

Innovation for Cool Earth Forum

4th Annual Meeting | 2017



Innovation for
Cool Earth Forum
4th Annual Meeting



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
Prime Minister of Japan



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Cool Earth Forum**
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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.

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.



4th Annual Meeting

Date October 4 and 5, 2017

Venue Hotel Chinzanso Tokyo, Japan

Hosts



Co-hosts



Participants More than 1,000 participants from governments, international organizations, the business sector and academia representing about 80 countries and regions

Overall theme

Further Exploration of Innovations toward Achieving Global Net-Zero Anthropogenic Emissions of CO₂

Outcomes of ICEF 2017

- Top 10 Innovations
- Roadmap Projects on CO₂ Utilization 2.0 and Energy Storage
- Statement from the Steering Committee



Program

October 4, 2017

- 09:15 – 10:00 **Opening Session**
- Opening Remarks
 - Keynote Discussion
- 10:00 – 11:30 **Plenary Session 1**
- Driving Innovation for Net-Zero Emissions:
Role of Business and Market
- 11:30 – 13:00 **Lunch**
- 11:50 – 12:30 **Side Event: Top 10 Innovations**
- 13:00 – 13:50 **Spotlight**
- Expectations on ICEF2017 and Beyond
- 14:00 – 15:00 **Plenary Session 2**
- Enabling Innovation for Net-Zero
Emissions: Global Perspectives
- 15:00 – 15:30 **Short Break**
- 15:30 – 17:30 **Concurrent Sessions 1**
- Social System Innovation
in the Energy Sector: Blockchain
 - Materials Development
for Net-Zero Emission
 - CO₂ Utilization
 - Technology Innovation and Diffusion
- 17:30 – 18:00 **Short Break**
- 18:00 – 20:00 **Official Dinner**

October 5, 2017

- 10:00 – 12:00 **Concurrent Sessions 2**
- Energy Storage
 - Biofuels
 - CCS
 - Role of Diversity:
Challenges for Climate Change
- 12:00 – 13:30 **Lunch**
- 12:10 – 12:40 **Side Event:**
The International Renewable Energy Agency (IRENA)
- 12:50 – 13:20 **Side Event:**
International Energy Agency (IEA)
- 13:30 – 15:30 **Concurrent Sessions 3**
- Managing Energy Demand and Supply
 - Nuclear Energy
 - Hydrogen & Fuel Cells
 - Business Action to Tackle Climate Change
- 15:30 – 16:00 **Short Break**
- 16:30 – 17:30 **Plenary Session 3**
- Directing Innovation for Net-Zero
Emissions: Transformational Narratives
- 17:30 – 18:00 **Closing Session**
- Closing Remarks
 - Final Thoughts on the Event
 - Top 10 Innovations Announcement
 - Roadmap Announcement
 - Statement from Steering Committee

Opening Session

Opening Remarks



Video message from Shinzo Abe, the Prime Minister of Japan

Last year the Paris Agreement came into force. The whole world is now standing up against global warming and this trend is gaining momentum as never seen before. Now is the time to bring together the wisdom of mankind. We need to address the issue by joining forces and bringing about breakthrough innovations. I am convinced that in that sense it is becoming increasingly meaningful to organize ICEF, where once a year the world's leading researchers, corporate executives, and government officials meet to discuss measures to solve this issue. It is our duty to pass on a rich global environment to the future generations. The future of the planet earth depends on actions we take now. I am determined to demonstrate strong leadership, as continued efforts are being made in the world, to take on all challenges to overcome the issue of climate change. I strongly hope the discussions in this year's ICEF will lead to a major step forward toward solving the issue of climate change.



Video message from Hiroshige Seko, Minister of Economy, Trade and Industry

Climate change is the most critical issue for human survival and innovation is key for the achievement of the long-term goal to hold the increase in the global average temperature to well below 2°C set under the "Paris Agreement." I present Japan's experience when skyrocketing oil prices in the "oil crisis" were caused by political turmoil in the Middle East in the 1970s. The Government of Japan responded to it by promoting the innovation of energy efficient technology through legislation such as enactment of the Energy Conservation Act and the introduction of energy efficient equipment across sectors. As a result, Japan's energy efficient technology became among the best in the world. This innovation, now, must be further encouraged for resolution of the global warming issues. We need to reiterate the necessity of reducing greenhouse gas emissions in the world as a whole. Japan has excellent technologies and know-how, including energy saving technology and hydrogen / fuel cell related technology. Japan also knows that innovation to address climate change can help boost industrial competitiveness. In addition, Japan will contribute to sustainable development in countries which are expected to see economic growth and increase their demands for energy in the future, by supporting the deployment of these resulting innovations.

Keynote Discussion

Mr. Nobuo Tanaka, Chair of the ICEF Steering Committee, introduced the current movements with regard to climate change issues including policy uncertainty. He pointed out that we are on the cusp of a new civilization, evolving from the petroleum-based one, with innovation and new technologies such as electric or fuel cell vehicles and ride-sharing.

Mr. Hiroaki Nakanishi, Executive Chairman of Hitachi, Ltd., pointed out that their target of 80% CO₂ emission reduction by 2050 is very challenging and would be hard to achieve without considering the global supply chain of their overall manufacturing process. Therefore the various business arrangements should be coordinated. He also emphasized the importance of setting up the new future super-smart society "Society 5.0" which enables us to use electricity more intelligently through digital technology.

Dr. Hoesung Lee, as a chair of IPCC, gave an update on how the IPCC plans to facilitate the implementation of the Paris Agreement. He also pointed out that improvements to climate policy programs need to incorporate broader national priorities and mentioned the diverse actors participating in climate policy, uncertainties related to technology development and deployment, and risk management techniques.

The following topics were discussed after their remarks; how to contribute to global climate change mitigation through the super-smart society and how to cope with policy uncertainty. Digital technology itself is based on electricity and is indispensable for our daily life. Therefore, the panelists emphasized that it will be necessary to introduce a variety of energy sources looking toward the super-smart society through digital technologies. International cooperation is one of the keys for alleviating policy uncertainty. The Paris Agreement is one of the facilitating avenues for helping government to think over the long term, with a long-range vision.



Nobuo Tanaka (Moderator)

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



Hiroaki Nakanishi

Executive Chairman, Hitachi, Ltd.



Hoesung Lee

Chair of the Intergovernmental Panel on Climate Change (IPCC); Endowed Chair Professor, Graduate School of Energy and Environment, Korea University

Plenary Session 1

Driving Innovation for Net-Zero Emissions: Role of Business and Market

The session explored what is happening in the business sector towards achievement of climate goals in a mix of viewpoints including perspectives from policy, industry, market stakeholders and international organizations. Recent trends showed that major transitions are underway: the shift to renewable energy, flat energy demand with simultaneous economic growth and the rise of Environmental, Social and Governance (ESG) investing. However, there is a need for further initiatives including the global commitments to decarbonization, more and more sectors' transformation and accelerated technological advance. Key takeaways from the panel included: 1) the huge challenge required to achieve climate goals should be regarded as a huge opportunity, 2) in terms of power auctions, price discovery in some form is absolutely vital, 3) there is a growing trend against coal, and some people expect that the share of coal in the power mix will drop in the near future, 4) carbon capture storage is one of the keys to achieving the goals, and further efforts should be needed to raise its profile.



Nobuo Tanaka (Moderator)

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



Anneli Pauli

Hors Classe Adviser (Innovation and Competitiveness), Directorate-General Climate Action, European Commission



Michael Liebreich

Chairman of the Advisory Board and Founder of Bloomberg New Energy Finance

Research and innovation strategy and incentives for private sector towards driving Innovation: the European experience

Dr. Pauli's presentation highlighted more than two decades of the EU's experience in designing and implementing climate policies for driving the transition to a low greenhouse gas emissions economy. The emphasis was put on how consistent policy signals to industry, businesses and investors are fundamental to creating a holistic enabling environment to drive this transition. She noted that, in this context, the role of policies and regulations, and aligned standards combined with a coordinated approach to investment and deployment of targeted financial instruments are key elements of this consistent approach. She concluded that, in light of the experience of the EU, the global commitments to decarbonization require profound changes all over the world, which would offer enormous business opportunities.

Mr. Liebreich's presentation focused on what is happening on the industrial front. He highlighted the following findings: by 2040, one third of electricity will be from wind and solar, one third of all vehicles will be electric, and the global economy will be one third more energy efficient; other sectors such as shipping, air travel, freight, industry, petrochemicals, land use, agriculture, forestry, energy access and heat will look much the same in 2040. He summarized that, in order to achieve climate goals, it is not enough to accelerate the electricity and transportation sector transformation, and other sectors need to change as well. He concluded with a recommendation that we should regard this huge challenge as a huge opportunity.



Hiromichi Mizuno

Executive Managing Director and Chief Investment Officer, Government Pension Investment Fund (GPIF), Japan

Investing in the Future: Role of ESG and the Financial Sector towards Driving Innovation - How investors and business share the long-term sustainability and prosperity -

Mr. Mizuno shared why the Government Pension Investment Fund (GPIF) has been stepping up as a leader in Environmental, Social and Governance (ESG) investment, why it is relevant, and the background to what is really happening. He highlighted the following points: 1. Recently, ESG has been increasing its relevance among the long-term investors like GPIF, that seek to maximize its portfolio's investment return over the long run by minimizing the negative externalities, such as climate risks and social issues; 2. Investors regard ESG as the key to make the market sustainable and stable, while corporations can increase their enterprise values by improving their ESG evaluations; 3. ESG factors are mutually beneficial both for investors and corporations, and we expect that the overall markets and economies will steadily thrive and grow through the ESG integration, and contribute to a more sustainable society.



David Turk

Acting Director, Directorate of Sustainability, Technology and Outlooks, International Energy Agency (IEA)

Tracking Clean Energy Progress and Driving Innovation for Energy Sector Transformations

Drawing from the International Energy Agency's latest global assessment on global clean energy research and development, Mr. Turk shared the very latest trends and provided insights for governments, companies and other stakeholders going forward about the importance of and opportunities for accelerated technological advances. He highlighted that global CO₂ emissions from energy remained flat in 2016 for the third year in a row, even though the global economy grew. The contributions of technology to global cumulative CO₂ reductions and broader trends in the digitalization of energy were also explained.

Spotlight

Expectations on ICEF2017 and Beyond

The session explored the current transformation of the energy sector in addition to what can be expected from this year's ICEF. Further to the Opening Session and Plenary Session 1, the panel discussed the key challenge of what energy solution would be sustainable enough. Key takeaways from the panel included: 1) in terms of renewable energy, electrical storage is important, and the price of renewables, in particular solar, with storage would need to be less than the price of electricity generated from coal or gas, 2) the overall cost of relying one hundred percent on intermittent renewable technologies would be higher at this stage, and there are possibilities for coal and gas fired electricity generation, with carbon capture and storage, and nuclear power in terms of base load requirement.



Eija-Riitta Korhola (Moderator)
Delegate of the Consultative Commission
on Industrial Change; Advisor in the EU affairs



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



Richard K. Lester
Associate Provost, Massachusetts Institute
of Technology



Plenary Session 2

In this session, three speakers made presentations respectively on the role of standards in enabling innovation, the German “Energiewende (Energy transformation),” and the role and challenge of fossil fuel use in the future.

Enabling Innovation for Net-Zero Emissions: Global Perspectives



Ralph Sporer

Vice-President and Chair of Standardization Management Board (SMB), International Electrotechnical Commission (IEC)

Dr. Sporer’s presentation focused on International Standards, testing and certification, which together can be key strategic enablers for the spread of net-zero innovations. He emphasized that the private sector takes an active role in driving innovation and the success of net-zero innovations directly depends on the broad adoption and use of International Standards in combination with testing and certification, by showing examples of innovations that have directly benefitted from this approach. He also outlined why a systems approach is important to provide the best chances for net-zero outcomes and how this is supported by International Standards in the area of automation and interoperability.



Peter Hennicke

Senior Scientist at Wuppertal Institute for Climate, Environment and Energy

The German Energiewende in a global context: Innovations, opportunities and challenges

Prof. Hennicke shared German “Energiewende” and focused on the energy transition in two global megatrends which are about to be strategic game changers: the paradigm shift to “Efficiency First” (IEA/Paris) and the spectacular decreasing costs of electricity from wind and photovoltaic power generation (PV). He also pointed out that the strategic combination of efficiency, green electricity and electrification of the transport and heat sectors would make the energy transition possible.



Christopher Smith

Advisory Board Fellow, Baker Institute for Public Policy, Rice University

The Future of Fossil Energy

Mr. Smith presented that a critical success factor to addressing climate change will be examining the role that fossil fuels will play in the future, a challenge that involves both technological and market forces. He emphasized that fossil fuels currently make up around eighty percent of the world’s energy consumption, and modernizing energy systems to combat climate change will require both the implementation of new, low-carbon technologies, and significant action to retrofit fossil fuel systems currently in use.



Plenary Session 3

Directing Innovation for Net-Zero Emissions: Transformational Narratives

This panel explored ways to reduce CO₂ emissions to net-zero at a time when a large-scale transformation is underway. The panelists talked about the integrated modeling perspective, a critical assessment of 2 degrees C stabilization particularly from the technological change perspective, how much time we would need for a major decarbonization, and what would be needed in particular from the viewpoint of technology. Key takeaways from the discussion included: 1) Accelerate the fusion of advanced technologies and human behavior, 2) Note that time might be the scarcest resource because it will be difficult to tackle the challenges ahead given how little time we have until the net-zero emissions will be required, 3) Generate more information on what is being tried by the research community.



Nebojsa Nakicenovic (Moderator)
Deputy Director General and Deputy CEO, International Institute for Applied Systems Analysis (IIASA); Professor Emeritus, Vienna University of Technology (TU WIEN)



James A. Edmonds
Laboratory Fellow and Chief Scientist, Joint Global Change Research Institute, Pacific Northwest National Laboratory

Lessons from Scenarios

Dr. Edmonds focused on five highlights of lessons from scenarios: (1) there are many pathways to 2 degrees assessed by the modelers' community, and Carbon Capture and Storage (CCS) deployment is necessary in most of the pathways to 1.5 degrees; (2) all pathways to 2 degrees require fundamental changes to the global energy system; (3) all pathways to 2 degrees also require fundamental changes in the surface of the planet, and note that very deep negative emissions can be seen using bio energy with CCS; (4) If large-scale free air CO₂ scrubbing were inexpensive, land could be less affected; (5) uncertainty in both the physical earth system and in the climate system changes is pervasive. He concluded with some projections that unforeseen technologies will come into existence because of combinations of breakthroughs in science and other parts of the system that come together, and that these changes will be important in shaping when and where we achieve 2 degrees.



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

Challenges and opportunities for net zero CO₂ emission harmonized with sustainable development

Dr. Akimoto made a presentation with the message that net-zero CO₂ emissions will be required for temperature stabilizations while the other Sustainable Development Goals (SDGs) must be achieved harmoniously. He explained that many Integrated Assessment Models (IAMs) provide feasible solutions for achieving the 2°C target including the 450 ppm CO₂eq. pathway; however, the mitigation costs estimated by the IAMs are huge and unrealistic in the real world. Therefore he insisted alternative scenarios must be considered beyond the current IAM framework. He also emphasized that carbon prices must be kept low, and technological and social innovations particularly in products and services contributing to high energy productivity, which are crucial, must be promoted for tackling climate change sustainably.



Vaclav Smil
Distinguished Professor Emeritus, University of Manitoba

Ambitious goals and technical realities

Dr. Smil focused on the fact that forecasts of rapid decarbonization are easy to make, but realities intervene and transitions take time. He explained the greatest long-term challenge will be to displace fossil carbon in several key industrial uses (smelting of iron, production of cement, synthesis of ammonia and plastics) and in long-range air and ocean transportation, because we either lack any readily deployable non-carbon alternatives or because the new techniques are in the earliest stages of development and hence far from able to meet the requisite mass-scale needs. It is noted that development and adoption of non-carbon alternatives will require two to three generations (50-75 years) before they become dominant.



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

Making Deep Decarbonization Work: the Politics of Energy Transformation

In his presentation, Dr. Victor began by introducing the world's adoption two years ago of the Paris framework along with Mission Innovation, flexible and potentially effective systems for promoting international cooperation on climate change. Then he posed a question on whether they are working in ways that will accelerate the needed radical transformation in energy technologies as required to make deep cuts in emissions. He identified the shortcomings of the current approach and focused on models that could prove to be much more effective. He emphasized the need for promoting technologies within niches where they can be improved and the role for direct regulation instead of simply carbon pricing as an impetus for change.

Concurrent Sessions

Social System Innovation in the Energy Sector: Blockchain

At this session, firstly, the status of research on blockchain technology via an open platform was introduced. Thereafter, a number of case studies of blockchain technology application were also introduced, such as a microgrid case using demand response with photovoltaic power generation (PV) and batteries in the U.S., and a case utilizing blockchain technology with integrating decentralized generation, electric vehicles and financing in Germany. It was discussed that, through blockchain technology, the business model could be changed from unidirectional provision of electricity to "prosumers" where producers and consumers of electricity become integrated. Blockchain technology has the potential to enable quick transactions at lower cost, while reducing risk of fraud. Issues raised during the Q&A session included governance by system operators and governments, and the need to harmonize with structural and regulatory change in the financial and electricity sectors. It was also noted that, while there would be expectations that application of blockchain technology in developing countries could be explosive, concerns were raised on possible exertion of governmental control.



Georg Erdmann (Chair)

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



Aeron Buchanan

Co-Founder of Grid Singularity and Energy Web Foundation



Belinda Kinhead

Director, LO3 Energy Australia



Carsten Stöcker

Senior Manager, Innogy Innovation Hub, Machine Economy Lighthouse



Kenichiro Yamaguchi (Moderator)

Research Director, Smart Energy Group, Environment and Energy Division, Mitsubishi Research Institute Inc.



Materials Development for Net-Zero Emission

The session aimed to share the expected contribution to CO₂ emissions reductions through materials development accelerated by informatics technologies. Presentations covered latest informatics system development in Japan, Integrated Computational Materials Engineering (ICME) achievement in the U.S. and expectations for informatics by the private sector. There were two pillars of topics in the discussion, one was how we can effectively utilize the database and machine learning and the other was the possibilities for significant CO₂ reductions through materials innovation. For the first topic, speakers referred to the advantages of utilizing databases in microscope structure design and the necessity for reasonable data structure based on scientific knowledge. For the second topic, speakers introduced the potential for application of the membrane system to the chemical industry, improvement of combustion efficiency with high temperature heat resistant alloys and utilization of recycled materials enabled by ICME technologies. It was also noted that we should bear in mind each country's focused area in reducing CO₂ reduction when taking on materials innovations.



Itaru Yasui (Chair)

Honorary Adviser, National Institute of Technology and Evaluation (NITE); Emeritus Professor, The University of Tokyo



Kohei Uosaki

Fellow, National Institute for Materials Science (NIMS)



Aziz Asphahani

Chief Executive Officer, QuesTek International LLC



Takahiro Onai

Deputy General Manager, Research & Innovation Promotion Headquarters, Hitachi Chemical Co. Ltd.



Fabrice Stassin

Managing Director - EMIRI Association (Energy Materials Industrial Research Initiative)



Concurrent Sessions

CO₂ Utilization

The draft of the CO₂ Utilization Roadmap 2.0 was presented in this session. Two speakers presented detailed analyses of the short-term and long-term opportunities for CO₂ utilization especially in cement, chemical products, and durable carbon materials from the roadmap. After a short discussion and additional explanation on the draft, two subsequent presentations were given on the topics of chemical reaction in CO₂ utilization and current R&D programs on CO₂ utilization being conducted in Japan. These presentations emphasized the importance of catalyst development in advancing toward a circular carbon economy and the key role of R&D support and international collaboration.

In the panel discussion, the distinction between the amount of CO₂ utilized in the process and the avoidance of CO₂ emissions was discussed extensively. In this regard, the need for standardization of life cycle assessment (LCA) for CO₂ utilization was emphasized among the panelists. It was announced that the final CO₂ Utilization Roadmap 2.0 would be published at COP23 in November 2017.



David Sandalow (Chair)

Inaugural Fellow, Center on Global Energy Policy,
Columbia University



Julio Friedman

Distinguished Associate, Energy Future Initiative



Roger Aines

Energy Program Chief Scientist, Global Security Principal
Directorate, Lawrence Livermore National Laboratory



Michele Aresta

CEO, Innovative Catalysis for Carbon Recycling Innovative
Start-Up; Professor of Chemistry, University of Bari



Masakazu Toyoda

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



Technology Innovation and Diffusion

In this session, various approaches for technology innovation and diffusion from the perspectives of the market, policy and international cooperative efforts were introduced. Specific cases and initiatives in urbanization and agriculture, where the importance of climate change measures is increasing, were discussed. Technology solutions for climate change already exist, and the necessity of executing approaches to scale-up diffusion while observing the market was pointed out. Also, not only existing technologies but also promising new technologies, such as energy-saving buildings and storage batteries, were mentioned as ones to be diffused. There was also an opinion expressed that it is important to integrate scientific methods such as information technology and education fields in order to create social innovation.



Ismail Serageldin (Chair)

Founding Director Emeritus, Library of Alexandria



Marco Monroy

CEO, MGM Innova Capital



Manu Maudgal

Programme Advisor, Energy Efficiency Services Limited / GLZ



Jim Falk

Professorial Fellow, Melbourne Sustainable Society Institute,
The University of Melbourne



Tareq Emtairah

Director of the Energy Department, United Nations Industrial
Development Organization (UNIDO)



Wataru Matsumura

Director, Global Environmental Partnership Office, Industrial
Science and Technology Policy and Environment Bureau,
Ministry of Economy, Trade and Industry (METI), Japan



Concurrent Sessions

Energy Storage

Energy storage technology can enhance energy system flexibility and integrate high share variable renewable resources. Stationary energy storage for power systems, mobility energy storage for transportation, and stationary thermal storage systems were particularly focused on this year, and related technology roadmaps and topics in each technological area were presented and discussed in this session. There was also a report indicating that deployment of energy storage and electric vehicles appears to be progressing on track to satisfy a two-degree scenario, owing to recent battery technology improvements and cost reductions. In the panel discussion, the importance of not only battery technologies but also other storage technologies developments and further utilization of electric vehicles for grid stability were emphasized. In addition, examples of solar heat storage technology were presented and it was pointed out that thermal energy storage is important, especially for cold climate regions.



Hiroshi Asano (Chair)

Associate Vice President, Energy Innovation Center, Central Research Institute of Electric Power Industry



David Turk

Acting Director, Directorate of Sustainability, Technology and Outlooks, International Energy Agency (IEA)



Ravi Seethapathy

Executive Chairman, Biosirus Inc.; Former Adjunct Professor, University of Toronto



Kari Maki

Research Manager, Smart Energy and Transport Solutions, VTT Technical Research Centre of Finland



Simon Furbo

Associate Professor, Department of Civil Engineering, Technical University of Denmark



Atsushi Kurosawa

Director, Global Environment Programs, Research and Development Division, The Institute of Applied Energy



Biofuels

Presentations were given by eight speakers related to global trends in policy, industry and innovative technology in bio-jet fuels. The challenges in Japan of research & development and commercialization were also introduced. Through the question and answer session, it was argued that the cooperation between fuel producers, the supply-chain and the aviation industry is important in order to expand the global production and consumption of bio-jet fuels. It was also pointed out that not only these stakeholders, but also governments can play an important role in overcoming the issues of cost or technology. At the end of the session, the international guests expressed their keen interest in the active challenges to use bio-jet fuels in Japan and indicated that they would like to provide cooperation and support.



James D. Kinder (Chair)

Senior Technical Fellow, Boeing Commercial Airplanes



Elizabeth Wood

Regional Director, North America and Asia Pacific Environmental Strategy, Boeing Commercial Airplanes



Valerie Reed

Deputy Director, Bioenergy Technologies Office, Energy Efficiency and Renewable Energy, Department of Energy, U.S.A.



Eline Schapers

Head of Supply & Operations, SkyNRG



Takahisa Yano

Project Manager, New Energy Technology Department, New Energy and Industrial Technology Development Organization (NEDO)



Mamiko Saito

Manager, Corporate Business Development Division, IHI Corporation



Yasuhiro Yamauchi

General Manager, Boiler Technology Development Department, Boiler Technology Integration Division, Engineering Headquarters, Mitsubishi Hitachi Power Systems, Ltd.



Korehiro Odate

General Manager, Biofuels Business Department, euglena Co., Ltd.



Masayuki Inui

Group Leader, Chief Researcher, Research Institute of Innovative Technology for the Earth (RITE)



Concurrent Sessions

CCS

The session focused on the present status of actual projects for Carbon Capture and Storage (CCS). The details and current conditions of various CCS projects in Canada, Europe, and Japan were presented by each speaker, and they shared their experiences. These presentations included a project on Integrated coal Gasification Combined Cycle (IGCC) with CO₂ capture and a post-combustion carbon capture system on an existing lignite coal-fired generator plant.

In the subsequent discussion, how to accelerate actual CCS projects was raised as one of the most important issues. Also, vigorous discussion took place on the necessity for reduction of the overall cost of CCS and strong support from the government.



Alex Zapantis (Chair)

General Manager Commercial, Global Carbon Capture & Storage Institute



Ian Yeates

Director, Carbon Capture and Storage Initiatives, Planning, Environment and Sustainable Development Division, SaskPower



Leslie Mabon

Lecturer in Sociology, School of Applied Social Studies, Robert Gordon University



Yutaka Tanaka

General Manager, Technology and Planning Department, Japan CCS Co., Ltd.



Nobuyuki Zaima

Director General (Clean Coal), Environment Department, New Energy and Industrial Technology Development Organization (NEDO)



Role of Diversity: Challenges for Climate Change

This session explored the very perspective that enables social transformation. "Diversity" has a broad meaning including not only gender issues, but also age, national origin, disability, education, religion, and culture, and possibly even work experience, lifestyle. The panel talked about diversity from various viewpoints: the necessity of pooling innovative ideas and capabilities from many disciplines, sectors, technologies, and people of all backgrounds and nationalities; the importance of role models and education in terms of women's issues at the bottom of the pyramid; consumption-based emissions as another perspective looking toward a climate smart society; the role of Japanese women in terms of diversity in finance; the role of the international centers and academies toward advancing "diversity in excellence" defined as multicultural, ethnic diversity, national and gender-balanced diversity. Key takeaways from the discussion included: 1) education and outreach as a tool for disseminating the efforts worldwide, 2) providing opportunities to discuss and boil down a perspective on implementing academic outcomes successfully.



Reiko Kuroda (Chair)

Professor, Research Institute for Science and Technology, Tokyo University of Science; Professor Emeritus, The University of Tokyo; Ambassador, Women's Initiative in Developing STEM Career (WINDS)



Robert Armstrong

Director of MIT Energy Initiative



Behjat Al Yousuf

Interim Provost, Department of Engineering Systems and Management, Masdar Institute of Science and Technology



Kiyoshi Matsuda

Adviser/Public Policy and Relation Office, Mitsubishi Chemical Holdings Corporation



Mizue Tsukushi

Founder & CEO of The Good Bankers Co., Ltd.



Mohamed Hag Ali Hassan

President, Sudanese National Academy of Sciences (SNAS)



Concurrent Sessions

Managing Energy Demand and Supply

As a result of the massive introduction of renewable electricity generation and subsequent changes in electricity generation and consumption structures, it is becoming increasingly important to develop managing technologies for demand control and grid systems, as well as bring about the associated institutional reforms. In this session, discussion focused on future perspectives on managing technologies, both hardware and control software, that could contribute to realizing a low-carbon society and simultaneously to maintaining grid stability. Specifically, based on the rapid development of Information and Communications Technology (ICT), the Internet of Things (IoT), and big data technology, the speakers introduced the challenges and opportunities that exist in endeavoring to achieve a smart energy system, standardization of communication technology, and also introduced a new utility business model to engage consumers in management of energy demand. The participants further discussed the transformation and future role of the utility industry in decarbonization of society, as well as the significance of conducting various types of demonstration projects.



Kenji Yamaji (Chair)

Director-General, Research Institute of Innovative Technology for the Earth(RITE); Professor Emeritus, The University of Tokyo



Richard Schomberg

IEC Ambassador for Smart Energy



Alex Laskey

President and Co-Founder, Opower; Strategic Consultant for Utilities Solutions



Hiroshi Okamoto

Executive Vice President, Corporate Planning, TEPCO Power Grid Inc.



Kazuyuki Takada

Director, Planning Division, Technology Strategy Center (Former Director of Smart Community Department), New Energy and Industrial Technology Development Organization (NEDO)



Nuclear Energy

At this session, the speakers gave presentations based on their expertise, such as the small and medium size reactors (PRISM, IMSR), the current situation in the U.S.A., and Japan's R&D on innovative reactors. In the subsequent panel discussion, policy and technical aspects were debated. As for the policy aspects, it was pointed out that improving economic competitiveness is a key issue in enhancing public acceptance. It was also emphasized that promoting investment from the private sector is important especially for new ventures, and innovative technology and innovative capital planning are the important issues. With regard to technical aspects, the benefits of small and medium size reactors were introduced by the representatives from the development domain.



Noriko Endo (Chair)

Project Professor, Keio University



Michael Shellenberger

Founder & President, Environmental Progress



Jason Bordoff

Professor of Professional Practice in School of International and Public Affairs, Columbia University



Simon Irish

Chief Executive Officer, Terrestrial Energy Inc.



Eric P. Loewen

Chief Consulting Engineer, GE Hitachi Nuclear Energy



Yutaka Sagayama

Assistant to the President, Japan Atomic Energy Agency (JAEA)



Concurrent Sessions

Hydrogen & Fuel Cells

The objective of this concurrent session was to discuss the ideal shape of government/private international cooperation in the domain of hydrogen energy.

The speakers presented the current status of policy support and international cooperation for hydrogen energy and fuel cells. Following the presentations, the participants argued that cooperation between the public and private sectors and coexistence with other electrification technologies for transportation, such as batteries, are important for the dissemination of hydrogen, especially in the three following utilization areas: renewable energy storage, transportation, and stationary usage. Specifically, as for renewable energy storage, hydrogen would be suitable for seasonal storage of renewables; as for transportation, Fuel Cell Electric Vehicles (FCEVs) can co-exist with Battery Electric Vehicles (BEVs) in freight transport and long-distance driving; and in the area of stationary usage, hydrogen can be a solution for decarbonizing industrial and domestic heating.



Pierre-Etienne Franc (Chair)

Vice President, Advanced Business and Technologies World Business Unit, Air Liquide; Secretary General, Hydrogen Council



Zong Qiang MAO

Professor, Tsinghua University



Bernd Heid

Senior Partner, McKinsey & Company, Inc.



Tim Karlsson

Executive Director, International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE)



Bart Biebuyck

Executive Director, Fuel Cells and Hydrogen Joint Undertaking (FCH JU)



Toshiki Shimizu

Head of Fuel Cell Business, Smart Energy System Business Division, Appliances Company, Panasonic Corporation



Business Action to Tackle Climate Change

In this session, the role of business sector in aiming towards decarbonization was discussed. Even if we achieve the current Nationally Determined Contributions (NDC), there are some gaps due to ambitious goals of Paris agreement. Under the circumstances, disruptive innovations are crucial in the future and business sectors are expected to play a significant role in those Research and Development (R&D).

The participants from various backgrounds exchanged their views on:

- 1) Future disruptive innovations for adaptation as well as mitigation
- 2) To disseminate BAT (Best Available Technology) and the importance of CO₂ emissions based on LCA (Life Cycle Assessment) transboundary
- 3) Innovation is occurring from “unexpected marriage” of various technologies in various fields. The approach of research and development (R&D) should be different from the past.
- 4) The significance for a sustained dialogue between stakeholders and companies. Practical disclosure activities for stakeholders should be required.
- 5) Internal carbon pricing is a useful “proxy”, but its level is not the sole criteria for evaluating business sector’s action on climate change.



Jun Arima (Chair)

Professor, Graduate School of Public Policy, The University of Tokyo



Ted Nordhaus

Founder and Executive Director, Breakthrough Institute



Phillippe Fonta

Managing Director, Cement Sustainability Initiative (CSI), World Business Council for Sustainable Development (WBCSD)



Hiroyuki Tezuka

Chair, Working Group on Global Environment Strategy, Committee on Environment & Safety, Keidanren



Nicolette Bartlett

Director, Carbon Pricing, CDP



Closing Session



① Remarks

Iwao Horii, Parliamentary Vice-Minister for Foreign Affairs, Japan

② Closing Remarks

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

③ Final Thoughts on the Event

Nobuo Tanaka, Chairman, The Sasakawa Peace Foundation; Former Executive Director, International Energy Agency (IEA)

④ Top 10 Innovations Announcement

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

⑤ Roadmap Announcement

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

⑥ Statement from Steering Committee

Kenji Yamaji, Director-General, Research Institute of Innovative Technology for the Earth (RITE); Professor Emeritus, The University of Tokyo

Statement

The ICEF 2017 statement, a set of principles and recommendations from the Steering Committee, was announced at the closing session. The overall theme of ICEF 2017 was “Further Exploration of Innovations toward Achieving Global Net-Zero Anthropogenic Emissions of CO₂”, in line with the key concept in the ICEF of “Global Net-Zero Anthropogenic Emissions of CO₂” that was agreed in 2016. In the statement, the absolute necessity of the goal to achieve at least global net-zero anthropogenic CO₂ emissions over the long term towards CO₂ net-zero emission was reaffirmed. Also, various recommendations were made to the global community in order to further accelerate technology innovation and diffusion.



ICEF 2017 Statement from the Steering Committee

October 5, 2017

1. Introduction

The Innovation for Cool Earth Forum (ICEF) was established in 2014 through the initiative of Shinzo Abe, the Prime Minister of Japan. The fourth annual ICEF was held on October 4-5, 2017 in Tokyo. More than 1,000 experts from government, the business sector 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 is pleased to announce the following statement.

2. Ultimate necessity of net zero CO₂ emissions

We emphasize that innovation and its diffusion for reducing greenhouse gas emissions is becoming increasingly important considering current and future unpredictability of a political will directed toward climate change mitigation. Consequently, significant progress in reducing GHG emissions will require a coalition of willing national and local governments, the private sector as well as all people. We reaffirm the absolute necessity of the goal to achieve at least global *net zero anthropogenic CO₂ emissions* over the long term in order to stabilize global temperature levels, including holding the increase in the global average temperature to well below 2°C above pre-industrial levels as adopted under the Paris Agreement at COP21. “Net zero” means that while most areas should seek zero emission, some areas could be permitted positive emission only in case they should be offset by negative emissions. In order to achieve this goal, CO₂ emissions must peak as soon as possible. The global community should pursue this goal together with other goals described in SDGs (Sustainable Development Goals), such as poverty alleviation, economic growth and energy access, as articulated in the UN 2030 Agenda for Sustainable Development.

3. Importance of technology innovation

Technological innovation is crucial not only to achieve our goals but also to allow us to enhance our goal to be more ambitious while ensuring multiple benefits for the economy. Innovation can contribute to job creation and economic development. With this in mind, all countries should endeavor to achieve the goal of net zero emissions in the following ways: first, through reducing energy demand by deploying new technologies such as the Internet of Things; second, through expanding use of zero emission technologies such as renewables and nuclear power; third, by accelerating the diffusion of advanced low carbon products and promoting the use of infrastructure utilizing low carbon technologies; and fourth, by supporting financial and social innovation as well as international cooperation. In view of the enormous demand for energy in developing countries, it is important for developed countries to promote worldwide dissemination of the technologies mentioned above.

4. Promotion of social innovation

Use of the Internet of Things, the Artificial Intelligence and the Big Data affects energy systems as well as social behavior. Emerging new technologies are expected to be widely used in the future to reduce energy use and to reform social systems. At ICEF 2017, emerging technologies and the need for social system innovation which may have significant effects on society and human behavior were discussed in sessions such as “Social System Innovation in the Energy Sector” and “Managing Energy Demand and Supply.” ICEF 2017 also included a session on the role of diversity in promoting innovative approaches to deal with climate change, such as empowerment of youth and women.

5. Role of the industrial sector

The industrial sector is key for innovation and its diffusion. We should recognize that the role of the industrial sector in reducing CO₂ emissions is not limited to production processes but also includes transboundary diffusion of eco-products. It is therefore important to accelerate industrial sector actions which contribute to reducing CO₂ emissions and to also announce their contributions to encourage stakeholders’ supports such as investments by the financial sector.

6. Strategy to accelerate innovation in a holistic system

Due to significant efforts by both the private and public sectors, innovation in the energy sector is accelerating along with rapid diffusion of many market-ready technologies such as wind and solar power. To further accelerate dissemination of these technologies, a systems approach, especially with regard to appropriate market design, is necessary in order to mobilize finance, technology transfer and international cooperation. In addition to research and development activities, human resource development and investment are also required. It should be emphasized that a large-scale transformation of the energy sector will also contribute to promoting sustainable development, including creation of employment opportunities and other multiple benefits for Sustainable Development Goals.

Top 10 Innovations

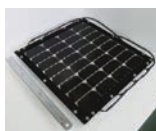
Based on the three perspectives of (1) large GHG emission reduction potential, (2) excellence in innovativeness and (3) feasibility, the Top 10 Innovations Working Group members from the ICEF Steering Committee selected the 25 cases of top-level technological developments and policies in the fields of energy and environment that had been presented within the past 2 years.

Ultimately, the Top 10 Innovations were selected through votes by ICEF 2017 participants. The winners are the following cases:

Stage R&D Area Solar

31.17% solar sunroof triple-junction module efficiency

Organization Sharp



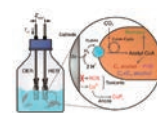
Source: © SHARP CORPORATION (<http://www.sharp.co.jp/corporate/news/160519-a.html>)

Sharp has created a triple-junction compound solar module with a conversion efficiency of 31.17% in NEDO's project. While Sharp has previously achieved an efficiency of 37.9% for an individual PV cell using similar technology, that device had an area of just 1.047cm². Using a triple junction cell means that the photovoltaic properties of the compounds indium gallium-phosphide (InGaP), gallium arsenide (GaAs) and indium gallium arsenide (InGaAs) can be used to capture a wider range of the spectrum of sunlight.

Stage R&D Area Hydrogen

Water splitting–biosynthetic system with CO₂ reduction efficiencies exceeding photosynthesis

Organization Harvard University



Source: Liu, C., B. C. Colon, M. Ziesack, P. A. Silver, and D. G. Nocera. 2016. "Water Splitting–Biosynthetic System with CO₂ Reduction Efficiencies Exceeding Photosynthesis." *Science* 352 (6290) (June 2): 1210–1213. doi:10.1126/science.1250399. <https://dash.harvard.edu/handle/1/27304973> (<https://dash.harvard.edu/bitstream/handle/1/27304973/aaf5039%20Manuscript%20rev%20complete.pdf?sequence=1>)

Daniel Nocera, a professor of energy science at Harvard and his colleague Pamela Silver have devised a system that completes the process of making liquid fuel from sunlight, carbon dioxide, and water at an efficiency of 10 percent. That is much higher than natural photosynthesis, which converts about 1 percent of solar energy into the carbohydrates used by plants, and it could be a milestone in the shift away from fossil fuels. Improving on a previous artificial photosynthesis design, they combined the hydrogen-oxidizing bacterium *Raistonia eutropha* with a cobalt-phosphorus water-splitting catalyst.

Stage R&D Area Solar

New world record for thin-film solar cells

Organization ZSW (Centre for Solar Energy and Hydrogen Research Baden-Württemberg)



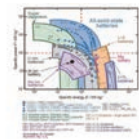
Source: © 2017 Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg

The Centre for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW) has nudged up the performance bar for thin-film solar cells yet another notch. The Stuttgart-based scientists achieved 22.6 % efficiency with their latest advance, topping the performance of a Japanese-made cell by 0.3 % points and bringing the world record back home to ZSW for the fifth time. And the pace of advances is picking up as recent strides in cell performance go to show: The efficiency of thin-film solar cells based on copper indium gallium diselenide (CIGS) has increased more in the last 3 years than in the previous 15.

Stage R&D Area Energy Storage

High-power all-solid-state batteries using sulfide superionic conductors

Organization Tokyo Institute of Technology, Toyota Motor Corporation



Source: Kato et al. *Nature Energy*, 1, 16030 (2016)

Toyota Motor Corporation and the Tokyo Institute of Technology, as part of a NEDO project, have discovered superionic conductors with the world's highest lithium-ion conductivity. The superionic conductors have been applied to develop an all-solid-state battery that has achieved a power density three times as high as the conventional lithium-ion batteries. The all-solid-state battery is able to operate efficiently at a wide range of temperatures, between -30 and 100 degrees Celsius while a conventional lithium ion cell showed very low discharge capacity at -30 degrees and couldn't operate at 100 degrees. All-solid-state batteries are a promising solution to creating a high-capacity and highly-power of the future.

Stage R&D Area Solar

World's highest conversion efficiency of 26.33% achieved in a crystalline silicon solar cell

Organization Kaneka Corporation



Source: Kaneka Corporation/NEDO

Kaneka Corporation developed a high conversion-efficiency crystalline silicon solar cell (heterojunction back-contact type) in NEDO's Development of High-Performance and Reliable PV Modules to Reduce LCOE project, and has achieved the world's highest conversion efficiency of 26.33% in a crystalline silicon solar cell having a practical size (180cm²). This achievement breaks the world record of 25.6% by ~0.7%, exceeding 26% for the first time in the world. The result was achieved by means of a combination of heterojunction technology using high-quality amorphous silicon, low resistance electrode technology, and a back-contact structure that captures more solar energy, all of which were developed by Kaneka Corporation.

Stage R&D Area Energy Storage

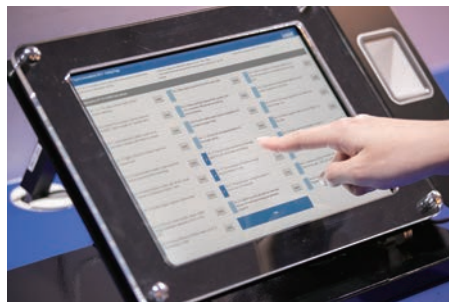
Long-lasting flow battery could run for more than a decade with minimum upkeep

Organization Harvard University



Source: © Harvard School of John A. Paulson School of Engineering and Applied Sciences (<https://aaz.see.harvard.edu/electrochemistry#metal-free>)

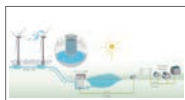
Research team from Harvard John A. Paulson School of Engineering and Applied Sciences has developed a new flow battery that is non-toxic, non-corrosive with long lifespan and low production cost. The flow battery overcomes the challenge of degradation by dissolving organic electrolyte molecules in pH neutral water; even after 1000 cycles, the battery only loses one percent of its capacity. Further research into flow batteries with aqueous soluble organic electrolytes may pave the way for safe, cost-effective, and long-lasting energy storage, contributing to a larger deployment of intermittent renewables.



Stage Pilot & Start-up Area Wind

World's tallest wind turbine integrated with pumped storage hydro

Organization Max Bögl Wind AG, GE Renewable Energy



Source: © Max Bögl Wind AG
(<http://www.ge.com/reports/unique-combo-wind-hydro-power-revolutionize-renewable-energy/>)

General Electric Company announced it has signed a Turbine Supply Agreement with Max Bögl Wind AG to deliver and commission the world's tallest and first ever wind turbine integrated with pumped storage hydro-electric power. The full scope of the Gaildorf project, located in Germany, will consist of 4 units of GE's new "3.4-137" model wind turbine technology and a 16 MW capacity pumped storage hydro-electric power plant. The base and surrounding area of each wind turbine tower will be used as a water reservoir, effectively increasing tower height by 40 meters. At a total tip height of 246.5 meters, once installed these units will become the tallest wind turbines in the world to date.

Stage Pilot & Start-up Area Smart Grid/Microgrid

Demonstration of peer to peerelectricity trading using blockchain technology

Organization LO3 Energy, Siemens



Source: © Brooklyn Microgrid Prosumer Participant
(<https://www.brooklynenergy.org/lightbox=datatable-201701>)

Peer-to-peer trading of residential PV surplus using blockchain technology was successfully conducted within a microgrid for the first time in Brooklyn. LO3 Energy, peer-to-peer trading platform provider for the microgrid, will collaborate with Siemens Digital Grid, experienced provider of microgrid control solutions, to further enable the use of blockchain technology for local energy trading. Blockchain technology has the potential to allow large-scale deployment of distributed energy resources at the local level with lower cost, by enabling peer-to-peer trading of local energy resources and balancing out local production and consumption. The collaboration of the two companies may accelerate the development of microgrids that allow local trading of energy using blockchain technology.

Stage Pilot & Start-up Area Biomass

Flight powered by biofuel made from residual wood

Organization Northwest Advanced Renewables Alliance, ICM, GEVO



Source: © GEVO 2017

ICM Inc. contributed to the successful production of renewable biojet fuel from woody biomass used on a commercial Alaska Airlines flight Nov. 14 as part of the USDA-sponsored Northwest Advanced Renewables Alliance project. The Northwest Advanced Renewables Alliance produced fermentable sugars from the woody biomass sources of hemlock and lodge pole pine, using pretreatment, milling and hydrolysis. The wood based sugars were converted to isobutanol (intermediate to making jet fuel) at ICM's and GEVO's pilot plant co-located in St. Joseph, MO. The jet fuel was produced at GEVO's Demonstration plant located at South Hampton Resources in Silsbee, TX.

Stage Pilot & Start-up Area Smart Grid/Microgrid

Pioneering the networking of storage batteries with blockchain technology

Organization TenneT, Sonnen, IBM



Source: © Sonnen

TenneT, Sonnen, and IBM have launched a pilot project to utilize stationary batteries for system operation using blockchain solution. Sonnen, Europe's largest stationary battery energy storage system provider, will provide aggregation of its residential stationary batteries for the system operation of TenneT, with blockchain solution provided by IBM. As more intermittent renewable energy resources are installed, procuring flexibility in the power system becomes a serious issue for system and grid operation. The exciting project explores the effectiveness for residential batteries to contribute to power system flexibility, and the possibility of utilizing blockchain technology for such solution.

Stage Pilot & Start-up Area Biomass

100 Percent bio-based plastics for beverage bottles

Organization Anellotech, Suntory



Source: Courtesy of Suntory

Anellotech and Suntory have focused on advancing the development and commercialization of cost-competitive 100 percent bio-based plastics for use in beverage bottles as part of Suntory's commitment to sustainable business practices. Suntory currently uses 30 percent plant-derived materials for their Mineral Water Suntory Tennensui brands and is pursuing the development of a 100 percent bio-bottle through this partnership. The Anellotech alliance with Suntory supports the development of bio-aromatics including bio-paraxylene, the key component needed to make 100 percent bio-based polyester (polyethylene terephthalate, or "PET") for use in beverage bottles.

Stage Pilot & Start-up Area ZEB / ZEH

Demonstration of Positive Energy Building Begins in Lyon

Organization Toshiba



Source: © New Energy and Industrial Technology Development Organization (NEDO)
(http://www.nedo.go.jp/english/news/ASen_100016.html)

Toshiba has started the demonstration of the positive energy building HIKARI ("Light") in NEDO's project, which produces energy in excess of the amount consumed by the building, as part of the smart community demonstration project being conducted in Lyon, France. Such performance was made possible through the introduction of PV power generation, storage batteries, and heat storage materials that are controlled by an energy management system. As France has set a goal of making all new public buildings constructed positive energy buildings, NEDO is aiming to disseminate the results of the demonstration widely in other cities and countries.

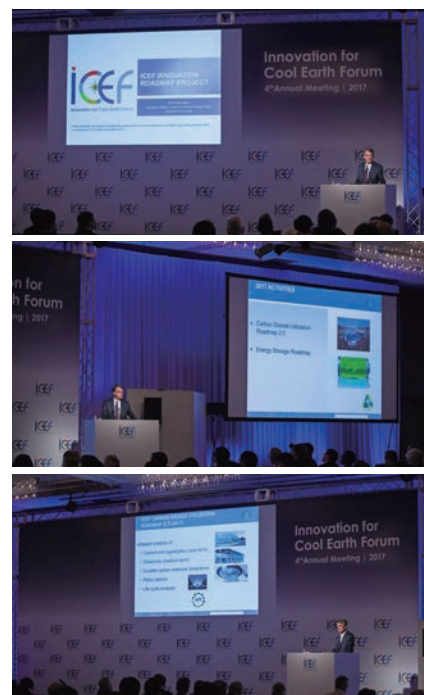
Roadmap Projects

Two ICEF 2017 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 development on CO₂ utilization resulted from the efforts of Steering Committee member Mr. David Sandalow and the Lawrence Livermore National Laboratory group. Last year's roadmap on CO₂ utilization 1.0 presented the commercial and technical landscape of CO₂ conversion. In this year's CO₂ Utilization Roadmap 2.0, much deeper analysis is made on the possibilities of cement and aggregates, chemicals, and durable carbon materials and their life cycle assessments.

The other roadmap is for energy storage. In this roadmap, particular focus is placed on stationary energy storage for power systems, mobility energy storage for transportation, and stationary thermal storage systems. The roadmap summarized the current status of energy storage technologies and clarified required R&D targets and support policies. In the concurrent session, these were presented and discussed among the panelists. The importance of not only battery technologies but also other storage technologies developments and further utilization of electric vehicles for grid stability were emphasized.

The two drafts were revised to reflect the opinions and comments received at ICEF, and the final versions were launched at an event during COP23, and also published on the ICEF website.



Side Events



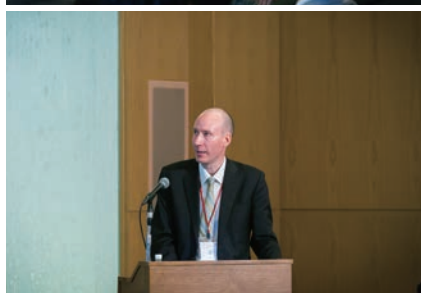
IRENA Launch Event - Battery energy storage: Facilitating the next phase of the energy transition

The International Renewable Energy Agency (IRENA) launched for the first time in the world its latest report "Electricity Storage and Renewables: Costs and Markets to 2030." Dr. Dolf Gielen, Director of the IRENA Innovation and Technology Centre, gave the opening remarks, emphasizing the importance of technology in electricity storage. Mr. Michael Taylor, Senior Analyst of IRENA, presented the contents of the report and, in particular, indicated that the installed energy cost of different energy storage technologies would be reduced by 50 - 66% in 2030. During the discussion, the presenter pointed out that application to the aviation sector would require further innovation in the technologies for energy storage.



IEA Side Event: Energy Technology Perspectives 2017 – Catalysing Energy Technology Transformations

Mr. David Turk, Acting Director, Directorate of Sustainability, Technology and Outlooks, the International Energy Agency (IEA), presented the IEA's flagship publication devoted to energy technologies entitled "Energy Technology Perspectives 2017." This year's edition focused on the increasing impacts of technological innovation on the energy sector, analyzing the potential of an accelerated and scaled-up deployment of clean energy technologies to shape energy security and environmental sustainability. The meaning of "Beyond 2°C Scenario," the cost analysis undertaken by the report and feasibility study on CCS were highlighted in the discussion. In addition, IEA's upcoming report on digitalization and energy to be published in November 2017 was previewed.



Steering Committee Members



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



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



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
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Industrial Change
Adviser in the EU affairs, Finland



Reiko Kuroda
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Technology, Tokyo University of Science
Professor Emeritus, The University of Tokyo
Ambassador, Women's Initiative in
Developing STEM Career (WINDS), Japan



Hoesung Lee
Chair of the Intergovernmental Panel on
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Endowed Chair Professor, Graduate School of
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Korea



Richard K. Lester
Associate Provost, Massachusetts Institute of
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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
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Professor Emeritus, Vienna University of
Technology (TU WIEN)



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



Ismail Serageldin
Founding Director Emeritus, Library of
Alexandria, Egypt



Vaclav Smil
Distinguished Professor Emeritus,
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Laurence Tubiana
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Emeritus Professor,
The University of Tokyo, Japan



ICEF 2018

Save the Date

5th Annual Meeting

OCTOBER 10-11 2018
TOKYO

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

