Renewables and Energy Systems Integration Workshop

Summary

September 8, 9, 2014, Golden Colorado

The integration of variable renewable energies into electricity grids was the dominant topic of the two day workshop. However the integration of other technologies such as storage, active demand, micro generation and energy efficiency also featured prominently as they are all part of the changing landscape. The importance of coupling of heat grids and transport to the electricity system to optimise the overall energy system efficiency and increase the penetration of variable renewable energy was identified as an opportunity. Interactions with the water system, in particular the reductions of water use in high renewable penetrations also featured. Therefore a well-integrated energy system is a key enabler to high penetrations of variable renewable energy onto electricity grids and this can be done at a reasonable cost while maintaining energy system reliability.

The utilisation of non-variable renewable generation assets will decline as the penetration of variable renewables increases; this was identified as one of the challenges to the existing business model for electricity grids. The increasing amounts of distributed energy resources, storage and active demand are also challenging the business models and impacting technically on the grid. The non-synchronous nature of most of the variable renewable energy technologies and their lack of inertial response is causing stability concerns. The modernisation of power grids to accommodate variable renewables and other changes requires new business models, advanced technologies that are demonstrated to perform and new control and data architectures.

Successful integration of variable renewables will require flexibility both physical and institutional. Flexibility comes in many different forms ranging from non-variable generation physical capabilities to start quickly and ramp up and down rapidly through to proper market design which allows physical resources e.g. demand response and storage to participate in balancing the system. Additional transmission is a critical factor in accessing the renewable resources, delivering the flexibility and in harnessing the diversity of multiple renewable resources spread across large geographical areas. Good forecasting can reduce the need for physical flexibility. Coupling of energy vectors is being driven by both security of supply, emission policies and flexibility needs and heat /cooling coupled with electricity in high variable renewable penetrations are particularly attractive. The device technology, at the interfaces between the energy vectors need development. In heat for example the cost and performance of heat pumps needs to be improved to see wide scale market adoption. Power to gas technologies need to increase efficiency in order to impact on the transport market.

The simultaneous similarities and differences of the energy systems globally and the opportunity to learn from one another was widely recognised. Energy systems have a range of characteristics e.g. densely populated cities to very sparsely populated areas leading to dramatic differences in the energy network characteristics. Different renewable resources at different costs are available, different institutional and market arrangements are in place and social and economic circumstances are different. Most importantly government policies can be dramatically different. These all have an impact on the integration of variable renewable energy sources. The uniqueness of every system, which leads to unique system solutions provides a rich and diverse set of experiences which can be shared and develop better and unique solutions globally.

The complexity of large scale energy systems and the amounts of data that can and are being gathered and processed was a common theme during the workshop. Increasing amounts of distributed resources and aggregation of the demand side for participation in balancing will be supported by large volumes of data, new control architectures and high performance computing.

Highlighting the impact across all aspects of the energy system, all scales and all time frames were addressed during the workshop. Continental scale integration at hourly resolution of very high penetrations of variable renewables was shown to be feasible at reasonable cost. Continental scale gas/electricity and transport infrastructure planning with high variable renewable energy penetrations were also discussed. Microgrids at the community level are being developed and deployed as demonstrations.

As with previous iiESI and IEA RIAB workshops the need to communicate the conclusions of these meetings to the policy makers in a meaningful way is important.

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