



IRED2014

The 6th International Conference on Integration of Renewable
and Distributed Energy Resources

Summary Report

November 18 (Tue) – 20 (Thu), 2014/12/02

*Side Events: November 17 (Mon) & 21 (Fri)

Kyoto International Conference Center, Kyoto, Japan

<http://www.nedo.go.jp/english/ired2014/index.html>



New Energy and Industrial Technology
Development Organization

6th International Conference on Integration of Renewable Energy and Distributed Energy Resources

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Kyoto International Conference Center, Kyoto, Japan

The conference successfully attracted 349 participants from 29 countries and has surely contributed to increase the dialogue between countries and also multidisciplinary between industry, utility and research.

Since its inception in Brussels in 2004, the International Conference on Integration of Renewable Energy and Distributed Energy Resources has taken place biennially in varying countries and cities that are Napa in 2006, Nice in 2008, Albuquerque in 2010 and Berlin in 2012.

This year the event was firstly staged in Asia, Kyoto, Japan, the country pioneering renewable technology development and the place where is currently facing challenges to adopt high penetration of Renewable Energy especially Photovoltaic, in the atmosphere of former imperial capital of Japan for more than one thousand years with beautiful colored leaves.

Led by conference chair Kazuhiko Ogimoto from the University of Tokyo, Tokyo, Japan, 49 high level experts from 17 countries, 20 from Asia, 15 from Europe and 14 from North America discussed latest technical, market and policy aspects related to integration of renewable and distributed energy resources and smart grids.

In the plenary and following six sessions, distinguished speakers and the audience shared their experiences and gave up-to date information. Topics covered were Policies and Program (Session 1), Standards for the Integration of Higher Penetration of Renewables and Distributed Resources (Session 2), Reporting on Result of Large Project Portfolios (Session 3), First of a Kind Achievements in Technology, System Integration, Modeling & Simulation (Session 4), Markets and Regulatory Framework (Session 5) and End User Energy Management System in the Near Future (Session 6). There were also five side events: International Institute for Energy Systems Integration Workshop, ELECTRA IRP/EERA Smart Grids Workshop and the Aim towards International Cooperation, ISGAN Smart Grid International Research Facilities Network (SIRFN) Technical Meeting, Microgrid Application to Infrastructure Resilience and US Japan Smart Grid Project Workshop.

[PROGRAM AT A GLANCE and Presentation data \(PDF\)](#)

The presentation of 42 posters on specific subtopics stimulated the discussion in the conference to be diversified and drilled down. The evening gala dinner and get-together served as a perfect backdrop for intensive high-level dialog and networking with exciting elevator talks of posters. As a result, three poster presentations were awarded as good posters, and two as young engineer award. [Poster Session](#)

Overall Summary

Conference Chair

Kazuhiko Ogimoto, The University of Tokyo, Japan



Until now, the discussions of the integration of renewable energy into a energy system were mainly based on the hypothesis of large implementation of renewable energy and distributed energy resources in the near future. However, many regions including those in the United States, the EU countries, and Japan are confronting the issues due to large implementation of renewable energy as the current emerging problems.

Through the conference, we were able to share our various considerations and approaches. I think that the role of this conference was, firstly, to share initiatives and lessons learned of each country and areas; and secondly, to lead the realization of the next-generation society in a prompt manner.

In this conference, we had 349 participants from 29 countries. I think this is a very good number for this conference which is held in Japan so far away for the many participants. We had the opportunity to attend 49 speeches which focused on policies of each country, relevant standards and criteria, results of large project portfolios, latest achievements in technology, system Integration, modeling and simulation in the levels of transmission, distribution and demand, relationship with electricity market and various demonstration projects, and their status from system level to customer level.

There was a specific discussion to share lessons learned through, for example, the standardization discussion, while each country or region seeks solutions that correspond to the actual situation of each local conditions. As a total through the preceding sessions, we found that we have developed diversified technologies with the certain values for the next-generation energy system. These technologies are becoming available to offer good possibilities for us to overcome the current and future challenges.

However, we recognize that we will face difficulties to realize the technology's value or monetize them due to the constraints of market or regulation of now. I hope that the knowledge we gained through this occasion will be reflected into our works.

When we meet again at the next IRED, I hope we can share the results.

Session 1 : Policies and Program

Session Chairs

Patrick Von Hove, European Commission

Lisa Dignard-Bailey, Natural Resources Canada, Canada



We were in that session able to see samples of what is happening in the world. I found that this was a very interesting collection of information that was provided. Of course, I cannot fully do justice to that in these few statements.

We saw a number of common elements and we also saw some differences. In the common, we would see that in all the regions that were presented, we have seen incentives of some type, driving a substantial increase in the installation of renewable energy. Of course, there are different rates of progress and of acceleration and we have different types of schemes. There are some things like portfolio obligations, auctions, feed-in tariffs, renewable certificates, tax incentives, while different governments have found different ways to incentivize the development of renewable energy and this has worked in most cases. Very recently in parallel to these government incentives, the cost of renewable electricity has been reduced so much that we are starting to see new opportunities for, let us say, private investors to act independently of government incentives.

Now, we have of course quite different situations in the developing world or countries. We see that there is still a very substantial increase of demand over the years and this is expected to continue, whereas in the developed world at least in some countries we have stagnating or even decreasing demand in part due to energy efficiency measures. Therefore, the impact of renewable generation on other types of generation is quite different.

There are, of course, therefore different issues that are raised. In quite a number of cases, the renewable energy is not evenly distributed so that, in fact, more grid capacity is needed to ship the renewable electricity to the load centers. We see that in Latin America, and in fact also in Austria, the generation mix is dominated by hydropower. This makes it relatively easy to accommodate variable renewable generation. However, this accommodation may raise different issues in other countries.

Some other highlights I would give are that, perhaps in India, wind and solar resources may also provide

solutions for off-grid electrification in remote areas. In Latin America there is a very high share of renewable energy already from hydropower, but a large increase is also foreseen in variable renewables such as wind. In Australia, which is quite a sunny region, residential photovoltaic is reaching grid parity in some areas, and so the penetration can be very high locally. Then in Austria we see a promotion of models of community-based integration of renewable energy so that this is rather easy to replicate in other areas of the country.

These were in a nutshell a few highlights from the session, but of course there was much more in there. I would recommend that in future conferences it will be very interesting to continue these sorts of samples of what happens in the world, to give an opportunity to other regions to present progress in their areas and also for us to see how the renewable penetration and integration is progressing in the world.

Session 2 : Standards for the Integration of Higher Penetration of Renewables and Distributed Resources

Session Chairs

Jim Reilly, Reilly Associates, USA

Philipp Strauss, Fraunhofer IWES, Germany



As a chair, I was very pleased that all of the speakers stayed on topic, and especially pleased that they did so from different perspectives taking different approaches to the importance of standards in the future integration of renewables into a distribution system.

Kjell Sand talked about the integration of DG and DER in Norway, and he related that to standards codes developments in CENELEC and the IEC. He was particularly interested in addressing issues related to contradictory requirements in standards in network codes between the countries in Europe, and I think by inference, what was going on in the United States.

The second speaker, Professor Tsukamoto of the Yokohama National University, talked about grid code development in Japan. He gave a very neat concise history of the grid code, both low and high-voltage distribution networks, spot networks, and sub-transmission. He just gave us a nice picture of the Japanese view on the standards. He spent quite a bit of time on anti-islanding and made the link with the demonstration projects and the lessons learned from Ota City making the link between pilot programs, demonstration projects,



and foundational information for standards development.

The third speaker was Mark McGranaghan from EPRI. He took the approach of giving an overview of standards from the point of view of integrating distributed energy resources. He gave a rather comprehensive approach to this, starting with defining architecture. Referencing the NIST framework, he talked about communications and cyber security, and common information models, and concluded with a very nice slide on the importance of testing. He gave a list of 17 testing labs around the world. Then he led us to know that there are opportunities for testing in different countries. He closed with some important coordinating efforts going on between NIST, IEEE, and IEC. He then closed with an inspirational comment on working together.

Roland Bruendlinger covered a massive amount of material in the 20 minutes, and then asked for questions, but it was a very comprehensive set of slides on grid codes in Europe for low and medium voltage. He divided into two parts: an overview of the current grid codes in Europe and the second part advanced functional requirements that he has identified. At the end of his presentation, he spoke about requirements for grid connections that are applicable to all generations in the Federal Republic of Germany. He said that this is one of the first projects that should be addressed. He said the purpose of this is to ensure increased system security with a growing share of renewable energy and variable generation. He said that standards and looking at these were very important to avoid future regret and costly retrofits. He gave a neat chart on country requirements in the EU from 2007 to 2014. The second part of his presentation was much more technical. He talked about voltage support, frequency support, grid management and dynamic grid support. He closed with a comment on how advanced grid codes provide the basis for grid integration of DER and gave four specific examples.

The last speaker was Tom Key who talked about interconnection standards in North America, again taking a different perspective starting with the standards of IEEE 1547 and relating that to the FERC SGIP. This gave us a timeline from the past to where we are today, which kind of indicates how we can move forward. He had some very helpful remarks on technical aspects of grid support functions; these technical aspects relating quite directly to the standards development process in the United States. He talked about voltage regulation and reactive support, volt-VAR control, and many of the other technical inputs and important elements for standards development. His conclusions were that standards need to evolve with technology and practices; that it is important to set limits and settings and use field data to inform the standards development; use modeling and simulation; and to have sharing of international experiences in the standards development process.

I cannot do justice to the quality of these presentations. There is a great amount of useful reference information included in them. For the future, I would suggest that we continue with the panel on standards and address new standards that are under development that are highly relevant to the integration of microgrids in terms of

aggregated DER and microgrids. This would be the revision of 1547 that will be well on its way in two years, and the standard for specification of microcontrollers which will probably be in draft form by the time of the next meeting. I think it is a very helpful session in order to emphasize that there is a relationship between the proactive standards development process and the actual physical integration of higher penetrations of DER.

Session 3 : Reporting on Result of Large Project Portfolios

Session Chairs

Yuzuru Ueda, Tokyo University of Science, Japan

Mark McGranaghan, Electric Power Research Institute, USA



What we have seen is very much a variety of the results from all over the world. Sharing the experience from these large regional and national demonstrations around the world remains as one of the most valuable aspects of this conference. Demonstrations around the world are maturing after technology itself was already developed.

The Smart Grid Demonstration at EPRI and also sponsored by DOE has now more than five years of experience and the large-scale demonstration about the demand response is already conducted in Japan, Europe and in Korea. The international collaboration accelerates implementation of the advanced technology to the real-world grid; for example, between the US and Japan collaboration a lot of new technology already implemented in the real grid.

The experience with many important smart grid technologies that are enabling integration of distributed resources are Advanced Metering Infrastructure and PV development, including the initial experience of the smart inverter. A large number of storage demonstrations are already also conducted and demand response is becoming a widespread resource and becoming more dynamic. We have seen a lot of different types of demand response demonstrations from all over the world. Electrical vehicle infrastructure also is being put in place in a smart grid.

We have many challenges to meet in our future tasks, for example, for standards and the maturity of the applications. Integration is becoming increasingly important because individual technology itself is already becoming more mature; for example, the storage, the very cheap PV, and demand response smart metering.

The individual technologies are already there, so integration is much more important. The models for planning and operation also are required.

Policy is becoming a critical part of the discussion and tools and the methods to understand the overall economic cost and the benefit are becoming more critical. It must be used to educate policy makers and also maybe citizens. There are many opportunities for continuing sharing the lessons learned and there are next-generation challenges. ISGAN is a good example. The potentiation from the ISGAN summarizes the importance of this kind of integration and the international collaboration.

The smart grid has to be cleaner, more reliable, and more resilient, but it also has to be affordable. The task we have to do for next two years before the next conference is sharing experience.

Session 4 : First of a Kind Achievements in Technology, System Integration, Modeling & Simulation (Transmission, Distribution, and Customer Levels)



Session Chairs

Benjamin Kroposki, National Renewable Energy Laboratory (NREL), USA

Nikos Hatzigiorgiou, Public Power Corporation S.A., Greece

Hirohisa Aki, National Institute of Advanced Industrial Science and Technology (AIST), Japan

We had a very large session with three sub-sessions. I want to walk through each of those and discuss the main relevant points of those discussions.

Sub-session of Transmission Level

In the first sub-session, we talked about large-scale integration at the bulk transmission system level of renewables. We heard from great places like the country of Ireland which is right now integrating at times over 50% of variable generation in the form of wind, and believes it can get over 75% on their system, so amazing amounts of wind are being integrated at a very large scale. We also heard from the New York state ISO which is using innovative market to safely integrate wind.

One of the things to remember is that we cannot be looking at technical solutions in the vacuum without understanding the market mechanisms that also enable these technologies to flourish. Therefore, we need to both take technical solutions and integrate those with market and regulatory solutions.

We heard from Germany that integrating a very large amount of photovoltaic at the distribution level, but this has such a high penetration that it affects the entire operation of the bulk transmission system, and so understanding the effects of the distributed generation at the bulk level is very important.

Then, finally, we saw a presentation that looked at large-scale PV plants and how they can provide transmission in grid services. This will become increasingly important as we see much larger deployments, especially in countries like the United States and China, where they will eventually deploy PV systems into the gigawatt scale of individual plants. There you are rivaling the size of nuclear power plants in terms of capacity from these PV systems.

Sub-session of Distribution Level

In the second sub-session, which focused on integration of renewable and distributed energy at the distribution level, there were a lot of issues that were brought up and projects that explained how to best integrate these types of systems. First, there were several projects that were looking at the use of microgrids and how to actually coordinate individual microgrids and clusters of microgrids. This will become increasingly important as we see reliability of service become important due to natural disasters and other disasters.

Also, two very important technology deployments were discussed: one on energy storage as an enabling technology and also the aggregation of demand response as an enabling technology. The use of both energy storage and demand response will become critical as we reach higher penetrations of distributed technologies in the distribution system.

Then we also heard a presentation that talked about advanced screening methodologies for deployment of PV that are being developed in the United States. This is specifically to help utilities more quickly handle applications of deployments in the United States of solar, but this is a way for utilities to quickly understand the hosting capacity and the impacts of distributed generation on their circuits to allow higher penetrations.

Sub-session of Customer Level

In the final session, Sub-session 3, we looked at integration from the customer level. In this session we learned of several first-of-a-kind demonstrations all the way from new ways of storing energy in the form of thermal energy storage to increase the renewable energy penetrations. There were also some presentations on demand response and electric vehicle charging. These are key to understanding, how to integrate more renewables at the customer level and understanding how to deal with customer preference of those kinds of

technologies.

We also looked at a couple of energy storage and even very localized energy storage at that point of individual apartments inside larger buildings, and also finally end-to-end smart grid controls as an example of Maui where you are deploying technologies all the way from the customer to the larger energy system.

Finally, one of the things that was brought up in our discussion in our groups is really how the regulatory issues around these new technologies, things like electric vehicles and demand response, these will all need to be solved so that these enabling technologies can allow for higher penetrations of renewables.

As we move forward, this is definitely a session that highlights the technical aspects of this particular conference and where we can learn where people are becoming successful across the broad spectrum of integration from the customer level to the distribution level to the bulk transmission system level. I think this will be an important aspect to continue in future conferences.

Session 5 : Markets and Regulatory Framework



Session Chairs

Satoshi Morozumi, New Energy and Industrial Technology Development Organization (NEDO), Japan
Luciano Martini, Ricerca sul Sistema Energetico - RSE SpA, Italy

We could invite five very nice, very big speakers from the United States and Europe. They showed much information regarding the impact by the penetration of the renewable energy on the regulation side or on the operation side of power systems.

One thing we could recognize through the session is that we know such a big impact is coming on both sides of regulation and operation or utility business, but still we are not so exact about how large the impact will be on both sides of the energy market business. Also we expect just in next IRED meeting 2016 this topic becomes more important than now. Also, we expect that we can get more concrete information about these issues.

The first three speakers were really addressing the topic of regulatory framework bringing and sharing with us some important experience in three different areas; two states in the United States, California and Texas, also as an example of Europe the situation that took place and still is in place in Italy. I think these were like addressing the topic perfectly. They were approaching with different way that has been tackled this issue of integration of renewable in the power system in those countries. I believe they were also highlighting the lessons learned and the ambitious target that some of the countries place for future steps.

The last two speakers of the session were not addressing the regulatory framework, but they were touching some topic that will have a relevant impact on future energy markets. The issue of prosumers has been presented and also one important issue related to charging points and recharging points of the electric vehicle. Of course, mobility and transportation also contributed to global warming to global emissions, so this is an important issue. Energy market and trading is also very important.

We share that this topic should be further developed and presented at future IRED conferences. We put ourselves available to draft some possibilities and some suggestions for addressing this topic even further and better in the next events.

Session 6 : End User Energy Management System in the Near Future

Session Chairs

Kazuhiko Ogimoto, The University of Tokyo, Japan
Abraham Ellis, Sandia National Laboratories (SNL), USA



I would like to say about Session 6 that we had, first of all, a very diverse group of speakers. We had Mr. Oota from Sekisui Chemical Company, which is a housing developer. We had Mr. Baba from Tokyo Electric Company, a utility. We had Mr. Nagasawa from Mitsubishi Electric, the manufacturer focusing now on HEMS devices; Mr. Goli from a very large manufacturer, General Electric, focusing more in terms of the presentation on the commercial and industrial sector; and finally, Mr. Ringelstein from Fraunhofer IWES, which is a research institute.

I think the conversation was really interesting. As a matter of summary, I would like to say that we have heard



several times even in the summary several people mentioned the potential role of demand response as a way to create additional flexibility for the integration of more renewable energy on the grid. This is a very big promise and we can do something about it. The question is can we get down to the customers, to the homes, particularly residential customers, to extract some of that value? I think that the answer for residential consumers was that we are not seeing, in the words of one of the speakers, a very widespread trend of adoption. We are, however, seeing a very strong demand from the commercial and maybe industrial side, but not so much in the residential side. I believe that some of the speakers share that opinion that there are several challenges.

On the home energy management system side, I think that what we heard in the last session is that the business proposition is evolving. We heard people talking about energy efficiency and quality of life being the drivers. However, there are challenges here. There are some high costs of HEMS equipment and also the smart appliances those continue to be barriers. One of the questions was whether the value of the promise of grid support could be a driver or an additional value to make a difference, and if so, whether we need to target something in addition to the energy market. Perhaps we need to include participation in capacity markets and other kinds of things in order to enhance the value proposition.

There is some active technology development and demonstrations. We heard from our speakers from Japan and from other places that there are examples of residential developments in Japan with smart homes with home energy management systems included. We are seeing the same in the US. There are also demonstrations of excellent technologies, but not yet so much of an integration with the utility. We do not see that a whole lot.

The use case for HEMS technology is being refined; there is a recognition that this is no longer only about energy efficiency and demand response, but we need to integrate electric vehicles, we need to integrate generation like PV, energy storage, and also interactivity with the utility as part of the use case.

There are huge barriers. One that was mentioned several times was the issue of standardization. We have challenges in interoperability, communication protocols, things that need to be settled, and a need for open platforms, open standards that can allow innovators to do what they do to unleash innovation. Privacy and data security was also mentioned as a barrier.

Lastly, as a way to move forward, that was one of the challenges for the summary. I believe that there is a two-way lane forward in terms of technology development and standards development. The industry consortia like the HEMS Dojo that Mr. Baba talked about, is one of the ways forward. We have some of those and in the US as well. Finally, there was a question about energy policy, drivers, the role of things like zero-energy mandates, and those kinds of incentives as a way to deploy additional amounts of HEMS on the grid.

Poster Session

Session Chair

Reza Iravani, University of Toronto, Canada



Posters were invited on the following topics:

1. Grid Integration of Centralised and Decentralised Storage Devices
2. Large-Scale Renewable Generation
3. Renewable Power Forecasting
4. Market and Business Models
5. Grid Operation
6. Regulatory Issues
7. Successful Demonstrations
8. Energy Management
9. Generation and Load Management
10. Solar and Wind Energy Integration
11. Information and Communication Technologies (ICT)
12. Island Grids and Micro-Grids
13. Transmission and Distribution

55 abstracts were submitted, 44 were accepted, 2 were withdrawal and 42 posters were finally presented.

2-minute summary presentation for each poster were made and Poster Awards were given to

IRED2014 Good Poster Award

1st Prize P3-3 Probabilistic Forecasting of Spatial Average Irradiance Based on Reliability of Grid Point Values of Numerical Weather Prediction

Takeyoshi Kato (Dept. of Electrical Engineering and Computer Science, Nagoya University, Japan)



2nd Prize P1-1 IEC61850-7-420 Based Information Model of Virtually Aggregated Distributed Energy Resources

Eri Isono (Transmission & Distribution Systems Division, Toshiba Corporation, Japan)



3rd Prize P7-1 Demonstration of the Smart Grid at a Commercial Building in City of Albuquerque

Kimio Morino (Institute of Technology Shimizu Corporation, Japan)



IRED2014 Poster Award for Young Engineer

P3-1 A Comprehensive Method of PV Prediction based on Significant Factor recognition

Yingfei Gong (Tsinghua University, China)



P5-1 Economic Analysis of Flexible Reserve for Large Penetration of Renewable Energy

Yuji Hashimoto (The University of Tokyo, Japan)



Next IRED Conference in Canada

Niagara Falls.



Lisa Dignard-Bailey, Natural Resources Canada, Canada

Thomas Key, Electric Power Research Institute (EPRI), USA

We are pleased today to announce the host of the 7th IRED 2016. It will be held in Niagara Falls, Canada. We hope that you will all attend. We look forward to following in the steps of the NEDO. We hope that, in 2016, we also will have a very successful event as successful as this one has been. I thank you very much and I look forward to having all of you contribute.

EPRI are happy to support our neighbors in Canada to help plan and manage the conference in North America.

Conference Chair

Kazuhiko Ogimoto

About the announcement of the next exciting venue, it is where the first AC transmission took place in 1896, more 100 years ago. I wish you all the best in the course of your work and am looking for seeing you at the next IRED.



Scientific Committee Members

Hirohisa Aki

National Institute of Advanced Industrial Science and Technology (AIST), Japan

Scott Backhaus

Los Alamos National Laboratory (LANL), USA

Britta Buchholz

ABB AG, Germany

Eng Kiat Chan

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