Michal Jasinski, Arsalan Najafi, Omid Homaee, Mostafa Kermani, Georgios Tsaousoglou, Zbigniew Leonowicz and Tomas Novak, 2023, Operation and planning of energy hubs under uncertainty — A review of mathematical optimization approaches, *IEEE Access*, vol. 11, pp.7208–7228. DOI 10.1109/ACCESS.2023.3237649

Abstract Co-designing energy systems across multiple energy carriers is increasingly attracting attention of researchers and policy makers, since it is a prominent means of increasing the overall efficiency of the energy sector. Special attention is attributed to the so-called energy hubs, i.e., clusters of energy communities featuring electricity, gas, heat, hydrogen, and also water generation and consumption facilities. Managing an energy hub entails dealing with multiple sources of uncertainty, such as renewable generation, energy demands, wholesale market prices, etc. Such uncertainties call for sophisticated decision-making techniques, with mathematical optimization being the predominant family of decision-making methods proposed in the literature of recent years. In this paper, we summarize, review, and categorize research studies that have applied mathematical optimization approaches towards making operational and planning decisions for energy hubs. Relevant methods include robust optimization, information gap decision theory, stochastic programming, and chance-constrained optimization. The results of the review indicate the increasing adoption of robust and, more recently, hybrid methods to deal with the multi-dimensional uncertainties of energy hubs.

Keywords Energy hub, multi-carrier energy systems, mathematical optimization, robust optimization, IGDT, stochastic programming, chance constrained, uncertainty.

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