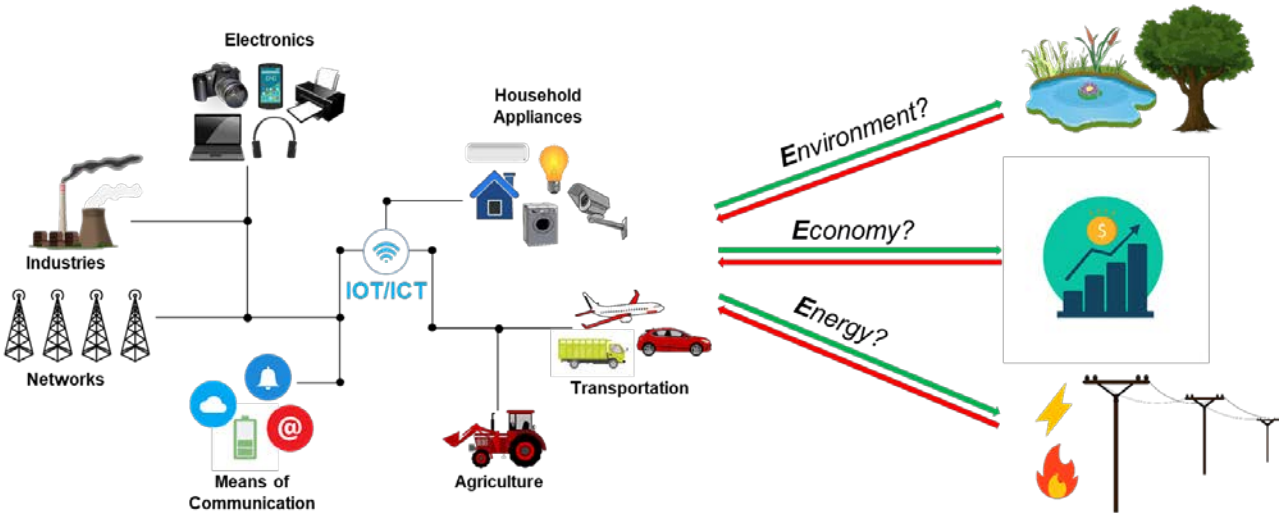
Energy-Environmental-Economic (EEE) Analysis of Internet of Things (IOT) and Information & Communication Technologies (ICT)

Dr. Fengqi You, Roxanne E. and Michael J. Zak Professor
Process-Energy-Environmental Systems Engineering
fengq.you@cornell.edu | you.cbe.cornell.edu

Over the past few years, the rapidly increasing demand and utilization of electronic technologies and communication has led to the extensive development of the Internet of Things (IOT) and Information and Communication Technologies (ICT), with estimates of nearly 30 billion interconnected devices by the year 2020. Though this has undoubtedly been linked to economic progress, it has also given rise to concerns regarding the effects on the global energy demand as well as other environmental impacts such as exponentially increasing e-waste (44.7 MT generated globally in 2016 with only 20% recycling) and other forms of pollution. For instance, experts are now analyzing whether the increase in energy demand due to direct use and production of these devices, as well as the demand by remote technologies and the changes in user behavior (rebound effect) could outweigh the benefits offered by these systems. Hence, it is extremely important to analyze these systems from the energy-environmental-economic (EEE) points of view to identify hotspots and the scope for improvement and optimization as soon as possible.



To address this problem, we would conduct both a life cycle environmental and economic analysis on our chosen system (either the entire network, or one of the major categories form the diagram above) and then incorporate multi-objective optimization to identify the optimal pathways to help increase economic gains but keep the environmental and energy demand impacts under control. Depending on the progress and direction of our work, we could consider incorporating data analytics to increase the accuracy of our estimates owing to the magnitude of

this problem and the fact that there is already abundant data available for most of our interconnected components in the system. One of the key challenges in this problem would be to deal with the uncertainties associated with the indirect and user-behavior dependent impacts, as they are generally not easy to recognize and quantify without a thorough analysis.