

# COVER PAGE

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2020 The 4th International Conference on  
**Energy and Environmental Science**  
**(ICEES 2020)**

2020 The 6th International Conference on  
**Renewable Energy Technologies**  
**(ICRET 2020)**

Perth, Australia | January 8-10, 2020

**Published by**



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# WELCOME

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Dear distinguished delegates,

We are pleased to welcome you to the 2020 4th International Conference on Energy and Environmental Science (ICEES 2020) and its workshop-The 6th International Conference on Renewable Energy Technologies (ICRET 2020) which are held in Perth, Australia during January 8-10, 2020.

The objective of the conference is to bring together interested academics and industry experts in the field of Energy and Environmental Science, Renewable Energy Technologies to a common forum. Three keynote speeches will be delivered. Prof. Saad Mekhilef (IET Fellow) from University of Malaya, Malaysia will address the third keynote speech "Power Converters for Energy Storage Applications". Prof. Danny Sutanto, from University of Wollongong, Australia, will present a keynote speech "Integration of Renewable Energy, Energy Storage, Electric Vehicles, Superconductor and Magnetic Bus in Future Distribution Grid". Prof. Hee-Je Kim, from Pusan National University, South Korea will give the keynote speech "New Approach of Solar Energy Generation + ESS Applications Connected to IoT controlled by Personal Smart-phone". Papers will be presented in four sessions of the conference: 1) Energy Engineering and Sustainable Development, 2) Power System and Energy, 3) Battery Technology and Energy Storage Materials, and 4) Engineering Materials and Building Energy Consumption. 38 presentations are given by participants from 16 countries.

Perth is the capital and largest city of the Australian state of Western Australia (WA). It is named after the city of Perth, Scotland and is the fourth-most populous city in Australia, with a population of 2.06 million living in Greater Perth. Perth is part of the South West Land Division of Western Australia, with the majority of the metropolitan area located on the Swan Coastal Plain, a narrow strip between the Indian Ocean and the Darling Scarp. The first areas settled were on the Swan River at Guildford, with the city's central business district and port (Fremantle) both later founded downriver. Perth is famous for being the most isolated city in the world, completely surrounded by Australian nature: the Indian Ocean on one side and the Australian outback on the other. Tourist attractions are generally focused around the city centre, Fremantle, the coast, and the Swan River. In addition to the Perth Cultural Centre, there are dozens of museums across the city. Hope you enjoy your time here!

We would like to thank all the authors who are attending the conferences, and also the organizing committees, reviewers, speakers, chairpersons, sponsors and all the conference participants for their support to ICEES 2020 and ICRET 2020.

Yours sincerely,

Conference Chairs


Prof. Saad Mekhilef, University of Malaya, Malaysia

Prof. Danny Sutanto, University of Wollongong, Australia

Program Chairs

Prof. Hee je Kim, Pusan National University, South Korea

# AGENDA OVERVIEW

January 8, 2020 (Wednesday)   Conference Preparations		
10:00-17:00	Registration & Conference Kits Collection	ibis Perth Lobby
January 9, 2020 (Thursday)		
09:00-09:10	Opening Remarks - Prof. Danny Sutanto University of Wollongong, Australia	Salt Room
09:10-09:50	Keynote Speech I - Prof. Saad Mekhilef	Salt Room
09:50-10:00	 Group Photo	
10:00-10:30	 Coffee Break	
10:30-11:10	Keynote Speech II - Prof. Danny Sutanto	Salt Room
11:10-11:50	Keynote Speech III - Prof. Hee-Je Kim	Salt Room
11:50-13:30	Lunch	Restaurant (Murray Street Grill)
13:30-16:00	Session 1 – Energy Engineering and Sustainable Development	Salt Room
13:30-16:00	Session 2 – Power System and Energy	Pepper Room
16:00-16:30	 Coffee Break	
16:30-18:45	Session 3 – Battery Technology and Energy Storage Materials	Salt Room
16:30-18:45	Session 4 – Engineering Materials and Building Energy Consumption	Pepper Room
18:30-20:00	Dinner	Restaurant (Murray Street Grill)
January 10, 2020 (Friday)		
8:00-17:00	Social Program	Perth

## Conference Venue



### ibis Perth

<https://www.accorhotels.com/gb/hotel-1773-ibis-perth/index.shtml#origin=accorhotels>

Add: 334 Murray Street - Perth WA 6000 - Australia

### Access to ibis Perth

#### From Perth Airport

##### By Car

- It is about 13 km (26 minutes during normal hours) via National Highway 94
- It is about 15.8 km (28 minutes during normal hours) via State Route 8
- It is about 14.3 km (31 minutes during normal hours) via State Route 51

##### By Bus

- [48 minutes ]: About 3 minutes-walk from Perth Airport to Fauntleroy Av Before Miller Rd→ Elizabeth Quay Bus Station[40]→ About 39 minutes(32 stops) from Elizabeth Quay Bus Station[40] to St Georges Tce Stand NOP-Before William St. → About 6 minutes-walk (450m) to ibis Perth
- [56 minutes ]: About 3 minutes-walk from Perth Airport to Fauntleroy Av Before Miller Rd→Perth[935] → St Georges Tce Stand OST-After William St. → About 5 minutes-walk(350m) to ibis Perth

# GUIDELINE

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## Oral Presentation Guideline

- ✧ Get your presentation PPT files prepared. Please copy your PPT to the computer on January 8 or in the morning of January 9 at the registration table. The size of PPT is 16:9.
- ✧ Regular oral presentation: 15 minutes (including Q&A).
- ✧ Laptop, projector & screen, laser sticks will be provided by the conference organizer.
- ✧ Certificate of Presentation will be awarded after your presentation by the session chair.
- ✧ One Best Presentation will be selected from each parallel session and the author of best presentation will be awarded at the end of each session on January 9, 2020.

# DETAILED AGENDA

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[January 8, 2020 (Wednesday)]

10:00-17:00



**Registration & Materials Collection**



**ibis Perth (Lobby)**



Give your **Paper ID** to the staff.



**Sign your name** in the attendance list and check the paper information.



Check your **conference kit**, which includes conference bag, name tag, lunch & dinner coupon, conference program, the receipt of the payment, the USB of paper collection.



## **Tips for Participants**

- ✧ Your punctual arrival and active involvement in each session will be highly appreciated.
- ✧ The listeners are welcome to register at any working time during the conference. Certificate of Listener can be collected at the registration counter.
- ✧ Please kindly keep your Paper ID in mind so that the staff can quickly locate your registration information onsite.
- ✧ Wearing your name tag when you enter the meeting room. Name tag is not allowed to borrow to irrelevant persons.
- ✧ Do not bring irrelevant persons into the meeting room.
- ✧ Please keep all your belongings at any time.

**For the personal and property safety of the participants, please pay attention to notes below:**

**1-Please take care of your belongings all the time in case of any loss.**

**2-Participants are required to wear the conference representative card near the conference venue, please do not lend the representative card to the irrelevant people and not "carry" irrelevant people into the venue.**

**3-The organizer is not responsible for the loss of participants**

# DETAILED AGENDA

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[January 9, 2020 (Thursday)] Morning



Opening & Keynote Speechs



SALT ROOM (Level 1)








09:00~09:10	Opening Remarks	<b>Prof. Danny Sutanto</b> University of Wollongong, Australia
09:10~09:50	Keynote Speech I	<b>Prof. Saad Mekhilef</b> University of Malaya, Malaysia <b>Speech Title:</b> Power Converters for Energy Storage Applications
09:50~10:00	 <b>Group Photo</b>	
10:00~10:30	 <b>Coffee Break</b>	
10:30~11:10	Keynote Speech II	<b>Prof. Danny Sutanto</b> University of Wollongong, Australia <b>Speech Title:</b> Integration of Renewable Energy, Energy Storage, Electric Vehicles, Superconductor and Magnetic Bus in Future Distribution Grid
11:10~11:50	Keynote Speech III	<b>Prof. Hee-Je Kim</b> Pusan National University, South Korea <b>Speech Title:</b> New Approach of Solar Energy Generation + ESS Applications Connected to IoT controlled by Personal Smart-phone
11:50~13:30	<b>Lunch</b>	



# DETAILED AGENDA

[January 9, 2020 (Thursday)] Afternoon

 Authors' Parallel Presentations

 <b>SALT ROOM (Level 1)</b>	
<b>13:30~16:00</b> 	<b>Session 1 – Energy Engineering and Sustainable Development</b> Chaired by
	<b>10 Presentations</b> P2-007-A, P2-024, P2-031-A, P1-045, P1-1005-A, P1-006, P2-015, P2-020-A, P2-1006, P2-021,
<b>16:00~16:30</b>	 <b>Coffee Break</b>
<b>16:30~18:45</b> 	<b>Session 3 – Battery Technology and Energy Storage Materials</b> Chaired by Prof. Yong Suk Yang Pusan National University , South Korea
	<b>9 Presentations</b> P1-023-A , P1-005-A , P1-024-A , P1-019-A, P2-022-A , P2-028 , P1-011-A , P2-029 , P2-035
 <b>PEPPER ROOM(Ground Level)</b>	
<b>13:30~15:15</b> 	<b>Session 2 – Power System and Energy</b> Chaired by Dr. Thorsten Hickmann Eisenhuth, Germany
	<b>7 Presentations</b> P2-013 , P2-014 , P2-030 , P2-1004, P1-039 , P2-032-A ,P1-048
<b>16:00~16:30</b>	 <b>Coffee Break</b>
<b>16:30~18:30</b> 	<b>Session 4 –Engineering Materials and Building Energy Consumption</b> chaired by Prof. Jaichan Lee Sungkyunkwan University, South Korea
	<b>8 Presentations</b> P1-021-A , P1-042-A , P1-016 , P1-012-A , P1-018 , P1-028-A , P1-046 , P1-008-A
<b>18:45~20:00</b>	<b>Dinner</b>

# DETAILED AGENDA

[January 10, 2020 (Friday)]

## Social Program

**Duration Time: 08:00AM-05:00PM**

*(Tips: The following schedule is only for participants who registered the visit & tour. The following places are for references, and the final schedule should be adjusted to the actual notice.)*

\* **Assembly Time:** 08:00 AM

\* **Assembly Point:** ibis Perth

\* **Return Location:** ibis Perth

Address: 334 Murray Street - Perth WA 6000 - Australia

### Overview

**Kings Park & Botanic Garden → Elizabeth Quay → The Swan Bells → Perth City Hall → Cottesloe Beach → Fremantle Pier**



**Kings Park & Botanic Garden** is located in the largest world-class urban park on the western edge of Perth, covering an area of 4.06 square kilometers. It is the best place to view the panorama of Perth, the capital of Western Australia. The park has green spaces, botanical gardens, birds and wild flowers in the west. Every September, King's Park holds Australia's largest wild flower exhibition. The park is also a busy city dweller, a good place for family-sized leisure.



**Elizabeth Quay** is an exciting new waterfront precinct on the banks of the Swan River. The place to see and be seen in Perth. Here you'll find the island playground, the BHP Billiton Water Park, public artwork, promenades, open spaces and a range of bars and restaurants.



**The Swan Bells** include the twelve bells of St-Martins-in-the-fields. They were originally housed in the St-Martins-in-the-fields Church, in Trafalgar Square London, where they rung in the New Year for over 275 years. The Church of England traded up to a new set in 1988, and gifted the old bells to the City of Perth, as part of Australia's bicentenary celebrations that year. Gee, thanks guys. Six additional bells were cast to bring the total up to eighteen. With a full set of bells and no where to go, the Swan Bell Tower was constructed. Now housed in this spectacular structure, the bells continue to ring, and be enjoyed to this very day.



**Perth City Hall** is set to become a new heritage and arts attraction for the city, designed by international architectural firm Mecanoo. There is displaying local museum collections alongside iconic loans from elsewhere and touring exhibitions from the UK and abroad.

# DETAILED AGENDA



**Cottesloe Beach** is as pretty as a picture. It's one of the city's most popular spots for swimming, snorkelling, surfing and drinking in ocean sunsets over a glass of wine, a refreshing beer or a relaxed dinner. Crystal clear waters and consistent swell make it a regular hangout for swimmers, body boarders and surfers, while the rocks and reefs invite snorkellers to hit the water too.



**Fremantle Pier** is the birthplace of Perth. This town is located in the south of Perth city centre and still houses some 19th century buildings. It is also a gathering place for artists. There are many small shops, art shops, bookstores, etc. that are full of literary atmosphere in the narrow streets of the town. Travelers who like to go shopping are not bored. There are many restaurants, bars and coffee shops on the main streets of the town, High St and Market St. You can find a small donkey and feel at ease.

## \* Included

- Air-conditioned vehicle pick-up and drop-off from hotel
- English tourist guide
- Entry/Admission - Kings Park and Botanic Garden
- Entry/Admission - Cottesloe Beach

## \* Not Included

- Meal cost
- Personal expenses such as souvenirs

## \* Note

- This social program is optional and chargeable.
- The guide will leave on time. Please arrive at the assembly point 5 minutes earlier.
- If you are interested, please give your feedback before **January 03**. If you miss this date, we can't accept your request anymore.
- Please keep your belongings with you. The conference organizer and travel agency will not be responsible for the loss of your personal property

# KEYNOTE SPEAKER

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**Prof. Saad Mekhilef (IET Fellow)**

**University of Malaya, Malaysia**

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**Speech Title---** Power Converters for Energy Storage Applications

**Speech Abstract---** Recent works have highlighted the growth of battery/super capacitor energy storage system (BESS) in the electrical system. In the scenario of high penetration level of renewable energy in the distributed generation, BESS plays a key role in the effort to combine a sustainable power supply with a reliable dispatched load. Several power converter topologies can be employed to connect

BESS to the grid. There is no defined and standardized solution, especially for medium voltage applications. This work aims to carry out a literature review on the main converter topologies used in BESS and highlight the main advantages and disadvantages of each one. The topologies used for each conversion stage are presented and their combinations are analyzed. Finally, applications of BESS in Controlled Electric Drives, Renewable Energy, Diesel Electric Generators, Power Quality, and UPS will be presented.

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Saad Mekhilef received the B. Eng. degree in Electrical Engineering from University of Setif, in 1995, and Master of Engineering science and PhD from University of Malaya in 1998 and 2003 respectively. He is currently professor at Department of Electrical Engineering; University of Malaya. Prof. Saad is the author and co-author of more than 250 publications in international journals and proceedings. He is actively involved in industrial consultancy, for major corporations in the power electronics projects. His research interest includes power conversion techniques, control of power converters, renewable energy and energy efficiency.

Prof. Dr. Saad Mekhilef is an IET Fellow and IEEE senior member. He is the associate editor of IEEE Transaction on Power Electronics and Journal of Power Electronics. He is currently a Professor in the Department of Electrical Engineering, University of Malaya. He is the Director of Power Electronics and Renewable Energy Research Laboratory-PEARL- He is the author and coauthor of more than 250 publications in international journals and proceedings (189 ISI journal papers) with more than 10000 citations and 46 H-index, 53 Ph.D. and master students have graduated under his supervision. He is actively involved in industrial consultancy for major corporations in the power electronics projects. His research interests include power conversion techniques, control of power converters, renewable energy, and energy efficiency.

# KEYNOTE SPEAKER

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**Prof. Danny Sutanto,**  
**University of Wollongong, Australia**

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**Speech Title---** Integration of Renewable Energy, Energy Storage, Electric Vehicles, Superconductor and Magnetic Bus in Future Distribution Grid

**Speech Abstract---** This paper focuses on a review of the state of the art of future distribution grids, where new and modern technologies will be integrated into the power distribution grid, and will become the future building blocks for electricity generation,

transmission and distribution. The current power grids are undergoing an unprecedented transformation from the original design, changing the way how energy has been produced, delivered, and consumed over the past century. This new energy era includes the integration of renewable sources such as wind and solar, supported by distributed or community energy storage, to power distribution grids through innovative high frequency magnetic links and power electronic converters. The use of emission free transportation, such as electric vehicles, and energy efficient technologies, such as superconducting generators and storage systems, are also rapidly emerging and will be integrated into the power grids in the foreseeable future. The energy systems are evolving to provide clean energy to consumers to meet increasing demands from smart appliances to electric vehicles. The connections are also developing among the power infrastructure and non-power infrastructures such as transportation, communication, etc. As these connections evolve, it is necessary to reconsider the current paradigms of system analysis and planning with a focus on how to achieve the most flexible, efficient, and reliable power grid for the future – the one that enables operation in a domain which is very different than the current one to deliver the services to consumers at an affordable cost.

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Danny Sutanto received his B.Eng. and Ph.D. from the University of Western Australia in 1978 and 1981 respectively. Following his graduation he joined GEC Projects, Australia as a Power System Analyst. In 1982 he joined the School of Electrical Engineering at the University of New South Wales. In 1996 he joined the Hong Kong Polytechnic University as a Professor in Electrical Engineering. In 2006, he joined the School of Electrical, Computer and Telecommunications Engineering at the University of Wollongong as the Professor of Power Engineering.

His main areas of research are power system analysis, power system economics, voltage stability, harmonics, power electronics and computer aided education. He has published numerous papers in the areas of electromagnetic transient analysis, power system analysis, voltage instability, design of harmonic filters, FACTS, Battery Energy Storage Systems, computer aided teaching systems, power system expansion planning, electrical machines and power electronics, in total over 170 papers.

He was awarded the N. Svennson's Award for Teaching Excellence in the Faculty of Engineering in 1994. In 2000, he was awarded the HK Polytechnic University President's Award for Outstanding Performance in Teaching. He has extensive consultancy experience both in Australia and Hong Kong covering areas such as power system planning, fault analysis and harmonic filter design. While at the Hong Kong Polytechnic University, he received grants from the RGC, Learning and Teaching Development Committee (LTDC), British Council, various research studentship and grants from the Hong Kong Polytechnic University totalling more than HK\$15 million. He was appointed as the Regional Representative of the Power Engineering Society of the Institute of Electrical and Electronics Engineers (IEEE) for Region 10, Asia-Pacific from 2001-2004. He has been invited to be the members of International Advisory Board for several international conferences. He is also a member of the International Editorial Advisory panel of the International Journal "Electric Power Systems Research"

# KEYNOTE SPEAKER

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**Prof. Hee-Je Kim,**  
**Pusan National University, South Korea**

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**Speech Title---** Approach of Solar Energy Generation + ESS Applications  
Connected to IoT controlled by Personal Smart-phone

**Speech Abstract---** Around the world, many governments have strived to increase the share of renewable green energy in their power productions. Concerning the global shipping is a major contributor to GHG (global greenhouse gas) emissions,

bring responsible for approximately 3% of global CO<sub>2</sub> emissions. Firstly, the first application of solar-ship fabrication process here in Korea is introduced.

In addition, we introduce the second application of stand-alone PV and Wind power hybrid system. The solar and wind power hybrid generation and ESS will be very important in the isolated island and distant place without electrical power supply. So we demonstrate a cold storehouse for fresh fruits with a proto-type stand-alone PV system with ESS by using IoT technology based on internet networking as the next generation solar power system with various new applications.

Furthermore, we have been developed the micro dust removing device and fast charging technology for electrical transportation system based on the new ESS (super-capacitor/the conventional Batteries).

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Prof. Hee-Je Kim got PhD of Energy Conversion, Kyushu University, Fukuoka city, Japan. (1990, March) At present he is professor of Department of Electrical Engineering in Pusan National University (Busan, South Korea). And the group leader of BRL (Basic Research Lab.). He is currently working as an Associate Editor of NJC (New Journal of Chemistry)-RSC shared and Editorial Board Member of Journal [Energies], and the two permanent member of Korea Institute of Electrical Engineers [KIEE] / Renewable Energy. His main research area is dynamic, multi-objective, practical solution based research with a focus on highly efficient solar energy conversion and effective energy storage. That is related to mainly four area: i) Fabrication and commercialization of next-generation solar cells such as dye synthesized solar cells, quantum-dot, and perovskite solar cells). ii) Improving efficiency of existing solar PV and wind hybrid systems using different tools and techniques. iii) High energy and power density flexible super-capacitor for hybrid energy storage system. v) Dual active bridge (DAB), DC/DC Converter, MPPT, PV Inverter, Remote control by smart-phone with novel algorithm for Power conditioning system.

# SESSION I

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**January 9, 2020**  
**Session 1**

**Energy Engineering and Sustainable Development**

**🕒 13:30-16:00**

**📍 SALT ROOM (Level 1)**

Chaired by

**10 Presentations—**

P2-007-A, P2-024, P2-031-A, P1-045, P1-1005-A,  
P1-006, P2-015, P2-020-A, P2-1006 , P2-021

**\*Note:**

- \* Please arrive at the conference rooms 30 minutes before the session start.
- \* Certificate of Presentation will be awarded to each presenter by the session chair at the end of each session.
- \* One Best Presentation will be selected from each parallel session and will be announced at the end of each session.
- \* Please keep all your belongings at any time!

# SESSION I

<p><b>P2-007-A</b> <b>13:30-13:45</b></p>	<p>Numerical Simulation and Evaluation of Cavity Growth during the Underground Coal Gasification  <b>Shashank Sharma</b>, Hari B. Vuthaluru, Chun-Zhu Li, Rajesh R. Nair  Curtin University, Australia / IIT Madras, India</p> <p><b>Abstract-</b> To utilize the large quantities of coal deep beneath the ground as a clean source of energy has created a renewed interest in the underground coal gasification (UCG). The UCG process is capable of releasing the chemical energy locked-up in deep coal deposits, which otherwise cannot be recovered through conventional mining and energy generation technologies. My research focus is on the underground cavity that is formed due to the depletion of coal during the UCG process. The study of the cavity growth and its dependence on various operating parameters during UCG operation enables us to determine the extent of coal seam consumption from each pair of wells, and the rate of gasification reaction for a given feed gas. Ansys-Fluent 19.2 software is used to develop a 3D CFD model of the UCG process and numerical solutions are validated with the existing experimental data. The results elucidate the mechanism of the cavity growth by quantifying the key factors that control the local rate of cavity growth during underground coal gasification. This model provides a comprehensive picture of cavity growth that is immensely useful for the purpose of site selection as well as for the UCG design and operation.</p>
<p><b>P2-024</b> <b>13:45-14:00</b></p>	<p>Simulation of Tidal Energy Extraction, Using Fluent Model  <b>Hamidreza Alizadeh Hamedani</b>  Isfahan University of Technology, Iran</p> <p><b>Abstract-</b> This study has been performed to develop our knowledge about marine sources energy extraction. Water in the channel has been simulated in laboratory scale by means of FLUENT software. The turbine tidal flow is generated by a moving disk which applies a pressure decrement with energy dissipation. Free water surface is estimated by means of fluid volume in the model which changes freely. The numerical results illustrate that eddy sequence has been generated after the tidal flow of turbine and a flow acceleration is generated nearby, especially beneath the energy extraction devise. Free water surface drop due to energy extraction is considered in model results that seems a to improve the turbine eddy sequence.</p>
<p><b>P2-031-A</b> <b>14:00-14:15</b></p>	<p>Long-term Effects of Reducing Fuel Costs and CO2 Emissions by Introducing Renewable Energy Systems in Japan  <b>Ikumi Suzuki</b>, Shintaro Negishi , Hitoshi Azuma, Suguru Fukutome , Takashi Ikegami  Tokyo University of Agriculture and Technology , Japan</p> <p><b>Abstract-</b> As the introduction of renewable energy (RE) systems into the conventional power grid, output curtailment of RE will increase due to supply and demand balance constraints. In this study, we have developed the long-term power</p>



# SESSION I

	<p>supply and demand analysis model and calculated the fuel costs and CO2 emissions from 2020 to 2050 in each power system in Japan. In our model, we could analyze considering the influence of the change of power supply configuration of each power system. As a result, we were able to quantitatively evaluate the future economic and environmental values of RE systems for each power system under different RE penetration scenarios.</p>
<p><b>P1-045</b> <b>14:15-14:30</b></p>	<p>Temporal Analysis of Radiocesium Concentration in Sewage Sludge after Fukushima Daichi Nuclear Power Plant accident  <b>Muhammad Arsyad Faturrohman</b>, Mochamad Adhiraga Pratama and Setyo Sarwanto Moersidik  University of Indonesia, Indonesia</p> <p><b>Abstract</b>-Fukushima Dai-ichi Nuclear Power Plant (FDNPP) accident in April 2011 had released radioactive substances to the environment. Radiocesium transported from the urban area to the sewerage system by transfer wash-off mechanism. Eventually, radiocesium accumulated in the sludge produced by the wastewater treatment plant. This study was aimed to evaluate the possibility of using the time-series of Radiocesium concentrations in sewage sludge to quantify the wash off rate of the radionuclide on the surface of an urban area. This study used monitoring data from four WWTPs in Fukushima Prefecture and daily concentrations of Radiocesium in their sewer sludge over 8 years were collected. The results show time-dependent of Radiocesium concentration in sludge fitted with double exponential regression which means there are two rates: rapid rate (22 – 36 months) and slow rate (123 – 213 months). Values of the model parameters based on temporal analysis of radiocesium concentrations in sewage sludge are consistent with radiocesium wash off after the Chernobyl accident indicating that the decreasing rate of radiocesium concentrations in sewage sludge reflect the wash off rates on the surface of the corresponding urban area.</p>
<p><b>P1-1005-A</b> <b>14:30-14:45</b></p>	<p>Solar Energy for Off-grid Rural Communities in Tanzania  <b>Nwabialu Biola Onyeausi</b>  Sophia University, Japan</p> <p><b>Abstract</b>-Grid extension projects have stalled in many African countries due to poor electricity infrastructure, insufficient generation capacity, high cost of technical expansion and expected transmission losses. Efficient and reliable source of energy are important tools that drive development and increased production in various sectors and localities. While the diffusion of renewable energy technologies are hindered by technological availability, technical know-how and the financial implication for installations, solar energy has become the most viable solution for energy access in countries like Tanzania where most rural communities are not connected to the grid and the urban areas energy demand is continuously growing. Reduced cost, government incentives, donor contribution, awareness and the widely available private businesses have led to the growth of solar energy in rural communities in Tanzania. This study addresses the potential of solar energy in rural</p>

# SESSION I

	<p>Tanzania and reviews the benefits and challenges of two solar PV installations prevalent in rural communities; the Solar Home Systems (SHS) and the micro/mini grids.</p>
<p><b>P1-006</b> <b>14:45-15:00</b></p>	<p>Maximizing the ENVI-met Capability of Modelling the Mean Radiant Temperature of a Tropical Archaeological Site  <b>Floriberta Binarti</b>, Mochamad Donny Koerniawan, Sugeng Triyadi and Sentagi Sesotya Utami  Institut Teknologi Bandung, Indonesia</p> <p><b>Abstract-</b> ENVI-met is one of the most widely-used outdoor microclimatic models. Since previous studies found that ENVI-met tends to overestimate the MRT, this study attempted to maximize the ENVI-met capability of modelling the MRT in order to obtain accurate simulation results. This study developed three variations of the 3D-model and employed some features to improve the large MRT discrepancy between the field measurement and simulation that resulted from the preliminary model. The field MRT measurements were conducted using a globe thermometer method on two hot days, i.e., September 21 and October 17. After comparing the results of field measurements and simulations, this study came into a conclusion that the current free version software is capable of performing MRT predictions with a low discrepancy (5%) by using “Solar Adjustment Factor” and “Cloud Conditions” features (19.7% improvement), and maximizing the spatial resolution. The spatial resolution in z-axis decreases the discrepancy by 2.5%.</p>
<p><b>P2-015</b> <b>15:00-15:15</b></p>	<p>Integrated energy purchase-sale decision making and scheduling for integrated energy service provider considering user grading dynamic combination  <b>Jun Wang</b>, Xun Dou, Shizhen Wang and Longzhang Zhao  Nanjing TECH University ,China</p> <p><b>Abstract-</b> In an open energy market environment, energy retail competition is intensifying. integrated energy service provider (IEPS) with the right to operate regional integrated energy system. Under the requirement of distributed resource transaction access and scheduling security, how to integrate multi-level and multi-type user resources to participate in market operation, allocate resources within the region under its jurisdiction and improve the income of energy purchase and sale is the key for IESP to gain a favourable position in the market competition. Based on the operation framework of IESP including user grading and dynamic combination platform, integrate real-time dynamic combination of user resources into optimal scheduling, aiming at the operating economy of IEPS, an integrated energy purchase-sale decision making and scheduling method for IEPS considering user grading dynamic combination is proposed. Finally, an example is given to analysis through the regional integrated energy system with electric-gas-heat coupling. The results show that by reasonably combining users and scheduling distributed energy and adjustable load. The IESP can ensure the stable operation of the regional energy system, integrate and utilize decentralized resources to participate in the market, and maximize the economic benefits of energy purchase</p>

# SESSION I

	and sale.
<b>P2-020-A</b> <b>15:15-15:30</b>	<p>Energy efficiency of China hydrogen supply chain using a gas pipeline  <b>Jiaren Li</b>, Shin'ya Obara  Kitami Institute of Technology, Japan</p> <p><b>Abstract-</b> In the eastern part of China, due to lack of primary energy resources, the electricity load is relatively concentrated, resulting in an imbalance in the distribution of energy resources and power load. At the same time, in the northwestern region, solar wind power generation is developing rapidly, and power supply is far greater than demand leads to waste of resources. Therefore, this paper proposes a hydrogen energy supply system, which aims to convert renewable energy into power resource in the western and transport it with hydrogen to the eastern region where electricity is scarce. The system will set hydrogenation facilities near wind farm or solar farm so that renewable energy is supplied to the commercial transmission network or is stored as hydrogen by a water electrolyzer. Hydrogen produced by electrolysis will be compressed to 10 MPa to be stored. The compressed hydrogen will be transported to a consumer region by pipeline. And then it will be converted into electricity and heat through an SOFC (Solid Oxide Fuel Cell) to power the system and at the same time, it also can provide heat for home. By analyzing the distribution of renewable energy which area is rich in wind, solar energy and freshwater resource, considering the suitable pilot city in China, we investigated the energy system will transport compressed hydrogen from Qinghai to Shanghai. And in this paper, we will take the pipeline route represented by the China's existing West-East Gas Pipeline, starting from Qinghai, passing through Lanzhou and finally arriving in Shanghai. By analyzing the energy loss of all devices, energy efficiency of the system was 36% when the output of renewable energy was set to 100%, the total electrical power efficiency was about 19% and the efficiency of the heat supply was 16%. Assuming that the system's pipeline transportation capacity of hydrogen is <math>12 \times 10^9</math> m<sup>3</sup>/year, it can reduce <math>72 \times 10^6</math> ton of coal and <math>1.866 \times 10^9</math> ton of carbon dioxide emissions for China.</p>
<b>P2-1006</b> <b>15:30-15:45</b>	<p>Impact of Energy Crypto Currencies on Efficient Portfolios of Top US Energy Listed Companies  <b>Ikhlaas Gurrib</b>, Elgilani Elsharief and Firuz Kamalov</p> <p><b>Abstract-</b> This paper investigates if energy block chain based cryptocurrencies can help diversify equity portfolios consisting primarily of leading energy companies of the US S&amp;P Composite 1500 Energy Index. Key contributions are in terms of assessing the importance of energy cryptos as alternative investments in portfolio management, and whether different volatility models such as Autoregressive Moving Average – Generalized Autoregressive Heteroskedasticity (ARMA-GARCH) and Machine Learning (ML) can help investors make better investment decisions. The methodology utilizes the traditional Markowitz mean-variance framework to obtain optimized portfolio combinations. Volatility measures, derived from the Cornish-Fisher adjusted variance, ARMA family</p>

# SESSION I

	<p>classes and machine learning models are used to compare efficient portfolios. The study also analyses the effect of adding cryptos to equity portfolios with non-positive excess returns. Different models are assessed using the Sharpe performance measure. Daily data is used, spanning from 21st November 2017 to 31st January 2019. Findings suggest that energy based cryptos do not have a significant impact on energy equity portfolios, despite the use of different risk measures. This is attributable to the relatively poor performance of energy cryptos which did not contribute in improving the excess return per unit of risk of efficient portfolios based on the leading US energy stocks.</p>
<p><b>P2-021</b> <b>15:45-16:00</b></p>	<p>Investigation of Installation Conditions of a Complete Artificial Light Type Savoy Spinach Plant Factory for Cold Regions  <b>Naoki Kikuchi</b>, Shin'ya Obara            Kitami Institute of Technology, Japan</p> <p><b>Abstract-</b> This paper considers energy consumption and choice of the optimal area for plant factory with low-temperature treatment of spinach. When exposed to a low-temperature (less than 7 °C) environment, spinach increases the sugar content. In order to process by exposure to the coldness of spinach, it is necessary to hold the inside of the proposed plant factory at 7 °C. The maximum air temperature from December to March of Kitami in Okhotsk is less than 7 °C. Therefore, in this period, a ventilation fan is used to air cooling the plant factory. On the other hand, the plant factory is cooled by an absorption refrigerator from April to November. Because many regions where the maximum temperature of winter is less than 7 °C were located in Hokkaido, the payback period of the proposed system based on equipment cost and energy consumption were investigated about seven regions (Wakkanai, Asahikawa, Abashiri, Kutchan, Obihiro, Hiroo, Kitami) of them. When the proposed plant factory is installed in seven regions, because the analysis results of payback period are 6.83 years, the proposal plant factory and energy system for low-temperature treatments of spinach can be introduced enough commercially.</p>



**16:00-16:30 Coffee Break**

# SESSION II

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**January 9, 2020**

**Session 2**

**Power System and Energy**

**🕒 13:30~15:15**

**📍 PEPPER ROOM (Ground Level)**

Chaired by

**Dr. Thorsten Hickmann**

**Eisenhuth, Germany**

**7 Presentations—**

P2-013 , P2-014 , P2-030 , P2-1004,

P1-039 , P2-032-A ,P1-048

**\*Note:**

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# SESSION II

<p><b>P2-013</b> <b>13:30-13:45</b></p>	<p>Study of a Clean Microgrid for the Japanese Antarctica Showa Base <b>Shoki Fujimoto</b>, Shin'ya Obara kitami institute of technology , Japan</p> <p><b>Abstract-</b> The Antarctica Showa Base has been powered primarily by diesel power generation. However, heavy oil fossil fuel is used for power generation by diesel generators. The Showa base is located in Antarctica, so there is heat demand throughout the year. Therefore, the capacity of transportation of fuel and emissions of carbon dioxide has become an issue. For these reasons, construction of clean energy systems using renewable energy in order to locally produce energy for local consumption is being planned. In this study, we will design a microgrid based on the introduction of renewable energy (photovoltaics generation and wind power generators) and solid oxide fuel cell (SOFC), which does not emit carbon dioxide during power generation and can use heat cascades. However, there is a risk of a power failure because the power quality decreases with the introduction of renewable energy. In this paper, we clarified the introduction rate of renewable energy with the lowest frequency fluctuation and clarified the introduction limit of renewable energy in summer and winter.</p>
<p><b>P2-014</b> <b>13:45-14:00</b></p>	<p>Design of Flywheel Energy Storage System with Target Specifications Using Load Distribution Method Ho Yeong Lee, <b>Dae Yong Um</b>, Hee Je Kim and Gwan Soo Park Pusan National University, Republic of Korea</p> <p><b>Abstract-</b> Flywheel energy storage system is an important part of microgrid. It can store electrical energy as rotational kinetic energy and supply it back to electrical energy as needed. FESS can play various roles such as storing large energy, supplying large electric power momentarily, or supplying low electric power stably according to usage purpose. Since Fess has various characteristics according to the specification, it is important to design it so that it is suitable for the purpose of use. Therefore, in this paper, we constructed design process of FESS using load distribution method, and FESS with specific discharge rate and capacity suitable for the purpose of use is designed. The designed flywheel was simulated through finite element analysis, and the design process was verified through experiments of the actual FESS based on the process.</p>
<p><b>P2-030</b> <b>14:00-14:15</b></p>	<p>Design and sizing of solar PV plant for an electric bus depot in Malaysia <b>Shah Mohammad Mominul Islam</b>, Arshad Adam Salema, Joanne Lim Mun Yee Monash University Malaysia, Malaysia</p> <p><b>Abstract-</b> Electric buses consume a high amount of electricity during the charging process, resulting in a high maximum demand (MD) that leads to high operational cost and emissions. Therefore, the aim was to use solar energy to reduce the MD. The solar PV plant has been designed and sized based on the MD data of the bus depot. The results include the number of PV modules; area required to install the</p>

# SESSION II

	<p>PV modules; and sizing of balance of system. For example, about 7350 PV modules, 1200 flooded deep cycle batteries, 760 kW inverter size, 566 MPPT smart solar charge controllers and 23,200 m<sup>2</sup> (5.73 acres) area are needed to offset 466.5 kW of MD.</p>
<p><b>P2-1004</b> <b>14:15-14:30</b></p>	<p>Advanced control of a district heating system with high residential domestic hot water demand  <b>Stanislav Viktorovich Chicherin</b>, Lyazzat Ryskhanovna Junussova, Timur ZHahsylykovich Junussov  Omsk State Transport University, Russia</p> <p><b>Abstract-</b> Proper adjustment of domestic hot water (DHW) load structure can balance energy demand with the supply. Inefficiency in primary energy use prompted Omsk DH company to be a strong proponent of a flow controller at each substation. Here the return temperature is fixed to the lowest possible value and the supply temperature is solved. Thirty-five design scenarios are defined for each load deviation index with equally distributed outdoor temperature ranging from +8 for the start of a heating season towards extreme load at temperature of -26 °C. All the calculation results are listed. If a flow controller is installed, the customers might find it suitable to switch to this type of DHW supply. Considering an option with direct hot water extraction as usual and a flow controller installed, the result indicates that the annual heat consumption will be lower once network temperatures during the fall or spring months are higher. The heat load profiles obtained here may be used as input for a simulation of a DH substation, including a heat pump and a tank for thermal energy storage. This design approach offers a quantitative way of sizing temperature levels in each DH system according to the listed methodology and the designer's preference.</p>
<p><b>P1-039</b> <b>14:30-14:45</b></p>	<p>Application of Thermal Pressure Ventilation Technology in Extra Long Construction Tunnel with High Ground Temperature  <b>Zhuwei Xie</b> and Yimin Xiao  Chongqing University, China</p> <p><b>Abstract-</b>The feasibility of thermal pressure ventilation technology for ventilation and cooling of extra long construction tunnel with high altitude and high ground temperature was discussed. A physical model was built with a proportional factor of 1:1 based on the design documents of Zilashan tunnel in China. The CFD model considering buoyancy effects was used to evaluate the influence of the initial rock temperature, the insulation performance of the left tunnel and the outdoor air temperature on the effect of thermal pressure ventilation. Results show that the effect of thermal pressure ventilation increases by 12.2%, and the effect of cooling enhances by 3.7% when the left tunnel has no insulation. Compared with the initial rock temperature, the outdoor air temperature has a greater influence on thermal pressure ventilation. When the initial rock temperature is below 54 °C, outdoor air temperature is below 17.5 °C and the left tunnel has no insulation, thermal pressure ventilation technology is feasible for ventilation and cooling of Zilashan</p>

# SESSION II

	<p>tunnel with a shaft of 450 m height. The thermal pressure ventilation technology provides a reference for other construction tunnel projects as a design of ventilation and cooling.</p>
<p><b>P2-032-A</b> <b>14:45-15:00</b></p>	<p>Effects of Demand Shifting and Response for Regulating Reserve Using Residential Heat Pump Water Heaters in Japan  <b>Hiroyuki Omori</b>, Shintaro Negishi, Takashi Ikegami  Tokyo University of Agriculture and Technology , Japan</p> <p><b>Abstract-</b> Recently, large amount of renewable energy (RE) technologies has been penetrated into power systems in Japan. To maintain the balance of supply and demand, the need to curtail the output of RE is beginning to occur in a power system. In the future, with the further introduction of RE, there is a concern that the required amount of RE output curtailment will further increase. As one of the measures to avoid this RE output curtailment, demand shifting and response using residential heat pump water heaters (HPWHs) are expected. In this study, we assumed the demand shifting by indirect control using dynamic electricity prices which reflects the marginal price of electricity, and the demand response for regulating reserve by direct control performed only when an HPWH is in operation. We have developed a method to use two models, which are an HPWH model in a house and a demand-supply analysis model in a power system, in cooperation. Using these two models, we analyzed the transition of the effects of avoiding the RE output curtailment and the effects of reducing the fuel costs by HPWHs from 2030 to 2050. As the result, It was found that the demand response for regulating reserve by HPWHs in addition to the demand shifting can provide 2.4 times the avoiding effect of RE output curtailment, and that the values of demand shifting and response become higher as the introduction of RE will increases from 2030 to 2050.</p>
<p><b>P1-048</b> <b>15:00-15:15</b></p>	<p>Influence of Heat Reflective Wall on Air Conditioning Energy Consumption of Office Buildings in Chongqing  <b>ZhongYu Hao</b>, DaChuan Shi, ZhiQiang Wang and YaFeng Gao  Chongqing University, China</p> <p><b>Abstract-</b>As the main channel of heat and humidity exchange between the building and the external environment, the improvement of the thermal insulation performance of the external wall is crucial to reduce the building energy consumption. However, the influence of heat reflective exterior walls on the energy consumption of air conditioning is rarely studied. This paper aims to study the effects of heat reflective walls on air conditioning energy consumption (ACEC) through testing and simulation. The measured results show that the heat reflective exterior walls will reduce the summer ACEC of the room and increase the ACEC of the room in winter, but the contribution rate is higher in summer than in winter. At the same time, the ACEC simulation results show that the energy saving per unit area of the heat reflective wall of the office building is 0.0149 kWh/(m<sup>2</sup>•a) for the west outer wall, 0.01131 kWh/(m<sup>2</sup>•a) for the east outer wall, 0.0121 kWh/(m<sup>2</sup>•a)</p>



# SESSION II

	for the south outer wall, and 0.0113 kWh/(m <sup>2</sup> •a) for the north outer wall. These provide a useful reference for the research and application of heat reflective walls in Chongqing.
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**16:00-16:30 Coffee Break**

# SESSION III

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**January 9, 2020**

**Session 3**

**Battery Technology and Energy Storage Materials**

**🕒 16:30~18:45**

**📍 SALT ROOM (Level 1)**

Chaired by

**Prof. Yong Suk Yang**

**Pusan National University , South Korea**

**9 Presentations—**

P1-023-A , P1-005-A , P1-024-A , P1-019-A,

P2-022-A , P2-028 , P1-011-A , P2-029 , P2-035

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# SESSION III

<p><b>P1-023-A</b> <b>16:30-16:45</b></p>	<p>High-efficient, Eco-friend, Flexible Silver/Core-Carbon/Shell Nanofiber Mats for Energy Storage Yong Il Kim, <b>Chan Woo Park</b> Korea University, South Korea</p> <p><b>Abstract-</b> Highly flexible freestanding carbon nanofibers electroplated with silver were fabricated for supercapacitor applications. The brittle carbon nanofibers were encased with bendable silver shells, leading to superior flexibility of the supercapacitors. The enhanced electrical conductivity derived from the silver shell structure dramatically increased the capacitance of the supercapacitor. The silver shell also conferred structural stability to the carbon core, thus furnishing stable, long-term electrode performance. Nearly 100% of the specific capacitance was retained after N = 10,000 galvanostatic charge-discharge cycles. The mechanical endurance or stability of the fabricated electrode was evaluated in 1,000 bending cycles, demonstrating that the electrode performance remained unchanged. Cyclic voltammetry and galvanostatic discharge curves were respectively obtained at various scan rates and current densities. The fabricated electrodes were characterized by scanning electron microscopy, X-ray photoelectron spectroscopy, and transmission electron microscopy, which clearly illustrated the carbon-core and silver-shell structure.</p>
<p><b>P1-005-A</b> <b>16:45-17:00</b></p>	<p>Highly Stable Perovskite Solar Cells with a Surface-treated PCBM Layer Pesi Mwitungwa Hangoma, Danbi Kim, Hyun-Seok Yang, Bo Ram Lee, Sung Heum Park and Jung Hyun Jeong Pukyong National University, South Korea</p> <p><b>Abstract-</b> Having achieved power conversion efficiencies higher than 22%, perovskite solar cells (PSCs) look set to be game changers in the field of photovoltaics. Their instability in humid environments, however, reduces their potential for commercialization. In this study, we investigate the role chemical degradation plays in moisture-affected devices and, based this concept, develop a technique that enhances the device stability of p-i-n PSCs. By surface treatment of the [6,6]-phenyl-C61-butyric acid methyl ester (PCBM) layer with hydrophobic stearic acid and ethylenediamine, we achieved increased moisture resistivity of PCBM. The treated surface of the PCBM layer had improved hydrophobicity, with a contact angle of 108°, and also prevented water ingress in the perovskite layer longer than non-treated surfaces. In addition, interfacial stability is enhanced by the suppressed interaction between the ions and the electrodes, resulting in treated devices exhibiting improved stability in their photovoltaic parameters compared to non-treated devices when exposed to a dark environment with a relative humidity (RH) of 45%.</p>
<p><b>P1-024-A</b> <b>17:00-17:15</b></p>	<p>The Multi-Layered Photoanode with Supersonically Sprayed Fe<sub>2</sub>O<sub>3</sub> Layer and Atomic Layer Deposited ZnO/TiO<sub>2</sub> Layers. <b>Chan Woo Park</b>, Taegun Kim and Yong Il Kim Korea University, South Korea</p>

# SESSION III

	<p><b>Abstract-</b> We demonstrate a promising Fe<sub>2</sub>O<sub>3</sub>/ZnO/TiO<sub>2</sub> multilayer photoanode for applying solar water splitting. The Fe<sub>2</sub>O<sub>3</sub> surface is passivation with atomic layer deposited ZnO and TiO<sub>2</sub> thin layer to enhance the photo current density of Fe<sub>2</sub>O<sub>3</sub>. The increased photoelectrochemical activity of the hematite-based structure with heterojunctions, compared to that of bare Fe<sub>2</sub>O<sub>3</sub>, results from improved charge separation during water oxidation. The multilayered Fe<sub>2</sub>O<sub>3</sub> film shows a seven times photocurrent density (to 4.25mA cm<sup>2</sup>) compared with bare Fe<sub>2</sub>O<sub>3</sub> photoanode. Because it suppresses the recombination of electrons and holes. By evaluating the transient photocurrent density and impedance, we evaluated the passivation layer thickness of Fe<sub>2</sub>O<sub>3</sub> film and improved photowater probability with ultra thin ZnO / TiO<sub>2</sub> layers to achieve high photocurrent at low potential (0.7V vs. Ag / AgCl).</p>
<p><b>P1-019-A</b> <b>17:15-17:30</b></p>	<p>Synthesis and Characterization of Glass-ceramics Sealant for Solid Oxide Fuel Cell  <b>Yong Suk Yang</b>, Chang Gyu Baek and Young Hoon Rim  Pusan National University, South Korea</p> <p><b>Abstract-</b> Solid oxide fuel cell (SOFC) is characterized as having high electrical energy conversion efficiency, green power generation, fuel flexibility and solid state compounds. SOFC consists of electrode, electrolyte, interconnect and housing, and several sealing procedures are required between those components. Among compressive, compliant and rigid bonded sealants, the rigid bonded glass-ceramics is recognized to be advantageous because of the comparable properties in its thermal expansion coefficient, the variety of composition, the high resistance to chemical reactions and structural stability. In this work, we have synthesized various glass-ceramics with the composition of SrO-SiO<sub>2</sub>-B<sub>2</sub>O<sub>3</sub>-Al<sub>2</sub>O<sub>3</sub> and investigated structural, thermal, mechanical, adhesion properties and local molecular vibrational modes. It is found that the thermal expansion coefficients of the glass-ceramics are in the SOFC-required range of 8.0~11.0*10<sup>-6</sup> oC<sup>-1</sup>. The vibrational mode population in Raman scattering is found to be a measure of bonding strength. When annealed at 800 oC, some samples keep their glass phases even after 50 h, and they have good adhesion properties. For selected glasses of high temperature annealing, the cross-sectional views of electron microscope show homogeneous morphologies with good adhesion and clean surface boundaries between the sample and substrate. Based on the results, we have developed a glass-ceramics sealant for application.</p>
<p><b>P2-022-A</b> <b>17:30-17:45</b></p>	<p>Investigation of SOFC single cell output corresponding to output fluctuations of renewable energy  <b>Satoshi Niinuma</b>, Shin'ya Obara  Kitami Institute of Technology, Japan</p> <p><b>Abstract-</b> Recently, global warming has become a serious problem. It is positive to regulation of greenhouse gas in each country. Therefore, many industrial technology aim at zero emission. In the energy technology which aims at zero</p>

# SESSION III

	<p>emission, fuel cell using hydrogen of renewable energy origin is developed. A fuel cell is a major candidate as one of energy sources which change to proposed heat engine. Currently, research on fuel cell is mainly about cell durability and electrode materials. However, there is no research on the followability of fuel cell aimed at interconnection with renewable energy. In Japan, heat engine is responsible for both middle load and peak load, so it is essential to investigate the load followability of the fuel cell. In this study, load followability is investigated by a generator using a single cell of a solid oxide fuel cell (SOFC) that operates at the highest efficiency among some kinds of fuel cells. First, the validity of the power generator was investigated from the I-V (current and voltage) characteristics of the single cell. The experimental conditions were a furnace temperature of 700 °C, and the air flow rate and hydrogen flow rate were both 3.3 mL/s. As a result, the peak output value was 0.1 W/cm<sup>2</sup>. Since this output value is almost correct compared to a standard single cell, the power generator is considered appropriate. Next, when the furnace temperature was 650 °C, 675 °C, and 700 °C, the load followability was investigated every 10% of the load factor. As a result, it was possible to follow the load factor up to 20% in about 0.6 seconds at any temperature, but it took about 1 second to follow up after the load factor of 30%. Then, the load followability of the single cell with respect to the output value of wind power generation was investigated. The fluctuation cycle of wind power generation was 1 second. As a result, it was found that the single cell has high followability at any temperature. In particular, it has been found that the followability to the voltage drop (current rise) is excellent as the operating temperature becomes high. For this reason, when used as a peak power source, it is desirable to use it at a high operating temperature.</p>
<p><b>P2-028</b> <b>17:45-18:00</b></p>	<p>Bipolar plates: Different materials and processing methods for their usage in fuel cells  <b>Thorsten Hickmann</b>  Eisenhuth , Germany</p> <p><b>Abstract-</b> In this paper a system for experiments on redox flow batteries is presented, giving the operator the possibility of dealing independently with advantages and challenges of this innovative energy converter, in particular with regard to testing new, in this case recycled, materials. The recycling aspect is included due to the permanent requirement of reducing cost of especially as far as bipolar plates is concerned. In addition the hole recycling discussion, it is necessary to use the material recycling in different stages of system development and evaluation. Included in the tests was the development of a four-part series of experiments, in the framework of which the operators will treat intensely the cell structure, its characterization as well as testing of the electrolytes and the challenge of the crossover.</p>
<p><b>P1-011-A</b> <b>18:00-18:15</b></p>	<p>Hydrogen Production from Polyethylene through Integrated Pyrolysis-tar Decomposition over Low-grade Iron Ore  <b>Ade Kurniawan, Keisuke</b>, Abe, Masafumi Sanada, Takahiro Nomura and Tomohiro Akiyama</p>

# SESSION III

	<p>Hokkaido University, Japan</p> <p><b>Abstract-</b> Waste plastic, which polyethylene (PE) as its significant component, has 66.7 mol%-H<sub>2</sub> and 33 mol%-C, is a promising fuel candidate for H<sub>2</sub> production as well aiming to its utilization for ironmaking fuel addressing to the depletion of coking coal. On the other hand, the low-grade iron ore (i.e., goethite) also now abundantly use as a raw material in ironmaking, since the high-grade ore become depleted. However, goethite cannot be directly used for ironmaking since it causes permeability issues during the reduction in a conventional blast furnace operation. We developed the technology named integrated pyrolysis-tar decomposition through chemical vapor infiltration (CVI) over dehydrated goethite iron ore. The objective of the recent study is to investigate PE decomposition behavior on integrated pyrolysis-tar decomposition over dehydrated goethite iron ores. The effect of steam injection was also investigated as well. Simultaneous processes of PE pyrolysis, catalytic tar decompositions, and carbon deposition occur producing syn-gas and carbonized iron ore. Without steam injection, PE generates more CH<sub>4</sub> than H<sub>2</sub>. CO and CO<sub>2</sub> are also produced from gas reforming and iron ore indirect reduction by CO, respectively. In contrast, the injection of steam promotes more tar cracking as well as steam reforming decreasing CH<sub>4</sub> and increasing H<sub>2</sub> significantly. Steam inhibits the tar carbon deposition in ore by converting it into light tar and gases. At the higher steam flow rate, H<sub>2</sub> and CO<sub>2</sub> increase significantly, probably due to water gas shift reaction (WGSR) predominating the overall reactions. Also, significant H<sub>2</sub> production is generated from decomposition at a higher temperature (900 oC) due to wustite is formed in iron ore increasing the catalytic activity of reforming reaction. However, the overall structure of pre-reduced iron ore is still predominantly as magnetite, with carbon deposited. This approach is attractively promising in waste plastic treatment producing H<sub>2</sub> as well as raw material preparation for ironmaking, simultaneously.</p>
<p><b>P2-029</b> <b>18:15-18:30</b></p>	<p>Redox Flow Battery: System for test series with recycling material <b>Thorsten Hickmann</b> Eisenhuth , Germany</p> <p><b>Abstract-</b> In this paper a system for experiments on redox flow batteries is presented, giving the operator the possibility of dealing independently with advantages and challenges of this innovative energy converter, in particular with regard to testing new, in this case recycled, materials. The recycling aspect is included due to the permanent requirement of reducing cost of especially as far as bipolar plates is concerned. In addition the hole recycling discussion, it is necessary to use the material recycling in different stages of system development and evaluation. Included in the tests was the development of a four-part series of experiments, in the framework of which the operators will treat intensely the cell structure, its characterization as well as testing of the electrolytes and the challenge of the crossover.</p>
<p><b>P2-035</b></p>	<p>Amplitude enhancement of flow-induced vibration for energy harnessing</p>

# SESSION III

<b>18:30-18:45</b>	<p><b>Ze Shao</b> The University of Western Australia , Australia</p> <p><b>Abstract-</b> In this paper, flow-induced vibrations of bluff bodies with four different cross-sectional geometries (circle, square, triangle and semi-circle) arranged both in single and tandem (gap ratio equals to 3 and 5) configurations are investigated in a wind tunnel. It is found that triangular and square cylinders have the higher amplitude than that of the semi-circular and the circular cylinders in the single configuration. When two cylinders are arranged in tandem, the circular cylinders have the highest amplitude among all tested cylinders. Furthermore, the semi-circular cylinder shows that its vibrating amplitude increases with the reduced velocity in the tandem system due to the galloping effect.</p>
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**Dinner 18:45~20:00**

# SESSION IV

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**January 9, 2020**

## **Session 4**

**Engineering Materials and Building Energy  
Consumption**

📍 **16:30-18:45**

📍 **Pepper Room (Ground Level)**

Chaired by

**Prof. Jaichan Lee**

**Sungkyunkwan University, South Korea**

**8 Presentations—**

P1-021-A , P1-042-A , P1-016 , P1-012-A ,

P1-018 , P1-028-A , P1-046 , P1-008-A

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# SESSION IV

<p><b>P1-021-A</b> <b>16:30-16:45</b></p>	<p>Efficient Eliminate the Hot Spot Using Supersonically Sprayed Graphene and Silver Nanowire Taegun Kim, Yong Il Kim and <b>Chan Woo Park</b> Korea University, South Korea.</p> <p><b>Abstract-</b> Heat spreader in high-power and -density microelectronic devices are a important problem because insufficient dissipation of heat can cause device malfunction. We introduce supersonically sprayed thin cooling films made of reduced graphene oxide (rGO) and silver nanowires (AgNW) that can easily spread heat to remediate hotspots. A rGO film heat spreader is deposited on an Al<sub>2</sub>O<sub>3</sub> substrate (10 10 cm<sub>2</sub>), which is Joule-heated using a nickel–chrome heating wire. Joule heating produces a line hotspot on the substrate. However, heat quickly spreads over the entire surface due to the rGO film, eliminating the localized hotspot. The effect of film thickness is optimized to characterize the optimal thickness of the fabricated rGO film heat spreader. The cooling capability of pure graphene oxide films is identified and compared to the heat dissipation performance of a rGO–Ag NW film and an uncoated substrate. The morphology and surface properties of the films are characterized using scanning electron microscopy(SEM), Raman spectroscopy, optical profilometry(OP), and thermal infrared imaging. An rGO film thickness of ~10 nm produced the lowest thermal resistance and the addition of AgNW facilitated film thermal performance by reducing the thermal resistance.</p>
<p><b>P1-042-A</b> <b>16:45-17:00</b></p>	<p>Transition Metal Dichalcogenides for Multiple Energy Harvesting Bongwook Chung, Md Mokhlesur Rahman and <b>Jaichan Lee</b> Sungkyunkwan University, South Korea</p> <p><b>Abstract-</b> Two dimensional (2D) transition metal dichalcogenide (TMDC) materials exhibit a wide range of functional properties, allowing a variety of application to electronic, photonic, spintronic, and energy harvesting devices. The variety is enriched by stacking 2D TMDC layers with different layers, which becomes a Weak van der Waals junctioned material. Experimental study utilizing various stacking structures has been limited despite of the flexibility in stacking whereas computational study becomes effectively viable. We used the first-principles calculation to study the physical properties of TMDC multilayered structures relevant to energy harvesting. We found an optimal combination of the TMDC multilayered structures with simultaneous evolution of piezoelectric and photovoltaic properties for multiple energy harvesting. Here, we show the optimal material selection and underlying principles of the simultaneous evolution of piezoelectric and photovoltaic properties.</p>
<p><b>P1-016</b> <b>17:00-17:15</b></p>	<p>Sulfur and Water Resistance and Activity of Ru-Ce-Zr-Ox Catalysts for NO Catalytic Oxidation <b>Yiwen Dong</b>, Xing Fan, Pubo Chen and Jian Li Beijing University of Technology, China</p>

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	<p><b>Abstract-</b> Most mobile pollution sources have narrow space. Due to its small occupation area, fast SCR is more suitable for controlling NO<sub>x</sub> in exhausted gas in mobile pollution sources such as vessels. The fast SCR reaction can be divided into two stages: NO catalytic oxidation stage and NO<sub>x</sub> removal stage. This paper focused on the study of NO oxidation catalysts consists of Ru-Ce-Zr metal-oxides. It was found that the doping of ruthenium which is the precious metal, greatly improved the catalytic activity. The NO oxidation rate of catalyst doped with 0.5% Ru at 300 °C was about 15% higher than that without Ru. However, with the increasing content of ruthenium, the sulfur and water resistance of catalysts decreased and the activity of the catalysts was only partially restored after regeneration. The results showed that Ru increased the activity of the catalysts when Ce and Zr improved the resistance of SO<sub>2</sub> and H<sub>2</sub>O. Our work provided a solution to the space problem of mobile pollution sources such as vessels.</p>
<p><b>P1-012-A</b> <b>17:15-17:30</b></p>	<p>Porous Carbon Production Using Cheap and Abundant Fe-based Template  <b>Keisuke Abe</b>, Ade Kurniawan, Masafumi Sanada, Takahiro Nomura and Tomhh  Hokkaido University, Japan</p> <p><b>Abstract-</b> Electric double-layer capacitor (EDLC) is a high-speed charge/discharge and long-life energy storage device, and is expected to be used for steady-state power generation with large time fluctuations such as wind power generation. Porous carbon with nano-ordered pores is generally used as the electrode of EDLC. One of the production methods for the porous carbon is inorganic template method in which carbon is filled in an inorganic porous oxide as a template, and then the template is chemically removed to produce porous carbon. Ultra-low-cost natural ore mainly composed of goethite (FeOOH) exists mainly in Oceania and Southeast Asia. The FeOOH becomes nanoporous Fe<sub>2</sub>O<sub>3</sub> by low-temperature calcination at around 300 °C. When the porous Fe<sub>2</sub>O<sub>3</sub> is heat-treated with coal-tar, carbon-infiltrated Fe<sub>2</sub>O<sub>3</sub> can be obtained. The carbon-infiltrated Fe<sub>2</sub>O<sub>3</sub> has a possibility to become porous carbon if the Fe<sub>2</sub>O<sub>3</sub> component is successfully removed. However, FeOOH has not been investigated as the template of porous carbon. Therefore, the purpose of this study is to investigate the probability of the porous carbon obtained by inorganic template method. The carbon-infiltrated Fe<sub>2</sub>O<sub>3</sub> was prepared and treated by acid to obtain porous carbon. The specific surface areas and the pore size distributions of the obtained materials were calculated based on the results of nitrogen adsorption/desorption experiments. The effects of tar amount to the FeOOH template and the treatment temperature on the pore structures were mainly investigated.</p>
<p><b>P1-018</b> <b>17:30-17:45</b></p>	<p>Performance for the Catalytic CO Oxidation Over the Mo<sub>0.5</sub>Sn<sub>9</sub>Co<sub>90.5</sub>O<sub>2</sub> Catalyst  <b>Danting Lu</b>, Xing Fan, Jianyu Cai and Jian Li  Beijing University of Technology, China</p> <p><b>Abstract-</b> In this study, carbon monoxide catalytic oxidant MoSnCoO<sub>x</sub> was prepared by coprecipitating method to investigate the effect of MoO<sub>3</sub> addition amount on catalyst activity. Meanwhile, the sulfur and water resistance of the</p>

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	<p>catalysts were researched by simulating the industrial conditions of sintering smoke emission. The samples were studied using BET, XRD, SEM and H<sub>2</sub>-TPR techniques. The results revealed that catalyst added with 0.5% MoO<sub>3</sub> had better activity than the original Sn<sub>9</sub>Co<sub>91</sub>O<sub>2</sub> catalyst and its efficiency reached 98.04% at 70 °C. After 21 h reaction with sulfur and water in the flue gas, the catalyst efficiency only decreased to 89.75%. According to the results of characterization, Mo<sub>0.5</sub>Sn<sub>9</sub>Co<sub>90.5</sub>O<sub>2</sub> catalyst could better resist sulfur and water, because the presence of MoO<sub>3</sub> not only reduced the crystallinity of the catalyst, but it also increases the specific surface area and oxidation capacity.</p>
<p><b>P1-028-A</b> <b>17:45-18:00</b></p>	<p>Energy and Land Conservation: Brown sugar processing with appropriate technology  <b>Rahim Darma</b>, Riri Amandaria and Rida Akzar  Hasanuddin University, Indonesia</p> <p><b>Abstract-</b> Brown sugar traditionally produced is a substitute for crystal sugar and a potential export commodity. The production of brown sugar from palm (hybrid coconut) and cane using appropriate technology (AT) can be carried out on a micro and small business scale by rural communities. This study aims to examine the feasibility of brown sugar production by specifically looking at the efficiency of utilization of wood as fuel in the production process and marginal land to cultivate sugarcane. A case study in two groups of brown sugar producers was conducted in two different districts in South Sulawesi, Indonesia. Data analysis includes business feasibility, wood fuel efficiency, producers' potential incomes, and socio-economic and environmental impacts. The results show that the use of cooking stoves as AT has potential to increase the income of brown sugar producers through energy efficiency and production capacity improvement. Additionally, the cultivation of cane on marginal land can contribute to land conservation, which also can be a potential source of income for rural communities. The R / C ratio of brown sugar production made from coconut is 3.34, 1.82 from cane and 1.22 from coconut. The use of energy-efficient technology in the production of brown sugar can increase the efficient use of wood fuel, employment opportunities and income of rural communities while encouraging forest preservation and agricultural land conservation.</p>
<p><b>P1-046</b> <b>18:00-18:15</b></p>	<p>nfluence of A Baffle and Shaft Spacing on Shaft Exhaust Efficiency  <b>Hou QianKun</b>, Miao-cheng Weng and Fang liu  Chongqing University, China</p> <p><b>Abstract-</b> In road tunnel. A baffle-coupled shaft is used to decrease the plug-holing and boundary layer separation. Install baffle on both sides of the shaft (when the fire occurs upstream of the shaft, the baffle upstream of the shaft closes and the baffle downstream of the shaft opens), it can function as a smoke barrier. In order to study the distance between the baffle and shaft, numerical simulation was performed using the Fire Dynamic Simulation (Version 6.7.1). We use the mass flow of carbon monoxide discharged through the shaft as a basis for evaluating the</p>

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	<p>efficiency of exhausting smoke. As the spacing increases, the exhaust efficiency increases first and then decreases. In this paper, the baffle-coupled is set 2 meters.</p>
<p><b>P1-008-A</b> <b>18:15-18:30</b></p>	<p>Reducing Wasting food: Exploring Consumers' Perspectives toward Expiring Products Hsiu-Hua Chang and <b>Jing-Wen Su</b> Feng Chia University, Taiwan</p> <p><b>Abstract-</b> Food waste, which causes the rapid exploitation of natural resources and imposes environmental pollution, is a serious problem in the whole world. The retail and personal consumption stages produce the highest food waste in the supply chain. It is necessary to avoid or to reduce the large quantity of food waste from the consumer side. For example, consumers are likely to waste food that is close to the expiration date whether or not the food is available. However, it has rarely been studied to examine how consumers view and buy the expiration date-based food. Regarding the related literature, consumers would evaluate the price promotion and the level of product's perishability in their decision-making. In recent year, many developed countries have increasingly discussed that how to encourage consumers to recognize, buy and consume the expiration date-based products to reduce the avoidable wasting of food. This problem is also existed in developing countries, such as in Taiwan. Few studies have used quantitative techniques to examine how consumers view the expired date in the process of purchasing. This study thus tries to explore the price promotion and food category that influence consumers' attitudes and behavioral intentions. The 2x2x2 experimental design is used to interact with expiration date-based products (expiring items or not), food category (perishable or non-perishable) and price promotion (20% off or 40% off). The two studies are respectively conducted to test consumers' attitudes and intentions toward the situations of the products. The online questionnaire method is adopted to collect a total of 700 sampling data. Based on the findings of this study via ANOVA analysis and regression analysis, this study finds that the different level of price promotion and food category would significantly consumers' attitudes toward the expiration date-based products. The impact power of price discount is stronger than that of the food whether is perishable. Consumers' attitudes toward expiring food is also a vital predictor of behavioral intention. Finally, this study provides some theoretical and practical contributions that should be a base for future study.</p>

**18:45-20:00 Dinner**

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