the research activity to concretely design the system based on this concept.

Accomplishments:

In order to implement the above plan, guidelines were made by the discussion with the scenario group as follows:

- Fusion cannot expect large market share in Japan and significant contribution for global CO2 reduction.
- If fusion requires decades to be introduced, market chance in the developing countries will be significantly smaller because market will be expanded and matured during that period. In order to make considerable contribution, early energy production is needed.
- In the electricity markets in the world, competition with hydro, renewable such as solar and nuclear is anticipated, and it does not result in the significant reduction of CO2 emission.
- Global fuel market has several times larger scale, and dependence on the fossil such as oil is higher, therefore supplying substitute of fuel is expected to make significant CO2 reduction in the global scale.

Concept development based on the above guideline resulted in the proposal of “Fusion-Biomass Hybrid System” that converts fusion energy to high temperature heat with liquid metal blanket, and synthesizes hydrogen and fuels from biomass. This system is possible with current level of plasma performance, and provides liquid fuel instead of electricity, that is quite unique in the world fusion community. By this concept, we suggested that fusion can make significant contribution in near future as a substitute of fossil energy toward CO2 zero emission. Also as a preparation for the practical design study from the next year, simulation codes system for neutronics and thermal hydraulics were established.

These results satisfied the original research plan for the fiscal year 2008, and the outcome is so significant that the contribution of the energy system concept proposed here would be an important part of the entire zero emission energy scenarios to be established by this GCOE project.

6.4.3 Development of Advanced Nuclear Materials

[1] Research on Thermal Diffusivity Estimation of Irradiated Ceramics

Masafumi Akiyoshi
(Graduate School of Engineering)

➢ Target (Plan) and Achievement in FY2008

Material that survives under severe irradiation environment is the key factor to develop the future

fusion reactor and other nuclear applications, such as high-temperature gas cooling fission reactor. Especially, these reactors are designed to operate at high-temperature to achieve higher generation efficiency or to actualize direct hydrogen production, and ceramics are one of the candidate materials. Thermal diffusivity is one of the most important factors for materials used at high temperature, but it has been reported that the thermal diffusivity of neutron-irradiated ceramics showed significant degradation. Changes after the irradiation that depend on the irradiation conditions were clarified step by step with the past study, still changes during the irradiation is not estimated, and that inhibit to obtain the guide to develop materials.

The thermal diffusivity at the irradiation temperature is evaluated from the dependence of thermal diffusivity on measurement temperature, and it can be considered to represent the thermal diffusivity during irradiation with several assumptions. In this work, 30MeV electron accelerator is used to induce defects to ceramic materials at several temperatures, and then the thermal diffusivity of post-irradiation specimens is measured to obtain relation between thermal diffusivity at the irradiation temperature and the irradiation temperature. Specimens are radio activated with the irradiation, so all measurements are operated in radiation controlled area at Radiation Laboratory, Uji campus.

In this project, sample preparation system was equipped by introducing automatic polishing machine, that can form ceramic materials in high precision efficiently, and we have prepared specimens for electron-irradiation experiments. Also we improved measurement system of thermal diffusivity to present better measurement efficiency.

[2] Improvement of In-situ Observation System of Irradiation Defects

Hidetsugu Tsuchida
(Graduate School of Engineering)

- Target (Plan) and Achievement in FY2008

Nowadays, positron annihilation method is widely used to investigate the irradiation defects, and expected to clarify the behavior of irradiation defects under the irradiation environment. In previous works, the behavior of irradiation defects has been analyzed by measurements of post irradiation specimen, but behavior during the irradiation is little studied. So, we have been trying in-situ observation of defects during ion-beam irradiation using tandem accelerator in Radiation Laboratory, Uji campus. But still time resolution of positron annihilation lifetime measurement is not enough good, and each measurement required very long time, so improvement of the system is required.

In this project, the existing system that measure positron annihilation lifetime was improved. BaF_2 crystals of scintillation detectors were changed to larger one to achieve higher detection efficiency. The irradiation chamber was modified, and measurement layout using avalanche-photo-diode was arranged to achieve better time resolution. This improved measurement system may present more detailed behavior of defects during irradiation, so now we fix the setting of the system to obtain the guide to develop materials that was used irradiation environment.

[3] Development of Advanced Oxide Dispersion Strength Ferritic Steels

Akihiko Kimura (Institute of Advanced Energy)

- Target (Plan) and Achievement in FY2008

Nuclear energy is one of the promising energy to reduce the emission of carbon dioxide near future. In this research, innovative structural materials R&D is performed for applications to next generation nuclear systems which require high-performance to structural materials. It is essential to elevate operation temperature of the plants, which is controlled by upper limit temperature of the materials, to increase thermal efficiency of the plants. In this research, advanced oxide dispersion strengthened (ODS) ferritic steels were selected as a candidate of the structural materials of the next generation nuclear plants, because nano-sized oxide particle dispersion has been considered to be effective to improve materials performance.

In 2008, Ph.D course students lead the discussion

for developing ODS steels from a point of view of requirements for advanced nuclear systems. Finally, it was concluded that one of the most important key technologies for high performance of ODS steels are the size and number density of the oxide particles. Based on the discussion, it is concluded that the R&D of ODS steels can be focused on the processing technology to form nano-sized oxide particles in high density.

A research group of Japanese and Korean student worked together to collect scientific information by attending at annual meeting of Japan Institute of Metals and Atomic Energy Society of Japan. Collaborative research was carried out among Kyoto University, Korea Advanced Institute of Science and Technology and China Academy of Institute of Modern Physics. The following symposiums and workshop were held:

1) Research group meeting on fuel cladding (Kyoto University）
2) Research group meeting on fusion materials (NIFS)
3) US/Japan Workshop on blanket structural materials (Kyoto University)
4) Summer school on nuclear materials（Hakone）

Finally, a model ODS material was produced as a surveillance test materials on the bases of the above research activities. The research group was well organized by students, and the objective of this working group was clearly defined. Japan/Korea/China collaborative research by Ph.D students also started with the effective support by professors of each country.

6.4.4 Activity of Global COE Program-Specific Assistant Professor

In Advanced Nuclear Energy Research, two program-specific assistant professors have been performing the following research activities.

1. Development of high-precision numerical simulator for multi-physical thermofluid dynamics

   To develop a numerical simulator of thermofluid dynamics under severe conditions on nuclear reactor engineering, such as high pressure, high temperature, strongly heat flux, magnetic field, super-critical states, etc., and multi-physics complexities (multiphase flow, turbulence, and phase change).

2. Research on Reactor Physics of Accelerator Driven Subcritical Reactors

   To perform the experimental research on the neutronic characteristics of Accelerator Driven Subcritical Reactors, that a subcritical core constructed in KUCA (Kyoto University Critical Assembly) driven by high energy proton beam.

6.4.5 Research Presentation and Workshop

Research results of Advanced Nuclear Energy Group are presented in domestic and international conferences, and published in scholarly journals. The presentation numbers in 2008 are as follows:

	Scholarly Journal, etc.	International Conference	Domestic Conference	Workshop	Patent
Number	12	39	22	27	0

In addition, the following presentations by program specific assistant professors were conducted in the session of Advanced Nuclear Energy Research at the Kick-off symposium of GCOE, following the invited speech by Dr. D. J. Jackson, emeritus professor of Manchester University, UK, entitled “The status prospects of nuclear energy development in the UK and Europe.”

1. Jae-Yong Lim, “Numerical Analyses for Neutron Guide of Accelerator-Driven System (ADS) with High-Energy Protons in Kyoto University Critical Assembly (KUCA).”
2. Yoshinobu Yamamoto, “Development of high-precision numerical simulator for multi-physical thermofluid dynamics and its application.”

Moreover, the post-symposium seminar on mixed convection on heat transfer research by Prof. D. J. Jackson was held on the next day of Kick-off symposium, with 39 attendees.

On March 11th, 2009, a joint workshop of Advanced Research Cluster and Scenario Planning Research Group was held, and scenario to introduce the advanced energy resources for zero CO2 emission by 2100.

6.4.6 Major Equipment

[1] Research on New-Type Nuclear Reactors and Accelerator Driven Subcritical Reactors

The following equipments were set up for the research on New-Type Nuclear reactors.

- Test loop for gas-liquid two-phase flow experiments
- High measurement system for two-phase flow: Optical probe system, high resolving visualization system with high resolution on time and space

The following equipments were set up for the research on Accelerator Driven Subcritical Reactors.

- Power supply system for the MCBT magnets of FFAG accelerator
- Beam optics design and vacuum chambers development (Development of charge-exchange beam injection with negative hydrogen ions)
- Data acquisition system for time-series neutron data (MCS, instrumentation module)
- Proton irradiation system (for material irradiation research)

[2] Research on Nuclear Fusion Reactors

The following equipments were set up for the research on Fusion Reactors with Heliotron J.

- Power amplifier for microwave reflectometer to measure electron density profile
- High sensitive and time-resolved CCD camera for charge exchange recombination spectroscopy (CXRS) system
- Workstation with eight cores for integral plasma simulation code development

The following equipments were set up for the development of Integral Tokamak Simulation Code.

- Installing of more main memory of the integrated simulation server

[3] Development of Advanced Nuclear Materials

The following equipments were set up for the research on Advanced Nuclear Materials.

- High precision automatic polishing machine for the specimens of electron-irradiation experiment
- Improvement of In-situ Observation System of Irradiation Defects

6.4.7 Others

The budget for research works was allocated in FY2008, however, there will be no more budget allocation in the coming years. To promote the nuclear research works, especially the experimental researches, in the coming years, it is necessary to obtain budget for operation and maintenance of the facilities by any means.

7. Curriculum Committee

7.1 Curriculum Design in GCOE Unit for Energy Science Education

7.1.1 Preparation of Education Unit Overview and CO2 Zero Emission Education Program Course Syllabus

Aiming for a full-scale start of the Education Unit and the CO2 Zero Emission Education Program from April 2009, the "Education Unit Overview and CO2 Zero Emission Education Program Course Syllabus" was prepared. The gist is as follows.

➢ **Kernel of "Education Unit Overview and CO2 Zero Emission Education Program Course Syllabus"**

I. Registration for Education Unit

Those eligible to register for the Education Unit

By registering to participate, the doctoral students who are enrolled in the following departments of the graduate schools can join this education unit while belonging to their current departments.

- Graduate School of Energy Science
  Department of Socio-Environmental Energy Science
  Department of Fundamental Energy Science
  Department of Energy Conversion Science
  Department of Energy Science and Technology
- Graduate School of Engineering
  Department of Nuclear Engineering

II. Research Support

(1) Those who signed up for this education unit will be eligible to be appointed as GCOE RA.

(2) Those who signed up for this education unit can receive grants for travelling expenses for research presentation.

(3) As for those who signed up for this education program subject, "International Energy Seminar (Group Research)", based on the research plan submitted by each group, the required research expenses will be supported, amounted to the maximum of 1.5 million yen a year per person.

III. CO2 Zero Emission Education Program

(1) Requirement for Completing the Education Program

Those who registered to join the Education Unit, and acquired the total of 14 credits and above from the following subjects within the course period will be certificated as graduates of the education program, and a completion certificate will be issued for each student.

- International Seminar on Energy Science I, II, III, IV (Including Group Research) (Each 2 credits, compulsory 4 credits, maximum 8 credits)
  Cultivate international and comprehensive way of thinking and views.
- Advanced Research for CO2 Zero-Emission I, II (Each 1 credit, compulsory 2 credits)
  Cultivate creativity and independence.
- Field Practice (Compulsory 2 credits)
  Dispatched to places that have tense relationship with the public such as nuclear power plants, and learn about the problems out in the field.
- Research Presentation I, II, III (Each 1 credit, compulsory 1 credit, maximum 3 credits)
  Research presentation at academic meetings.
- Overseas Practical (1 – 4 credits)
  Research or practical at International Institutions
- Classes in English (Half term: 2 credits, quarter term: 1 credit)

(2) Course period

While enrolled in the doctoral program. Provided that course application for classes is done each year.

IV. Subject List

Subject title	International Seminar on Energy Science I, II, III, IV
Place	To be determined by the Advisor
Time	International Seminar on Energy Science I: First semester of 2009 International Seminar on Energy Science II: Second semester of 2009 International Seminar on Energy Science III: First semester of 2010 International Seminar on Energy Science IV: Second semester of 2010 Participants will be informed of the details separately.
Instructor	Academic staffs in charge of the Committee of Scenario Planning (Ishihara, Tezuka, Konishi, Unesaki)
Credits	2 credits each (Compulsory 4 credits, maximum 8 credits)
Course Description	The class will be organized with small groups (7-8 people/group). Students learn techniques and strategies for the Zero CO2 Emission Energy Society through group discussions in English based on Problem Based Learning (PBL).

Subject title	Advanced Research for CO2 Zero-Emission I, II
Place	Not particularly specified
Time	Advanced Research for CO2 Zero-Emission I: First semester Advanced Research for CO2 Zero-Emission II: Second semester

Instructor	Supervisor and academic staffs in charge of Advanced Research Committee (Ikkatai, Morii, Saka, Nakajima)
Credits	1 credit each (Compulsory 2 credits)
Course Description	To conduct energy socio-economics research to evaluate the feasibility of the scenario and advanced energy technology development research without fossil fuel while systematically coordinating with the Energy Scenario Planning Research. To promote the "Energy Socio-Economics Research", "Renewable Energy (Solar Energy, Bio-mass Energy) Research" and "Advanced Nuclear Energy Research" that are integrated with a variety of fundamental researches and elemental technologies for a sustainable energy system, and to conduct researches related to the CO2 Zero Emission Energy Scenario Planning, which is based on the outcome of each research.

Subject title	Field Practice
Place	On-campus practice: Research Reactor Institute (Kumatori-cho, Sennan-gun, Osaka) External practice: Scheduled at Nuclear Power Research and Development Agency (the Monju fast-breeder reactor), Kansai Electric Power Co., (Mihama)
Time	First semester (Intensive) On-campus practice: 3 days in August External practice: 2 days in August to September Details will be announced separately.
Instructor	Academic staffs in charge of Curriculum Committee (Kamae, Mizuuchi)
Credits	2 credits
Course Description	1. On-campus practice Address experimental subjects related to fundamental reactor physics using the Kyoto University Critical Assembly (KUCA), which is a small-sized nuclear reactor with low output and to further conduct reactor operation practice for all students. The practical is for 3 days, the first day is for maintenance lesson, facility visit and lectures on reactor physics, the second day is for dynamic behavior experiment of the reactor (measuring the reaction level of the control rod), and the third day is for conducting the reactor operation practical. 2. External practice Learn about the nuclear power plant design and safety through operation practice by nuclear power plant visit and operation simulator. Additionally, in the field learning about the contents, issues, and future prospect of the living together activities in the nuclear power plant area.

➢ **Research Presentation**

Research presentation and patents related to the doctoral students (April 1, 2008 – March 31, 2009) are as follows. The detailed listing is recorded in the Appendixes.

	Scholarly Journal, etc.	International Presentation	Domestic Presentation	Award	Patent
Number	115	95	151	11	2

7.2 RA Program

Five judges evaluated RA candidates based on the following evaluation points using their application forms as shown in Table 7-1 and the appointment was determined based on the 5 judges' total points. Especially the top candidates were appointed on special hourly unit price. As shown in Table 7-2, a total of 19 RAs were appointed (among these, 9 RAs were appointed based on the special hourly unit price).

Evaluation points: Each item carries 25 points full mark, and total 100 points full mark.

1. Contribution to this GCOE program
2. Academic importance and achievement in the concerned field
3. Research prospects and comprehensive evaluation
4. Research performance

(Concerning research performance, grade (the number of years since starting the research) is considered)

Table 7-1 Application form for GCOE-RA

Applicant name			
Research plan as RA			
Comments by advisor （In case of D3, the date of submission for a dissertation should be given			
Signature (advisor)		Date of signature	

Publications and others（Write the following items on separate A4 sheets of paper in order）

(1) Journal paper(including bulletin, transaction, proceeding)

Note: State “with or without reviewing”. In case of “with reviewing”, write down only accepted one. If it is not published yet, attach the letter of acceptance.

Authors (same order as publication), title, journal name, publisher, volume, year, first page to last page

(2) Presentations in international conference

Note: State oral or poster presentation, “with or without reviewing”

Authors (same order as publication), title, conference name, presentation number, place, year, month, day

(3) Presentation in domestic meeting

Note: ibid

(4) Others

Table 7-2 Appointed RA List

(D1, D2: December 2008 – March 2009, D3: December 2008 – February 2009)

Department	Grade	Name	Research Subject	Hourly unit price (Yen)
Socio-Environmental Energy Science	D1	Kosuke Hara	The synthesis of photocatalyst using mechanical milling and its performance evaluation	2,500
Fundamental Energy Science	D2	Yusaku Nishimura	The formation and control of silicon film by electrochemical process	2,500

Fundamental Energy Science	D2	Kenji Imadera	Transport analysis of the turbulent flow inside nuclear fusion plasma based on the gyro movement theory	2,500
Fundamental Energy Science	D3	Shinya Watanabe	High time resolution band spectrum detector for plasma radiation measurement	2,500
Fundamental Energy Science	D3	Osamu Yoshikawa	Experiment related to the invention of super layer nano structure element and data analysis support	2,500
Fundamental Energy Science	D3	Masafumi Inoue	Controlling formation of nano fiber structure using tau protein aggregated phosphopeptide	2,500
Fundamental Energy Science	D1	Shun Nakano	Correlation between RNP receptor structure and functions	2,500
Fundamental Energy Science	D2	Hironori Hayashi	Control of enzyme reaction characteristics based on the molecular design of the coenzyme binding site	2,500
Energy Science and Technology	D2	Kazumichi Yoshii	Non-linear optical process and application of the high intensity femtosecond laser induced oriented molecules	2,500
Socio-Environmental Energy Science	D3	Dlamini Ndumiso Goodwill	Life-cycle energy assessment and analysis	1,400
Socio-Environmental Energy Science	D1	Wu Yunga	Sustainable energy supply and demand system in cattle-breeding district of the Inner Mongolia	1,400
Socio-Environmental Energy Science	D1	Daisuke Miyazaki	Reduction of carbon dioxide emissions considered from residential sector	1,400
Socio-Environmental Energy Science	D1	Seiji Matsuoka	Elucidation of thermal decomposition mechanism at molecular level of wood polysaccharides for the purpose of highly selective conversion of woody biomass	1,400
Fundamental Energy Science	D3	Shin-nosuke Ichikawa	Analysis of charge-discharge behavior of electrode material of the Lithium-ion secondary battery	1,400
Fundamental Energy Science	D2	Akinobu Matsuyama	Helical plasma neoclassic transport theory and particle simulation	1,400
Fundamental Energy Science	D3	Yoshiyuki Takahashi	Nuclear power utilization in the global warming age	1,400
Fundamental Energy Science	D1	Takahiro Yagi	Nuclear power utilization in the global warming age	1,400
Energy Conversion Science	D1	Toshihiro Shibata	Tritium behavior in the environment associated with nuclear fusion energy utilization	1,400
Department of Nuclear Engineering (Graduate School of Engineering)	D2	Masaki Hada	Direct observation of ultra-high speed phonon dynamics utilizing femtosecond X-ray probe	1,400

8. International Exchange Promotion Committee

8.1 Activity Objectives

This committee conducts the following activities in order to “conduct information dissemination through hosting international and domestic symposiums (once a year) and the like, in order to promote international exchange of students and educators, and dissemination of research outcome abroad, and to operate the teaching and research activities while ensuring the coordination with the

society. Additionally, promoting activities such as the existing SEE Forum and core university program, and cooperating with the energy scenario planning in each country in the world while coordinating with research institutes abroad", as described in the GCOE application documents.

- **Publication Activities**
  1) Newsletter is published in order to convey information related to GCOE in a precise and recordable form.
  2) The website operation and updating are done in close coordination with the Scenario Planning Groups in order to release information related to GCOE rapidly.

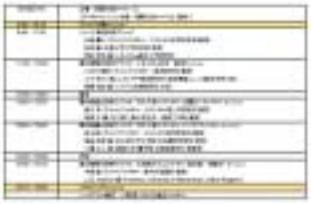
- **Hosting International and National Symposiums (Workshops)**
  1) Carry out the planning and holding the GCOE hosted international and national symposium (workshops).
  2) Carry out co-hosting for the related international and national symposium (workshops).

- **National and foreign collaboration activities**
  1) Collaboration activities with related local research organization (Japan SEE Forum, etc.).
  2) Collaboration activities with the related foreign research organization (SEE Forum).

8.2 Newsletter

We have issues the GCOE Newsletter written in Japanese and English, and upload on the GCOE website. Two newsletters (No. 1 and No. 2) have been issued in this year.

Newsletter No. 1



Newsletter No. 2


地球温暖化時代の
エネルギー科学拠点

8.3 Homepage

We have been promoting our GCOE program to public while issuing a GCOE pamphlet as well as updating GCOE homepage, where the latest activities of research and education are updated in Japanese and English. We are also paying attention to the individual privacy as well as human right during the public information.

A staff has been appointed as a web manager who has updated the latest information of GCOE programs, such as an upcoming symposium/seminar, announcement of educational program by GCOE Unit for Energy Science Education, Image share of Zero CO2 emission Scenario by Research and Planning Zero CO2 Emission Scenarios group, and Research plan by Advanced Research Clusters (Energy socio-economics, solar energy, biomass energy, advanced nuclear energy groups).

Fig. 8-1. GCOE homepage.

Fig. 8-2. GCOE pamphlet.

8.4 International and National Symposiums (Workshops)

- **GCOE Kick-off Symposium (28-29 January, 2009)**

Graduate School of Energy Science, Institute of Advanced Energy (IAE), Department of Nuclear Engineering, and Research Reactor Institute (RRI) jointly organized the Kick-off Symposium of "the Global COE Program of Energy Science in the Age of Global Warming – Toward a CO2 Zero-emission Energy System – " , during 28-29 January 2009, at Kyoto University Clock Tower Centennial Hall.

The chairman, Prof. Satoshi Konishi (IAE) declared the symposium opening. At first, Prof. Takeshi Yao (G-COE leader) gave an opening address. Following this, Prof. Hiroshi Matsumoto (President of Kyoto University), Mr. Hiroshi Yoshimoto (Director, MEXT), Dr. Kenkichi Hirose (Senior Executive Director, JST), Dr. Takashi Murata (Vice Director, RIKEN Kobe Institute), and Prof. Yoshikazu Nishikawa (President, RIAS) made opening addresses.

In the afternoon session, with paying attention to the human-resource management and international relationships toward a CO2 Zero-emission Society, Mr. Shinichi Akaike (Director, MEXT) introduced the "Policy for Science & Technology and its Diplomacy in Japan", and Prof. Hideaki Ohgaki (IAE) presented the G-COE activities of international cooperation. Based on the information, the moderator, Prof. Keiichi N. Ishihara, invited 4 distinguished commentators, Dr. Shuji Tamura (Senior Executive Director, IDES), Mr. Nonilo A. Pena (Chairman of ASEAN COST sub-committee), Dr. Shigeru Sudo (Vice President, NIFS) and Dr. Akira Kawahara (Former President, AESJ) to encourage the G-COE program. Following this, Prof. Yuzuru Matsuoka (Leader, G-COE program of Human Security Engineering for Asian Megacities), Prof. Shigeo Fujii (Leader, Global Environment Leader Program), Prof. Hideo Nagashima (Leader, Kyushu University G-COE Program, Novel Carbon Resource Science), Dr. Kazuyuki Yagi (senior researcher, NIAES), and Kaoru Sugihara (Leader, G-COE program in search of Sustainable Humanosphere in Asia and Africa), introduced their research activities and programs.

Poster session (64 posters) was also took place by G-COE students. After that, reception party was organized and coordinated by Prof. Yoshiaki Kunugi.

On 29th January, technical sessions by G-COE research clusters were held. Researching and Planning Zero CO2 Emission Scenarios (RPZCES, headed by Prof. Keiichi N. Ishihara) and four Advanced Research Clusters (ARCs, headed by Prof. Seiji Ikkatai in Energy Socio-Economics, Prof. Takashi Morii in Solar Energy, Prof. Shiro Saka in Biomass Energy and Prof. Ken Nakajima in Advanced Nuclear Energy) organized the technical sessions with inviting eminent researchers. Finally, Prof. Yao gave a closing remark.

On 30th January, as post meetings & seminars, Japan SEE Forum meeting (headed by Prof. Susumu Yoshikawa) and 1st G-COE Energy Seminar on mixed convection phenomena by Prof. J. D. Jackson (Manchester University) were organized.

Fig. 8-3. Participants of the kick-off symposium of "the Global COE Program of Energy Science in the Age of Global Warming – Toward a CO2 Zero-emission Energy System – ".

- **Renewable Energy Asia 2008 & 4th SEE Forum (11-14 December, 2008)**
  http://web.iitd.ac.in/~rea2008/

Global warming is recognized as one of the most challenging problems for sustainable environment, particularly in the Asian region. To counter this challenge the Asian countries are expected to pursue for the sustainable society. Under these circumstances Indian Institute of Technology Delhi (IIT-D), SEE Forum, and Kyoto University Global COE Program co-hosted an International Conference titled Renewable Energy Asia 2008 and 4th SEE Forum Meeting in New Delhi, India, during December 11-13, 2008.

・Inaugural Session (11 December, 2008 at 10:00-11:30 AM)

The conference was inaugurated with lighting of the solar lamp at the deity Saraswati, goddess of wisdom. In a star-studded event, Prof. P.L. Dhar, Head, CRDT delivered welcome address, Prof. H.P. Garg, Emeritus Professor of IIT-D gave an opening remarks, special address was made by Prof. Susumu Yoshikawa, President of SEE Forum, A Video Address by Prof. Hiroshi Matsumoto, President, Kyoto University was also shown to the delegates. Dr. R. Chidambaram, Principal Scientific Advisor to the Government of India flagging relevant issues and concerns in his inaugural address setting the tone for the conference. He made a presentation on "**Renewable Energy & Climate Change**" and raised issues to be addressed by scientific community. He highlighted that Biofuels, Hydrogen, Solar PV should be emphasized along with nuclear as clean fuels to control the climate change. Keynote Address was delivered by Mr. Deepak Gupta, Secretary, MNRE who highlighted that priority is being given to performance and cost reduction of renewable energy devices to substantially increase share of renewable energy in the total energy mix. He informed that MNRE has planned mission mode research for various renewable energy technologies and emphasized on the need to work on upscaling of R&D. Dr. V.K. Vijay outlined the objectives of the conference and proposed vote of thanks.

・Plenary Session-I (11 December, 2008 at 12:00-01:45 PM)

The first plenary session had opening presentation from Dr. Victor Reis, Scientific Adviser to the US Secretary of Department of

Energy on “Nuclear Energy and Global Warming” and highlighted the merits of nuclear technology as an environment friendly alternative. A broader viewpoint of energy in terms of “Pure Zero Source of Energy-Myth, Miracle and Might” was outlined by Chaturvedi Swamiji, Chairman, Ramanujan Mission Trust, Chennai. Inspiring facts about “Organic Photovoltaics as a Next Generation Solar Cell” was presented by Prof. Susumu Yoshikawa of Kyoto University. Paper on "General Outlook on Energy” was presented by Prof. H.P. Garg of IIT-D. The session was chaired by Prof. P.V. Indiresan, Former Director of IIT Madras & Chairman, BOG, NSIT, New Delhi.

・Plenary Session-II (12 December, 2008 at 09:00-11:00 AM)

The second plenary session had presentations on “Renewable Energy Policy Framework of India” and “Recent Progress and Challenges in Sustainable Energy Development in Thailand” highlighting measures taken by the Governments of India and Thailand. These presentations were made by Dr. P.C. Maithani, Director, MNRE and Prof. Fungtammasan, JGSEE, Thailand. Dr. Rajeswaran, CTO from Moser Baer Photovoltaic Ltd., New Delhi presented the active industry perspective on “Silicon-Based Photovoltaic Technologies”. The need to look at the two big Es, namely Entropy and Ethics, without which the web of the other 5 classical Es of Energy, Ecology, Economy, Equity and Employment cannot be solved, was emphasized in powerful presentations by Prof. P.L. Dhar, IIT-D. The session was chaired by Prof. R.R. Gaur, IIT-Delhi.

・Plenary Session-III (13 December, 2008 at 11:30-01:00 PM)

The third plenary session had presentations on “Research & Development in Centre for Energy Studies, IIT Delhi” by Prof. S.C. Kaushik, Head, CES, IIT-D; “Metabolic Engineering for Biofuels” from Prof. Pogaku Ravindra, Malaysia; “Cooperative Research Activities in Asia at Ecotopia Science Institute” by Prof. T. Hasegawa, Japan; “Mainstreaming Renewable Energy in Asia” by Dr. Pradeep Chaturvedi, IAAS, New Delhi, and “Financing Renewable Energy Projects” from Mr. A.K. Khatana, IREDA. The session was chaired by Prof. M.S. Sodha who emphasized on practical Utilization Aspects of Renewable Energy Sources.

・Technical Sessions (11-12 December, 2008)

A total of 151 contributed papers (80 Oral and 71 Poster) and 12 invited lectures were presented in three plenary and fifteen technical sessions besides the inaugural session and the valedictory session. Sessions covered diverse topics in the area of renewable energy, including technological, social, economical, educational and policy aspects.

Technical sessions took place in four sets of three parallel sessions. A number of interesting studies were presented on optimization of various renewable energy technologies, namely, biodiesel and bio alcohol production, biomethanation, pyrolysis and gasification, solar thermal and phtotovoltaic, micro-hydel and hydrogen energy. Studies threw light on social, economic and demographic issues in India and other Asian countries with reference to entrepreneurship development in renewable energy. Many useful recommendations on policy on renewable energy were suggested, including incentives for renewable energy usage and disincentives for fossil energy use.

・Meeting of SEE Forum (11-13 December, 2008)

The meeting was convened to further discuss the research and education on new and renewable energy among Asian Countries. The meeting brought together from 18 countries over 200 participants who are committed to that objective. The meeting was co-chaired by Prof. H.P. Garg, Emeritus Professor of IIT-D, and Professor Susumu Yoshikawa, Institute of Advanced Energy, Kyoto University and coordinated by Prof. V.K. Vijay of IIT-D.

The meeting focused on Human Capacity Building and Collaboration among Asian Countries toward sustainable society. At the final stage, the proposal of SEE Forum Action Plan – 2009 was discussed. The proposal set forth the further actions that will address among others: (1) Research issues,

(2) Education and training issues, (3) Networking issues, and (4) Project financing issues, toward the New Energy Initiative.

All participants agreed to take forward the following plan of actions:

① To establish the SEE Forum at each country and the NOEs
② To cooperate in the establishment of NECSE (Education) under Japan's leadership
③ To form the SEE young researcher / Student forum (Network)
④ To establish the IJSEE (International Journal of Sustainable Energy and Environment)
⑤ To cooperate the 5th SEE Forum in Bangkok May 2009, and 6th SEE Forum in Yogyakarta in December 2009
⑥ To secure the SEE Forum funding
⑦ To initiate activities of Indian Chapter of SEE Forum – formed during the 4th SEE Forum

- **1st GCOE Energy Seminar (30 January, 2009)**

As a post seminar of the G-COE kick off symposium, the first G-COE Energy Seminar was held at Clock Tower Centennial Hall, Kyoto University, January 30, 2009. Prof. D. J. Jackson of Manchester University gave one day seminar on fundamentals and state of the arts of mixed convection phenomena. There were 39 attendees: 13 attendee from Kyoto University and 26 from other Universities and Institutions. The seminar was quite successful.

- **2nd GCOE Energy Seminar (16 February, 2009)**

The second G-COE Energy Seminar was held on 16th, Feb. 2009 from 14:00, inviting Dr. J. F. Facetti, Professor at Institute of Strategic Studies, Ministry of Defense, and former Minister of Environment, Paraguay. The title of talk was "Energy Security and Strategy in South America facing the Economic Global Crisis". The South America, especially, Paraguay is far from Japan, thus the information about energy is limited. However, his talk and discussion with students gave us fresh information about the present and future energy situation in this area.

- **3rd GCOE Energy Seminar (2 March, 2009)**

The third G-COE Energy Seminar entitled of "Activity of Dalian University of Technology (DUT) toward Environmental Problems in China" was held on 2nd March 2009 at Kyoto University, co-organized by Symbio Community Forum. There were 3 invited speakers from Dalian; Prof. Xie Quan (Dean, DUT), Prof. Li Aimin (DUT), and Prof. Xiujing Hua (Dalian Environmental Protection Bureau). From Kyoto University, Prof. Susumu Tohno, Prof. Shigeo Fujii (Leader, Environmental Management Leader Program), Prof. Yoshihisa Shimizu (G-COE program of Human Security Engineering for Asian Megacities), presented their researches and project activities.

- **Lecture for International Trends of Energy and Environment Issues (6 March, 2009)**

This series of lecture meeting has been co-organized annually by Symbio community forum, Atomic Energy Society of Japan, Kansai Branch, Kan Gen Kon since 1999 to conduct a lecture for international trends of energy and environment issues. In this year, (1) Current status of utilization of biomass energy in southeast Asia, and (2) comparison of atomic energy conservation.

For the lecture of (1), Prof. Tetsuo Tezuka from GCOE program introduced the current status of biomass utilization in Thailand, based on international cooperative research for promoting biomass power plant within 21 COE program on "Establish on Sustainable Energy System". On the other hand, Mr. Eiji Hiraoka committee of Atomic Energy Security and Mr. Takashi Dodo from Japan Nuclear Technology Institute presented a utilization of risk information as well as Japanese government attitudes toward Nuclear Energy security.

8.5 Industry-Academia Collaboration

The industry-university cooperation symposium was held at Kyoto Terrsa (Kyoto Citizen's Amenity Plaza) on December 19. About 130 people have participated in our symposium from company mainly in manufacturing industry, research organization and universities. The Program was composed of two parts: lectures by invited speakers and seeds presentations by members of departments moving ahead with our G-COE program. The invited speakers were Professor Hiroshi Matsumoto, President of Kyoto University and

Mr. Hiroshi Morimoto, Executive Vice President and Director of Kansai Electric Power Co. Inc. In seeds presentation session, 18 presentations of findings from research were delivered first by oral and then at poster booths. Many booths were filled with people having interest in the topics and lively discussion and information exchange were conducted there.

8.6 Other Activities

8.6.1 National Collaboration Activities

- **University Education Innovation Conjunction Forum and Poster Session (13 January3, 2009)**

The booth for introducing G-COE activities was established at the University Education Innovation Conjunction Forum and Poster Session on January 13, 2009, valuable ideas was exchanged with research agencies concerned and related government agencies, and information gathering was conducted that contributes to the improving the quality of this G-COE business, along with collecting information related to other G-COE programs and university activities. G-COE Assistant Professor Taro Sonobe attended on behalf of this GCOE program.

- **Japan SEE Forum Inaugural Meeting (January 30, 2009)**

On January 30, 2009 (Friday), a meeting was held for Japan SEE Forum Inaugural preparation with Professor Susumu Yoshikawa of the Institute of Advanced Energy as the Chairman, at 2nd Floor, Kyoto University Clock Tower Centennial Hall. The 4th SEE Forum was held in New Delhi, and the "New Delhi Initiative" was adopted, but the initiative strongly demanded the establishment of SEE Forum in each country, and Japan's multi-dimensional contribution. Japan is the SEE Forum core institution and requires an organization for the purpose of promoting dynamic cooperation at home and abroad. Until today, activities have been progressing as "New Energy Forum", centering on universities in charge of 21 COEs related to new energy, but this time, in light of the necessity of an organization for the purpose of promoting dynamic cooperation at home and abroad from the "New Delhi Initiative", these were re-organized into Japan SEE Forum. As the result of this meeting, the Japan SEE Forum Secretariat was established in the GCOE, and was required to host a promotion meeting prior to the 5th SEE Forum on May 18, 2009.

8.6.2 Overseas Collaborative Activities

- **The 3rd ASEAN Committee on Science and Technology (COST) + 3 assembly participation (5 November, 2008)**

The ASEAN COST (Committee on Science and Technology) + 3 (Japan, China, Korea) accelerates the beneficial science and technology department for ASEAN + 3 countries. It is a framework launched for the purpose of possible future cooperation in the field with respect of mutual benefit, and is held as an assembly at the undersecretary level, and the Ministry of Education, Culture, Sports, Science and Technology is the assembly's information desk for our country. Following the 1st assembly (Kuantan, Malaysia in August 2006), and the 2nd assembly (Tokyo, Japan in October 2007), the 3rd assembly was held in Kuching, Malaysia on November 5, 2008. Due to the request from the Ministry of Education, Culture, Sports, Science and Technology, from GCOE, Professor Keiichi Ishihara and GCOE Assistant Professor Taro Sonobe attended the meeting, and representing the Japanese Government. Professor Ishihara reported the proposal for establishing the University Consortium (New Energy Consortium for Sustainable Environment: NECSE) as the result of the ASEAN COST+3: New Energy Forum for Sustainable Energy (NEFSE), co-organized by the Ministry of Education, Culture, Sports, Science and Technology, Japan Society for the Promotion of Science and Kyoto University. Others, participants from Japan are as follows. (Toichi Sakata, Deputy Minister, Minister of Education, Culture, Sports, Science and Technology; Shinichi Akaike, Director of International Exchange Promotion, Science and Technology Policy Bureau; Takeshi Mori, Researcher for International Exchange Promotion, Science and Technology Policy Bureau; Atsushi Hibino, Article Clerk for International Exchange Promotion, Science and Technology Policy Bureau; Yuuji Kato, Researcher, Japan Science and Technology Agency International Department).

In addition, Malaya University, Malaysia and

Singapore National University, who are SEE Forum member universities were visited and discussion toward establishing NECSE was conducted. Cooperative agreement from both parties in establishing the NECSE was obtained.

- **Dalian University of Technology Visit (1 December, 2008)**

Kyoto University Emeritus Professor Hidekazu Yoshikawa and GCOE Assistant Professor Taro Sonobe visited Dalian University of Technology, China on December 1, 2008. There, they met with Professor Xie at the University and the Deputy Director Hua of Dalian Environmental Conservation Bureau, and collected information regarding the content of the proposal related to establishing a cooperation center at the Dalian University of Technology.

This cooperation center was broached by Professor Xie when the Chairman of the Sym-bio Social Research Committee, (Kyoto University Professor Emeritus) Hidekazu Yoshikawa visited Dalian University of Technology in October 2008. On the matter of the cooperation center establishment, when Professor Xie visited Kyoto University in March 2009, the intention was to iron out the details, but since the information concerning this cooperation center establishment proposal was too little and the purpose was unclear, and cannot be decided by March next year, this visit was conducted upon the request by the GCOE Steering Committee as a preliminary survey. Professor Xie understood that it will be centered on "For Kyoto University, it is entering the agreement of wide-range technical cooperation of energy and environmental issue between Kyoto University and Dalian University of Technology (training and research cooperation of students, researchers), and then, to establish a cooperation center as a platform of international industry - academic collaboration for both universities, channeled through this", after summarizing the information such as "the name of the school, main lecturers, and the list of specialized field involved with Dalian University of Technology, hope related to mutual relation of academic cooperation and the image of the cooperation center to be established at Dalian University of Technology", the information was promised to be submitted, and upon receiving it, the meeting between this G-COE program and Kyoto University Headquarters (Industry, government and academic collaboration headquarters) was set in early March.

- **Egypt, City University of New York and University of California, Los Angeles Collaborated Information Survey (13 − 24 March, 2009)**

Along with being a guest speaker at the Cairo 11th International Conference on Energy and Environment & 8th World Conference on Solar Electricity held at Hurghada, Arab Republic of Egypt, we also surveyed the current state of energy research. As for the problems of the area concerned, we understood that together with securing the energy source, there is a high demand for the development of environmental clean-up technology for pollution problems and for ensuring safe and secure resources. Those who were present were mainly from Egypt, but there were also energy researchers from Ethiopia, and we felt the possibility of an international network foothold. Next, we visited the recently established energy laboratory at CUNY, US. Professor Banerjee, the laboratory chief was not present due to sudden business trip, but Professor Kawaji explained the activity summary of the said laboratory. The laboratory's main topics were nuclear safety research and next generation storage battery development research. We discussed about the possibility of a collaboration activity with the GCOE, and both sides will study about the academic exchange cooperative agreement with Kyoto University. Finally, we visited the UCLA nuclear fusion research group. There, we surveyed the current state of the US nuclear fusion reactor liquid blanket research and discussed about the possibility of collaboration activity, and will be proceeding with joint research together with student dispatch.

- **Thailand and Indonesia Collaborated Information Survey (22 − 29 March, 2009)**

To accelerate the effects of G-COE outcome in the Asian region and the joint research implementation, it is necessary to use the science and technology cooperation program utilizing ODA. Therefore, between March 22 to March 28, 2009, GCOE Assistant

Professor Taro Sonobe and Nuki Agya Utama GCOE research fellow visited Bangkok, Thailand and Jakarta, Indonesia, to discuss with SEE Forum participating members and local JICA who manages the current ODA program, and investigated the possibility of joint research implementation and human resources exchange program. Additionally, they also requested cooperation for the 5th SEE Forum launching in May. Furthermore, to facilitate the University Consortium (NECSE) establishment preparation, they visited Mr. Piniti, previous Executive Director of ASEAN University Network (AUN) (current post: Deputy Secretary General Thailand Commission of Higher Education), and fine tuning the future preparation policy.

In addition, they visited JGSEE, University Indonesia who is a SEE Forum participating university, and collected energy supply and demand data in South-East Asia, and at the same time, discussed the researchers of the related research organization and the future data sharing.

9. Self-Inspection and Evaluation Committee

The committee consists of a chair (Prof. Yao, program leader), one secretary and three members. The main activity is to evaluate the result of activity plan and goal during FY 2008 and achievement in this program and to issue the report as a summary early in FY 2009. At first, the contents of the report (items should be included in the report) were presented at the third meeting of PHC and some discussions were made. Based on the program developments, modified contents of the report were submitted to the eighth meeting of PHC and approved. Then, the committee asked the members in charge to write the manuscripts of the report and edited the submitted manuscripts. Major contents of the report are goal of the program, organization setup, activities of the *Steering Committee of GCOE Unit for Energy Science Education* as well as other committees, and summary. In addition, questionnaire survey was carried out about the group work of doctoral students under the supervising of the *Committee of Scenario Planning*. Furthermore, the committee considered the contents of annual report in collaboration with *International Exchange Promotion Committee* and asked the members in charge to write the manuscripts of the report.

10. Advisory Committee

Advisory Committee comprising external intellectuals is organized to assess the activity plan and development of the GCOE Program and to offer the opinions and recommendations that will improve the program activity. At the meetings, five committees making up this program (*Scenario Planning, Advanced Research, Curriculum, International Exchanger Promotion*, and *Self-Inspection and Evaluation*) reported their activities and future plans, and then exchange of opinions between the participants with confirmation of future directions were conducted. Insightful comments and valuable recommendations of the members of the *Advisory Committee* are essential for this program. Table 10-1 shows the members of the advisory committee and the two meetings were held during FY 2008as shown below.

The 1st Committee Meeting: October 30, 2008

The 2nd Committee Meeting: January 28, 2009

Table 10-1 Members of Advisory Committee

Chair	Yoshikazu Nishikawa	Professor Emeritus at Kyoto University Professor Emeritus at Osaka Institute of Technology Chairman, Research Institute for Applied Sciences
Member	Kenji Ohta	Director and Senior Executive Managing Officer, Sharp Corporation
	Keiji Kanda	Professor Emeritus at Kyoto University Director, Japan Energy Policy Institute
	Shigeru Sudo	Vice Director, National Institute for Fusion Science
	Hiroshi Morimoto	Executive Vice President, the Kansai Electric Power Co., Inc.
	Kenji Yamaji	Professor, School of Engineering, The University of Tokyo
	Shinya Yokoyama	Professor, Graduate School of Agricultural and Life Sciences, the University of Tokyo

Appendixes
付　録

Ⅰ．制規関係 Regulations

- グローバル COE 特定有期雇用教員選考内規
  Selection Bylaws of Program(Global COE)-Specific Fixed-Term Faculty Members

グローバル COE 特定有期雇用教員選考内規

第１条　グローバル COE 特定有期雇用教員の選考は、この内規の定めるところによる。

第２条　特定有期雇用教授、特定有期雇用准教授、特定有期雇用講師及び特定有期雇用助教となることができる者は、エネルギー科学研究科、エネルギー理工学研究所、工学研究科原子核工学専攻、又は原子炉実験所（以下「部局」という。）の教授、准教授、講師及び助教とそれぞれ同等以上の資格を有する者とする。

第３条　特定有期雇用教授、特定有期雇用准教授、特定有期雇用講師及び特定有期雇用助教（以下「特定有期雇用教員」という。）の選考を行うときは、グローバル COE 拠点リーダー（以下「拠点リーダー」という。）は、GCOE 教育ユニット運営委員会（以下「統括本部」という。）の議を経て、特定有期雇用教員選考委員会（以下「選考委員会」という。）を設ける。

２　選考委員会は、拠点リーダーが主宰し、次の委員で構成する。

(1) 拠点リーダー

(2) 統括本部から拠点リーダーが指名する者　若干名

(3)その他、拠点リーダーが必要と認める者　若干名

３　選考委員会は、審議結果を統括本部に報告する。

第４条　統括本部は、前条第３項の報告において、選考委員会から候補者の推薦があるときは、当該候補者について審議する。

２　前項の審議において統括本部は、委員総数（海外出張中の者を除く。）の３分の２以上の出席を必要とする。

３　統括本部は、選考委員会から推薦された候補者について審議のうえ、単記無記名投票を行い、出席者の過半数の同意を得られた者を候補者として決定する。

附　則

この内規は、平成２０年９月８日から実施し、平成２０年９月１日から適用する。

➢ エネルギー科学研究科特定助教再任審査に関する内規
Reappointment Bylaws of Program-Specific Fixed-Term Assistant Professors

エネルギー科学研究科における特定助教の再任審査に関する内規
（平成 20 年 12 月 11 日制定）

（趣旨）
第１条　この内規は、国立大学法人京都大学特定有期雇用教職員就業規則（平成 18 年 3 月 29 日達示第 21 号）に基づき雇用されたエネルギー科学研究科（以下「研究科」という。）の特定助教で、再任を希望する者に対する再任審査に関し、必要な事項を定めるものである。
（再任申請の申し出）
第２条　再任を申請しようとする特定助教（以下「申請者」という。）は、原則として任期満了日の３ヶ月前までに別紙様式１により、同様式に定める再任審査に必要な書類を添えて、研究科長に申し出るものとする。
２　前項に規定にかかわらず、任期が３ヵ月に満たない特定助教が再任が申請しようとする場合は、任期満了日までに別紙様式２により、再任を研究科長に申し出るものとする。
（再任審査の開始）
第３条　研究科長は前条の申し出により、研究科専攻長会議（以下「専攻長会議」という。）に再任審査の開始を附議し、決定する。
（再任審査委員会の設置）
第４条　研究科長は、前条の決定を受けて、申請者の学術的業績、学内の教育への貢献、社会的貢献及び再任後の研究計画に関する審査を目的として、研究科再任審査委員会（以下「審査委員会」という。）を設置する。
（審査委員会の構成）
第５条　審査委員会の構成は、申請者の所属する専攻において定め、専攻長会議に報告するものとるす。
２　審査委員会は、委員長を置き、委員の互選によって選出する。
３　委員長は、審査委員会を招集し、議長となる。
（審査委員会による審査）
第６条　審査委員会は、申請者より提出された書類に基づき審査を行う。また、必要に応じて、審査委員会は申請者に対して口頭試問を行うことができる。審査委員会は、書類審査及び口頭試問の結果に基づき、申請者の再任の可否について決定する。
２　審査委員会は、委員（外国出張中の者は除く。）の３分の２以上の出席をもって成立するものとする。
３　審査委員会は、出席委員の過半数をもって決議する。
４　審査委員会は、第１項による審査の結果を、原則として、申請者の任期満了日の１か月前までに専攻長会議に報告するものとする。
（可否決定の通知）
第７条　研究科長は、専攻長会議の議を経て、前条により再任の可否が決定されたとき、別紙様式３により再任の可又は否を、否の場合はその理由を付して、直ちに申請者に通達するものとする。
（再任に関する特例）
第８条　第２条第２項の申し出により、専攻長会議において申請者の所属する専攻の意向を勘案して再任審査を行い、その審査結果に基づいて任期１年以内で当該特定助教を再任することができる。
（その他）
第９条　この内規に定めるもののほか、再任審査に関し必要な事項は、専攻長会議の議を経て、研究科長が定める。

附　則
１　この内規は、平成 20 年 12 月 11 日から実施し、平成 20 年 11 月 1 日から適用する。

Ⅱ. 博士後期課程学生の関係する研究発表等一覧（該当 DC 学生は下線で示す）
List of Publications and Contributed Papers with Doctoral Students
(Student names are underlined)

A 学術雑誌等（紀要・論文集・プロシーディングも含む）
Scholarly Journals (including bulletin, proceedings, etc.)

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4. Jaturong Jitputti, Thitima Ratanavoravipa, Surawut Chuangchote, Sorapong Pavasupee, Yoshikazu Suzuki, and Susumu Yoshikawa, Low Temperature Hydrothermal Synthesis of Monodispersed Flower-like TiO_2 Nanosheets, *Catalysis Communications,* 10, 2009, 378-382.
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11. Surawut Chuangchote, Takashi Sagawa, and Susumu Yoshikawa, Electrospun Conductive Polymer Nanofibers for Organic Photovoltaic Cells, Proceeding of the 1st Thailand-Japan International Academic Conference (TJIA2008), Thai Students Association in Japan (TSAJ), 2008, 131-132, with review.
12. Surawut Chuangchote, Takashi Sagawa, and Susumu Yoshikawa, Fiber-Based Bulk-Heterojunction Organic Photovoltaic Cells, Mater. Res. Soc. Symp. Proc., Materials Research Society, 1149E, 2008, 1149-QQ11-04, with review.
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B 国際会議における発表（登壇者 0）

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150. 斎藤大介^{O}, Chen Mo,李継全,岸本泰明（口頭発表）「高強度レーザーに照射された物質の電離と熱緩和のダイナミックス」物理学会,２００８年秋大会,岩手県　岩手大学,2008年9月21日
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D　その他特記事項（特許、受賞等）
Special Affairs (patent, award, etc.)

1. *Excellent Poster Presentation* (エクセレントポスター賞), Surawut Chuangchote, from The Society of Polymer Science, Japan, in the 54th SPSJ (The Society of Polymer Science, Japan) meeting (Kansai Regional Chapter), July 18, 2008,
2. NTHAS6: Sixth Japan-Korea Symposium on Nuclear Thermal Hydraulics and Safety 学生セミナー 優秀プレゼンテーション賞受賞：永武　拓
3. Student Travel Grants：西村友作 (The Electrochemical Society, May, 2008)
4. ポスターセッション優秀賞：西村友作（第50回マテリアルズ･テーラリング研究会，2008年7月）
5. 第17回 国際交流活動助成 (研究者海外渡航)：西村友作（財団法人 関西エネルギー･リサイクル科学研究振興財団，2008年10月）
6. 毛利ポスターセッション優秀賞：西村友作、日本マイクログラビティ応用学会　第23回学術講演会(JASMAC-23)，2008年11月
7. Award for Encouragement of Research in Materials Science：西村友作、(The IUMRS International Conference in Asia 2008 [IUMRS-ICA 2008], December, 2008)
8. 関西電気化学奨励賞　：西村友作、(2008年度 第3回関西電気化学研究会，2008年12月)
9. 日本科学協会　平成２０年度笹川科学研究助成《学術研究部門》採用：仲野　瞬
10. ‘The Energy Related LCA for HDPE versus Mild Steel as Materials for a Car Fuel Tank.’: Report on results from an energy related LCA analysis for company. At least three updates submitted to Nippon Steel between September 2008 and March 2009: Ndumiso Dlamini
11. 特許　“ウランの濃縮方法”　萩原理加，金谷崇系，松本一彦
12. Jiayu Xin, Shiro Saka, The First-class Paper Award “High Oxidation Stability of Biodiesel as Prepared by Supercritical Methanol Method” International Conference on Biomass Energy Technologies (ICBT2008), Guangzhou, China, December 3-5, 2008.
13. Award for Encouragement of Research in Materials Science (受賞), Masafumi Inoue, Kazuki Tainaka, Takashi Konno, Takashi Morii, The amyloid fibrillization of phosphorylated human tau core peptides, The IUMRS International Conference in Asia 2008, Nagoya, Japan, December 9-13, 2008, poster.
14. 発明者：河本晴雄、松岡聖二、坂 志朗「セルロースの高温での着色を抑制する方法」､出願人:京都大学、特願 2009-3416（2009/1/8）
15. 受賞：第 7 回核融合エネルギー連合講演会優秀発表賞：渡辺淑之、「核融合炉 SiC 材料の照射損傷モデリング（１）欠陥エネルギー評価」、青森市民ホール，2008 年 6 月 21 日
16. 平成 20 年 9 月 5 日　2008 年原子力学会春の年会、加速器・ビーム科学部会、優秀講演賞　受賞：全 炳俊
17. 「日本原子力学会　フェロー賞」2009 年 3 月：植木祥高

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