



# Innovation for Cool Earth Forum

## ICEF2016 Report



## Greetings



The first decade of the 21st century have been warmer than any preceding period since global temperature records began in 1850 and it is extremely likely that human influence has been the dominant cause of the observed warming, according to the latest IPCC reports. Climate change is a challenge that humanity is facing at this very moment, not in the future.

In 2007, I, as Prime Minister of Japan, proposed a 50% reduction of global greenhouse gas emissions by 2050. Innovation is the key to achieving this ambitious goal and it is essential for governments, businesses, and academia around the world to share their wisdom and closely cooperate with each other.

Based on this concept, I proposed the establishment of a new international conference where the world's leading policy makers, business persons, and researchers can meet and cooperate with each other to address climate change through innovation. This is an unprecedented attempt, an energy- and environment-focused version of the World Economic Forum.

It would be very beneficial if you, who are at the forefront of one of the biggest challenges to humanity, climate change, and are responsible for shaping the future of the earth, would participate in this forum. I hope to see you in Tokyo.

*Shinzo Abe*

**Shinzo Abe**

Prime Minister of Japan

## 3rd Annual Meeting

- Date:** October 5 (Wednesday) - October 6 (Thursday), 2016
- Venue:** Hotel Chinzanso Tokyo, Japan
- Hosts:** Ministry of Economy, Trade and Industry (METI), New Energy and Industrial Technology Development Organization (NEDO)
- Co-Hosts:** Ministry of Foreign Affairs (MOFA), Ministry of the Environment (MOE)
- Attendees:** More than 1,000 participants from governments, companies, academia and international agencies from about 80 countries and regions
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## What is ICEF?

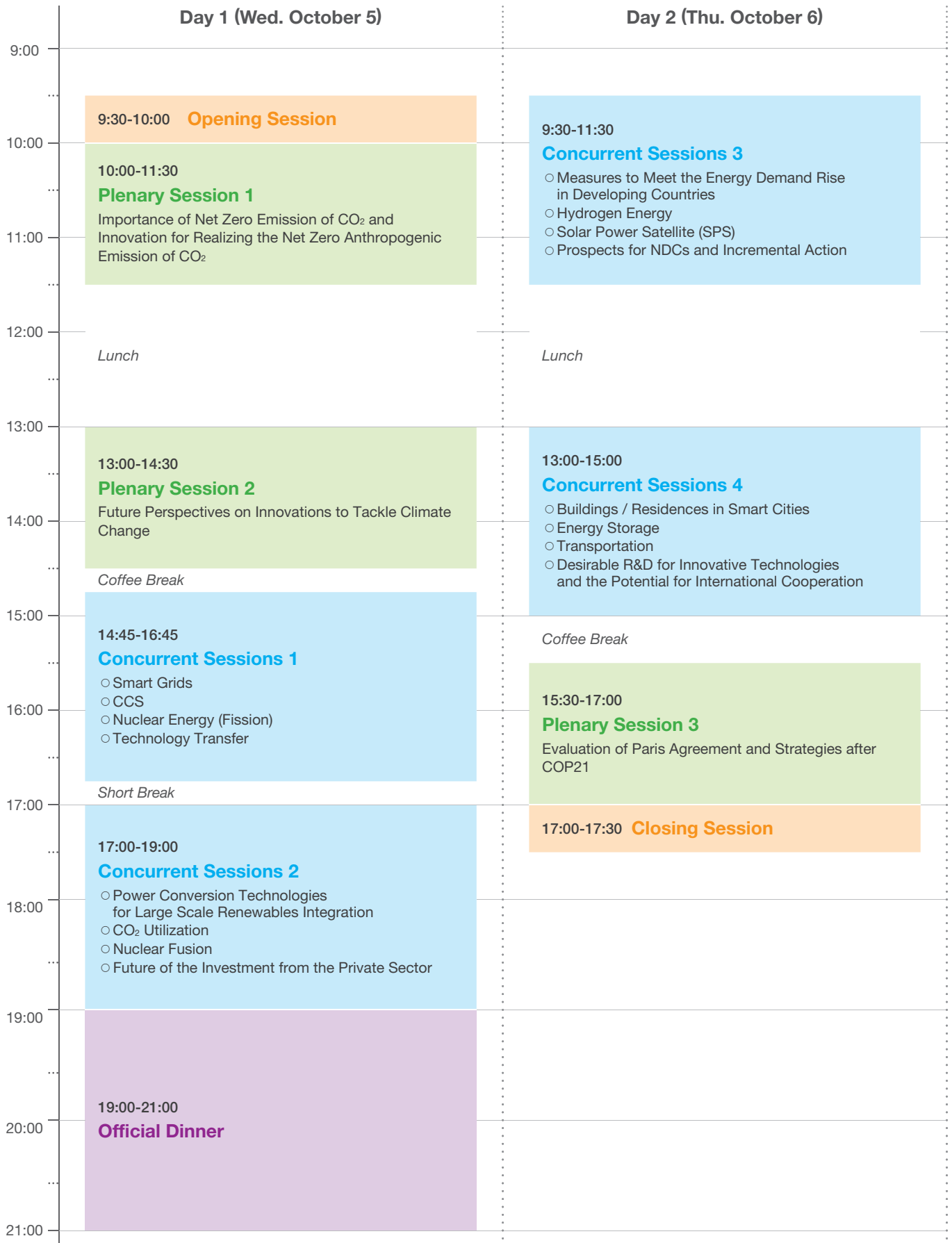
Prime Minister Shinzo Abe announced that the Government of Japan will host an annual global conference, the Innovation for Cool Earth Forum (ICEF) every year in October in Tokyo. ICEF is aimed at providing a global platform to promote discussions and cooperation among researchers, business persons, and policymakers from around the world in order to address climate change through innovation of energy and environmental technologies including their dissemination.

ICEF will also provide the On-line Discussion in order to promote year-round discussions between annual forums.

ICEF is hosted by Ministry of Economy, Trade and Industry (METI) and the New Energy and Industrial Technology Development Organization (NEDO) and co-hosted by Ministry of Foreign Affairs (MOFA) and Ministry of the Environment (MOE).

The Steering Committee has been established in order to ensure that ICEF is operated in a manner reflecting the wide range of views of the international communities.

# Program





# Opening Session

## Innovation for Cool Earth Forum



### Takumi Ihara

Parliamentary Vice-Minister of Economy, Trade and Industry, Japan

Mr. Takumi Ihara, Parliamentary Vice-Minister of Economy, Trade and Industry read a message on behalf of Mr. Hiroshige Seko, Minister of Economy, Trade and Industry. He mentioned the remarkable industrialization and economic growth of Japan accompanied by various technological innovations such as those in energy efficiency and renewable energy. In April 2016, the Government of Japan published the innovation strategy toward 2050 and identified innovative technologies in energy and environmental area with large potential for reduction in GHG emission such as the ultra-supercritical geothermal power generation and hydrogen. According to this strategy, he indicated that Japan will perform the leading role to tackle climate change and to achieve a long-term goal of the Paris Agreement at the COP21 through technological innovation and its overseas deployment. He also pointed out the importance in exchanging views among the national R&D institutes by promoting international cooperation. At the end he stated that ICEF should be a platform for such international cooperation.



### Akie Abe

Spouse of the Prime Minister of Japan

Mrs. Akie Abe, spouse of the Prime Minister of Japan showed her gratitude to have an opportunity to make a speech at ICEF. She then introduced her social activity in the field of agriculture, regional development, international exchange, etc., and stated that the sustainable development with environmental conservation is one of the most important agendas not only for Japan but also for other countries. She also pointed out the importance of achieving economic growth while implementing measures against global warming, and stressed that it is possible if we make innovation happen. It is important for each country to work together, because the global warming is our common challenge and is needed to be addressed globally. Mrs. Abe expressed her strong interest in possible consequences of not taking appropriate measures against global warming immediately. She concluded her speech by expressing hope that ICEF will be a place for exchanging ideas for innovation to tackle climate change.



### Yoichi Kaya

Chair, ICEF Steering Committee; President, Research Institute of Innovative Technology for the Earth (RITE)

On behalf of the ICEF Steering Committee, Dr. Kaya gave an address of welcome to the audience. He then described that the ICEF meeting was started in 2014 by the initiative of the Prime Minister Abe for promoting a discussion in the world about innovations in the field of climate change, and based on the results of the past 2 meetings, this 3rd meeting focuses on the clear target of achievement of the net zero anthropogenic emission of CO<sub>2</sub>. Showing the figure from the Fifth Assessment Report by the IPCC, Dr. Kaya explained the linear relationship between the cumulative total emissions of CO<sub>2</sub> and global mean surface temperature response, and pointed out the need to achieve at least net zero anthropogenic CO<sub>2</sub> emissions in the long run as a goal for stabilizing global surface temperature levels. It takes time to achieve this goal and we need innovative technologies. Dr. Kaya picked up two examples of possible innovative technologies in the future among others. One is the CO<sub>2</sub> capture and storage systems (CCS) and the other is the space solar power systems (SSPS) which utilize outer space to set solar power and send it to the earth.

# Plenary Session

## Part 1

Innovation for Cool Earth Forum

### Importance of Net Zero Emission of CO<sub>2</sub> and Innovation for Realizing the Net Zero Anthropogenic Emission of CO<sub>2</sub>

It is fundamentally important for tackling climate change, to control the increase of temperature to a certain level. Paris Agreement states that it is important to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century. This means to realize net zero anthropogenic emission of CO<sub>2</sub>.

The four speakers in this plenary session 1 shared this recognition on the net zero anthropogenic emission of CO<sub>2</sub>, and made presentations on the scenarios, measures to realizing the net zero anthropogenic emission of CO<sub>2</sub> in the context of the happiness and the electricity consumption, the energy supply system and private sector's contribution to the CO<sub>2</sub> net zero emission.

The discussion topics ranged widely from the lack of political will for energizing the public opinion in the world of climate change to the appropriate measures for promoting the policy of climate change.



#### **Nebojsa Nakicenovic** (Moderator)

Deputy Director General and Deputy CEO, International Institute for Applied Systems Analysis (IIASA)



#### **James A. Edmonds**

Laboratory Fellow and Chief Scientist, Pacific Northwest National Laboratory, College Park, MD.

#### **Getting CO<sub>2</sub> Emissions to Zero -What Do Scenarios Tell Us?**

Dr. Edmonds introduced scenarios in the AR5 by the IPCC and pointed out some technologies that could make a large contribution, for example hydrogen, space solar power, etc.



#### **Vaclav Smil**

Distinguished Professor Emeritus, University of Manitoba

#### **Drastic Change of the Social System Towards Net Zero Anthropogenic Emission of CO<sub>2</sub>**

Prof. Smil concluded only if affluent countries cut their energy demand and if the pace of global energy transition is greatly accelerated, concurrent reduction of global inequality, reduction of global carbon emissions and increase of per capita consumption in low-income countries would be possible.



#### **Nobuo Tanaka**

President, The Sasakawa Peace Foundation, Japan; Former Executive Director, International Energy Agency (IEA)

#### **Energy Security and Sustainable Nuclear Power**

Mr. Tanaka pointed out that diversity of energy sources is essential from the energy security's point of view. In relation to this, the Integral Fast Reactor and Pyro processing of Argonne National Laboratory of the US were indicated as candidates of nuclear energy technology.



#### **Charles O. Holliday**

Chairman, Royal Dutch Shell plc.

#### **The Role of an Oil and Gas Company in the Global Transition to Net Zero Emissions**

The world has a long way to go before reaching net zero emissions, but it can get there by committing to a radical change of the energy system, using innovative technology and if consumers move to new ways of consuming. As we all walk this path together, an oil and gas company like Shell can make a major contribution.



# Plenary Session

## Part 2

Innovation for Cool Earth Forum

### Future Perspectives on Innovations to Tackle Climate Change

Presentations were given by five speakers from business, academia, government and international organizations on ways to tackle climate change. All speakers emphasized the fact that technological development and innovation is critical to decarbonize the economy and move towards a zero-carbon society. In some of the presentations, examples of innovative environmental technologies to reduce GHG emissions were also explained.

One topic that was discussed in most of the presentations was about how to incentivize R&D and innovation. Innovation is continuing in the area of energy and environment, however considering the current situation and future outlook, it is necessary to speed up the technology development process. Each speaker proposed methods to promote innovation through different channels such as government policies, corporate strategies and financing. Also it was emphasized that strong cooperation between different countries across different sectors is important to effectively accelerate the process towards a zero-carbon society.



#### Carlo Carraro

Scientific Director, Fondazione Eni Enrico Mattei; President Emeritus, University of Venice; Vice Chair, IPCC WG III

##### Perspectives on Innovations to Tackle Climate Change: the Governance Dimension

Innovation in governance processes is additionally important for tackling climate change, Climate clubs, namely a subgroup of countries implementing more ambitious and effective climate policies than others, may be effective for providing incentives to reduce GHG emissions in countries. In these climate clubs, incentives may come from adopting R&D and innovation policies that provide benefits to the club members.



#### Pierre-Etienne Franc

Vice President, Advanced Business and Technologies World Business Unit, Air Liquide; Former Chairman of the Fuel Cells and Hydrogen Joint Undertaking

##### Thoughts to Foster Engagement in Tackling Climate Change

The speed and volume of what needs to be done to decarbonize our economy is enormous. To achieve the necessary energy transition, it is important to engage large companies to move towards the goal. The need for policy makers to provide efficient long term incentives and regulations for tackling climate change would be stronger than ever.



#### Anatoly B. Chubais

Chairman and Chief Executive Officer, RUSNANO, RUSSIA

##### Russian Impact to Tackle Climate Change

When tackling climate change through technologies, it is important to utilize the best available technologies as well as "breakthrough" technologies. Also, though most discussion on environment and climate change focuses on energy, more attention needs to be paid to materials, which is also important for reducing emissions.



#### Fidel Castro Diaz-Balart

Scientific Advisor, State Council of Cuba; Vice-President of the Academy of Sciences of Cuba

##### Future Perspectives on Innovations to Tackle Climate Change

Process of innovation is essential in the society, especially in combatting climate change. Massive technological change is necessary to reduce GHG emissions, and to achieve this goal, public funding and incentives need to be fully utilized to promote innovation.



#### Takehiko Nakao

President, Asian Development Bank

##### Asian Climate Challenge and how ADB Plans to Support

Asia is a very important region in tackling environmental and climate change issues. ADB supports the region by 1) Increasing climate finance for mitigation and adaptation, 2) Promoting partnership with other financial institutions, and 3) Working with the private sector to implement COP21 framework.





# Plenary Session

## Part 3

Innovation for Cool Earth Forum

### Evaluation of Paris Agreement and Strategies after COP21

The focus was “how to make Paris Agreement successful” from both the technological aspect and the institutional aspect. For the technological aspect, there were discussions on R&D cooperation strategies in Mission Innovation and prospects for business with electric vehicles. For institutional aspects, it was emphasized that “serious review mechanism” is a key element to make Paris Agreement workable and it may be initiated within a small club. Level playing fields for business were also referred to as a key component of a successful regime. Policy innovation was another theme raised from the institutional point of view. There were a couple of new policy ideas raised to address large portion of CO<sub>2</sub> emissions effectively managed in the world.

In the discussion, it was mentioned that substantial outcome is expected for the international framework and swift evolution of Paris Agreement would help us to do it. There were also discussions on desirable partnership between government and private sectors to bring momentum, as well as necessity of people’s consciousness for climate change.



**David Sandalow** (Moderator)  
Inaugural Fellow, Center on Global Energy Policy,  
Columbia University



**David Victor**  
Professor of International Relations, School of Global Policy  
and Strategy, University of California, San Diego (UCSD)

#### What Institutional Innovations are Needed after COP21?

Prof. Victor indicated elements necessary to make Paris Agreement substantially work. One is serious review mechanism involving NGOs, referring to the peer review report for fossil fuel subsidy phase out pledge in G20. He also introduced an idea setting goals on impacts and adaptation instead of bold emission reduction goal. He also emphasized institutional innovation is needed to implement these elements.



**Sir David King**  
UK Foreign Secretary’s Special Representative for Climate  
Change, Foreign and Commonwealth Office (FCO)

#### The Opportunities from Managing the Risks of Climate Change by Reducing Emissions

Prof. Sir David King’s speech explored the extent to which the Paris Agreement is the solution, how far it goes, and how other agreements reached in the margins of Paris support the goal of net zero emissions. Mission Innovation was the one featured in his presentation and its steadily progressed activities were introduced.



**Philippe Benoit**  
Head, Energy Environment Division, Directorate of Sustainability,  
Technology and Outlooks, International Energy Agency (IEA)

#### Energy and Climate Change: From Paris to Marrakesh and Beyond

IEA’s latest scenario aiming at a 2 degrees increase was introduced. Mr. Benoit emphasized is the significance of energy demand increases of Non-OECD countries. In this context, he picked up air pollution issues in city areas as a simultaneous challenge in Non-OECD countries. He also referred to policy innovation, exemplifying policy mix and measures for state owned entities.



**Eija-Riitta Korhola**  
Delegate of the Consultative Commission on Industrial  
Change; Adviser in the EU affairs

#### Evaluation of Paris Agreement and Strategies after COP21

Dr. Korhola explained her evaluation of the Paris Agreement by reviewing her experience with Kyoto Protocol. She remarked the harmful effect of undermining level playing fields in business and gave a warning of disparity in the market caused by Paris Agreement.



**Toshiyuki Shiga**  
Vice Chairman, Nissan Motor Co., Ltd.

#### Business initiatives after COP21

Mr. Shiga insisted transformation of business and society is required in order to implement net-zero CO<sub>2</sub> emission that Paris Agreement stipulates. Mr. Shiga introduced his company’s current business activities with electric vehicles and future prospects for their ambitious goal of 90% emission reduction in new vehicles, showing lessons learned from their EV business.







## Concurrent Sessions

16 Sessions

Innovation for Cool Earth Forum

### Smart Grids

The landscape change in the production side and the supply side of the grid was explained, and the rise of a new business model “energy resource aggregation” was introduced. Following the introduction, presentations were given covering the establishment process of such business model in Japan, their technological aspect of interoperability, and their business aspect of value provided for customers. In the panel discussion, it was pointed out that appropriate policies which would signal/set a price for the service provided by such new businesses are necessary for establishment of the new business model. Furthermore, the importance of customer engagement was emphasized.



**Bo Normark** (Chair)  
Chairman, Annex 6 Power T&D Systems, ISGAN



**Hideo Ishii**  
Professor, Advanced Collaborative Research Organization for Smart Society, Waseda University



**Stuart McCafferty**  
VP, EnergyIoT, Hitachi Energy Solutions Division, North America



**Norio Murakami**  
President & CEO of ENERES Co., Ltd

### CCS

This session focused on the global status of Carbon Capture and Storage (CCS), including ongoing CCS projects, current policy frameworks that can help drive CCS deployment and multilateral/global cooperative efforts on CCS. It was emphasized that CCS is crucial in the portfolio of low-carbon energy technology to achieve ambitious climate target. In the panel discussion, participants discussed implications of the Paris Agreement for CCS and the challenges to deploy CCS from a variety of perspectives.



**Tim Dixon** (Chair)  
Manager, Technical Programme, IEAGHG



**Alex Zapantis**  
General Manager, Asia Pacific Region, Global CCS Institute



**Jarad Daniels**  
Director, Strategic Planning and Global Engagement, Office of Clean Coal and Carbon Management, Office of Fossil Energy, United States Department of Energy



**Brian Allison**  
Assistant Head, CCS R&D and Innovation, Department for Business, Energy and Industrial Strategy (UK BEIS)



**Ziqiu Xue**  
Chief Researcher, CO<sub>2</sub> Storage Research Group, Research Institute of Innovative Technology for the Earth (RITE)



## Nuclear Energy (Fission)

Nuclear energy is one of the important energy sources from the view point of energy security and CO<sub>2</sub> reduction. For the continuous use of nuclear energy, development of innovative reactors such as generation IV reactor is important for improved safety, minimizing radioactive waste, and so on.

In this session, the speakers presented the mid-to-long-term nuclear strategy and current status of technology development for leading countries. After presentations, the speakers and the audience actively discussed about the required innovation on technology development and social issues such as regulation and financing. The speakers stressed that both the technical and social issues are important for the development of innovative reactors and continuous use of nuclear energy.



**Yutaka Sagayama** (Chair)  
Assistant to the president JAEA (Japan Atomic Energy Agency)



**Sal Golub**  
Associate Deputy Assistant Secretary for Nuclear Reactor Technologies, Office of Nuclear Energy, U.S. Department of Energy



**François GAUCHÉ**  
Director of Nuclear Energy Division, the Alternative Energies and Atomic Energy Commission (CEA)



**Dohee Hahn**  
Director, Division of Nuclear Power, Department of Nuclear Energy, International Atomic Energy Agency



**Koji Okamoto**  
Professor, Nuclear Professional School, Graduate School of Engineering, The University of Tokyo

## Technology Transfer

Presentations were given on the key changes on the Paris Agreement and concrete examples of technology transfers by the activities of CTCN, UNIDO and shecco. In the panel discussion, it was pointed out that the implementation phase has already come, therefore both technology and financial mechanisms must be scaled up. The Montreal Agreement is one good example, and it shows that policies are still the effective way to lead the industry to tackle the climate change issues with collaboration between both public and private sectors, and developed and developing countries.



**Ismail Serageldin** (Chair)  
Director, Library of Alexandria



**Kazuhiko Hombu**  
Visiting Professor, Graduate School of Public Policy, The University of Tokyo



**Pradeep Monga**  
Special Representative of the Director General and Director of Energy, UNIDO



**Jan Dusek**  
Business Development Manager, shecco Japan





## Power Conversion Technologies for Large Scale Renewables Integration

Presentations were given on the situations and challenges posed to the grid by the increasing renewables connected to the grid, and power conversion technologies on the grid side to deal with such situations were introduced, including HVDC, smart inverters, adjustable speed pumped storage hydro, etc. In the panel discussion, it was emphasized that while power conversion technologies for the grid may seem much more expensive than the other distributed technologies such as residential batteries, they may often be a more economically viable option when the investment cost of the whole power system is taken into account.

## CO<sub>2</sub> Utilization

The draft of the ICEF CO<sub>2</sub> Utilization Roadmap was presented. It included details regarding the implementation of CO<sub>2</sub> utilization technologies that can consume a large amount of CO<sub>2</sub> and sequester it for a long time. CO<sub>2</sub> is a stable molecule emitted from the combustion of fossil fuels. CO<sub>2</sub> is currently used for various industrial feedstocks such as chemicals, bath additives, foaming gas, refrigerant and dry ice. However, the volume of CO<sub>2</sub> for such usage is small. The draft roadmap presented various plans to develop a roadmap on research, development and deployment of CO<sub>2</sub> utilization technologies. In the panel discussion, the speakers discussed CO<sub>2</sub> mitigation potential and market values of the suggested CO<sub>2</sub> usages (fuel, construction materials, chemical products and polymers).



**Georg Erdmann** (Chair)  
Professor, Berlin University of Technology



**David Sandalow** (Chair)  
Inaugural Fellow, Center on Global Energy Policy, Columbia University



**Bo Normark**  
Chairman, Annex 6 Power T&D Systems, ISGAN



**Issam Dairanieh**  
CEO, CO<sub>2</sub> Sciences



**Johannes Henkel**  
Head of Energy Market Development, Energy Economics, 50 Hertz Transmission GmbH



**A.-H. Alissa Park**  
Director, Lenfest Center for Sustainable Energy, The Earth Institute, Columbia University



**Yoshiro Owadano**  
Director-General, Fukushima Renewable Energy Institute, National Institute of Advanced Industrial Science and Technology (AIST)



**Tohru Setoyama**  
Fellow, Executive officer, Mitsubishi Chemical Corporation



**Atsushi Nishioka**  
Energy Solution Business Unit, Hitachi, Ltd. (Chairman & CEO, Hitachi ABB HVDC Technologies, Ltd.)



**Etsuko Fujita**  
Senior Chemist, Leader of the Artificial Photosynthesis Group, Chemistry Division, Brookhaven National Laboratory



**Colin McCormick**  
Chief Technologist, Valence Strategic LLC





## Nuclear Fusion

Nuclear fusion has been a subject of research as the energy of future for a long time and important technologies have been developed under ITER program, which aims to construct their test reactor in 2020s. At the same time, various private companies and national projects are already competing towards commercialization of economically viable nuclear fusion power plants beyond ITER program. With this in the background, the participants discussed the overview of nuclear fusion R&D and possible strategy for commercialization, while discussing challenges in R&D and many different approaches of fusion reactors.



**Yasushi Ono** (Chair)

Professor, Department of Advanced Energy, Department of Advanced Energy, Graduate School of Frontier Sciences, University of Tokyo



**Masayuki Ono**

NSTX-U Department Head, PPPL, Princeton University



**Antony Ford**

Consultant, Japan, Tokamak Energy Ltd



**Sergei Putvinski**

Chief Scientist, Tri Alpha Energy

## Future of the Investment from the Private Sector

There were presentations of an LED project in India, activities of GCF and ADB for private investment, environmental technologies and the role of the mining sector, and the trend of investment in climate change mitigation. In the panel discussion, the importance of three pillars: technologies (e.g. promotion of technology transfer), finance (e.g. introduction of innovative finance mechanism), and policies were highlighted. Regarding policies, speakers pointed out the importance of setting national priorities. Some speakers suggested that regulatory framework can promote creation of the market and others recommended that governments should provide much more stable regulations or keep the unregulated market for private sectors in order not to stall investment.



**Takashi Hongo** (Chair)

Senior Fellow, Mitsui Global Strategic Studies Institute



**Manu Maudgal**

Programme Advisor, Energy Efficiency Services Limited /GIZ



**Jiwoo Choi**

Head (Acting) of the Private Sector Facility, Green Climate Fund



**David Barton**

Investment Specialist, Private Sector Operations Department, Asian Development Bank



**Robert M. Friedland**

Founder and Executive Chairman, Ivanhoe Mines



**Joshua L. Steiner**

Head of Industry Verticals, Bloomberg L.P.



## Measures to Meet the Energy Demand Rise in Developing Countries

Presentations were made on current situations in the power sector of South and Southeast Asian countries, and on ways to meet the energy demand while also reducing GHG emissions. During the discussions, it was pointed out that considering each country's situations and energy reserves, fossil fuel generation is still needed to meet the energy demand in the region. In that sense, better and more efficient generation technologies need to be utilized. However, implementing new technologies is difficult and there are still a lot of issues. Therefore it is important to consider how to organize technical and financial support.



**Shozo Kaneko** (Chair)  
Senior Cooperative Researcher Institute of Industrial Science, University of Tokyo



**Masakazu Toyoda**  
Chairman & CEO, The Institute of Energy Economics, Japan (IEEJ)



**Priyantha D C Wijayatunga**  
Principal Energy Specialist, Sustainable Development and Climate Change Department, Asian Development Bank



**Le Huu Phuc**  
Director General, International Cooperation Department, Ministry of Industry and Trade, Viet Nam



**Yozaburo Mabuchi**  
Senior Vice President, Assistant to President, Mitsubishi Hitachi Power Systems, Ltd.

## Hydrogen Energy

There were five presentations on hydrogen usage for energy, two were on activities with government funding, and three were on activities with private funding. In the panel discussion, a couple of points are featured to verify the relevancy of utilizing hydrogen in the energy system. One was safety and public acceptance. Customer communication was referred to as a way to obtain public acceptance. Another point was efficiency, including energy efficiency, economic efficiency and CO<sub>2</sub> reduction. Speakers introduced ways to improve efficiency and reaffirmed hydrogen is one option that is suitable for long distance transportation and seasonal storage. Finally they agreed that stakeholder involvement is the key to overcome obstacles.



**Reiko Kuroda** (Chair)  
Scientific Advisory Board of the UN Secretary-General; Professor, Research Institute for Science and Technology, Tokyo University of Science



**Shigeru Muraki**  
Executive Adviser, Tokyo Gas Co., Ltd.



**Klaus Bonhoff**  
Managing Director (Chair), NOW GmbH, National Organisation Hydrogen and Fuel Cell Technology



**Koichi Kojima**  
Project General Manager, R&D and Engineering Management Div., Advanced R&D and Engineering Company, Toyota Motor Corporation



**Ingmar Ploemen**  
Manager, New Energy Technologies, Shell Global Solutions



**Hideo Shigekiyo**  
Technical/Commercial Manager, Industrial Gases Dept., Air Products Japan K.K.





## Solar Power Satellite (SPS)

This session focused on Solar Power Satellite (SPS), which generates electricity with abundant solar radiation in space and transmits the power to a receiver on the earth surface for consumption. The SPS will provide carbon-free power to meet the base load demand on a mass scale. In recent years, there have been developments in feasible system designs and R&D of key technologies for wireless power transmission. In this session, the followings were discussed: 1) the overview of the SPS; 2) the key technologies and 3) the strategy for SPS deployment in order to cultivate ideas for R&D and realization of the SPS.



**Hiroshi Matsumoto** (Chair)  
President, RIKEN



**John C. Mankins**  
President, Artemis Innovation Management Solutions LLC



**Tadashi Takano**  
Visiting Professor, Department of Electronic Engineering,  
Nihon University



**Darel Preble**  
President and Executive Director, Space Solar Power  
Institute



**Naoki Shinohara**  
Professor, Kyoto University



**Raymond J. Kopp** (Chair)  
Senior Fellow, Co-Director, Center for Energy and Climate  
Policy, Resources for the Future



**Keigo Akimoto**  
Group Leader of Systems Analysis Group, Chief Researcher,  
Research Institute of Innovative Technology for the Earth  
(RITE)



**Sir David King**  
UK Foreign Secretary's Special Representative for Climate  
Change, Foreign and Commonwealth Office (FCO)



**David Victor**  
Professor of International Relations, School of Global Policy  
and Strategy, University of California, San Diego (UCSD)



**Ryuji Matsuhashi**  
Professor, Graduate School of Engineering, The University  
of Tokyo

## Prospects for NDCs and Incremental Action

Four speakers gave presentations about the prospects for NDCs and incremental actions including reviewing systems and integrated contribution approaches based on the background of policies of world nations, especially the USA, the UK and Japan. In the panel discussion, the effectiveness and difficulties of using abatement cost as evaluating indicators were pointed out. Also, methods of approaches for collectively increasing ambition and expectations of disruptive clean energy technologies were discussed.





## Buildings/Residences in Smart Cities

In this session, technology development and policies for the implementation of Smart Cities were discussed. Smart City is a concept of future city based on advanced energy system and ICT infrastructure, through optimizing energy use, public service, security and transportation among others.

Main focuses of technology development were technology integration of building envelope, energy-efficient equipment, renewable energy integration and building energy management. Policy aspects such as energy saving requirement and/or performance labelling embedded in building codes were essential to promote green technology diffusion to the market. The speakers also discussed behavioral aspects of the consumers.

## Energy Storage

Presentations were given on the background of required energy storage technologies including the off-grid situation and concrete examples of projects for resiliency in the USA. Also, two different manufactures explained their technologies on redox flow battery and hydrogen storage system. In the panel discussion, it was argued that regulatory reform is needed for the penetration of the grid market, while on the other hand, being off-grid is a suitable condition to introduce energy storage technology. It was also pointed out that energy storage technologies should be evaluated not only based on cost but also on benefits provided by each technology.



**Alan Meier** (Chair)  
Senior Scientist, Lawrence Berkeley National Laboratory



**Itaru Yasui** (Chair)  
Honorary Advisor, National Institute of Technology and Evaluation (NITE); Professor Emeritus, The University of Tokyo



**Shin-ichi Tanabe**  
Professor, Ph.D., Department of Architecture, Waseda University



**Seth Mullendore**  
Project Director, Clean Energy Group



**Patrick Quinton**  
President, Civic Innovation NW, LLC



**Takashi Yano**  
General Manager, Business Development Department, Energy System Division, Sumitomo Electric Industries, Ltd.



**Atsushi Kurosawa**  
Director, Global Environment Program Research and Development Division, The Institute of Applied Energy



**Ravi Seethapathy**  
Executive Chairman, Biosirus Inc.



**Hiroyuki Ota**  
General Manager, New Energy Solution Project, Toshiba Corporation



## Transportation

Multiple measures for the reduction of CO<sub>2</sub> emission, such as low-carbon fuel, improvement of fuel efficiency, low-carbon mobility, and improvement of traffic flow, have become an important issue. In particular, introduction of advanced road traffic systems for reduction in CO<sub>2</sub> emissions has a great potential for future CO<sub>2</sub> emissions reduction. To aim for CO<sub>2</sub> net-zero emission over the mid-to-long term, the session focused on opportunities and challenges for the introduction of advanced road traffic systems such as urban traffic management, urban mobility, and road vehicle automation. Panelists discussed barriers and success factors in introduction and adaptation of new road transport systems.



**Yoshihiro Suda** (Chair)  
Professor, Dr.Eng., Institute of Industrial Science, The University of Tokyo



**Cecilia Tam**  
Special Adviser, Asia Pacific Energy Research Centre



**Lutz Rothhardt**  
Director, Development Japan, BMW GROUP Japan



**Takashi Iwasaki**  
Project General Manager, System R&D Dept. No.1 Advanced Safety System R&D Div., Toyota Motor Corporation

## Desirable R&D for Innovative Technologies and the Potential for International Cooperation

Presentations were made by six speakers from the government, academia and business sector. The topics covered by the presentations were Mission Innovation and the national innovation strategy in the USA, the Japanese innovation strategy toward 2050 and its technological focus, and desirable private sector involvement in the publicly funded R&D programs. Also the result of the G7 Working Group (G7WG) was unveiled as a promising approach to the international cooperation on public R&D programs between developed countries in the field of hydrogen carrier systems and high temperature geothermal power generation.

In the panel discussion, challenges to the international cooperation in each R&D cycle were pointed out, in the context of increasing competition between countries. Also it was pointed out that international standards could be a serious problem for international collaboration.



**Carlo Carraro** (Chair)  
Scientific Director, Fondazione Eni Enrico Mattei; President Emeritus, University of Venice; Vice Chair, IPCC WG III



**Michał Kleiber**  
Head of Computational Science & Engineering Dept., Institute of Fundamental Technological Research Polish Academy of Sciences, Warsaw, PL



**Tom Autrey**  
Staff Scientist, Physical Science Division, Pacific Northwest National Laboratory, Catalysis Science



**Akira Yabe**  
Director General, Renewable Energy Unit, Energy System & Hydrogen Unit, Technology Strategy Center, New Energy and Industrial Technology Development Organization (NEDO)



**Shane Kosinski**  
Deputy Director for Operations for the Advanced Research Projects Agency-Energy (ARPA-E), U.S. Department of Energy



**Laura Diaz Anadon**  
University Lecturer (tenured assistant professor) in Public Policy, Department of Politics and International Studies, University of Cambridge



**Chad Evans**  
Executive Vice President, Council on Competitiveness



# Closing Remarks



**Toshinao Nakagawa**  
Parliamentary Vice-Minister of Economy, Trade and Industry, Japan



**Yoshihiro Seki**  
State Minister of the Environment, Japan



**Kiyoshi Odawara**  
Parliamentary Vice-Minister for Foreign Affairs, Japan



**Kazuo Furukawa**  
Chairman, New Energy and Industrial Technology Development Organization (NEDO)

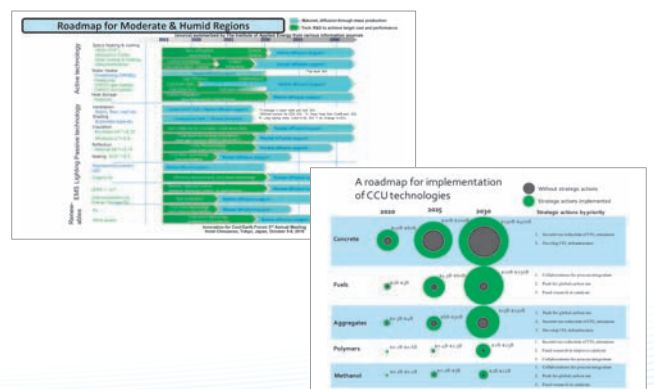
# ICEF2016 Roadmaps

Two ICEF Roadmap drafts were presented in concurrent sessions and discussed as global industry-academia-government initiatives for sharing visions for the development and dissemination of innovative low carbon technologies. They were also presented at the Closing Session.

The roadmap for CO<sub>2</sub> Utilization resulted from the efforts of the Steering Committee member Mr. David Sandalow et al. After assessing almost 180 global technology developments on the basis of their technology feasibility, readiness, markets and momentum, 4 fields (fuel, construction materials, chemical products and polymers) have been shown close to practical use.

The other roadmap is for ZEB / ZEH (Zero-Energy Building / Zero-Energy House). Many roadmaps of this area have been created by international organizations or national/local governments, but none took the humidity factor fully into consideration, even though it greatly affects the level of comfort. The draft ICEF roadmap focused on humidity because the regions where population and energy demand are expected to increase are located in humid areas. In the concurrent discussion, humidity, natural ventilation and insulation of windows were the main topics of discussion.

The two drafts were revised to reflect the opinions and comments received at ICEF, and the finalized versions were presented at an ICEF side event of COP22. The final roadmaps have been published on the ICEF website.







## Statement

At the closing session, the steering committee issued a statement. This statement is a set of principles and recommendations drafted by the ICEF Steering Committee, taking into account discussion of the conference and the adoption of Paris Agreement in December last year. This year's statement clarified the role of ICEF and made various recommendations to the actors in the government, business and academia with emphasis on "Net Zero Anthropogenic CO<sub>2</sub> Emissions" as the key concept of ICEF.

## ICEF 2016 Statement from the Steering Committee

- Toward achieving net zero anthropogenic CO<sub>2</sub> emissions -

October 6, 2016

### Preamble

ICEF (Innovation for Cool Earth Forum) was established in 2014, by the initiative of Shinzo Abe, the Prime Minister of Japan, and the ICEF's Third Annual Conference was held on October 5-6, 2016 in Tokyo. More than 1,000 experts from governments, businesses and academia representing about 80 countries and regions attended and discussed a variety of topics in plenary and concurrent sessions. The Steering Committee of the ICEF welcomes the historic Paris Agreement reached at COP21 in December 2015. Taking into account the Agreement as well as active discussions at ICEF, the Steering Committee is pleased to announce the following statement.

### Our basic understandings

1. The climate is changing and global emissions continue to rise despite global effort since 1997 when The Kyoto Protocol was agreed. As a result, the global temperature is on the rise, posing a great threat to humanity. Since the recent rise is caused mainly by human activities, we must ultimately stabilize the global temperature at levels that are not dangerous.

### Our goal

2. The Fifth Assessment Report by the IPCC states that "cumulative total emissions of CO<sub>2</sub> and global mean surface temperature response are approximately linearly related". This means we must adopt as a goal to achieve at least NET ZERO ANTHROPOGENIC CO<sub>2</sub> EMISSIONS in the long run in order to stabilize global temperature levels. This is the principle applicable to any level of temperature stabilization including the 2-degree target.

We should pursue this goal together with other Sustainable Development Goals (SDGs), such as poverty alleviation, economic growth and energy access as articulated in the UN 2030 Agenda for Sustainable Development.

This is not an easy task; rather, it is very challenging. Achieving net zero CO<sub>2</sub> emissions requires, for example, 100% carbon-free power generation (renewables, nuclear and fossil fuel with CCS) and all energy sources of automobiles must be converted to bio-fuels, electricity and hydrogen that are produced in carbon-free processes. In doing so, technological innovation and policies to transform global energy and socio-economic systems are essential.

### Role of ICEF

3. ICEF is an international forum to promote innovation in addressing climate change. Therefore ICEF is one of the best-suited platforms to discuss the long-term innovations needed to achieve our goal. Innovation is crucial not only to achieve our goal but also to enhance our ambition for deep emission cuts without causing additional burden to our economy.

### Role of public and private sectors in promoting technology innovation

4. Technological innovation in both supply and demand sides should be promoted through free competition among actors in the private sectors. At the same time, the role of the public sector is essential especially for the long-term research and early deployment of new technology through institutional arrangements and financial supports. It is rather hard for actors in the private sectors to bear the full cost to develop innovative but uncertain technologies while the fruits will be shared with competitors. To mobilize massive amount of financial resources for investing in innovation, it is essential for governments to show the private sector the clear direction of our future. The best combination of private and public roles in innovation should be pursued.

### Need for international cooperation

5. To cope with global climate change, international cooperation is imperative in every aspect from policy to technology innovation. In this sense, we welcome "Mission Innovation" launched in November 2015 by 20 Major Economies, and other international initiatives in this area being promoted. In view of enormous demand for infrastructure in developing countries, developed countries should cooperate with developing countries to promote diffusion of technologies to avoid "lock-in" effects. Such efforts should be accompanied by financial and other means of assistance.

# Steering Committee Members



**Yoichi Kaya** (Chair)  
President, Research Institute of Innovative Technology for the Earth, Japan



**Sally M. Benson**  
Professor, Department of Energy Resources Engineering, School of Earth, Energy & Environmental Sciences, Stanford University  
Director, Global Climate and Energy Project, Stanford University, United States



**Georg Erdmann**  
Professor, Berlin University of Technology  
Member of the independent Expert group "Energy for the Future" consulting the Federal Government on the German Energy Transformation, Germany



**Eija-Riitta Korhola**  
Delegate of the Consultative Commission on Industrial Change  
Adviser in the EU affairs, Finland



**Reiko Kuroda**  
Scientific Advisory Board of the UN Secretary-General  
Professor, Research Institute for Science and Technology, Tokyo University of Science  
Professor Emeritus, The University of Tokyo, Japan



**Richard K. Lester**  
Associate Provost, Massachusetts Institute of Technology, United States



**Ajay Mathur**  
Director General, The Energy and Resources Institute (TERI), India



**Valli Moosa**  
Former Minister for Environmental Affairs and Tourism, South Africa



**Nebojsa Nakicenovic**  
Deputy Director General and Deputy CEO, International Institute for Applied Systems Analysis (IIASA), Austria



**David Sandalow**  
Inaugural Fellow, Center on Global Energy Policy, Columbia University, United States



**Ismail Serageldin**  
Director, Library of Alexandria, Egypt



**Vaclav Smil**  
Distinguished Professor Emeritus, University of Manitoba, Canada



**Nobuo Tanaka**  
President, The Sasakawa Peace Foundation  
Former Executive Director, International Energy Agency (IEA), Japan



**Laurence Tubiana**  
Professor, Sciences Po Paris, France  
Professor, Columbia University, United States



**Itaru Yasui**  
Honorary Adviser, National Institute of Technology and Evaluation (NITE)  
Emeritus Professor, The University of Tokyo, Japan





# ICEF2017

Save the Date

## Innovation for Cool Earth Forum 4th Annual Meeting

Date: **October 4-5, 2017**

Venue: **Hotel Chinzanso Tokyo, Japan**

URL: <http://www.icef-forum.org/>

