DG CONNECT, JRC INSTITUTE FOR ENERGY AND TRANSPORT

Workshop on

VISIONS IN GLOBAL SYSTEMS SCIENCE: ENERGY FUTURES

Brussels, 18th-19th March 2013

The context: Energy systems are increasingly characterized as "multi-layered flow networks" spanning over different geographical areas. These spatial networks are global for their geographical extension. The different interacting layers of energy systems span from physical/technical (the hardware of the network), cyber (measurement, communication and control), market and business (wholesale and retail, services and operations), social (customers, users, stakeholders, …), normative (administrative issues, standards, etc.), and political (local, national and regional decision making, and geopolitical implications).

On the other hand, energy systems are constrained by environmental considerations (environmental impact, climate change and limitation of usable natural resources), and the set of externalities (from local to global; from immediate to long lasting). This results in the co-evolution of the technical, cyber, market and business, social normative and political layers that must be assessed in a global perspective.

An ideal case study are Electric Power Systems (EPS) that are multi-scale/multi-layers systems, characterized by two different interconnected and interacting levels, with different scales both in terms of extension and power/energy involved. The High and Extra High voltage transmission systems (supergrids) are emerging as global energy infrastructures spanning over continents (from EU to Russia to China to northern Africa,…); while, at a smaller scale, the distribution systems (smart grids) serve a set of prosumers with local distributed production and storage of electricity with new real-time bidirectional communications with the external word (network, retailer, …). The social networks among the prosumers, that might show different behavior in terms of acceptance or adaptation, may play a crucial role in the feasibility and sustainability of these systems.

Policy decision making, at local, national and international level, and regulation provide the rules that constrain the behavior of the different stakeholders. It is generally considered that the goal is that of maximizing the system performance (technical, economic, energetic, environmental), striving towards the highest sustainability, efficiency and security of the EPS; but social values can determine, for instance, the choice of more expensive options.

The modeling and simulation of the multi-layer interacting emerging EPS is key for supporting their design and assessment, and for anticipating future impacts and options to help all stakeholders in determining their decisions. A continuous feedback from reality will help adjusting both the models and the decision making.

Research challenges in Global Systems Science (GSS):

Modeling & simulation: proper models, simulation and large data management tools are needed to capture the global dimension of energy and electricity systems (both geographical and multilayer) and the high linkage between different players and systems. They consistency check and the validation prior of their application is a key issue.

Scientific evidence: key concepts, describing desirable performance, such as sustainability, interoperability, security,.. need to be clearly defined. The approaches and theories to be used must be identified (complex systems and sustainability sciences, …). The concepts express goals in the policy decision making that need to be quantitatively defined and linked to the possibilities of the former scientific approaches to provide adequate assessment.

Link into the decision process and involvement of stakeholders: The logical chain from modeling and simulation over concepts/performance, into the policy decision processes is of the essence. Feedback between modellers and stakeholders can be facilitated by, among others, the use of narratives and gamification.

The key stakeholders (supernational, national and local policy decision makers, civil society) should be involved not only in the final stage of the application of the tools but also interactively during the design stage.

Visions:

- What is your scenario for smart energy systems by 2030 ?
- How to analyze the potential for new advanced services w.r.t. end consumers, energy utilities, authorities?
- How to analyze the interaction between social networks and energy choices?
- How can system models and data abundance enrich decisions processes in energy by policy-makers, business people and citizens?

Agenda

Monday 18th

13.30-13.45	Global System Science Perspective
13.45-14.15	Electric Power Systems as Global Complex Systems (JRC-IET)
14.15-15.00	Visions collected
15.00-17.30	Brainstorm Session (World Café')
17.30-18.00	Themes for the next day
20	Networking dinner

Tuesday 19th

9.30-10.00	Themes for working groups
10.00-11.00	Working groups
11.00-11.30	Feedback
11.30-12.30	Working groups
12.30-13.30	Sandwich lunch
13.30-14.30	Conclusions and input to GSS orientation paper

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