

**International Conference on Energy Systems Integration**  
National Renewable Energy Laboratory  
Golden, Colorado, USA  
December 5-6, 2017

**Day 1: December 5, 2017**

*San Juan Meeting Room, Research Support Facility X344*

**Breakfast 08:00 to 09:00**

***Opening Session 09:00 to 09:30***

Infrastructure is at the heart of an integrated energy system. It physically couples the energy vectors across scales, and at the “edge,” it connects with the consumer. It enables all the potential benefits of Energy Systems Integration (ESI), i.e. environmental, security of supply and economic. Renewable energy technologies are infrastructure, and hence capital, intensive. Energy infrastructure generally benefits a multitude of market players, is heavily influenced by policy and regulation, can be difficult to finance, and can attract a lot of negative attention, such as protests from local communities.

- *Welcome: Martin Keller, Director NREL*
- *Introduction: Beth LaRose, GE, Conference Chair*
- *Outline & Objectives: Mark O’Malley, Conference Scientific Chair*

***Session 1: Sector coupling solutions to Renewables Integration 09:30 to 12:00***

*Chair: Phil Taylor, CESI*

One of the drivers of ESI is the integration of variable renewable energy into the energy system. In times of excess in one form, such as electricity, it can be converted and used in other forms, such as fuels and heat. This sector coupling concept where energy is converted to another form for later use is at the heart of the potential benefits of ESI. This sector coupling requires specialized infrastructure, i.e. thermal networks, electric charging stations, heat pumps, electrolyzers, etc. Variable renewables are very distributed, leading to the need for additional infrastructure to harvest this renewable energy across different scales.

**Presentations**

- Kevin Harrison, NREL, United States, “Power-to-X: Utilizing biological gas fermentation, carbon dioxide and renewable electricity to produce renewable hydrogen, methane, chemicals and other high-value products”
- Ning Zhang/Chongqing Kang, Tsinghua University, China, “Multi Energy System Planning in China”
- Leah Kaffine, GE, United States, “Integrated gas-electric modeling”
- Ben Haley, Evolved Energy, United States, “Sector Coupling with Electricity: Promise and Pitfalls”

**Coffee Break 10:50 to 11:00**

**Panel Discussion – moderated by Phil Taylor 11:00 to 12:00**  
Featuring Presentation by Steve Chalk, Department of Energy, USA

***Food for Thought 12:00 to 12:30***

- William D’Haeseleer, KU Leuven, Belgium, “Energy efficiency revisited, what it means in an integrated energy system and the impacts on infrastructure investment”

**Lunch 12:30 to 13:45**

**Session 2: The role of energy demand in an Integrated Energy System 13:45 to 16:15**

Chair: Charlie Smith, UVIG

The energy infrastructure is in existence to provide services (i.e. mobility and comfort) to society. There is no reason why the consumers of these services should know or indeed care about the details of the energy system that delivers these services. The energy and the enabling data and communications infrastructure is there to deliver these services from source to sink and should be driven by the needs of the consumers. However, in contrast to the “don’t care” attitude, there is a growing trend for behind-the-meter generation, storage, and participation. Self-consumption cannot be driven purely by economic benefit to the consumer; it can also be driven by other values including the desire to participate in the energy transition. Participation of the demand side in providing more flexibility in the energy system can contribute to the integration of variable renewables.

**Presentations**

- Goran Strbac, Imperial College, United Kingdom, “Flexibility potential for the EU energy intensive industrial sector to facilitate cost effective integration of variable renewable sources”
- Jochim Seel, Lawrence Berkley National Laboratory, United States, “Impacts of High Variable Renewable Energy (VRE) Futures on Electric-Sector Decision Making”
- Linda Steg, Groningen University, Netherlands, “The motives to engage in the energy system and the impact on infrastructure”
- Henrik Madsen, DTU, Denmark, “Can heating and cooling really be flexible enough to have an impact on the energy infrastructure”

**Coffee Break 15:05 to 15:15****Panel Discussion – moderated by Charlie Smith 15:15 to 16:15**

- Featuring Presentation by Tim Unruh, Department of Energy USA

**Closing Remarks for Day 1 – Mark Ahlstrom (NextEra Energy Resources)****Poster Session & Reception 17:00 to 19:00**

Denver West Marriott, Monarch Room

*The poster session will include students from University of Groningen, Imperial College London, University College Dublin, University of Stuttgart, University of Cambridge, NREL, Tsinghua University, TU Delft, ETH Switzerland, Strathclyde University, and KU Leuven. Posters will be displayed around the reception room, allowing researchers and conference attendees the opportunity to discuss and review the posters throughout the evening reception.*

*Chairs: Laurens de Vries, EERA and Mel Devine, ESRI*

**Day 2: December 6, 2017***San Juan Meeting Room, Research Support Facility X344***Breakfast 08:00 to 09:00*****Session 3: Electrification: The Good, The Bad & The Ugly 09:00 to 12:00****Chair: Mark McGranaghan, EPRI*

The integrated energy system by its nature includes sub infrastructures for the different vectors (and at different scales) including electricity, heat, cooling and fuels. However, one of these infrastructures—electricity—is arguably at the centre of the integrated energy system and may well be set to become the dominant infrastructure. There are multiple reasons for this trend ranging from the relative ease of integrating variable renewables into electricity, the convenience of electricity, its cleanliness at the point of use, etc. Regardless, if this infrastructure is set to dominate in the future then it has enormous impact on the energy system as a whole, on the other energy vectors, and other infrastructures such as transport.

**Presentations**

- Nick Miller, GE, United States, “Keeping it together: Transient stability in a world fully electrified by wind & solar generation”
- Stephen Beuning, Xcel Energy, United States, “Electricity markets in an electrified world”
- Tom Wilson, EPRI, United States, “Electricity scenarios and the need for infrastructure”

**Coffee Break 10:50 to 11:00****Panel Discussion – moderated by Mark McGranaghan 11:00 to 12:00**

- Featuring Presentation by Bob Ethier – New England ISO, United States

***Food for thought 12:00 to 12:30***

- Gretchen Bakke, University of Montreal, Canada, “Why anthropology is important in understanding the evolution of energy infrastructure”

**Lunch + Energy Systems Integration Facility Tour 12:30 to 14:30*****Session 4: Infrastructure investment for resilience: How do we improve? 14:30 to 17:00****Chairs: Tim Green, Imperial College London*

Energy infrastructure may well be the Achilles heel of an integrated energy system. It physically couples the system across scales and vectors and when it fails, as it will on occasion, the failure can be global and catastrophic. The energy infrastructure can be planned for so that it is “resilient” with respect to failure. Unfortunately, these failures may be malicious and do not necessarily require physical failure but can be caused by cyber related failures.

**Presentations**

- Muireann Lynch, ESRI, Ireland, “Infrastructure investment in a future integrated energy system: an application to power-to-gas”
- Jim McCalley, Iowa State University, United States, “Planning the infrastructure of a resilient integrated energy system”
- Jim Watson, UKERC, United Kingdom, “Energy infrastructure scenarios for the UK: Are they resilient?”
- David Brayshaw – Reading University, United Kingdom, “Climate impacts on energy infrastructure - risks and opportunities”

**Coffee Break 15:50 to 16:00****Panel Discussion – moderated by Tim Green 16:00 to 17:00**

- Featuring Presentation by Juan Torres, NREL

**Closing Remarks** – Stathis D. Peteves (Joint Research Centre) and Beth LaRose (GE Energy Connections)