

DOMAIN COMPONENTS OF THE IMPENDING CYBER-PHYSICAL ENERGY SYSTEM TRANSFORMATION

MONDAY: SESSION 4, TRACK 1

SESSION CHAIR

Paul Roege, Typhoon-HIL

PRESENTERS

- Dr. Rob Hovsopian, National Renewable Energy Laboratory
- Dr. Charles Forsberg, Massachusetts Institute of Technology
- Sarah Davis, S. R. D. Consulting

SESSION ABSTRACT

Anthropogenic energy is transforming from single-vector commodity market enterprises to become vertically integrated systems of social, commercial, and technological processes. Although chemical fuels and electricity are still transacted and delivered primarily through centrally owned and controlled systems with unit pricing, there is growing awareness that energy contributes value in many ways, and emerging technologies are unleashing the capacity for individuals and entities of any size to manipulate energy for maximum value. Moreover, socio-political pressures motivate a major shift away from fossil fuels - which are convenient to deliver, store, and utilize upon demand – to alternative sources. Energy system physics are migrating from inherently stable features of on-demand delivery (of fossil energy) and inductively coupled power systems (with inherent energy buffers) to digitally-controlled cyber-physical systems that must manipulate and mediate diverse demands of energy supply, conversion, and safety everywhere, every microsecond. This transformation involves fundamental shifts in human, cyber, and physical domains, each of which must be coordinated to achieve resilience in lieu of chaos.

This panel will highlight key cross-domain challenges in this energy system transformation covering:

- cyber-physical transformation from analog power, information, and control technologies to systems that embody high speed and increasingly intelligent digital information and electrical power manipulation;
- physical layer issue of energy buffers – across multiple time scales - associated with shifting energy technologies;



- human system evolution needed, and inherent friction associated with the shift from commodity to value creation and resilience mindsets.

Presentations will be organized to stimulate creative and critical conversation among session participants to inform future lines of inquiry and action.