

Innovation for Cool Earth Forum

ICEF 2019 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.



Abe Shinzo
Prime Minister of Japan



Contents



Innovation for Cool Earth Forum ICEF 2019 Report

Greetings	1
What is ICEF?	3
6th Annual Meeting	4
Program	5
Opening Session	6
Plenary Session 1	7
Plenary Session 2	9
Plenary Session 3	11
Concurrent Sessions	13
Side Events	19
Closing Session	20
Statement	21
Top 10 Innovations	23
Roadmap Projects	25
Steering Committee Members	26

What is ICEF?

Prime Minister Abe Shinzo 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.



6th Annual Meeting

Date	October 9 and 10, 2019
Venue	Hotel Chinzanso Tokyo, Japan
Hosts	



Co-hosts



Institutional Partners



Participants

More than 1,000 participants from governments, international organizations, the business sector and academia representing about 70 countries and regions

Overall theme

Bending down the emissions trajectory by Innovation and Green Finance

Outcomes of ICEF 2019

- Top 10 Innovations
- Roadmap on Industrial Heat Decarbonization
- Statement from the Steering Committee



Program

DAY 1 (Wednesday, October 9)

10:00-10:30 Opening Session

Opening Remarks

10:30-12:00 Plenary Session 1

Business Decarbonization Initiatives

12:00-12:45 Side Event

Top 10 Innovations

12:45-14:15 Lunch Buffet

13:30-14:00 Side Events

13:30 – 14:00 **Impact of Climate Change Countermeasures on Civilization**

13:30 – 14:00 **Transforming industry: a focus on CCUS**

14:15-15:45 Plenary Session 2

Green Hydrogen Global Network

15:45-15:55 Short Break

15:55-17:30 Concurrent Sessions 1

15:55 – 17:30 **Grid Integration of Renewables**

15:55 – 17:30 **Innovations in Nuclear Energy**

15:55 – 17:30 **Genetic Engineering for CO₂ Reduction**

15:55 – 17:30 **E-Mobility in Sharing Services and Fleets**

18:30-20:30 Official Dinner

DAY 2 (Thursday, October 10)

10:00-11:40 Concurrent Sessions 2

10:00 – 11:40 **Digital Technology for Distributed Energy Resources**

10:00 – 11:40 **CO₂ Utilization**

10:00 – 11:40 **Climate Communications**

10:00 – 11:40 **Green Urbanization**

11:40-12:10 Short Break

12:10-13:00 Side Event

ICEF 2019 Roadmap Project on “Industrial Heat Decarbonization”

13:00-13:50 Lunch Buffet

13:10-13:40 Side Event

Solutions to Integrate High Shares of Variable Renewable Energy

13:50-15:30 Concurrent Sessions 3

13:50 – 15:30 **Fuel Cells**

13:50 – 15:30 **Impact of Carbon Removal Technologies**

13:50 – 15:30 **Energy Productivity through IT and AI**

13:50 – 15:30 **Balance between the Benefits of Plastics and Marine/Land Ecosystem Protection**

15:30-16:00 Short Break

16:00-17:30 Plenary Session 3

Industrial Decarbonization

17:30-18:00 Closing Session

Remarks

Final Thoughts on the Event

Top 10 Innovations Result Announcement

Roadmap Announcement

Statement from Steering Committee

Closing Remarks

Opening Session

Opening Remarks

Video message from Minister of Economy, Trade and Industry

A video with the following message from Mr. Sugawara Isshu, Minister of Economy, Trade and Industry (METI) was shown:

ICEF started in 2014, and this year marks the 6th. Since its beginning, ICEF has earned global recognition as a major international conference for innovation of environmental technologies. I would like to express my gratitude to the conference participants, as well as to the members of the Steering Committee and the organizers for making this possible.

This year's ICEF is attended by leading climate change experts from more than 70 countries. I have traveled alone in 60 countries around the world when I was a student or while working at a company. Though I think that this number is more than that of most Japanese, the number of countries represented this year at ICEF is more than that, which indicates the worldwide recognition of ICEF.

The major themes of this year's ICEF are Hydrogen, Decarbonization of Industry and Finance. In fact, these are topics that I have been working on attentively ever since I became a Minister of METI. About two weeks ago, on September 25, I hosted an international conference on hydrogen and carbon recycle, two key areas of innovation to solve climate change. Participants representing the government, industry, and academia from 37 countries, regions, and international organizations shared lively discussions. I was reminded of the global rush to innovate systems and technologies to solve climate change and the high expectations of the solutions to come. Under my leadership, new actions to advance the introduction of hydrogen and carbon recycle have been launched. We invite leaders of leading international research institutions to RD20, which has been formed through an agreement reached at the G20 and will be held the day after tomorrow. The purpose of RD20 is to share the state-of-the-art knowledge and information in hydrogen and carbon recycle to nurture international collaboration.

In addition, the TCFD Summit was launched yesterday with the mission of establishing a scheme to enhance investment in innovative enterprises. We will encourage companies to work on unconventional and discontinuous innovation in areas such as hydrogen and carbon recycle and to disclose information on their activities, while also encouraging the financial sector to evaluate their activities positively and enhance financial support.

In terms of perception, activities to address climate change must be recognized as a source of competitiveness. Thinking of such activities merely as risks or costs, and carrying out divestments, will not be a solution for changing the world.

At the TCFD Summit I released the "Green Investment Guidance," a document summarizing how financial institutions should evaluate and boost corporate innovations and initiatives. I hope that the guidance will be widely referred to in the world.

There are many participants at this 2-day meeting who were at the TCFD Summit as well as many participants who will attend the RD20. Innovation and finance are the two essential drivers, just like two wheels of a cart. I sincerely hope that we will deepen the discussions on the realization of a virtuous cycle between environment and growth by nurturing mutual cooperation and network among industry, the financial sector, and academia.



Plenary Session 1

Business Decarbonization Initiatives

In this session, panelists mainly presented on the significance of disclosing climate change-related financial information and what governments, businesses, financial institutions and investors should do in the future. First, it was introduced that 70 Japanese companies had set internal carbon pricing and the TCFD recommends disclosing the internal carbon price in cases where it has already been set; then the advantages of establishing internal carbon pricing were discussed. Additionally, the panelists emphasized their growing expectations for the involvement of women in discussion about this issue through efforts to improve gender balance, as they were generally not beneficiaries in the old business models, but are now very interested in tackling the issue of climate change.



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



Mark Carney
Governor of the Bank of England

Mr. Carney stated that financial markets and systems would pay more attention to resilience strategies in each company and advocated the importance of reporting, risk management and sustainable investment. He asserted that only companies with reliable plans for the transition to decarbonized economies over the next several decades would receive funding from financial institutions and ultimately become profitable. Additionally, he highlighted that such practices of financial institutions are necessary to truly move from where we are today collectively to a decarbonized society and economy, and risks would arise if they do not prepare and create a market.



Mary L. Schapiro
Vice Chair for Global Public Policy and Special
Advisor to the Founder and Chairman,
Bloomberg L.P.

Ms. Schapiro stressed that companies engaged in activities which are susceptible to climate-related risks are less resilient in the transition to a low-carbon economy and their investors might experience lower returns; conversely, companies well-positioned on sustainability and climate issues are likely to produce better returns for their investors over the long run. She also noted that many companies opt not to disclose information because the securities laws in the U.S.A. leave it to the discretion of the companies themselves to decide what needs to be disclosed, and the climate impacts are too uncertain or complex for many companies to disclose. She reiterated the importance of information disclosure, and highlighted the need for voluntary disclosure in the framework in line with the recommendations of the TCFD.



Mizuno Hiro
Executive Managing Director and CIO,
Government Pension Investment Fund (GPIF)

Mr. Mizuno reported that analysis reveals that the GPIF portfolio was aligned with the 3.5°C scenario, and was not in line with the Paris Agreement. He also explained that this was representative of worldwide trends due to the diversity of GPIF's portfolio and to the fact that GPIF had disclosed it as is, instead of making it look better in terms of carbon footprint in order to send a signal that 'this is where the world is heading.' He expressed concern over major asset owners that have not integrated or priced in climate risks, pointing out that if investors ask companies to disclose climate-related information, they have to take the responsibility for utilizing it. In addition, he claimed that refraining from taking action is contrary to their fiduciary duties. Finally, he mentioned that more companies agreed with TCFD recommendations in Japan this year, and how its non-mandatory nature had been helpful toward that end.



Charles O. Holliday
Chairman, Royal Dutch Shell Plc

Mr. Holliday announced that Royal Dutch Shell has engaged in scenario planning for many years, and has tied their executive's compensation to the goals of reducing their carbon footprint by 2% to 3% in the next three years; 20% by 2030, and 50% by 2050, as well as the goal to provide electricity to 100 million people by 2030. He mentioned the fact that Royal Dutch Shell has invested large amounts of money in new energy technologies and spent much time in board meetings to discuss them; and highlighted the expectations of hydrogen.



Laurence Tubiana
CEO, European Climate Foundation

Ms. Tubiana criticized the fact that things are not moving fast enough toward the Paris goals because everyone is waiting for everyone else to take action, although a lot of countries, cities and businesses around the world are genuinely supporting the goals, and financial institutions are trying to align their portfolios with them. She mentioned the need for strong regulation, for which the government has to step up, and asserted that companies, businesses and financial actors have to support it. She further stressed that the wait-and-see attitude is impeding climate action policy. She highlighted that the solution is to now create a coalition of progressive governments, companies, financial institutions and financial actors that decide they will bet on the future positively, not bet on the future by saying, 'let's see what happens.'



Sue Howells
Chief Operating Officer, CDP Worldwide

Ms. Howells asserted that climate change is very clearly apparent as a material risk to the economy, and stated that 8,400 companies are using the CDP platform to disclose risks and other climate-relevant information. She highlighted that one-third of the companies that report to CDP are using internal carbon pricing; and made three policy recommendations: 1) that each country should enhance and be much more ambitious with their NDCs, 2) that policymakers should provide the right policy environment for companies and investors to be able to do the work we need to see from them, and 3) that governments should think about putting a price on carbon (which may encourage companies to reduce their emissions regardless of whether the price will be actually put on or not.)



Plenary Session 2

Green Hydrogen Global Network

Firstly, this session highlighted the sense of urgency of the climate problem, technological improvements in the value chain, and urban air pollution as drivers of significant progress in hydrogen utilization. In the ensuing discussion, it was pointed out that the cost is a major hurdle to using hydrogen, and that innovative technologies, deregulation of hydrogen infrastructure including hydrogen stations, and infrastructure investment are necessary to reduce the cost in production, storage, transportation and use. During the panel discussion, panelists expressed that we should also pay attention to topics such as public acceptance of hydrogen, hydrogen's role in seasonal storage where it is difficult for batteries to play a role, business models in which electrolyzers in the distribution grids are utilized to stabilize the grids (not only to make hydrogen as a side product), and the impact of decarbonization on job creation.



Sally M. Benson (Moderator)
Professor, Department of Energy Resources Engineering, School of Earth, Energy & Environmental Sciences, Stanford University;
Co-Director, Precourt Institute for Energy, Stanford University



Ishizuka Hiroaki
Chairman,
New Energy and Industrial Technology Development Organization (NEDO)

Mr. Ishizuka explained NEDO's hydrogen strategy as follows: The first step is to bring residential fuel cells using city gas to the market, which will serve to increase public familiarity with fuel cells as a product. The next step is to propagate fuel-cell vehicles and hydrogen refueling stations. He also introduced NEDO's demonstration project for a hydrogen gas turbine in an urban area that supplies heat and electricity to surrounding facilities such as the hospital and the sports center from the turbine located on Kobe Port Island, adjacent to Kobe Airport. He additionally referred to a project in cooperation with the Australian government and other entities, in which hydrogen is being cooled to -253°C to condense it into a liquid for shipping. Lastly, he stated the goal to gain the ability to adapt to fluctuations in electricity supply and demand by adjusting the load on hydrogen production facilities in order to achieve low carbon hydrogen production using renewable energy.





Christopher Hebling

Director, Hydrogen Technology,
Fraunhofer Institute for Solar Energy Systems, ISE

Mr. Hebling noted that, if renewable energy makes it possible to source low-priced electricity in Europe, Australia, South Africa, China, South Korea and anywhere else in the world, it will be possible to produce hydrogen and transport hydrogen as a gas or in a liquefied state, as well as produce the chemical materials such as ammonia and methanol, or other liquid fuels. He stated that the transformation of the energy system in line with greenhouse gas emissions targets is technically feasible, but the market design has to be tailored in such a way that the investment flow automatically goes to the right solutions.



Marcel Galjee

Director Energy & New Business,
Nouryon

Mr. Galjee stressed that hydrogen would play an essential role in building up the bio-based and circular value chain in the future, and hydrogen would play an essential role in various industries, including the chemical industry, in terms of decarbonization. After an introduction on Nouryon's projects which produce hydrogen with off-gases and waste, and further convert hydrogen into chemical materials such as methanol or jet fuel, he emphasized that a large-scale value chain, including storage, and a massive scale-up from renewables are needed for competitive hydrogen. As for mobility, he stated that the scale will not come from the mobility side, but that it can profit from the scale created by the industrial side.



Fukazawa Kazuhiro

Executive Vice President, Advanced R&D and
Engineering Company,
TOYOTA MOTOR CORPORATION

Mr. Fukazawa presented Toyota's efforts to tackle environment issues: 1) Demonstration tests of Mirai, a mass-produced FCEV with a total of 10,000 units delivered across Japan, the U.S.A. and Europe, are being conducted in Australia, Canada, U.A.E., China and Saudi Arabia; 2) Toyota provided its FC system to overseas companies in countries such as Portugal and China; 3) Toyota has started demonstrations for FC heavy-duty commercial trucks in harbor areas in California to examine whether FC technology fostered through Mirai can be applicable to such vehicles; 4) Toyota is cooperating with other companies to construct the Tri-Gen which generates hydrogen, electricity and water from biomass such as animal feces and sludge in the U.S.A. He emphasized the need to work together with various stakeholders such governments, investors and customers in order to realize a hydrogen society.



Plenary Session 3

Industrial Decarbonization

Key takeaways from the presentations and discussions on the pathway to decarbonization in industrial sectors such as steel, petrochemicals and transportation, where reduction of greenhouse gas (GHG) and Short-Lived Climate Pollutants (SLCPs) emissions are difficult, included the necessity to 1) balance the different circumstances in countries and different initiatives, 2) attain a recognition among all stakeholders in a science-based manner, 3) consider the entire lifecycle of CO₂, including emissions during manufacturing and transporting as well as emissions from final products, and 4) design markets that encourage long-term investments for sustainability over short-term capital efficiency. In the panel discussion, it was pointed out that views on carbon offset vary depending on regions and industry sectors. It was also stated that individual corporate targets could stimulate development and innovation in the entire sector of companies who are delivering technologies to their industry.



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



Annette Stube
Head of Sustainability, A.P. Møller – Mærsk's

Ms. Stube remarked that many of A.P. Møller – Mærsk's customers see sustainability as important for long-term business success, and the number of companies requesting sustainability information as part of the business relationship was increasing. She explained that A.P. Møller – Mærsk is committed to becoming carbon neutral by 2050, because it was not only the right thing to do for the planet, but also necessary to remain relevant in a future low-carbon economy as a business. She additionally stated that the target would attract both talent and customers, and emphasized that we have less than 10 years until new fuels and technology would be needed to achieve decarbonization, considering that it would take a couple of years for the shipbuilding and designing of the first carbon-neutral vessel. She highlighted that achieving carbon neutrality would require cooperation between stakeholders including both companies and governments across borders.





Kobayashi Yoshimitsu

Chairperson, Carbon Recycling Fund Institute

Mr. Kobayashi assessed this year, 2019, as the initial year of carbon recycling, because CCUS had been stated at the World Economic Forum in Davos and in the G20 Declaration, and the roadmap on carbon recycling technology had been formulated in June. He explained that the Carbon Recycling Fund Institute was established based on the belief that forms of support other than policy support by the national government were needed; the Institute raises funds from private companies and provides the funds to entities as grants or other types of support, along with conducting research and development on carbon recycling. He introduced the demonstration project on carbon capture plus Integrated Coal Gasification Fuel Cell Combined Cycle (IGFC) implemented in Osakikamijima, Hiroshima Prefecture, and expressed the Institute's intention to contribute to regional revitalization and new job creation in local areas, as well as expand initiatives for international joint projects and supporting overseas researchers.



Julien Perez

Vice President, Strategy & Policy, OGCI

Mr. Perez introduced the six main areas, including CCUS, that the Oil and Gas Climate Initiative (OGCI) is working on, and explained that OGCI has a 1-billion fund to invest in startups and various projects. He commented that decreasing greenhouse gas emissions, such as reduction by 70% or 80% by 2050, is an urgent matter in the energy world. He listed the reduction of methane emissions and leakage as well as the substantial expansion of CCUS as concrete measures for reducing emissions from oil and gas businesses, and highlighted the need to secure the science around methane and to create partnerships with stakeholders for the substantial expansion of CCUS over the next decade.



Concurrent Sessions

Grid Integration of Renewables

Panelists introduced that the data in the possession of regulators, utility companies and others, along with best-in-class tools and cloud-based computing power, could be used to visualize the power flow, and that this might become a key way of managing over-generation caused by broadly distributed generation. It was also pointed out that the value of grid flexibility is rising in the electric power market, that typical solutions such as lead-acid and lithium-ion batteries are working, and that hydrogen storage systems are being tested as a part of minigrids or microgrids in Uganda and Singapore. The importance of public consultation and public ownership of the idea of aiming to move toward a power system based on grid flexibility rather than baseload was stated. Given the diversity of resources, legal systems, and priority in renewable energy, room exists for experimenting with variations of market design at a suitable size, and panelists stressed that Kyushu would be a very interesting size for such experimentation.



Ajay Mathur (Chair)
Director General, The Energy and Resources Institute (TERI);
Member of the Prime Minister's Council on Climate Change



Douglas J. Arent
Deputy Associate Lab Director,
Scientific Computing and Energy Analysis,
National Renewable Energy Laboratory (NREL)



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



Peter Jørgensen
Vice President, Associated Activities, Energinet



Jens Jæger
Policy & Business Development Manager (Asia),
the Alliance for Rural Electrification (ARE)



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

Innovations in Nuclear Energy



In this session, the panelists exchanged their views on issues of nuclear energy and nuclear fusion for decarbonization and pointed out the following:

- 1) The language used to explain nuclear related technologies and potential of such technologies is frequently boringly technical and often deliberately misleading. The terminology poses a problem for public acceptance and the nuclear industry should take the blame for this. For example, shutdown is called 'scram' even though it is operated in a safe manner; the word denotes 'run away' according to dictionaries. Nuclear experts in the next generation will be expected to use terms which people can better assimilate, in order to take the mystery out of nuclear.
- 2) It is very important to keep to the construction timeframe to ensure cost reduction, as the extension of the construction timeframe would cause huge cost increase. Planned construction in a factory is needed with a controlled environment in which it can proceed as scheduled, similar to aircraft engine manufacturing.
- 3) Universities, where it is possible to bring new developments into closer proximity to each other, would play an important role in resolving the issue of the safety culture in the nuclear industry obstructing the introduction of new technologies into this industry.



Richard K. Lester (Chair)
Associate Provost, Massachusetts Institute of Technology



Robert C. Braun
Sr. Vice President & Chief Operating Officer,
Advanced Reactor Concepts



Sunil Felix
Nuclear Counsellor, French Embassy in Japan



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



Neil Wilmshurst
Vice President, Chief Nuclear Officer, Electric Power Research
Institute (EPRI)

Concurrent Sessions

Genetic Engineering for CO₂ Reduction

In contrast to many industrial chemical processes, natural bioprocesses are very efficient and environmentally friendly. Though CO₂ reduction is an urgent issue for humankind and biotechnology, including genetic engineering, needs to be utilized, most research in environmental fields such as photosynthesis, biofuels, CO₂ fixation and so on, appear to still be at the basic research level. In this session, the current status and future prospects of biotechnology aimed at reducing CO₂ were reported, as well as the ethical aspects. Several factors preventing the progress of research were pointed out, such as 1) low profitability discourages research activities in business, 2) the impact on the ecosystem is unclear, 3) the social and ethical impacts have not been well discussed and 4) the impression of genetic engineering is not good due to lack of opportunities for the public to acquire a solid understanding. Key takeaways from the discussion included: i) the impact on the ecosystem must be considered at all times; ii) the impression on consumers would vary depending on whether genetic improvement technology is used for food or for microorganisms that produce chemical products; and iii) since the functions of genes involved in processes such as photosynthesis are very complex, long-term studies and large budgets would be required in the future to understand what target genome should be edited to improve the processes.



Kuroda Reiko (Chair)

Designated Professor, Institute of Science and Technology Research, Chubu University;
Professor Emeritus, The University of Tokyo



Fujiwara Sumire

Senior Researcher, Plant Gene Regulation Research Group, Bioproduction Research Institute, National Institute of Advanced Industrial Science and Technology (AIST)



Inui Masayuki

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



Aono Yuri

Editorial Writer, The Mainichi Shimbun (The Mainichi Newspapers)

E-Mobility in Sharing Services and Fleets



After the presentations on the global expansion of sharing services for passenger vehicles and trends in electrifying freight transport systems, panelists highlighted the key drivers for e-mobility markets as follows: 1) various sharing services' options for short-range travel purposes including e-scooters and micro EVs, 2) utilization of e-trucks and e-bicycles to cover the last mile delivery, and 3) improvement of convenience and utilization rate through big data collection and usage. It was stated that the key policies of government for accelerating decarbonization are: i) formulating appropriate regulations/incentives, ii) supporting the standardization of companies' carbon accounting, and iii) re-modeling of infrastructure including charging points and parking lots.



Jon Moore (Chair)

Chief Executive Officer, BloombergNEF



Ali Izadi-Najafabadi

Head of Intelligent Mobility, BloombergNEF



Kumura Haruyoshi

Fellow of Nissan Motor Co., Ltd



Kuroda Toshio

Executive Officer, General Manager, Office of the President, Yamato Transport Co., Ltd.



Tom White

General Manager, JUMP North Asia, Uber

Concurrent Sessions

Digital Technology for Distributed Energy Resources

In this session, the value of using EVs and heat pump water heaters attracted participants' attention as means for effectively increasing self-consumption of renewable energy. It was highlighted that EVs could be solutions for balancing power supply and demand, as long as the grid maintains frequency and voltage, and panelist expressed the following views: 1) such services could not be provided by automobile manufacturers alone, 2) standardization of chargers is needed, yet they should not be disruptive to the grid, and 3) EV owners might have a negative attitude toward utilization of their vehicles for stabilizing the grid. Based on this discussion, the chair stated that the public has high expectations regarding utilization of distributed energy resources, but the situation lacks transparency; this calls for technological development and a social system that could operate and be utilized with distributed energy resources. Also, a regulatory framework would be important for business deployment.



Yamaji Kenji (Chair)

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



Yiğit GÜVEN

Director, New Market Development Asia & International Channel Strategy, Sonnen



Nemoto Koshichi

Director, Energy Innovation Center,
Central Research Institute of Electric Power Industry



Mattia Marinelli

Associate Professor in distributed energy resources at the Center for Electric Power and Energy, Department of Electrical Engineering, Technical University of Denmark (DTU)



Hayashi Ryusuke

Senior Manager, EV Operation Department, Global EV Division,
Nissan Motor Corporation

CO₂ Utilization



In this session, panelists pointed out that 1) the cost of CO₂ utilization would be reduced through scale-up of capital investment and decrease in the cost of energy, 2) carbon taxes, carbon pricing, and low carbon fuel standards such as in California would be incentives for promoting Enhanced Oil Recovery (EOR), and 3) because collection efficiency is important for CO₂ capture and utilization, the by-product gas of a specific chemical process was of note due to its very high CO₂ concentration stream. In addition, it was highlighted that vertical agriculture, even if it might only provide a few percent of the global food system, is an interesting approach because of advantages such as transport CO₂ emission reduction and effective land use, although it requires low carbon energy and addition of CO₂ to the system.



David Sandalow (Chair)

Inaugural Fellow, Center on Global Energy Policy, Columbia University
Co-Director, Energy and Environment Concentration,
School of International and Public Affairs, Columbia University



S. Julio Friedmann

Senior Research Scholar,
Center on Global Energy Policy,
Columbia University



Sally M. Benson

Professor, Department of Energy Resources Engineering,
School of Earth,
Energy & Environmental Sciences, Stanford University



Jennifer Holmgren

CEO, LanzaTech



Dohi Hideyuki

Director General, Environment and Green Chemistry Unit,
Technology Strategy Center (TSC), New Energy and Industrial
Technology Development Organization (NEDO)



Roger Aines

Energy Program Chief Scientist,
Lawrence Livermore National Laboratory



Aqil Jamal

Chief Technologist, Carbon Management Research Division,
Saudi Aramco's R&D Center

Concurrent Sessions

Climate Communications

Today, most people, not only scientists and highly educated people, know that climate change is happening, however they have not changed their habits. In this session, the following three opinions were expressed:

- 1) Conventional communication on climate change has been too negative to give people enough room to think, "if I change my behavior I can contribute to tackling climate change;"
- 2) Positive communication, such as to familiarize people with the concept that the installation of photovoltaic panels is a normal practice in the neighborhood, is needed; and
- 3) Behavioral changes can be triggered by new markets, such as Tesla's electric vehicles which can be perceived as "cool," and by installing more insulation in buildings to increase comfort.



Valli Moosa (Chair)
Former Minister for Environmental Affairs,
Republic of South Africa



Kameyama Yasuko
Deputy Director, Center for Social and
Environmental Systems Research,
National Institute for Environmental Studies



Philippe Fonta
Founder and CEO, SCRUM-Consult (Sustainability, Corporate
Responsibility and Uncertainties Management)



Tanaka Izumi
Senior Commercial Officer (Energy and Environment),
Royal Danish Embassy Tokyo



Ken Haig
Senior Director of Market Development & Regulatory Affairs,
Oracle Utilities

Green Urbanization



Ismail Serageldin (Chair)
Emeritus Librarian of Alexandria, Founding Director of the
Library of Alexandria



Dolf Gielen
Director of Innovation and Technology Centre,
IRENA



Nishida Yuko
Senior Manager, Climate Change,
Renewable Energy Institute



Nohara Fumio
President, Nikken Sekkei Research Institute

The following points were highlighted in the panel discussion.

- 1) Cities where urbanization is progressing, particularly in Africa, tend to become consumption cities, where the most of the citizens are living on cheap imported products. It is important for these cities to become productive, and provide education and employment opportunities to young people.
- 2) Although local governments are close to citizens and are able to understand their needs, they often lack budget and capacity. However, solutions can be found through collaboration between the cities, the national government and the stakeholders.
- 3) Facilitating educational opportunities for all children can not only safeguard their human rights, but also mitigate rapid population growth, according to past study results.
- 4) In rural areas of China, the directive to ban agricultural waste incineration and subsidies for low-emission agricultural machinery were implemented. Additionally, middle-class urban residents spend their weekends in rural areas to help farmers, which contributes to education on better living for farmers.
- 5) Regionally distributed power facilities are beneficial to local economies.
- 6) A primary care system employing AI and IoT has been introduced in China, which aids the local clinics and elderly population care.
- 7) A basic IT infrastructure is required, because leapfrogging digital technologies and mobile applications enhance further technological innovation and entrepreneurship; there have been cases of local issues resolved by combining existing technologies.



Jingjing Xu
Managing Partner and Founder,
Global Green Development Capital



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

Concurrent Sessions

Fuel Cells

Key takeaways from the discussion on the cost and quality of fuel cells and fuel cell electric vehicles (FCEVs) included: 1) in the past several years, fuel efficiency has been sacrificed and a lot of attention focused on technological developments to suppress initial costs while improving safety and durability. However, now it is necessary to look at the total cost of ownership (TCO); 2) in China, commercial vehicle operators place high importance on the purchase cost, resulting in TCOs that are somewhat high. Therefore, rather than focus solely on TCO, other ways to make FCEVs more attractive and acceptable to customers are called for; 3) since technological issues such as the use of large amounts of platinum still remain, academia can make some important contributions; 4) more active discussion on standardization and harmonization should take place; and 5) there are similarities and synergies between fuel cell technology and electrolysis technology that uses renewable energy to produce hydrogen.



Georg Erdmann (Chair)

Retired Professor for Energy Systems,
Berlin University of Technology;
President of the Board, KSB Energie AG, Berlin



Moriya Takashi

Senior Chief Engineer,
Technology Development Division 5,
Automobile Center, Honda R&D Co., Inc.



Alfred Wong

Managing Director,
Asia Pacific, Ballard Power Systems Inc.



Yan Zhou

Advanced Planning Senior Manager,
Planning and Program Management Dept., SAIC Maxus.



Sasaki Kazunari

Senior Vice President,
Kyushu University

Impact of Carbon Dioxide Removal Technologies



Key takeaways from the discussion on carbon dioxide removal technology included: 1) estimated scalability of carbon capture and storage (CCS) is 5.6 Gt including 2.5 Gt to 2.6Gt of bioenergy with CCS (BECCS), and by the contrast, Direct Air Capture (DAC) would depend on the energy supply and supply chain; 2) energy consumption of DAC is 7 to 8 GJ/t-CO₂; and 3) although the cost of CCS is \$100/t-CO₂ and DAC is \$150/t-CO₂, those estimated costs would change depending on the level of technology and market conditions. Panelists also discussed the risks of these technologies, including how BECCS would spoil food production and biodiversity, how deep water CCS would lead to maritime pollution, and how solar radiation management using stratospheric aerosol injection would lead to apprehension regarding air pollution, destruction of the ozone layer, radiation decrease and heterogeneous effects on the climate. It was highlighted that tradeoffs exist between those technological risks and climate change risks, and that there is a need for open dialogue among all experts.



Kurosaki Miho (Chair)

Head of Japan and Korea Research, BloombergNEF



Samantha McCulloch

Head of CCUS Unit,
International Energy Agency (IEA)



David Keith

Professor of Applied Physics and Professor of Public Policy,
Harvard University



Janos Pasztor

Executive Director,
Carnegie Climate Governance Initiative (C2G)



Hirai Shuichiro

Professor,
Department of Mechanical Engineering,
School of Engineering, Tokyo Institute of Technology

Concurrent Sessions

Energy Productivity through IT and AI

On the subject of model analysis, the panelists pointed out that: i) even if energy demand for a certain purpose could be reduced by digitization, the reduced amount might be used for other purposes; ii) further improvement is necessary, and information exchange on quantitative analysis methods and data is required to improve the model analysis; and iii) the objective function is the total energy consumption, but the control variables are highly-diversified. For the purpose of further progress in digitalization, the issues noted by participants were as follows: 1) concern for privacy protection and data security, 2) enormous investment required for new technology integration, such as AI, into existing infrastructure, 3) data quality, 4) return on investment (e.g. if the sales volume of electricity decreases due to digitalization, it causes decline in profitability of electric power companies), 5) engagement of people to gather opinions and then reflect them in projects, and 6) increment of energy demand for producing more semiconductors and processing the increasing volume of data.



Nebojsa Nakicenovic (Chair)
Executive Director, The World in 2050 (TWI2050)



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



Ohtake Satoru
Project Professor, Institute for Future Initiatives,
The University of Tokyo



Douglas J. Arent
Deputy Associate Lab Director,
Scientific Computing and Energy Analysis,
National Renewable Energy Laboratory (NREL)



Amemiya Shunichi
Head of Research and Development Headquarters,
NTT DATA Corporation



Noguchi Tatsuya
President & Representative Director,
ABB Bailey Japan Limited

Balance between the Benefits of Plastics and Marine/Land Ecosystem Protection



The panelists presented that plastics, which are used for such purposes as food packaging, apparel and reducing weight of materials, have specific values, i.e. healthy, hygienic, functional and economical. Also, results of experiments using tofu and strawberries were shown as examples of lifecycle assessment (LCA), and the importance of investigation based on LCA was highlighted. Initiatives for 3R (Reduce, Reuse and Recycle) and Replacement of plastics were also explained. The necessity of cooperation among various stakeholders including the government was emphasized in order to realize a circular economy with increased efficiency in collection, separation and recycling of plastics. Key takeaways from the discussion included: 1) solutions can vary depending on products (e.g., biodegradable plastic is a good solution for products which are difficult to collect); and 2) to realize a circular economy, merchandise should be attractive to consumers in order to encourage use.



Yasui Itaru (Chair)
President, Institute of Promotion for Sustainable Society
Honorary Adviser, National Institute of Technology and Evaluation (NITE);
Emeritus Professor, The University of Tokyo



Seki Motohiro
Managing Executive Officer, Chief Operating Officer,
Advanced Polymers Business Domain,
Mitsubishi Chemical Corporation



Titoy Francisco
Executive Vice President,
General Manager, Technical,
Coca-Cola (Japan) Company, Ltd.



Noda Yumiko
President & Representative Director,
Veolia Japan K. K. / Veolia Jenets K.K.



Tahara Kiyotaka
Director, Research Laboratory for IDEA,
Research Institute of Science for Safety and Sustainability,
National Institute of Advanced Industrial Science and Technology (AIST)



Eric Kawabata
APAC General Manager, TerraCycle



David J. Muenz
Executive Officer, Senior Vice President,
ESG Division, Kao Corporation

Side Events

Impact of Climate Change Countermeasures on Civilization

Prof. Jim Falk, Professorial Fellow, Melbourne Sustainable Society Institute, University of Melbourne gave a presentation on “the countermeasures to climate change.” Referring to the achievements of recent technological innovations, he stated that people around the world need to work together to create political will and that it is essential to change to a market where technical development advances vigorously.

Dr. Peter H. Gleick, President-emeritus, Pacific Institute for Studies in Development, Environment, and Security presented and discussed “the integration between energy, water and climate change.” He introduced that there was an enormous connection between water resources and various problems such as energy, economy, ecosystem, security, etc., and that using water efficiently not only led to saving energy related to water resources, but also had the potential to reduce greenhouse gases. He described the importance of water reuse, and thinking about water and energy at the same time.

After that, the two presenters held a discussion with Prof. Dr. Vaclav Smil, Distinguished Professor Emeritus, University of Manitoba, and participants, and the following two points were stressed: 1) regions where the populations are growing the most are vulnerable to climate change, and providing safe water and sanitation is an important aspect to save people from poverty caused by population growth; and 2) priority should be given to considering how to reduce food waste rather than whether or not to eat beef.



Transforming Industry: a Focus on CCUS

Ms. Samantha McCulloch, Head of CCUS Unit, International Energy Agency (IEA), pointed out that high-temperature heat and process emissions from fossil fuel utilization are the main routes of industrial CO₂ emissions, especially from iron and steel, cement and chemicals. She also stressed the fact that industrial facilities are very long-lived assets - over 50 years - and have the potential to lock in emissions for decades. She highlighted the importance of CCUS as countermeasures not only for these emission routes, but also for hydrogen production from fossil fuels and for coal-fired power plants. In addition, she mentioned the need to support CCUS deployment through development of CO₂ transport and storage infrastructure, public procurement of low-carbon products, and technological innovations. In the Q&A section, participants discussed the capacity of CO₂ storage and the future path of CO₂ utilization.

Solutions to Integrate High Shares of Variable Renewable Energy

Dr. Dolf Gielen, Director of Innovation and Technology Centre, International Renewable Energy Agency (IRENA), introduced that the costs of variable renewable energy (VRE) in G20 countries have been declining. He also pointed out that decentralization, electrification in combination with digitalization, and smart grids were trends related to rapidly increasing shares of VRE, and stressed the necessity of innovation, including system operation, business models, and market design. Regarding measures to add significant flexibility in Japan, he recommended examples such as production of hydrogen using surplus VRE, increasing the interconnection capacity, and charging EVs at peak times in solar PV generation.



Closing Session



① Remarks

Nakatani Shinichi, Parliamentary Vice Minister for Foreign Affairs, Japan

Aoyama Shuhei, Parliamentary Vice Minister of the Education, Culture, Sports, Science, and Technology, Japan

Yagi Tetsuya, Parliamentary Vice Minister of the Environment, Japan

② Final Thoughts on the Event

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

③ Top 10 Innovations Result Announcement

Yasui Itaru, President, Institute of Promotion for Sustainable Society;

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

④ Roadmap Announcement

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

Co-Director, Energy and Environment Concentration, School of International and Public Affairs, Columbia University

⑤ Statement from Steering Committee

Yamaji Kenji, Senior Vice President/Director-General, Research Institute of Innovative Technology for the Earth (RITE);

Professor Emeritus, The University of Tokyo

⑥ Closing Remarks

Ishizuka Hiroaki, Chairman, New Energy and Industrial Technology Development Organization (NEDO)

Statement

A set of principles and recommendations from the Steering Committee was announced as the “ICEF 2019 Statement from the Steering Committee” at the closing session.

ICEF 2019 Statement from the Steering Committee

October 10, 2019

1. Preamble

The sixth annual meeting of the Innovation for Cool Earth Forum (ICEF 2019) was held in Tokyo on October 9 and 10, with more than 1,000 participants from government institutions, international organizations, industry, and academia, from approximately 70 countries and regions. The theme of this year’s forum was “Bending down the emissions trajectory by Innovation and Green Finance.” Global CO₂ emissions are increasing at about 2% per year, which is in line with the long-term historical trends since the beginning of the industrial revolution. We affirm our goal of achieving net-zero CO₂ emissions, meaning that immediate peak and vigorous decline of CO₂ emission is necessary. Since the gap between current trends and our goal is still getting worse, we have to re-emphasize the necessity of innovation in deployment as well as R&D, which are the key to narrow the gap. Additional policy measures such as fiscal incentives and new technologies that could reduce emissions at scale must be deployed on an urgent basis. ICEF’s mission is to facilitate discussion and encourage cooperation among participants with a view to promoting technological and social innovation in the field of energy and environment. The following statement summarizes how the world will accelerate actions that should be taken with high priority.

2. Importance of ESG investing and a virtuous cycle of environment and growth

At the G20 Ministerial Meeting on Energy Transitions and Global Environment for Sustainable Growth held in June, ministers realize the importance of a virtuous cycle of environment and growth that is strongly supported by innovations, mobilization of finance including investment, and improvement of the business environment. According to G20 Ministerial meeting's communiqué, the G20 Energy Ministers will step up existing international efforts to unlock the potential of hydrogen as a clean, reliable and secure source of energy including cooperation in research and development, evaluating hydrogen’s technical and economic potential, cost reduction pathways and addressing the various challenges including regulations and standards. Fundamental decarbonization of industrial activities is one of the major challenges to realize net-zero CO₂ emissions. New approaches such as CCUS, hydrogen-based direct reduced iron, carbon recycling and zero-emission cement are inevitable. While recognizing that public finance and gender lens investing plays an important role, we call upon all players to support efforts to mobilize private finance and increase transparency through more enhanced climate-related financial disclosure based on the TCFD’s recommendation with effective communication between business and financial sectors, as well as to improve the market and investment environment. During ICEF 2019, these topics were taken up in the three plenary sessions. In addition, twelve different approaches to accelerating innovation—six in the social context and six in the technological context—were chosen and discussed in depth in concurrent sessions. Conclusions are as follows:

3. Acceleration of activities toward realization of Social Innovation

- For promotion of larger scale deployment of carbon dioxide removal technologies, social understanding and awareness as well as the clarification of the magnitude of emission reduction are indispensable.
- Involvement of businesses as well as customers in accelerating technologies and innovation is of great importance. Enhancing the efficacy of climate communications could contribute widely.
- Electrification of the transport sector requires enhancement of electricity infrastructure, including massive expansion of EV charging systems.
- Scaling up renewable energy use and extensive introduction of Zero Energy Buildings could contribute to coping with growing energy demand and to easing environmental damages, such as air pollution resulting from rapid urbanization.
- Demand-side driven transformation has been happening; and digitalization utilizing AI and IT devices as core technology can contribute to the realization of a low energy demand scenario.
- Evaluation of benefits and impacts of plastics at each phase of use, such as value of plastics use for durable products and contribution to food preservation, is necessary to substantially protect the marine and land ecosystem, as well as could contribute to the development of alternatives for plastics.

4. Acceleration of activities toward the realization of Technology Innovation

< Innovations in deployment stage >

- Deployment of existing renewable technologies such as solar, wind and storage should be accelerated. Advancing grid technologies and acknowledging economic value of system stabilization can contribute to the efficient use of renewable energy. Microgrid technology utilizing renewable energy and network technologies can play an important role in improving grid resilience.
- Expanding the use of fuel cells, setting standards for element technologies, as well as the standardization and modularization of total systems are major concern.
- Wider application of digital technology on both the supply and demand side of electricity and heat such as remote control and unmanned operation, enables efficient use of distributed power sources.

< Innovations in R&D stage >

- Small modular and nuclear fusion reactors are currently under development by various actors, including venture businesses. Policy and R&D strategy from a longer-term perspective will effectively guide actors, especially venture businesses, in their endeavors.
- The rapid advancement of genome technologies shows huge potential in contributing to CO₂ emission reductions, but such technologies need to be treated carefully from an ethical perspective to avoid negative implications.
- In order to promote research and development in the field of CO₂ utilization, comprehensive assessment of life-cycle CO₂ emission/absorption is recommended.

5. Strategies for bending down the emissions trajectory

Achieving and deploying innovation requires the engagement of all industrial sectors, academia, governmental institutes, financial institutions, and investors in promoting research, development, investment, and business creation. Although “Bending down the emissions trajectory” itself is difficult to realize at this immediate moment, the short-term target should be attained within a few years to pave the way towards the long-term goal of net-zero emissions. We call upon all players to join forces in further cooperation and collaboration, and to carry out with unprecedented urgency the “Three Key Actions” identified at ICEF 2018: 1) inspire investment in technology, products, and services for green growth; 2) involve industry and consumers in accelerating technologies and innovation for decarbonization; and 3) internationalize cooperative efforts for deploying innovation outcomes. In addition, we call for urgent policy support for accelerated emission reduction from carbon-intensive facilities.



Top 10 Innovations

“Top 10 Innovations” is an event to select the most notable recent innovative developments in energy and climate change mitigation. This year, 20 nominees from 2 categories, “Research & Development: Commercial Potential of the Technological Innovation by 2050” and “Adoption & Implementation: Commercial Potential of the Technological Innovation by 2030” were selected by the Top 10 Innovations working group. Ultimately, ICEF 2019 Top 10 innovations were selected as follows through votes by ICEF 2019 participants.

Category Research & Development:
Commercial Potential of the Technological
Innovation by 2050

Carbon-neutral fuels made from sunlight and air



Solar mini-refinery for sustainable fuels at ETH Zurich
Source : Aldo Steinfeld et al
<https://ethz.ch/en/news-and-events/eth-news/news/2019/06/pr-solar-mini-refinery.html>

Organization ETH Zurich

The solar mini-refinery on the roof of ETH Zurich demonstrates the technology for the thermochemical production of carbon-neutral liquid hydrocarbon fuels. Using concentrated solar energy, a high-temperature solar reactor splits CO₂ and water extracted directly from ambient air and produces syngas, which is processed into hydrocarbons such as kerosene or methanol. These drop-in fuels are carbon neutral because they release only as much CO₂ during combustion as was previously extracted from the air, and can therefore contribute particularly to sustainable aviation and shipping.

Category Research & Development:
Commercial Potential of the Technological
Innovation by 2050

A new chemical catalyst based on indium oxide that converts CO₂ and hydrogen into methanol



Source : ETH Zurich

Organization ETH Zurich

ETH Zurich succeeded in boosting the activity of the catalyst for methanol production via CO₂ hydrogenation, without affecting its selectivity or stability. They achieved this by treating the indium oxide with a small quantity of palladium. ETH Zurich and Total have jointly filed a patent for the technology. Total now plans to scale up the approach and potentially implement the technology in a demonstration unit over the next few years.

Category Research & Development:
Commercial Potential of the Technological
Innovation by 2050

New minerals for carbon capture



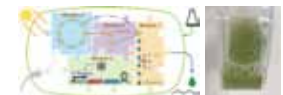
Capture and storage of CO₂ in the subsurface of mine wastes.
Hydrotalcite minerals (naturally occurring layered double hydroxides) are storing atmospheric CO₂ in finely ground ultramafic mine wastes (tailings).
Source : University of Alberta, University of British Columbia and University of Queensland.
(<https://www.ualberta.ca/science/science-news/2018/december/carbon-sequestration-new-minerals>)
Turvey, C.C., Wilson, S.A., Hamilton, J.L., Tait, A.W., McCutcheon, J., Beinlich, A., Fallon, S.J., Dipple, G.M., and Southam, G. (2018) International Journal of Greenhouse Gas Control, 79, 38–60. doi:www.doi.org/10.1016/j.ijggc.2018.09.015

Organization University of Alberta,
University of British Columbia and University of Queensland

An international research team from multiple universities has confirmed new minerals, members of the hydrotalcite supergroup, are capturing and storing atmospheric CO₂.

Category Research & Development:
Commercial Potential of the Technological
Innovation by 2050

Solar energy becomes biofuel without solar cells



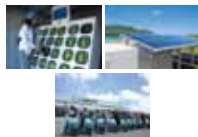
Cyanobacteria producing 1-butanol from solar energy and CO₂.
Source : Uppsala University

Organization Uppsala University

Uppsala University has successfully developed microorganisms that efficiently produce butanol directly from carbon dioxide and solar energy, without the need for biomass or solar cells.

Category Adoption & Implementation:
Commercial Potential of the Technological
Innovation by 2030

A sharing service using battery-replaceable electric smart scooter and a charging station for replaceable batteries



A sharing service using battery-replaceable electric smart scooter
Source : e-SHARE
Ishigaki Co., Ltd.

Organization e-SHARE Ishigaki Co., Ltd.

e-SHARE Ishigaki started a sharing service “GO SHARE” in Ishigaki City, Okinawa Prefecture, using Gogoro's battery-replaceable electric smart scooter and a charging station for replaceable batteries. At the charging station, it can be replaced with a charged battery in about 6 seconds. Solar panels and recycled batteries from Nissan LEAF are installed at some of the charging stations, and can be used as emergency power for disaster prevention bases in the event of a disaster.

Category Adoption & Implementation:
Commercial Potential of the Technological
Innovation by 2030

Commercialization of alcohol-to-jet, sustainable aviation fuel



• sustainable aviation fuel, fuel time
• sustainable aviation fuel, into wing
• LanzaTech Freedom Pines Biorefinery, Georgia, USA
Source : LanzaTech

Organization Lanza Tech

LanzaTech is using their advanced microorganism-powered gas fermentation technology to create ethanol from waste carbon pollution. 4,000 USG of jet and 600 USG of diesel was produced from ethanol in their facility in Georgia, USA and a portion of this fuel was used to power a commercial flight operated by Virgin Atlantic from Orlando, Florida to London in 2018. In June 2019, All Nippon Airways (ANA) signed an offtake with LanzaTech to purchase sustainable aviation fuel.



Category Adoption & Implementation:
Commercial Potential of the Technological
Innovation by 2030

Megawatt-scale solid polymer hydrogen generation system enclosed in a 40-foot container



Hydrogen Generation System "HYDROSPRING" and Water Electrolysis Cell
Source : © Hitachi Zosen Corporation

Organization Hitachi Zosen Corporation

Hitachi Zosen Corporation started selling PEM-type hydrogen generation system "HYDROSPRING" in 2000 and have developed larger one enclosed in a 40-foot container. This is the first type in Japan. HYDROSPRING has a capacity of 200Nm³/h for enabling the storage of surplus power at megawatt-scale power generation facilities and have been developed by uniting of Hitachi Zosen's own technologies, electrolysis and filter press. That system installed in container so that it can be installed easily and there is no need of constructing the building. Through this Power to Gas system, Hitachi Zosen contribute to expansion of renewable energy and realizing the sustainable hydrogen society.

Category Adoption & Implementation:
Commercial Potential of the Technological
Innovation by 2030

Floating offshore wind power generation system in shallow water area



Barge-type floating body "HIBIKI"



Demonstrator of barge-type floating offshore wind power generation system
Source : NEDO

Organization NEDO
(Marubeni Corporation, Hitachi Zosen Corporation, GLOCAL corporation, Cosmo Eco Power Co., Ltd., The University of Tokyo, Kyuden Mirai Energy Company, Incorporated)

NEDO and Marubeni et al. have developed a floating offshore wind power generation system with a 3 MW turbine at about 15 kilometers off the coast of Kitakyushu, western area in Japan. This system has a compact turbine with two blades on a steel barge type floating body and a mooring system with studless chains and super high holding power anchors, which is installed in relatively shallow waters with a depth of about 50 meters.

Category Adoption & Implementation:
Commercial Potential of the Technological
Innovation by 2030

Electrothermal energy storage system can store up to 130 megawatt-hours of thermal for a week in volcanic rock



Source : Siemens Gamesa

Organization Siemens Gamesa

Siemens Gamesa has begun operation of its hot-rock thermal energy-storage system. Around 1,000 tons of volcanic rock is used as the storage medium. The pilot plant converts electrical energy into hot air using a resistance heater and a blower in order to heat the rock up to 750 degrees C. When required, it converts the stored thermal energy back into electricity using a steam turbine.

Category Adoption & Implementation:
Commercial Potential of the Technological
Innovation by 2030

Fully-integrated flow battery



40 kWh, 10 kW module Includes BMS, cooling, enclosure



2 MWh, Gonghe, China Operator: Huanghe Hydro / SPIC



1 MWh, Iowa, USA Operator: Ideal Energy / MUM



0.5 MWh, Alabama, USA Operator: Southern Hydro / EPRI

Organization Avalon Battery Corporation

Avalon manufactures "utility grade" energy storage that is dependable, safe, and economical. From facilities in Canada, the USA and China, Avalon has delivered unparalleled durability to projects around the world, with current installations in the USA, China, Australia, Korea and Spain.



Source : Avalon Battery Corporation

Roadmap Projects

ICEF develops roadmaps on how key innovative technologies can contribute to a transition to clean energy.

At the ICEF 2019 side event, the draft version of the roadmap on Industrial Heat Decarbonization was presented.

Mr. David Sandalow, Inaugural Fellow, Center on Global Energy Policy, Columbia University, Dr. S. Julio Friedmann, Senior Research Scholar, Center on Global Energy Policy, Columbia University, and Dr. Roger Aines, Energy Program Chief Scientist, Lawrence Livermore National Laboratory, presented the background of the draft, technology options for low-carbon industrial heat, case studies on each industrial sector, innovation challenges, policy instruments, future challenges, and recommendations.

After the presentation, the following key takeaways were stated as the main message: 1) 5 Gt of CO₂, which accounts for approximately 10% of the world's CO₂ emissions and is greater than the sum of emissions from cars and airplanes, is emitted annually when industrial heat is produced, and 2) various issues exist, including: the large amount of low-cost carbon-free power; special sensors and hydrogen pipelines being necessary to supply and burn hydrogen; calculation of carbon footprint, calculation of cost, land use, food competition, necessity of water resources, nitrogen oxides, chemical fertilizers, uneven regional distribution associated with biomass use; the design of new electric heating equipment that can be heated to high temperatures; and the distance from the CO₂ storage area. Thus, a great deal of study is required.

After that, with a view to long-term competitiveness in the future, they recommended construction of new steel mills for developing countries at specific sites close to the CO₂ storage area, as direct reduction iron and arc furnaces. Furthermore, participants commented on the need to develop alternative materials for steel and cement.

The draft was released for public comment in addition to the discussion at ICEF 2019. After revisions to reflect the comments, the definitive version was presented at COP25 in Madrid, Spain.



Steering Committee Members



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



Georg Erdmann
Retired Professor for Energy Systems,
Berlin University of Technology;
President of the Board, KSB Energie AG, Berlin
Germany



Kuroda Reiko
Designated Professor, Institute of Science and
Technology Research, Chubu University;
Professor Emeritus, The University of Tokyo
Japan



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



Jon Moore
Chief Executive Officer, BloombergNEF
United Kingdom



Nebojsa Nakicenovic
Executive Director, The World in 2050 (TWI2050)
Austria



Ismail Serageldin
Emeritus Librarian of Alexandria,
Founding Director of the Library of Alexandria
Egypt



Laurence Tubiana
CEO, European Climate Foundation;
Chair of the Board of Governors, French Development
Agency (AFD);
Professor, Sciences Po Paris
France



Yasui Itaru
President, Institute of Promotion for Sustainable Society;
Honorary Adviser, National Institute of Technology and
Evaluation (NITE);
Emeritus Professor, The University of Tokyo
Japan



Sally M. Benson
Professor, Department of Energy Resources Engineering,
School of Earth, Energy & Environmental Sciences,
Stanford University;
Co-Director, Precourt Institute for Energy,
Stanford University
United States



Eija-Riitta Korhola
Delegate of the Consultative Commission on Industrial
Change;
Advisor in the EU Affairs
Finland



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



Ajay Mathur
Director General, The Energy and Resources
Institute (TERI);
Member of the Prime Minister's Council on Climate
Change
India



Valli Moosa
Former Minister for Environmental Affairs
Republic of South Africa



David Sandalow
Inaugural Fellow, Center on Global Energy Policy,
Columbia University;
Co-Director, Energy and Environment Concentration,
School of International and Public Affairs,
Columbia University;
United States



Vaclav Smil
Distinguished Professor Emeritus, University of
Manitoba
Canada



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



ICEF 2020

Save the Date

7th Annual Meeting

OCTOBER 7-8 2020
TOKYO

Follow us on LinkedIn

<https://www.linkedin.com/company/icef-forum-tokyo/>

