Summary of iiESI Workshop, Kyoto, Japan, Nov 17th 2014

This third iiESI workshop focussed on understanding Energy System Integration (ESI) challenges and opportunities in Japan in particular, the contrast and similarities with Europe and the United States and the opportunities for collaboration between Europe, the United States and Japan (and more broadly Asia). There was also a focus on the future role of iiESI and its activities. There were 34 attendees from Japan, United States, Europe, China, Korea and Australia. We were welcomed by Dr. Ogimoto who gave an overview of the energy system in Japan. The Japanese energy system is in a major transition, in part driven by the 2011 Great Sendai Earthquake and the subsequent closing of all the nuclear power plants in Japan. This has resulted in significant economic impact and adequacy challenges although it is likely that several of the nuclear power plant will be restarted shortly. However the longer term plan is to significantly increase the share of variable renewables (wind and solar photovoltaics) in Japan. Very substantial subsidies have resulted in a dramatic increase in solar photovoltaic (PV) installed, now 9GW, with over 65 GW certified and this is causing significant technical and regulatory challenges. In parallel, the electricity system in Japan is also in transition with the establishment of Organization for Cross-regional Coordination of Transmission Operators (OCCTO) to overcome the inflexibility of a lack of coordination between regions. There is also ongoing electricity market reform to improve retail, wholesale competition and to unbundle ownership.

To cover the nuclear shortfall, a large a amount of additional gas fuel is being used in the electricity system, resulting in significant economic impact to the Japanese economy. Gas in Japan is imported in the form of liquid natural gas (LNG) and Japan is the number one importer of LNG in the world. Heating is 50% of the Japanese energy consumption and combined heat and power and district heating and cooling technologies are being deployed to increase overall energy system efficiency. Japan has a very extensive rail transport system, much of it electrified. This electrified transport system has had significant innovation to make it energy efficient and is integrated into the Japanese electricity grid.

Europe has a very ambitious decarbonisation agenda requiring the integration of significant amounts of variable renewable energy into the electricity grids and the electrification of heat and transport. Ireland as a relatively small synchronous electricity grid has particularly high targets and is knocking up against some fundamental technical barriers in particular the lack of synchronous inertia. Ireland has an aggressive programme to address these challenges and significant technical and regulatory/market innovations across the energy system will be required to overcome them. At a European level there is significant coordination through European Network of Transmission System Operators (ENTSO-E) to help tackle the challenges at a European level and has identified necessary major grid infrastructure investments. It is recognised in Europe that Energy Systems Integration is necessary to provide the required flexibility to successfully integrate large amounts of

variable renewable energy and this is leading to, for example, the development of a joint programme within the European Energy research Alliance (EERA) in ESI.

The US through its Department of Energy (DOE), National Renewable Energy Laboratory, Energy Systems Integration Facility and other assets is pursuing a clean energy future with a modernized and resilient integrated infrastructure. To achieve the President's Climate action Plan it is recognized that a modernized electricity grid is required to provide clean, reliable and affordable energy. The DOE is coordinating a national effort amongst its laboratories to underpin, through innovation and demonstration, the modernization of the electricity grid.

Comparing the energy sectors there are strong similarities between Japan and Europe. Both are reliant on large imports of fossil energy and for security of supply and environmental reasons are pursuing a strong renewables agenda. However both are grappling with the cost implications which can undermine competitiveness. In contrast the US is potentially energy independent in particular with the shale gas revolution. However globally we all face the trilemma Energy security, Economy and Environment and collective action will be required and the recent US/China agreement on emissions is seen as an excellent example.

There are a wide variety of collaborations. Through the New Energy and industrial technology Development Organization (NEDO) in particular Japan has an extensive suite of energy system collaborations and demonstrations in Europe and the United States. Japan, through the National Institute of Advanced Industrial Science and Technology (AIST) recently established the Fukushima Renewable Energy Institute in Koriyama, Fukushima Prefecture in April 2014, to promote R&D into renewable energy. The European Strategic Energy Technology Plan (SET plan) and associated Horizon 2020 research investments will underpin Europe's aggressive de-carbonization agenda. The Horizon 2020 research initiative Europe has many collaborative research efforts. For example Europe and Japan are collaborating on the development of new generation of concentrator photovoltaic cells, modules and systems. In the US, a new Grid Modernization effort will look at technical and institutional advancements from within the US and through international collaborations to meet national clean energy goals.

Through the discussion that occurred at the workshop, it was realized that the International Institute for Energy Systems Integration (iiESI) is fulfilling an important international collaboration role and should continue to develop its activities. Several avenues for future activities were discussed. The Institute should consider being a source of objective data on best practice, benchmarking, roadmaps along with its initial activities of communication and education for the development of integrated energy systems. Having workshops in each region has demonstrated that there are still many challenges to creating a truly sustainable energy system. This will be the focus of 2015 workshops and the next workshop will focus on identifying the grand challenges in energy systems integration.