FIPSE-6 Short Presentation 3a

Coordination of Multi-Stakeholder Process Networks in a Highly Electrified Chemical Industry

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ABSTRACT

Increasingly, electrification is seen as one of the most important strategies for decarbonizing the chemical industry. As electrification efforts intensify in the coming years, we will see a drastic increase in the number of chemical processes that consume large amounts of electricity, and it will require a rethinking of the way in which the chemical industry needs to operate. Highly dynamic plant operation is required for the efficient use of intermittent renewable electricity, yet dynamic operation on its own is not a new challenge. The open problem lies in the sheer number of power-intensive processes; not all of them will be able to follow fast dynamics, and not all products can be easily stored to counter intermittency. Under these circumstances, ensuring safe and cost-effective operation across the strongly interconnected value chains of the chemical industry becomes a daunting task.

The efficient operation of an electrified chemical industry will require effective coordination across highly integrated process networks. While coordination in the chemical industry, of course, exists, it is usually achieved through bilateral contracts negotiated over and for long periods of time, but such mechanisms would be too slow in light of electricity availability and prices that change on an hourly basis. Instead, we require coordination systems that can react in real-time, much akin to those used to operate modern power grids. However, chemical supply chains are arguably more complicated than power grids as they involve many different products and often exhibit more complex network structures. Given that different production processes in a chemical value chain are typically owned and operated by different stakeholders (i.e., companies), we need to answer two key questions: (i) How do we achieve effective coordination among multiple stakeholders while respecting privacy and confidentiality? (ii) How do we improve the performance of the overall system while also meeting the individual stakeholders' objectives? Potential solutions to this open problem may involve concepts from distributed optimization, cooperative game theory, fairness, and market design.

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