OKINAWA INSTITUTE OF SCIENCE AND TECHNOLOGY GRADUATE UNIVERSITY
沖縄科学技術大学院大学

Simultaneous Interpretation Available

The Second International Symposium on Open Energy Systems
Date: February 2-3, 2015
Venue: OIST Campus, B250
Sponsor: Okinawa Institute of Science and Technology Graduate University (OIST)
Co-sponsor: Sony Computer Science Laboratories, Inc. (SONY CSL)

Program
February 2, 2015 (Monday): 9:00-18:00

----Session 1: OES Vision & Current Status----

09:20-10:00: Open Energy Systems: Toward a Global Agenda Solution for Sustainability
Professor Hiroaki Kitano
OIST Professor/SONY CSL President

Providing energy for all, particularly in the form of electricity from sustainable sources, is one of the major global agenda. Transition to cleaner and sustainable energy is one of the most important issues that require technical breakthroughs, extreme thinking, and pragmatic yet strategic business and policy development. Open Energy Systems (OES) concept based on distributed intelligent micro-grid systems that are connected via DC networks, is one of the key technical solutions. At the same time, OES has to support different infrastructures and activities distinctive in each region. Urban architecture, transportation, medical systems, and others are typical examples that have to be well integrated in many industrialized countries. Cost, reliability, resilience, and scalability can be forefront issues in both developing and developed regions. This talk addresses OES in the context of global agenda and discusses what need to be done to make it into practice.

10:00-10:40: From the Economy of Scale to the Economy of Choice
Professor Patrick Whitney
Professor, Illinois Institute of Technology, USA

While it is easy to envisage the potential capabilities of a new technology, it is almost impossible to predict how a new technology will fit into the daily life of people and become a viable business. For example, why did the AT&T picture telephone fail three times, even though it was an extension of an existing technology and business, while TV became dominant medium of the 20th Century despite the lack of a business model and an ecosystem to produce content?

Jumping forward to today, of all the capabilities that are possible with the advent of open energy, how do we increase our insights about how people will use it? Professor Whitney will describe new design methods that enable business leaders to discover consumer needs and aspirations and link them with frameworks of technology and business to help improve the fit between the new technology and how people live.

10:40-11:20: DCOES: DC-Based Bottom-Up Energy Exchange System for Community Grid
Dr. Mario Tokoro
Founder, SONY CSL, Japan

A DC-based, bottom-up system that generates, stores, and shares electrical energy has been developed and deployed in a community of 19 inhabited houses at Okinawa Institute of Science and Technology (OIST). Each house is equipped with PV panels, batteries, and an energy exchange system, through which it is connected to the others via DC networks. The system is

proven in real environment to be efficient in the use of renewable energy, flexible in size, as well as to increase dependability when used with utility's electricity. It is designed to use the combination of various renewable energy sources and is expected to be deployed in various types of communities, from a very small, isolated one to one that grows not only by expansion or merging, but also by incorporating hierarchical architectures. This research and development has been carried out by joint efforts of Sony CSL, OIST, and Okisokou.

11:20-13:45: DCOES Project Tour and Lunch

----Session 2: New Deployment for Energy Sustainability----

13:45-14:25: Future of Electricity
Mr. T. P. Chopra
President & CEO, Bharat Light & Power, India

Electricity will shape our future in more ways than we can imagine. In today's world, the role of electricity has changed drastically. It has changed from being a unidirectional flow of electrons to a bidirectional flow of electrons and data. Today we see generation sources moving away from fossil fuels to renewable sources of energy with more and more new technologies coming up every day. Given the concern about the environment and the eventual decline in the availability of cheap fossil fuels, electricity production in future will increasingly make use of renewable sources of energy leading to a cleaner environment. The key to improving the performance in generation of renewable energy will be our ability to leverage the cloud, big data and analytics.

Over the coming decades the world must make fundamental transformations in how energy is used and produced. The benefits of the next generation of energy technologies occur throughout the interconnected system of energy suppliers, transmitters, and consumers. These technologies, however, need support from industry and policy makers, and the public itself, to reach the point of competitive maturity. Balance between generation and consumption needs to be reliably maintained in an economically viable fashion. This necessitates close monitoring and control of the power system where technologies like smart grid/communication can play a major role.

Investment in the electric transmission and distribution industry is booming. This boom is supported by four fundamentals: the need to maintain system reliability, the need to deliver generation to load, the need for environmental and regulatory compliance. There are five megatrends in the electric transmission and distribution industry: grid modernization, energy storage, maximum use of existing transmission rights-of-way, distributed energy resources and operational efficiency.

At the same time, consumers are pursuing distributed generation. As energy storage technology matures and regulators continue supporting these new market entrants, customers will have more options. It will become easier for consumers to decide whether to buy power (and from whom) or whether to generate it. The benefits include capturing renewable production and delivering it when transmission capacity is available, relieving congestion, deferring transformer upgrades attributable to peak load growth. With self-healing grids the security and stability calculation and development of emergency plans of current power grids are still off-line analysis, However, smart grid has better self-management and self-healing ability. With real-time monitoring and use of advanced analytics, problems can be automatically detected and responded.

14:25-15:05: NANO GRID: Sustainable Green Energy Solution for Off-Grid
Mr. Didar Islam
Managing Director & Founder, Solaric, Bangladesh

NANO Grid is an efficient distributed energy solution to provide electricity for household, community and agricultural use in off-grid areas by delivering affordable, proven solar technology on a commercially sustainable basis. Each Nano-grid can serve 50 households in a range of up to 2 kilometers to meet the residential need and also support rural economies by providing power for small-scale irrigation pumps and commercial or community establishments (such as tea shops and local government offices) These systems are widely viewed within Bangladesh and also many parts of Africa as 'the next step' in supplying electricity to off-grid communities.

The project is transformative by providing highly efficient technology and a scalable business model that is replicable across communities and countries. This "Inverter–less" technology is innovative owing to SOLARIC's converter ("Optimizer") and a business model that overcomes the challenge of distribution, payment collection and maintenance and promotes local entrepreneurship. It also delivers affordable solar energy that goes beyond lighting which has been the key focus for many off-grid systems.

Owing to the high capital requirement for any renewable energy product, it is essential to reduce upfront cost as much as possible and also for sustainability it is important to reduce the operational costs below the available alternative sources of energy in off-grid areas, such as kerosene or diesel generator. SOLARIC's NANO-grid achieves the goal of reducing end user cost by as much as 70% through innovative and appropriate technologies. Improved energy efficiency, modularised design, scalable system, pre-paid metering, power line communication are the key attributes of the system.

15:05-15:30: Break

15:30-16:10: New Microgrids and Smart Community Architectures and Business Models
Mr. Laurent Schmitt
Vice President for Smart Grid, ALSTOM, France

MICROGRIDS TODAY…
Smart grids are fundamental to transform today's electricity grids to address growing demand, renewable intermittent and distributed generation, and environmental pressures. Microgrids are an integral part of the transformation. As grids evolve, the balance of energy on the grid will rely on larger volumes of distributed energy resources (renewable energy, demand response and storage). Because today's distribution network does not accommodate these new types of energy flows, new optimisation layers around local distribution grid nodes are needed, while maintaining the quality and security of energy supply. These new architectures are progressively coming to service within early demonstration projects such as in France with ERDF NiceGrid project as well as in the US with Duke Energy Integrated Smart Distribution.

... AND TOMORROW
Microgrids are progressively evolving to become foundational building blocks of tomorrow's smart cities. They take full advantage of the flexibility of "prosumers" (consumers who also produce electricity) while integrating new distributed energy resources and storage solutions. Fragile areas susceptible to blackouts, as well as densely populated cities, will eventually be made up of autonomous grids within an overall smart grid able to survive major disturbances. Tomorrow's energy management systems will be designed around a decentralised, multilayer

architecture, where microgrids provide the local intelligence and optimisation. New sources of renewable energies like biomass and microhydro solutions, as well as new storage solutions such as thermal storage in district heating networks, will be integrated at the local level. Local microgrids and smart campuses will be part of smart districts, which in turn will be part of smart cities, with each layer optimising the layer below to build up the overall smart grid infrastructure. Campus such as the OIST in Okinawa constitute idea opportunities to deploy Microgrid and Smart Communities and progressively develop new living lab environments. The presentation will sketch out typical IT architectures which could be expanded further in the context of the OIST research institute.

16:10-16:50: Innovative Business Opportunities Combining Storage with Renewables
Mr. Riccardo Amoroso
Chief Innovation Officer, ENEL Green Power, Italy

The presentation will cover the potential innovative business opportunities that can be created combining new battery storage technologies with interruptable renewable power plants (in particular solar and wind). In more details, the presentation will touch upon the needs that are arising from the market, the breakthrough technologies that are emerging in the battery storage area, how these technologies can complement and mitigate the interruptability of solar and wind renewable power plants, the possible business models that innovative energy players can implement, the regulatory frameworks that are being shaped throughout the industry and the activities that Enel Green Power is bringing forward in this area.

16:50-17:30: Panel Discussion
Moderator: Professor Hiroaki Kitano

18:00-20:00: Working Dinner@OIST Restaurant (Optional)

February 3, 2015 (Tuesday): 8:30-15:30

----Session 3: Smart Energy for Smart City----

08:30-09:10: Infrastructure Disruption: Behind the Meter Control and Energy Storage
Mr. Jon Dogterom
Venture Services Lead, MaRS, Canada

I will provide a Canadian perspective on the trends and changes we are seeing in the energy industry. How behind the meter control and energy storage are set to disrupt the conventional operation and planning of energy infrastructure. The profound impact these changes will have on the traditional business of electric utilities and the economic opportunities that will emerge in the shift to new business models.

09:10-09:50: Centralized or Distributed?:
The Power System Reformation and Business Chances in Japan
A Case Study in Hokkaido
Mr. Akihiro Kogure
Executive Managing Director, Eneco-op, Japan

Currently, 10 vertically integrated power companies' share is more than 95% (2013). Japanese government is working on reformation of electric power industry that will expand retail competition to the residential sector in 2016, then unbundle the transmission/distribution

sectors of 10 big vertical integrated companies at around from 2018 to 2020.

Meanwhile, after 2 years from Japanese FIT was introduced in 2012, 7 vertically integrated power companies out of 10 stopped the purchase of electricity from additional renewable energy, and they are now working with the government to introduce new regulation.

Hokkaido (northern part of Japan) is isolated in the sense of power distribution. There is only a narrow connection between mainland of Japan and Hokkaido. Hokkaido Electric Power Company's (vertically integrated power company in Hokkaido) is highly dependent on Nuclear power, and there is only a little space for renewable energies to grow.

In this presentation, I will describe the outline of the electricity market reformation in Japan and expected business opportunities with focus in Hokkaido area. I will then like to clarify regulatory/policy limitations that authority is imposing on energy start-up companies like ourselves, and how we would like to overcome those challenges.

ENECOOP is a subsidiary company of CO-OP Sapporo. CO-OP Sapporo is the Consumers' Co-operative in Hokkaido area. Over half of the households of Hokkaido area belong to it. ENECOOP built mega level of solar power plant by the bond invested by the CO-OP Sapporo's members. ENECOOP is now planning to start the electric power retail business based on the huge customer base.

09:50-10:30: A Holistic Approach to Distributed Sustainability
Mr. Vincent Paul Ponthieux
Director and CTO, Blue Planet Research, USA

Blue Planet Research is located on the Big Island of Hawaii, and has been involved in renewable energy research since January of 2011 using our 32-acre microgrid. Primarily, we are focused on control systems and storage technologies, including hydrogen as load banks. Using what we learn, we design systems for clients around the state ranging from individual homes to commercial properties.

Most concepts of a microgrid focus on a hybrid model of the existing utility structure where small community grids are using the larger utility grid as its storage. Only recently has renewable energy engineering started looking seriously at true islanded nano and microgrids as a realistic concept. The reason for this shift is that storage technologies have made significant advances in the last five years, and we have moved well beyond traditional lead acid batteries as the way to chemically store electrons. Modern battery chemistries such as Vanadium Redox Flow Batteries, and Lithium Ion have dramatically extended the cycle life of energy storage systems.

This evolution of storage technologies has facilitated a paradigm shift in the way we view renewable energy with regards to intermittent technologies such as wind and solar. Rather than just allowing greater saturation of renewables to integrate into the utility grid, we are now seeing an increasing number of totally isolated energy systems where individual structures and small communities are responsible for their own energy production and distribution. This is the future of distributed energy in its purest sense, and the future is happening now.

Going forward and beyond just the production of electrons is the next phase. This involves a broader approach to solutions that make a society sustainable including not only energy, but transportation and agriculture as well. Technological advancements are enabling us to integrate these components into a new model in an effort to repair the damage from decades of neglect.

Scientists from around the world have acknowledged the urgency of not only pursuing carbon neutral technologies, but also the necessity of carbon negative ones to begin to reverse the negative effects of greenhouse gases, and avert the impending runaway of global climate change. Replacing carbon-based fuels with clean energy carriers like hydrogen is the next phase of evolution for mankind. By harvesting carbon from renewable sources like methane, we can sequester it in the form of durable goods such as carbon fiber, nanotubes, foam and graphene –creating new opportunities to be distributed on a global scale.

10:30-10:50: Break

10:50-11:30: Keys to Consumer Engagement and Cooperation: How to Get Consumers to Adopt and Participate in Commercially Viable Open Energy Systems
Dr. Philip E. Lewis
CEO and Founder, VaasaETT, Finland

The success of open energy systems will be influenced by their ability to appeal to a global mass market - albeint mass customised - and the ability for new business models to achieve the cooperation of customers in order to enable the systems to balance. Control by force will not be enough as has already been seen in Africa and developed markets.

Only through scale will technological solutions become cost-effective enough to be relevant to the lives of ordinary people, be they in the developed or developing world. Only through scale will business models appeal to the most powerful investors. Only through universal appeal will scale grow to the required proportions. Only through the willing and participatory adaptability of consumers will enough flexibility emerge in systems.

Applications will be mass customised depending on the situation. More basic solutions will be more relevant to regions with less to spend. But extensive research has indicated that energy consumer psychology and behaviour is surprisingly universal. Global appeal of and cooperation with energy solutions is therefore possible.

The presentation will consider some key current global drivers of change in developed energy markets and the resultant emerging new energy (and beyond energy) solutions for consumers. The expected impact of these developments on open energy systems in developed and developing markets will then be considered. Key drivers of consumer participation will also be identified based on recent research by VaasaETT and other organisations. Suggestions for successful open energy systems will be proposed, systems that appeal to customers, public and investors alike.

Ultimately a practical approach to creating appealing open energy systems will be proposed.

11:30-12:10: The HVDC Power Supply System Implementation in NTT Group and Next Generation Power Supply System
Mr. Toru Tanaka
Senior Researcher, NTT Energy & Environment Systems Lab, Japan

In this presentation, I will report the NTT Group's development of HVDC (high-voltage direct current) power supply systems that are higher in both efficiency and reliability. The HVDC power supply system uses DC 380 V, which is converted from commercial AC 200V, and supplies power to ICT equipment while charging the batteries. The NTT Group has designed an HVDC system topology, built a system concept, and developed power supply equipment. We

have focused in particular on system safety and stability and have developed a system that protects against electric shocks and maintains stability when the short accident occurs.

I will then touch upon the NTT Group's leading role in international standardization efforts that have resulted in the introduction of two international Recommendations, ITU-T (International Telecommunication Union Telecommunication Standardization Sector) L.1200 and ITU-T L.1201.

To spread HVDC system, we have introduced large-scale HVDC systems in the NTT Group companies and have summarized the technical specifications for introducing them to telecommunication buildings and datacenters in the NTT Group. And also, the NTT Group has established HVDC strategies for introducing HVDC systems in telecommunication buildings and datacenters of NTT.

I will also describe a new power supply system concept in order to further reduce power consumption and facilitate the adoption of next-generation networks. This system converts voltage of input port of the building into voltage of input port of IC chips by only three converters. Two kinds of DC voltage (DC 380 V and DC 48 V) are used as bus voltage in this system. The important point in this system is that voltage of motherboard is raised conventional 12 V to 48 V. Therefore, the power supply system is simpler and has higher efficiency. This system can be applied to future networks and datacenters.

Through this presentation, I would like to explain the advantage of using DC and to spread the adoption throughout the world.

12:10-13:10: Lunch@Restaurant (Level B, Center Building)

----Session 4: R&D Cluster Formation----

13:10-13:50: Hawaii's Renewable Energy Future:
The Maui Smart Grid-An Energy Technology & Applications Showcase
Mr. Leon Roose
Specialist, University of Hawaii, USA

Island and isolated power systems offer unique opportunities and challenges to the integration of intermittent renewable energy resources such as solar and wind, particularly at high levels of penetration. Renewable integration issues that must be effectively addressed include not only the technical issues related to interconnection of resources to the power grid, but the often as challenging policy and commercial issues that require resolution to achieve project success and power grid transformation. In addition, enabling policies and laws passed at a national level are often less than optimal for small or isolated power systems with their own unique set of technical and economic constraints. The history of the integration of renewable energy resources in the Pacific island of Hawaii provides an invaluable case study into the issues faced by island or isolated grid systems and the solutions developed through collaboration and alignment of interests of national and local government, the local utility and its regulators, renewable energy project developers and technology innovators. In particular, the Island of Maui has become the leader and test bed of technical and commercial solutions needed to achieve high penetration levels of wind and solar energy. Maui has a daily peak demand of approximately 200 MW and a minimum load of approximately 85 MW. To date, Maui has connected 72 MW of wind power and over 50 MW of distributed solar power, which is projected to reach more than 70 MW in the near future. Applying lessons learned from previous renewable projects developed in the islands, the results of in-depth wind and solar

integration studies, and smart technology innovation and applications, the island has not only successfully integrated the renewable resources, but also generated cost savings for its customers. This presentation provides a case study of renewable energy integration success on Maui and lessons learned that are applicable for many other areas of the world, particularly in the Asia-Pacific region.

13:50-14:30: Energy Systems Research and Applications at Monash University
Dr. Ariel Liebman
Monash University, Australia

Energy infrastructure and markets are facing a perfect storm of transformative forces around the world and in Australia. The key transformative forces being: policy imperatives to reduce carbon emissions, the rising trend in the price of fossil fuels (the recent drop in crude oil and coal prices likely being a short term aberration), and the avalanche of new technologies such as cheap solar photovoltaic panels soon to be followed by the mass uptake of battery storage and electric vehicles. These trends are putting new and unprecedented pressures on energy supply business models and infrastructure planning practices. An additional and unexpected trend in many developed countries, and in particular Australia, is the decoupling of economic growth from energy demand growth. In Australia electricity demand in particular has been steadily declining since 2009! Furthermore, new smart grid based technologies are enabling consumers to become much more active consumers in the energy markets through coordinated demand response and market models such as Transactive Pricing.

In order to plan for these new conditions new decision support tools and energy system modelling approaches are needed. In particular the integration of renewables into electricity grids creates new planning challenges. Whereas previously demand growth was relatively predictable and system expansion could be met with incremental investment in new generation plant in small numbers of possible locations, this is now no longer the case. Demand growth is uncertain on both temporal and geographic dimensions and the number of possible expansion scenarios thus explode exponentially. At Monash Energy Materials and Systems Institute (MEMSI) we are developing new tools to model these situations. A case study will be presented where new and distributed generation technology (wind, solar and natural gas microturbines) investment on a 30 node electricity network is modelled where the location of investment is critical due to network flow constraints. The study shows that with new computing cloud based optimisation tools can be used to identify optimal investment configurations in reasonable time for a number of scenarios on the order of 10^24. This cannot be achieve with current computational tools.

We also discuss a modelling methodology being developed at MEMSI and at Monash's NICTA Optimisation Lab for the purposes of distributed decision making and demand management across large numbers of small residential customers (100,000's or more households). This can be used to model the interaction between smart grid enable households and wholesale markets with large penetration of renewables.

Finally we will describe work MEMSI is doing jointly with the Australia Indonesia Centre's Energy Cluster looking at how to best meet growing demand in developing countries where the growth is coming from remote areas. In these cases more traditional solutions such as building more fossil fuel generation and then reinforcing the transmission grid while are most likely inferior.

14:30-14:50: Panel Discussion
Moderator: Robert Baughman

----Closing---

14:50-15:20: Wrap-up Panel
Professor Hiroaki Kitano
Dr. Mario Tokoro
[TBD]

15:20-15:30: Closing Remarks