Innovation for Cool Earth Forum

ICEF2018 Report

METI
Ministry of Economy, Trade and Industry

NEDO

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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ICEF2018 Report

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.

5th Annual Meeting

Date October 10 and 11, 2018

Venue Hotel Chinzanso Tokyo, Japan

Hosts

METI Ministry of Economy, Trade and Industry

NEDO

Co-hosts

MOFA Ministry of Foreign Affairs

Ministry of the Environment

Participants More than 1000 participants from governments, international organizations, the business sector and academia representing about 70 countries and regions

Overall theme

Driving Green Innovation

Outcomes of ICEF 2018

- Top 10 Innovations
- Roadmap Projects on Direct Air Capture of Carbon Dioxide
- Statement from the Steering Committee

Program

DAY 1（Wednesday, October 10）

10:00-10:30 Opening Session

Opening Remarks

Keynote Discussion

10:30-12:00 Plenary Session 1

Cool Capitalism

12:00-13:30 Lunch / Side Event

12:10 – 12:40 Side Event: Top 10 Innovations

12:50 – 13:20 Side Event: Digitalization and the Transformation of Cities and Communities

12:50 – 13:20 Side Event: IPCC Special Report Global Warming of 1.5 °C

13:30-15:00 Plenary Session 2

Mobility Transition

15:00-15:15 Executive Talk

Environmental Initiatives of Mitsubishi Electric Corporation

15:15-15:45 Short Break

15:45-17:45 Concurrent Sessions 1

15:45 – 17:45 Circular Economy

15:45 – 17:45 IoT for CO_2 Reduction

15:45 – 17:45 Hydrogen

15:45 – 17:45 Growing Renewable Energy and Grid Stabilisation

18:00-20:00 Official Dinner

DAY 2（Thursday, October 11）

10:00-12:00 Concurrent Sessions 2

10:00 – 12:00 Decarbonisation by Industrial Sector

10:00 – 12:00 Renewable Microgrid and Energy Access

10:00 – 12:00 Small Modular Reactor for Nuclear

10:00 – 12:00 CCUS

12:00-13:30 Lunch / Side Event

12:10 – 13:05 Side Event: ICEF2018 Roadmap: Direct Air Capture

13:30-15:30 Concurrent Sessions 3

13:30 – 15:30 SDGs for Business Activity

13:30 – 15:30 Smart Consumers

13:30 – 15:30 Fintech for Climate Change

13:30 – 15:30 Biorefinery

15:30-16:00 Short Break

16:00-17:30 Plenary Session 3

Inclusive Action towards a Net-zero Emissions Future

17:30-18:00 Closing Session

Closing Remarks

Final Thoughts on the Event

Top 10 Innovations Result Announcement

Roadmap Announcement

Statement from Steering Committee

Opening Session

Opening Remarks

Video message from Shinzo Abe, the Prime Minister of Japan

The global environmental and economic situation has transformed over the last several years. Countermeasures in response to global warming are no longer a cost to companies but a source of competitiveness. Companies that actively address environmental issues will be able to attract finance from around the world, enabling future economic growth and further countermeasures. This transformation, which can be called "the virtuous cycle of environment and economic growth" has advanced at a tremendous speed on a global scale over the past five years or so. Against this backdrop, I really think that the theme for this year's ICEF, "Driving Green Innovation" , with business in the lead matches these global trends. It is my hope that ICEF, which brings together the world's leading pioneering corporate executives, researchers, and government officials, will play an important role in leading the trends of the times, and represent a significant step towards solving the issue of global warming.

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

This year marks the fifth time the Innovation for Cool Earth Forum (ICEF) has been held since it was launched in 2014. I would like to express my appreciation that ICEF has developed into a global conference attended by over 1,000 experts from more than 70 countries around the world. I feel that, along with the growth of ICEF, its global influence and role in climate change countermeasures have also grown. For example, past ICEFs have drafted technology roadmaps for solar power generation and energy storage including batteries. These roadmaps have a track record of being quoted in reports by the IEA and the U.S. Department of Energy, as well as academic papers. I would like to thank everyone for their contributions and humbly request for your continued cooperation for the development of ICEF going forward.

It goes without saying that innovation will play a significant role in solving the issue of climate change, and I would like to consider what we should do to realize innovation. I think that there are three keys to innovation.

First of all, set a highly challenging vision. It is important to set inspirational, ultimate goals, which are unattainable without transcending bottom-up discussions, and pursue all possibilities to achieve these goals. In Japan, the public and private sectors have set forth major visions and are striving to achieve them. For example, in the automotive industry, a long-term goal of Well-to-Wheel Zero Emission that aims for zero total CO_2 emissions from the stage of fuel extraction to driving has been established, and innovation in pursuit of this goal is underway.

The second is selection and concentration in R&D. In order to drive energy transition and decarbonization, it is important to make decisive and focused investments of resources in technologies that are particularly promising, with the aim of accelerating innovation, while promoting the development of innovative technologies in multiple fields. In Japan, focused R&D centered around five areas, including hydrogen and next generation industrial processes, is underway based on the 5th Basic Energy Plan.

The third is the pursuit of global open innovation. In order to achieve the ambitious vision of the Paris Agreement, it is necessary to gather the world's collective wisdom and realize disruptive innovations. Japan will lead opportunities for global coordination including the hosting of the Hydrogen Energy Ministerial Meeting in addition to the ICEF. At this year's ICEF, discussion will be held on new technologies such as those related to mobility and hydrogen, on the industrial sector's innovative initiatives, as well as on financial measures, with the aim of solving the issue of climate change through innovation. I expect that people who are at the forefront of the global response to climate change will have lively discussions at ICEF. I also strongly hope that the discussion at ICEF will generate "Green Innovation" leading to sustainable growth all over the globe.

Keynote Discussion

Mr. Nobuo Tanaka, Chair of the ICEF Steering Committee, introduced this year's overall theme as Driving Green Innovation, aiming at the ultimate goal of achieving net-zero CO_2 emissions and the necessity of actions, especially in the business sector. He also pointed out that financial institutions' engagement through ESG or SDG investment is quite helpful.
Mr. Xie Zhenhua, Special Representative for Climate Change Affairs, China, stressed that a lot of climate problems have been witnessed in many countries. His recommended methods to combat climate change include: 1) lower energy consumption, 2) increase non-fossil fuel energy and 3) promote a low carbon lifestyle. He also highlighted that China is willing to work with other countries hand-in-hand to promote a common environment which is beneficial for all humankind.
Dr. Thelma Krug, Vice-Chair of IPCC, summarized the IPCC Special Report. She advocated that limiting global warming to 1.5 degrees is not impossible and has clear benefits compared with 2 degrees, though it requires unprecedented transition in all aspects of society.
The panelists discussed ways to achieve net-zero CO_2 emissions. Key takeaways from the discussion included: 1) international collaborations are necessary, as well as technology innovation and investment, 2) mix of political will and transparency in terms of what policy plans would attract innovation and investment are crucial factors and 3) international cooperation has to change completely to become stronger, and realize effects for developing countries.

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

Thelma Krug
Vice-Chair of the Intergovernmental Panel on Climate Change (IPCC)

Xie Zhenhua
Special Representative on Climate Change Affairs, China

Plenary Session 1

Cool Capitalism

In this session, the panelists talked about the nexus between the financial sector and manufacturing sector, notably how the financial sector is affecting the industrial sector. It was highlighted that there is a trend towards ESG investment and disclosure under initiatives such as TCFD, and that the industry is responding to the trend through measures such as using internal carbon pricing or leading carbon efficiency. Key takeaways from the discussion included: 1) there is a trend for investors to favor companies who are putting forth greater efforts towards sustainability and 2) industry's view is that activities to reduce climate impact are an opportunity to differentiate investment.

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

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

At the beginning, Mr. Mizuno noted that the goal of GPIF is to make the global capital market more sustainable, and stated their commitment to eliminating short-termism from their investment chain. He stressed the importance of ESG integration as vital to portfolio management, and reported that GPIF is incorporating ESG and proactively engaging with businesses, though GPIF has a policy of no divestment. He introduced GPIF's activities, such as expanding ESG investment from equity to fixed income, its recent launch of the Global Environmental Index, and publication of its ESG activities.
Mr. Mizuno also pointed out that innovation is necessary to reach the Paris Agreement aims, and that it is the responsibility of investors to make sure those innovations are financed.

Yves Perrier
Chief Executive Officer of Amundi Asset Management

Mr. Perrier highlighted Amundi's ESG strategy, based on the convictions that long-term investors have a responsibility to consider the interests of society, and that there is no contradiction between financial performance and interests of the society in general. He also pointed out that ESG rating is integrated into their voting policy, which provides incentive for companies to take this into account. Mr. Perrier also noted that ESG criteria can be incorporated in passive as well as active management, and stated the company's objective that, by 2021, all its funds will have an ESG rating, and that ESG assets under passive management will be doubled. He concluded that, due to these efforts, ESG is becoming mainstream as well as a part of the service Amundi provides to its clients.

Nobuhide Hayashi
Chairman, Mizuho Bank, Ltd.

Mr. Hayashi stated that companies should consider environmental issues, not passively and defensively in terms of compliance and CSR, but proactively as an opportunity for future growth, and incorporate SDG and ESG in their strategies. He also noted that financial institutions should leverage their ability to communicate with their clients to help transform their policies. He cited Japan's competitive edge in environmental technology in areas such as CO_2 capture and recycling, but noted that such accomplishments are not appreciated due to insufficient disclosure. Mr. Hayashi stressed the role of financial institutions in promoting transformation to a sustainable society as proposed by the Paris Agreement and SDGs.

Yoshihiro Hasebe
Member of the Board and Senior Managing Executive Officer and Senior Vice President, R&D, Kao Corporation

Dr. Hasebe focused on the consumption of plastics, notably the issues of plastic waste in the oceans and microplastics. He highlighted the deficiencies in waste management in some regions' cultures, and cited the company's activities; refill packaging, smart forest, and "recycreation," where additional value is created through systematic and easy-to-use combinations of reuse and recycling. Through this, products are not downgraded but upgraded, for example from packages to children's playing blocks. He concluded with a call for cooperative action to reduce plastics.

Ahmad O. Al Khowaiter
Chief Technology Officer, Technology Oversight & Coordination, Saudi Arabian Oil Company

Mr. Al Khowaiter announced Aramco's vision of becoming a leading integrated energy and chemicals company. He stressed that a third of Aramco's research is focused on sustainable technologies, and highlighted their associated gas recovery system, high-efficiency cogeneration, and carbon capture projects as leading results. He also noted Aramco's research on advanced transport technologies and mobile carbon capture, and the conversion of hydrocarbons to chemicals, using hydrogen as fuel and carbon for materials. Mr. Al Khowaiter highlighted the large variation in the carbon footprint of oil, which provides an opportunity to differentiate investment, providing incentive to improve carbon efficiency.

Plenary Session 2

Mobility Transition

At the beginning of this session, it was noted that the world is on the cusp of a major mobility transition, yet this is not the first mobility transition in history. After citing examples of electric subways, horse-drawn carriages giving way to automobiles, and motorization in China, the trend of automated, connected, electric, and shared (ACES) mobility was pointed out as a future transition. Key takeaways from the discussion included: 1) competitiveness of EVs and FCVs, where the panelists noted a declining trend in cost, with some models being at a competitive level with internal combustion engines; and 2) the current share of EVs has exceeded 1%, which signals that we can have high expectations for advancement. The necessity to improve the performance of batteries was also highlighted, as well as the issue of charging during the day and material recycling.

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

Liu Xueliang
General Manager, Asia-Pacific Auto Sales Division,
BYD Auto (BYD COMPANY LIMITED)

Mr. Liu noted that his company wishes to solve the two major issues of cities, environmental pollution and congestion, through electric vehicles and monorails. He stated that introduction of electric buses and taxis, which have high daily mileage, served as a beneficial demonstration toward gaining customers' confidence; and the performance of vehicles operating worldwide helps to establish confidence in the EV itself. He explained that the company plans to expand to intercity connections utilizing monorails. Mr. Liu also pointed out that the challenges that EVs face cannot be resolved by the efforts of a single company or a single country, and called for society-wide cooperation in areas such as battery recycling.

Takeshi Uchiyamada
Chairman of the Board of Directors, Toyota Motor Corporation

Mr. Uchiyamada explained the reasons why the company thinks that hydrogen is an important energy source, namely that it does not emit CO_2 when used, it can be produced from a variety of primary energy sources, it can be produced and consumed locally, and it can be stored and transported easier than electricity. He noted that Toyota's hydrogen-powered FCV, Mirai, is a product of 2 million km of test driving, and its global sales have risen to a total of 7,000 units to date. Mr. Uchiyamada stressed that the realization of a hydrogen-based society requires working together with all stakeholders including governments and customers, and expressed the will to promote such networks and collaboration across different stakeholders.

Peter Kronschnabl
President and CEO of BMW Group Japan

Mr. Kronschnabl highlighted BMW's efforts which cover all aspects of ACES, stressing that transformation in business structure is needed, and that this trend must accommodate sustainability. He illustrated BMW's commitment to sustainability throughout the lifecycle of cars by citing BMWi, its electric vehicle sub-brand. Examples of sustainability include the use of recycled or biogenic materials, and powering factories by renewables. Mr. Kronschnabl also introduced other initiatives such as Drive Now, a combination of EV-based car sharing and public transport, and Charge Forward, a collaborative project with a power company to aid grid stability by optimizing EV charging time. These kinds of activities respond to mobility transition while simultaneously responding to demands for sustainability.

Executive Talk

Environmental Initiatives of Mitsubishi Electric Corporation

This session explored Mitsubishi Electric Corporation's activities to reduce carbon dioxide gas that have generated a variety of high-efficiency devices and solutions to achieve the goal of a low carbon society. 1) Room air conditioner series that has received many awards, 2) net Zero Energy Building (ZEB) and 3) hybrid storage battery system for facilitating and expanding the utilization of renewable energy, were highlighted as examples. Also, the company launched the first large-scale plastic recycling plant in Japan in 2010 and observation satellites that monitor concentration and distribution of GHG, as well as water runoff and forest degradation. All combined, Mitsubishi Electric's products and initiatives contribute to creating a low-carbon, recycling-based society.
In the subsequent discussion, the following topics were highlighted: 1) the Paris agreement is impacting business in that it is driving business in the right direction. 2) The next decade will be the era of IoT and Mitsubishi Electric Corporation is endeavoring to connect all their equipment to provide a total system with optimum control and efficiency.

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

Masaki Sakuyama
Chairman, Mitsubishi Electric Corporation

Plenary Session 3

Inclusive Action towards a Net-zero Emissions Future

This session focused on inclusive action of the private sector and the regions, which may be leading us toward net-zero CO_2 emissions. It highlighted that the private sector and the regions might be steering the pursuit for new technologies. In the discussion, the panelists converged on the need for urgent action and expected governments to take the role of providers of regulatory stability. Key takeaways from the discussion included: 1) sustainable policies are needed to realize a sustainable society and 2) it is important to ensure that long-term visions are not destroyed or eroded by a belief that the policies will not be sustainable themselves.

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

Tatsuo Ogawa
Executive officer, Innovation Promotion Sector, Manufacturing Technology and Engineering Division, Panasonic Corporation

Mr. Ogawa introduced Panasonic's Environmental Vision 2050, which sets a commitment for the company to create more energy through its products than the energy consumed by its business activities and products. He noted that this is a very difficult target, but stressed the company's intention to achieve the goal through renewables, storage, hydrogen and energy-efficient products, as well as sustainable society measures embodied by "zero emission factories" currently being introduced. He also stated that the circular economy is the foundation of all the company's activities. Mr. Ogawa also discussed the choice between hydrogen and electricity, proposing that hydrogen is suitable for large-scale applications whereas electricity has the opposite characteristic.

Pascal de Sain
Vice President, DSM Advanced Solar

Mr. de Sain recalled that DSM has transformed itself from a coal mining company to a health and nutrition company committed to renewables. He noted, however, that the biggest transition, to a company with sustainability as a purpose, is yet to come. He stated that DSM aims to improve the impact of its operation, with goals to reduce greenhouse gas emissions by 30% by 2030, and increase the proportion of renewables from 21% in 2017 to 75% by 2030. The company aims to enable its customers to deliver more sustainable solutions, as well as be active in advocacy, such as introduction of carbon pricing. In closing, Mr. de Sain noted the need to engage customers and shareholders, and the need for leadership.

Sarah Chandler
Senior director of Operations Product Development and Environmental Initiatives, Apple Inc.

Ms. Chandler stated that Apple's goal is to make products without taking from the Earth, which requires renewable energy, safer materials and resource conservation. She noted that Apple has achieved 100% procurement from renewable energy, and underscored the importance of engaging government and energy providers. She emphasized that Apple is on its way to reducing emissions throughout its manufacturing processes, and efforts to engage its suppliers to procure renewable energy are underway, although she warned that it won't be easy for Apple or its manufacturing partners. Other efforts include conserving resources by using only recycled or renewable materials in production, and adopting safer materials. Ms. Chandler also emphasized the need for further work through partnership with governments and NGOs.

Robert B. Weisenmiller, Ph.D.
Chair, California Energy Commission

Dr. Weisenmiller noted that California's GHG emissions represent 1% of the world's total, half of which is transport-related. He stated that California's targets include achieving 100% renewable electricity by 2045 as well as introducing 5 million zero emission vehicles by 2030. He also noted California's new policy to require rooftop solar, and projected that this will be cost effective since it will bring about reductions in marketing costs. Dr. Weisenmiller emphasized that the urgency to act stems from the actual impact of climate change, as evidenced in forest fires, coastal erosion and large temperature extremes, affecting traffic and power grid planning.

Toshiyuki Hata
Vice-Governor of Fukushima Prefecture

Mr. Hata underscored Fukushima prefecture's goal to establish a sustainable society without relying on nuclear power. To this end, he stated that the prefecture aims to generate renewable energy in excess of demand by 2040, and noted that progress is on track. He also noted plans to increase transmission capacity. The prefecture has established a research facility on renewables, as part of its efforts to promote renewable energy. Mr. Hata also cited a 10MW hydrogen production / transport / storage project as an example of research activities. He further noted outreach efforts such as cooperation with regions outside Japan, and efforts to promote development of industry based on renewables.


Plenary Session 3
Inclusive Action towards a Net-zero Emissions Future
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Concurrent Sessions

Circular Economy

Moving forward from the linear economy to the circular economy is encountering enormous challenges. In the session, enormous opportunities were also highlighted in terms of business and sustainable development. The way forward is to link business opportunities and issues underlying the SDGs, such as the circular economy, with climate change and the protection of biodiversity and natural resources. The first issue that should be addressed is people' s behavior; currently, the demand for new products is still higher than that for refurbished ones. The second issue is the cost of recycled materials which is generally higher than that of virgin ones. To deal with these issues, educating stakeholders on all the stages of the product supply chain is essential, especially the life cycle point of view which would enhance understanding of the best circularized strategies for their given products. Furthermore, governments' clear guidelines, leadership, and support will be effective in boosting the circular mindset of society.

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

Fulvia Raffaelli
Head of DG GROW Unit 'Clean Products and Technologies', European Commission

Daniela Cristina Antelmi Pigosso
Associate Professor, Department of Mechanical Engineering, Section of Engineering Design and Product Development, Technical University of Denmark

Hiroyuki Tsutsumi
Senior Vice President, Royal Philips; President and CEO, Philips Japan, Ltd.

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

Yasunori Naito
Senior Specialist, Environmental Evolution Department, Sustainability Management Division, Ricoh Co., Ltd.

Circular Economy

IoT for CO_2 Reduction

IoT for CO_2 Reduction

IoT has already been deployed in the real-world, however, the relationship between IoT and CO_2 emissions reduction is unclear. Therefore, the session focused on how the use of IoT will contribute to CO_2 emissions reduction in the future. The participants expressed their views and advocated:

Firstly, to realize the full potential of IoT for utilities, the following would be important: 1) modernizing infrastructure and improving operations, 2) device efficiency improvement, and 3) business transformation for more value-added services to consumers. Installation of smart metering would be at the heart of energy transition toward the establishment of a low-carbon society.

Secondly, the key to CO_2 emissions reduction by IoT is how to utilize the data. Based on the real-world data, it is important to propose recommendations for reducing CO_2 emissions to customers, and to identify the particular reasons for the purpose of improvement.

Thirdly, with the use of IoT, demand-side resources should be bundled, and it would be important to create market conditions that can allow VPP to compete in all grid services product categories.

The last point is that standardization of data models and interfaces is a master key to unlocking the overall value and pre-resolving the daunting complexity related to the use of IoT for CO_2 emissions reduction.

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

Shota Kobayashi
Manager, Market Development, Enel X

Akio Yamada
Vice President, Enterprise Business Unit, NEC Corp.

Tatsuya Noguchi
President & Representative Director, ABB Bailey Japan Limited

Richard Schomberg
IEC Ambassador for Smart Energy

Hiroyuki Fujita
Professor, Advanced Research Laboratories, Tokyo City University

Concurrent Sessions

Hydrogen

This session explored the solutions to bridge the gap between the current situation and future prospects of hydrogen energy. The panel discussed the state-of-the-art contributions and their insights into the future of commercial and passenger Fuel Cell Vehicles (FCVs), hydrogen production from hydrocarbons, international hydrogen supply chains, and refueling infrastructures. Comments in the discussions included: 1) the importance of passenger vehicle mass production for reducing the cost, size, and weight of FCV components, which are essential for application to commercial vehicles, 2) the importance of Battery Electric Vehicles (BEVs) and FCVs to coexist when they attain widespread use, considering reduction of emissions from the transportation sector and to ensure convenience and efficiency of refueling for all vehicle types and 3) the safety, reliability, and durability of products would be vital, when the volume of hydrogen and production scale of products increases. The key takeaway from this session is that whilst one company or government alone cannot solve the problems we face, we will be able to reach a solution by working together.

Kazunari Sasaki (Chair)
Senior Vice President & Distinguished Professor,
International Research Center for Hydrogen Energy,
Kyushu University

Aqil Jamal
Chief Technologist, Carbon Management Research Division,
Saudi Aramco, Dhahran Saudi Arabia

Markus Bachmeier
Head of Hydrogen Solutions,
Technology & Innovation, The Linde Group

Kazuhiro Fukazawa
Executive General Manager, Advanced R&D and Engineering Company, Powertrain Company, Toyota Motor Corp.

Alfred Wong
Managing Director of Asia Pacific,
Ballard Power Systems Inc.

Motohiko Nishimura
Deputy General Manager, Associate Officer, Hydrogen Project Development Center, Corporate Technology Division,
Kawasaki Heavy Industries, Ltd.

Hydrogen

Growing Renewable Energy and Grid Stabilisation

Growing Renewable Energy and Grid Stabilisation

With the amount of renewable energy increasing, the power system will be faced with new operational challenges with a wide-ranging time horizon from seconds to years, and various solutions to balance power supply and demand, such as batteries, demand response, and inverter technologies, are being considered. In order to mobilize these solutions in the power system, the economic feasibility of these solutions must be improved through cost reduction and prolonged lifecycle, market mechanisms for monetarizing the value of grid stabilisation must be in place, and power system operation cost must be allocated among stakeholders through appropriate regulatory schemes. It is expected that through these approaches, implementation of solutions for grid stabilisation, whose value was not recognized in the conventional centralized power system, will be accelerated, and that the future power system will be built and operated in a cost-effective manner.

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

Satoshi Morozumi
Senior Researcher, Smart Community Department, New Energy and Industrial Technology Development Organization (NEDO)

Toshiro Kudama
Chief Power Development Officer,
Senior Executive Vice President, JERA Co., Inc.

Marc Crauwels
Vice President, Utility Sales, REstore NV

Vahan Gevorgian
Chief Engineer, Grid Integration,
National Renewable Energy Laboratory (NREL)

Concurrent Sessions

Decarbonisation by Industrial Sector

There were three topics highlighted in this session: 1) Disruptive innovation will be essential in order to achieve the 2 or 1.5℃ goal. The Task Force on Climate-related Financial Disclosures (TCFD) drives greater tension on the opportunity side of climate risks, and stresses the importance of incorporating measures to describe what the corporate sector is aiming for in the future. 2) The digital evolution, including IoT, AI and big data is having a big impact on CO_2 reduction through making processes more efficient in the production areas and creating brand new products and services, known as the sharing economy or circular economy. 3) Price is always a sensitive issue, as it is not easy to simply pass the cost on to the products. However, not all environmental products are burdensome, expensive and low quality. It is important to present sustainable solutions as positive. If they are then perceived as adding value, consumers would be willing to pay a bit more for them.

Jon Moore (Chair)
Chief Executive Officer,
Bloomberg New Energy Finance

Yukiko Araki
Corporate Officer, Executive General Manager,
Sustainability Promotion Division, Hitachi, Ltd.

Takayuki Kitajima
General Counsel, Representative Director,
Unilever Japan Holdings K.K.

Matthias Finkbeiner
Managing Director Institute of Environmental Technology,
Chair of Sustainable Engineering,
Technische Universität Berlin

Masaaki Nagamura
General Manager, International Initiatives,
Strategy and Synergy Department, Tokio Marine Holdings, Inc.

Decarbonisation by Industrial Sector

Renewable Microgrid and Energy Access

Renewable Microgrid and Energy Access

It was introduced that many people still lack access to electricity and modern sources of energy, but that solutions are already appearing thanks to renewables and microgrids. It was also pointed out that, because the central grid can act as a balancing pool for local networks, a new form of microgrid that is connected to the central grid is emerging. In the panel discussion, in addition to policy support and finance support, it was highlighted that not only providing a very simple kit consisting of the solar panel, battery and inverter, but also encouraging the establishment of new businesses using that kit is important to further deploy microgrids. In this regard, training on matters such as entrepreneurial skill and electrical engineering skill is deemed desirable.

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

Akihiko Shirahata
Country President Japan, Schneider Electric

Shigeki Miwa
Representative Director & CEO,
SB Energy Corp.

Franck Girard
Chairman and Managing Director,
Electrical & Automation, Nidec ASI s.a.

Abhishek Ranjan
Additional Vice President and Head Renewable,
DSM & EE and Energy Analytics, BRPL

Francisco Boshell
Analyst, RE Technology, Standards and Markets, Innovation and Technology Centre,
International Renewable Energy Agency (IRENA)

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

Concurrent Sessions

Small Modular Reactor for Nuclear

In this session, it was highlighted that a development of new Small Modular Reactors (SMRs) are going on with keen interest as one of the new possibility of future nuclear application. The panelists exchanged their views on: 1) In order for SMRs to be utilized, cost reduction is very important because energy market is highly competitive. The cost of SMRs is reduced with their extreme simplification of the system enabled by utilizing new technologies including passive decay heat removal. The cost is also reduced by building or manufacturing the containment in a factory instead of at the site, by utilizing learning effect through constructing many modules, and by accepting many suppliers' participation. 2) Ability to reduce the burden of radioactive waste and compatibility with renewable energy are also important points to increase competitiveness of SMRs. 3) A policy framework to support development of SMRs has been implemented in the United States, United Kingdom, Canada, and other countries. 4) Discussions with regulators are necessary to fully demonstrate the ability of SMRs, and discussions between the vendors and the regulators have been going on.

Noriko Endo (Chair)
Project Professor, Graduate School of Media and Governance, Keio University

Julio Friedmann
Distinguished Associates, Energy Futures Initiative

Jose Reyes
Chief Technology Officer and Co-founder, NuScale Power

Robert C. Braun
Sr. VP & COO, ARC Nuclear, LLC.

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

Small Modular Reactor for Nuclear

CCUS

CCUS

Carbon Capture, Use and Storage (CCUS) is a key technology to achieve CO_2 net-zero emissions and thus should be further promoted, although the reduction in the cost of renewable energy has prompted questions about it. The session discussed and proposed that 1) As revealed by CCUS projects in Japan, the United States, China and other regions, implementing more demonstration projects is necessary to further reduce the cost of CCUS. 2) More financial incentives and further international cooperation can provide momentum to accelerate the development of CCUS. 3) To increase the economic competence of CCUS projects, it is important to choose project locations suitable to selling CO_2 easily, cooperate with other partners to share industrial resources, and construct standardized CCUS plants, etc. 4) To speed up the deployment of CCUS as well as to create better policy proposals, a suitable Life Cycle Analysis (LCA) approach to CCUS technologies is the key approach.

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

Fatima Maria Ahmad
Senior Solutions Fellow, Center for Climate and Energy Solutions (C2ES)

Tao Wang
Professor, College of Energy Engineering, Zhejiang University

Masaki Iijima
Senior Chief Engineer, CO_2 EOR Business Department, Mitsubishi Heavy Industries Engineering, Ltd.

Hideo Nomoto
Chief Fellow, 8Rivers Capital LLC

Andrea Ramírez
Professor, Engineering Systems and Services, Group Energy & Industry, Faculty of Technology, Policy and Management, Delft University of Technology

Concurrent Sessions

SDGs for Business Activity

The contrast between the actions on climate change mitigation initiated by the leaders of civil society and business, and the retrogressive movements recently fueled by populism and social division was pointed out. In view of this, it was stressed that there is a need to utilize collective wisdom, collaboration, technology and capital in order to achieve the SDGs. Also, the endeavors of corporations, which are squarely facing feedback from customers and partners, both positive and negative, and setting forth clear visions and aims as they carry out their activities, were introduced. Finally, it was highlighted that there is substantial potential for the fields of biology, agriculture and oceanography to contribute to achieving SDGs, as these fields can have multiple impacts on issues such as land use, water use and food supply, as well as both mitigation and adaptation aspects of climate change.

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

Kanako Fukuda
General Manager, CSR Office,
Sumitomo Chemical Co., Ltd.

Masafumi Okuda
Assistant Manager,
Corporate Citizenship Dept., AEON Co., Ltd.

Nicolette Bartlett
Director of Climate Change, CDP

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

SDGs for Business Activity

Smart Consumers

Smart Consumers

In this session, it was highlighted that consumer purchasing decisions are the driver of CO_2 emissions. The session also focused on how to change consumer behavior through innovation without sacrificing economic growth.
The panel exchanged views on the important role of legislation and introduced some concrete examples: 1) in the automobile industry, the incentive by legislation which rewards consumers for driving eco-friendly cars induces them to buy; 2) in Japan, currently a Feed-In-Tariff (FIT) law supports consumers to set up photovoltaic (PV) systems on their houses; 3) in the electric utility industry, retail market liberalization and demand response trials create the value for the consumers; 4) from the insights into human behavior, it was understood that the government's role is to facilitate consumer's comparison which makes it easier for the individual consumer to see the longer-term benefits.
It was confirmed that communication with consumers is a key to the behavior change for sustainable lifestyles.

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

Julian Hill-Landolt
Director, Sustainable Lifestyles,
World Business Council for Sustainable Development (WBCSD)

Joe Pattinson
Head of Mobility Services, BMW China

Masakazu Shio
Technical General Manager,
External Relation Group, Housing Company,
Sekisui Chemical Co., Ltd.

Kiyoshi Nishimura
General Manager,
Marketing and Digital & DER Sales Planning Department,
Kansai Electric Power Co., Inc.

Alexander Clark
Advisor, Behavioural Insights Team

Concurrent Sessions

Fintech for Climate Change

This session focused on the application of financial technology (fintech) such as mobile payments to finance projects in the field of environment and energy. It was highlighted that fintech has considerable potential, by e.g. enabling people who have no credit history or security against theft to purchase and use clean energy and products. Three examples of financial projects were also explained: 1) planting real trees synchronized with the users' activities on apps, 2) enabling payment of the weekly charges for electric vehicles, and 3) allowing people, through a crowd-funding platform to buy solar energy in parts of the world where they have no access to clean, affordable, reliable energy. It was also pointed out that personalized data which is collected with the customer consent and put in a very safer place can work to the customers' advantage through provision of new products or loans.

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

Toyohito Tanaka
Executive Vice President, Alibaba Japan

Marei Oshima
Executive Officer, Head of Corporate Planning Office, Chief Financial Officer, Global Mobility Service Inc.

Makoto Goda
CEO, Nippon Biodiesel Fuel Co., Ltd. (NBF)

Matthew McShane
Regional Manager, TRINE

Fintech for Climate Change

Biorefinery

Biorefinery

Biorefineries means utilization of biomass into technologies that produce fuels and chemical products, and bioeconomy is an initiative aimed at incorporating the utilization of biomass into economic activities. This session explored the factors of both impeding and boosting for the popularization of the biorefinery. Bioeconomical progress was introduced while exampling the biorefinery projects for chemical products and biofuels, efforts to utilize waste biomass, and methods of life cycle design for biomass-derived production. It was also pointed out that bioeconomy in educational level has already started in European countries. The panel discussed the issues related to "Biorefinery awareness" such as the global market for biochemicals, public opinion, national policies, and the importance of life cycle assessment. Involving the audience, topics of cost competitiveness with fossil fuel products, uniqueness of biomass products, and importance of biodiversity were discussed. The chair closed the session while expressing the expectation and anxiety about the possibility caused by the change in the state of biorefinery through new technologies such as genome editing.

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), Ministry of Foreign Affairs

Kiyohiko Igarashi
Associate Professor, Forest Chemistry Laboratory, Department of Biomaterial Sciences, Graduate School of Agricultural and Life Sciences, The University of Tokyo

Tom Granström
Senior Expert and Team Leader, St1 Nordic Oy/ St1 Renewable Energy Oy/ Advanced Fuels R&D

Unggul Priyanto
Chairman, Agency for the Assessment and Application of Technology (BPPT), Indonesia

Yasunori Kikuchi
Associate Professor, Integrated Research System for Sustainability Science, The University of Tokyo

Closing Session

❶ Remarks
Norikazu Suzuki, Parliamentary Vice-Ministers for Foreign Affairs, Japan
Takaaki Katsumata, Parliamentary Vice-Minister of the Environment, Japan

❷ Final Thoughts on the Event
Nobuo Tanaka, Chairman, The Sasakawa Peace Foundation; Former Executive Director, International Energy Agency (IEA)

❸ Top 10 Innovations Result Announcement
Itaru Yasui, Honorary Adviser, National Institute of Technology and Evaluation(NITE); Emeritus Professor, The University of Tokyo

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

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

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

Statement

The overall theme of ICEF 2018 was "Driving Green Innovation." The meeting focused on business-led technological innovation towards decarbonisation as well as social innovation involving industry and consumers.
A set of principles and recommendations from the Steering Committee was announced as the "ICEF 2018 Statement from the Steering Committee" at the closing session.

ICEF 2018 Statement from the Steering Committee

October 11, 2018

1. Introduction

The fifth annual meeting of the Innovation for Cool Earth Forum (ICEF 2018) was held in Tokyo on October 10 and 11. The theme of this year' s forum was "Driving Green Innovation." More than 1,000 people from government institutions, international organizations, industry, and academia from approximately 70 countries and regions participated in the event. According to the ICEF Steering Committee, our mission is to facilitate discussion and encourage the cooperation among participants in order to promote technological and social innovation in the energy and environmental fields so as to reaffirm our ultimate goal of achieving net-zero CO_2 emissions. This ultimate goal cannot be achieved in the near future, but first steps and actions need to be taken today. This following statement summarizes what kind of actions should be taken with high priority.

2. Realization of a virtuous cycle of climate change countermeasures and economic growth

In order to achieve the net-zero goal, total CO_2 emissions must begin decreasing as soon as possible. However, worldwide emissions of carbon dioxide have not yet started to decline but are still rising. Under such circumstances, a combination of climate change countermeasures and economic growth is required. In recent years, there has been much activity by making use of corporate and investor-led financial innovation, largely centered on renewable energy. For example, the flow of global funds such as environment, social, and governance (ESG) investments and green bonds is expanding greatly. In addition, climate change countermeasures are no longer costs but are now considered to be a stimulus for economic growth. In fact, there has been a change of worldwide trend which reflects recommendation by Task Force on Climate-related Financial Disclosures (TCFD) based on G20's request. As such, financial and investment institutions (as well as various industry sectors) are beginning to promote business-led innovation. Furthermore, future energy savings will be possible with the spread of electrified vehicles and shared economy in the mobility field. The involvement of independent parties such as local governments and individual companies is also increasing, generating opportunities to scale up such advanced approaches. During ICEF 2018, these topics were taken up in plenary sessions. In addition, a total of 12 directions of innovations—six from social fields and six from technical fields—were chosen and discussed in concurrent sessions as following.

3. Toward social innovation

- Movement toward establishing sustainability at the core of business activities is progressing in order to pursue the Sustainable Development Goals (SDGs) specified in the United Nations "2030 Agenda for Sustainable Development." There are multiple co-benefits to achieving SDGs targets from CO_2 reduction.
- New business concepts such as "product as a service" have been actively introduced aiming to lead to economic activities not depending on resource consumption. A circular economy is also attracting attention as a possible measure for CO_2 reduction through a transition to economic activities less dependent on resource consumption.
- By aggregating and networking power generation and storage devices and optimally controlling them according to demand, microgrids have the potential to contribute to a massive introduction of renewable energy in harmony with existing grids. There is a movement to address the energy access problem by disseminating microgrids with renewables as a form of a distributed power supply.
- Companies are investigating how to change consumer behavior through innovation without sacrificing economic growth in order to reduce consumption-based CO_2.
- Proper application of FinTech is leading to developments in climate change countermeasures that utilize smartphone transaction applications and financial platforms, movements in renewable energy expansion, and applications of block chain technology.
- There are emerging trends to reduce CO_2 emissions not only through manufacturing processes but also through the spread of eco-friendly products across national borders.

4. Toward technological innovation

- Reductions in CO_2 emissions are being carried out through energy-saving processes, digitalization, and other IoT functions.
- Solutions are being sought for possible problems in power grid operation caused by the transition to renewable energies for power generation.
- Various problems pertaining to the production, storage, transportation, and utilization of hydrogen are expected to be solved as part of efforts to increase its use as an energy source.
- Along with renewable energy and hydrogen, nuclear is feasible CO_2-free power source that has the potential to contribute considerable reduction of CO_2 emission. Further development of small modular reactor (SMR) is underway and it is one of the leading candidates having a possibility to produce CO_2-free energy.
- There is an expectation concerning an increasing use of biorefinery technologies for manufacturing chemical products and fuel from biomass resources.
- Further development of CO_2 capture from industry and air, utilization, and storage (CCUS) technology has the potential to make a big contribution to the reduction of CO_2 emissions. CCUS is an effective, transitional technology to reduce CO_2 emissions and to support energy security and diversity in power generation.

5. Key actions

Industry, government, academia, and investors must come together to realize and promote innovation and create businesses using innovation by facilitating research and development and investment under international collaborative frameworks. In this regard, the private sector should continue to play an active and central role. In order for the private sector to fully commercialize innovation and make it widely available, it is recommended that government and the industrial sector carry out the following key actions that are needed for the future with unprecedented urgency.

Action 1. Inspire investment in technology, products, and services for green growth

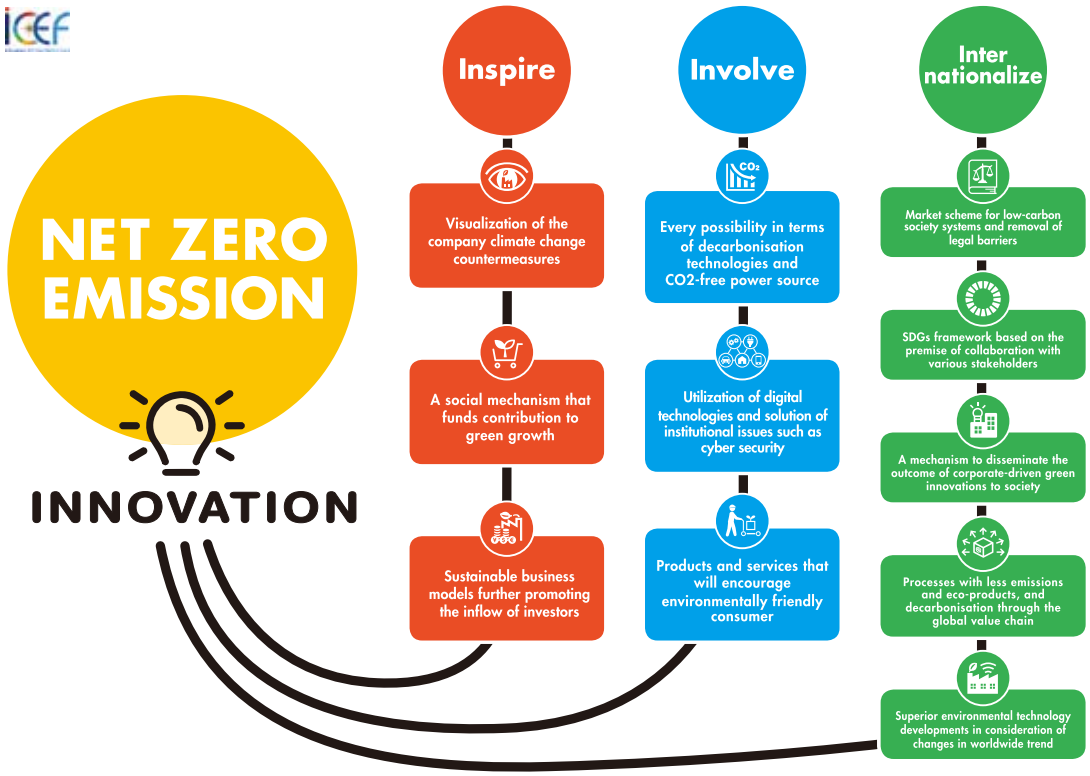
- Government should promote the industrial sector in visualizing the contributions and strengths of company climate change countermeasures in consideration of the key metrics to manage climate-related risks and opportunities as well as, if necessary, the internal carbon pricing. This will promote dialogue between manufacturing and service companies and the financial and investment sectors as proposed by TCFD.
- Government and the industrial sector should encourage the private sector to change consumer behavior for the establishment of a social mechanism that funds technology, products, and services that contribute to green growth. In such cases, it will be beneficial to explore consumer behavioral change using advanced behavioral science and technologies.
- Government and the industrial sector should encourage the private sector to establish sustainable business models that will further promote the inflow of investors. Investors should support efforts for sustainable growth to realize SDGs.

Action 2. Involve industry and consumers in accelerating technologies and innovation for decarbonisation

- The industrial sector should pursue every possibility in terms of decarbonisation technologies including electrified mobility, distributed power supplies, SMR, biorefineries, and CCUS as well as in terms of utilization of feasible CO_2-free power source such as renewable energy, hydrogen and nuclear.
- The industrial sector should utilize digital technologies such as IoT to further reduce CO_2 emissions. In addition, government and the industrial sector should solve institutional issues such as cyber security.
- Based on the fact that the spread of advanced technologies can influence consumer behavior, government and the industrial sector should help the private sector create products and services that will encourage environmentally friendly consumer behavior.

Action 3. Internationalize cooperative efforts for deploying innovation outcomes

- Government and the industrial sector should enhance worldwide cooperation to promote the introduction of market scheme for low-carbon society systems and removal of legal barriers.
- Government and the industrial sector should utilize the SDGs framework based on the premise of collaboration with various stakeholders inside and outside of a country.
- Government should establish a mechanism to disseminate the outcome of corporate-driven green innovations to society.
- The industrial sector should reduce global CO_2 emissions by promoting not only manufacturing processes with less emissions but also spreading eco-products across national borders so as to decarbonise through the global value chain. In addition, the industrial sector should consider the mitigation of short-lived climate pollutants such as black carbon.
- Governments and the industrial sector and investors should encourage private companies to promote their superior environmental technology developments in consideration of changes in worldwide trend such as caused by TCFD recommendations.



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, 28 nominees from 2 categories, "Technology foreseen by 2050" and "Business model transformation" were selected by the Top 10 working group according to the following criteria: 1) Technological innovativeness and 2) CO_2 emissions reduction potential for "Technology foreseen by 2050," and 1) Market impact potential, 2) Completeness of business model and 3) Uniqueness for "Business model transformation".
Ultimately, Top 10 innovations were selected through votes by ICEF 2018 participants. The winners are the following:

Category Technology foreseen by 2050

New materials for photocatalysts to produce hydrogen

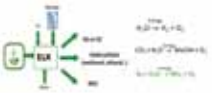
Source : © The Institute of Scientific and Industrial Research, Osaka University (http://www.sanken.osaka-u.ac.jp/en/e_toppage/e_hot_topics/topics_20170530/)

Organization Osaka University

Currently, only ultraviolet (UV) region of solar light can be harvested by catalysts to produce hydrogen, resulting in a very low rate of conversion (only a few percentage points). Researchers at Osaka University have developed a broadband solar response photocatalyst which can harvest not only UV but also visible light and near-infrared region for energy to produce hydrogen, consisting of gold nanoparticles, lanthanum, titanium and oxygen, ($Au/La_2Ti_2O_7$) sensitized with black phosphorus. This technology could be one significant step towards direct conversion of sunlight into hydrogen.

Category Technology foreseen by 2050

High efficiency ammonia synthesis from water and nitrogen



Source : © Giner Inc., Newton, MA
Acknowledgment
This work was funded in part by the Advanced Research Projects Agency – Energy (ARPA-E), U.S. Department of Energy, under Award Number DE-AR000814.

Organization Giner Inc., Newton, MA

Ammonia is produced today by Haber-Bosch method, which is energy and emissions-intensive (1.7t-CO_2/t-NH_3). A group of advanced membrane / catalyst components are being developed, enabling ammonia to be produced by water, nitrogen and renewable electricity. There are two merits for this innovation. The first is that the temperature and pressure are much lower than conventional methods, leading to improved overall energy efficiency. The second merit of innovation is the opportunity to utilize renewable electricity, allowing for reduced CO_2 emission.

Category Technology foreseen by 2050

Advanced small modular reactor (aSMR)

Source : © Advanced Reactor Concepts, LLC. "A Sustainable, Cost-Effective Energy Solution for the 21st Century" (http://www.arcnuclear.com/uploads/File/arc-100-product--brochure.pdf)

Organization Advanced Reactor Concepts, LLC.

An advanced small module reactor (aSMR) will be deployed in a Canadian province pursuing the establishment of a center of excellence for advanced SMR products. The project is also expected to provide a nuclear supply chain created in the province.
The aSMR named ARC-100 is a 100 MWe sodium-cooled, fast flux, pool-type reactor with metallic fuel that builds upon the 30-year successful operation of the EBR-II reactor. Waste created by light-water reactors can be used as fuel, offering a solution to the problem of nuclear waste. Furthermore, its passive safety system prevents meltdowns of the reactor, even in the case of a complete loss of power.

Category Technology foreseen by 2050

Capture and conversion of atmospheric CO_2 into carbon nanotubes

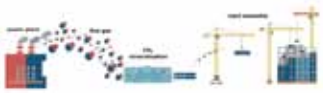
Source : © Dr. Stuart Licht, Professor of Chemistry, George Washington University at SL@C2CNT.com

Organization C2CNT LLC

This new method developed by researchers at the George Washington University is not only used for sequestering carbon directly from the atmosphere or from the stack, but also produces a valuable product, carbon nanotube (CNT), whose strength, conductivity, flexibility and durability are expected to have applications including capacitors, Li-ion batteries, lighter-weight structural materials. However, the use of CNT, the strongest material known is limited to date, hindered by high production costs, which means that producing CNTs inexpensively by C2CNT's proprietary new method can be a notable achievement.

Category Technology foreseen by 2050

Turning carbon dioxide into concrete



Source : © Co_2Concrete, LLC.

Organization University of California, Los Angeles (UCLA) and CO_2Concrete, LLC

UCLA researchers have developed a technology that turns carbon dioxide (CO_2) emissions into CO_2Concrete™, a replacement for traditional concrete, although with a much lower CO_2 footprint.
The technology demonstrates energy efficiency and scalability since (a) it directly utilizes CO_2 from flue gases without a need for carbon capture, (b) it operates at ambient temperature and pressure and does not need extrinsic energy, and, (c) it does not use ordinary portland cement (OPC), which is CO_2 and energy intensive.

Category Technology foreseen by 2050

Development of a new, low combustible electrolyte for lithium ion batteries

Source : © Hitachi, Ltd.

Organization Hitachi and the Institute of Multidisciplinary Research for Advanced Materials of Tohoku University

A new electrolyte for lithium-ion batteries that have low combustibility (with a flash point about 100°C higher than conventional organic electrolyte solutions, whose flash point is about 20° C) have been developed. In addition, it was calculated that conventional lithium ion conductivity is expected to increase fourfold. This increases safety of lithium-ion batteries, while also increasing capacity and energy density. This is an important development for expanding the use of lithium ion batteries in stationary (e.g. homes) and mobile applications. Additional benefit would be reduced reinforcements and cooling mechanisms to address safety, which can drive down the price.

Category Technology foreseen by 2050

The world's first 100 kW class demonstration test of ocean current power generation

Source : © New Energy and Industrial Technology Development Organization (http://www.nedo.go.jp/english/news/AA5en_100295.html)

Organization NEDO, IHI Corporation

The world's first 100 kW class ocean-current power generation demonstration was conducted. This demonstration test was conducted using the Kuroshio Current in the waters off the coast of Kuchinoshima, Toshima, Kagoshima Prefecture.
NEDO expects ocean-current energy to be a promising source renewable energy resource due to its large energy content and low fluctuations, and expects it to be applied especially on isolated islands. Using the results of this demonstration, IHI Corporation will evaluate its generation performances and control systems, with the goal of application of a subsea floating-type ocean-current power generation system, which can effectively and economically utilizes ocean current energy after the year 2020.

Category Business model transformation

Converting waste heat into electricity

Source : © Climeon (https://climeon.com/ja/how-it-works-japan/)

Organization Climeon

Climeon provides technology that converts low temperature waste heat from industries and geothermal heat into electricity. It uses the temperature difference between hot and cold water to produce clean electricity. The system operates at low pressure, which enables a more compact and modular design. Each module generates 150 kW with a small footprint and requires only three connections including a hot source, a cold source and a power connection. These modules can be connected in a way that scales the system from 150 kW to 50 MW. The efficiency of the system can be as much as twice as that of other low temperature solutions.

Category Business model transformation

Delivering 100 MW storage within 100 days

Source : © Tesla, Inc.

Organization Tesla, Inc.

In 2016, South Australia experienced a statewide blackout. Tesla CEO Elon Musk placed a wager to install a 100 MW battery system within 100 days to solve South Australia's power crisis, or the system would be free. The 100 MW (129 MWh) Powerpack system was connected to a 309 MW wind farm and was installed well ahead of schedule. The system will deliver electricity during peak hours to prevent blackouts and increase grid reliability that will accelerate the expansion of renewable energy. Furthermore, it enabled Neoen, the owner of the wind farm, to take advantage of the fluctuation in energy prices of the region and to maximize its profits.

Category Business model transformation

The world's first hydrogen-powered train

Source : © Alstom / Rene Frampe (https://www.partners.alstom.com/Assets/View/92a183b6-b12a-4561-b356-76a587d0de4e)

Organization Alstom

The world's first hydrogen fuel cell passenger train has entered commercial service in Germany. Running on hydrogen, the train is equipped with clean energy conversion, flexible energy storage in batteries, and smart management of traction power. The vehicle is emission-free, with low levels of noise, and only exhausting steam and condensed water. In the future, Alstom aims to support hydrogen production from renewable energy. Train fuel can be a viable entry point for utilization of hydrogen fuel in the transportation sector. The innovation serves as a major step towards cleaner mobility.

Roadmap Projects

ICEF develops roadmaps on how key innovative technologies can contribute to a transition to clean energy. At the side event on the ICEF2018 Roadmap, the draft version of roadmap on Direct Air Capture (DAC) of Carbon Dioxide was presented. Dr. Etsushi Kato, Vice Director of the Research and Development Division, The Institute of Applied Energy (IAE), presented the scientific understanding of the global carbon cycle, the disturbance caused by anthropogenic CO_2 emissions, and the requirements and limitations of Negative Emissions Technologies (NETs) as an introduction. Following the talk, Mr. David Sandalow, Inaugural Fellow, Center on Global Energy Policy, Columbia University, and Dr. Julio Friedmann, Distinguished Associate, Energy Futures Initiative, presented the key messages of the draft roadmap.

The history of DAC technologies was explained as consisting of small-scale application on space missions and submarines; however, the confronting scale of the technologies needed now in climate mitigation, particularly on the 1.5 degrees C target, was highlighted. Starting with emphasizing the existing DAC technologies, their benefits compared to other NETs in terms of scale of water and land footprint were discussed. R&D on scale-up, cost reduction and improvement of performance were explained. Finally, the presenters discussed the importance of policy measures to promote them, and the opportunities through long-term commitments in markets in R&D programs, innovation and public-private partnerships. During the open floor discussions, views on the possible pathways on cost reduction and the policy support needed for development of these technologies looking toward 2030 were exchanged among the speakers and the audience.

This draft was revised to reflect the comments received at ICEF, and the definitive version was presented at an event at COP24.

Side Events

Digitalization and the Transformation of Cities and Communities

Prof. Michael Joseph Kelly, University of Cambridge, gave a presentation on "IT, Infrastructure and the Energising of Megacities of the Future." He emphasized that fossil fuel and nuclear fuel would be needed in energising megacities where electrification and "electronification" were developing, while pointing out the development of three-dimensional lifts and automated logistics. Mr. Theo Blackwell, Chief Digital Officer, London City, gave a presentation on "Making London the World's Smartest City." He introduced the importance of data sharing and data collaboration, and of creating open libraries for micro actions. After that, the two presenters discussed with Prof. Vaclav Smil, Distinguished Professor Emeritus, University of Manitoba, such topics as the scarcity of storage capacity when a renewable-dominant system is disrupted, and transport issues, including the possible problems related to autonomous vehicles. Also, it was highlighted that a larger city would need to improve the connectivity between itself and universities.

IPCC Special Report Global Warming of 1.5°C

Dr. Thelma Krug, Vice-Chair of the Intergovernmental Panel on Climate Change (IPCC), introduced the new findings in the IPCC special report. E.g. 1) If the world continues to warm at the present rate, global warming of 1.5° C will be reached in the period between 2030 and 2052. However, it is still possible to limit global warming at 1.5° C and this would require changes on an unprecedented scale. 2) The use of a wide range of technologies is critical. This includes CO_2 removal technologies such as large-scale reforestation, large-scale bioenergy with CCS, and technologies that are still not mature enough or have yet to be proven on a large scale.

Steering Committee Members

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

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

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Professor Emeritus, Vienna University of Technology (TU WIEN)
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Chair of the Board of Governors, French Development Agency (AFD)
Professor, Sciences Po Paris
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Honorary Adviser, National Institute of Technology and Evaluation (NITE)
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Valli Moosa
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Co-Director, Energy and Environment Concentration, School of International and Public Affairs, Columbia University
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Vaclav Smil
Distinguished Professor Emeritus, University of Manitoba
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Kenji Yamaji
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Japan

Innovation for Cool Earth Forum

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