

A framework for the optimization of the operation of an industrial power plant under demand uncertainty

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The cogeneration of heat and power helps to increase the energy-efficiency, to reduce CO₂ emissions and to increase the robustness of the energy infrastructure through decentralized generation [1]. For a typical chemical production site, the power plant is of a high importance, as it incinerates the off-gases produced by the production plants and provides them with steam and electricity. The significance of the Combined Heat and Power (CHP) plants is also recognized by the European Union through the CHP directive (Directive 2004/8/EC, 2004), which promotes the construction and operation of cogeneration plants [2].

The typically heat-driven operation of a power plant in the chemical industry is determined by the steam demand of the production plants. This demand is often uncertain due to inaccuracies in the production plan and fluctuations induced by the operation of the plants. The demand uncertainty can result in an inefficient operation due to the surplus/deficiencies of the steam needed to balance the steam network.

In this contribution an approach for the optimization of the operation of the power plant at INEOS in Köln that was developed in the framework of the European project CoPro is presented. The approach is based on a two-stage stochastic mixed-integer linear programming formulation, which is solved consecutively on a rolling horizon. At each iteration of the rolling horizon scheme, the model parameters are updated according to the new information acquired from the plants and the optimization is re-executed.

Hedging against steam demand uncertainty results in the reduction of the vented steam and a better tracking of the time-sensitive electricity price, which enables significant savings in the power plant e.g. in the natural gas consumption.

[1] Mitra, S., Sun, L., & Grossmann, I. E. (2013). Optimal scheduling of industrial combined heat and power plants under time-sensitive electricity prices. *Energy*, 54, 194-211.

[2] The European Parliament. Directive 2004/8/EC of the European Parliament and of the Council of 11 February 2004 on the promotion of cogeneration based on a useful heat demand in the internal energy market and amending Directive 92/42/EEC 21/02/2004.